TROPOMI Ca II Index README Document

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This file gives a basic description of the solar proxy index data that we have produced from Sentinel-5P TROPOMI solar measurements. The measurements from all cross-track swaths are combined into a single high (up to 10^4) signal-to-noise daily average irradiance product, where each contributing spectrum is acquired at a slightly different and systematically shifted wavelength grid. This method yields a highly over-sampled daily spectrum that allows us to optimize the choice of spectral samples and efficiently screen deviating measurements. We employ the latest v.2.01 TROPOMI irradiances (available at [1] and [2]). We construct spectral line indices as a ratio of line-core flux to the average line-wing flux, using the relationship

$$\text{Index} = 0.5*\text{Flux(Center)}/[\text{Flux(Left)}+\text{Flux(Right)}]$$

consistent with the traditional approach (*Heath and Schlesinger*, 1986). The line-core spectral range is centered on the line minimum (393.35-393.55 nm for Ca II K, and 396.80-397.00 nm for Ca II H), and the line-wing ranges sample the least line-contaminated areas adjacent to a given transition (391.49-391.53 nm, and 395.00-395.20 nm for Ca II K; 395.00-395.20 nm, and 398.20-398.50 nm for Ca II H). The fluxes coming from the oversampled daily average spectrum are wavelength-binned at 0.02 nm step. In each spectral bin, the assembled fluxes (typically, 30-40 values) are clipped to eliminate 3-σ outliers, weighted, then averaged. The weights are chosen to be inversely proportional to the distance of the individual flux sample from the center of a spectral bin.

The first measurement date in the proxy index data file 'tropomi_caii_index_20240323.txt' is 30 April 2018, and the last measurement date is 14 March 2024. The standard TROPOMI solar observation cadence is once every 15 orbits, which causes selected calendar days to have no observation. We therefore include the measurement time of each observation to properly capture the regular nature of TROPOMI sampling. There are 9 columns in the data file with the following contents.

Column 1: Julian date of measurement
Column 2: Year of measurement
Column 3: Month of measurement
Column 4: Day of measurement
Column 5: Hour of measurement [UT]
Column 6: Minute of measurement [UT]
Column 7: Second of measurement [UT]
Column 8: Daily average Ca II K proxy index (393.4 nm)
Column 9: Daily average Ca II H proxy index (396.8 nm)

NOTE: The Ca II K and Ca II H index values have been adjusted to the scale of the National Solar observatory ISS 1 Å bandpass data sets.

References

[1] TROPOMI irradiance (Ludewig et al. 2020): https://dataspace.copernicus.eu/

[2] TROPOMI irradiance:
https://disc.gsfc.nasa.gov/datasets/S5P_L1B_IR_UVN_2/summary?keywords=TROPOMI

Heath, D. F., and B. M. Schlesinger (1986). The Mg 280-nm doublet as a monitor of changes in solar ultraviolet irradiance. *J. Geophys. Res*., *91*, 8672-8682.

Ludewig, A., Q. Kliepool, R. Bartstra, *et al*. (2020). In-flight calibration results of the TROPOMI payload on board the Sentinel-5 Precursor satellite. *Atmos. Meas. Tech*., *13*, 3561-3580, https://doi.org/10.5194/amt-13-3561-2020.