CASE STUDY AND NUMERICAL SIMULATION OF AN INVERTED COMMA CLOUD OVER PARAGUAY AND SOUTHERN BRAZIL

Presented by

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Inverted comma cloud systems are meteorological phenomena of meso-α scale associated with a cyclonic vortex in the wind field and recognized from a satellite perspective due to their shape similar to and inverted comma.

Heavy precipitation and severe weather are features not uncommon with these phenomena and its impact may be seen in all seasons over Paraguay, Uruguay, Northern Argentina and Southern Brazil. Their impact in the hydrological cycle of the La Plata Basin motivates the present study of a particular case observed in August 22, 1989. Main focus is on the ability of a numerical model with high resolution to simulate the main features of the system. Besides the enhanced rainfall in the region, the development of an inverted comma cloud may intensify the low-level jet parallel to the Andes. The low-level jet is an important factor in advecting moisture from the tropical regions in the summer and biomass burning material in winter to the subtropics. Both moisture and aerosols are important factors in the short and long wave radiation budgets with impact in local climate.

The case of 22 August 1989 was seen to develop in the rear of a surface front, in the cold air mass, in a time scale of 6 hours, starting just after local midnight. Local precipitation data showed daily totals early in the morning between 30 and 90 mm in several stations in Paraguay and Southern Brazil. The large scale upper level situation included a geopotential trough to the west in the previous day intensifying and moving to form a cut off low south of Uruguay. The vortex associated with the inverted comma cloud developed in the boundary of the cold air mass between Paraguay and the Brazilian state of Mato Grosso do Sul, also a region of low level moisture convergence. The potential vorticity field showed two centers of intrusion of upper level air to middle levels associated with the cut off low to the south and to the inverted cloud position. However, the large-scale analysis places the vortex to the south of the observed position in the satellite image.

The model used to simulated the inverted comma cloud is the Regional Atmospheric Modeling System (RAMS) with two grids. A coarse resolution grid with 60 km resolution and a nested grid with higher resolution of 15 km. Several experiments are performed to identify physical processes and explore the role of resolution and of the physical parameterizations of convection and cloud microphysics.

Main conclusions are:

- a low-level NW jet is associated with the intensification of the inverted-comma cloud system;
- the RAMS simulation reproduced main features of the vortex in the 2 grids;
- higher resolution gives higher amounts of rainfall and features are better located;
- higher resolution runs show internal structures of meso β and meso γ scales;
- the simulated comma-cloud tail is a baroclinic region with enhanced rainfall; satellite images suggest that this is a more active region also;
- cumulus parameterization is more important in the early stages of the system;
- the microphysics parameterization is fundamental for the organization and maintenance of the system.

The successful simulation of this case is an encouragement to pursue the research on the role of the organized mesoscale convective systems on the water budget of the La Plata Basin.