Kite sonde measurements of the evaporation duct at TAPS 2013

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The Tropical Atmospheric Propagation Study 2013 (TAPS 2013) was a two week field experiment focused on simultaneous measurements of one-way radar performance and environmental parameters effecting refractivity in the tropical environment. Defence Technology Agency (DTA) scientists collected a series of 108 profiles of humidity, temperature and pressure from 1.4 m to 100 m above sea level during the campaign. These low level measurements were collected to enable comparison with modelled meteorological data.

Profiles were collected using a Vaisala RS92 radiosonde tethered beneath a small fishing kite. The launch procedure of the radiosonde, developed over several campaigns aimed to decrease contamination from the vessel. Once launched the kite and sonde ascended and descended using a winch. Data was collected using a Vaisala Digicora III receiver, with atmospheric pressure and GPS continuously being recorded at the vessel to enable post processing of the data.

The measured profiles show the presence of an evaporation duct, however the data are noisy and to enable comparison with modelled data smoothing is required. Within the Marine Surface Boundary Layer, the refractivity profiles can be approximated with good accuracy by a log-linear law:

$$M(z) = M(0) + g_M \cdot \left(z - z_d \cdot Ln\left(\frac{z+z_0}{z_0}\right)\right)$$

with $z_0 = 1.5 * 10^{-4}\, m$, and z_d being the evaporation duct height. Moreover:

$$\frac{dM}{dz} \approx g_M \left(1 - \frac{z_d}{z}\right)$$

Thus g_M is the refractivity gradient when the altitude becomes infinite. So this parameter should be closed to the standard gradient: $g_M \approx 0.118\, M/m$.

Finally, fitting the measured kite sonde profiles with such a log-linear law enables an estimation of the evaporation duct height. For each location of the kite sonde, the obtained duct heights will be compared with the values deduced from mesoscale NWP models.