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Composite TOA clearsky solar fluxes for the GERB processing

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The estimation of the top-of-the-atmosphere (TOA) composite clearsky fluxes is crucial in climate research. Indeed, such quantities serve as diagnostic variables to assess the accuracy of General Circulation Models (GCMs). They can also, once inverted, provide the surface albedos which in turns can be ingested in GCMs or monitored for changes. Moreover, they allow to estimate the cloud radiative forcing as well as its variations when considering decadal time-series. This has drawn the need to generate a dedicated TOA clearsky flux product within the Geostationary Earth Radiation Budget (GERB) experiment.

The majority of techniques found in the literature to infer the solar clearsky fluxes at a given repeat cycle considers the average of the fluxes associated to clearsky conditions over some time period. A refinement of this approach consists to substitute the averaging process by a spline fit. Similarly, other methods operates on a shorter time period but increases the sampling to the complete diurnal cycle. Binning of these clearsky samples according to the time allows to fit a spline, half-sine or even a more complex modeled curve. However, these techniques suffers from major drawbacks. First, the averaging does not take into account of the variability of the clearsky fluxes with the solar zenith angle over the time period. Then, abovementioned curve fitting exclusively relies on theoretical models and not on measurements.

In this paper, we propose a new method to estimate solar clearsky fluxes for the GERB processing without such drawbacks. It considers solar fluxes at a given repeat cycle and location over some time period. To maximize the number of clearsky events within the GERB product footprints, it uses the High Resolution GERB L20 solar flux products as input. Moreover, the time period is dynamically chosen to enclose a fixed number of clearsky conditions according to the scene identification provided in the products. It results that each footprint can be associated to a time–series of fluxes. Since the clearsky fluxes are varying with the solar zenith angles over this time period, the clearsky Clouds and the Earth's Radiant Energy System (CERES) shortwave broadband angular dependency models (ADMs) are used to model this variability. Composite clearsky fluxes can then be derived for cloudy conditions over the time period based on such knowledge of their angular variations. Preliminary results are given together with a sensitivity study of the considered parameters.