# Abstract View

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# Wind Stress and Roughness Length over Breaking Waves

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ABSTRACT

The effects of surface wave breaking on the adjacent atmospheric boundary layer are examined. It is argued that the transition from aerodynamically smooth to rough flow in a neutral atmosphere corresponds to the onset of extensive small-scale wave breaking. The association of wave breaking with the generation of turbulence in the boundary layer above leads to the result that the friction velocity is approximately equal to the phase velocity of the breaking waves. It is argued that this approximate relationship holds even when the small-scale breaking waves are riding on a swell. The existence of a minimum phase velocity for surface waves then requires that there be a minimum friction velocity, in the neighborhood of 23 cm $s^{-1}$ below which rough flow cannot occur. A result of Phillips and Banner (1974) which describes the limiting amplitude of small gravity waves under the action of wind drift and swell is used to derive a relationship between the roughness length and friction velocity which is a generalization of Charnock's (1955) equation. The published field measurements of a number of workers are shown to support these results.