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Cloud detection using SEVIRI IR channels for the GERB processing

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The first Geostationary Earth Radiation Budget (GERB) instrument was launched during the summer 2002 together with the Spinning Enhanced Visible and InfraRed Imager (SEVIRI) on board of the Meteosat-8 satellite. This broadband radiometer aims to deliver near real-time estimates of the top of the atmosphere (TOA) solar and thermal radiative fluxes at high temporal resolution thanks to the geostationary orbit. Such goal is performed at the Royal Meteorological Institute of Belgium by running the L20 GERB processing which generates these fluxes at several spatial resolutions from the directional filtered radiance measurements of the instrument. This processing consists of successive components, one of them being a radiance-to-flux conversion. Such conversion is carried out in the solar region by using information from a scene identification of SEVIRI data. This scheme estimates the cloud mask over the whole SEVIRI/GERB field-of-view with solely visible SEVIRI channels. While this method gives good results during daytime, it cannot be applied during nighttime. Nevertheless, cloud mask information is valuable to study clouds and aerosols thermal radiative forcing. Thus, a nighttime cloud mask would benefit the GERB flux products in the thermal region.

A majority of cloud detection schemes found in the literature relies on multispectral threshold tests applied to equivalent brightness temperatures (BTs) or brightness temperature differences (BTDs) associated to the 3.9, 8.7, 10.8 and 12 μm bands. These thresholds are commonly estimated using skin surface temperatures as well as water vapor and temperature profiles from numerical weather prediction (NWP) models. However, such dependency on external NWP models cannot guarantee the required stability and accuracy of these cloud masks for climate datasets. Therefore, in this contribution we present a cloud detection method mainly based for every pixel and SEVIRI IR channels on its 60 days time–series of BTs acquired at the same time of day. Our main assumption is that clearsky surfaces are associated with the highest IR radiances while clouds, usually colder, exhibit a significantly lower IR signature. Assuming that clearsky conditions are not too sparse over this 60 days period and that the BT distributions of cloudy and clearsky events can be statistically discriminated, it is possible to perform an unsupervised clustering on such time–series to extract those two classes and thus classify the most recent BT measurement. It results that the only ancillary data needed in this scheme is the first guess of the clearsky BT distribution width which is estimated through 10 years of skin surface temperatures from ERA-40 re-analyses. Moreover, this technique allows us to combine the results obtained independently from each IR band. The best combination strategy is selected through objective comparisons with the EUMETSAT MPEF and NWCSAF cloud masks using both NWP fields.