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Atmospheric Measurement Techniques Discussions

Interactive comment on "HelioFTH: combining cloud index principles and aggregated rating for cloud masking using infrared observations from geostationary satellites" *by* B. Dürr et al.

B. Dürr et al.

bruno.duerr@gmail.com

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We want to thank the referee for the constructive and detailed comments on our manuscript. The following text states our replies to the specific comments of the referee. Additional references are given in the appendix of our author comments.

#1 (p1861-L5-6): We will include a reference to the summary report of Stubenrauch et al. (2012).

#2 (p1862, first paragraph): In the revised manuscript we will avoid the statement that processing raw counts is an advantage. Instead we will emphasize the fact that

the new scheme has to be independent from any auxiliary model input data. The first paragraph will be formulated as follows: "The calculation of the long-wave cloud index for HelioFTH using Heliosat principles is based on raw sensor counts instead of brightness temperature. The calculation of brightness temperature is dependent on the calibration of the MVIRI IR window channel. Despite the blackbody cavity on board the Meteosat First Generation satellites a vicarious calibration method has to be applied to obtain the calibration coefficients (Gube et al, 1996). The vicarious calibration is based on radiative transfer calculations for cloud-free pixels using atmospheric input data from numerical weather prediction (NWP) models. The restriction to cloud-free pixels shows some deficiencies for the calibration of the coldest sensor counts (Knapp, 2007). Another potential vulnerability is the dependency on satellite data from different platforms as demonstrated by Knapp (2007) for the ISCCP B1 dataset. Therefore a feasibility study is presented here which elaborates the potential to define a IR cloud mask for geostationary satellites based on Heliosat principles and a modified SPARC rating scheme without the need for auxiliary model or satellite input data." The second paragraph of p1862 with eq. (1) will be moved to section 3 and the derivation of LCI with empirical data from surface radiation measurements will be added.

#3 (p1864, section 2.1.2 and 2.1.3): We propose to change the order of sections 2.1.3 and 2.1.2. Former section 2.1.3 will be formulated as follows: "The cloud screening and cloud masking are performed using the NWC SAF MSG v2010 algorithm, which is described in more detail in Derrien and Gleau (2005). The cloud mask comprises 6 categories: Cloud filled, cloud-free, partially cloudy and non-processed, snow/ice contaminated, undefined. The cloud fractional cover is defined as the fraction of cloudy pixels per grid square compared to the total number of analyzed pixels in the grid square. Pixels are counted as cloudy if they belong to the classes cloud filled or cloud contaminated. Fractional cloud cover is expressed in percent. The cloud mask is produced in an operational environment since summer 2006. Therefore, ...(from section 2.)... A typical issue with passive IR is the detection of thin clouds with an optical thickness of approximately 0.3 or less. Some thin clouds (particularly, ice clouds) over cold ground surfaces may remain undetected even if having cloud optical thicknesses higher than the above mentioned detection limit. Even though a special twilight transition procedure has been applied, the switch from day- to night-time algorithm might lead to spurious spikes. Finally, a distinct dependency on viewing zenith angle (VZA) occurs that leads to an overestimation of cloudiness at high VZA (Kniffka et al., 2012)."

Former section 2.1.2: "ISCCP provides cloud properties over a period of more than 25 years (Rossow and Schiffer, 1991; Rossow et al., 1996; Rossow and Schiffer, 1999). This project was established in 1982 to analyze weather satellite radiance measurements (from geostationary and polar orbiting satellites) to infer the global distribution of clouds, their properties, and their diurnal, seasonal and inter-annual variations. This project and its results are considered to be the state of the art today on what can be derived from routine weather satellite data to study the role of clouds in climate. ISCCP is the first existing TCDR for cloud physical properties. The ISCCP-DX product contains a cloud mask and CTP and is available at 30 km and 3 h spatio-temporal resolution. The 3-hourly ISCCP-DX product was obtained from the EOS data server (http://eosweb.larc.nasa.gov/PRODOCS/isccp/table isccp.html) and the cloud flag was calculated according to Rossow et al. (1996, see Sect. 2.3.4). The ISCCP-DX cloud mask is based on an IR threshold test during night and a VIS (if available) or a near infrared threshold test (not available for Meteosat-7) during day. Stubenrauch et al. (2012) provides estimates on uncertainties: cloud fractional cover within 10 % and CTP within 100 hPa."

#4 (p1873-L115): We will include the references suggested by the referee: McClatchey, R. A., R. W. Fenn, J. E. A. Selby, F. E. Volz, and J. S. Garing (1971), Optical properties of the atmosphere (revised), Tech. Rep. AFCRLTR-71-0279, 354 pp., Air Force Cambridge Res. Lab., Cambridge, Mass.

#5 (p1874, eq. 26): The term “cloud-contaminated” will be replaced by “partially cloudy” throughout the text and figures.

#6 (section 4): It’s the opinion of the authors that no general conclusions can be drawn from only 1 month of satellite-intercomparison data and therefore we focused on the straight comparison of our products with CM SAF and ISCCP cloud products for this feasibility study.

#7 (section 1): We will change the third bullet on p. 1861 into: “No auxiliary input data from NWP or radiative transfer models, nor from other satellite plattforms, shall be necessary.” And the last bullet on p. 1861 will be changed into: "It is able to detect middle- and high-level clouds, that is, clouds with cloud top pressure smaller than 680 hPa." and remove the remaining part of the bullet. The following paragraph will be included after the bullet list in the introduction: "The EUMETSAT’s Satellite Application Facility on Climate Monitoring (CM SAF) in cooperation with Centre National de la Recherche Scientifique (CNRS) produced and released a long-term data record of free tropospheric humidity (FTH). The FTH retrieval is reliable under clear sky and low level cloud conditions, that is, in presence of clouds with cloud top pressure larger than approximately 680 hPa. In a future release the FTH product shall be based on minimum temporal and spatial resolutions of 1 h and 0.25°, respectively. This goes beyond the specifications of currently available cloud mask data records. Therefore, CM SAF initiated this development and intends to utilize the results".

#7 (section 5): We will include a new section 5 called “Future plans”, which includes the following paragraph: “CM SAF products and their documentations, in particular the validation report are subject to external reviews. The validation report will include a section on assumptions and limitations. Here, based on the full METEOSAT FTH record problematic areas/periods will be discussed, together with recommendations on utilization.” Another plan concerns the distinction between vertically elongated and stratiform clouds in the modified SPARC scheme for the retrieval of the long-wave cloud index: “The current formulation of the long-wave cloud index obviously overestimates LCI values for stratiform and single-layer middle- and high-level clouds such as alto- or cirrostratus. A future version of the modified SPARC algorithm shall be able to separate scenes with single-layer stratiform clouds to some extent." Another future plan concerns the potential to retrieve the atmospheric infrared emission at the surface: "In analogy to the Heliosat method the retrieval of the surface downward long-wave (SDL) radiation and of the long-wave cloud effect (Philipona and Dürr, 2004) shall be investigated based on LCI and surface measurements or long-term reanalysis data of 2 meter air temperature and relative humidity."

#8 (Table 6-7): We will check this idea and possibly include such a map in the revised manuscript.

#9 (Figures 1-3): Variability will be indicated in the figures 1 – 3 in the revised manuscript.

#10 (Figures 4-5): The continental outlines will be thickened in the revised manuscript.

#11 (Figures 2-5): Font size will be increased in the revised manuscript.

All suggested technical corrections will be included in the revised manuscript, too.

References: Kniffka, A., J. F. Meirink, M. Stengel, 2012: Product User Manual - SEVIRI dataset cloud products edition 1. Reference Number: SAF/CM/DWD/PUM/SEV/CLD, issue: 1.0, date: 30.09.2012.

Philipona, R., and B. Dürr, 2004: Greenhouse forcing outweighs decreasing solar radiation driving rapid temperature rise over land, Geophys. Res. Lett., 31, L22208, doi:10.1029/2004GL020937.

Rossow, William B., Robert A. Schiffer, 1991: ISCCP Cloud Data Products. Bull. Amer. Meteor. Soc., 72, 2–20. doi: http://dx.doi.org/10.1175/1520-0477(1991)072<0002:ICDP>2.0.CO;2

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Rossow, William B., Robert A. Schiffer, 1999: Advances in Understanding Clouds from ISCCP. Bull. Amer. Meteor. Soc., 80, 2261–2287. doi: http://dx.doi.org/10.1175/1520-0477(1999)080<2261:AIUCFI>2.0.CO;2

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Interactive comment on Atmos. Meas. Tech. Discuss., 6, 1859, 2013.