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Spatio-temporal distribution of ozone pollution over south Asia and associated loss of crop yields

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Rapidly increasing anthropogenic emissions of the ozone precursors have intensified the photochemistry over tropical Indian region, however the tropospheric ozone budget and implications towards crop loss remain highly uncertain in this region. The uncertainties are associated with lack of in situ observations, especially in rural agricultural areas, and large differences among different emission inventories being used in modeling studies. Here we perform a series of numerical simulations employing three different emission inventories: 1) EDGAR-HTAP (global inventory; base year 2010), 2) SEAC4RS (regional inventory; base year 2012), and 3) INTEX-B (regional inventory; base year 2006) coupled with RADM2 chemical mechanism in the WRF-Chem model. Evaluation of ozone diurnal variations against observations over 15 stations demonstrates model's ability to reproduce the clean, rural and polluted environments across the south Asian region. The choice of employed emission inventory is found to significantly affect the simulated noontime ozone build up, with HTAP generally leading to 10–30 ppbv higher ozone levels than SEAC4RS and INTEX-B over certain regions of the south Asia. Modelled ozone further showed considerable sensitivity towards employed chemical mechanism with MOZART leading to stronger ozone production aloft as compared to than in RADM2. Based on comparison with ozone observations, the set up coupling SEAC4RS inventory with RADM2 chemical mechanism is found to be the best choice for simulating surface ozone fields, which is being used to assess the losses in crop yields over this region. Our study indicates a need for the evaluation of O_3 precursors also over a network of stations, and the development of high-resolution regional inventories accounting for year-to-year changes to further reduce uncertainties in modelled ozone over this region.