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Synoptic Disturbances over the Western Maritime Continent Region during Boreal Winter

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During boreal winter, the Maritime Continent is a region of deep cumulus convection and heavy precipitation systems that play a major role in several global- and regional-scale processes. Over the western part of this region, the synoptic-scale Borneo vortex and northeast cold surge and the intraseasonal Madden Julian Oscillation (MJO) contribute to the variability in deep convection. This work studies the impact on deep convection due to interactions among these three different motion systems. Furthermore, the role of the unique topography of the region is examined with respect to the variability in the synoptic-scale cold surge and Borneo vortex. The primary data used in this study are the three-hourly Geostationary Meteorological Satellite (GMS) black-body temperature (Tbb) at 1º x 1º grids, and the once daily (00 UTC) NCEP/NCAR Reanalysis winds at 925 hPa at 2.5º x 2.5º grids, for 21 boreal winters (December 1980 – February 2001). On the synoptic scale, interaction of northeast winds with local topography and dynamic response to the change in latitude contribute to turning of the winds and localized patterns of deep convection. In days without a Borneo vortex, deep convection tends to be suppressed over the South China Sea and Borneo and enhanced downstream over the landmasses on the western and southern peripheries of the equatorial South China Sea. The pattern is reversed in days with a vortex. The presence of a cold surge enhances this contrast. The surge also interacts with the Borneo vortex, in that the vortex is strengthened and the vortex center shifts from over the South China Sea to be located over the western coast of Borneo. The frequency of cold surges and vortex days is reduced during periods when the MJO is present. Composites of large-scale circulation and outgoing long wave radiation are used to show that often the MJO-related circulation patterns oppose the synoptic-scale cold surge and vortex circulations. Thus, a primary impact of the MJO is to inhibit weak cold surge events, which then produces a secondary impact on the Borneo vortex via the previously established interactions between the cold surge winds and the vortex.

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