Energy Conversions of a Desert Depression

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ABSTRACT

This work is concerned with the energy conversions of a developing atmospheric system in sub-tropical regions. It deals, specifically, with a North African depression, which is known locally as Khamsin. This storm developed during the period from 1200 UTC 26 April to 1200 UTC 30 April 1982 and caused numerous sand storms in the area. Although its life cycle lasted about 5 days, its rapid development was associated with severe weather conditions over the southern Mediterranean coast. The vertical distribution and temporal variations of various components of the energy budget are presented in a detailed analysis. The energy contents and their changes in different atmospheric levels are discussed in the course of the cyclone's development. By integrating over the entire volume of the computational area, the complete energy cycle of the cyclone is obtained and discussed within the framework of cyclone energetics.

1. Introduction

The energetics of the atmosphere have been a favorite subject of many investigators during the past three to four decades. Initially, a great effort has been made to identify and quantify the various forms of atmospheric energy and their transformations on the global scale. The extension of the energetics research to individual synoptic scale disturbances was the natural consequence of the establishment of the energetics approach as a useful diagnostic tool on the global scale. Particular attention was paid to synoptic scale cyclonic circulations due to the intense weather conditions normally associated with them. Much of contemporary energetics research is based on the turn of the century work by Margules (1903), that attempted to explain energy properties of atmospheric cyclone systems. Lorenz (1955) extended Margules' basic ideas to derive a set of equations that explained the complete energy cycle for the general circulation. Following Lorenz, several authors (e.g., White and Saltzman, 1956; Saltzman Fleisher, 1961) focused their attention on conversion of available potential energy to kinetic energy by differential vertical motions. Recognizing that the intensity of the conversion process is likely to be scale-dependent, Eddy (1965) and Tomatsu (1979) decomposed energy conversion processes into different scales in order to determine which scales are the most important contributors over a given domain.

Most of the Mediterranean systems were selected for study on the basis of associated intense weather during their life cycle: very strong to gale force winds, intense and widespread precipitation and high seas (Michaelides and Angouridakis 1980; Michaelides 1987; Prezerakos and Michaelides 1989; Michaelides 1992; Michaelides et al. 1996). ***In the present study,*** the energetics of a desert depression formed south of the Mediterranean coast is studied in terms of the energy conversions.