

Royal Netherlands
Meteorological Institute
*Ministry of Infrastructure
and Water Management*

Results of the Operational TROPOMI Ozone Profile

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20221012T113408 UTC

- Implemented into S5P Payload Data Ground Segment (PDGS) in November 2021
- Processor NL-L2 v2.3.1 since November 16 (OFFL) and 24 (NRTI), 2021, from L1B v2.0.0
- Processor NL-L2 v2.4.0 since July 17 (OFFL) and 20 (NRTI), 2022, from L1B v2.1.0
- QA-value threshold update on Sept. 8, 2022

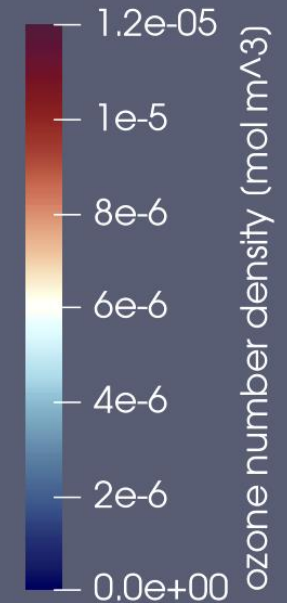
Pressure Level (-)

- O₃ profile is retrieved from Band 1&2 of TROPOMI using optimal estimation
- Significant pre-processing is required, including time dependent soft calibration

Along Track Index (-)

Pressure Level (-)

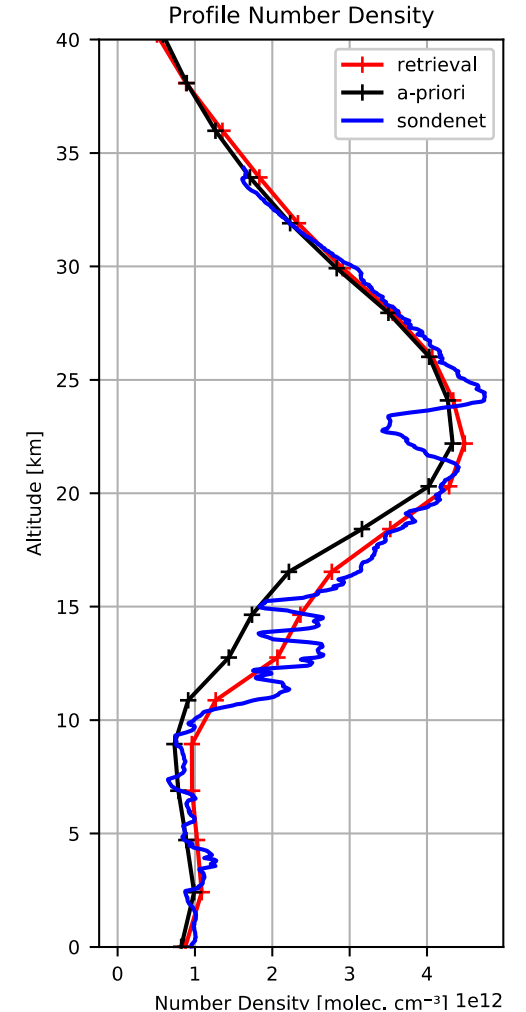
Across Track Index (-)





O₃ Profile Product Main Characteristics

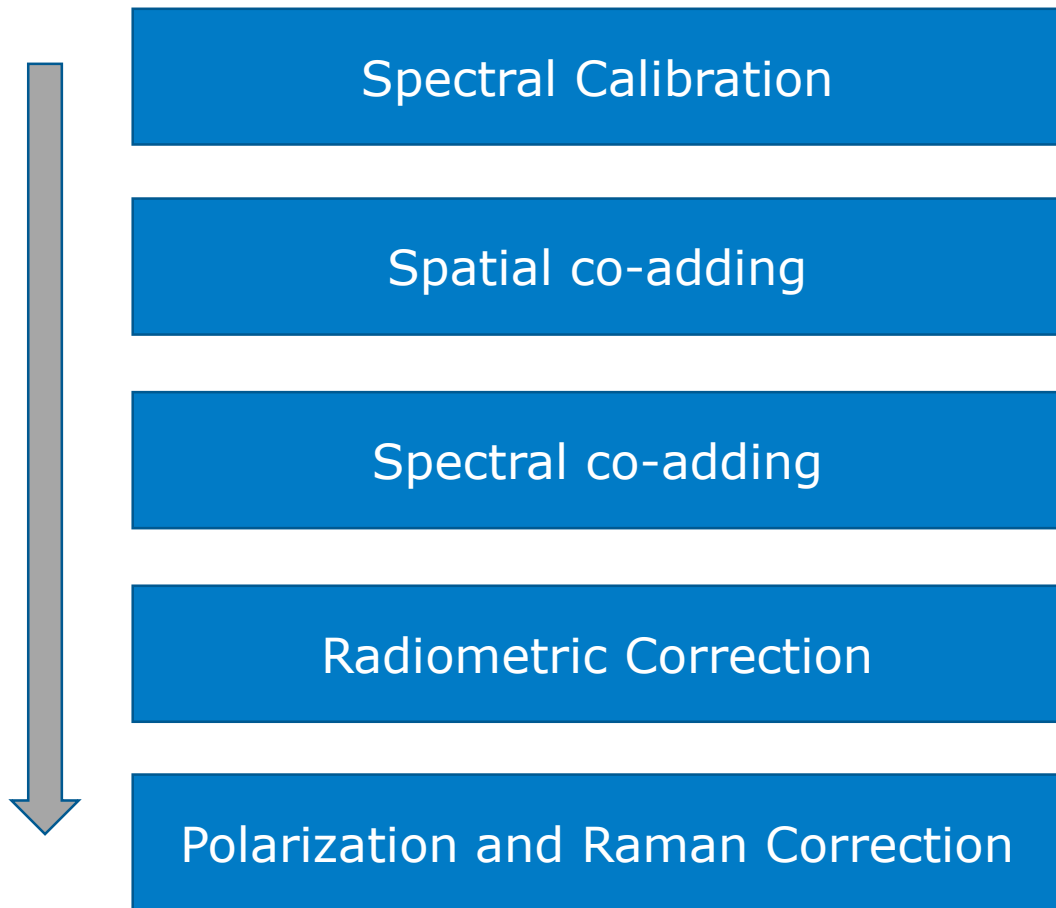
- › O₃ number density at 33 levels
 - Approximately 5-6 independent pieces of information on O₃
 - A priori, noise and smoothing errors
 - Averaging kernel
 - 77 across track ground pixels
- › Column density for 6 sub-columns.
 - 0-6, 6-12, 12-18, 18-24, 24-32, 32-TOA km
- › Total and tropospheric column density (WMO T-definition)
- › Detailed diagnostics including fit results for other state vector elements.



Example of a retrieved ozone profile from TROPOMI (red line) over De Bilt, The Netherlands on 8 August 2019. Also shown are the a priori profile (black) and the co-located balloon sounding (blue). Note that the vertical resolution of the retrieved profile is much lower compared to the balloon sounding.



Pre-Processing Steps



Spectral calibration derives shift based on the irradiance, shift also applied to the radiance.

Co-add Band-2 ground pixels to match Band-1.
Co-add 5 scanlines.
Nadir spatial sampling 28x28 km².

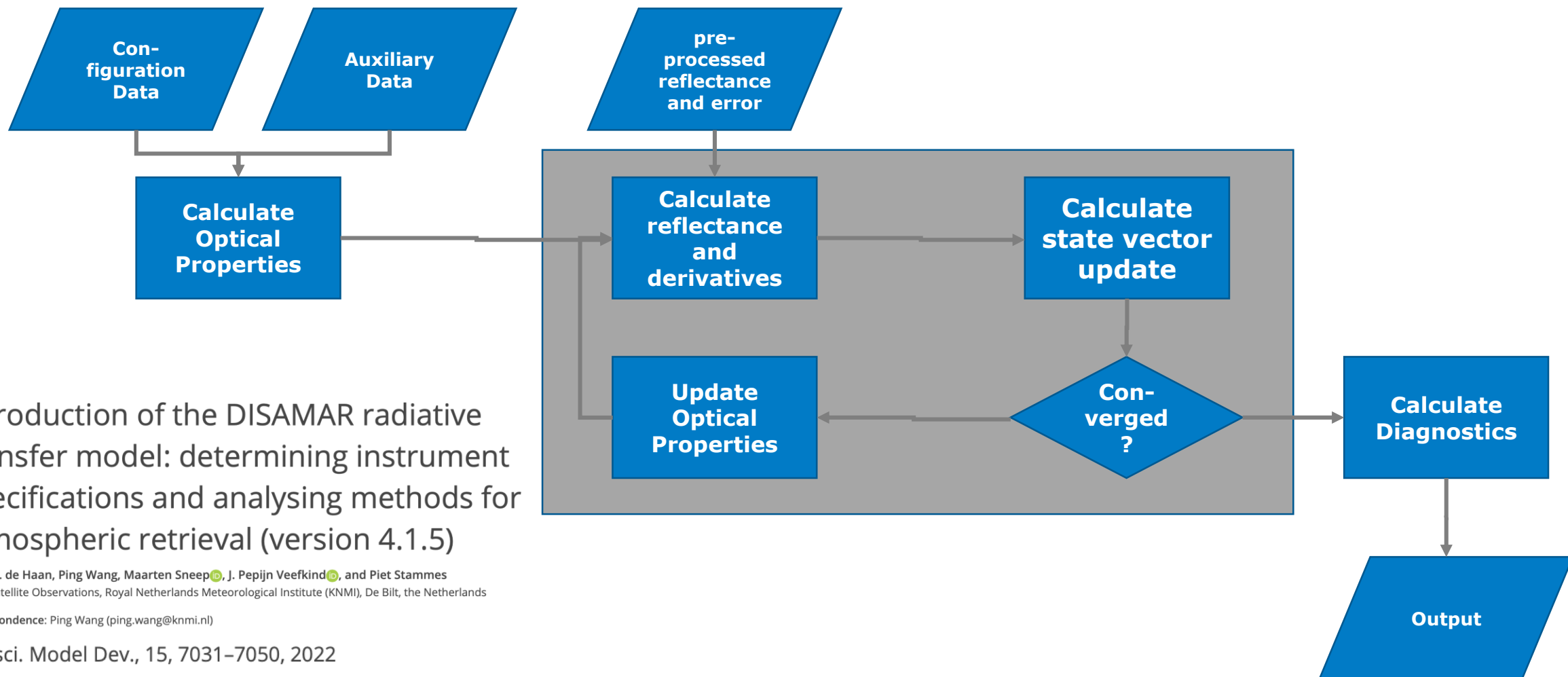
Co-add 3 spectral pixels reducing the spectral oversampling ratio to >2.3.

Apply correction to the radiance data, based on soft-calibration.

Correction for polarisation and Raman scattering, to allow for simplified radiative transfer.



Optimal Estimation Retrieval



Introduction of the DISAMAR radiative transfer model: determining instrument specifications and analysing methods for atmospheric retrieval (version 4.1.5)

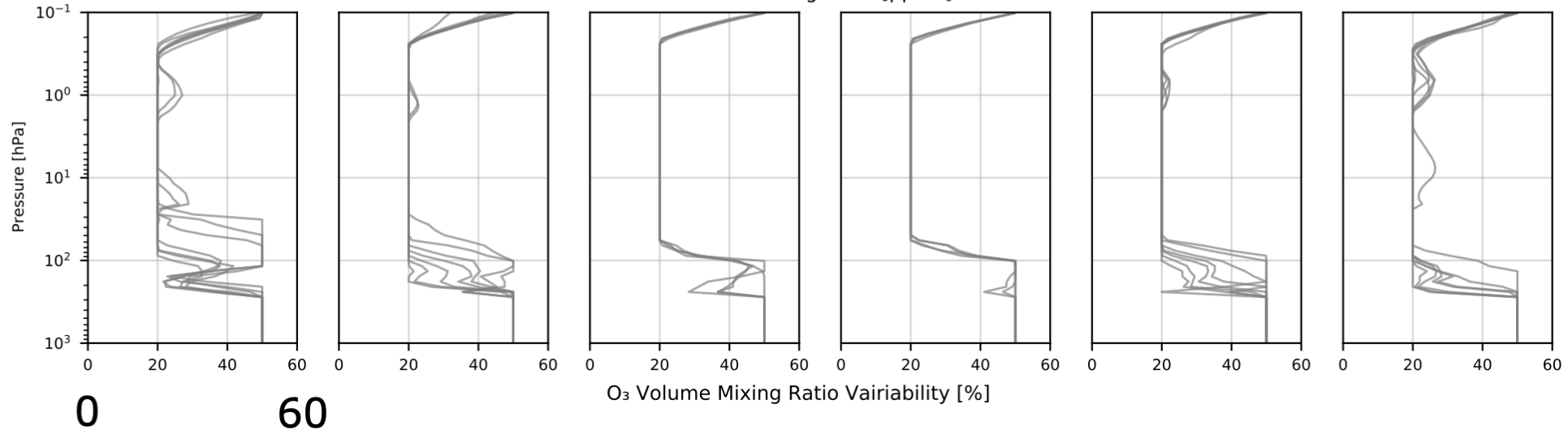
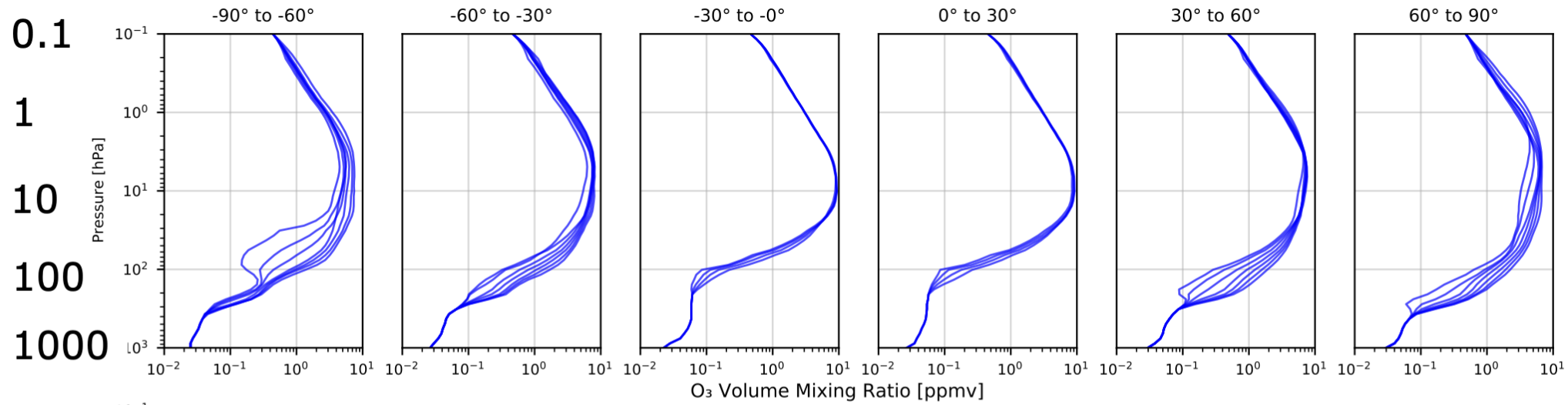
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R & D Satellite Observations, Royal Netherlands Meteorological Institute (KNMI), De Bilt, the Netherlands

Correspondence: Ping Wang (ping.wang@knmi.nl)

Geosci. Model Dev., 15, 7031–7050, 2022
<https://doi.org/10.5194/gmd-15-7031-2022>

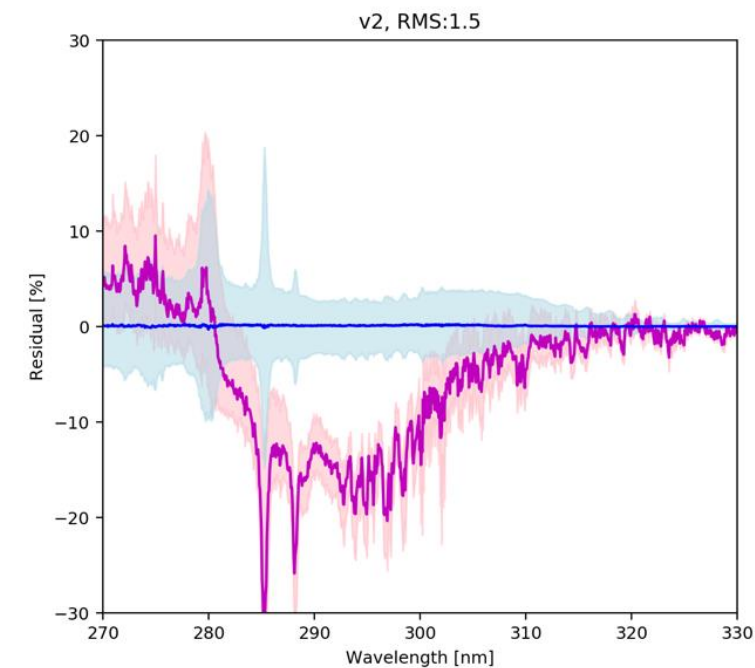
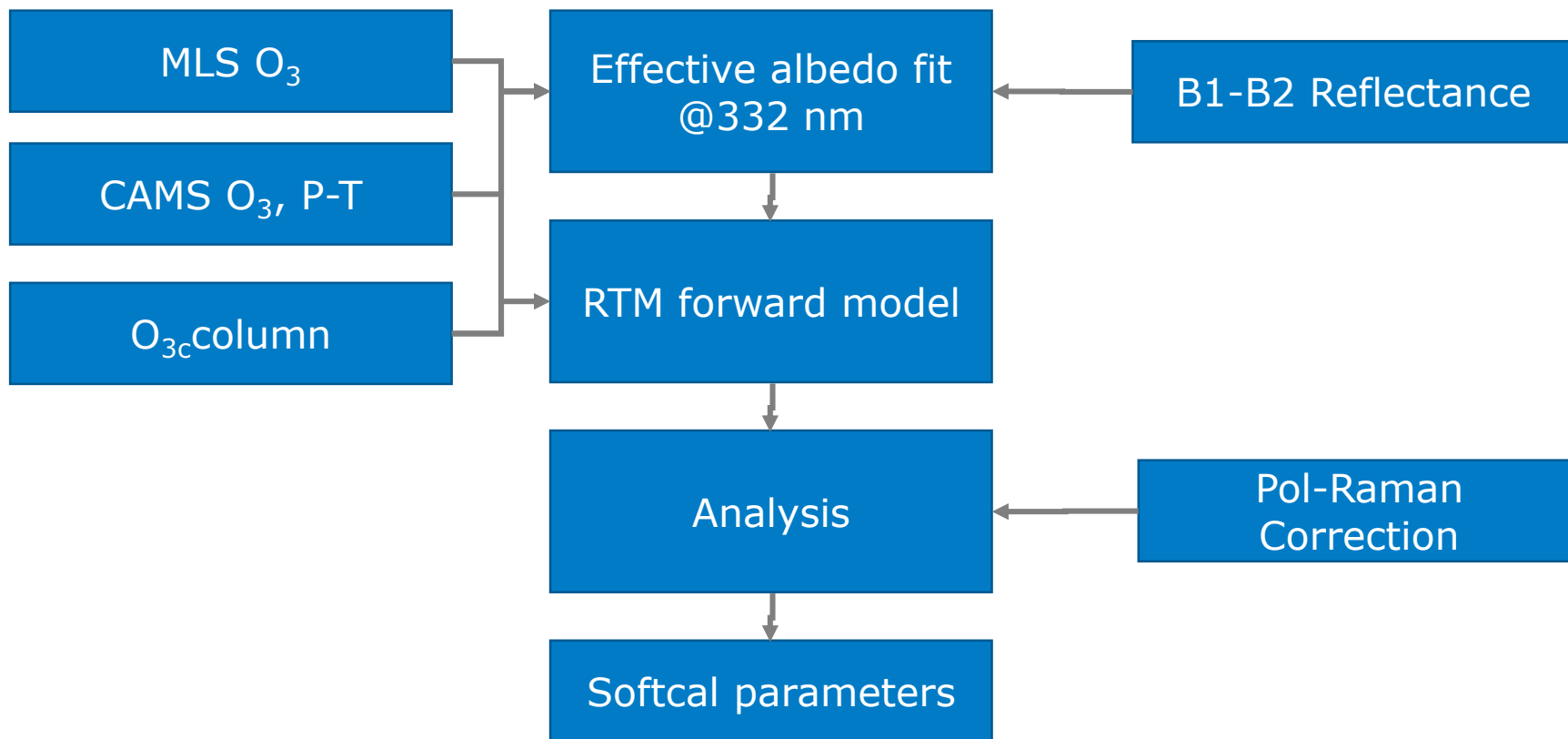


A Priori Ozone Profile Climatology





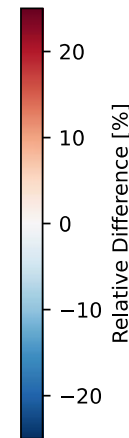
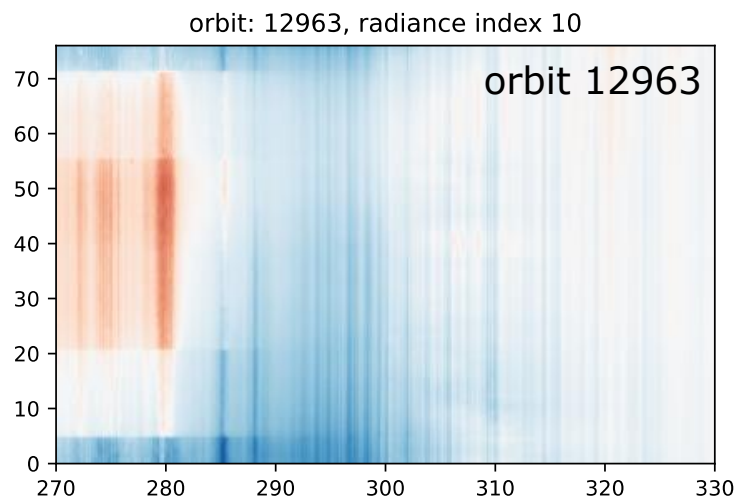
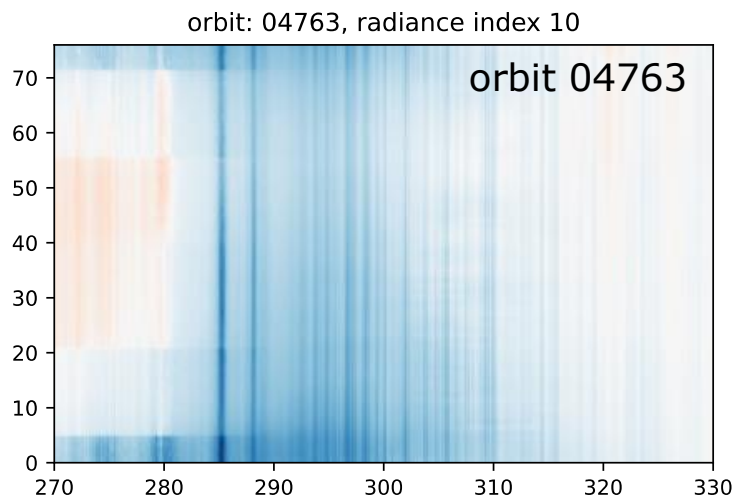
Soft Calibration Approach



Relative radiance residuals for ground pixel number 35 without correction (magenta) and after PWL version 2 correction.



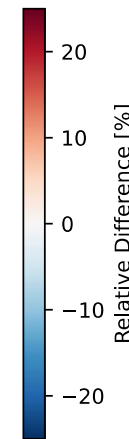
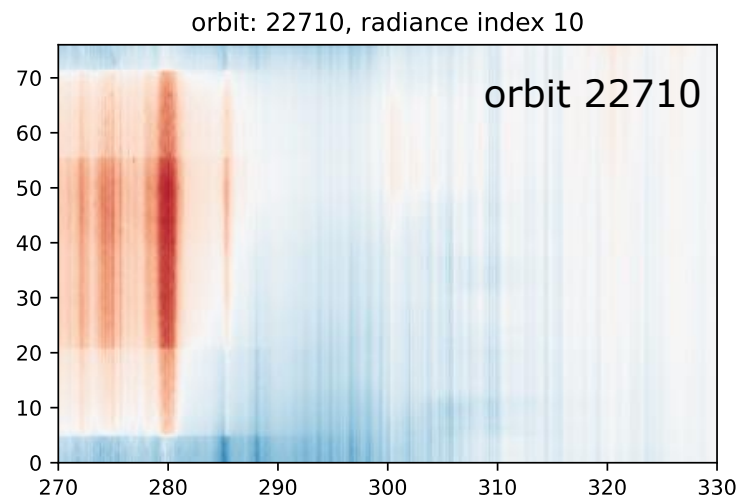
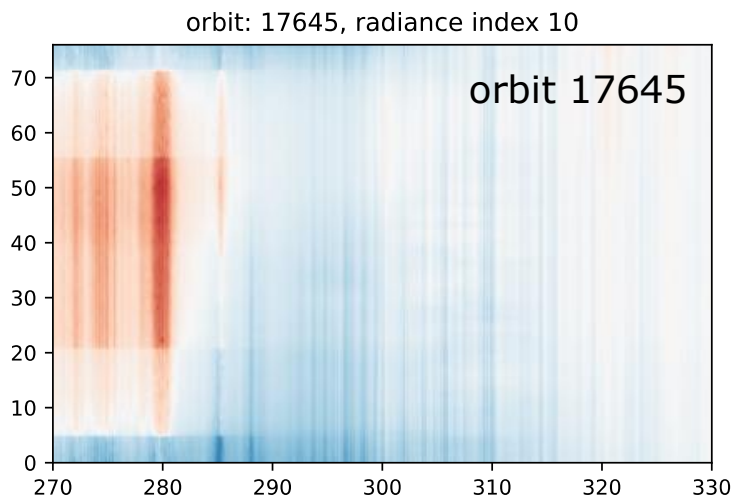
B1 Ground Pixel Nr.



Orbits

- Effects of detector pixel binning
- Increase in Fraunhofer lines
- Little change above ~ 310 nm

B1 Ground Pixel Nr.



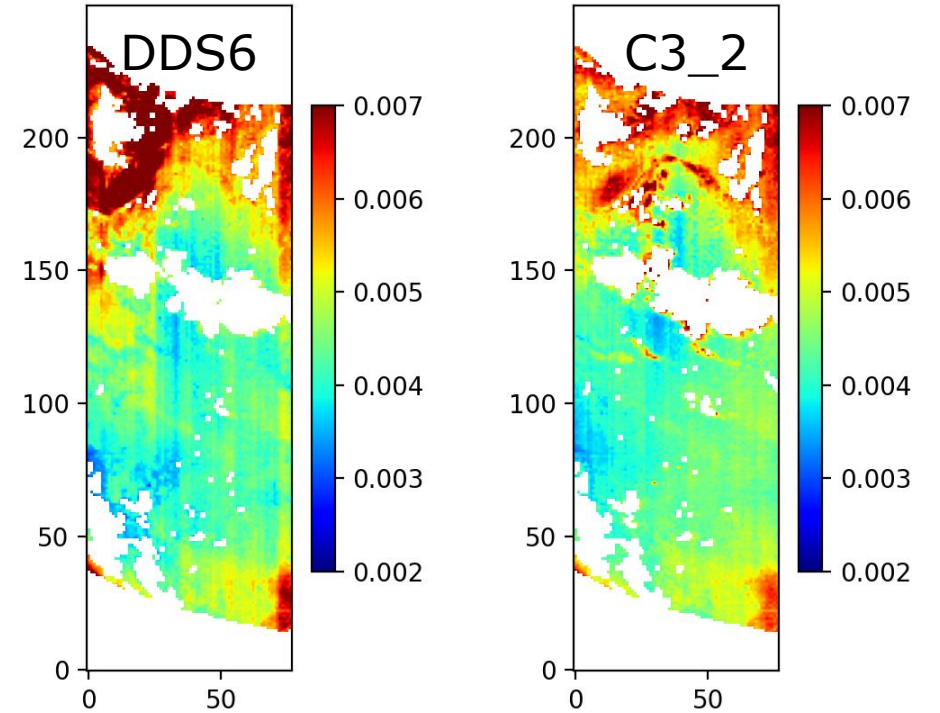
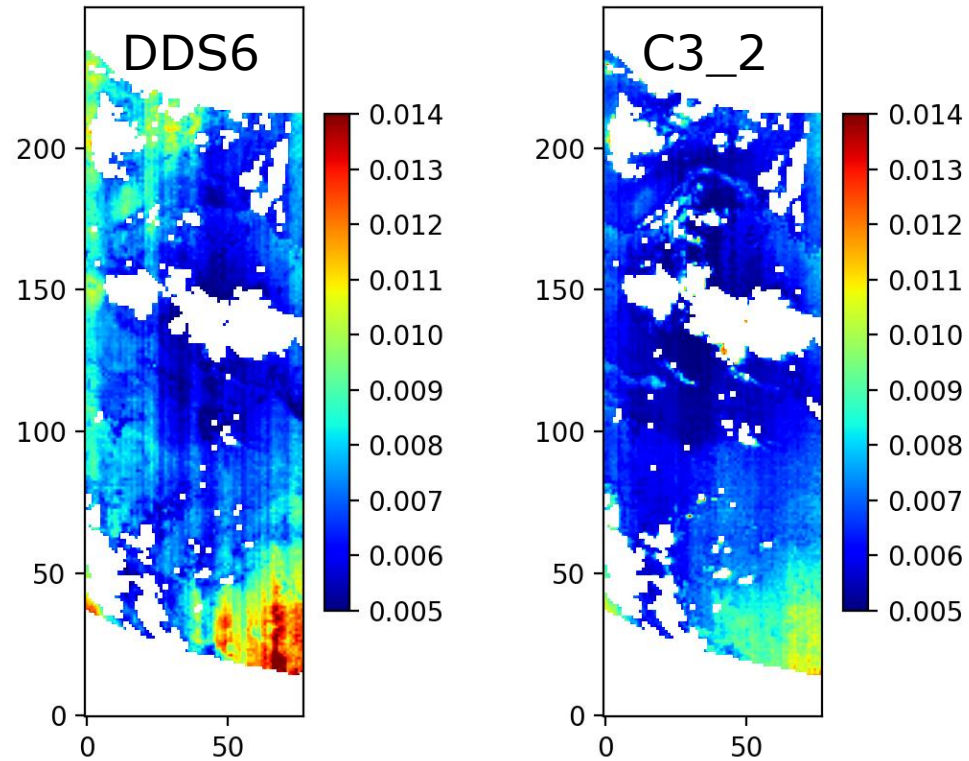
Wavelength [nm]

Wavelength [nm]



0-6 km

12-18 km



Parts of Orbit 24696 over the tropics

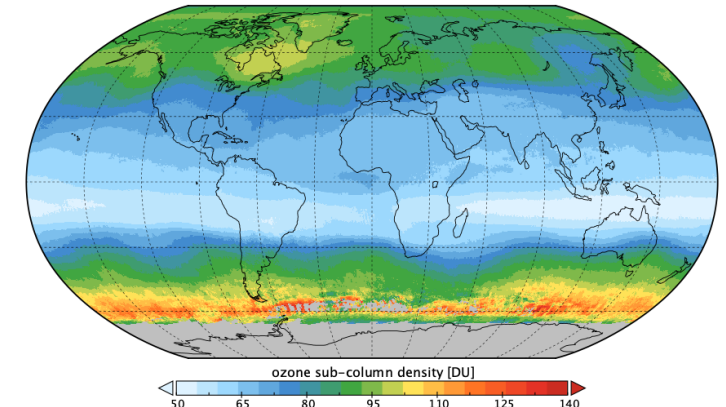
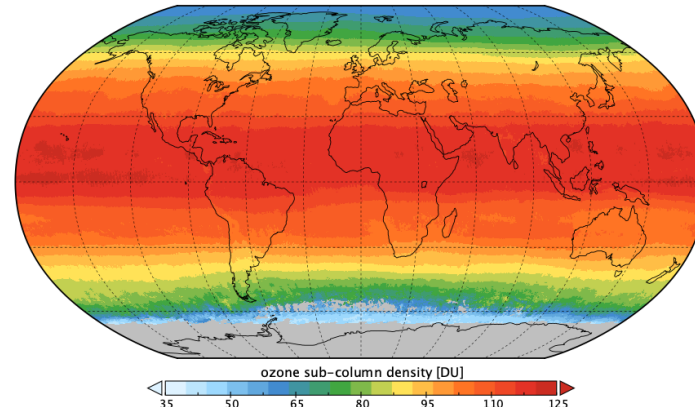
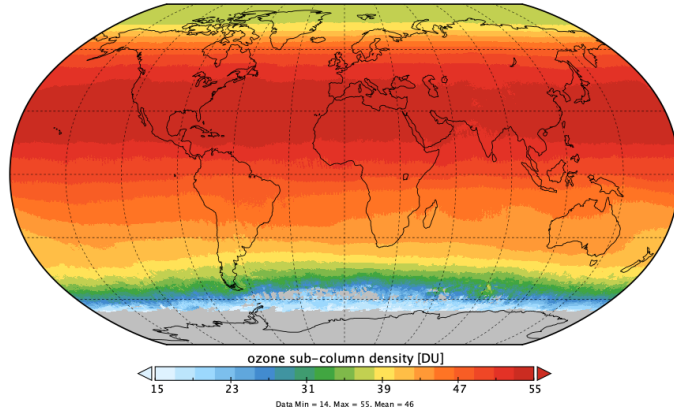


O₃ sub-column density, mean July 2022

32-78 km

24-32 km

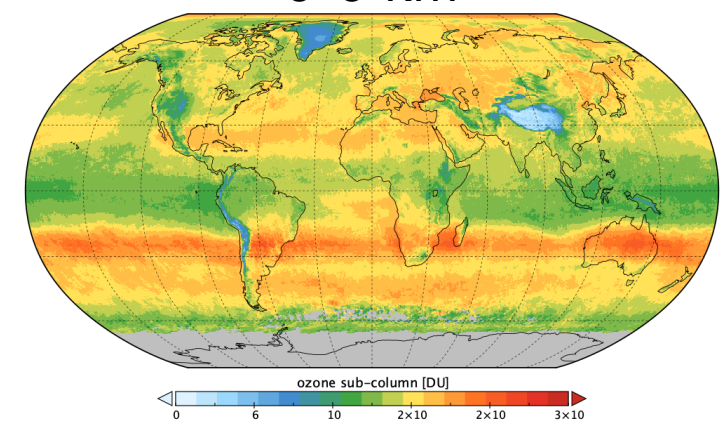
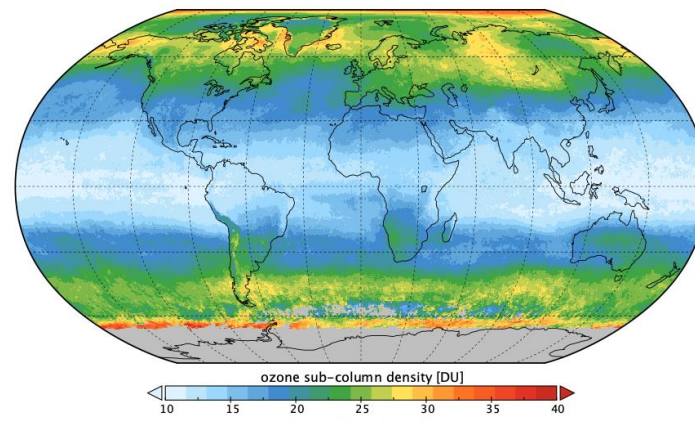
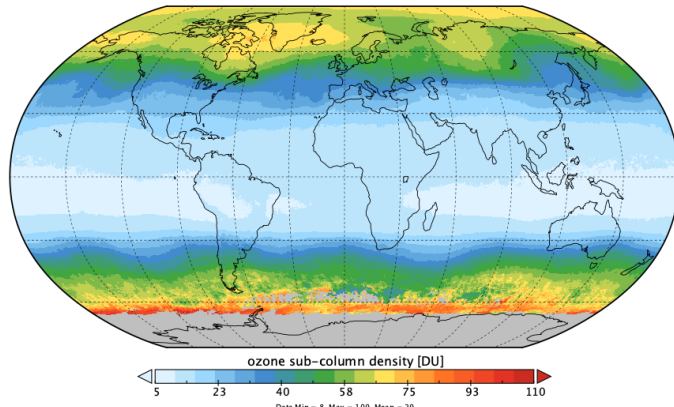
18-24 km



12-18 km

6-12 km

0-6 km

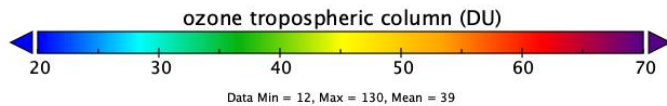
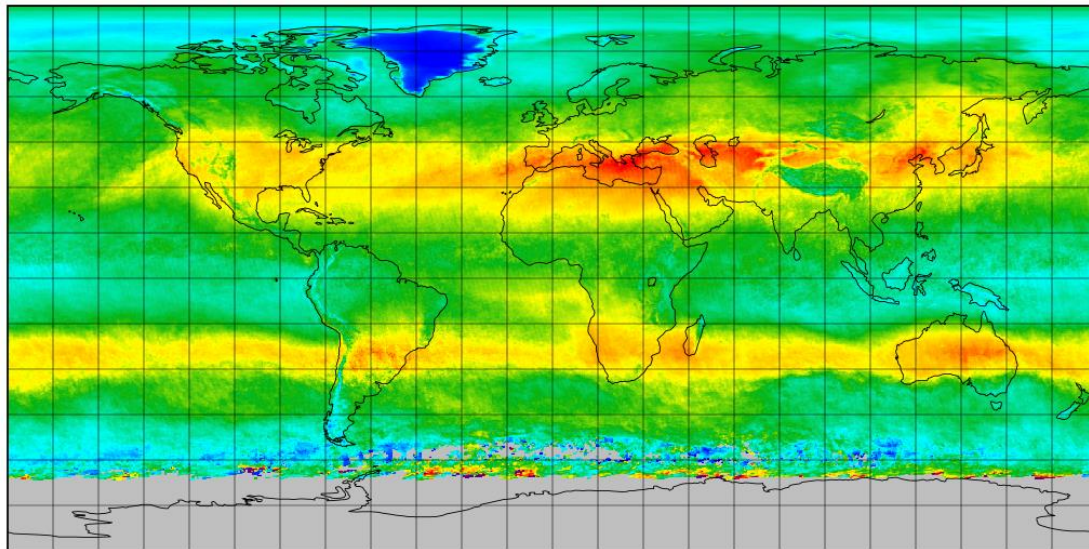


Color scales optimized by layer

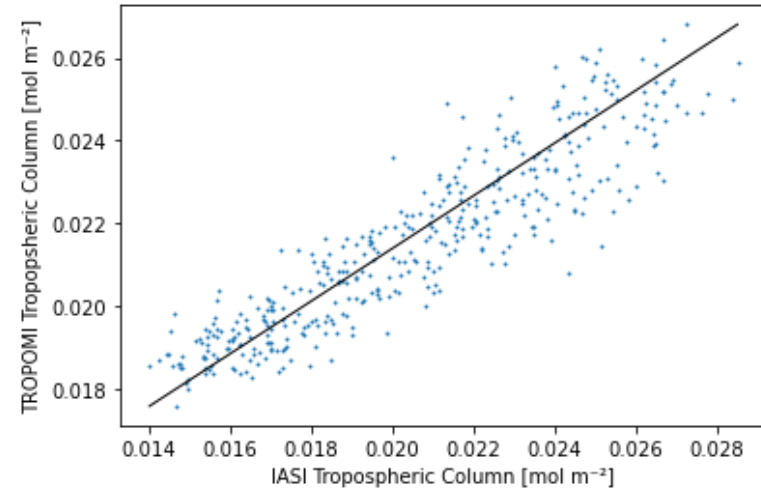


Tropospheric Ozone Comparisons with IASI

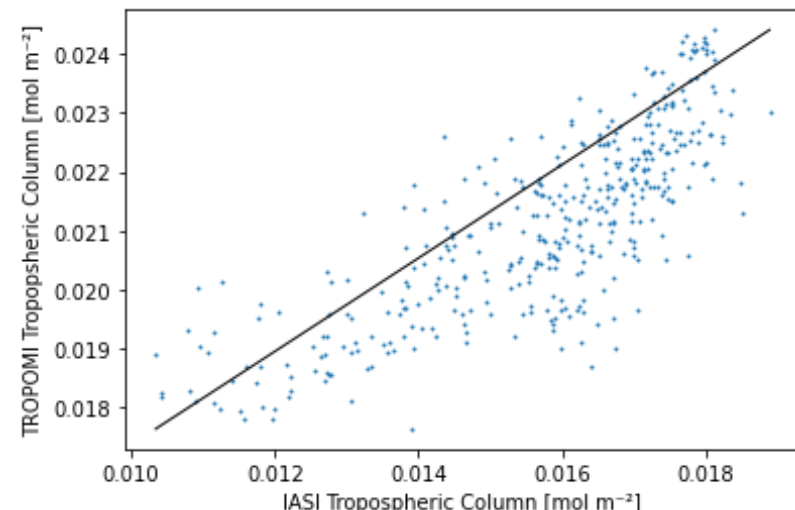
ozone tropospheric column



July 2022; 30-40°N, 120-130°E

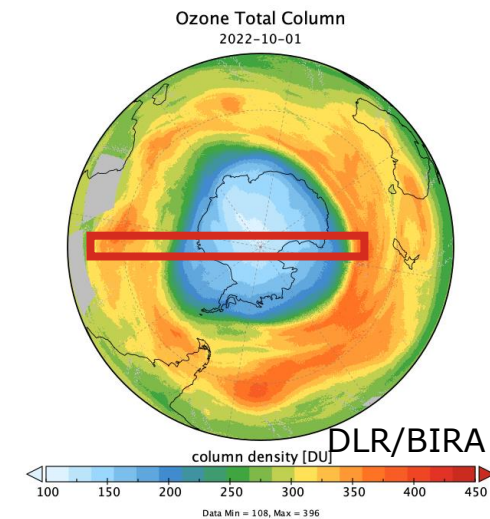
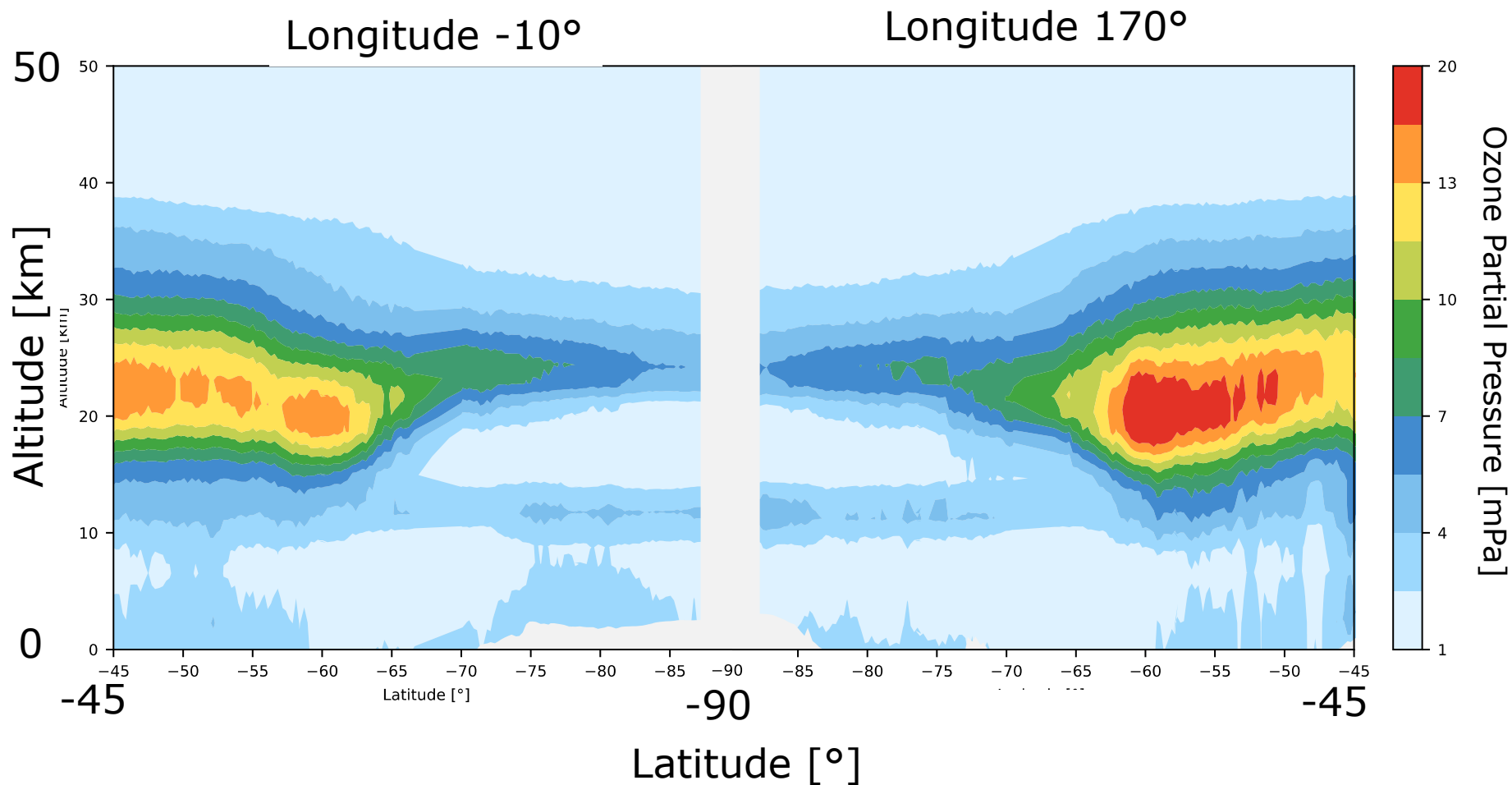


July 2022; 20-30°S, 20-30°E





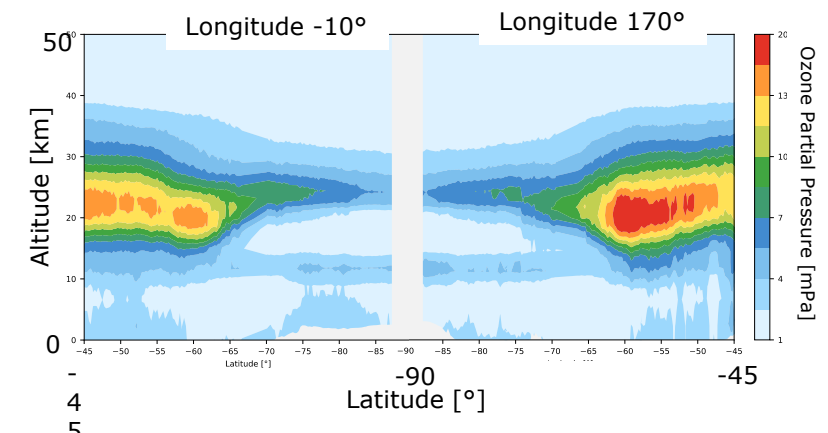
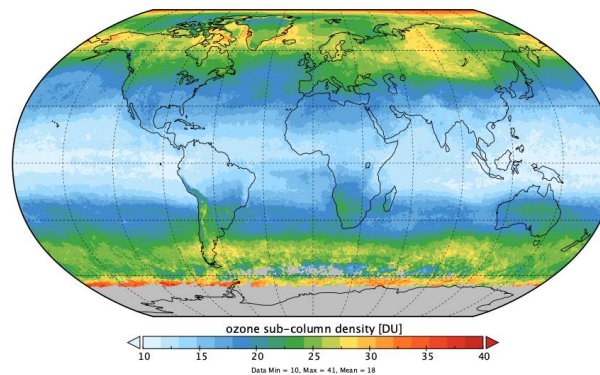
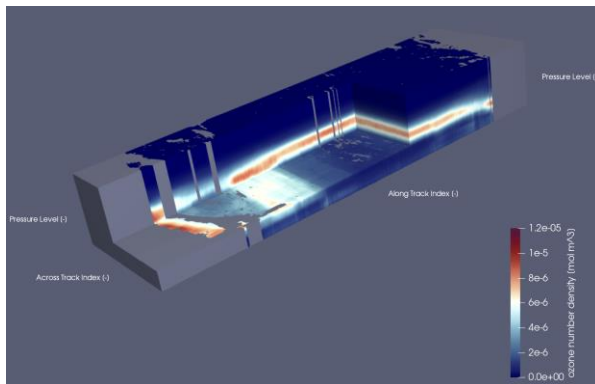
Ozone Profile 2022-10-01

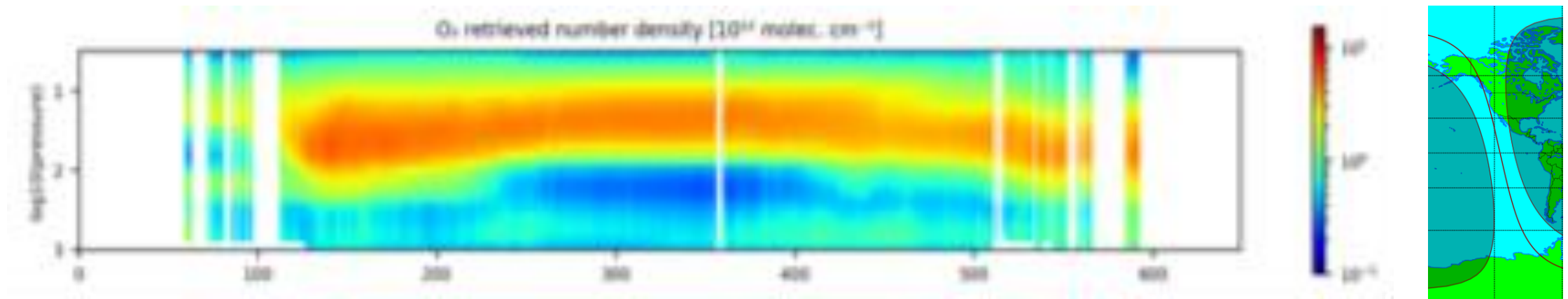




Planned Updates

- > Update of the softcal file (TBD)
- > Change of the sampling grid in NRT to a “checkerboard” pattern
- > Reprocessing of the 5 year record
- > Investigate possible radiometric corrections in L0-1B
- > Investigate the validation results





Curtain plot (time versus pressure) of all valid ozone profile retrievals for ground pixel number 30 for orbit 4958 measured on 27 September 2019. The right panel show the coverage of the orbit, which starts over Antarctica.