PROPAGATION MEASUREMENTS IN THE COASTAL OCEANIC EVAPORATION DUCT AT 45 GHZ

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This paper presents results from a series of experiments that were conducted to measure the effect of evaporation ducting on propagation path loss at 45 GHz. The tests were performed in February and June of 2005 off the Mid-Atlantic coast near Ocean City, Maryland. Testing involved transmitting a tone from a research vessel (RV) and measuring the signal strength of the tone at several receivers positioned along the coast in high-rise hotels, ranging in height from 19 to 50 meters. Path loss, which was computed as a function of distance between the RV and the various receiver locations, was estimated by computing the FFT of the received signal and examining the amplitude of the appropriate frequency bins containing the tone energy. By calibrating the receivers appropriately, it was possible to map the FFT magnitudes of the tones to actual received power levels, which, when compared to the known transmit power, provided a straightforward means of estimating the path loss. This process was repeated as the RV moved along a relatively straight coarse beginning close to shore (about 4 km) and continuing out to about 55 km at its furthest point. Data was collected during a total of eight days, four in February and four in June.

In addition to measuring signal strength, meteorological data was also collected on the RV to help characterize the evaporation duct height and to produce refractivity height profiles, which were used to identify the presence of surface and elevated ducts. The evaporation duct height was inferred from measured air and sea temperature, relative humidity, wind speed, and atmospheric pressure. The refractivity profiles were obtained from measurements made by rocketsondes launched from the RV. The meteorological data were collected periodically during the course of the experiment. In the February tests, the evaporation duct heights were observed to vary between about 3 and 9 meters, and no significant surface or elevated ducts were present. During the June tests, the opposite conditions were observed negligible evaporation ducting, but occasional pronounced surface and elevated ducts.

The paper presents plots of measured path loss versus over-water path length. In order to facilitate the interpretation of these results, reference curves are superimposed on these plots showing free space path loss and path loss due to the refractivity effects of a standard atmospheric model. The impact of ducting on path loss is readily observed by comparing the measured path loss with the reference curves. The February 2005 results show that evaporation ducting reduces path loss by 50 dB or more relative to a standard atmosphere. It is shown that this is equivalent to more than doubling the potential communications range. The corresponding data from the June tests shows significantly less path length extension, presumably due to the near total absence of evaporation ducts during the June collection period. Further testing is ongoing at the same frequency to more thoroughly examine the seasonal impact of evaporation ducting on path loss. This study addresses the impact of evaporation ducts on propagation at a frequency for which there is little data in the published literature.

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