



Heavy Thunderstorm Synoptic Climatology and Forcing Mechanisms in Saudi Arabia.

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ABSTRACT

Meteorologists are required to provide accurate and comprehensive weather information for planning and operational aviation, agricultural, water projects and also for the public. In general, weather phenomena such as thunderstorms over the area between the tropics and the middle latitudes are not fully understood, particularly in the Middle East area, for many reasons such as: 1) the complexity of the nature of the climate due to the wide-ranging diversity in the topography and landscape in the area; 2) the lack of meteorological data in the area; and 3) the lack of studies on local weather situations.

In arid regions such as Saudi Arabia, the spatial and temporal variation of thunderstorms and associated rainfall are essential in determining their effects on social and economic conditions. Thunderstorms form rapidly, due to the fact that the significant heating of the air from the surface and the ensuing rainfall usually occurs within a short period of time. Thus, understanding thunderstorms and rainfall distribution in time and space would be useful for hydrologists, meteorologists and for environmental studies.

Research all over the world has shown, however, that consideration of local factors like Low Level Jets (LLJ), moisture flux, sea breezes, and the Red Sea Convergence Zone (RSCZ) would be valuable in thunderstorm prediction. The combined effects of enhanced low-level moisture convergence and layer destabilization due to upslope flow over mountainous terrain has been shown to be responsible for thunderstorm development in otherwise non-favourable conditions. However, there might be other synoptic features associated with heavy thunderstorms or cause them, but these features have not been investigated in any research in Saudi Arabia. Thus, relating the local weather and synoptic situations with those over the middle latitudes will provide a valuable background for the forecasters to issue the medium-range forecasts which are important for many projects. These forecasts become possible when the movement and the development of the mid-latitude disturbances are known very well.

To further increase our understanding of the inter-annual variability of thunderstorms in semi-arid areas such as Saudi Arabia, it is necessary to consider the relationship between this variability and the large-scale atmospheric parameters in addition to the geographical features. Moreover, better insight into the monthly variations of the synoptic situations in Saudi Arabia is considered to be important for understanding the broad mechanisms responsible for thunderstorm occurrences in this geographical area. This information is highly important for aviation and other sectors in Saudi Arabia – both public and private.

This paper aims to investigate the favourable synoptic environments for heavy thunderstorm initiation and development in Saudi Arabia. The importance of the monthly synoptic analysis of all days (1998-2003), heavy thunderstorm days, and dry days was intended to be demonstrated. Therefore, the monthly mean charts and deviations from the mean (anomalies) of specific meteorological parameters for heavy thunderstorm days and dry days for the months of January-December for the period 1998-2003, was illustrated to examine the synoptic conditions leading to heavy thunderstorm events in Saudi Arabia.