STRUCTURE OF TROPICAL CYCLONE OUTFLOW LAYER

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Tropical cyclones can interact with their environment in many ways. Recent theoretical studies have pointed out that due to the vorticity distribution, the tropical cyclone's outflow layer is dynamically unstable and therefore is a potential conduit for interaction with upper tropospheric systems. In this study, satellite observations and numerical model simulations are used to examine the dynamic and thermodynamic structure of the tropical cyclone outflow layer. Observations reveal that the outflow layer of tropical cyclones consists of divergent flows and is dominated by one or two jets. It is observed from TOMS observations of individual tropical cyclone and ensembles that there exists a local maximum (minimum) of total ozone amount on the cyclonic (anticycionic) shear side of the jet. Because total ozone amount is negatively correlated with the height of tropopause, the observed anomalous total ozone distribution around tropical cyclxones suggests the existence of organized circum-jet transverse circulations.

Numerical simulstion with the NRL limited-area model starting from an idealized Rankine vortex in a composite tropical sounding without zonal wind illustrate the major role of the outflow jet in angular momentum transport and in evacuation of heat and moisture from the inner core. The simulated tropical cyclone has a single jet with circum-jet secondary circulations that are thermally direct (indirect) in the jet entrance (exit) region. The thermally direct circulation has an ascending (descending) branch in the anticyclonic (cyclonic) shear side of the jet and an inward (outward) branch beneath (above) the jet. The indirect secondary circulation is in the opposite directlon. Distridutions of the potential vorticity and the humidity fields are consistent with the transvese circulation. In variational numerical experiments, when the outflow jet is accelerated, deep convection is induced in the region of the ascending motion of the secondary circulations, indicating there is certain instability in the tropical cyclone associated with the outflow jet.

Many tropical cyclones (e.g. ,Hurricane Florence of 1988, Hurricane Hugo of 1989, Typhoon Flo of 1990) have experienced intensity, structure and motion changes that may have caused by the interaction of the outflow and the large scale environment. Objective analyses and numerical experiments are now being conducted to establish the cause-and-effect relationship of the observed behavior. A special objective analysis technique is utilized to incorporate omega dropsonde data into the conventional analysis. Simulation results of Hurricane Florence will be discussed.