Id-109

Tropospheric Ozone Column Data Records based on Total Columns from TROPOMI and Precursor Missions using CCD algorithm or in Combination with BASCOE/MLS

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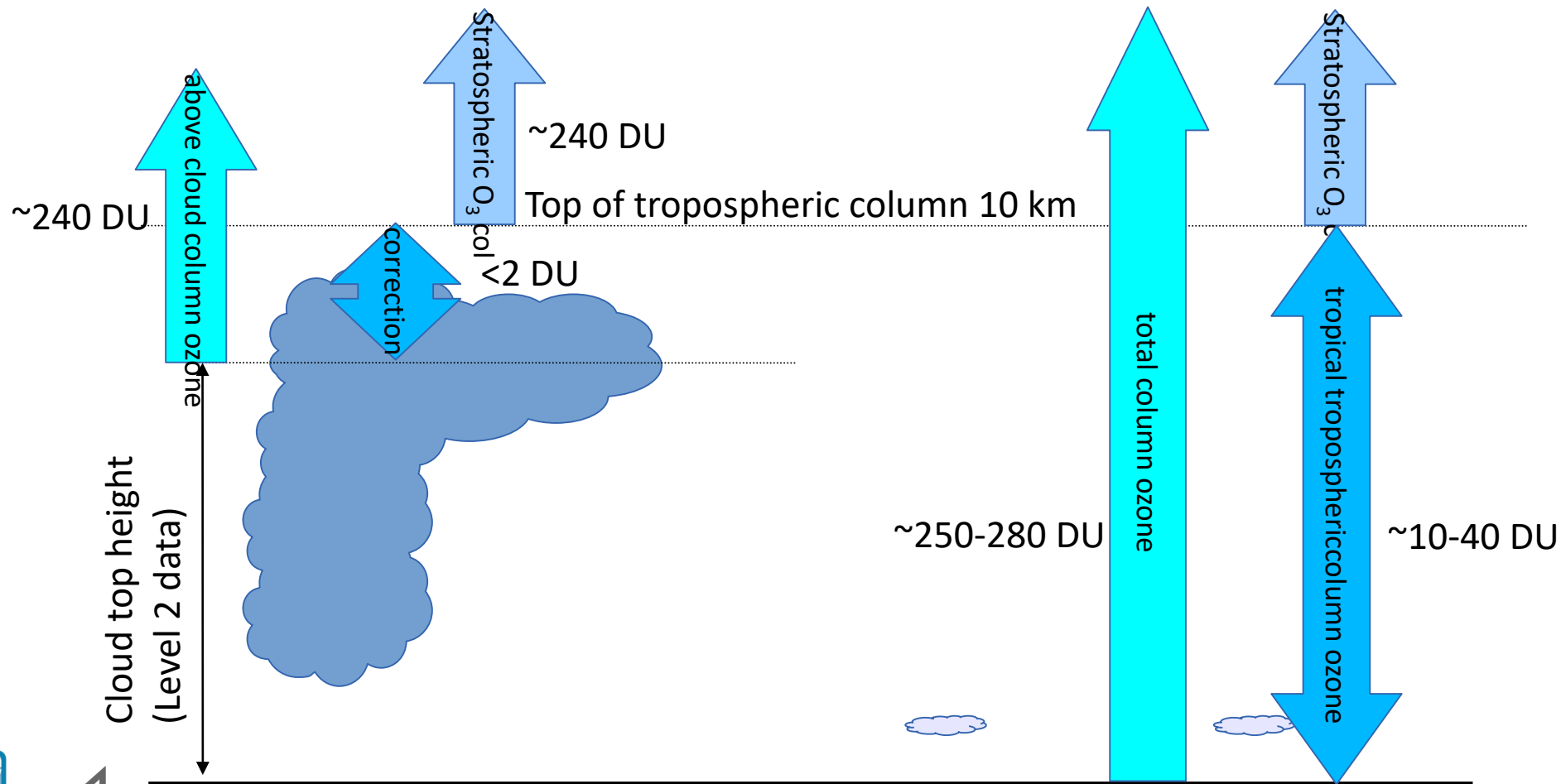
1) DLR Oberpfaffenhofen
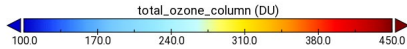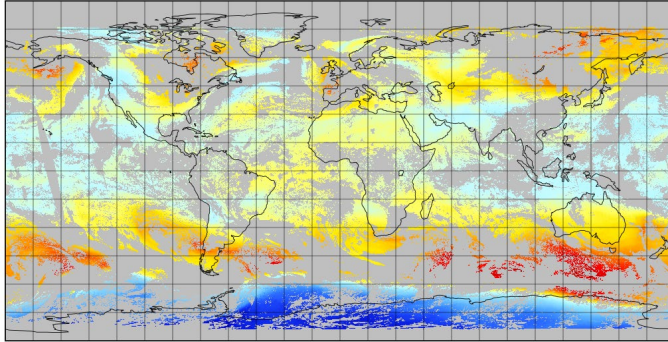2) TUM München
3) BIRA-IASB Bruxelles

Knowledge for Tomorrow

DLR

CCD method

~240 DU

above cloud column ozone

Stratospheric O₃ col

~240 DU

Top of tropospheric column 10 km

correction

Stratospheric O₃ col <2 DU

Cloud top height (Level 2 data)

total column ozone

~250-280 DU

Stratospheric O₃ col

tropical tropospheric column ozone

~10-40 DU

DLR

S5P-BASCOE

total_ozone_column
2020-10-02

total_ozone_column (DU)
100.0   170.0   240.0   310.0   380.0   450.0

Also applied to CCI
GODFIT data for
GOME, SCIAMACHY,
OMI and the
GOME_2 instruments

stratospheric_ozone_column
2020-10-02

stratospheric_ozone_column (DU)
100.0   170.0   240.0   310.0   380.0   450.0

TROPOMI total
column ozone
cloud free (cf<0.2)

tropospheric_ozone_column
2020-10-02

tropospheric_ozone_column (DU)
0.0   20.0   40.0   60.0   80.0
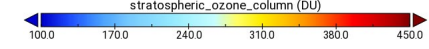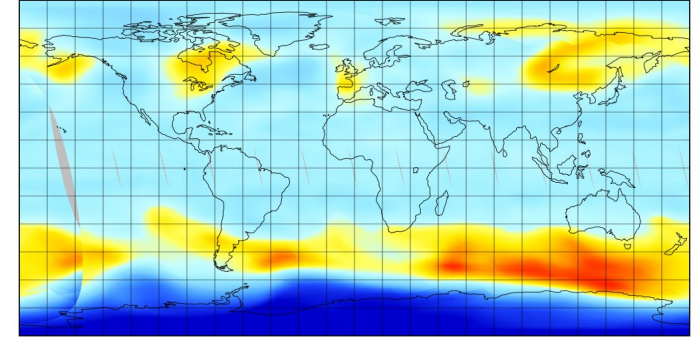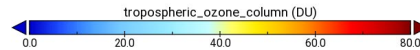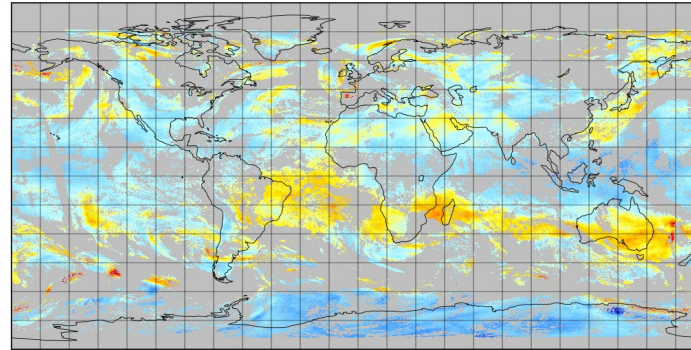
BASCOE assimilated MLS
ozone profile integrated
above tropopause and
interpolated to TROPOMI
pixel

Tropospheric residual ozone

DLR

Tropospheric ozone data

|	GOME	SCIAMACHY	GOME_2 (A,B,C)	OMI	TROPOMI	
CCD	Monthly 1.25° x 2.5°				3 days 0.5° x 1°	Monthly 1.25° x 2.5°
CCD harmonised	SCIAMACHY as Reference merged data set 1995 – 2020 monthly 1.25 x 2.5°					
GODFIT - BASCOE	No data	No data	Daily natural pixel resolution			
harmonised			total column harmonisation, OMI as reference			
Gridded climatology			Monthly 0.25° x 0.25°			

Harmonising CCD
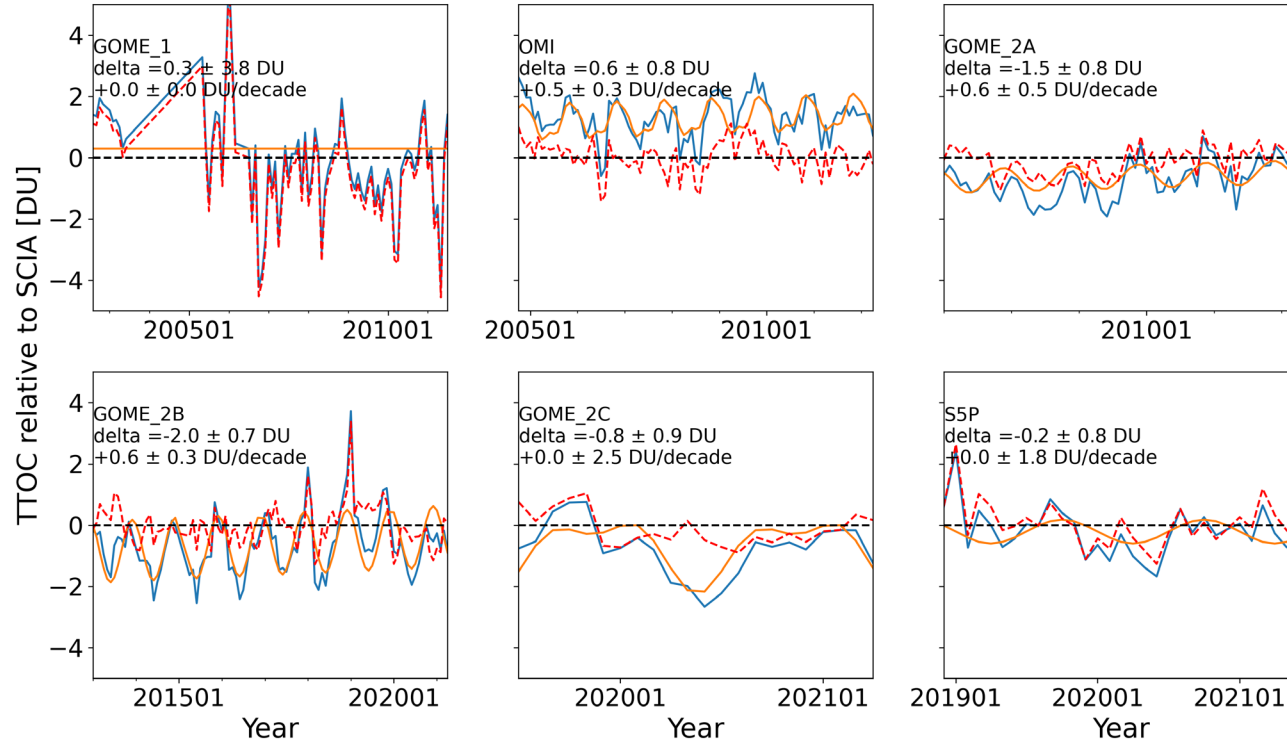
Comparison to SCIAMACHY / Merged data and correction of
- Bias
- Trends
- Seasonal pattern

Method described in Heue et al. 2016 AMT

Tropospheric Trend

Fit to tropospheric ozone above: global tropics
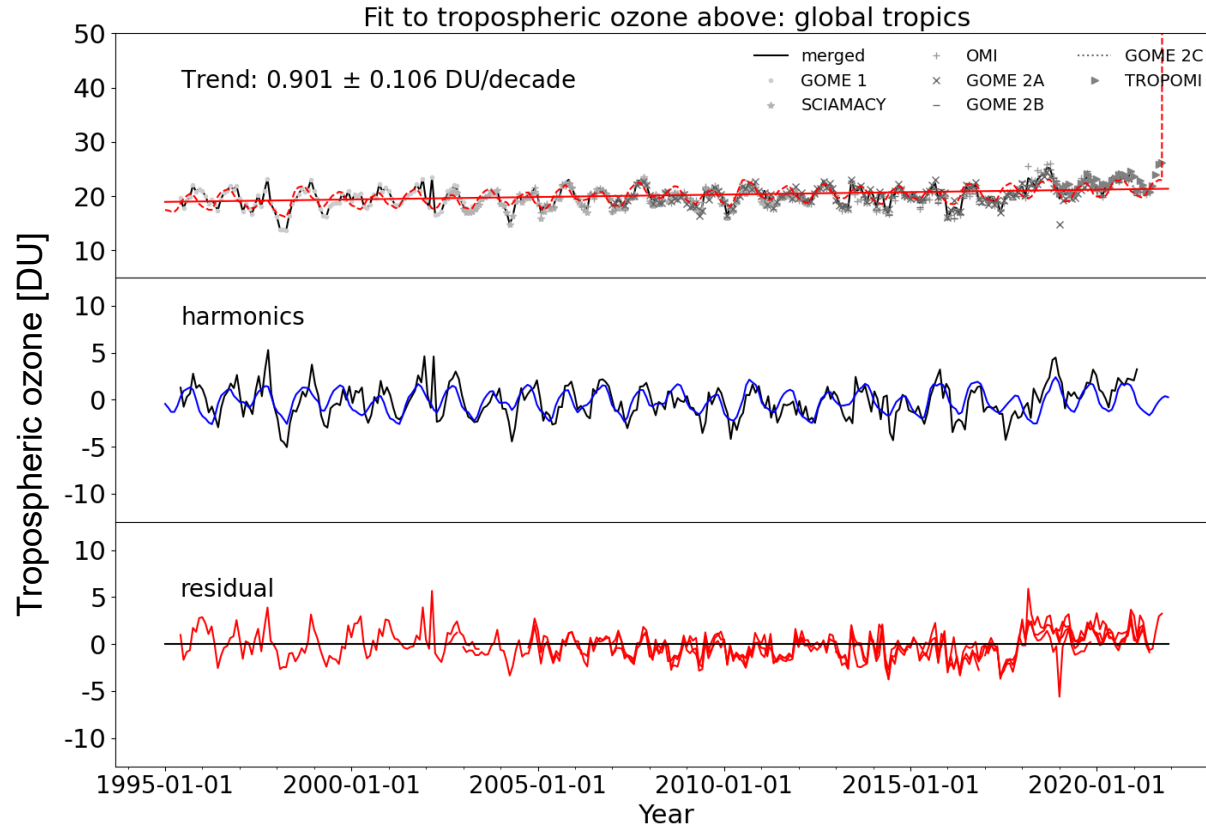
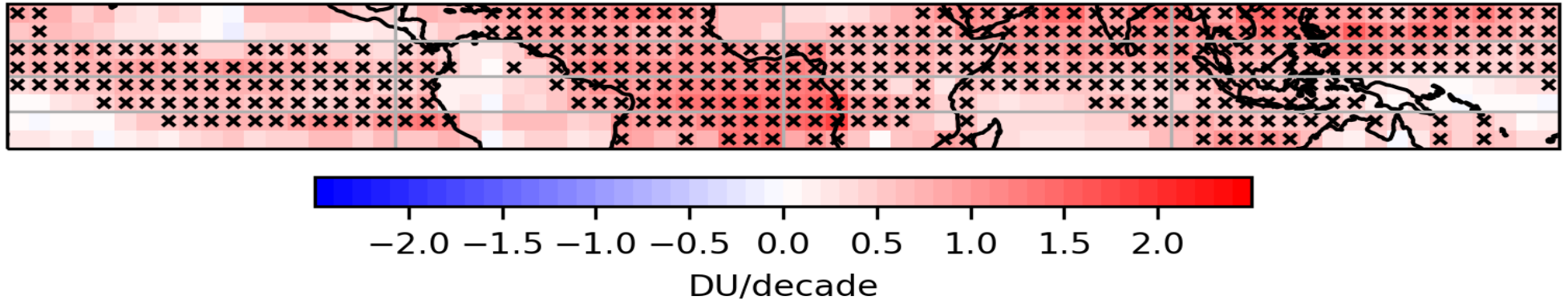The mean trend in the tropics shows an increase of ~0.9 DU/decade

Fitted functions
- Linear
- Harmonics
- QBO indices (not shown)
- ENSO index (not shown)

Tropical trends

trend in tropospheric column ozone

DU/decade

Data averaged to 5°x5° fitted trends as before
x = significant trend (slope > 2 slope error)
No significant decrease found
Strongest increase over African Atlantic coast ~2 DU/decade
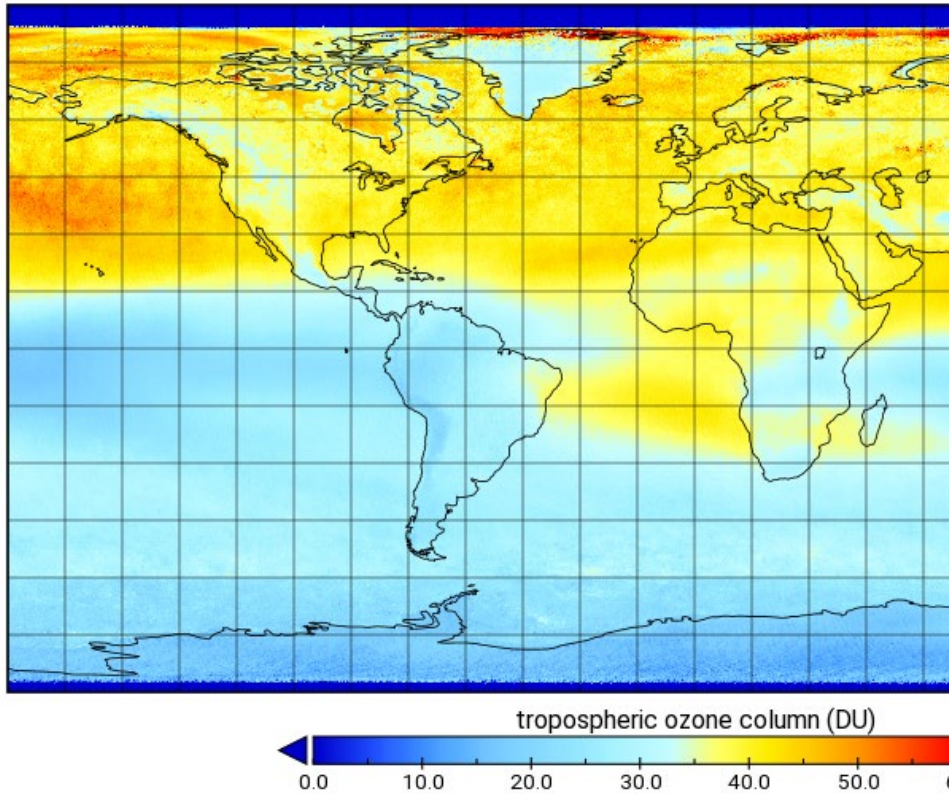
Harmonisation CCI - BASCOE

Total column harmonisation by Coldewey-Egbers (2020 AMT)
For individual sensors and latitude bands using OMI as
reference

Bias and trend correction applied to total columns
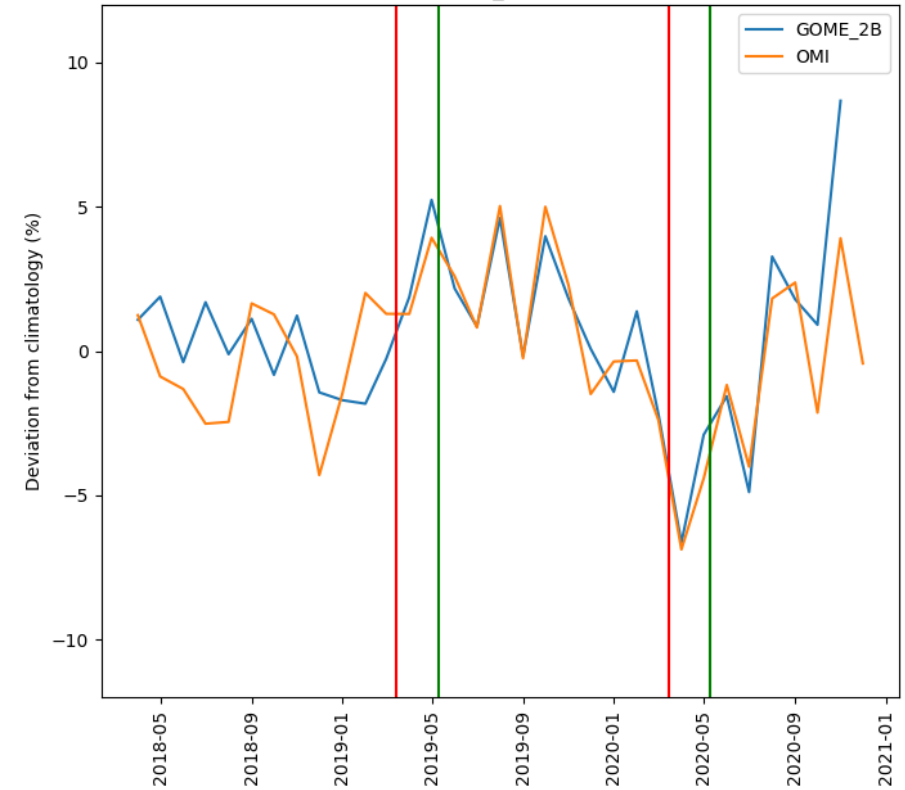Difference added to tropospheric columns

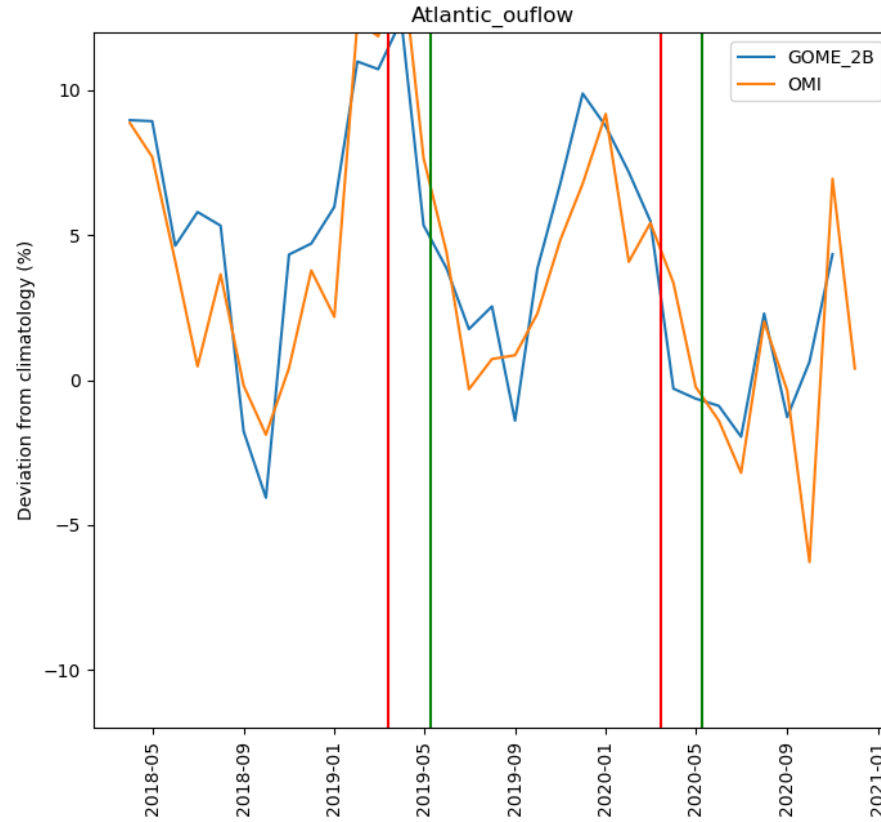# Climatology

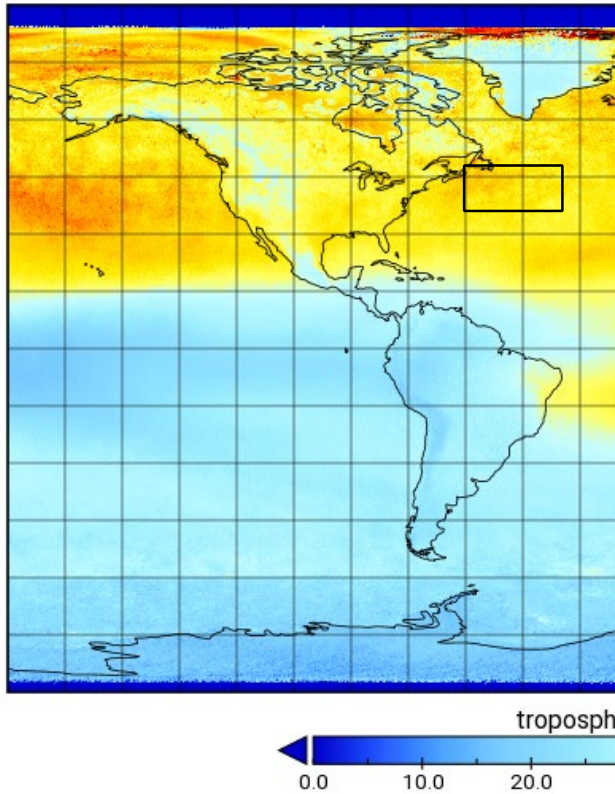

tropospheric ozone column
March

tropospheric ozone column (DU)

Pacific_ouflow

Climatology

troposp...

...d harmonized
month

Summary

Summary
- Based on the CCD data set from 1995 to 2020 we derived a mean tropical trend of 0.9 DU/decade in the tropospheric ozone data
- We are building up a new tropopheric ozone climatology based on the harmonized tropospheric data from CCI – BASCOE
- Comparing the regional and monthly means of tropospheric ozone columns a decrease ~5% relative to the climatology is observed in some parts of the world during the CORONA virus lockdown period in April 2020
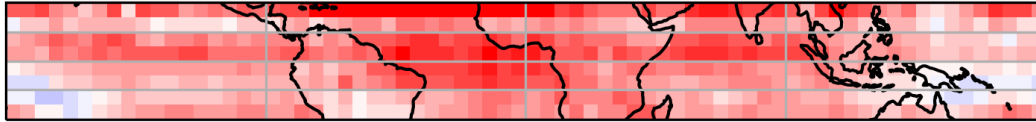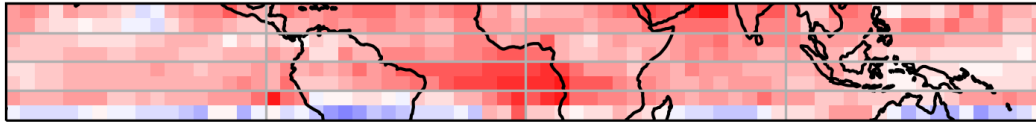
CORONA effect with S5P

Europe
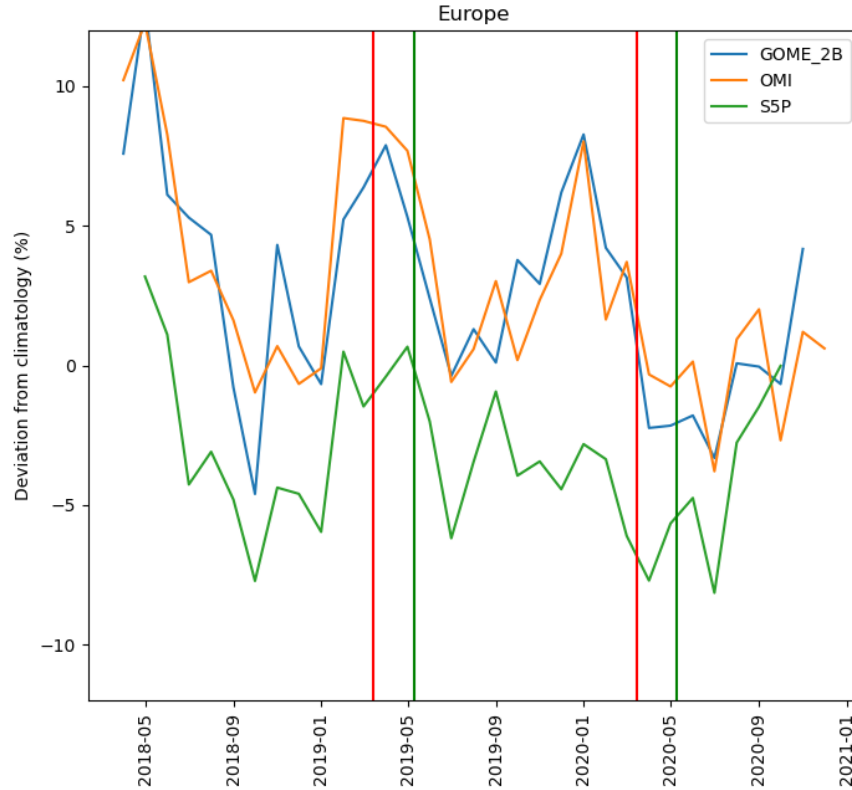
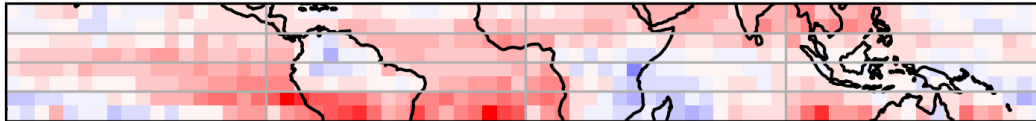There is clear negative bias of S5P relative to OMI and GOME-2B, also the data are not parallel.

trend in tropospheric column ozone (MAM)

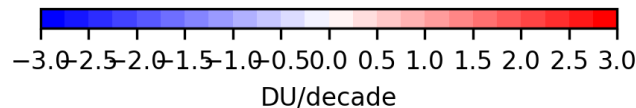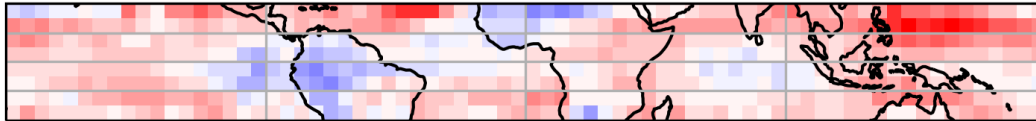trend tropospheric column ozone (JJA)

trend tropospheric column ozone (SON)

trend in tropospheric column ozone (DJF)
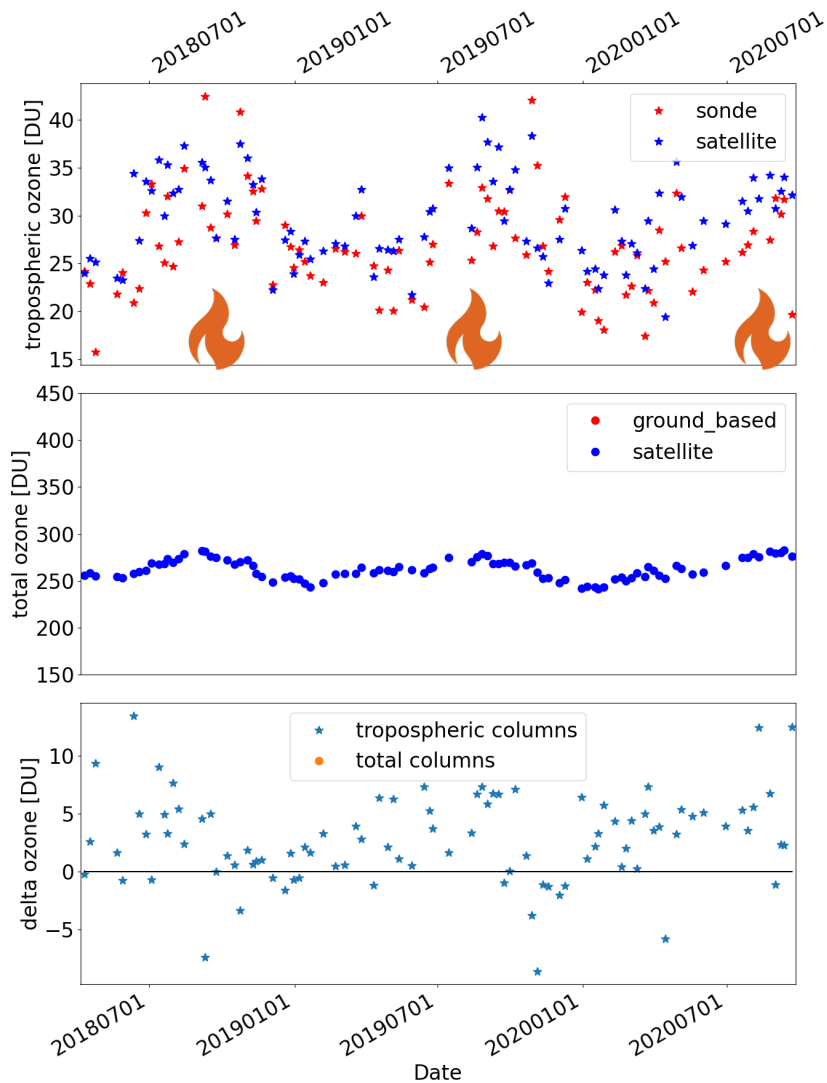
−3.0 −2.5 −2.0 −1.5 −1.0 −0.5 0.0 0.5 1.0 1.5 2.0 2.5 3.0
DU/decade

"All stations exhibit strong positive FT ozone trends in the February-May period …" Thompson et al., 2021
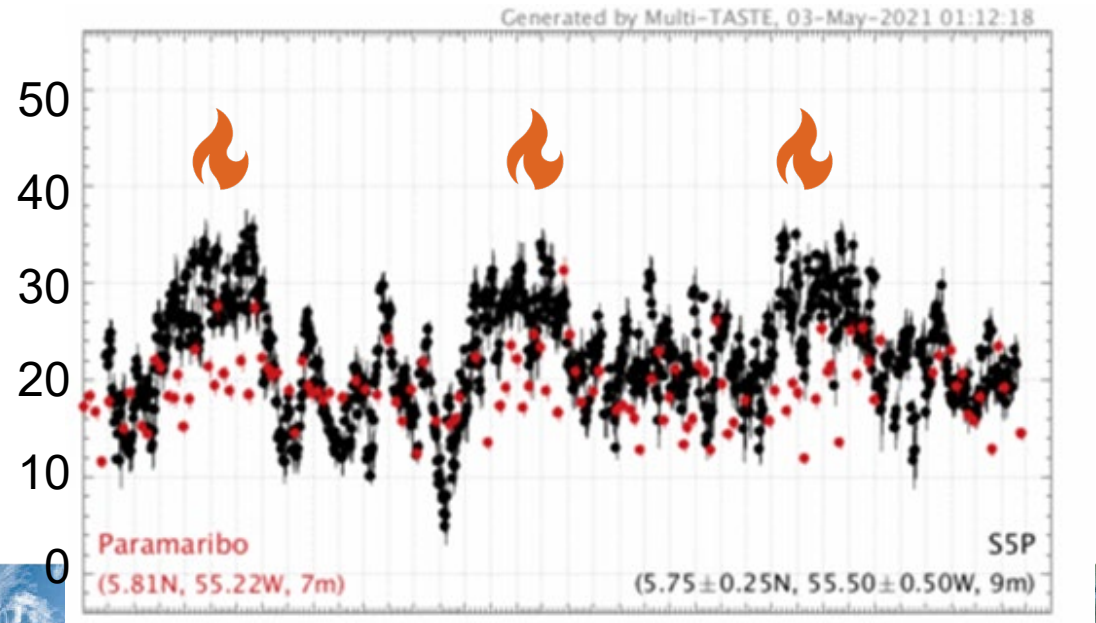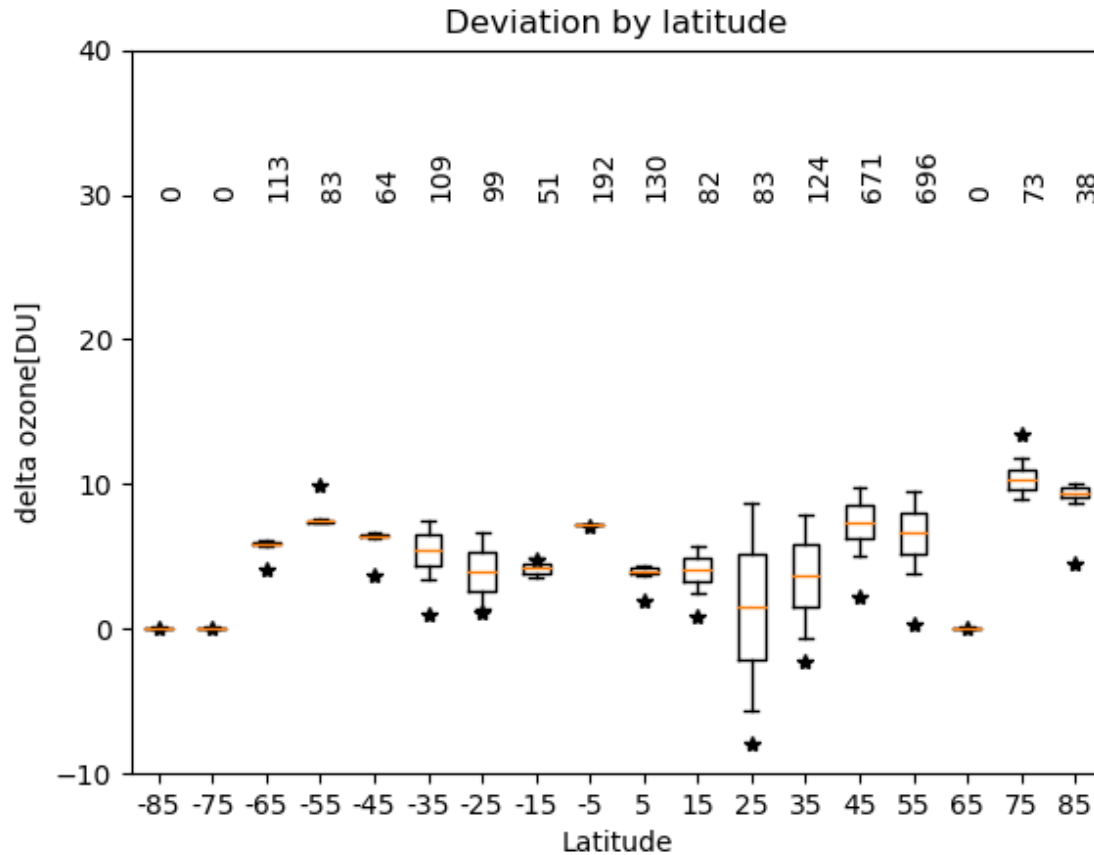
Paramaribo 5.806°N -55.214°E

Validation example

- Overstesimation during the burning season (~5 DU)
- But better agreement compared to the CCD data (~10DU)

S5P_CCD validation courtesy of D. Hubert (BIRA)

Generated by Multi-TASTE, 03-May-2021 01:12:18

Paramaribo
(5.81N, 55.22W, 7m)

(5.75±0.25N, 55.50±0.50W, 9m)

S5P

Mean values per 10° latitude bin

Deviation by latitude

Number of comparisons per latitude band
Not evenly distributed e.g.
258 out of 671 data between 40° N and 50° N
from Hohenpeißenberg

• Mostly positive bias up to ~10 DU