Evaluation of ERA-40 Reanalysis Data on a Regional Scale: Cloud Fraction and Solar Radiation in the North Sea Area

Nils H. Schade, Hartmut Heinrich
German Federal Maritime and Hydrographic Agency (BSH)

Martin Stengel, Rainer Hollmann, Gudrun Rosenhagen
German Meteorological Service (DWD)

Within the research program KLIWAS (Impacts of Climate change on waterways and navigation) of the German Federal Ministry of Transport, Building and Urban Development (BMVBS), investigations of changes of the coastal waterways are carried out to develop actual and future adaptation strategies, coastal protection, etc. Clouds and solar Short-wave Radiation (SWR) play a key role not only for the processes of the atmosphere but also of the oceans. Solar Radiation drives the climate, while clouds influence the cooling/heating of the atmosphere and the amount of SWR reaching the ground. The atmosphere model calculates heat, freshwater and momentum fluxes and receives in turn sea surfaces temperatures from the ocean model. Therefore, the quality of cloud and radiation calculations defines to a great extent the quality of the results of the coupled Atmosphere-Ocean model runs.

For the evaluation and assessment of the climate models reference data are needed. However, cloud fractions over the oceans are not measured in-situ in a sufficient solution, whereas solar radiation parameters are not measured operationally at all. Most of the in-situ data are coming from Voluntary Observing Ships (VOS), buoys and platforms, some from scientific cruises. Since the automation of observations is proceeding, it can be expected, that especially cloud parameters won't be available from VOS data for climate research in the future. However, in order to discern temporal trends from natural climate variability long time series of homogeneous high quality controlled measurements are necessary. Here, satellites provide the only data source.

In conjunction with the studies of climate change, the quality of today's climate models must be investigated. For lack of measurements of sufficient temporal and spatial resolution data calculated by reanalysis models are often used. Within the KLIWAS, hindcast products from the EU project ENSEMBLES are investigated. These are calculated with several Regional Climate Models (RCM's), driven by the ERA-40 Reanalysis. To assess the quality of these RCM simulations, reference data as well as Global Climate Model (GCM) simulations of high quality are required.

The CM SAF (EUMETSAT's Satellite Application Facility on Climate Monitoring), which is a consortium of 6 international institutions with the German Meteorological Service as the leading entity, provides satellite-based long-term records of, for example, cloud properties and surface radiation. These Climate Data Record are derived from measurements of, amongst others, the Advanced Very High Resolution Radiometer (AVHRR), on-board NOAA and MetOp-A satellites, in a regional scale resolution of 0.25° on a daily basis, going back to 1982. Cloud cover products have been validated against globally distributed synoptic observations, solely on airports world-wide, the radiation products against the high quality BSRN (Baseline Surface Radiation Network) stations, 37 world-wide. Both data sets compare well on a global scale and show only small biases. The cloud products were additionally evaluated against other satellite cloud products (PATMOS-X, MODIS, ISCCP, A-Train) and show also good agreement. Further investigations on collocation over the North Sea Area with buoy data and Atlantic transect cruises with the research vessel Polarstern indicate, that CM SAF data can be used for comparisons on a regional scale, where only few, or no in-situ measurements are available.

The results of the comparisons between reanalysis data and both, in-situ measurements and satellite products, over the North Sea area for the 1982-2002 period are presented. Daily means of short-wave surface radiation and cloud fraction fields from CM SAF AVHRR data are compared to the ERA-40 reanalysis. Comparisons with in-situ measurements for cloud fraction are carried out for grid boxes, for

which the temporal and spatial coverage is sufficient.

Corresponding author:

Name: Nils H. Schade
Organization: German Federal Maritime and Hydrographic Agency (BSH)
Address: Bernhard-Nocht-Str. 78
20359 Hamburg
Germany