Using Numerical Weather Prediction to support radar propagation modeling during the Tropical Air-sea Propagation Study

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The Tropical Air-sea Propagation Study (TAPS) was a collaborative campaign involving the US, France, UK, Australia and New Zealand which took place off the coast of Queensland, Australia between 25th Nov and 6th December 2013. The aim of TAPS was to facilitate the collection of atmospheric and Radio-Frequency (RF) measurements in order to validate mesoscale model refractive index predictions and propagation models in the tropical maritime environment.

From a meteorological perspective, the tropical environment presents a variety of challenges for Numerical Weather Prediction (NWP) models. Characterized by high temperatures and humidity, vertical gradients in the surface layer and at the top of the boundary layer often result in ducting features that cause radar waves to be trapped in wave-guide structures. The proximity of the TAPS trial area to the coast provides additional complexity due to sharp transitions in the meteorology across the land-sea boundary. Sea- and land-breeze circulation patterns are also common in these environments and can impact the refractive structure perpendicular to the coastline. Observations collected during the TAPS campaign therefore provide a unique opportunity to validate propagation forecasts in this challenging environment.

The analysis presented here focuses on a 100km long transect perpendicular to the coastline, along which intensive land and marine based vertical profiling of the boundary layer took place. Received power levels from X, Ku and W band variable range links were also collected along the line of sight of the transect. This work will describe the temporal and spatial evolution of modified refractivity structure along the transect, over a selected three day period when strong, elevated ducts and moderately high evaporation ducts were present. These features were generally well modeled by our standard NWP configuration, with little performance gain offered by configurations with greatly increased vertical resolution. We will discuss in detail the validation of Met Office NWP forecasts against sonde observations, along with ongoing progress made through comparisons of NWP driven propagation models against received power levels. The ultimate aim of this analysis is to validate the full end-to-end process of using Met Office NWP data in combination with the Advanced Refractive Effects Prediction System (AREPS) to generate radar propagation predictions.