A non linear approach for temperature retrieval from AMSU-A measurements onboard NOAA-15,16,18 and JPSS satellites and a case study during cyclones.

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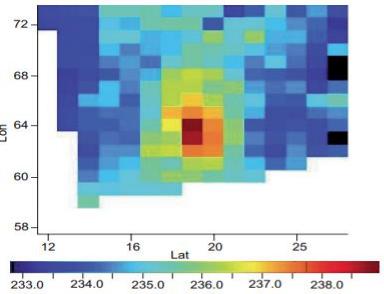
Abstract

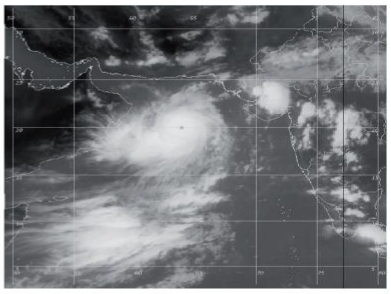
A neural network (NN) technique is used to obtain vertical profiles of temperature from NOAA-15 and 16 Advanced Microwave Sounding Unit-A (AMSU-A) measurements over the Indian region. The corresponding global analysis data generated by National Center for Environmental Prediction (NCEP) and AMSU-A data are used to build the NN training data-sets and the independent dataset divided randomly into two independent dataset for training (land) and testing (ocean). NOAA-15 and 16 satellite data has been obtained in the form of level 1b (instrument counts, navigation and calibration information appended) format and pre-processed by ATOVS (Advanced TIROS Operational Vertical Sounder) and AVHRR (Advanced Very High Resolution Radiometer) Processing Package (AAPP). The root mean square (RMS) error of temperature profile retrieved with the NN is compared with the errors from the International Advanced TOVS (ATOVS) Processing Package (IAPP). The over all results based on the analysis of the training and independent datasets show that the quality of retrievals with NN provide better results over the land and comparable over the ocean. Finally, the network based AMSU-A 54.94-GHz (Channel-7) brightness temperature (maximum Tb) and its warm core anomaly near the center of the cyclone has been used for the analysis of Gonu cyclone formed over Arabian Sea during 31 May to 7 June 2007. Further, the anomalies are related to the intensification of the cyclone. It has been found that the single channel AMSU-A temperature anomaly at 200 hPa can be a good indicator of the intensity of tropical cyclone. Therefore it may be stated that optimized NN can be easily applied to AMSU-A retrieval operationally and it can also offer substantial opportunities for improvement in tropical cyclone studies.

Methodology

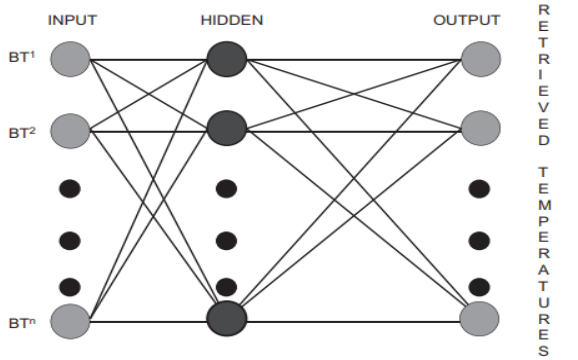
In the present study, temperature profiles have been retrieved by two different retrieval schemes:NN and IAPP using NOAA15 and 16 measurements. The retrieval results have been evaluated by the root mean square (RMS) differences and bias deviation between the retrievals from International ATOVS Processing Package (IAPP) and NN with the collocated NCEP analysis for the months of May 2007 to July 2007. The collocated data sets are constructed based on the temperature profiles retrieved using neutral network and IAPP that are within 2.5 hour of time difference and within 2º x 2º Lat/Lon of NCEP analysis. Finally, NN retrieved AMSU-A 54.94-GHz (Channel-7) brightness temperature (maximum Tb) near the center of the cyclone has been used for the study of super cyclone Gonu formed over Arabian Sea during 31 May to 7 June 2007. The derived atmospheric

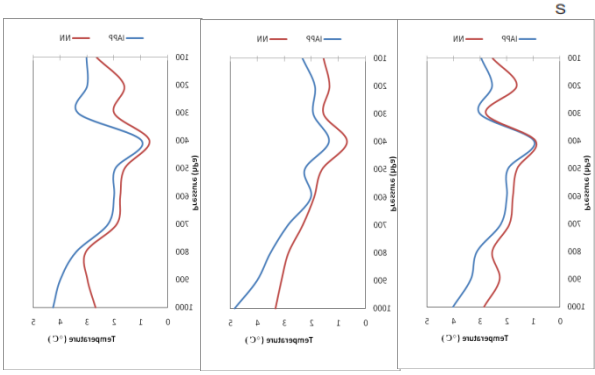


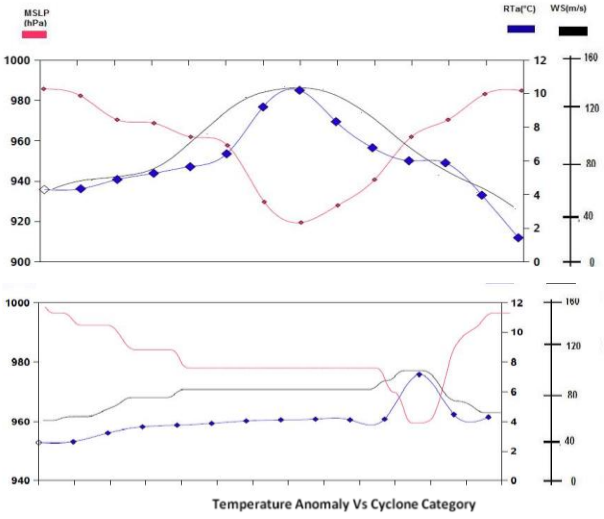
(a) Retrieved AMSU-A 54.9 GHz image of NOAA-15



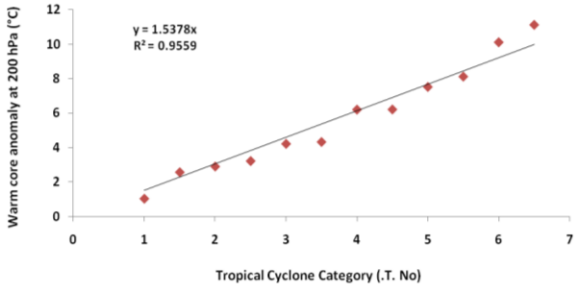
(b) Infrared image of Kalpana-1







Temperature Anomaly Vs Cyclone Category



Results

An application of the upper tropospheric warm core anomaly can be used in assessing the intensity of tropical cyclones (Kidder et al., 2000). Because of warming in the upper troposphere, which is responsible for the surface pressure drop in the tropical cyclones; the maximum temperature anomaly increases with higher correlation with MSLP. Finally, we merged the anomalies of 12 cyclones(Gonu,Nargis,Gulab,Yaas,Jawad,GATI,Amphan,FANI,Kyaarr Vardh,HudHud and Thane with cyclone intensity (.T. No) during the active cyclonic period.

The figure gives an indication of how well RT_a can be categorize the different warm core intensities of cyclone. As a cyclone intensifies, the warm core temperature anomaly will increase which is the indication of the positive relationship of cyclone intensities with warm core anomaly. The regression line indicates that for each 1.5 °C rise in the RT_a, the cyclone advances in one category i e. T. No. Although the categories are not large in this small sample of storms, the technique is simple to implement and could be very useful to operational forecasters.

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