Assessment of the Low Level Jets Effects on MCSS Formation in the Southwest Iran

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Extended Abstract

Introduction

The most notable convective systems are Mesoscale Convective Systems (MCSs). These systems are developed when clouds occurring in response to convective instability organize upscale into a single cloud system with a very large cirriform cloud structure and rainfall covering large contiguous areas (Houz, 2004). Detection and monitoring of MCSs is very important in southwest Iran because they produce hazardous weather, such as lightning, heavy rainfall, hail and strong winds. Several factors influence the development of MCSs such as the flow generated by a weak midlevel trough and the occurrence of low level jets (LLJs). LLJs transport moisture at the jet level, increase the low-level convergence and are responsible for sustaining convection especially at night.

Materials and Methods

The aim of this study was to assess the influence of low level jets on MCSs formation across the southwest Iran in the period from 2001 to 2005. The months of January, Mars, April and December was selected because of more MCSs occurrence. Event days were selected using synoptic station data (a set of storm reports such as thunderstorm, lightning, and shower and precipitation) across the study area. IR brightness temperature data from Meteosat 5 were utilized to detect MCSs. It has a resolution of 4 km with temporal resolution of 30 min. Detection of MCSs was performed on the basis of brightness temperature and areal extent

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thresholds. In this approach 'convective cells' are connected zones of the pixels below the temperature threshold that exceed the areal extent threshold (Woodley et al., 1980). The best threshold for detection of the area characterized by deep moist convection was determined 228 K. Based on Morel and Senesi (2002), 1000 km^2 of area threshold was selected. Those systems have been considered as a MCS which reached at least an area of 10000 km^2 during its mature stage and lastedat least 3 h.

To determine the influence of low level jet on MCSs development, the occurrence percent, maximum extension and duration of MCSs was analyzed in both LLJ and NOLLJ condition. The detection of low level jet events is based on Bonner (Bonner, 1968). According to this classical definition, a low level jet event is detected when the wind speed is equal to or higher than 12 *m/s*. In addition, the wind speed should decrease by at least 6 *m/s* to the next higher minimum. Furthermore, the moisture fluxes at 850 hPa are analyzed to identify low level jets in moist air advection. Moisture flux (MF850) is calculated by multiplying the specific humidity and wind speed (Remedio, 2013). The regions with intense moisture transport are identified during the mean monthly conditions as well as during the composite of low level jet events.

Results and Discussion

The result of this study showed that most of the MCSs is triggered and developed during low level jet event in all months. Thus, 85% of MCSs in January, 96% of MCSs in Mars, 84% of MCSs in April and 88% of MCSs in December has formed during Low Level Jet event. The MCSs triggering without low level jets was rare. Analysis of the 850-mb isotachs showed that there was the Low Level Jet many hours before the organized convective systems is established in most of cases. The center of Low Level Jets was mainly in the vicinity of Persian Gulf. Its speed was equal to 14 - 18 *m/s* approximately and its axis was in north to south direction. The high wind speeds generally advect the warm and moist air from the Arab and red sea towards the southwest Iran. These conditions caused the release of latent heat and increase in the low-level convergence. This was favorable for development of convection and MCSs formation.

Westerly wind with low speed is prevailed during the mean monthly conditions at 850 hPa. But, it was southwesterly during the composite of low level jet events which transmitted heat and moisture to the study area.

Conclusion

The result of this research revealed that the biggest and the most lasting formed MCSs in the days with low level jet event was bigger and more lasting than those with no low level jet event. But, the mean extension and duration of MCSs in two different conditions showed no significant difference.

Keywords: low level jet, mesoscale convective systems, moisture flux, southwest Iran, wind speed.