

How Do Breaking Waves Show Up In Low-Grazing Angle Backscatter and Ocean Wave Spectra?

William J. Plant
APL/UW

June 3, 2015

Time/space imagery of the line-of-sight velocities measured by a coherent, low-grazing angle, high-resolution radar show striking wave patterns. As wavenumber/frequency spectra of these images show, not all of these wave features can be explained by freely propagating waves. Rather, as I will show, a linear feature through the origin of the wavenumber/frequency spectrum is due to breaking waves produced by the interference pattern of nearly dominant waves. The proof of this comes from low-grazing angle microwave Doppler spectra, video measurements of Phillips Lambda function, and acoustic tracking measurements. This much is not speculative.

The speculative part of this talk lies in trying to explain how the breaking wave features show up in short wave curvature spectra and therefore in low-grazing-angle microwave Doppler spectra. We will speculate that the roughness to which microwaves respond is produced by the breaking of waves with wavelengths between about 0.2 and 2 m that move at the speed of the interference pattern of the dominant waves. If waves of this wavelength were alone on the surface, they would not move at this speed. But because these waves are advected by the dominant waves they have some probability of appearing at the speed of the interference pattern. When these waves do move at the proper speed, their amplitude is increased to the point that they break to produce gravity-capillary waves moving at the same speed. These waves are the scatterers of microwaves and show up in the short wave curvature spectrum as a pronounced peak just above the phase speed minimum. I will contend that this peak is therefore due to the breaking waves produced indirectly by the interference pattern of the dominant waves.