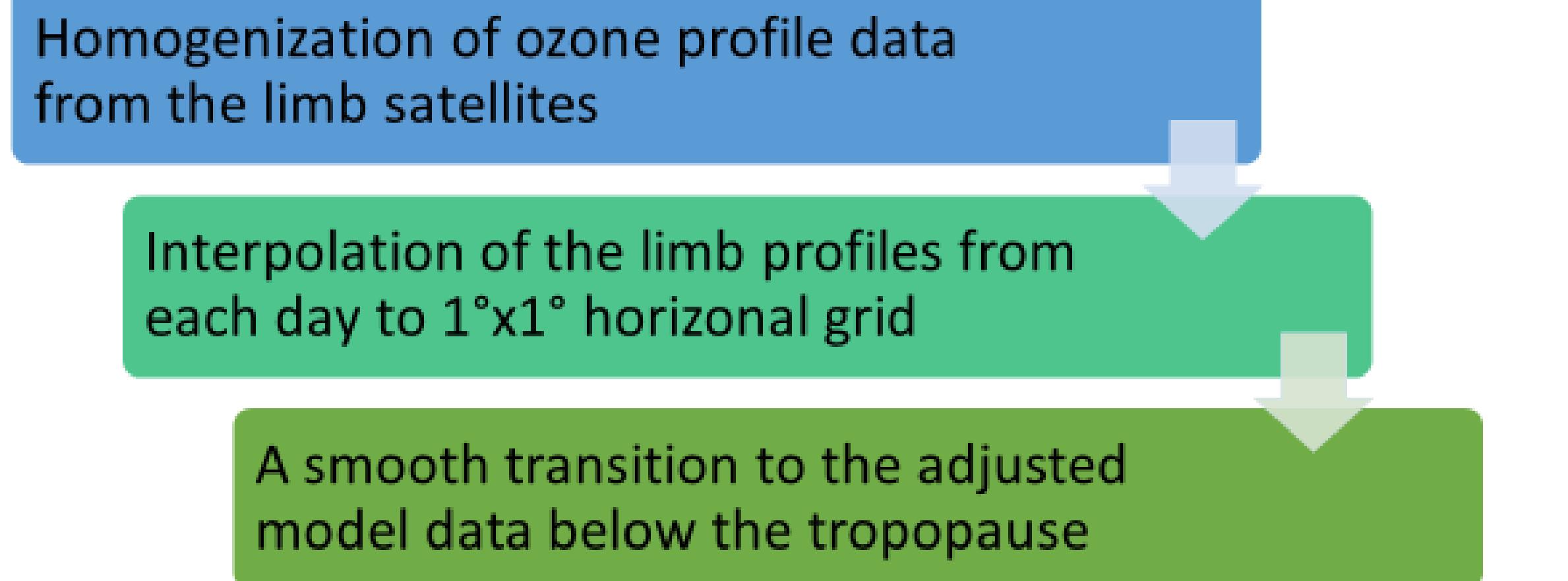


## Synergy of Using Nadir and Limb Instruments for Tropospheric ozone monitoring

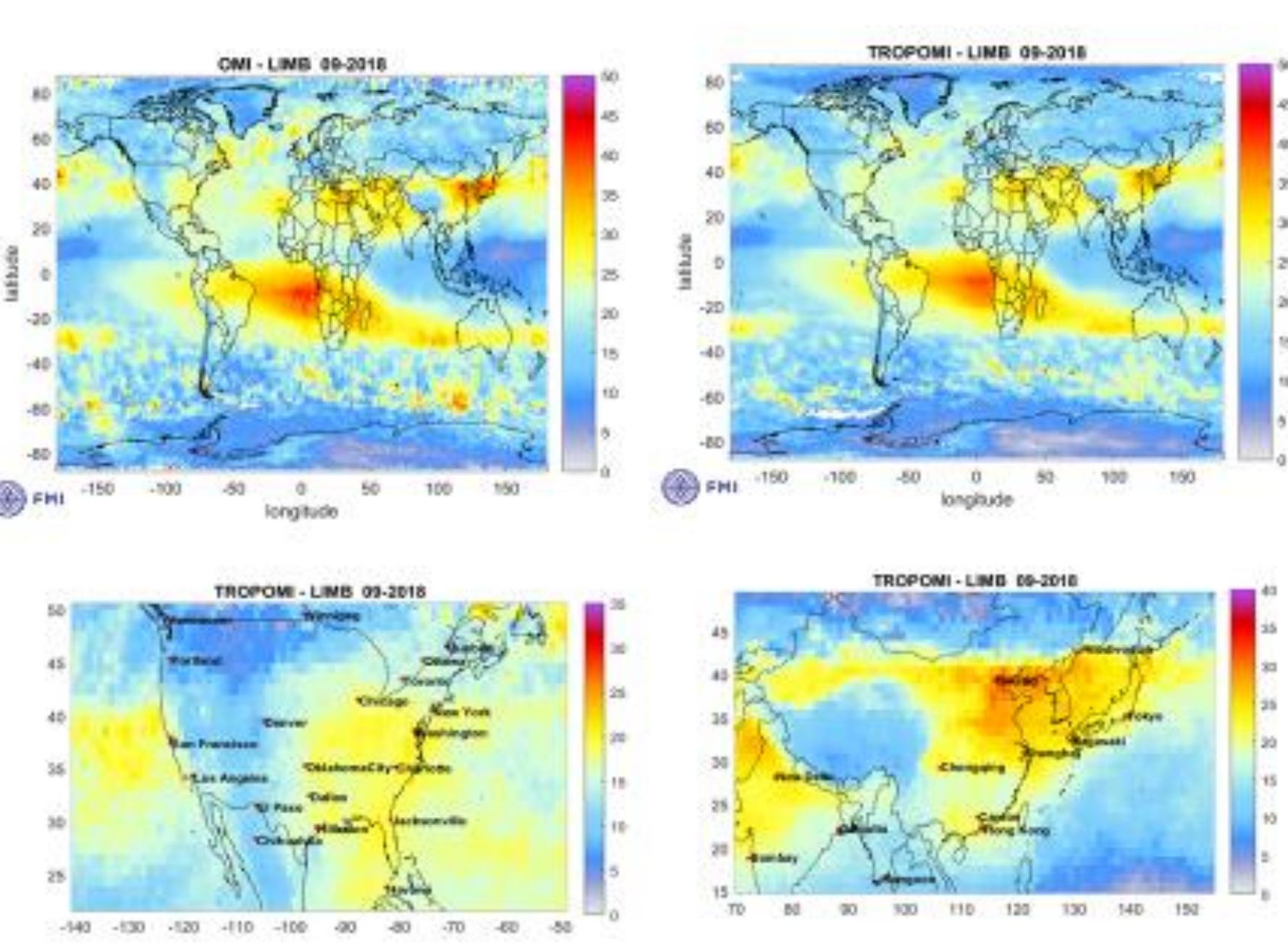
- Scientific objective:  
Application of residual method to create tropospheric ozone column data
  - TROPOMI combined with MLS, OMPS-LP, OSIRIS
  - OMI combined with MLS, GOMOS, MIPAS, SCIAMACHY, OSIRIS, OMPS-LP
- Novelty and challenge: stratospheric ozone is estimated using data from several satellite instruments
- New development: daily high vertical and horizontal resolution ( $1^\circ \times 1^\circ$ ) dataset of ozone profiles
  - The method for homogenization of data from limb sensors
  - Using the FMI chemistry-transport model SILAM for optimal data interpolation and improved data quality in the UTLS

## Homogenized and interpolated dataset of ozone profiles

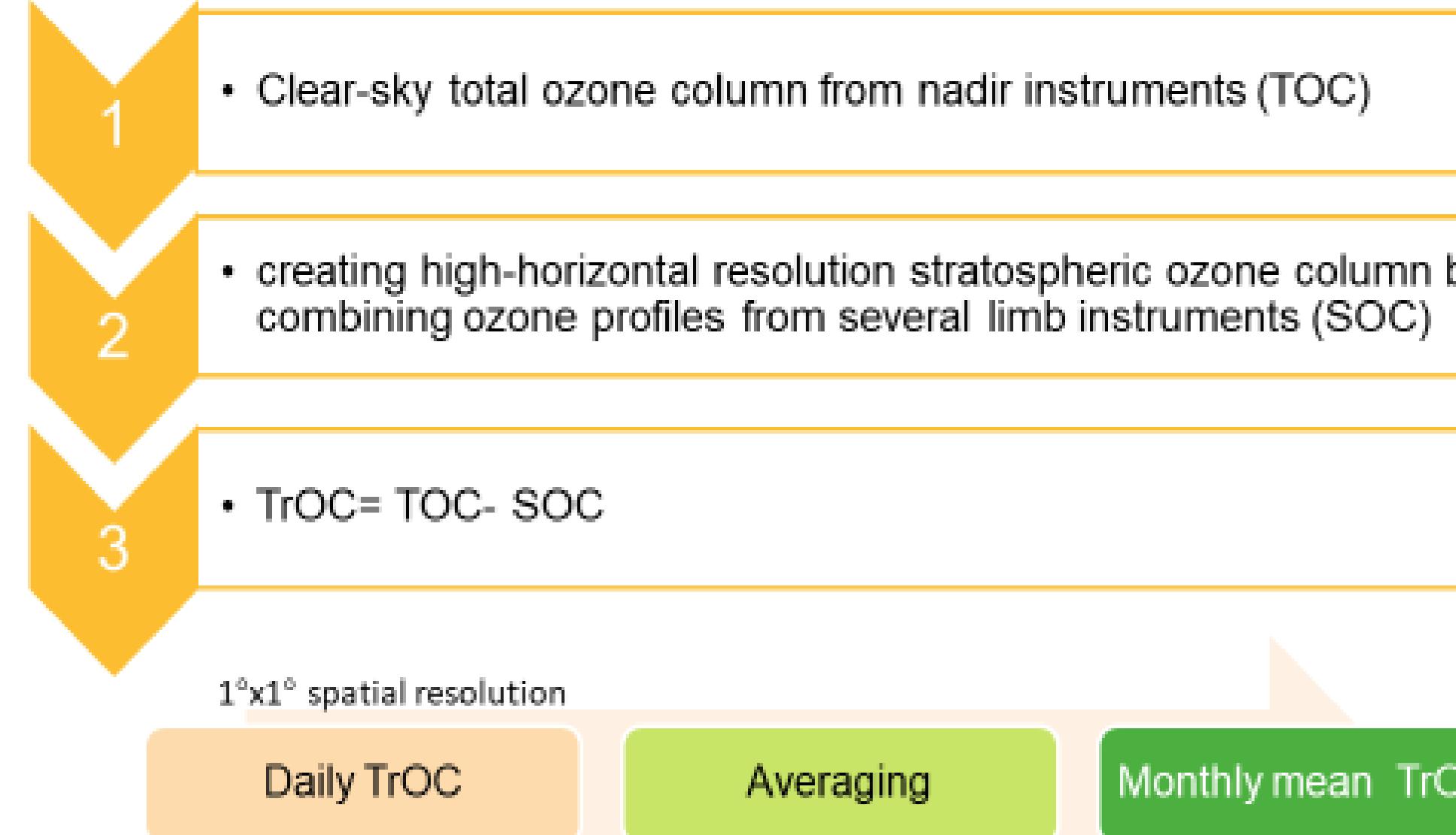


## Results

- Monthly  $1^\circ \times 1^\circ$  global tropospheric ozone column datasets
  - OMI-LIMB
  - TROPOMI-LIMB
- The global distributions of tropospheric ozone exhibit enhancements associated with the tropospheric sources



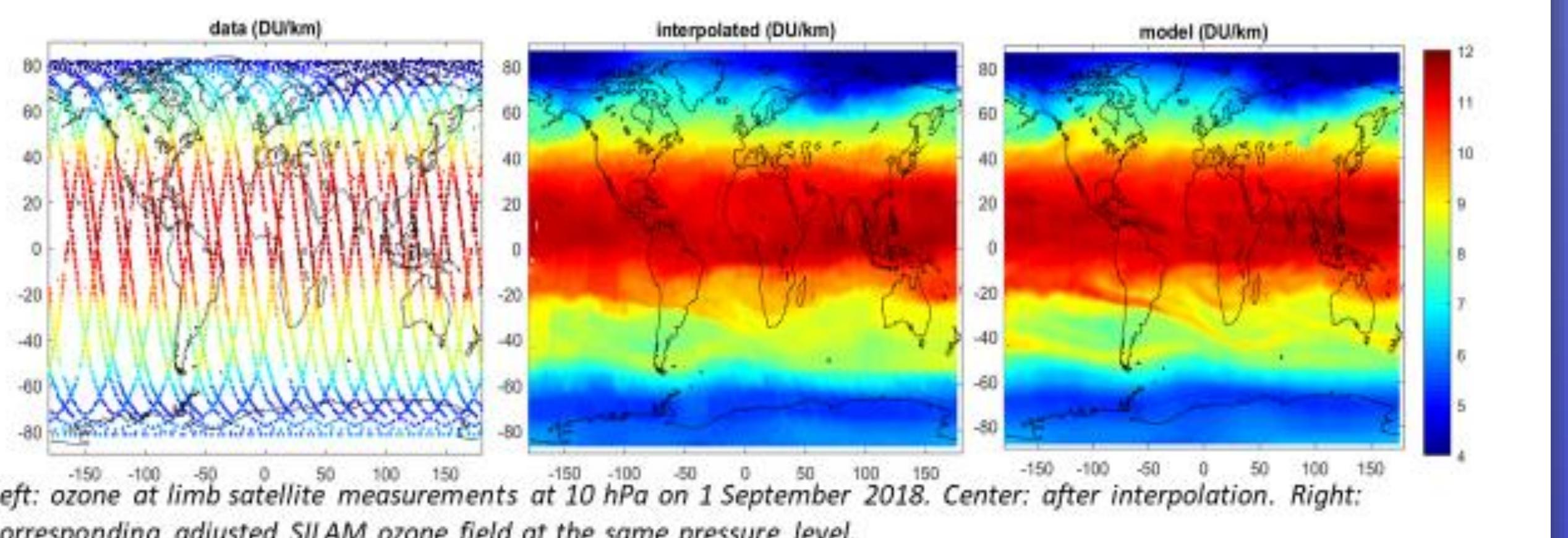
## Tropospheric ozone column by residual method: methodology in general



## Horizontal interpolation

- A kriging-type interpolation at each pressure level
  - Weighted mean of data in a neighborhood
  - Weights are inversely proportional to total uncertainties
  - The mismatch uncertainties are estimated using the SILAM model

$$x(\mathbf{r}) = \sum_i w_i x_i(\mathbf{r}_i), \quad \sigma_{tot,i}^2 = \sigma_{noise,i}^2 + D(\mathbf{r}_i - \mathbf{r})$$



## Main datasets

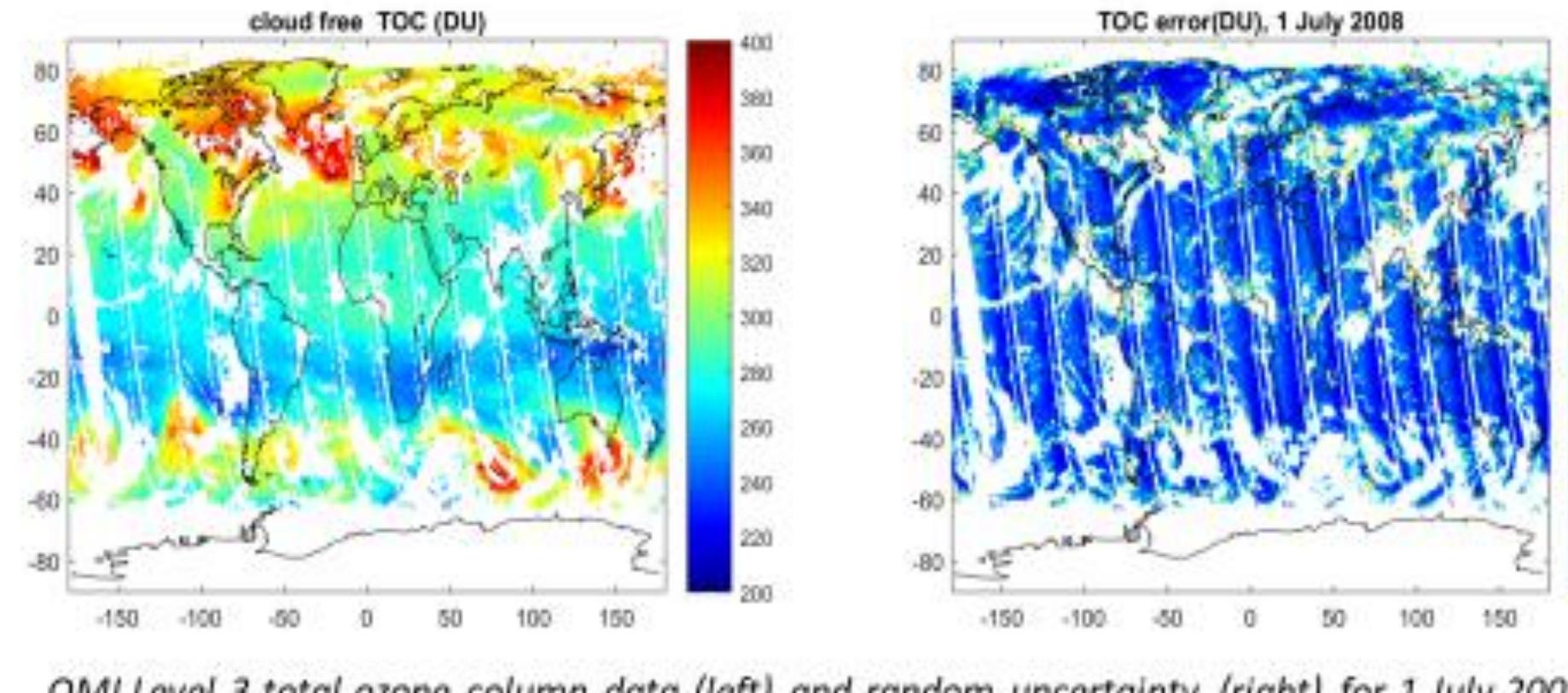
- Monthly  $1^\circ \times 1^\circ$  global tropospheric ozone column dataset using OMI and limb instruments (2004-2020)
- Monthly  $1^\circ \times 1^\circ$  global tropospheric ozone column dataset using TROPOMI and limb instruments (2018-2020)
- Daily  $1^\circ \times 1^\circ$  interpolated stratospheric ozone column from limb instruments (2004-2020)

## Other datasets

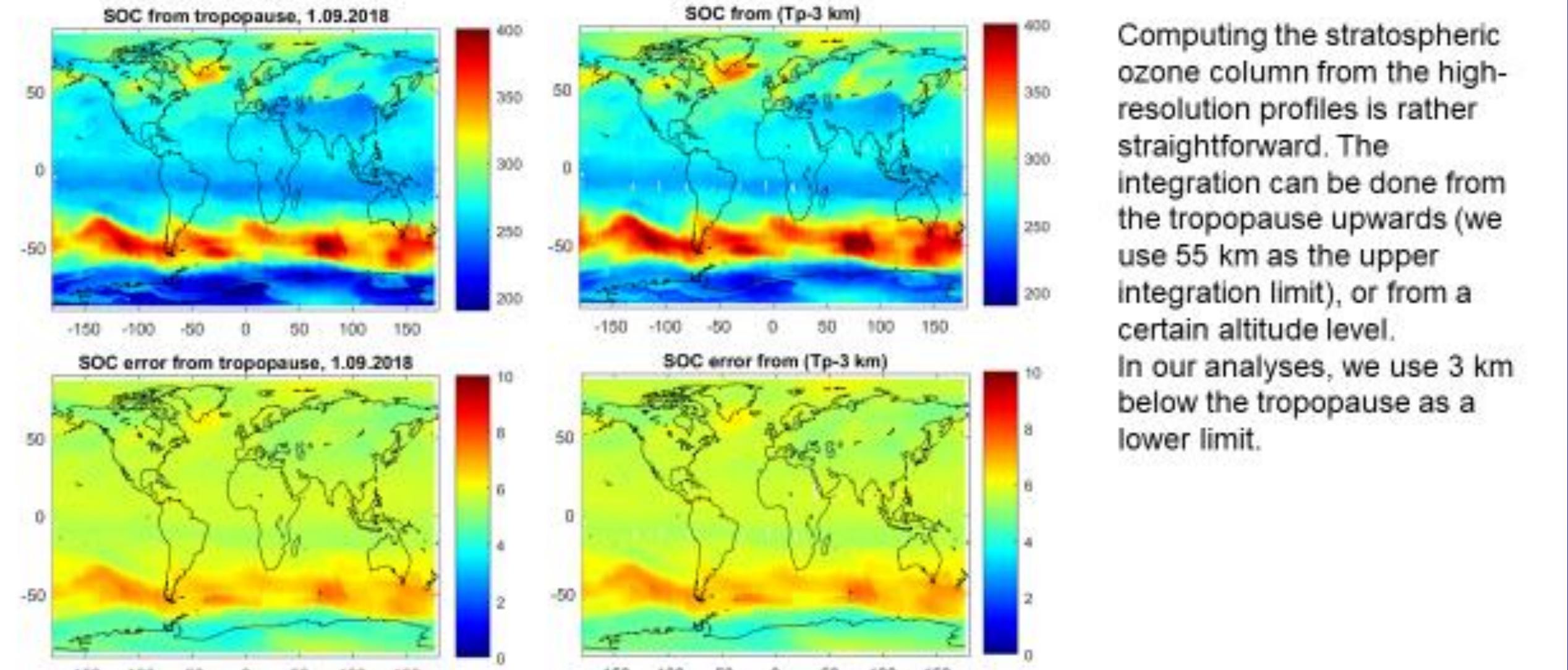
- Daily  $1^\circ \times 1^\circ$  clear sky and total ozone column from OMI and TROPOMI
- Daily  $1^\circ \times 1^\circ$  homogenized and interpolated dataset of ozone profiles
- Daily  $1^\circ \times 1^\circ$  dataset of ozone profiles from SILAM simulations with adjustment to satellite data.

## Gridded clear-sky TOC from nadir data

- Clear sky: cloud fraction <0.2
- Simple averaging in  $1^\circ \times 1^\circ$  spatial bins
- Random uncertainties:  $\sigma^2 = \frac{1}{N} \sum_i \sigma_i^2 + \frac{1}{N} \text{var}(\rho_i)$



## Stratospheric ozone column and uncertainties



Stratospheric ozone column, SOC, (DU) from tropopause (left top) and from 3 km below the tropopause (right top) computed from  $1^\circ \times 1^\circ$  merged (homogenized and interpolated) limb ozone profiles. The corresponding uncertainties are shown in bottom panels.

## Data access:

[https://nsdc.fmi.fi/data/data\\_sunlit.php](https://nsdc.fmi.fi/data/data_sunlit.php)



## Reference

Sofieva, V. F., Hänninen, R., Sofiev, M., Szelag, M., Lee, H. S., Tamminen, J., and Retscher, C.: Synergy of Using Nadir and Limb Instruments for Tropospheric Ozone Monitoring, Atmos. Meas. Tech. Discuss. [preprint], <https://doi.org/10.5194/amt-2021-280>, in review, 2021.