Analysis of radio link measurements from the TAPS2013 (Tropical Atmospheric Propagation Studies) distributed transmit-receive radio link network experiment

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The reliable prediction of RF system performance depends on the morphology of the tropospheric environment. For instance, the performance of systems, operating at frequencies above 10 GHz, are particularly affected by hydrometeor scattering and molecular resonance processes occurring in the moist and unstable sea surface air. In addition, the turbulent transport processes occurring near the sea surface have a major influence in predicting communication and radar system performance. Evaporation ducts arise from such processes near the sea surface and therefore their characterization require humidity gradient measurements which are difficult to obtain at low heights. Successful implementations of Parabolic Equation Modelling (PEM) for predicting propagation rely on knowing the refractive index at very low heights.

An aim of the TAPS2013 campaign, held in November-December 2013, was to deliver meteorological measurements for validating meso-scale refractive index structure predictions and various propagation models. Refractive index profiles in the marine surface layer were obtained from flux and bulk parameter data collected by an instrumented tower. An aircraft equipped with similar instrumentation provided in situ measurements across the propagation path.

This paper describes the analysis of multichannel millimetric (9, 17, 35 and 94 GHz) wave radio link measurements recorded on a radio network experiment assembled for TAPS2013. The network comprised height distributed multi transmit-receive radio link channels. The transmission site was Lucinda township, and the receive elements were mounted on the Marine Vessel (MV) Cape Ferguson. The MV sailed 78 km seaward from Lucinda jetty on each day of the trial. There were seven transmissions, viz., X band (9 GHz), and I band (17 GHz) a W band (94 GHz) and four Ka band (35 GHz) complex wave modulated sources. There were seven receiver elements (four Ka band and three single X, I and W band).

This paper presents a study of significant anomalous propagation events associated with the sea surface layer environment. The characterization of evaporation ducting in these events is established due to coordinated refractive index profiling from the jetty-based and aircraft meteorological measurements.