OCEAN SURFACE REMOTE SENSING WITH AIRCRAFT MICROWAVE SCATTEROMETER AND RADIOMETER

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Oman winds are a key driving force of momentum, humidity, and heat exchanges between the atmosphere and ocean. Measurements of ocean wind are critical for meteorological and air-sea interaction studies. Early studies of data from many airborne and Lowrcl-based scatterometers have shown that the microwave ocean backscatter is sensitive to the speed and direction of surface winds. Based on this observation, many satellite scatterometers, including SeaSat scatterometer, ERS-1 and -2 scatterometers, and the NASA scatterometer (NSCAT) have been flown to provide a global mapping of ocean surface winds. In addition to scatterometer observations, it has been discovered recently that sea surface brightness temperatures are also sensitive to wind direction as well as wind speed. Jet Propulsion Laboratory (JPL) has developed 19 and 37 GHz polarimetric radiometers. A series of NASA DC-8 aircraft flights was conducted over the National Data Buoy Center (NDBC) buoys deployed off the US west coast from 1993 to 1995 to examine the dependence of polarimetric ocean brightness temperatures on surface wind speed and direction. Measured radiometric temperatures from all polarization channels showed directional dependence at 2 to 24 m/s. The directional signals increase with increasing wind speed from low to moderate winds (< 1'2 m/s) and appeal to saturate at higher wind speeds. Wind directional signals observed in the 37 GHz channel were similar to those in the 19 GHz channel. This indicates that sea surfaces have a similar directional spectrum at centimeter and millimeter wavelengths. To enable the comparison of scatterometer and radiometer measurements, the JPL Ku-band scatterometer (NUSCAT) was deployed together with the 19 and 37 GHz radiometers on the NASA Wallops P-3 aircraft in November 1996. A set of flights were successfully completed to acquire coincidental active and passive microwave observations of sea surfaces off the US east coast. It is found that the directional signatures of ocean thermal radiation at 19 and 37 GHz are consistent with that in Ku-band ocean backscatter. Theoretical analysis based on a two scale scattering model was performed to investigate the physical mechanisms which may contribute to the observed speed and direction signals. The wind velocity signals in the J 1'1, active and passive measurements were found to agree reasonably well with model predictions. Sensitivity analysis of the modelled scattering mechanisms suggests that short-gravity and capillary waves are the dominant scattering source for the measured anisotropic direction signatures in ocean backscatter and radiation.