Geophysical Research Abstracts
Vol. 21, EGU2019-4444, 2019
EGU General Assembly 2019


# Improved understanding of global methanol sources and sinks using novel atmospheric constraints

Trissevgeni Stavrakou (1), Jean-François Müller (1), Bruno Franco (2), Lieven Clarisse (2), Maite Bauwens (1), Pierre-François Coheur (2), Cathy Clearbaux (2,3)

(1) Royal Belgian Institute for Space Aeronomy, Brussels, Belgium (jenny@oma.be), (2) Université libre de Bruxelles (ULB), Service de Chimie Quantique et Photophysique, Atmospheric Spectroscopy, Brussels, Belgium, (3) LATMOS/IPSL, Sorbonne Université, UVSQ, CNRS, Paris, France

Methanol is identified as a major organic compound in the atmosphere, second in abundance after methane. It plays a key role in tropospheric chemistry through its influence on the OH levels in the boundary layer, and its contribution to the ozone cycling, but also as a significant atmospheric source of formaldehyde and carbon monoxide upon oxidation by OH. Methanol is released primarily during plant growth with measured concentrations over forests reaching several ppb. Oceans are recognized as another important methanol source, although this contribution is largely counterbalanced by deposition, resulting in a low net oceanic sink. Aside from natural sources, methanol is directly released from vehicles, industrial activities and biomass burning at much lower rates. Photochemical production of methanol occurs through methylperoxy radical ($CH_3O_2$) self- and cross-reactions with other organic peroxy radicals and via the oxidation of $CH_3O_2$ by OH. Based on recent estimates, the ocean and the terrestrial source represent 70% of the total methanol flux, and the secondary source is responsible for 20% of the global total. There is, however, a large uncertainty regarding the magnitude and distribution of these sources.

New insights into our understanding of methanol sources and sinks are brought forward by methanol column observations retrieved from the IASI satellite sensor. The new IASI dataset is based on an improved version of the Artificial Neural Network for IASI (ANNI) retrieval framework, which relies on a hyperspectral range index (HRI) for the quantification of the gas spectral signature and on an artificial feedforward neural network to convert the HRI into a gas total column (Franco et al. 2018). Here, monthly observations over seven years (2011-2017) are used. The IASI data are first validated against ground-based observations and aircraft campaign data. To interpret the IASI dataset, multiannual model simulations with the MAGRITTEv1.0 (Müller et al. 2018) global and regional chemistry-transport model are performed.

This model incorporates a revised deposition scheme as well as updated chemical sources and sinks of methanol. The consistency between the model, IASI observations, aircraft mission data (D3C, SENEX, SEAC$^4$RS, KORUS-AQ, ATom), in situ surface measurements, as well as ground-based methanol column data is carefully assessed. Furthermore, we use the adjoint model technique to infer updated methanol source strengths and their seasonal variability. The IASI-derived fluxes are compared with previous (inverse) modeling studies, and independent measurements are used to evaluate the inversion. The combination of multi-platform observations with models can help reducing the uncertainties in the knowledge of the methanol distribution and budget.