Phillips' spectral framework for ocean whitecaps revisited.

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Abstract

There has been a recent upsurge in interest in quantifying kinematical properties and dynamical effects of wave breaking in both the open ocean and in coastal zones. This emphasis of this research has shifted from breaking probability and whitecap cover to the Phillips (1985) spectral framework, amenable to both measurement and modeling, for quantifying mean wave breaking wave properties in the wave spectrum. He introduced the spectral distribution $\Lambda(\mathbf{c})$ such that $\Lambda(\mathbf{c})\, d\mathbf{c}$ is the average total length per unit sea surface area of breaking fronts that have velocities in the range of $\mathbf{c}$ to $\mathbf{c}+d\mathbf{c}$. This $\Lambda(\mathbf{c})$ distribution provides a valuable scale-dependent measure of wave breaking kinematics that can be measured remotely using visible or infrared video imaging from towers or aircraft. It provides a useful diagnostic for understanding air-sea interaction, with strong relevance to the wave energy dissipation rate, momentum flux from the waves to the currents, and air–sea fluxes of gas and sea salt aerosols.

In this presentation, after outlining the Phillips (1985) framework, we focus on a fundamental misunderstanding of a key aspect of this quantification, i.e., the most appropriate independent variable in the expression for $\Lambda(\mathbf{c})$. We then highlight the consequences of the different choices of independent variable used by various investigators.