



area bounded by 5°N to 22°N latitude and 80°E longitude to 100°E longitude from the original 1°x 1° data set by incremental process as mentioned below.

Suppose  $A=[a_{ij}]$  be the matrix of original 1°x 1° data set and  $B=[b_{ij}]$  be the new data matrix. Then  $b_{ij}=(\sum a_{ik})/9$  where  $l=i-1$  to  $i+1$  and  $k=j-1$  to  $j+1$ .

Primary cyclone season over north Indian Ocean is post monsoon months (October, November and December) in south Asia (Singh et al 2001). In this aspect a Time series of daily maximum values of average surface vorticity (ASV), (2°x 2° data, based upon new data matrix) over Bay of Bengal for the available data period 1999 to 2008 has been constructed and comparison study has been done for such vorticity values between occurrence and non occurrence cases of cyclonic activity over Bay Bengal. Autocorrelation function (Box and Jenkins 1976) of different lag has been applied to the above time series. Daily maximum ASV in association with first day of cyclone as dependent variable(Y) and previous consecutive mostly correlated lag days as dependent variables has been taken to construct a prediction equation using the multiple regression method. Threshold of predicted value and threshold for anomaly of predicted value from value of days just before of correlated lag days has been determined by iteration process for identifying tropical cyclogenesis signature over Bay Bengal. The categorical score considered in this study is the probability of detection (POD), which evaluates the effectiveness of detection techniques. It is defined as

$$POD=H/(H+M)$$

where H is the number of hits and M is the number of misses.

### 3. Result and Discussions

Post Monsoon Season (October, November and December Months) is the peak period of occurrence of severe cyclonic storms over Bay of Bengal and Indian Ocean area. 17 TCs observed during the period of 1999 to 2008 have been considered in this study considering availability of scatterometer data in association with the occurrence period of the cyclones. The best tracks of these cyclones are presented in Fig.1. It is observed that lifecycle of most of cyclones covers area oriented from southeast Bay to southwest or west-central Bay and some of them moved northwards towards Bangladesh Coast across Central Bay and most of TCs were observed during month of October and November. Average vorticity pattern during October and November months are depicted in Fig.2 which reveals distribution of positive vorticity covers almost same area as followed by cyclone lifecycles or tracks. Though cyclone activity days is very less as compared total period, the much higher values of surface relative vorticity associated with cyclone activity contributed for higher positive vorticity over tropical cyclones tracks and genesis area. Time series of daily maximum ASV of 920 days of 10 years period (1999 to 2008) of post monsoon season has been depicted in Fig.3. Almost all the peak values of Daily maximum ASV as seen in the Time series graph are attributed with the occurrence of cyclonic storm activity

over Bay of Bengal. Also the average value of Daily maximum ASV during post monsoon period based on the 10 years data is  $3.1 \times 10^{-5} \text{ s}^{-1}$  with standard deviation  $2.6 \times 10^{-5} \text{ s}^{-1}$  which may be due to fact that very high values of positive vorticity observed during persistent of cyclonic storm or low pressure system over the region. Autocorrelation function with Lag 15 is depicted in Fig.4. It is observed that there are significant coefficient correlation (CC) values upto Lag3 and the CC values are 0.69, 0.42 and 0.24 respectively for Lag1, Lag2 and Lag3. Daily maximum ASV in association with first day of cyclone as dependent variable(Y) and previous consecutive three days (termed as  $D1_{Obs}$ ,  $D2_{Obs}$  and  $D3_{Obs}$ ) as three dependent variables has been taken to construct a prediction equation using the multiple regression method. The following prediction equation has been obtained.

$$Y= 5.0+0.71x D1_{Obs} +1.31x D2_{Obs} - 1.78x D3_{Obs}$$

Then anomaly values of Y (Say  $Y_{anom}$ ) from preceding fourth day values i.e (Y-  $D4_{Obs}$ ) has been examined. It has been found that the higher values of Y and  $Y_{anom}$  are associated with the cyclogenesis days. Investigation through iteration process reveals that the value of Y greater than  $6.7 \times 10^{-5} \text{ s}^{-1}$  and  $Y_{anom}$  greater than  $4.5 \times 10^{-5} \text{ s}^{-1}$  is associated with probability of detection (POD) value as 0.76 for detection of Cyclogenesis over Bay of Bengal. It is attributed with the fact that higher values of surface relative vorticity with significantly rise for 2 to 3 days is favourable for tropical cyclone development. Thus Daily maximum ASV derived from scatterometer data can be used as an important prediction parameter for identification of cyclogenesis over Bay of Bengal.

### 4. Conclusion

Surface vorticity at 10 meter height over ocean surface obtained from scatterometer observations derived wind field can be used as an important predictor of TCG over Bay of Bengal. The vorticity-based detection technique described herein is an effective tool in identifying and monitoring tropical cyclogenesis and its development over Bay of Bengal. Higher values of maximum average surface relative vorticity over 220km x220km area with increase in order of  $5 \times 10^{-5} \text{ s}^{-1}$  during 48 to 72 hrs prior to cyclone development are favourable for cyclogenesis over Bay of Bengal.

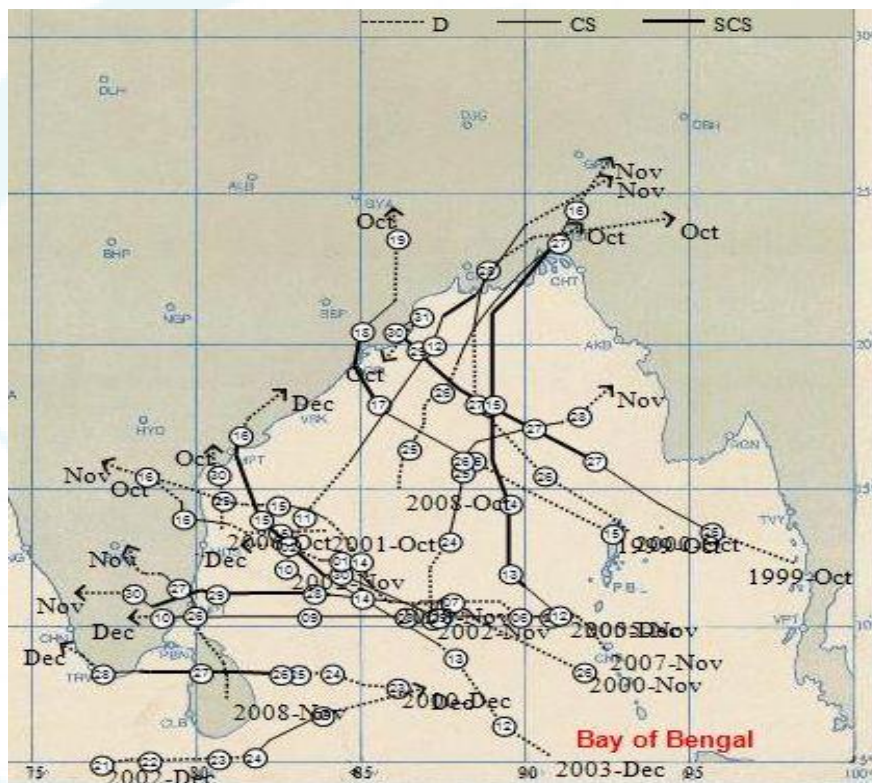
### Acknowledgement

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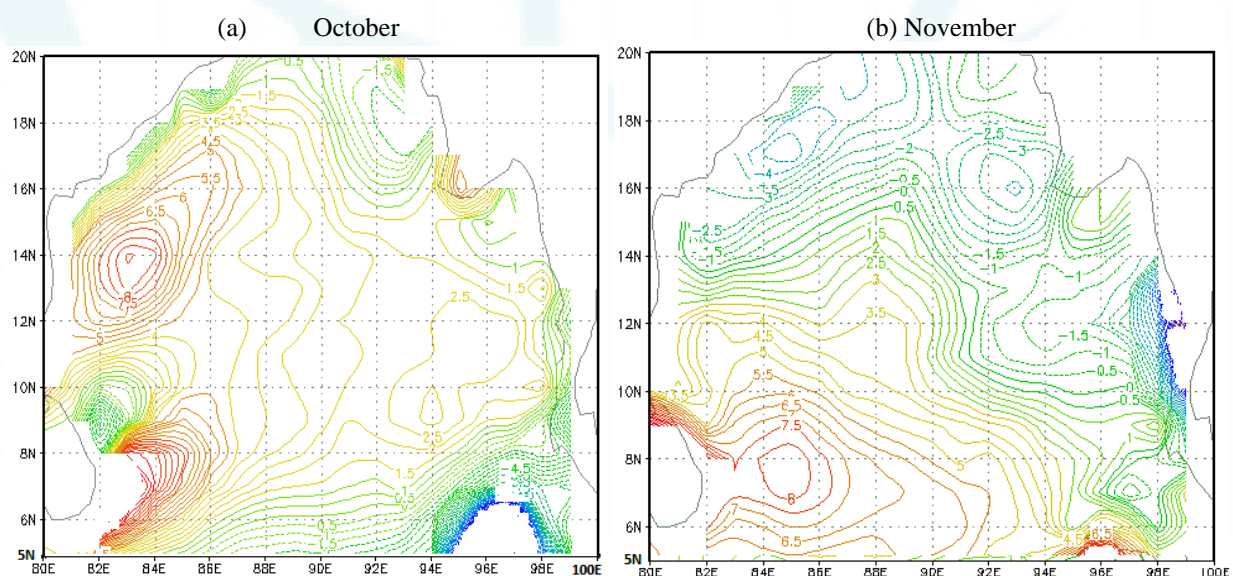
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**Figure 1:** Tracks of 17 Tropical cyclones observed during the period of 1999 to 2008 over Bay Bengal



**Figure 2:** Mean surface relative vorticity( $\times 10^{-6} s^{-1}$ ) pattern during (a) October and (b) November over Bay of Bengal.

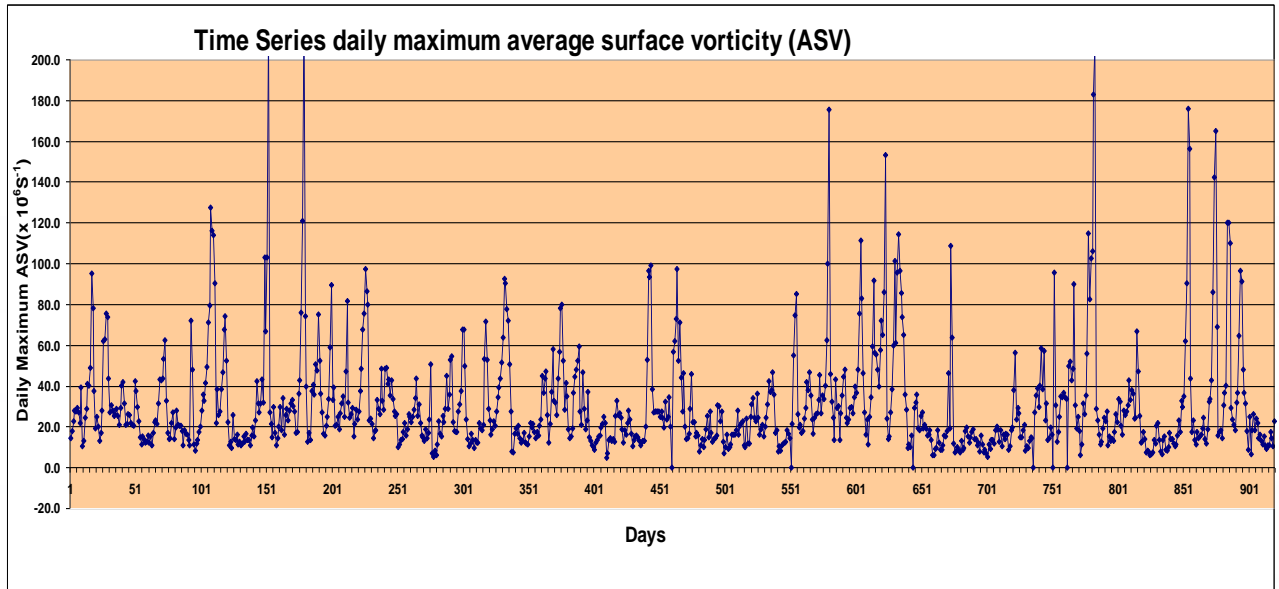


Figure 3: Time series of daily maximum ASV of 920 days of 10 years period (1999 to 2008) of post monsoon season

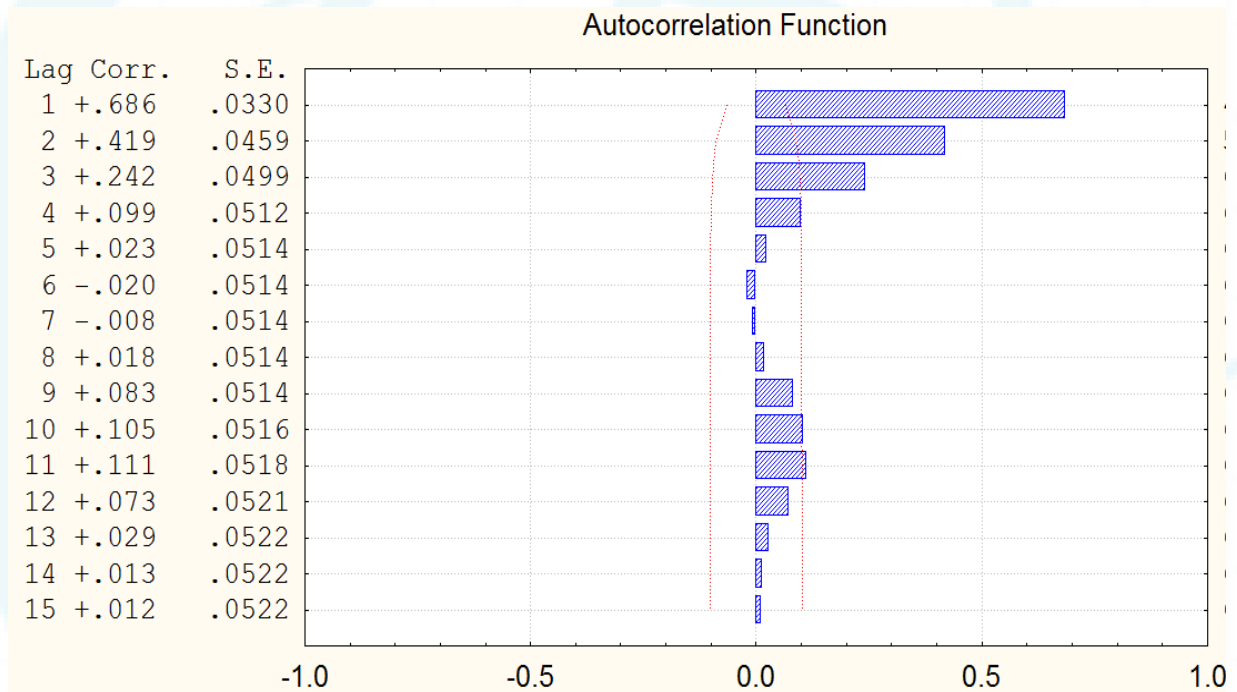


Figure 4: Autocorrelation functions (upto Lag 15) for the time series of Daily maximum average surface relative vorticity during post monsoon season