Southern Hemisphere Additional Ozonesondes (SHADOZ) Network, Data Quality Assurance, and Trends Updates

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Anne Thompson (SHADOZ Founding PI), Debra Kollonige (SHADOZ Archiver), Bryan Johnson, Gary Morris, Patrick Cullis (NOAA), dozens of SHADOZ colleagues

CEOS AC-VC-19 / ACSG Joint Meeting 2023

Brussels, Belgium / Hybrid

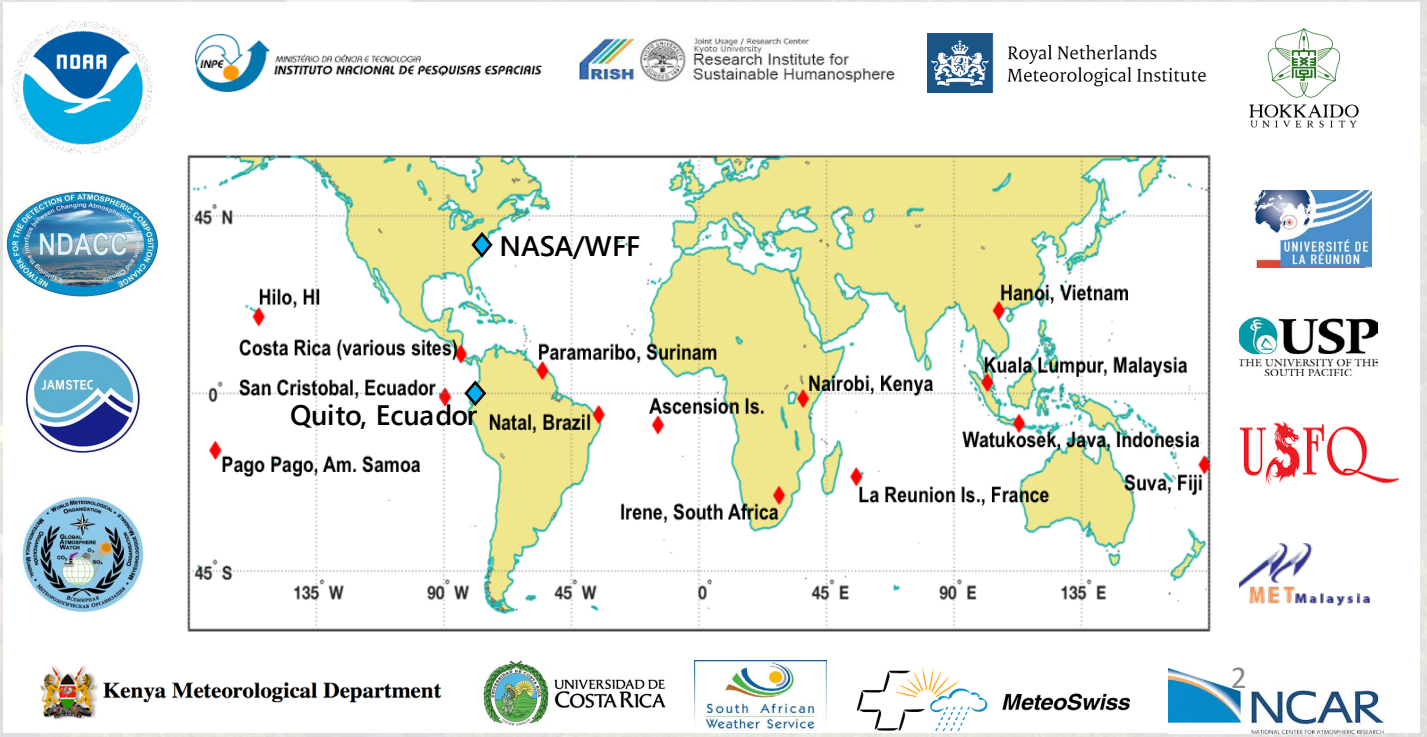
26 October 2023, 1455-1510

SHADOZ Basics: SHADOZ is >25!

SHADOZ Data Collection & Archive

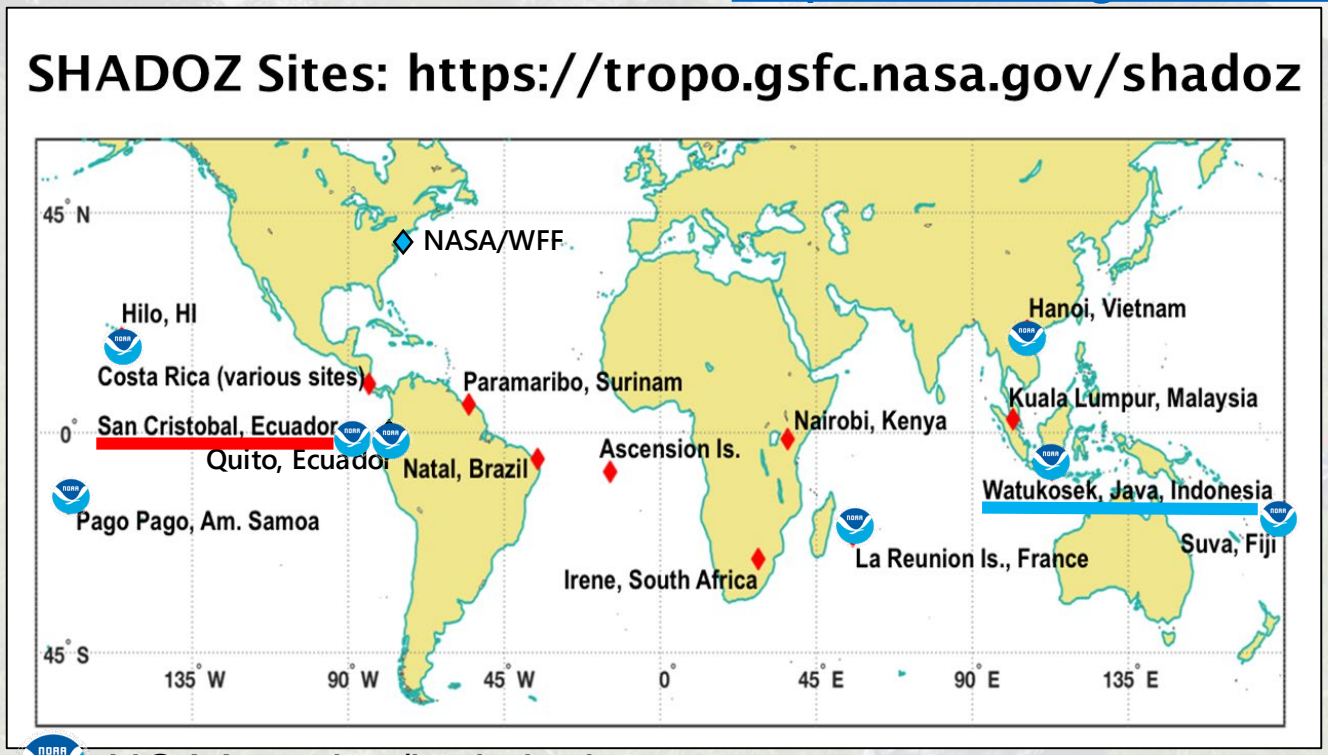
- Currently 14 stations and >20 sponsoring organizations. 2-4 profiles per month at individual stations
- Data Archive Statistics: **>10,000 profiles.** Post-COVID rebound in yearly data collection
- Note: NASA/GSFC also oversees NASA/WFF >50-year record

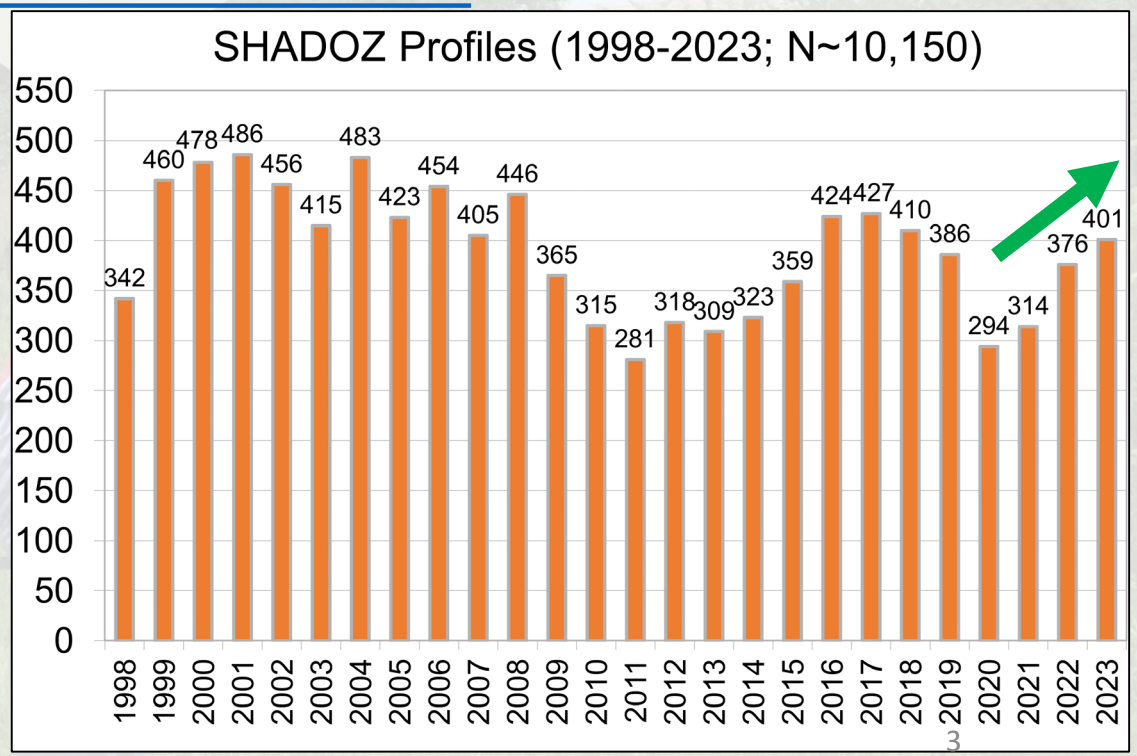
- **SHADOZ Network Status**
- **SHADOZ Data Quality Assurance and Science Updates**
  - ✓ **Update to Thompson et al. (2021; JGR; "T21")**
  - ✓ **Focus on SE Asia ozone and convective trends (Stauffer et al., 2023; in prep)**
  - ✓ **TOAR-II and evaluating satellite tropospheric ozone trends**



SHADOZ Data Archive Status

- 14 stations with >10-year records
- 2021: **Watukosek** and **San Cristóbal** stations reactivated, plus monthly profiles from Quito. **Likely to add Palau (TWP) soon (Müller et al., 2023a;b)**
- >10,000 O_3-PTU profiles archived on SHADOZ website
- SHADOZ v6 data DOI: https://doi.org/10.57721/SHADOZ-V06





NOAA station/logistical support

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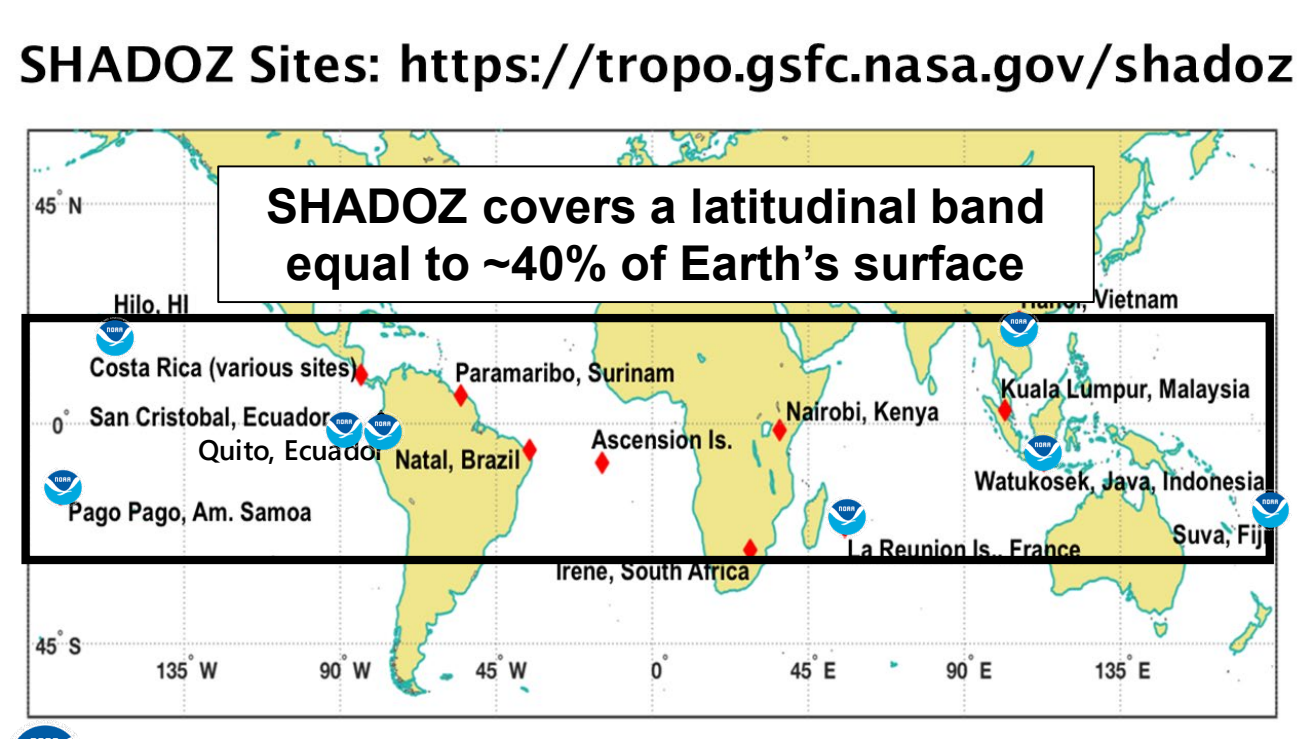

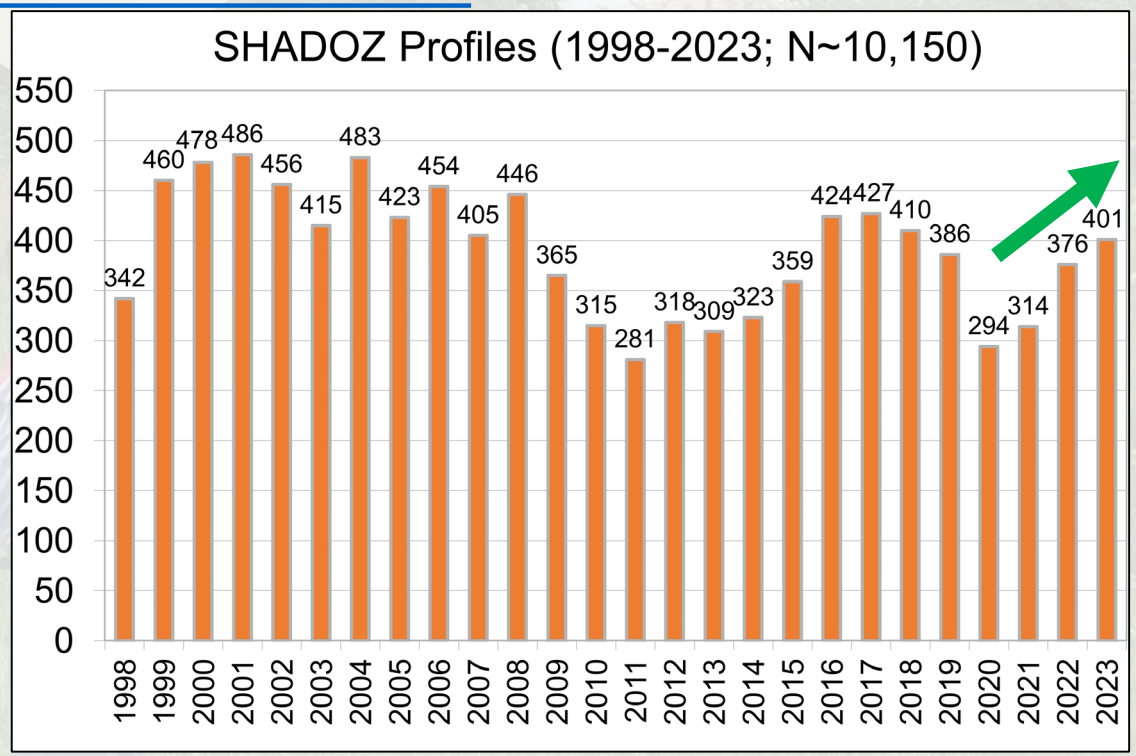

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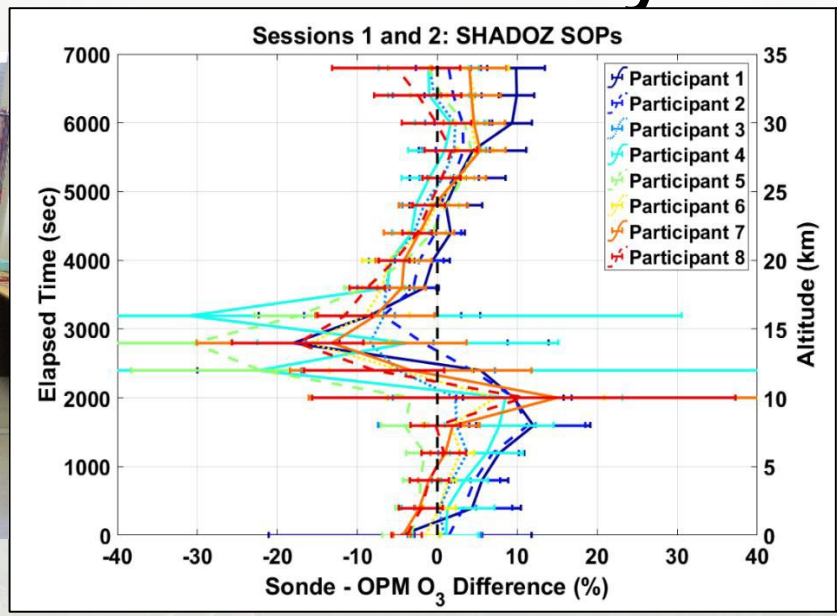
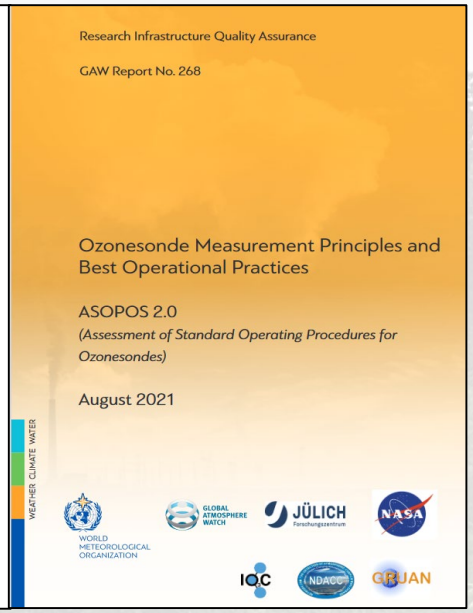
SHADOZ Data Quality Assurance and Recent Science

SHADOZ' Role in O_3Sonde Data Quality Assurance





- 2017 JOSIE-SHADOZ campaign assembled SHADOZ operators to intercompare station SOPs (Week 1) and "JOSIE SOPs" (Week 2)
- Ozonesonde agreement with JOSIE OPM for both sets of SOPs averaged within ~3% total column ozone.
- Results were used to document new, updated SOPs in WMO/GAW #268. Peer reviewers from 6 continents. Data homogenization (e.g., R. Van Malderen talk in this session) based on ASOPOS recommendations have been highly successful

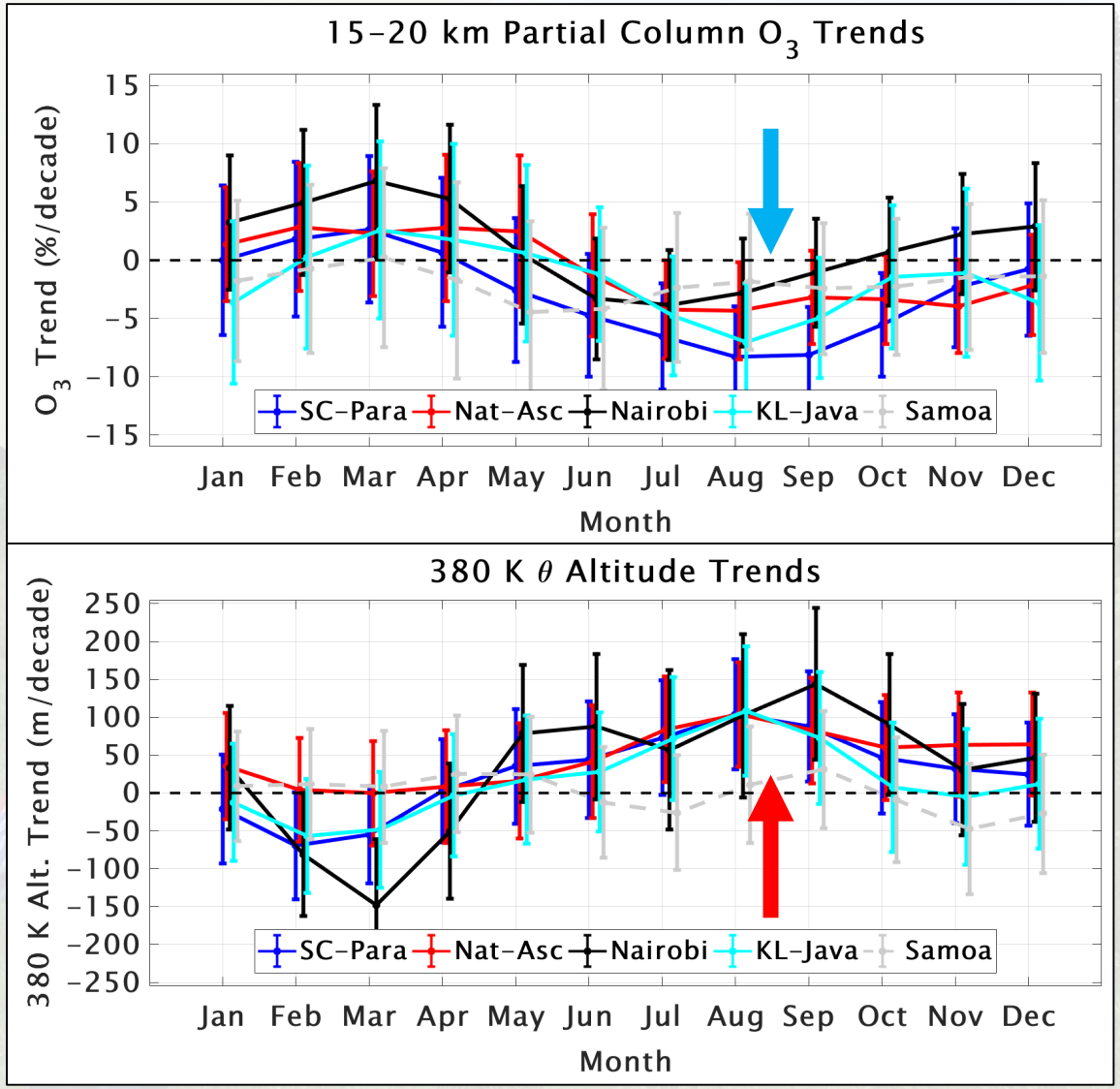
SHADOZ Science: O_3 Profile Trends

- SHADOZ ozonesonde profile trends updated from Thompson et al., 2021 (“T21”). 1998-2022 were calculated from 5-20 km with a multiple linear regression model at five stations

- In the 15-20 km layer, significant negative trends (-5 to -10 %/decade) occur in several months during the second half of the year (**top**)

- This is coincident with significant positive trends in the tropopause height at the stations (**bottom**)

- Are the SHADOZ lower stratospheric ozone trends an artifact of tropopause height changes?



Update of Thompson et al. (2021)

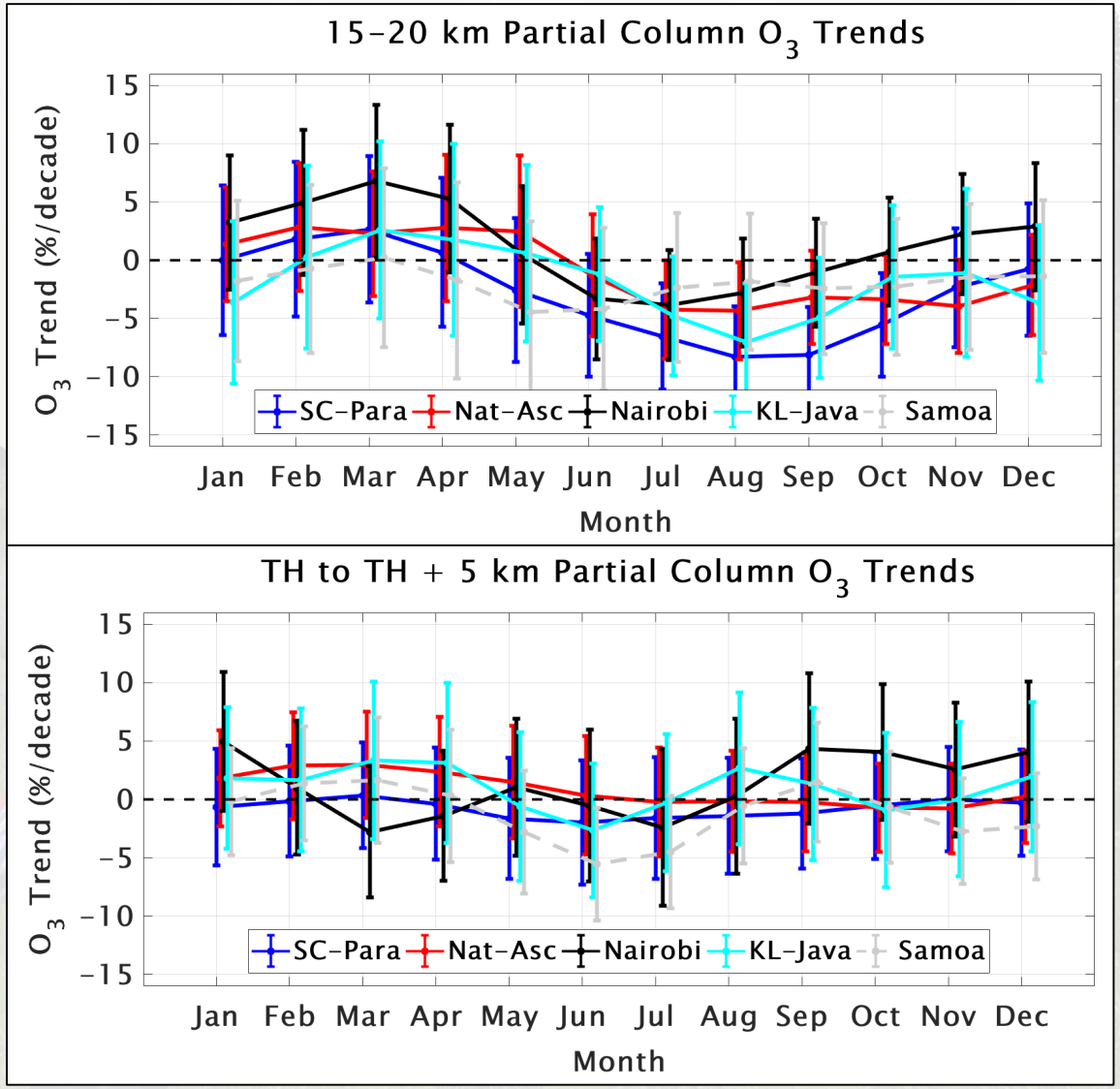
SHADOZ Science: O_3 Profile Trends

- Referencing the ozonesonde profiles to the tropopause height and re-calculating trends shows that the trends largely “disappear”! (**bottom**)

- Potential climate signal in tropopause height increases are leading to negative ozone trends in the lower stratosphere

- Trends output from Thompson et al., (2021; JGR) are found at: https://tropo.gsfc.nasa.gov/shadoz/SHADOZ_PubsList.html.

- **Use the output to evaluate your satellite and model-based trends calculations!**



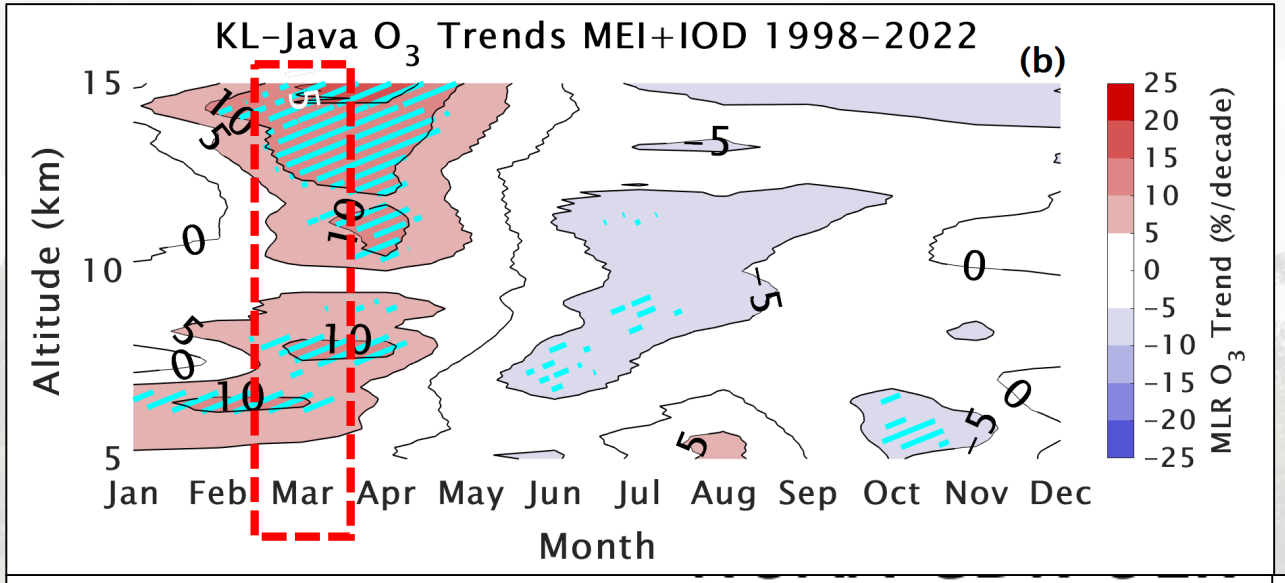
Update of Thompson et al. (2021)

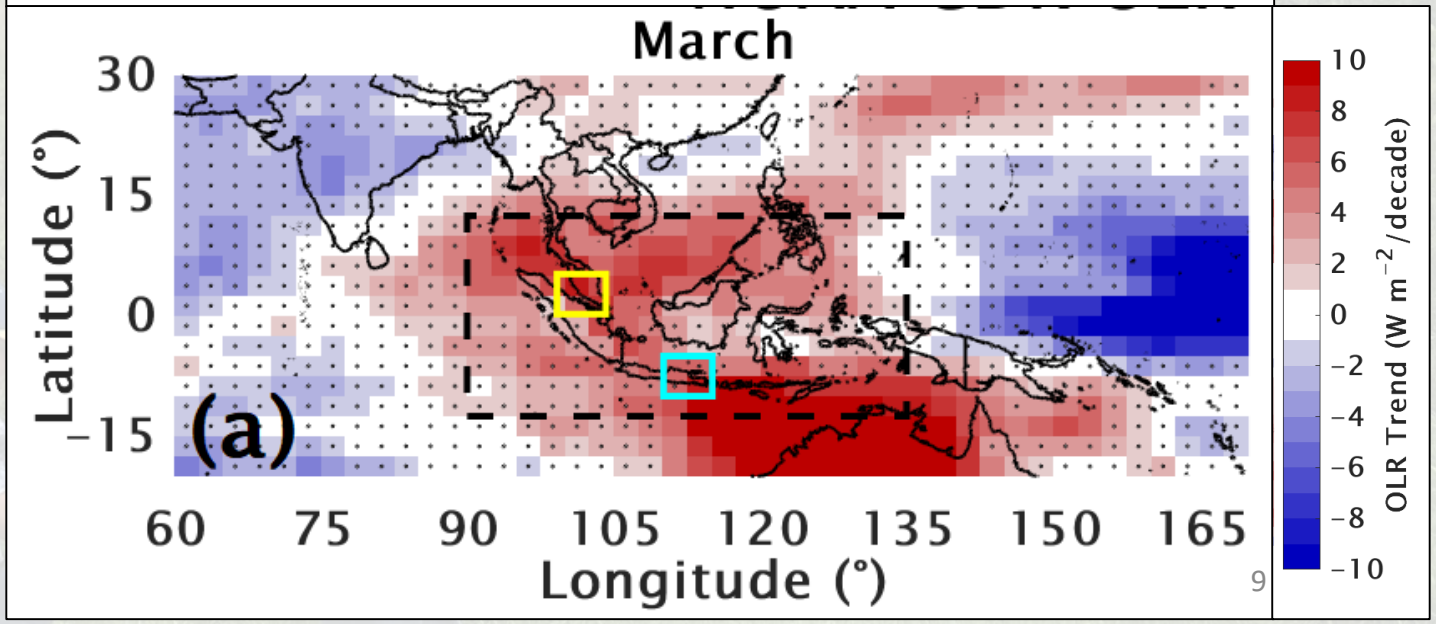
SHADOZ Science: O_3 Profile Trends

- Stauffer et al., (2023; in prep) shows that **Feb-Apr large positive ozone trends** over Southeast Asia (**top;** KL and Java SHADOZ stations) are associated with a significant decrease in convection (**bottom) 1998-2022**

- Decrease in convection reduces the lofting and redistribution of near-surface ozone poor air, and tropospheric ozone accumulates

- Look for paper on this topic soon…



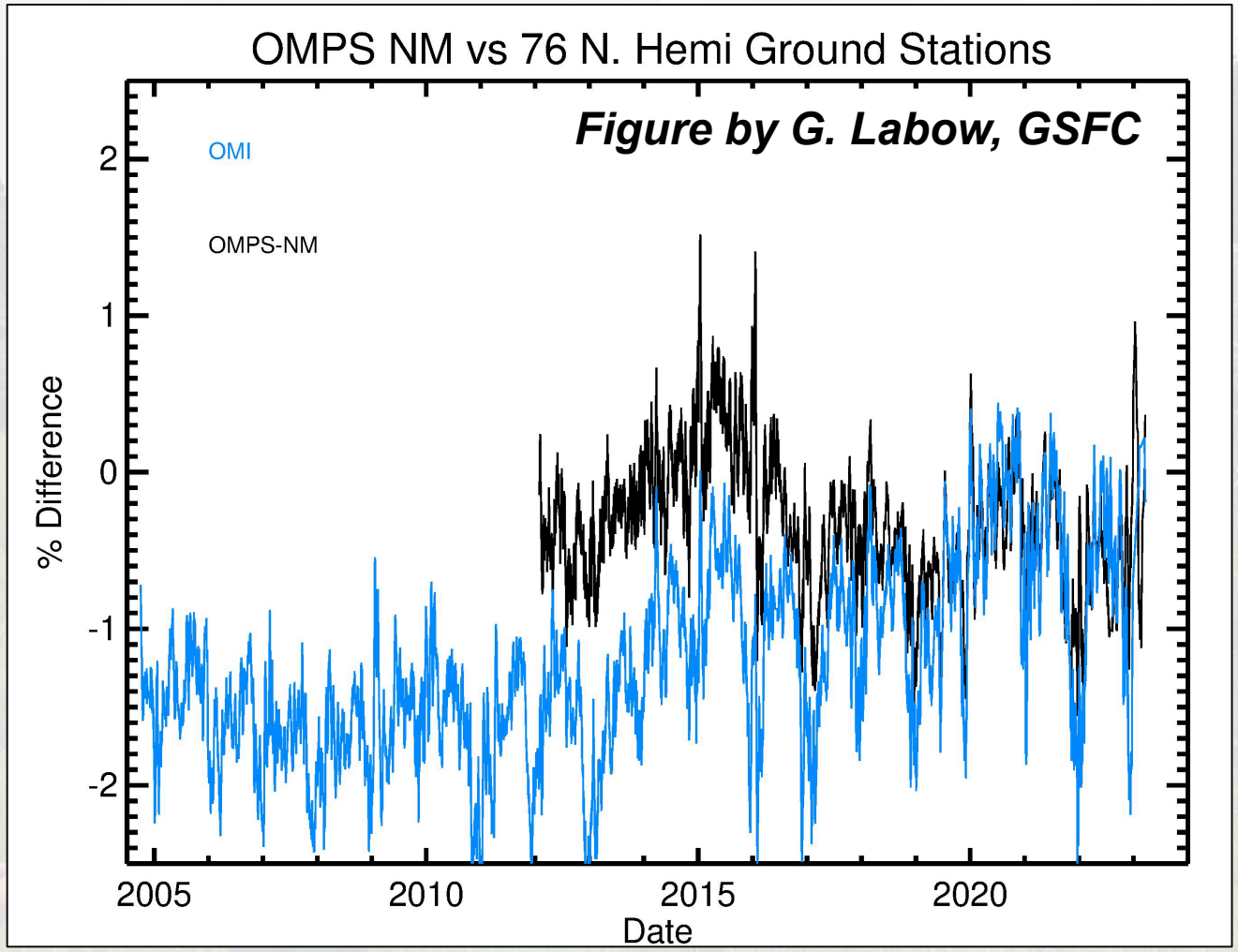


SHADOZ Science: TOAR-II

- Ground-based total column ozone from Dobsons and Brewers confirm OMI has drifted higher by >1% over its lifetime

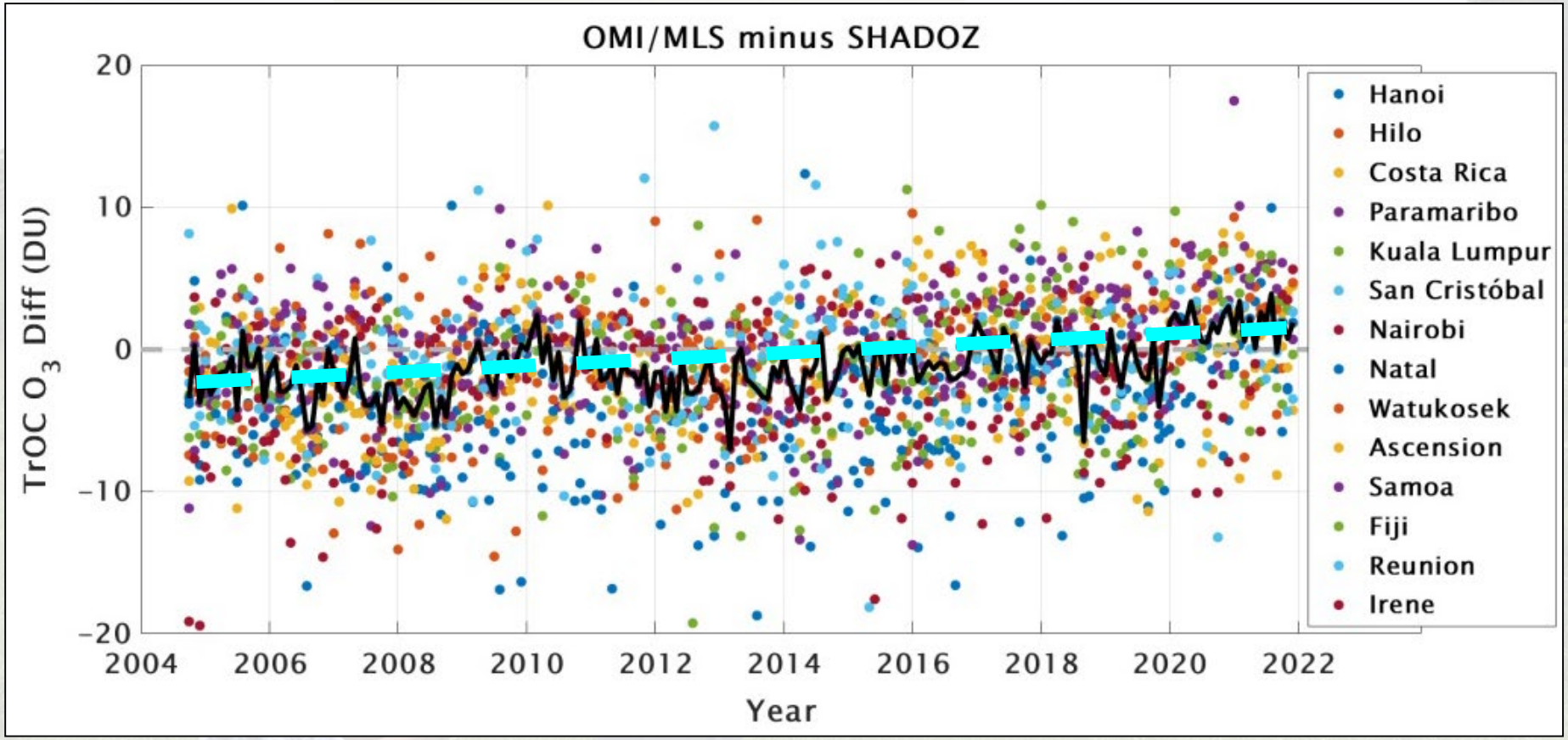
- This has implications for satellite tropospheric ozone calculations via the subtraction method (i.e., OMI/MLS)

- We can leverage the ozonesonde tropospheric ozone to validate and correct satellite tropospheric ozone



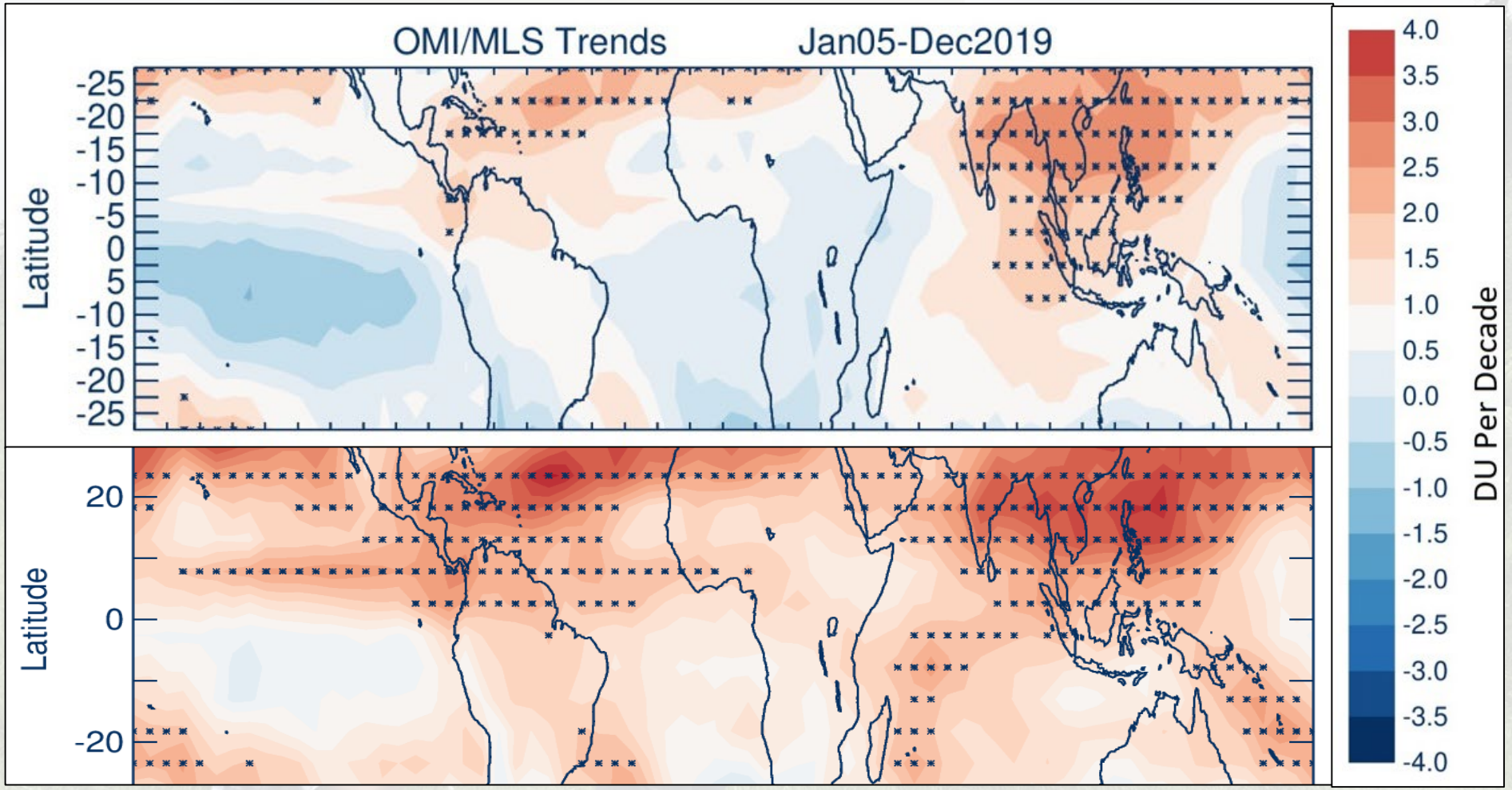
SHADOZ Science: TOAR-II

- OMI ~1% positive total column ozone drift means ~10% positive drift in OMI/MLS tropospheric ozone
- Ozonesonde data are high enough quality to detect the drift in both total and tropospheric column ozone →
- We are working with J. Ziemke (NASA/GSFC) to correct the OMI/MLS drift for TOAR-II



SHADOZ Science: TOAR-II

- Additional correction of -0.6 DU/decade was applied to OMI/MLS (already contained -1 DU/decade correction; **Ziemke et al., 2019**)
- Corrected (**top**) vs. original (**bottom**) shows better agreement with in-situ ozonesonde and IAGOs-derived trends
- Corrected data set now online and provided to TOAR-II



Figures by J. Ziemke

Summary

- SHADOZ fills an otherwise huge gap in ozonesonde data in the tropics. **10,000th profile archived in late 2023**

- *How do we know our data are of high-quality?* Lab and field tests inform reprocessing efforts that have helped us achieve high accuracy and close to the ~5% uncertainty goal for ozonesonde data

- SHADOZ ozone measurements and trends set the standard for satellite product evaluation and activities like TOAR-II

Thanks to our partners, collaborators, and NASA HQ Program Manager K. Jucks for support