Satellite Observations of CH_4 using CrIS and its comparison with AIRS and IASI

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1. INTRODUCTION

The Cross-track Infrared Sounder (CrIS) on the NPP/JPSS in conjunction with Atmospheric InfraRed Sounder (AIRS, since August, 2002), the Infrared Atmospheric Sounding Interferometer (IASI, since 2008) can provide realistic 4-D concentrations of CH_4 over 20 years. This unique data set will help to monitor the CH4 change associated with global change, particularly the permafrost thawing, clathrate in the Arctic regions.

2. CH_4 Retrieval from CrIS/AIRS/IASI

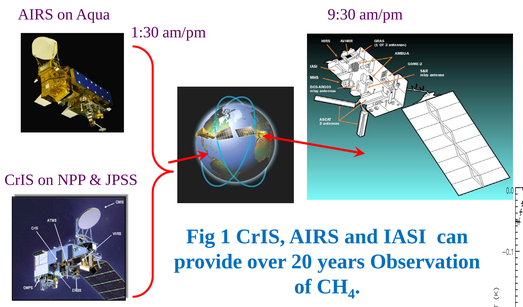
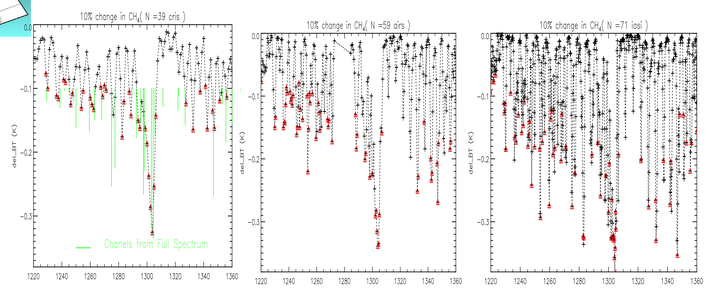


Fig 1 CrIS, AIRS and IASI can provide over 20 years Observation of CH_4.

- **Better channels are available from finer spectral resolution; → Full spectrum of CrIS data is required to get a parallel CH_4 product as AIRS and IASI;**
- **Precision is ~1.5%; sensitive to 150-700 hPa.**



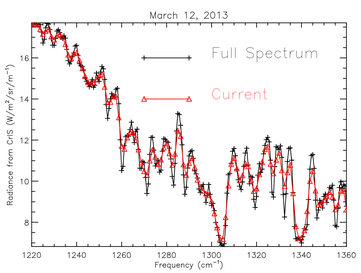
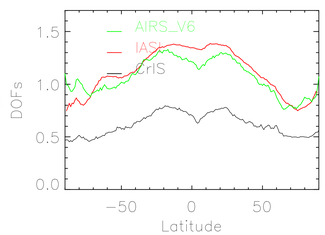
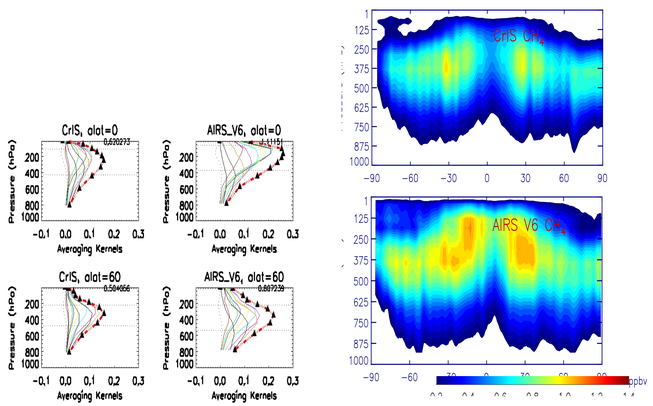


Fig 2 Upper panels are channels used for CH4 retrievals (change of DT for 10% change of CH_4); Current CrIS CH_4 has less Degree of Freedom (right) and Better channels can be available from CrIS spectrum (right).





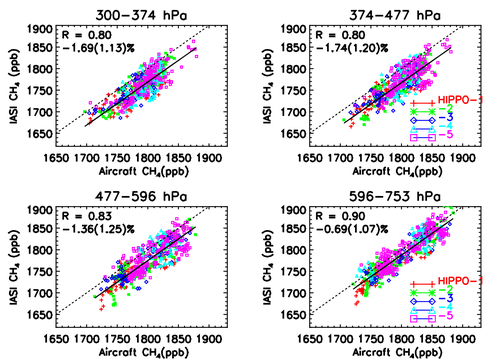
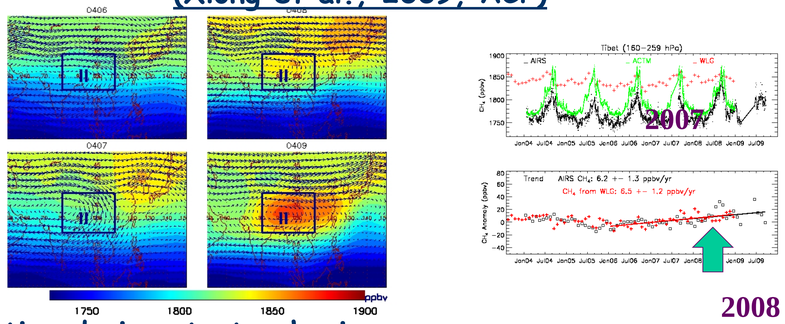


Figure 3 The averaging kernels for CrIS and AIRS (left), area of averaging kernels in differ latitudes (middle) and Validation to IASI products on NOAA CLASS system (Xiong et al., 2013, AMT)

3. Highlights of Some Results

3.1. Strong enhancement over the South Asia in Monsoon Season (Xiong et al., 2009, ACP)

Fig.4 Spatial distribution of MUT-CH_4 over south Asia in summer (left), its seasonal variation (upper right) and trend (lower right).



3.2. Detection of CH_4 depletion during stratospheric Intrusion (Xiong et al., 2013, GRL)

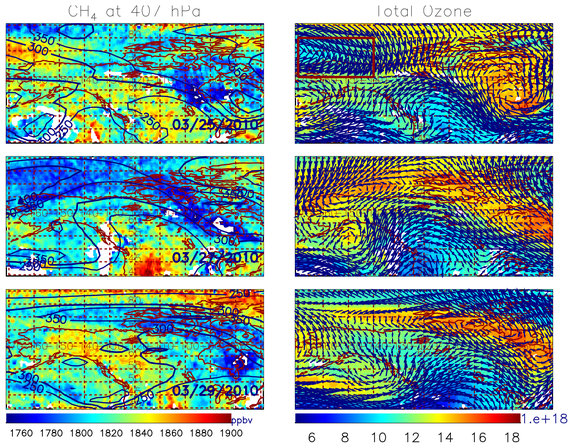


Figure 5 Distribution of CH_4 from AIRS at 407 hPa and the contour of tropopause (left panels) and total ozone amount from AIRS (overlaid with wind vectors at 400 hPa, right panels) for three days on 3/25, 3/27, and 3/29/2010. Dark blue regions in the left panels are air masses with low CH_4 impacted by stratospheric intrusion, and the enhancement of ozone is evident in the corresponding regions in the right panels.

3.3. Significant Increase of MUT-CH_4 is about one year delayed as compared to CH_4 in MBL) (Xiong et al., Remote Sensiong, 2010)

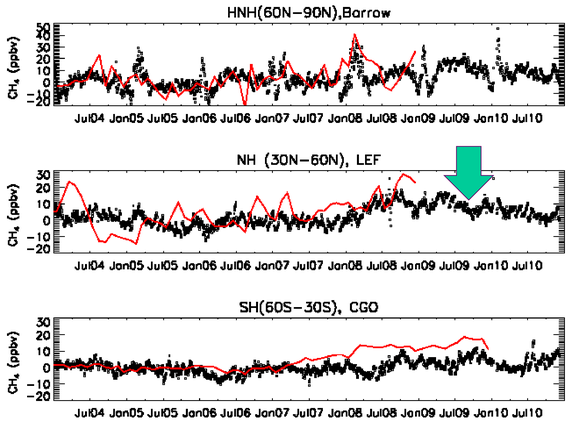


Fig. 6 The time series AIRS MUT-CH_4 (black) and its comparison with CH_4 in the MBL (red) in HNH, NH and SH.

- **To develop a good CH_4 products with finer spatial resolution over the Arctic will be very valuable;**
- **More research (including CH_4 Spectroscopy and RTA error and better QC) needs to be done to make a consistent product among AIRS, IASI and CrIS;**
- **NOAA is very engaged in the Carbon retrieval from hyperspectral sounders and we welcome any collaboration on the retrieval, validation and data analysis.**

Acknowledgments:

Ground measurement CH_4 data are from NOAA/ESRL/GMD and GLOBALVIEW-CH4: Cooperative Atmospheric Data Integration Project - Methane. CD-ROM, NOAA ESRL, Boulder, Colorado [Also available on Internet via anonymous FTP to ftp.cmdl.noaa.gov, Path: ccg/ch4/GLOBALVIEW], 2009, HIPPO aircraft data from Steve Wofsey and the team