LITE Shuttle Lidar Measurements of Ocean Surface Directional Reflectance

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On several occasions during the. LITE mission in September 1994 the orientation of the shuttle Discovery was maneuvered in order to permit measurements of the back reflectance of a selected patch of sea surface for a range of nadir angles, a maneuver called the "landmark track". The angular dependence of the reflectance depends strongly on the surface winds, which determine the surface wave structure. At low and moderate surface wind speeds the surface reflectance depends primarily on the slope distribution of the capillary wave facets superimposed on the longwave swells, The reflectance characteristics depart significantly from those of the ideal diffuse Lambertian surface. At higher surface wind speed the contributions from foam (whitecaps) and spray alter the angular reflectance properties. The departure from Lambertian behavior is important for emissivity modeling at 1}? (infrared) wavelengths, affecting the ability to recover accurate surface temperatures and cloud optical thicknesses from satellite IR radiometer data, The size and dynamic range of the sea surface back reflectance vs. nadir angle is also important for performance evaluations of future scanning Earth-orbiting lidars such as Doppler wind lidars.

The LITE measurements were taken during low to moderate surface wind conditions and provide a means of testing ocean surface models which link capillary wave slope distribution to surface wind speed. Data from the ERS-1 scatterometer were used to support the landmark track studies in the tropical Atlantic and Pacific oceans. Additional data were obtained from the Gulf of California and Lake Superior. in all cases the directional reflectance was sharply peaked around the specular direction.