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Simulating clear-sky reflectance of the Earth as seen by spaceborne optical imaging systems with a radiative transfer model

Benoît Tournadre (1), Benoît Gschwind (1), Claire Thomas (2), Laurent Saboret (2), and Philippe Blanc (1)

(1) MINES ParisTech, PSL Research University, O.I.E. - Centre Observation, Impacts, Energy, 06904 Sophia Antipolis, France, (2) Transvalor, Parc de Haute Technologie, 694 Av. du Doc. Maurice Donat, 06255 Mougins

Acquisition of reflectance of the Earth by spaceborne optical imaging system in the visible spectral domain is useful for many applications, notably dedicated to environment, climate and ocean.
Accurate concomitant simulations of clear-sky (i.e. cloudless) top-of-atmosphere (TOA) reflectance of the Earth as seen by such observation systems can help notably to discriminate the effects of clouds on downwelling surface solar radiation (DSSR, also referred as surface solar irradiance (SSI)) from those induced by e.g. water vapour or aerosols. This is of primary importance in the framework of our development of a new Heliosat method meant to estimate DSSR from images acquired by spaceborne optical imaging systems.
Hence, we present a new method simulating TOA clear-sky reflectances using the discrete ordinate DISORT radiative transfer algorithm, available within the libRadtran software package. The anisotropy of the ground reflectance is taken into account by using the RossThick-LiSparse model of bidirectional reflectance distribution function (BRDF). This BRDF model is here fed by parameters derived from the imagery produced by the spaceborne Moderate Resolution Imaging Spectroradiometer (MODIS) instrument and provided by the MODIS product MCD43A1 v6. The optical state of the clear atmosphere is constrained by Copernicus Atmosphere Monitoring Service (CAMS) products of ozone, water vapour total columns and aerosol optical depth forecasts and analyses. For the sake of computation time, the spectral approximation developed by [Kato et al. 1999] is used while initially developed for surface irradiance products. The validation of our method is also presented for several snow-free land locations by comparing the simulated reflectances with different spaceborne optical imaging systems with different types of orbits and different spectral bands (MSG/SEVIRI, DSCOVR/EPIC, Terra/MODIS).