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MESOSCALE CONVECTIVE SYSTEMS OVER THE UNITED STATES DURING 1999-2000

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1. INTRODUCTION

Large-scale anomalies of the atmospheric circulation were present over the continental U.S. during the El Nino/La Nina cycle of 1997-2000 (Bell et al. 1999, Bell et. al 2000). Since the large-scale circulation affects the seasonal distribution of large mesoscale convective systems (MCSs) (Fritsch et. al. 1986, Augustine and Howard 1991), it is of interest to document MCS activity during the 1997-2000 El Nino/La Nina. Anderson and Arritt (2001) have documented large MCSs during the 1997-1998 El Nino. A summary of large MCSs during the 1998-2000 La Nina is provided here.

2. DATA AND METHODOLOGY

Characteristics of cloud shields in hourly GOES-8 infrared imagery were documented with an automated routine (Augustine 1985, Anderson and Arritt 1998). Large, long-lived MCSs were classified as either mesoscale convective complexes (MCCs) or persistent elongated convective systems (PECS). An MCC is identified by the area, shape, and duration of the -52^{O}C cloud shield. For an MCC the -52^{O}C cloud shield must have a contiguous area $\geq$50,000 km^2 for $\geq$6 hours with ratio of major to minor axis (ellipticity) $\geq$0.7 at the time of maximum -52^{O}C cloud area (Augustine and Howard 1988). PECS are MCSs that satisfy all of the MCC criteria except the ellipticity is $\geq$ 0.2 and < 0.7. Each PECS and MCC was viewed manually to verify that the automated routine did not report spurious systems. A catalogue of MCCs and PECS was then generated for the warm seasons (March-September) of 1999 and 2000.

3. RESULTS

Preliminary results show that both MCCs and PECS were more numerous in the warm season of 2000 than in 1999. The number of PECS in 2000 (114) is the largest recorded of the six warm seasons (1992-1993, 1997-2000) that have been documented with the automated routine used in this summary, while the number of PECS in 1999 (69) is below the six-year average (81). MCC occurrences in both 1999 (47) and 2000 (54) are greater than the six-year average frequency (36).

Monthly PECS and MCC totals show trends similar to those reported in other MCS summaries (Figure 1). In both 1999 and 2000 peak MCC frequency occurs in early to mid-summer, while PECS are more frequent in March-May than July-August. A large disparity between 1999 and 2000 is evident in the number of MCCs and PECS that occur in July-September. The combined total of MCCs and PECS in July-September 2000 (67) is more than twice the total for the same period in 1999 (32).

The sharp decrease of PECS and MCC frequency from June to July 1999 may be related to the intensity of the summer monsoon in the southwest U.S. Higgins et al. (1998) found that wet monsoons are associated with an abnormally strong upper-level ridge situated over the continental U.S., thereby hindering widespread precipitation in the central U.S. Bell et al. (2000) report that average precipitation over Arizona and New Mexico in July-September 1999 was >150% of the 30-year average (1961-1990). During the same period extremely dry conditions were observed over much of the central U.S. beneath an unusually strong upper-level anticyclone.

The mean position of MCC initiation in July 1999 is located along the periphery of the anomalous summertime ridge near 45^{O}N, which is northward of the typical location of summertime MCC development. This displacement may have contributed to lower MCC frequency in two ways. First, some MCCs may have developed over Canada rather than the U.S. Second, the horizontal extent of quasi-circular MCSs tends to decrease with increasing distance from the Gulf of Mexico, which is the main low-level moisture source for these systems (Fritsch et al 1986). Thus a higher proportion of quasi-circular MCSs may have failed to satisfy the MCC criteria.

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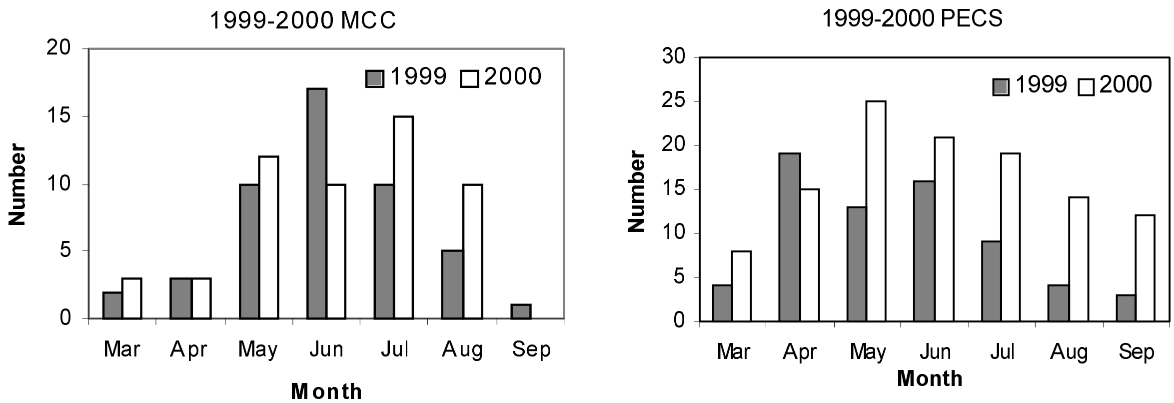

Figure 1. Monthly counts for (left) MCCs and (right) PECS in 1999 and 2000.

4. DISCUSSION

Gutzler and Preston (1997) argue that La Nina events can impact the intensity of the southwest U.S. monsoon by hindering the buildup of snow in the southwest U.S. during the preceding winter and spring. This hypothesis suggests that the MCS population should exhibit abnormalities in the summer after a La Nina event. Out of the 15 years for which MCC summaries have been produced (1978-1983, 1985-1987, 1992-1993, 1997-2000) a sharp decline of MCC frequency from June to July has been recorded only in the four summers that were preceded by weak (1981, 1982) to moderate (1985, 1999) La Nina events (http://www.cdc.noaa.gov/~kew/MEI).

More detailed study appears warranted in order to confirm and clarify the relationship of La Nina occurrence to summertime convection over the central U.S., through the effect of the former on the North American monsoon.

5. ACKNOWLEDGMENTS

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