Preliminary Spectral Analysis of TAPS Airborne Measurements
USNC-URSI National Radio Science Meeting

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Measurement campaigns help anchor RF propagation models by revealing the true structure of atmospheric refractivity. The 2013 Tropical Air-sea Propagation Study (TAPS) conducted by the Australian DSTO in partnership with the U.S. Navy resulted in a large database of meteorology and RF measurements, preparing the way for a more detailed understanding of refraction phenomena in the lower maritime atmosphere (Kulessa et al., BAMS, 2016.)

The TAPS dataset enables analysis of atmospheric refractivity in both spatial and wavenumber domains. The equilibrium vertical refractivity profile determines the overall bending of rays, while the random turbulent fluctuations give rise to RF decoherence and scattering. Random turbulence (and stability waves) can be observed most easily in the wavenumber or wavelength domain through Fourier analysis.

In propagation modeling it is standard practice to work with a simplified, compact representation of turbulence strength, such as the localized structure parameters of temperature and index of refraction, Ct2 and Cn2 respectively. However these parameters assume simple Kolmogorov turbulence. Therefore we should expect problems with this theory in the complex boundary layer especially approaching the sea surface. In the Fourier domain these spectral (wavenumber) models can be assessed, and turbulence/stochastic effects can be identified. The outer scale of turbulence is a central question that can be addressed in this domain.

We present preliminary processing and analysis of eight days of TAPS airborne measurements from a powered glider, showing the spectra (power versus wavelength) of temperature, humidity and pressure throughout the lowermost 600m of tropical atmosphere. Significant variation in the spectra is observed as a function of height over water. We compare observations with the predictions of statistical turbulence models including Kolmogorov. Finally we discuss possible implications for the efforts to predict equilibrium vertical Cn2 profiles using routine meteorological “prognostic variables” from radiosonde flights and numerical weather prediction fields.