

TROPICAL LARGE-SCALE INTERACTIONS AND TROPICAL CYCLONE DEVELOPMENT DURING THE 1996-97 AUSTRALIAN MONSOON

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During the northern winter monsoon, several large-scale tropical motion systems are active in the southern equatorial region of the maritime continent and West Pacific, including the vicinity of northern Australia. The time-mean convection is organized into the ITCZ and the SPCZ, with the former often influenced by low-level cross-equatorial flow from the north and the latter characterized by low-level cyclonic vorticity. Superimposed on this mean state, the transient large-scale systems include the Madden-Julian Oscillation from the equatorial Indian Ocean, the northeasterly cold surges from the northern hemisphere, and the easterly waves from the central or western Pacific. This work uses GMS water vapor data and NCEP reanalysis to study the possible roles of the interactions among these large-scale systems, particularly with respect to the development of tropical cyclones, between December 1996 and March 1997.

Based on a South China Sea meridional wind index, seven cold surges occurred in this season. These are broad-scale events that cover a wide longitudinal band of the subtropical northwestern Pacific. Composites of 1000 hPa winds indicate that systematic large-scale changes in the southern tropics occurred as the surges develop, such that the low-level vorticity tends to intensify to the northwest of Australia and in the vicinity of the SPCZ. This relationship makes these two areas more favorable for tropical cyclogenesis during surges. Two MJO systems moved across the region during the season. A total of 18 TCs formed between 18S-10N (3 in the northern tropics and 15 in the southern tropics), most of them appear to be in the vicinity of the MJO super cloud clusters. Meanwhile, synoptic-scale easterly waves on both sides of the equator propagate into the region from time to time.

Examination of daily maps of 1000 hPa wind and GMS water vapor data revealed that most of the TC development requires the interaction of two or more large-scale transient systems. The most frequent occurrences involved the interaction of MJO and cold surges, followed by the interaction of MJO and easterly waves. In two cases all three systems were involved. In one case the "double vortex" mechanism often associated with MJO models can be clearly identified, where the southern TC was initiated by the cross-equatorial flow enhanced by a northern typhoon.

Key words: Australian monsoon, northern winter monsoon, MJO, tropical cyclone, typhoon