Characterizing the Marine Refractivity Environment from Numerical Weather Prediction Data for Electromagnetic Propagation Modeling

Paul A. Frederickson
Department of Meteorology, Naval Postgraduate School, Monterey, CA

The U.S. Navy has increasingly relied on the use of numerical weather prediction (NWP) model data to assess and predict electromagnetic (EM) propagation and sensor performance to provide guidance for operational planning and decision making. Several critical issues must be addressed when using NWP data for this specific purpose, including how to characterize refractivity conditions along a specified path from gridded data and how to characterize refractivity conditions at the spatial scales required by the parabolic equation (PE) methods often used in propagation models. For example, the Advanced Propagation Model (APM) requires vertical refractivity profiles at each PE range step, which can vary between approximately 50 and 900 meters, depending upon the frequency being modeled. Currently NWP data are usually not available at this high resolution along bearings of interest, therefore interpolation in range between the adjacent available NWP vertical refractivity profiles is necessary to achieve the required PE range step resolution. The interpolation must be performed in a manner that ensures that the important refractivity features, such as trapping layers, vary realistically with range and height between adjacent NWP refractivity profiles. The marine refractivity environment can include both evaporation ducts and upper-air ducts, which makes the problem even more complicated. Generally the evaporation duct is characterized by a surface-layer refractivity model using the surface and lowest-level NWP data as input. This near surface refractivity profile must then be realistically blended onto the bottom of the upper-air NWP refractivity profile. This presentation will examine different methods and sequences for performing the vertical profile blending and horizontal profile interpolation operations to characterize marine atmospheric refractivity conditions along a specified propagation path from gridded NWP model data.