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Geostationary or not: can we consider Meteosat-8 viewing geometries as stationary?

Benoît Tournadre, Xuemei Chen, Benoît Gschwind, and Philippe Blanc

The imagery from geostationary meteorological satellites (GEO) is broadly used to produce various datasets describing the Earth's surface and atmosphere, or else energy fluxes. Some GEOs are not on a strictly geostationary orbit, with an inclination relatively to the equatorial plane that can reach several degrees. A striking example is Meteosat-8: due to operation constraints, its orbit is currently oscillating on a daily basis between latitudes circa 7° N and 7° S. A consequence is that the actual viewing geometry differs from the simple calculation based on the stationary nominal subsatellite position. In the case of Meteosat-8, the viewing zenith angles can differ up to ±7°.

We study how these differences of viewing angles can influence top-of-atmosphere (TOA) reflectance of Earth scenes. To achieve this, we simulate both clear-sky (i.e. cloudless) and overcast TOA reflectances corresponding to nominal and non-stationary viewing geometries of Meteosat-8 for the 0.6 µm channel during the period 2017-2018. Simulations are performed using the 1-D radiative transfer model DISORT within the libRadtran software package. They consider notably the anisotropy of surface reflectance which is modeled by the RossTick-LiSparse model of bidirectional reflectance distribution function and associated parameters of the product MCD43C1v6 derived from the imagery of the Moderate Resolution Imaging Spectroradiometer (MODIS). Overcast TOA reflectances are modeled with a plane-parallel thick liquid cloud.

In this presentation, we will describe how errors on TOA reflectances due to erroneous viewing geometry are distributed on the Meteosat-8 field of view and for different solar geometries. Both for clear-sky and overcast conditions, typical absolute errors range between 0.01 and 0.05, but can reach much higher values for specific geometries, notably close to the forward scattering direction.