Impact of SSM/I retrieval data in analysis and forecast of the Indian summer monsoon using WRF assimilation system

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Abstract

Assimilation and forecast experiments have been carried out in this study using conventional observations as well as total precipitable water and surface wind data retrieved from the Special Sensor for Microwave Imaginary (SSM/I) sensors. The main objectives of this study were to document the bias in short-range predictions of the Weather Research and Forecasting (WRF) version 3.1 models over the Indian region during the summer monsoon season and the impact of SSM/I data. All the experiments were carried out in the monsoon seasons of 2001 as a part of pilot phase studies for the South Asian Regional Reanalysis (SARR) project. It is seen that the model has strong bias in wind forecasts over the Arabian Sea and the Indian Ocean. A cyclonic bias in the forecasts exists over south-west India. Over the equatorial Indian Ocean, a strong southerly bias towards the Bay of Bengal is noticed. The model has a systematic bias to increase moisture over most parts of the equatorial Indian Ocean. Except over the Gangetic plains, the model exhibits dry bias with reduced moisture over most parts of India in 24 hour forecasts. The impact of assimilation of SSM/I products has been to increase the moisture over the Bay of Bengal, where the model has shown dry bias. The moisture content over the equatorial Indian Ocean (western sector) reduced significantly after assimilation of SSM/I data, where the model has a tendency to enhance moisture. Major rainfall zones during the monsoon season are brought out well in 6 hour forecasts by the model; however, the rainfall amount increased over the Bay of Bengal due to the assimilation of SSM/I data. These features are consistent with the moisture and wind differences between the two assimilation experiments. A quantitative verification of model rainfall in terms of equitable threat scores indicate that the accuracy of rainfall products is higher when SSM/I data are assimilated. It is seen that the general pattern of rainfall tendency in 24 hour forecasts remains the same irrespective of whether the forecast initial conditions are with or without SSM/I data. Examination of a case of monsoon depression showed that assimilation of SSM/I data improved the analysis.