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Temporal Trends in Ambient SO_2 at a High Altitude Site in Semi-Arid Western India: Observations versus Chemical Transport Modeling

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ABSTRACT

Ambient sulphur dioxide (SO_2) measurements have been performed at a high altitude site in the semi arid region of western India, Gurushikhar, Mt. Abu (24.6˚N, 72.7˚E, 1680 m ASL), during different sampling periods span over Sep-Dec 2009 and Feb-Mar 2010. A global three dimensional chemical transport Model, GEOS-Chem, (v8-03-01) is employed to generate the SO_2 profile for the entire region for the different sampling months which in turn is used to explain the major features in the measured SO_2 spectra via correlating with HYSPLIT generated wind back trajectories. The mean SO_2 concentrations recorded at the sampling site varied for the different sampling periods (4.3 ppbv in Sep-Oct 2009, 3.4 ppbv in Nov 2009, 3.5 ppbv in Dec 2009, 7.7 ppbv in Feb 2010 and 9.2 ppbv in Mar 2010) which were found to be strongly influenced by long range transport from a source region surrounding 30˚N, 75˚E—the one projected with the highest SO_2 concentration in the GEOS-Chem generated profiles for the region—lying only a few co-ordinates away. A diurnal cycle of SO_2 concentration exists throughout the sampling periods, with the greatest day-night changes observed during Feb and Mar 2010, barely detectable during Sep-Oct 2009, and intermediate values for Nov and Dec 2009 which are systematically studied using the time series PBL height and OH radical values from the GEOS-Chem model. During the sampling period in Nov 2009, a plume transport to the sampling site also was detected when a major fire erupted at an oil depot in Jaipur (26.92˚N, 75.82˚E), located few co-ordinates away. Separate runs of the model, performed to study the long range transport effects, show a drop in the SO_2 levels over the sampling region in the absence of transport, throughout the year with Jan to Apr seen to be influenced the lowest by long range transport while Jul and Dec influenced the highest.

KEYWORDS

SO_2; GEOS-Chem; HYSPLIT; IOCL Oil Fire; PBL Height; OH Radical

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