Solar irradiances discussion

Pieter De Vis, Adam Howes, Nigel Fox

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Modelling methodology

- Using in-house (NPL) python tool that wraps various RT codes such as Libradtran & 6S (RTTOV and Eradiate under development), with consistent inputs and outputs

- Allows to specify extra-terrestrial solar irradiance models

- Atmospheric properties from AERONET and/or ERA5+CAMS reanalysis datasets, surface reflectances from HYPERNETS

- Matheo (https://matheo.readthedocs.io/en/latest/) python package used for convolution with spectral response function of sensors (building on pyspectral)

Solar spectra considered

- Thuillier et al (2003)
  - Previous CEOS recommended spectrum
  - based on the space-based measurements of the solar irradiance obtained from ATLAS & EURECA missions
  - Used in L1B processing of Sentinel-2, Sentinel-3, ENMAP, MERIS, NOAA-20 VIIRS, ...
  - mean absolute uncertainty of 2 to 3%
  - Downloaded from https://oceancolor.gsfc.nasa.gov/docs/rsr/f0.txt

- Coddington et al (2021) – TSIS-1 HSRS (v2)
  - current CEOS recommended spectrum (since March 2022)
  - Developed by applying a modified spectral ratio method to normalize very high spectral resolution solar line data to the absolute irradiance scale of the TSIS-1 Spectral Irradiance Monitor (SIM) and the CubeSat Compact SIM
  - Uncertainty is 0.5% from 0.4 to 0.46 µm, 0.3% from 0.46 to 2.365 µm, and 1.3% below 400 nm and above 2365 nm.
  - Downloaded from https://lasp.colorado.edu/lisird/data/tsis1_hsrs_p1nm

Solar irradiance differences

Bhatt et al. 2021
https://doi.org/10.3390/rs13081438
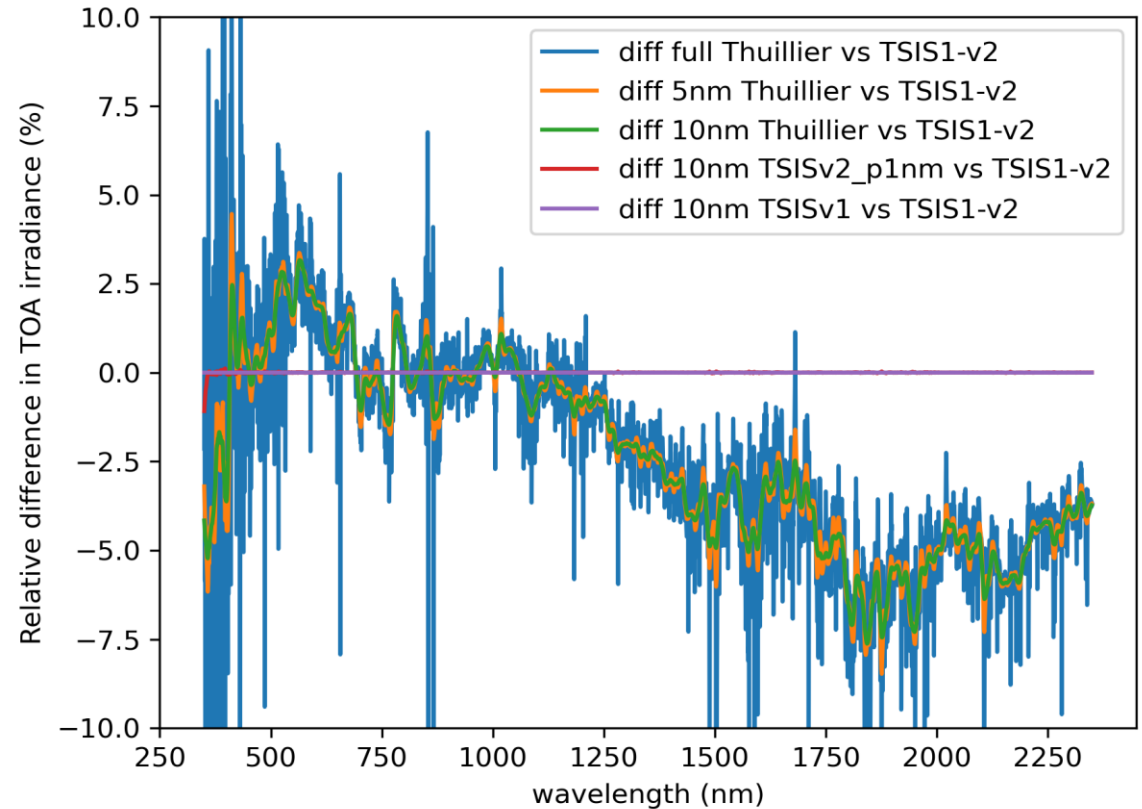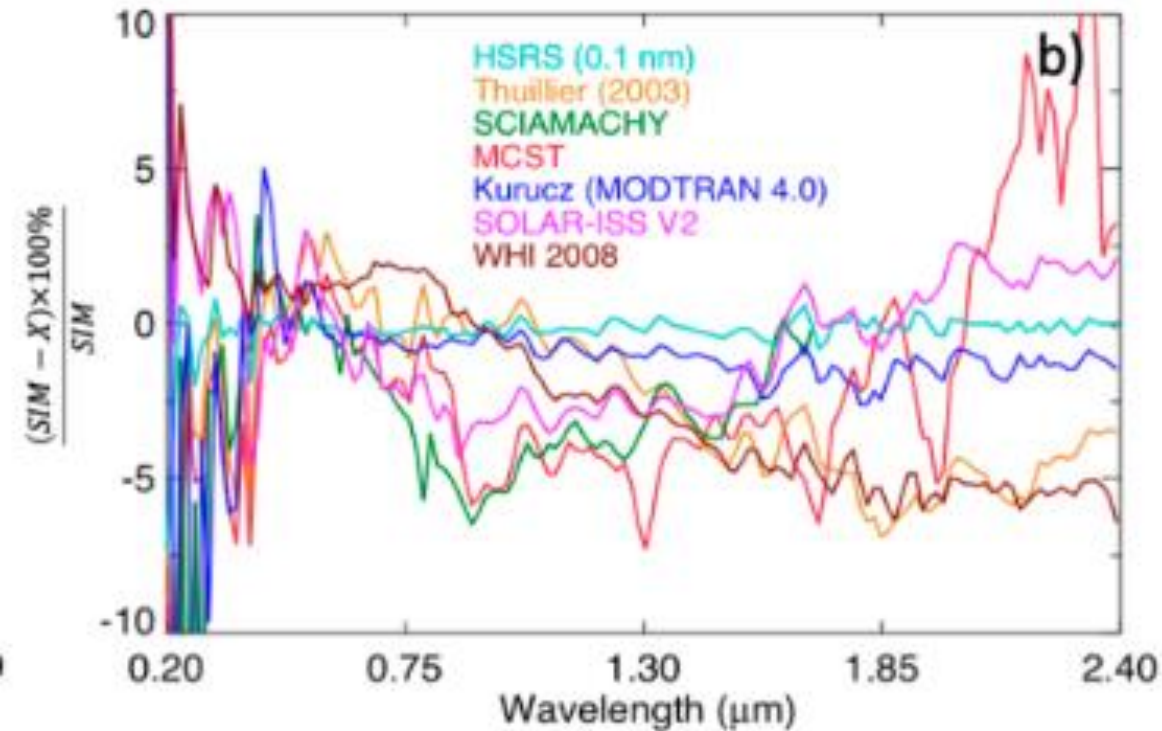
Satellites calibrated using reflectance panel

- Satellites such as Sentinel-2, Sentinel-3, MERIS, … are calibrated using reflectance panel, and use Thuillier et al 2003 spectrum to obtain calibrated radiance.

- TSIS is the CEOS-recommended solar irradiance spectrum

- When using radiances from such sensors, a correction can be applied in order to be consistent with TSIS

- (Note e.g. Landsat-8/9 are calibrated separately in radiance and reflectance, and thus don't use a model solar irradiance spectrum)

- Significant errors can be introduced in L2 products if a different solar irradiance model is used in the L2 processing than in the derivation of the L1C radiance estimation.

De Los Reyes et al. 2022 - https://doi.org/10.3390/rs14174237

Observed TOA radiance differences for different sensors