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Slope and curvature of microbreaking wind waves

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Microscale breaking is commonly observed at sea for steep waves less than 30 cm in wavelength. This phenomenon generates high surface slope and curvature roughness at the water surface, which has numerous implications for air-sea exchange and remote-sensing studies. In particular, microbreaking affects momentum transfer from wind to waves, leads to formation of vortices in water, and plays a key role in scattering of electromagnetic and acoustic waves by the air-sea interface. The geometric properties of the parasitic capillaries generated upon steep steady gravity-capillary waves have been well studied over the last decades, both experimentally and numerically. However, owing to their variability, the basic features of naturally occurring wind wave breakers as observed at sea or even in laboratory are far from being identified up to now. To this end, an experimental investigation of microbreaking wind waves was made in a large wind wave tank which combined visualizations of wave breaker profiles with single-point wave elevation and slope measurements. We show that microscale breakers exhibit a characteristic signature in slope and curvature suggesting formation of a bulge on the forward face of the wave crest. Parasitic ripples however are not necessarily generated ahead the bulge. Such breakers are observed for a wide range of wave steepness and wave slope skewness, their structure being only weakly dependent on wavelength and wind forcing. The geometric properties of microbreakers are analysed statistically and compared with the results of the recent numerical simulations by Hung and Tsai (J. Phys. Oceanogr., 2009).