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TEMPERATURE PROFILE USING NOAA SATELLITE AMSU DATA AND THEIR IMPACT ON NWP MODEL.

This paper brings out results of recent studies carried out at IMD,New Delhi, regarding quality of temperature and humidity profile derived from NOAA-ATOVS data. Assimilation of humidity profile derived from this data into the Limited Area Model forecasts being run operationally at IMD shows positive impact.

CGMS Members are invited to take note.

TEMPERATURE PROFILE USING NOAA SATELLITE AMSU DATA AND THEIR IMPACT ON NWP MODEL.

Abstract

India Meteorological Department receives and processes NOAA ATOVS data in real time. The physical and neural network approaches have been used to retrieve atmospheric temperature and moisture profiles using AMSU data over Indian region received from NOAA 16 and NOAA 17 satellites. The earlier training data set based on global data only for two seasons used in neural network technique has been replaced by new training data set based on regional data over land and ocean for all the seasons. The new training data set has improved the temperature accuracy retrieved using neural network approach compared to physical method. The detail validation and inter comparisons of temperature and moisture profiles have also been carried out with ECMWF analysis over sea and land separately for different seasons. The performance of neural network technique is found to be superior compared to physical method.

Recently, temperature and moisture profiles retrieved from NOAA-16 ATOVS data over Indian region have been used in regional NWP model for the impact study. The operational NWP system of India Meteorological Department is based on a Limited Area Analysis and Forecasting System (LAFS), which consists of real time processing of data received on Global Telecommunication System (GTS), objective analysis by 3-D multivariate optimum interpolation (OI) scheme and a multi-layer primitive equation model. Several experiments were performed using temperature and moisture profiles retrieved from NOAA-16 ATOVS data. Using this data several experiments were undertaken to examine the impact of these data sets on some of the important weather systems such as monsoon depression, active monsoon conditions during the monsoon season of current year (2003). The preliminary results reveal that these additional data have a positive impact on rainfall prediction of the limited area model.

1. Introduction

Neural Network technique has been used for temperature and moisture profiles retrievals using AMSU data over Indian regions (Singh, et. al., 2002 and 2003). An evaluation of this method versus a physical inversion approach for retrieval of atmospheric temperature and moisture profiles from Advanced Microwave Sounding Unit (AMSU) derived brightness temperatures is presented in this paper. Limited results only for January 2003 are presented in this paper.

India Meteorological Department (Prasad et al, 1997) had earlier shown the positive impact of this data in a limited area model. Impact study was also carried out using high resolution (80 km) TOVS temperature-humidity profile data locally derived at IMD, New Delhi (Bhatia et al, 1999). This high-resolution data was able to bring out the impact in the synoptic scale prediction associated with tropical easterly wave activity over the north Indian Ocean. In view of the importance of accurate initial humidity fields in tropical NWP, it is necessary to maximize use of these data from nonconventional sources. With this end in view, the present study was taken up to study the impact of ATOVS temperature and moisture profile data on limited area analysis and forecast fields.

2. Accuracy of temperature and moisture profiles

The temperature and moisture profiles have been retrieved using two different retrieval techniques namely Neural Network and Physical inversion using NOAA-16 & 17 AMSU measurements. The bias and rms error of temperature and moisture profiles were computed for the month of July 2002 and January 2003 separately on land and sea over India and its surrounding regions. These errors have been computed against ECMWF analysis. It has been observed that these errors are smaller for Neural Network approach as compared to the physical inversion approach in both seasons over land and sea (Fig-1 a&b). This may be probably due to lack of proper NWP guess in case of physical inversion method.

3. The impact study

The impact study was carried out for heavy rainfall events of 9 July 2003. The specific humidity fields were found to be 12-13 gm/kg over the monsoon trough region over central parts of India with a decrease of moisture towards north. The temperature fields also showed similar features. These features are consistent with the normal meteorological conditions prevailing over this area, which conforms that qualitatively NOAA sounding products are good.

3.1 Heavy rainfall event of 9 July 2003

A low-pressure area formed on 10th over Haryana and adjoining areas of east Rajasthan & west Utter Pradesh (northern parts of India) on 9th evening with associated cyclonic circulation extending up to mid-tropospheric levels. Under its influence heavy to heavy rainfall occurred at most places over north and northwest parts of India and moderate rainfall over peninsula and northeast parts of India. The day-1 rainfall forecast by limited area model valid for 10 July 2003 is presented in Fig.2. A marked improvement is seen in the predicted rainfall pattern over northwest parts of India where the control run was unable to predict the heavy to very heavy rainfall that occurred at most places over northern and northwest India. In the control run most of this area showed 3 to 10 mm rainfall and in experiment it shown from 10 to 40 mm, whereas the realized rainfall was 30 to 80 mm with isolated heavy rain fall of 130 mm over Delhi.

4. Summary

Use of the updated training data set based on the regional input for all the seasons has improved the accuracies of temperature and moisture profiles retrieved from AMSU measurements onboard NOAA satellite series. During actual operations of temperature and humidity retrieval, the scheme uses only the satellite measurements and satellite geometry data, without requiring additional first-guess from modeled profiles with limited Internet connections.

The study has brought out a distinct positive impact of the ATOVS derived humidity profile data on the limited area analysis scheme. The forecast model runs to study the impact of the additional humidity data on the rainfall predictions have shown a considerable improvement over northwestern parts of India, as seen from the corresponding observed rainfall.

References

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Comparison of errors of Temperature profiles using Neural Network and Physical inversion approaches for NOAA-16 & 17 satellites AMSU data

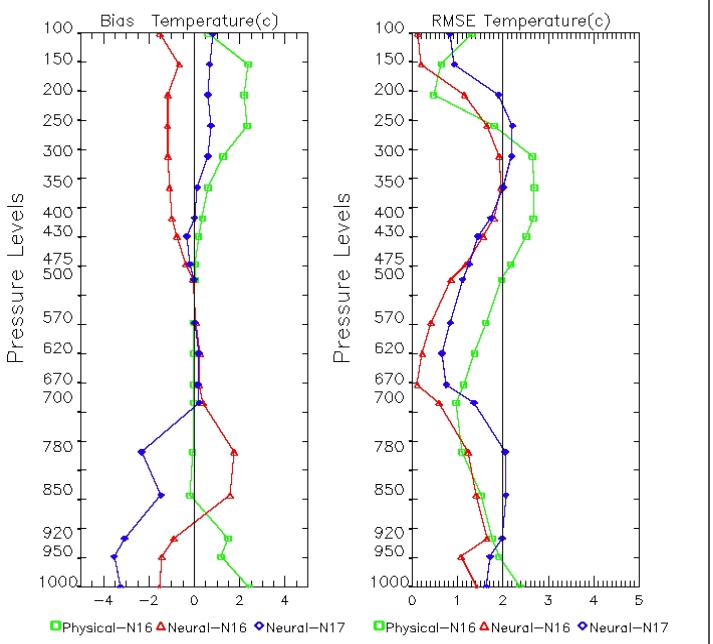

Fig-1 (a) Over Land, January, 2003

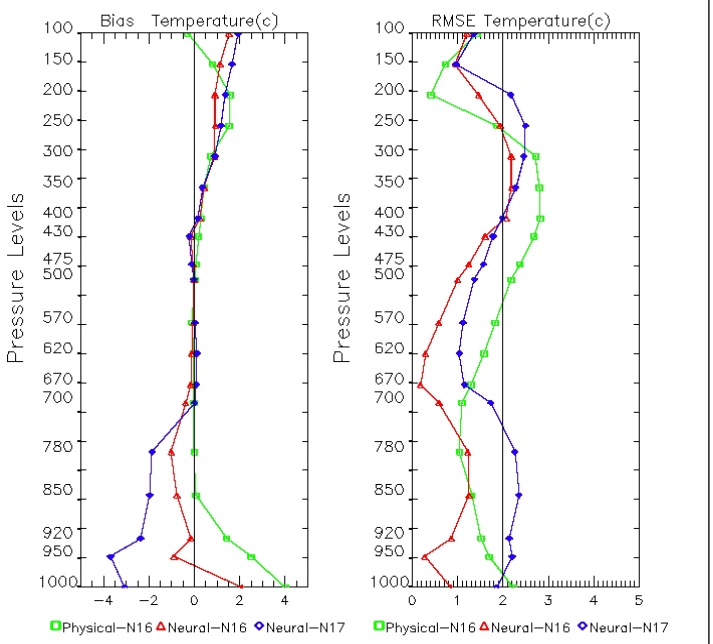

Fig-1 (b) Over Sea, January, 2003

Day-1 forecast rainfall (mm) for 10 July 2003. Left: Control Right: Experiment