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Assessment of regional-scale variability in total and tropospheric ozone using Sentenel-5p TROPOMI and DSCOVR EPIC measurements

Natalya Kramarova[1], Jerald Ziemke[2,1], Stacey Frith[3,1], Liang-Kang Huang[3,1], Jay Herman[4,1], David Haffner[3,1], P.K. Bhartia[1], Klaus-Peter Heue[5], and Diego Loyola[5]

1- NASA Goddard Space Flight Center, Greenbelt; 2- Morgan State University; 3- Science Systems and Applications; 4- University of Maryland Baltimore County; 5- DLR, Germany

Sentinel-5P Mission:5 years anniversary, October 10-14, 2022, Taormina, Italy

NASA merged TCO Record

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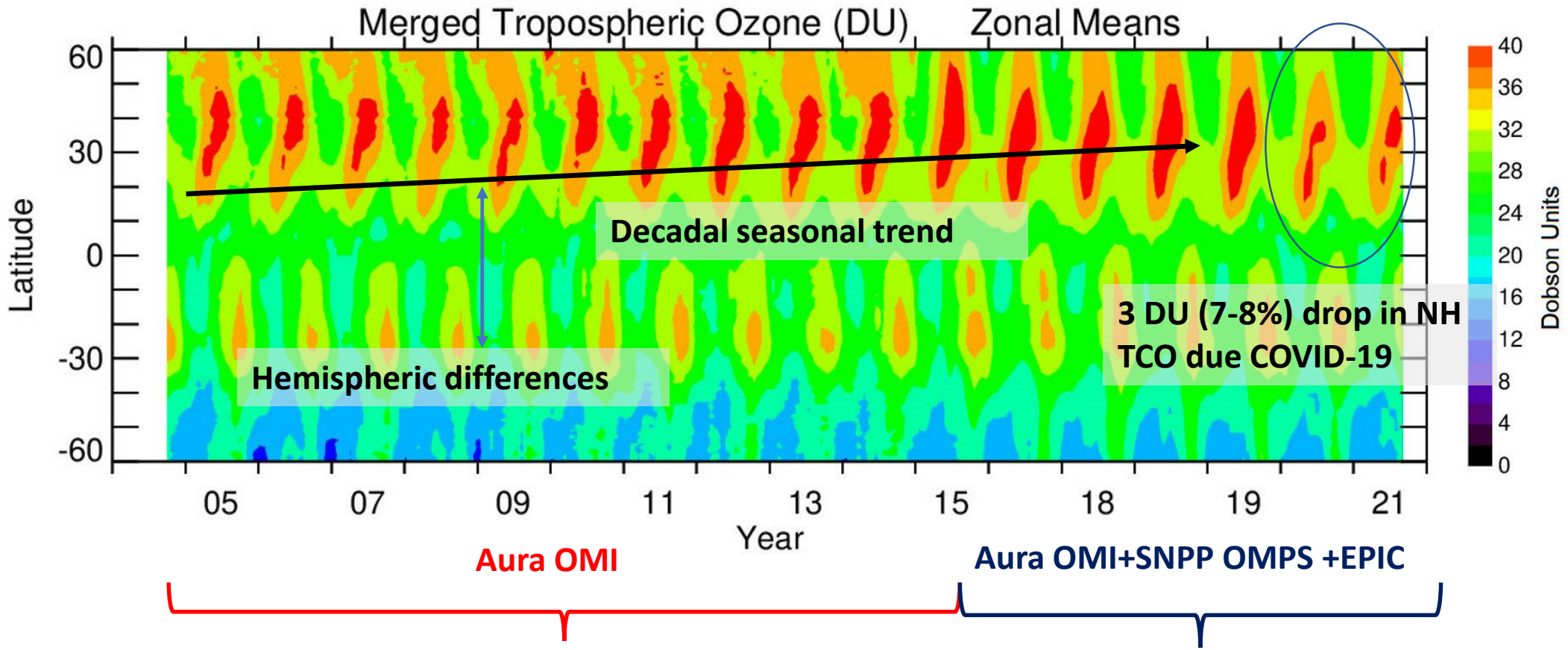

Stratospheric ozone column derived from MERRA-2 assimilated MLS profiles

Ziemke et al., 2022, 10.1029/2022GL098712

Part I. Global scale evaluation of TROPOMI and NASA merged TCO

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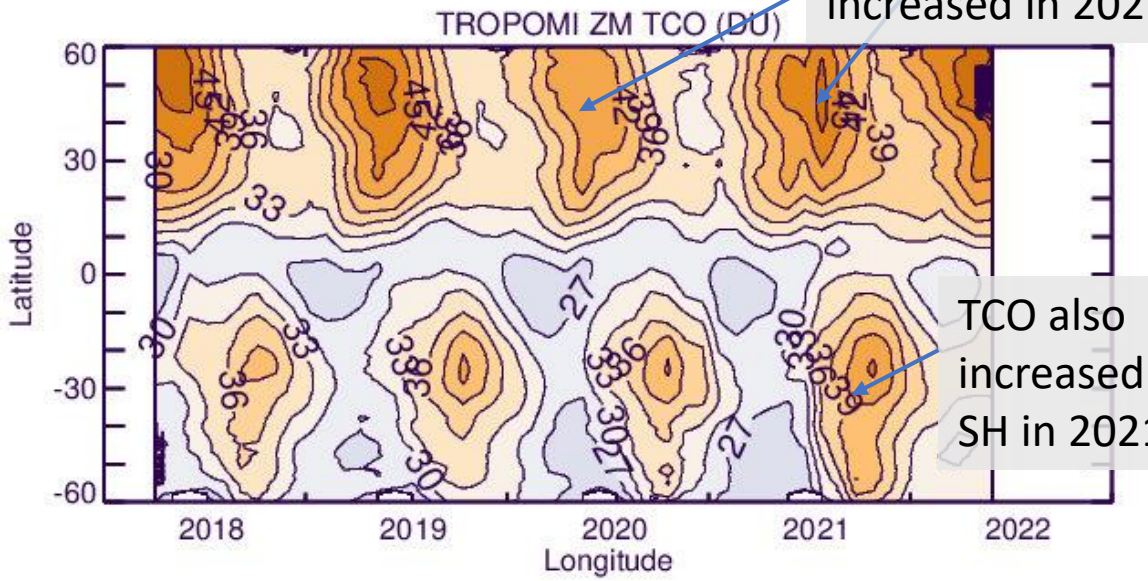
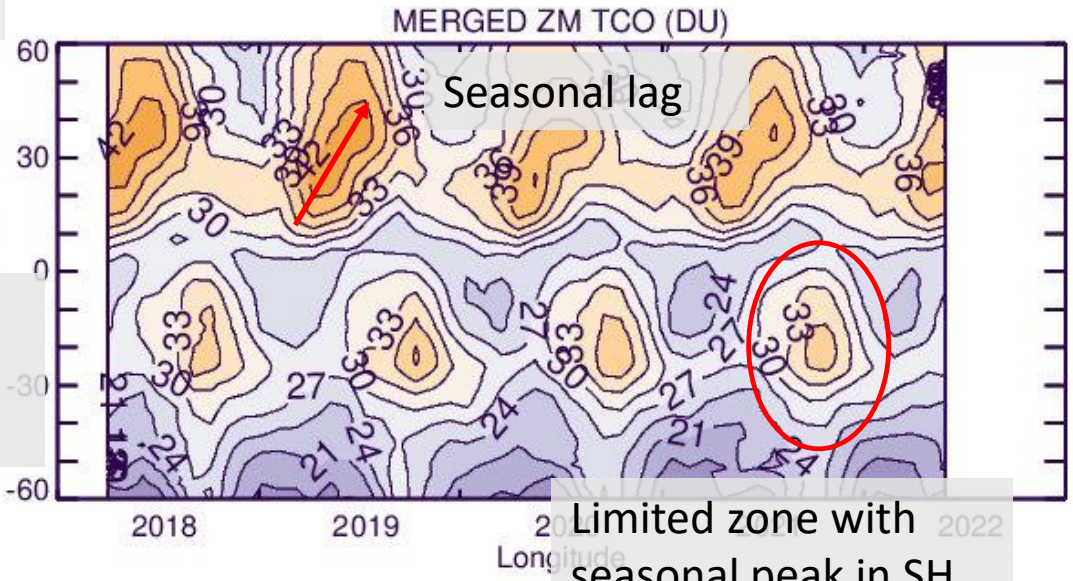
TROPOMI/BASCOE

TCO declined in 2020 but then increased in 2021



TCO also increased in SH in 2021

Aura OMI+SNPP OMPS +EPIC/MERRA-2



Limited zone with seasonal peak in SH

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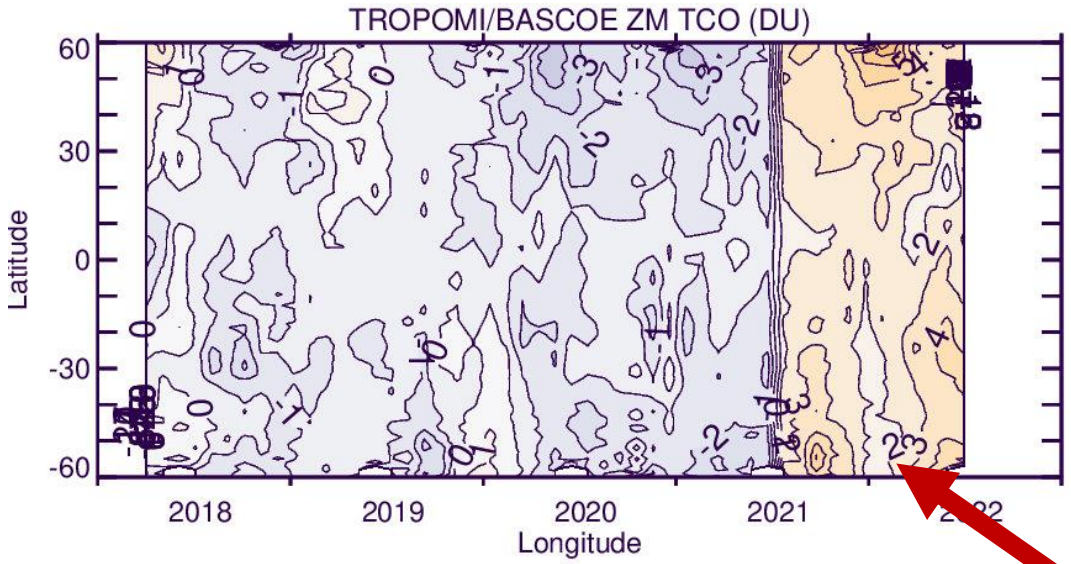
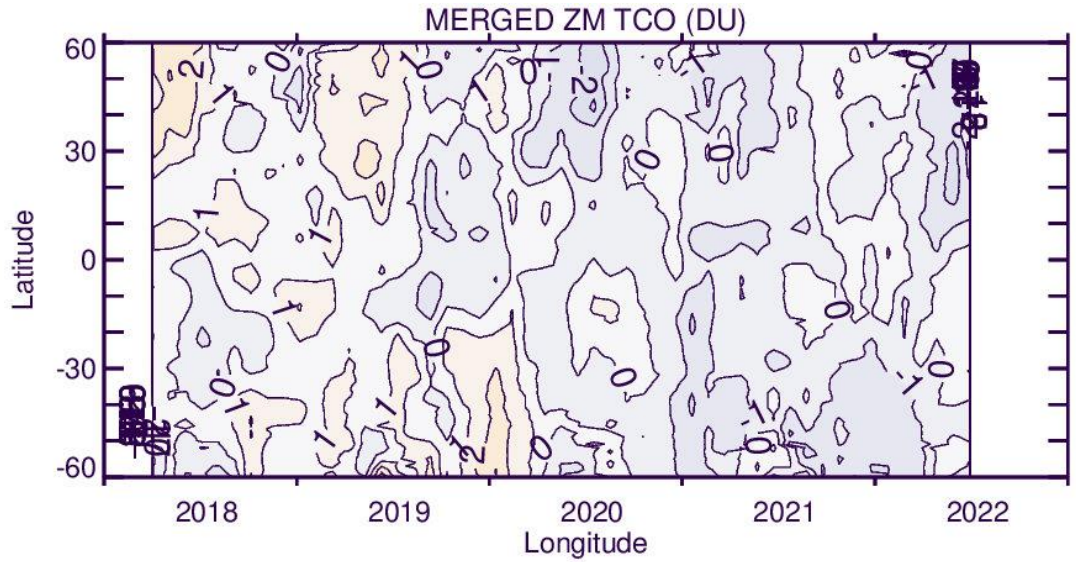
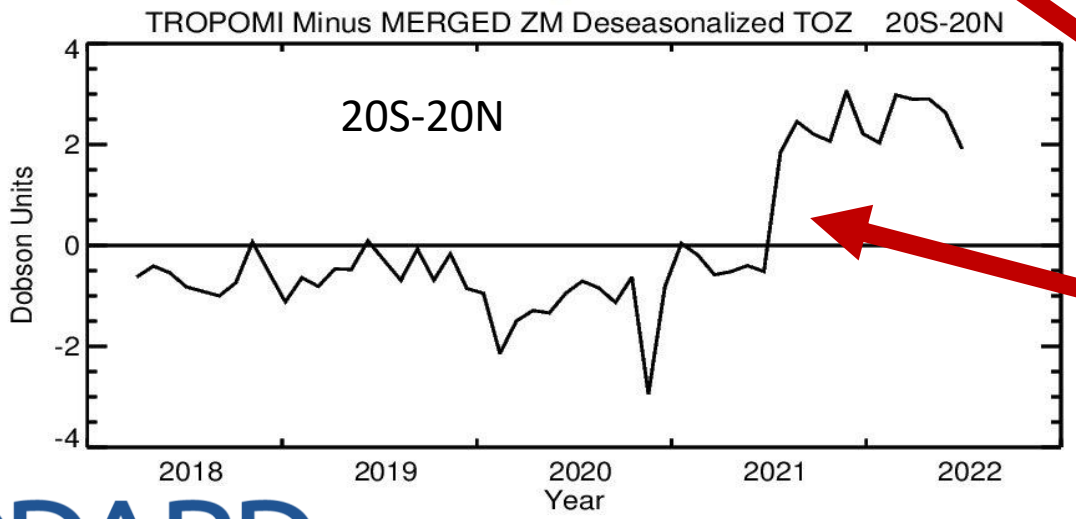
Part I. Global scale evaluation: De-seasonalized TCO Records



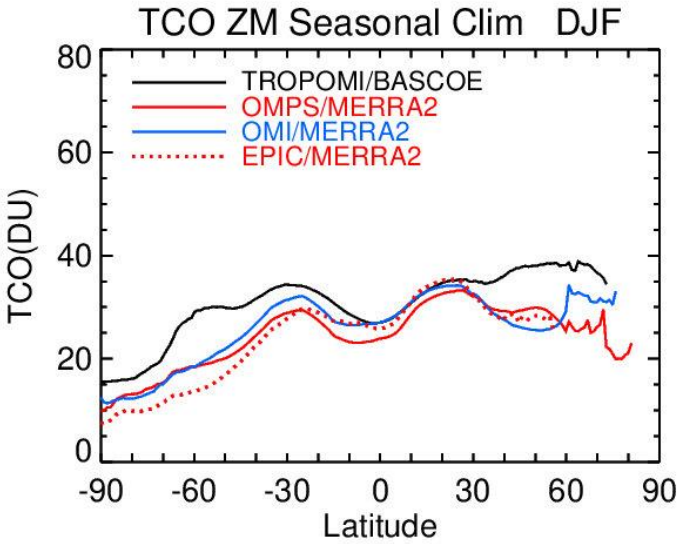


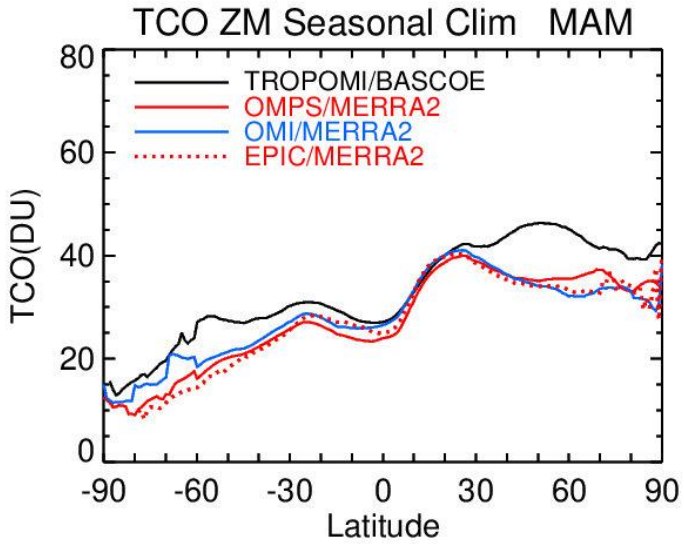


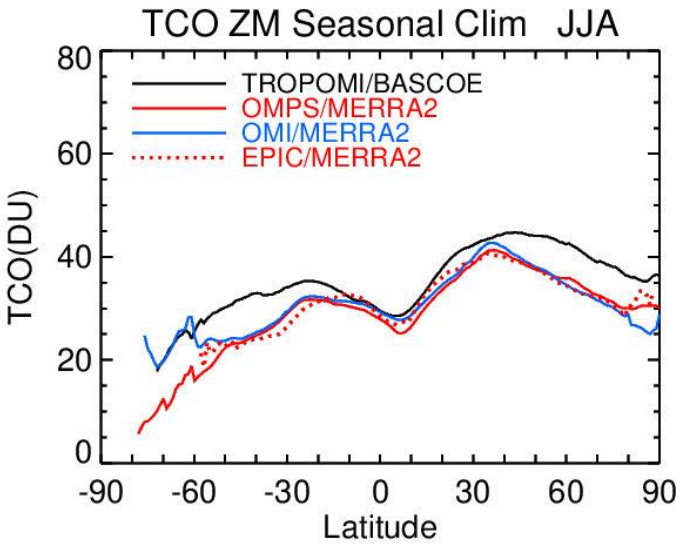
+3-4 DU Jump in TROPOMI TCO in mid 2021

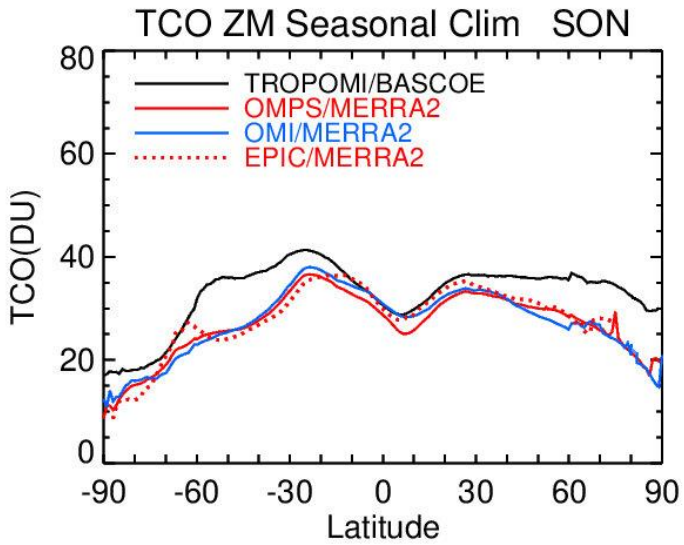
This Jump is also present in TROPOMI total ozone record and is related to switch in L1 data

Part I. Global scale evaluation: comparisons of seasonal mean TCO





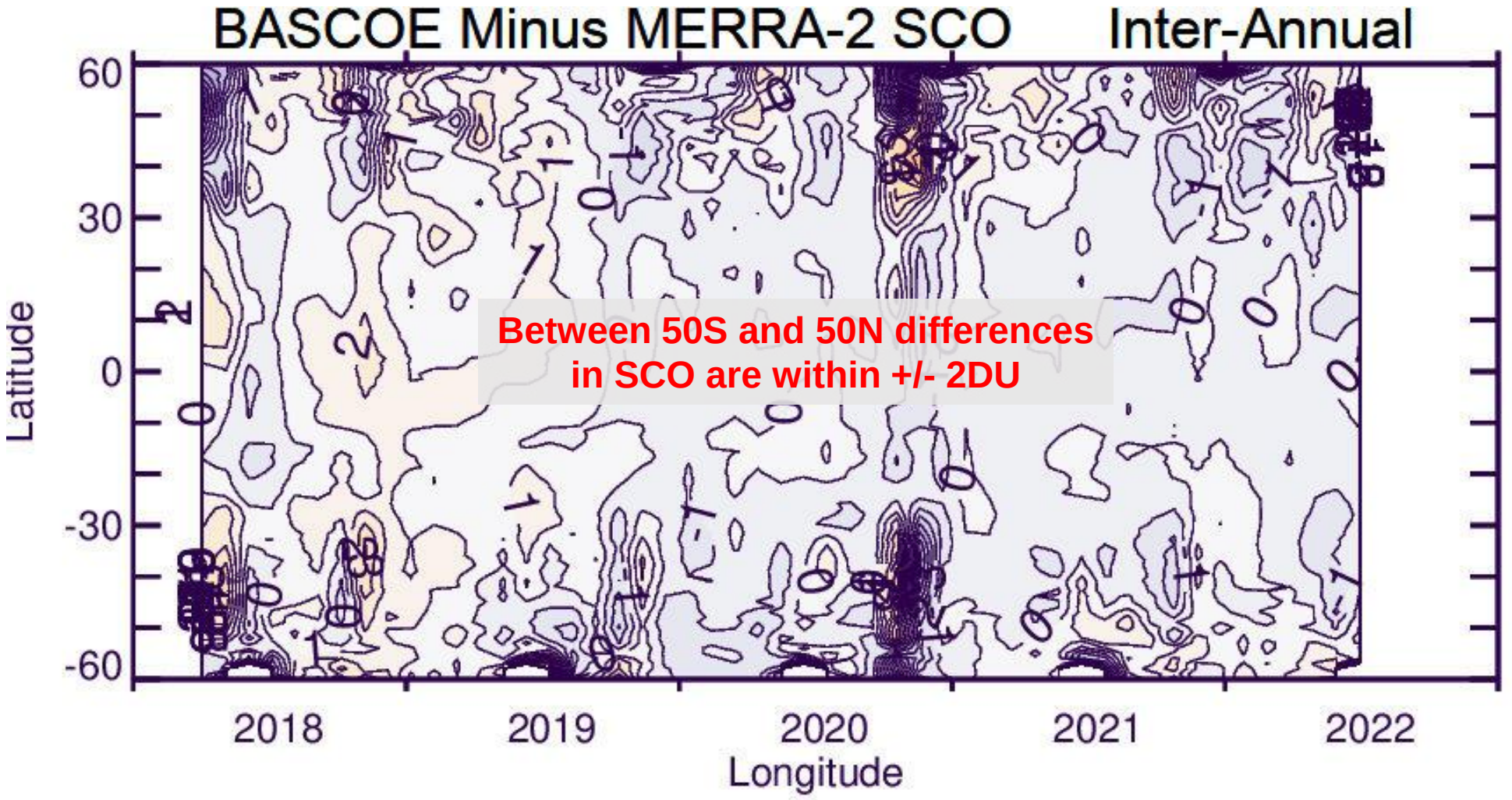




NASA TCO records are consistent

Biases with TROPOMI are smaller in tropics and increase in mid-latitudes

Part I. Global scale evaluation: BASCOE and MERRA-2 SCO



Part I. Global scale evaluation: comparisons with sonde TCO

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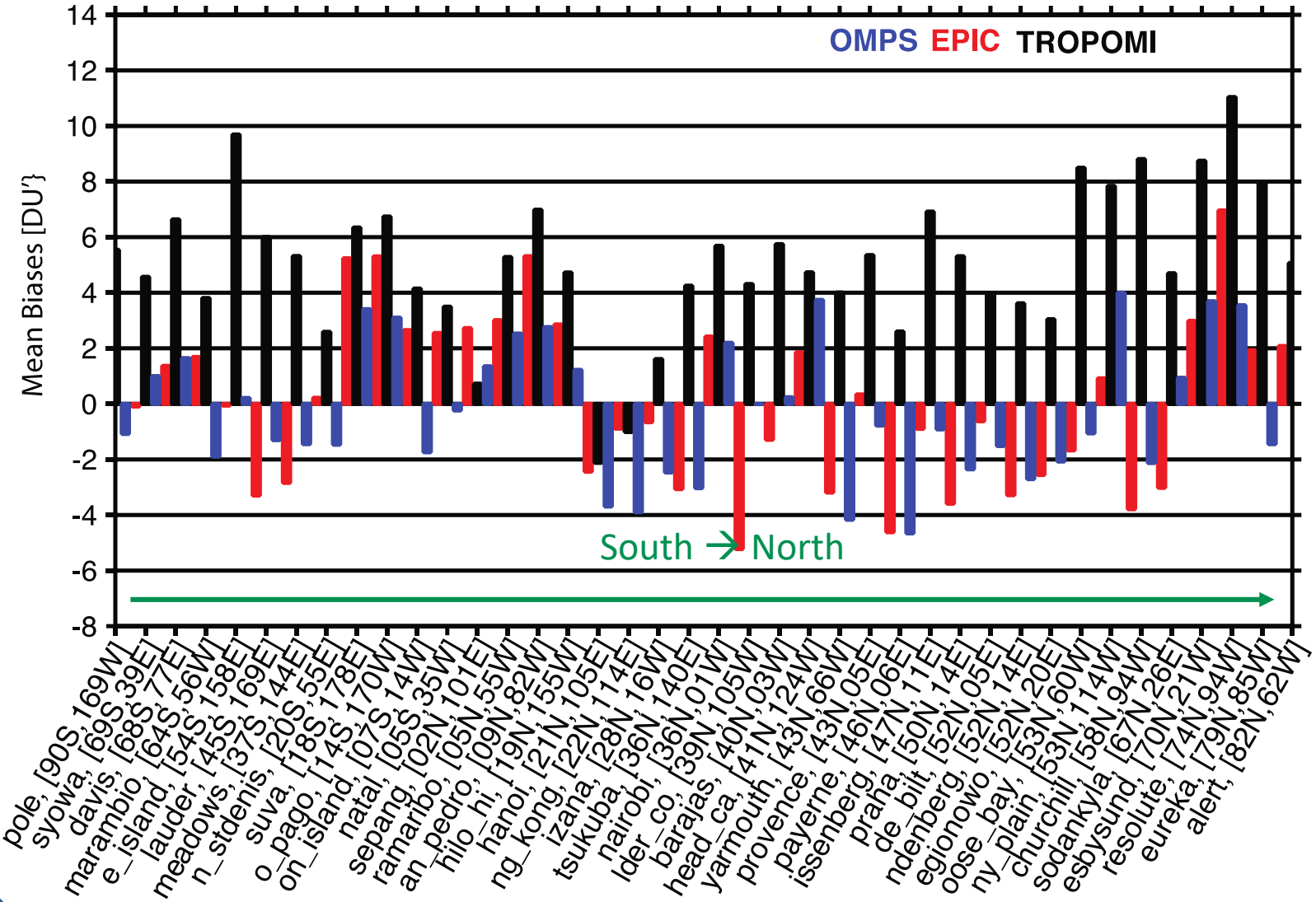
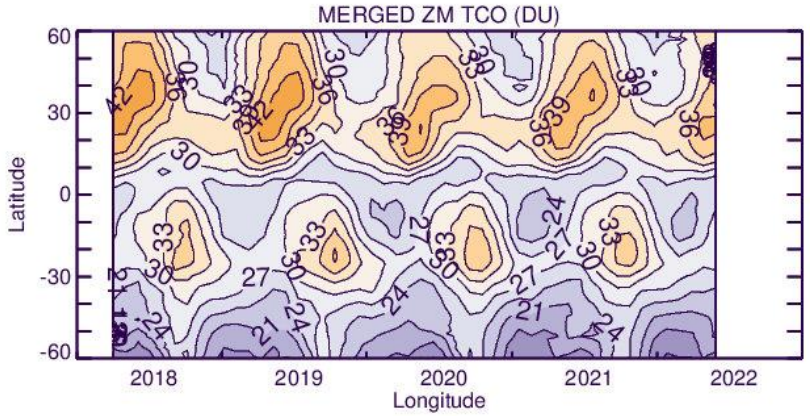
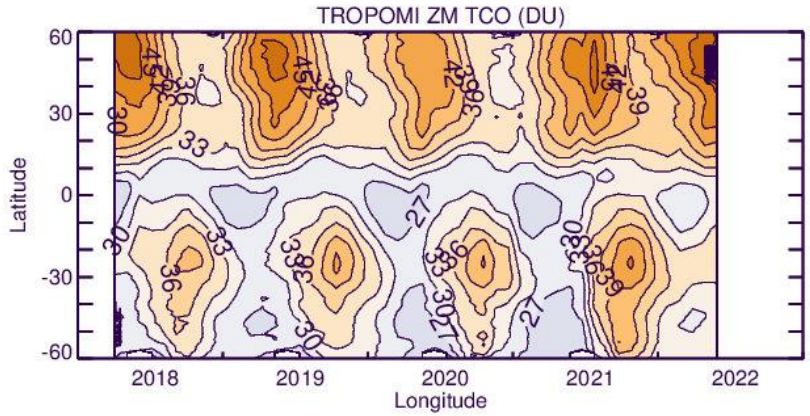
Mean biases with sondes

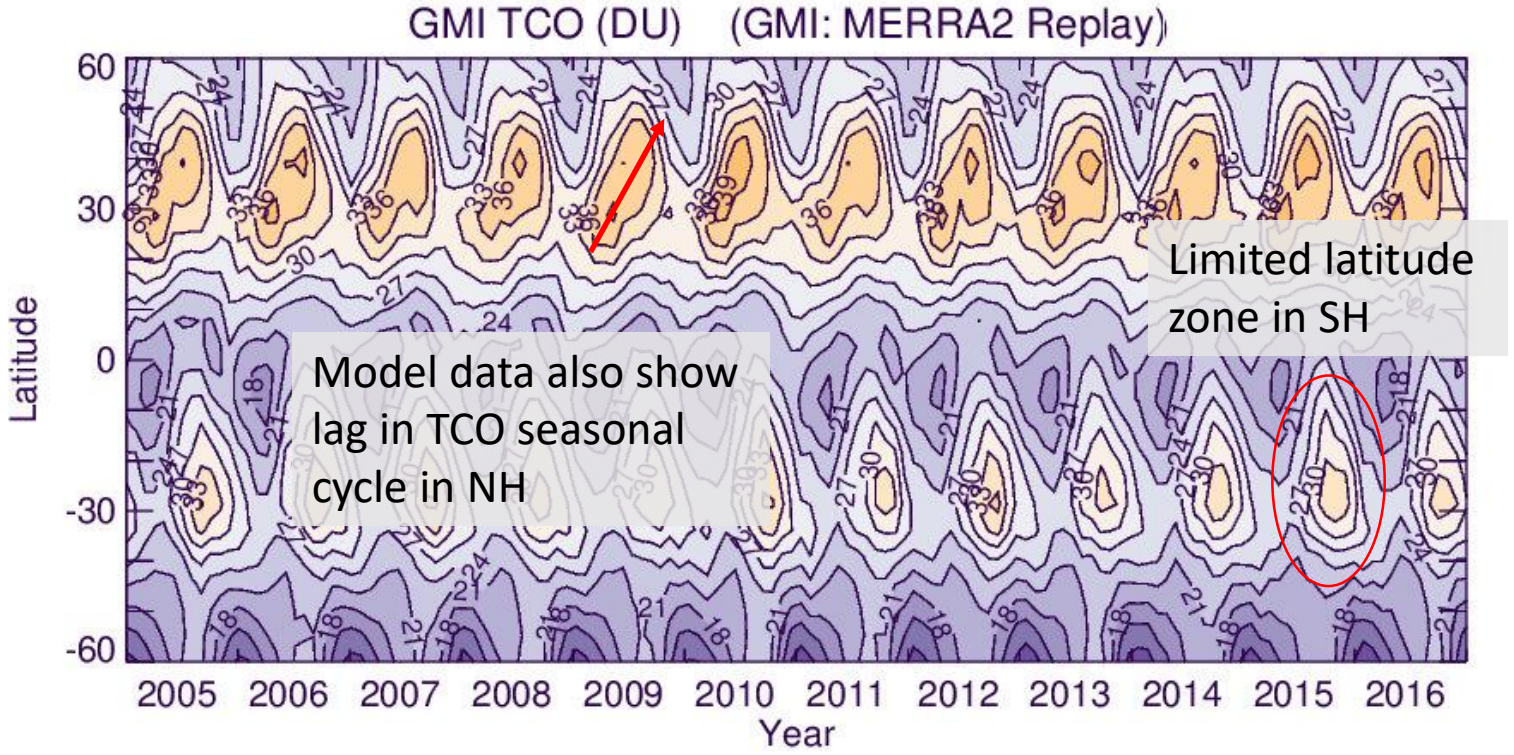


TROPOMI overestimates TCO compared with sondes

Part I. Global scale evaluation: seasonal patterns in GMI TCO







Model data also show lag in TCO seasonal cycle in NH

Limited latitude zone in SH

Part I. Global scale evaluation: seasonal patterns in sonde TCO

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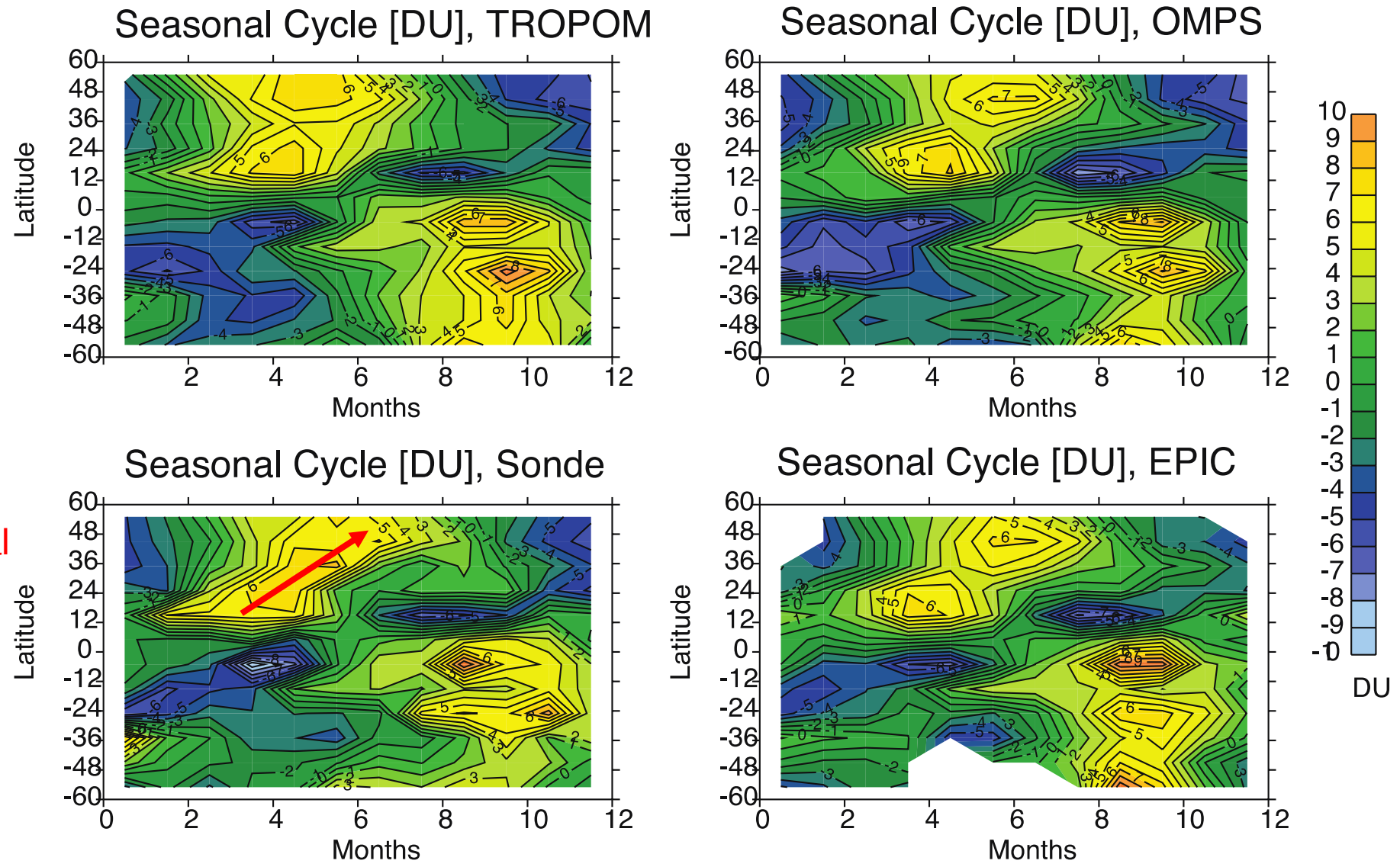
Comparable amplitudes of seasonal TCO variations

Sonde data also indicate seasonal lag in NH



Part II. Regional scale analysis: daily TCO maps

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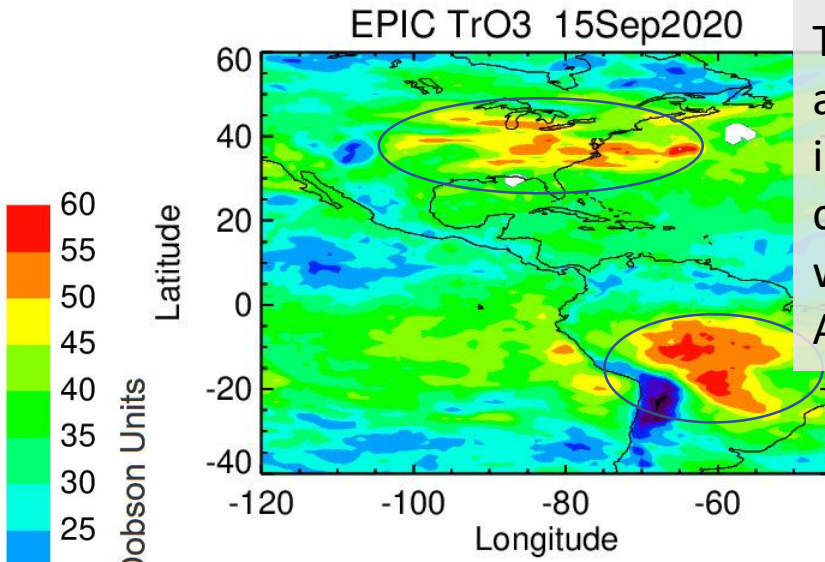
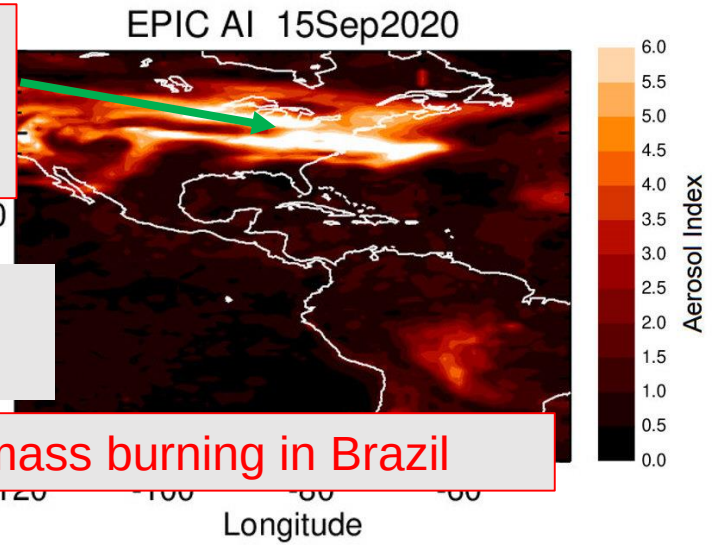
Positive TCO anomalies in EPIC coincide with high AI

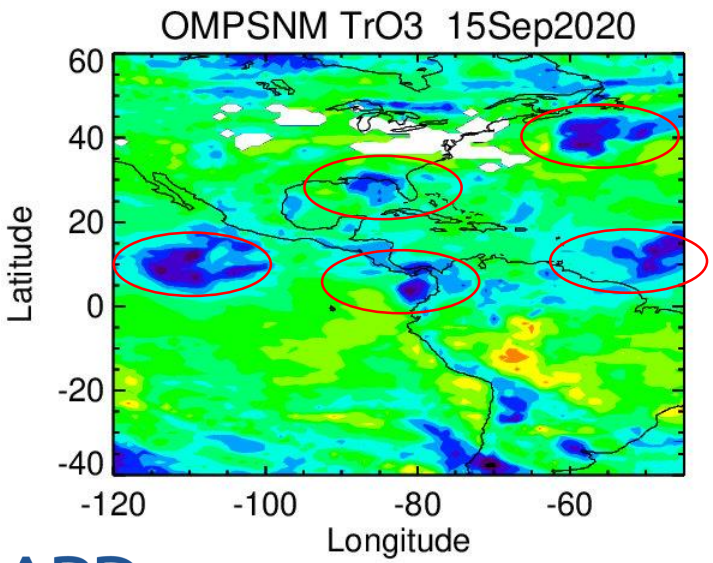


Aerosol transport from the West Coast wildfires across Northern America

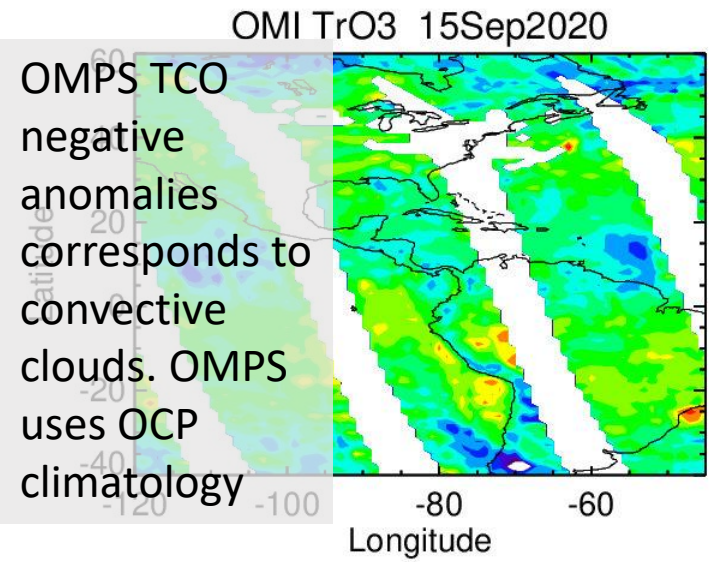


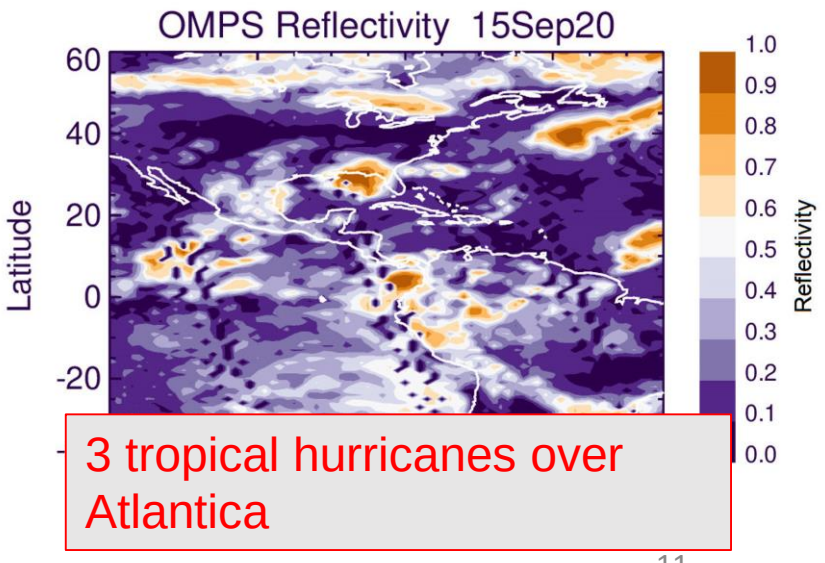
No obvious artifacts in TROPOMI TCO daily maps

Biomass burning in Brazil



OMPS TCO negative anomalies corresponds to convective clouds. OMPS uses OCP climatology





3 tropical hurricanes over Atlantica

Part II. Regional scale analysis: daily TCO maps

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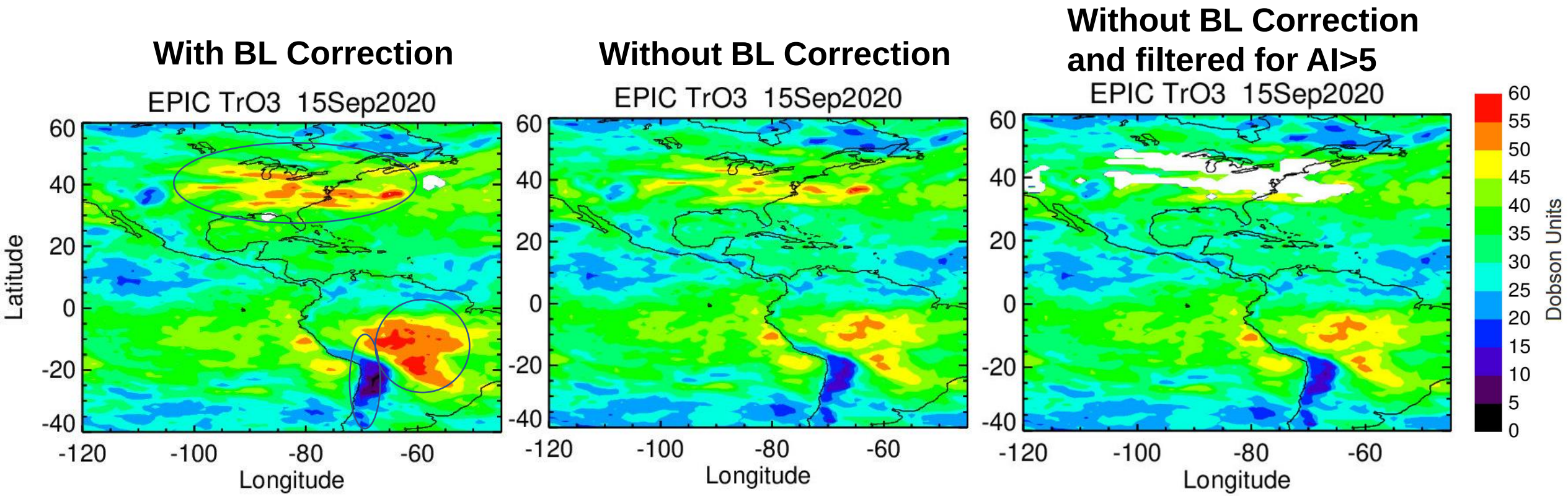

Boundary layer correction:

$$\beta = (1 - CWF^{BL}) * \Delta OZ_{dm}^{BL}$$

Kramarova et al., 2021

Summary:

Part I. Global scale evaluation:

- Overall positive bias of +2-4 DU in TROPOMI TCO compared to NASA merged TCO and sonde network, which originated from TROPOMI total ozone;
- Good agreement between BASCOE and MERRA-2 SCO with biases mostly within +/-2 DU between 50S-50N;
- Jump in TROPOMI TCO and total ozone in July 2021 related to changes in TROPOMI Level 1 data;
- There are differences in TCO seasonal patterns between TROPOMI and NASA merged.

Part II. Reginal scale analysis:

- TROPOMI daily TCO maps have no obvious anomalies associated with aerosol or cloud contaminations;
- Positive anomalies were found in EPIC TCO co-located with high Aerosol Index. Boundary layer correction applied to EPIC TCO amplifies these positive anomalies;
- Accurate cloud height information is required to produce accurate TCO maps.

For questions email: Natalya.a.Kramarova@nasa.gov or Jerald.r.Ziemke@nasa.gov

Thank you for your attention!

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EPIC Synoptic total and TCO maps are available at NASA LaRC DISC:

NASA/LARC/SD/ASDC, 2017. DSCOVR EPIC Level 4 Tropospheric Ozone. https://doi.org/10.5067/EPIC/DSCOVR/TrO3_L4.01.

For questions email: Natalya.a.Kramarova@nasa.gov or Jerald.r.Ziemke@nasa.gov

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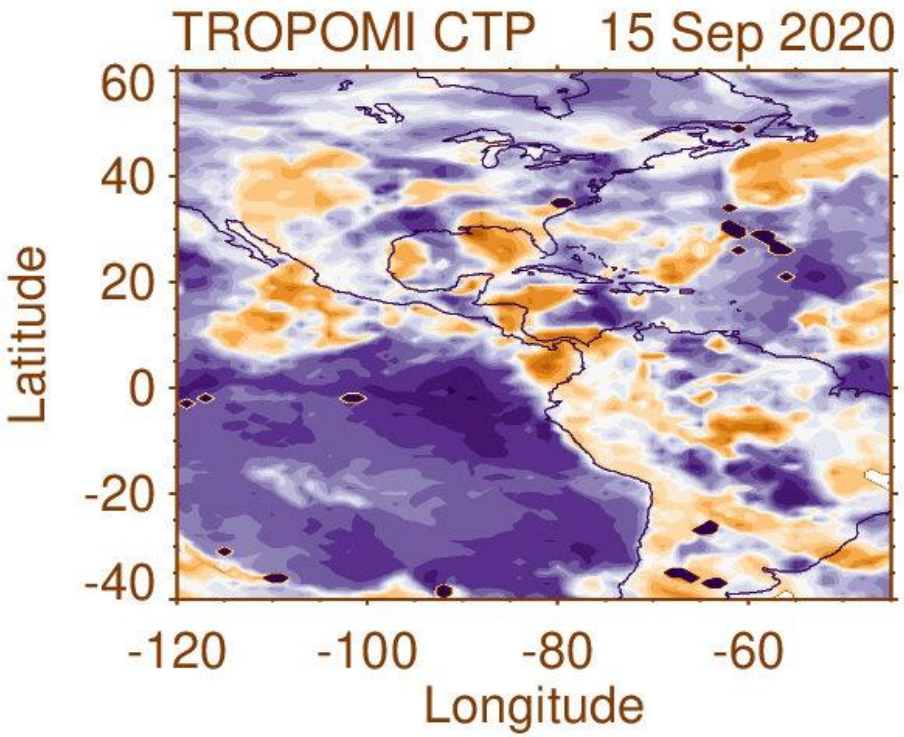
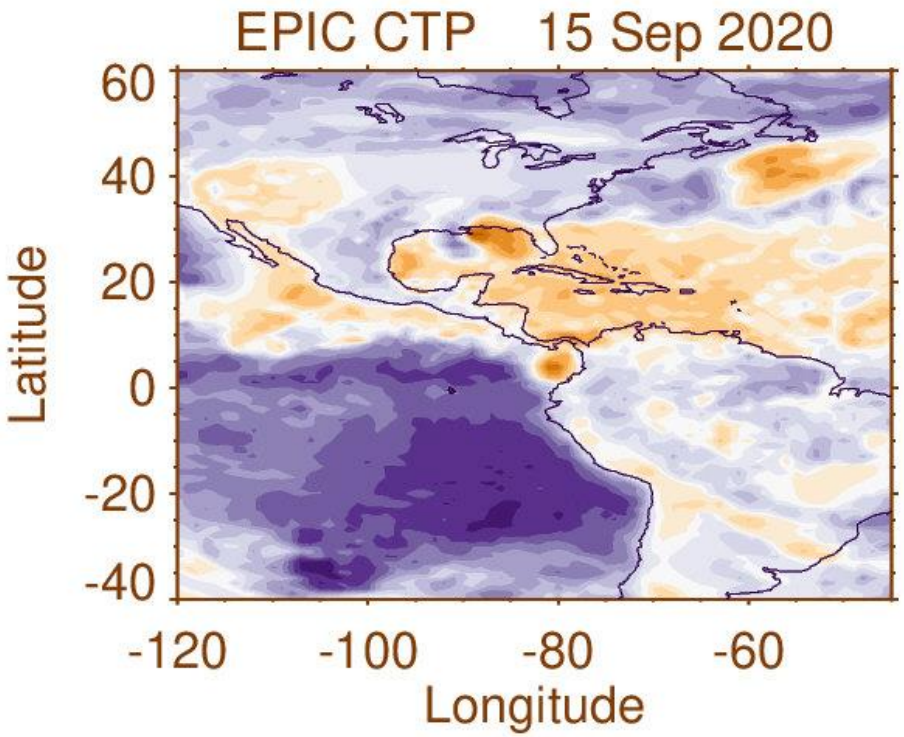
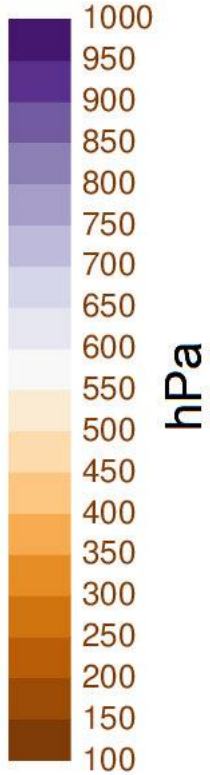
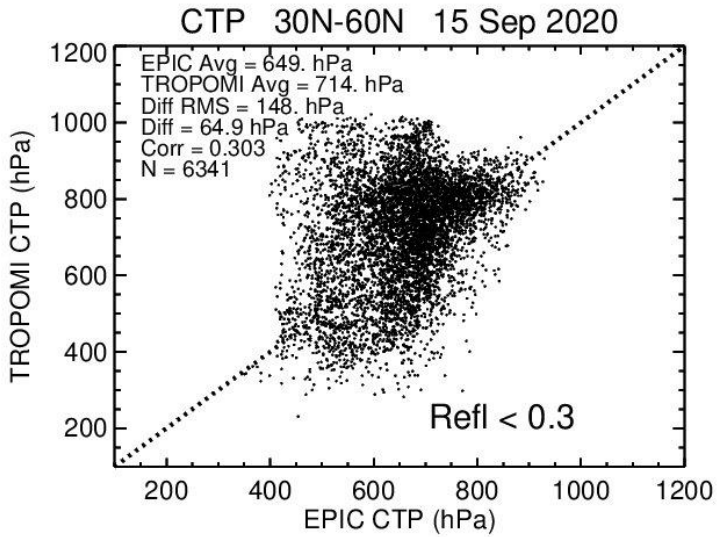
Part II. Regional scale analysis: daily TCO maps

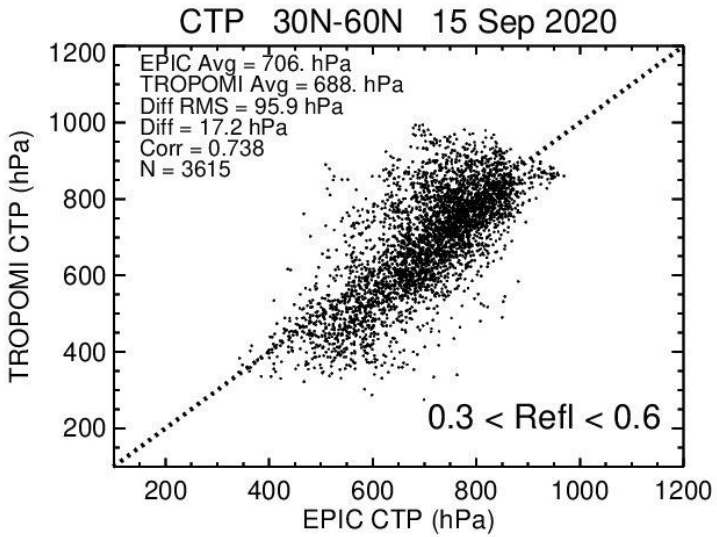


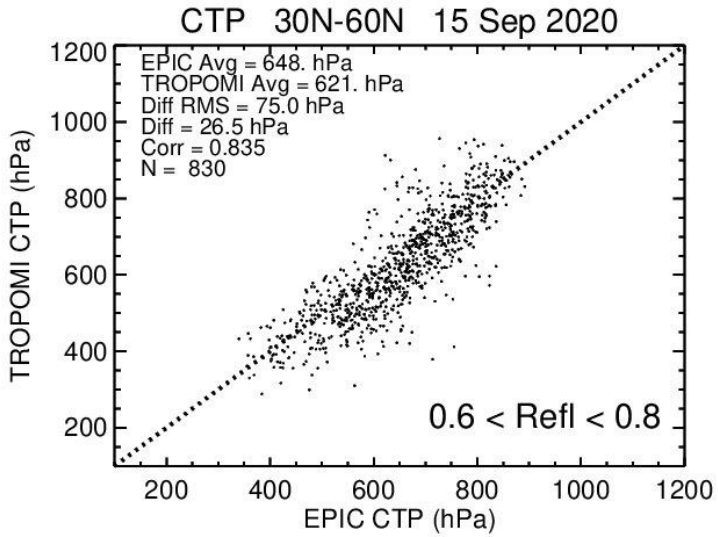


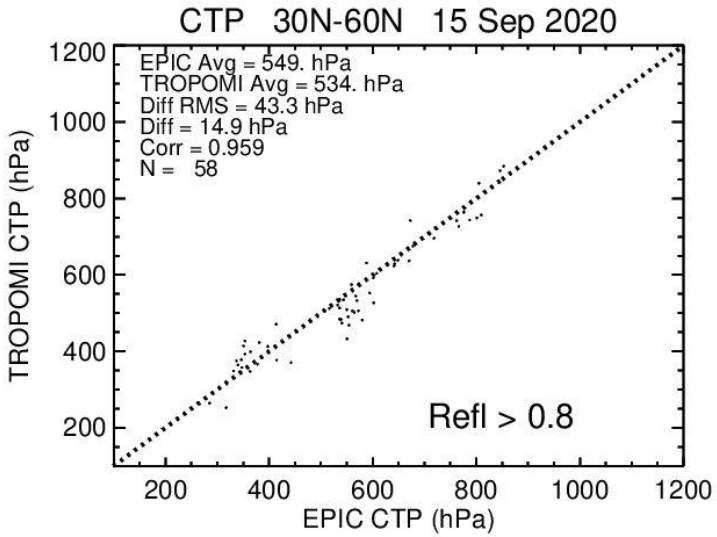


Part II. Regional scale analysis: daily TCO maps









TROPOMI and NASA Total Ozone Columns

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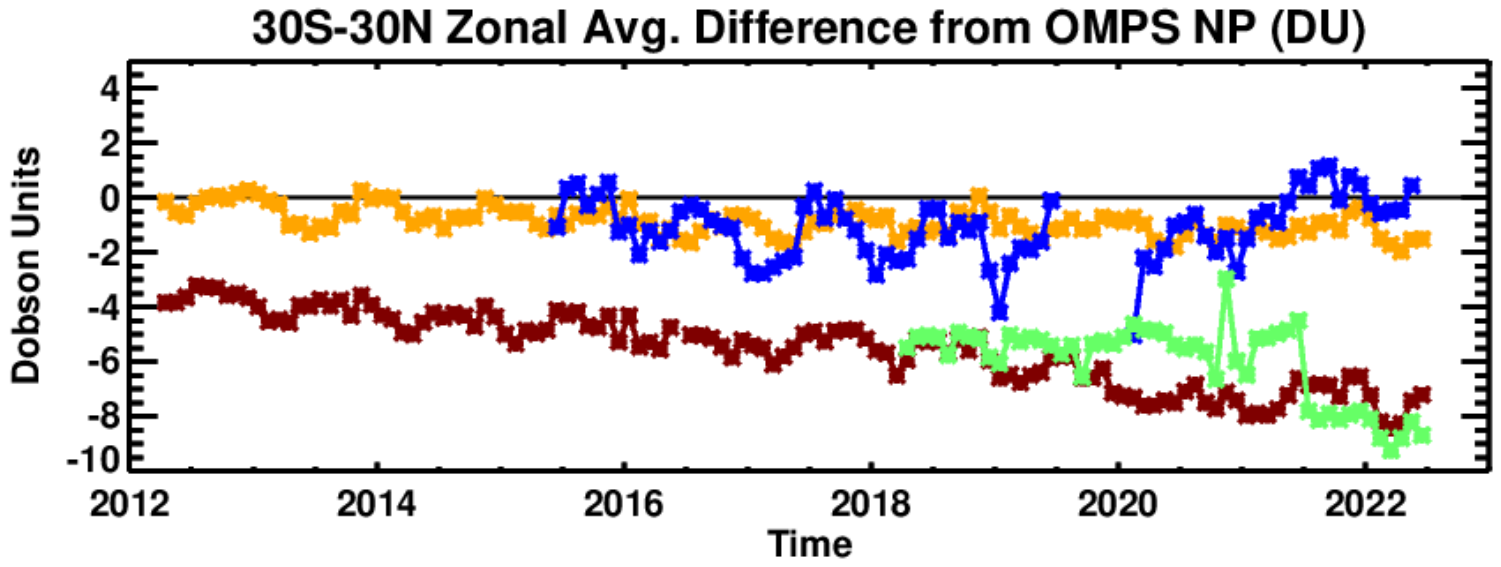
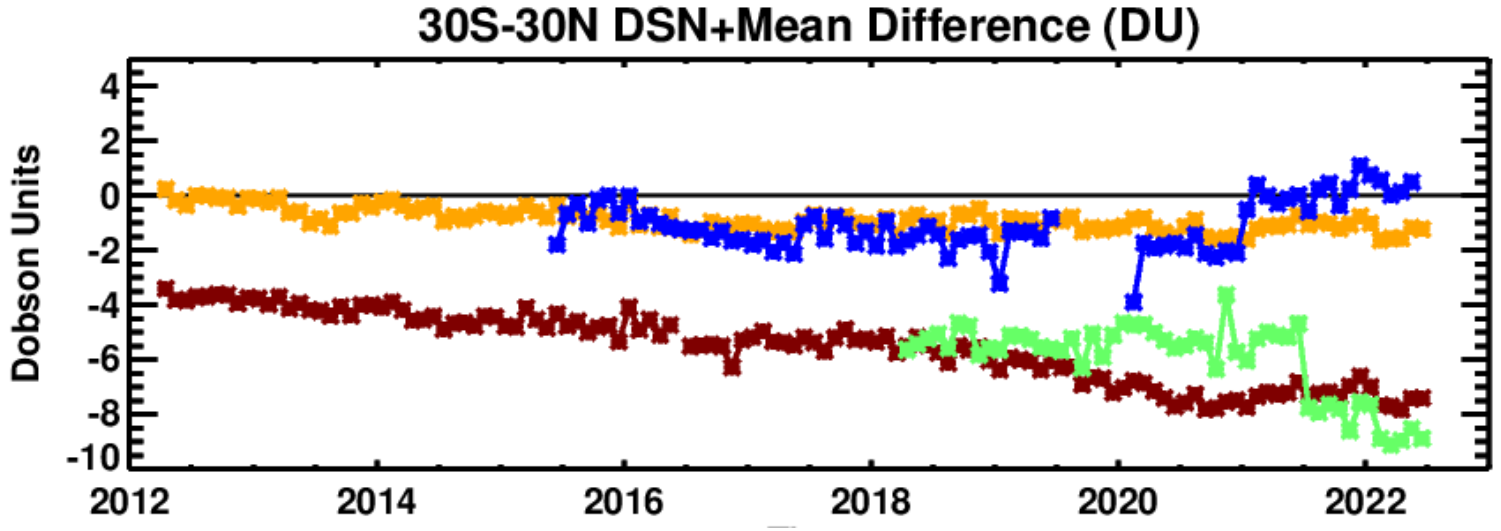
opernicus Europe's eyes on Earth





A small ~1 DU change in EPIC TOZ in early 2021

Significant drift in OMI TOZ

Jump in TROPOMI TOZ in mid-2021

omps np v2.8-omi v8.5 (+1.5%)
omps np v2.8-omps nm v2.1
omps np v2.8-epic (from Jerry)
omps np v2.8-tropomi (from Jerry)

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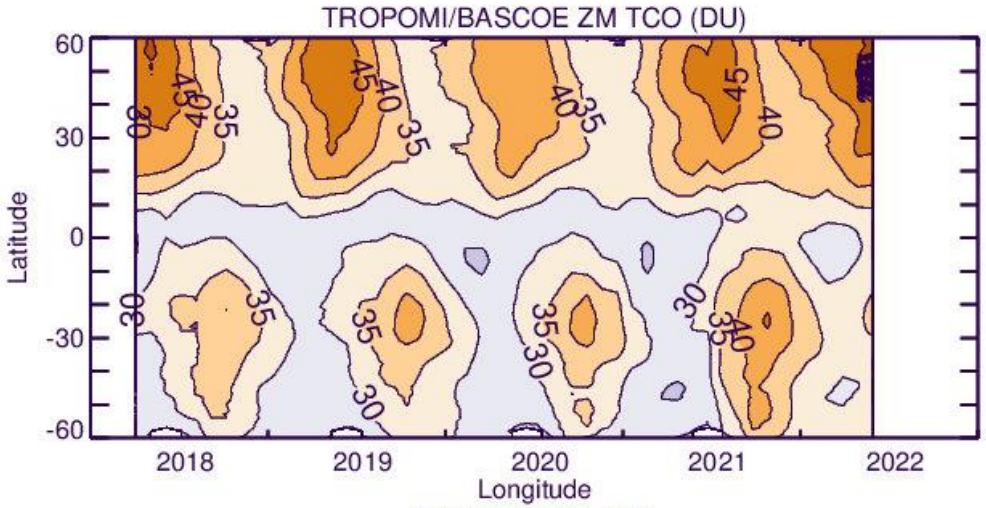
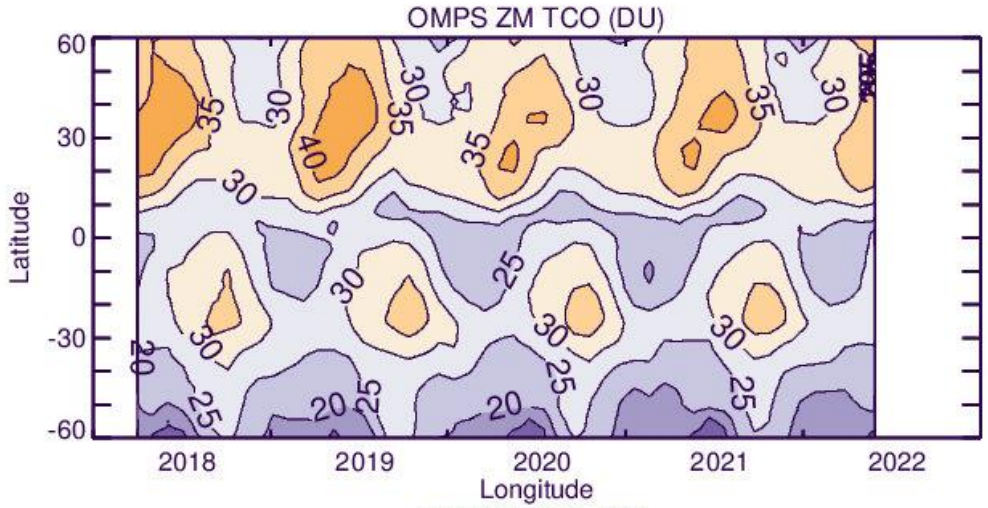
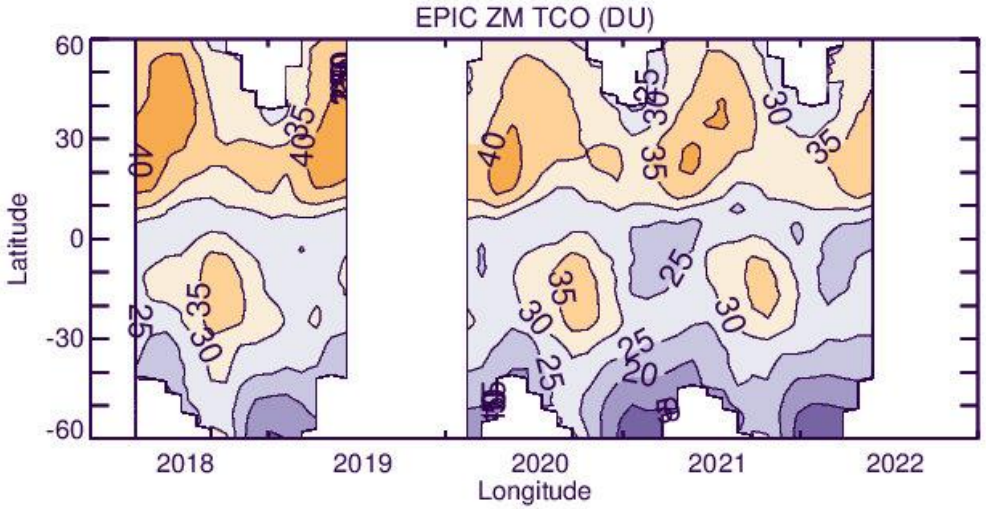
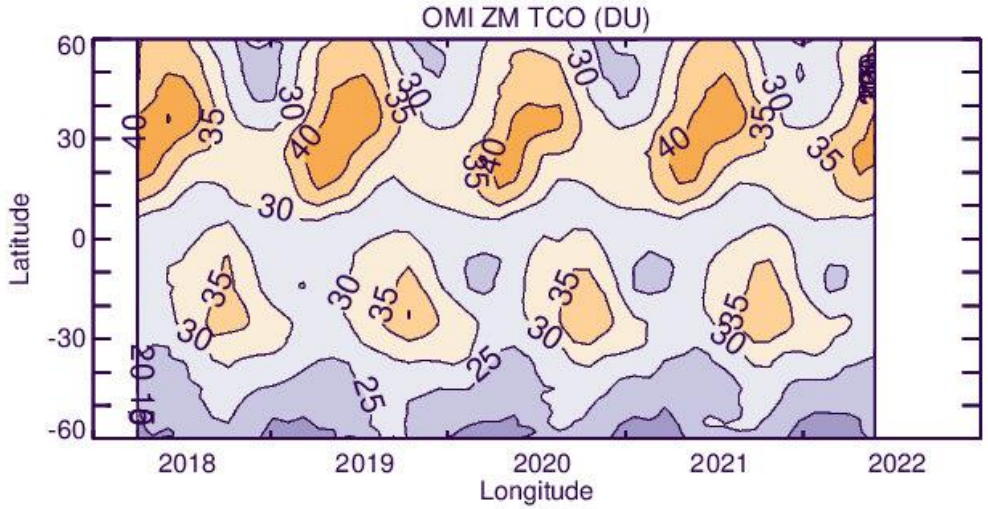
NASA merged TCO Record









TCO comparisons with sondes