Study on Thunderstorm Development and Evolution in the East China Coastal Metropolitan Area

Session: Meteorological Applications of Lightning Data

Jianhua Dai (China Meteorological Administration/Shanghai Meteorological Service, 166 Puxi Road, Xuhui, Shanghai 200030, China; djhnn@sina.com), Wang Yuan, Tao Lan, and Sun Min

Using 9 years of WSR-88D Doppler weather radar data and Vaisala total lightning detection data, thunderstorm climatology is investigated for the East China coastal metropolitan area, which includes a mega-city (Shanghai) and other more than 10 other cities. The spatial and temporal distribution, evolution, and life time of the thunderstorms, as well as the vertical structure of storm cells and lightning activity during the evolutionary stages of thunderstorms are analyzed.

Local storms, 80% of thunderstorms, are close to some medium-sized cities, mountains or hills (especially those isolated), and water-land borders. The medium path thunderstorms tend to be close to the borders of land and water, while the long path thunderstorms concentrate in several major corridors under certain synoptic situations.

Local storms tend to intensify and weaken in the same areas, such as cities, isolated mountains or hills, and water-land borders. These thunderstorms tend to weaken over city centers and intensify 10-30 km downwind of the city center. The strengthening and weakening mechanisms are related to the underlying surface features. Significantly, the strengthening area of medium-path storms also shows a downwind effect with a distance of 20-40km from medium-sized cities and centers of larger cities, while significant weakening areas are located over water bodies downwind of land. Long-path thunderstorms usually intensified in two areas: over land areas downwind of large water bodies, and over terrain with a windward slope.

Thunderstorms peak in the afternoon in midsummer while thunderstorms show a bimodal diurnal distribution during monsoon season. Thunderstorm initiation is often associated with an urban heat island, valley circulation, and land-water (sea or lake) circulation, mostly at 12-18 (LST) for the short- and medium-path thunderstorms.

Midsummer thunderstorms show the tallest and strongest vertical structure, followed by Meiyu season thunderstorms, and those with tropical weather systems the least. The statistical results show a significant change in the vertical structure and lightning activity during the life cycle of thunderstorms. However, severe thunderstorms show less difference among the various seasons. Some vertical features of storms and lightning activity can be indicators of thunderstorm evolution. No significant differences of storm cell vertical structure are found between local storms and long path storms. Squall line cells show longer life time than average.