Methane emission sources in South Asia inferred from enhancement ratios of GHG concentrations based on satellite GHG data

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Focusing on South Asia, which is one of the largest methane emission regions, we have calculated excess concentrations of XCH_4 and XCO relative to their background concentrations (ΔXCH_4 and ΔXCO) using XCH_4 and XCO data from Thermal And Near infrared Sensor for carbon Observation - Fourier Transform Spectrometer-2 (TANSO-FTS-2) on board Greenhouse gases Observing Satellite-2 (GOSAT-2) and TROPOspheric Monitoring Instrument (TROPOMI) on board the Sentinel-5P and then calculated Enhancement Ratio (ER) by taking the ratios of the excess concentrations of the two gases to characterize the concentration variations and emission sources of CH_4 there. Here, we have divided South Asia into 10 regions: high CH_4 emission land areas (three regions), low CH_4 emission land areas (five regions), and ocean areas (two regions), and calculated seasonal ER values of $\Delta XCH_4/\Delta XCO$ for each Monsoon season (winter: January-March, pre-Monsoon: April-June, Monsoon: July-September, and post-Monsoon: October-December) in each of the 10 regions by using the three different satellite products: the TANSO-FTS-2 full-physics and proxy products and the TROPOMI product.
Seasonal ER values and their correlation coefficients in high CH_4 emission land areas were higher (correlation coefficient > 0.4) during the Monsoon period, which suggests that agricultural CH_4 was a predominant emission source there. In the low CH_4 emission land areas, seasonal ER values and their correlation coefficients showed the highest in different seasons in the different regions of arid India, central India, and southern India, which implies that CH_4 and CO were emitted from different emission sources (biomass burning, rice cultivation, etc.) in each of the regions. ER values in the two different ocean areas, which are located in the east and west sides of the Indian Subcontinent, showed the highest in different seasons (Monsoon period over Arabian Sea and post-Monsoon periods over Bay of Bengal), which may reflect from different atmospheric transport processes over the two ocean regions.
This study shows that satellite-based ER values could captuer the characteristics of CH_4 emission sources in each of the regions in South Asia; in some regions, however, the ER values based on TANSO-FTS-2 and TROPOMI exhibited different characteristics, so it should be required to refine the method of setting appropriate background concentrations and calculating ER.

Keywords: GOSAT-2, TROPOMI, methane, carbon monoxide, ER

