

**RECENT IMPROVEMENTS IN TEMPERATURE
AND MOISTURE PROFILES USING NOAA
SATELLITES AMSU DATA AND THEIR MPACT
ON NWP MODEL OVER INDIAN REGIONS**

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INTRODUCTION

- ☞ Retrieval techniques for profiles**
- ☞ Validation and inter-comparisons of profiles**
- ☞ Assimilation of profiles in NWP model**
- ☞ IMD Analysis and Forecast Model**
- ☞ Impact Studies**
- ☞ Conclusions**

Temperature and Humidity Profiles

- Tropical general circulation is mainly governed by convective heating. Thus NWP over low latitudes is sensitive to the four dimensional structure of parameterized convective heating. The distribution of humidity is very important in this regard.
- High Resolution Picture Transmission (HRPT) Direct Readout ground receiving station was installed at IMD, New Delhi to receive the NOAA Satellite ATOVS data in real time in addition to earlier installed HRPT station since,1985.
- The AMSU temperature and moisture profile pre-processed data are received over the pass area from Equator to latitude. 50°N and longitude. 55° to 110°E.

- Using the limited area analysis and forecast fields as inputs to ATOVS and AVHRR processing package (AAPP), processed temperature and moisture profiles are retrieved from AMSU data using ICI (inversion coupled imager) developed at Meteo France and IAPP developed at SSEC, University of Wisconsin.
- These profiles have also been retrieved using Neural Network Technique on an experimental basis. Recently training data set has been updated based on regional input covering all the seasons.
- Daily 2 to 3 passes data from each satellite with approx. 1100 observations in a single pass covering the land and ocean area available over the Indian region.

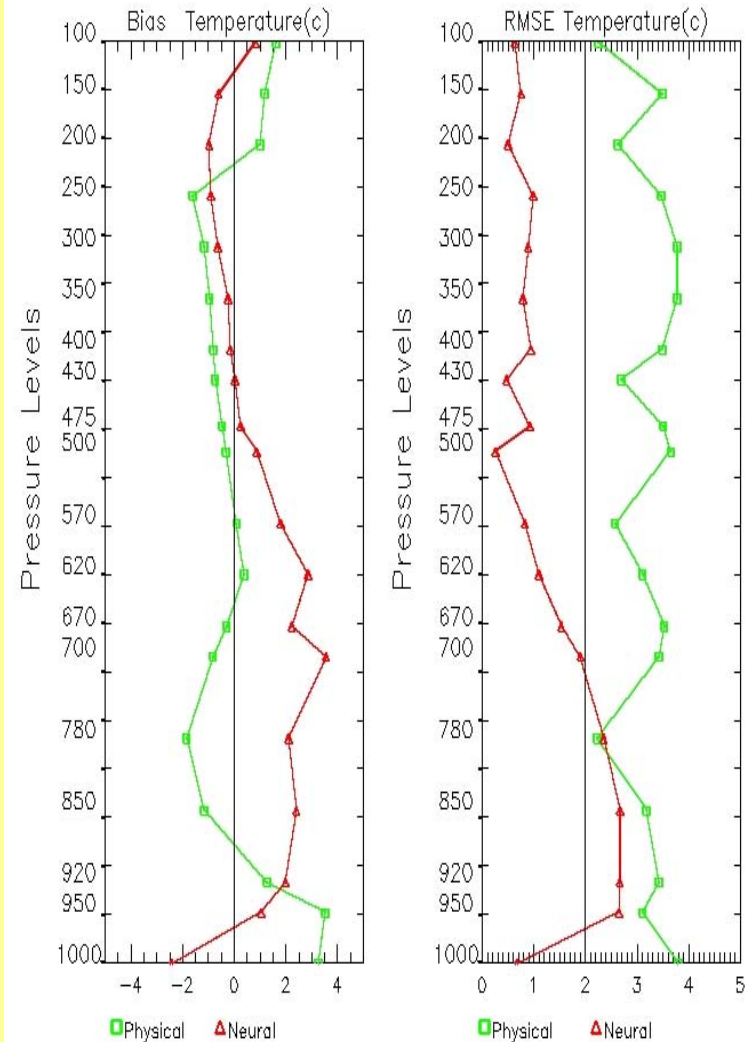
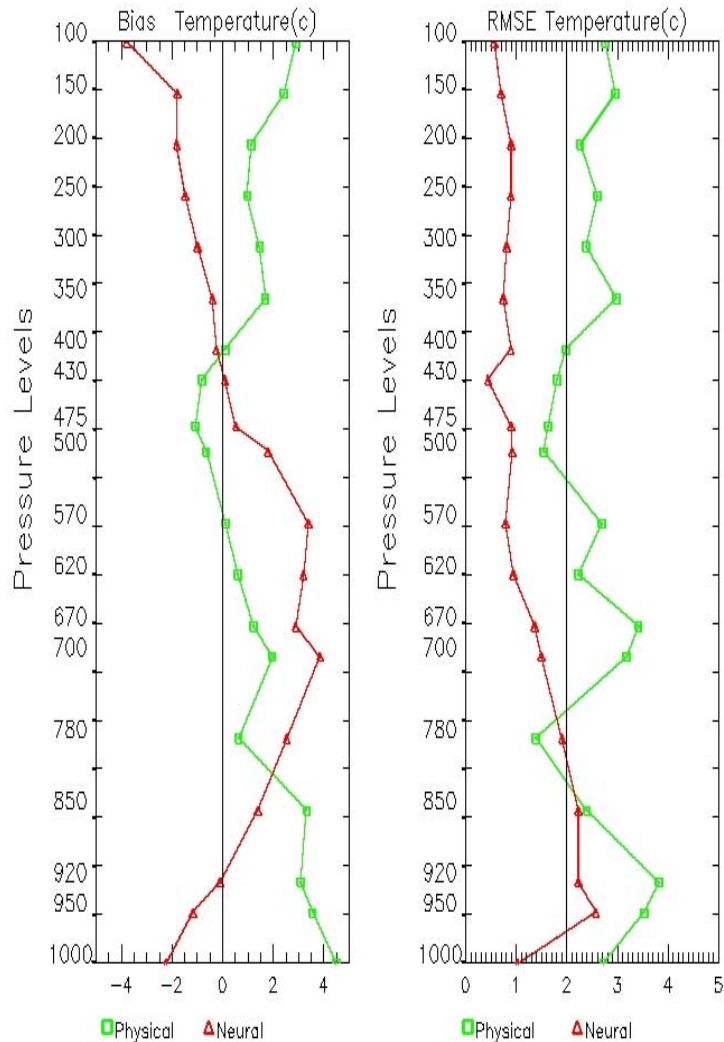
Retrieval techniques for profiles

1. Physical inversion iterative technique

(ICI and IAPP coupled with AAPP software package)
ICI is being used with first guess from LAM Model run at IMD Delhi operationally while IAPP is being used without first guess from LAM Model. However, work is in progress to inject first guess from LAM Model into IAPP package.

2. Neural Network Technique

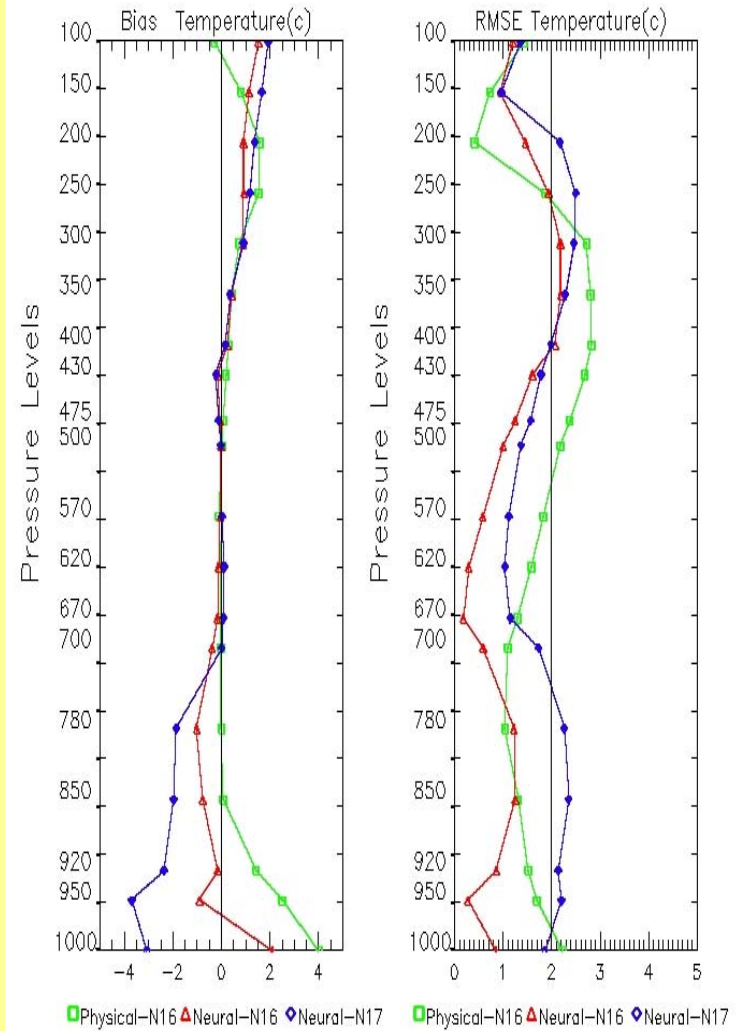
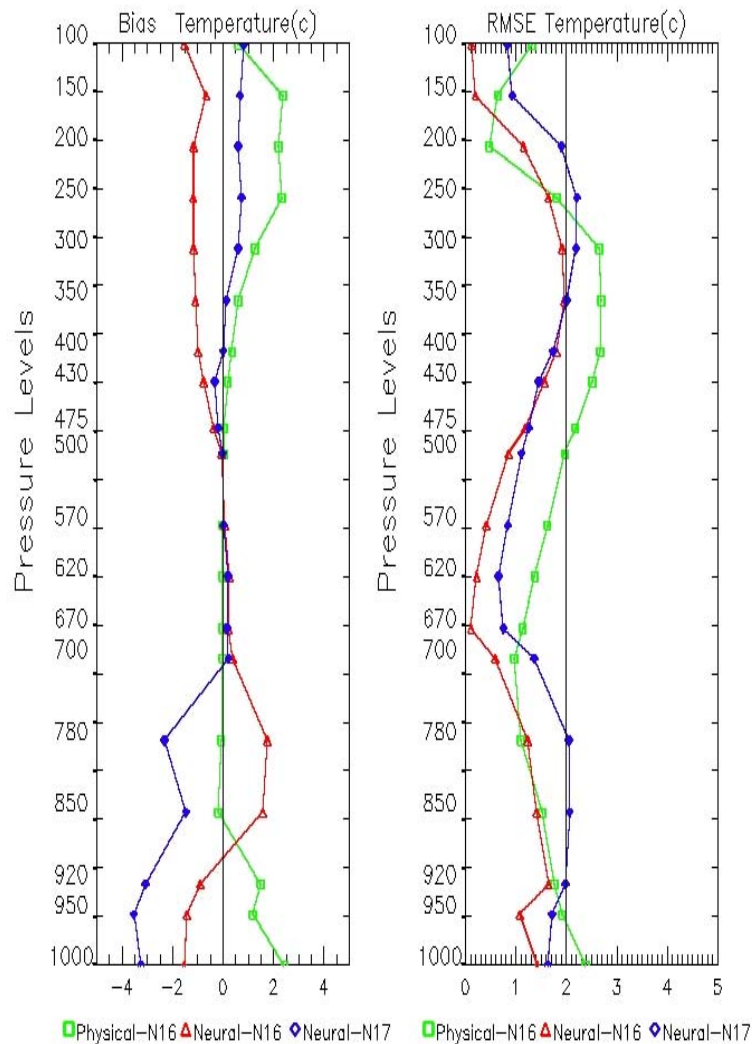
Validation and inter-comparisons of Temperature profiles July2002(land) July2002(sea)



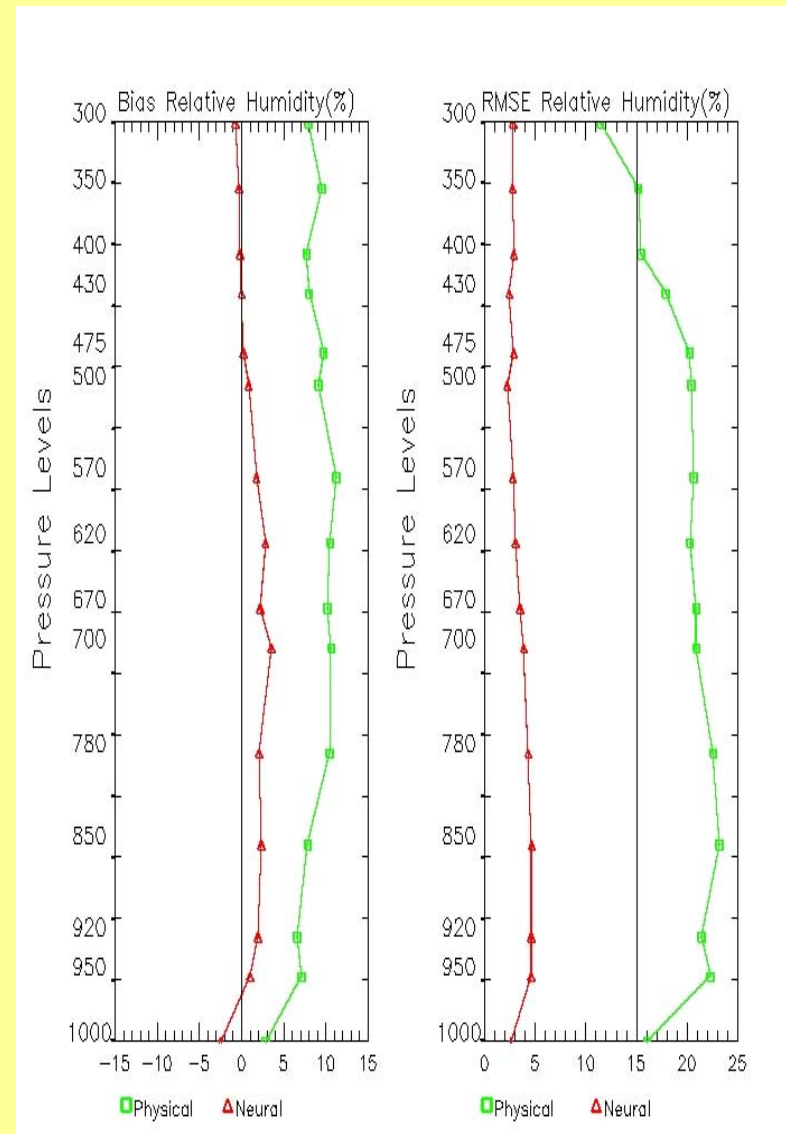
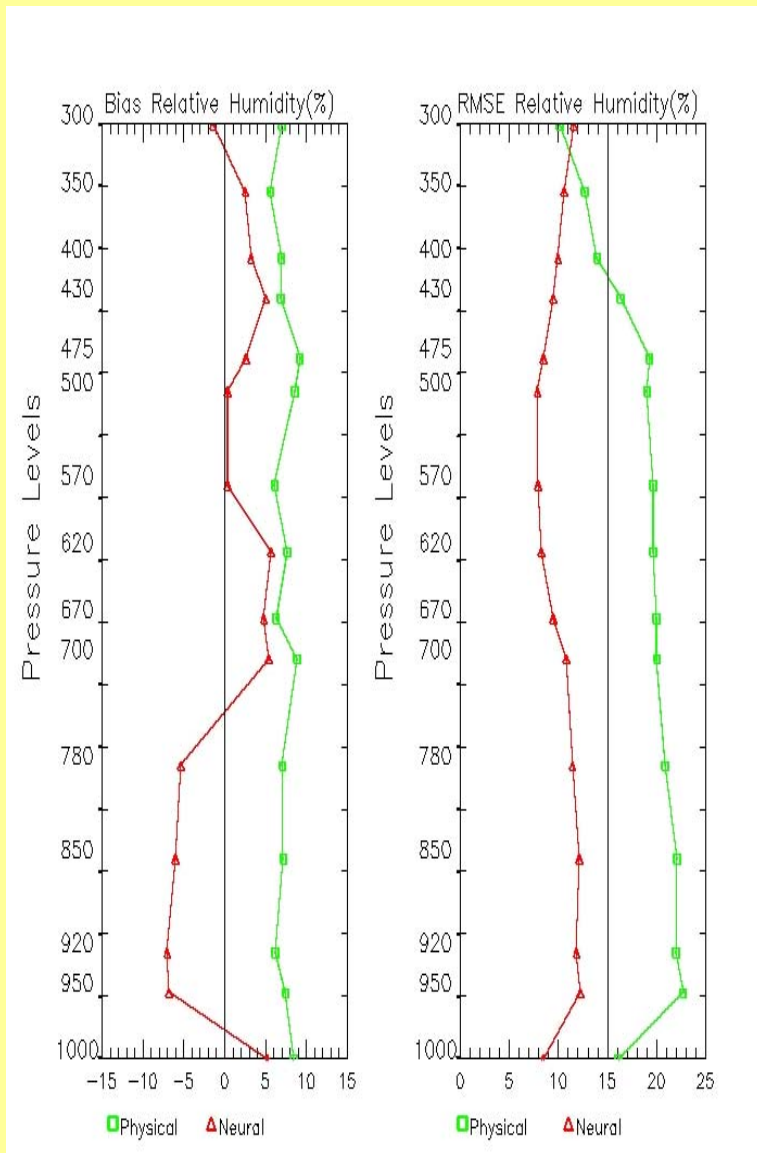
Validation and inter-comparisons of Temperature profiles

January 2003(land)

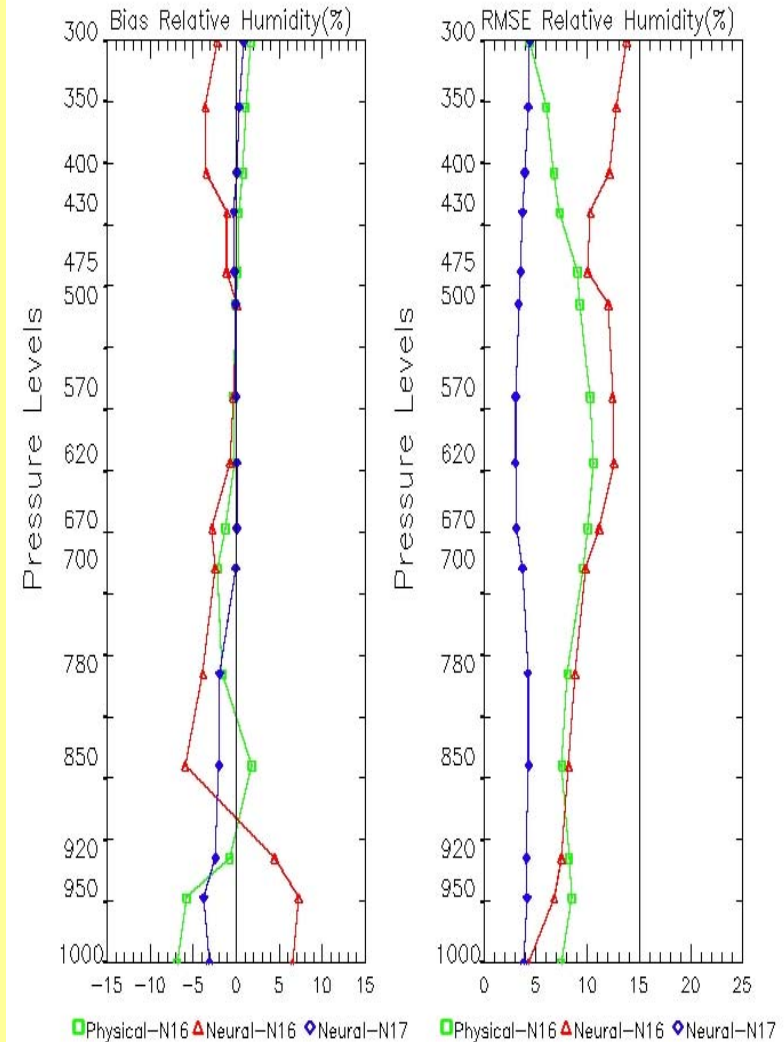
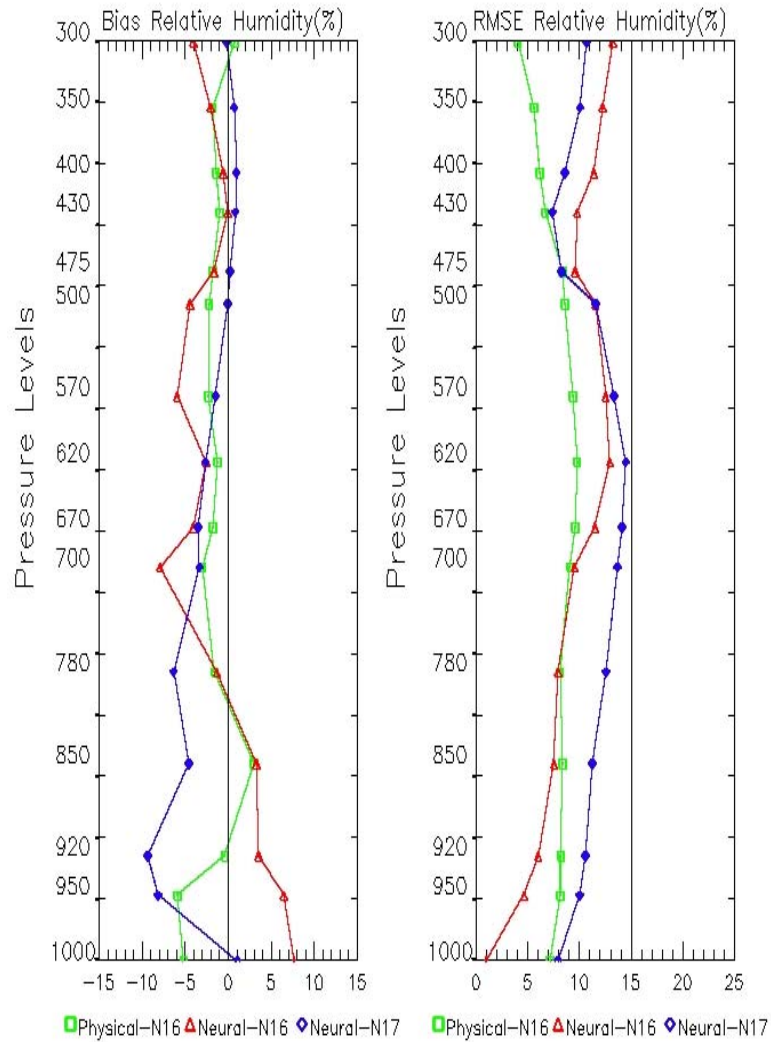
January 2003(sea)



Validation and inter-comparisons of Relative Humidity profiles July 2002(land) July 2002(sea)

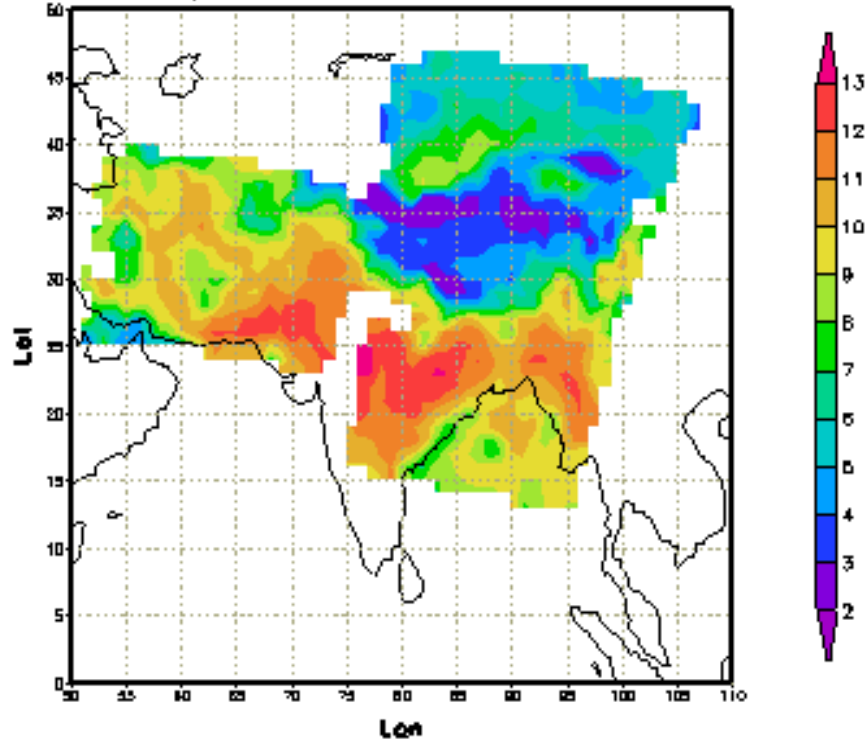


Validation and inter-comparisons of Relative Humidity profiles January 2003(land) January 2003(sea)

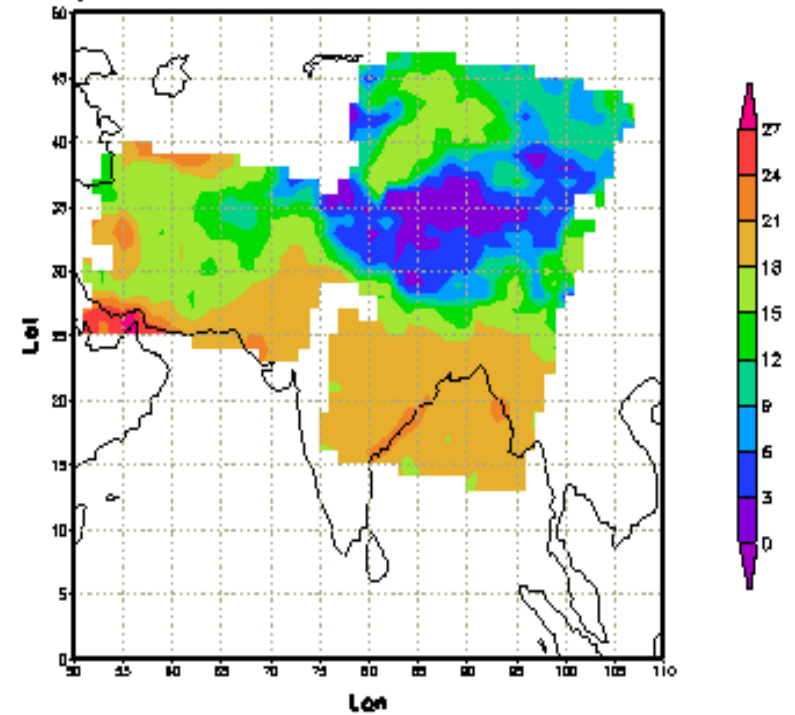


NOAA-16 (HRPT, New Delhi) Specific Humidity and Temperature

Sph Humidity at 850mb on 08-07-03 20-22 UTC



Temperature at 850mb on 08-07-03 20-22 UTC



Assimilation of profiles in NWP Model

The impact of humidity profiles estimated from NOAA-16 ATOVS data on initial moisture analysis in the IMD's operational limited area forecast system has been investigated.

Method for assimilation of humidity profiles data as pseudo observations in the analysis scheme has been developed and implemented in the regional analysis scheme.

The impact study was carried out for:

- Active monsoon conditions of 18-22 June 2003
- Heavy rainfall event of 9 July, 2003
- Monsoon depression 24-28 July 2003

LIMITED AREA FORECAST SYSTEM (LAFS)

ANALYSIS

OBJECTIVE ANALYSIS: 3-D MULTIVARIATE OPTIMUM INTERPOLATION

DATA INPUT : SYNOP, PILOT, SATEM, SATOB, AIREP, AMDAR, DRIBU

BOGUSSING DATA: CYCLONE INFORMATION, MOISTURE/TEMPERATURE PROFILES

FIRST GUESS : GLOBAL 24 HR F/C FROM T80 GLOBAL MODEL OF NCMRWF

RESOLUTION : 1X1 DEGREE LAT./LONG., 12 SIGMA LEVELS

DOMAIN : REGIONAL (30°S- 60°N; 0-150°E) & GLOBAL

VARIABLES : GEOPOTENTIAL (Z), TEMPERATURE (T), ZONAL (U) & MERIDIONAL (V) COMPONENTS OF WIND, SPECIFIC HUMIDITY

FORECAST MODEL (LIMITED AREA MODEL)

RESOLUTION : 0.75 °X0.75 ° LAT./LONG. 16 SIGMA LEVELS

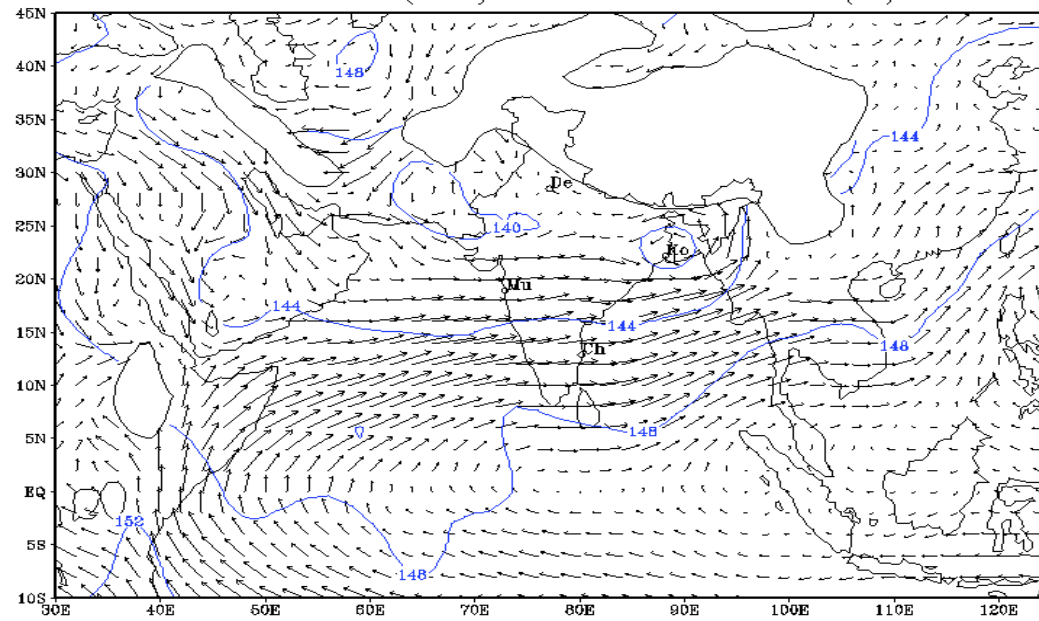
INTEGRATION : 25°E - 125°E, 30°S - 50°N

OUTPUT FIELDS : 24H & 48H FORECAST SURFACE PRESSURE Z,T,U,V,RH AT 14 PRESSURE LEVELS; RAINFALL AND FIELDS OF DERIVED PARAMETERS SUCH AS VORTICITY, DIVERGENCE, VERTICAL VELOCITY, MOISTURE FLUX DIVERGENCE ETC.

BOUNDARY CONDITIONS: GLOBAL MODEL T80 FORECASTS, NCMRWF, NEW DELHI

RSMC(IND) New Delhi 850 hPa Analysis
MEAN (Con.) 18-22 Jun 2003 wind (kt)

Con

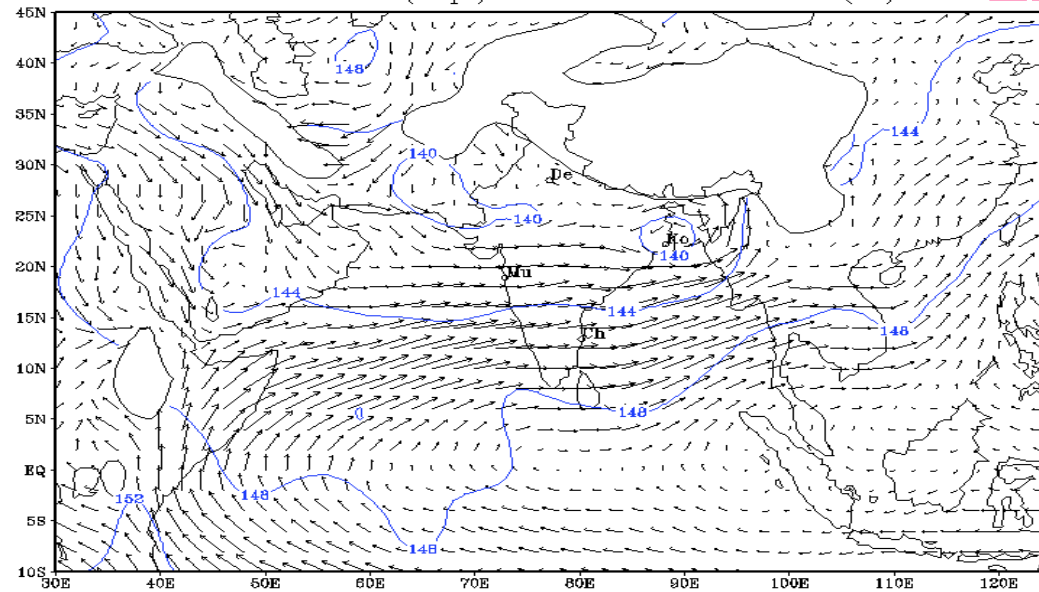


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RSMC(IND) New Delhi 850 hPa Analysis
MEAN (Exp.) 18-22 Jun 2003 wind (kt)

Exp

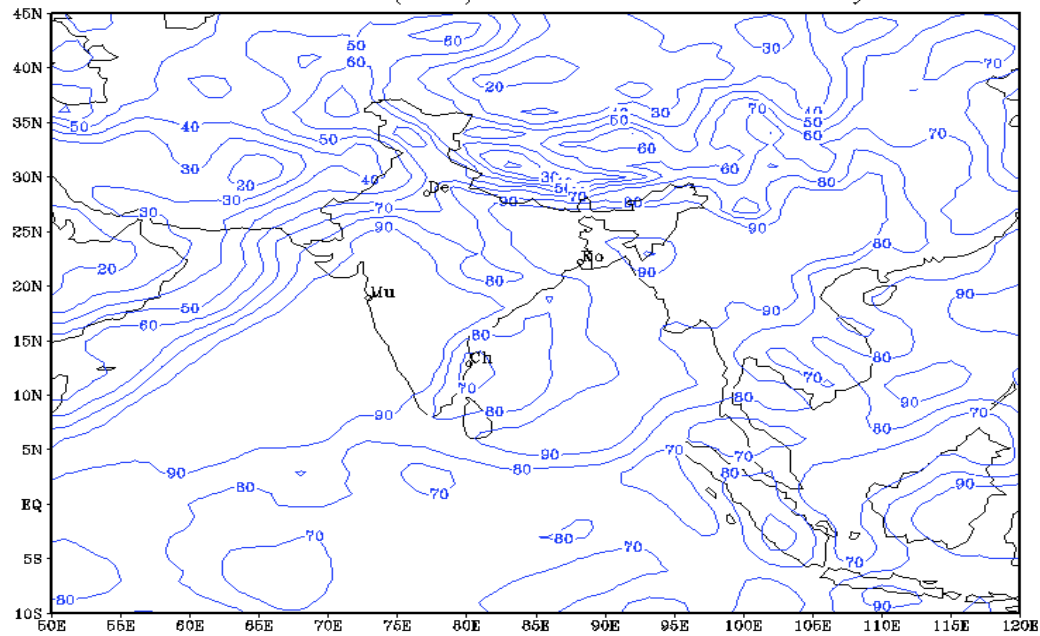


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RSMC(IMD) New Delhi 850 hPa Analysis
MEAN (Con.) 18-22 Jun 2003 Humidity

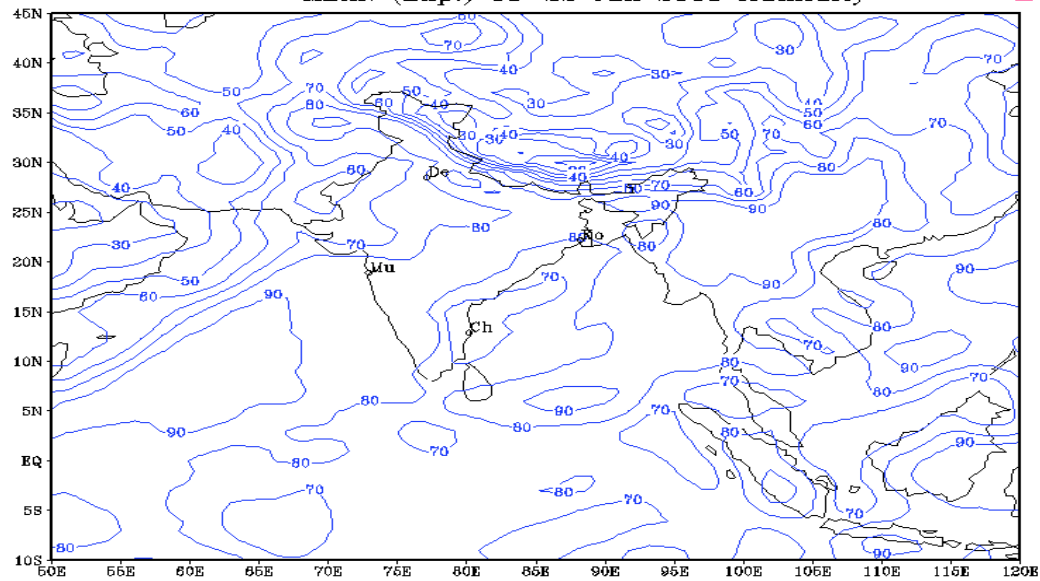
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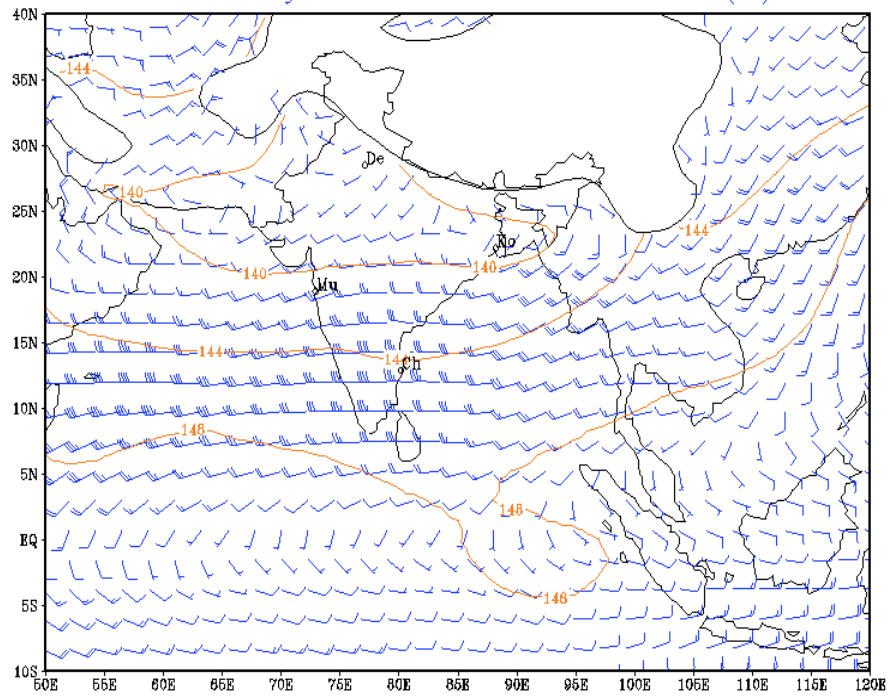
RSMC(IMD) New Delhi 850 hPa Analysis
MEAN (Exp.) 18-22 Jun 2003 Humidity

Exp



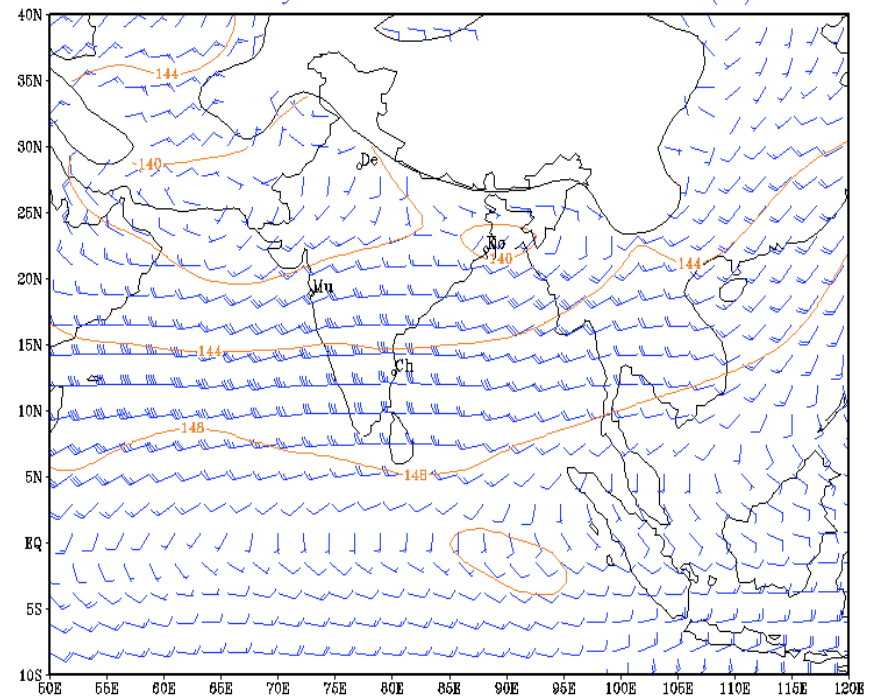
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RSMC(IND) New Delhi 850 hPa Day-1 Forecast (Con)
5 Day Mean for 19-23 June 2002 wind (kt)



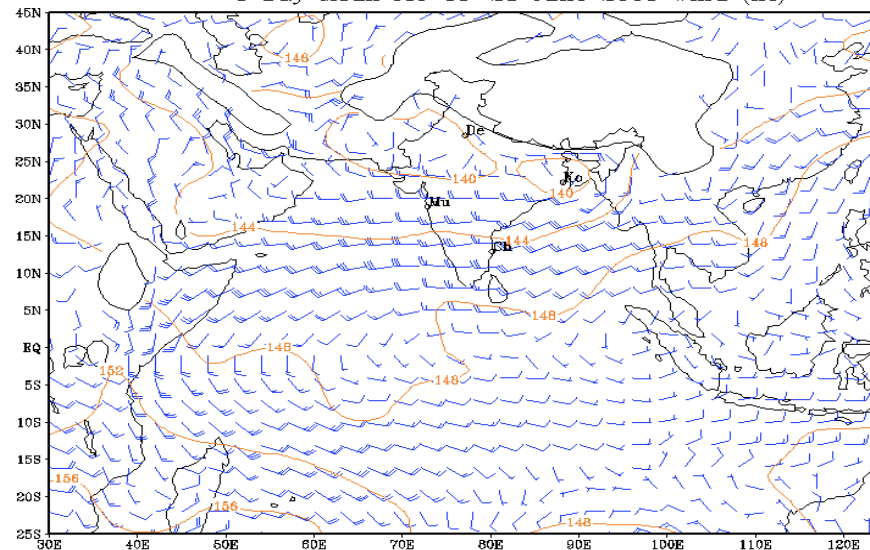
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RSMC(IND) New Delhi 850 hPa Day-1 Forecast (Exp)
5 Day Mean for 19-23 June 2002 wind (kt)



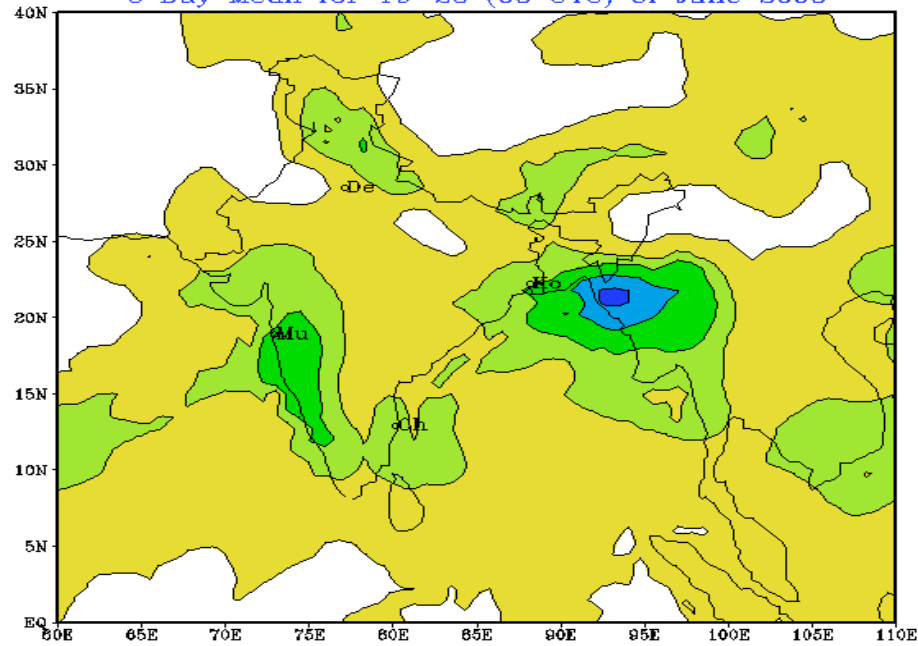
Verification Analysis

RSMC(IND) New Delhi 850 hPa Analysis
5 Day Mean for 19-23 June 2003 wind (kt)



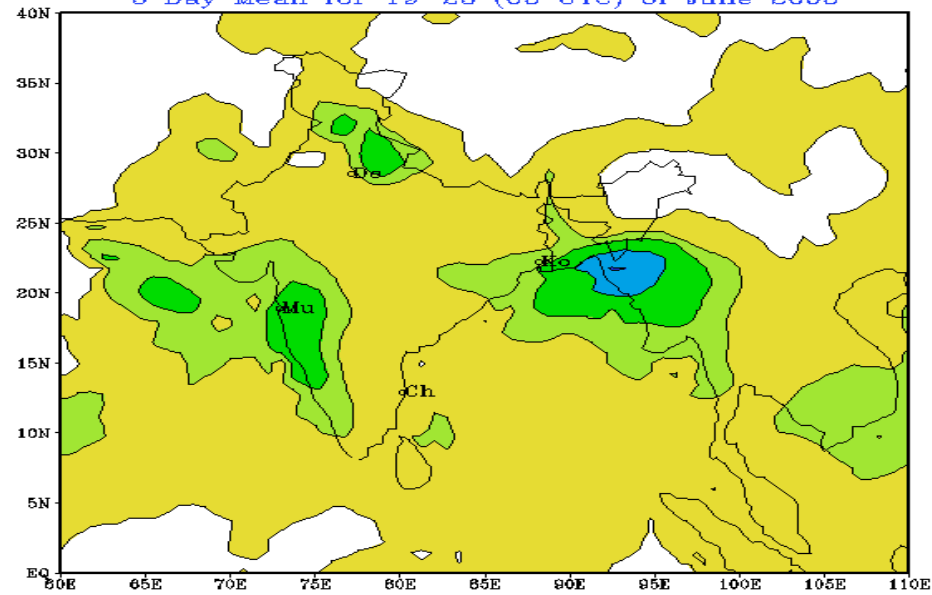
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Limited Area Model
Day-1 Forecast rainfall (cm) (Con)
5 Day Mean for 19-23 (03 UTC) of June 2003



Con

Limited Area Model
Day-1 Forecast rainfall (cm) (Exp)
5 Day Mean for 19-23 (03 UTC) of June 2003

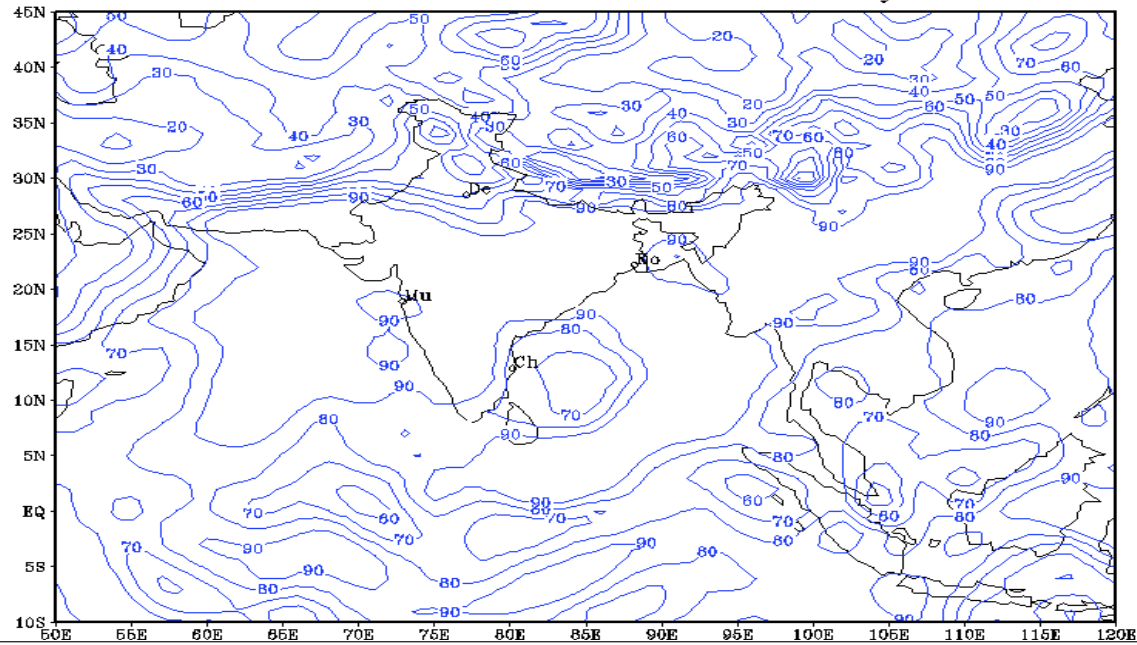


Exp

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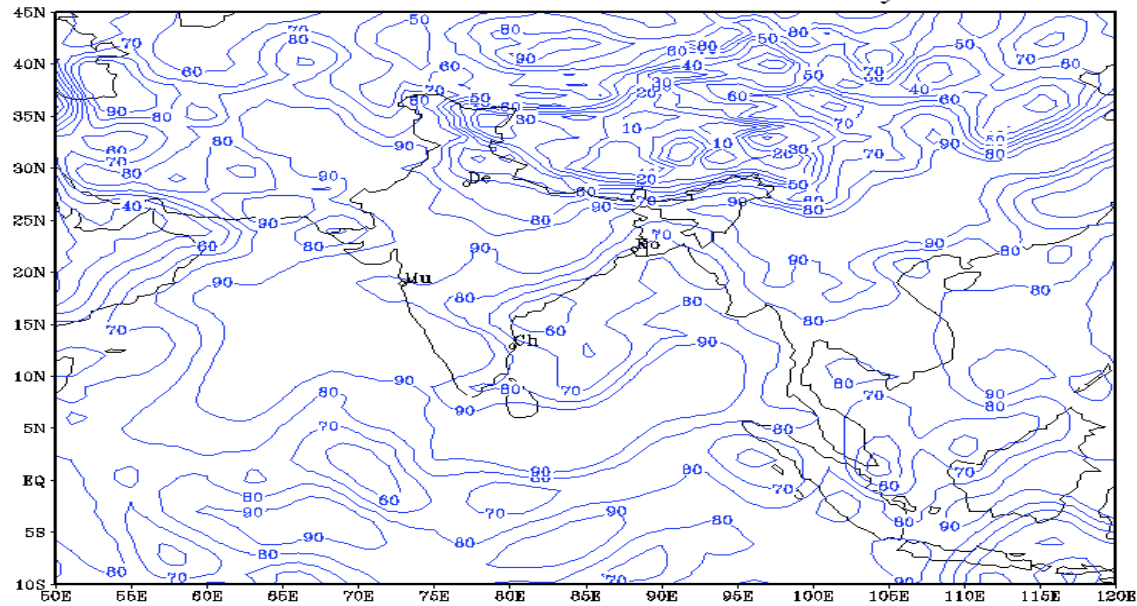
RSMC(IND) New Delhi 850 hPa Analysis
00 UTC of 9 Jul 2003 Humidity

Con



RSMC(IND) New Delhi 850 hPa Analysis
00 UTC of 9 Jul 2003 Humidity

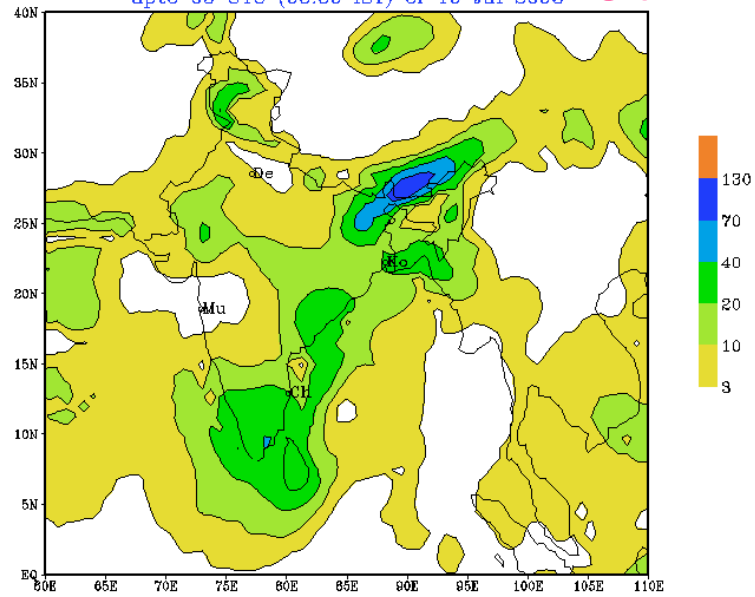
Exp



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Limited Area Model
24 hrs Forecast rainfall (mm)
upto 03 UTC (08:30 IST) of 10 Jul 2003

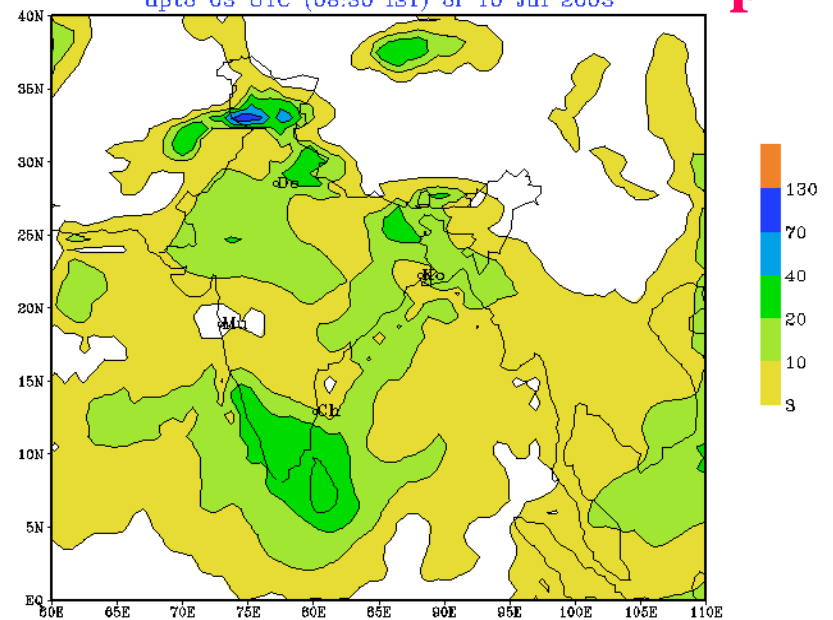
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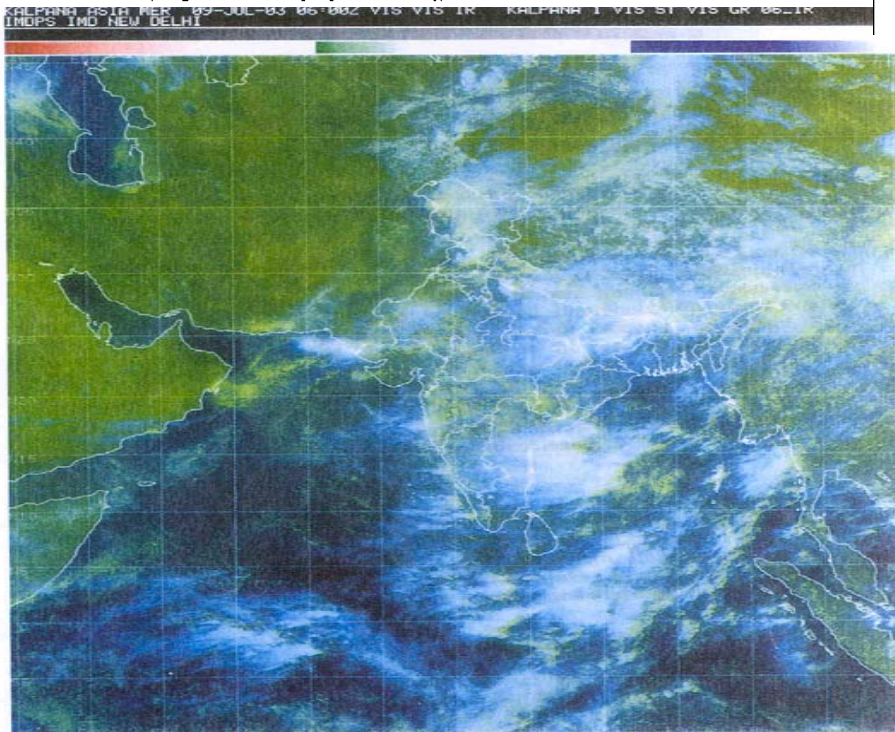
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Limited Area Model
24 hrs Forecast rainfall (mm)
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Exp

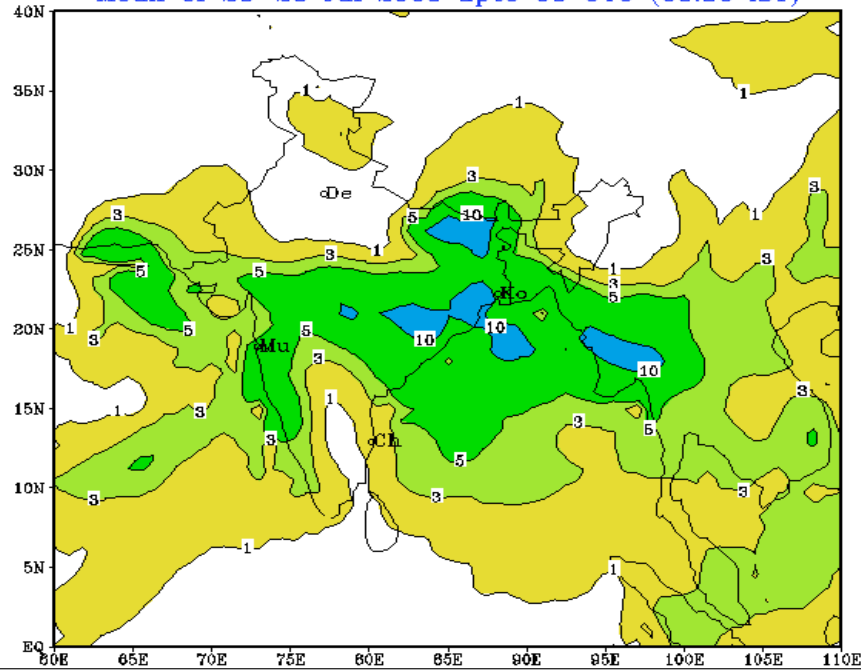


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Impact of NOAA-16 (HRPT)
Humidity Fields in LAFS System

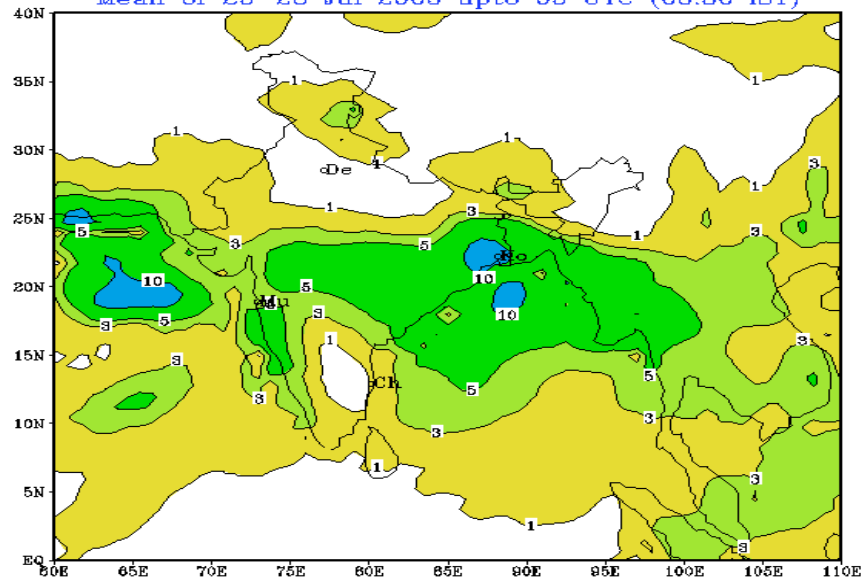
Limited Area Model
24 hrs Forecast rainfall (cm)
Mean of 25-28 Jul 2003 upto 03 UTC (08:30 IST)



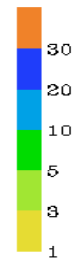
Con



Limited Area Model
24 hrs Forecast rainfall (cm)
Mean of 25-28 Jul 2003 upto 03 UTC (08:30 IST)



Exp



(Background does not depict political boundary)

Concluding Remarks

- The 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 of 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. This gives advantage to many operational sites including those with limited Internet connections.
- The study has brought out a distinct positive contribution of the ATOVS derived humidity profile data, used as pseudo observations in 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. Maximizations of use of such satellite-based observations are expected to considerably improve the initial humidity analysis and subsequent forecasts produced by NWP models.

THANKS

International TOVS Study Conference, 13th, TOVS-13, Sainte Adele, Quebec, Canada, 29
October-4 November 2003. Madison, WI, University of Wisconsin-Madison, Space Science and
Engineering Center, Cooperative Institute for Meteorological Satellite Studies, 2003.