An Evaluation of Surface Layer Models and the Evaporation Ducts using Radio Frequency Loss Inversions

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The evaporation duct height (EDH) is a critical parameter oft used to gauge the effects of the environment on radio frequency (RF) sensor performance. For low frequency emissions near the surface (S-band), there is a clear linear relationship between propagation loss with range and the height of the evaporation duct. During the CASPER East field campaign (Oct/Nov 2015), RF signals were continuously transmitted from shore-to-ship (Duck, NC pier to the Research Vessel Atlantic Explorer) over a 20 day period as the vessel tracked along an East/West path from Duck to 60nmi from shore. In addition to an X-band receiving array, an ultra-wide band system received frequencies between 2 and 40GHz. From those propagation loss measurements, an inversion technique was employed to estimate the EDH.

In this study, model-derived EDHs from several surface layer models, and their different versions, are evaluated against the EDH inversion dataset. Our aim is to explore new methods for verifying predictions of the evaporation duct, and characteristics of the surface layer, which are important factors influencing propagation from shipboard or land-based radars and communications systems. The gradient structures that comprise the surface layer are highly dependent on stability, transfer functions and fluxes given by each of the various model parameterizations, which represent a 'bulk' or mean profile. Observations within the surface layer tend to be turbulent having wide scatter, making estimates of the observed EDH, problematic. On the contrary, the EDH experienced by the RF sensor and derived from the inversion process, contain the surface layer's mean characteristics. It remains unclear the degree to which the inversion estimate is affected by inhomogeneous, range-dependent variations in the surface layer, and if there are such variations, where along the range the EDH validation should be applied. Both of these topics will be considered in the presentation.