



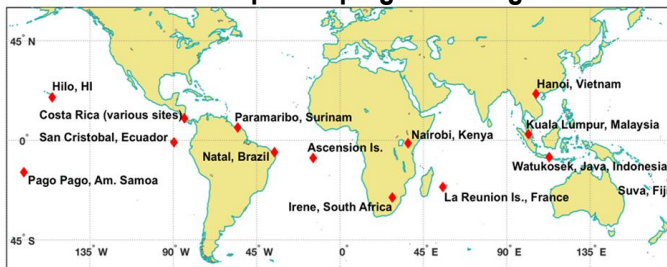
# SHADOZ Notes

## Southern Hemisphere Additional Ozonesondes

A NASA/Goddard Space Flight Center public archive of tropical and remote ozonesonde profile data

SHADOZ is a NASA project to augment and archive balloon-borne ozonesonde launches and to archive data from tropical and remote operational sites. The project was initiated in 1998 by NASA/Goddard Space Flight Center, the NOAA/Global Monitoring Division, and international co-investigators. There are currently thirteen stations launching ozonesondes in the SHADOZ network. The collective data set provides the first climatology of tropical ozone in the equatorial region, enhances validation studies aimed at improving satellite remote sensing techniques for tropical ozone estimations, and serves as an educational tool to students, especially in participating countries.

SHADOZ Sites: <https://tropo.gsfc.nasa.gov/shadoz>



## ❖ NASA GSFC HOSTS REGIONAL STATION VIRTUAL MEET-UPS ❖

The COVID-19 pandemic has restricted travel for site visits, conferences, and technical meetings in 2020 and so far in 2021. To help facilitate communications with SHADOZ stations during this period, the NASA GSFC SHADOZ team organized and hosted **Regional Station Virtual Meet-Ups** March-May 2021 with three regions so far: **Southeast Asia, Equatorial Americas and the NOAA Pacific stations** (Screenshots of attendees in **Figure below**). Attendees for each Meet-Up numbered 16, 15 and 13 respectively including the GSFC team (**Anne Thompson, Ryan Stauffer and Debra Kollonige**), NOAA/GML partners (**Bryan Johnson and Patrick Cullis** pictured below), station PIs, field operators and data managers. Individual stations presented updates on their current staff, ozonesonde launch operations and future plans (e.g. participation in the upcoming Quadrennial Ozone Symposium). The GSFC team shared updates on new ozonesonde standards, data quality assurance and the importance of metadata for data processing.



Figure: Screenshots of: (left) Meet-Up #1 attendees for Southeast Asia stations. (middle) Meet-Up #2 attendees for Equatorial Americas stations and (right) Meet-Up #3 attendees for the NOAA Pacific stations.

## ❖ Founding PI Thank You ❖



Dear SHADOZ Colleagues,

The purpose of this note is twofold: (1) to thank all the SHADOZ operators, data providers and sponsors who have kept data flowing during the pandemic and (2) to reflect on SHADOZ highlights over the past 23 years as I transition from SHADOZ Principal Investigator (PI) to SHADOZ “Founding PI.” There are still restrictions in SHADOZ host countries but thanks to dedication of operators and their organizations, all but 2 stations are launching 15 months after “work from home” orders began. This is an extraordinary achievement – thank you! Year after year, the station people make SHADOZ the “premier ozonesonde network” as our Archiver of 20 years (Sept. 1998-April 2019), Jacquie Witte, liked to call us.

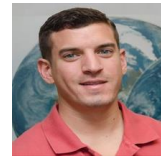
What began as a 3-year funded proposal in 1997 with NOAA’s Global Monitoring Lab and partners from 5 continents representing 10 stations (see logo), has grown to 14 stations with more than a decade of ozonesonde-radiosonde profiles – 9000 pairs at <https://tropo.gsfc.nasa.gov/shadoz>. Indeed, there are years when SHADOZ profiles have accounted for 15-20% of the WOUDC record. SHADOZ has > 2000 citations and the data are now used in countless papers assimilated in models and with satellite data. SHADOZ has had tremendous impact on tropical atmospheric science and beyond. **Among other highlights and spinoffs of SHADOZ are:**

- 1) Filling in ozone structure in the upper troposphere and lower stratosphere in the tropics led to the discovery of a distinct “tropical tropopause layer” that is neither simply stratospheric nor tropospheric in nature. **SHADOZ has an *h-index* of 26 with an average of 109 citations per year for 1998-2021.**
- 2) Since 1998 more than 20 ozone-measuring satellites have used SHADOZ profiles for algorithm development and validation of new products. **See SHADOZ-satellite timeline in *The Earth Observer* here at: [https://eospsa.gsfc.nasa.gov/sites/default/files/2019-09/20190904\\_color\\_508.pdf#page=4](https://eospsa.gsfc.nasa.gov/sites/default/files/2019-09/20190904_color_508.pdf#page=4).**
- 3) From 2000 and beyond, the participation of SHADOZ in quality assurance activities has been highly visible and effective. SHADOZ was active in the 2000 Jülich Ozonesonde Intercomparison Experiment (JOSIE) and the PI and Archiver joined the Assessment of Ozonesonde Standard Operating Procedures (ASOPOS) expert team when it formed in 2004. The first WMO/Global Atmospheric Watch (GAW) Report was based on JOSIE-2000 and the ASOPOS activities. **The 2017 JOSIE experiments were dedicated to SHADOZ, with all test profiles simulating tropical conditions (Thompson et al., BAMS, 2019).** Eight SHADOZ station personnel participated in a major capacity-building exercise.
- 4) The capstone project of the JOSIE series is the 2021 ASOPOS 2.0 Report, sponsored by WMO/GAW, the Intl Ozone Commission and the Network for the Detection of Atmospheric Composition Change (NDACC). **Anne Thompson is Co-Editor of ASOPOS 2.0 and Ryan Stauffer and Debra Kollonige are Chapter authors.**
- 5) **The “strategic ozonesonde network” concept (Thompson et al., Atmos. Env., 2011) was extended by the SHADOZ team to 4 North American field campaigns when coordinated launches were conducted during US-Canada-Mexico aircraft experiments in the “IONS” (Intensive Ozonesonde Network Study).** Collaborators were NOAA/Global Monitoring Laboratory (S. Oltmans and B. Johnson, Boulder) and Environment and Climate Change Canada (D. Tarasick, Downsview).

At the end of May 2021, I formally retired in a transition from NASA/Goddard Senior Scientist for Atmospheric Chemistry to “Senior Scientist Emeritus.” I expect to stay active as time allows in international ozonesonde quality assurance work but the day-to-day leadership of SHADOZ and of the NDACC Wallops Island ozone station has transitioned to Dr. Ryan Stauffer. Many of you know Ryan from JOSIE-SHADOZ, sites visits and conferences. Please welcome Ryan as he takes on the Principal Investigator duties. I look forward to seeing many of you at ongoing virtual meetings, and before long, in person again.

Anne Thompson  
SHADOZ Founding Principal Investigator

## ❖ Message From New PI ❖



Dear SHADOZ Community,

I am thrilled and honored to introduce myself as the new SHADOZ Principal Investigator. I assumed the PI role in June 2021 after Dr. Anne Thompson transitioned to Emeritus at NASA/GSFC. Dr. Thompson will continue to be involved in SHADOZ as I take over the day-to-day PI responsibilities.

Dr. Thompson was my MS and PhD advisor beginning in 2010 when I was a graduate student at Penn State University, and I started launching and working with ozonesondes that summer. After her move back to NASA/GSFC in 2013, Dr. Thompson continued to advise me through the completion of my Penn State PhD in 2016. After graduation, I continued working with Dr. Thompson as a University of Maryland contractor and NASA postdoc, and eventually as a new NASA hire in March of this year. Like Dr. Thompson, I have also worked with SHADOZ Archiver Dr. Debra Kollonige for several years, beginning in 2012 when she was hired as a postdoc at Penn State.

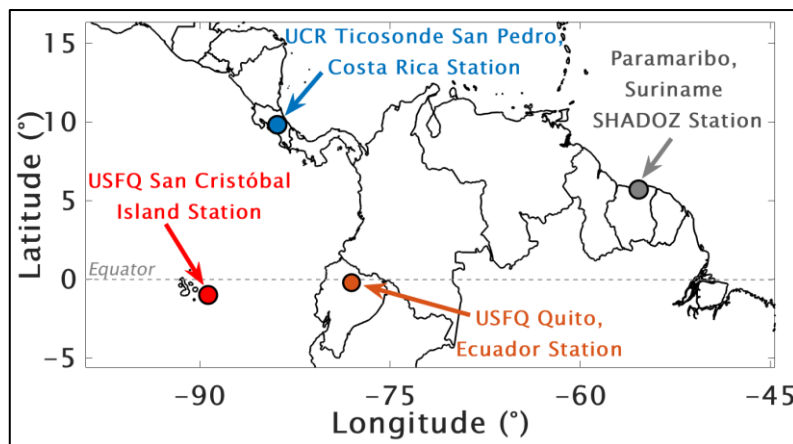
I am beginning my role during an exciting year for SHADOZ: Thanks to the efforts of Dr. Thompson, NOAA, NASA HQ, and several international partners, we have re-activated the Watukosek and San Cristóbal stations, and will be welcoming a new station, Quito, Ecuador, into SHADOZ. I will strive to continue the great work led by Dr. Thompson over the past 23 years by providing the highest-possible quality data from the world's premier ozonesonde network and conducting exciting new science! **Please join me in thanking Dr. Thompson for her many years of service to the SHADOZ network and NASA.** I am looking forward to meeting/seeing many of you again when travel resumes in the future.

Sincerely,

Dr. Ryan M. Stauffer  
SHADOZ PI

## ❖ New 2021 Funding for 3 Equatorial Americas Stations ❖

In February, NASA Headquarters funded 3 SHADOZ stations in the Equatorial Americas region beginning in 2021. These stations are Costa Rica through a renewed partnership with Professor Andres Diaz and the University of Costa Rica (UCR); and San Cristóbal in the Galápagos and Quito, Ecuador, through a new arrangement with Professor María Cazorla and the University of San Francisco Quito (USFQ). Costa Rica has been a part of SHADOZ since 2005 and San Cristóbal was an active SHADOZ station until early



2016. During the Equatorial Americas Meet-Up in April, Professor Cazorla shared the history of the newest SHADOZ station, Quito, which has ozonesonde launches dating back to 2014, and her plans for the reactivation of the San Cristóbal station. The SHADOZ PI is currently working with the station PIs on the logistics for launching ozonesondes regularly this year.



## ❖ SHADOZ at NOAA Global Monitoring Annual Conference ❖

- On May 26, **Ryan Stauffer**, **Anne Thompson**, and **Debra Kollonige** presented on ozonesonde data quality and tropical ozone trends at NOAA's eGMAC (<https://gml.noaa.gov/annualconference/index.html>):
  - Stauffer**, talk: "An Updated Examination of the Post-2013 Ozonesonde Total Column Ozone Dropoff"
  - Thompson**, talk: "Regional and Seasonal Trends in Tropical Ozone from SHADOZ (So. Hemisphere Additional Ozonesondes) Profiles: Reference for Models and Satellite Products"
  - Kollonige**, poster: "ASOPOS (Assessment of Standard Operating Procedures (SOPs) for Ozonesondes) 2.0: Ozonesonde Measurement Principles and Best Operational Practices".
- Other presentations during eGMAC from **SHADOZ Colleagues** include:
  - Bryan Johnson (NOAA/GML)**, poster: "New ECC Ozonesonde Pump Flow Efficiency Measurements".
  - Holger Vömel (NCAR)**, poster: "The Importance of the Time Response of Electrochemical Concentration Cell (ECC) Ozonesondes for Measurements of Tropospheric and Stratospheric Ozone".

## ❖ Recent noteworthy ozonesonde publications ❖

Thompson, A. M., Stauffer, R. M., Wargan, K., Witte, J. C., Kollonige, D. E., and Ziemke, J. R. (2021). Regional and Seasonal Trends in Tropical Ozone from SHADOZ Profiles: Reference for Satellite and Model Products, *J. Geophys. Res. Atmos.*, paper in revision, <https://www.essoar.org/doi/abs/10.1002/essoar.10506068.1>.

Tarasick, D. W., Smit, H. G. J., Thompson, A. M., Morris, G. A., Witte, J. C., Davies, J., et al. (2021), Improving ECC Ozonesonde Data Quality: Assessment of Current Methods and Outstanding Issues. *Earth and Space Science*, 8, e2019EA000914, <https://doi.org/10.1029/2019EA000914>.

Vömel, H., Smit, H. G. J., Tarasick, D., Johnson, B., Oltmans, S. J., Selkirk, H., Thompson, A. M., Stauffer, R. M., Witte, J. C., Davies, J., van Malderen, R., Morris, G. A., Nakano, T., and Stübi, R. (2020). A new method to correct the ECC ozone sonde time response and its implications for "background current" and pump efficiency, *AMT*, 13, 5667–5680, <https://doi.org/10.5194/amt-13-5667-2020>.

Stauffer, R. M., Thompson, A. M., Kollonige, D. E., Witte, J. C., Tarasick, D. W., Davies, J., et al. (2020). A post-2013 dropoff in total ozone at a third of global ozonesonde stations: Electrochemical concentration cell instrument artifacts? *Geophys. Res. Lett.*, 47, e2019GL086791, <https://doi.org/10.1029/2019GL086791>.

Thompson, A. M., et al. (2019). Ozonesonde Quality Assurance: The JOSIE-SHADOZ (2017) Experience. *Bull. Amer. Meteor. Soc.* <https://doi.org/10.1175/BAMS-D-17-0311.1>

Sterling, C. W., et al. (2018). Homogenizing and estimating the uncertainty in NOAA's long term vertical ozone profile records measured with the electrochemical concentration cell ozonesonde. *Atmos. Meas. Tech.* <https://doi.org/10.5194/amt-2017-397>

Witte, J. C., A. M. Thompson, H. G. J. Smit, H. Vömel, R. Stübi, and F. Posny (2018). First Reprocessing of Southern Hemisphere ADDitional OZonesondes (SHADOZ) Profile Records. 3. Uncertainty in Ozone Profile and Total Column. *J. Geophys. Res.*, 123. <https://doi.org/10.1002/2017JD027791>

Thompson, A. M. et al. (2017). First Reprocessing of Southern Hemisphere ADDitional OZonesondes (SHADOZ) Ozone Profiles (1998-2016). 2. Comparisons with Satellites and Ground-based Instruments. *J. Geophys. Res.*, 122. <https://doi.org/10.1002/2017JD027406>

Witte, J. C., A. M. Thompson, et al. (2017). First reprocessing of Southern Hemisphere ADDitional OZonesondes (SHADOZ) profile records (1998-2015) 1: Methodology and evaluation. *J. Geophys. Res.*, 122. <https://doi.org/10.1002/2016JD026403>

## ❖ Upcoming Relevant Meetings ❖

SHADOZ will be represented at the following:

**19-23 July 2021:**

Ozone Research Managers Meeting

**13-17 September 2021:**

NDACC Steering Committee Meeting  
International Global Atmos. Chem. (IGAC) Meeting

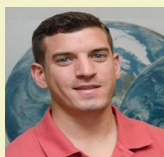
**3-9 Oct 2021:**

Quadrennial Ozone Symposium  
Seoul, Korea

### Attention Data Users:

- Questions about SHADOZ should be directed to PI, Ryan Stauffer. SHADOZ data sets are products of evolving research by the site Co-Investigators (Co-Is) and ongoing community collaboration.
- The SHADOZ homepage gives technical and contact information for each station and their Co-Is responsible for the original data processing. Co-Is should be consulted for details of their methods & appropriate references to their work.
- Questions about the final data and any news updates should be directed to the Archiver: Debra Kollonige.

### ► SHADOZ GSFC Science Team ◀



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Suva, Fiji	Bryan Johnson (PI; NOAA/GML), Patrick Cullis (NOAA/CIRES), Matakite Maata, Francis Mani & Miriama Vuiyasawa (USP)
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