

# Tropospheric ozone columns observed by S5P/TROPOMI combined with BASCOE MLS data

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3. NASA GSFC, Washington D.C., USA



Knowledge for Tomorrow

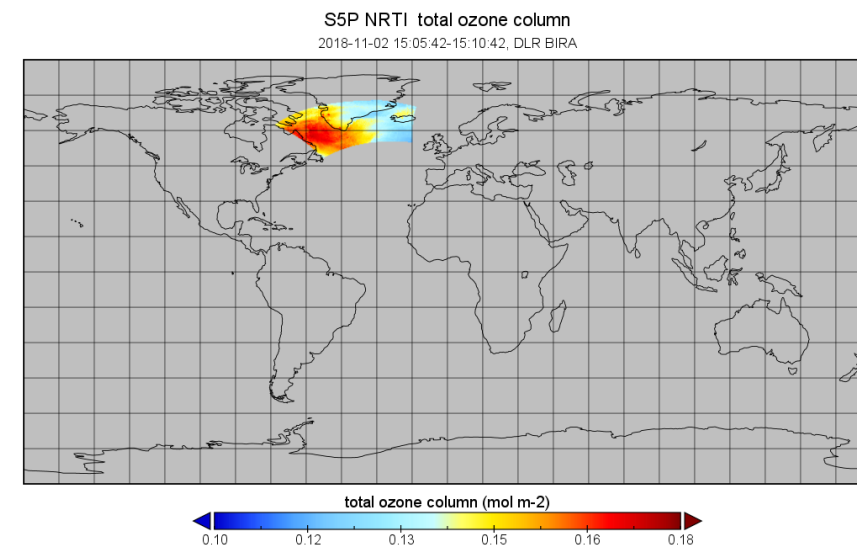
# Overview

- Method
  - S5P total columns to S5P-BASCOE/MLS tropospheric column
- Comparison to OMPS-MLS (J. Ziemke)
- Groundbased validation
- Results
  - Global
  - Central Africa
  - Northern America
  - Mediterranean
  - East Asia



# Method

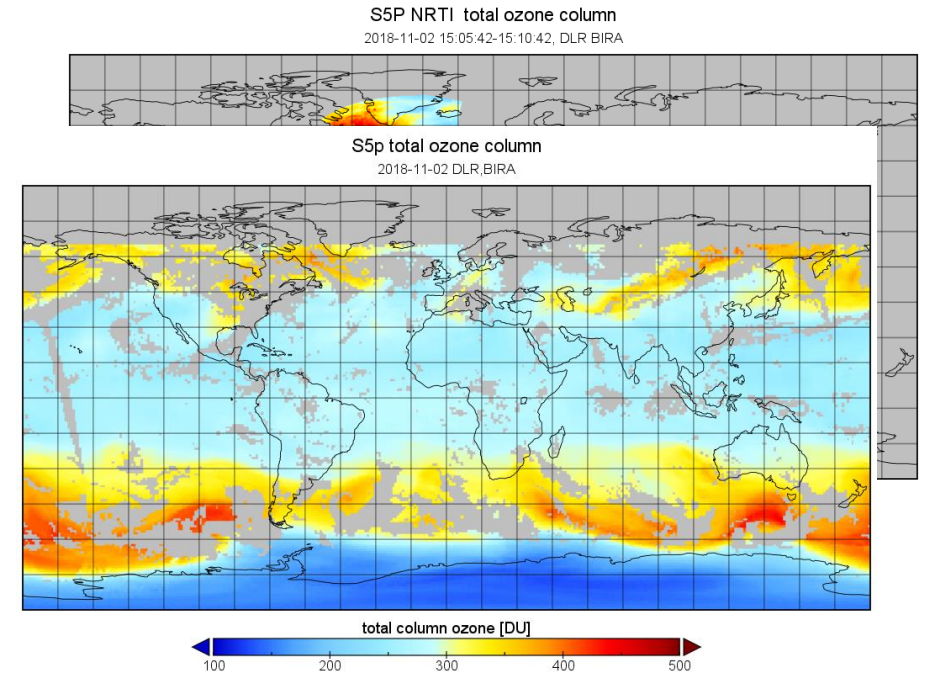
TROPOMI NRTI total ozone column



## Method

TROPOMI NRTI total ozone column

TROPOMI Total ozone columns for cloud free observation for one day gridded to  $0.2^\circ \times 0.2^\circ$

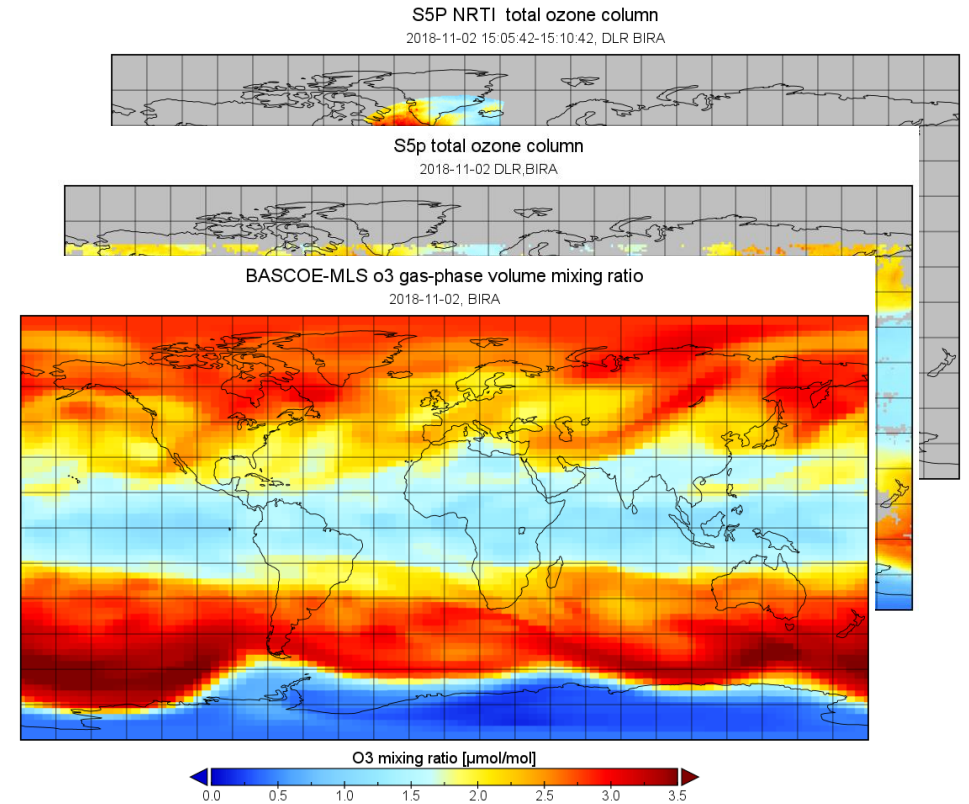


## Method

TROPOMI NRTI total ozone column

TROPOMI Total ozone columns for cloud free observation for one day gridded to  $0.2^\circ \times 0.2^\circ$

BASCOE \ MLS stratospheric ozone mixing ratios and tropopause pressure





## Method

TROPOMI NRTI total ozone column

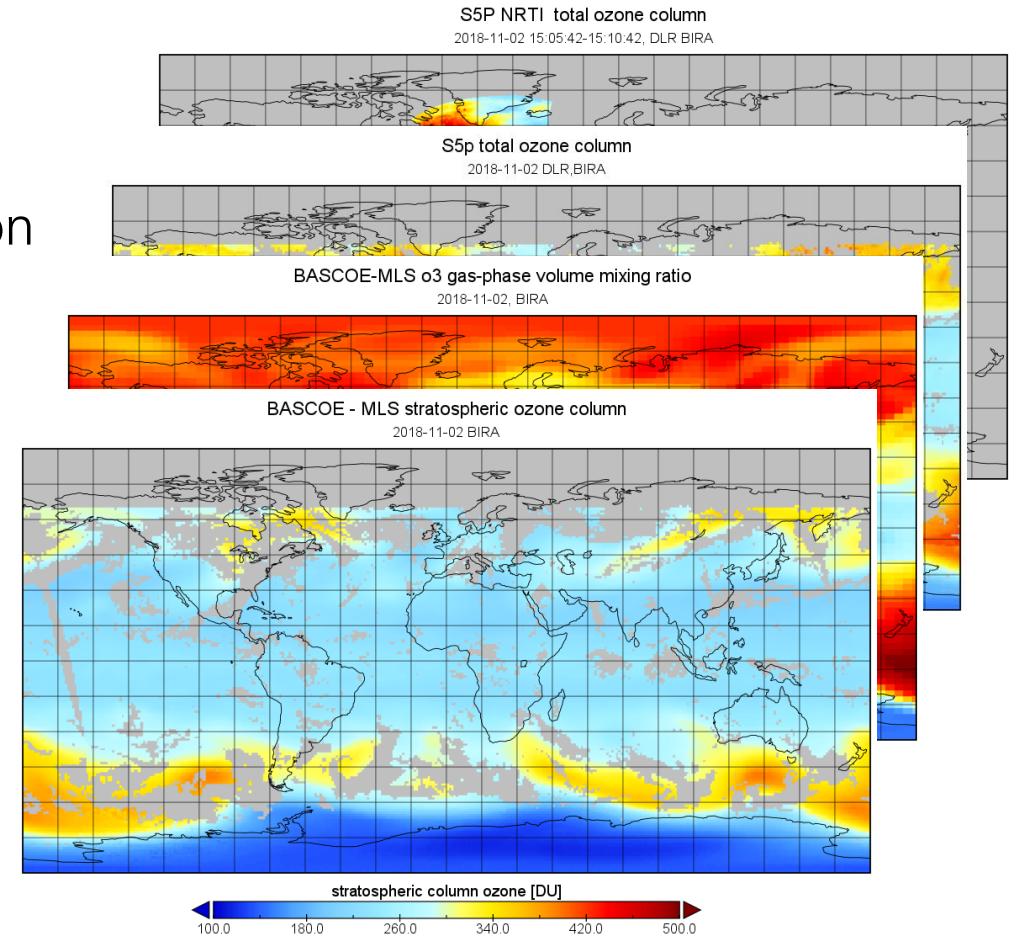
TROPOMI Total ozone columns for cloud free observation for one day gridded to  $0.2^\circ \times 0.2^\circ$

BASCOE \ MLS stratospheric ozone mixing ratios and tropopause pressure

Integrate mixing ratio above tropopause

Interpolate linear in time and place to S5P observations

Subtract stratospheric from total ozone column



## Method

TROPOMI NRTI total ozone column

TROPOMI Total ozone columns for cloud-free pixels for one day gridded to  $0.2^\circ \times 0.2^\circ$

BASCOE \ MLS stratospheric ozone mixing ratio above tropopause pressure

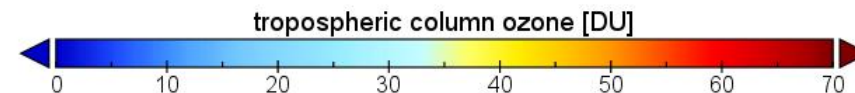
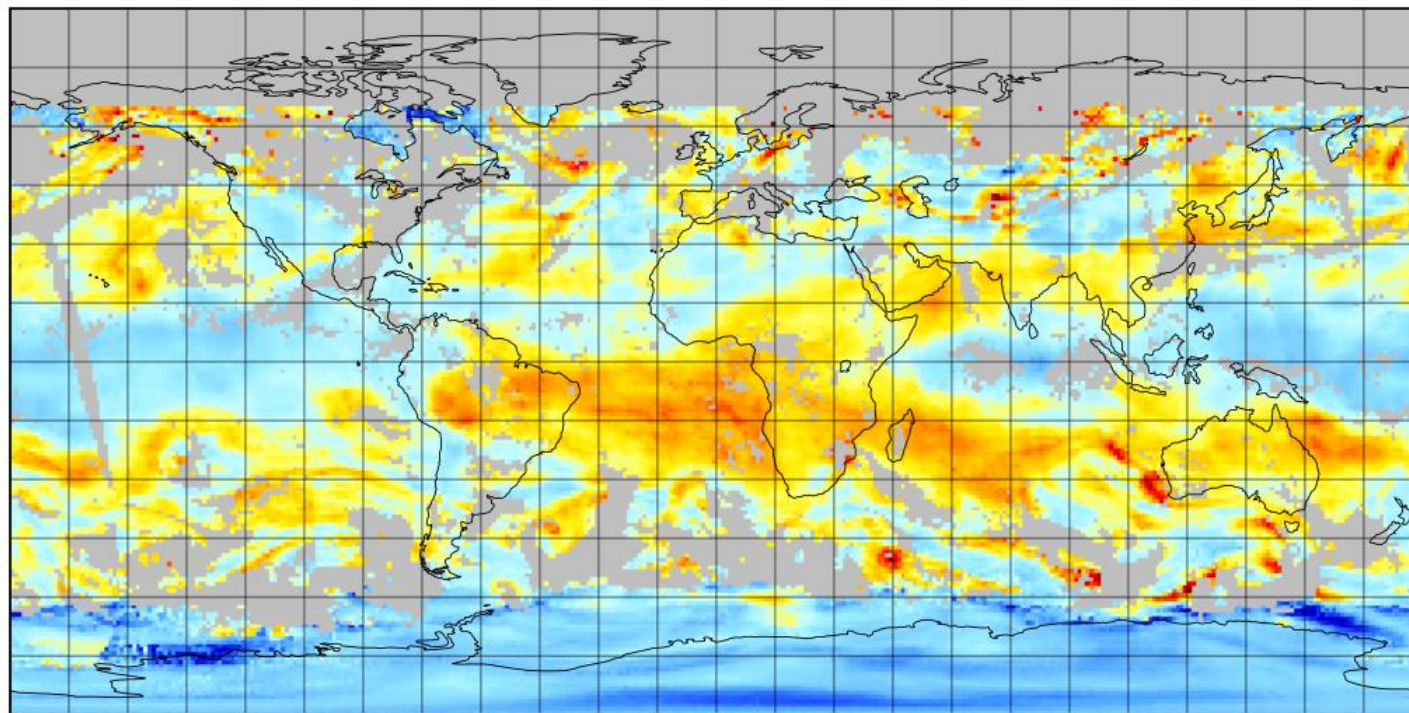
Integrate mixing ratio above tropopause

Interpolate linear in time and place to 1 km resolution

Subtract stratospheric from total ozone column

S5p - BASCOE tropospheric ozone column

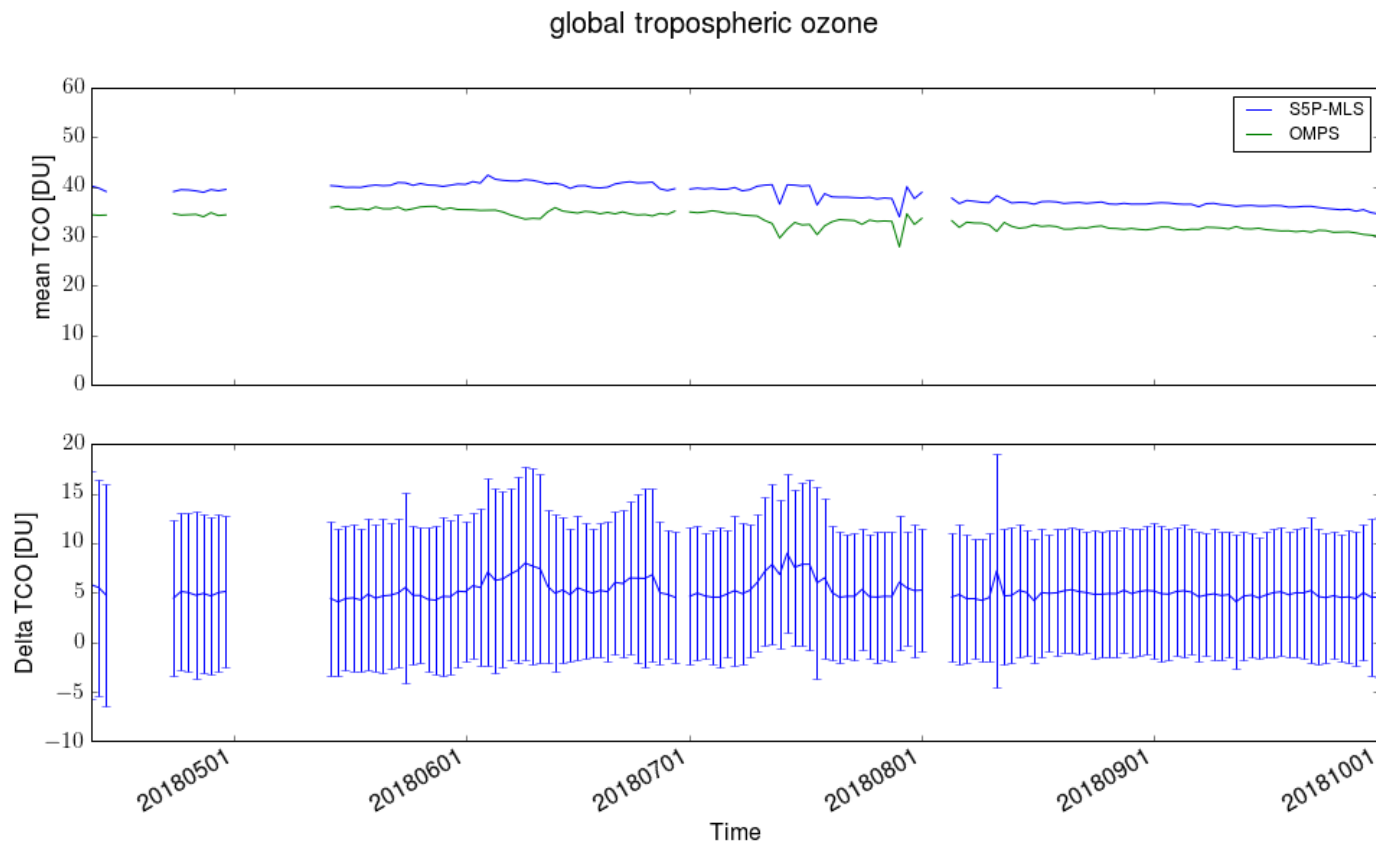
2018-11-02 DLR,BIRA



## Comparison to OMPS-MERRA2/MLS

5 DU BIAS (constant) due to

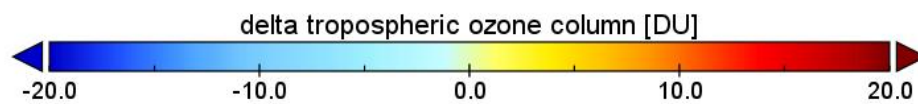
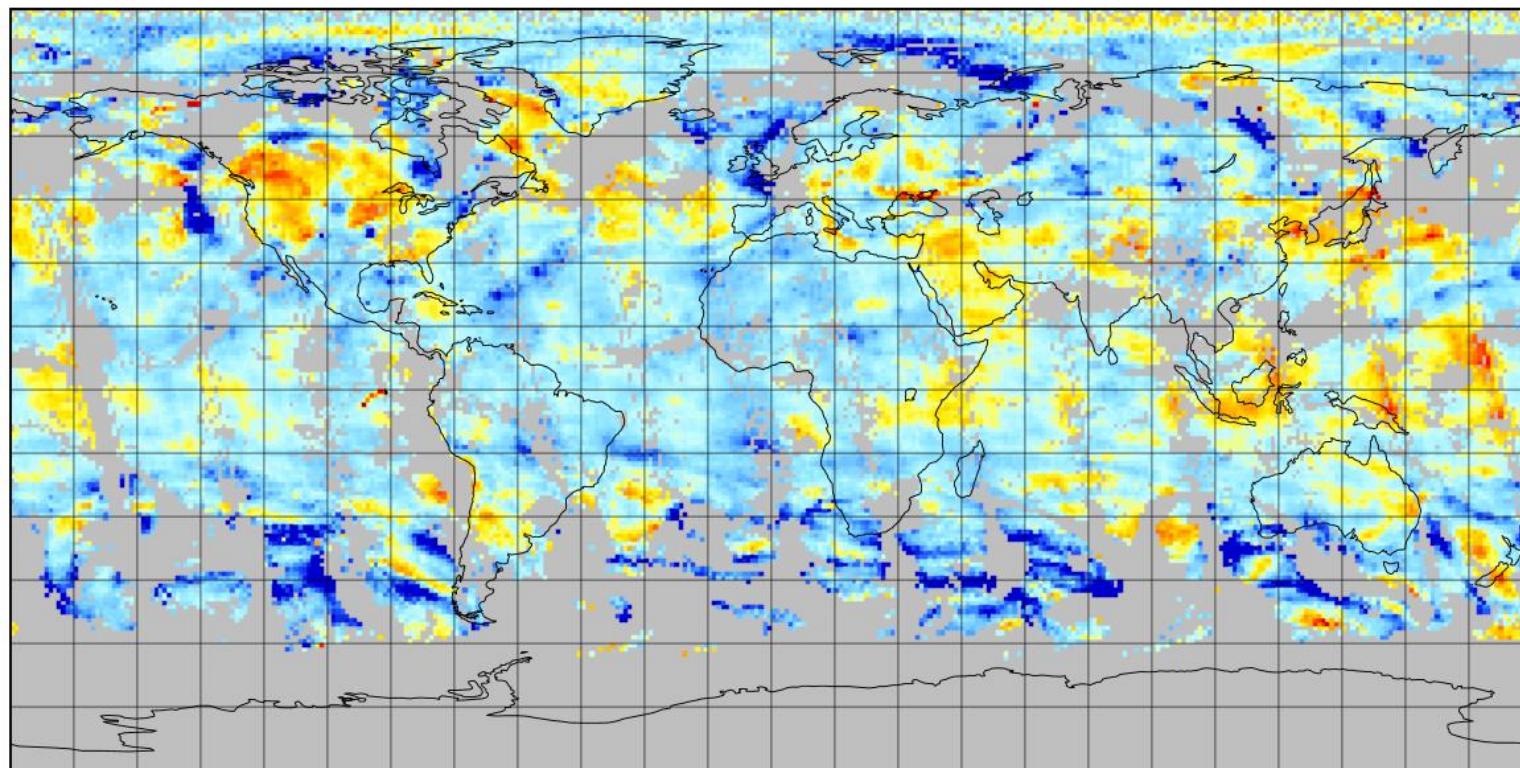
- different Tropopause definition
- ozone deficit above 4hPa in BASCOE analyses





# Comparison to OMPS-MERRA2

ozone\_tropospheric\_vertical\_column  
2018-08-09 OMPS - (S5P-AMLS)



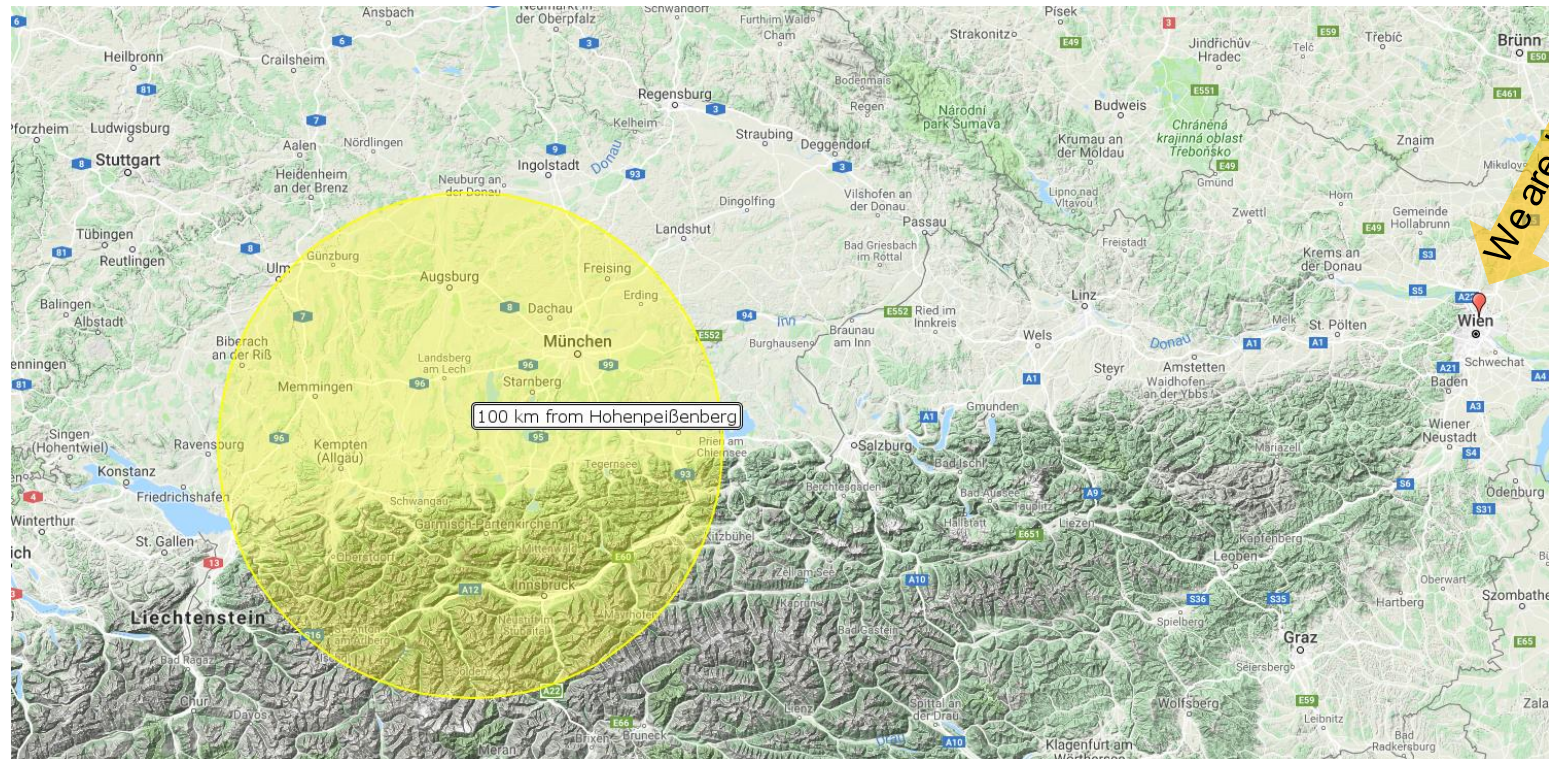
Data Min = -56.1, Max = 20.4, Mean = -4.0



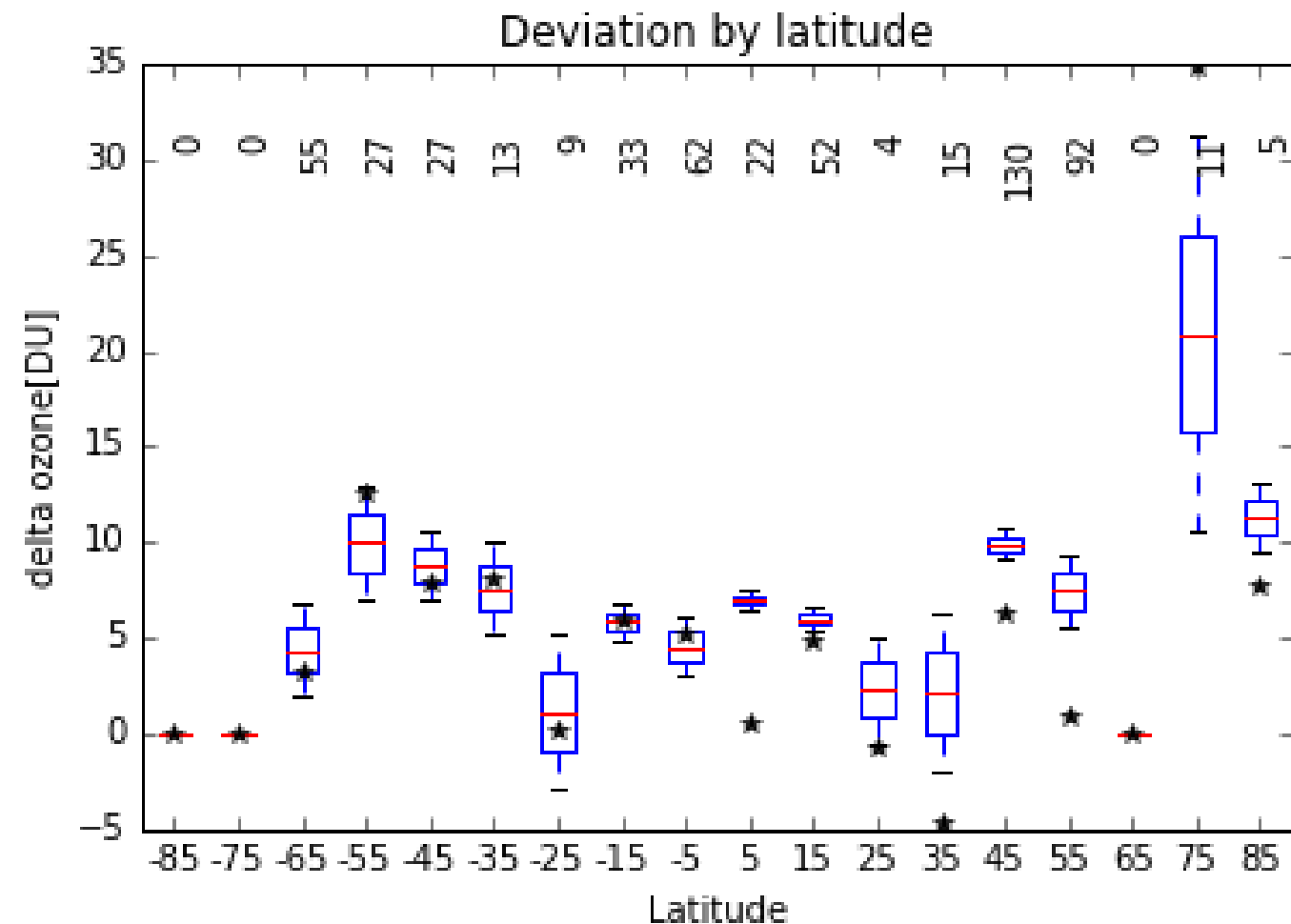


## Sondebased Validation (I)

- S5P BASCOE Daily tropospheric ozone data and tropopause height
- Integrate sonde data up to Tropopause level
- Mean of TROPOMI tropospheric ozone within 100km around the station
- Closest Measurement to station



## Sondebased Validation (II)



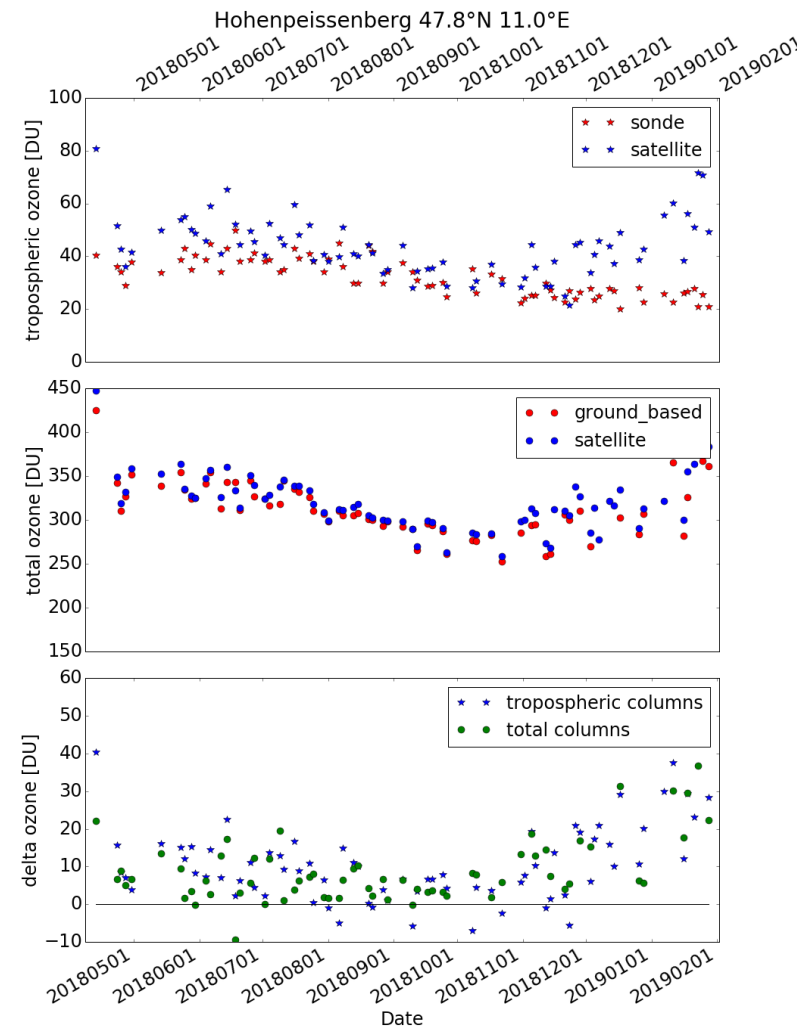
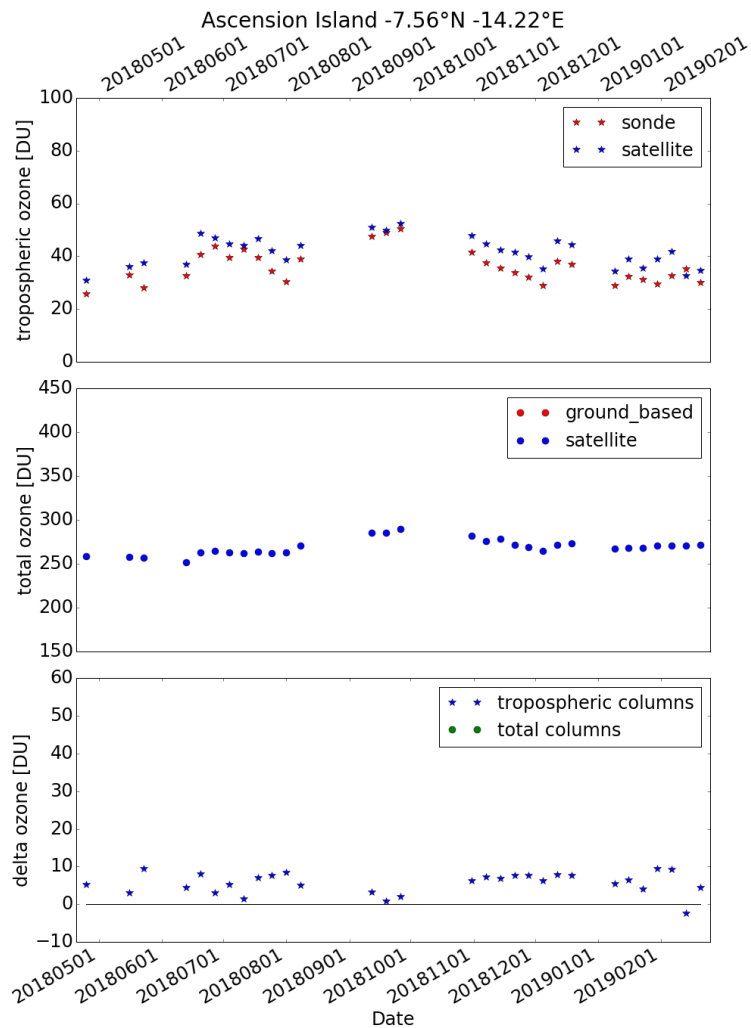
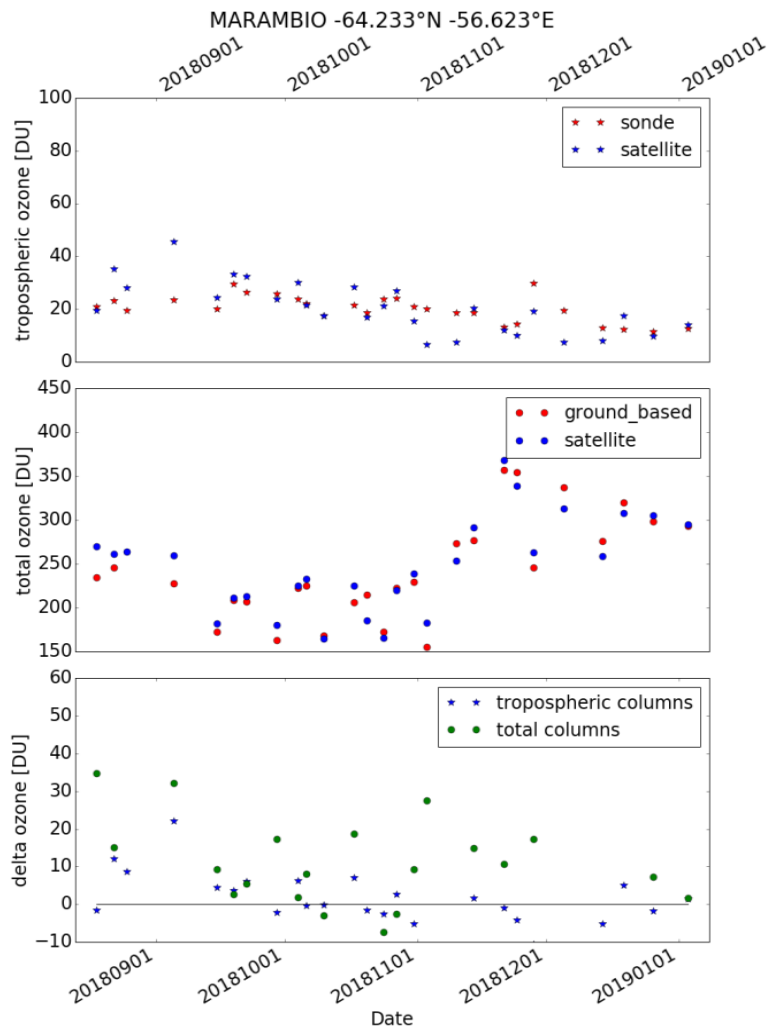
Mean Validation for April 2018 to March 2019

- highest number of sonde data in Northern midlatitude
- Mostly positive bias
- Largest deviations in polar regions

Thanks to all the Pls of the Soundings stations for providing the data to SHADOZ and to the World Ozone and Ultraviolet Radiation Data Centre



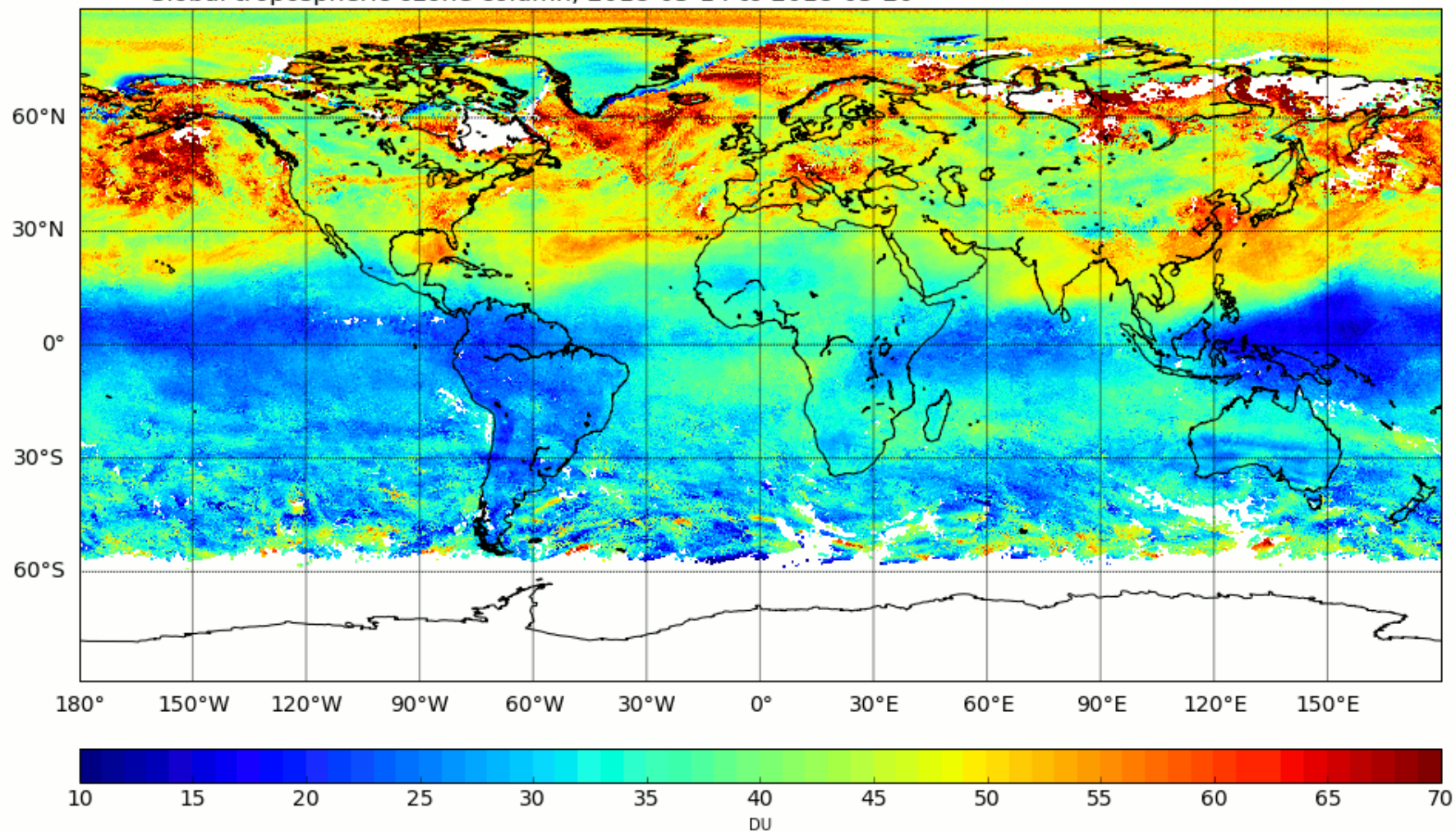
# Sondebased Validation (III)





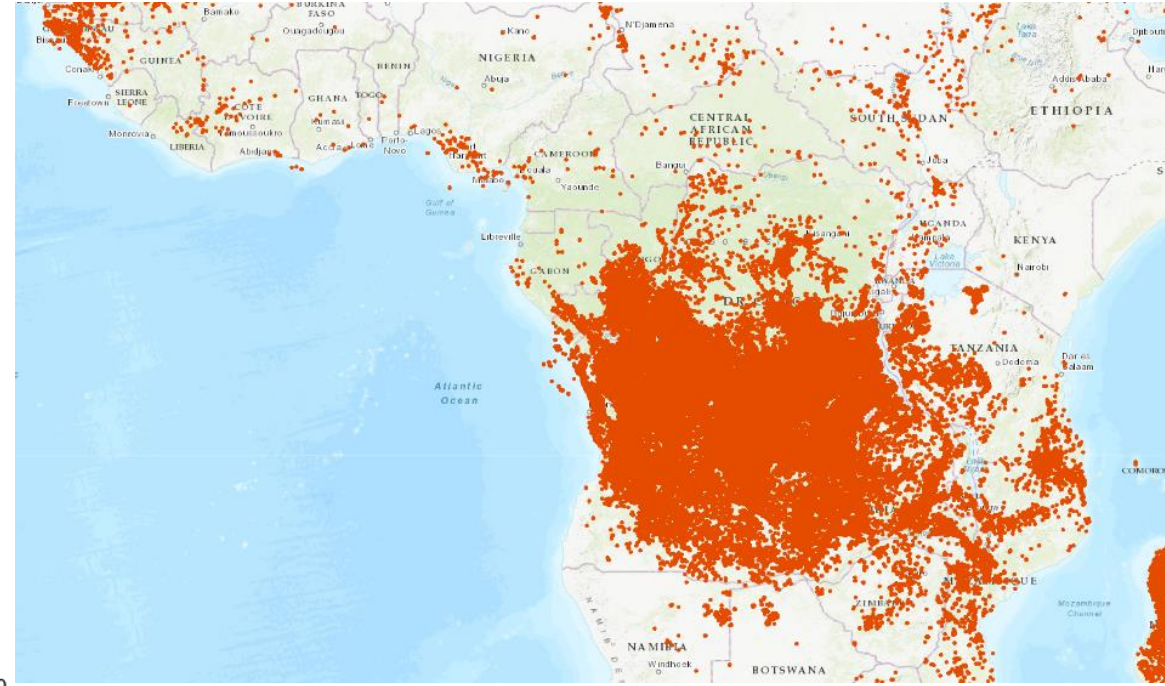
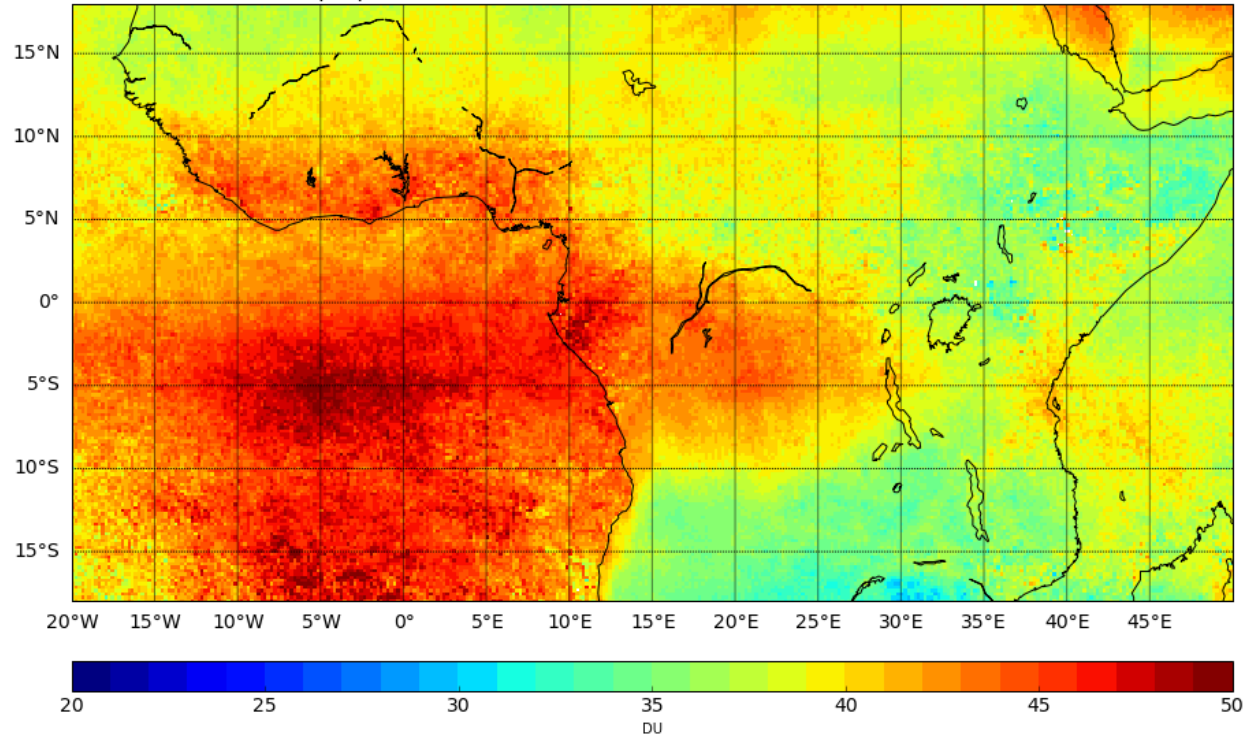
## Example results

Global tropospheric ozone column, 2018-05-14 to 2018-05-20



# Central Africa June 2018

Central Africa tropospheric ozone column, 06



Fires June 2018

Modis Active fires

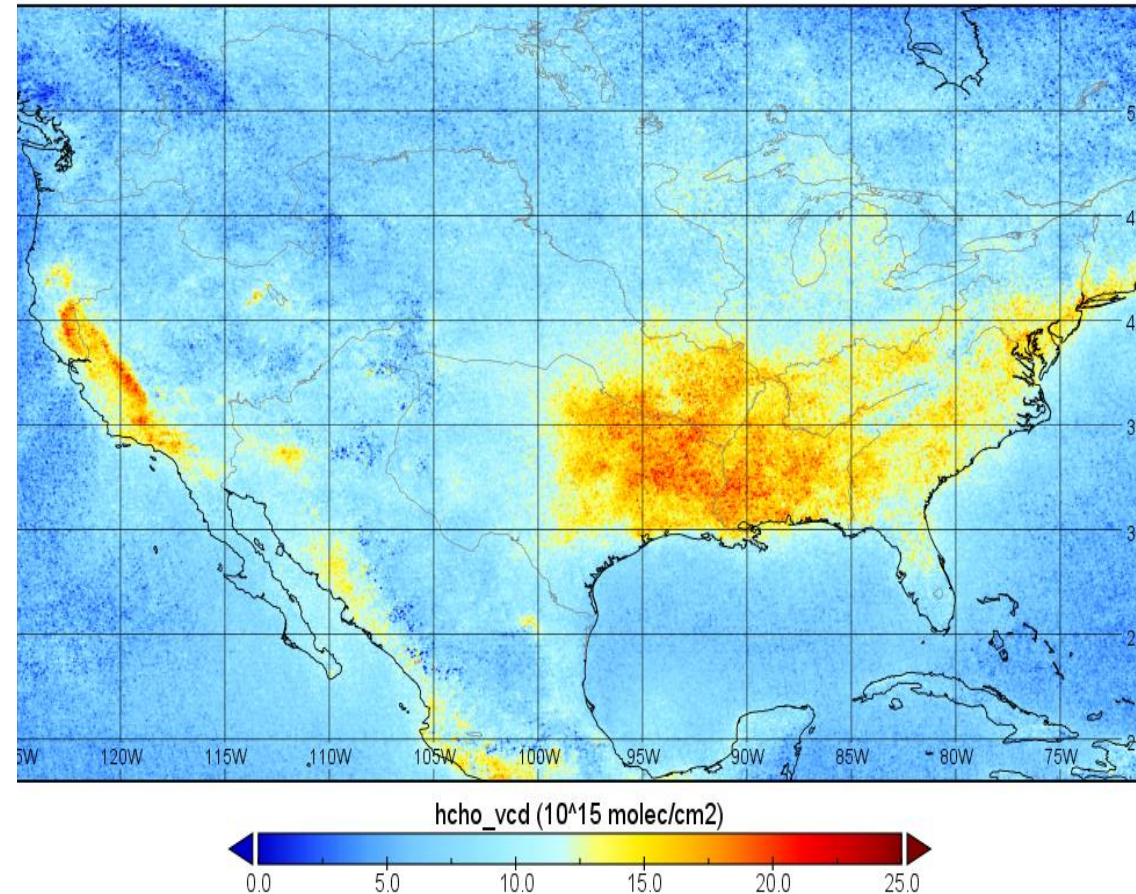
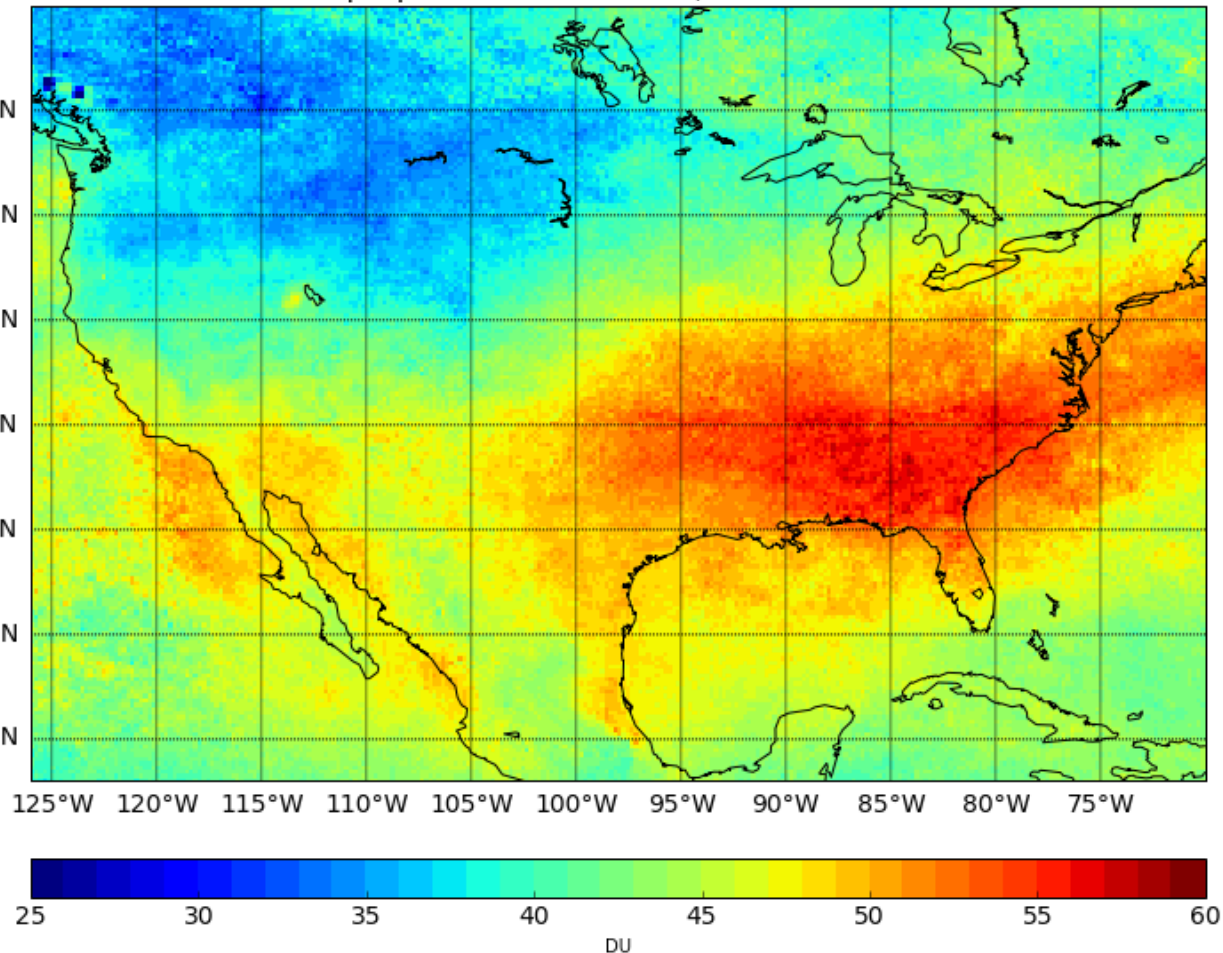
<https://fires.globalforestwatch.org/map/>





# South-Eastern US July

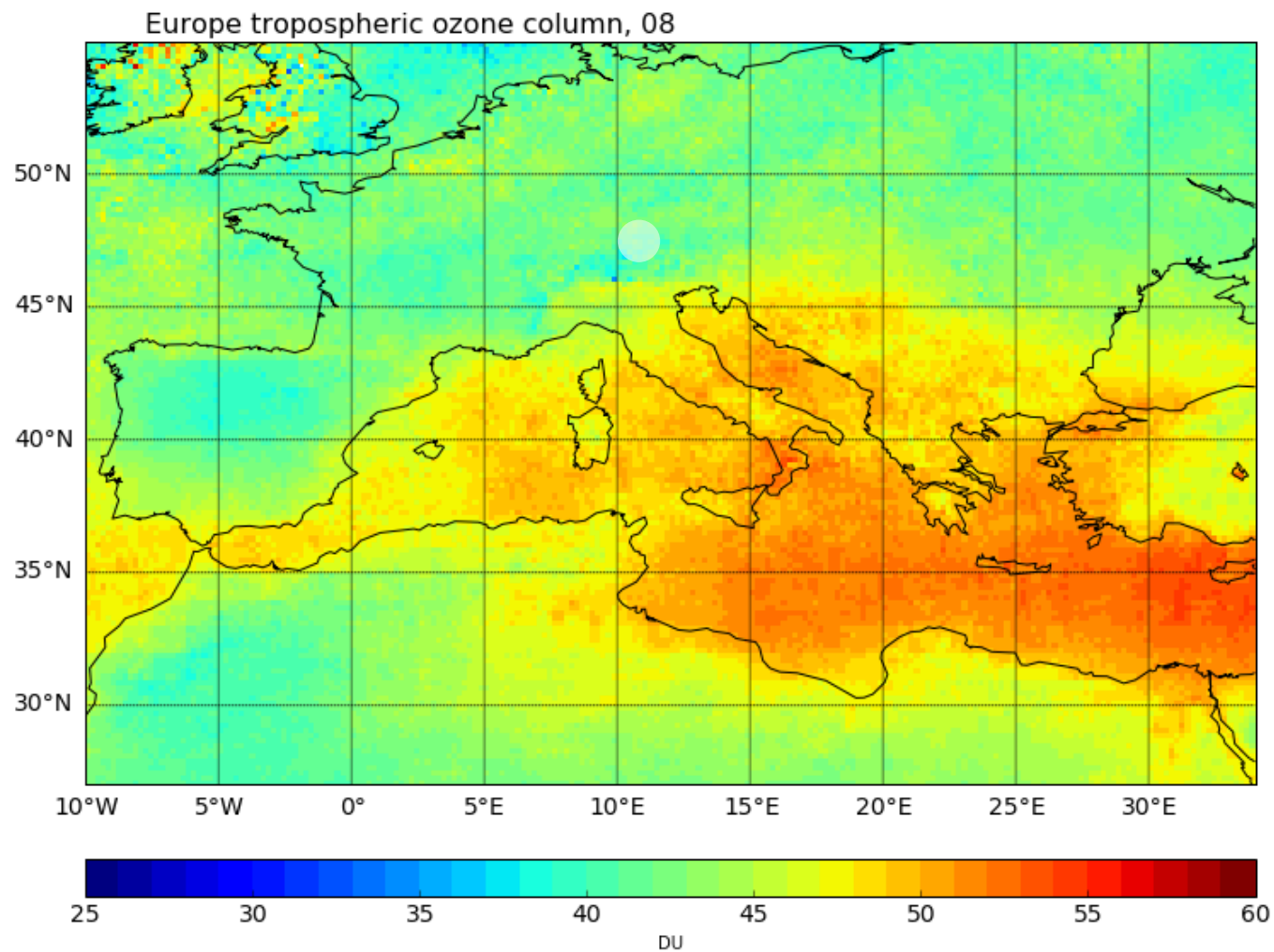
North America tropospheric ozone column, 07



S5P HCHO columns

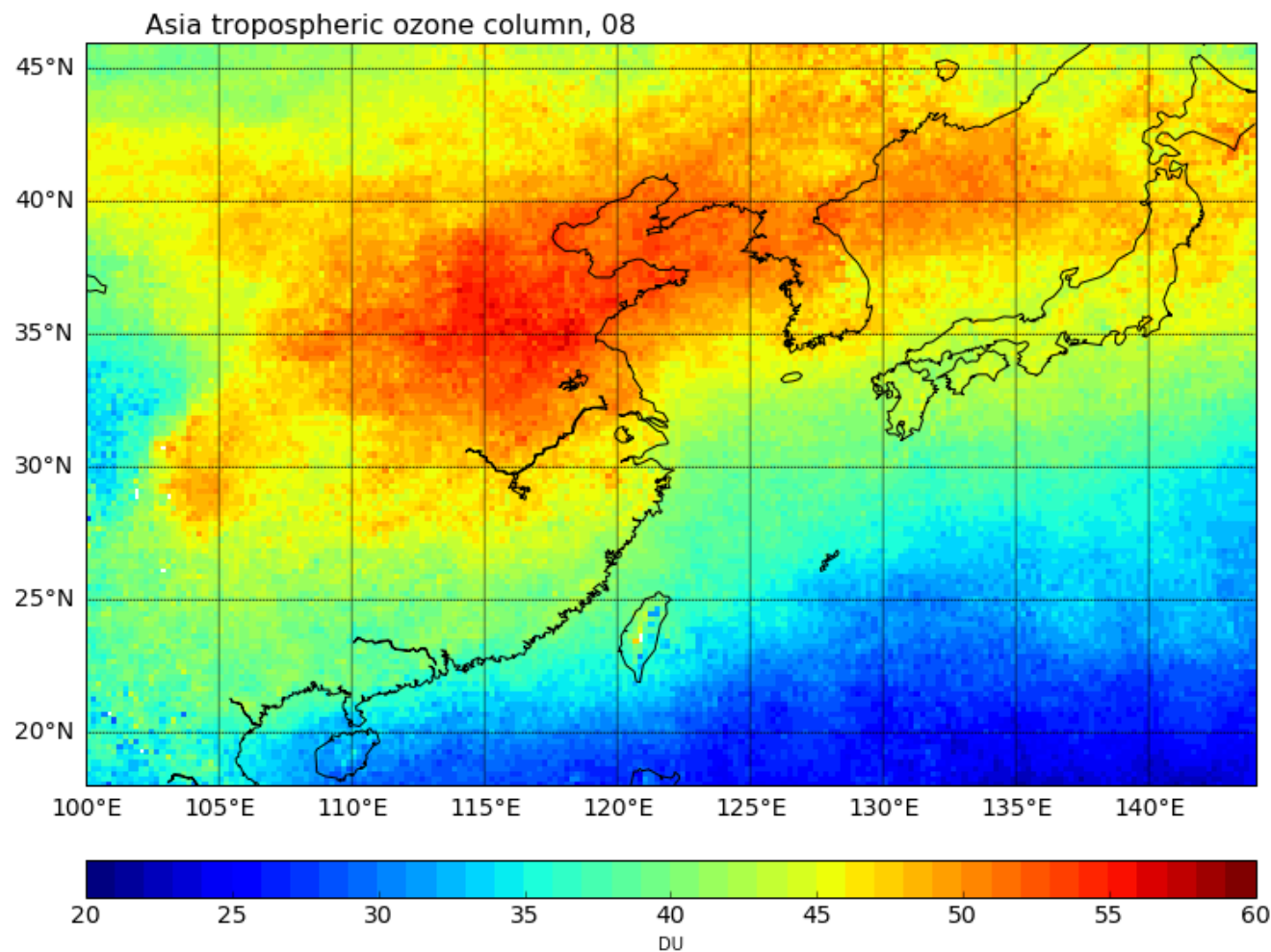
Courtesy of Isabelle de Smedt and Ka Lok Chan

# Mediterranean in August





# East Asia in August



## Conclusion

- S5P /BASCOE MLS tropospheric ozone retrieval works fine
- Positive bias compared to OMPS / MERRA 2
- Bias with respect to soundings is partially caused
  - By the total column and the albedo
  - By the ozone deficit above 4hPa in BASCOE analyses
- High tropospheric ozone columns were observed over
  - Atlantic Ocean close to Central Africa
  - South eastern US – transport to the east Atlantic
  - Mediterranean Sea
  - East Asia Transport from China over Korea to Japan

## Acknowledgment

Sentinel-5 Precursor is a European Space Agency (ESA) mission on behalf of the European Commission (EC). The TROPOMI payload is a joint development by ESA and the Netherlands Space Office (NSO). The Sentinel-5 Precursor ground-segment development has been funded by ESA and with national contributions from The Netherlands, Germany, and Belgium.

