An Evaluation of Coupled Ocean Atmosphere Mesoscale Prediction System Performance for an Over the Horizon, Over Water Geometry using Long Term, Multi-Band Radio Frequency Measurements

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Radar, Electro-Optical/Infrared (EO/IR), and electronic warfare systems are among the many systems whose performance is dependent on atmospheric propagation conditions. Accurate predictions of the refractive environment allow operators of such systems to understand how their systems will perform at any given time and determine how to best use and interpret data from those systems. Ideally, measurements of the operational environment would be available; however, this is prohibitively expensive and logistically unfeasible. Numerical weather prediction (NWP) is often used when atmospheric measurements are not available so it is vital that NWP and surface layer models are as accurate as possible. The Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS) is the US Navy's mesoscale NWP model and is the model evaluated in this study. COAMPS data are compared to calibrated radio frequency (RF) electromagnetic wave measurements collected on Dahlgren, Virginia's, Potomac River Test Range. This Test Range provides a challenging environment for COAMPS due to the influence of land in the littoral environment. The RF measurements are a multi-band (L, S, and X), long-term data set with a low-elevation, over-the-horizon, over-water geometry. Path loss values are calculated from measured power levels corrected for system losses. The RF measurement data set captures diurnal and seasonal cycles as well refractivity conditions including ducting, super-refraction, near standard atmosphere, and subrefraction. In addition to RF measurements, surface observations from WeatherFlow systems on Coast Guard navigational markers in the Potomac River were collected. To compare the RF path loss measurements to COAMPS data, the COAMPS data are blended with a surface layer model and input to the propagation model Tropospheric Electromagnetic Parabolic Wave Equation Routine (TEMPER) from which path loss values are obtained. The TEMPER path loss values are then compared to the measured path loss values. The differences between the predicted and measured path loss values as well as metrics such as air-sea temperature difference and evaporation duct height, both obtained from WeatherFlow measurements, are analyzed, and conditions under which model predictions are inaccurate are identified. Because this data set is yearlong with concurrent multi-band RF and meteorological data, analysis of these data provides the unique opportunity to evaluate seasonal and diurnal effects on modeled path loss predictions.