Database of satellite-based foam fraction for investigation of whitecaps variability with correlation analysis

Magdalena D. Anguelova, Michael H Bettenhausen, William F. Johnston, Peter W. Gaiser
Code 7223 Passive Microwave Remote Sensing
Naval Research Laboratory
Washington, DC 20375
maggie.anguelova@nrl.navy.mil / 202 404 6342 (voice) / 202 767 9194 (fax)

Oceanic whitecaps manifest the breaking of wind-driven water waves with air entrainment. They alter the ocean surface albedo and roughness and produce bubbles, sea spray and sea-salt aerosols. Through these processes breaking waves affect the remote sensing of surface wind vector, salinity and ocean color and are involved in the turbulent mixing of the upper-ocean layer, planetary heat budget, air-sea gas exchange, tropical cyclone intensification, and aerosol radiative forcing of climate. Foam fraction, *W*, quantifies the area covered with whitecaps and is used as a forcing variable in models and parameterizations of these processes. Traditional photographic measurements of foam fraction have high experimental uncertainty and are not sufficient to build a database necessary to investigate and model the geophysical variability of whitecapping.

Within the framework of WindSat mission, Naval Research Laboratory has developed an alternative method of estimating foam fraction from satellite-based passive radiometric data. The algorithm relies on changes of ocean surface emissivity at microwave frequencies (6 to 37 GHz) due to presence of sea foam on a rough sea surface. The shortcomings of the feasibility-study algorithm were improved by usage of independent sources for the input variables of the algorithm; physically based models for the emissivity of rough sea surface and emissivity of foam; improved rain flag, and improved atmospheric model necessary for the atmospheric correction.

With this new version estimates of foam fraction for one year (2006) were computed and used to characterize its geographical and seasonal variability. The *W* data were matched in time and space with data for wind speed and direction, sea surface temperature, air temperature, significant wave height, and peak wave period available either from satellites or global geophysical models. This database of *W* and additional meteorological and oceanographic data was used to investigate the geophysical variability of whitecaps with correlation analysis.

We will report results on foam fraction spatial and temporal features over the globe and correlation maps quantifying the relative importance, in different geographic regions, of each of the additional factors in shaping the foam fraction variability.