Ingesting multi-satellite radiances to improve the predictability of regional NWP model

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Abstract

The difficulties in getting quality observations of the atmosphere over the open oceans have been largely overcome with the advent of satellite based remote sensing. This has essentially sealed the gap of data deficiency over oceans. Both geostationary and orbiting satellites are fitted with various sensors like microwave / infrared sounders, imagers, Synthetic Aperture Radars (SAR) etc. The methods to assimilate these observations have undergone changes to accompany wide spectrum of data. Ensemble based techniques have got their due attention in recent times. With the current computational resources, different variants of Ensemble Kalman Filters (EnKF) are being tested by various researchers. In this study, a Local Ensemble Transform Kalman Filter (LETKF) which is a variant of Ensemble Square Root Filter (EnSRF) is employed to assimilate radiance observations. Radiances from infrared sounder atop INSAT 3D and microwave humidity sounder radiances from SAPHIR aboard Megha-Tropiques are assimilated into the Weather Research and Forecasting (WRF) model. An assimilation system for ingesting these radiance data was developed and the performance of the system was evaluated for different mesoscale events which includes a tropical cyclone VARDAH (2016) and three cases of heavy rainfall during the month of November, 2015. Assimilation experiments were performed for three cases by assimilating 1) only SAPHIR radiances 2) only INSAT 3D radiances and 3) Multi-satellite radiances. The improvements in the analysis and forecast fields were calculated and finally a comparison of 48-hour average forecast improvement in Temperature, Specific Humidity, U and V-Velocity revealed the positive impact of the multi-satellite radiance assimilation on the atmospheric fields. Furthermore, the predictability of such a multi-satellite radiance assimilation system was evaluated for heavy precipitation forecasts. The results show a considerable impact of the multi-satellite radiances on the forecast of heavy precipitation when compared against the control run.