Validation of Simulated Propagation using Measured and Modeled Refractivity Profiles from CASPER-East with LATPROP-UWB EM Propagation Data

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Coupled Air-Sea Processes and EM ducting Research (CASPER) is a multidisciplinary University Research Initiative (MURI) project that aims to explore atmospheric effects on EM propagation in the coastal marine atmospheric boundary layer (MABL). The CASPER-East campaign was conducted in October/November 2015 offshore of Duck, North Carolina. CASPER-East obtained extensive concurrent atmospheric data and range dependent propagation loss to characterize the vertical refractivity profiles and their horizontal variations. Two research vessels, R/V Huge R. Sharp (Sharp) and R/V Atlantic Explorer (AE) and a Twin Otter (TO) research aircraft and its Controlled Towed Vehicle (CTV) were operated during CASPER east.

The lower atmospheric propagation ultra-wideband (LATPROP-UWB) transmitter was installed at the end of the Army Corps of Engineers Field Research Facility pier emitting towards the east. A synchronized receiver was installed on the AE. The LATPROP-UWB measurement system was used to measure range dependent propagation loss over 2-40 GHz as the AE moved toward the shore along an east-west path.

A large number of environmental refractivity data obtained from measurements or mesoscale models during CASPER-East will be used in this study. Rawinsonde launches were made on both vessels and at the pier for sampling the refractive environment along the propagation path. The high-rate measurement of wind, temperature, humidity and pressure were recorded by fixed height sensors on the bow masts of both the Sharp and AE. The TO and CTV also provided high-resolution measurement of environment data from several low-altitude level and straight runs and from vertical sawtooth profiling patterns along the CASPER path. The corresponding refractivity profiles of the marine atmospheric surface layer were obtained using Monin-Obukhov Similarity Theory (MOST) based evaporation duct models with input from the ship-based measurements. Mesoscale simulations of refractivity were generated by the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS) in the CASPER-East operational area. A blending algorithm was used to attach the obtained evaporation duct refractivity profiles to radiosonde and/or COAMPS profiles with refractivity profiles above the surface layer.

The parabolic wave equation method is used to calculate electromagnetic wave propagation along the experiment track using the different measured refractivity profiles and modeling the LATPROP-UWB antenna parameters. The simulated propagation loss was compared with measured propagation loss. Comparison results with different atmospheric models will be presented.