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Improving the parameterization of short wave radiation at sea surface in the Atlantic Ocean.

A. Sinitsyn and S.K. Gulev
P.P.Shirshov Institute of Oceanology, RAS, SAIL, Moscow, Russian Federation (sinitsyn@sail.msk.ru)

The major source of uncertainties in the estimation of solar radiation at sea surface is associated with strong variability in the atmospheric transmission factor under different cloud types, even under the same total cloud cover. Existing parameterizations account mostly for the amount of clouds (quantified through the fractional cloud cover) and do not include cloud types. The latters are characterized by highly variable optical properties of clouds and can, when used, critically improve the accuracy of parameterizations of short wave radiation at sea surface. To resolve the problem of the absence of accurate parameterizations based on cloud type characteristic and to develop and advanced methodology we performed 4-year (2004-2007) experiment designed to measure the incoming shortwave radiation at the ocean surface under different could conditions. The data array includes 130 daily series of field in-situ measurements of short wave radiation and simultaneous visual observations of cloud type and cloud cover in different regions of the Atlantic Ocean. Data were collected during several research cruises with the routes aligning from the sub-polar North Atlantic to Antarctica and, thus, cover most of climate conditions. Observations were used to build statistically new dependencies of the atmospheric transmission on cloud cover under different could types. Using this approach we were capable of improving the accuracy of computations of surface short wave radiation fluxes by 20% compared to the existing models using information about fractional cloud cover only. Importantly the highest improvement of the accuracy was obtained under near-overcast or overcast conditions. Further development of this project goes along designing a system for automatic determination of cloud cover and the engagement of these estimates into calculations of the incoming short wave radiation fluxes. For the development and testing this system we used cloud cover data collected in the Atlantic Ocean during the period 2007-2011. It has been found that the automatic system provides quantitative estimation of fractional cloud cover with 20% accuracy and in case of the manual correction of records the accuracy increase up to 10%. This is equivalent to the accuracy of visual observations. Since the digital system allows for high resolution nearly operational observation of fractional cloud cover and types, further plans can be associated with the development of low-cost package for the on-line estimation of short wave incoming radiation at sea surface even at merchant vessels.