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Distribution of Methane in the tropics from MetOp/IASI hyperspectral infrared observations

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The Infrared Atmospheric Sounding Interferometer (IASI) launched onboard the European MetOp platform in October 2006 provides new information on methane (CH4) distribution in the mid-troposphere and gives the opportunity to follow the recent evolution of CH4 concentration. In May 2010, 34 months of IASI observations will have been interpreted in terms of methane distribution.

With its high spectral resolution, IASI provides ten channels in the 7.7 μm band highly sensitive to CH4 with reduced sensitivities to other atmospheric variables. We use coupled observations in the thermal infrared from IASI, and in the microwave from the Advanced Microwave Sounding Unit (AMSU), also launched onboard MetOp, to retrieve mid-to-upper tropospheric contents of methane (CH4) in clear-sky conditions, in the tropics. Thermal observations, sensitive to both temperature and CH4, are used in conjunction with microwave observations, only sensitive to temperature, to decorrelate 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 1%.

Features of the retrieved CH4 space-time distributions include: (1) a CH4 trend of ∼10 ppbv.yr-1 in the last couple of years, which confirms the recent increase of methane detected at surface stations; (2) a strong seasonal cycle in the northern tropics, and a lower seasonal cycle in the southern tropics, in agreement with in-situ measurements; (3) a latitudinal decrease from 20 N to 20 S lower than what is observed at the surface but in agreement with tropospheric aircraft measurements; (4) geographical patterns in good agreement with simulations from the TM5 atmospheric transport and chemistry model; (5) signatures of CH4 emissions transported to the troposphere such as a large plume of elevated tropospheric methane south of the Asian continent, which might be due to Asian emissions from rice paddies uplifted by deep convection during the monsoon period and then transported towards Indonesia.