The Structural Evolution of African Easterly Waves

Matthew A. Janiga

University at Albany

Albany, NY

Northeast Tropical Conference

Abstract

The mean lifecycle of African easterly waves (AEWs) is investigated by examining the composite structure of AEWs at four locations characterized on average by different phases of AEW evolution. AEW composites were produced from long-lived, mid-level, synoptic-scale vorticity maxima found south of the African easterly jet (AEJ) in the troughs of AEWs during JAS 1998-2009. The first phase of AEW evolution is characterized by low-amplitude, developing AEWs and occurs over the elevated terrain of East Africa (20°E). The plains of West Africa (5°W) are characterized by AEWs that have developed a mature baroclinic structure. At the West African coast (15°W), several important structural changes are observed including the deformation and weakening of the northern vortex along the intertropical front (ITF) and a low-level spin-up of the southern convective vortex south of the AEJ. AEWs over the East Atlantic (30°W) possess a strong and symmetric low-level circulation with reduced low-level cooling beneath the southern vortex; they lack an accompanying northern vortex.

The kinematic and thermodynamic structures of the composite AEWs are assessed by composting gridded fields from the National Centers for Environmental Prediction Climate Forecast System Reanalysis (CFSR). One aspect of AEW structural evolution examined in the composites is the phasing between the developing Rossby waves on the mid-level potential vorticity (PV) strip south of the AEJ and along the ITF at the surface. Diabatic terms from the CFSR forecasts are used to examine the changing heating profiles between AEW convection over land and over the ocean. The heating profiles associated with AEW convection over land leads to peak PV generation near 600-700 hPa. In contrast, heating profiles associated with oceanic AEW convection have less low-level diabatic cooling and peak PV generation near 800-950 hPa. This lowering of the peak PV production at the West African coast is linked to the rapid spin-up of the southern vortex at low-levels in this region.