Patterns of Thunderstorm Evolution Over Lake Victoria Basin Based on Meso- and Local-Scale Environmental Factors

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One of the over-arching goals of the HIGH Impact Weather lAke sYstem (HIGHWAY) Project is to obtain scientific understanding of the thunderstorms that form over Lake Victoria in East Africa. HIGHWAY is funded by the United Kingdom Department for International Development (DFID) and managed by the World Meteorological Organization (WMO). Lake Victoria thunderstorms not only produce some of the highest lightning frequencies in the world, but reportedly they are also responsible for causing up to 5000 human fatalities over the lake annually. It is hypothesized that the outflows from these thunderstorms spread out over the water and produce high wave heights that can capsize fishermen’s boats and ferries that transport hundreds of people across the water. The Tanzania Meteorological Service operates an S-Band polarimetric radar on the south shore of the lake by the city of Mwanza. This radar is the primary instrument being used in the HIGHWAY program, along with satellite and lightning data, for studying the patterns of thunderstorm evolution over the lake, using a combination of high and low PRF volume scans. The radar is being operated continuously 24 h per day as part of HIGHWAY Field Campaign collections during the rainy and dry seasons of Lake Victoria Basin (LVB). The most surprising and fortuitous finding in this radar data is the ability to see radar clear air echo over the lake and radar fine lines associated with thunderstorm gust fronts. Fortunately, the clear air return is best at night and coincides with the maximum period of thunderstorms over the lake. Using radar, lightning and satellite observations, we have found some distinct patterns of thunderstorm evolution over the LVB. Storms frequently build up during the day associated with diurnal heating over land and over the slopes of the higher terrain surrounding the lake. Often a subset of these storms will move over the lake during the late afternoon or evening. Around midnight land breezes, particularly along the north and northeast coastlines, lead to increased surface convergence over the lake and along the coastal regions forcing convection initiation. Gust fronts from these storms will typically move over the water and trigger additional convection. Existing thunderstorms will often track westward with the steering level winds, while new convection initiation continues to occur southward over the lake in concert with the propagation of storm gust fronts. In this presentation we will elaborate on the patterns of convection observed over LVB. This will include documentation on the prevailing mesoscale winds over the LVB each day and identification of days when land-lake breezes are in existence. A preliminary climatology of storm tracks and precipitation accumulations using the NCAR TITAN tracking algorithm run on the Mwanza radar data will be discussed. We will also document the low-level wind magnitudes associated with the thunderstorm outflows in relation to wind thresholds documented in the literature as critical for producing large wave heights.

Keywords: Thunderstorms, Lake Victoria, Storm evolution, Lightning, Convection initiation, Land breeze