TROPOMI UVN status

OCO-TROPOMI-GOSAT Calibration Team Meeting #14

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Tropomi calibration status

1. In-flight calibration using LED in ICU: monitoring electronic gain drift
   - Corrected for, in hindsight, by bi-yearly CKD updates (‘temporal CKDs’)

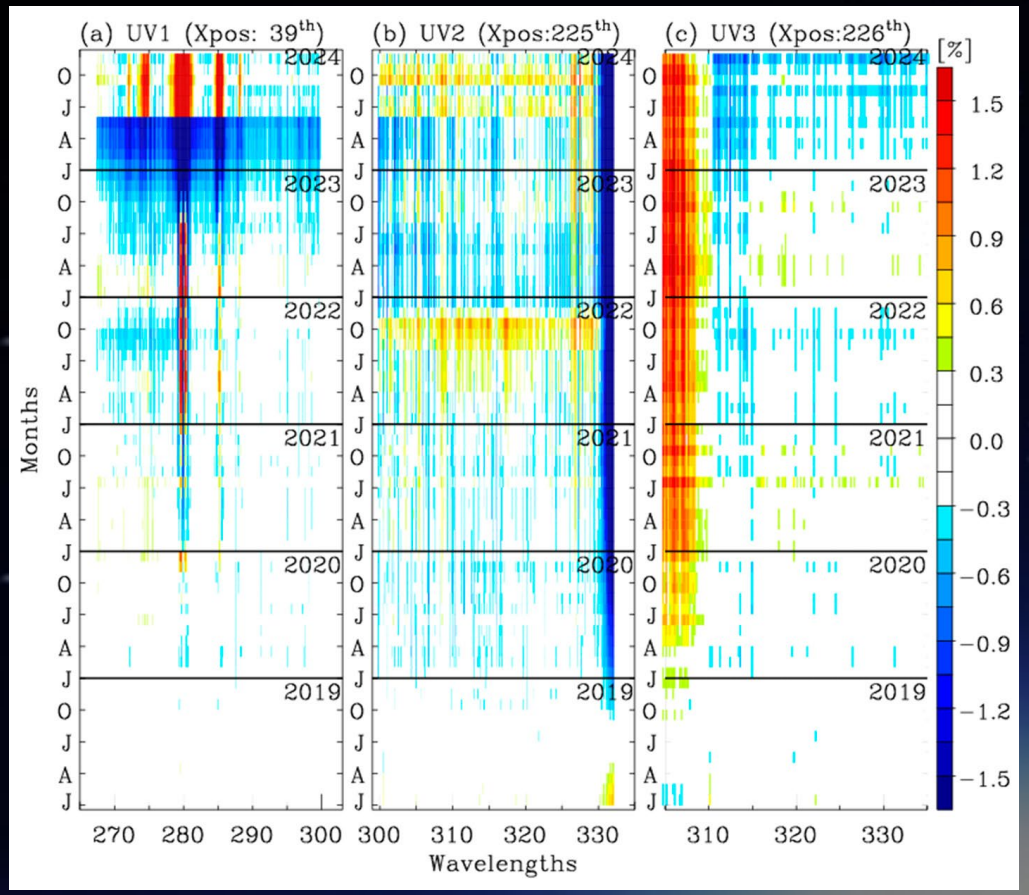
2. In-flight calibration using solar port measurements: to assess optical degradation
   - Corrected for, in hindsight, by bi-yearly CKD updates (‘temporal CKDs’)

3. L1B Processor update will be released in October 2025 with four changes:
   1. UV dynamic straylight correction based on shielded detector rows (instantaneous information)
   2. UV straylight convolution kernel based on reassessment of on-ground measurements (static CKD)
   3. UV-UVIS-NIR residual background correction based on dark IF measurements (temporal CKDs)
   4. UVIS detector ‘scratch’ correction (temporal CKD)

   → Two new L1b Processor correction algorithms; 4 (was 2) temporal CKDs; and a dynamic non-local correction algorithm (usual caveat on robustness…)

   → Complete L1 reprocessing envisaged for Q2 2026

On reprocessing…

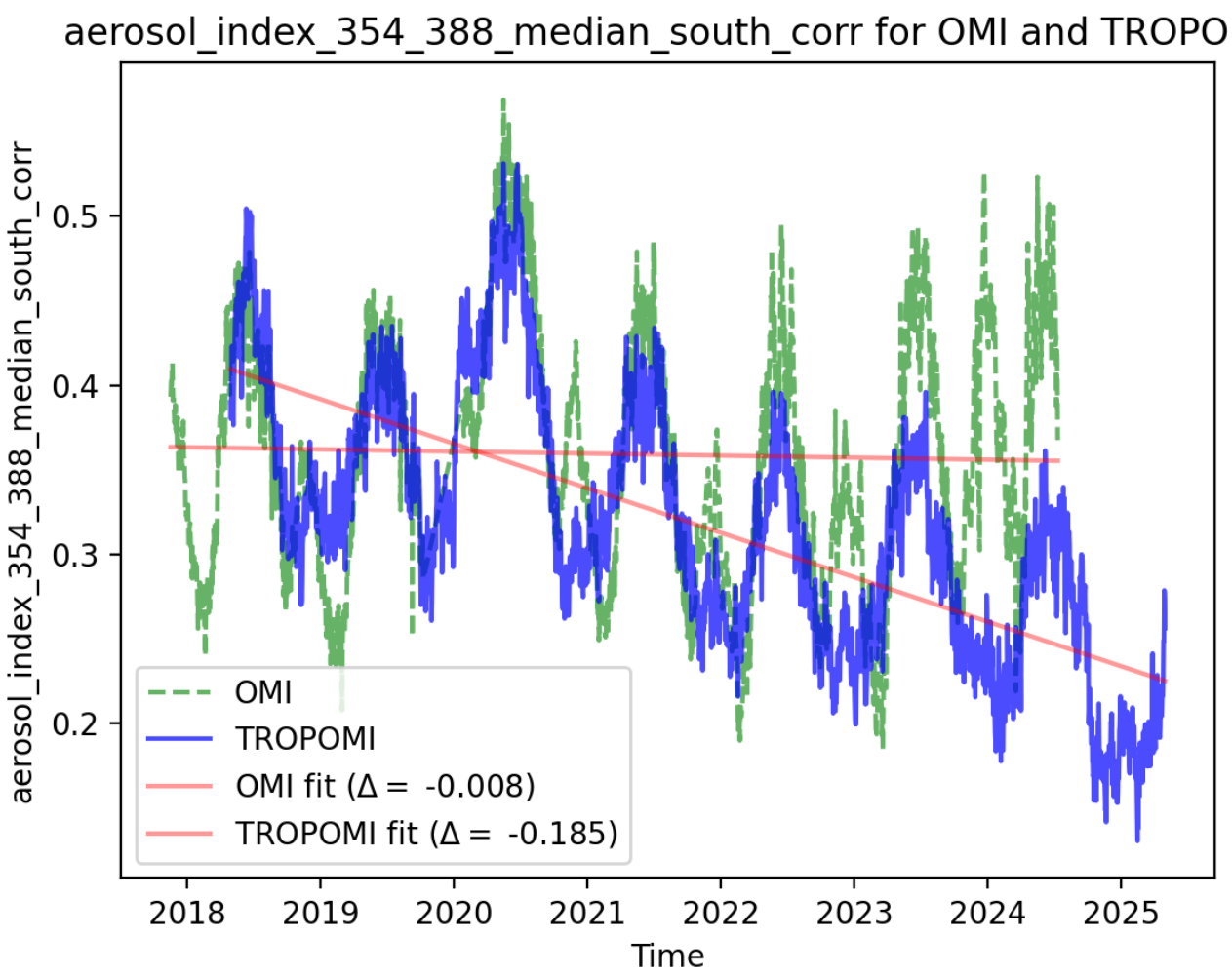


Temporal changes in monthly TROPOMI irradiances.
From:" An Extension of Ozone Profile Retrievals from TROPOMI Based on the SAO2024 Algorithm", Juseon Bak et al

Note: Latest complete reprocessing in Q2 2022;

minor temporal CKD updates in Nov 2022, July 2023, June 2024…

Thoughts and questions: AI



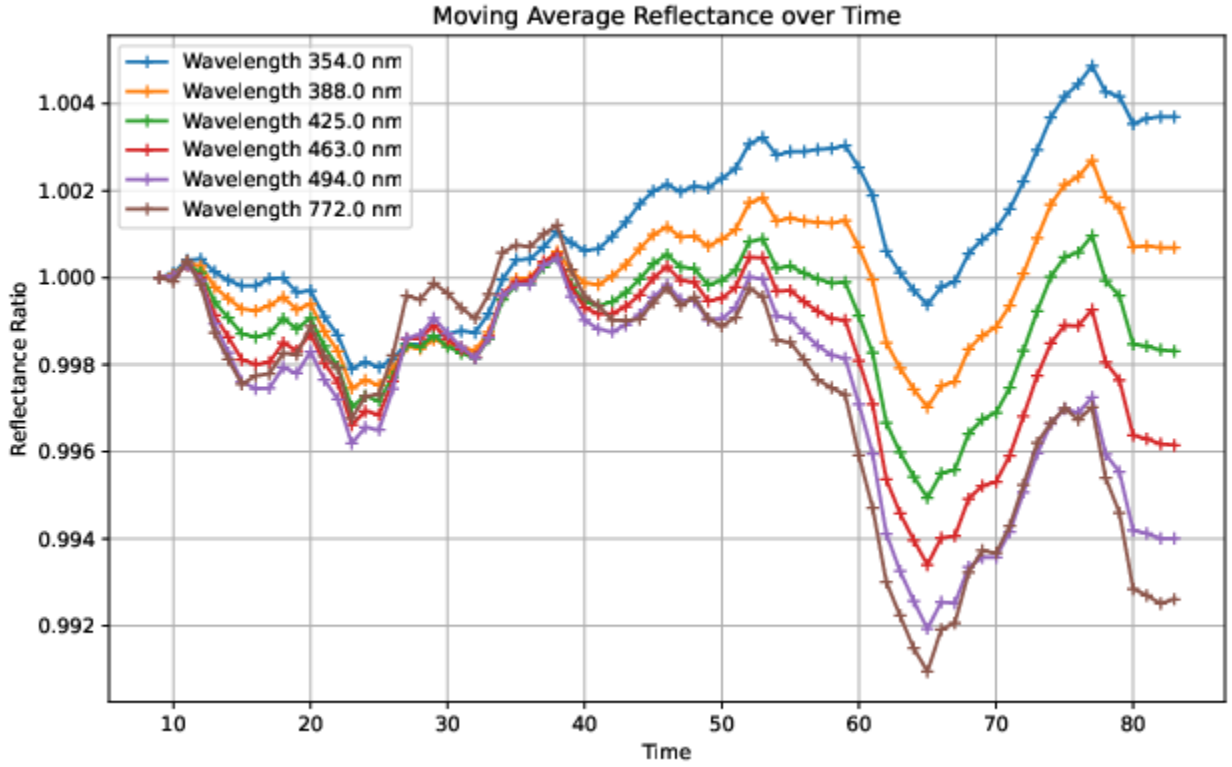
Aerosol index algorithm: straightforward, reflectance ratio of two wavelengths (here: 354, 388 nm)

Sensitivity? Note: Tropomi B3 shows strong degradation. This is of course corrected for… well enough?

Does TROPOMI, because of the small ground pixels, see too much details wrt OMI, thereby challenging Lambertian assumptions?

(After reprocessing next year, we might see yet other differences!)

Thoughts and questions: Reflectances



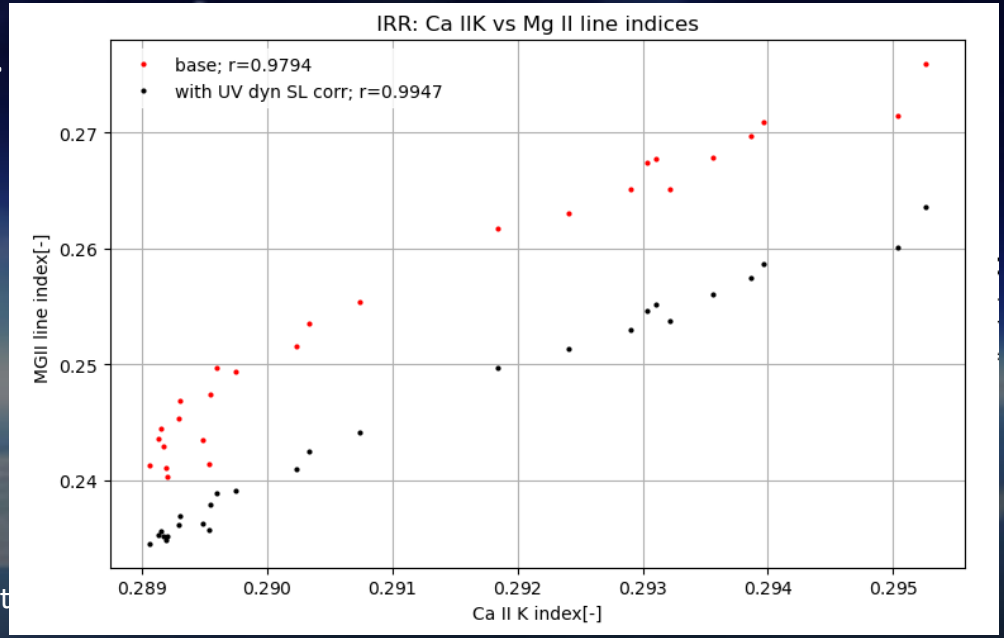
Monthly global reflectances (months after 2018.01)

all regions, all scanlines , not cloud-filtered
The overall shape of the timeseries is determined by El Nino / Southern Oscillation.

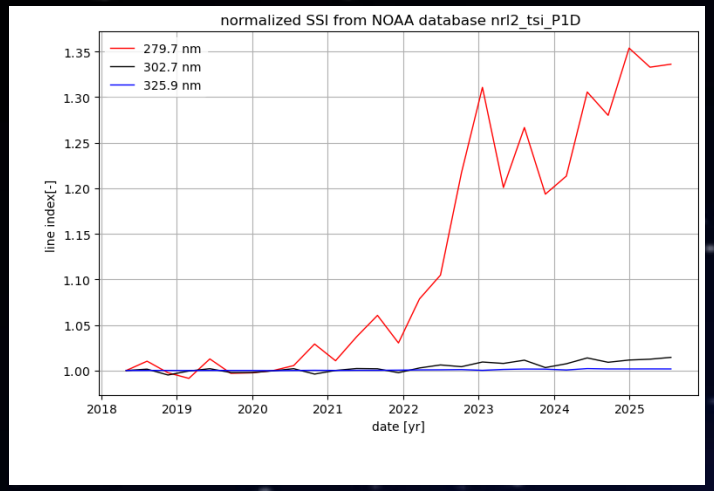
Causes of deviations? Not related to processor updates…

Thoughts and questions: on additive errors

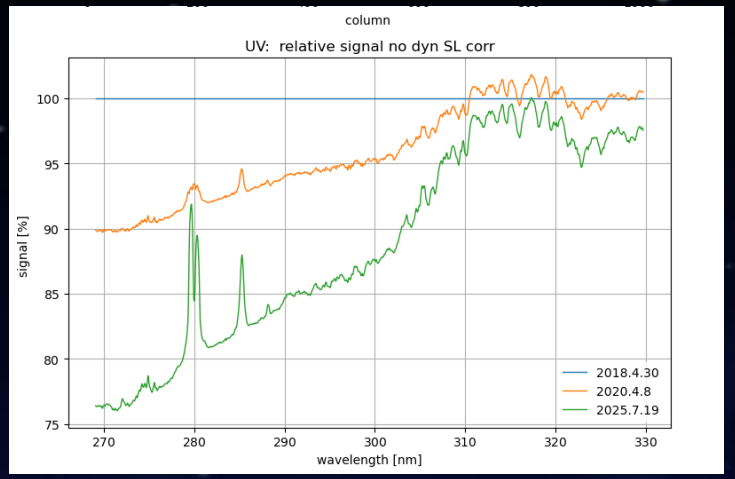
- Improperly corrected additive signal errors:
  - Background (dark current, thermal background)
  - Straylight
- (task 1:) All additive terms must perfectly be corrected OG/first orbit…
- (task 2:) … and remain so, despite IF-growth of these terms
- Remark: background signal can be sampled in-flight using dark msmts in same orbit (‘residual’, last resort). Hence Tropomi processor adjustment.
- Remark: if straylight increases in-flight, reliable monitoring is needed. Hence Tropomi dynamic straylight processor adjustment, but only in UV
- Ultimate check for perfect correction, e.g. RAD vs IRR FL line indices
- Metrics for not-perfect correction? →



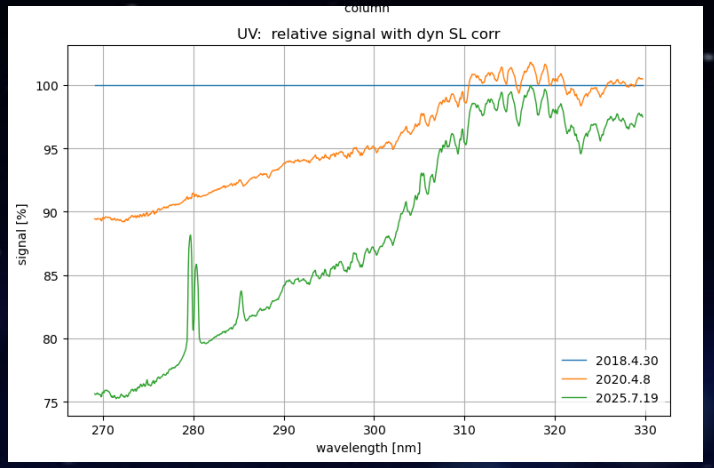
Disentangle straylight and solar activity



Best available TSI time series (Lisird NNLTSI1), projected on TROPOMI times/wavelengths. ‘Take-off’ Q3 2020

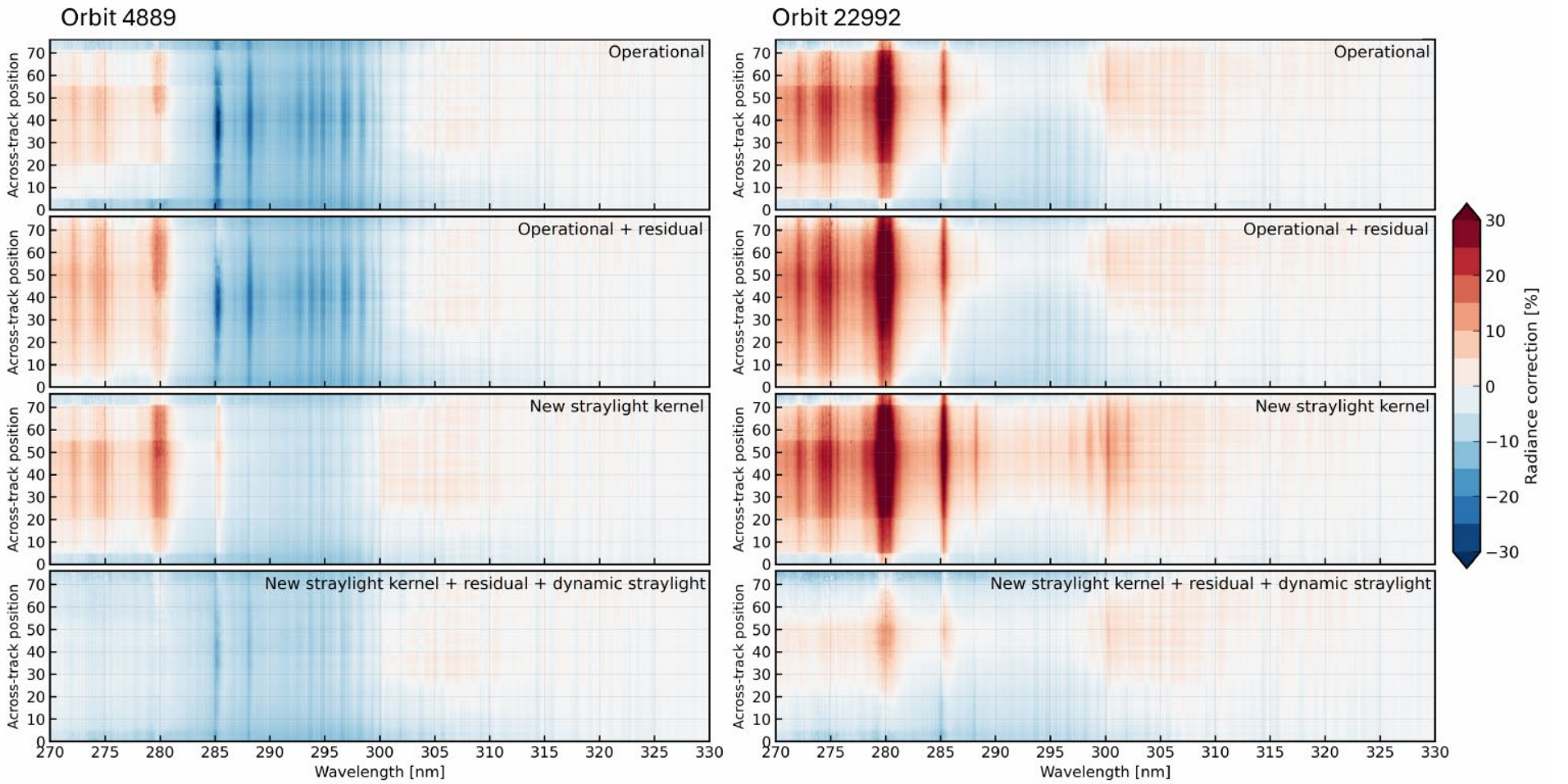


Old L1b Processor: no dynamic straylight correction. Orange line (2020): single peak due to additive straylight term



New L1b Processor: with dynamic straylight correction. At least additive straylight seems to have been removed, double solar peak remains (green line, 2025)

Results: soft calibration ozone profile retrieval algorithm



("Characterization of the TROPOMI UV radiometric calibration for the operational Ozone Profile retrieval algorithm", Di Pede et al, in prep.)

Resume

- Regular CKD updates
  - Changes to time dependent key data only: UVN gain drifts, degradation
- New L1b processor release (autumn 2025) with
  - *Dynamic* UV straylight correction algorithm
  - Improved (*static*) UV straylight convolution kernel CKD
  - UVN Residual correction (temporal CKD)
  - Correction for UVIS sharp detector feature (temporal CKD)
- Ongoing analysis and investigations:
  - Straylight in UVIS. Straylight in NIR (including OOB)
  - Solar line indices. Comparison with other instruments / time series (Bremen MgII etc). Ca II K seems OK, Mg II really needs the UV SL dynamic corrections
  - Aerosol index long-time trends and validation of degradation components in UVIS