Abstract View

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Wave-Related Fluctuations in the Airflow Above Natural Waves

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ABSTRACT

Simultaneous observations of wave heights and velocity fluctuations at two levels above the waves are analyzed to examine properties of the wave-related fluctuations in the allow. Results are obtained from spectral and joint probability density function, conditional mean function (JPDF-CMF) analyses. Results are examined with respect to predictions from potential flow theory and recent theoretical formulations for wind-wave coupling. Of interest are recent formulations which allow interaction between the wave-induced motion and turbulence in the airflow, the so-called “turbulence” models.

Cospectral results exhibit features which are predicted by theoretical formulations with regard to height variations of the wave-related momentum transfer. These features include the oscillatory variations predicted by recent turbulence models and also enhanced transfer at both levels as predicted by the quasi-laminar model.

JPDF-CMF analyses are used to obtain phase-amplitude information for those variables examined in the spectral analyses. For a period in which the presence of the “critical level” could have been a factor, the phase relation between the wave-related vertical velocity and the wave height agrees with the quasi-laminar prediction. For periods in which only the turbulence in the airflow would be expected to influence the wave-induced motion, phase and amplitudes of the wave-related fluctuations differ from the potential flow predictions.

It is concluded that the interaction between the wave-induced motion and airflow turbulence had a significant effect on the observed wave-related fluctuations. Another conclusion is the assertion of the value in using JPDF-CMF analyses for examining wave-related fluctuations.

top

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