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The recent increase of methane as seen by IASI onboard MetOp-A in the tropical band

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Since July 2007, monthly averages of mid-tropospheric methane are retrieved in the tropics over land and sea, by day and night, in clear-sky conditions from the Infrared Atmospheric Sounding Interferometer (IASI) flying onboard MetOp-A, yielding a complete view of the geographical distribution, seasonality and long-term tendency of methane in the mid-troposphere.

With its high spectral resolution, IASI provides nine channels in the 7.7 μm band highly sensitive to CH_4 with reduced sensitivities to other atmospheric variables. However, infrared radiances being sensitive to both temperature and methane, simultaneous observations from the Advanced Microwave Sounding Unit (AMSU) also flying onboard MetOp-A and sensitive to temperature only are used to help decorrelating both signals through a non-linear inference scheme based on neural networks. A key point of this approach is that no use is made of prior information in terms of gas seasonality, trend, or geographical patterns. The precision of the IASI retrieval is estimated to be about 20 pbbv (1 month, $5^\circ \times 5^\circ$).

Retrieved methane displays a clear seasonal cycle of 25 ppbv in the northern tropics, with a maximum in November and a minimum in April-May, a more complex cycle of 15 ppbv in the southern tropics, and a South-to-North gradient of 30 ppbv. The retrievals are in good agreement with simulations from atmospheric transport models, which help analysing the signatures of surface emissions transported to the mid-troposphere, and to aircraft measurements.

In 2007 and 2008, IASI shows an increase of mid-tropospheric methane of 9.5 ± 2.8 and 6.3 ± 1.7 ppbv yr^{-1} respectively, in good agreement with the rate of increase measured at the surface after almost a decade of near-zero growth. IASI also indicates a slowing down of this increase in the following years, with methane reaching a near-zero increase in 2010. This result might indicate a decrease in methane surface emissions in the tropics (predominantly wetlands and biomass burning).

With the launch of two other successive IASI-like instruments scheduled for 2012 and 2016, more than 20 years of observations of mid-tropospheric methane will be available for climate studies.