On the Applicability of ERA-Interim data for Climate Monitoring of the Surface Radiation Budget

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A continuous monitoring of the climate system is required to detect and potentially attribute changes of the climate. The requirements for climate monitoring information are different to those for weather observations, especially in terms of their long-term availability and their temporal stability. The longest instrumental time series currently available for climate monitoring are based on surface observations and provide high-quality information on surface quantities (e.g., pressure, temperature). However, these data sets were often not designed to meet the needs for climate monitoring and have to be adjusted to fulfil the stability requirements for climate monitoring data sets. Also, these direct observations mainly exist over land in the populated regions of the Northern Hemisphere and provide only a very limited set of atmospheric observables. Still, these surface-based data sets form the basis of our current climate monitoring systems.

For a comprehensive climate monitoring system, global climate data sets, including land and ocean, are mandatory. Such data sets can only be derived from satellite observations directly or by the application of a global reanalysis system using an atmospheric model. Satellite observations are available only since the early 1980's, which fundamentally limits the temporal extent of the climate data records that can be derived from satellite observations only. Reanalysis systems also make widely use of satellite measurements, but also include information from other sources, e.g., surface observations and vertical soundings, in combination with an atmospheric model.

To detect and correct inhomogeneities in climatological data sets based on surface measurements several statistical methods have been developed, recommended (e.g., by WMO), and applied to generate high-quality climate data records that are the foundation of our current climate monitoring system. So far, no corresponding measures and tests have been applied to the climate data records derived from satellite measurements and reanalysis data sets.

Here we present results from the application of quality and homogeneity tests to the ERA-Interim data set to evaluate its applicability for climate monitoring. The focus will be on the downwelling short- and longwave surface radiation, which have been identified by GCOS as Essential Climate Variables (ECVs) to support the work of the UNFCCC and the IPCC. As reference, long-term surface observations from the Baseline Surface Radiation Network (BSRN) are used, which have not been assimilated in the 4D VAR data assimilation scheme of ERA-Interim.

The monthly-averages of the BSRN station data are used to evaluate the quality of the ERA-Interim data sets using traditional quality measures (e.g., bias, variance) and measures that reflect the climate monitoring quality of the ERA-Interim data sets (e.g., the correlation of the anomalies, comparison of linear trends). The relative Standard Normal Homogeneity Test (SNHT) is used to detect temporal inhomogeneities in the ERA-Interim data sets at the location of the BSRN surface stations. An absolute SNHT test is performed on the global scale and the types of the detected inhomogeneities (break-like or trend-like) are determined. Possible reasons for the detected inhomogeneities are discussed.

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