



How do Arabian Sea cyclones propel faster onset advance of monsoon over the west-coast?

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Recent trend in the Arabian Sea shows the formation of more cyclones during the critical window when the Indian Summer Monsoon onset occurs. This research highlights the impact of cyclones on the initial stages of the monsoon, its establishment and onset advance. This study investigates the role of cyclones in the faster northward advance by comparing the speed of advance of monsoon precipitation between cyclone years (CY) and non-cyclone years (NCY) using data from 2000 to 2023. Further, we employed the data from ECMWF reanalysis (ERA5) and clouds and the earth's radiant energy system (CERES) to gain detailed insights into wind behavior during the monsoon onset phase in addition to wind profiles from a 205 MHz radar located at the Advanced Centre for Atmospheric Radar Research (ACARR) at Cochin University of Science and Technology (CUSAT). A potential link has been observed between the presence of cyclones during the monsoon onset period and a redistribution of rainfall patterns which helped in pre-conditioning the atmosphere. Moreover, this paper brings out a dynamical mechanism by which Arabian sea cyclones facilitate a faster northward advance of the monsoon.

The west coast of India witnessed a temporary dip in precipitation in the month of June during CY. Analysis shows a rapid drop in pressure around northern India and strong cyclonic winds in the Arabian Sea which correspond with cyclone events. During the cyclone years over AS, the northward propagation of OLR and precipitation is faster (1.4 degrees/day) compared to that in non-cyclone years (0.83 degrees/day), indicating a quicker monsoon onset and progression. Anomalies in wind speed and mean sea level pressure reveal a faster spread of anomalies across northern latitudes in CY compared to NCY, potentially linked to the faster northward propagation observed in CY. Further analysis suggests higher easterly shear during CY inducing cyclonic vorticity to the north, and anticyclonic vorticity to the south of the convection centre propelling the northward advancement of the convection band. Our findings suggest a complex interplay of atmospheric dynamics influencing the northward advance of relative vorticity and hence the precipitation, thereby revealing the seminal role of vertical easterly shear and moisture convergence in dictating the speed of monsoon onset progression.

References

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