Assessment of Evaporation Duct Model Performance in a Tropical Littoral Environment

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Evaporation ducts are natural waveguides caused by an inversion in the profile of the modified refractivity of air above the sea, where there is significant drying away from the surface. They have the potential to enhance the range of a radio signal; hence can significantly impact radar propagation. Forecasting this process in tropical, littoral environments is the key focus of this study.

Understanding the effect of an evaporation duct on radar transmissions requires a detailed knowledge of the modified refractivity structure close to the sea surface, or more specifically the marine surface layer. In support of this, meteorological data and radar propagation observations were collected during the Tropical Air-Sea Propagation Study (TAPS) campaign, which took place off the coast of Queensland, Australia over a two week period in November and December 2013. A high volume of observations were recorded during the trial, allowing spatial and temporal properties of the boundary layer to be captured.

Two types of meteorological observations are utilized in this study. The first set contains bulk surface layer measurements of air temperature, sea surface temperature, pressure and humidity. The second contains high temporal frequency measurements from a co-located sonic anemometer, from which vertical turbulent fluxes can be derived using eddy covariance techniques. The aim of this study is to use these measurements to validate the Met Office evaporation duct model. The model provides detailed pressure, temperature and humidity information using observations, or Numerical Weather Prediction (NWP) data, at a single altitude within the surface layer; such that accurate modified refractivity profiles can be calculated.

One key measure employed to assist in the validation of the evaporation duct model is to examine the Monin-Obukhov scaling parameters which are output from the model. The scaling factors returned from driving the evaporation duct model (A. A. Grachev and C. W. Fairall, J. Appl. Meteor., 36, 406-414, 1996), using the bulk observations are compared to those directly derived from the sonic measurements. A summary of the results to date are presented, together with a discussion of the assumptions and limitations of the model for radar propagation predictions.