Novel Applications of Remote Sensing for Improved Quantification of Sea Spray Source Function

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By producing bubbles, sea spray and marine aerosols, whitecaps are involved in the planetary heat budget, air-sea gas exchange, atmospheric marine boundary layer visibility, tropical cyclone intensification, and aerosol radiative forcing of climate. In addition, whitecaps affect geophysical retrievals of ocean surface wind vector, salinity, and ocean color. Better measurements and parameterizations of the whitecap fraction would improve the evaluation of these processes.

The sea spray source function currently used in climate models is based on the relation between whitecap fraction W and wind speed U. However, parameterization $W(U)$ does not capture adequately the high spatial and temporal variability of the oceanic whitecaps caused by water temperature, atmospheric stability, wave age, and wind history. Developing a predictive relationship capable of estimating W over the range of conditions encountered globally requires that the dependence of W on these additional factors be understood and modeled. The existing database of W compiled from photographs, while valuable in gaining knowledge, represents only a limited range of conditions.

Satellite remote sensing of whitecap fraction opens the possibility to improve the modeling of its variability, hence the quantification of the sea spray source function. Using satellite based estimates, we have assembled a database of W and additional meteorological and environmental factors with global coverage and a much greater range of variability. This extensive database allows comprehensive analysis of W variability. This knowledge provides basis for improvement of existing or development of new models for W which more fully account for effects of additional factors.

A systematic research program is underway at the Naval Research Laboratory (NRL) to retrieve W from existing satellite-borne microwave instruments. Building on initial feasibility study, NRL now has the capability of obtaining W globally with an improved algorithm. The validation, tuning, and further refining of this capability is ongoing. We will present the principle of radiometric measurements of whitecap fraction, results on its spatial and temporal features over the globe, and implications for quantifying global sea spray fluxes.