Sensitivity of RF Propagation Loss to Variations of Environmental Refractivity along the Path

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While the propagation of electromagnetic waves in the atmosphere interacts with the instantaneous refractive field of the atmosphere, the propagation loss (PL) at the certain time and space is an integrated effect of the three-dimensional refractivity field and the underlying surface in the vicinity along the propagation path. Many past studies indicated strong sensitivity of PL to the specifics of the modified index of refractivity (*M*) profiles. In case of evaporation ducts, the specifics of an *M*-profile include not only evaporation duct height and duct strength, but also the shape of profiles. It is generally believed that the propagation loss measured at a given point is sensitive to the 2-dimentional refractive field along the path and that multiple *M*-profiles along the path of propagation as input to propagation models should result in more realistic propagation loss simulations compared to those using a single profile to represent a homogeneous atmosphere along the path. Therefore, in a heterogeneous environment, it is important to characterize atmospheric refractivity along the bearing of intended propagation simultaneously with the PL measurements. However, it is not clear how sensitive the PL at a given range is to the variability of atmospheric conditions along the path. This presentation intends to address this issue with some preliminary results.

During the Coupled Air-Sea Processes and Electromagnetic (EM) ducting Research (CAPSER) east coast field campaign (CASPER-East), a significant amount of PL measurements were made offshore of Duck, NC together with a large amount of atmospheric and oceanic environmental data to include parameters needed to quantify *M*-profiles. In this research, we intend to systematically investigate the sensitivity of the integrated PL to the spatial variability of refractivity profiles along the path. Different cases representing various levels of spatial variability will be examined and we assume simple refractive conditions with effects of evaporation ducts only. The Advanced Propagation Model (APM) will be utilized for calculating PL based on input *M*-profiles derived from an evaporation duct model. Given the measured atmospheric variability on various length scales, we intend to quantify the expected variability of the PL sampled from a given distance. For cases of weak spatial variability, we intend derive effective evaporation duct properties from the environmental measurements, which will be compared to the duct properties retrieved from the mean PL measurements. For cases of strong spatial variability, the key parameters dominating the range integrated PL will be identified.