

# **Use of Satellite Microwave Sensors in Qualitative Evaluation of Surface Level Moisture Influx and Study of its Impact on the Intensification of Indian Ocean Tropical Cyclones.**

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## **Extended Abstract**

### **Introduction**

Considering the gigantic destructive power associated with the tropical cyclone winds, it is not very convenient to make the observations of a cyclone with conventional surface based observation network. Moreover, over the vast oceanic regions where these cyclones originate, develop, and intensify, there are very few observation sites, and these are far too insufficient for making routine observations for monitoring the tropical cyclone developments. In such data sparse regions the meteorological satellites come to aid. These satellites make use of visible, infrared and microwave region of the electro-magnetic spectrum for observing such synoptic scale systems. Observations from visible/infrared sensors onboard the geostationary satellites are being extensively used for monitoring tropical cyclones and almost all operational centers worldwide depend on them for monitoring and predicting tropical cyclone movements. On the other hand, microwave sensors that generally operate from a polar orbiting platform, provide the advantage of sensing the parameters like surface wind and vertically integrated water vapor over a large area of tropical cyclones, though in the central region of the cyclone where the intensity of precipitation is very high, the determination of these parameters becomes difficult. In the present study, we have used satellite microwave observations for the qualitative assessment of low-level moisture flux into the Indian Ocean tropical cyclones during their life cycle, and also have tried to study the delayed impact of moisture flux on the intensification of these cyclones.

### **Data and Methodology:**

For the present study we have analyzed the observations of vertically integrated water vapor (Total Precipitable Water, or TPW) and ocean surface wind speed (SW) from Special Sensor Microwave Imager (SSM/I) and TRMM Microwave Imager (TMI) for the qualitative evaluation of low-level moisture transport into various tropical cyclones over Indian Ocean. Inflow region of tropical cyclones can be identified clearly in images of TMI and SSM/I by high values of TPW and SW. We assumed that the low level wind in the inflow region follows a spiraling trajectory terminating at a single point in the core of the cyclone (Fig.1). Also, the vertical velocity in this region is assumed to be very small compared to horizontal velocity, and the moisture is assumed to decrease exponentially in the vertical direction. Under these

assumptions we can apply the divergence theorem to compute the inward moisture transport using the available satellite observations. The intensification of cyclones was inferred by the size of central dense overcast (CDO) from INSAT-VHRR observations, as well as by the fractional density of deep convection obtained from the polarization corrected temperature of 85 GHz channel of TMI. Observations of precipitation by TMI and Precipitation Radar have also been used in a few cases to support the above observations.

## Results

This analysis reveals that the major peaks and the decay pattern of SSM/I derived transport parameter leads the CDO size variation by about 18 hours (Fig.2) which indicates that the influx of moisture at the lower levels guides the growth of the tropical cyclones. With larger number of samples of vector winds from satellites such as QuikSCAT, and humidity profile information from advance sounders, it is possible to quantify the actual moisture transport into the cyclones. Since a lead-lag relationship is found between the moisture influx and the variation in CDO size, this can be a useful inference for the study of the intensification of tropical cyclones by passive infrared and microwave sensors and could aid to improve forecasting skills.

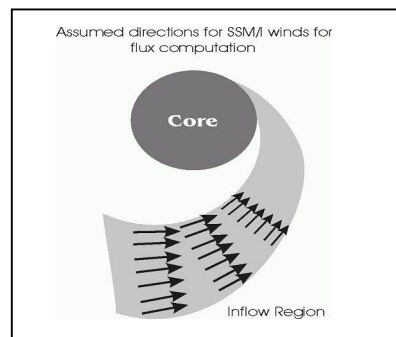


Fig. 1 : Assumed directions of SSM/I and TMI winds for flux computation

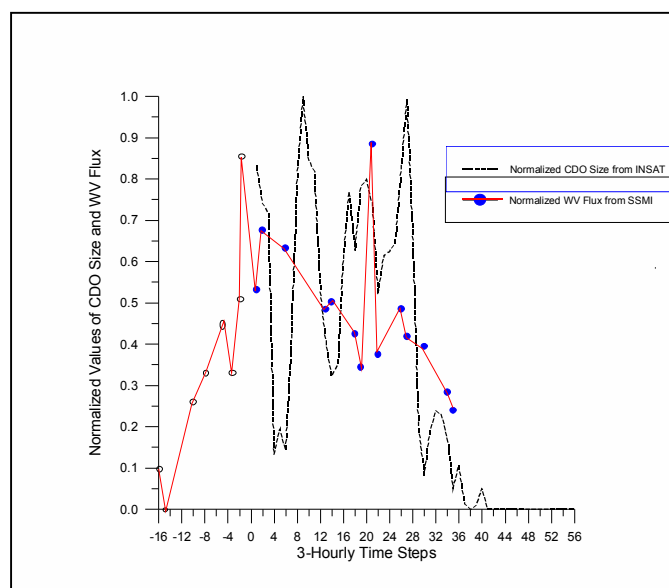


Fig.2: CDO size variation plotted with SSM/I derived surface level moisture flux for Arabian Sea cyclone