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Quantifying India's methane emissions using satellite, aircraft and surface data

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We present a quantification of regional methane (CH4) emissions from India by combining measurements from satellite, aircraft and surface sources with new modelling techniques. India contains large CH4 emissions sources particularly from its intensive rice agriculture and ruminants. However, emissions from this region have been highly uncertain and this is largely due to insufficient constraints from atmospheric measurements. Compared to parts of the developed world, which are well-observed through monitoring efforts, data from India is very sparse and this is especially critical given India's importance to the global CH4 budget. Here, we used data from a variety of surface sites and aircraft campaigns collected over the past several years, in conjunction with column methane data from the GOSAT satellite, to quantify emissions at a regional scale. Using the Met Office's Lagrangian NAME model at 12 km resolution, we simulated the effect of regional emissions on concentrations. We used these model sensitivities with a newly developed hierarchical Bayesian inverse estimation scheme to estimate regional fluxes over the period of 2010-2015 in addition to ancillary "hyper-parameters" that characterize uncertainties in the system. We present our analysis of the trend in emissions from this period as well as results showing which source sectors show large differences from bottom-up inventories. In this work, we will also present derived model uncertainties for each data stream, inferred through the inverse modelling framework, and the limitations of using remotely-sensed data for emissions estimation in regions where poor satellite validation exists.