2013 NOAA Satellite Conference
for Direct Readout, GOES/POES, and GOES-R/JPSS Users
Poster Abstracts

Poster Session I
Tuesday April 9, 2013
10:15 am

T-1 Data Access and Use *Robert A. Iacovazzi, Jr.*

GOES-R Program Calibration and Validation (Cal/Val)

Authors: Robert A. Iacovazzi, Jr., Edward C. Grigsby, Changyong Cao, Jaime Daniels, Kathleen McIntyre, Joe Zajic

The United States' Geostationary Operational Environmental Satellite R-Series (GOES-R) weather satellite system has requirements for finer instrument spectral, spatial and temporal resolution than its predecessor series. Also, the instruments of this new GOES series often have more stringent calibration standards compared to the previous GOES series. These more stringent standards arise from GOES-R series product measurement accuracy requirements, and the need for them has been recognized by calibration specialists and users of satellite data alike. This translates to diligent calibration (cal) and validation (val) efforts within the GOES-R Program to ensure that GOES-R data usability accompanies data accessibility. In this presentation, a synopsis is given of GOES-R series cal/val efforts through the pre- and post-launch development phases, with special emphasis on the Advanced Baseline Imager (ABI) instrument.

T-2 Applications *Jun Li*

A Near Real-Time Assimilation and Forecasting System for Tropical Cyclone Application of NPP/JPSS Sounding Measurements

Authors: Jun Li, Tim Schmit, Mitch Goldberg, Jinlong Li, Pei Wang, and John L. Beven

Reliable and stable forecasts on tropical cyclones (TCs) such as Isaac and Sandy landed on CONUS in 2012 are critical for decision making and better preparation. Observations of atmospheric temperature and moisture information in environment and hurricane region are very important to the prediction of the genesis, intensification, motion, rainfall potential, and landing impacts of TCs through numerical weather prediction (NWP) models. The CrIMSS (CrIS and ATMS) onboard the Suomi NPP and JPSS provide atmospheric temperature and moisture information with high vertical resolution and accuracy, which is critical for the prediction of hurricane evolution. In order to maximize the benefit of NPP/JPSS measurements for TC forecasts, a near real time assimilation and forecasting system is being developed at CIMSS, it is called satellite Sounder Data Assimilation system for TC forecasts (SDAT). The regional NWP models (WRF – Weather Research and Forecasting, and HWRF – Hurricane WRF) along with the operational Community Gridpoint Statistical Interpolation (GSI) assimilation system developed by NCEP are used as the frames of SDAT. The SDAT comprises of data ingestion and processing, data assimilation and forecasting. The conventional and satellite observations (radiances, soundings, layer precipitable water – LPW etc.) are ingested into Bufr file used by GSI, then 72-hour forecasts are conducted after each assimilation time. SDAT can not only assimilate the data contained in Bufr file, but also can assimilate other products such as soundings from NPP/JPSS and high temporal resolution LPW from current GOES Sounder and GOES-R ABI.

T-3 Data Access and Use *T. Karthikeya Sharma*

Study of Textural Variation of Ocean Features of Satellite SAR Image Using ANN Technique

Authors: T. Karthikeya Sharma, Y. N. Mamatha

There has been a focus on developing image indexing techniques which have the capability to retrieve image based on their contents. The main feature extraction methods are content Based Image Retrieval (CBIR) also known as query by Image content (QBIC) and texture-classifying neural network algorithm (TCNNA), which analyzes the textural content of SAR (Synthetic aperture radar) data in the context of sensor parameters and environmental variables.. This paper presents a technique to derive the colors, shapes, textures, or any other information that can be derived from a satellite image Using Texture filters and also to delineate oil slicks from a SAR image using TCNNA technique and realizing it with artificial neural networks. This image processing techniques are been utilized to identify important urban features such as buildings and gardens and rural features such as natural vegetation, water bodies, oil content and pollution in ocean. The methodology applied in CBIR is Spatial Transformation and the content extraction using different filters and in TCNNA we implement Image transformation, Dark Spot Detection, Level Set Segmentation and finally the Grey level mask using multiple hysteresis thresholding for fine analysis. In feature extraction Textures are represented by Texel, which are then placed into a number of sets, depending on how many textures are detected in the image. The identification of specific feature in an image is achieved primarily by modeling texture and content as a two dimensional gray level variation. The relative brightness of pairs of pixels is computed such that the degree of contrast, regularity, coarseness and directionality may be estimated. An

Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. ANN tool works on the principle of SOM (Self Organization Mapping). Pattern recognition can be implemented using Feed-Forward technique neural network which has to be trained accordingly

T-4 Current and Future Programs and Systems

Dan Mamula

Global Navigation Satellite System (GNSS) Radio Occultation (RO) Mission and Ground System Planning

Authors: Daniel M. Mamula, Peter Wilczynski, Mike Wenkel

The United States and Taiwan, through an Agreement signed in May 2010, have agreed to jointly develop a satellite program to deliver next-generation GNSSRO data to users around the world. The new program, FORMOSAT-7/COSMIC-2, is a follow-on to the FORMOSAT-3/COSMIC mission, which was a joint US-Taiwan 6-satellite constellation demonstration mission launched in April 2006. The COSMIC mission was the world's first operational GPS radio occultation (GPS-RO) mission for global Earth weather forecast; climate monitoring; atmospheric, ionospheric, and geodetic research. The GPS-RO data from COSMIC has been extremely valuable to the climate, meteorology, and space weather communities, including real-time forecasting users as well as U.S. and international research communities. Unfortunately, COSMIC reached the end of its design life in 2011 and the critical real-time satellite observing capability has begun to significantly degrade. The National Oceanic and Atmospheric Administration (NOAA), the US Air Force (AF) and Taiwan's National Space Organization (NSPO) are partnering on the FORMOSAT-7/COSMIC-2 program. This paper will provide a current overview of the COSMIC-2 Program. It will discuss the updated status of the Program including current satellite and constellation configuration, activities to determine the optimal and minimal ground system architecture to meet data latency requirements, and other discussions on the mission and scientific payload technology that will be used to meet the Program objectives. In addition, NOAA's role is that of the ground system provider. This paper will provide information on the ongoing ground architecture study.

T-5 Current and Future Programs and Systems

Scott Rogerson

The Future of the Argos Data Collection and Location System

Author: Scott Rogerson

The Argos Data Collection & location System (DCS) is administered under a joint agreement between the National Oceanic and Atmospheric Administration (NOAA) and the French Space Agency, Centre National d'Etudes Spatiales (CNES). Additional partners include the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) and the Indian Space Research Organization (ISRO). There are currently over 21,000 active Argos Platforms being tracked by 1,900 users in 118 countries. An overview of the Argos system and diversity of user applications will be provided – with a focus on recent and future improvements to the overall system (e.g., Metop-B and SARAL launches in 2012-2013, NASA/NOAA JPSS Free Flyer in 2016-2017, Fourth Generation "Argos-4" Instruments).

T-6 Applications *Fred J. Schoeffler*

Large Wildfire Growth in the United States Influenced by Dry Slots: A Case For More Consistent and Accurate Wildland Fire Nowcasting and Forecasting Utilizing Satellite Water Vapor Imagery

Author: Fred J. Schoeffler

It is fairly well documented and recognized in the literature that mid- to upper-tropospheric and lower-stratospheric weather is responsible for dry air intrusions. In most cases, these dry air intrusions result in abrupt surface and planetary boundary drying, often radically influencing wildland fire weather and hence wildfire behavior. These dry air intrusions sometimes manifest themselves as tropospheric and/or stratospheric intrusions. They show up as dark bands in the satellite water vapor imagery, referred to as dry slots. Dry slots are well documented in Australian wildfire literature, however, little is known or documented for such occurrences in the United States. In the documented cases examined, it will be shown that seven U.S. wildfires from 1988 to present have in fact been influenced by these dry slots. In all cases, these dry slots caused extreme and unusual fire behavior, resulting in large wildfire growth.Recognizing dry slots in the water vapor imagery and how they influenced wildfire behavior will be emphasized. A case will be made for more consistent use of the term 'dry slot' and utilization of water vapor imagery for fire weather nowcasting and forecasting to determine dry slots in the United States. In addition, both the positive and negative aspects of satellite imagery and relying on model forecasting will be discussed, including major shortfalls during the 2006 Texas and Oklahoma wildfires.

T-7 Current and Future Programs and Systems

Zhenping Li

GOES Imager IR Channel to Channel Co-Registration Correction Algorithm in the GOES Ground System

Authors: Zhenping Li, Michael Grotenhuis, Timothy J. Schmit, Xiangqian Wu, Tony Schreiner, J.P. Nelson, Fangfang Yu, Hyre Bysal

The channel-to-channel co-registration is an important performance metric for the GOES Imager, and large co-registration error could have a significant impact on the reliability of derived products that rely on the combinations of the multiple IR channels. Example products include the cloud mask, fog and hot spot detection. This is especially the case for GOES-13, in which the co-registration error between channel 2 (3.9 micrometer) and 4 (10.7 micrometer) could be as large as 1 pixel along the East-West direction. Characterization results show significant large co-registration errors along the East-West direction for both GOES -13 and 14, while the errors are generally smaller along the North-South direction. Furthermore, all co-registration errors have a 24 hour periodic behavior. In this work, we present an algorithm using the temperature correlation and the Fast Fourier Transformation Resampling (FFTR) algorithm to characterize the IR channel-to-channel co-registrations. The co-registration errors are used to generate a co-registration table (CORT) by the least square fitting of a Fourier expansion series to the data over a 5 day period. The CORT is an array with 48 elements representing the co-registration error every half hour of the day. It is used as the input in the GOES ground system to correct the IR channel-to-channel co-registration error, and this is performed by image resampling with the FFTR algorithm. The evaluation of the resampled images shows no degradation of the image quality, and the reliability of the derived products has improved with the resampled images. The changes to GVAR block 0 to include the information on the IR-channel to channel co-registration are proposed.

T-8 Applications *Boris Petrenko*

Incremental Regression SST Algorithm for NPP VIIRS within the ACSPO

Authors: Boris Petrenko, Alex Ignatov, Yury Kihai, John Stroup, XingMing Liang

The Incremental Regression (IncR) sea surface temperature (SST) algorithm was developed during preparations to the GOES-R ABI mission and tested for MSG SEVIRI as a proxy of ABI. Compared with conventional regression algorithm (CR), the IncR has improved the uniformity of accuracy and precision of retrieved SST under various observational conditions. Currently, the IncR is being implemented within the Advanced Clear-Sky Processor for Oceans (ACSPO) and tested for the Visible Infrared Imaging Radiometer Suite (VIIRS) flown onboard the Suomi National Polar-Orbiting Partnership (S-NPP) satellite. The presentation describes some results of validation of IncR SST for VIIRS. In particular, the validation shows that 1) IncR reduces average bias and standard deviation (SD) of VIIRS SST with respect to in situ SST, compared with CR; and 2) IncR produces more uniform bias and SD of retrieved SST as functions of satellite view zenith angle (VZA) and total precipitable water vapor content in the atmosphere. The better uniformity in terms of VZA is especially important because the most of operational SST algorithms restrict the range of VZAs, within which high-quality SST retrievals are possible. Operational use of IncR may slacken or remove these restrictions and this way increase the coverage of the ocean surface with high-quality SST retrievals.

T-9 Data Access and Use *Mark Piper*

A Rapid Cloud Mask Algorithm for Suomi NPP VIIRS Imagery EDRs

Author: Mark Piper

A cloud mask algorithm, adapted from the Landsat 7 Automatic Cloud Cover Assessment, has been developed for use with Suomi National Polar-orbiting Partnership (NPP) Visible Infrared Imager Radiometer Suite (VIIRS) Imagery Environmental Data Records (EDRs). The algorithm consists of a sequence of pixel-based tests that use thresholds on VIIRS top-of-atmosphere reflectances and brightness temperatures. Each test returns a binary (clear or cloudy) result. For a pixel to be classified as cloudy, it must pass all tests. This cloud mask algorithm provides a simpler, though less informative and robust, alternative to the VIIRS Cloud Mask (VCM) Intermediate Product, with the advantage in that it can be applied to a higher spatial resolution VIIRS Imagery EDR. The algorithm is compared with the VCM in three case studies, with preliminary results indicating a quantitatively good match between the two. A consistent failure of the algorithm occurs in scenes containing snow: the original Landsat 7 algorithm uses ETM+ band 2 (0.53-0.61 µm), which isn't present in the VIIRS Imagery product, in computing a normalized snow difference index to separate snowy from cloudy pixels. Ongoing research will investigate the use of the VIIRS Normalized Difference Snow Index algorithm to help identify snowy pixels.

T-10 Current and Future Programs and Systems *Nikisa George*

Preparing for JPSS-1/ATMS Direct Readout Readiness

Authors: Nikisa S. George, Kent Anderson

The Advanced Technology Microwave Sounder (ATMS), manufactured by Northrop Grumman Electronic Systems (NGES) in Azusa CA, was launched on October 28, 2011 aboard the Suomi National Polar-orbiting Partnership (NPP) spacecraft. The ATMS works in conjunction with the Cross-track Infrared Sounder (CrIS) to measure atmospheric temperature and humidity profiles. ATMS is the follow-on to

the Advanced Microwave Sounding Units –A and –B (AMSU-A and AMSU-B respectively), incorporating the functions of AMSU-A temperature sounding and AMSU-B humidity sounding into a single package. The next ATMS, currently in system-level testing, will be on the Joint Polar Satellite System-1 (JPSS-1), planned for launch in 2017. The ATMS is expected to provide overall better performance than its predecessors, thus enhancing the National Weather Service (NWS) capability in weather forecasting. This study reviews the current calibration and validation activities and presents our performance assessments, including a discussion of scan-dependent radiometric biases and "striping". Finally, we present preliminary algorithm options that may be useful for direct readout users.

T-11 Applications *William Denig*

Societal Impacts of Space Weather

Authors: William Denig, Steven Hill

Space weather is all around up yet it is difficult for the average person to understand its nature and to assess its impacts on everyday life. The ancient Nordic people were captivated and, at times, in fear of the aurora borealis which is perhaps the most dramatic and clear manifestation of space weather. As society's dependence on high-technology systems has increased so too has its vulnerability to space weather. In 1859 a truly remarkable solar flare erupted off the surface of the sun that, in the current parlance of space weather, was extremely geo-effective and had a major impact on the Nation's telegraph network. More recently we have learned the hard way that space weather can have debilitating impacts on the electric power grid, wireless communications, geo-positioning and navigation, man-in-space, and satellite operations. In this talk I will trace the history of space weather and its impacts on society. I will also discuss how NOAA is responding to the threat of hazardous space weather by monitoring the solar and near-earth space environment and by forecasting conditions that can have deleterious effect on our way of life.

T-12 Current and Future Programs and Systems *Karen Dubey*

Preparing the Direct Broadcast Community for GOES-R

Authors: Karen Friedman Dubey, Eric Baptiste, Kota Prasad, Hae-Yong Shin

The first satellite in the United States next generation weather satellite program, GOES-R, will be launched in 2015. SeaSpace Corporation is using our recent experience and lessons learned from bringing Suomi NPP-capable direct reception systems online, to similarly bring direct reception solutions to future GOES-R users. This includes earlier outreach to customers, due to the advance budgeting deadline for procurement in many agencies. With the cancellation of eGRB, all current GOES gvar customer will need a new direct readout system, with a new receiver, high powered processing subsystem, and a larger antenna in some locations. SeaSpace's preparations have also included communicating with program leaders in NOAA and NASA regarding direct readout specifications and the development of the borrowing process for the government-procured GRB emulator. At the request of NASA, SeaSpace has offered input towards the emulator check-out process, which is expected to begin in spring 2013. After the launch of Suomi NPP, SeaSpace found a need by non-traditional customers (such as customers with non-SeaSpace ground stations or those getting data via the NOAA archive), for a processing-only subsystem. In response to this need, SeaSpace developed such a solution for Suomi NPP users, and plans to do similar for GOES-R. This presentation will cover the steps that SeaSpace is undertaking to prepare the members of the direct reception community for reception and processing of GOES-R satellite data, and detail the solutions offered.

T-13 Data Access and Use *Irina Gladkova*

Cloud-Top Pressure Estimation from VIIRS using Statistically Reconstructed 13.3 micron channel

Authors: Irina Gladkova, James Cross, Andrew Heidinger, Paul Menzel, Michael Grossberg

VIIRS does not have any spectral bands located in H2O or CO2 absorption bands, which degrades its ability to determine semi-transparent cloud properties, including cloud top pressures/heights. In an effort to ensure continuity and consistency between historical cloud products and those provided from the SNPP sensors (and JPSS in the future), we demonstrate a VIIRS plus CrIS cloud algorithm that can extend the AVHRR/HIRS and MODIS/AIRS cloud record. VIIRS has 16 spectral bands measured at 780 meter resolution at nadir, 9 in the visible and near infrared plus 5 in the infrared. We will present a technique to generate an additional VIIRS channel at 13.3 micron statistically constructed from CrIS and VIIRS measurements. The CrIS sensor makes 1305 high spectral resolution measurements from 15.1 to 3.8 micron at 15 km resolution; the measurements in the 15 micron CO2 absorption bands are especially important for cloud property retrieval. Using the infrared spectral bands on VIIRS at 780 meter resolution and a convolution of the 15 micron spectral measurements on CrIS at 15 km resolution, a reconstruction of a 13.3 micron channel at 780 meter resolution is accomplished by statistical estimations. The observed VIIRS channels combined with the statistically constructed 13.3 micron channel are then used in a cloud top pressure algorithm that has been developed for the pending Advanced Baseline Imager to be launched in 2015 on GOES-R. We will present results demonstrating that the statistically synthesized data from VIIRS and CrIS would allow VIIRS/CrIS to match

GOES-R in terms of cloud-top pressure determination, to within the GOES-R specifications, which is especially important for getting such values for night scenes.

T-14 Current and Future Programs and Systems
Allen Huang

The Development of Polar Orbiting Satellite Processing Packages in Support of International Direct Broadcast Community

Authors: Allen Huang, Liam Gumley, Kathy Strabala, Mitch Goldberg

In cooperation with the NOAA Suomi NPP/JPSS program, CIMSS/SSEC continues to expand NASA funded International MODIS/AIRS Processing Package (IMAPP) effort, and to facilitate the use of polar orbiter satellite data through the development of a newly conceived Community Satellite Processing Package (CSPP) to support the Suomi NPP and JPSS, and subsequently build up over time, to support GOES-R and other international polar orbiting and geostationary meteorological and environmental satellites for the global direct broadcast user community. This paper highlights more than 12 years of success of IMAPP as a pathway to the development of a freely available software package to transform VIIRS, CrIS, and ATMS Raw Data Records (RDRs) (i.e. Level 0) to Sensor Data Records (SDRs) (i.e. Level 1), and SDRs to Environmental Data Records (EDRs) (i.e. Level 2) in support of Suomi NPP and subsequently the JPSS missions under the CSPP framework. Summary will be given to report on the current software release and the initial experimental and operational use of SDR and EDR of VIIRS, CrIS, and ATMS in National Weather Service (NWS) field offices' daily operation and many other direct broadcast users around the world for their real time applications and weather and environmental research.

T-15 GSICS Users' Workshop *Tim Hewison*

Migrating from Metop-A/IASI to Metop-B/IASI as GSICS inter-calibration reference for Geostationary IR Imagers

Author: Tim J. Hewison

Inter-calibration products have been developed for the infrared channels of current geostationary imagers by the Global Space-based Inter-Calibration System (GSICS). These are based on comparison of collocated observations from hyperspectral sounders in Low Earth Orbit. The Infrared Atmospheric Sounding Interferometer (IASI) onboard the Metop-A polar-orbiting satellite has been defined as the reference sensor by GSICS since it became operational in 2007, because of its high spectral resolution covering (almost) the full spectrum of infrared channels and excellent orbital and calibration stability. The latter has been demonstrated by various comparisons with the Atmospheric Infra-Red Sounder (AIRS), operating on EOS-Aqua. However, the Metop-A/IASI will not endure indefinitely. It has recently been complemented by its successor instrument on Metop-B, which has been producing commissioning data since December 2012. This provides us with a valuable dataset to test the proposed method of migrating from one reference instrument to another. This is a double differencing method based on the three-way comparison of Metop-A/IASI and Metop-B/IASI in the channel space of the Meteosat-9/SEVIRI imager. Both comparisons are used to generate linear functions to convert the calibration of SEVIRI to be consistent with either reference, which form the basis of the GSICS Corrections. The small differences between these functions provides an indirect comparison between the counterpart IASI instruments on board Metop-A and –B, which is not possible by direct means due to their orbital configurations. This approach allows different references to be used to generate Fundamental Climate Data Records (FCDRs) by inter-calibrating a series of instruments, while ensuring their traceability to a common reference. Inter-calibration results will also be shown from the commissioning tests of the third Meteosat Second Generation (MSG-3) SEVIRI instrument, which recently became operational as Meteosat-10. These show changes, particularly in the IR13.4 channel, but also to a lesser extent in IR3.9, due to a buildup of ice contamination on the optics, which modifies the spectral response functions of these channels. Although these changes were rapid during the first few months, these are becoming more stable and the calibration of all channels is now within 1 K of the both Metop-A/IASI and Metop-B/IASI.

T-16 Research to Operations *Jordan Gerth*

The Ingredients for Sustaining Success in NOAA R2O for GOES-R

Author: Jordan Gerth

In order to achieve its mission as both a science and service agency, the National Oceanic and Atmospheric Administration (NOAA) must successfully achieve a sustainable and time-effective path for research to transition to operations, particularly from the National Environmental Satellite, Data, and Information Service (NESDIS) and the NOAA Cooperative Institutes (Cis) to the National Weather Service (NWS). However, this process is continually mired in the byproduct of bureaucracy and complexity which neither serves the agency nor its science partners, the NOAA Cis. Proving grounds have been a popular mode of organization to facilitate research-to-operations activities between NOAA's agencies and their partners, namely the Cis. As a catalyst which connects scientists and interagency users, namely the NWS, the Geostationary Operational Environmental Satellite R-Series (GOES-R) Proving Ground serves as a mechanism to

evaluate simulated GOES-R imagery and products in operations prior to the launch of the spacecraft. This exercise is now expanding to include an initial demonstration for highlighting the operational significance of imagery and products from Suomi National Polar-orbiting Partnership (NPP). The proving ground concept as applied to our nation's satellite programs has been successful. As the satellite proving grounds grow, operations-ready products are identifiable, but lack a permanent entrance strategy into operations. The Satellite Products and Services Review Board (SPSRB) process is one which has not been efficiently integrated as a proving ground exit point for successfully demonstrated products. Integrating the SPSRB process into the proving ground could consolidate steps of the process and streamline the functions of the Board, ultimately decreasing the time required for the research-to-operations process to complete. As new satellite systems begin to replace our existing constellation over the upcoming decade, effectively using resources will be paramount. In fact, an increased burden may result from maintaining current capabilities while implementing new algorithms and science for GOES-R and NPP. Beyond recommending possible improvements to the proving ground and SPSRB process, this presentation examines four factors which have potential to produce overarching success and keep NOAA on the cutting-edge of research and development transitions. These factors are: personnel on the interagency interface who are conversant in requirements to facilitate across interagency gaps; sufficient and certain budget allocations, particularly for operational continuity; necessary information technology (IT) resources and infrastructure, including computing capabilities and telecommunication bandwidth; and emphasized mission-priority principles, where security and non-mission regulations are not restrictions. Experiences in research to operations from the Cooperative Institute for Meteorological Satellite Studies (CIMSS) are shared. Several non-standard examples of successful research to operations will be discussed, evinced by positive results from recent NOAA testbeds with GOES-R Proving Ground involvement, and new direct broadcast reception in Hawaii, which has increased the availability and timeliness of polar-orbiting satellite imagery and products for the central Pacific Ocean.

T-17 Data Access and Use *Katja Hungershoefer*

VIIRS Imagery in NinJo

Authors: Katja Hungershoefer, David Hoese, William Straka III, Ray K. Garcia, Eva Schiffer, Kathleen Strabala

New, high-capacity sensors and improved satellite broadcast possibilities call for new acquisition and processing facilities to provide existing and new products to the various users. A recent example is the Suomi National Polar-orbiting Partnership (Suomi NPP) satellite. The high spatial resolution (up to 360 meters) images obtained with Suomi NPP's Visible/Infrared Imager Radiometer Suite (VIIRS), and the temperature and moisture vertical profiles from the infrared (CrIS) and microwave (ATMS) sounders will certainly play a decisive role in terms of improving weather forecasts and severe weather warnings of national meteorological services like e.g. Deutscher Wetterdienst (DWD), especially for nowcasting, if regional data is available within near-real time through direct broadcast. The Cooperative Institute for Meteorological Satellite Studies (CIMSS) has developed the Community Satellite Processing Package (CSPP) to support the Suomi NPP/JPSS direct broadcast community as part of the NOAA Joint Polar Satellite System (JPSS) project. CSPP generates VIIRS, CrIS and ATMS Science Data Records (SDR) as well as Environmental Data Records (EDR). In order for forecasters to be able to use the data from Suomi NPP, the data must be available to the visualization systems the weather services use. The US National Weather Service (NWS) uses the Advanced Weather Interactive Processing System (AWIPS), while DWD uses a software called NinJo. NinJo is a meteorological visualization and production system developed by a consortium of five meteorological services, namely Deutscher Wetterdienst, Bundeswehr Geoinformation Service, Meteo Swiss, Danish Meteorological Institute, and Environment Canada. CIMSS has developed a post-processing package, polar2grid, which is used to take the VIIRS SDR data and output it in a form that can be read in both AWIPS and AWIPS-II. In cooperation with DWD, CIMSS/SSEC developed a software module for polar2grid so that the VIIRS SDR data is converted into tiled, multi-page tagged image file format files which can be handled by the NinJo system. This means that this module can be of use for other meteorological centres using NinJo.

T-18 Data Access and Use *Simon J. Keogh*

The Utilization of Data from Suomi NPP at the Met Office (UK)

Authors: Simon J. Keogh, Nigel C. Atkinson, William Bell, Ian D. Brown, Brett Candy, Andy Doherty, John Eyre, Bridget George, Paul Odams, Roger Saunders, Andrew Smith

Suomi NPP was launched 28 October 2011. The Met Office now receives Suomi NPP data via EUMETCast and X-band Direct Broadcast. The Suomi NPP data are preprocessed utilizing both AAPP (EUMETSAT NWP SAF) and CSPP (University of Wisconsin) processing packages before being made available for both NWP data assimilation and forecaster imagery applications. CSPP is used to generate Sensor Data Records from raw direct broadcast data. AAPP is used to perform spatial filtering (and noise reduction) on ATMS, channel selection on CrIS, to map ATMS to the CrIS grid and

to encode the resulting combined file into BUFR format. Data from ATMS and CrIS have been evaluated in NWP forecast trials and are being operationally used in the Met Office global forecast model. Strong positive impact on forecast quality has been seen from the assimilation of ATMS. Positive impact is also observed as a result of assimilating CrIS data. NWP comparison is a powerful technique for identifying instrument-related signals: for example, a "striping" noise is prominent in the ATMS data, and this is now believed to be due to 1/f noise in the front end of the receiver. During the NPP cal/val period the Met Office has collaborated with NOAA, NRL, MIT and others in order to characterize this unexpected noise source. High resolution data from VIIRS is received by X-band Direct Broadcast at the Met Office's satellite reception facility, which has recently been upgraded to X band specifically to enable us to receive Suomi NPP data. Our downstream systems transform these data into meteorological imagery products (e.g. Visible, InfraRed, Fog etc), which are of great benefit to forecasters. Results from our assimilation and imagery work will be presented along with details of our preparatory work to enable X-band direct broadcast reception. We will also present future plans to improve the assimilation process for ATMS and CrIS and the generation of further derived products from VIIRS.

T-19 Data Access and Use *Isaac Moradi*

Developing Climate Data Records from AMSU-B and MHS Channels

Authors: Isaac Moradi, Huan Meng, Ralph Ferraro

Current passive microwave sounder data, used in reanalyses and hydrological applications, are derived from POES satellites for which the primary mission is operational weather prediction. These data are not calibrated with sufficient stability for climate applications. A properly calibrated fundamental climate data record (FCDR) needs to be developed to enable the utilization of these data for Thematic CDR (TCDR) and Climate Information Records and to extend their application into the JPSS era (e.g., POES/AMSU to NPP/ATMS to JPSS/ATMS). Once the FCDR's are developed, they will be use to create TCDR's for water cycle applications (precipitation, water vapor, clouds, etc.) which will become key components in international programs such as GEWEX, CEOS and GPM; collaborators on this project hold key roles in many of these programs. Passive microwave sounder data have proven their worth in more than just tropospheric temperature and moisture monitoring. NOAA/NESDIS generates operational products from the Advanced Microwave Sounding Unit (AMSU) focused on the hydrological cycle (e.g., rainfall, precipitable water, cloud water, ice water, etc.) through two product systems known as the Microwave Surface and Precipitation Products Systems (MSPPS) and the Microwave Integrated Retrieval System (MIRS). MSPPS has the longest legacy dating back to NOAA-15 (July 1998) while MIRS is an advanced, 1Dvar retrieval system that is portable to different passive MW sensors thus making it attractive for multi-sensor TCDR generation. MSPPS and MIRS products are archived at NCDC and are being widely used in the scientific community. As we enter the JPSS era, AMSU-A and AMSU-B (and its successor, MHS) will be replaced with the ATMS sensor, first to be flown on NPP, then on all of the JPSS spacecraft. These data offer the unique opportunity to develop CDR's that can contribute to other satellite time series with similar capabilities such as the DMSP SSM/I and SSMIS, the TRMM TMI, and Aqua AMSR-E. This project will focus on the development of AMSU FCDR's for the AMSU-A window channels and the AMSU-B/MHS sensor. Th AMSU/MHS project utilizes established methods or develops new approaches to generate FCDR's and take "multiple paths" to determine which methodology is the most applicable to AMSU. The generation of TCDR's is a necessary step to assess the accuracy of the FCDR's; similar results by multiple methods yield confidence and uncertainty estimates in the CDR's.

T-20 Applications *Tianfeng Chai*

Chemical data assimilation with CMAQ and MODIS aerosol optical depth observations

Authors: Tianfeng Chai, Hyun-Cheol Kim, Pius Lee, Li Pan

The PM2.5 forecasts using the Community Multi-scale Air Quality (CMAQ) model by for the National Air Quality Forecast Capability (NAQFC) experimental runs have high biases in winter and low biases in summer. While emissions inventories and aerosol dynamics need improvement, it is possible to constrain the model with aerosol observations to improve PM2.5 forecasts with the current model and emissions. MODIS (Moderate Resolution Imaging Spectroradiometer) provide near real-time aerosol optical depth (AOD) observations with good spatial resolutions and global coverage. In this study, MODIS AOD observations are assimilated into the CMAQ model using an optical interpolation (OI) method. In two separate assimilation cases, fine mode AOD or total AOD observations are assimilated at 17Z daily from July 1 to July 12, 2011. Results show that assimilating either of the MODIS AOD products is able to improve AOD predictions for the following days compared with the baseline cases. AOD assimilation also helps PM2.5 predictions for the entire 12 days in both cases, measured by daily- and domain- average biases and RMSEs compared with the hourly observations from the AIRNow surface monitoring network. For the test period, assimilating the total AOD observations proves to be more beneficial in correcting the PM2.5 underestimations than assimilating the fine mode AOD observations.

T-21 Applications *Christopher Brown*

Estimating Sea Surface Salinity in the Chesapeake Bay from Ocean Color Radiometry Measurements

Authors: Christopher W. Brown, Ronald L. Vogel

Sea-surface salinity (SSS) is a critical factor in understanding and predicting both physical and biological processes in the coastal ocean. Unfortunately, SSS cannot be currently estimated in estuarine waters at the temporal and spatial resolution required for many applications. To overcome the limitations of deriving SSS from microwave satellite measurements in these coastal waters and assess the likelihood of using satellite-retrievals to improve model forecasts of SSS through data assimilation, we implemented an experimental Artificial Neural Network (ANN) to retrieve SSS from MODIS ocean color radiometry (OCR) measurements and evaluated these retrievals, as well as model predictions of SSS, against in situ observations. A latitudinally dependent bias was observed in OCR-SSS retrievals in the Chesapeake Bay, with highest positive bias in the northern portion of the Bay that generally decreased to a negative bias at the mouth. This bias is likely due to the application of the ANN to waters outside of the salinity range for which it was trained. The root mean square error and bias of the SSS predicted by the Chesapeake Bay Operational Forecast System (CBOFS) model were both lower than OCR-SSS retrievals at all match-up locations. Given this result, assimilation of OCR-SSS retrievals estimated using the present ANN into CBOFS will not improve model forecasts of SSS in the Chesapeake Bay.

T-22 GSICS Users' Workshop *A. Angal*

Sensor Calibration Inter-comparison Using the Sonoran Desert

Authors: A. Angal, X. Xiong, A. Wu, G. Chander, and T. Choic

The Sonoran Desert (+32.35º,-114.65º) is a large flat area, partially vegetated, with typical horizontal visibilities of around 30-45 km. This site is particularly suitable for radiometric calibration and validation purposes because of its high spatial and spectral uniformity and reasonable temporal stability. This study uses measurements from Terra and Aqua MODIS, Landsat 7 ETM+, and Landsat 5 TM and compares the top-of-atmosphere (TOA) reflectances for their spectrally matching bands. The impact due to sensor spectral response and measurement viewing geometry differences is also characterized and discussed. Regression curves and coefficients of determination for the TOA trends from these sensors are generated. Additionally, the newly available Landsat Climate Data Record (CDR) Surface Reflectance product generated using ETM+ has been used to assess the suitability of the Sonoran desert target for long-term radiometric calibration.

T-23 GSICS Users' Workshop *Wenze Yang*

Inter-Calibration of AMSU-A Window Channels

Authors: Wenze Yang and Huan Meng, and Ralph Ferraro

More than one decade of observations from the Advanced Microwave Sounding Unit-A (AMSU-A) onboard the polar-orbiting satellites NOAA-15 to NOAA-19, and European Meteorological Operational satellite program-A (MetOp-A) provide global information on atmospheric temperature profile, water vapor, cloud, precipitation, etc. After the addressing of the asymmetric cross-scan bias of the AMSU-A window channels, three approaches of simultaneous nadir overpass (SNO) method are applied to inter-calibrate among the same sensor onboard the different NOAA (NOAA-15, -16, -17, -18 and -19) and EUMETSAT (MetOp-A) satellites. The advantage of such a technique is that it can account for non-linear calibration effects and other potential calibration issues. Approaches of the same method provides better estimation of the uncertainty of final radiance/brightness 8isible8ent. This serves as the second step towards a more stable fundamental and thematic climate data record (CDR) to be used in hydrological and meteorological applications.

T-24 Current and Future Programs and Systems *Huan Meng*

Snowfall Rate Retrieval Using Passive Microwave Measurements

Authors: Huan Meng, Banghua Yan, Ralph Ferraro, Cezar Kongoli, Limin Zhao

A land snowfall rate (SR) product has been developed and is running operationally at NOAA National Environmental Satellite, Data, and Information Service. The algorithm employs Advanced Microwave Sounding Unit (AMSU) and Microwave Humidity Sounder (MHS) passive microwave data and performs retrieval in three steps: snowfall detection, retrieval of cloud properties, and estimation of snow particle fall velocity and SR. Snowfall detection (Kongoli et. Al, 2003) is based on a set of statistically derived criteria involving multiple channels of AMSU/MHS and ancillary data. Cloud properties are retrieved using an inversion method with a two-stream Radiative Transfer Model (RTM) (Yan et. Al, 2008) that is coupled with an iteration scheme. A method developed by Heymsfield and Westbrook (2010) is adopted to calculate snow particle fall velocity. Finally, snowfall rate is computed by numerically solving a complex integral. This algorithm has been validated against both in-situ ground snowfall observations and StageIV, a radar and gauge combined snowfall product. The validation results have shown that the algorithm performs well for different types of snowfall events. Currently, a NPP ATMS based snowfall rate algorithm is under development at NOAA/NESDIS. The project is expected to be completed by the end of 2013.

T-25 Data Access and Use *Evan Ellicott*

Suomi NPP (SNPP) Visible Infrared Imager Radiometer Suite (VIIRS) Active Fire Data for Fire Management and Fire Weather Applications

Authors: Evan Ellicott, Ivan Csis, Wilfrid Schroeder, Peter Roohr, Brad Quayle, Louis Giglio, Chris Justice

Active Fires is one of the operational environmental data products generated from the Visible Infrared Imager Radiometer Suite (VIIRS) sensor on the Suomi National Polar-orbiting Partnership (SNPP) satellite. The standard Applications Related Product generated by the SNPP Interface Data Processing Segment (IDPS), processes radiometric measurements from the VIIRS 750m moderate resolution bands using a heritage algorithm from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Earth Observing System (EOS) Terra and Aqua satellites. Since on-orbit data became available in January 2012, the Joint Polar Satellite System (JPSS) Active Fires Algorithm Development and Validation team has carried out a detailed evaluation of the product to characterize and improve its performance. As a result, the product reached Beta maturity status in October 2012 and is now available for the broad user community. As part of a user readiness and proving ground activity, the team has also developed a web-based data visualization, analysis, and distribution system, which provides near-real-time data and a rolling archive of all VIIRS fire observations over North America. For select cases, near-simultaneous observations from Aqua MODIS are also presented for comparison. The data are also converted into GIS formats to assist on-site fire managers in evaluating the usefulness of the product in daily operations. Planning is underway for the detailed a posteriori analysis of select fires in the 2012 fire season, which was particularly active over the Conterminous United States. Imagery of major fire events was also generated from an experimental product, based on 375m VIIRS Imagery resolution band measurements. The system is currently being augmented to distribute data from a science code that includes the latest MODIS algorithm components, a full spatially explicit fire mask, and Fire Radiative Power. Science support and coordination is also being provided to the domestic and international direct readout user community, which is incorporating VIIRS fire data into near-real-time applications. In this presentation we will highlight some of the progress made since launch, outreach activities and end-user engagement, as well as current and future activities.

T-26 Instrument Calibration and Validation *Michael Grotenhuis*

On-orbit characterization of the GOES Imager channel-to-channel co-registration and correction algorithm evaluation

Authors: Michael G. Grotenhuis, Xiangqian Wu, Zhenping Li, Timothy J. Schmit, Fangfang Yu, Scott Lindstrom, and Changyong Cao

On-orbit characterization of the GOES Imager channel-to-channel co-registration and correction algorithm evaluation Michael G. Grotenhuis (1), Xiangqian Wu (2), Zhenping Li (3), Timothy J. Schmit (4), Fangfang Yu (1), Scott Lindstrom (5), and Changyong Cao (2) 1. ERT, Inc. @ NOAA/NESDIS Center for Satellite Applications and Research (STAR), College Park, MD, 20740, U.S.A. 2. NOAA/NESDIS Center for Satellite Applications and Research (STAR), College Park, MD, 20740, U.S.A. 3. SGT, Inc., Greenbelt, MD, 20770, U.S.A. 4. NOAA/NESDIS Office of Research and Applications, Advanced Satellite Products Branch (ASPB), Madison, WI, 53706, U.S.A. 5. University of Wisconsin–Madison/Space Science and Engineering Center (SSEC), Madison, WI, 53706, U.S.A. Abstract The channel-to-channel co-registration of a satellite imaging system is an important performance metric that has a direct impact upon the reliability of the imager's quantitatively-derived products. For example, if the co-registration is too large, then products that use band differences can be adversely impacted. Fog detection is one such example. In this work, standard full-disk image data are used to measure the on-orbit channel-to-channel co-registration of the infrared channels of several GOES Imagers at a sub-pixel level. This is accomplished with two separate methods, one of which furthers preliminary research by Wu et. Al. using GOES-8 and 9 spatial-spectral brightness temperature gradients, the other of which uses a statistical approach. The diurnal, seasonal, and long-term co-registration behavior is analyzed. The diurnal variation patterns were later confirmed by ITT/Exelis. These algorithms later were used to evaluate the operational co-registration error correction to be implemented within the GOES ground system (Li et. Al., 2013 NOAA Satellite Conference). The STAR evaluation of the algorithm is presented.

T-27 Applications *Gang Liu*

NOAA Operational Satellite SST for Monitoring Coral Bleaching Thermal Stress: Coral Reef Watch's Satellite Decision Support System for Coral Reef Managers

Authors: Gang Liu, C. Mark. Eakin, Jacqueline L. Rauenzahn, Jianke Li, Scott F. Heron, William J. Skirving, Alan E. Strong

NOAA Coral Reef Watch (CRW) has been applying satellite remote sensing to monitor coral reef environments for more than a decade. CRW's operational satellite data products, including Coral Bleaching HotSpots and Degree Heating Weeks products based on satellite sea surface temperature (SST) measurements, monitor global current reef

environmental conditions to quickly identify areas at risk of thermally-induced mass coral bleaching. Mass coral bleaching events have been well correlated with thermal stress. In the event of severe thermal stress, disease and mortality may follow. Severe bleaching events also have dramatic long-term ecological and social impacts. Continuous monitoring of SST and bleaching-level thermal stress at the global scale provides reef managers, researchers and stakeholders with critical information to understand, predict, and monitor the development of mass coral bleaching. To meet the ever-growing needs of coral reef managers and scientists for accurate and timely information on coral reef ecosystems, CRW has been taking advantage of continual improvement in NESDIS' operational satellite SST products. CRW is now developing a next-generation near-real-time satellite decision support system using NESDIS' new operational 5 km SST product blended from both geostationary and polar-orbiting satellite observations. This poster provides an overview of CRW's operational twice-weekly 0.5 degree (50 km) satellite coral bleaching thermal stress monitoring product suite, representing CRW's heritage product suite and the core of CRW's current DSS for much of the last decade, and introduces a new-generation 5 km product suite. A separate poster provides information on the application of these tools for marine resource management.

T-28 Current and Future Programs and Systems

Chris Velden

Overview of the GOES-R Proving Ground Activities at the National Hurricane Center

Authors: Christopher Velden, Mark DeMaria, John Knaff, Mike Brennan, Jack Beven, Hugh Cobb, Jessica Schauer, Kevin Fuell, Jason Dunion, Michael Folmer

The purpose of the GOES-R (U.S. next generation geostationary satellite) Proving Ground (PG) demonstration at the National Hurricane Center (NHC) is to provide NHC forecasters with an advance look at tropical cyclone related products for evaluation and feedback during the peak of the hurricane season (August 1 – November 30). The PG facilitates the testing and validation of expected products from GOES-R before the actual satellite launch, in order to provide user readiness for smooth integration into the operational environment. Nine GOES-R products and decision aids provided by NESDIS/STAR, CIRA, CIMSS, CIMAS, SpoRT and OAR are currently being evaluated at the NHC. The image-based products are derived using proxy data from Meteosat, GOES, and MODIS, and the lightning product is derived from ground-based World Wide Lightning Location Network (WWLLN) data. Examples of these products will be shown in the poster. Although the same nine products were demonstrated in 2012 as in 2011, more of them were available in N-AWIPS format during the 2012 demonstration, thanks to coordination between SpoRT, HRD, CIMAS, CIMSS and CICS/UM. NHC forecasters indicated that this capability was a significant improvement to their ability to assess the products, since many had previously only been available via the web. Feedback on the potential utility of these products is being gathered through a web based form and informal email exchanges between the NHC participants and product providers.

T-29 Data Access and Use *Kevin Gallo*

Enhanced data access and retrieval for analysis and validation of ABI and VIIRS land data and products

Authors: Kevin Gallo, Calli Jenkerson, Greg Stensaas, Gyanesh Chander, John Dwyer

NOAA and the U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center are collaborating on the development of a Land Product Validation System (LPVS) that will facilitate the application of multi-satellite and in-situ data for characterization and validation of GOES-R and JPSS land-related products (e.g., Surface Reflectance, Normalized Difference Vegetation Index, and Land Surface Temperature). The system is planned to utilize data and products anticipated to be available from the USGS Landsat-8, ESA Sentinel-2 and -3 series of satellites, and other relatively high and medium resolution sensors, to validate GOES-R Advanced Baseline Imager (ABI) and JPSS Visible Infrared Imager Radiometer Suite (VIIRS) products. The VIIRS products from the Suomi National Polar-orbiting Partnership (NPP) satellite will also be integrated into the system as they become available. The LPVS includes data inventory, access, and analysis functions that will permit selection of data housed within multiple archive facilities to be easily identified, retrieved, co-registered, and compared statistically through a single interface. This functionality is evolving through a prototype phase (2012) and a beta operational phase (2013) before becoming operational in 2014.

T-30 Current and Future Programs and Systems

Jason Otkin

Assimilation of water vapor sensitive infrared brightness temperatures during a cool season high impact weather event

Author: Jason Otkin

A regional-scale Observation System Simulation Experiment of a high impact weather event across the central U.S. was used to examine the impact of water vapor (WV) sensitive infrared brightness temperature observations on the analysis and forecast accuracy. Vertical error profiles at the end of the assimilation period showed that the wind and temperature

analyses were most accurate when observations sensitive to WV in the upper troposphere were assimilated; however, the largest improvements in the cloud and moisture analyses occurred after assimilating observations sensitive to WV in the lower and middle troposphere. The more accurate analyses at the end of the WV band assimilation cases lead to improved short-range precipitation forecasts compared to the Control case in which only conventional observations were assimilated. Equitable threat scores were consistently higher for all precipitation thresholds during the WV band forecasts. These results demonstrate that the ability of WV-sensitive brightness temperatures to improve not only the 3D moisture distribution, but also the temperature, cloud, and wind fields, enhances their utility within data assimilation systems.

T-31 Current and Future Programs and Systems

Tish Soulliard

Overview of the NOAA GCOM AMSR2 Algorithm Software Processor (GAASP)

Authors: Letitia Soulliard, Thomas King, Elizabeth McMichael, Zorana Jelenak, Walter Wolf, Paul Chang, and Ralph Ferraro

As part of NOAA's mission goal to serve society's need for weather and water information, NOAA/NESDIS is acquiring data from the Japan Aerospace Exploration Agency's (JAXA) Global Change Observation Mission (GCOM) to enable the distribution of data products to operational users. The first in the series of GCOM satellites, 1st-Water (GCOM-W1), was launched May 18, 2012 with the Advanced Microwave Scanning Radiometer 2 (AMSR2) sensor on board to measure hydrometeorological parameters. GCOM-W1 data will contribute to observations related to global water and energy circulation. A custom built software package, the STAR GCOM AMSR2 Algorithm Software Processor (GAASP), will combine all aspects of ASMR2 data processing and Environmental Data Record (EDR) production and will be implemented operationally at the Office of Satellite and Product Operation (OSPO). EDR algorithms being developed include ocean scene products (sea surface temperature, total precipitable water, cloud liquid water, sea surface wind speed and ocean rain rate), snow and sea ice, soil moisture and surface type, and global rain rate. The GAASP software will be comprised of a preprocessor for the sensor data records (SDRs, brightness temperatures), the science algorithms, and a postprocessor for the EDRs. Output products will be made available in netCDEF4, BUFR, and GRIB2 formats according to operational user needs. The timeline of the project is to make AMSR2 brightness temperatures and day 1 products available operationally by November 2013. Details of the software and its products will be discussed.

T-32 Current and Future Programs and Systems

Frank A. Alsheimer

Recent NWS/Eastern Region Participation in the GOES-R Proving Ground and Operational Use of New Satellite Data

Authors: David B. Radell and Frank A. Alsheimer

In 2011-2012, NWS/Eastern Region Weather Forecast Offices (WFOs) continued to be actively involved in the GOES-R Proving Ground, with 10 WFOs and Eastern Region Headquarters participating in five different product evaluations. In addition to the Proving Ground activities, supplemental super rapid-scan 1-minute imagery from GOES-14, while currently outside of NWS operational forecast systems, was used in a few instances for on-site decision support services (DSS) during convective season. These high resolution satellite data provide critical information to Eastern Region forecasters, supporting their emphasis on enhanced short term (0-36 hours) public forecasting, aviation and marine forecasting, as well as decision support services. Satellite products including the CIMSS Fog/Low Stratus products, CIRA WRF simulated ABI products, and the UAH/SPoRT RGB Air Mass product have been introduced into Advanced Weather Interactive Processing Systems (AWIPS) and in some cases the Graphical Forecast Editor (GFE) for evaluation by operational forecasters. The new products are evaluated for use in the forecast process, and formal feedback is provided back to the GOES-R Proving Ground and algorithm developers. In this way, a direct link between operations and research is fostered, and the operational community is not only well prepared for new satellite data use, but also has a voice in the development of these new products and visualizations. Examples of the use of the products have been presented at conferences and workshops, as well as posted on blogs and listservs, so other forecasters can see the operational benefits. This poster will give an overview of satellite products evaluated by Eastern Region WFOs and ERH, along with some recent examples of use in operational forecasting.

T-33 Applications *Banghua Yan*

NOAA Ocean Color Operational Product System

Authors: B. Yan, I. Simpson, E. Rodriguez, E. Ladd, D. Zbesheski, D. Vanpelt, H. Gu, P. Keegstra, S. Ramachandran, M. Soracco, and K. Hughes

Ocean Color (OC) is the water hue due to the presence of tiny plants containing the pigment chlorophyll, sediments, and colored dissolved organic material (DOM). Its observations from space can be used to monitor the variability of marine primary productivity and the occurrence of harmful algal blooms. Since 2006, a series of OC operational products have been created from multiple satellite sensors in the NOAA CoastWatch (CW) Okeanos system, which is a flexible, expandable software system for generating ocean color

products using NOAA and NASA OC algorithms. Current OC products include daily chlorophyll concentration (anomaly), water turbidity, and remote sensing reflectance from Moderate-resolution Imaging Spectroradiometer (MODIS)/Aqua by using the NASA l2gen and the NOAA SWIR algorithms. OC products from MODIS/Terra are also available for backup. Early this summer, chlorophyll frontal products from MODIS/Aqua will be operational. The products will be extended to NPP and JPSS Visible/Infrared Imager Radiometer Suite (VIIRS) and other upcoming ocean color sensors in the next few years. These products have been widely applied to USA local and state ecosystem research, ecosystem observations, and fisheries managements for coastal and regional forecasting of ocean water quality, phytoplankton concentrations, and primary production. For example, the chlorophyll concentration product has been used to predict harmful algal blooms in the Gulf of Mexico by the NOAA Center for Operational Oceanographic Products and Services (CO-OPS) (http://tidesandcurrents.noaa.gov/hab/). MODIS/Aqua and NPP/VIIRS chlorophyll operational products will be applied to NOAA ocean forecast models.

T-34 Current and Future Programs and Systems

Gerald Dittberner

The GRB Simulator: A Testing System for GOES Rebroadcast (GRB) Receivers

Authors: Kevin Gibbons, R. Race, C. Miller, K. Barnes, and G. Dittberner

GOES Rebroadcast (GRB) signals in the GOES-R era will replace the current legacy GOES Variable (GVAR) signal and will have substantially different characteristics, including a change in data rate from a single 2.1 Mbps stream to two digital streams of 15.5 Mbps each. The GRB Simulator is a portable system that outputs a high-fidelity stream of Consultative Committee for Space Data Systems (CCSDS) formatted GRB packet data equivalent to live GRB data. The data is used for on-site testing of user ingest and data handling systems known as field terminal sites. The GRB Simulator will provide GRB data as either baseband or Intermediate Frequency (IF) output to the test system. GRB packet data will be sent in the same two output streams as used in the operational system: one for Left Hand Circular Polarization (LHCP) and one for Right Hand Circular Polarization (RHCP). Use of circular polarization in the operational system allows the transmitting antenna to multiplex the two digital streams into the same signal, thereby doubling the available bandwidth. The GRB simulator is compliant with MIL-STD-1472F transportability guidelines and may be used at any site that receives GRB downlink. The GRB Simulator is a fully self-contained system which includes all hardware units needed for operation. The GRB Simulator has two modes of operation, online and offline. The offline mode allows the user to manage various setup configurations, test scenarios, event logs, and reports. The online mode continuously outputs the GRB data stream at IF or baseband levels until the simulation ends. Simulations are controlled by test scenarios, which are scripts that specify the test data and provide a series of actions for the GRB Simulator to perform when generating GRB output. Scenarios allow for the insertion of errors or modification of GRB packet headers for testing purposes. The GRB Simulator provides a built-in editor for managing scenarios. It also provides a capability to allow operators to create test data from image files. Data output by the simulator is derived from either proxy data files containing Level 1b (L1b) data or test pattern images. Proxy data and test patterns provide the capability to test both nominal and error cases. The GRB Simulator outputs both instrument packets and GRB Information packets. Instrument packets contain data simulated from any instrument: the Advanced Baseline Imager (ABI), Solar Ultraviolet Imager (SUVI), Space Environment In-Situ Suite (SEISS), Extreme Ultraviolet Sensor (EUVS) and X-ray Irradiance Sensor (XRS) called EXIS, Geostationary Lightning Mapper (GLM), or the Magnetometer.

T-35 Current and Future Programs and Systems

Kerry Grant

Algorithm Development Library for Environmental Satellite Missions

Authors: Kerry D Grant, Shawn W Miller, Michael Jamilkowski

The National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) are jointly acquiring the next-generation civilian weather and environmental satellite system: the Joint Polar Satellite System (JPSS). JPSS will replace the afternoon orbit component and ground processing system of the current Polar-orbiting Operational Environmental Satellites (POES) managed by NOAA. JPSS satellites will carry a suite of sensors designed to collect meteorological, oceanographic, climatological, and solar-geophysical observations of the earth, atmosphere, and space. The ground processing system for JPSS is known as the Common Ground System (JPSS CGS), and provides command, control, and communications (C3) and data processing and product delivery. As a multi-mission system, CGS provides combinations of C3, data processing, and product delivery for numerous NASA, NOAA, Department of Defense (DoD), and international missions, such as NASA's Earth Observation System (EOS), NOAA's current POES, the Japan Aerospace Exploration Agency's (JAXA) Global Change Observation Mission – Water (GCOM-W1), and DoD's Defense Meteorological Satellite Program (DMSP). The first satellite in the JPSS constellation, known as the Suomi National Polar-orbiting

Partnership (Suomi NPP) satellite, was launched on 28 October 2011, and is currently undergoing product calibration and validation (Cal/Val) activities. As Cal/Val proceeds, changes to the science will need to migrate into the operational system. In addition, as new techniques are found to improve, supplement, or replace existing products, these changes will also require implementation into the operational system. In the past, operationalizing science algorithms and integrating them into active systems often required months of work. In order to significantly shorten the time and effort required for this activity, Raytheon created the Algorithm Development Library (ADL). The ADL enables scientist and researchers to develop algorithms on their own platforms, and provide these to Raytheon in a form that can be rapidly integrated directly into the operational baseline. As the JPSS CGS is a multi-mission ground system, algorithms are not restricted to Suomi NPP or JPSS missions. The ADL provides a development environment that any environmental remote sensing mission scientist can use to create algorithms that will plug into a JPSS CGS instantiation. This paper describes the ADL and how scientists and researchers can use it in their own environments.

T-36 Current and Future Programs and Systems

Kerry Grant

Suomi National Polar-orbiting Partnership (Suomi NPP) Ground System Performance

Authors: Kerry Grant, Craig Bergeron

The National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) are jointly acquiring the next-generation civilian weather and environmental satellite system: the Joint Polar Satellite System (JPSS). JPSS will replace the afternoon orbit component and ground processing system of the current Polar-orbiting Operational Environmental Satellites (POES) managed by NOAA. JPSS satellites will carry a suite of sensors designed to collect meteorological, oceanographic, climatological, and solar-geophysical observations of the earth, atmosphere, and space. The ground processing system for JPSS is known as the Common Ground System (JPSS CGS), and provides command, control, and communications (C3) and data processing and product delivery. As a multi-mission system, CGS provides combinations of C3, data processing, and product delivery for numerous NASA, NOAA, Department of Defense (DoD), and international missions, such as NASA's Earth Observation System (EOS), NOAA's current POES, the Japan Aerospace Exploration Agency's (JAXA) Global Change Observation Mission – Water (GCOM-W1), and DoD's Defense Meteorological Satellite Program (DMSP). The first satellite in the JPSS constellation, known as the Suomi National Polar-orbiting Partnership (Suomi NPP) satellite, was launched on 28 October 2011, and is currently undergoing product calibration and validation activities. CGS's data processing capability will process the satellite data from JPSS satellites to provide environmental data products (including Sensor Data Records (SDRs) and Environmental Data Records (EDRs)) to NOAA and DoD processing centers operated by the United States government, as well as NOAA's Comprehensive Large Array-data Stewardship System (CLASS).. CGS is currently processing and delivering SDRs and EDRs for Suomi NPP and will continue through the lifetime of the JPSS program. Following the launch and sensor activation phase of the Suomi NPP mission, full volume data traffic is now flowing from the satellite through CGS's C3, data processing, and data delivery systems. Ground system performance is critical for this operational system. As part of early system checkout, Raytheon measured all aspects of data acquisition, routing, processing, and delivery to ensure operational performance requirements are met, and will continue to be met throughout the mission. Raytheon developed a tool to measure, categorize, and automatically adjudicate packet behavior across the system, and metrics collected by this tool form the basis of the information to be presented. This presentation will provide details of ground system processing performance, such as data rates through each of the CGS nodes, data accounting statistics, and retransmission rates and success, along with data processing throughput, data availability, and latency. In particular, two key metrics relating to the most important operational measures, availability (the ratio of actual granules delivered to the theoretical maximum number of granules that could be delivered over a particular period) and latency (the time from the detection of a photon by an instrument to the time a product is made available to the data consumer's interface), are provided for Raw Data Records (RDRs), SDRs, and EDRs. Specific availability metrics include Adjusted Expected Granules (the count of the theoretical maximum number of granules minus adjudicated exceptions (granules missing due to factors external to the CGS)), Data Made Available (the number of granules provided to CLASS) and Availability Results. Latency metrics are similar, including Data Made Available Minus Exceptions, Data Made Latency, and Latency Results. Overall result, measured during a ninety day period from October 2012 through January 2013, are excellent, with all values surpassing system requirements.

T-37 Current and Future Programs and Systems

Jurandir Zullo Junior

Monitoring of Sugarcane Fields in Brazilian Southeast Region using AVHRR/NOAA Multitemporal Images

Authors: Jurandir Zullo Junior, Luciana Alvim Santos Romani, Renata Ribeiro do Valle Gonçalves

Satellite images of medium and low spatial resolution have been used to identify areas
of agricultural expansion, assess its social and economic impacts, and predict the yield,
among other applications. AVHRR/NOAA is an example of an orbital system that can
be used as source of spectral information about agricultural regions, mainly for crops that are cultivated on large fields such as the sugarcane.The huge volume of AVHRR/NOAA images stored by institutions around the World exceeds the human ability for comprehension without the support of data analysis tools. The potential of satellite multitemporal imagesto support research of agricultural monitoring has increased according to improvements in technological development, especially in analysis of large volume of data and knowledge discovery.In this context, this paper describes the methodologies that are being developed by researchers from Unicamp (University of Campinas), Embrapa (Brasilian Company for Agricultural Research) and USP (University of São Paulo) based on multitemporal images of AVHRR/NOAA recorded at Unicamp since April 1995 in order to monitor the expansion and production of sugarcane crops in the Southeast Region of Brazil.Brazil is the largest sugarcane producer in the world, contributing with 35% of global production, followed by India, Thailand and Australia. Sugarcane is strategic to the country since it is the main renewable source of energy in order to replace fossil fuels and reduce the emission of greenhouse gases. The main derivatives of sugarcane, such as sugar and ethanol are important to Brazilian economy, attending the national and international market.

T-38 GSICS Users' Workshop *Wenhui Wang*

AMSU-A Atmospheric Temperature TCDRs

Authors: Wenhui Wang and Cheng-Zhi Zou

The Advanced Microwave Sounding Unit A (AMSU-A, 1998-present) continues atmospheric temperature measurements after the historical Microwave Sounding Unit (MSU, 1978-2006) and Stratospheric Sounding Unit (SSU, 1978-2006). It is also a predecessor of the Advanced Technology Microwave Sounder (ATMS, 2011-present). AMSU-A provides critical satellite observations for higher vertical resolution and long-term climate change research and trend monitoring. This poster presented methodologies for generating AMSU-A only atmospheric temperature thematic climate data records (TCDRs) from surface to the top of stratosphere. We used the AMSU-A recalibrated level 1c radiances recently developed by the Center for Satellite Application and Research group. The recalibrated radiances were adjusted to consistent sensor incidence angle (nadir), channel frequencies (pre-launch specified central frequencies), and observation time (local noon time). Extensive radiative transfer simulations were used to correct sensor incidence angle effect and NOAA-15 channel 6 frequency shift. Multi-year averaged diurnal anomaly climatologies from climate reanalysis as well as climate model simulations were used to adjust satellite observations to local noon time. Adjusted AMSU-A observations from 6 satellites were merged to generate the 13+ years (1998-2011) monthly averaged 2.5º x 2.5º gridded atmospheric temperature TCDRs at 11 layers. The AMSU-A only TCDRs will be released to public and update monthly.

T-39 Applications *William L. Smith Sr.*

Forecasting Hurricane Intensity and Severe Convective Storms Satellite Sounding Pairs

Authors: William Smith Sr., Elisabeth Weis, Nadia Smith, Henry Revercomb, Allen Larar

The NPP and the Aqua satellites share the same sun synchronous orbital plane with an equator crossing Local Solar Time (LST) of ~0130 am and pm in ascending and descending nodes, respectively. However, since the two satellites are at slightly different altitudes (i.e., 825 km for NPP and 705 km for Aqua), the same regions of the Earth are observed with time differences varying between zero and fifty minutes during a period of ~2.7 days. The Metop-A and Metop-B satellites fly in a sun-synchronous orbit, at an altitude of about 820km and an equator crossing Local Solar Time (LST) of ~9:30 am and pm in descending and ascending nodes, respectively. They have a constant time separation of about 50 minutes. Since the AIRS on Aqua, CrIS on NPP, and IASI on Metop-A and Metop- B are ultraspectral sounding instruments, atmospheric profile time tendency, water vapor flux, and cloud convection measurements are achieved from the Aqua/NPP and Metop-A/Metop-B pairs of satellites. It is shown that satellite sounding vertically resolved water vapor convergence, atmospheric stability change, and cloud convection are useful predictors of severe weather initiation and tropical storm intensity change and track.

T-40 Applications *Bigyani Das*

Integrating JPSS Algorithms with Efficiency and Ease: STAR Algorithm Integration Team (AIT)

Authors: Bigyani Das, Walter Wolf, Valerie Mikles,Youhua Tang, Marina Tsidulko, Shanna Sampson, Kristina Sprietzer, Yunhui Zhao, Weizhong Chen

Effective processing of satellite data involves transition of science-based algorithms and models into operational systems using software engineering principles. JPSS Science mission goals include processing of products that can provide critical insights into Earth phenomena such as clouds, oceans, vegetation cover, soil moisture, ice, wind speed and direction, concentrations of atmospheric pollutants, and numerous

others. These science goals have resulted in the generation of respective instrument specific Sensor Data Records (SDRs), and over thirty Environmental Data Records (EDRs) and Intermediate Products (Ips). STAR AIT provides expertise and support in effective integration of science algorithms for SDRs, EDRs and Ips into operational systems to meet JPSS Science mission goals. Using the Algorithm Development Library (ADL) framework, STAR AIT assists with initial testing of scientific algorithm upgrades, emulation of various operational testing scenarios, analysis of results for scientific comparison, submission of algorithm change requests and communication between scientists and JPSS Ground Project Data Products Engineering (DPE) Team. STAR AIT's expertise is tailored to meet the needs of JPSS Science Teams for integrating the algorithms with efficiency and ease.

T-41 Applications *Jacqueline Rauenzahn*

Application of NOAA Coral Reef Watch's Near-Real-Time Satellite Decision Support System to Local Coral Reef Management

Authors: Jacqueline L. Rauenzahn, C. Mark. Eakin, Gang Liu, Jianke Li, Scott F. Heron, William J. Skirving, Alan E. Strong

Multiple natural and anthropogenic stressors impact coral reef ecosystems and contribute to bleaching, slower growth, infectious diseases, and mortality. Satellite-based observations monitor, at local, regional, and global scales, environmental conditions influencing coral reef health. NOAA Coral Reef Watch (CRW) utilizes remote sensing, in situ, and modeled data to develop, maintain, enhance, operate, and deliver online a global decision support system (DSS) to help reef managers (target audience) and other stakeholders around the world prepare for and respond to coral reef ecosystem stressors related to climate change (see separate poster for product details). This management-oriented DSS is comprised of near-real-time satellite products, which are primarily sea surface temperature (SST)-based but also incorporate light, wind, carbonate chemistry, and ocean color (soon). It also includes weekly- to seasonal-forecasts that project future reef condition scenarios, informing national and international assessments, management responses, and conservation decisions. Furthermore, the DSS provides the only global early-warning system of changes in coral reef physical and chemical environments to help managers and other stakeholders monitor climate change impacts to reef ecosystems, assess when coral reefs are at risk for bleaching (especially mass bleaching) from thermal and light stress, and then prepare and implement timely, effective protective responses and adaptation actions. In response to NOAA's alerts of ongoing or impending bleaching events, managers have acted to reduce local stressors (e.g., dredging, tourism, fishing); certain countries have even closed major dive areas. These data have also been used in conjunction with climate change models to help identify regions potentially resilient to climate change, aiding in marine protected area planning.This poster discusses different applications of the near-real-time satellite-based products in NOAA CRW's DSS to local coral reef management. CRW engages and interacts directly with key management stakeholders in the field to incorporate local user feedback into the development and improvement of new and existing products, so that CRW can continue to provide reef managers worldwide with climate-quality, consistent, authoritative information on the present and future severity of threats that lead to coral bleaching.

T-42 Applications *Thomas M Smith*

What can satellite data tell about times with no satellites?

Authors: Thomas M Smith, Phillip A Arkin, Li Ren, Sam Shen

Spatially complete high-resolution satellite-based analyses are possible since roughly 1980, when data from a sufficient number of satellites with advanced instruments became available. Satellite-based analyses allow the computation of high-resolution statistics that can be used to help analyze in situ data available at times with no satellite sampling. Many large-scale features of the pre-satellite era can be resolved by analyses using the satellite-based statistics. Cross-validation testing is used to show what ocean-area precipitation variations may be resolved from the historical in situ sampling.

T-43 Current and Future Programs and Systems *Ted Kennelly*

End-to-End Design, Development and Testing of GOES-R Level 1 and 2 Algorithms

Authors: Alex Werbos, Eric Steinfelt, Paul Van Rompey, Scott Zaccheo

GOES-R is the next generation of the National Oceanic and Atmospheric Administration's (NOAA) Geostationary Operational Environmental Satellite (GOES) System, and it represents a new technological era in operational geostationary environmental satellite systems. GOES-R will provide advanced products, based on government-supplied algorithms, which describe the state of the atmosphere, land, and oceans over the Western Hemisphere. The Harris GOES-R Core Ground Segment (GS) Team will provide the ground processing software and infrastructure needed to produce and distribute these data products. As part of this effort, new or updated Level 1b and Level 2+ algorithms will be deployed in the GOES-R Product Generation (PG) Element. In this work, we describe the general approach currently being employed to migrate these Level 1b (L1b) and Level 2+ (L2+) GOES-R PG algorithms from government-provided scientific descriptions

to their implementation as integrated software, and provide an overview of how Product Generation software works with the other elements of the Ground Segment to produce Level 1/Level 2+ end-products.

In general, GOES-R L1b algorithms ingest reformatted raw sensor data and ancillary information to produce geo-located GOES-R L1b data, and GOES-R L2+ algorithms ingest L1b data and other ancillary/auxiliary/intermediate information to produce L2+ products such as aerosol optical depth, rainfall rate, derived motion winds, and snow cover. In this presentation we provide an overview of the Algorithm development life cycle, the common Product Generation software architecture, and the common test strategies used to verify/validate the scientific implementation. This work will highlight the Software Integration and Test phase of the software life-cycle and the suite of automated test/analysis tools developed to insure the implemented algorithms meet desired reproducibility. As part of this discussion we will summarize the results of our algorithm testing to date, and provide illustrated examples from our ongoing algorithm implementation.

T-44 Current and Future Programs and Systems *Ted Kennelly*

Design and Development of the GOES-R Inspect and Analyze Client Visualization Application

Authors: Jordan Bentley, Ryan Feather, Barry O'Reilly, Michael Sze and T. Scott Zaccheo

Data products and information provided by GOES-R Ground System (GS) represents a significant increase in the data currently being produced by the National Oceanic and Atmospheric Administration's (NOAA) Geostationary Operational Environmental Satellite (GOES) System. In order to accommodate this increase in data volume, new tools are needed to monitor the performance of these products in an operational environment. Inspect & Analyze, a software application current under development as part of the GOES-R Ground Segment, is designed to provide operators with the means to quickly analyze products as they are generated so that anomalies can be detected in near-real time. To achieve this goal, Inspect & Analyze has been designed based on an intuitive interface customized for the GOES-R mission. The Inspect & Analyze software allows NOAA operators to display product data in both tabular and graphical form, as well as assess relevant metadata and metrics. Images are rendered in real time from large datasets, and operators can interact with an image through the pan and zoom functionality. Metrics for a time series can be displayed as a graph, and include Product Repeatability, which assess product performance based on the idea that similar inputs should produce similar outputs. Inspect & Analyze has been designed with the knowledge that new products may be added to the GOES-R program in the future. In this design, new products as well as application tailoring are driven by XML-based configuration, and require no modifications to the existing code base. Features such as geopolitical map overlays or different pseudo-coloring schemes may be added or removed by modifying only the XML definition. This poster will discuss the both the underlying design of Inspect & Analyze as well as its practical application to the GOES-R mission.

T-45 GSICS Users' Workshop *Fangfang Yu*

Analysis of GOES Imager Infrared Radiometric Calibration Accuracy toward Long-term Climate Data Record

Authors: Fangfang Yu, Xiangqian Wu, Scott Lindstrom, Mat Gunshor, and Mitch Goldberg

The current Geostationary (GEO) Operational Environmental Satellite (GOES) I-P series have been in-orbit observing the Western Hemisphere since 1994, providing invaluable continuous images for weather monitoring and important data for numerical weather prediction (NWP). Yet they have relatively limited application in climate change studies, mainly due to diurnal calibration variation and lack of long-term calibration consistency within, and between, different sensors. To generate a long-term climate data record from GOES, a common well-characterized reference is often used to harmonize radiance quality and make it traceable to a reference standard. Under the umbrella of the Global Space-based Inter-Calibration System (GSICS) project, the well-calibrated hyperspectral radiometer of the Atmospheric Infrared Sounder (AIRS) onboard the Low Earth Orbiting (LEO) satellite Aqua is selected as a reference to inter-calibrate the GOES Imager infrared (IR) radiances. NOAA/National Environmental Satellite, Data and Information Service (NESDIS) and the University of Wisconsin/Cooperative Institute for Meteorological Satellite Studies (CIMSS) recently generated the GOES-AIRS collocation database which covers all eight GOES Imager instruments since October 2002. This poster will report the GOES Imager IR radiometric calibration accuracy at various temporal scales, using AIRS observations as the reference. The error budget of the GOES-AIRS inter-calibration correction will also be presented.

T-46 Applications *Kathleen Strabala*

VIIRS in AWIPS: Supporting Operational Forecasters

Authors: Kathleen Strabala, Scott Bachmeier, Dayne Broderson, Ray Garcia, Jordan Gerth, Liam Gumley, Tom Heinrichs, David Hoese, Allen Huang, Scott Macfarlane, Eva Schiffer

The Joint Polar Satellite System (JPSS) project has funded the inclusion of Soumi National Polar-orbiting Partnership (NPP) Visible Infrared Imaging Radiometer Suite (VIIRS) data in the Advanced Weather Interactive Processing System (AWIPS) in support of operational National Weather Service (NWS) Forecasters. The focus of this effort is to provide VIIRS data to high latitude regions (Alaska), where there are more frequent polar overpasses, and where the geostationary data large view angles make it less effective in monitoring small scale events. Because the Suomi NPP data is available via direct broadcast (DB), it can be acquired by X/L band antennas and processed in near-real time using the free Community Satellite Processing Package (CSPP), which transforms VIIRS raw data into SDRs identical in name, format and structure to the IDPS VIIRS SDRs. Working closely with the University of Alaska – Fairbanks Geographic Information Network of Alaska (GINA) team, the CSPP software is running operationally with products remapped and fed to the forecast offices for display in AWIPS. Along with the installation, forecaster training was provided to help operations personnel understand the kinds of events where the high resolution data will be most useful. The high quality of the VIIRS data, the improved spatial resolution and coverage as well as the new day/night band, point to operational use of the data over all AWIPS domains. Examples of how the data are being used will be shown from direct broadcast data collected over Alaska, CONUS (collected and processed at SSEC), as well as Hawaii (antenna installation summer 2012).

T-47 Current and Future Programs and Systems

Dennis Buechler

Investigating the use of Deep Convective Clouds (DCCT) to monitor on-orbit performance of the Geostationary Lightning Mapper (GLM) using Lightning Imaging Sensor (LIS) measurements

Authors: D.E. Buechler, H.J. Christian, W.J. Koshak, and S.J. Goodman

The Geostationary Lightning Mapper (GLM) on the next generation Geostationary Operational Environmental Satellite-R (GOES-R) will not have on-orbit calibration capability to monitor its performance. The GLM design is based on that of the Lightning Imaging Sensor (LIS), which has been providing lightning observations over the Earth's Tropics from the Tropical Rainfall Measuring Mission (TRMM) satellite since 1997. This makes LIS a good proxy data set for GLM observations. This study examines the performance of LIS throughout its time in orbit by examining the radiance of LIS background pixels of Deep Convective Clouds (DCCs). DCCs have been found to be invariant targets in the solar reflective region of the solar spectrum. The GLM and LIS both use a narrowband (~1 nm wide) filter at a wavelength of 777.4 nm to help identify the lightning signal. In this study, DCCs are identified as having cold Infrared (IR) brightness temperatures as measured by the Visible and Infrared Sensor (VIRS) which is also on-board the TRMM satellite. Radiances from LIS DCC background pixels were obtained for July and August of each year from 1998-2010. The resulting distributions of LIS background DCC pixel radiance for the July-August periods are very similar for each year, indicating stable performance. In addition, the mean July-August radiances of LIS DCCs do not show a long term trend. The maximum deviation of the July-August mean LIS DCC radiance for each year is within 0.8% of the overall mean. These results demonstrate that there has been no discernible change in LIS performance throughout its lifetime. This study shows that this approach is feasible to use to monitor the on-orbit GLM performance. In the case of GLM, cold cloud identification will be accomplished using IR data from the Advanced Baseline Imager (ABI) on GOES-R. Since GLM and LIS designs are similar, the LIS results indicate that GLM should also experience stable performance over its lifetime.

T-48 Applications *Yuling Liu*

Assessment of the Suomi NPP VIIRS Land Surface Temperature Product-Beta to Provisional Maturity

Authors: Yuling Liu, Yunyue Yu, Zhuo Wang, Dan Tarpley

The Visible Infrared Imaging Radiometer Suite (VIIRS), aboard the Suomi National Polar-orbiting Partnership (Suomi NPP) satellite, is used to provide measurements of the atmosphere, land and ocean, which are referred to as Environmental Data Records (EDR). The Land Surface Temperature (LST) EDR provides the measurement of the skin temperature over global land coverage. LST is derived from VIIRS data using the baseline split-window regression algorithms. Coefficients of the LST algorithm are surface type dependent, referring the 17 International Geosphere-Biosphere Programme (IGBP) types. This study presents an evaluation of the LST product based on the on-orbit NPP data. The evaluation is performed through the internal evaluation, which includes flags, maps and upstream inputs, and the external evaluation, which includes the cross comparison with MODIS LST and evaluation against ground in-situ LST. The evaluation results show that the surface type dependency of the LST product performance is significant; nighttime performance exceeds the daytime performance; LST algorithm tends to overestimate surface temperature at daytime and underestimate at nighttime. To sum up, the LST EDR product has achieved the beta quality and continues to mature. The efforts are being made to reach provisional quality in May, 2013.

T-49 Applications *Suman Goyal*

Application of satellite data for monitoring and prediction of weather systems in Indian region.

Author: Suman Goyal

Indian region experiences a number of severe weather phenomenon including tropical cyclones, thunderstorms, heavy rain/snowfall and fog etc. The eastern and northeastern part of India gets affected by severe thunderstorms during pre-monsoon months (April-May). These thunderstorms are locally named as "Kalbaishakhi" which means killing hazard in the month of Baishakh (April). These severe thunderstorms associated with thunder, squall lines, lightening and hail cause extensive losses to life and property. The casualty due to lightening associated with thunderstorms in this region is the highest in the world. In India 72% of tornadoes are associated with the above thunderstorms. Another severe weather event over India is tropical cyclone which affects coastal India mainly eastern coast. Though the frequency of tropical cyclones over north Indian Ocean is less as compared to other ocean basin, the impact of the cyclones in term of loss of life & property is quite significant. Hence, early warning of these disturbances with improved monitoring & predictions plays major role to mitigate the disaster. Extreme north India is affected in winter season during passage of western disturbances causing snowfall over the region and dense fog over northern plains. Various applications of satellite data and products are presented here with for effective monitoring and nowcasting of above mentioned meteorological hazards. The primary tools for detecting thunderstorms are weather radar and satellite imagery. Since radar network in India is not enough to monitor the thunderstorms half hourly satellite images are used for monitoring and nowcasting of thunderstorms. North Indian Ocean is a data sparse region with limited buoy and ship data and without the facility of aircraft reconnaissance, unlike other Ocean basins. So remotely sensed observation & products through satellite plays a major role in monitoring and predicting genesis, intensification & movement of cyclonic disturbances over North Indian Ocean. Day time fog is monitored by using visible images obtained from geostationary satellite kalpana-1, however to monitor night time fog products from polar orbiting satellites NOAA Metop are used.
In the absences of adequate number of meteorological observatories basic satellite imageries and products are available to forecasters. Satellite data are assimilated in various NWP models like Wind, Radiance etc. Assimilation of satellite data are helpful in (a) Bogussing (b) Initial error (c) Track and Intensity forecast. As a future plan data and products of Megha Tropiques and INSAT 3D will be utilized as and when they will be available for operational use.

T-50 GSICS Users' Workshop *Sebastien Wagner*

Inter-calibration of the SEVIRI VIS0.6 channel with MODIS Aqua, using Deep Convective Clouds as transfer targets

Authors: Sébastien C. Wagner, Tim Hewison

The past and current operational weather satellite imagers aboard geostationary satellites have had on-board calibration units for thermal bands only. As far as solar bands are concerned, only the next generations of geostationary satellites will make use of on-board calibration systems. As a result, the calibration of those solar bands exclusively relies on vicarious methods that consist mainly of comparing observed radiances with a 18isible signal over a variety of targets (deserts, oceans, clouds, Moon, etc.). As the set of geostationary satellites currently in operation do no sense the same part of the Earth, the type and the properties of the targets available in their field of regard vary significantly from one instrument to another, making the harmonization and the comparability of the data sets challenging. One possible approach to homogenise these observations is to inter-calibrate the geostationary imagers against a common reference instrument on-board a polar satellite, as such an instrument can provide temporally and spatially co-located observations with all the geostationary instruments on a daily basis. The Global Space-based Inter-Calibration System (GSICS) community recommended using the Moderate Resolution Imaging Spectroradiometer (MODIS) on-board Aqua as a reference. However, in order to reduce uncertainties, the inter-calibration must be performed over similar targets with well-characterised radiative properties. Within the context of geostationary satellites, deep convective clouds (DCC) are natural candidates as calibration transfer targets as they are available across the entire globe. Following the method presented by Doelling et al. (2011), a prototype was developed at EUMETSAT in order to inter-calibrate the visible bands, in particular the VIS0.6 channel, available on the Spinning Enhanced Visible and Infrared Imager (SEVIRI) aboard the Meteosat-8, - 9 and -10 satellites with MODIS-Aqua. The latest results of the inter-calibration are discussed for those operational Meteosat imagers. We also present the future development plans at EUMETSAT regarding i) the other solar reflective bands available on SEVIRI, ii) the routine operation of this algorithm and iii) the generation of GSICS corrections.

T-51 Applications *Luiz Machado*

IR Multichannels and Lightning a contribution to GOES-R and Nowcasting – The CHUVA Project

Authors: Luiz A. T. Machado, Rachel Albrech, Wagner F. A. Lima, Renato G. Negri and Enrique Matos

The Cloud processes of the main precipitation systems in Brazil: A contribution to cloud resolving modeling and to the GPM (CHUVA Project) is a project designed to measure the cloud processes of the main precipitating systems in Brazil to improve precipitation estimation from satellite over land and the knowledge of cloud microphysics. CHUVA is designed to measure from typical warm clouds on the tropical coastal systems up to cold fronts and large MCCs in the Brazil extra tropics. Four field campaigns have already been realized in the following places: Alcantara (MA), Fortaleza (CE), Belem

(PA) and Vale do Paraíba (SP). The first three campaign were held in tropical region, on the coast, from the Amazonia to the semi-arid in the Northeast Brazil. The fourth campaign was held in a valley between two mountains, around 100 km far from the ocean. This campaign was jointed with the GOES-R Geostationary Lightning Mapper – pre-launch algorithm validation. This campaign was designed to measure ground-based regional 2-D and 3-D total lightning mapping networks coincident with overpasses of the Tropical Rainfall Measuring Mission Lightning Imaging Sensor (LIS) and the SEVIRI (Spinning Enhanced Visible and Infrared Imager) on the Meteosat Second Generation (MSG) satellite in geostationary orbit. This data will be used to generate proxy data sets for the GOES-R, to develop nowcasting tools and understand the cloud process of the cloud electrification. This study also describes the use o IR multichannel to get information about the dynamical and cloud structure of convective clouds. Using MSG data combined with TRMM and weather models we developed a cloud reflectivity profile classification and describe cloud top inner wind structures. Finally, we will describe an operational tool for severe storm nowcasting using radar, lightning network and satellite images. The system is a Web based Geographic Information System called SOS-CHUVA (Severe storm Observation System using data for the CHUVA project). This system is a useful tool to interpret, summarize and integrate the environmental information and display or sends warning for emergency management groups. This is an open access system to also serve the population giving real time information to reduce citizen vulnerability. The SOS-CHUVA shows real time high resolution radar and lightning data the nowcasting for the next minutes and the probability to happen lightning, among several others functions. For the regions outside radar coverage, the system has the Hidroestimator and the HidroTrack, a precipitation estimation and nowcasting system for the next two hours using GOES-12 images.

T-52 Current and Future Programs and Systems

Chunhui Pan

On the Provisional S-NPP Ozone Mapping and Profiler Suite Performance

Authors: C. Pan, X. Wu, L. Flynn and F. Weng

The Ozone Mapping Profiler Suite (OMPS) was launched aboard the Suomi National Polar-orbiting Partnership (S-NPP) spacecraft on October 28, 2011. A successful thorough Early Orbit Checkout (EOC) and the current Intensive Calibration and Validation enabled the provisional SDR mature level. Our results demonstrate that the OMPS orbital characterizations of detector performance show that the sensors' electronic bias, detector gain, dark smear, dark current rate, and linearity remain within 0.2% of the prelaunch values with significant margin below sensor requirements. Sensor signal-to-noise ratio meets the system requirement. Detector gain and bias performance trends are generally stable. System linearity performance exhibits excellent stability and is highly consistent with the prelaunch values. Topics considered include dark performance, system non-linearity, electronic bias, instrument noise analysis and solar calibration.

T-53 Current and Future Programs and Systems

Joint Polar Satellite System (Jpss) Common Ground System (Cgs) Multimission Support

Authors: Michael Jamilkowski, Shawn W. Miller, Kerry Grant

The National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) are jointly acquiring the next-generation civilian operational weather and environmental satellite system: the Joint Polar Satellite System (JPSS). JPSS will contribute the afternoon orbit component and ground processing system of the restructured National Polar-orbiting Operational Environmental Satellite System (NPOESS). As such, JPSS will replace the current Polar-orbiting Operational Environmental Satellites (POES) managed by NOAA and the ground processing component of the Polar-orbiting Operational Environmental. The JPSS satellites will carry a suite of sensors designed to collect meteorological, oceanographic, climatological, and solar-geophysical observations of the earth, atmosphere, and space. The ground processing system for JPSS is known as the JPSS Common Ground System (JPSS CGS), and consists of a Command, Control, and Communications Segment (C3S) and an Interface Data Processing Segment (IDPS). Both segments are developed by Raytheon Intelligence and Information Systems (IIS). The C3S currently flies the Suomi National Polar Partnership (S-NPP) satellite and transfers mission data from S-NPP and between the ground facilities. The IDPS processes Suomi NPP satellite data to provide Environmental Data Records (EDRs) to NOAA and DoD processing centers operated by the United States government. When the JPSS-1 satellite is launched in early 2017, the responsibilities of the C3S and the IDPS will be expanded to support both Suomi NPP and JPSS-1. The JPSS CGS currently provides data processing for Suomi NPP, generating multiple terabytes per day across over two dozen environmental data products – that workload will be multiplied by two when the JPSS-1 satellite is launched. But the CGS goes well beyond mission management and data processing for the Suomi NPP and JPSS missions. The CGS also provides data routing support to operational centers and missions across the globe. The multimission capabilities of the CGS facilitate support to an array of missions beside S-NPP and JPSS. The CGS also provides raw data acquisition, routing and processing for GCOM-W1 to support further processing by NOAA. The CGS

provides data routing for numerous other missions, systems and organizations, including USN's Coriolis/Windsat, NASA's Space Communications and Navigation (ScaN) network (including the Earth Observation System or EOS), National Science Foundation's (NSF's) McMurdo Station communications, the DoD's Defense Meteorological Satellite Program (DMSP), NOAA's Polar Operational Environmental Satellite (POES) and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT's) Meteorological Operational Satellites (Metop). For the satellite systems previously listed, each orbits the Earth 14 times a day, downlinking mission data once or twice per orbit at up to hundreds of megabits per second, to support the generation of tens of terabytes per day across hundreds of environmental data products. Raytheon and the government have invested a significant amount in Raytheon's suite of mission management, command & control and data processing products and capabilities. The CGS's flexible, multimission capabilities offer significant opportunities for cost reduction and improved information integration across missions. Raytheon has a unique ability to provide complex, highly secure, multi-mission ground systems. As disaggregation, hosted CGS Multi-mission payloads, and other space architecture trades are implemented and new sensors come on line that collect orders of magnitude more data, the importance of a flexible, expandable, virtualized modern ground system architecture increase. The CGS offers that solution support. The Command, Control and Communications Segment (C3S) manages the operational mission, including mission planning, satellite command & control, global communications networks, enterprise management, situational awareness, anomaly resolution, system security, and reliable delivery of data to and from central users. The Mission Management Center provides accurate, high performance tools that precisely manage CGS supported missions. The Command, Control and Communications Segment tools give crews keen insight, comprehensive operational oversight, detailed mission planning capability, full control of space and ground assets, continuous monitoring and assessment of overall system performance. The Interface Data Processing Segment (IDPS) features high speed, symmetric, multi-processing computers that rapidly convert large streams of environmental sensor data at 100 times the legacy data volume, providing numerous Environmental Data Records to the weather Centrals. The Environmental Data Records detail cloud coverage, temperature, humidity and ozone distribution, as well as snow cover, vegetation, sea surface temperatures, aerosols, space environment and earth radiation budget information. This wealth of information enables numerous users to monitor and predict changes in weather, climate, and ocean conditions. Supports five global ground stations that can receive Suomi NPP and/or JPSS-1 mission data. These ground stations, linked with high-bandwidth commercial fiber, can quickly transport the data to the IDPS for environmental data product generation and delivery. Processes and delivers data to the operational users in the United States in less than 80 minutes from the time of collection for JPSS-1. Leverages the fiber network for Suomi NPP and JPSS-1 to additionally provide data routing for a wide array of missions on a global scale. The JPSS CGS is a mature, tested solution for supporting operational weather and storm forecasting for civil, military, and international partners as well as climate research. It features a flexible design that handles order-of-magnitude increases in data over legacy satellite ground systems volumes and meets demanding science accuracy requirements. The Raytheon-built JPSS CGS provides the full JPSS common ground capability, from design and development through operations and sustainment. These features lay the foundation for the future evolution of the CGS to support additional missions, like the JPSS Free Flyer.

T-54 Data Access and Use *Kaba Bah*

Near-Real-Time validation of simulated GOES-R ABI radiances and derived products, using the WRF-Chem model forecast over CONUS for all 16 ABI bands.

Authors: Marek Rogal, Kaba Bah, Tom Greenwald, Brad Pierce, Allen Lenzen, Jim Nelson, Jason Otkin, Todd Schaack, Jim Davies, Eva Borbas, Justin Sieglaff and Hung-Lung Huang

The GOES-R Algorithm Working Group (AWG) Proxy Data team at UW-Madison (CIMSS) has been providing the community with a number of invaluable near-real-time Advanced Baseline Imager (ABI) proxy imagery and products. These data sets have been used extensively by a number of groups within the GOES-R Program, including Proving Ground, the Algorithm Integration Team (AIT), and the AWG Winds, Aviation, and Imagery/Visualization teams. Over the past year we provided simulated ABI data to the AIT for retrieval algorithm evaluation, and have been supplying near-real-time simulated imagery to the Proving Ground team from WRF model forecasts (for 10 of the ABI bands over CONUS) to help prepare users of these data. This poster summarizes of our efforts to provide near-real-time proxy ABI data from WRF-Chem model forecasts over CONUS using the Community Radiative Transfer Model (CRTM) for all 16 ABI bands. We have developed a validation system for verification of model simulated ABI radiances and simulated derived products in near-real-time using current GOES sounder and other satellite data obtained from our direct broadcast data collection system. The products are distributed to the users in current ABI Fixed Grid Format, compatible with the GOES-R Re-Broadcast Level 1b data. The end-to-end validation tools are designed to be portable, scalable and fully automated. We will describe the near-real-time system we developed to first generate simulated ABI data, remap it to the ABI Fixed Grid

Format, validate the data against observations and then derive products for distribution. This system is also fully applicable to future proxy data and validation of next generation GOES series satellites.

T-55 GSICS Users' Workshop *Xingming Liang*

Sensitivity of CRTM coefficients towards quantitative cross-platform consistency analysis in MICROS

Authors: "XingMing Liang, Yong Chen, Tiejun Chang, Alexander Ignatov

Monitoring of IR Clear-Sky Radiances over Oceans for SST (MICROS; www.star.nesdis.noaa.gov/sod/sst/micros) is NESDIS near-real time web-based radiance monitoring system. It analyzes Model (Community Radiative Transfer Model, CRTM) minus Observation (M-O) biases in brightness temperatures (BT) in three bands centered at 3.7 (IR37), 11 (IR11), and 12μm (IR12), for several AVHRR (NOAA-16, -17, -18, -19, and Metop-A, -B), VIIRS (Suomi National Polar Partnership, S-NPP), and MODIS (Terra, Aqua) sensors. Double-differences (DD) are employed to check BTs for radiometric stability and consistency. However, it was observed that DDs are sensitive to the way the CRTM coefficients are calculated, which makes challenging their application for quantitative GSICS applications to better than ~0.1K. This paper documents the sensitivity of DDs to the different CRTM coefficients, which may be trained using different versions of line-by-line RTM (LBLRTM), different sets of atmospheric profiles, may include or exclude different absorbing gases, and utilize different fit algorithms for fast RTM applications, including ordinary (ORD) versus Planck-Weighted (PW) and Optical Depth in Absorption Space (ODAS) versus Optical Depth in Pressure Space (ODPS). The joint effort by the SST, CRTM and Sensor Calibration Teams is underway, towards recalculating of all CRTM coefficients, using consistent training sources and algorithms, and ensure uniform set of CRTM coefficients for all platforms and sensors is used in calculating MICROS DDs.

T-56 Applications *Hai Zhang*

Near-real-time VIIRS Aerosol Imagery over CONUS for Air Quality Monitoring and Forecasting Applications

Authors: Hai Zhang, Shobha Kondragunta, Hongqing Liu, Pubu Ciren

The Suomi-NPP (National Polar Partnership) Visible and Infrared Imaging Radiometer Suite (VIIRS) contains visible and SWIR bands similar to MODIS that can be used for high quality aerosol retrievals. Beginning January 2013, CIMSS (Cooperative Institute for Meteorological Satellite Studies) at the University of Wisconsin Madison has been processing direct broadcast (DB) VIIRS data over theCONUS. The VIIRS radiances, cloud mask, and fire products are delivered through CIMSS FTP in near-real-time. To expand the provision of MODIS to include VIIRS satellite data, a near real time processing system that uses the VIIRS DB data to generate aerosol optical depth (AOD) and dust mask has been developed. The outputs from the algorithms are used to generate images that are then posted on the IDEA (Infusing satellite Data into Environmental Applications) website (https://www.star.nesdis.noaa.gov/smcd/spb/aq/index_viirs.php) along with VIIRS natural color image and VIIRS active fire hotspots. The latency of the whole process, which includes processing VIIRS DB data at UW, downloading VIIRS DB data, running the algorithms to generate products, converting the products to images, is about 1.5 hours. After accumulating several months of data, the VIIRS retrievals were compared to AERONET and the operational VIIRS, and MODIS AOD products. This website will be deployed to the users at the March 2013 GOES-R Air Quality Proving Ground (AQPG) workshop to acquire user feedback.

T-57 Current and Future Programs and Systems

Mathew Gunshor

GRAFIIR and JAFIIR – Efficient End-to-End Semi-Automated Algorithm Performance Analysis and Implementation Verification Systems

Authors: Mathew Gunshor, Hong Zhang, Eva Schiffer, Ray Garcia, and Allen Huang

The next generation of national operational environmental satellites are being developed under the GOES-R (geostationary) and JPSS (polar-orbiting) programs. The Advanced Baseline Imager (ABI) on GOES-R and the Visible Infrared Imaging Radiometer Suite (VIIRS), along with other sounding sensors, represent a technological leap in the nation's operational satellite imaging sensing capabilities. In support of these missions, CIMSS at the University of Wisconsin-Madison is contributing to the critical role of performing tasks for risk reduction, data processing system framework, proving ground, next generation sensor design and tradeoff, sensor impacts on algorithm performance, and calibration/validation. This work is being done in concert with other major ongoing efforts, such as the GOES-R Algorithm Working Group (AWG), and in support of JPSS program system development and science advancement. This presentation will overview the updated capability of GOES-R Analysis Facility for Instrument Impacts on Requirements (GRAFIIR) and the JPSS sister program JAFIIR. GRAFIIR is a mature ongoing program under the GOES-R AWG in its 7th year, while JAFIIR is currently being spun up, leveraging the tools built for GRAFIIR. GRAFIIR is a system facility established to leverage a host of projects including AWG proxy, AWG algorithms, AWG Imagery and McIDAS visualization, GOES-R Risk Reduction, sensor tradeoff and calibration/validation. GRAFIIR is to support GOES-R

analysis of ABI instrument impacts on meeting user and product requirements. GRAFIIR is for "connecting the dots", the components that have been built and/or are under development, to provide a flexible frame work to effectively adopt component algorithms toward analyzing the sensor measurements with different elements of sensor characteristics (i.e. noise, navigation, band to band co-registration, diffraction, etc.) and their impact on products. GRAFIIR continues to play a key role in assisting government on addressing instrument specification waivers. JAFIIR will provide much the same service for JPSS as GRAFIIR elements and tools are adapted to fit the JPSS program. In addition, JAFIIR is to support the design and performance analysis of the next series of JPSS sensor suites, which would leverage the technology advancements and emerging operational requirements. One of the components developed for GRAFIIR is GLANCE, an efficient comparison analysis tool built to assess and evaluate many of the GOES-R data and products (i.e. imagery, clouds, derived products, soundings, winds, etc.) in a consistent and semi-automated way. This tool can be used to ensure the instrument effects on the products can be fully accounted for, characterized and product performance can be analyzed. It can also be used to quickly test proper product algorithm implementation as various product algorithms are transferred from developers to operators. Furthermore, the concept and build details of GLANCE will also be highlighted to demonstrate a truly functional and effective end-to-end system which supports NOAA's LEO and GEO future environmental satellite projects.

T-58 Current and Future Programs and Systems

Curtis Seaman

VIIRS Imagery: Applications and Outreach at CIRA

Curtis Seaman, Don Hillger, Steve Miller

The Visible Infrared Imaging Radiometer Suite (VIIRS) aboard the Suomi National Polar-orbiting Partnership (NPP) satellite has been producing high-quality imagery for more than a year. With the exception of the Near Constant Contrast (NCC) product, all other VIIRS Imagery products have achieved "Beta" stage, making them available to the public. VIIRS Imagery, in the form of Scientific Data Records (SDRs), and Imagery products, provided as Environmental Data Records (EDRs) are useful for detecting many hazards including: tropical cyclones, severe thunderstorms, volcanic eruptions, dust storms, smog, fires, and floods. These VIIRS data records are also useful for monitoring vegetation health, snow and ice extent, ocean currents and other natural phenomena. The Day/Night Band (DNB) has the ability to view clouds and snow at night under moonlit conditions, as well as lightning, auroras, fires, volcanic eruptions, gas flares, and city lights at night for any phase of the moon. To highlight these and other uses of VIIRS imagery, the JPSS Imagery and Visualization Team members at the Cooperative Institute for Research in the Atmosphere (CIRA) at Colorado State University (CSU) have created a website, in the form of a blog, detailing the many uses of VIIRS imagery and the methodology behind them. Readers are presented with basic concepts in satellite meteorology and related sciences in an informal setting. The goal is promote the high quality of VIIRS imagery in an 22isible22ent that will appeal to expert and novice users of satellite imagery. This poster will highlight topics covered on the website and other activities at CIRA/CSU in support of JPSS Imagery and Visualization Team objectives.

T-59 Current and Future Programs and Systems

Don Hillger

Suomi NPP VIIRS Imagery after 1 Year

Authors: Don Hillger, Tom Kopp, Steven Miller, Daniel Lindsey, Curtis Seaman

The Suomi National Polar-orbiting Partnership (Suomi NPP) satellite was launched on 28 October 2011, heralding the next generation of operational U.S. polar-orbiting satellites. It carries the Visible Infrared Imaging Radiometer Suite (VIIRS), a 22-channel visible/infrared sensor that combines many of the best aspects of the NOAA Advanced Very High Resolution Radiometer (AVHRR), the Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS), and the National Aeronautics and Space Administration (NASA) MODerate-resolution Imaging Spectroradiometer (MODIS) sensors. VIIRS has nearly all the capabilities of MODIS, but offers a wider swath width (3000 km vs. 2330 km) and much higher spatial resolution at swath edge. VIIRS also has a Day/Night Band (DNB) that is sensitive to very low levels of visible light at night such as produced by moonlight reflecting off low clouds, fog, dust, ash plumes, snow cover, in addition to detection of light emissions from cities, ships, oil flares, and lightning flashes. NPP crosses the equator at about 0130 and 1330 local time, with VIIRS covering the entire Earth twice daily. Future members of the Joint Polar Satellite System (JPSS) constellation will also carry VIIRS. This paper presents dramatic early examples of multi-spectral VIIRS imagery capabilities and demonstrates basic applications of that imagery for a wide range of operational users.

T-60 Current and Future Programs and Systems

Wei Yu

Ozone Instrument Calibration and EDR Products Validation with STAR ICVS

Authors: Wei Yu, Larry Flynn, Jianguo Niu, Eric Beach, X. Wu, Zhihua Zhang, Yan Hao, Chunhui Pan

The measurements from The Ozone Mapping and Profiler Suite (OMPS) are used to generate estimates of total column ozone and vertical ozone profiles. The STAR Integrated Calibration Validation System (ICVS) ozone section is created to monitor onboard ozone instrument performance and ozone data quality in real time. ICVS provides real time ozone sensor instrument performance and Ozone EDR data quality monitoring to meet operation mission; provides long term monitoring ozone sensor instrument performance and Ozone EDR data quality to meet the requirements of climate study; provides Ozone product bias analyses recommendations and feedbacks to science team for solutions to turn instrument measurements into accurate ozone environmental products. This poster presented many results to show that ICVS ozone section is an efficient tool for monitoring ozone data quality and instrucment performance. It is an integrated system that incorporates prelaunch, post launch onboard, real time and long term monitoring system.

T-61 Current and Future Programs and Systems

Lawrence Flynn

Suomi National Polar-Orbiting Partnership: Ozone Mapping and Profiler Suite Product Calibration, Validation aand Performance

Authors: L. Flynn, C. Seftor, W. Yu, D. Rault, I. Petropavlovskikh, G. Jaross, J. Niu, Z. Zhang, C. Long, Y. Hao, C Pan, E. Beach, X. Wu

NOAA, through the Joint Polar Satellite System (JPSS) program, in partnership with National Aeronautical and Space Administration (NASA), launched the Suomi National Polar-orbiting Partnership (S-NPP) satellite, a risk reduction and data continuity mission, on October 28, 2011. The JPSS program is executing the S-NPP Calibration and Validation (Cal/Val) program to ensure the data products comply with the requirements of the sponsoring agencies. The Ozone Mapping and Profiler Suite (OMPS) [1] consists of two telescopes feeding three detectors measuring solar radiance scattered by the Earth's atmosphere and solar irradiance by using diffusers. The measurements are used to generate estimates of total column ozone and vertical ozone profiles. The calibration and validation efforts are progressing well, and both Level 1 (Sensor Data Records/SDRs) and Level 2 (Ozone Environmental Data Records/EDRs) are advancing to release at Provisional Maturity. This presentation will provide information on the execution of the OMPS Cal/Val Plan with emphasis on the instrument and product performance observed over the first 18 months of the mission.

T-62 GSICS Users' Workshop *Fangfang Yu*

A Combined Calibration Method for GOES Imager Visible Channel

Authors: Fangfang Yu and Xiangqian Wu

GOES instruments experience continuous degradation in space. However, due to the lack of onboard calibration systems, vicarious calibration is the only way to provide accurate radiometric data for the solar reflective channels. Even with the inclusion of onbard calibration devices, vicarious calibration will continue to play an important role in verifying and serving as risk reduction for the onboard systems. A variety of vicarious calibration methods have been considered at National Oceanic and Atmospheric Admission (NOAA)/National Environmental Satellite, Data, and Information Service (NESDIS), in addition to the operational calibration that provides post-launch calibration coefficients for the Imager visible channels. These include satellite observations of deep convective cloud, desert, and ocean targets, inter-calibration with different reference sensors, and time-series observations of stable extra-terrestiral targets. Each method has the pros and cons with compariable relatively calibration accuracy. In this study, a combined calibration algorithm is proposed to increase the absolute calibration accuracy of the GOES Imager 23isible data. Each algorithm used in the combined analysis should be traceable to Aqua MODIS, if possible. Detailed results will be presented the coming meeting.

T-63 Current and Future Programs and Systems

Kathleen Lantz

Ground-Based Radiation Budget and Aerosol Validation of GOES-R Products Using a NOAA Mobile SURFRAD Station

Authors: K. Lantz, J. Michalsky, G. Hodges, J. Wendell, E. Hall, D. Longnecker, J. Augustine

In preparation for the GOES-R satellite launch in late 2015 a mobile field site for ground-based validation of radiation and aerosol products has been developed. The instruments are much like the current SURFRAD (http://www.srrb.noaa.gov/surfrad/index.html) suite of instruments with the addition of a spectral surface albedo capability. The goal is to validate many of the baseline and options 2 products that are being developed for GOES-R. Permanent SURFRAD stations and the mobile SURFRAD station will provide validation for several baseline products including aerosol smoke detection, aerosol optical depth, clear-sky masks, downward surface shortwave radiation, and land surface temperature. Option 2 products include absorbed surface shortwave radiation, downward longwave radiation, spectral surface albedo, vegetation fraction and index. The mobile SURFRAD station has been deployed at two campaigns: 1) DOE ARM TCAP (Two Column Aerosol Project) in July and August 2012, and 2) the DISCOVER Air Quality Campaign in the San Joaquin Valley of California in January and February 2013. The first deployment and test of the mobile SURFRAD station was at ARM's Mobile Facility

(AMF1) deployment in Cape Cod. This deployment was a subset of SURFRAD measurements consisting of spectral aerosol optical properties and spectral surface albedo. The DISCOVER-AQ featured the suite of radiation products for radiation budget including downwelling and upwelling shortwave and longwave radiation, retrievals of spectral aerosol properties, and spectral surface albedo as measured by the MFRSR at 415, 500, 673, 870, and 1625 nm. We will give an overview of the measurement capabilities and results from these two campaigns.

T-64 Data Access and Use *Liam Gumley*

The Community Satellite Processing Package (CSPP) for real-time processing of data received by direct broadcast from Suomi NPP, POES, Metop, and FY-3.

Authors: Liam Gumley, Allen Huang, Kathleen Strabala, Scott Mindock, Ray Garcia, Geoff Cureton, Graeme Martin, Nadia Smith, and Elisabeth Weisz.

The Suomi National Polar Orbiting Partnership (NPP) mission is the first of a new generation of US polar orbiting operational meteorological satellites. Suomi NPP includes a suite of sensors for imaging the Earth's land and oceans and sounding the atmosphere. Global data from Suomi NPP are downlinked at the Svalbard Ground Station for transmission to NOAA and NASA facilities for operational processing. Real-time data from Suomi NPP are continuously transmitted on X-band, and may be received anywhere in the world. The Community Satellite Processing Package (CSPP) allows anyone with the ability to receive the High Rate Data (HRD) direct broadcast (DB) from Suomi NPP to create Sensor Data Record (SDR) and Environmental Data Record (EDR) products from the following sensors: Visible Infrared Imaging Radiometer Suite (VIIRS), Cross-track Infrared Sounder (CrIS), and Advanced Technology Microwave Sounder (ATMS). In addition to supporting Suomi NPP, CSPP also contains software to create Level 2 geophysical products and image products from the NOAA Polar Orbiting Environmental Satellite (POES) series, the EUMETSAT Metop series, and the Chinese FY-3 series of polar orbiting meteorological satellites. CSPP software is available at no cost to DB stations around the world, and is in use at operational meteorological agencies including the US National Weather Service, Geoscience Australia, UK Met Office, EUMETSAT, CONABIO (Mexico), INPE (Brazil), SMHI (Sweden), FMI (Finland), DWD (Germany), JMA (Japan), and NSMC (China). CSPP software is made available in compiled format for Intel Linux computers, and source code is also available. CSPP software packages are designed to be easy to install, operate, and maintain, and are extensively tested before release to the DB community. For Suomi NPP, CSPP software for SDR and EDR product generation is based on the Algorithm Development Library (ADL) created by the NOAA/NASA Joint Polar Satellite System (JPSS) Project and Raytheon. ADL is a stand-alone Linux environment for executing the same operational algorithms that run operationally at the global NPP/JPSS NOAA processing facility. None of the algorithms have been modified to work in the CSPP; they are identical to the algorithms running operationally at NOAA. The data formats and file name conventions for Suomi NPP products from CSPP are identical to those used by the NOAA CLASS archive. Value added features for Suomi NPP products provided in CSPP include aggregation of multiple granules into one granule per satellite overpass, internal compression of HDF5 product files, and automatic run-time downloading of any required dynamic ancillary data. As of January 2013, the CSPP suite includes software for generating the following products:

- VIIRS M-band, I-band, and Day/Night band radiances, reflectances, and geolocation;
- CrIS radiances and geolocation
- ATMS antenna temperatures and geolocation,
- CrIS, IASI, and AIRS temperature and moisture profiles and cloud-top parameters.

New products in testing for release as part of CSPP in the next 6 months include: VIIRS Cloud Mask and Active Fires, VIIRS, AVHRR, and MODIS Cloud Top Parameters, VIIRS Sea Surface Temperature and Ocean Color, VIIRS and MODIS single-band and multi-band projected GeoTIFF and JPEG images, VIIRS Aerosol Optical Thickness and Vegetation Index, FY-3 MERSI and VIRR true color and false color images. CSPP is supported by the NOAA/NASA JPSS Project, and is expected to continue to be developed and maintained throughout the lifetime of the Suomi NPP and JPSS-1 satellite missions. CSPP continues the heritage of the IMAPP and ITPP software packages released by CIMSS/SSEC since 1985 and will assist the DB community in making the transition from Terra, Aqua, and POES to the new generation of JPSS polar orbiting satellites.

T-65 Current and Future Programs and Systems

Tom Greenwald

Near-Real-Time Proxy ABI Products for GOES-R User Readiness

Authors: Tom Greenwald, Brad Pierce, Todd Schaack, Jason Otkin, Kaba Bah, Jim Davies, Justin Sieglaff, Allen Lenzen, Jim Nelson, Marek Rogal, Allen Huang

For the past few years we have been providing simulated proxy ABI imagery derived from CONUS WRF model forecasts produced by the National Severe Storms Laboratory (NSSL) to several NWS forecast offices in near-real-time. These products are used within AWIPS and, overall, have been received favorably by forecasters. Recently, we have also

been producing proxy ABI imagery in near-real-time from CONUS WRF-Chem model forecasts and NOAA's Community Radiative Transfer Model (CRTM). While these data are at lower spatial resolution (8x8km) as compared to the NSSL-WRF proxy ABI data (4x4km) they have all 16 ABI bands and include the radiative effects of ozone and aerosols, such as smoke, dust, and sulfate, which will be important for air quality applications of the ABI measurements. This new effort will support Proving Ground testbed activities by providing selected proxy baseline and future capabilities products within AWIPS in addition to providing imagery from all ABI bands. The proxy products include cloud mask, cloud top height/phase/temperature/pressure, cloud optical depth, cloud particle size, temperature/moisture profiles, total precipitable water, stability indices, total ozone, low cloud and fog detection, as well as pseudo-true color imagery, which will be done in collaboration with the Cooperative Institute for Research in the Atmosphere (CIRA). All proxy imagery data are produced in GOES-R ReBroadcast (GRB) NetCDF files using the Fixed Grid Format coordinate system (at 2 km) following the GOES-R Product definition and User's Guide (PUG) conventions. All of the proxy products are generated in near-real-time by the GEOstationary Cloud Algorithm Testbed (GEOCAT) processing system and converted to AWIPS compatible NetCDF files to support Proving Ground testbed activities.

T-66 Data Access and Use *Sathyadev Ramachandran*

VIIRS NPP Ocean Color Products at NOAA CoastWatch – A First Look

Authors: Kent Hughes, Heng Gu, Phillip Keegstra, Yong Sung Kim, Sathyadev Ramachandran, Michael Soracco, Ronald Vogel

Following the launch of the Suomi NPP satellite CoastWatch has routinely processed the VIIRS NPP data in near real time mode for two possible choices of the ocean color algorithms made available to us, to produce Ocean Color products. One is the IDPS OC3V empirical algorithm and the other is CoastWatch's implementation of NASA OBPG's L2gen, which is also currently being used for our heritage products from MODIS on Aqua and Terra and in the past for SeaWiFS and MERIS data streams. For both algorithm streams, current experimental products (Chlor_a, nLw, Chlorophyll Anomaly) are produced for all CoastWatch regions for the CONUS area at full resolution, and additional L3 and L4 products will be created for daily Global coverage at a reduced spatial resolution of 4km. In addition, global data at full native resolution, divided into 24 sectors, will also be made available via a THREDDS server. The L3 and L4 global reduced resolution experimental products will be distributed via the STAR web server initially and later from the CoastWatch and OceanWatch web servers familiar to our current operational users when the products are declared operational after their initial assessment. We also present results from the preliminary Quality Assessment of the Ocean Color products (Chlor_a, nLw) from VIIRS NPP addressing our operational end user requirements. The QA approach includes comparison of VIIRS data with NASA MODIS climatologies. There is an ongoing effort to engage operational users with VIIRS data as a replacement for MODIS for the HAB (Harmful Algal Bloom) bulletin issued by NOAA/NOS for the Gulf of Mexico region off the Florida coast. Other potential operational users of the VIIRS NPP ocean color data are NCEP/EMC for their ocean modeling activities and forecast, for fisheries modeling by NMFS Pacific basin users, and for ecological modeling by the NOAA Chesapeake Bay Office.

T-67 Data Access and Use *Nadia Smith*

Thinking Inside the Grid: From Multi-Instrument Satellite Data to Uniform Space-Time Information

Authors: Nadia Smith, Paul Menzel, Elisabeth Weisz, Bryan Baum

Polar orbiting payloads have provided spatially and temporally consistent data for more than three decades with two instruments in tandem; imagers and sounders. The former measures radiation in the visible to near-infrared spectrum in broad bands with high spatial resolution, while the latter measures the infrared spectrum in narrow spectral channels with coarser spatial resolution. Together they provide a complimentary set of data from which to retrieve information about the Earth surface, clouds and vertical atmospheric structure. The challenge, however, lies in a meaningful combination of the information content from each instrument for improved geophysical characterization and comparison. The space-time gridding (STG) framework developed at the University of Wisconsin-Madison is applied here to the imager-sounder pair most recently launched on the Suomi-NPP (National Polar-orbiting Partnership) payload, namely VIIRS (Visible Infrared Imaging Radiometer Suite) and CrIS (Cross-Track Infrared Sounder). STG is instrument independent and allows the projection of radiance measurements or retrieved data from their unique instrument configuration to a uniform space-time configuration through data filtering, spatial resampling, and statistical characterization. We use STG here to study instrument signal-to-noise ratio (SNR) at a range of spatial scales. The bias and root-mean-square difference (RMSE) of brightness temperature measurements in the infrared window region (~11μm) are mapped on 0.25, 0.5, 1.0 and 2.0 degree uniform equal-angle grids. Daily space-time grids are built that are aggregated into longer time frames for comparison with other standard gridded products. In this sense, STG is unique in the flexibility is allows analysis in gridded space. Characterizing the SNR of different instruments in the same space-time grid

has the potential to greatly improve the study of geophysical and climate variability over long time scales.

T-68 Current and Future Programs and Systems
Stacy Bunin

NOAA's Transition to Operations of S-NPP and Multi-satellite Blended Satellite Products

Authors: Kevin Berberich, Tom Schott, Stacy Bunin

The launches of the Suomi National Polar-orbiting Partnership (S-NPP) satellite in October 2011 and the Global Change Observation Mission – Water (GCOM-W1) satellite in May 2012 bring opportunities for new and enhanced satellite products for NOAA's users. The National Environmental Satellite, Data, and Information Service (NESDIS) within NOAA will perform data processing, archiving, and distribution of data sets from both the S-NPP and GCOM-W1 satellites. NOAA's S-NPP Data Exploitation (NDE) Project will provide users of polar-orbiting data with temperature, sensor, and environmental data records derived from S-NPP instrument observations. NDE's data selection service enables tailoring of the data sets to meet user requirements and needs such as required formats, aerial coverages, frequencies, map projections, etc. In addition, NDE will have capabilities to apply science algorithms to data records allowing for the generation of additional products required by NOAA's users. This additional suite of unique S-NPP products will include an array of atmospheric, oceanic, and land surface products. New science algorithms and NDE's product tailoring will optimize fulfillment of end user requirements. NOAA has a Memorandum of Understanding (MOU) with the Japan Aerospace Exploration Agency (JAXA) to use microwave data from the GCOM-W1 satellite. Data from the GCOM-W1 instrument, the Advanced Microwave Scanning Radiometer 2 (AMSR-2), will be blended with other satellite data to generate total precipitable water, rain rate, soil moisture, and snow and ice cover products. Users will be able to take advantage of new and improved products from S-NPP and GCOM-W1 for continuity of their missions. This presentation will describe product development efforts taking place at NESDIS utilizing sensor data observations from these newly launched satellites.

T-69 Applications *Marouan Bouali*

Towards improved ACSPO SST imagery

Authors: Marouan Bouali and Alexander Ignatov

Scan-to-scan radiometric miscalibration errors generate stripe noise in imagery acquired by multidetector spectroradiometers such as MODIS or VIIRS. Consequently, native resolution sea surface temperature (SST) imagery derived from such whiskbroom scanners often display pronounced striping which reduces the accuracy of the data and its usefulness for downstream processing tasks such as thermal front detection, and applications based on visual image analyses such as fisheries. An algorithm has been designed to reduce the effect of striping and improve the quality of the imagery in the National Environmental Satellite, Data and Information Service (NESDIS) Advanced Clear-Sky Processor for Ocean (ACSPO) SST products. In this presentation, the performance of the proposed method is tested via quantitative and qualitative analysis using three days of Terra/Aqua MODIS and NPP VIIRS top of atmosphere clear-sky calibrated radiances, and derived SSTs. Preliminary results demonstrate substantial improvement in image quality without any impact on the geometrical features or global statistics of SST data.

T-70 Current and Future Programs and Systems
Robert Holz

A processing and validation system to collocate GOES-R and JPSS products to support combined GEO/LEO product development and validation activities using advanced physical collocation techniques.

Authors: Robert Holz, Greg Quinn, Ralph Kuehn, Fred Nagle, Walter Wolf, Haibing Sun

Decades of experience in applying vector algebra and analytic geometry to problems in satellite navigation at the University of Wisconsin's Space Science and Engineering Center has led to development of a variety of techniques for computationally practical efficient and accurate physical collocations. As will be presented, the collocation software library provides powerful tools that facilitate GOES-R Algorithm Working Group (AWG) validation and as well as algorithm development using of merged products by using multiple instruments on a diverse suite of observational platforms (LEO and GEO). Leveraging the computationally efficient methods, we are developing a near real time system that will provide merged operational GEO and POLAR (GOES-R/JPSS and SEVIRI/JPSS) products for cloud, aerosol, and sounding products. This system will provide near real time validation of both SDR and EDR products for GOES-R and provide the ability to develop joint POLAR and GEO algorithms for operational users. We will present the results from this system with a focus on merged CrIS/GOES-R and VIIRS/GOES-R (using GOES-E, and SEVIRI as proxy) products available to the community in near real-time. We expect a merged LEO/GEO product latency of less the 45 min using NPP direct broadcast capability allowing for the operational focused product developmentmerged products that using use GEO/LEO observations to be used operationally.

T-71 GSICS Users' Workshop *Haifeng Qian*

Application of DCC targets with GOME-2 observation for vicarious calibration of visible channels of NOAA GOES instruments

Authors: Haifeng Qian, Xiangqian Wu, Fangfang Yu and Trevor Beck

In this study, we take the advantage of observation from Global Ozone Monitoring Experiment-2 (GOME-2) and AVHRR (Advanced Very High Resolution Radiometer) both onboard Metop-A satellite to apply deep convective cloud (DCC) calibration for visible channels of NOAA GOES satellite instruments. We first identify DCC on the collocation between GOME-2 and AVHRR in 2010 in the region (180°W, 180°E, 20°S, 20°N) to characterize DCC temporal and spatial variation, and then investigate the spectral calibration uncertainty with DCC calibration to provide insights to improve SFR accuracy. Our analysis shows that DCC occurrence is sensitive to the thresholds with the brightness temperature (BT) of AVHRR Channel 11μm (Ch4). A threshold of Ch4 BT <205K has identified 0.16% of collocated GOME-2 pixels as DCC. Spatially, the land DCC has the large seasonal variation with 4.3% -16.3% of the total DCC pixels due to DCC moving in the tropics and subtropics. Generally, the seasonal movement of DCC is largely in line with the movement ITCZ. Boreal spring and summer season has large DCC occurrence in 2010 with an apparent transition period with least DCC pixels in 04/2010. A high frequency of DCC is observed in the zonal 5°S-8°S, and 4°N-6°N, rather than in the tropics. The subtropics of West Pacific, South Asian have the most frequent DCCs in the boreal spring and summer season. With the comparison with the AVHRR Ch1 observation on the DCC pixels, our analysis shows DCC with GOME-2 hyper-spectral observation is reliable as an invariant target. Our results indicate that DCC method in this study helps to improve the convergence of the reflectance difference between MODIS and GOES SFRs in DCC pixels and quantify that the contribution due to SFRs difference to the bias can been narrowed to <1% with a small increasing tendency with reflectance in DCC pixels. With this DCC calibration we suggest that the lower O2 absorption may offsets the contribution from the wider right tailor of GOES-11 SRF, resulting in that the contribution from GOES-11 SRF is very close to MODIS SRF. Finally, we detected a lightly decreasing tendency of the DCC reflectance at GOME-2 off nadir, which implies somewhat influence of the satellite viewing angle on the morning sunshine, especially in the position 6.

T-72 Current and Future Programs and Systems

Bernadette Connell

Satellite Training Activities: What's new and what's being recycled? VISIT, ShyMet and WMO Vlab

Authors: Bernadette Connell, D. Bikos, E. Szoke, S. Bachmeier, S. Lindstrom, A. Mostek, M. Davison, K. Caesar, V. Castro, L. Veeck

This presentation highlights the recent training activities being carried out collaboratively nationally through the Virtual Institute for Satellite Integrated Training (VISIT) program, the Satellite Hydrology and Meteorology (ShyMet) program, and internationally through the Virtual Laboratory for Training and Education (Vlab). It reviews the training approach and content directed towards the US community that has been directly applicable to the international community and vice versa. It also touches on those aspects that have been different. Through education and training, are we addressing basic, advanced, and experienced user needs?

T-73 Data Access and Use *Bernadette Connell*

Sending Training Videos Through GEONETCast? What Will They Think of Next!

Authors: B. Connell, P. Seymour, K. Caesar, and L. Veeck

GEONETCast is a near real time, global network of satellite-based data dissemination systems designed to distribute diverse data sets and products to diverse communities. It is an ideal transfer mechanism and supplements delivery to locations that have limited internet capabilities. For the GEONETCast Americas (GNC-A) system, desirable file size is under 20MB. What type of training do you send that is timely, relevant, and fits this size limitation? Starting in August 2012, we started sending monthly short video clips (less than 5 minutes) via the GNC-A VLAB Training Channel from topics discussed at that month's virtual Focus Group training session. We are looking to expand on these efforts. How can we repurpose existing training materials to best meet the needs of the user? Come find out our suggestions.

T-74 Current and Future Programs and Systems

William Straka III

McIDAS-V, visualization and data analysis for Suomi National Polar-orbiting Partnership

Authors: William Straka, Tommy Jasimin, Thomas Rink, Dan Lindsey, Don Hillger, Steve Miller, Thomas Achtor

The fifth generation of the Man computer Interactive Data Access System (McIDAS-V) is the next generation in the University of Wisconsin's Space Science and Engineering Center's 35-year history of sophisticated McIDAS software packages. It is a Java-based, open-source, and freely available software visualization package for satellite and other geophysical data. Its advanced capabilities provide interactive 4-D displays, an abstract mathematical data model with built-in metadata, and user-defined analysis and computation. These powerful capabilities to integrate data, analysis and visualization are being applied to the next generation of geostationary remote sensing instrument. While McIDAS-V

can visualize data from the current set of polar and geostationary satellites from a variety of countries (GOES, MSG, etc.), as part of the JPSS Risk Reduction Program, McIDAS-V was updated to be able to visualize data from the Suomi National Polar-orbiting Partnership (Suomi NPP) satellite. This includes all of the channels from the Moderate resolution bands as well as the I-bands and the Day Night Band on the VIIRS instrument. In addition, data from the ATMS and CrIS instruments can be visualized. McIDAS-V supports data from both the official processing system as well as the Community Satellite Processing Package (CSPP). Results from specific cases from VIIRS, ATMS and CrIS will be shown.

T-75 Current and Future Programs and Systems

Jingfeng Huang

Validation of Suomi NPP/VIIRS Operational Aerosol Products through Multi-Sensor Intercomparisions

Authors: Jingfeng Huang, I. Laszlo, S. Kondragunta, H. Liu, H. Cronk, H. C. Huang, L. Remer, H. Zhang, P. Ciren, S. Jackson, C. Hsu, A. M. Sayer, M. Oo, R. E. Holz, E. J. Hyer, L. Munchak, R. Levy, S. Mattoo, M. Petrenko, C. Ichoku, R. Kahn, and A. Smirnov

The Suomi National Polar-orbiting Partnership (NPP) Visible Infrared Imaging Radiometer Suite (VIIRS) instrument began collecting data shortly after its launch in October 2011 and its aerosol products have been available at a beta maturity state beginning in May 2012. The NPP/VIIRS operational aerosol products include aerosol optical depth (AOD) at 11 wavelengths, aerosol size parameter (Ångström Exponent, AE) and type-related information (Suspended Matter). VIIRS aerosol retrieval is performed at moderate resolution pixel level (~0.75 to 1.6 km from nadir to edge), and aggregates to ~6 to 12.8 km resolution for the Environment Data Record products. To use this newly released data in numerical weather prediction and to build it into long-term aerosol climate record requires a thorough characterization of the aerosol products, particularly in comparison to the preceding established well-characterized aerosol products. This talk highlights the multi-sensor intercomparison approach that is currently used for the calibration/validation (Cal/Val) of the VIIRS aerosol products. The aerosol products are compared with multiple ground (Aerosol Robotic Network, AERONET) and spaceborne (MODIS, MISR, CALIPSO, etc.) sensors, and similarities and discrepancies are discussed. The Cal/Val results indicated that VIIRS achieves comparable performance to MODIS in terms of observing spatial and temporal variability of global aerosols. In comparison to MODIS and AERONET, the VIIRS AOD retrieval algorithm performs better over ocean than over land, and improvements were made continuously to ensure the quality of the dataset. More detailed data analyses are currently underway to further improve the algorithms. The most updated results from the ongoing extended evaluation will be reported at the conference. It is expected that through intensive Cal/Val activities and algorithm refinements, the NPP/VIIRS aerosol products will prove a valuable asset to the data user community in meeting the operational and research needs of air quality, weather forecasting, and climate impact studies.

T-76 Data Access and Use *Scott Mindock*

CSPP VIIRS SDR – Acquisition, Production, Verification and Quality Control

Authors: Scott Mindock, Geoff Cureton, Ray Garcia, Liam Gumley, Graeme Martin, Kathy Strabala

The Community Satellite Processing Package (CSPP) has been developed at the UW-Madison Space Science and Engineering Center to support the Direct Broadcast Community (DB). The CSPP SDR software package includes the Suomi NPP VIIRS SDR algorithm as provided by the Algorithm Development Library (ADL). The CSPP SDR package provides DB users the opportunity to process VIIRS data as collected by a Soumi NPP capable antennas. The poster illustrates how additional software packages and ancillary support severs are coupled with ADL to provide this capability. The poster also describes the process employed by the CSPP team members at SSEC ensure the accuracy of the SDR products. Comparisons of IDPS SDRs to CSPP SDRs are highlighted.

T-77 Data Access and Use *Patrick Rowley*

Communicating Satellite Data via NOAA's Science On a Sphere: The EarthNow Project

Authors: Patrick Rowley, Steven Ackerman, Phil Arkin, Dan Pisut, Rick Kohrs, Margaret Mooney, Stephanie Schollaert Uz

The NOAA Science on a Sphere (SOS) is one of the fastest growing museum and science center exhibits worldwide, with over 80 installations. Rightfully so—few other exhibits captivate and mystify audiences in the way SOS does. Harnessing audience excitement about the science, however, has been challenging for docents. The EarthNow project (http://sphere.ssec.wisc.edu) from the Cooperative Institute for Meteorological Satellite Studies (CIMSS) allows SOS institutions to go beyond the scientific facts to create meaningful visitor experiences about weather and climate connections. CIMSS, in collaboration with the NOAA Environmental Visualization Lab and the Cooperative Institute for Climate and Satellites, regularly updates a blog-style website, providing a central location for SOS facilitators to find timely weather and climate stories to speak about how current events will affect and are affected by global change. Along with these stories, the website also provides relevant,

visually appealing SOS-formatted datasets and animations with appropriate annotations, leading to easier comprehension by presenters and the public.

Along with conveying the logistics and background of the EarthNow project, this poster will showcase how museums are using the EarthNow resources and. We will also seek input regarding data and potential topics for the EarthNow resources. http://sphere.ssec.wisc.edu/

T-78 Applications *Xiaofang Zhu*

Coastal Diurnal Warming Study through In-situ and Satellite data

Authors: Xiaofang Zhu, Peter Minnett, J. Hendee, C. Manfrino and R. Berkelmans, Helen Beggs

A good understanding of diurnal warming phenomenon is important for satellite sea surface temperature (SST) validation against in-situ buoy data and satellite data merging. For the coastal region, it also helps to improve the satellite data application to predict ecosystem health such as coral reef bleaching. Compared to its open ocean counterparts which have been studied extensively and modeled with good success, coastal diurnal warming has more localized characteristics including coastline geometry, bathymetry, water types, tidal and wave mixing properties, and is researched much less. The goal of this study is to quantify the coastal diurnal warming use both in-situ dataset as well as polar-orbiting and geostationary SST, and elucidate the similarity and difference from its open ocean counterpart. In-situ data include two extensive datasets from Caribbean and Great Barrier Reef, Australia. The AVHRR and MTSAT-1 SST data are used to study the warming in NE Australia coastal nodes close to Great Barrier Reef, and compare with the second in-situ dataset.

T-79 GSICS Users' Workshop *Likun Wang*

Inter-Comparison of S-NPP/CrIS Radiances with AIRS and IASI toward Infared Hyperspectral Benchmark Measurements

Authors: Likun Wang, Yong Han, Fuzhong Weng, and Mitch Goldberg

The Cross-track Infrared Sounder (CrIS) on the newly-launched Suomi National Polar-orbiting Partnership (Suomi NPP) and future Joint Polar Satellite System (JPSS) is a Fourier transform spectrometer that provides soundings of the atmosphere with 1305 spectral channels, over 3 wavelength ranges: LWIR (9.14 – 15.38 μm); MWIR (5.71 – 8.26 μm); and SWIR (3.92 – 4.64 μm). An accurate spectral and radiometric calibration as well as geolocation is fundamental for CrIS radiance Sensor Data Records (SDRs). In this study, through inter- and intra-satellite calibration efforts, we focus on assessment of NPP/CrIS post-launch radiometric and spectral calibration. The purpose of this study is to use inter-calibration technologies to quantify the CrIS calibration bias and uncertainties. We will compare CrIS hyperspectral radiance measurements with the Atmospheric Infrared Sounder (AIRS) on NASA Earth Observing System (EOS) Aqua and Infrared Atmospheric Sounding Interferometer (IASI) on Metop-A and –B to examine spectral and radiometric consistence and difference among three hyperspectral IR sounders. The newly-launched CrIS on Suomi NPP, combined with AIRS and IASI, provide the first-ever inter-calibration opportunity because three hyperspectral IR sounders can observe the Earth and Atmosphere at the same spectral regions from different satellites. We will directly compare CrIS with AIRS and IASI at orbital crossing points of satellites occurring at high latitudes, the so-called simultaneous nadir overpasses (SNO). The CrIS, AIRS, and IASI spectra will be processed at common grids and then the spectral differences will be computed. In addition, an accurate collocation algorithm has been developed to collocate high spatial resolution measurements from the Visible Infrared Imager Radiometer Suite (VIIRS) within each CrIS Field of View (FOV). The collocated VIIRS radiances will be used to characterize the homogeneity of CrIS FOVs to further reduce comparison uncertainties. Finally, the inter-comparisons between CrIS and AIRS will be further extended to the tropical scenes because Aqua and NPP have similar equator cross time.

T-80 Applications *Elisabeth Weisz*

Community Satellite Processing Package (CSPP)
Cross-track Infrared Sounder (CrIS) Dual-Regression Retrievals and Applications

Authors: Elisabeth Weisz, William L. Smith Sr., Nadia Smith

The Dual-Regression (DR) algorithm, developed as part of CSPP at the University of Wisconsin-Madison, retrieves atmospheric, surface and cloud parameters at single field-of-view (FOV) resolution from polar-orbiting high-spectral resolution instruments like AIRS on Aqua, IASI on Metop-A/B, and CrIS on Suomi-NPP (National Polar-orbiting Partnership). The DR algorithm uses the full information content of radiance measurements from these instruments to obtain reliable geophysical characterization anywhere on the globe. It is unique in its multi-instrument capability and rich suite of collocated retrieval parameters. This paper focuses on demonstrating the capability of the DR retrieval algorithm with the first year of CrIS measurements. The fact that retrievals are obtained with a high accuracy at single FOV makes it applicable to local as well as global applications. It is shown that when applied to direct broadcast data the algorithm permits a real-time and efficient acquisition of the current atmospheric conditions for the analysis of localized

atmospheric temperature and moisture variation. This is especially important for detecting stability changes that occur shortly before severe weather outbreaks. Alternatively, the DR algorithm can be applied to archived data and thus provide global climate data records with which to study seasonal variation in the distribution and frequency of geophysical parameters (e.g. surface skin temperature, trace gases, high clouds). With this we conclude that the DR algorithm allows the retrieval of high quality local and global information from hyperspectral sounding measurements to the benefit of data assimilation, weather forecasting, as well as global climate change and prediction studies.

T-81 Current and Future Programs and Systems

Shawn Miller

JPSS CGS Overview and Evolution

Authors: Shawn Miller, Michael Jamilkowski, Kerry Grant

The National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) are jointly acquiring the next-generation civilian weather and environmental satellite system: the Joint Polar Satellite System (JPSS). The Joint Polar Satellite System will replace the afternoon orbit component and ground processing system of the current Polar-orbiting Operational Environmental Satellites (POES) managed by the National Oceanic and Atmospheric Administration. The JPSS satellites will carry a suite of sensors designed to collect meteorological, oceanographic, climatological and solar-geophysical observations of the earth, atmosphere and space. The ground processing system for JPSS is known as the JPSS Common Ground System (JPSS CGS), which consists of a Command, Control and Communications Segment (C3S) and an Interface Data Processing Segment (IDPS). Both segments are developed by Raytheon Intelligence and Information Systems (IIS). The C3S is currently flying the Suomi National Polar Partnership (Suomi NPP) satellite and transfers mission data from Suomi NPP and between the ground facilities. The IDPS processes Suomi NPP satellite data to provide Environmental Data Records (EDRs) to NOAA and DoD processing centers operated by the United States government. When the JPSS-1 satellite is launched in early 2017, the responsibilities of the C3S and the IDPS will be expanded to support both Suomi NPP and JPSS-1. The CGS will also provide mission management and data routing for the Free Flyer-1 mission in the JPSS-1 timeframe. The CGS also employs its ground stations at Svalbard, Norway and McMurdo Station, Antarctica, along with a global fiber communications network, to provide data acquisition and routing for multiple additional missions. These include POES, DMSP, NASA Space Communications and Navigation (ScaN, which includes the Earth Observing System [EOS]), the Japan Aerospace Exploration Agency's (JAXA) Global Change Observation Mission – Water (GCOM-W1, for which the CGS also generates Raw Data Records [RDRs]), MetOp for the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), Coriolis/WindSat for the DoD, as well as research activities of the National Science (NSF). This paper will provide an overview of the CGS as it is deployed and operating today, along with a summary of how the CGS architecture will evolve over the next few years to provide continued support of multiple missions. The CGS architecture is evolving for several key reasons:

1) "Operationalizing" Suomi NPP, which had originally been intended as a risk reduction mission
2) Leveraging lessons learned to date in multi-mission support
3) Taking advantage of newer, more reliable and efficient technologies
4) Satisfying new requirements and constraints due to the continually evolving budgetary environment

Three key aspects of the CGS architecture are being prototyped as part of the path to improve operations in the 2015 timeframe:

1) A new front end architecture for mission data transport
2) Enhanced flexibility and modularity in IDPS
3) Comprehensive situational awareness across the CGS

The front end architecture for CGS mission data transport is being re-architected to increase reliability and address the incorporation of new ground stations. A reliable data transport protocol will be employed to converge the data from multiple ground stations to a JPSS Stored Mission Data (SMD) Hub (JSH). The JSH will then distribute the data to multiple users for generation of environmental products, instrument performance and health analyses, and telemetry analysis for CGS-managed satellites. Since S-NPP launch in October 2011, the CGS Interface Data Processing Segment (IDPS) has successfully undergone a significant technology refresh to more efficiently support S-NPP and Global Change Observation Mission (GCOM) operations. This includes addressing requirements to deliver 95% of S-NPP data products to end users within 140 minutes, with 99.9% data availability for long-term archival. To extend this capability to JPSS-1 and an array of other potential new missions, we are enhancing key areas of the IDPS to address a wider range of inputs, a higher volume of data delivery, and plug-n-play algorithm insertion and upgrades. Finally, through continual communication and coordination with the CGS operators, a solution for comprehensive situational awareness across the CGS is being developed to increase operational efficiency and facilitate quicker and more efficient identification and resolution of system anomalies.

T-82 Applications *Korak Saha*

Quantifying the effect of ambient cloud on clear-sky ocean brightness temperatures and SSTs

Authors: Korak Saha, Alexander Ignatov, and XingMing Liang

Advanced Clear Sky Processor for Oceans (ACSPO) is NESDIS operational system which produces clear-sky ocean brightness temperatures (BTs) in three bands centered at 3.7, 11 and 12 μm, and Sea Surface Temperatures (SST) as functions of these BTs and view zenith angle (VZA). In this presentation, we quantify the effect of ambient cloud on the clear-sky BTs and SSTs. The pixels identified in ACSPO as cloud free, may be still affected by their cloudy neighbors. This cloud filter may be triggered (or not) on pixels with elevated aerosols and water vapor (cloud-halos), depending upon threshold settings. Since such transient states are difficult to classify using a threshold-based clear-sky-mask employed in ACSPO, it will affect the clear-sky BTs and SSTs. We use a number of clear-sky ocean pixels (NCSOP) around each clear-sky pixel, calculated using sliding window technique, as (an inverse) proxy of ambient cloud. SST and BT differences are calculated in each clear-sky ACSPO pixel, by subtracting the expected (first guess) SST and BTs (simulated using the community radiative transfer model, CRTM). It was shown earlier using one week of global data that the SST and BT differences decrease exponentially with NCSOP, and asymptotically approach their "confidently clear-sky" limits, when NCSOP is large enough. To verify this observation on longer time scale, the NCSOP dependencies of SST and BT differences have been routinely calculated and published in near-real time web-based Monitoring of IR Clear-Sky Radiances over Oceans for SST (MICROS; www.star.nesdis.noaa.gov/sod/sst/micros/) system since March 2012. In this study, we fit an exponential curve with three fit parameters using a modified Levenberg-Marquardt least-square minimization technique, termed MPFIT. The stability of the fitting is investigated by trending the fit parameters with time. Results of this study are used to more accurately validate CRTM and its first guess input fields, and quantify residual cloud contamination in ACSPO products.

T-83 Current and Future Programs and Systems *Houria Madani*

Image Navigation and Registration For the Next Generation Geostationary Weather Satellites

Authors: Houria Madani, Jim Carr, Francis Olivier

GOES-R is the next generation weather satellite program for the western hemisphere and is a follow on to the GOES I-P satellite series that is currently used for weather prediction. Similarly, Meteosat Third Generation (MTG), which is a continuation of the successful Meteosat Second Generation (MSG) program, will provide Europe and Africa with an operational satellite system that is capable of supporting the accurate prediction of meteorological phenomena and the monitoring of climate and air composition. The MTG system will consist of two spacecraft, MTG-I and MTG-S, one dedicated to imaging via the Flexible Combined Imager (FCI) and the Lightning Imager (LI) and the other to sounding via the InfraRed Sounder (IRS) and the Ultraviolet Visible Near-infrared (UVN) spectrometer. Data from one satellite program can be exploited by the other program for development of proxy data used in algorithm validation or for on-orbit cross calibration; for example, MSG images have been used to generate proxy data for testing and validation of GOES-R landmarking algorithms as described at AMS 2013 (1). Therefore, it is important to have a good understanding of the similarities and differences between GOES-R and MTG. Both MTG and GOES-R have embraced some major innovations in their INR approaches. GOES-R will be the first of the next generation GOES satellites fleet to implement an on-ground INR, a departure from the on-board Image Motion Compensation (IMC) method that was used in GOES I-P. The GOES-R Advanced Baseline Imager (ABI) has more spectral channels, and finer temporal, spectral, and spatial resolutions than the current GOES imager. One major innovation for Meteosat is using a 3-axis stabilized platform for the first time. The MTG FCI has more channels, and better temporal, spatial, and radiometric resolution than its predecessor, the MSG Spinning SEVIRI. Both Meteosat and GOES systems will be flying a lightning imager (LI for MTG and GLM for GOES-R) for the first time. The combined result of these innovations is that GOES and Meteosat share more features than their previous versions. It is therefore logical that both systems use INR solutions that have a lot in common. The MTG system uses an INR approach that is applicable to all its instruments and which resembles the INR solution for the GOES-R ABI. In addition, monitoring of INR performance on both programs is achieved via landmark measurement functions based on those used in the current GOES system. The goal of this presentation is to discuss the Image Navigation and Registration (INR) methods used by the two satellite systems.

T-84 Applications *Richard J Dworak*

The Validation of GOES-Li and AIRS Total Precipitable Water Retrievals Using Ground Based Measurements.

Authors: Richard J. Dworak and Ralph Peterson

The CIMSS GOES NearCasting System is designed to monitor and predict pre-storm environments in which severe convection is likely to occur over the next 1-9 hours. The hourly-updated system is exceptionally data-driven and is highly dependent on accurate measurements of atmospheric moisture content. The NearCasting System uses 3 deep-layers of Precipitable Water (3LPW) provided by the GOES-Li retrieval. The three individual layer measurements can also be

summed to determine the Total Precipitable Water (TPW) in each retrieval. Experiments with the NearCasting system, however, have pointed to a number of potential issues with the GOES-Li retrievals, most notably diurnally varying biases (systematic error) and an apparent annual cycle in random errors. In order to determine the characteristics of and correct these errors throughout the day and from season to season across the US, GOES-Li retrievals from 2011-12 have been compared to a variety of high-quality ground-based observations available throughout the day, including TPW from a network of GPS Receivers found across the Contiguous United States, as well as 3LPW observations derived from the Southern Great Plains Atmospheric Radiation Measurement (SGP-ARM) Microwave (MWR) and Raman-Lidar (RL) systems. Background 3-9 hour GFS model forecasts used in the GOES-Li retrieval processing were also compared against the retrievals themselves at ground based sites using the same validation experiments to help determine the source of the bias errors and whether the GOES data reduce random errors in other forecast products. The validation experiments were partitioned by month, diurnal cycle and cloud amount. Validation of the GFS forecast provide useful information on model bias, with differences between GOES sectors (East and West) discovered. The AIRS retrievals over the CONUS were also compared against ground based GPS and SGP ARM when available to determine their utility in subjection forecaster applications. Results showed that the strong diurnal variations in bias were highly correlated with similar biases in the GFS first guess fields in the TPW fields. The quality of the GFS background TPW fields also varied from one forecast cycle to another, with substantially larger biases and random errors in the runs started at 1200 and 1800 UTC. The largest reduction in random errors (information addition) from the satellite observations used in the GOES-Li retrievals occurred during the warm months. Substantial vertical differences in the biases (both GFS and retrieval) were also observed in the 3LPW data, with the moisture in the lowest 100 hPa having the largest positive bias. Finally, although the monthly biases in the GOES-Li retrievals of TPW show a substantial annual cycle, the relative biases (calculated as the monthly bias divided by the month mean TPW value) show little annual variability and therefore should be useful as a means of removing cycle-to-cycle bias changes observed in NearCast evaluations.

T-85 Current and Future Programs and Systems
Marlin Perkins

Current and Future Direct Readout Services

Author: Marlin Perkins

The National Oceanic and Atmospheric Administration (NOAA) is in the process of implementing new direct readout services. A transition from the current legacy services the new direct readout services will take place across both the polar-orbiting and geostationary satellite constellations. The current direct readout services are derived from satellite sensor data on NOAA's GOES and POES spacecrafts. NOAA's geostationary (i.e., GOES) direct readout services include Low Rate Information Transmission (LRIT), Emergency Managers Weather Information Network (EMWIN), Data Collection System (DCS) and GOES VARiable (GVAR) transmissions. The polar orbiting (i.e., POES) direct readout services include the analog Automated Picture Transmission (APT) and digital High-Resolution Picture Transmission (HRPT) transmissions.
The SNPP/JPSS and GOES-R satellite constellations will employ new downlink frequency allocations, larger bandwidths, and faster data rates. The legacy direct readout services will not be available on the new spacecrafts. Environmental data users must employ new field terminal receivers unique to that particular broadcast service.
This poster describes the planned transition of the new direct readout services from the current POES and GOES to SNPP/JPSS and GOES-R. A summary of the direct readout service changes and the proposed field terminal updates is presented.

T-86 Data Access and Use *Daniel Vila*

The role of DSA/CPTEC/INPE in the dissemination of POES/GOES products

Authors: Osvaldo Moraes, Nelson Ferreira, Daniel Vila, Luiz A. Machado

The mission of the Environmental Satellites and Systems Division of Center for Weather Forecasting and Climate Studies (CPTEC) is to carry out scientific research based on measurements from meteorological and environmental satellites and develop retrieval methods for atmospheric and surface variables, such as wind, temperature, humidity, radiation and precipitation. These activities are intended to generate operational information to be used for monitoring the weather and climate, assimilate data into numerical prediction models and provide high quality products to a wide variety of users in Brazil and South America. The aim of this poster is to make a short summary of the products based on GOES and POES satellites available at DSA, the profile of the users of our products and services and the training efforts to target different user's groups to fulfill their requirements.

T-87 Current and Future Programs and Systems
Daniel Vila

Brazilian Contribution for the GeonetCast System

Authors: Nelson Ferreira, Daniel Vila, Luiz A. Machado

The GEONETCast system provides free and open access to environmental data for the public good. Data providers can use GEONETCast to send products such as rainfall rates,

volcanic or earthquake activity, sea conditions, air quality, climate data, weather warnings and much more – globally, in a timely manner. The GEONETCast environmental data dissemination system was developed in support of the Global Earth Observation System of Systems (GEOSS). GEONETCast uses a global network of communications satellites to transmit environmental, satellite data, in situ data, and Earth observation products from providers to users. Commercially available technology provides cost-efficient solutions with easy to use terminals, which are commonly employed in direct-to-home digital television systems (DVB-S). The aim of this poster is show how CPTEC/INPE is contributing to this network in terms of products for South America and which are the future plans to enhance the capabilities of the system to achieve user's needs.

T-88 Applications *Daniel Vila*

Ice Water Path (IWP) Retrievals and Life Cycle Stage of Convective Clouds

Authors: Ramon Braga, Daniel Vila

This research is focused on the possible relationship between Ice Water Path (IWP) retrievals using satellites and the life cycle stage of convective clouds and its possible application on satellite-based rain rate retrievals. The IWP is retrieved using the Microwave Surface and Precipitation Products System (MSPPS), which use high frequency channels (89 and 150 GHZ) from AMSU-B and MHS sensors (NOAA 15-19), while the cloud expansion rate analysis was calculated using FORTRACC algorithm, which makes possible identify and track mesoscale convective systems using thermal infrared images (10.7µm) on board of GOES satellites. Two regions with different precipitation patterns were selected for this study: São José dos Campos region (23.2ºS, 45.95ºW) and the Fortaleza region (5.06ºS, 39.26ºW) at the Brazilian southeast and northeast regions respectively. In the first region, it was found that, during the selected period, 84% of precipitant clouds has ice in their structure, while in Fortaleza only a half of precipitant clouds has ice. The results of this research shows that, while convective systems are intensifying (area is expanding and temperature is decaying), larger IWP values tends to be observed. Larger rain rates and larger convective fraction is also measured for radar retrievals when convection is in the early stage compared with mature systems. An update for the current methodology is proposed for precipitation retrievals applying high frequency channels from AMSU-B/MHS sensors using particle effective diameter (De) and IWP. The proposed equation showed a significant improvement compared with the global algorithm developed at MSPPS.

Poster Session II
Wednesday April 10, 2013

10:15 am

W-1 Current and Future Programs and Systems

Russell Stringer

Satellite User Requirements and Readiness in WMO Region V (South-West Pacific)

Authors: Russell Stringer, Bryan Hodge, Ed Young, Riris Adriyanto, Kelly Sponberg, Paul Seymour, Jennifer Lewis, Agnes Lane

WMO Region V extends from Malaysia and the Philippines to the western and central Pacific, including the areas of Melanesia, Polynesia and Micronesia where small islands are scattered across vast ocean areas. The sparseness of surface-based observations increases the value of satellite observations for nowcasting and short range forecasting, as well as through impact on NWP model forecasts. None of the countries in WMO Region V operate weather satellites, hence there is a critical dependence on global cooperation supported by an informed dialog between satellite operators and users. One contribution to this informed dialog is being made by the countries of WMO Region V through their Working Group on Infrastructure which includes a Task Team on Satellite User Requirements and a Task Team on Pacific Satellite Communications. Specifically, work has commenced to follow the WMO ""Procedure for documenting Regional requirements for satellite data access and exchange"" in order to develop a prioritised set of requirements. Such a set of requirements was recently completed in WMO Regions III and IV (for South and Central America and the Caribbean islands), providing a good demonstration for others to follow. However there are some unique complicating factors in Region V including the larger number of geostationary satellites covering some part of the Region, the various direct- or re-broadcast services in different parts of the Region, and the available communications bandwidth and reliability for internet and other distribution.

W-2 Data Access and Use *Ray Garcia*

Exporting VIIRS and MODIS Products for Visualization using Polar2Grid

Authors: R.K.Garcia, K.I.Strabala, D.J.Hoese, E.N.Schiffer, W.C.Straka III

Polar-orbiting multi-band meteorological sensors such as VIIRS and MODIS pose substantial challenges for taking imagery "the last mile" to forecast offices, scientific analysis environments, and the general public. To do this quickly and easily, an open-source, modular application system, Polar2Grid, has been created by the Cooperative Institute for Meteorological Satellite Studies at the University of Wisconsin. Polar2Grid provides and automates tools for converting VIIRS and MODIS products into a variety of output formats, including GeoTIFF, AWIPS and AWIPS2, as

well as NinJo forecasting workstations. Polar2Grid also includes perceptual enhancements for products such as the VIIRS Day-Night Band (DNB), and performs conversions and projections in seconds on large swaths of data. Polar2grid is currently providing VIIRS imagery over the Continental United States, as well as Alaska and Hawaii, from various Direct-Broadcast antennas to forecasters in the NWS offices in their AWIPS terminals, within minutes of an overpass of the Suomi NPP satellite. Usage of this data has proven useful in the issuance of forecasts by the NWS.

W-3 Current and Future Programs and Systems

Alan Jeffries

JPSS Science Data Processing within the MagicDraw Formalism Facilitates User and Developer Interaction

Authors: Laura Ellen Dafoe, Jeffrey Hayden

The science data processing system for the Joint Polar Satellite System (JPSS) produces dozens of meteorological data products useful to weather and climatology scientists. The processing chain to result in these products is complex, with interdependency among the products themselves as well as with databases external to the JPSS system. The science data processing system has been modeled using MagicDraw, an Enterprise Architecture application using DODAF formalism. The MagicDraw modeling tool allows different views or perspectives of the same system. This facilitates communication among different disciplines while maintaining a unified system representation. The model presented is based upon the JPSS operational ADL version from January 3, 2013 and includes the operational names of processes and data elements. The model is being used in the JPSS program in creating specifications for continued work. It is hoped that operational code will be linked to the model to create a functional data processing system for JPSS. Top level views of the science data processing system are presented, and examples are given for different views pertaining to different disciplines.

W-4 Applications *Prasanjit Dash*

First year of VIIRS SST in SQUAM: Evaluation and comparison with other satellite SSTs

Authors: Prasanjit Dash, Sasha Ignatov, Yury Kihai, John Stroup, Xingming Liang, John Sapper, Feng Xu

The Suomi NPP satellite launched in October 2011 is a bridge mission between the NOAA POES and NASA EOS mission, and the future Joint Polar Satellite System (JPSS). The Visible Infrared Imager-Radiometer Suite (VIIRS) sensor onboard S-NPP and JPSS builds upon the heritage of AVHRR and MODIS sensors, flown onboard NOAA/MetOp and Terra/Aqua satellites, respectively. Global sea surface temperature (SST) products at native resolution of VIIRS IR bands have been generated operationally since January 2012 by the Interface Data Processing Segment (IDPS) system, developed by the Raytheon, and experimentally by the Advanced Clear-Sky Processor for Oceans (ACSPO) system, developed at STAR. The support and maintenance of the IDPS SST product has been also transferred to STAR in 2011. The ACSPO system, in addition to VIIRS data, also generates operational SSTs from several AVHRRs (NOAA 16-19, and MetOp-A &- B) and experimental SSTs from two MODISs, onboard Terra and Aqua. With a range of SST products available from different systems, a required and desirable step in the SST community is validation and cross-comparison of these products to check for their relative merits, in a timely manner. The SST Quality Monitor (SQUAM), developed at STAR, monitors most major global SSTs from polar-orbiters generated at different agencies and reports their performance and comparisons statistics online at www.star.nesdis.noaa.gov/sod/sst/squam. The SQUAM methodology is based on statistical analyses of differences in retrieved SST (TS) with respect to several reference SST fields (TR), including global L4 fields and in situ SST data. One year of VIIRS SST observations from IDPS and ACSPO in SQUAM will be presented in this poster. Performances of VIIRS SST algorithms and cloud-masks, from both ACSPO and IDPS systems, will be shown and cross-comparison of VIIRS products with those from AVHRR and MODIS discussed.

W-5 Data Access and Use *Wayne Feltz*

Overview of UW-Madison SSEC/CIMSS GOES-R Proving Ground Activities

Authors: Wayne F Feltz, Tim Schmit, Michael Pavolonis, Andrew Heidinger, Jordan Gerth, Scott Bachmeier, Kaba Bah, Scott Lindstrom, Tony Schreiner, Christopher Velden, Ralph Petersen

A proving ground is designed to showcase future capabilities and identify possible gaps as a forward-thinking exercise to prepare the end user for upcoming science and technology. The Geostationary Operational Environmental Satellite R-Series (GOES-R) Proving Ground connects research and operations to assure widespread day-one readiness through: applying current earth observing systems and numerical weather prediction models to demonstrate GOES-R capabilities today; transitioning new algorithms and techniques to the field early to assure forecaster familiarity with GOES-R products; and making operational meteorologists part of the discussion when it comes to designing and implementing effective GOES-R decision support products and visualization tools. The GOES-R Proving Ground is a collective effort between many NOAA and NOAA-supported agencies and universities. The University of Wisconsin-Madison Cooperative Institute for

Meteorological Satellite Studies (CIMSS) has been participating in GOES-R Proving Ground activities since 2008. UW-CIMSS in 2011-2012 provided multiple near real-time GOES-R proxy decision support products for evaluation at NOAA demonstration/testbed sites including, fog/cloud detection, convective cloud top cooling, WRF simulated satellite imagery, convective overshooting-top, hurricane intensity estimation, fire detection, cloud properties, nearcasting, and volcanic ash products These activities are part of the larger GOES-R Proving Ground program with participation from other institutes including CIRA and NASA SPORT which provide valuable lightning data proxy and other related decision support aids. CIMSS plans for 2013 and beyond include demonstration of GOES-R proxy decision support products at multiple testbeds as defined by NWS needs. This poster will overview how various GOES-R proxy decision support products are being evaluated at Hazardous Weather Testbed, Aviation Weather Testbed, Hurricane Testbed and 5 other demonstration and evaluation sites for possible future operational usage.

W-5 Current and Future Programs and Systems

Wayne Feltz

GOES-R Cloud and Aerosol Validation during the NSF DC3 field mission

Authors: Wayne Feltz, R. Bradley Pierce, Ed Eloranta, K. Sebastian Schmidt, Andrew Heidinger, Shobha Kondragunta, Andi Walther

Validation of cloud and aerosol properties is challenging. The options available to the GOES-R AWG teams are limited. Most of the Aerosol and Cloud team's efforts have been focused on comparisons to other satellite products generated the EOS/MODIS Science teams. While these comparisons are valuable for ensuring that the algorithms behave correctly in a gross sense, they offer little information on the performance of GOES-R retrievals for specific retrieval scenarios. This is due to the fact that the physical retrieval assumptions are often shared between the GOES-R and EOS/MODIS algorithms. This poster focuses on validation of GOES-R Advanced Baseline Imager (ABI) aerosol and cloud retrievals using surface and airborne based measurements during National Science Foundation (NSF) sponsored field campaigns. Cloud height and aerosol optical depth validation was performed using ground based HSRL measurements deployed at Norman, OK during the NSF Deep Convective Clouds and Chemistry (DC3) mission (May-July, 2012). Cloud microphysical validation was performed using ground based high-spectral resolution Solar Spectral Flux Radiometer (SSFR) measurements of solar irradiance at Boulder, CO during DC3. The airborne and surface validation tools and procedures developed under this effort provide the foundation for post-launch ABI validation activities.

W-6 Data Access and Use *Dmitry Fedotkin*

Construction Technology of Ground Stations Network for Receiving and Processing Data from Polar-Orbital Satellites

Author: Dmitry Fedotkin

Such Earth observation application as ecological monitoring, meteorological monitoring, etc. requires daily near real-time acquisition of remote sensing data covering vast territories. To provide stable receipt and real-time data processing from a number of space satellites and covering all the area of interest as well as to control data reception and imagery quality, a joint network of receiving stations is needed. Such network should consist of several receiving centers, geographically located so that their footprints could completely cover the required territory. As one station can receive the signal from only one satellite at a time, each receiving center should be equipped with several antenna systems to enable the simultaneous reception from several satellites. Such operating mode requires automation. The network stations are connected with each other via Internet and are controlled from a single control center using specially developed software without on-site operators (unattended). A general timeline (pass schedule) is prepared every daily in the center as the combination of all stations operation programs. Each particular program is automatically delivered to the respective station, automatically executed and the execution reports are automatically sent to the control center, where they are analyzed and archived – also automatically. All interaction is implemented asynchronously by means of file exchange and does not have any special requirements towards communication lines. Each station is receiving data automatically in compliance with the pass schedule, received from the center, in unattended mode. Preliminary data processing is carried out straight away. A good example of such network is ground receiving stations network built by ScanEx Research & Development Center. It has already been functioning successfully in Russia for several years, providing near real-time satellite imagery data to private users and different public ministries and agencies. This network includes 9 ground stations, located in 4 reception centers (Moscow, Megion, Irkutsk and Magadan) with a control center located in Moscow. Data is received daily from 10-15 international space satellites. This network of stations enables to do regular near real-time observation of the entire territory of Russia and adjacent part of the Arctic Ocean utilizing data from different remote sensing satellites. Over the past few years, successful operation of this network ensures the implementation of such large projects in Russia, as annual flood monitoring, forest fires monitoring, maritime oil pollution monitoring, ice situation monitoring, etc.

W-7 Current and Future Programs and Systems

Shanna Sampson

GOES-R AWG Product Processing System Framework: Current Capibilities and Future Plans

Authors: Walter Wolf, S. Sampson, X. Liu, A. Liu, T. Yu, R. Garcia, G. Martin, W. Straka, E. Schiffer, and J. Daniels

NOAA/NESDIS/STAR has designed, developed, and implemented the GOES-R Algorithm Working Group (AWG) Product Processing System Framework. The framework has enabled the development and testing of the Level 2 Advance Baseline Imager (ABI) and the GOES-R Lightning Mapper products within a single system. Fifty-six GOES-R ABI algorithms and one GLM algorithm have been run within the framework with product precedence. Since the AWG algorithm development phase has been completed, the framework is currently being used to continually test the twenty-five baseline algorithms on new proxy and simulated datasets. The output from these data runs are compared to "truth" data for algorithm validation. The framework was designed and developed as a plug-and-play type system with the scientific algorithms. This enabled an algorithm to be developed and/or tested in both the framework and the scientist's offline research system with little to no modification or addition to either system. The future plans are to expand the framework processing capibility by modifying the GOES-R AWG algorithms to create products from GOES and Visible Infrared Imaging Radiometer Suite (VIIRS) data. The design details of the framework, algorithm processing, and the future algorithm implementation plans shall be discussed.

W-8 Current and Future Programs and Systems

Ted Kennelly

Systematic Approach for the Transition of Research to Operations

Authors: Scott Zaccheo, Ned Snell, Ted Kennelly, David Hogan, Gary Gustafson

The transition of algorithms and software from a research environment to operations is a complex process requiring a methodical series of steps to ensure success. As new systems are proposed and developed, new technology in the form of scientific and data processing algorithms is an integral part of system upgrades. The National Research Council Committee on NASA-NOAA Transition from Research to Operations recommends improved transitional processes for bridging technology from research to operations. The two key elements of this process are: A well-defined algorithm development processes that is shared by the science/engineering teams, and a two-tiered software framework comprised of a development/algorithm engineering and production environments, which shares common infrastructure/interface elements. This shared data model interface provides common methods for integrating test and proved seamless mechanism for transitioning. In addition, it also promotes algorithm "buy back" from the operational environment to the development environment which facilitates continued algorithm improvements and their transition to operations based on a shared baseline. In this paper, we describe an overall framework for developing a research to operations transition plan, provide examples of the successful transition of diverse algorithms for multiple customers, and discuss recommendations for how the both the research community and operational centers could work together to ensure a more efficient transition.

W-9 Applications *Ralph Petersen*

Improving very-short-range Forecasts of the Pre-Convective Environment and Heavy Precipitation Events using operational Satellite Observations

Authors: Ralph A. Petersen, Robert Aune, and William Line

We will briefly describe the development and configuration of the CIMSS Lagrangian NearCasting system and the advantages of the approach for retaining the information content in hourly-updated GOES sounding. This will be followed by results of forecaster evaluations made during the past several years and plans for the future, including supplementary information provided by an isentropic version of the model and expansion of the system to use POES soundings in support of the NWS Alaska Region. Tests of the 1-9 hours forecasts of GOES products have been made at US National Weather Service (NWS) Forecast Offices and both the Storm Prediction Center (SPC) and the Aviation Weather Center (AWC) for several years. Additional evaluations are planned this year at both the Hydrometeorological and Ocean Prediction Centers (HPC and OPC). Previous tests focused both the ability of the GOES NearCasts to help forecasts determine where/when severe convection will occur, as well as where/when any form of deep convection will and will not occur. All evaluation groups wanted: a) to increase lead-time, b) to reduce false alarms and increase probability of detection, c) to provide updates / detail to NWP guidance for the next several hours, and d) to increase usefulness of satellite products. Results showed that the NearCast prediction period could be successfully increased from 6 to 9 hours, that the analysis improved by increasing the number of observations projected forward from previous cycle and, most importantly, that the NearCasts enhanced NWP guidance by isolating which forecast areas were and were not likely to experience convection and when, especially during summer. Results from the isentropic version show further that the NearCast wind fields and adiabatic moisture transport provide information about low-level lift and triggering mechanisms

needed to release the predicted convective instability, help determine storm severity and, very importantly, enhance the ability to differentiate between cases of short-lived convective hazards and longer-lived heavy convective rainfall events. The tests also revealed that successful use of the NearCasting tools requires increased forecaster training and education: both about the NearCast system itself and how to interpret satellite observations and derived products. Case studies from several severe weather events will be highlighted, including the Branson MO tornadoes and the Ohio Valley/Washington DC Derecho. Finally, we will describe future plans for the CIMMS NearCasting system. This will include expanding applications to the NWS Alaska Region in an effort 1) to increase the operational utility of frequently updated LEO soundings to forecasters and 2) to help fill the large data gaps that exist between the sparse conventional and radar sites. The specific objectives include: 1) determining the 'best' LEO sounder moisture products to be used in very-short-range forecast guidance for products specifically designed to fill Alaska Region (AR) forecasting needs and 2) testing the impact of LEO-retrieval on improving a variety of AR operational very-short-range forecasting problems, ranging from the timing and location of the summer-time convection to orographically-driven winter-time heavy snow events. We will also briefly discuss plans for testing future GOES-R ABI data in the NearCasting system using EUMETSAT SEVIRI in forecaster assessments over Europe and equatorial Africa.

W-10 Applications *Andrew Heidinger*

Generating Real-Time and Climate Products in Support of Solar Energy Applications

Authors: Andrew Heidinger, Christine Molling, Willliam Straka III, and Michael Foster

Solar energy production in the USA and in the world is growing rapidly. One of challenges facing this industry is the need to forecast solar energy output for a given site over a short time scale. This problem is essentially a problem of short-term cloud forecasting. A critical aspect in this process is the need for accurate real-time knowledge of cloud properties at the highest possible temporal and spatial scales. This poster outlines the current activities by NOAA/NESDIS and its partners in providing this information. NOAA/NESDIS currently generates solar flux and cloud products from the GOES Surface and Insolation Project (GSIP). The products are generated hourly with a spatial resolution 12.5 km. GSIP shares its core processing system with the operational NESDIS AVHRR Cloud Products System (CLAVR-x). CLAVR-x has been modified to process GOES Imager data at 1km and 15-minutes which represents the highest spatial and temporal resolution offered by the routine operation of the GOES Imagers over CONUS. If this high-resolution processing successful, it will influence the evolution of the operational GSP processing.This poster demonstrates the CLAVR-x GOES 1km/15minutes GOES processing at CIMSS. The processing is being done to support a new DOE/NOAA Solar Energy Initiative. In addition, this processing is being run retrospectively on GOES Imager data (2006-2012) to provide climate data to NREL. Both of these efforts will be explained in this poster.

W-11 Climate *Eric Leuliette*

Jason altimetry and NOAA's Sea Level Climate Data Record

Authors: Eric Leuliette, Remko Scharroo, John Lillibridge, Gary Mitchum, Deirdre Byrne, Laury Miller

As part of its Polar Satellite Program, NOAA operates the Jason-2 altimetry satellite. The Jason series began with TOPEX/Poseidon (1992-2005) and Jason-1 (2001-present) — a partnership between NASA and CNES. With the launch of Jason-2 in June 2008, the partnership was extended to include NOAA and EUMETSAT as the missions transitioned from research to operations. Jason-3 will be launched in early 2015, with NOAA and EUMETSAT assuming primary roles. The series will continue in 2018 with the Jason-CS (Continuity of Service) missions, adding the European Space Agency as a new partner. Considering the tremendous social implications if an accelerated rate of sea level rise were to be sustained, evaluations and interpretations of the sea level will increasingly be needed to provide information relevant and useful to decision makers, stakeholders, and the public. Because of their demonstrated stability and unique coverage, sea level observations from the Jason series of altimeters are essential to building a climate data record (CDR). While satellite radar altimetry is one of the most complex forms of remote sensing, over the last 20 years, it has achieved levels of accuracy and stability in observations of sea level necessary to meet or exceed the requirements for a GCOS Essential Climate Variable. A key factor necessary to demonstrate the maturity of a climate data record is an observation strategy designed to reveal systematic errors through independent cross-checks, open inspection, and continuous interrogation. For satellite radar altimetry, the observation strategy includes a rigorous inter- satellite calibration and calibration with a global network of tide gauges. A companion poster by Lillibridge et al. discusses the operational applications of near-real time Jason altimetry, including monitoring of high seas wind/wave conditions for maritime safety, improvement of hurricane intensity forecasting, and assimilation in numerical ocean models.

W-12 Applications *Michael J Foster*

Cloud Climate Applications for the AVHRR Record

Authors: Michael J Foster, Andrew Heidinger

NOAA's Advanced Very High Resolution Radiometer (AVHRR) record begins in 1978 and represents over three decades of continuous cloud measurements. The Pathfinder Atmospheres Extended (PATMOS-x) team processes this record using consistent algorithms and inter-sensor calibrated radiances, making the data set suitable for climate monitoring and assessment of extreme environmental events. Identifying statistically significant trends in cloud amount or its properties requires the additional step of quantification and aggregation of various sources of uncertainty. In this study we quantify uncertainty in the PATMOS-x AVHRR record from multiple sources such as the naïve Bayesian cloud masking algorithm, sensor calibration, satellite drift, viewing geometry and synoptic and seasonal variability. These diverse, and often correlated, sources are aggregated into a single estimate of uncertainty, from which an analysis of long-term changes in cloudiness and cloud optical properties over North America is performed.

W-13 Applications *Ted Strub*

Partnerships in the Use of GOES SST in the CONUS

Authors: P. Ted Strub, Alexandre Kurapov, David Foley

Two types of partnerships are underway in CIOSS that enhance user readiness and utility of GOES sea surface temperature (SST) data in the coastal ocean of the continental U.S. (CONUS):

1. GOES SST data are provided by NESDIS for assimilation into a pilot forecast ocean circulation model at Oregon State University (OSU). Data assimilation (DA) of the SST fields increase the accurate representation of temperature and velocity features within the model forecasts. Besides the development of DA techniques for SST in coastal ocean forecast models, the DA process itself includes quality control (QC) and editing procedures that inform those providing the data within NESDIS of problems in the data processing system. Partnerships and interactions between modelers using the data and the NESDIS data providers are becoming more critical as NOAA moves into the era of active coastal ocean forecasts, as it is doing within the U.S. Integrated Ocean Observing System (IOOS) framework.

2. The model forecasts include 3-D fields of temperature, salinity and ocean current velocities. Using the Pacific Northwest component of IOOS (NANOOS, the Northwest Association of Networked Ocean Observing Systems) and the NANOOS Visualization System (NVS), we are working with external (to NOAA) user communities to test products that serve as decision aids. The first such product identified by the fishing community consists of cloud-free SST forecasts, which help in planning more fuel efficient fishing cruises. We are now exploring multiple uses of the subsurface currents, which the fishers have identified as their top priority. Access to these fields through the NVS allows fishers to use their smartphones to update the forecasts in real time while working in the coastal ocean. Developing these partnerships now will assure the rapid and effective use of the improved SST fields from GOES-R. Examples of these internal and external partnerships will be presented in this poster.

W-14 Data Access and Use *John Lillibridge*

The Jason Altimetry Missions - NOAA/EUMETSAT Operational Products & Applications

Authors: John Lillibridge, David Donahue, Julia Figa-Saldaña, and Olivier Thépaut

As part of its Polar Satellite Program, NOAA operates the Jason-2 altimetry satellite and shares production of near real-time (NRT) products with EUMETSAT. The Jason series began with TOPEX/Poseidon (1992-2005) and Jason-1 (2001-present), which was a partnership between NASA and CNES. With the launch of Jason-2 in June 2008, the partnership was extended to include NOAA and EUMETSAT as the missions transitioned from research to operations. Jason-3 will be launched in early 2015, with NOAA and EUMETSAT assuming primary roles. The series will continue in 2018 with the Jason-CS (Continuity of Service) missions, adding the European Space Agency as a new partner. Production of the NRT Operational Geophysical Data Record is shared between NOAA and EUMETSAT, with each agency generating products from the telemetry downloaded through their ground stations. Product dissemination is provided by EUMETCAST, the Global Telecommunication System (GTS, in BUFR format), and through ftp sites at NOAA's National Oceanographic Data Center, the Environmental Satellite Processing Center's Data Distribution Server, and the Comprehensive Large Array-data Stewardship System archive. Operational applications of NRT altimetry include monitoring of high seas wind/wave conditions for maritime safety, improvement of hurricane intensity forecasting by inclusion of altimetric upper ocean heat content, and assimilation of sea surface heights into numerical ocean models for surface current and subsurface state predictions. Examples of these applications, as well as further information on data access, will be provided in this poster. A companion poster by Leuliette et al. discusses the primary application of Jason altimetry: monitoring global climate change and its regional variability via NOAA's Sea Level Climate Data Record.

W-15 Data Access and Use *Jerrold Robaidek*

Satellite Data Collaborations Between NOAA and the University of Wisconsin SSEC Data Center - Past, Present, and Future

Authors: Jerrold Robaidek, Thomas Achtor, Delores Wade

The University of Wisconsin Space Science Engineering Center (SSEC) has had a long history of collaboration with several groups at NOAA over the last 35 years. From 1979 until 2004 the University of Wisconsin SSEC ingested and archived GOES satellite data for National Climatic Data Center. From 1995 until present, GOES and GVAR real-time satellite data servers have been made available to several NOAA scientists during satellite checkout or during satellite testing. In recent years SSEC has also provided data from its online satellite archive. In 2012, the Super Rapid Scan imagery from GOES-14 ingested at SSEC during Hurricane Sandy was transferred to NOAA NCDC for inclusion in the national satellite archive. The satellite data collaborations have extended beyond US Geostationary satellites. Since 2004 SSEC has made real-time data from the Indian Kalpana satellite available to NOAA scientists. In 2012 SSEC began receiving data from the South Korean COMS satellite. The COMS data has also been made available to NOAA researchers. SSEC had plans to receive GOES-R data and hopes to continue similar collaborations with NOAA for the foreseeable future. Details of past collaborations between SSEC and NOAA will be presented and discussed. Future plans for satellite data archiving and serving and collaborations will also be discussed.

W-16 Applications *Zhibo Zhang*

Toward better understanding of passive remote sensing of cloud droplet effective radius: A combination of LES model and 3-D radiative transfer model

Authors: Zhibo Zhang, Andrew S. Ackerman, Graham Feingold, Steven Platnick, Robert Pincus, and Huiwen Xue

This study investigates effects of drizzle and cloud horizontal inhomogeneity on cloud effective radius (re) retrievals from the Moderate Resolution Imaging Spectroradiometer (MODIS). In order to identify the relative importance of various factors, we developed a MODIS cloud property retrieval simulator based on the combination of large-eddy simulations (LES) and radiative transfer computations. The case studies based on synthetic LES cloud fields indicate that at high spatial resolution (~100 m) 3-D radiative transfer effects, such as illumination and shadowing, can induce significant differences between retrievals of re based on reflectance at 2.1 μm (re,2.1) and 3.7 μm (re,3.7). It is also found that 3-D effects tend to have stronger impact on re,2.1 than re,3.7, leading to positive difference between the two (Δre,3.7-2.1) from illumination and negative Δre,3.7-2.1 from shadowing. The cancellation of opposing 3-D effects leads to overall reasonable agreement between re,2.1 and re,3.7 at high spatial resolution as far as domain averages are concerned. At resolutions similar to MODIS, however, re,2.1 is systematically larger than re,3.7 when averaged over the LES domain, with the difference exhibiting a threshold-like dependence on both re,2.1 and an index of the sub-pixel variability in reflectance ($H\sigma$), consistent with MODIS observations. In the LES cases studied, drizzle does not strongly impact re retrievals at either wavelength. It is also found that opposing 3-D radiative transfer effects partly cancel each other when cloud reflectance is aggregated from high spatial resolution to MODIS resolution, resulting in a weaker net impact of 3-D radiative effects on re retrievals. The large difference at MODIS resolution between re,3.7 and re,2.1 for highly inhomogeneous pixels with $H\sigma > 0.4$ can be largely attributed to what we refer to as the "plane-parallel re bias", which is attributable to the impact of sub-pixel level horizontal variability of cloud optical thickness on re retrievals and is greater for re,2.1 than re,3.7. These results suggest that there are substantial uncertainties attributable to 3-D radiative effects and plane-parallel re bias in the MODIS re,2.1 retrievals for pixels with strong sub-pixel scale variability, and the $H\sigma$ index can be used to identify these uncertainties.

W-17 Current and Future Programs and Systems

Murty Divakarla

The CrIS, IASI and AIRS - A Perspective on Hyper-Spectral Infrared Sounder Retrievals, Validation, and Applications

Authors: Murty Divakarla, Chris Barnet, M.Wilson, E. Maddy, A. Gambacorta, N. Nalli, C. Tan, and X. Xiong

The Cross-track Infrared Sounder (CrIS) aboard the Suomi-NPP satellite, the Infrared Atmospheric Sounding Interferometer (IASI) aboard MetOp series of satellites, and the Atmospheric Infrared Sounder (AIRS) aboard the Aqua satellite are providing high quality hyper-spectral infrared measurements to retrieve many geophysical products, namely, the atmospheric temperature, moisture, and many trace gas profiles. These IR sounders are accompanied by microwave (MW) sounding instruments to enable the generation of these products in scenes with up to 80% cloud-cover. The Aqua-AIRS is accompanied by the 15-channel Advanced Microwave Sounding Unit (AMSU-A) instrument. The IASI instrument is accompanied with two microwave instruments, the AMSU-A and a 5-channel Microwave Humidity Sounder (MHS). The Advanced Technology Microwave Sounder (ATMS) instrument that accompanied the CrIS has a combination of channels similar to that of the AMSU-A and MHS. The National Oceanic and Atmospheric Administration (NOAA) center for Satellite Applications and Research

(STAR) has been involved in the development and implementation of a variety of retrieval algorithms to process these instrument observations into sensor data records (SDRs) and geophysical products (Environmental Data Records, EDRs). A variety of in-situ measurements, model forecast analysis fields, and other correlative measurements are used in evaluating the EDR products and ensure the retrieved products are meeting the specifications. This paper presents a perspective on these hyper-spectral IR sounder retrieval algorithms, the validation efforts, and the application of these retrieval products towards day-to-day forecasting, long-term climate records, and atmospheric composition.

W-18 Current and Future Programs and Systems
Robert Adler

GOES-R Rain Estimation with Combined ABI and GLM Data--Development and Testing of a Technique with TRMM Data

Authors: Robert Adler, Weixin Xu, Nai-Yu Wang

A technique is developed and tested to estimate convective system rainfall from a combination of satellite infrared and lightning information that could be applied to GOES-R ABI and GLM data. The algorithm is developed and tested using seven years (2002-2008) of TRMM measurements over the southern United States during the warm season. Lightning information is coupled with a modified IR-based convective/stratiform technique (CST) [Adler and Negri, 1988] and produces a lightning-enhanced CST (CSTL). Both CST and CSTL are then applied to the training (2002-2004) and independent (2005-2008) datasets. In general, this study shows significant improvement over the IR-only rainfall estimates (in terms of rain area, intensity, and volume) through the addition of lightning information. The CST can generally identify the heavy (convective) and light rain regions, while CSTL further identifies convective areas that are missed by CST, removes convective cores that are incorrectly defined by CST, and provides more dynamic range in detecting extremely heavy precipitation. Specifically, CSTL improves the convective detection by about 10% and reduces the convective false alarm rate by more than 30%. Similarly, CSTL improves the CST in the overall estimate of instantaneous rainfall rate by about 20%, especially for heavy precipitation. Both CST and CSTL reproduce the rain area and volume fairly accurately over a region, although CST shows systematical overestimation. The study is continuing with comparisons with operational geosynchronous rain estimation techniques.

W-19 Applications *Huan Wu*

A Real-time Global Flood Estimation System Using Satellite Rainfall Information and a Hydrological Model

Authors: Huan Wu and Robert Adler

A real-time experimental system, the Global Flood Monitoring System (GFMS) produces quasi-global flood estimates with updates every three hours. Images and output data are available for use by the community (http://oas.gsfc.nasa.gov/globalflood/). The current flood detection and intensity estimates are made using satellite precipitation information from the TRMM Multi-satellite Precipitation Analysis [TMPA]) and a hydrological model developed at the U. of Oklahoma. The method uses the 3-hr resolution composite rainfall analyses as input into the hydrological model that calculates water depth and streamflow at each grid (at 0.125 ° latitude-longitude) over the tropics and mid-latitudes. Flood detection and intensity estimates are based on water depth thresholds calculated from a 13-year retrospective run using the satellite rainfall and model. Examination of individual cases in real-time or retrospectively often indicates skill in detecting the occurrence of a flood event and a reasonable evolution of water depth (at the scale of the calculation) and downstream movement of high water levels. A recently published study evaluating calculated flood occurrence from the GFMS against a global flood event database is reviewed. The statistics indicate that flood detection results improve with longer duration (> 3 days) floods and that the statistics are impacted by the presence of large dams, which are not accounted for in the model calculations. Overall, for longer floods in basins without large dams, the Probability of Detection (POD) of floods is ~ 0.7, while the False Alarm Rate (FAR) is ~ 0.6. Limitations in the flood calculations that are related to the satellite rainfall estimates include space and time resolution limitations and underestimation of shallow orographic and monsoon system rainfall. Recent cases from 2012, mainly over Asia, are discussed as examples of the utility of the output information and the importance of accurate rainfall input. These calculations in their current form can provide information useful to national and international agencies in understanding the location, intensity, timeline and impact on populations of these significant hazard events.

W-20 Current and Future Programs and Systems
Patrick Dills

Contributing to User Readiness: A View from the COMET Program

Authors: Patrick Dills, Wendy Schreiber-Abshire

The COMET® Program (www.comet.ucar.edu) receives funding from NOAA NESDIS as well as EUMETSAT and the Meteorological Service of Canada to support education and training in satellite meteorology. These partnerships enable COMET to create educational materials of global interest on polar-orbiting and geostationary remote sensing platforms. Over the last several years, COMET's satellite education programs have focused on the capabilities and applications of current and next-generation operational environmental satellites and their relevance to operational forecasters and

other user communities. By partnering with experts from the Naval Research Laboratory, NOAA-NESDIS and its Cooperative Institutes, Meteorological Service of Canada, EUMETSAT, and other user communities, COMET stimulates greater use of current and future satellite data observations and products. Nowhere is this more evident than in the usage of MetEd modules by university faculty and students. As an example of the extent of the recent usage of these training materials, in 2012 over 20,000 satellite module user sessions occurred on the MetEd Web site (www.meted.ucar.edu/topics/modules/satellite). These lessons include 45 satellite-specific modules in English, 20 in Spanish, and 10 titles in French. Some of the recent modules focus on the instruments and capabilities on board Suomi NPP, JPSS, GOES-R+, as well as European satellites. Additionally, COMET works to infuse example satellite data and products not only into the satellite-specific training materials, but also into modules covering other geoscience topics. Finally, COMET's Environmental Satellite Resource Center (ESRC) Web site (www.meted.ucar.edu/esrc), also funded by NESDIS, provides access in three languages to nearly 600 satellite training resources from COMET and various contributors representing global training and education communities. Examples and links to this large and diverse body of training materials available from COMET that are actively contributing to user readiness will be presented.

W-21 Applications *Geoff Cureton*

VIIRS Atmospheric Products in the Community Satellite Processing Package (CSPP)

Authors: Geoff Cureton, Liam Gumley, Scott Mindock, Graeme Martin, Ray Garcia, Kathleen Strabala

The Cooperative Institute for Meteorological Satellite Studies (CIMSS) has a long history of supporting the Direct Broadcast (DB) community for various sensors, recently with the International MODIS/AIRS Processing Package (IMAPP) for the NASA EOS polar orbiters Terra and Aqua. CIMSS has continued this effort into the NPP/JPSS (previously NPOESS) era with the development of the Community Satellite Processing Package (CSPP), supporting the VIIRS, CrIS and ATMS sensors on the Suomi National Polar-orbiting Partnership (Suomi NPP) spacecraft. In time it is intended that CSPP will support GOES-R, JPSS and other geostationary and polar orbiting platforms. Here we focus on the implementation and usage of the Visible Infrared Imaging Radiometer Suite (VIIRS) atmospheric product sub-packages within CSPP, which are based on the Interface Data Processing Segment (IDPS) code as implemented by Raytheon in the Algorithm Development Library (ADL). The VIIRS atmospheric algorithms currently available in CSPP include the Cloud Mask and Active Fires Mask. The Aerosol Optical Thickness, Cloud Optical Properties and Cloud Top Parameters algorithms are planned. Each ADL sub-package consists of a binary executable and a series of configuration XML files. A series of python scripts handle ancillary data retrieval and preparation for ingest into ADL, manage algorithm execution, and provide a variety of execution options which are of utility in operational and algorithm development settings. Examples of these options, applied to operational and direct-broadcast VIIRS SDR data, are described.

W-22 Data Access and Use *limin zhao*

NOAA/NESDIS Operational Satellite Precipitation Products and Service

Authors: Limin Zhao, Ralph Ferraro, Bob Kuligowski

For many years NOAA/NESDIS has been providing the user community with operational satellite precipitation products from both polar and geostationary satellites. These products have been instrumental in supporting NOAA's role in protecting life and property, and are used for a wide range of applications from short-term forecasts and warnings (e.g., rainfall potential from tropical systems, flash floods, etc.) to long-term climate studies (e.g., seasonal to inter-annual variability). In this presentation, the current status of the NOAA/NESDIS operational precipitation products and their applications, dissemination and access will be reviewed. Discussions will also cover recent developments and future plans for operational precipitation products as NOAA enters the NPP, JPSS, GOES-R and GPM eras.

W-23 Applications *limin zhao*

The NESDIS Operational Blended TPW Products System

Authors: Limin Zhao, Stanley Kidder, Sheldon Kusselson, John Forsyth, Andrew Jones, Ralph Ferraro, Jiang Zhao, Clay Davenport

The blended TPW products system merges individual Total Precipitable Water (TPW) products derived operationally from NOAA and DMSP low-earth-orbiting polar satellites and also from the Global Positioning System (GPS) and the GOES Sounders over US to provide unified TPW and Percentage of Normal TPW products over a globe. These products have served the NOAA and private communities for years and have been proven very useful to satellite analysts and NWS forecasters in improving the analysis and prediction of heavy precipitation and in providing more comprehensive, continuous spatial information about moisture transfer. Since March 2009, the blended TPW products system has being implemented into operation and supported under 24/7 at the NESDIS Environmental Satellite Processing Center (ESPC) to provide users up-to-date, accurate, and reliable products. The operational availability of the blended TPW products provides

timely assistance to forecasters in assessing the evolution and transport of moisture, and also in predicting precipitation, especially extreme events such as heavy precipitation and flooding. The blended TPW products can be accessed through http://www.osdpd.noaa.gov/bTPW, where the web-based image animation loop provides users everywhere a tool for tracking atmospheric rivers/moisture plumes, over a specified time period for particular regions, which have been found to play a central role in modulating extreme rainfall events. This presentation will briefly review the operational generation, monitoring and distribution of the blended TPW products, and will provide an updated status of the products for the forthcoming years. Application of the blended TPW products to analysis and forecasting of heavy precipitation and flooding will also be discussed, and case studies showing their use for hazardous weather conditions will be presented.

W-24 Current and Future Programs and Systems
Wonkook Kim

Characterization of Bidirectional Reflectance of the Sonoran Desert using Historical GOES data for Vicarious Calibration of GOES-R ABI Sensor

Authors: Wonkook Kim, Shunlin Liang, Changyong Cao

The Geostationary Operational Environmental Satellite-R series (GOES-R) is the next generation geostationary environmental satellite, scheduled to be launched in 2015. The Advance Baseline Imager (ABI) is the primary instrument in GOES-R that provides images of visible, near-infrared, and infrared spectral bands for a wide range of environmental, weather, and climate applications. The calibration quality of the ABI sensors is managed by onboard calibration devices such as solar diffusor and blackbody, but due to the post-launch changes sensor performance needs to be further monitored by vicarious techniques that involve exterior calibration targets such as the Moon, stars, and deserts. The Sonoran Desert is one of the best calibration sites located in North America that has been used vicarious calibration of many operational satellites such as POES, GOES, Landsat, and MODIS. Bidirectional reflectance distribution function (BRDF) of the desert site needs to be fully characterized before it is used as vicarious targets, because the angular dependency of satellite measurements can obscure precise assessment of sensor degradation. In this study, we investigate the anisotropy of both surface and atmosphere of the Sonoran Desert by using TOA reflectance measurements of historical GOES data. BRDF of the Sonoran Desert has been studied mainly using polar-orbiting satellite such as Landsat and MODIS. However, due to nearly identical local overpass time of the data, angular distribution of polar-orbiting satellite data is very limited, prohibiting complete characterization of BRDF models. Geostationary satellite data can mitigate this problem since geostationary satellites provide measurements for a greater variety of angles distribution (e.g. a full range of solar zenith angles (0-90°) only in a single day). Acquisition of the sequential data in such short time period also minimizes the changes in other environmental variables. Several semi-empirical models such as Roujean, Staylor, RossLi models are applied to the series of TOA reflectance from GOES satellites, and the results are compared to the BRDF parameters derived from polar-orbiting satellite data and the combined results.

W-25 Data Access and Use *Shuang Qiu*

SNPP/JPSS Data Access Process and Operational Products in Development at NOAA/NESDIS

Authors: Shuang Qiu, Christopher Sisko, Antonio Irving, Jingsi Gao

Since its launch in October of 2011, the Suomi National Polar-orbiting Partnership (SNPP) has provided valuable global earth surface and atmospheric satellite observations at excellent quality. Globally, users are looking for new ways to incorporate SNPP data into their environmental numerical weather prediction models and leverage those observations in climate studies. NOAA/NESDIS/OSPO has a well-defined policy on access and distribution of environmental satellite data and products. OSPO's data access review policy has been refined to include both NOAA and non-NOAA datasets to permit access by external users outside of the Environmental Satellite Processing Center (ESPC) domain when a valid real-time data need exists. OSPO has already approved several SNPP data access requests (DARs) for global users and continues to re-validate the efficiency of this process in the coming years as new dissemination systems provide dynamic data subscription capability. The Joint Polar Satellite System (JPSS) program will provide continuity for NOAA's Polar-orbiting Operational Environmental Satellite (POES) series of satellites that operationally tasked with providing sensor data and data products to support NOAA's operational missions and enable new remote sensing capabilities. Scientists at NOAA/NESDIS have worked diligently to prepare the continuation of current data products and product upgrades for SNPP. Product Area Leads (PALs) at OSPO are actively working to ensure a smooth and quick transition of these products into operations, so users can benefit from the technological advancements provided by the JPSS mission. Operational users requiring access to these new data sets will do so via submission of a DAR to OSPO. Details of OSPO data access process will be presented and new challenges described that OSPO faces as it inherits these new satellite missions that require generation and distribution of large volumes of data. An overview of the operational products utilizing SNPP data at OSPO that will be available to the user community in the near future shall be presented.

W-26 Data Access and Use *Eric Stevens*

Suomi NPP VIIRS Imagery and the Grounding of the Oil Platform Kulluk in Alaska

Authors: Eric Stevens, James Nelson

After a significant and violent storm in the Gulf of Alaska severed the connection between the oil drilling platform Kulluk and the tugboats towing it to Seattle for annual winter maintenance, the Kulluk was driven aground on the shore of a small island near Kodiak, Alaska on December 31st, 2012. During the storm which initially triggered the incident, and during subsequent efforts to free the Kulluk, imagery delivered by the Suomi NPP's Visible Infrared Imaging Radiometer Suite (VIIRS) proved highly useful to the forecast staff at the National Weather Service forecast office in Anchorage. Of particular relevance was the VIIRS day/night band, as this event occurred during the darkest month of the Alaskan winter but fortunately only days after the full moon of December 28th, 2012. Thanks to the presence of ample moonlight and the sensitivity of the VIIRS instrument, National Weather Service forecasters had access to real-time satellite imagery at a spatial resolution far superior to any imagery previously available during the night-time hours. Forecasters also benefited from a higher temporal resolution of this imagery than might be expected, due to the high latitude of the region and the orbital path of the Suomi NPP satellite.

W-27 Data Access and Use *Eric Maddy*

Combined use of polar imager and sounder measurements for enhanced sounding capability

Authors: Eric S. Maddy, Chris D. Barnet, Haibing Sun, Sergio DeSouza-Machado

We will present ongoing work to improve infrared soundings from polar satellite instruments such as AIRS. IASI. CrIS by using collocated imager measurements from MODIS, AVHRR, and VIIRS. Work presented will include improvements to cloud-clearing using the imager measurements, the retrieval of aerosol (Saharan dust and/or volcanic ash) from IR sounder measurements, and assessment of the effect of aerosol on IR sounder temperature and moisture retrievals.

W-28 Current and Future Programs and Systems *Jong-jae Lee*

Wildfire duration model for Air Quality Forecast systems

Authors: Jong-Jae Lee, HyunCheol kim, CheolHee kim, Fantine Ngan, Ariel Stein, Pius Lee

Wildfire duration model for Air Quality Forecast, using satellite-based fire detection and assimilated meteorological condition measurement, has developed. In order to forecast the impact of wildfire emissions to regional air quality, accurate and prompt detection of wildfire events with respect to both timing and location is crucial. Satellite detection of active wildfires is one of the most efficient ways of retrieving wildfire information, and is widely used for fire impact forecast systems. Such systems, however, have inherent weaknesses since satellite products have finite latency. Even the fastest product (e.g. MODIS Rapid Response Fire Product) does not provide turely realtime information, and does not postulate information into the future.. To overcome this incapability, many systems apply natural decaying rates for the longevity of fire events due to climatology, but such methods cannot deal with rapid changes of meteorological conditions. We have utilized a multi-year satellite-detected-fire data set (e.g. Hazard Mapping System (HMS) and Fire Radiative Power (FRP) data from MODIS and GOES) and meteorological information from North American Mesoscale Model (NAM), to develop a wildfire duration model to predict how long current fire events, detected by satellite, can last for a given meteorological condition and land type information. Based on previous studies on Fire-Weather correlation, such as the Haines Index (HI) and Canadian Fire Weather Index (FWI), we improved model's performance by adding more information from satellite and land type information. The goal of this study is to build a practical methodology to predict (1) wildfire occurrence probability, and (2) duration of wildfire events under given meteorological and geographical conditions. The former has been studied by modelers for a long time, yet much uncertainty remains. The latter is a more robust and straightforward problem since we know the occurrence and circumstantial conditions of the wildfire events. and is more useful information for air quality forecast systems. Moreover, hind-cast and process analyses of occurred fires can effectively identify deficiencies of the model and allow focused effort for improvement. Applications of the model will be tested and verified for various cases.

W-29 Applications *Kristopher Bedka*

Applications Of A Satellite-Based Objective Overshooting Convective Cloud Top Detection Product

Authors: Kristopher Bedka, Richard Dworak, Cecilia Fleeger, Wayne Feltz, Larry Carey

An objective overshooting convective cloud top (OT) signature detection algorithm have been developed over the past several years in support of the GOES-R ABI Aviation Algorithm Working Group. OT features are detected via recognition of spatial IR brightness temperature patterns present within the thunderstorm anvil cloud in combination with tropopause temperature information from an NWP

model. While the algorithms have been shown to better detect OT signatures in high temporal and spatial resolution MODIS, AVHRR, and synthetic proxy ABI imagery, they have been successfully applied to current generation geostationary imagery for use in diagnosis and nowcasting of hazardous convective weather at the present time. The algorithms can process a GOES CONUS scan in under 45 seconds allowing for real-time product distribution to National Weather Service (NWS) forecast offices and National Centers and for climate studies. A 17-year GOES-East OT detection database has recently been produced using all available imagery from GOES-8, GOES-12, and GOES-13, highlighting the regional, diurnal, and seasonal distribution of hazardous convection across the Eastern U.S., Gulf of Mexico, and Atlantic Ocean offshore waters. OT detections have been directly compared with WSR-88D radar reflectivity to better understand how these signatures relate to a commonly used forecasting dataset. Large sample sizes of OT detections have been directly compared with 1) NLDN cloud-to-ground lightning, 2) total lightning from the Northern Alabama Lightning Mapping Array, 3) United Airlines Eddy Dissipation Rate turbulence observations, 4) severe storm reports collected by the Storm Prediction Center, and 5) National Weather Service severe weather warnings to demonstrate statistical relationships between the OT product and hazardous weather and to illustrate how this product can augment convective storm nowcasting especially in data-poor regions. This algorithm has also been applied to GOES-14 1-minute SRSO data from summer 2012 to monitor the co-evolution of satellite, radar, and total lightning fields. This poster presentation will describe these algorithms, briefly touch on product validation, and focus on hazardous storm nowcasting applications and climatological behavior.

W-30 Current and Future Programs and Systems

Nai-Yu Wang

Improving precipitation retrieval using total lightning data: A multi-sensor and multi-platform synergy between GOES-R and GPM

Authors: Nai-Yu Wang, Kaushik Gopalan, Rachel Albrecht

GOES-R will fly two major weather instruments : the Advanced Baseline Imager (ABI) and the Geostationary Lightning Mapper (GLM), defining remarkable advances in spatial, temporal and spectral resolutions from today's geostationary satellite constellation. GOES-R ABI Quantitative Precipitaion Estimation (QPE) algorithm requires microwave-based rain rates as a calibration target, where the upcoming Global Precipitation Measurement Mission (GPM) satellite will be of great value. The microwave rainfall retrievals over land have made significant strides in the last few years, but the retrieval algorithms still have room for improvements. The better microwave rain rate estimates will result in better ABI QPE. Microwave precipitation signals are sensitive to the presence of ice, which is the key parameter for lightning generation. Lightning activity is also a good indicator of deep convection. One of the main difficulties in microwave rainfall retrievals over land is to delineate convective and stratiform precipitation from precipitating clouds. In this matter, collocated total lightning observations can improve the microwave segregation of precipitation in convective and stratiform, and also refine the rainfall retrievals necessary for the GOES-R QPE. In this scope, we focus on using the lightning measurements to provide a constraint on the microwave convective-stratiform index (CSI), which is the convective rain fraction in a pre-defined resoulution. To achieve this goal, we use TRMM Microwave Imager (TMI), TRMM Precipitation Radar (PR), and TRMM Lightning Imaging Sensor (LIS) as proxy data for GPM and GLM, respectively. Currently, the TMI CSI is trained with the TRMM PR using radiometer radiances and polarization inputs as predictors. The TRMM precipitation radar has the advantage of higher resolution and the ability to actively sense hydrometeors through the depth of the column. The LIS sensor operates as a lightning event detector, where several events are grouped in space and time to determine a "flash". Flash initiation rate is related to the recharging rate of a local electric field, which happens most readily where active inter-hydrometeor charge separation is taking place, i.e., in deep convective cores. We examine multiple years of LIS total radiances and flash rates, in conjunction with the TMI and PR co-located data. The relationships between lightning, convective characteristics and ice scattering intensity over land as measured by radiances and flash occurrences and rates, radar reflectivity vertical structures, and 85 GHz brightness temperatures (TB), are analyzed. From four years (2002-2005) of TRMM version 6 data and fourteen millions rain observations over land, 7% shows lightning activities which is defined by LIS flash rate greater than 0; 13.5% of the lightning occur in stratiform and 86.5% in convective. In general, radar reflectivity increases with increasing flash rate both on the surface and the vertical structure, with the higher reflectivity for convective than stratiform. For rain systems without lightning, 85 GHz TB peaks at 260 K for both convective and stratiform and drop off sharply to lower brightness temperatures. For rain systems with lightning activity, 85 GHz TB are uniformly distributed from 100-280 K for convective and narrowly distributed from 200-280 Kelvin for the bulk of stratiform. Based on analysis of the relationships between lightning flash rate and rain type distribution, a method that incorporates lightning flash rates to classify microwave convective fraction, which is correlated with the likelihood of convection, is developed. The new method clusters TMI TB with respect to LIS flash rates. For example, for a given set of TMI TB, the new classification

yields higher probability of convection with more rigorous lightning activity as indicated by LIS flash rates. This lightning-microwave convective fraction and rain rate estimates are evaluated using 2006-2009 TRMM data. The general conclusion is that lightning data contain useful information in microwave convection fraction and microwave estimated rain rate, particularly in moderate to intense convection. Preliminary result shows a reduction of about 5% in the root-mean-square-error of TMI convective fraction and rain rate estimates from using LIS flash rates.

W-31 Data Access and Use *Benjamin Scarino*

Surface Skin Temperature from Geostationary Satellite Data

Authors: Benjamin Scarino, Rabindra Palikonda, Patrick Minnis

Remote sensing of the Earth's energy budget, particularly with instruments flown on geostationary satellites, allows for near-real-time evaluation of cloud and surface radiation properties. The persistence and coverage of geostationary remote sensing instruments grant the frequent retrieval of near-instantaneous near-global skin temperature. Among other cloud and clear-sky retrieval parameters, NASA Langley provides a non-polar, high-resolution land and ocean skin temperature dataset by applying an inverted correlated k-distribution method to clear-pixel values of top-of-atmosphere infrared temperature. Depending on cloud-cover thresholds, this method yields skin temperature values that are within 0.5 to 2.0 K of measurements from ground-site instruments like the Southern Great Plains Atmospheric Radiation Measurement (ARM) Infrared Thermometer. The level of accuracy relative to the ARM site is comparable to that of the Moderate-resolution Imaging Spectroradiometer (MODIS) with the benefit of an increased number of daily measurements without added bias or increased error. Matched comparisons of the high-resolution skin temperature product with MODIS land surface temperature reveal a level of accuracy well within 1 K for both day and night. These data would be useful for assimilation with atmospheric models, which rely on high-accuracy, high-resolution initial radiometric and surface conditions. Modelers should find the immediate availability and broad coverage of these skin temperature observations valuable, which can lead to improved forecasting and more advanced global climate models.

W-32 Applications *Wei Chen*

Estimation of Surface Velocity from Geostationary Satellite Multiband Imagery

Authors: Wei Chen and Richard P. Mied

High-resolution image sequences of the same water surface provided by the next generation geostationary satellites will make it possible to extract velocity fields from surface tracers. As a prototype, we address the problem of extracting surface velocities from a pair of multispectral remote sensing images over ocean and rivers using a new nonlinear form of the Global Optimal Solution (GOS). The derived velocity field is a valid solution across the image domain to the nonlinear system of equations obtained by minimizing a cost function inferred from the conservation constraint equations for multiple tracers. An iteration equation for the velocity is derived based on the single/multiple-tracer displaced frame difference equations, and a local approximation to the velocity field. The iterative technique uses Gauss-Newton and Levenberg-Marquardt methods and our own algorithm of the progressive relaxation of the over-constraint. Test results with an ocean model and several real AVHRR image sets demonstrate that the new model provides excellent performance compared to rival techniques in the coastal ocean. Extension to complex river currents, is made possible by the multispectral nonlinear approach, which can adequately handle typical intervals between satellite overpasses (LandSat and ASTER) of approximately 30 min. This new technique can employ all the benefits of more spectral bands, faster imaging, higher spatial resolution, and better navigation for retrieving accurate velocity from the Advanced Baseline Imager (ABI) on the Geostationary Operational Environmental Satellites (GOES) series.

W-33 Applications *Michael Ondrusek*

Coastal Optical Characterization Experiment (COCE) Activities at STAR.

Authors: Michael Ondrusek, Eric Stengel

The Coastal Optical Characterization Experiment (COCE) is an ongoing project at NOAA/NESDIS/STAR Satellite Oceanography and Climatology Division. The primary goals of COCE are satellite ocean color validation and application development. The COCE group has been validating all ocean color sensors since the SeaWiFS sensor launch in 1997 by measuring in situ the water leaving radiances seen by the satellite. Currently, this effort concentrates on the initialization and validation of the Joint Polar Satellite System (JPSS) VIIRS sensor aboard the Suomi National Polar-orbiting Partnership (SNPP) sensor. The performance of the sensor is evaluated by presenting comparisons between ground truth measurements and VIIRS retrievals made off Florida, Hawaii and in the Chesapeake Bay. The application development effort focuses on developing new ocean color satellite remote sensing tools for monitoring relevant coastal ocean parameters. A COCE developed high-resolution Total Suspended Matter (TSM) algorithm is used to monitor several high sediment runoff events in the Chesapeake Bay including

the record runoff event following Tropical Storm Lee in the Fall of 2011. An experimental TSM loading algorithm is also presented. These COCE activities improve the utility of ocean color satellite data in monitoring and analyzing coastal and oceanic processes.

W-34 Current and Future Programs and Systems
Patrick Heck

Extension of the GOES-R Nighttime Cloud Optical and Microphysical Properties algorithm to other instruments.

Authors: Patrick W. Heck, Patrick Minnis, Gang Hong, Robert F. Arduini, J. Kirk Ayers

A variation of NASA Langley's Solar-infrared Infrared Split window Technique (SIST) has been applied to Spinning Enhanced Visible and Infrared Imager (SEVIRI) data, serving as the proxy for Advanced Baseline Imager (ABI), as well as to simulated ABI data. This variation, the Nighttime Cloud Optical and Microphysical Properties (NCOMP) algorithm, which uses thermal channels (3.9-, 11.2- and 12.3-μm) to derive cloud optical depth, effective particle size and liquid or ice water content, has recently been extended for application to VIIRS data from the Suomi NPOESS Preparatory Project (NPP). NCOMP can also be applied to Moderate Resolution Imaging Spectroradiometer (MODIS), Advanced Very High Resolution Radiometer (AVHRR), GOES and similar instruments in a test bed framework at Langley and/or in the GEOCAT framework in order to explore algorithm enhancements. Each application has required updates to instrument-specific cloud emittance parameterizations that anchor the retrieval. A new technique that has been developed and applied to SEVIRI data, adding 6.15-μm radiances to the channel set and using a trained neural network technique that has been integrated into NCOMP and SIST, will be demonstrated. The addition of this capability significantly extends the range of retrieved nighttime optical depths. This technique will not be applicable to VIIRS due to its lack of a water vapor channel, but the increase in optical depth for ABI will allow for an accompanying extension of liquid and ice water path ranges, thereby adding value to other product applications, including aviation uses. This poster will present and discuss the extension of the original NCOMP version to VIIRS and other instruments, as well as new enhancements.

W-35 Applications *Mike Pavolonis*

Introduction of a New Suite of Fog/Low Stratus Products into NWS Operations

Authors: Mike Pavolonis, Corey Calvert, Chad Gravelle, Scott Lindstrom

Low ceiling and visibility is a weather hazard that nearly every forecaster, in nearly every National Weather Service (NWS) Weather Forecast Office (WFO), must regularly address. In addition, national forecast centers such as the Aviation Weather Center (AWC) Alaska Aviation Weather Unit (AAWU), and the Ocean Prediction Center (OPC) are responsible for issuing low ceiling and visibility related products. As such, reliable methods for detecting and characterizing hazardous low clouds are needed. Traditionally, hazardous areas of Fog/Low Stratus (FLS) are identified using a simple stand-alone satellite product that is constructed by subtracting the 3.9 and 11 μm brightness temperatures. The 3.9-11 μm brightness temperature difference (BTD) has several major limitations. In an effort to address the limitations of the BTD product, the GOES-R Algorithm Working Group (AWG) developed an approach that fuses satellite, Numerical Weather Prediction (NWP) model, Sea Surface Temperature (SST) analyses, and other data sets (e.g. digital surface elevation maps, surface emissivity maps, and surface type maps) to determine the probability that Instrument Flight Rules (IFR) conditions are present. IFR conditions are characterized by a cloud ceiling below 1000 ft and/or a surface visibility less than 3 miles. Satellite and non-satellite predictors are used in a naïve Bayes model to determine the probability of IFR at the resolution of the satellite data. The GOES-R fog/low cloud algorithm is an enterprise system in that it can use satellite data from a variety of current data sensors (GOES, MTSAT, MODIS, AVHRR and SEVIRI) and future operational sensors (ABI and VIIRS) and NWP data from a variety of models (GFS, RUC, and RAP). Validation efforts, using surface observations over CONUS from each month of the year, indicate that the GOES-R IFR probability product is nearly twice as skillful as the traditional 3.9-11 μm BTD product at identifying IFR conditions. The GOES-R FLS algorithm also produces an estimation of the fog/low stratus thickness (cloud top height minus cloud base height). The GOES-R FLS thickness product can be used to infer dissipation time for single cloud layer radiation fog events. The GOES-R IFR probability and FLS thickness products are available in AWIPS and have been evaluated within NWS operations during the last two years as part of the Satellite Proving Ground. Forecaster feedback collected so far has been predominantly positive and product improvements have been made as a result of the feedback. References to these products within Area Forecast Discussions (AFD's) indicate that the products are influencing operational forecasts. The goal of this presentation is to describe the challenges associated with developing a new application based fused product line and successfully introducing that product line to NWS operations.

W-36 Applications *Patrick Minnis*

CERES-consistent cloud and surface temperature CDR using AVHRR data

Authors: Patrick Minnis, Kris Bedka, Qing Trepte, Patrick Heck, Sarah Bedka, Gang Hong, Konstantin Khlopenkov, Benjamin Scarino, Chris Yost

Climate data records (CDRs) are essential for understanding long and intermediate changes in climate and can be valuable for validating and improving models needed for predictions of climate change. Satellite CDRs of variables affecting climate are often dependent on how the data are interpreted and calibrated. Independent approaches to analyses of climate parameters are important for ensuring that observed changes are due to actual variations instead of artifacts of calibration or analysis technique. Additionally, when such analyses are considered together, they can provide an estimate of the uncertainties in the results. Clouds and radiation are important climate variables that have been determined from geostationary imager data from ISCCP and from NOAA AVHRR data by PATMOS-X and other analyses. Here we present preliminary results from an independent approach based on different calibration methods, input data, and analysis techniques. This approach is based on the core algorithms used to analyze MODIS data to provide cloud property data for the CERES program and is designed to provide results that are optimized to agree with the CERES results. It yields a variety of cloud parameters such as cloud amount, phase, height, optical depth, and effective particle size, as well as clear-sky albedo and surface skin temperature. Data from several NOAA satellites are analyzed, and the results are summarized and compared with other datasets.

W-37 Applications *Thomas Harris*

ENVI Services Engine: Earth and Planetary Image Processing for the Cloud

Authors: Thomas Harris, Amanda O'Connor, Kevin Lausten, Bill Okubo

The imagery analysis and exploitation community has a growing need for online analytic capabilities. Work previously done at desktop workstations must migrate to a web-accessible environment to mitigate growing data volumetrics, bandwidth usage, and end user requirements. Web based applications (or 'apps') are intended to apply analytic methods, procedures, and routines to image datasets stored within centralized server repositories. Exelis Visual information Solutions (VIS) developed an enterprise-enabled processing engine that provides remote users access to the power of ENVI image analysis and IDL applications from a web client interface. The working name for this capability is the ENVI and IDL Services Engine (ESE). This engine now enables the remote user to gain access to the same compiled ENVI and IDL functions and procedures that remote sensing scientists have utilized for decades at the desktop. ESE operates in a RESTful state, listening for http calls to arrive then initiating an operation once those messages are registered. It is middleware agnostic, meaning users can implement this approach using their current enterprise architecture such as ArcGIS Server, GeoServer or Java EE. ESE represents bringing long term earth science monitoring analysis capabilities to a wider audience, harnessing existing ENVI and IDL tools and deploying them to the enterprise and improving access to earth and plantary science data. ESE architectural elements and a reference implementation will be presented.

W-38 Applications *Eileen Maturi*

NESDIS Operational Oceanic Heat Content Products (N. Atlantic and Pacific Basins)

Authors: Eileen Maturi, David Donahue, Nick Shay , Jodi Brewster, Jerry Guo

NOAA N

where it has been validated and running for 10 years. The OHC product measures the integrated vertical temperature from the sea surface to the depth of the 26°C isotherm. The Algorithm uses a reduced gravity model to estimate the 20 degree isotherm depth based on objectively analyzed blended sea surface height anomaly fields from operational altimeters (Jason-1, Jason-2) and GOES-POES blended SST analyses. OHC provides additional useful information about the ocean structure (including the mixed layer) than just SSTs can provide because it locates the energetic mesoscale eddy structure of currents that have deep, warm structures. NOAA Coral Reef Watch (CRW), which uses sea-surface temperature anomalies (SSTAs) to monitor the ocean conditions on coral reefs, will utilize the estimated isotherm depths to monitor temperature variations at depth. The National Hurricane Center (NHC) will use the operational OHC product to improve hurricane intensity forecasts and increase warning lead times for high impact events, which will reduce the loss of life and property.

W-39 Applications *Eileen Maturi*

NOAA Suite of Operational Geostationary and Blended Sea Surface Temperature Products

Authors: Eileen Maturi, Andy Harris, Jonathan Mittaz, John Sapper, Robert Potash, Gordana Rancic

The National Oceanic and Atmospheric Administration’s satellite office generates sea surface temperature (SST) retrievals on an operational basis from a suite of geostationary satellites, the NOAA GOES-East and West satellites, the European Meteosat Second Generation (Meteosat-9) satellite, and the Japanese Multi-functional Transport Satellite (MTSAT-2). The SST retrieval methodology is based on a

physical retrieval algorithm (Modified Total Least Squares) with an improved probabilistic Bayesian cloud masking methodology. Products from these satellites include gridded regional hourly and 3-hourly hemispheric imagery, and 24 hour merged composites, as well as original satellite projection. The latter are provided in GHRSST (Group for High Resolution Sea Surface Temperature) Level-2P format, which incorporates a substantial quantity of ancillary information including quality flagging and error estimates for each pixel. Alongside the products mentioned above, a combined POES-GOES sea surface temperature global analysis is generated to provide a gap-free sea surface temperature product at resolutions of 11- and 5-km. The POES-GOES blended product ingests data from NOAA's operational AVHRR-based suite of products as well as the aforementioned Geo-SST products. This product is a critical component of NOAA's flagship Coral Reef Watch program, the Oceanic Heat Content product, which is used in tropical storm intensity and track prediction, the wide range of CoastWatch & OceanWatch users, and the National Weather Service Ocean Prediction Center (for their high-seas forecasts). We will describe the above products and discuss our future plans which include the utilization of sea surface temperatures from the recently-launched Visible Infrared Imaging Radiometer Suite (VIIRS) as an input into the analyses. VIIRS will also be used as a primary input to generate a regional analyzed products (e.g. for the North American Great Lakes) at 2-km resolution using the same methodology.

W-40 Applications *Tom Heinrichs*

Use of GOES-R Imagery in the Detection Volcanic Ash and the Production of Aviation Warnings in Alaska

Authors: Tom Heinrichs and Eric Stevens

Under the auspices of the GOES-R Proving Ground, the Geographic Information Network of Alaska is supplying the National Weather Service's Alaska Aviation Weather Unit with a suite of MODIS-derived imagery specifically calibrated for the detection of airborne volcanic ash. This suite of products is routinely processed and delivered in real-time to the NWS' Advanced Weather Interactive Processing System (AWIPS) for use by forecasters. Two examples are presented which illustrate how the GOES-R imagery played a decisive role in the warning-decision process at the Alaska Aviation Weather Unit: the Bezymianny event of March, 2012 and the Cleveland Volcano event of June 2012.

W-41 Applications *Xiaozhen Xiong*

Satellite Observations of Mid-upper Tropospheric Methane using CrIS and its comparison with AIRS and IASI

Authors: Xiaozhen Xiong, Chris Barnet, Antonia Gambacorta, Eric S. Maddy, Thomas. S. King

As one of the most important greenhouse gases after carbon dioxide (CO2), methane (CH4) plays a major role in global climate change and atmospheric chemistry. Much more attentions have been paid to its increase since 2007 after a stable period of about one decade, and the concern about CH4 release from permafrost soils, a likely positive feedback of arctic warming. Space-borne observation using the Cross-track Infrared Sounder (CrIS) on the NPP provides an opportunity to measure atmospheric CH4, as a continuation to measure CH4 from the thermal infrared sounders: Atmospheric InfraRed Sounder (AIRS, since August, 2002), the Infrared Atmospheric Sounding Interferometer (IASI, since 2008). These measurements provide realistic 4-D concentrations of trace gases to NCEP/EMC data assimilation system. This paper presents the recent progress in using CrIS/ATMS to retrieve CH4 and some comparisons of retrievals from AIRS and IASI using the same algorithm.

W-42 Current and Future Programs and Systems

Chengli Qi

Metop-B HIRS instrument On-orbit status and performance

Authors: Chengli Qi, Changyong Cao, Tiejun Chang, Fuzhong Weng

Metop-B launched on Sep, 2012, verification of instrument performance is an essential step before the L1 data distributed operationally. Verification performance including: BB temperature, channel noises, radiance data assessment, Geo-location evaluation, ICVS trending, et al. NEdN of all IR channels and NEdA of VIS channel meet specification. HIRS L1B data are evaluated with CRTM model simulation and NPP/CrIS observation and reached coincident conclusion, biases are within 1K for all IR channels except ch1 and ch16. Trend of instruments parameters and NEdN also discussed.

W-43 Current and Future Programs and Systems

Hu Yang

ATMS Striping Analysis and the Proposed Algorithms

Authors: Hu Yang, Fuzhong Weng, Xiaolei Zou

The Advanced Technology Microwave Sounder (ATMS) onboard the Suomi National Polar-orbiting Partnership (NPP) satellite is a total power radiometer and scans across the track within a range of ±52.77° scan angles from nadir. It has a total of 22 channels measuring Earth view antenna temperature from 22 different frequencies, with each frequency being measured from either quasi-vertical or quasi–horizontal polarization. An analysis of the ATMS space scan antenna temperature measurements reveals that there is channel dependent stripping noise existed in the dataset. Application of

ATMS observations in numerical weather forecast model also shows that the striping noise is significant enough to have negative impact to NWP model. Variance and spectrum analysis of the ATMS pitch-over maneuver data set shows that the root cause of stripping is due to improper processing of the inherit noise in calibration counts. In this paper, new algorithm was proposed for filtering of calibration counts in two point calibration process, results show that the stripping noise was effectively reduced in recalibrated antenna temperature and the channel sensitivity was largely improved, especially for those high-level temperature sounding channels.

W-44 Applications *Kunghwa Wang*

A Thematic Climate Data Record (TCDR) of Atmospheric Temperature Derived from Satellite Microwave Sounding Instruments Using 1D-Var

Authors: Fuzhong Weng, KungHwa Wang, and Xiaolei Zou

Microwave Sounding Units(MSUs) and the Advanced Microwave Sounding Unit (AMSU) on National Oceanic and Atmospheric Administration (NOAA) polar orbiting satellites have measured the upwelling microwave radiation emitted from atmospheric oxygen and provided a long-term monitoring of atmospheric temperature. The AMSU instruments are similar to the MSUs, but they make measurements using a larger number of channels, thus sampling the atmosphere in a larger number of layers. By using the AMSU channels that most closely match the channels in the MSU instruments, a long-term climate data record of atmospheric temperature can be constructed. Both MSU and AMSU instruments were intended for day-to-day operational use in weather forecasting and thus are not calibrated to the precision needed for climate studies. A climate quality data set can be extracted from their measurements only by careful inter-calibration of the distinct MSU and AMSU instruments. With one-dimension variation (1D-Var) scheme, the solution in the retrieval starts from a first guess and converges to the final estimate based on a forward model and it's Jacobian. The final atmospheric profile solution found fits the brightness temperatures measurements closest. In addition to the retrieval, the degree of fitting (or convergence) is also an excellent metric for assessing the quality of the retrieval.

W-45 Current and Future Programs and Systems

Tim Schmit

GOES @ 60 West – A Wisconsin Perspective

Authors: Timothy J. Schmit, Jun Li, Jim Nelson, Zhenglong Li, Gary S. Wade, Anthony J. Schreiner, and Mat Gunshor

The National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS) operates the Geostationary Operational Environmental Satellite (GOES)-12, which is routinely scanning South America and surrounding regions with both the Imager and Sounder instruments. The satellite is located at 60 degrees West longitude. GOES-12 was previously the operational GOES East. This effort is part of the Global Earth Observation System of Systems (GEOSS) program, which is a collaborative effort between NOAA and partners in the Americas and the Caribbean. Previously, GOES-10 operated at 60 degrees West longitude for three years, after it had been the operational GOES West. GOES-10 was the first operational geostationary satellite to routinely collect sounding data over South America; GOES-12 continues this mission, beginning in May of 2010. The GOES-12 Imager scans a full disk every three hours and scans an "extended Southern Hemisphere" sector every 15 minutes, while the Sounder (with 19 spectral bands) scans South America and its surrounding regions in four sectors in four hours. Since the satellite inclination is increasing, due to lack of fuel, the GOES-12 Imager data are remapped prior to re-distribution (i.e. with XGOHI (eXtended GOes High Inclination) operations). The Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin-Madison (UW-Madison) is producing experimental GOES Sounder products and posting them on a near-real time Web page (http://cimss.ssec.wisc.edu/goes/rt/goessa.php). The Sounder products include Derived Product Images (DPIs) of Cloud Top Pressure (CTP), Total Precipitable Water (TPW), and Lifted Index (LI). Animations of these DPIs, as well as selected Sounder and Imager spectral bands, are also available. Additionally, composite imagery from the GOES-12 Imager is used for aviation concerns over Antarctica by the UW-Madison Antarctic Meteorological Research Center (AMRC). The GOES-10 data were provided to the Washington D.C. VAAC (Volcanic Ash Advisory Center) by the UW-Madison's Space Science and Engineering Center (SSEC) Data Center, so that volcanic ash and/or upper-level SO2 plumes could be monitored. Finally, many countries in South America are using GOES-12 data either directly (from the satellite rebroadcast) or indirectly (via the Internet) for various applications. The current expectation is that GOES-12 will probably not operate past May of 2013.

W-46 Current and Future Programs and Systems

Xiuqing Hu

NPP/VIIRS Long Term Instrument Monitoring System

Authors: Xiuqing (Scott) Hu, Fuzhong Weng, Tiejun Chang, Peter Wang, Ninghai Sun

The Visible Infrared Imaging Radiometer Suite (VIIRS) is one of the five key environmental remote sensing instruments

onboard the Suomi National Polar-orbiting Partnership (SNPP) spacecraft. The VIIRS long term instrument monitoring system is the near real time (NRT) sub-system of STAR Integrated Calibration/Validation System (ICVS) for NPP/JPSS. This completely new system is designed and developed in NESDIS/STAR. The main goals of this system include: (1) monitor instrument running healthy status and diagnose the abnormal events; (2)analyze instrument performance and assess instrument degradation rate; (3) provide support for adjusting calibration coefficients (LUT) and SDR data quality assessment. The system makes use of VIIRS RDR, OBC IP and SDR data as its inputs and generate the intermediate output files and plotting files for the ICVS system. The output products include several processing IP files and the all kinds of images and plotting and analysis reports about the VIIRS telemetry parameters and instrument performance. The system provides a very useful tool for NPP project managers, instrument vendor and data users for understanding the VIIRS SDR data quality. It also helps the calibration/validation experts to monitor the instrument degradation or seasonal cycle trending.

W-47 Applications *Xiaolei Zou*

Applications of ATMS/AMSU Humidity Sounders for Hurricane Study

Authors: Xiaolei Zou, Qi Shi , Zhengkun Qin, Fuzhong Weng

Tropical cyclone (TC) structures consisting of eye, eyewall and rainband are clearly resolved by the ATMS/AMSU microwave humidity sounders at a 15-km resolution. It is firstly shown that TC center location and the radius of maximum wind could be well determined from MHS window channel 2 at 157 GHz. A revised quality control (QC) algorithm for ATMS/MHS humidity sounders aiming at identifying data points for which clouds have negligible impacts on ATMS/MHS humidity sounder observations is then developed and implemented in the Hurricane Weather Research Forecast (HWRF) system. The QC algorithm is based on the ice water path (IWP) and liquid water path (LWP), which can be derived from two window channels of ATMS/AMSU humidity and temperature sounders respectively. Finally, impacts of ATMS/MHS data assimilation on hurricane track and intensity forecasts are demonstrated for Hurricane Sandy with different forecast leading times (e.g., 1-8 days) before Sandy made landfall on October 30, 2012. It. Over ocean, the MHS window channel derived ice water path (IWP) is used to firstly remove those data with cloud scattering effects. Improvements and degradations by the assimilation of microwave humidity sounder data on hurricane forecasts with and without implementing the revised QC algorithm are analyzed. Areas for further improvements in satellite data assimilation using HWRF are discussed.

W-48 Data Access and Use *Kenneth Pryor*

A Downburst Study of the 29-30 June 2012 North American Derecho

Authors: Kenneth L. Pryor and Colleen Wilson

During the afternoon of 29 June 2012, a complex of strong thunderstorms developed over Illinois and Indiana and then tracked southeastward over the Ohio Valley and central Appalachian Mountains by evening. As the convective storm complex moved over and east of the Appalachian Mountains at a forward speed of 45 to 50 knots, the leading storm line re-intensified and eventually produced widespread significant severe winds (> 65 knots) over northern Virginia and the Washington, DC metropolitan area, and finally over southern New Jersey as the mesoscale convective system (MCS) reached the Atlantic coast. This convective system satisfied all criteria to be classified as a "derecho", defined as a family of downburst clusters produced by an extratropical MCS. This extraordinary derecho-producing convective system (DCS) event ultimately resulted in nearly a thousand severe wind reports from northern Illinois to the Atlantic Coast. This study will employ Geostationary Operational Environmental Satellites (GOES)-13 Rapid Scan Operations (RSO) water vapor (WV)-thermal infrared (IR) channel brightness temperature difference (BTD) imagery, level-II NEXRAD imagery, and Rapid Refresh (RAP) model-derived microburst prediction algorithm output, including the Microburst Windspeed Potential Index (MWPI) and vertical theta-e difference ($\Delta\theta e$), to demonstrate the development and evolution of severe DCS-generated winds. Three focus regions of significant severe winds will be featured in this poster: northern Indiana-central Ohio, Washington, DC-Baltimore, Maryland metropolitan areas, and southern New Jersey. Severe downburst events from the time of initiation over northern Indiana to the time that the DCS moved over the Atlantic coast have been identified and documented. In this poster, the overlying of NEXRAD and theta-e cross sections over RAP model-derived microburst product imagery will describe the tropospheric thermodynamic structure that was favorable for severe downburst generation. The comparison of NEXRAD imagery to Storm Prediction Center (SPC) high wind reports will emphasize the role of downburst clusters in the observation of regions of enhanced severe winds, especially over the Washington, DC-Baltimore, MD metropolitan areas. Initially, it has been found that during the period of DCS re-intensification, and its track through the Washington, DC metro area after 0200 UTC 30 June, the leading convective storm line was elevated through a prominent mid-tropospheric dry (low θe) layer. The combination of satellite, radar, and numerical model

resources, visualized by McIDAS-V software, will describe the evolution of this DCS and will serve as an example of how to use this data in forecasting meso- to micro-scale severe wind events (i.e. downbursts, microbursts) embedded in larger-scale derechos.

W-49 Current and Future Programs and Systems

Monte Bateman

A High-fidelity Proxy Dataset for the Geostationary Lightning Mapper (GLM)

Author: Monte Bateman

The Geostationary Lightning Mapper (GLM) is scheduled to launch aboard GOES-R in 2016. All the data handling systems and processing software need to be tested long before launch, hence the need for a realistic, high-fidelity proxy dataset. The best analog for GLM is the existing Lightning Imaging Sensor (LIS) aboard the TRMM satellite. The LIS is an optical sensor, but is in Low Earth Orbit (LEO), limiting its view time of a particular storm to about 80 s. A Lightning Mapper Array (LMA) is a high detection-efficiency system, but is an RF detection system with short range (a few hundred km). So the task for generating GLM proxy data was to build a mapping from LMA to GLM using LIS for guidance. A comparison study was done to develop a database of characteristics that could be mapped between RF and optical lightning sensors. This comparison study showed that the number of events detected by LIS was correlated to the altitude of a flash (higher flashes transmit more light out the top of the cloud). In order to create proxy lightning flashes, we needed to know how detected events (pixels) are distributed in size, shape, and time. This allows us to generate realistic proxy flashes. The proxy pixels were then input into the Lightning Cluster-filter Algorithm (LCFA) and proxy flashes were generated. These were compared to the original LMA flashes that were used originally. The final comparison showed that the GLM proxy data are indeed high-fidelity, holding the information content of the original LMA flashes at about 85%. This has shown to be sufficient for data users such as the Lightning Jump Algorithm to use the proxy data and work correctly.

W-50 Current and Future Programs and Systems

Monte Bateman

A comparison of ground-based lightning networks against satellite-based lightning measurements

Authors: Kelsey Thompson and Monte Bateman

Lightning stroke data from the World Wide Lightning Location Network (WWLLN) and lightning stroke data from the Earth Networks Total Lightning Network (ENTLN) were compared to lightning group data from the Lightning Imaging Sensor (LIS) from 1 January 2010 through 30 June 2011. The region of study, about 39°S to 39°N latitude, 164°E to 17°W longitude, chosen to approximate the Geostationary Lightning Mapper (GLM) field of view, was considered in its entirety and then divided into geographical sub-regions. We looked for coincidences between LIS groups and WWLLN strokes and between LIS groups and ENTLN strokes. We found day-to-day variability for both WWLLN and ENTLN coincidence percents (CP). There was a fair amount of spatial variability also. We will show some overall CP values for different regions and figures that detail CP values in individual 1° by 1° and 2° by 2° grid squares. We will also show time series plots that reveal the day-to-day variability.

W-51 Current and Future Programs and Systems

Yong Chen

Assessment of S-NPP CrIS Radiometric and Spectral Accuracy using Community Radiative Transfer Model

Authors: Yong Chen, Yong Han, and Fuzhong Weng

The Cross-track infrared Sounder (CrIS) on Suomi National Polar-orbiting Partnership Satellite (S-NPP), is a very important Fourier transform interferometer and provides soundings of the atmosphere with 1305 channels. The sounding information will be used to enhance weather forecast and help improve understanding of climate change. Quantifying the CrIS radiometric and spectral accuracy, and bias with other hyper-spectral infrared sensors such as Infrared Atmospheric Sounding Interferometer (IASI) on MetOp are crucial for creating fundamental climate data records and intercalibrating other infrared sensors. The CrIS Sensor Data Record (SDR) data sets were assessed by using Community Radiative Transfer Model (CRTM) and ECMWF forecast data for clear sky and over ocean and compared with IASI data. The CRIS SDR data sets were evaluated to estimate the FOV-2-FOV variability and sweep direction bias. Results show that FOV-2-FOV variability is small; The sweep direction bias among FORs is also small. Results from the double difference with IASI show that the differences are within ±0.2 K for most of channels. The CrIS spectral accuracy is also assessed by using the cross-correlation method to compare the CrIS fine grid spectral between observations and CRTM simulations. About 3 ppm and 4 ppm uncertainty are found in CrIS SDR data in band 1 (LWIR), and band 2 (MWIR), respectively. Overall, CrIS SDR meets the high quality standard for the usage by NWP and the scientific community.

W-52 Current and Future Programs and Systems

Yong Chen

Detection of Earth-rotation Doppler Shift from S-NPP Cross-track Infrared Sounder

Authors: Yong Chen, Yong Han, and Fuzhong Weng

The Cross-track Infrared Sounder (CrIS) on Suomi National Polar-orbiting Partnership Satellite (S-NPP), is a very

important Fourier transform spectrometer, and provides soundings of the atmosphere with 1305 channels. The sounding information will be used to enhance weather forecast and help improve understanding of climate change. Quantifying the CrIS spectral accuracy is crucial for using CrIS data in the satellite data assimilation systems that lead to improve weather forecasting. In this study, a cross-correlation method is applied to detect the Earth-rotation Doppler shift (ERDS) for CrIS observations. The observations from CrIS exhibit a relative Doppler shift up to 2.5 part per-million (ppm) due to the Earth's rotation near the Equator and at the satellite scan edge for field of regard (FOR) 1 and 30. The magnitude of the Doppler shift varies with the latitude and the scan position of the observation. The Doppler shift detected from CrIS observations is very close to theoretical Doppler shift, which indicates that the spectral stability from CrIS instrument is very high.

W-53 Current and Future Programs and Systems
Karen Gheno

GOES-R Geostationary Lightning Mapper (GLM)

Authors: Karen M. Gheno, S. Edgington

The Geostationary Lightning Mapper (GLM) is under development by Lockheed Martin to be flown as an operational instrument on the Geostationary Operational Environmental Satellite R-Series (GOES-R) spacecraft. GLM is a unique instrument, unlike any other meteorological instrument, both in how it operates and in the information content that it provides. Instrumentally, it is an event detector, rather than an imager. While processing almost a billion pixels per second with 14 bits of resolution, the event detection process reduces the required telemetry bandwidth by almost 105, thus keeping the telemetry requirements modest and enabling efficient ground processing that leads to rapid data distribution to operational users. Lightning is a product of the electrical energy produced during the collisional interactions of ice hydrometeors. This charging zone is deep in the interior of thunderclouds, where many of the hydrometeors develop and latent heat is released. Thus the GLM is one of the few geostationary sensors that provides information on the physical processes occurring in the heart of the cloud. Since cloud charging is controlled by ice production, latent heat release and up-draft development, GLM measurements provide a unique means of monitoring these important parameters. The presentation addresses the unique design of the GLM, the underlying physics that makes lightning observation valuable, and some of the important contributions that that the GLM will make during the GOES-R era.

W-54 Current and Future Programs and Systems
Tony Reale

Performance validation of candidate operational sounding retrievals from Suomi-NPP

Authors: Tony Reale, Bomin Sun, Michael Pettey, Frank Tilley, Charles Brown, Nick Nalli, Antonia Gambacorta, Dave Tobin and Chris Barnet

The National Oceanic and Atmospheric Administration (NOAA) produce global temperature and moisture soundings from operational environmental weather satellites. The NOAA Center for Satellite Applications and Research (STAR) operates the NOAA PROducts Validation System (NPROVS) which has provided centralized inter-comparisons of these products against common sets of collocated radiosonde (RAOB), dropsonde and numerical weather prediction (NWP) data since April, 2008. The satellite products include those from polar and geostationary observations processed at NOAA and EUMETSAT and also Constellation Observing System for Meteorology Ionosphere and Climate (COSMIC) profiles from the University Corporation for Atmospheric Research (NCAR). The first part of the report provides ensemble vertical statistics demonstrating the performance of pending operational sounding retrievals from the recently launched Suomi-NPP. These include respective Cross-track Infrared and Microwave Sounder Suite (CrIMSS) Interface Data Processing Segment (IDPS, version 6.3) and NOAA Unique Cross-track Infrared Scanner (CrIS) /Advanced Technology Microwave Sounder (ATMS) Processing System (NUCAPS) and Microwave integrated Retrieval System (MiRS) products systems. Results are based on identical samples of collocations with conventional RAOB observations and demonstrate relative performance of these evolving product systems through the implementation process. Adherence to CrIMSS performance specifications, which range from 1.5K to 2.5K per kilometer for tropospheric temperature and 20% to 40% over 2km layers for water vapor fraction for clear and cloudy profiles, respectively, is addressed. Results include comparisons against NOAA Global Forecast System (GFS) and Climate Forecast System Re-analysis (CFSR) data and selected legacy satellite products including hypersepctral infrared from Aqua (AIRS, version 5) and MetOp-B (IASI). Results include stratification based on available internal product qc and the respective impacts of moisture fraction weighting and using the RAOB versus NWP as "truth". The report concludes with an outline of NPROVS planned expansion and integration with evolving Global Climate Observing System (GCOS) Reference Upper Air Network (GRUAN) and initial plans for routine Suomi-NPP validation at these sites and dedicated validation programs including at Atmospheric Radiation Measurement (ARM) sites and NOAA Aerosols and Ocean Science Expeditions (AEROSE). The contents of this report do not necessarily reflect any position of the United States government or the National Oceanic and Atmospheric Administration.

W-55 Data Access and Use *Bomin Sun*

Relationship between clouds,temperature and humidity in NOAA IASI retrievals

Authors: Bomin Sun, Tony Reale, Eric Maddy, Antonia Gambacorta, and Chris Barnet

The NOAA Infrared Atmospheric Sounding Interferometer (IASI) retrieval system has been operated at NOAA/NESDIS/TAR since 2008. The L2 retrievals are based on the cloud-clearing method that combines the infrared radiances of IASI at 2 x 2 footprints and microwave radiance at the co-registrated single AMSU footprint. In this study, we aim to understand: (1) what are the impacts of cloud presence and cloud clearing on the accuracies of the retrievals; and (2) if the retrieved cloud properties are thermodynamically consistent to temperature and humidity retrievals. Three years (2009-2012) of IASI retrievals spatially and temporally collocated to global radiosonde data, collected at the NOAA Products Validation system (NPROVS, http://www.star.nesdis.noaa.gov/smcd/opdb/poes/NPROVS.php) are employed for the analysis. Radiosonde measurements are used as the reference to define the retrieval accuracy and comparison of the final physical retrievals with their first guess is used to infer the impact of the cloud clearing procedure. We discuss how such analysis can advance our understanding of the internal consistency of major components within the retrieval system and, furthermore, if major geophysical variables derived from the hyper spectral sounder represent a nominal level of maturity for application in climate monitoring. Methodologies developed from the study may be useful for evaluating the Environmental Data Records (EDRs) developed from the Cross-track Infrared and Microwave Sounder Suite (CrIMSS) on board Suomi NPP launched in 2011.

W-56 Applications *Pei Wang*

Improve hurricane Sandy forecasts with hyperspectral infrared sounder data

Authors: Pei Wang, Jun Li, Tim Schmit, Jinlong Li, Zhenglong Li, Wenguang Bai

The high spectral resolution infrared sounders such as AIRS, IASI and CrIS provide atmospheric temperature and moisture profiles with high vertical resolution and good accuracy. Those advanced IR sounders provide soundings in hurricane environment, which is critical for tropical cyclone (TC) forecasts. In order to demonstrate the application of advanced IR sounder data in tropical cyclone forecasts, both AIRS and CrIMSS temperature soundings in clear and partly cloudy skies are used in regional numerical weather prediction (NWP) model. The advanced research WRF (ARW) modeling system is used as NWP model and the Community Gridpoint Statistical Interpolation (GSI) system is used as data assimilation system in our experiments on hurricane Sandy (2012) forecasts. The assimilation conducted every 6 hours with conventional data, AIRS and CrIMSS soundings, and followed by the 72 hours forecasts. The operational HWRF and operational global GFS forecasts are compared with our experimental forecasts results. Quality control of AIRS and CrIMSS soundings are conducted before the data assimilation process. To verify the impact of assimilating hyperspectral IR soundings on Sandy forecasts, hurricane track, minimum sea level pressure (SLP) and maximum wind speed observations from national hurricane center (NHC) are used as references for comparisons with forecasts. Comparisons among operational HWF, global GFS and our experimental forecasts show that that for hurricane track, operational GFS forecast are better at the beginning 36 hours, and after 42 hours, our experimental forecasts are comparable with global GFS forecasts, and the RMSE of our experimental forecasts is smaller after 66 hours. For the whole forecast period, the central SLP RMSE of our experimental forecasts is smaller, which indicates the advantage of high resolution regional model on TC intensity forecasting. The GOES-13 Imager brightness temperature measurements are also compared with that of simulated from forecasts, indicating that the mesoscale systems around the TC could be well captured by our experimental assimilation and forecasting system.

W-57 Current and Future Programs and Systems *Xin Jin*

Efforts for the Readiness of the Operational NPP-CrIS SDR Products: Status Monitoring and Anomaly Handling

Authors: Xin Jin, Yong Han, Denis Tremblay, Likun Wang

The Cross-track Infrared Sounder (CrIS) onboard the NPP (NPOSS Preparatory Project) satellite has been on orbit for more than one year. To facilitate the readiness of the operational products, a web-based instrumental status and SDR product trending/monitoring system is set up at NOAA for operational use. Meanwhile, the offline CrIS calibration system (ADL) is used for diagnosing the anomalies found in the operational products through the monitoring/trending system. In the past year, some critical anomalies are diagnosed and solutions are suggested. With these efforts, the readiness of the operational SDR products significantly improved.

W-58 Applications *Amanda Terborg*

Satellite-Observed Signatures Associated With Moderate to Severe Turbulence Events

Authors: Amanda M. Terborg, Kristopher Bedka, Wayne Feltz

Moderate or greater (MOG) turbulence is one of the biggest weather related causes of aviation incidents. However, given

the subjective nature of Pilot Reports (PIREPs), identifying exactly where, and subsequently which phenomena may be responsible, is a challenge. For this reason several airlines have begun the use of onboard equipment on various 737s and 757s, designed to record information pertaining to turbulence measurements. One such measurement is the calculation of the Eddy Dissipation Rate (EDR), which provides valuable in-situ data regarding the nature and location of turbulence, and is based on the 'sea state' of the atmosphere rather than aircraft response. Using this EDR data, specifically MOG reports, in conjunction with satellite imagery from the Moderate-resolution Imaging Spectroradiometer (MODIS), allows for a more in detail study of turbulence and its associated weather phenomenon and also provides an exploration into the benefits of higher resolution satellite imagery. An overview of MOG EDR reports from 2010 – 2011 and the associated satellite signatures taken from MODIS imagery will be presented and discussed

W-59 Applications *Kathleen Strabala*

The Global Impact of 10+ Years of IMAPP Software in Support of Aqua and Terra

Authors: Kathleen Strabala, Liam Gumley, Allen Huan, James Davies, Elisabeth Weisz, Jeff Key, Brad Pierce and Lee Cronce

Starting with the launch of Terra in 1999, NASA's International MODIS/AIRS Processing Package (IMAPP) has been supporting the Earth Observing System (EOS) Aqua and Terra missions through the distribution of free software packages for local Direct Broadcast (DB) applications. Since that time, 47 different packages have been released in support of MODIS, AIRS and AMSR-E environmental applications for registered users from 67 different countries. In addition, 10 IMAPP direct broadcast application workshops have been held on 5 continents as a means of fostering interest, knowledge and use of Aqua and Terra data and products from students and decision makers. The success of the project can be traced to the scientific quality of the data and products, portability and robustness of the software and a good working relationship with the user community. This results in the support of a wide variety of applications globally, including operational weather forecasting, air quality monitoring and insect infestations. A selection of global examples will be presented.

W-60 Data Access and Use *Jaime Daniels*

Atmospheric Motion Vectors Derived via a New Nested Tracking Algorithm Developed for the GOES-R Advanced Baseline Imager (ABI)

Authors: Jaime Daniels, Wayne Bresky, Steve Wanzong, Andrew Bailey, Chris Velden

A new Atmospheric Motion Vector (AMV) nested tracking algorithm has been developed for the Advanced Baseline Imager (ABI) to be flown on NOAA's future GOES-R satellite. The algorithm has been designed to capture the dominant motion in each target scene from a family of local motion vectors derived for each target scene. Capturing this dominant motion is achieved through use of a two-dimensional clustering algorithm that segregates local displacements into clusters. The dominant motion is taken to be the average of the local displacements of points belonging to the largest cluster. This approach prevents excessive averaging of motion that may be occurring at multiple levels or at different scales that can lead to a slow speed bias and a poor quality AMV. A representative height is assigned to the dominant motion vector through exclusive use of cloud heights from pixels belonging to the largest cluster. This algorithm has been demonstrated to significantly improve the slow speed bias typically observed in AMVs derived from satellite imagery. Meteosat SEVERI imagery is serving as an important GOES-R ABI proxy data source for the development, testing, and validation of the GOES-R AMV algorithms given its similarities (spectral coverage, pixel resolution, and scanning rate) and performance (spectral noise, navigation/registration) to the future GOES-R ABI. The new GOES-R AMV algorithm is also being applied to the instrumentation on the current operational GOES series of satellites and is expected to replace the heritage AMV algorithm being used in NESDIS operations today. Plans at NOAA/NESDIS also include using the new GOES-R AMV algorithm to generate AMVs from the future VIIRS instrument on the NPP satellite. Details of the GOES-R ABI AMV algorithm and the validation results will be presented and discussed.

W-61 Applications *Xi Shao*

Quantifying Power Outages after Severe Storms using the S-NPP/VIIRS Day Night Band Radiances

Authors: Changyong Cao, Xi Shao, Sirish Uprety

Power outages after a major storm affect the lives of millions of people. The launch of the Suomi National Polar-orbiting Partnership (S-NPP) satellite with the Visible Infrared Imaging Radiometer Suite (VIIRS) significantly enhances our capability to monitor and detect power outages routinely with the well calibrated Day/Night Band (DNB), which outperforms the traditional OSL on DMSP satellites in both spatial resolution and radiometric accuracy. This study explores the use of the DNB with lunar radiance correction for quantifying power outages in the Washington DC metropolitan area in June 2012 due to the Derecho storm, and the Hurricane Sandy at the end of October 2012 on the east

coast near New York City. The former led to the largest non-hurricane power outage in history for the DC region with more than a million people without power, while the later caused power outages for more than 8 million people on the east coast. The results show that the DNB data are very useful for quantifying radiometric changes due to light loss, but also with some challenges due to clouds, lunar phase angle changes, and terminator straylight effect of the instrument for the northern hemisphere region during summer solstice. Comparison for power outage extent and recovery trend between that derived from analyzing DNB data and power company survey data shows reasonable agreement. This validates the usage of DNB radiance observation as a useful means and alternative/complement measures to quantify and monitor power outages after severe storms. It is expected that further refinements in the methodology will significantly reduce the uncertainties.

W-62 Current and Future Programs and Systems
Likun Wang

Inter-Calibration of NPP-S CrIS with VIIRS

Authors: Likun Wang, Yong Han, Denis Tremblay, Fuzhong Weng, and Mitch Goldberg

The Cross-track Infrared Sounder (CrIS) on the newly-launched Suomi National Polar-orbiting Partnership (Suomi NPP) and future Joint Polar Satellite System (JPSS) is a Fourier transform spectrometer that provides soundings of the atmosphere with 1305 spectral channels, over 3 wavelength ranges: LWIR (9.14 - 15.38 μm); MWIR (5.71 - 8.26 μm); and SWIR (3.92 - 4.64 μm). On the same satellite platform as CrIS, the Visible Infrared Imager Radiometer Suite (VIIRS), is a scanning radiometer with a wide-swath (3,040 km) and high spatial resolutions of 370 m and 740 m (at nadir) that collects visible and infrared imagery and radiometric measurements from 22 bands between 0.412 μm and 11.5 μm. In the first part of the inter-comparison studies of CrIS with VIIRS, we focus on assessment of CrIS geolocation using VIIRS radiance measurements. Just like spectral and radiometric calibration, accurate geolocation is fundamental for CrIS radiance Sensor Data Records (SDRs). Given a 14-km CrIS field-of-view (FOV) at nadir, the designed specification of CrIS geolocation is less than 1.5 km, which is on the order of tenth of CrIS FOV size. However, due to the large FOV size and gaps among FOVs, it is very hard to assess the sub-pixel geolocation accuracy using land features. Therefore, a method has been developed by using the collocated radiance measurements from VIIRS) infrared bands. Specifically, an algorithm has been developed to accurately determine the footprint shapes of CrIS FOVs. The VIIRS pixels are then spatially averaged to compare with CrIS measurements, which are convolved with VIIRS spectral response function to generate VIIRS band radiances. By shifting the VIIRS pixel toward along- and cross-track direction, the perfect collocation position can be indentified to quantify the geolocation bias of CrIS geolocation FOVs. This poster overviews the method, summarizes the first year of geolocation analysis, and provides the assessment statistical results on CrIS geolocation. In the second part of the inter-comparison studies of CrIS with VIIRS, we focus on examining the radiometric consistency between CrIS and VIIRS infrared bands. There are four VIIRS IR channels that are fully covered by CrIS, i.e. M13, M15, M16, and I5. In order to compare CrIS hyperspectral radiances with VIIRS band radiance, we need to perform spectral convolution to reduce the high resolution CrIS spectrum to match the band radiances from VIIRS. The VIIRS pixels are then spatially averaged to compare with CrIS-simulated VIIRS measurements. The out-of-band spectral response from VIIRS will be carefully addressed to reduce to comparison uncertainties. The CrIS-VIIRS BT radiance difference will be examined along with view angles, orbit, and scene temperatures. More important, the third sensor like (the Atmospheric Infrared Sounder or Infrared Atmospheric Sounding Interferometer) is also introduced to compare with VIIRS and CrIS to investigate the root causes of the differences.

W-63 ATMS Calibration *Lin Lin*

Absolute Calibration of ATMS Upper Level Temperature Sounding Channels Using GPS RO Observations

Authors: Xiaolei Zou, Lin Lin, Fuzhong Weng

The absolute accuracy of antenna brightness temperatures (TDR) from the Advanced Technology Microwave Sounder (ATMS) onboard the Suomi National Polar-orbiting Partnership (NPP) satellite is estimated using Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) Radio Occultation (RO) data as input to the U.S. Joint Center of Satellite Data Assimilation (JCSDA) Community Radiative Transfer Model (CRTM). It is found that the mean differences (e.g., biases) of observed TDR observations to GPS RO simulations are positive for channels 6, 10-13 with values smaller than 0.5K and negative for channels 5, 7-9 with values greater than -0.7K. The bias distribution is slightly asymmetric across the scan line. A line-by-line radiative transfer model is used to further understand the sources of errors in forward calculations. It is found that for some channels, the bias can be further reduced in a magnitude of 0.3K if the accurate line-by-line simulations are used. With the high quality of GPS RO observations and the accurate radiative transfer model, ATMS upper level temperature sounding channels are calibrated with known absolute accuracy. After the bias removal in ATMS TDR data, it is shown that the distribution of residual errors for ATMS

channels 5-13 is close to a normal Gaussian one. Thus, for these channels, the ATMS antenna brightness temperature can be absolutely calibrated to the sensor brightness temperature without a systematic bias.

W-64 Data Access and Use *David Santek*

Real-time Access to Weather Satellite Data and Products on Mobile Devices

Authors: David Santek, Dave Parker, Russ Dengel, Sam Batzli, Nick Bearson

A major challenge in mobile-device map application development is to offer rich content and features with simple and intuitive controls and fast performance. Our goal is to bring visualization and animation of near real-time weather and earth observation information derived from satellite and sensor data to mobile devices. Our robust back-end processing infrastructure can deliver content in the form of images, shapes, and raw data to a variety of desktop software, browsers, and mobile devices on demand. We have developed custom interfaces for low-bandwidth browsers (including mobile phones) and high-feature browsers (including smartphones), as well as native applications for Apple iOS devices. Mobile devices offer time- and location-awareness and persistent data connections, allowing us to tailor displays to the user's geographic and time context. WxSat is the first iOS app to display and animate full resolution real-time geostationary satellite data. In its current form, WxSat leverages SSEC WMS servers to provide global coverage for visible, infrared, and water vapor channels to iPhones, iPads, and iPod touches. The capability exists to deliver directly to the user's hand any product managed by the WMS, allowing the user to overlay, animate, and freely roam around any combination of products they choose. We already host over 150 products that range from model output fields to convective initiation targets to MODIS true-color imagery. We will report on the status and future plans of our mobile device apps. See http://wms.ssec.wisc.edu for more information.

W-65 Current and Future Programs and Systems *Yunyue Yu*

Upscaling of in situ Land Surface Temperature for Satellite Validation

Authors: Robert C. Hale, Yunyue Yu, Dan Tarpley

Land Surface Temperature (LST) will be an operational product derived from the Advanced Baseline Imager (ABI) of the Geostationary Operational Environmental Satellite R-Series (GOES-R) scheduled for launch in 2015. Validation of the LST product poses challenges due both to the paucity of in situ measures against which the satellite-derived LSTs may be compared and because of the mismatch in spatial scale between the two. The nominal resolution of the ABI LST is 2 km, whereas in situ instruments typically have fields-of-view on the order of 1 to 30 m. Research was undertaken to utilize high-resolution LSTs derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) in an effort to derive regression-based relations between small- and large-scale measures of LST in the vicinity of sites at which in situ LSTs are measured. The resulting regression equations then were applied to the in situ LSTs with results compared to LSTs derived from the Moderate Resolution Imaging Spectroradiometer (MODIS). It was found that the regression-based LST upscaling model resulted in statistically significant reduction of the standard deviation of differences at some sites, however these differences generally remained quite high, on the order of 2.5 K.

W-66 Applications *Konstantin Vinnikov*

Angular Anisotropy of Satellite Observed Land Surface Temperature

Authors: Konstantin Y. Vinnikov, Yunyue Yu, Mitchell D. Goldberg, Dan Tarpley, Peter Romanov, Istvan Laszlo, and Ming Chen

Satellite-based time series of land surface temperature (LST) have the potential to be an important tool to diagnose climate changes of the past several decades. Production of such a time series requires addressing several issues with using asynchronous satellite observations, including the diurnal cycle, clouds, and angular anisotropy. Here we evaluate the angular anisotropy of LST using one full year of simultaneous observations by two Geostationary Operational Environment Satellites, GOES-EAST and GOES-WEST, at the locations of five surface radiation (SURFRAD) stations. We develop a technique to convert directionally observed LST into direction-independent equivalent physical temperature of the land surface. The anisotropy model consists of an isotropic kernel, an emissivity kernel (LST dependence on viewing angle), and a solar kernel (effect of directional inhomogeneity of observed temperature). Application of this model reduces differences of LST observed from two satellites and between the satellites and surface ground truth - SURFRAD station observed LST. The techniques of angular adjustment and temporal interpolation of satellite observed LST open a path for blending together historical, current, and future observations of many geostationary and polar orbiters into a homogeneous multi-decadal data set for climate change research.

W-67 Current and Future Programs and Systems *Paul Seymour*

GEONETCast and GEONETCast Americas

Author: Paul Seymour

GEONETCast is a near real time, global network of satellite-based data dissemination systems designed to distribute space-based, air-borne and in situ data, metadata and products to diverse communities. GEONETCast is led by three regional infrastructure providers: EUMETSAT in Europe (EUMETCAST), Chinese Meteorological Administration (CMA)in the Asia-Pacific region (CMACast), and NOAA in the Western Hemisphere (GEONETCast Americas). GEONETCast Americas is the Western Hemisphere component of GEONETCast. Maintained by the U.S. National Oceanic and Atmospheric Administration (NOAA), the GEONETCast Americas service uses the commercial Intelsat-21 (IS-21) satellite to broadcast environmental data to an area covering most of North, Central, and South America, including the Caribbean Basin. GEONETCast Americas uses commercial Digital Video Broadcast for Satellites (DVB-S) to broadcast file-based products. Following commercial DVB standards, GEONETCast Americas uses the C-band broadcast frequency. It is broadcast on PID 4201 from the Intesat 21 satellite on a frequency of 3840 MHz. The receive terminal that will be able to receive the GEONetCast broadcast should have an antenna (normally 2.4 meter C band but a 1.8 meter C band dish will work in some areas), LNB, receiver or receiver card, and a PC running Kencast datacasting client software. The datacasting client software necessary to receive the files is either KenCast Fazzt Professional Client software or there is also an "Edge Span"" version for networks. The software can be purchased from KenCast Incorporated (www.kencast.com). International partners providing data and information include: the NOAA National Weather Service, NOAA Satellite and Information Service, the U.S. Environmental Protection Agency, the International Center for the Investigation of the El Niño Phenomenon located in Ecuador, the Argentine National Space Activities Commission, the Brazilian National Institute for Space Research, the National Meteorological Institute of Costa Rica, the Radio and Internet for the Communication of Hydro-Meteorological and Climate Related Information Program (USAID/UCAR/NWS), the European Organisation for the Exploitation of Meteorological Satellites EUMETSAT.

W-68 Applications *Matthew Lazzara*

Arctic and Antarctic Satellite Composites: Construction and Applications

Authors: Matthew A. Lazzara, David A. Santek, Richard A. Kohrs, Brett T. Hoover, and David E. Mikolajczyk

For over 20 years, the Antarctic Meteorological Research Center, Space Science and Engineering Center at the University of Wisconsin-Madison have generated composites of geostationary (GEO) satellites and polar-orbiting or low Earth orbit (LEO) satellites into a mosaic display over the Antarctic and adjacent Southern Ocean. This effort has expanded to the Arctic over the last half dozen years. These composites are created in the infrared window channel (~11.0 microns), longwave infrared (~12.0 microns), shortwave infrared (~3.8 microns), water vapor (~6.7 microns), and visible (~0.67 microns) channels that are most common to meteorological satellite observations. Generally made on an hourly basis, these composites are generated at as much as a 4-kilometer nominal resolution. The construction of the composite images has evolved over the years to consider a variety of factors including limb darkening, pixel resolution, observation time, and other weighting factors. Additionally, the composites have found a diversity of use in forecasting, education and operational arenas. The generation of atmospheric motion vectors (AMVs) from a version of these composites is being successfully produced, and the quality is on par with single satellite AMVs products. The generation of LEO/GEO composite AMVs fills a gap in the generation of global winds from all satellite platforms, and has shown impact when assimilated into the Global Forecast System (GFS). This poster presentation will review the history of the composites, including how they have been constructed as well as illustrate key applications.

W-69 Applications *David Santek*

McIDAS-V: A powerful visualization and data analysis tool for geostationary environmental satellites

Authors: David Santek, Thomas Achtor, Thomas Rink, William Straka, Joleen Feltz, Becky Schaffer

The University of Wisconsin's Space Science and Engineering Center (SSEC) has been at the forefront in developing data analysis and visualization tools for environmental satellite and other geophysical data. The fifth generation of the Man-computer Interactive Data Access System (McIDAS-V) is a Java-based, open-source, freely available system for researchers and algorithm developers that is being adapted and expanded for use with advanced geostationary environmental satellite observations. A key attribute of analysis and visualization systems is access to and display of a large variety of geophysical data. Providing these capabilities for numerous data types provides users with powerful tools for merging information, comparison of products and evaluation. McIDAS-V provides unique capabilities that support creative techniques for developing and evaluating algorithms, visualizing data and products in 4 dimensions, and validating results. For geostationary applications, McIDAS-V provides visualization and analysis support for GOES, MSG, MTSAT, FY2, and the future GOES-R data. NOAA is supporting the McIDAS-V development program for ABI imagery and products for the GOES-R/S series, which will bring an advanced multi-spectral imager into geostationary orbit. When used together, the geostationary environmental satellites provide the user community with detailed global coverage

with rapid update cycles. This poster will provide an overview of McIDAS-V with demonstrations of the data acquisition, visualization and analysis tools to support the international geostationary environmental satellite programs, including data and products acquired through EUMETCast and GEONETCast. It will also present results from research projects involving current and future environmental satellites, demonstrating how the McIDAS-V software can be used to acquire satellite and ancillary data, create multi-spectral products using both scripting and interactive data manipulation tools, and evaluate output through built-in validation techniques.

W-70 Current and Future Programs and Systems
Slawomir Blonski

Continuity of VIIRS/MODIS Radiometric Measurements: Simultaneous Nadir Overpass Comparisons for Reflective Solar Bands

Authors: Slawomir Blonski, Changyong Cao, Sirish Uprety, and Xi Shao

VIIRS (Visible Infrared Imager Radiometer Suite) is one of five instruments onboard the Suomi NPP (National Polar-orbiting Partnership) satellite which was launched in October 2011. To achieve the required quality of the radiometrically and geometrically corrected Sensor Data Records, VIIRS performance and accuracy of its data products are continuously evaluated. Since the finding of an accelerated degradation of VIIRS sensitivity in selected spectral bands, frequent monitoring of VIIRS radiometric performance became even more essential. SNO (Simultaneous Nadir Overpass) measurements have provided many opportunities for comparisons between VIIRS and the MODIS instruments from the Aqua and Terra satellites. TOA (Top-of-Atmosphere) reflectance values measured by VIIRS during the SNO events were found to be highly correlated with the MODIS data for the corresponding spectral bands. Observed discrepancies of a few percent can be attributed to differences between spectral responses of VIIRS and MODIS, as shown by estimates from 6S radiative transfer modeling. Experience gained with the NPP satellite will be used during calibration and validation of the VIIRS instruments deployed on the future JPSS (Joint Polar Satellite System) satellites.

W-71 Current and Future Programs and Systems
Nicholas Nalli

Validation of Environmental Data Records (EDRs) from the Cross-track Infrared Microwave Sounder Suite (CrIMSS)

Authors: N. R. Nalli, C. D. Barnet, T. Reale, D. Tobin, M. Divakarla, M. Wilson, C. Tan, X. Xiong, A. Gambacorta, E. Maddy, L. Borg, E. Joseph, V. Morris, T. King, X. Liu, S. Kizer, D. Gu, D. Hagan

The Joint Polar Satellite System (JPSS) is a U.S. National Oceanic and Atmospheric Administration (NOAA) operational environmental satellite mission in collaboration with joint international partnerships and the U.S. National Aeronautics and Space Administration (NASA) designed to retrieve and disseminate environmental data record (EDR) products to NOAA data users. To ensure the EDRs comply with the mission requirements (i.e., "meet spec"), a Calibration/Validation (Cal/Val) Plan was devised in advance of the launch of the Suomi National Polar-orbiting Partnership (NPP) satellite in October 2011. This presentation overviews the team approach for validating of the NPP Cross-track Infrared Microwave Sounder Suite (CrIMSS), a sounding system comprised of the infrared (IR) Cross-track Infrared Sounder (CrIS) and the microwave (MW) Advanced Technology Microwave Sounder (ATMS). CrIMSS is designed to retrieve atmospheric vertical profile EDRs under non-precipitating conditions, namely atmospheric vertical temperature, moisture and pressure profiles (AVTP, AVMP and AVPP, respectively). The EDR validation relies on science and user community leadership and participation, and demonstrated, cost-effective approaches using a "hierarchy" of correlative datasets. Validation of the NPP CrIMSS EDR algorithm has successfully progressed from the Pre-Launch and Early-Orbit Checkout phases into the current Intensive Cal/Val (ICV) phase, with the Long-Term Monitoring (LTM) phase to follow. The validation methodology will be overviewed and current NPP ICV CrIMSS EDR Cal/Val efforts for provisional maturity assessment will be highlighted.

W-72 Current and Future Programs and Systems
Haidao Lin

Mesoscale assimilation of AIRS and other satellite data in the Rapid Refresh system: strategies and impacts

Authors: Haidao Lin, Steve Weygandt, Tim Schmit

NASA's Atmospheric Infrared Sounder (AIRS) has the ability to provide atmospheric temperature and water vapor information at higher resolution and accuracy than previous systems, which may be very beneficial for improving forecasts of high impact weather and cloud and precipitation systems. Accordingly, we have conducted a series of tests to evaluate the impact of assimilating AIRS radiance data into experimental versions of the Rapid Refresh (RAP) mesoscale model system. In addition, we have conducted experiments in which AIRS single field-of-view (SFOV) retrieved

temperature and water vapor profiles (created by the Cooperative Institute for Meteorological Satellite Studies, CIMSS, at the University of Wisconsin-Madison), into the RAP. The RAP is a high frequency (1-hour) cycling assimilation and prediction system that runs operationally at the National Centers for Environmental Prediction (NCEP). A real-time experimental version of the RAP is run at GSD and provides initial conditions for the High Resolution Rapid Refresh (HRRR). In these experiments, forecast impact from the AIRS data is examined in 9 day GSD retrospective RAP runs and in subsequent HRRR runs. In tests using all AIRS observation within the data window (ignoring data latency issues), results indicate that assimilation of both AIRS radiances and retrievals yield small improvements in the RAP forecasts, provided a suitable bias correction scheme is applied. For the radiance data, bias correction is very straight forward with the use of the variational bias correction procedure built into the Gridpoint Statistical Interpolation (GSI) code. For the SFOV retrieved profiles, an elaborate bias correction procedure was developed based on detailed analysis of the SFOV retrievals (comparison with nearby radiosonde data, assessment of mean innovation differences, and evaluation of analysis biases with and without the SFOV data assimilation). Application of the resultant bias correction did improve results, but required considerable work that may not be easily generalizable to other cases. Additional work focused on examining the forecast impact in the radiance assimilation result from the model top (and deriving criteria for a successful channel selection procedure). Work continues in several areas, including: 1) analyzing the bias correction spin-up period requirement, 2) exploring different options for ameliorating the low model top problem, and 3) exploring the forecast impact for different locations and weather regimes (more focus on oceanic regions including tropical systems), and for enhanced data assimilation methods (hybrid ensemble). Additional work is focused on examining the assimilation of AIRS data in conjunction with other satellite data. A summary of these results including the latest updates will be presented at the conference.

W-73 Applications *Anthony Wimmers*

Current capabilities for identifying turbulence from real-time satellite imagery

Authors: Anthony Wimmers, Wayne Feltz, Sarah Monette

This poster will present the current capabilities at CIMSS for detecting satellite features indicative of aircraft turbulence. Ongoing real-time products include a CONUS display of tropopause fold and overshooting top products, shown together with manual pilot reports. Additional products being researched will also be presented, including gravity wave (and mountain-wave downslope wind) detection algorithms, along with the methods for interpreting the subset of conditions leading to hazardous turbulence. These products are validated with corresponding Eddy Dissipation Rate (EDR) measurements. A special case of gravity waves – transverse bands caused from nearby convective updrafts – will be examined in the context of its unique association with the mesoscale environment, and highly irregular sampling from modified aircraft paths.

W-74 *Nikolay Shabanov*

Monitoring Quality of VIIRS Vegetation Index (VI) EDR Retrievals With MODIS and AVHRR VI Data Using a Web-based Tool

Authors: Nikolay Shabanov, Marco Vargas

W-75 Data Access and Use *Sirish Uprety*

Radiometric Comparison between Suomi NPP VIIRS and AQUA MODIS using Extended Simultaneous Nadir Overpass in the Low Latitudes

Authors: Sirish Uprety, Changyong Cao, Slawomir Blonski, Xi Shao

VIIRS radiometric performance during early launch is studied using the extended Simultaneous Nadir Overpass (SNO) approach. The study uses MODIS as a reference to quantify VIIRS radiometric bias for reflective solar bands. SNOs in the low latitudes are extended over ocean and North African deserts to compare VIIRS channels M-1 through M-8 measurements with the matching MODIS bands. The study shows that there exists bias in several VIIRS channels primarily due to spectral differences as well as possible calibration uncertainties, residual cloud contamination and BRDF. Due to dual gain nature of most of the VIIRS channels analyzed, the bias trends observed at ocean are not consistent with that at desert. EO-1 Hyperion, NASA AVIRIS and MODTRAN are used to characterize the impact of spectral differences on VIIRS radiometric bias. The study shows that at ocean, VIIRS channels M-2, M-4, M-5 and M-6 have larger bias of more than 3% after accounting the impact due to spectral differences. The residual bias computed at desert suggests that VIIRS channels M-1 through M-8 agree with MODIS within 2%. In addition, VIIRS bias at the Antarctica Dome C site is used for validating the bias computed at desert. The bias estimated at Dome C agrees well (within 1%) with the bias estimated over desert. This study shows that SNO-X is a potential approach for continuous on-orbit calibration/validation of VIIRS. The performance of VIIRS imagery channels and thermal emissive channels will also be analyzed in future by using SNO-X technique.

W-76 Current and Future Direct Readout Services

Paul Seymour

High Rate Information Transmission And Emergency Managers Weather Information Network (HRIT/EMWIN)

Authors: Paul Seymour, Rob Wagner, and Santos Rodriguez

The Emergency Managers Weather Information Network (EMWIN) is a direct service that provides users with weather forecasts, warnings, graphics, and other information directly from the National Weather Service (NWS) in near real time. The Low Rate Information Transmission (LRIT) is a direct service that provides users with 3 channels of lower-resolution GOES East and West satellite imagery data, MTSAT IR imagery data, a copy of the GOES DCS and EMWIN broadcasts and selected products to remotely located user LRIT Terminals. The GOES-R series of satellites will combine the two services into a single HRIT/EMWIN—HRIT for High Rate Information Transmission broadcast service. HRIT/EMWIN will have a a larger data relay capacity of 400Kbps. This compares with the current LRIT service at 128 Kbps and EMWIN which transmits at 9.6 kbps on the GOES I-M (8-12) series and 19.2 kbps for the GOES-NOP (13-15) series. HRIT/EMWIN will also contain a re-broadcast of the GOES DCS data (DCSRB).

W-77 Current and Future Programs and Systems

Abhishek Agarwal

Design and Implementation of a Next-Generation Ground System for Jason/OSTM Mission

Authors: Abhishek Agarwal, Shahram Tehranian, Subir Vasanth, Ye Men, Inderjeet Saggu, Mark Sears, Desmond Smith, Angelo Wade

The National Environment Satellite, Data, and Information Service (NESDIS) develops, operates, and maintains the National Oceanic and Atmospheric Administration's (NOAA) operational environmental satellite programs. NESDIS has entered into a Memorandum of Understanding (MOU) with the National Aeronautics and Space Administration (NASA), the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), and France's Centre National d'Etudes Spatiales (CNES) on a joint effort named Ocean Surface Topography Mission (OSTM). The objective of this mission is to measure sea surface height by using a radar altimeter mounted on polar-orbiting satellites. It provides precise sea surface heights for determining global sea-level rise, ocean currents, and upper ocean heat contents. OSTM started with the Jason-2 satellite, and observations continue with the launch of the Jason-3 satellite. The Jason-3 satellite will carry instruments similar to Jason-2 as its baseline payload and will fly in the same orbit as Jason-2. The primary mission objective is to continue the same measurements as Jason-2 with equal or better performance. The Jason-3 satellite is currently planned to be launched in 2015. The NOAA/NESDIS Office of Systems Development (OSD) is in the process of re-architecting the existing Jason-2 Ground system, to provide new capabilities to simultaneously command and control Jason-2 and Jason-3 satellites. This next-generation consolidated ground system is called the NOAA Jason Ground System (NJGS) and will support the simultaneous operation of the Jason-2 and Jason-3 ocean surface topography missions. NJGS consists of several independent elements for spacecraft command and control, telemetry processing, and data archiving and distribution. The ground system processing elements are located at the Satellite Operations Control Center (SOCC), the Environmental Satellite Data Processing Center (ESPC), and the National Oceanographic Data Center (NODC) with its Comprehensive Large Array-data Stewardship System (CLASS) capabilities. The downlink and uplink stations - Command and Data Acquisition Stations (CDAS), are located in Wallops, Virginia and Fairbanks, Alaska. The NJGS also provides a Data Communications Network (DCN) that securely link NJGS components at NOAA with ground systems at EUMETSAT, CNES, and NASA/JPL. The DCN transfers commands, telemetry, and data products between the 4-Partners. The NJGS architecture significantly reduces ground system life-cycle costs; improves future standardization between ground system components; standardizes operation and maintenance of ground system equipment; provides reliable operations with hot backup and fault-tolerant component systems; provides significant IT security enhancements; and the ability to perform system hardware and software upgrades without incurring long system downtimes. This paper describes the design and development of various subsystems of NJGS, including the hardware and software architecture used to support mission critical applications for the Jason-2/Jason-3 mission.

W-78 Current and Future Programs and Systems

Abhishek Agarwal

Sustaining Ground System Operations for GOES-NOP Mission with GOES Enterprise Managed System (GEMS)

Authors: Shahram Tehranian, Abhishek Agarwal, Subir Vasanth, Keith McKenzie

The Geostationary Operational Environmental Satellite (GOES) provides a constant vigil for severe weather conditions over the United States and provides timely access to global environmental data to predict local weather events. The GOES operations ground equipment (OGE) is currently operating four GOES satellites - GOES-13 (GOES-East), GOES-15 (GOES-West), GOES-12 (GOES-South for coverage to the South American region), and GOES-14 (in on-orbit storage). The current constellation of GOES satellites is expected to be operational until 2020, after which GOES-R

will become the primary constellation. In order to increase the longevity of the GOES OGE, the Office of Systems Development (OSD) Ground Systems Division (GSD) developed a blade-based, scalable architecture called GOES Enterprise Managed System (GEMS). Since 2009, obsolete OGE components have been gradually migrated to GEMS, improving operational efficiency while reducing long-term operations and maintenance costs. The phased transition involved three critical components of the GOES OGE - Replacement Product Monitor (RPM), Sensor Processing System (SPS), and Consolidated Analysis Workstation (CAWS), which are located at Wallops Command and Data Acquisition Station (WCDAS), Fairbanks Command and Data Acquisition Station (FCDAS), Wallops Backup Unit (WBU), and NOAA Satellites Operational Facility (NSOF). GEMS provides an enterprise level architecture that significantly enhances performance, scalability and reliability of GOES OGE components. It uses x86 blades to provide a unified shared infrastructure that significantly reduces installation time, energy consumption, and maintenance costs. It encompasses latest virtualization technologies to simplify IT operations and streamline application deployment and migrations. It also provides enterprise backup capabilities to improve reliability of mission critical applications and data processing systems used for GOES. This paper provides an in-depth discussion on implementing state-of-the-art technologies to transition mission critical components of the GOES OGE to the GEMS architecture, thus enabling NOAA/NESDIS to efficiently and effectively operate the ground system for GOES NOP satellites.

W-79 Applications *Deirdre Kann*

Collaboration with NASA SPoRT: Supporting the Transition of New Satellite Products into NWS Operational Forecasting and Decision Support Services

Authors: Brian Guyer and Deirdre Kann

The Albuquerque NWS office entered a collaborative partnership with NASA's Short-term Prediction and Research Transition Center (SPoRT) in 2007. The NASA SPoRT program focuses on transitioning unique observations and research capabilities to the operational weather community to improve short-term forecasts on a regional scale. This collaboration has placed various NWS partners and university programs at the forefront to the future of advanced satellite analysis. The products made available by SPoRT have supported numerous operational programs at NWS Albuquerque by supplementing data void areas, enhancing decision support services, and expanding satellite training to the future capabilities of GOES-R. The collaborative transition of these unique satellite observations has provided valuable input not only for our operational products but also for our graphicasts, conference calls, emergency manager briefings, social media postings and media interviews. In particular, SPoRT products have improved the detection and monitoring of wildfire hot spots, smoke plumes, hazardous air quality, burn scars and subsequent flash flooding all associated with the record breaking wildfire seasons of 2011 and 2012. Improvements to nighttime satellite imagery have increased lead time for terminal aerodrome forecasts prior to the development of hazardous low cloud and fog events. The transition of CIRA/AMSU/SSMI precipitable water and percent of normal products have assisted in the advanced detection of moisture intrusions associated with significant flash flooding events during the summer monsoon. Collaboration between NASA SPoRT and the University of Alabama Huntsville provided NWS Albuquerque an opportunity to participate in an evaluation of satellite derived convective initiation. The successes demonstrated through collaboration between NASA SPoRT, the NWS, and various university programs have led to an increasing number of participating offices and product evaluations. Most recently, SPoRT has initiated an extension of our collaborative efforts beyond the NWS Southern Region to a "Front Range" collaboration including offices from Central and Western Regions. The most recent evaluation focuses on a suite of Red-Green-Blue (RGB) composite products developed by SPoRT and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). These composite products use MODIS as a proxy to future GOES-R capabilities. Additionally, new products currently being evaluated include RGB and high resolution hybrid composites of the GOES, MODIS, and Visible Infrared Imaging Radiomenter Suite (VIIRS) satellites. These proxy products focus on creating composite imagery to depict air mass, blowing dust, cloud microphysics, fog/stratus, snow cover, and true color. These products will be a focus of this presentation. Layered CIRA precipitable water products, expected later this year, will also be evaluated with the goal of improving critical fire weather forecasting. Initial results of the "Front Range" collaboration will be a second topic covered in this presentation.

W-80 Training *LeRoy Spayd*

Training in the NOAA Satellite Proving Ground – Getting Users Ready for Rapid Changes

Authors: LeRoy Spayd, Anthony Mostek, Brian Motta, James Gurka, Mark DeMaria, Tim Schmit

The GOES-R program is building a new series of satellites that will be used to support NOAA's environmental analysis, warning and prediction operations. User training for NOAA staff and the education of NOAA's many partners are critical to the success of current and future satellite programs. The critical role of training and education is clearly articulated in NOAA's Strategic Plan as the need to establish and maintain a

"World Class Workforce" and in the National Academy of Science report: "Weather Services for the Nation: Second to None" and the NWS "Weather Ready Nation". NOAA and its partners face many challenges to keep pace with rapid technological changes and to keep users informed and trained on how to utilize these new observations. If we fail in these critical user readiness efforts, NOAA and its partners face the prospect of being unprepared for the next Environmental Emergencies! To ensure that this does not happen in the area of satellite services, NOAA launched an active program called the GOES-R Proving Ground. The GOES-R Proving Ground began in 2008 and grew rapidly to include several critical programs involving many operational offices across NOAA. A critical component to the continued success of the Proving Ground is that training and user readiness activities are effectively integrated into the program. This Training Poster reviews the current plans of the NOAA satellite training program. The key steps needed to ensure that training and user readiness remains an integral part of the GOES-R Proving Ground program are shown. Satellite training is part of the ongoing success of the Proving Ground and will link to the new NWS Operational Proving Ground. The Training Division is taking several steps to prepare operational staff and partners for rapid changes as satellite products, dissemination and computer systems evolve:

- Work with the GOES-R Satellite Proving Ground to include training for data and products.
- Expand cooperative training programs to provide materials t hat reach a broad audience.
- Use innovative distance learning approaches that include interactive multimedia modules and simulation exercises.
- Use the Performance Development Series concept to focus on user performance and ensure that new products and tools are used effectively in the forecast, watch and warning programs.
- Build and enhance partnerships with key stakeholders as part of Weather Ready Nation for enhanced Decision Support Services.
- Engage users via monthly satellite training sessions and weather briefings and by providing access to education services (including testing, evaluation and certificates) using online libraries at COMET and the Commerce Learning Center.

W-81 Applications *Robert J. Kuligowski*

Validation and Improvement of the GOES-R Rainfall Rate Algorithm

Authors: Robert J. Kuligowski and Yaping Li

The Rainfall Rate Algorithm for the Geostationary Operational Environmental Satellite-Series R (GOES-R) Advanced Baseline Imager (ABI) was developed and tested using data from the METEOSAT Spinning Enhanced Visible InfraRed Imager (SEVIRI) because the current GOES Imager does not have all of the channels that will be utilized by the next-generation Rainfall Rate algorithm. However, evaluation of this algorithm has been limited because high-resolution, short-period rainfall data are not available over much of Europe and Africa. In response, a modified version of the GOES-R Rainfall Rate algorithm has been running in real time on the current GOES Imager over the entire GOES coverage area since August 2011. Validation against hourly Stage IV radar / gauge fields over the Conterminous United States (CONUS) will be presented, along with planned improvements to the algorithm that have been indicated by this evaluation.

W-82 Applications *Gary Jedlovec*

SPoRT Participation in the GOES-R and JPSS Proving Grounds

Authors: Gary Jedlovec, Kevin Fuell, Matthew Smith

For the last several years, the NASA Short-term Prediction Research and Transition (SPoRT) project at has been working with the various algorithm working groups and science teams to demonstrate the utility of future operational sensors for GOES-R and the suite of instruments for the JPSS observing platforms. For GOES-R, imagery and products have been developed from polar-orbiting sensors such as MODIS and geostationary observations from SEVIRI, simulated imagery, enhanced products derived from existing GOES satellites, and data from ground-based observing systems to generate pseudo or proxy products for the ABI and GLM instruments. The suite of products include GOES-POES basic and RGB hybrid imagery, total lightning flash products, quantitative precipitation estimates, and convective initiation products. SPoRT is using imagery and products from VIIRS, CrIS, ATMS, and OMPS to show the utility of data and products from their operational counterparts on JPSS. The products include VIIRS imagery in swath form, the GOES-POES hybrid, a suite of RGB products including the air mass RGB using water vapor and ozone channels from CrIS, and several DNB products. Over a dozen SPoRT collaborative WFOs and several National Centers are involved in an intensive evaluation of the operational utility of these products.

W-83 Current and Future Programs and Systems *John Petheram*

GOES-R Communication Subsystem

Authors: H. Silverman and T. Milbourne

GOES-R, to be launched in 2015, is the U.S. next-generation operational weather satellite system consisting of two Geostationary Satellites with one positioned at 75W longitude (GOES East) and one positioned at 137W longitude (GOES

West). The satellites will provide improved space weather and Earth image data, as well as, for the first time, lightning data. The GOES-R Communication System transmits raw data collected in space to the ground where it is processed into data products by the GOES-R ground system. Level 1b processed data is then uplinked to the satellite for distribution to the NOAA Satellite Operations Facility and other users for further processing. The Communication System also supports the global network Search And Rescue (SAR) system by receiving distress beacon signals and transmitting them to the in-view rescue ground stations for deployment of rescue personnel. In addition, the Communication System supports a network of remote autonomous ground stations with two transponders. The poster will provide details of the various communications links.

W-84 Current and Future Programs and Systems
Tiejun Chang

On-orbit Testing of MetOp-B AVHRR

Authors: Tiejun Chang, Xingqian Wu, Fuzhong Weng, Wei Guo, Felix Kogan, Xingming Liang , Alexander Ignatov

Following a successful launch of the Meteorological Operational (MetOp)-B spacecraft on September 17, 2012, on-orbit testing of its Advanced Very High Resolution Radiometer (AVHRR) has been performed. Tests included verification of the instrument performance and response, and five Cal/Val tests to improve the calibration and data quality. The tests for noise performance show that signal-to-noise ratio (SNR) in the visible channels, and NEdT in the IR channels meet the specifications. The instrument response and the dynamic range have been verified. The Cal/Val tests completed as scheduled, including checks for radiometric calibration and geo-location accuracy, stray light impact assessment, and consistency of brightness temperatures in the IR channels with other platforms sensors, using double-differences with the Community Radiative Transfer Model (CRTM) CRTM model calculations as a transfer standard. Following on-orbit verification of the instrument performance, calibration coefficients in the visible and near-infrared channel have been updated. Due to the lack of on-board calibrator, the post-launch calibration can only be carried out vicariously, using the Libyan Desert as a reference. The seasonal variation of Libyan Desert reflectance must be accounted for in the calibration. For early periods following launch, the seasonal variations were derived from previous AVHRR measurements. A new method was developed using the MetOp-A and MetOp-B inter-comparison, taking into account the BRDF effect, and applied to update the calibration. The derived calibration update has been verified by comparing NDVI from MetOp-B AVHRR measurement with those from the well-established MetOp-A product. In this paper, the post-launch test methods and results are presented.

W-85 Data Access and Use *Vaishali Kapoor*

Operational Ozone Products Available from NOAA/NESDIS

Author: Vaishali Kapoor

There are many agencies, groups and instruments making ozone products from satellites. This poster explains the operational ozone products produced by the US National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS) that are available to support near-real time operations. These products are used by United States and international environmental modeling groups for input into weather models, as input into other satellite algorithms to enhance radiative transfer models, as input for UV forecast models, and for climate monitoring. These products are available to users in a variety of formats such as BUFR, Binary, GRIB, GRIB2, and ASCII. Poster will also provide information on how to obtain operational access to these products. Poster will include the following products: NOAA currently produces near-real-time (NRT) total ozone and profile ozone products from the SBUV/2 instruments (The SBUV/2 instruments are non-scanning, nadir viewing (field-of-view directly below the satellite path) instruments designed to measure scene radiance in the spectral region from 160 to 400 nm) on the NOAA Polar-orbiting Operational Environmental Satellites (POES) NOAA-16 and NOAA-17, NOAA-18 and NOAA-19. The GOME-2 instrument was designed by the European Space Agency to measure radiation in the ultraviolet and visible part of the spectrum (240 - 790 nm) and derives measurements of atmospheric ozone and other trace gases. It is a scanning instrument (scan width 1920 km) with near global coverage daily. The field-of-view on the ground is 80 km X 40 km. NOAA/NESDIS is developing GOME-2 atmospheric chemistry products. TOAST is a near real-time operational ozone map generated by combining Advanced TIROS Operational Vertical Sounder (ATOVS) tropospheric and lower stratospheric (4 to 23 km) ozone retrievals with SBUV/2 spatially smoothed mid-to-upper stratospheric (24 to 54 km) layer ozone retrievals. Daily products are created in imagery (png), binary or GRIB format.

W-86 Data Access and Use *Awdhesh Sharma*

Noaa/Nesdis Sounding Systems Data Products and Services

Author: Awdhesh Sharma

The National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite Data and Information Service (NESDIS) provide vertical atmospheric

profiles of atmospheric soundings derived from Geostationary Operational Environmental Satellites (GOES) and Advanced TIROS (Television and Infrared Observation Satellite) Operational Vertical Sounding (ATOVS) systems. The GOES soundings are derived from the sounders aboard GOES West and GOES East. Operational ATOVS soundings are derived from the sensors aboard the NOAA-15, 18 and 19 series of Polar Orbiting Environmental Satellites (POES). The operational Infrared Atmospheric Sounding Interferometer (IASI) soundings are derived from the IASI instruments onboard the Metop-2 and Metop-1 satellites under the program managed by the European Organization for the Exploitation of Meteorological (EUMETSAT). In an effort to ensure consistent levels of service and quality assurance for these suites of products, the Office of Satellite Products and Services (OSPO) is implementing and executing new, innovative tools to better monitor performance and quality of the operational GOES and POES sounder and imager products being generated. The incorporation of these tools in both the Center for Satellite Applications and Research (STAR) and the OSPO will facilitate the joint diagnosis and resolution of problems when detected in the operational environment. This poster presentation will include several of these tools developed and deployed for the sounding products monitoring and data quality assurance which lead to improve the maintenance and sustainment of the Environmental Satellites Processing Center (ESPC) processing systems. The presentation will include the discussion on the ESPC system architecture involving sounding data processing and distribution for ATOVS, IASI, and GOES sounding products. Discussion will also include the improvements made for data quality measurements, granule processing and distribution, and user timeliness requirements envisioned from the next generation of satellites. There have been significant changes in the operational system due to system upgrades, algorithm updates, and value added data products and services. User requirements for GOES sounders, and ATOVS and IASI data products from the NOAA satellites and the MetOp-1 and MetOp-2 EUMETSAT satellites will also be discussed.

W-87 Current and Future Programs and Systems

Steven D. Miller

A Dynamic Enhancement Background Reduction Algorithm (DEBRA) Applicable to GOES-R ABI

Author: Steven D. Miller

This paper describes a new technique to mitigate traditional challenges associated with the detection of atmospheric properties over complex surfaces. Classic examples of challenging detection scenarios include low cloud/fog at night and mineral dust over barren (i.e., desert) surfaces. Here, the conventional multispectral techniques used for detection often produce widespread false alarm fields due to the surface exhibiting a similar spectral emission behavior to the atmospheric parameters of interest—limiting the utility of applications in these regions. The Dynamic Enhancement Background Reduction Algorithm (DEBRA) utilizes ancillary background information to flag and suppress false alarms associated with land surface artifacts (background reduction) while retaining a limited ability to detect the parameter of interest when present above these surfaces. The variable scaling across space and time provide the 'dynamic enhancement' element of DEBRA. The backgrounds utilized by DEBRA are comprised of either cloud-cleared composites or the University of Wisconsin/CIMSS Baseline Fit global surface emissivity database (derived from MODIS data and high resolution laboratory spectra for different surface types) customized to the sensor of interest. Global surface temperature climatology data from the NASA Modern Era Retrospective-analysis for Research and Applications (MERRA) have also been enlisted here to capture diurnal variability in the background fields. Versions of DEBRA configured to the detection of lofted mineral dust, low cloud/fog, and volcanic ash plumes have been applied to the EUMETSAT MSG/SEVIRI sensor. Similar capabilities will be applied to the expanded channel suite of the GOES-R ABI, including superior daytime performance by virtue of ABI bands 1 (0.47 μm; benefiting dust-over-water detection) and 4 (1.38 μm; benefiting cirrus detection). The underlying detection algorithms managed by DEBRA take advantage of multi-spectral information optimized for land/water backgrounds and blend day vs. night enhancements across the terminator for near-seamless transition and consistent interpretation. The detections are provided quantitatively as a confidence factor, but are readily visualized as value-added imagery, preserving the context of the meteorological/topographical situation. In this way, the algorithm is potentially useful to both automated processes and human analysts alike. DEBRA examples from SEVIRI observations of Saharan dust storms and comparisons to legacy detection methods are presented.

W-88 Current and Future Programs and Systems

Zhangyan Jiang

Developing a compositing algorithm for retrieval of green vegetation fraction from the Suomi NPP satellite

Authors: Zhangyan Jiang, Junchang Ju, Marco Vargas, Ivan Csiszar

Green Vegetation fraction (GVF) is defined as the fraction of a pixel covered by green vegetation if it were viewed vertically. Real-time weekly global GVF is needed in the numeric weather, climate and hydrological models. The current NOAA operational GVF product is derived from weekly AVHRR NDVI data, which are composited using the maximum-value compositing (MVC) method. MVC is a

widely used technique to remove cloud and atmospheric contamination over land surface by selecting the observation of the maximum NDVI in a compositing period. However, it is well documented that the maximum NDVI is often selected from high sensor zenith angles, which may introduce error in GVF retrieval. To reduce the composite sensor zenith angles, a view angle adjusted soil-adjusted vegetation index, instead of NDVI, is proposed as the criterion of compositing in this study. Compared with MVC, the new compositing method reduced sensor zenith angles significantly and high (not necessary maximum) NDVI and EVI values were retained.

W-89 Current and Future Programs and Systems

Jingfeng Huang

Validation of Suomi NPP/VIIRS Operational Aerosol Products through Multi-Sensor Intercomparisions

Authors: Jingfeng Huang, I. Laszlo, S. Kondragunta, H. Liu, H. Cronk, H. C. Huang, L. Remer, H. Zhang, P. Ciren, S. Jackson, C. Hsu, A. M. Sayer, M. Oo, R. E. Holz, E. J. Hyer, L. Munchak, R. Levy, S. Mattoo, M. Petrenko, C. Ichoku, R. Kahn, and A. Smirnov

The Suomi National Polar-orbiting Partnership (NPP) Visible Infrared Imaging Radiometer Suite (VIIRS) instrument began collecting data shortly after its launch in October 2011 and its aerosol products have been available at a beta maturity state beginning in May 2012. The NPP/VIIRS operational aerosol products include aerosol optical depth (AOD) at 11 wavelengths, aerosol size parameter (Ångström Exponent, AE) and type-related information (Suspended Matter). VIIRS aerosol retrieval is performed at moderate resolution pixel level (~0.75 to 1.6 km from nadir to edge), and aggregates to ~6 to 12.8 km resolution for the Environment Data Record products. To use this newly released data in numerical weather prediction and to build it into long-term aerosol climate record requires a thorough characterization of the aerosol products, particularly in comparison to the preceding established well-characterized aerosol products. This talk highlights the multi-sensor intercomparison approach that is currently used for the calibration/validation (Cal/Val) of the VIIRS aerosol products. The aerosol products are compared with multiple ground (Aerosol Robotic Network, AERONET) and spaceborne (MODIS, MISR, CALIPSO, etc.) sensors, and similarities and discrepancies are discussed. The Cal/Val results indicated that VIIRS achieves comparable performance to MODIS in terms of observing spatial and temporal variability of global aerosols. In comparison to MODIS and AERONET, the VIIRS AOD retrieval algorithm performs better over ocean than over land, and improvements were made continuously to ensure the quality of the dataset. More detailed data analyses are currently underway to further improve the algorithms. The most updated results from the ongoing extended evaluation will be reported at the conference. It is expected that through intensive Cal/Val activities and algorithm refinements, the NPP/VIIRS aerosol products will prove a valuable asset to the data user community in meeting the operational and research needs of air quality, weather forecasting, and climate impact studies.