The Role of Topographically Induced Vortices in Tropical Cyclone Formation over the Indian Ocean

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The role of Sumatra and adjacent topographic features in tropical cyclone (TC) formation over the Indian Ocean (IO) is investigated. Sumatra, as well as the Malay Peninsula and Java, have mountainous terrain that partially blocks low-level flow under typical environmental stratification. For easterly low-level flow, these terrain features often produce lee vortices, some of which subsequently shed and move westward from the northern and southern tips of Sumatra and thence downstream over the IO. Since Sumatra straddles the equator, extending in a northwest-to-southeast direction from approximately 6N to 6S, the lee vortices, while counter-rotating, are both cyclonic. Hence, they can serve as initial disturbances that eventually contribute to TC formation over the IO. In addition, low-level, equatorial westerly flow impinging on Sumatra is also typically blocked and diverges, at times contributing to cyclonic circulations over the IO, primarily near the southern end of the island.

Data from two recent tropical campaigns, the 2008-10 Year of Tropical Convection (YOTC) and the 2011 Dynamics of the Madden-Julian Oscillation or MJO (DYNAMO), are used to study these phenomena. These data sets reveal the frequent occurrence of shed and non-shed terrain-induced cyclonic circulations over the IO, the majority of which occur during boreal fall and winter. During the 2.5 years of the two campaigns, 13 wake vortices (13% of the shed circulations identified) were tracked and observed to subsequently develop into TCs over the northern and southern IO, accounting for 25% of the total TCs forming in the IO during that period.

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