Assessment of methane using the IASI instrument

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A. Introduction and previous work

Because of their good spatial coverage, satellite observations are appropriate to reach a better understanding of the sources and the spatio-temporal variability of methane. The remote sensing measurements will help to quantify its impact on climate change.

In order to retrieve CH_4 concentrations, we are working with two complementary retrieval tools. A neural network (SA-NN), designed at the SA [1], is firstly used to assess global distributions of methane total columns with a short execution time. Secondly, the *Atmosphit* software, based on the Optimal Estimation Method (OEM) [2] and developed at the ULB, provides vertical profiles and characterizations.

These retrieval tools have already been used to treat other trace gases during the 9 month of data collected in 1996-1997 by the IMG (*Inteferometric Monitor for Greenhouse gases)* instrument [3,4]. This instrument is considered as a predecessor of IASI because of its similar instrumental characteristics (nadir geometry, spectral range from 665 to 2500 cm-1) and a better resolution of 0.1 cm-1.

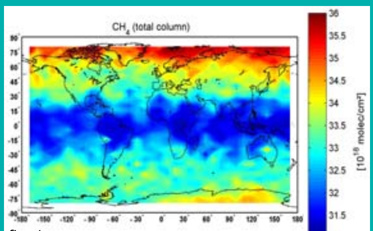

fig. 1

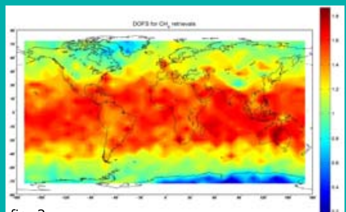
fig. 2

Figure 1 presents the global distribution obtained by the NN for the 10 first days of April 1997 where the north-south gradient can be seen. The characterization provided by *Atmosphit* in term of DOFS which represents the number of independent vertical information is shown on fig 2.

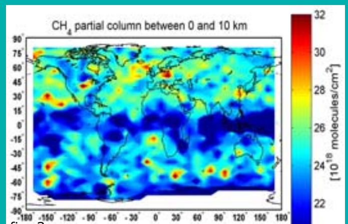

fig. 3

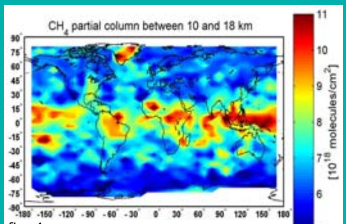

fig. 4

This DOFS values, reaching a maximum of 1.9, allowed us to differentiate two partial columns: from the ground to 10 km (fig. 3) and from 10 to 18 km (fig. 4). The north-south gradient is still observed in the lower troposphere and in the upper part, the tropical accumulation is due to the higher tropopause in this region.

B. IASI first results

The extended spectral range of IASI allows the retrieval of methane concentrations in two different spectral bands. Figure 5 illustrates the two regions used with the contribution of the v4 and v3 CH_4 absorption bands respectively and their best fit residuals.

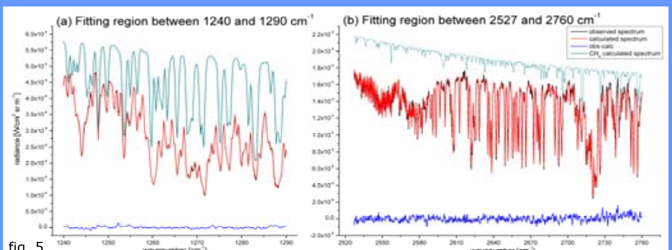

fig. 5

Due to the influence of solar radiation to wavenumber greater than 2500 cm-1, the additional inversion of the 2527-2760 cm-1 spectral region increases the sensibility in the boundary layer depending on the sunshine and the surface type. The averaging kernels calculated for a South-Pacific spectrum recorded on January 15, 2007 (fig. 6) illustrate this improvement and the resulting methane profiles on figure 7 exhibit a difference near the Earth's surface.

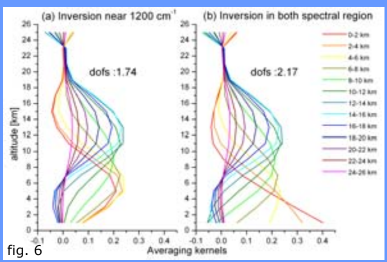

fig. 6

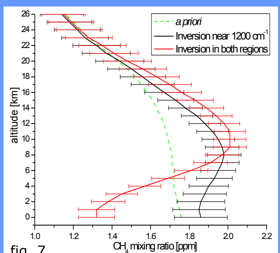

fig. 7

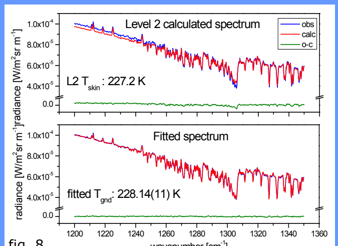

fig. 8

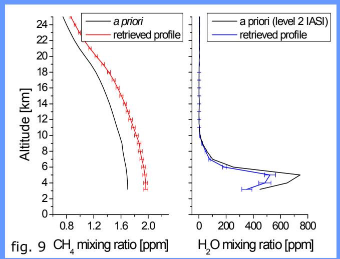

fig. 9

Figure 8 presents the spectrum calculated with the level 2 temperature and water vapor profiles provided by the Eumetsat ground segment (above) and the spectrum fitted for T_{gnd}, H_2O, N_2O, CH_4 and HNO_3 (beneath) of an Antarctic observation (lat: -74.9, long: 119.2). The resulting profiles of CH_4 and H_2O are shown on fig. 9 where the retrieved water vapor is about 40 % weaker than the *a priori* level 2 profile.

C. Work in progress

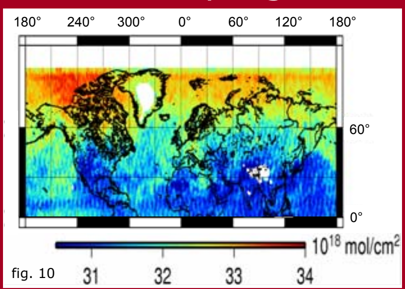

fig. 10

The northern distribution of CH_4 total columns obtained with SA-NN for the ten first days of September is shown on figure 10. An angle correction has been implemented to take the IASI swath into account but the satellite trace can still be seen. Moreover, the total columns in the southern hemisphere are abnormally high and this needs to be further investigated.

► Further work includes a new training of the SA-NN code in order to better represent the methane variability, as well as a detailed investigation of the information supplied by the spectral region situated above 2500 cm-1.

References :

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