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## Decadal variability and trends in the annual frequency of tropical cyclones and monsoon depressions of North Indian Ocean

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In the North Indian Ocean (NIO) Tropical Cyclones (TC) occur during the pre (post) monsoon months April-May (October-December). During the monsoon season (June-September) we get Monsoon Depressions (MD) that differ from TC in many of their features. They however have an in-phase Four Decade Oscillation (FDO) in annual frequency. This FDO had large amplitude during 1960 to 2000 with the years around 1970 (1990) having high (low) frequency of TC and MD. Annual frequency of MD during 1891 to 2009 had a very prominent decreasing trend with the FDO superposed on it. The annual frequency of TC during the same period had only a very small decreasing trend. However the ratio between annual frequencies of severe TC (maximum wind 48 knots and more) and TC (maximum wind 34 knots and more), taken as an Intensification Index, had a prominent long term increasing trend associated with global warming. The Gray's cyclone genesis parameters are found to have very little association with the FDO in TC and MD except that low level vorticity has an association. We find that the October to December (main season of TC) 850 hPa zonal wind averaged over an equatorial box bounded by latitude 2.5oS and 7.5oN and longitude 50oE and 10oE had a FDO during 1948 to 2009, in phase with that in TC frequency. The decreasing trend in the annual frequency of MD is associated with the decreasing trend in the strength of the Low Level Jetstream passing through peninsular India (1948 to 2009), which is hypothesized to be caused by the observed rapid increase in the Sea Surface Temperature of equatorial central Indian Ocean.