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

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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 O₃-PTU profiles archived on SHADOZ website
- SHADOZ v6 data DOI: [https://doi.org/10.57721/SHADOZ-V06](https://doi.org/10.57721/SHADOZ-V06)

SHADOZ Sites: [https://tropo.gsfc.nasa.gov/shadoz](https://tropo.gsfc.nasa.gov/shadoz)
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SHADOZ covers a latitudinal band equal to ~40% of Earth’s surface
SHADOZ Data Quality Assurance and Recent Science
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: O₃ 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: O₃ Profile Trends

• Referencing the ozonesonde profiles to the tropopause height and re-calcultating 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!
• 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.

*Figure by G. Labow, GSFC*
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
• 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

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