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A Study of Parameterisations of Insolation with the Use of Whole Sky Images

J. Kalisch (1), A. Sinitsyn (2), S. Gulev (2), A. Macke (1)

(1) Leibniz-Institut fuer Meereswissenschaften IFM-GEOMAR, Kiel, (2) Shirshov Institute of Oceanology, Moscow

Parameterisations of incoming solar radiation at the sea surface are widely used for calculating radiation budgets, because direct high quality measurements are available for a few stations and research projects only. In cooperation with the Shirshov Institute of Oceanology we have realised comprehensive in-situ and remotely sensed (both satellite and from the ship) meridional measurements of sea-air interaction parameters with a particular focus on radiation and SST in order to derive new parameterisations of SW radiation, to understand the mechanisms driving the spatial and temporal variability of SST and to depict different scales of variability of radiative fluxes and SST.

In the first step, we analysed existing parameterisations of insolation. All parameterisations calculate the insolation most accurately under clear sky conditions. Despite the fact that broken cumulus clouds cause large fluctuations on the observed insolation the downward flux averaged over 30 minutes and longer is reproduced surprizingly well. Stratus clouds cause the largest errors, because the optical thickness of the clouds is not taken into account in the parameterisations.

Some parameterisations define synoptic cloud categories that estimate the transmittance of the cloudy atmosphere. This classification is relatively rough and small reporting differences can cause large calculated irradiance differences. If the atmospheric transmittance is deduced from the pressure of water vapour at the ground level and the total amount of clouds, the calculated insolation is relatively exact. As a result an existing parameterisation was modified to minimize the systematic error and to reduce the standard deviation of the differences of parameterised and measured insolation. This new parameterisation has been applied to an independent data set and was found to be robust.

Special attention is given to cloud camera images, which allow the calculation of cloud amount and thereby the calculation of insolation without using synoptic observations.