Radar Performance for S, C and X Bands During the Onset of a Sea Breeze Event Off the California Baja

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Diurnal sea breeze circulations create shallow well mixed layers over the ocean capped by strong temperature inversions and water vapor gradients in the entrainment layer between the free atmosphere and the mixed layer. Significant surface based ducts develop in the entrainment layer over an eight hour period.

This paper reports on the modeled performance of notional S, C, and X band radars, designed for equivalent sensitivity, with the onset of a sea breeze event off the California Baja. The spatio-temporal structure of the refractivity field during the sea breeze development was resolved by the Regional Atmospheric Modeling System (RAMS). The equivalent sensitivity radars were modeled by the Advanced Refractivity Effects Prediction System. Validation refractivity profiles were obtained by rocketsonde.

The sea breeze affect is captured at three times over an eight hour period, prior to onset, midway through development, and after reaching minimum duct altitude and maximum refractivity gradient deficit. During this period the height of the ducts decreases from 190 to 120 meters. The azimuthal and temporal variations caused by the sea breeze onset are evident in the radar 90% probability of detection performance values for each of the radar designs, and is also apparent in height dependant propagation factor comparisons at the three radar frequency bands. During the period of strongest sea breeze flow, all three bands experience propagation factor losses relative to a standard atmosphere in excess of 30dB in the free atmosphere immediately above the entrainment layer. These effects were stratified in height by frequency sufficiently that more than 10dB of that loss were recoverable by a dual band technique. The affects of frequency, target altitude and the refractive environment are explored and contrasted. Implications of sea breeze forecasts and their effects on radar performance, design, operations and data interpretation are discussed.