Satellite-based datasets for validation of regional climate models: CM-SAF product suite and new tools for processing

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Increasing the confidence in model-based climate projections requires evaluation of climate simulations with high-quality observational datasets. Satellite data provide information on the climate system that are not available or difficult to measure from the Earth's surface like top of atmosphere radiation, cloud properties or humidity in the upper atmosphere. In particular over ocean and sparsely populated areas space-based observations are largely the only data source. Especially for evaluating the generality of climate models across varying locations, satellite-derived datasets have the strong advantage of consistent measurements and processing methodologies across regions. Existing satellite time series, especially from operational meteorological satellites, now reach a length that makes them useful for climate analysis.

Following this idea, EUMETSAT's Satellite Application Facility on Climate Monitoring (CM-SAF) is dedicated to the high-quality long-term monitoring of the climate system's state and variability. CM-SAF supports the analysis and diagnosis of climate parameters in order to detect and understand changes in the climate system. One goal is to support the climate modelling communities by the provision of satellite-derived geophysical parameter data sets.

CM-SAF provides data sets of several cloud parameters, surface albedo, radiation fluxes at top of the atmosphere and at the surface, atmospheric temperature and water vapour profiles as well as vertically integrated water vapour (total, layered integrated). They are derived from geostationary (SEVIRI and GERB instruments) and polar-orbiting (AVHRR, ATOVS and SSM/I instruments) meteorological satellites.

Products from the SEVIRI instrument on-board the geostationary Meteosat Second Generation satellites cover the full visible Earth disk, that extends from South America to the Middle East, with Africa fully included and Europe in the North. Products derived from the AVHRR-sensor on-board the polar-orbiting satellites cover Europe, the East Atlantic and the Inner Arctic. For these sensors, cloud and radiation products are generated at original pixel resolution of a few kilometres. These intermediate products are then aggregated to daily and monthly averages in equal-area projections.

SSM/I (over ocean only) and ATOVS water vapour products offer global coverage. The SSM/I total column water vapour series based on intercalibrated radiances already covers almost 20 years with a quality sufficient to perform studies of inter-annual variability and possibly trends.

In the past a drawback for such validation studies have been the different data formats of both communities. In order to allow easy access to the datasets, the CMSAF-file formats (HDF5) have recently been included into the processing package 'climate data operators (CDO)' which is a well-established conversion tool in the climate modelling community. This package was originally developed for processing and analysis of climate model data. It now also offers easy possibilities to interpolate the CM-SAF datasets to the model grids and conversion to established data formats, as e.g. NetCDF or GRIB.