

# A neural network based algorithm for the retrieval of TPW from AMSU measurements

By

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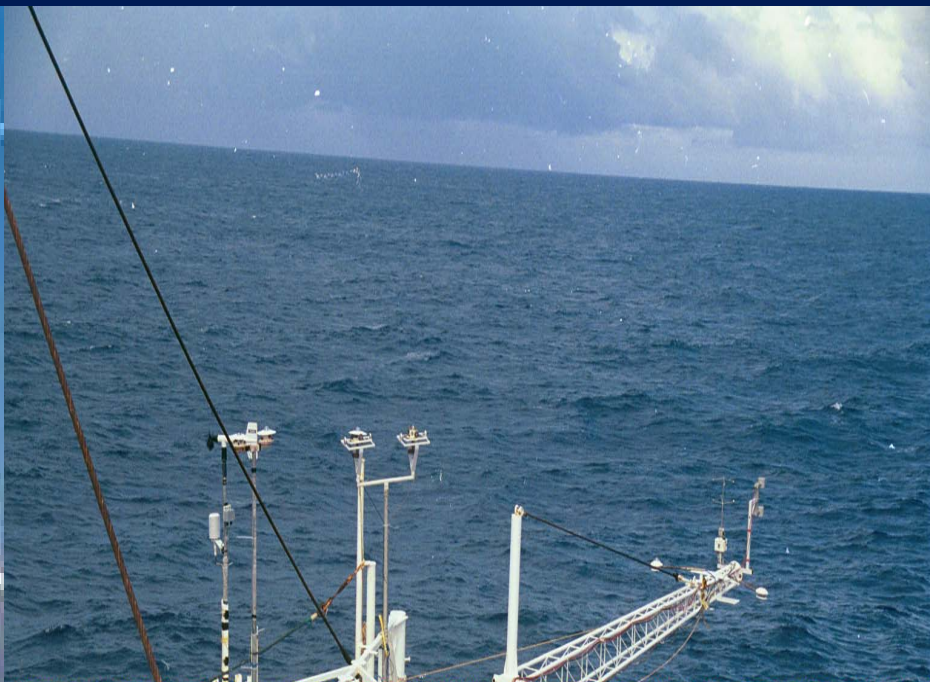
# Radiosonde observations

The radiosonde observations were taken using the Vaisala RS80 radiosonde instrument.

The pressure sensor is a capacitive aneroid with a measuring range from 1060 to 3 hPa and with a resolution of 0.5hPa.

The temperature sensor is a capacitive bead with a measuring range from +60°C to -90°C and with a resolution of 0.2°C.

The humidity sensor is a thin film capacitor with a measuring range from 0 to 100% RH and with a resolution of 3%.



# Specifications of the Meteorological Sensors used with AWS on board ORV Sagar Kanya during BOBMEX .

Sensor	Specifications																
Wind speed	<table><tbody><tr><td>Range</td><td>0-60 m/s</td></tr><tr><td>Gust survival</td><td>100 m/sec.</td></tr><tr><td>Threshold sensitivity</td><td>1.0m/sec.</td></tr><tr><td>Pitch</td><td>30 cm air passage per revolution</td></tr><tr><td>Distance constant</td><td>2.7meter for 63% recovery</td></tr><tr><td>Output frequency</td><td>3 cycles/rotation, 0.098m/s per Hz</td></tr><tr><td>Sensor type</td><td>propeller from RM YOUNG USA</td></tr><tr><td>Model No.</td><td>05103</td></tr></tbody></table>	Range	0-60 m/s	Gust survival	100 m/sec.	Threshold sensitivity	1.0m/sec.	Pitch	30 cm air passage per revolution	Distance constant	2.7meter for 63% recovery	Output frequency	3 cycles/rotation, 0.098m/s per Hz	Sensor type	propeller from RM YOUNG USA	Model No.	05103
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Air temperature	Range Accuracy Type	0-45°C ± 0.15°C Thermistor, YSI 44202, USA
Barometric pressure	Range Resolution Accuracy Sampling rate Output Power Type	800-1060 mbar 0.1 mbar ± 0.5 mbar 10 Hz RS232, TTL serial, parallel 8-16 volt dc, 6ma (oper), 10µA(stdby) Intellisensor AIR DB from A.I.R. USA
Humidity	Range Accuracy Power Type	0 - 100 %RH 3% 4.5 - 24 v, 10mA Capacitive polymer, from Rotronic USA
Solar radiation	Sensitivity Linearity Range Accuracy Type	80 µA/1000 mW/cm <sup>2</sup> 1% 0 - 200 mW/cm <sup>2</sup> 5% Silicon photodiode, LI-200 SA From Lycor Inc. USA

# BOBMEX 1999(July)

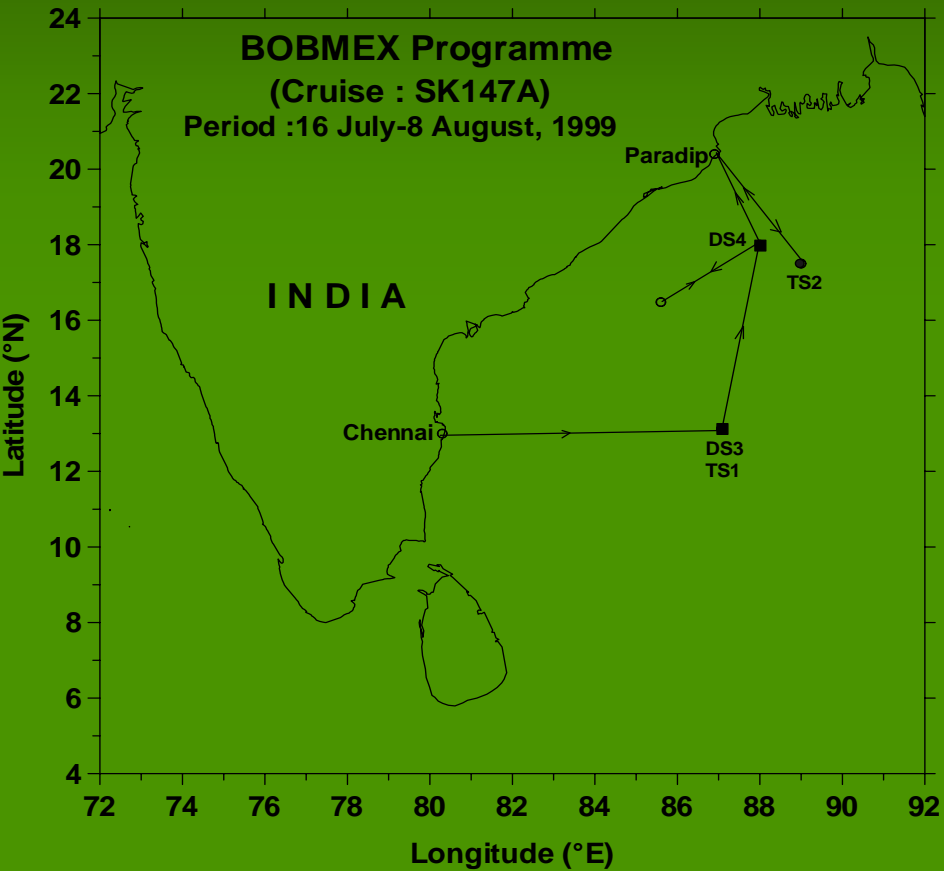


Fig. 1 : ORV Sagar Kanya cruise (SK147A) track.

# BOBMEX 1999(August)

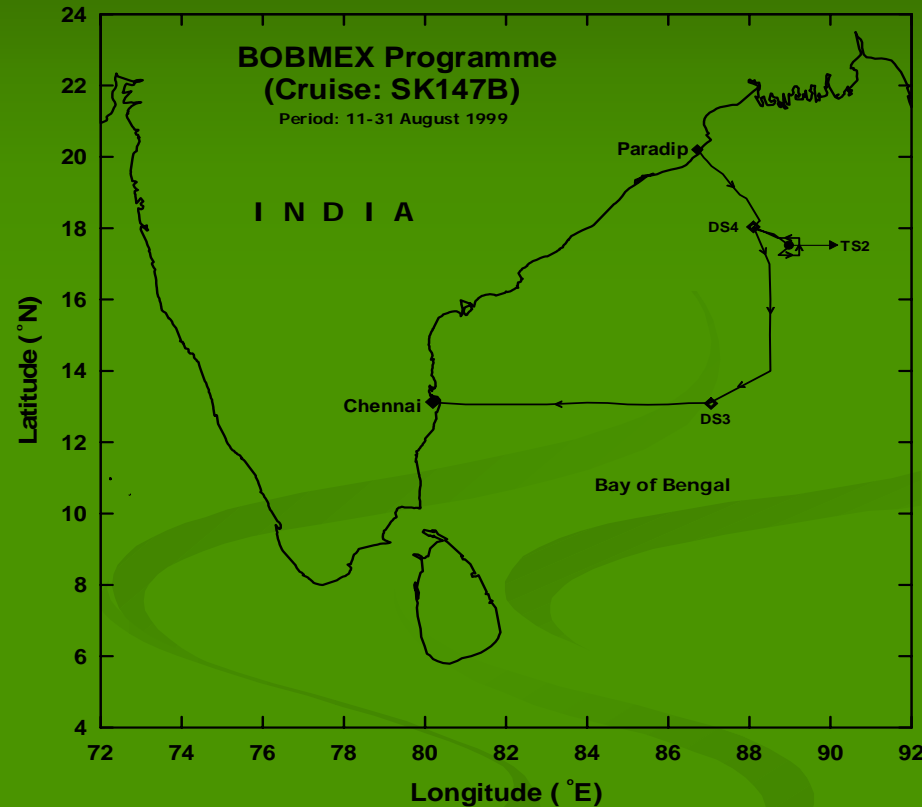
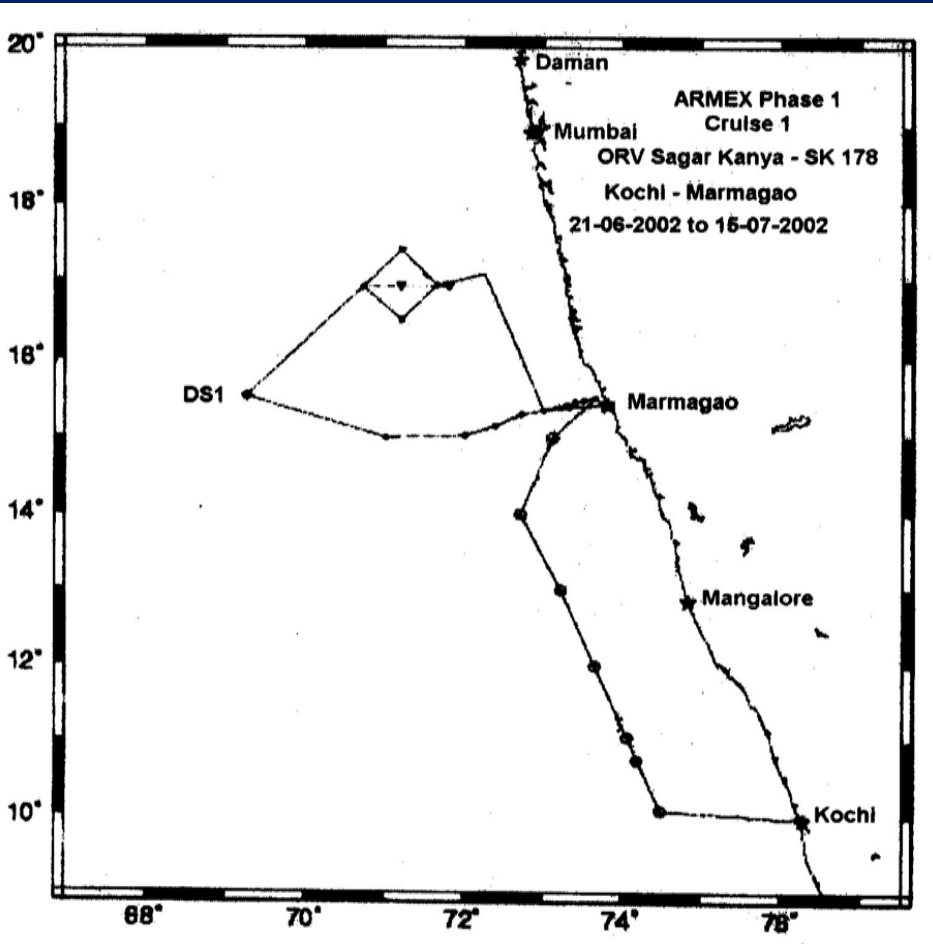
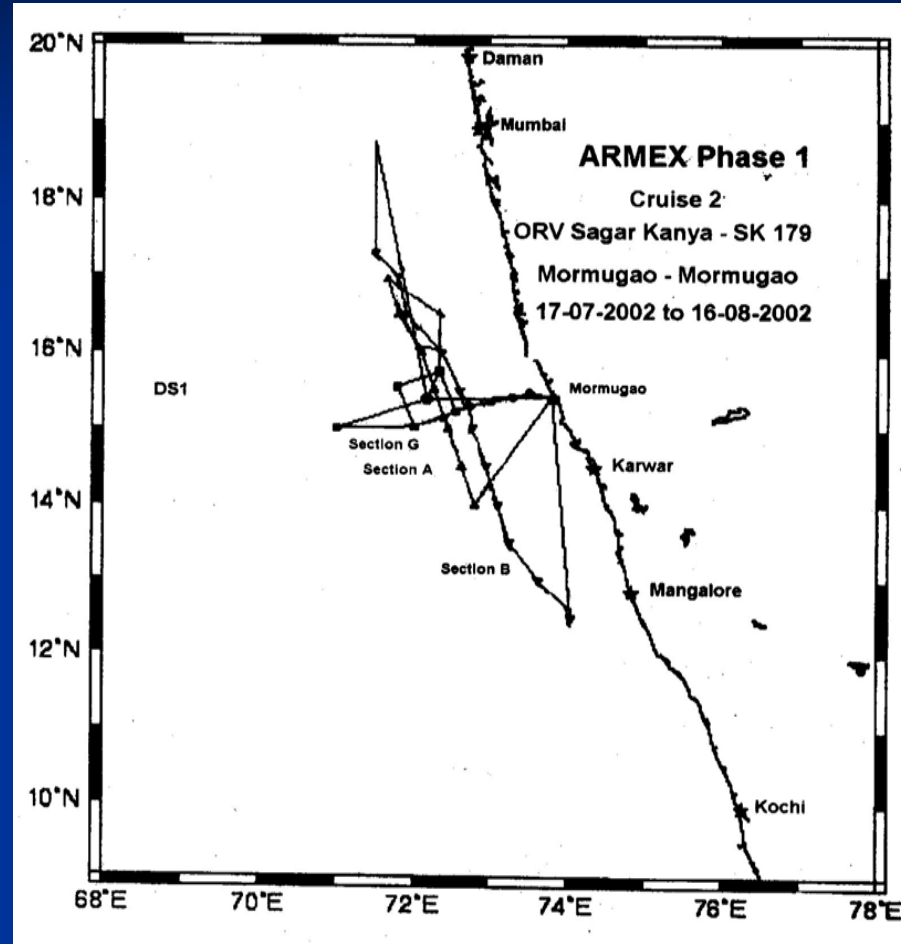


Fig. 2 ORV Sagar Kanya cruise (SK147B)Track

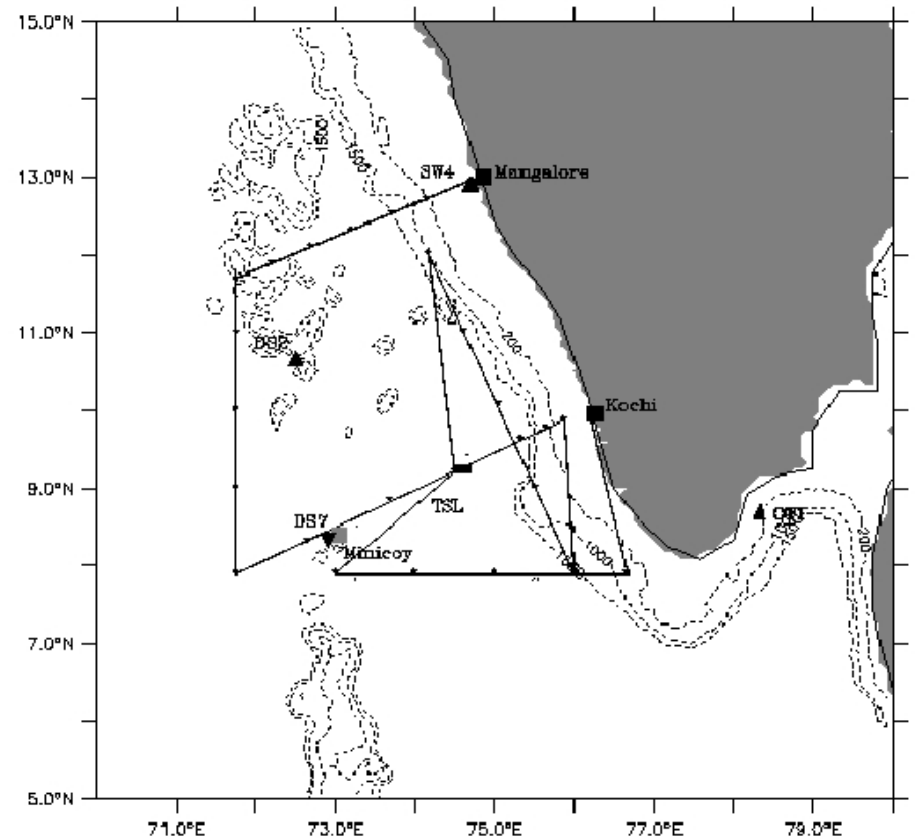
## ARMEX 2002(June-July)



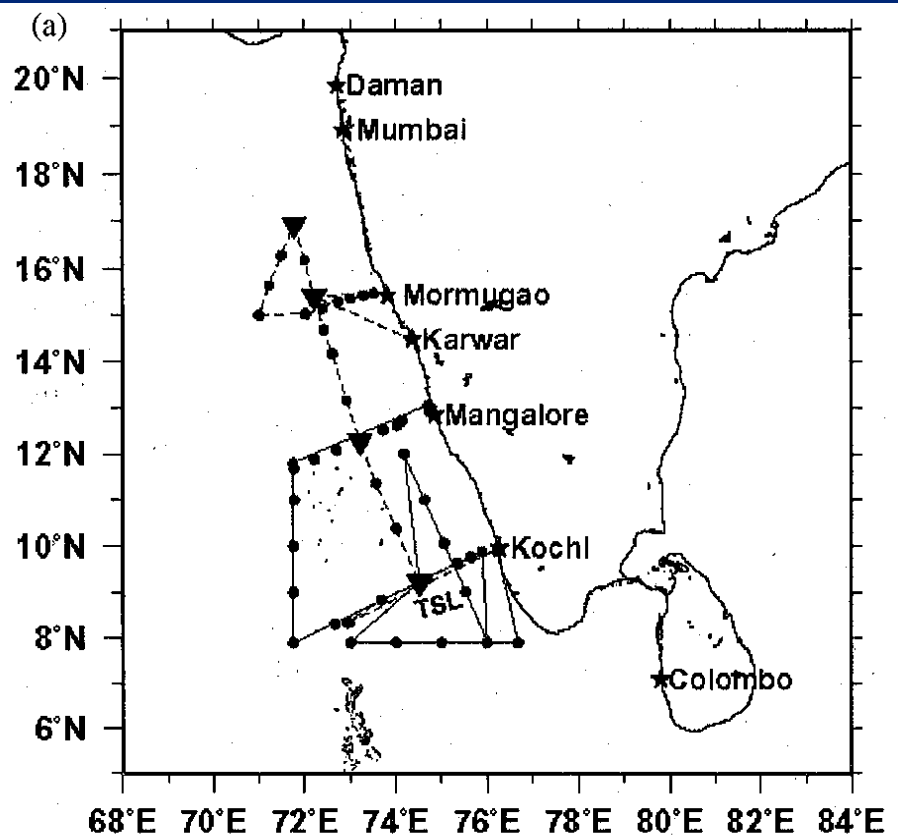
## ARMEX 2002(July-August)



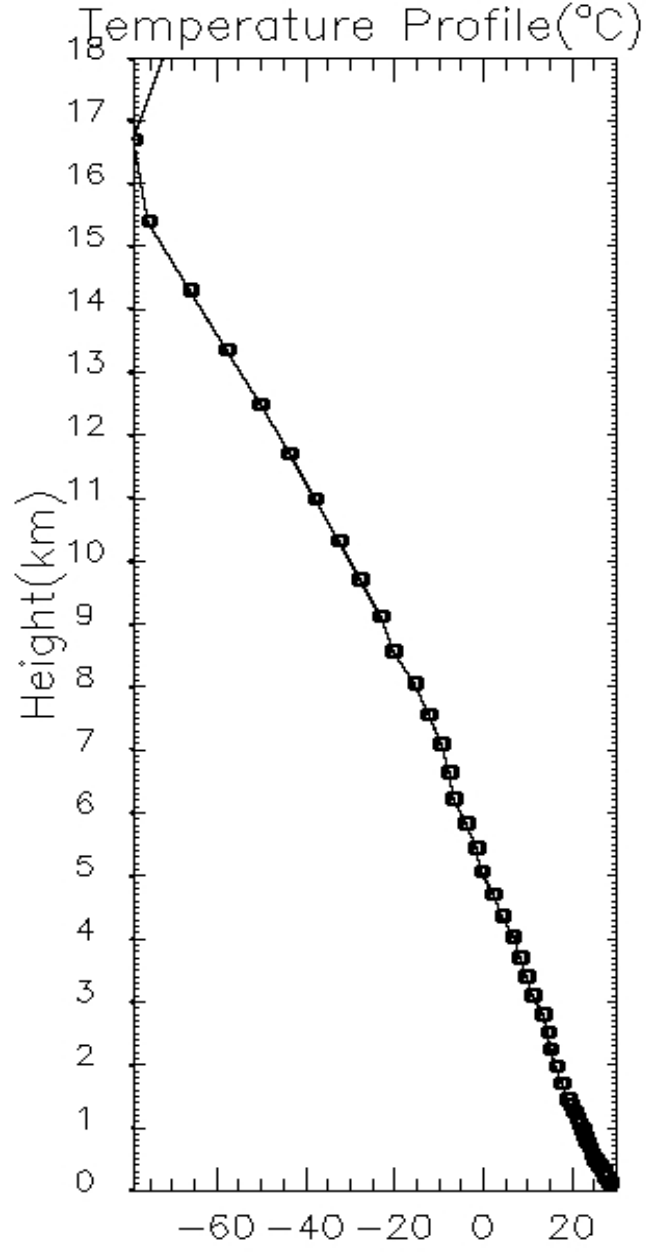
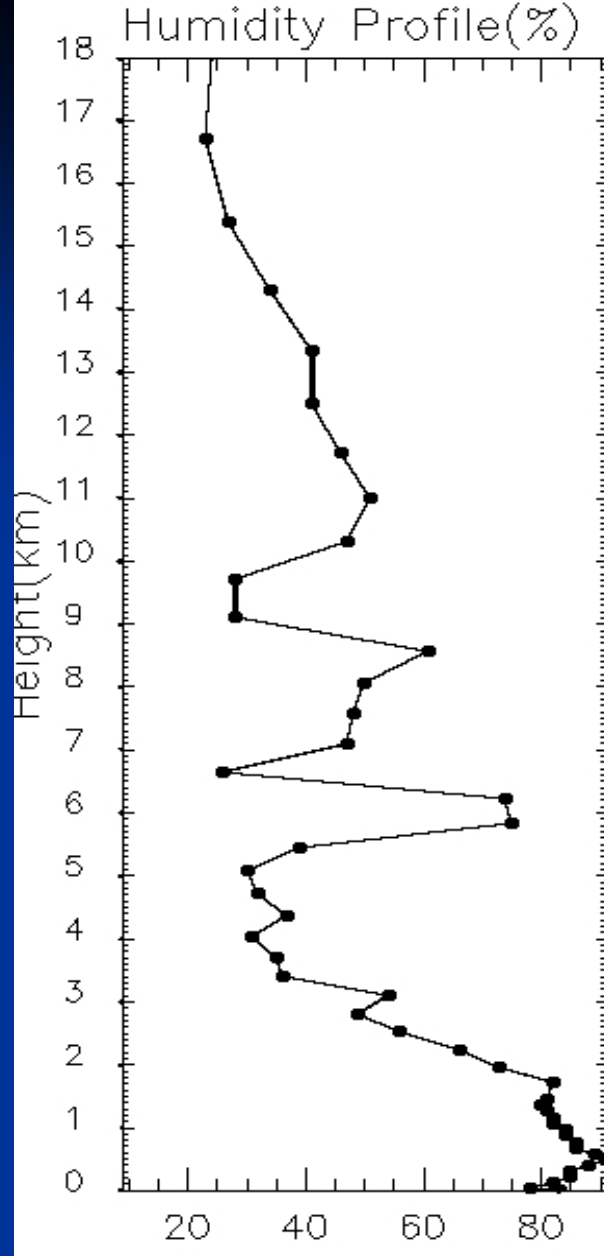
## ARMEX 2003(March-April)



## ARMEX 2003(May-June)







2003 - 06 - 18 05:28 UTC 15.39 N , 72.17 E

# Total Precipitable

## Water

The TPW is computed from radiosonde profiles using the hypsometric equation (Alishouse et al., 1990a).

Out of all the radiosonde profiles only those profiles were selected which exceeded the 300-hPa levels.

To assure good quality of data, a quality control filter was applied to remove the radiosonde profiles with less than four levels of good observations for pressure greater than 300 hPa or with bad observations at the lowest level.

# NOAA-16 AMSU MEASUREMENTS

The AMSU was designed primarily to improve the accuracy of temperature soundings beyond that of the four channels MSU.

AMSU-A also has window channels at 31.4 and 89 GHz to monitor surface features and precipitation and a 23.8 GHz channel for obtaining the total precipitable water over oceans (Grody et al. 2001).

The four brightness temperatures at 23.8, 31.4, 50.3 and 89 GHz are considered for the input to the Neural Network.

These four brightness temperatures are adjusted for limb correction (Goldberg et al. 2000) before using as input to the neural network algorithm.

# Why limb adjust?

- Retrievals based on collocated observations of satellite data and raobs are simplified if brightness temperatures are normalized to fixed angle.
- Physical retrieval algorithms are simplified if you do not need to have bias corrections as a function of fov.
- Information content (vertical resolution of retrieval) is constant as a function of fov.
- The limb adjustment of AMSU-A is extremely accurate.  
Goldberg

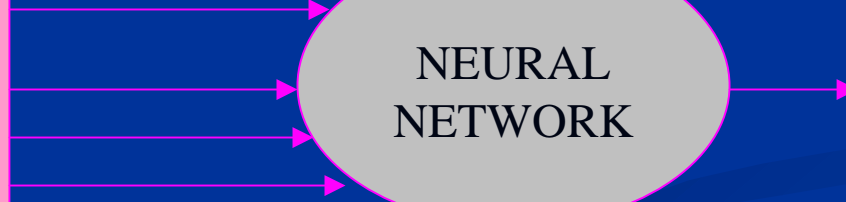
Mitchell D. Goldberg, Davis S. Crosby and Lihang Zhou, 2000: The Limb adjustment of AMSU-A Observations: Methodology and Validation, Journal of Applied Meteorology, Vol-40, 70-85pp.

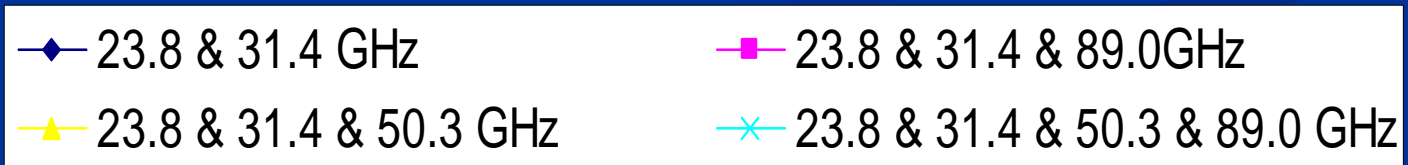
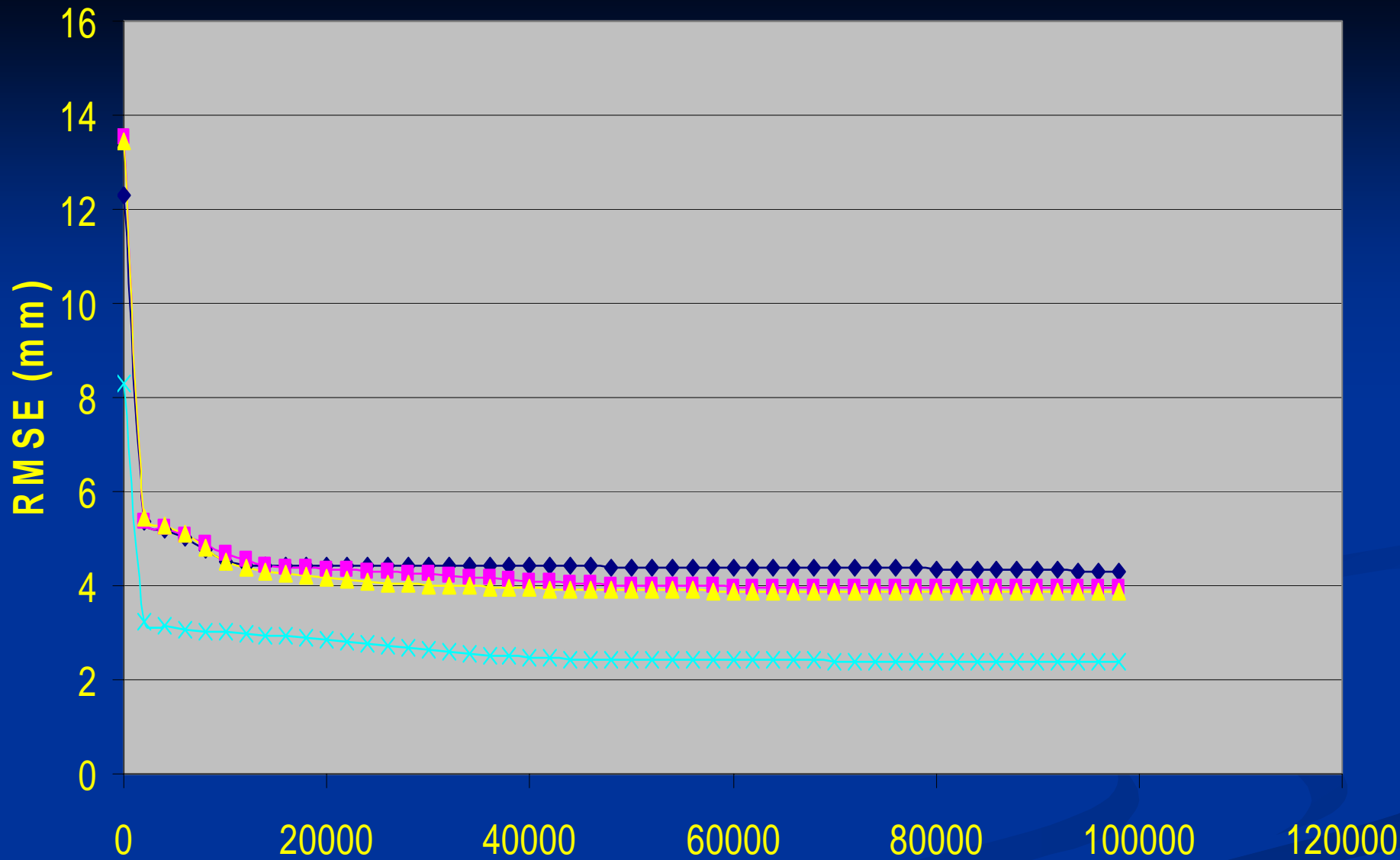
LIMB CORRECTED  
BRIGHTNESS  
TEMPERATURES  
AT AMSU-A  
FREQUENCIES: --

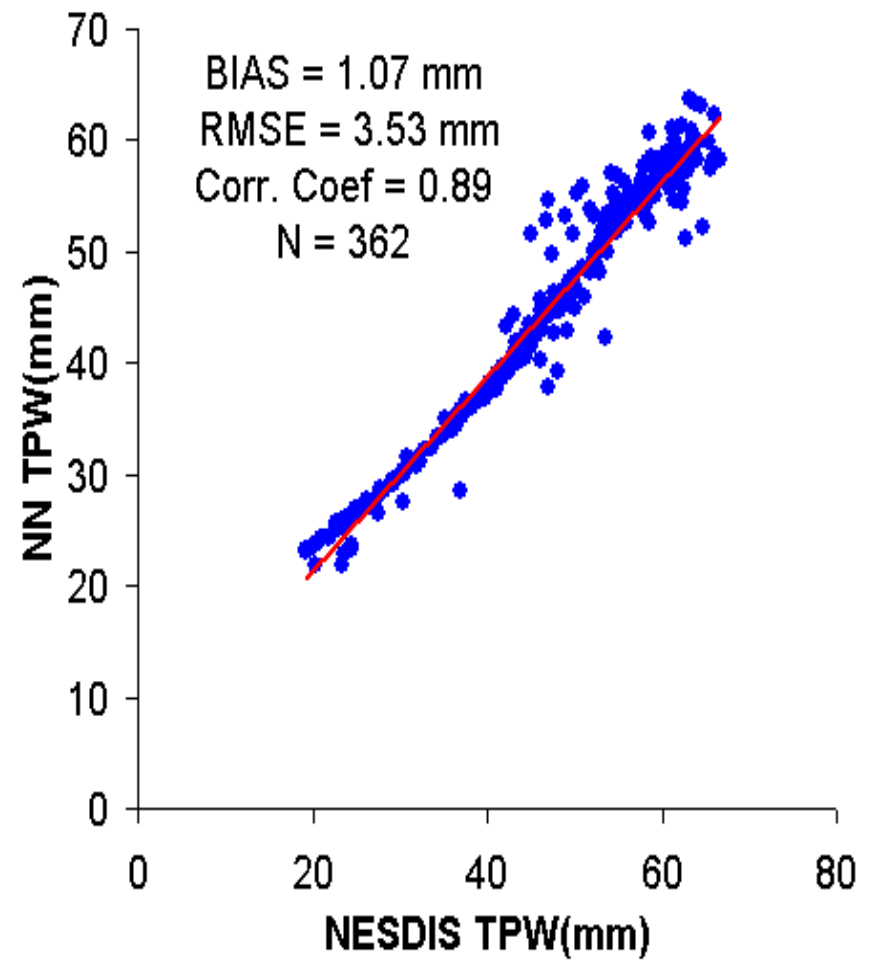
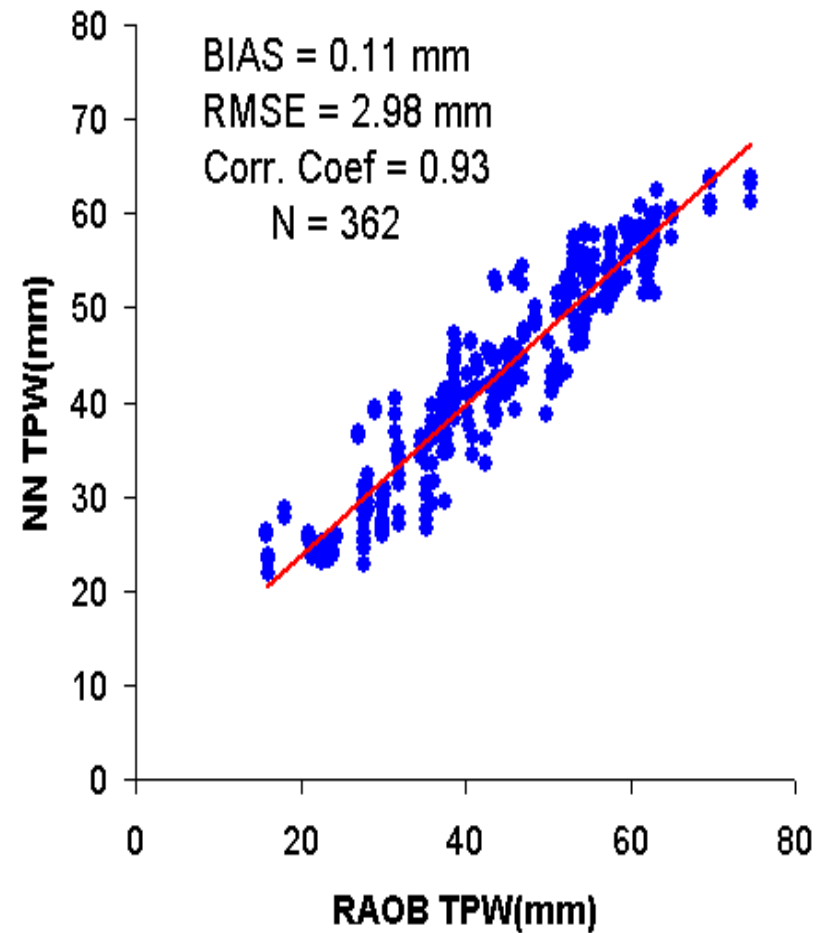
23.8 GHz  
31.4 GHz  
50.8 GHz  
89.0 GHz

NEURAL  
NETWORK

TOTAL  
PRECIPITABLE  
WATER





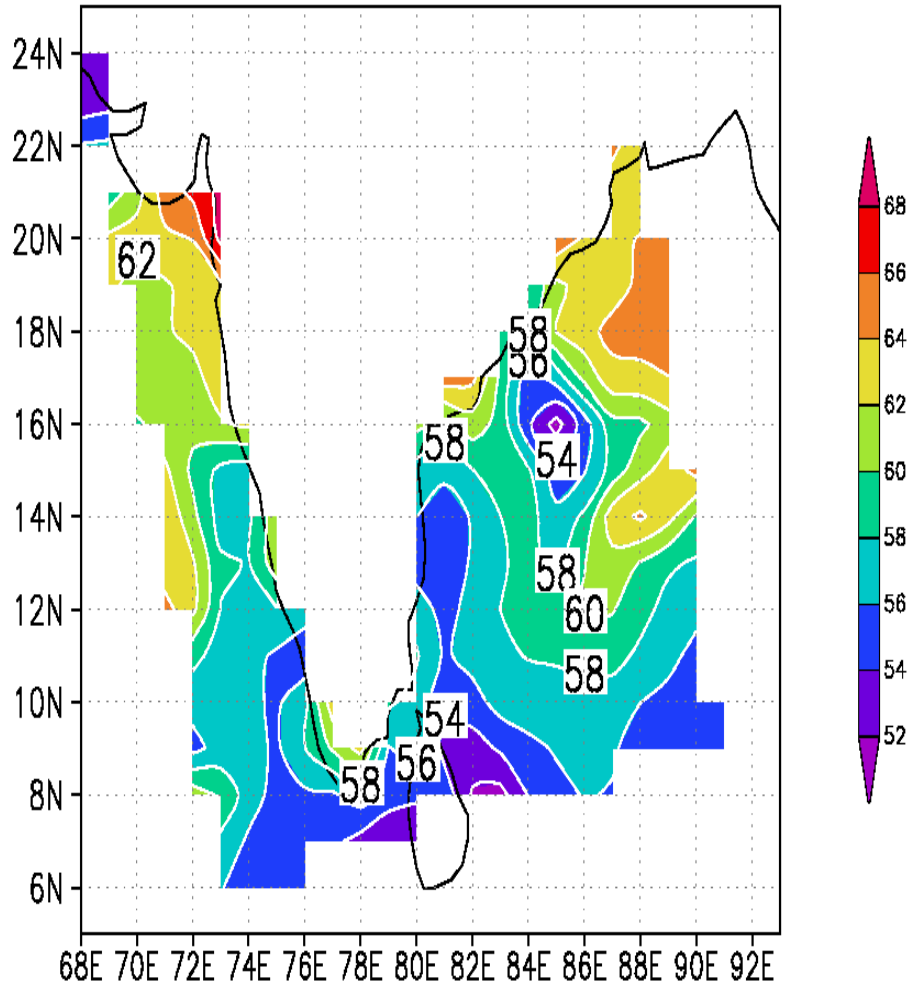


# Case Study

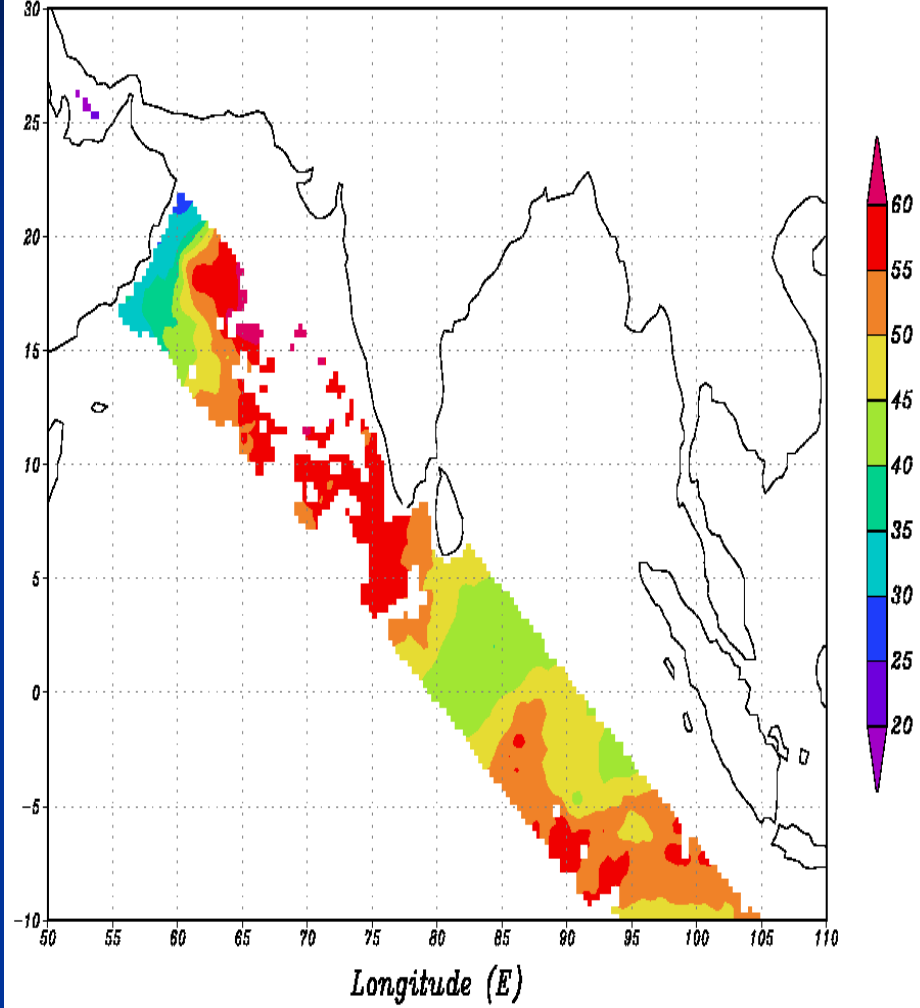
Application of Total Precipitable Water for predicting heavy rainfall along the west coast of India.



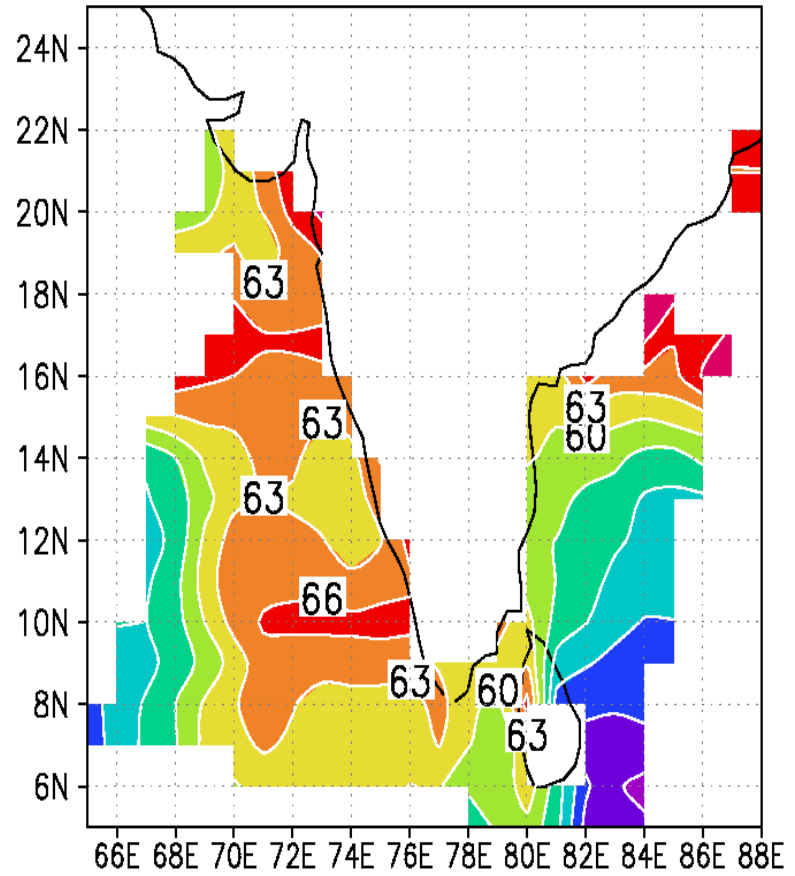
AMSU(NN) TPW(mm) 10th JUNE 2001 08:18 UTC



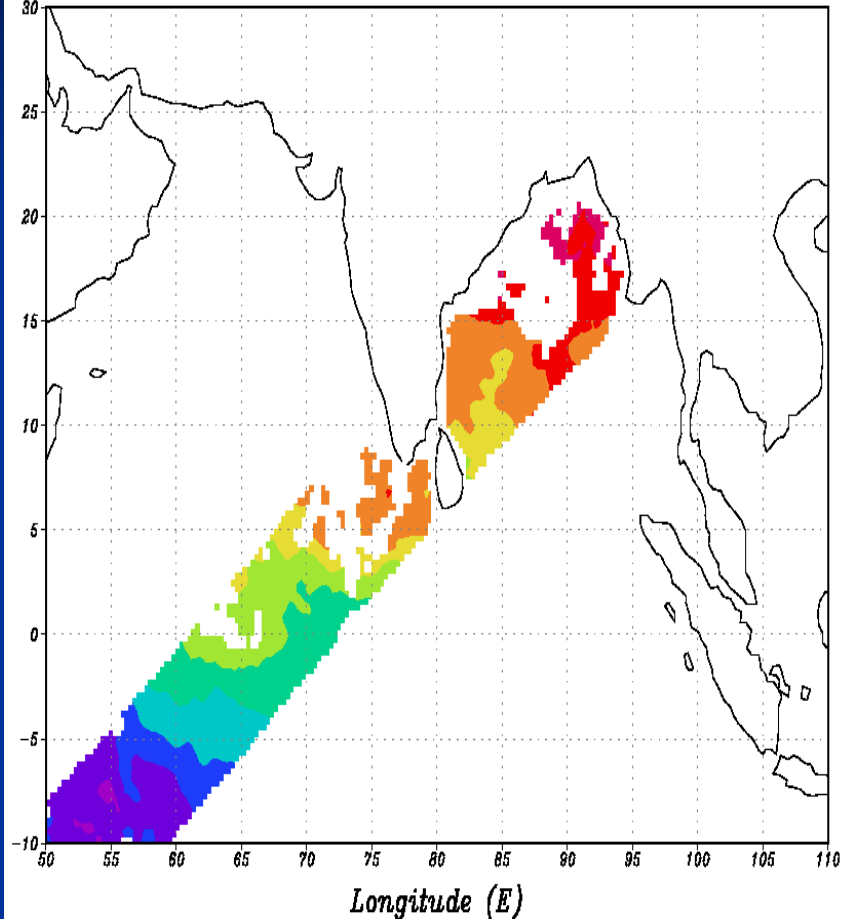
TMI TPW (mm) 10th June, 2001 08:00 UTC



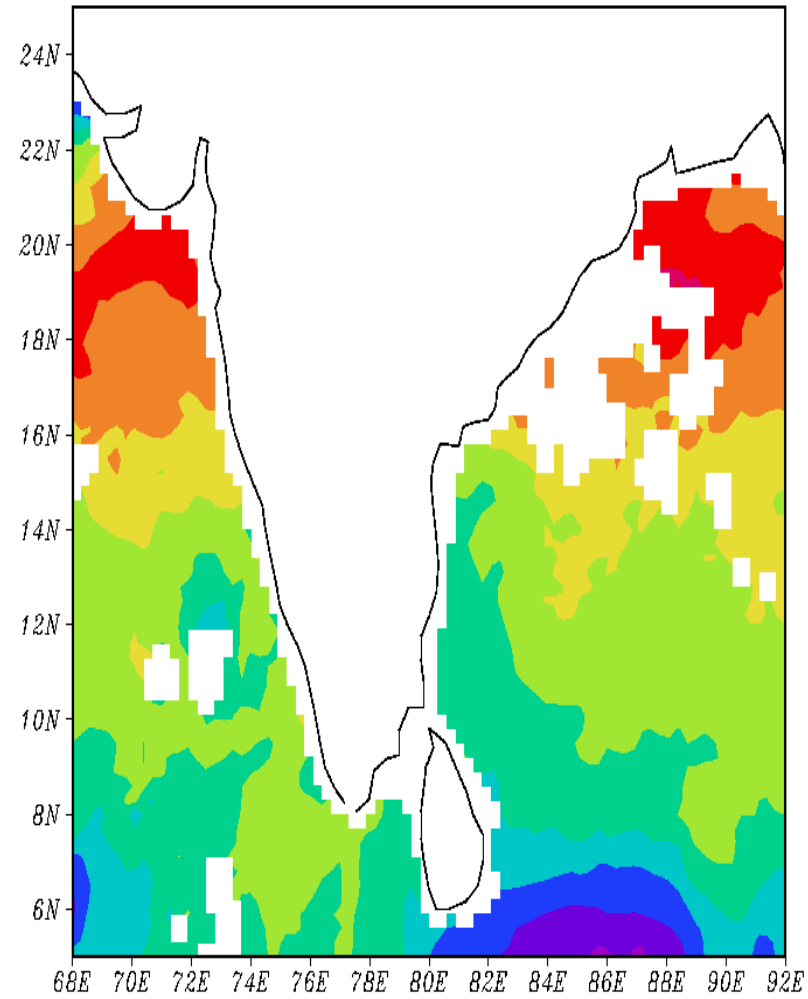
AMSU(NN) TPW(mm) 10th JUNE 2001 20:48 UTC



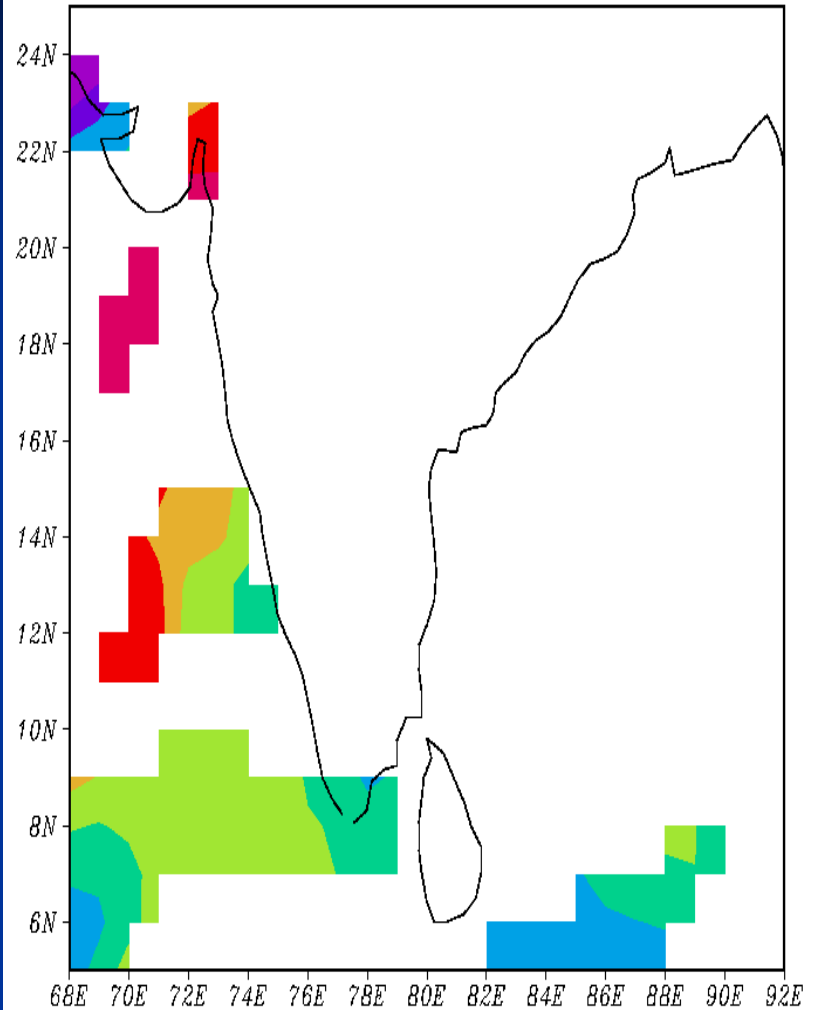
TMI TPW (mm) 10th June, 2001 21:00 UTC



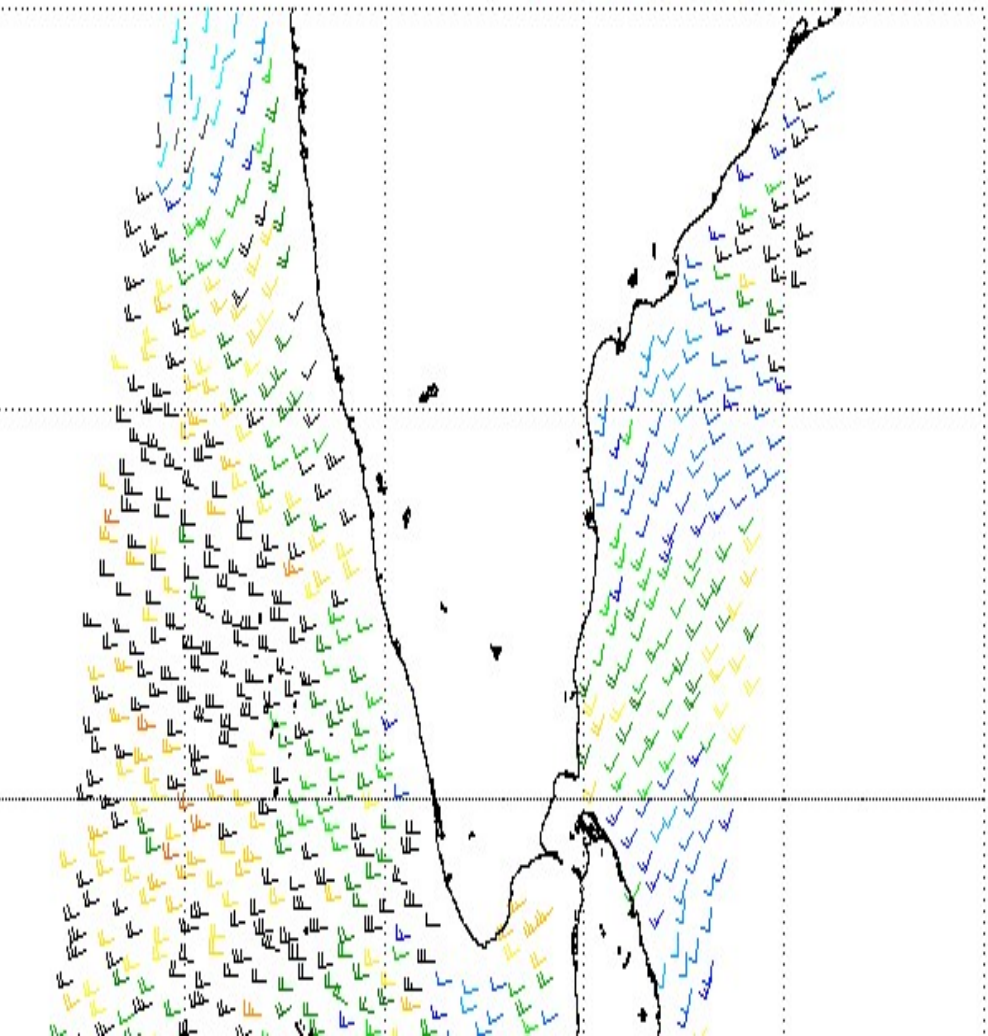
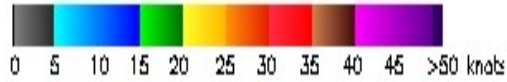
SSM/I TPW (mm) on 10 June, 2001



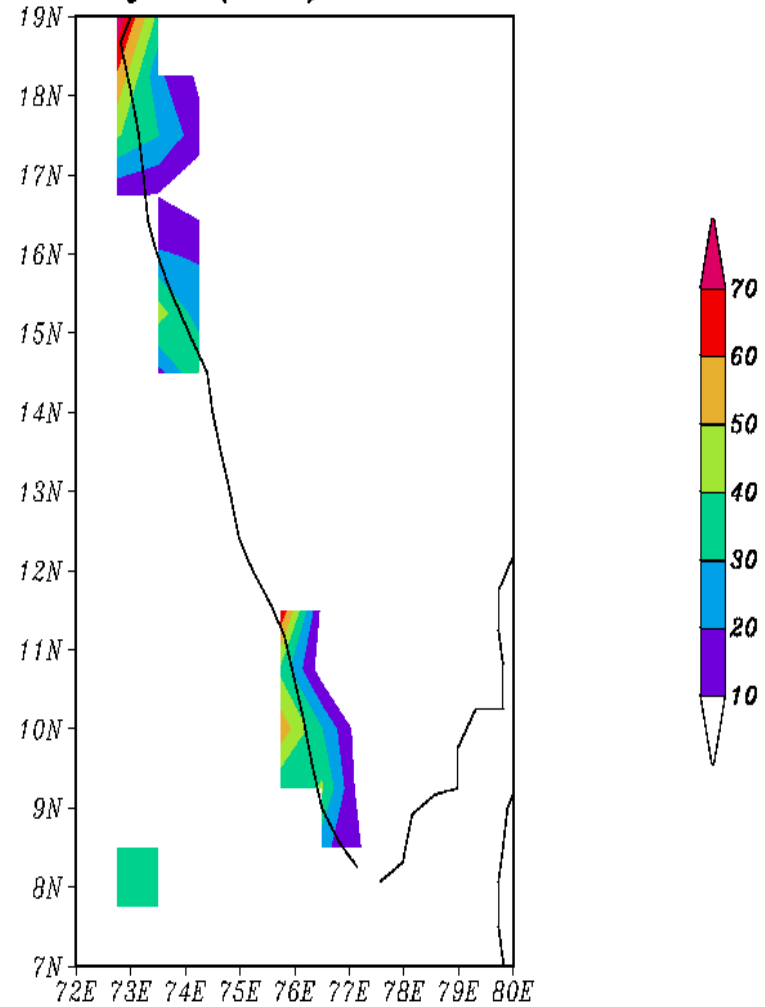
MODIS TPW (mm) on 10 June, 2001



QUIKSCAT NRT Winds 010610 descending



Actual Rainfall (mm) 11th June, 2001



# Conclusions

- TPW retrieved from AMSU data over Indian Oceanic region is comparable with that of other Instruments.
- The major advantage of locally retrieved TPW from AMSU measurements is that it is available in real time compared to the TPW from other sources to be used operationally by the field forecaster and numerical weather prediction centers.
- TPW along with Sea Surface Winds could be used to forecast heavy rainfall events at least 24 hours in advance.

# Acknowledgements

We are grateful to Indian Institute of Science, Bangalore for providing the vaisala raob data. We are also thankful to Dr. Mitch Goldberg NOAA / NESDIS for providing the limb correction coefficients for NOAA-16 AMSU-A.