Global tropospheric ozone from a combined retrieval using TROPOMI/S5P and BASCOE and algorithm application to GEMS

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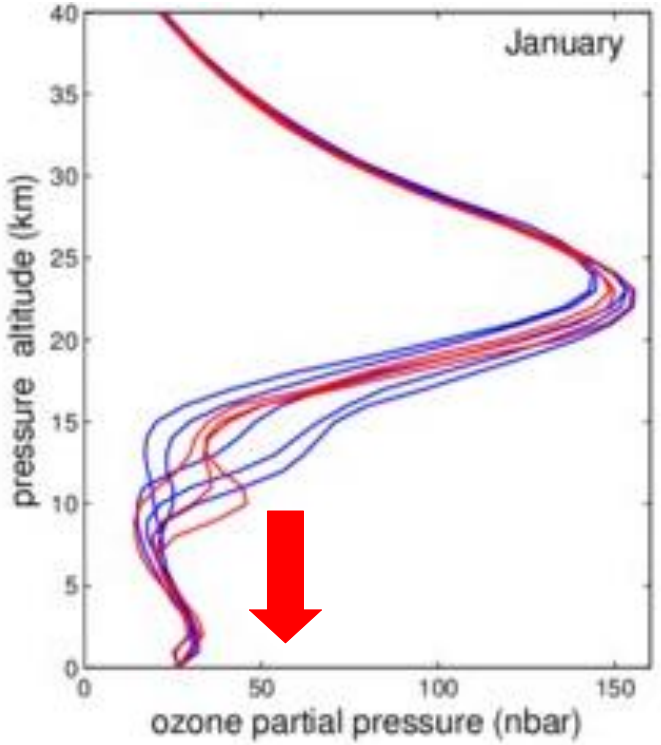
Outline

- Motivation
  - Why tropospheric ozone?
- S5p- BASCOE
  - Algorithm
- Example results
  - Global Distribution
  - Athens and Berlin
  - validation
- Application to GEMS

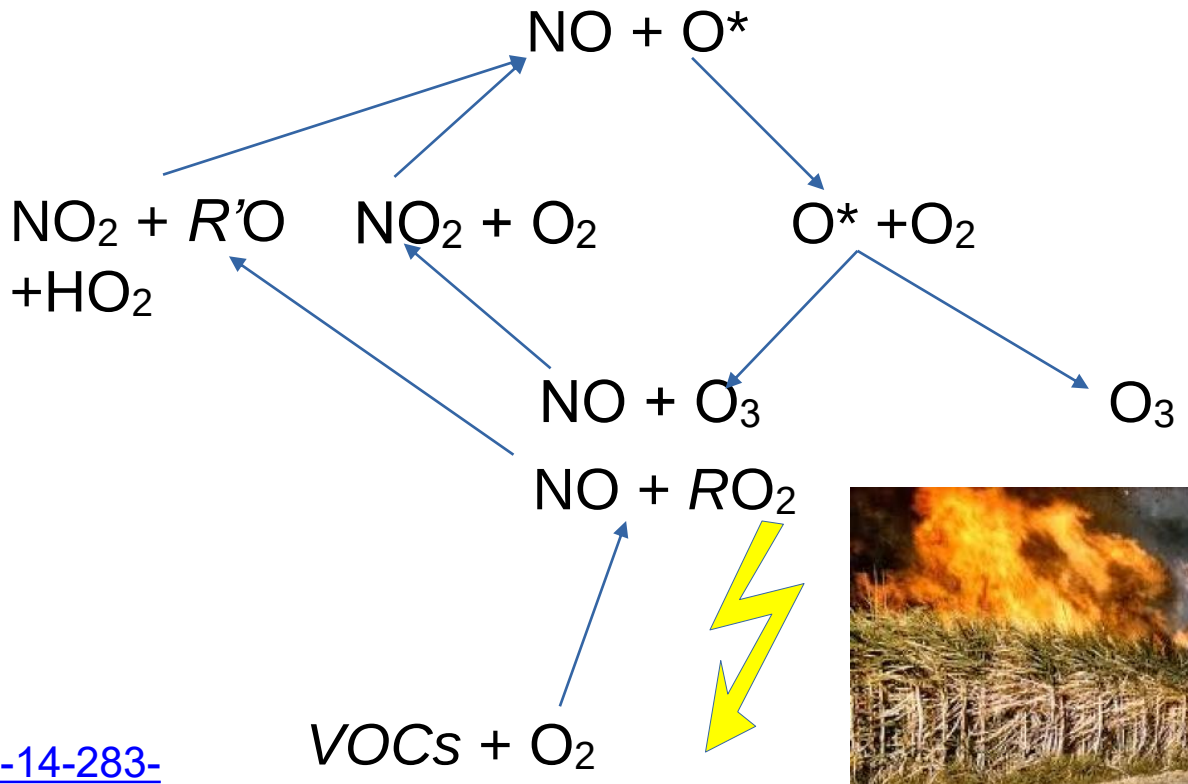
Sources of tropospheric Ozone

Downwards transport ~10%

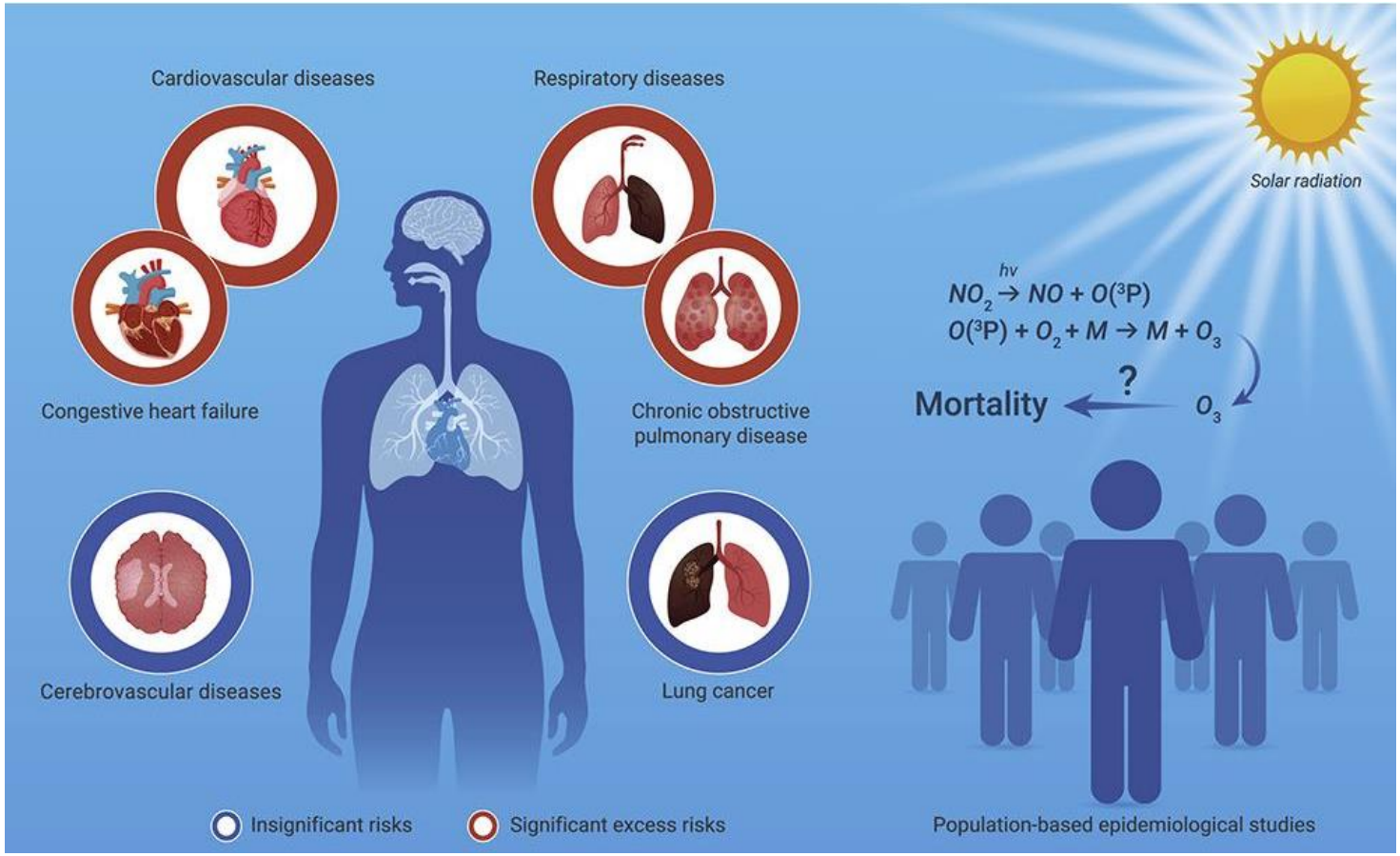


Sofieva et al. 2014 DOI: [10.5194/acp-14-283-2014](10.5194/acp-14-283-2014)

Chemical Production ~90%



Health effect of tropospheric ozone



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Check for updates

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Ozone pollution threatens the production of major staple crops in East Asia

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East Asia is a hotspot of surface ozone (O_3) pollution, which hinders crop growth and reduces yields. Here, we assess the relative yield loss in rice, wheat and maize due to O_3 by combining O_3 elevation experiments across Asia and air monitoring at about 3,000 locations in China, Japan and Korea. China shows the highest relative yield loss at 33%, 23% and 9% for wheat, rice and maize, respectively. The relative yield loss is much greater in hybrid than inbred rice, being close to that for wheat. Total O_3-induced annual loss of crop production is estimated at US$63 billion. The large impact of O_3 on crop production urges us to take mitigation action for O_3 emission control and adaptive agronomic measures against the rising surface O_3 levels across East Asia.

Tropospheric ozone (O_3) is a secondary air pollutant produced

assess the yield losses induced by ambient O_3. Estimates of yield loss

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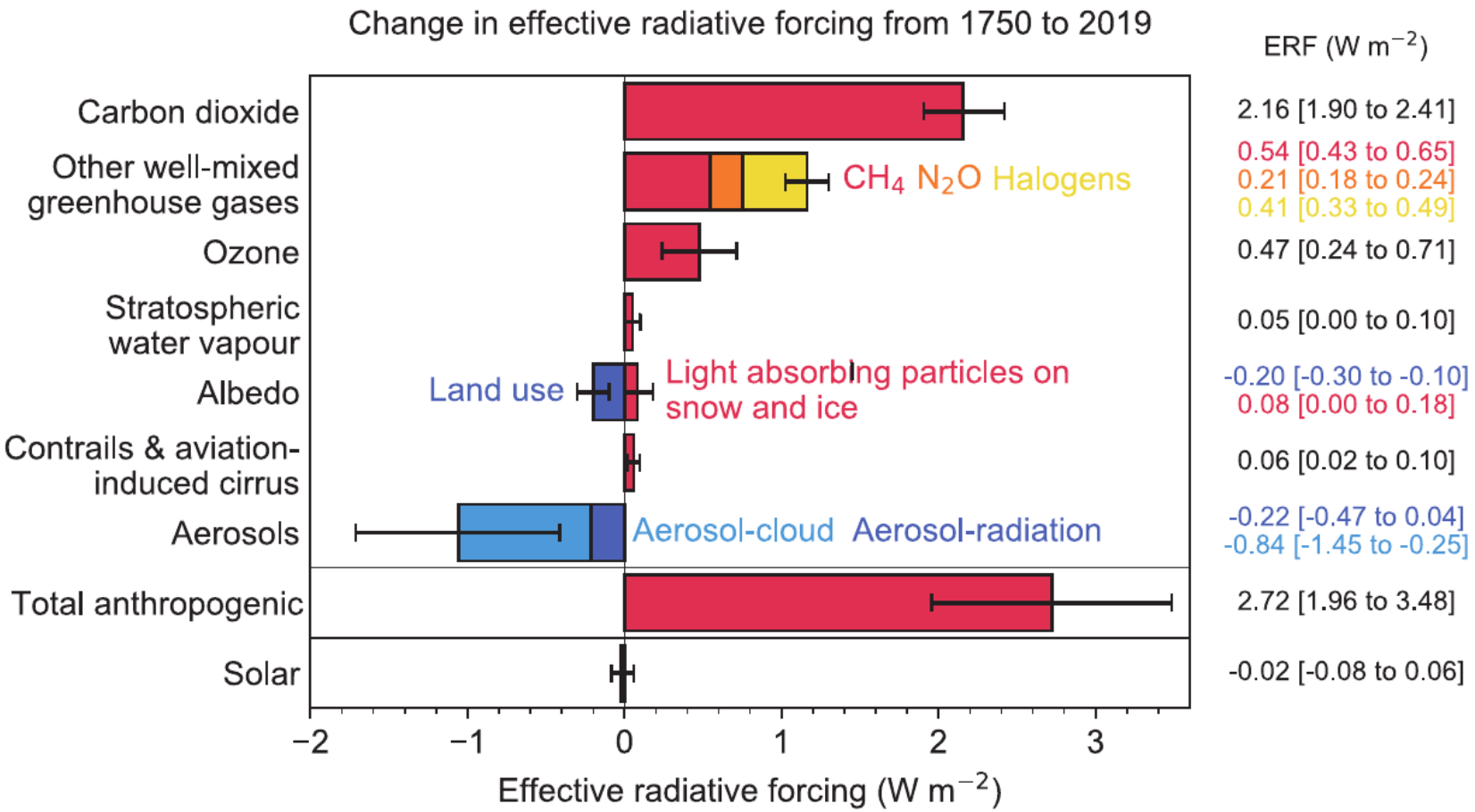
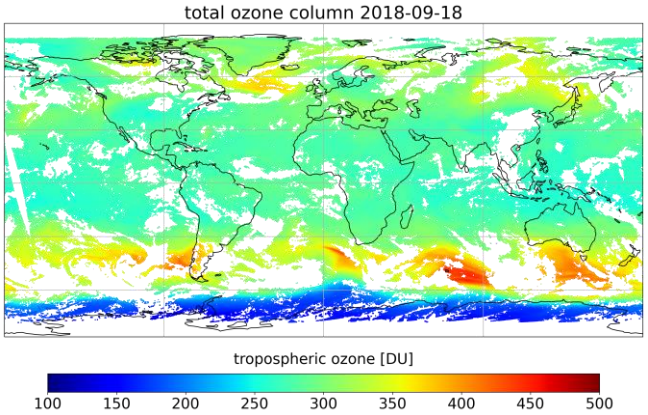
Ozone is green house gas

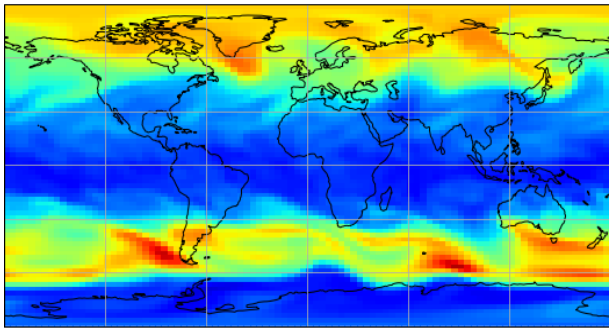


www.ipcc.ch

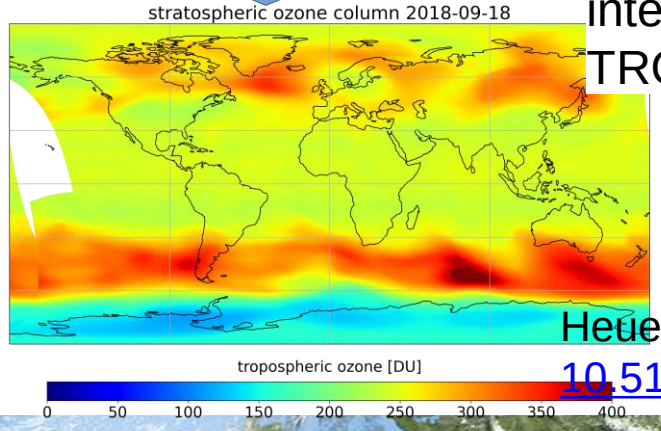
S5P - BASCOE



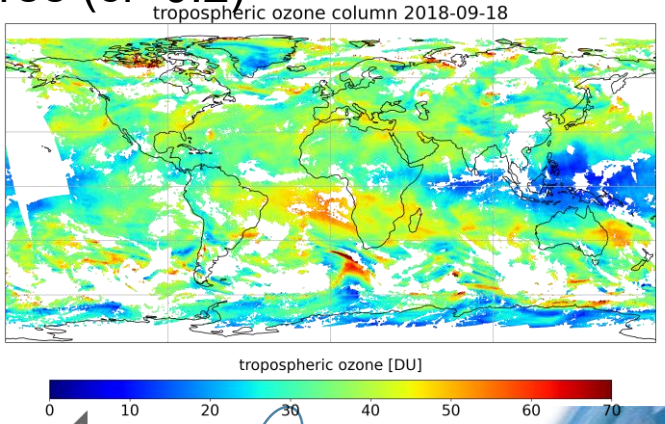
TROPOMI total column ozone cloud free (cf<0.2)



BASCOE ozone profile integrated above tropopause and interpolated to TROPOMI pixel



Subtract Stratospheric from Total Column



Heue et al. 2022
10.5194/amt-15-5563-2022

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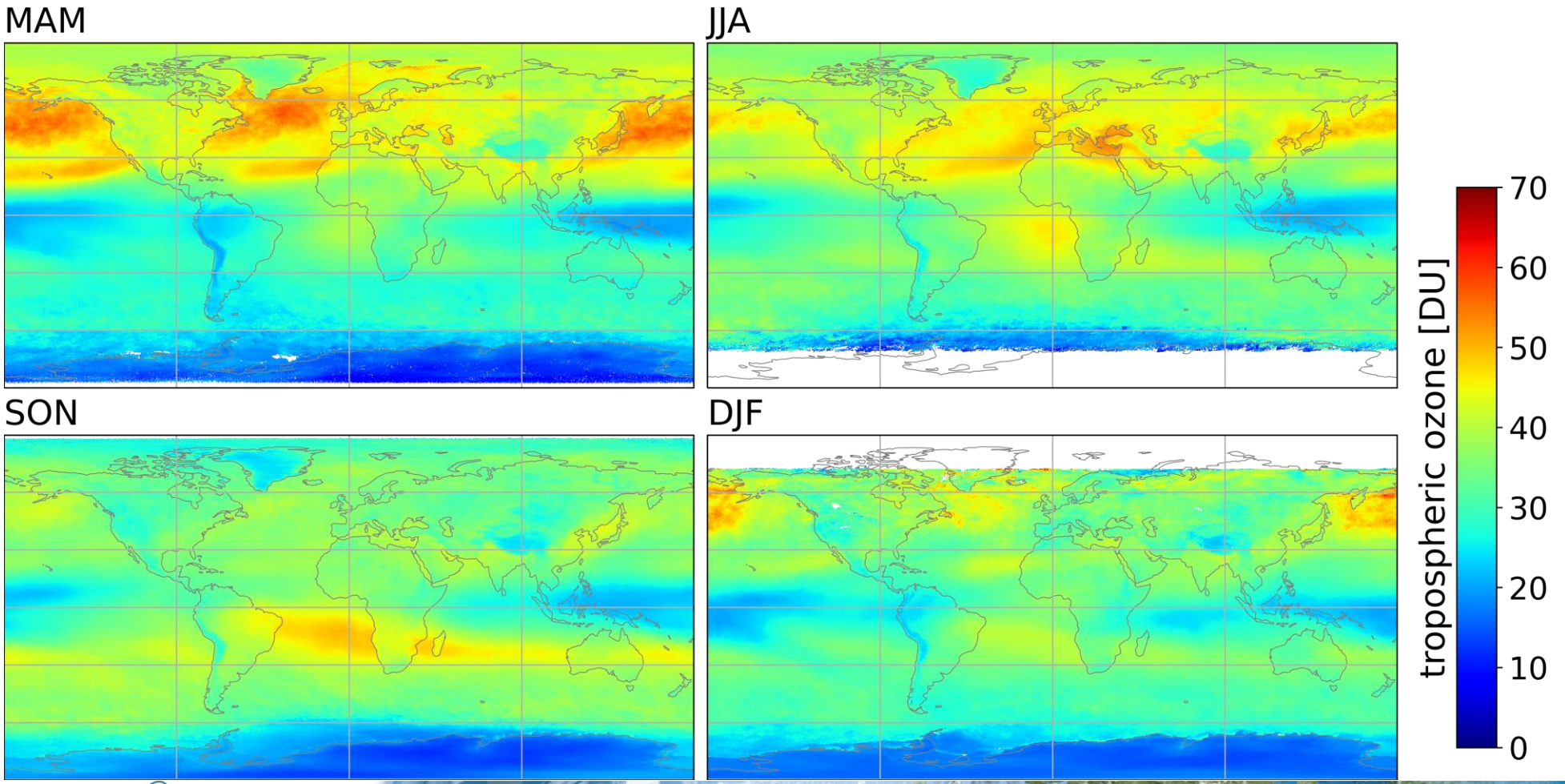
Example tropospheric Ozone



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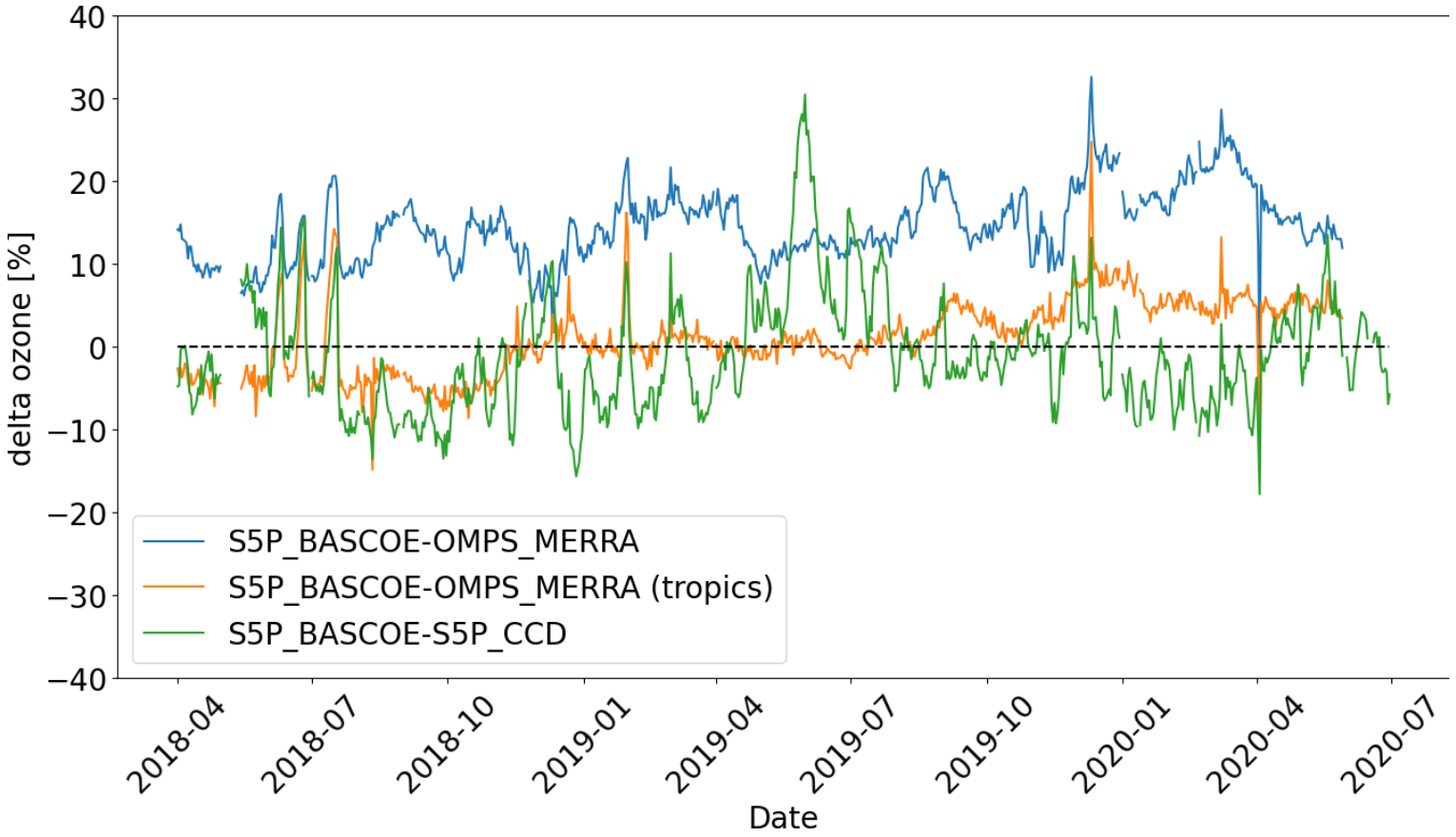
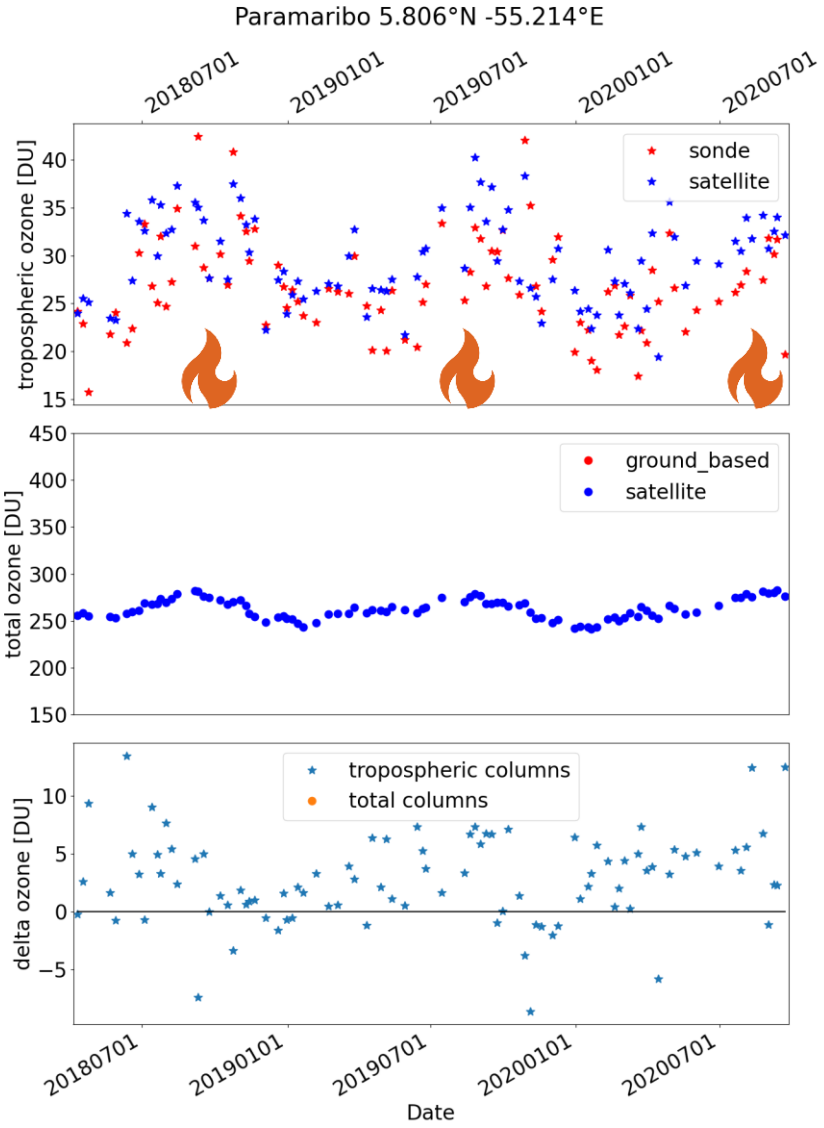
Comparison to S5p/CCD and OMPS-Merra

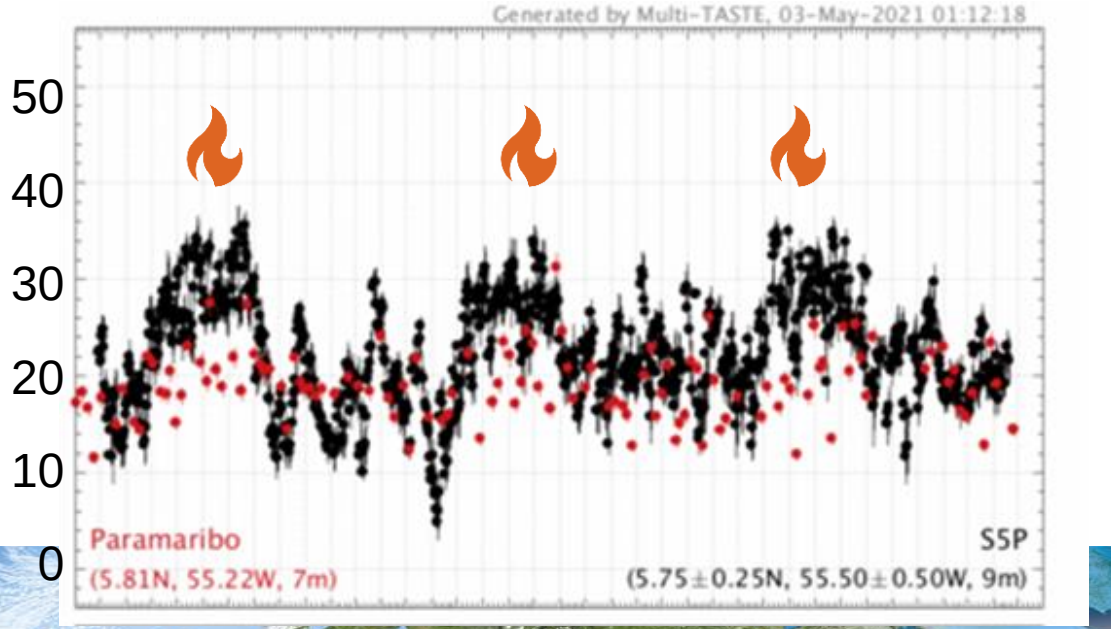




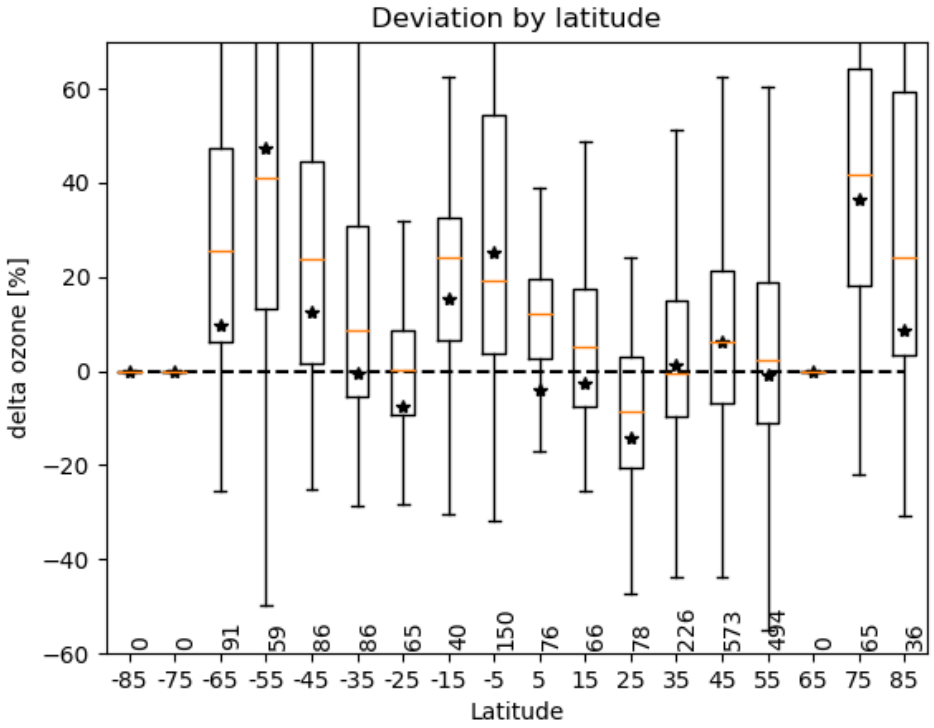
Validation example

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

S5P_CCD validation courtesy of D. Hubert (BIRA)



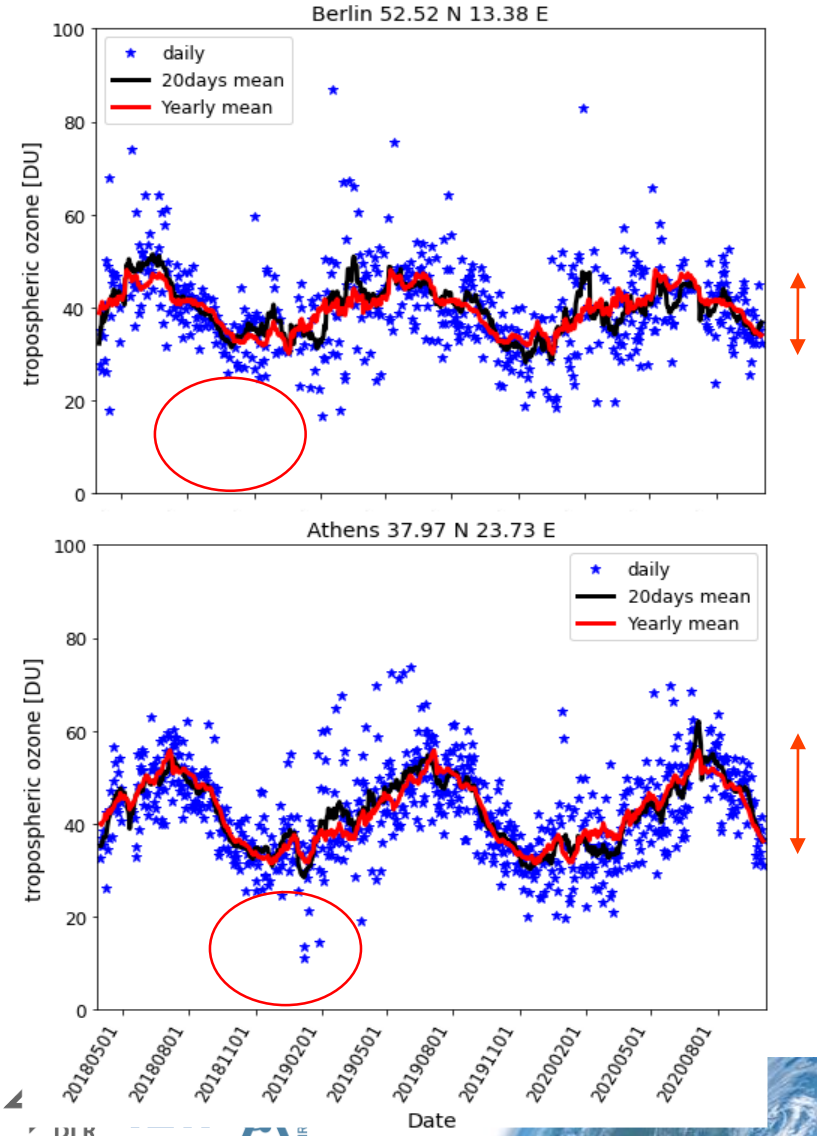
Mean deviations from sondes per 10° latitude bin

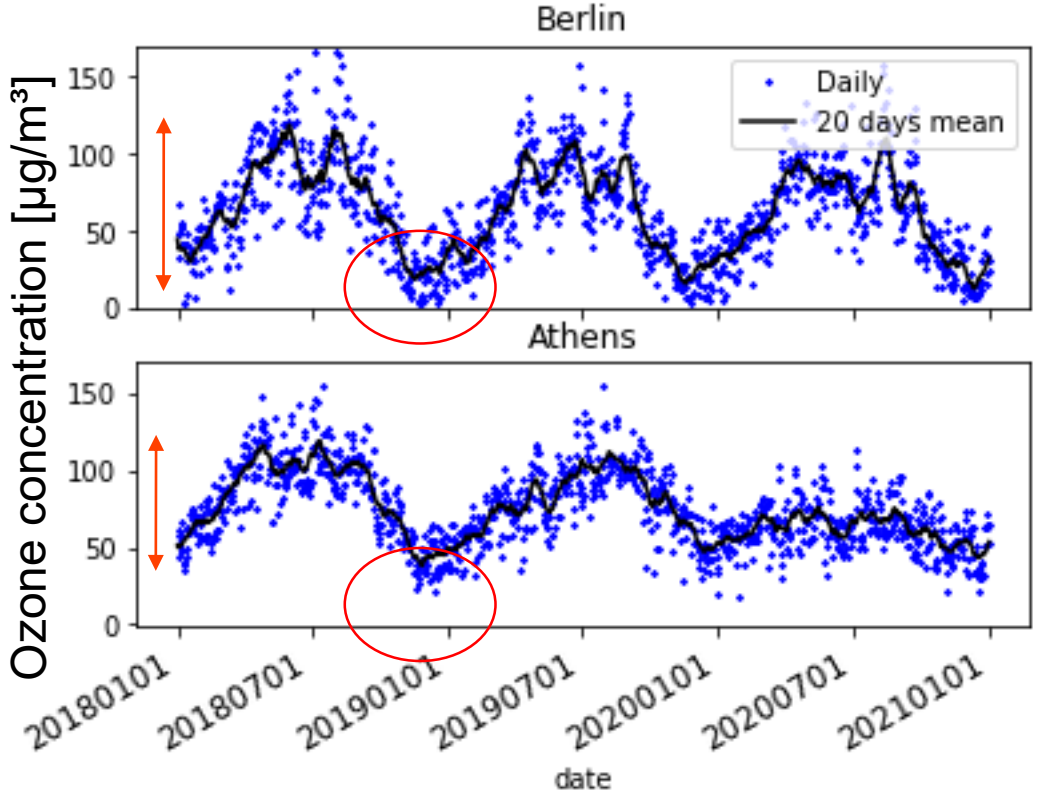


- Sonde profile integrated up to the tropopause
- S5P-BASCOE data averaged 25 km around sonde stations (~ 2000 comparisons)

	DU	%
S5P-CCD	0.91 ± 5.67	-0.82 ± 21.71
OMPS-MERRA2	3.33 ± 7.64	14.59 ± 31.51
Sondes	2.8 ± 9.4	15.5 ± 29.9

Columns and surface concentrations

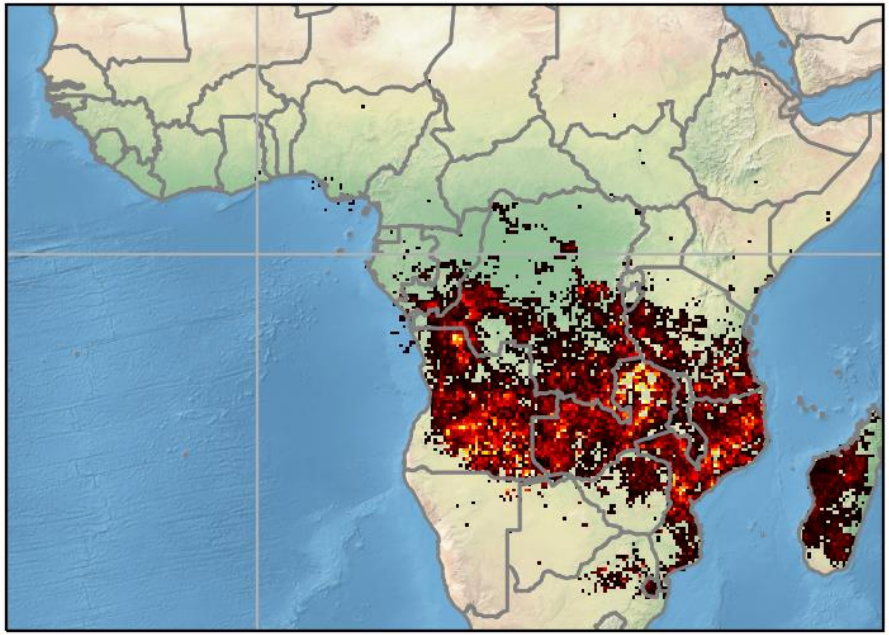




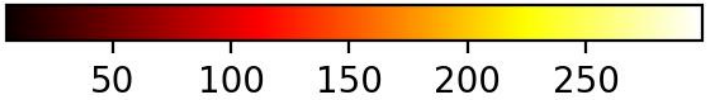
https://discomap.eea.europa.eu/map/fme/AirQualityExport.htm

Example African biomas burning

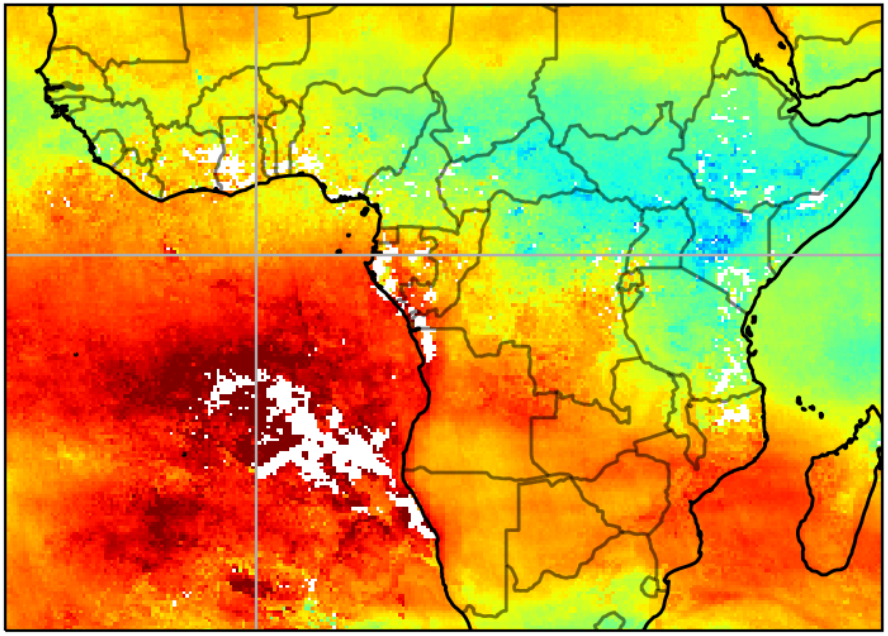
fire counts 2019/09/01–2019/09/07



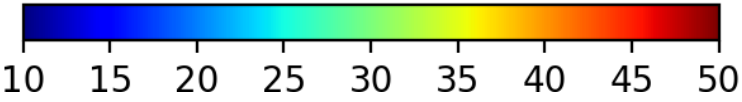
(a)



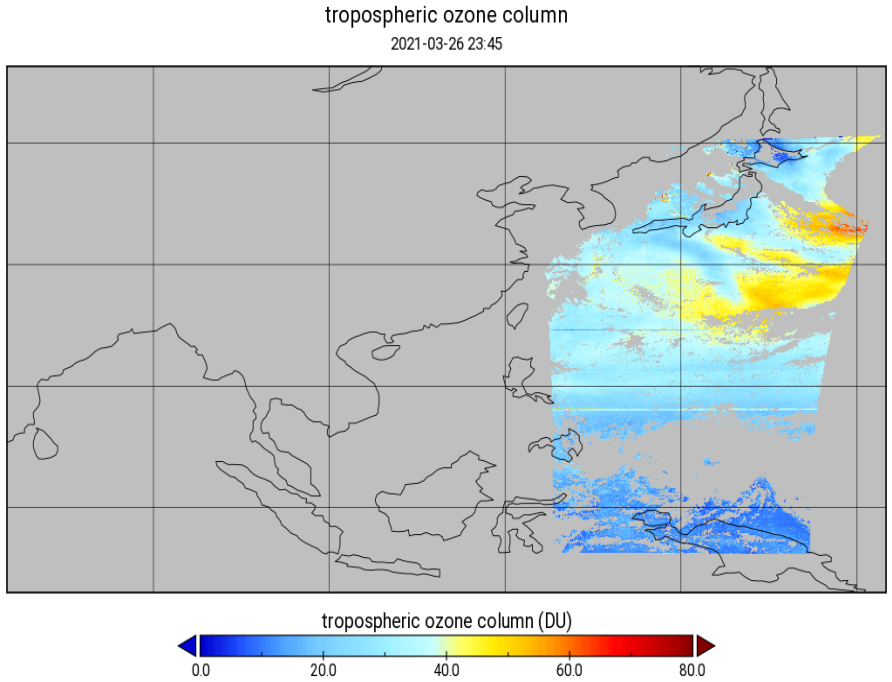
tropospheric ozone [DU] 2019/09/01–2019/09/07



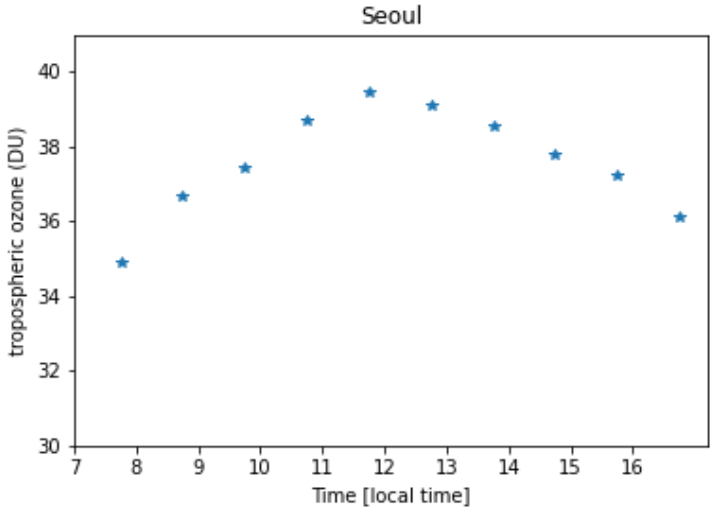
(b)



GEMS - BASCOE



Analysed data from 21 March – 30 June 2021
Cloud free observations only (cf <30%)
Mean daily cycle for Seoul



Summary

- High resolution TROPOMI/S5P tropospheric columns have been generated
- Relative to the sondes it shows a bias 2.8 DU and 3.3 or 0.9 DU to comparable satellite product
- S5P-BASCOE can be applied to Geostationary data as well GEMS- BASCOE showed nice daily cycle for Seoul. In the mean for April-June 2021

Outlook

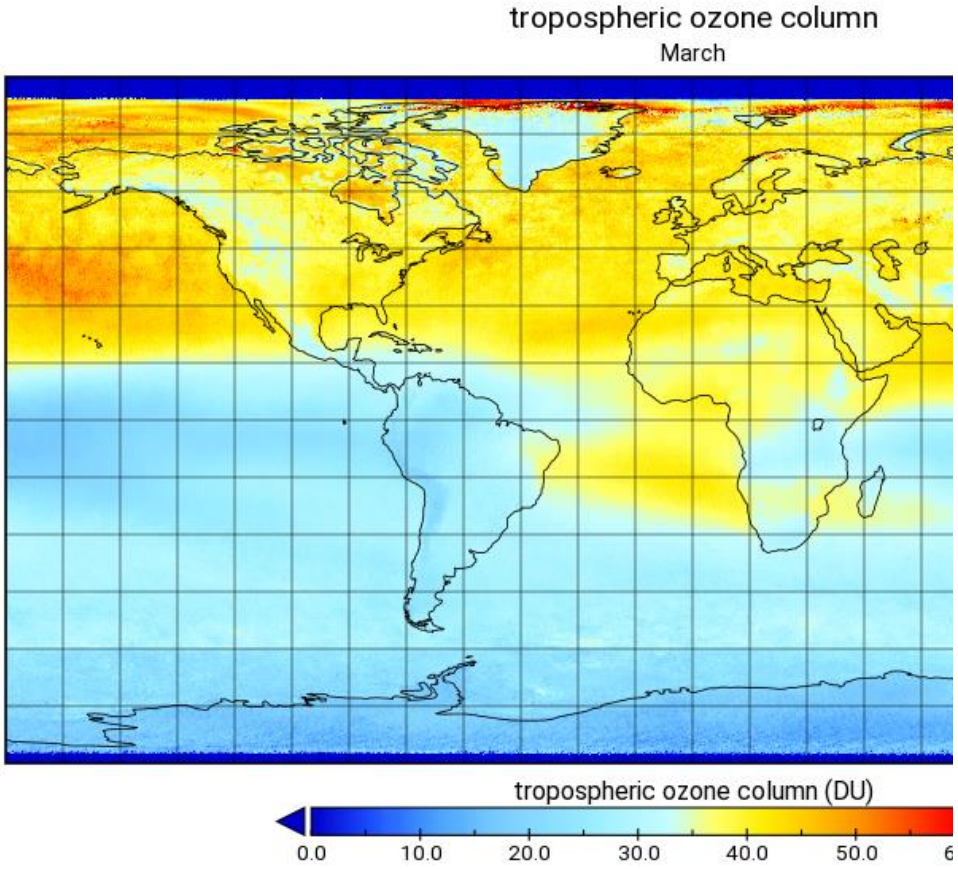
- The S5P -BASCOE algorithm is also applied to other sensors: GOME-2 and OMI (C3S GODFIT dataset)
- Building up a climatology for tropospheric ozone
- Setting up an operational dissemination infrastructure for S5P-BASCOE

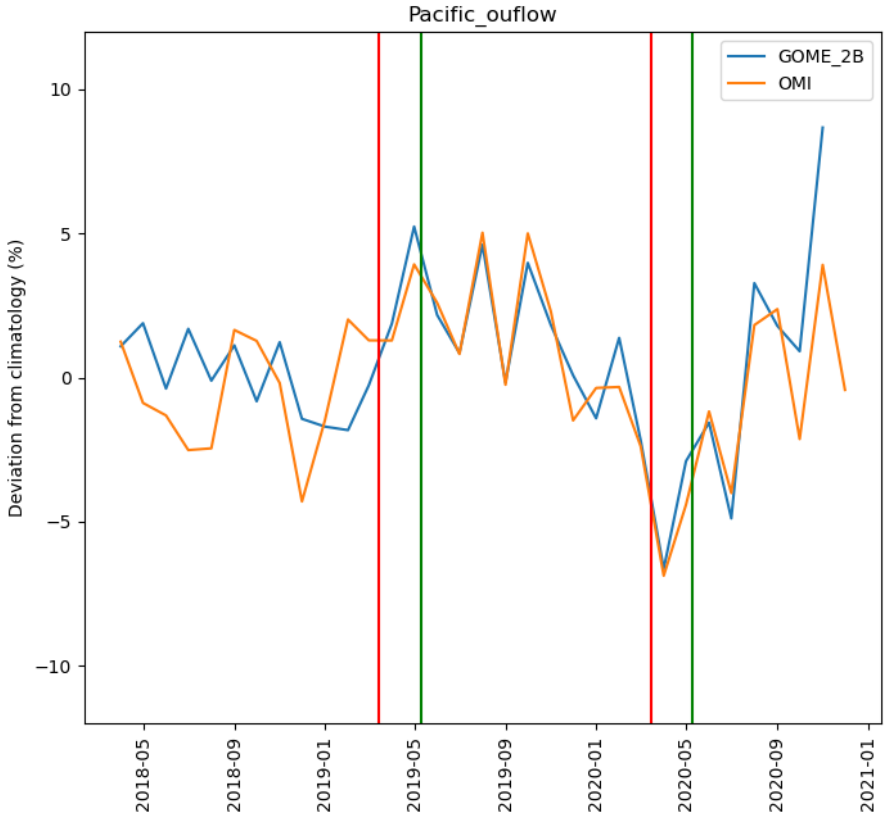
Harmonisation CCI - BASCOE

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

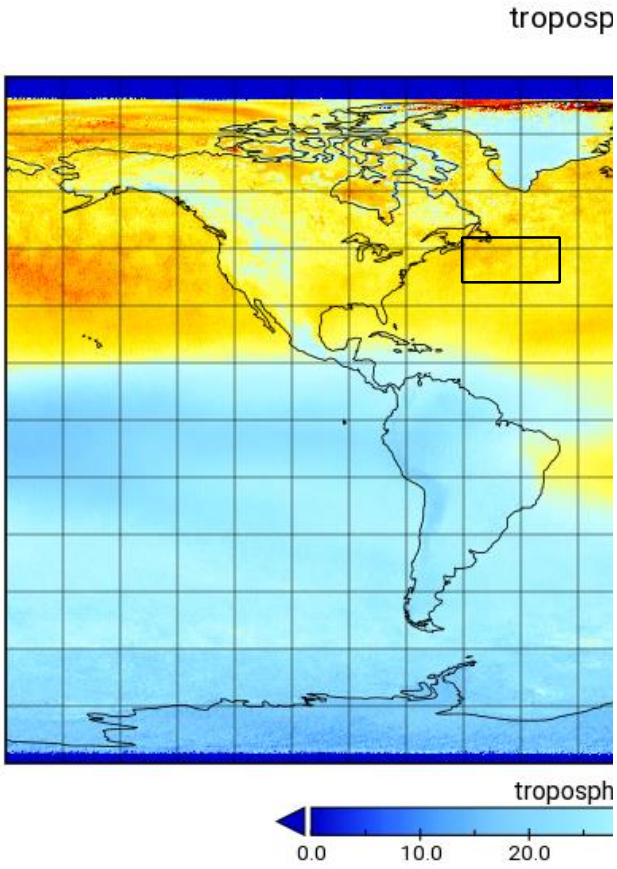
Bias and trend correction applied to total columns
Difference added to tropospheric columns

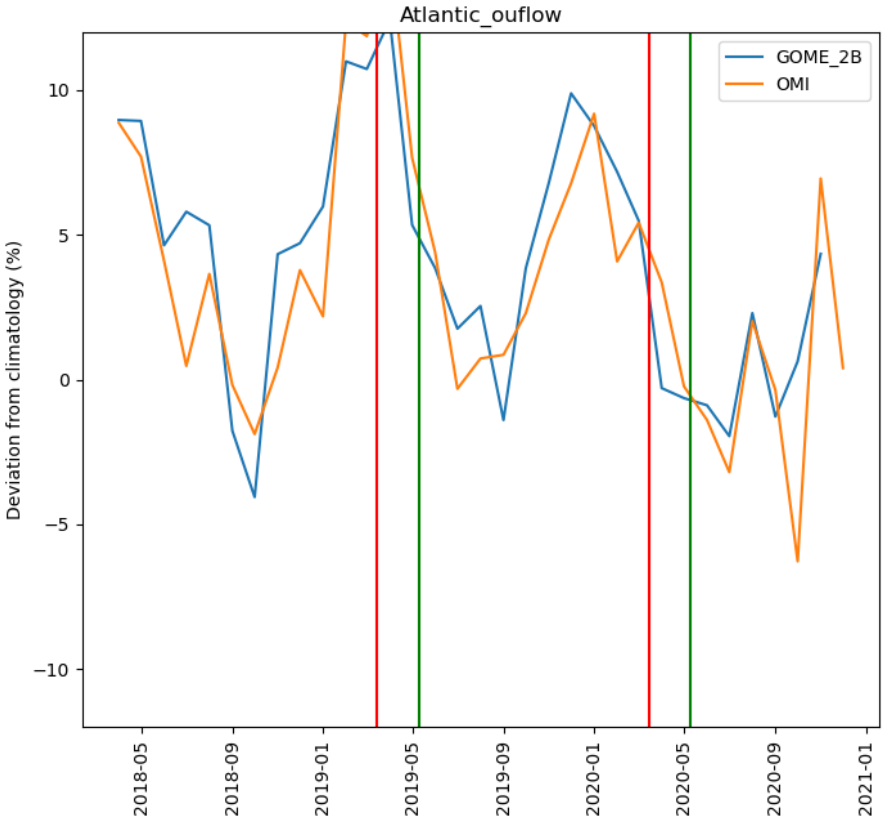
Climatology





Climatology





l harmonized
month