Megha-tropiques SAPHIR radiances in a hybrid 4D-Var data assimilation system: Study of forecast impact

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Abstract: Assimilation of microwave humidity channels from various satellites plays a key role in numerical weather prediction (NWP), especially over the Tropics. This article examines various characteristics and the impact of assimilation of Megha-Tropiques SAPHIR (Sondeur Atmospherique du Profil Humidite Intertropicale par Radiometrie) microwave radiances on model forecasts along with that of other similar microwave humidity sensors. A hybrid 4D-Var scheme is used for assimilation of these observations, and forecasts are carried out using an advanced global atmospheric model, National Centre for Medium Range Weather Forecasting (NCMRWF) Unified Model (NCUM). The impact of SAPHIR radiances along with similar kinds of sensors have been studied using adjoint-based Forecast Sensitivity to Observations (FSO) and Observing System Experiments (OSEs). The lowest altitude peaking channel of SAPHIR (183 ± 11 GHz) has the highest beneficial impact on the forecast compared to other channels of the same instrument and other similar instruments on board other satellites. FSO experiments show SAPHIR and Microwave Humidity Sounder (MHS) observations complement each other by having the higher beneficial impact in the lower and upper troposphere, respectively. The other microwave humidity sounders have less or negligible impact in comparison to SAPHIR/MHS, both globally and over the Indian region. An OSE shows that SAPHIR radiances assimilation influences the humidity and wind forecast of the tropical troposphere, while its impact on temperature is negligible.