Applying Numerical Weather Prediction Data to Improve One-way Path Loss Prediction

Edward H. Burgess [(1)]
(1) Naval Surface Warfare Center Dahlgren Division, Dahlgren, VA USA

As communication technology has evolved over the past 25 years, societies are, and have become, more dependent on wireless communication systems. As this dependency has increased, the need for accurately predicting communication system performance is becoming more important. One area of significant importance to wireless communication is the environmental impacts to electromagnetic (EM) propagation. One metric for measuring environmental impacts is one-way path loss.

One-way path loss is derived from propagation factor, which is a metric used to measure the multipath and diffraction impacts on EM propagation. Propagation factors are typically calculated using mathematical models. The current state of the art propagation models are parabolic equation (PE) models. The PE models typically require inputs that include antenna pattern, antenna geometry (e.g. antenna height), pointing angle, operating frequency, and atmospheric refractivity profiles. The characterization of atmospheric refractivity can be theoretical, based on measurements or climatological data, or modeled using numerical weather prediction (NWP) data. Mesoscale NWP models can now provide for a better characterization of the environment in range, height, bearing, and time. The evolution from low fidelity, theoretical approximations, to high fidelity model forecasts is providing more accurate predictions of propagation factor, and consequently, one-way path loss.

This presentation will cover the implementation of NWP modeling to generate refractivity profiles for use in propagation models. The presentation will highlight the improvements in path loss prediction resulting from increased fidelity in modeling the atmosphere using NWP data. The improvements will be compared to previous path loss predictions using simple, theoretical environmental assumptions.