Utilization of Suomi NPP data at the Met Office (UK).

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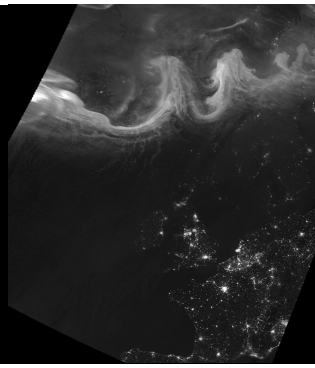

1. About the Met Office (UK)

The Met Office is the UK's National Weather Service. Our history of weather forecasting goes back to our foundation in 1850. We have also been working in the area of climate change for more than two decades.

As a world leader in providing weather and climate services, we employ more than 1,800 staff at 60 locations throughout the world. We are recognised as one of the world's most accurate forecasters, using more than 10 million weather observations a day, an advanced atmospheric model and a high performance supercomputer to create 3,000 tailored forecasts and briefings a day. These are delivered to a huge range of customers from the Government, to businesses, the general public, armed forces, and other organisations.

Satellite data, along with other observations, fundamentally underpin our entire forecasting capability. Suomi NPP is the latest in a long heritage of US polar orbiting satellites operating in the afternoon orbit that provide vital data for our forecasters and our numerical weather prediction (NWP) facility.

2. The Suomi NPP Satellite

Suomi NPP (figure 1) was launched on 25 October 2011. The satellite carries a variety of earth observation instruments. Of most interest to the Met Office (UK) are the microwave and infrared sounders ATMS and CrIS along with VIIRS - a Visible and Infrared imager.

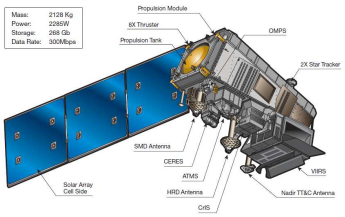

Figure 1. *Suomi NPP in orbit configuration © NASA.*

3. Reception and pre-processing of data

Suomi NPP data are received at the Met Office via direct broadcast, EUMETCast and the EUMETSAT regional EARS service. Pre-processing of NPP data is performed using the following software:-

- AAPP (ATOVS and AVHRR Prep-processing Package), which is developed by Met Office as part of its NWP SAF contribution
- CSPP (Community Satellite Processing Package), which is developed by University of Wisconsin.

ATMS and CrIS sounder data are stored in our meteorological database (MetDB) for later use in NWP. VIIRS data is used to generate imagery "on the fly" for the UK and Western Europe.

Figure 2. *Upgrade of the Met Office direct broadcast reception facilities at Exeter HQ. Our two polar orbiting satellite tracking antennae were upgraded to enable X-band reception specifically for the reception of Suomi NPP data.*

4. NWP Facility

For NWP, the pre-processed Suomi NPP data from ATMS and CrIS are quality controlled and then assimilated using our Observations Processing System (OPS) and the 4D Var assimilation system, which both run on the IBM Power 7 supercomputer at Met Office HQ in Exeter. This results in an "analysis", which is our best estimate of what the atmosphere is like at the analysis time and is used to initialise the forecast model.

Without a continual supply of high quality data from microwave and infrared sounders, the Met Office would not be able to maintain its record as a leading global forecasting centre.

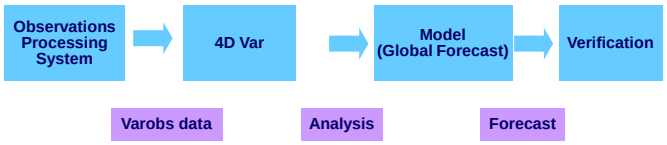

Figure 3. *The Met Office NWP system. NB. Varobs are quality controlled observations that are suitable for assimilation (use in 4D Var).*

5. Utilization of VIIRS imagery.

VIIRS data have been integrated into our polar obiter imagery system alongside Aqua and Terra MODIS, and NOAA AVHRR. From the raw data received by direct broadcast we produce a range of products for forecasters. In addition, we produce novel products such as night time fog imagery (figure 4). We are also currently experimenting with other imagery products using the day/night band (e.g. figure 5) and are using the University of Wisconsin's reflectance correction package CREFL v1.7.1 to remove Rayleigh scattering in visible channels (e.g. Figure 6). In future, we also plan to utilize the EUMETSAT EARS-VIIRS service for global imagery.

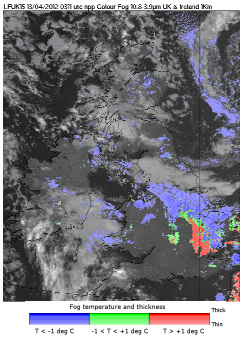

Figure 4. *VIIRS imagery of night time fog (red/blue) over the UK and Ireland.*

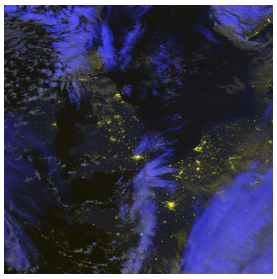

Figure 5. *VIIRS cloud/lighting imagery over the UK and NW France produced using day/night band data (yellow) and IR (blue) data. The cloud contrast is quite striking.*

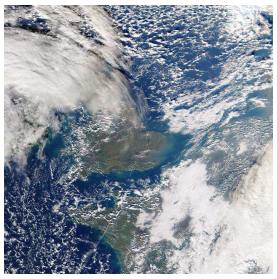

Figure 6. *VIIRS true colour image of the UK and NW France. Produced using CREFL v1.7.1 (U. Wisconsin) and in-house reprojection routines.*

6. Utilization of ATMS and CrIS data in NWP

ATMS data is of good quality generally and gives a good positive impact on forecasts, even when added to a full observing system in which data from four AMSU instruments are currently assimilated. This impact comes despite an instrument problem which introduces spatially correlated errors (stripes) into the observations as shown in figure 7.

Future work to better exploit additional channels, optimise thinning, tune quality control and make use of EARS-ATMS is expected to further improve the contribution of ATMS to the NWP system.

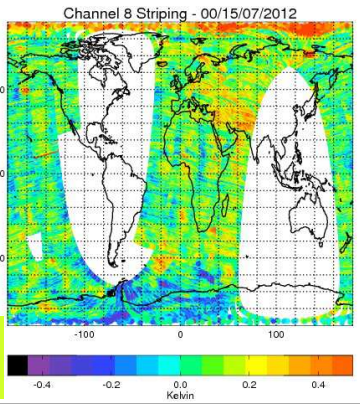

Figure 7: *Striping in ATMS channel 8 (54.94 GHz) is revealed in the observation(bias corrected)-background temperature differences (K).*

CrIS data were found to be of excellent quality and gave a modest impact on our NWP skill scores. Future use of EARS-CrIS is expected to further improve scores.

The combined impact on our NWP performance of both ATMS and CrIS together is shown in figure 8. The RMS forecast error was reduced by over 0.5% leading to a good impact on our performance index of 0.3 for both instruments.

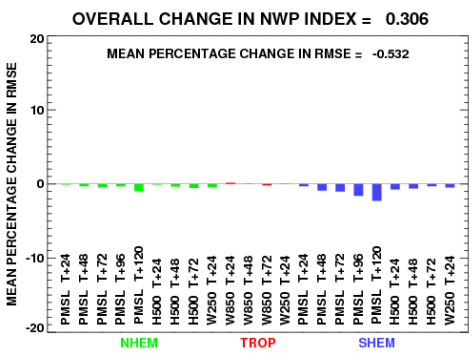

Figure 8: *The impact of both CrIS and ATMS on our NWP performance verified against observations. These results were obtained in a recent parallel suite trial prior to both instruments being operationally assimilated.*

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