AN IMPROVED OCLO RETRIEVAL FROM TROPOMI OBSERVATIONS

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Overview

- Introduction

- Current OClO retrievals from TROPOMI

- Evaluation of OClO retrievals for TROPOMI
    - Optimization of the fitting wi
    - Solar against Pacific reference
    - Empirical cross-section

- Evaluation against operational product

- Summary Outlook

Introduction

Importance of OClO in the Atmosphere

- **Reveals Chlorine Activity**: OClO (Chlorine Dioxide) is a direct indicator of active chlorine compounds in the atmosphere, which play a crucial role in ozone destruction.

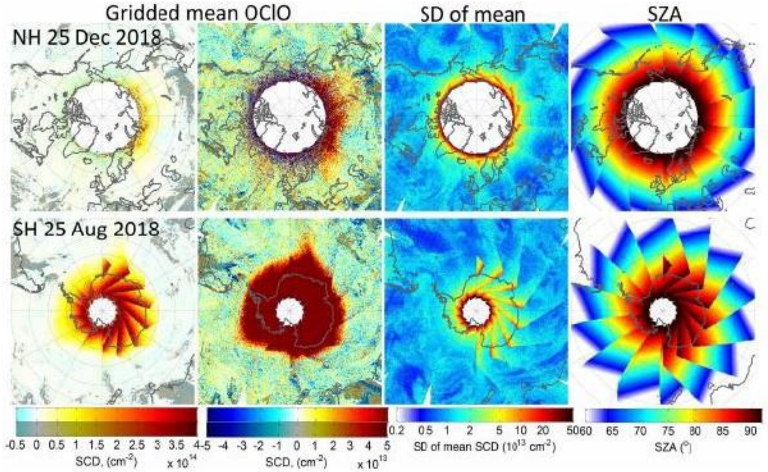
- **Reflects Ozone Depletion Potential**: The abundance of OClO correlates with the potential for ozone layer depletion, making it a critical parameter for understanding and predicting ozone loss.

- **Confirms Montreal Protocol Success**: A decline in OClO levels is a positive sign, indicating the effectiveness of international efforts like the Montreal Protocol in reducing ozone-depleting substances and aiding in the recovery of the ozone layer.

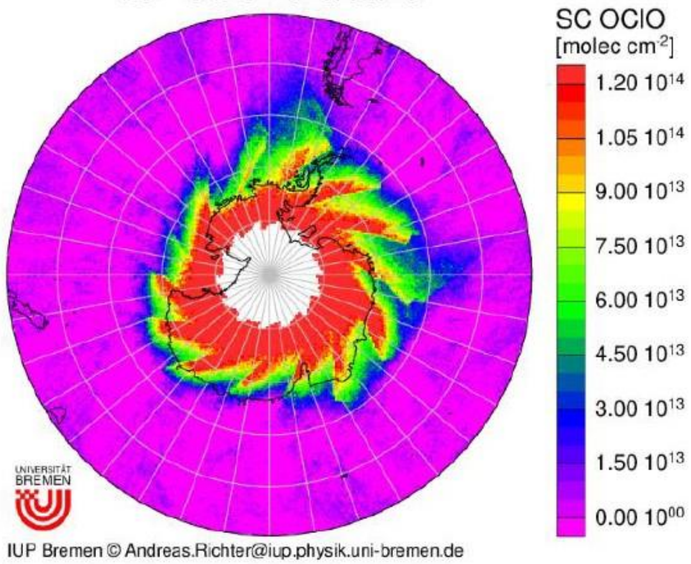
- **Indicator of Polar Stratospheric Clouds (PSCs)**: The presence of OClO is often associated with PSCs, which provide surfaces for chlorine activation, leading to significant ozone loss in polar regions.

Current OClO retrievals from TROPOMI

	Pukīte et al., ACP, 2021	Meier et al., ATBD, 2023
Targer gas	OClO (213 K, Kromminga et al., 2003)	OClO (213 K, Kromminga et al., 2003)
Fit window	363 – 390.5 nm	345 – 389 nm
Polynomial	5	5
Cross-sections	NO_2 (220 K, Vandaele et at., 1998), O3 (223 K, Serdyuchenko et al., 2014), O4 (293 K, Thalman and Volkamer, 2013)	NO_2 (220 K, Vandaele et at., 1998), O3 (223 K, 243 K, Serdyuchenko et al., 2014), O4 (293 K, Thalman and Volkamer, 2013); BrO (228 K,Wilmouth et al., 1999); Empirical cross-section from residual
Ring effect	4 Ring spectra (2x2) at 280 and 210 K Ring NO2 cross-section	Ring cross-section
BrO absorption correction	Substraction of BrO absortion, retrieved in another fit window	No
Intensity offset	$1/I_0$, λ/I_0, λ^2/I_0	1/I0, $(\lambda - \lambda_c)/I_0$
Reference spectrum	Daily mean earthshine spectrum within SZA range of 60-65°, detector resolved	Daily irradiance



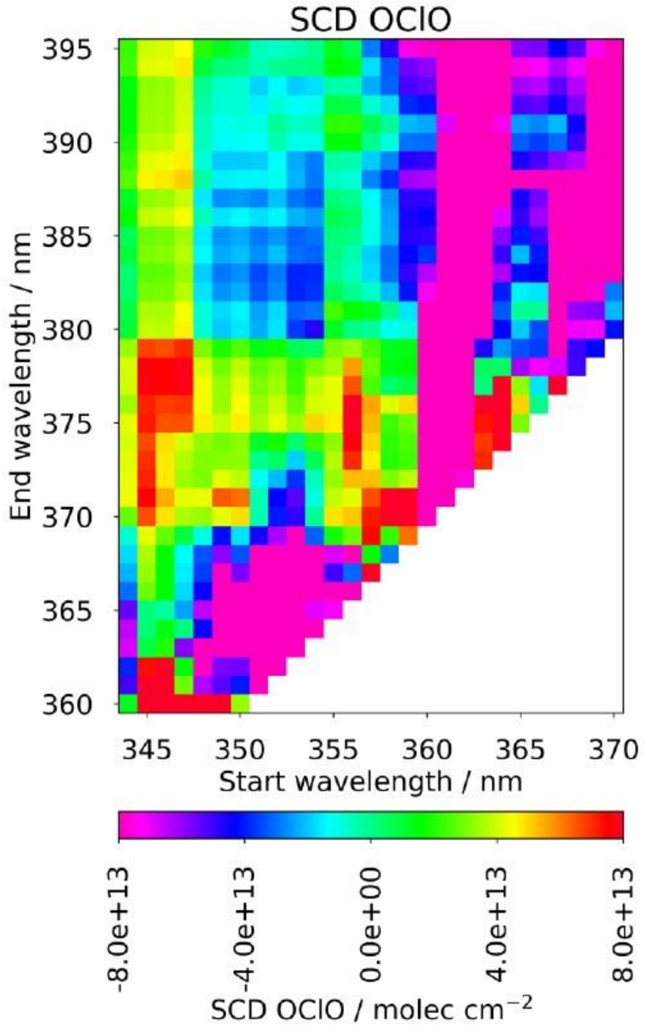
Pukite et al., ACP, 2021

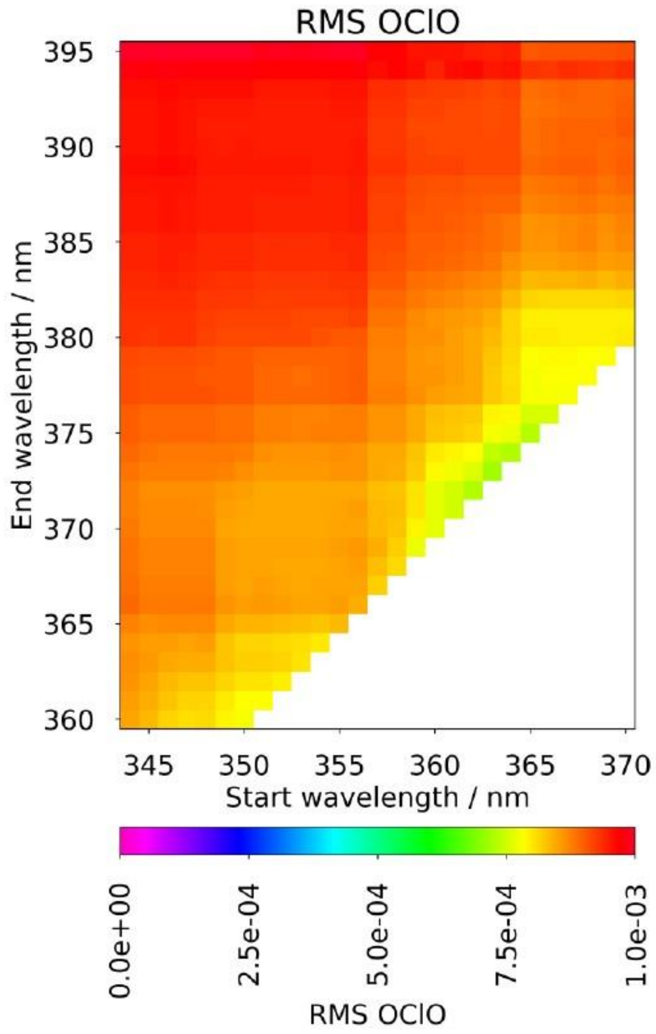


Meier et al., ATBD, 2023

Optimization of the fitting window

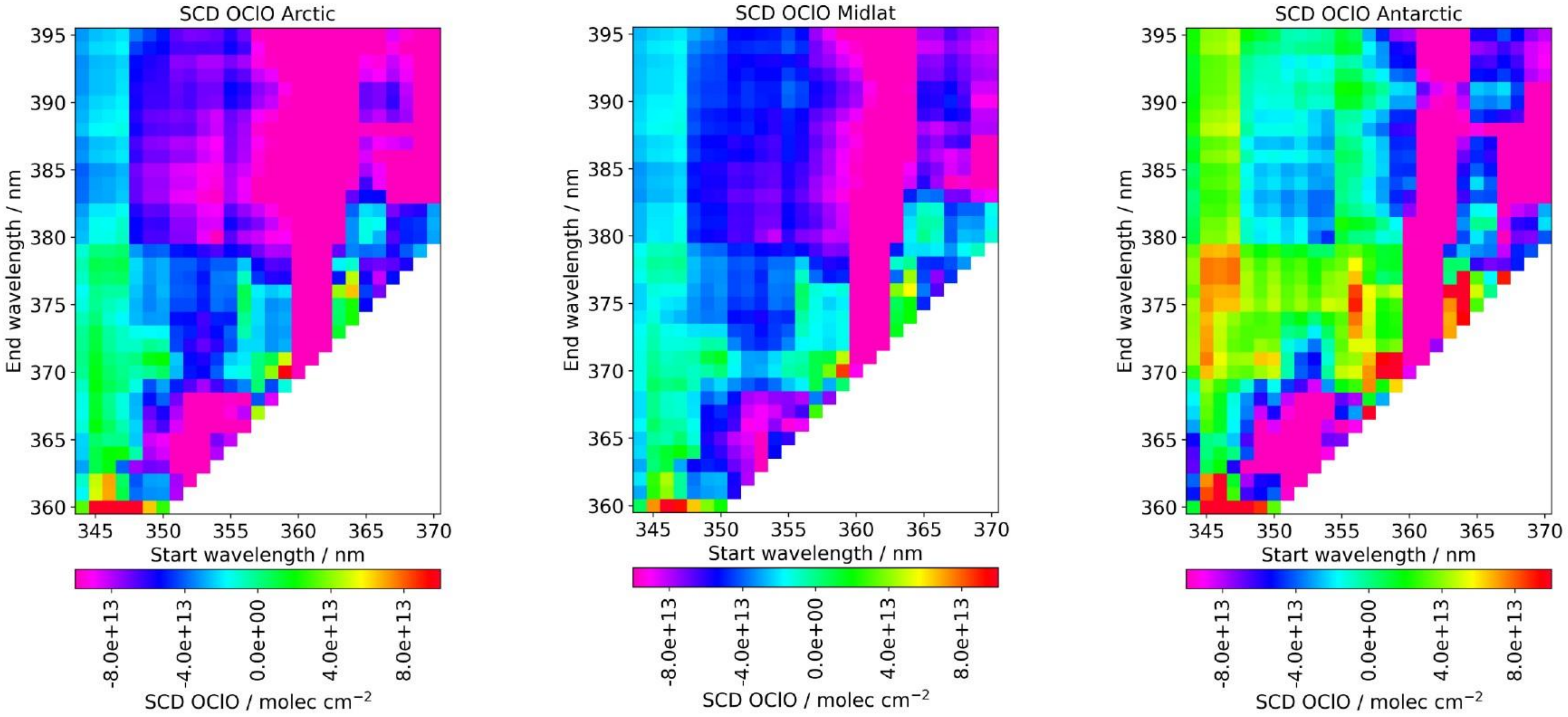
- Single day 2019-08-13



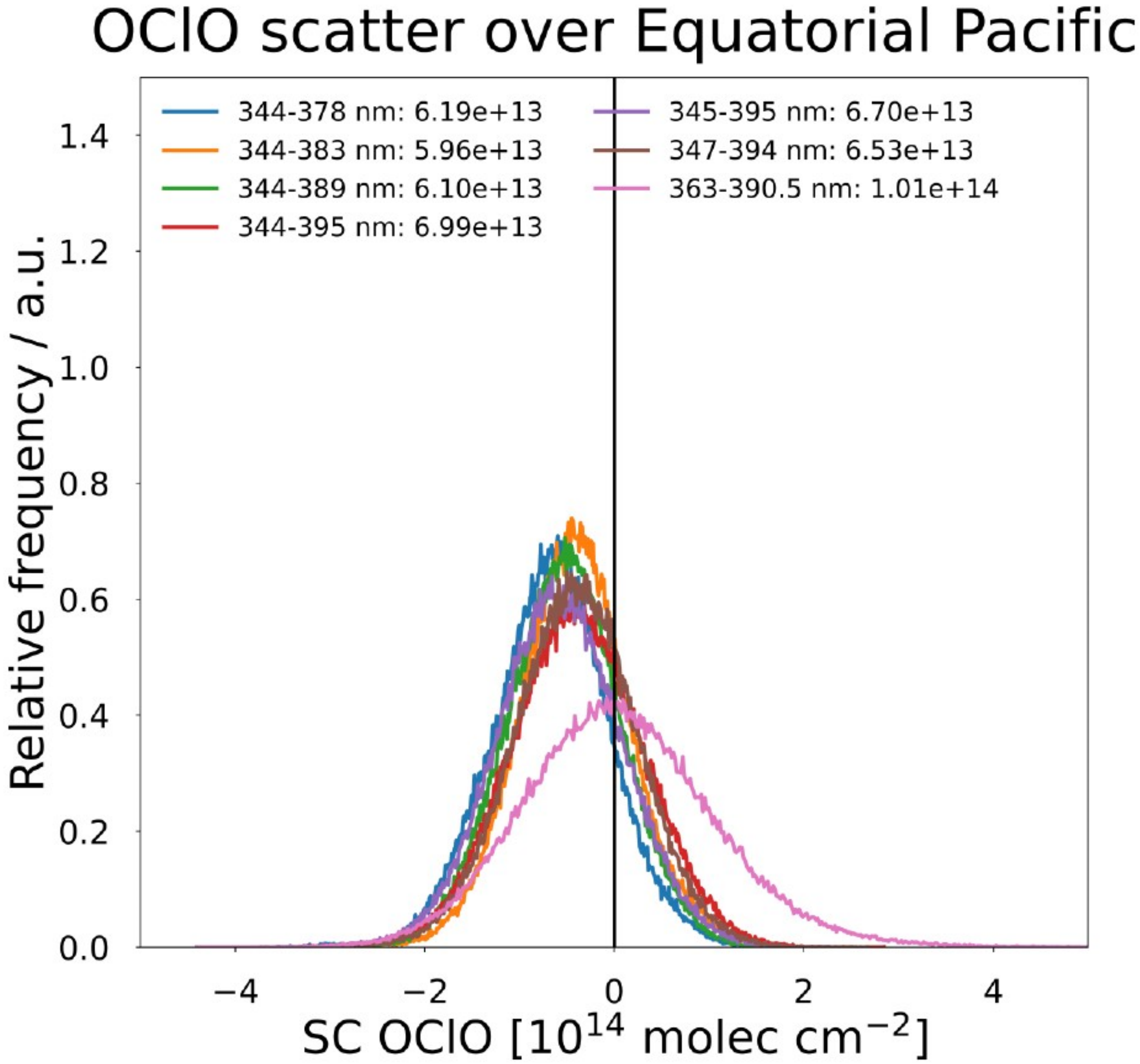


Optimization of the fitting window

- Single day 2019-08-13



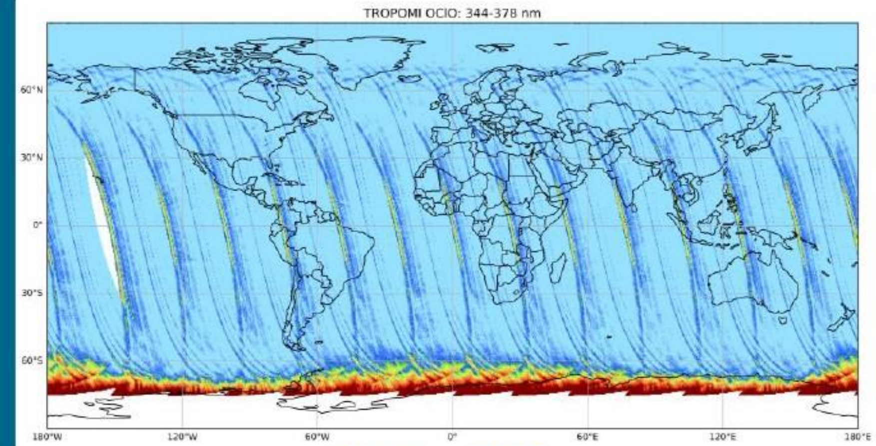
Optimization of the fitting window



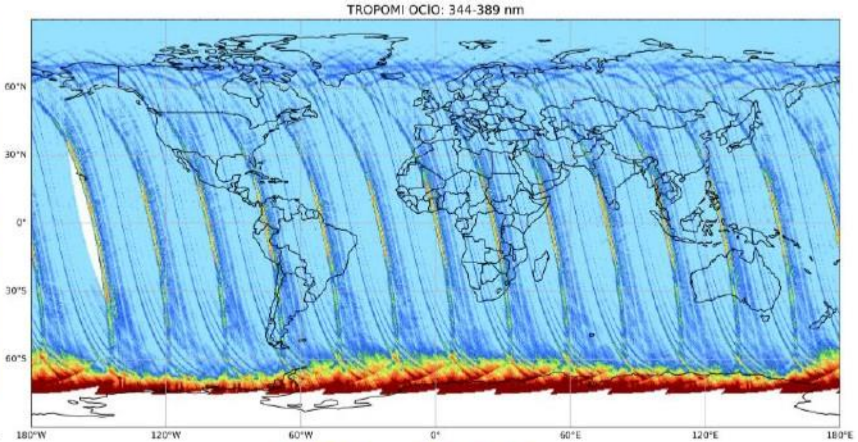
Good fit --> not always small residual and low scatter

Optimization of the fitting window

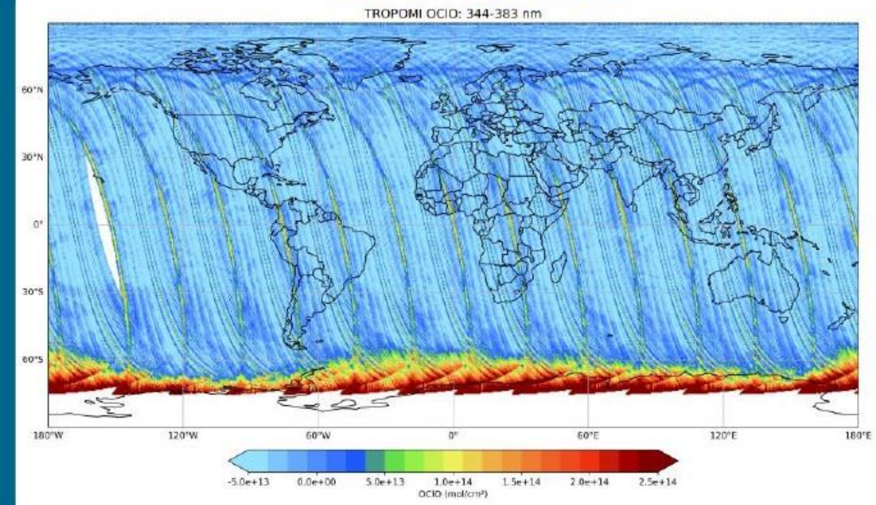
344 – 378 nm



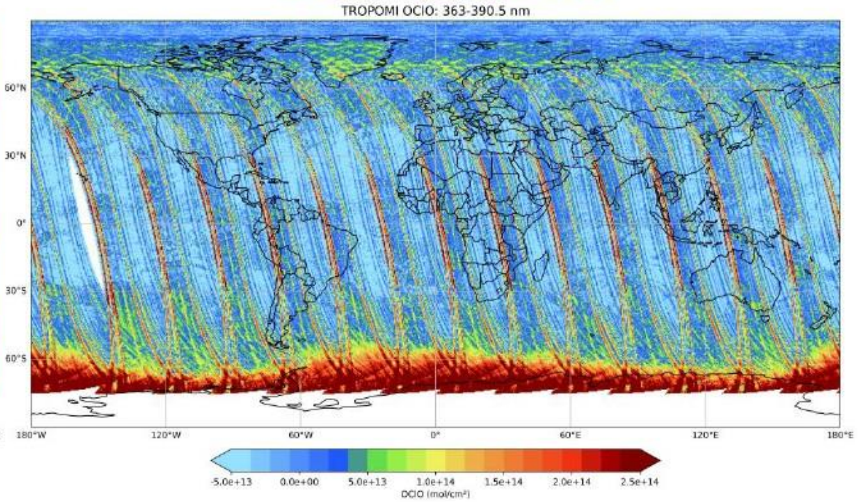
344 – 389 nm



344 – 383 nm

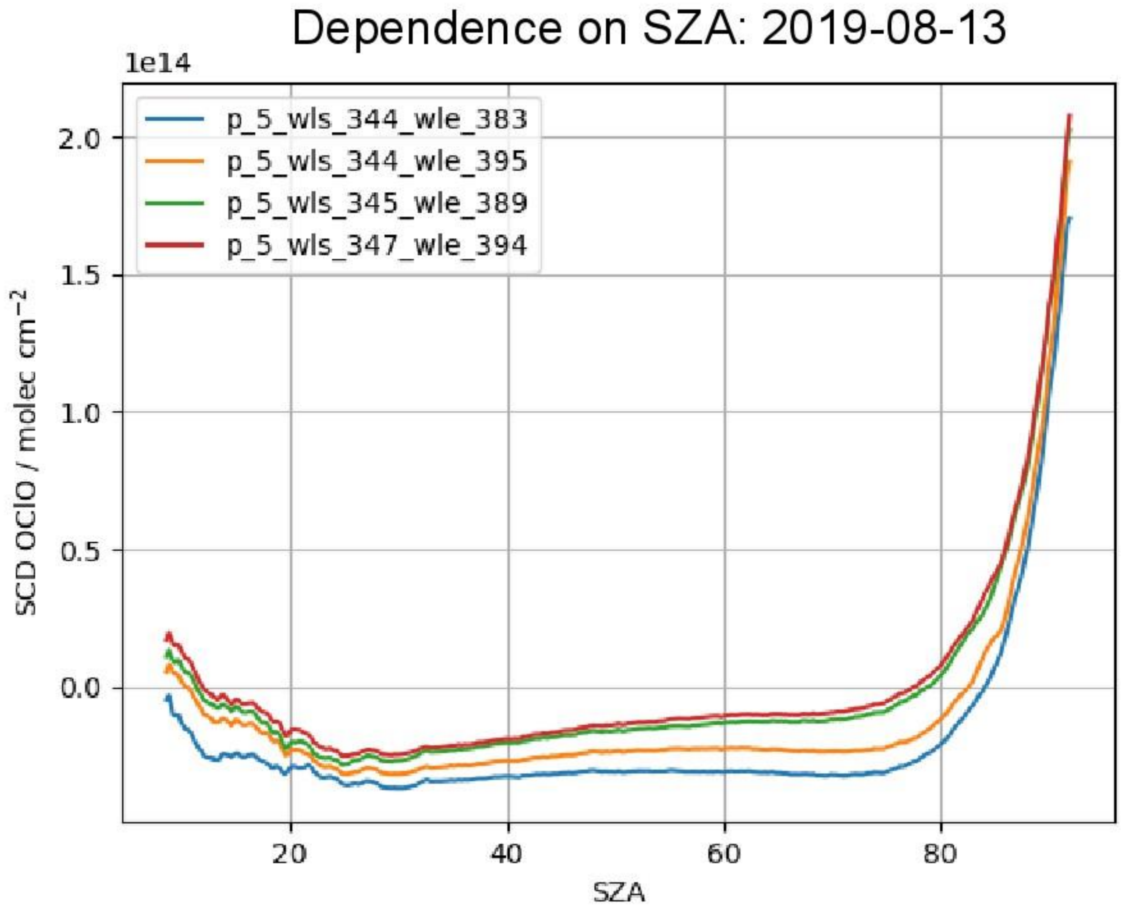


363 – 390.5 nm



- Single day 2019-08-13
- All fit windows show similar spatial distribution, but large negative bias for top panels
- Bottom panel seems to have larger noise, but maybe just color scale

Optimization of the fitting window

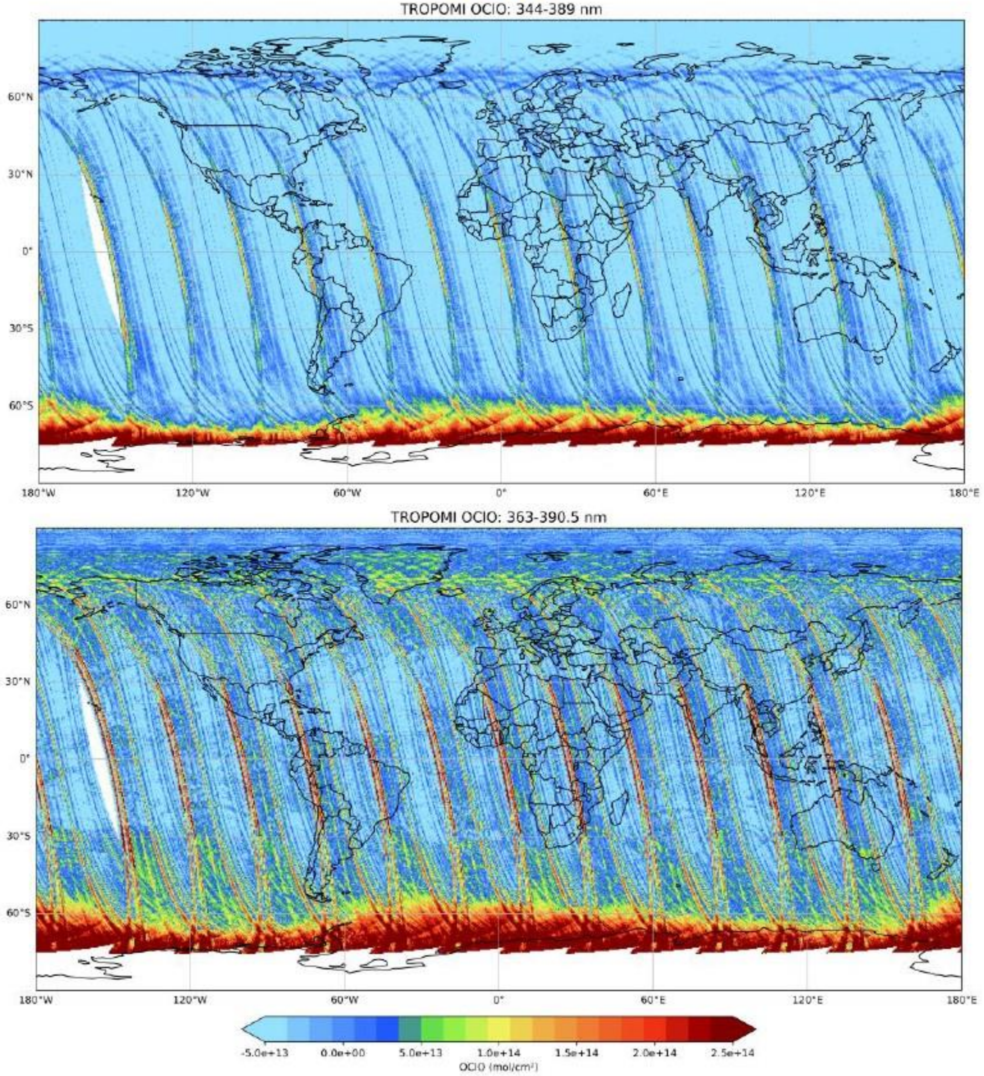


- Different fit windows also show similar behavior on SZA
- All products suffer from negative bias
  - Need to correct

Solar against Pacific reference

- Single day 2019-08-13

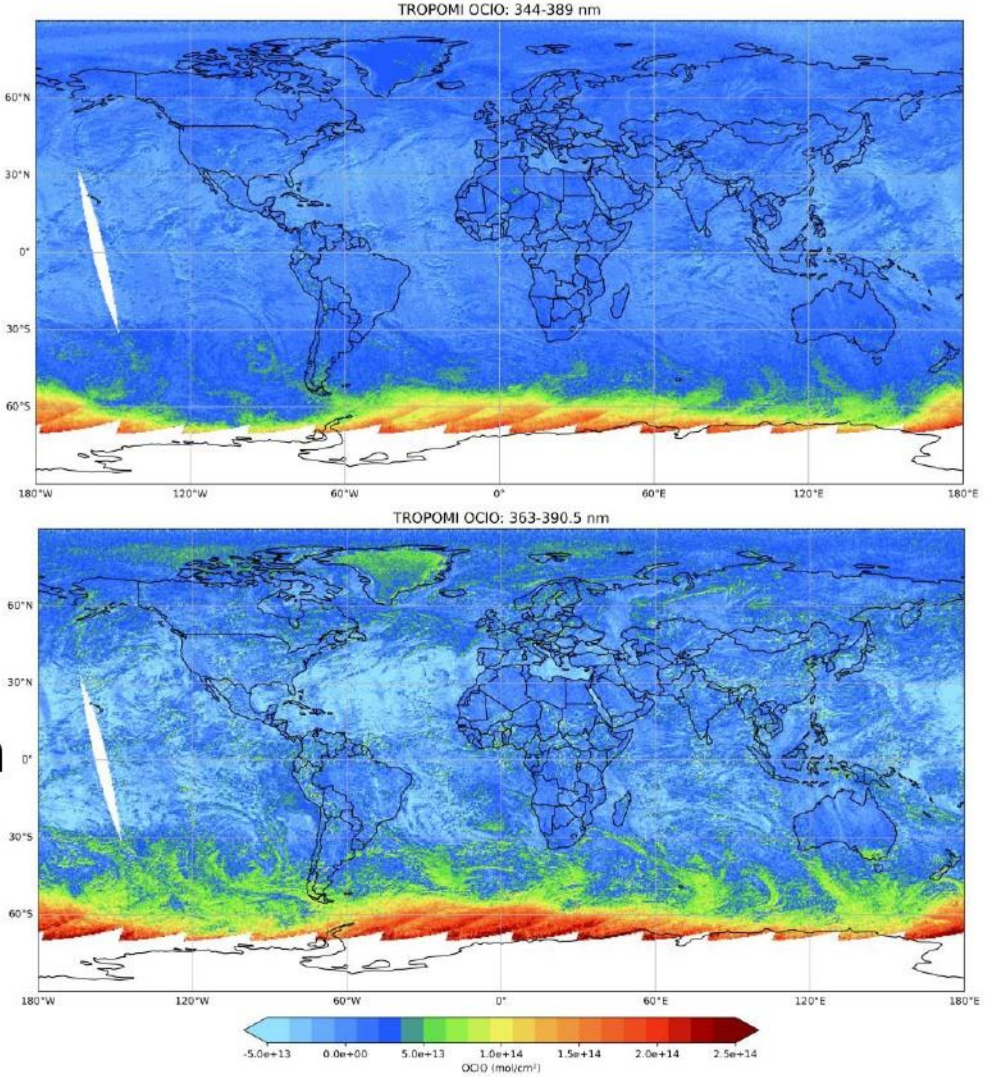
Solar



344-389 nm

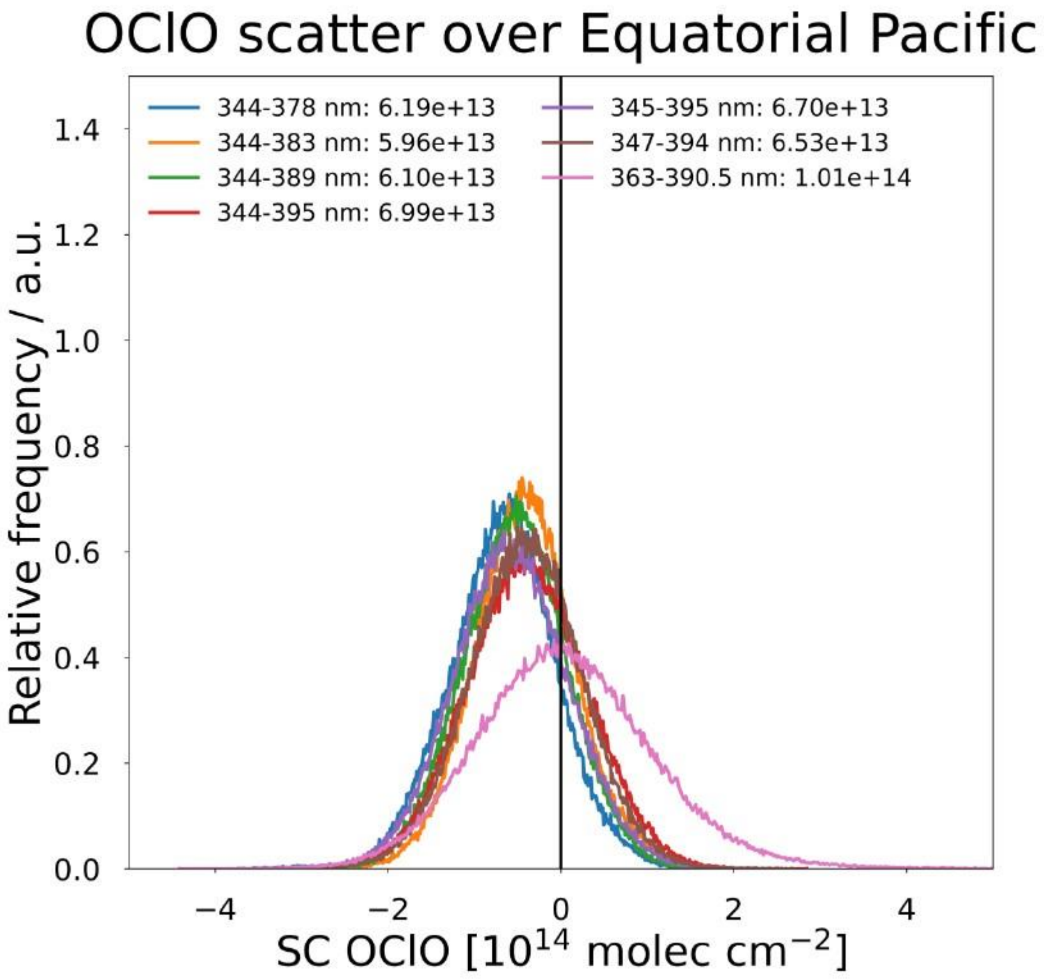
363-390.5 nm

Pacific

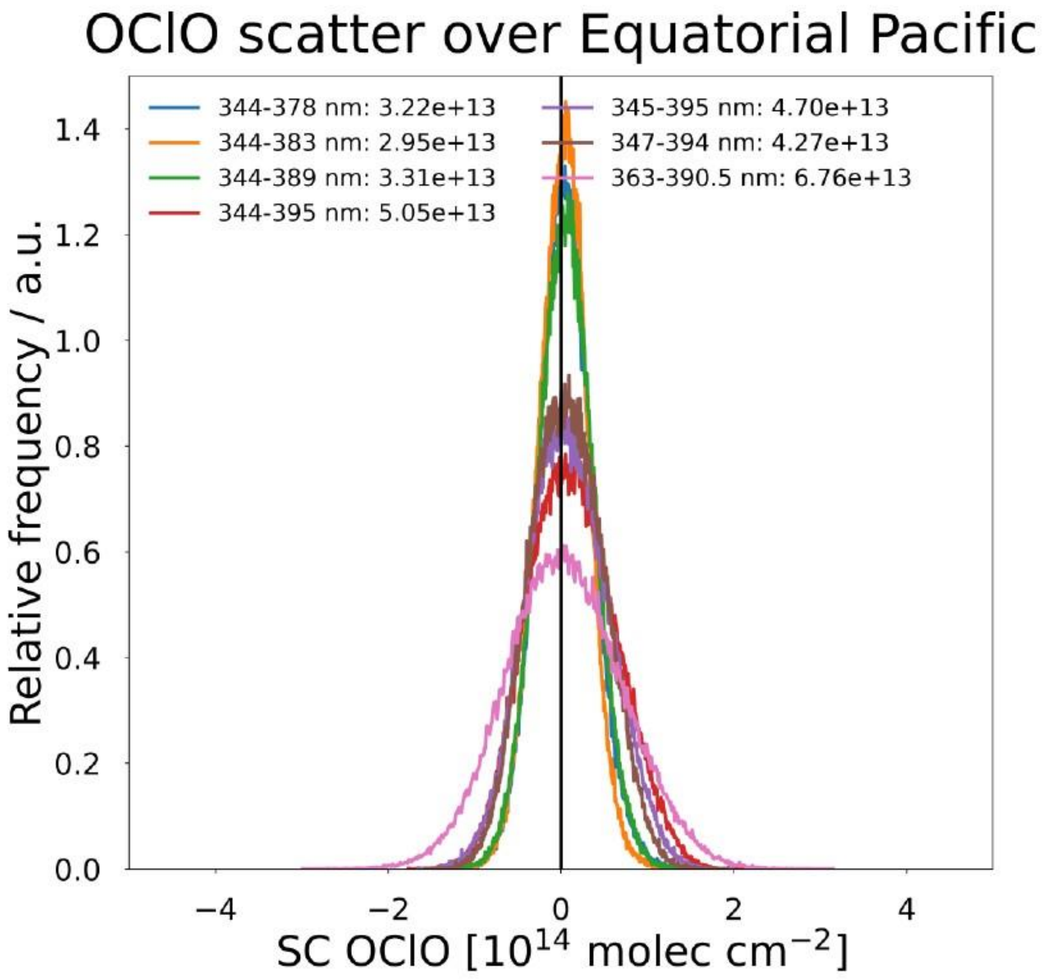


Solar against Pacific reference

Solar

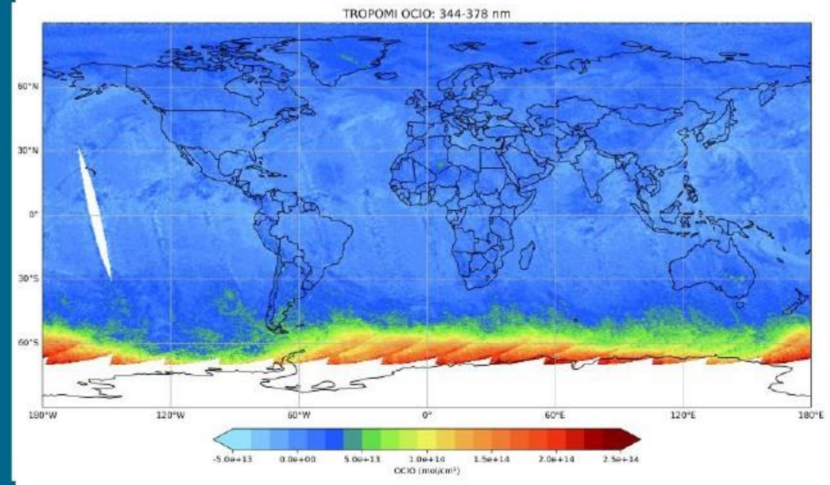


Pacific

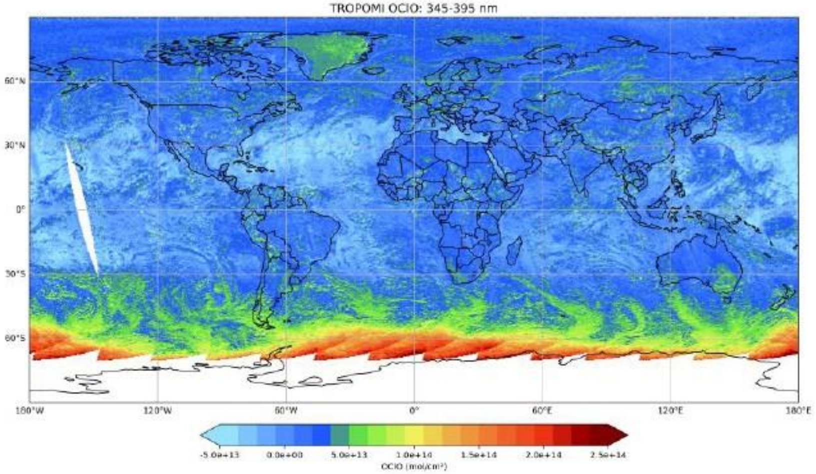


Solar against Pacific reference

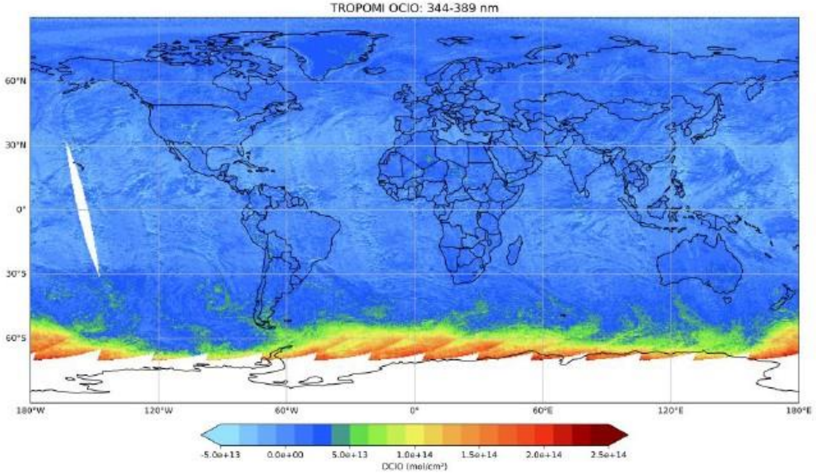
344 – 378 nm



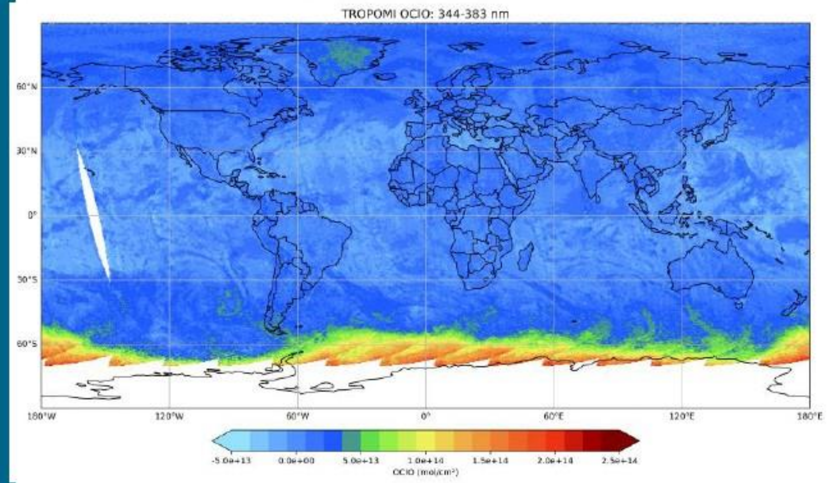
345 – 395 nm



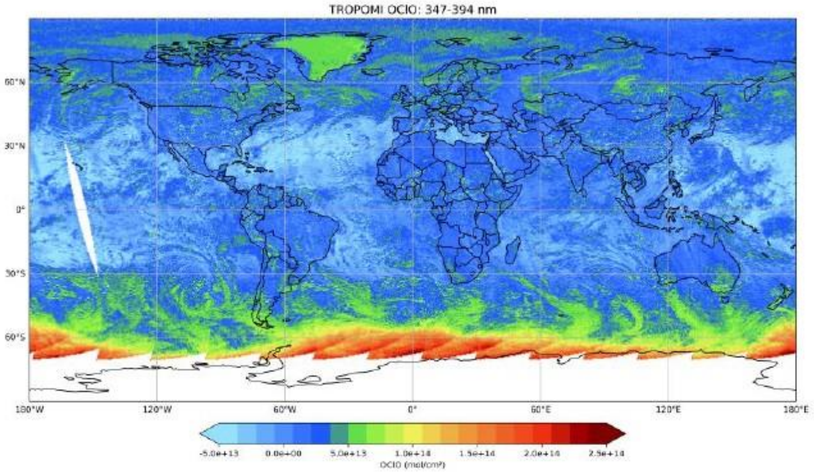
344 – 389 nm



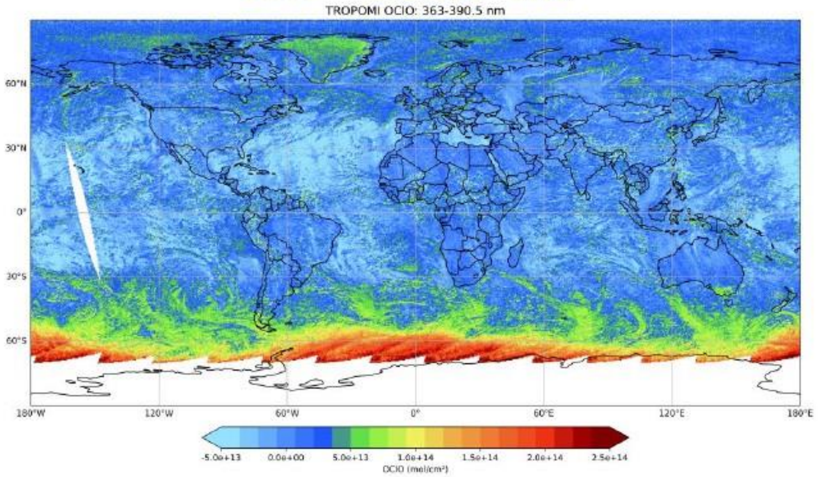
344 – 383 nm



347 – 394 nm

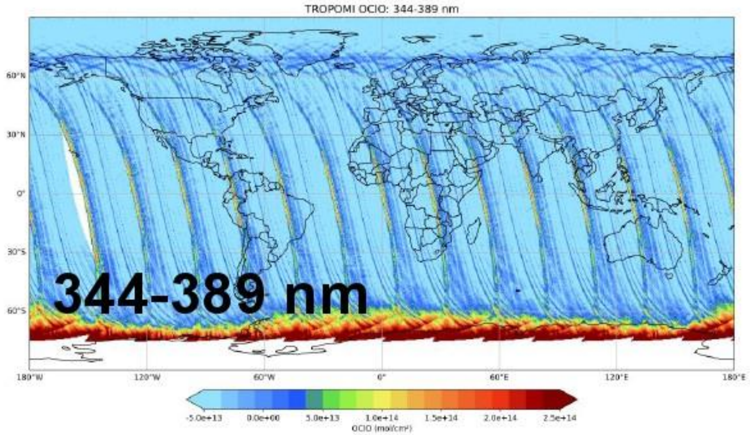


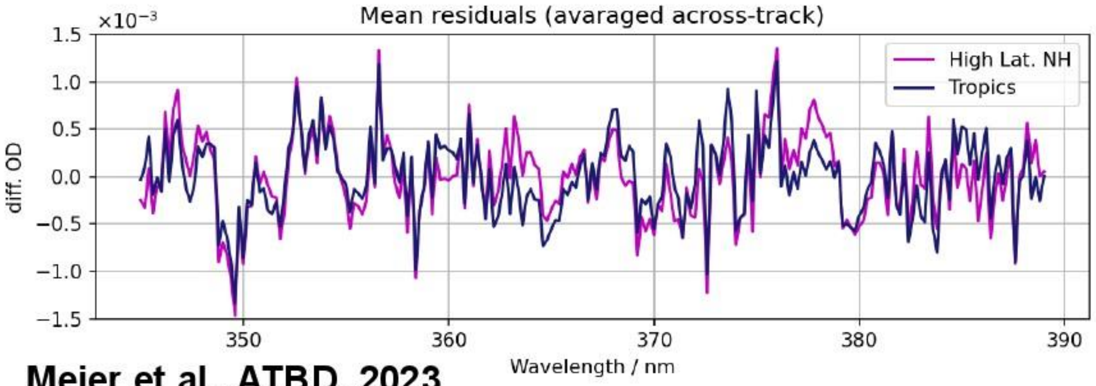
363 – 390.5 nm

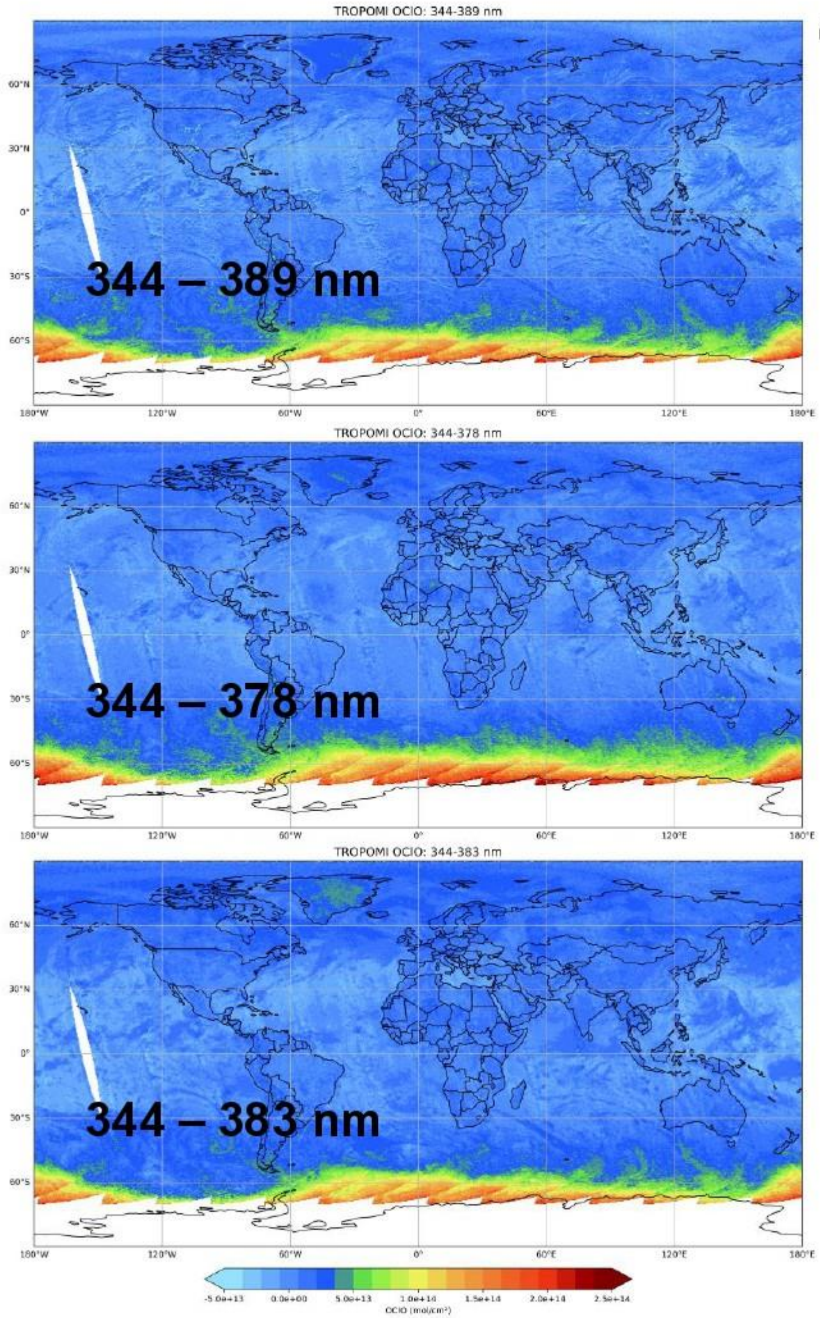


Empirical cross-section

- Identify regions with large negative bias
- Average fit residuals from special fit (exclude OClO)
- Add averaged residuals as pseudo-absorbers to normal fit (indiv. per ground_pixel)





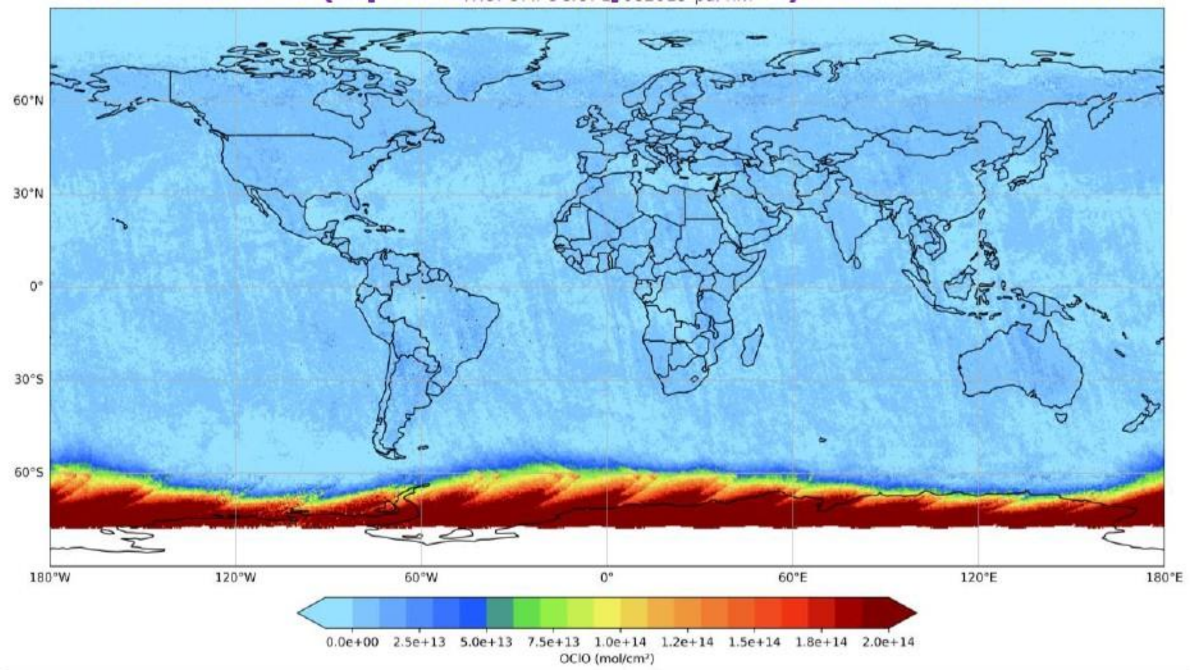


Meier et al., ATBD, 2023

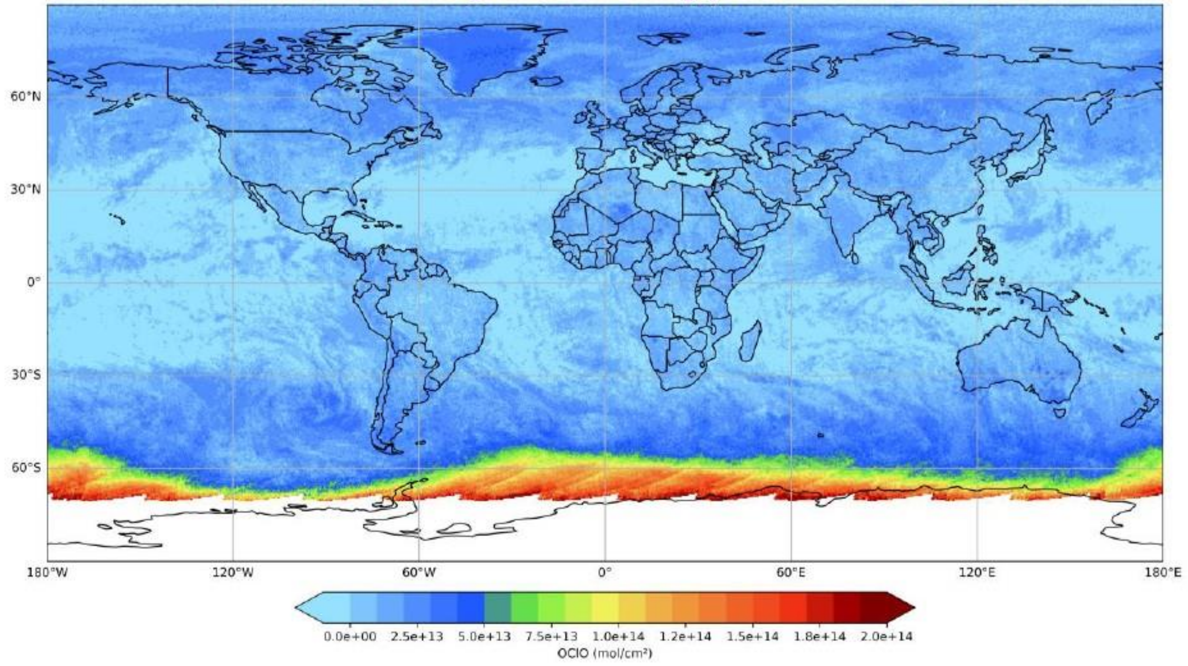
Evaluation against operational product

- Two days average: 13-14 August 2019.

OClO SCD (operational product): 344 – 389 nm



OClO SCD (this study): 344 – 383 nm



- A similar pattern is observed, but there are some differences over clouds and a global offset, which may be introduced by the empirical cross-sections.

Summary and Outlook

- OClO columns have been retrieved from TROPOMI observations.

- An appropriate selection of the fit window leads to a reduction of negative bias at high altitudes and tropical regions, as well as artifacts over bright surfaces.

- Using the Pacific region as a reference spectrum removes stripes in OClO columns and reduces the global negative bias.

- The new OClO retrieval is consistent with the operational product; however, further analysis is needed to evaluate the differences over bright surfaces.