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THE MAINTENANCE OF A MCC ACROSS NORHTERN AFRICA: A CASE STUDY AND ANALYSIS REALTING TO SURFACE MOISTURE VARIABLES AN FLUXES

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1. Introduction

This research focuses on the precursor of Hurricane Alberto that initially formed over the Ethiopian Highlands (EH) region in 2000, as first noted by Hill and Lin (2003). EUMETSAT infrared satellite imagery is used to trace this pre- Alberto mesoscale convective complex (MCC) back across the African continent and to identify convective genesis and lysis periods during the storm's lifecycle and evolution. NCEP reanalysis data is shown to describe the Northern Africa climatology and its effects on the Alberto system. ECMWF 0.5^o Operational Model data is also used to identify key features and atmospheric conditions that play a key role during the different convective periods that occur during the pre-development period.

Based on Lin *et al*. (2001), we hypothesize that the moisture flux plays an essential role in modulating the lifecycles of pre-TC MCCs. Thus, parameters associated with vertical moisture flux will also be examined in depth to determine: (1) the source of the vertical motion, which is split into orographically or environmentally induced, and (2) to find the source of the moisture being entrained into the pre-Alberto system.

2. Results

General topography, along with Alberto's convective cycles and track, are summarized in Fig. 1. This figure shows four convectively active genesis (G-I, G-II, G-III, G-IV) periods and three convectively dormant lysis periods (L-I, L-II, L-III) as analyze from METEOSAT-7 infrared satellite imagery provided by EUMETSAT.

Surface relative humidity (RH) of combined monthly means values from July-August of 2000 are shown in Fig. 2. The relative humidity fields show four separate maxima, which are also coincidentally collocated with the mountains identified in Fig. 1. In comparing Figs. 1 and 2, it becomes evident that the G-I and G-II coincide with the EH and the Darfur Mountains while the G-III and G-IV periods do not. This suggests that the EH and the Darfur Mountains have more influence and play a significant role in focusing surface moisture and initiating convection on the pre-Alberto system than the Cameroon Highlands and the Futa Jallon Highlands, which have relatively lower topographic relief.

Moisture and vertical motion must be present in order to trigger or sustain deep convection. The Alberto pre-development system can be traced and followed using the mixing ratio (not shown), suggesting that moisture is playing a considerable role during the genesis periods. Now it is important to find out the source of moisture. Fig. 3 shows the NCEP average streamlines at 850hPa from 00UTC 28 July to 00UTC 3 August. It becomes evident that initially the moisture is advecting in from the Indian Ocean via the Somali Jet. This moisture is funneled through the Turkana Channel to the south of the EH. As the system continues to propagate westward, the moisture is being entrained from the south from the African Rain Belt, and then the Atlantic Ocean by way of the West African monsoons.

The orographic and the general vertical moisture fluxes are calculated by $(\mathbf{V}_H \bullet \nabla h)q$ and wq, respectively, where $\mathbf{V}_H$ is the horizontal wind vector, h is the terrain height, q is the mixing ratio, and w is the vertical velocity. Both the vertical moisture fluxes are calculated and plotted in order to distinguish whether the convection is orographically or environmentally induced. It can be inferred that the vertical motion and moisture are initially orographically induced and entrained into the Alberto system at the beginning of the G-I and G-II periods. As the system moves westward, the vertical motion and moisture becomes more influenced and sustained by synoptic situations, for example certain planetary boundary layer effects such as surface heating.

Future research will also be conducted to determine if atmospheric waves are indeed generated in response to the EH using ECMWF 0.5^o analysis data and numerical simulations. Furthermore, a more extensive climatological study will be done in order to ascertain (i) why some storms develop and continue across Africa and why do others die out, and (ii) what key ingrediants and parameters cause the different genesis/lysis convective stages.

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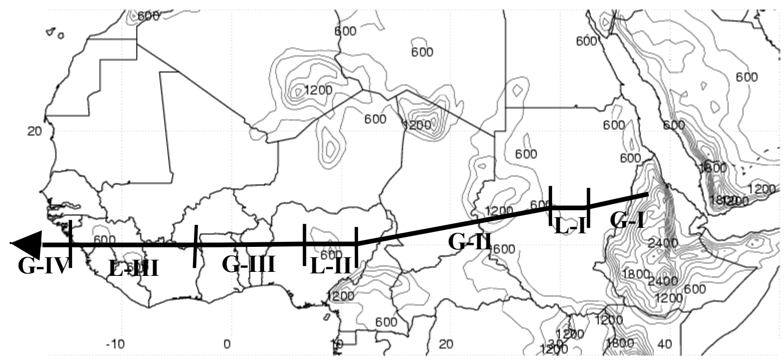

Figure 1: Alberto's pre-development convective cycle, system track, and topography of Northern Africa with a contour interval of 200m and values starting at 600m

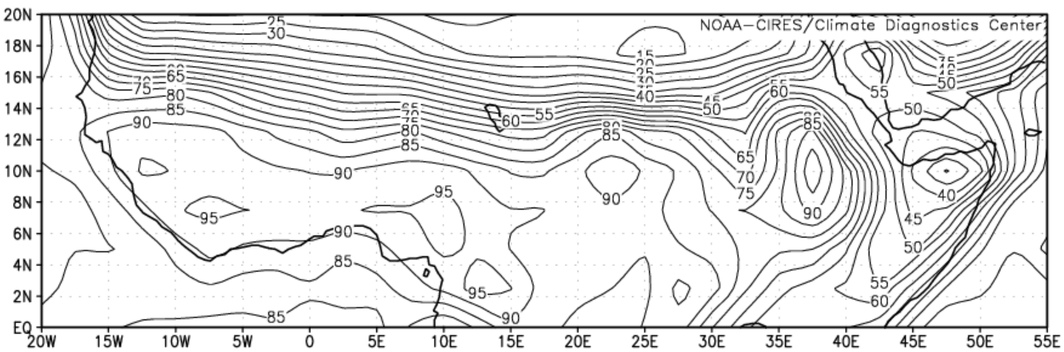

Figure 2: Surface relative humidity (%) of the combined monthly means values from July-August of 2000

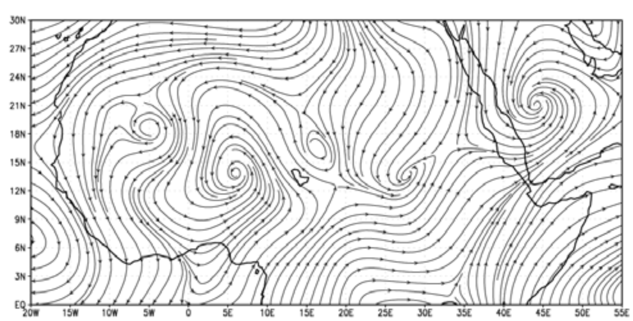

Figure 3: NCEP average streamlines at 850hPa from 00UTC 28 July to 00UTC 3 August