Abstract View

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On the Formation of Whitecaps by a Threshold Mechanism. Part III: Field Experiment and Comparison with Theory

R.L. Snyder, Linda Smith, and R.M. Kennedy

Nova University, Dania, FL 33004

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ABSTRACT

This paper is the third in a series of papers which seek to evaluate the hypothesis that deep water whitecapping is predictable in terms of a threshold mechanism involving the vertical acceleration. Parts I and II of the series have developed the descriptive framework for the investigation and examined several geometro-statistical predictions of the threshold model, the first by direct integration of the joint probability densities for the vertical acceleration, the second by Monte Carlo simulation of the vertical acceleration field.

In Part III we describe a field experiment designed to study the statistical geometry of the whitecap field and to test the theoretical predictions of Parts I and II. This experiment, conducted at an experimental site in the Bight of Abaco, Bahamas, combines a series of photographs of whitecap events with simultaneous array measurements of waves. The photographs were taken from above the water surface and cover an area nominally 10 m on a side. A total of 2292 whitecap events (~ 10 000 frames), obtained in winds to 10 m s^{-1}, were analyzed.

Using the technique of Snyder and Smith, the vertical acceleration field was estimated in the vicinity of selected whitecap events (from the recorded signals of a 7-component wave recorder array in the field-of-view of the camera). Statistical allowance for the contribution of higher frequency wave components not included in the analysis suggests that the observed accelerations are consistent with a vertical acceleration threshold of approximately 0.5*g*.

Statistical analysis of all observed events produces a probability of breaking and moment statistics which are likewise reasonably consistent, though not uniformly so, with the theoretical predictions of Parts I and II.

We conclude that to some level of approximation the vertical acceleration threshold model may indeed predict whitecapping. The appropriate threshold level appears to be approximately 0.5*g*. This conclusion is less than definitive because our analysis is limited to wave components with frequencies less than twice the frequency of the spectral

peak.