Jet stream Role on the Energy Budgets of two different cyclonic systems

H. Abdel Basset, M.M. Ibrahim and A.M. Lasheen

Department of Astronomy and Meteorology, Faculty of Science, Al-Azhar University, Cairo, Egypt.

ABSTRACT

Analysis of the kinetic energy budgets for two developing winter-type cyclones is presented. The first case represents a middle latitude cyclone that developed significantly north of the Mediterranean Sea. The development occurred as cold fresh air is advected to the rear of the system. The second situation represents typical middle latitude-tropical wave interaction. The event occurred in the area between a middle latitude cyclone located over Spain and a tropical disturbance west of Africa. The middle latitude cyclone is developed after the interaction. This location is one of the known favorite areas for such interaction. The role of the polar and subtropical jets is discussed.

The major contribution to vertical kinetic energy integral comes out due to a persistent upper troposphereic jet stream throughout the period of each cyclone. A large increase in the kinetic energy of the total flow fields occurs during the period of maximum amalgamation between the polar and subtropical jets. Dissipation of kinetic energy is an important source of energy during the life cycle of the two cases. Generation of kinetic energy via cross- contour flow is acting as a source of energy in the second cyclone, while it makes as a persistent sink of energy in the first cyclone. Horizontal flux convergence may act as a sink of energy during the period of each cyclone.

1. Introduction

Changes in atmospheric energy are associated with meteorological phenomena of all scales. An understanding of the energy processes of various scales of motion should help to explain and forecast many weather events that are not adequately understood. It is apparent from numerous investigations (e.g., Smith, 1973; Ward and Smith, 1976; Chen and Bosart, 1977 and Fuelberg and Scoggins, 1978) that kinetic energy sources and sinks show considerable spatial variation within individual synoptic-scale waves. Such inhomogeneities are especially prominent in the presence of a strong westerly jet core, where both transport and baroclinic conversion processes are maximized. In addition, highly variable energy fields are observed in the presence of intense prefrontal convection, which is often embedded within these jet flows. Although strong jet streams and convective regions are known to be energetically active, understanding of the processes within such flow regimes remains incomplete. This is primarily due to the fact that these regimes are strongly influenced by processes that are subgrid-scale with respect to the current upper air synoptic network.

The purpose of the present study is to examine the kinetic energy budgets of the two developing winter cyclones. The first system represents a middle latitude cyclone that developed significantly north of the Mediterranean mainly due to baroclinic effects. The second cyclone