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Feasibility study of the modification of the intensity of tropical cyclones by seeding CCN with an aircraft : A HAMP Project

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After the devastating 2005 United State hurricane season, the development of methods to mitigate storm intensity have regained interest. Recent studies suggest some new strategies (e.g., Rosenfeld et al., 2007; Cotton et al, 2007) that involve enhancing the CCN concentrations in the outer rainband region. Increasing CCN concentrartions would cause a reduced collision and coalescence, resulting in more supercooled liquid water to be transported aloft which then freezes and enhances convection via enhanced latent heat of freezing. The intensified convection would condense more water ultimately enhancing precipitation in the outer rainbands. Enhanced evaporative cooling from the increased precipitation in the outer rainbands would produce stronger and more widespread areal cold pools which block the flow of energy into the storm core, ultimately inhibiting the intensification of the TC. The feasibility of modifying the TC intensity by seeding aerosol particles that act as CCN in the outer rainband region is examined in this study. For this purpose, we designed a series of simulations for which the time of the “virtual flights” as well as the aerosol release rates are varied. RAMS@CSU was configured to have three two-way interactive nested grids with horizontal grid spacings of 24, 6, and 1.5 km, and time steps of 60s, 20s, and 15s, respectively. All runs consider a spin-up time of 36 hours and after that time, seeding is considered. A code that simulates the flight of a plane is used to increase the CCN concentrations as an aircraft flies. Based on the last RAMS output data, this code is run off-line to prescribe and visualize an adequate trajectory. We performed various runs considering virtual flights at an altitude slightly lower than cloud base and at several seeding times (every three hours). In addition, the aerosol release rates were also varied. All sensitivity experiments considered an aircraft speed of 150m/s and flight times t ranging from 10 to 30 min, increasing as the tropical cyclone develops. Preliminary results indicate a significant sensitivity to both the seeding time and the aerosol release rates.

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Previous paper

Browse or search entire meeting

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