Radio Refractivity in Stratiform and Convective Rain Revealed by Mesoscale Numerical Weather Prediction Data

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Radio Refractivity in the Marine Atmospheric Boundary Layer (MABL) has long been studied in clear air. Very little has been described regarding radio refractivity in the MABL during rain. Mesoscale numerical weather prediction (NWP) during rain events provides a convenient data set in which to analyze vertical thermodynamic structure and corresponding profiles of modified refractivity.

This paper will describe the range dependent thermodynamic and modified refractivity vertical profiles during two rain events off Wallops Island Virginia. Vertical profiles were analyzed every 10nmi along a 130nmi path from nearshore to further out to sea. The first is a stratiform rain event on February 26, 2013. The second is a convective rain event on April, 5, 2013. Each rain event was modeled by the Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS®) using data from a 3km horizontal resolution inner grid.

The stratiform rain event was characterized by slight thermal stability at all ranges in the offshore flow in the first 100m above the surface. Water vapor profiles in the unsaturated layer below 100m transition from slightly increasing in height near shore to slightly decreasing with height offshore. The resulting range dependent modified refractivity profiles varied from near sub-refractive near shore to slightly super-refractive offshore.

The convective rain event in comparison indicated a well mixed layer in the first 100m although relative humidity increased from 96% to 99% in the first 50m above the surface. This tended to produce modified refractivity in the normal range at all profiles below 100m along the 130nmi path. Tendency towards sub-refraction between 100 and 500m was driven by slight increases in water vapor.