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Highly accurate parametrization of short wave solar radiation at sea and it comparison with different alternative parameterizations.

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The major source of uncertainties in the existing methods of parametrization of solar radiation at sea is associated with the large scatter of the atmospheric transmission factor under different cloud types, even for the same total cloud cover. In order to resolve this problem and discriminate between different cloud type conditions we suggest to derive different approximations of the short wave radiation for different cloud conditions. We used about 1500 hours of highly accurate in-situ observations of solar radiation in the Atlantic Ocean in 2004-2006. Importantly, direct measurements were taken with approximately similar sampling in different latitudes in the belt from 60N to 60S at the Atlantic meridional section. Thus, these data account for most potential cloud conditions at sea. New parametrization represents a set of approximations derived for different cloud conditions and cloud cover. For the clear sky conditions additional improvement was implemented through the accounting for non-linearity of the transmission factor onto solar altitude. Furthermore, a special approximation was suggested for the eastern North Atlantic tropics and subtropics, influenced by the aerosols advected from Sahara. New parametrization demonstrates statistically significant improvement of accuracy compared to the other schemes based exclusively on the total cloud cover in octa. New approach is especially effective under high cloud cover and conditions close to complete overcast, when its accuracy may be 10% better. Comparison for the other cloud conditions demonstrates smaller, but also significant improvement of the accuracy. Critical analysis of the new parametrization and comparative assessment with the existing schemes of the last 2 decades also shows that the capability of the empirical parametrization (employing total/low cloud cover and cloud type information along with standard meteorological observations) to accurately describe short wave radiation is limited and hardly can be improved within given parameters. Further improvement may only be based on the use of upper layer data or cloud characteristics which are not massively measured at sea.