WRF model performance & challenges to predict fog events during the WIFEX field campaign at IGI Airport, New Delhi, India

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Abstract:
Context-Every winter, from November to February, the extended periods of dense fog affect lives of people living in the New Delhi metro area in India. The winter fog frequently reduces the visibility to a few meters, which causes fatalities from road accidents and significant economic losses via cancellation/delay of road, rail and air transport. WInter Fog Experiment (WIFEX) was conducted during 2015-2018 winter seasons (November to February) at Indira Gandhi International Airport (IGIA) India. Meteorological data were collected with a 20m micrometeorological tower, Radiometer, sodar, and radio-sondings.

Methods-To support WIFEX field campaign during 2016-17 and 2017-18 seasons, Weather Research and Forecasting (WRF) model was used to predict fog. The collected data set from the 20m mass tower, Radiometer and Radio-sonde were used to evaluate the model results during different visibility (Vis) conditions (moderate Vis <500m, Dense fog Vis <200m) in which airport operations can't hamper.

Results- This paper provides the model performance and its challenges for different visibility conditions during the WIFEX 2016-17 & 2017-18 seasons. Even though the model predicted most of the fog events, it shows difficulty in predicting accurate fog onset (in terms of liquid water content). Out of 40 moderate fog episodes model predicted 16 fog events and out of 44 dense fog events it captured 33. The model forecast also captured the deepest part of fog layer (when the Vis < 50m), low-level temperature inversion and moisture nicely during the most of the fog events. For the failed fog events it was found model has a dry bias for moisture which is coming from the initial condition.

Interpretation- Validation results with the WRF model and WIFEX observational site data suggesting that the WRF model shown 04 hours early onset and this bias may be due to the misrepresentation of different processes in which conditions fog forms. It is also noted that fog forecasting is very challenging to the present NWP models (in terms of horizontal and vertical spread).

Conclusion- Overall WRF model forecast for the national capital region (NCR) New Delhi, India, especially for airport operations, it was found reasonable results which can improve in future by using the observational data into the model.