Observations of Internal Marine Atmospheric Boundary Layer Development During the CASPER East Campaign

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Electromagnetic propagation in marine atmospheric boundary layers (MABL) has traditionally been characterized in terms of the modified refractivity parameter *M*, which is a function of the local temperature, pressure, and water vapor pressure. The vertical gradient of *M* dictates the type of refraction expected and thus, the refractive regime is determined by vertical gradients of atmospheric temperature and moisture profiles, which have historically been parameterized in terms of the fluxes of heat, moisture, and momentum via the Monin-Obukhov Similarity Theory (MOST). A key assumption of MOST, however, is the horizontal homogeneity of the boundary layer, which is intuitively expected to be invalid in a large number of cases.

The CASPER East field campaign provided an opportunity to investigate boundary layer features with respect to how they influence EM propagation patterns. This presentation will focus on the atmospheric boundary layer and its development in the nearshore region off the coast of North Carolina. A new framework is proposed which reformulates the expected structure of the refractivity parameter gradient in terms of the height of the developing internal boundary layer, which is known to develop downstream of surface inhomogeneities.

Intensive boundary layer profiling was performed during the CASPER field campaign from 12 October – 6 November 2015 on two research vessels and on the coast at the Army Corps of Engineers Field Research Facility in Duck, NC. Remote sensing systems and radiosondes were deployed, and measurement inter-comparisons were conducted for select cases. As part of these efforts, a scanning Doppler lidar was deployed aboard the R/V Atlantic Explorer to sample the lower MABL, highlighted by a novel deployment of a motion-stabilized platform for shipboard Doppler lidar systems. High-frequency launches of radiosondes enabled regular validation of remotely sensed profiles.

The motion-stabilized lidar was programmed to operate in a multi-scan strategy to measure vertical profiles of horizontal and vertical wind speeds and wind direction in the lower ~1km of the boundary layer, approximately every five minutes. Vertical and horizontal RMS velocity estimates were also retrieved from the lidar data to further characterize boundary layer dynamics. Radiosondes were released in an up/down sampling mode at overall rates of 7-8 per day with some periods of up to one release per hour. Daily measurement schedules were coordinated between the two research vessels, which transited an east-west track offshore. Findings from a subset of measurements during these transits will be presented, with an emphasis on the development of horizontal gradients of atmospheric parameters at the land-ocean discontinuities.