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Volume 9, Issue 4 (July 1979)

Journal of Physical Oceanography
Article: pp. 802–814 | Abstract | PDF (876K)

Temporal Rates of Growth and Decay of Microscopic and Macroscopic Surface Structures in a Wind-Wave Tank

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(Manuscript received September 6, 1977, in final form January 15, 1979)

DOI: 10.1175/1520-0485(1979)009<0802:TROGAD>2.0.CO;2

ABSTRACT

The distributions of water-surface slopes and wave heights were measured under suddenly started and stopped winds. The root-mean-square slopes and average wave heights are found to grow and decay exponentially with time; in each case, the growth rate is faster than the decay rate. Quantitative growth and decay rates of these slopes and heights approaching and departing an equilibrium state, respectively, are presented. The growth rates show strong dependence and the decay rates show insignificant dependence an wind-friction velocity. The growth time of slope statistics is found to be shorter than that of height statistics, suggesting that the ripples can be excited directly and effectively by the wind and that wave-wave interaction and wind gusts are important to wave generation by wind. This comparison, along with measurements of instantaneous growth of microscopic surface structures reported by others, also reveals that the development of the wave spectrum indeed starts at the high-frequency end, and that for remote sensing of sea-surface wind an uncertainty is introduced by unsteadiness of the wind.

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