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Global Whitecap Coverage From Satellite-Measured Brightness Temperature

Magdalena D. Anguelova, Ferris Webster

College of Marine Studies, University of Delaware
700 Pilottown Rd., Lewes, DE 19958
tel: (302) 645-4009; fax: (302) 645-4007; e-mail: magde@udel.edu

ABSTRACT

Natural and anthropogenic aerosols affect climate indirectly by varying the number of cloud condensation nuclei (CCN), and changing cloud properties and the lifetime of cloud droplets and directly by scattering short-wave light and influencing atmospheric chemistry. The inclusion of radiative forcing of different types of aerosol in general climate models improves model predictions. In models, aerosol generation, among other processes, must be simulated.

The generation functions of sea-salt aerosols currently used in climate models are based on the relation between whitecap coverage and wind speed. Whitecap coverage is traditionally estimated from photographs of the sea surface and is always somewhat subjective. The existing database for whitecap coverage is limited and, except for atmospheric stability, does not allow the relation between whitecap coverage and other environmental parameters to be determined. To establish that relation, and hence to improve the generation function, one needs data of global whitecap coverage under a variety of conditions.

We propose a method to estimate whitecap coverage using the brightness temperature of the sea surface measured by a passive microwave radiometer together with surface wind speed obtained with the Special Sensor Microwave/Imager (SSM/I). Concomitant measurements of atmospheric water vapor and cloud liquid content are used for the atmospheric correction. The concept of the method is described and its feasibility is validated with data. The propagation of error of measurement of each parameter and its contribution to the error of whitecap coverage estimates is analytically investigated. The conditions for whitecap coverage estimation with acceptable error are discussed.