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The influence of biogenic emissions on upper-tropospheric methanol as revealed from space

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Abstract. The distribution and budget of oxygenated organic compounds in the atmosphere and their impact on tropospheric chemistry are still poorly constrained. Near-global space-borne measurements of seasonally resolved upper tropospheric profiles of methanol (CH_3OH) by the ACE Fourier transform spectrometer provide a unique opportunity to evaluate our understanding of this important oxygenated organic species. ACE-FTS observations from March 2004 to August 2005 period are presented. These observations reveal the pervasive imprint of surface sources on upper tropospheric methanol: mixing ratios observed in the mid and high latitudes of the Northern Hemisphere reflect the seasonal cycle of the biogenic emissions whereas the methanol cycle observed in the southern tropics is highly influenced by biomass burning emissions. The comparison with distributions simulated by the state-of-the-art global chemistry transport model, LMDz-INCA, suggests that: (i) the background methanol (high southern latitudes) is correctly represented by the model considering the measurement uncertainties; (ii) the current emissions from the continental biosphere are underestimated during spring and summer in the Northern Hemisphere leading to an underestimation of modelled upper tropospheric methanol; (iii) the seasonal variation of upper tropospheric methanol is shifted to the fall in the model suggesting either an insufficient destruction of CH_3OH (due to too weak chemistry and/or deposition) in fall and winter months or an unfaithful representation of transport; (iv) the impact of tropical biomass burning emissions on upper tropospheric methanol is rather well reproduced by the model. This study illustrates the potential of these first global profile observations of oxygenated compounds in the upper troposphere to improve our understanding of their global distribution, fate and budget.

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