

# The Status of the TEMPO Total-Ozone and Ozone-Profile Algorithm: V04 Updates and Comprehensive Evaluations

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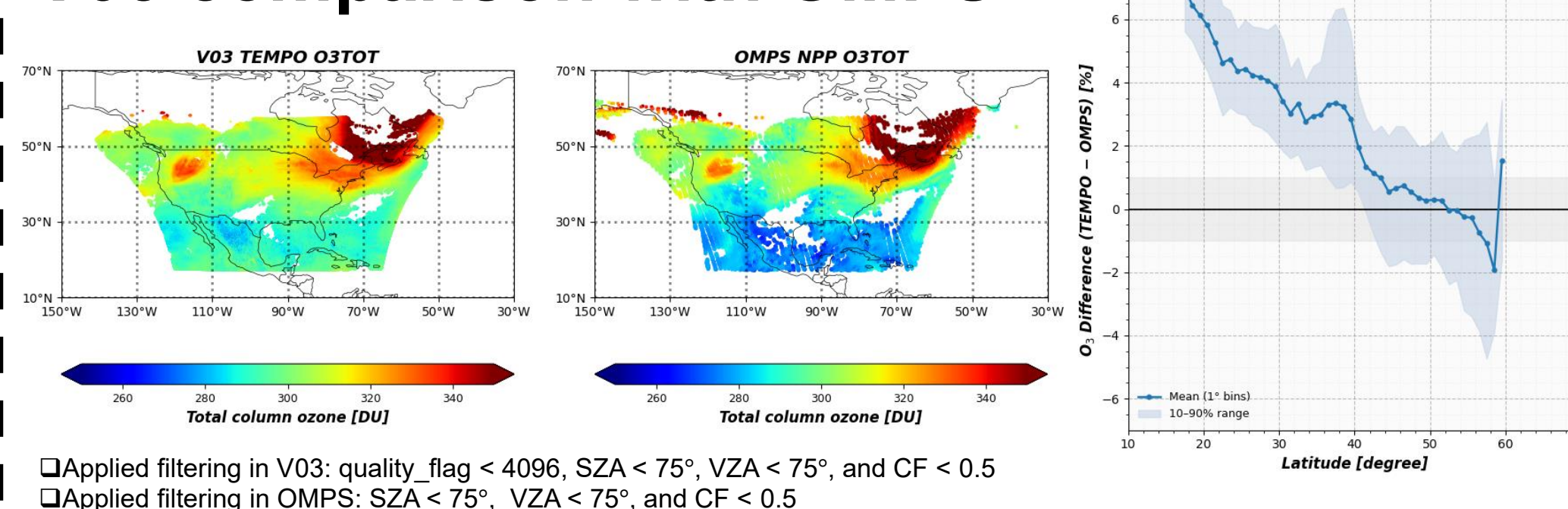
## Introduction

- For the TEMPO O3TOT algorithm, OMT03 V8.5 (also called Total Ozone Mapping Spectrometer (TOMS) V8.5) has been adapted to retrieve total ozone columns. This algorithm uses two wavelength pairs, one (317.62 nm for Ozone and 331.34 nm for the reflectivity) is for most conditions, and the other (331.34 and 360.15 nm) is for high ozone and high solar zenith angle conditions.
- For the TEMPO O3PROF algorithm, the OE-based SAO ozone profile algorithm is used, with a spectral fitting window from 308 to 340 nm.
- V04 TEMPO O3TOT shows a significant improvement in latitude-dependent bias, although it still exhibits a systematic negative bias due to instrument degradation and the algorithm's threshold.
- V04 TEMPO O3PROF shows a great agreement in ozone profile, tropospheric, stratospheric, and 0–2 km column ozone with other independent observations.

## V03 and V04 TEMPO O3TOT

- The TEMPO V03 O3TOT product demonstrated **strong agreement and high correlations** with Low-Earth-Orbit (LEO) sensors (OMI, OMPS, and TROPOMI) and ground-based observations (Brewer, Dobson, and Pandora). However, it had a **latitude-dependent bias**, characterized by negative biases at higher latitudes and positive biases in lower-latitude regions.

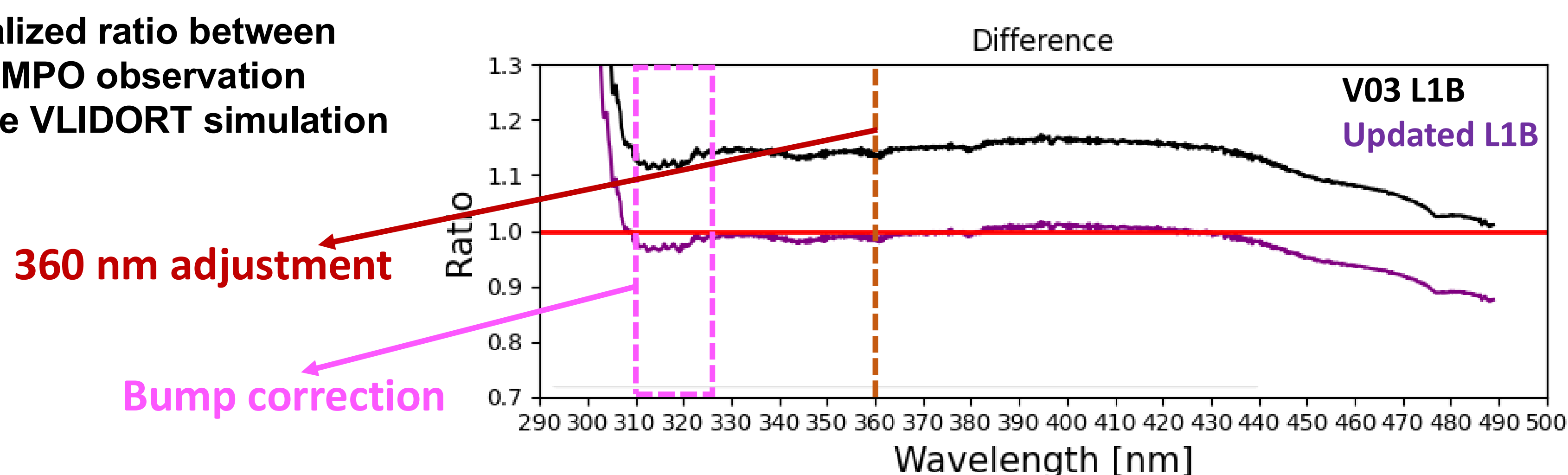
### V03 comparison with OMPS



### V04 Updates

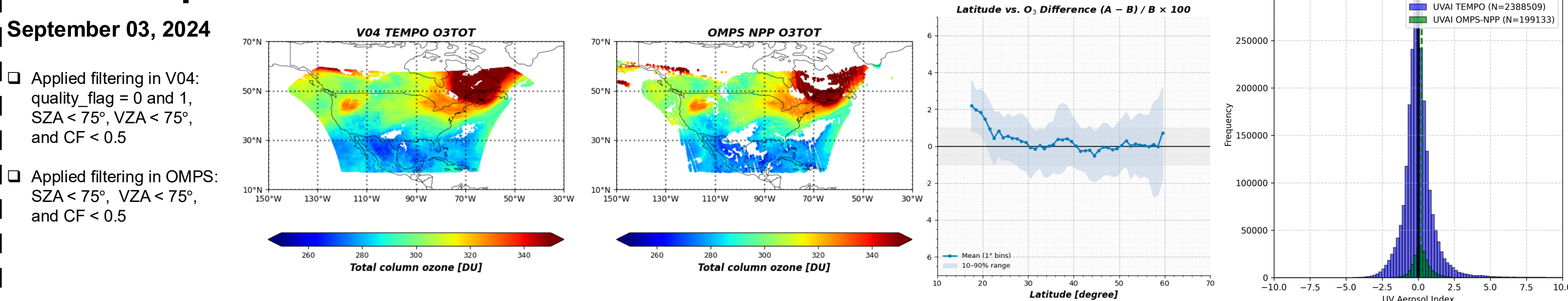
- 1<sup>st</sup> step: BTDF update in TEMPO L1B
- 2<sup>nd</sup> step: BTDF update in TEMPO L1B + bump correction
- 3<sup>rd</sup> step: BTDF update in TEMPO L1B + bump correction + 360nm adjustment

### Normalized ratio between the TEMPO observation and the VLIDORT simulation



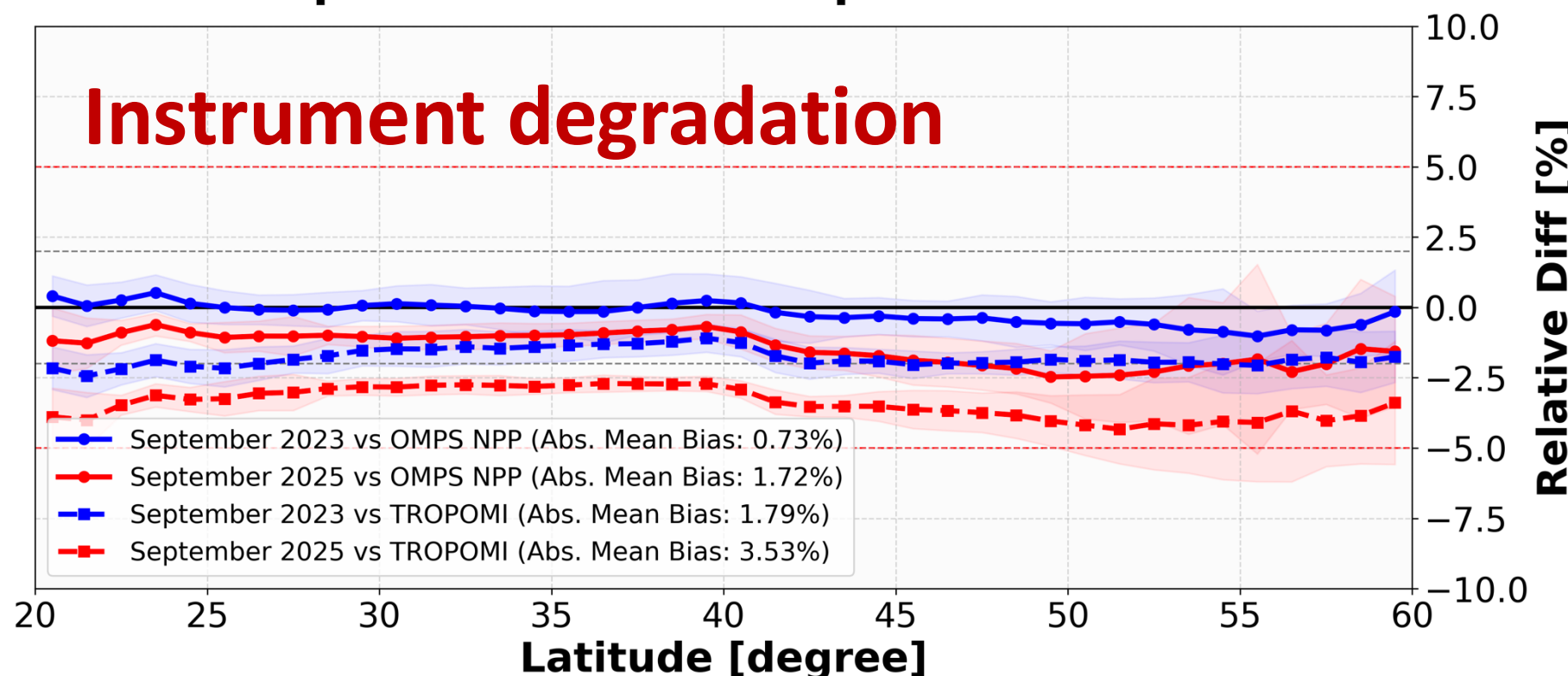
- After the BTDF correction update, total column ozone increased across the entire TEMPO observation domain. Although this update **did not address the latitude-dependent bias**, it **improved UVAI retrieval**.
- The addition of the bump correction after the BTDF update **significantly reduced the latitude-dependent bias** in total column ozone.
- With the combined application of the BTDF update, bump correction, and 360 nm adjustment, the **UVAI retrievals were further improved**, and total column ozone showed a slight decrease across the entire TEMPO observation domain.

### V04 comparison with OMPS and distribution of UVAI

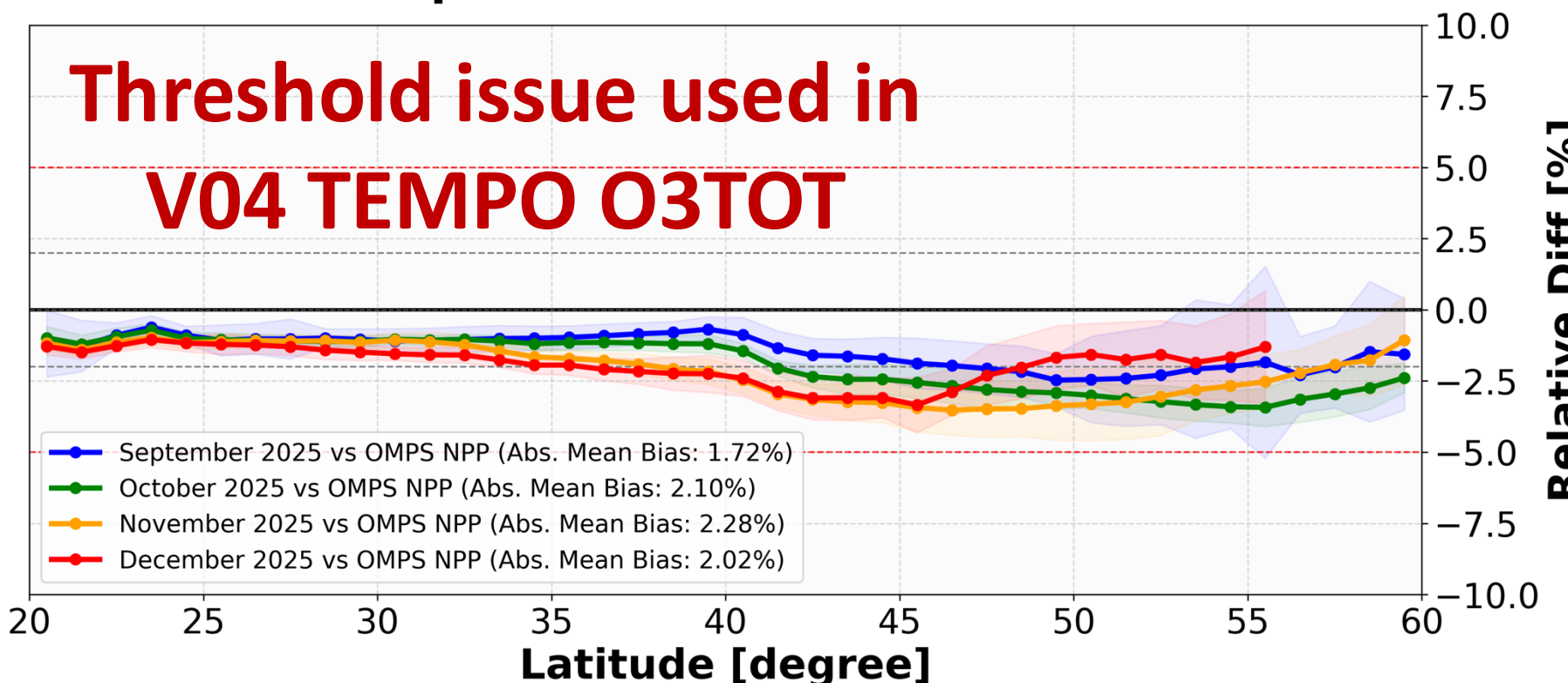


## Known issue of the V04 TEMPO O3TOT

Relative difference between TEMPO O3TOT and OMPS NPP / TROPOMI by latitude September 2023 vs September 2025



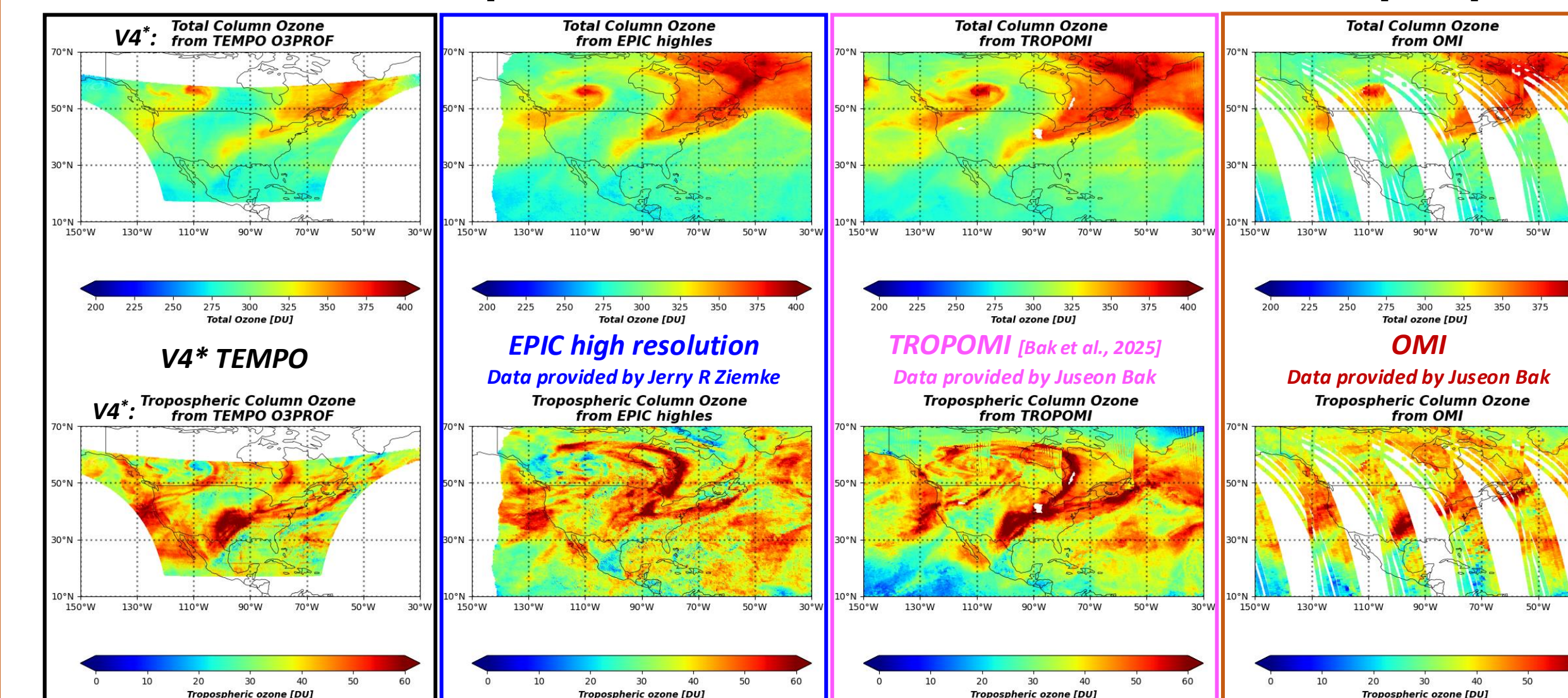
Relative difference between TEMPO O3TOT and OMPS NPP by latitude September-December 2025



## Status of the V04 TEMPO O3PROF

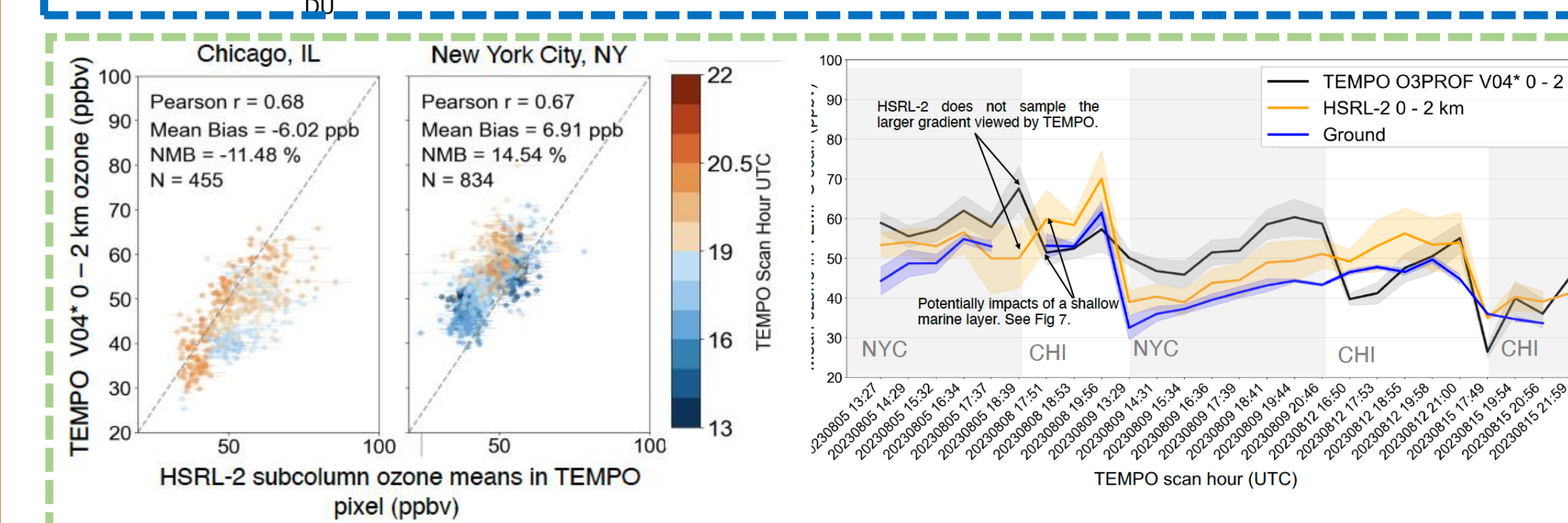
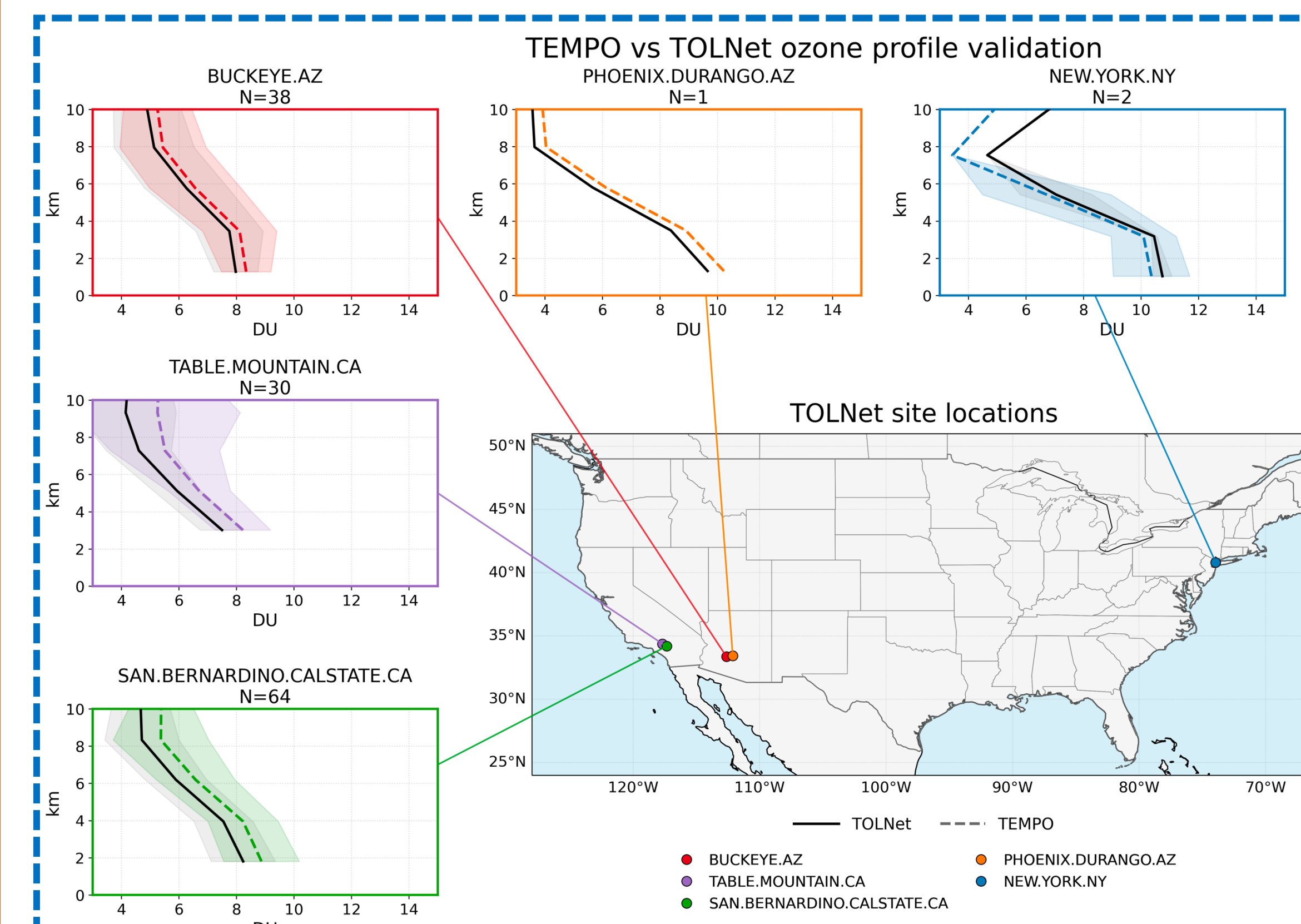
- The release of the TEMPO V03 O3PROF was limited to the TEMPO validation team.
- The release of the TEMPO V04 O3PROF was publicly released.

### Evaluation of the spatial distribution of the total and Tropospheric ozone using other satellites (EPIC, OMI, and TROPOMI)

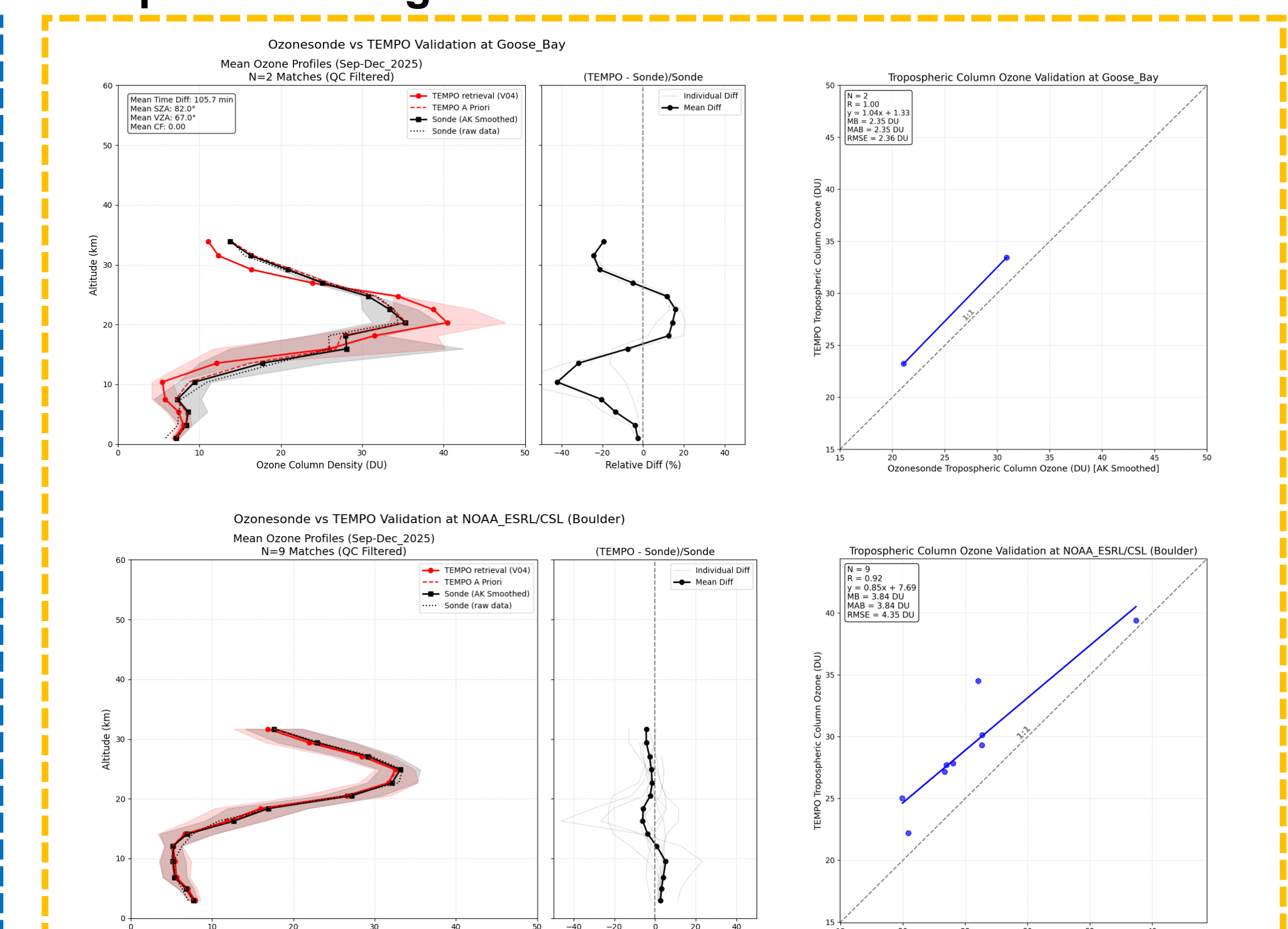


- We compared the TEMPO V04 O3PROF product with the EPIC high-resolution product (provided by Jerry R. Ziemke), OMI (provided by Juseon Bak), and TROPOMI (provided by Juseon Bak using a research algorithm [Bak et al., 2025]).
- The total and tropospheric column ozone show a good agreement with the other products.

### Evaluation of the 0–2 km column ozone using TOLNet and HSRL-2 observations

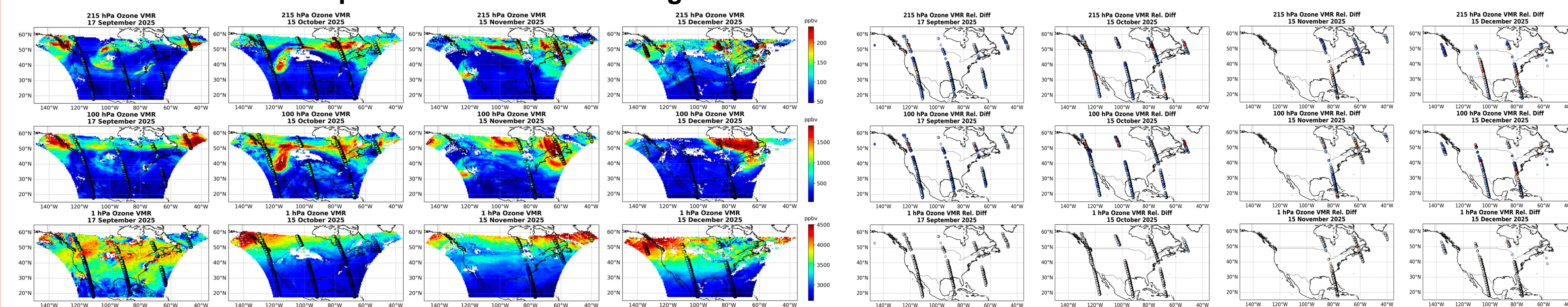


### Evaluation of the ozone profile and tropospheric ozone comparison using ozonesonde observations



- The 0–2 km column ozone shows a good agreement with TOLNet and HSRL-2 observations.
- The TEMPO ozone vertical profile is well correlated with the ozonesonde, but it shows a large discrepancy at ECCC ozonesonde sites located at high latitudes.
- Tropospheric column ozone shows a great agreement with ozonesonde observations.

### Evaluation of the stratospheric column ozone using MSL observations



- Stratospheric column ozone from TEMPO observations show a great agreements with MSL observations both spatial distribution and magnitude.

## Summary and Future works

- In V04, the performance of the total column ozone from the TEMPO O3TOT product improved significantly.
- In V04, we found the instrument degradation effect in TEMPO O3TOT retrieval.
- The TEMPO O3PROF product was publicly released for the first time in V04. In addition, it demonstrates a good performance in the tropospheric and 0–2 km column ozone
- We plan to conduct further validation as soon as the reprocessing of the V04 TEMPO data is finished.