X-Band Beacon-Receiver Phased Array Evaporation Duct Height Estimation

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Radiowave propagation in the marine atmospheric boundary layer (MABL) remains a subject of research interest given the potential utility of the ducting propagation mechanism. Ducting propagation is highly dependent on atmospheric conditions; experiments that combine propagation measurements with atmospheric characterization can offer opportunities for improved modeling of the MABL effects on propagation in the future. A recent campaign provided an opportunity to deploy a multichannel X-band receive array system and corresponding beacon transmitters to investigate their use in characterizing properties of the MABL.

The experiment reported here deployed the XBBR in La Jolla, CA at the Scripps Institution of Oceanography Pier for long term measurement of atmospheric effects in the MABL. During a short test of functionality on August 12th, 2014, successful data acquisition was shown by receiving transmit signals from two ship mounted beacons at distances of 15 km off shore. A second test was completed on Sept. 3rd, 2014 using three beacons carried by a small vessel to a distance of 25 km from the end of the pier. Long Term measurement began after deployment of the transmitting beacons on a moored bouy 15 km West of the Scripps Pier on May 13th, 2015.

Propagation loss and phase progression between transmitters at multiple heights and ranges and receive antennas at multiple heights were measured. The received power and phase, relative to the other transmit and receive pairs, were compared to TPEM (Barrios, 1994) modeling software results in order to estimate the evaporation duct height (EDH). Meteorological data was also recorded to act as input to the Navy Atmospheric Vertical Surface Layer Model (NAVSLaM); this allows for determination of the evaporation duct height from in-situ meteorological data to serve as the ground truth for comparison with our evaporation duct height estimation.

Sample results from the measurements will be presented, along with a discussion of the propagation effects observed and methods developed to improve future measurements and results.