10B.6 GENERATION AND PROPAGATION OF MCCS AND A MESOVORTEX ASSOCIATED WITH AN AFRICAN EASTERLY WAVE AS A PRECURSOR OF HURRICANE ALBERTO (2000)

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1. Introduction

A significant number of tropical cyclones that have occurred over the eastern Atlantic Ocean, particularly near the Cape Verde Islands, can be traced back to the African continent as mesoscale convective complexes (MCCs). In this study, we propose that a MCC and a mesovortex (MV), associated with a tropical disturbance that would become Hurricane Alberto (2000; see Hill and Lin 2003; Lin et al. 2005), were embedded within a wave-like disturbance over Northern Africa. The wave-like disturbance we observe may be classified as an African easterly wave (AEW). At the EH, there existed 2 modes of disturbance development: a stationary mode and a propagating mode. The stationary mode corresponded with the generation of new convective systems over the EH with a period of about 2 to 3 days. These convective systems then propagated westward within an AEW train at an average speed of 11.6 m s^{-1}. The average wavelength was roughly estimated to be about 2200 km.

For a recent 12-year period, a majority of tropical cyclones from the tropical eastern Atlantic Ocean began as a MCC in the vicinity of the EH. We analyzed the METEOSAT-7 IR imagery and ECMWF Operational Model (EOM) data from convective development of the first pre-Alberto MCC over the EH to the tropical cyclogenesis stage of Alberto over the eastern Atlantic Ocean. We investigated the characteristics of an associated AEW and determined propagation of AEWs and MVs from EH-like topography.

2. Results

In this study, we found that mesoscale convective complexes (MCCs) and a mesovortex (MV) were embedded within an African easterly wave (AEW) that led to the genesis of Hurricane Alberto (2000). Analysis of satellite imagery also revealed that a significant number of other pre-cyclogenic AEWs originated from the Ethiopian the origin point of the AEW to be at the EH. Analysis of satellite imagery also reveals that the incipient disturbances for 23 of 34 eastern Atlantic tropical cyclones originated from the Ethiopian Highlands (EH) region. An idealized mesoscale model simulation enabled us to gain insight into the formation and Highlands (EH). The pre-Alberto AEW propagated westward at an average speed of 11.6 m s^{-1} and has an average wavelength of about 2200 km. According to EOM analyses, vertical moisture flux was crucial to generation and maintenance in the convective cycle associated with the pre-Alberto system as it traveled westward across North Africa. Based on the cloud top area and brightness values observed from satellite data, 4 genesis and 3 lysis stages are identified within a cycle of moist convection associated with the pre-Alberto disturbance. The availability of water vapor is the most essential factor controlling the convective cycle of the pre-Alberto disturbance over the African continent. The presence of significant topography affected the timing and placement of the genesis and lysis stages by regulating the water vapor supply.

A regional climate model was adopted to investigate the formation mechanisms of the MCC, MV, and AEW. The simulated fields indicated that convection was generated over the EH, and the MV and AEW was generated near the lee of the EH. These processes occurred simultaneously. The MCC and MV comprised the pre-Alberto system, which was embedded in an AEW, and propagated westward. The EH is important for focusing and organizing AEW features by acting as a source point for a consistent stationary wave mode, lee side vorticity generation, and vertical moisture flux sufficient for initial convection. Planetary boundary layer (PBL) effects over the EH contribute to the initialization of convection through diurnal, diabatic heating. As the convection propagates downstream, an MCC develops at the lee of the EH and combines with orographically generated vorticity. PBL effects and moisture availability are important for maintaining AEWs. Surface moisture fluxes serve to affect these systems by aiding in convective development.

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4. References

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