Global distributions of IASI-CH_4

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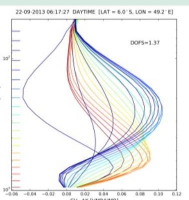
ABSTRACT : The IR team of BIRA has developed an automatized processing chain for **the fast retrieval of tropospheric IASI CH_4 profiles** with the **ASIMUT** Optimal Estimation Method (**OEM**) retrieval software [1]. Here we give a **quality assessment** of this new BIRA IASI CH_4 product and results of its **validation** with co-located **NDACC** ground-based observations. In addition first results will be shown of a **comparison**, on a **global scale**, with the **IASI mid-tropospheric CH_4** product from Laboratoire de Météorologie Dynamique (**LMD**), that have been obtained as part of the ESA Climate Change Initiative Greenhouse Gas (**GHG-CCI**) project.

IASI-CH_4 RETRIEVAL, RESULTS and INFORMATION CONTENT

Spectral range	1210 - 1290 cm^{-1}
Spectroscopy	HITRAN 2008
p, T, RH	IASI L2 product
State vector	CH_4, T_{surf}, H_2O, N_2O, CO_2
Emissivity	Zhou et al. [2]



Tbl.1 : BIRA IASI-CH_4 **retrieval set-up** and typical **IASI-CH_4 averaging kernel** (AK). **Sensitivity** of the retrievals lies in the **4-17 km altitude** range.

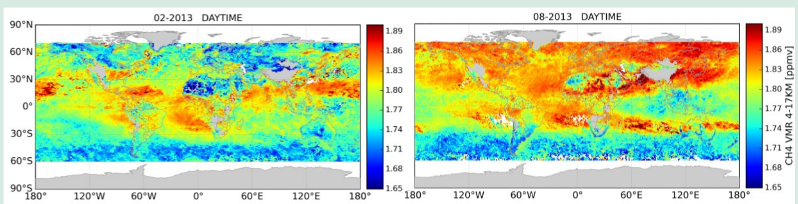


Fig. 1 : Monthly mean column averaged BIRA IASI-CH_4 between **4 and 17 km** for **February** and **August 2013**. Only **daytime** retrievals are shown. We see a clear increase in CH_4 at high latitudes in NH summer probably due to **increased wetland emissions**.

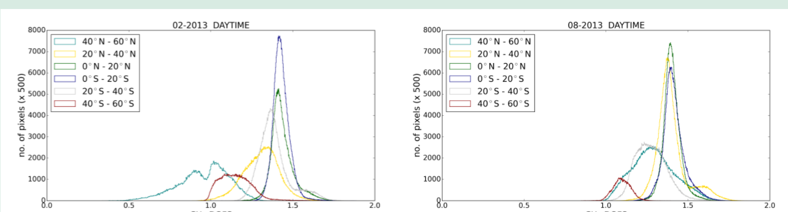


Fig. 2 : Degrees Of Freedom for Signal (DOFS) for different latitudinal bands for **February** and **August 2013** (daytime retrievals). On the global scale, the values range between 1 and 1.7 for NH summer, and between 0.5 and 1.7 for NH winter, when values can become less than 1 for latitudes > 40° N (between 0.9 and 1.6, and between 0.35 and 1.6 respectively for nighttime retrievals; not shown here). In the **tropics**, DOFS are typically **around 1.4**, hence 1 atmospheric column is retrieved.

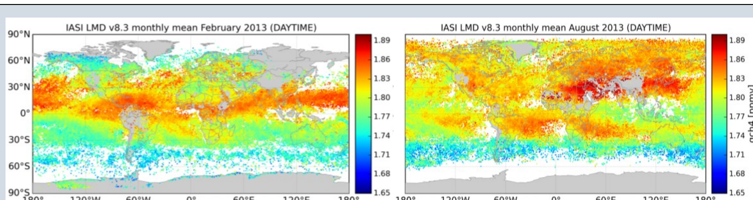


Fig. 7 : Monthly means of the **LMD v8.3** IASI-CH_4 **daytime** product for **February** and **August 2013**. Given is the so-called **qCH_4** in vmr, a mid-tropospheric column with peak sensitivity at about 230 hPa (~11 km) and half the peak sensitivity at 100 and 500 hPa (~6 and 16 km). The **LMD IASI-CH_4** retrievals are based upon a non-linear regression inverse radiative transfer model using Multi-Layer Perceptrons [3]. Comparing Fig. 7 to Fig. 1 we see that similar features in the CH_4 distribution are captured by the two algorithms.

VALIDATION with NDACC

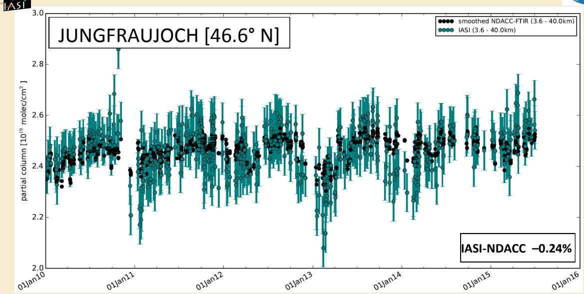


Fig. 4 : Timeseries of smoothed **NDACC FTIR CH_4 [black]** and **BIRA IASI-CH_4 [blue]** partial columns (surface-40 km) at Jungfraujoch. The vertical bars represent the retrieval error. The NDACC FTIR profiles are **smoothed with the IASI AK** and a common a priori profile is used for both IASI and NDACC retrievals. We see a **good representation of the seasonal cycle** by IASI and a mean relative difference of -0.24%.

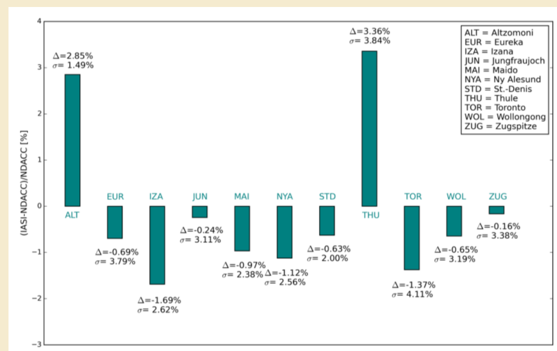


Fig. 5 : Barchart of **smoothed NDACC-IASI CH_4** partial columns (surface-40 km) at **11 NDACC sites** for the timeperiod **2010-2015**. The mean (IASI-NDACC)/NDACC (Δ) and standard deviation (σ) of the relative differences is given for each site. We have an overal negative bias for IASI < 1.7% with exception of the sites Altzomoni and Thule, who show a positive bias.

COMPARISONS with IASI-LMD CH_4

As part of ESA GHG-CCI the **BIRA IASI CH_4** fields are compared to the **LMD CH_4** product on a **global scale**.

For the comparison the BIRA qCH_4 is calculated as :

$$q_{BIRA} = \frac{\sum_{i=1}^{n} H_i \Delta p_i x_i}{\sum_{i=1}^{n} H_i \Delta p_i}$$

where H_i is the LMD weighting function interpolated to the BIRA pressure grid. n is the number of BIRA pressure layers Δp_i and x_i the BIRA CH_4 profile in vmr.

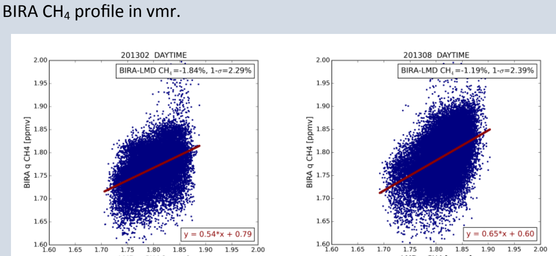


Fig. 6 : Correlation plots of **LMD qCH4** and **BIRA qCH_4** for February and August 2013. We see overal lower values of BIRA qCH4 wrt LMD qCH4 with relative differences of -1.84% for February and -1.19% for August, and a standard deviation (1-σ) of the difference below 2.4%.

ACKNOWLEDGEMENT : The work presented is funded by the **IASI.Flow** PRODEX program and by the **ESA GHG-CCI** project.

[1] Vandaele, A.C., et al., Modelling and retrieval of Atmospheric spectra using ASIMUT in Proc. of the First 'Atmospheric Science Conference', ESRIN, Frascati, Italy, 8 – 12 May 2006.
[2] Zhou, D. K., Larar, A. M., Liu, X., Smith, W. L., Strow, L. L., and Yang, P.: Global land surface emissivity retrieved from satellite ultraspectral IR measurements, IEEE T. Geosci. Remote, 49, 1277–1290, 2011.
[3] Crevoisier, C., Nobileau, D., Fiore, A., Armante, R., Chédin, A., and Scott, N. A.: Tropospheric methane in the tropics - first year from IASI hyperspectral infrared observations, Atmos. Chem. Phys., 9, 6337-6350, 2009.