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Atmospheric Model Evaluation with Observation Data for Persistent Fog Prediction in the Lower Region of the Himalayas

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Persistent fog is the issue that affect the life of people in Southern Nepal in winter these recent years, and the Atmospheric Modelling System, set up at International Centre for Integrated Mountain Development (ICIMOD) Headquarters in Kathmandu, Nepal, is used for making the assessment with an attempt to forecast the event during December. The Weather Research and Forecasting with Chemistry (WRF-Chem) model has been implemented over a regional domain stretching across 5000 x 4500 km centred at Kathmandu. Meteorological data from routine observation from 4 stations in the Terai are compared with meteorological output of the WRF simulation for the December time period at high horizontal resolution (1 km $\times$ 1 km), which is achieved by nesting the domain of interest, e.g. Kathmandu Valley, inside three coarser domains. Model evaluation is performed against these field data with the challenge of capturing the necessary atmospheric processes relating to persistent fog events in December 2013 and 2014. In 2014, the persistent fog events in December were likely happening on3 consecutive days at Biratnagar; 3 consecutive days and a week during December 23 – 30 at Bhairahawa; 5 intervals of the foggy day at Simara, and 5 intervals of two consecutive foggy days at Nepalgunj. It is clearly shown that, at Biratnagar, the dew-point temperatures were well predicted only on the 1st of December, while those were with much discrepancy between the observed and modeled ones, particularly on the foggy days. The dew-point temperatures were also poorly predicted at Bhairahawa except during December 13-15, 2014, when the Domain 2 output made a closer prediction to the observation. Note that observation, particularly for dew-point temperatures are very sparse with not only made 3-hourly during the day-time (0 – 12 UT, i.e. 05:45 – 17:45 LT), same like the ambient air temperatures, but also missing for one or two hours on some day. Therefore, it is quite challenging to actually observe the foggy hours by the standard meteorological method, during the most critical time.
Overall, the WRF meteorological model has a tendency to underestimate the temperatures in the Terai region.
Improved meteorological prediction will allow us to provide crucial information needed for mitigation and adaptation strategies. Better simulation of the atmospheric processes in the WRF modelling that when coupling chemical transport models will be able to provide more accurate prediction that may give warning that lead to mitigation actions that will reduce impact of the air pollution to the events and thus far the public across the affected area of the Himalaya region.