What controls the seasonal cycle of columnar methane observed by GOSAT over different regions in India?

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Methane (CH_4) is the second most important anthropogenic greenhouse gas (GHG), and plays critical role in air pollution chemistry in the troposphere. With the availability of satellite observations from space, variabilities in CH_4 have been captured for most parts of the global land with major emissions. The satellite observations however do not allow us to derive emission information directly, unlike the in-situ measurements, without separating the role of transport and chemistry in the columnar dry-air mole fractions (XCH_4). Here we analyze XCH_4 variability over different regions of India, Arabian Sea and Bay of Bengal, measured by the GHGs Observation SATellite (GOSAT) using an atmospheric chemistry-transport model (ACTM). We show that the peak in observed XCH_4 over the Indo-Gangetic Plain (IGP) during the southwest (SW) monsoon season (July-September) is produced mainly from the emissions on the surface (50% in 1000-600hPa layer) and uplifted high-CH_4 air mass in the upper troposphere (30% in the 400-0 hPa layer) using the ACTM simulations. These contributions are, in contrast, generated mostly from the upper troposphere over the semi-arid western India, up to 70% from the 600-0 hPa layers. This is because the signal from high CH_4 emissions during SW monsoon season is confined to a smaller region of the IGP, while the large-scale deep convection coupled with the anticyclonic wind during the SW monsoon lead to widespread CH_4 enhancement covering the whole South Asia and extending through the East Asia.

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