Geophysical Research Abstracts
Vol. 18, EGU2016-8206, 2016
EGU General Assembly 2016

Summertime mid-to-upper tropospheric nitrous oxide over the Mediterranean as a footprint of Indian emissions

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We used global scale thermal infrared measurements of mid-to-upper tropospheric nitrous oxide (N2O) from the Greenhouse gases Observing SATellite (GOSAT) and outputs from the 3D Chemical Transport Model LMDz-OR-INCA to assess the impact of the Indian subcontinent N2O emissions on the N2O field over the eastern Mediterranean Basin (MB) during summer. The use of nitrogen fertilizer coupled with high soil humidity during summer monsoon period produce high emissions of N2O in many south Asian countries and especially the Indian subcontinent. N2O is transported to the upper troposphere by updrafts associated to the monsoon and redistributed westward to the eastern Mediterranean via the Asian Monsoon Anticyclone. This summertime (June-July-August) enrichment in N2O in the eastern Mediterranean produces a maximum in the east-west difference of MB mid-to-upper tropospheric N2O anomaly representative for the period 2010-2013 with a maximum in July and a peak-to-peak amplitude of $\sim$1.0 $\pm$ 0.3 ppbv observed by GOSAT consistently with LMDz-OR-INCA but less intense ($\sim$0.5 ppbv). This summertime enrichment of N2O over the eastern Mediterranean is consistent with the increase of the surface emissions and the convective precipitations over the Indian subcontinent during the summer monsoon period. N2O over the eastern Mediterranean can therefore be considered as a footprint of Indian summertime emissions.