



# SHADOZ Notes

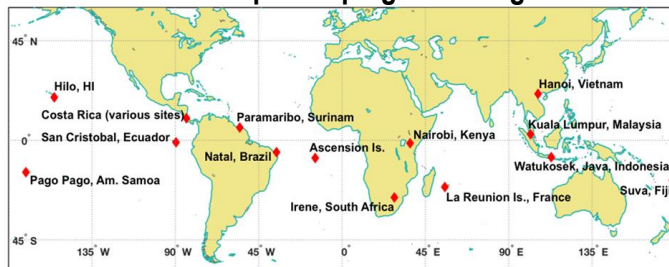
## Southern Hemisphere ADditional OZonesondes

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 fourteen 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>



## ❖ Ticosonde Costa Rica Visit in March 2022 ❖

The week of 21 March 2022, **Ryan Stauffer** (SHADOZ PI; NASA Goddard) traveled to **Costa Rica (CR)** with colleagues **Rennie Selkirk** (NASA HQ) and **Holger Vömel** (NCAR; *Photo lower right*), to visit: 1) the **Ticosonde** station and team on the **University of Costa Rica (UCR)** campus and 2) the **US Embassy San José, CR**. During the week-long trip, the 9<sup>th</sup> Ticosonde Interdisciplinary Workshop was hosted on the UCR campus (*Photo lower left*); **Stauffer** and his colleagues gave presentations on a variety of topics including ozonesondes, water vapor sondes, and the importance of having these ground observations as a part of NASA Earth Science research. Staff from the **US Embassy** (*Photo center below*) highlighted Regional Environmental Hub activities (e.g., the PM2.5 monitor hosted at the Embassy in San Jose). **Stauffer** also presented certificates of appreciation to the founding Costa Rica PI for the Ticosonde project, **Jessica Valverde** (Universidad Nacional de Costa Rica [UNA]), and her successor, **Jorge Andres Diaz** (UCR; *Photo lower right*), during the Ticosonde Workshop. (*More on Visit Next Page*).



**Photos:** (left) Ryan Stauffer (NASA) presents updates on the SHADOZ network at the 9<sup>th</sup> Ticosonde Interdisciplinary Workshop held at the University of Costa Rica. (middle) Ryan Stauffer [far left] stands with [left-to-right] Geoff Thomas (US Embassy San Jose), Pamela Zuniga (US Embassy San Jose), Elian Conejo (UCR CICANUM Director), and Gabriel Smith (US Embassy San Jose) at the Ticosonde Workshop. (right) [left-to-right] Ryan Stauffer, Jorge Andres Diaz (UCR), Rennie Selkirk (NASA HQ), Jessica Valverde (UNA), and Holger Vömel (NCAR) after certificates of appreciation presented during Ticosonde Workshop. **Photo credit:** Alfredo Alan (UCR).

## ❖ Costa Rica Station Visit (Cont'd) ❖

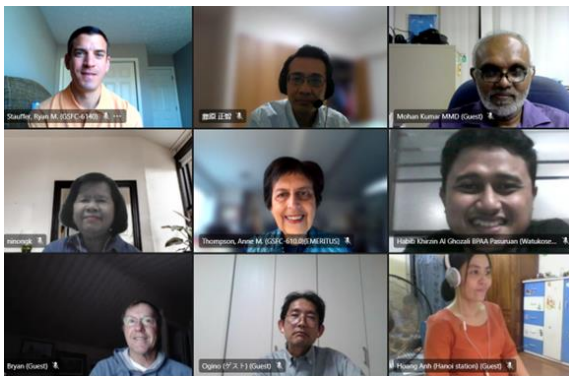
The Costa Rica trip also encompassed a visit to the UCR Center for Research in Atomic, Nuclear and Molecular Sciences (CICANUM)'s **GasLab**, the base of operations for atmospheric ground observations (e.g., SHADOZ launches) on campus. While there, **David Giles** (NASA Goddard/SSAI; *Photo left*), **AERONET** Technical/Science Lead, examined the installation of the first AERONET instrument in Costa Rica on the roof of GasLab; this is the first long-term AERONET station in Central America, which will collect aerosol concentration measurements (link to the data in photo caption). On 24 March, the 725<sup>th</sup> ozonesonde, as a part of SHADOZ, was successfully launched by the **Ticosonde team** (*Photo right*) and afterwards **Ryan Stauffer** and his colleagues visited the **US Embassy San José** to discuss outreach activities and Embassy support of Ticosonde and AERONET. Overall, this trip strengthened current and future collaborations in Costa Rica for ground-based Earth Science observations like Ticosonde, SHADOZ and AERONET.



**Photo: (left)** David Giles (NASA Goddard) with the new AERONET instrument on the UCR GasLab roof. Data can be found here: [https://aeronet.gsfc.nasa.gov/cgi-bin/data\\_display\\_aod\\_v3?site=GasLab\\_SJ\\_CostaRica&nachal=2&level=1&place\\_code=10](https://aeronet.gsfc.nasa.gov/cgi-bin/data_display_aod_v3?site=GasLab_SJ_CostaRica&nachal=2&level=1&place_code=10). **(right)** Alfredo Alan and Jorge Andres Diaz (UCR) holding the balloon while getting ready for an ozonesonde launch at UCR on 24 March. **Photo credit:** Alfredo Alan (left), Esteban Brenes (right).

## ❖ NASA GSFC HOSTS 2022 SHADOZ REGIONAL STATION VIRTUAL MEET-UPS ❖

In March-August 2021, the NASA GSFC SHADOZ team organized and hosted 4 SHADOZ **Regional Station Virtual Meet-ups** with the **Southeast Asia**, **Equatorial Americas**, **NOAA Pacific** and the **African region** stations. These meetings brought together the GSFC team (**Ryan Stauffer**, **Anne Thompson** and **Debra Kollonige**), NOAA/GML partners (**Bryan Johnson** and **Patrick Cullis**), station PIs, field operators and data managers to help facilitate communication while COVID-19 travel restrictions were in place.



**Photo:** Screenshot of Regional Meeting #1 attendees for Southeast Asia stations hosted by the NASA GSFC SHADOZ team on 13 April 2022. **Photo credit:** Debra Kollonige.

Pivoting off the success of last year's meet-ups, the NASA GSFC team has started hosting **2022 Regional Meet-ups**, with the **Southeast Asia** (*Photo at left*) and **Equatorial Americas** stations meetings held so far, making these an annual forum for communication with the SHADOZ PIs and station personnel. Individual stations presented updates on their current staff, ozonesonde operations, future plans and any logistical issues encountered over the past year. The GSFC team shared updates on: 1) ozonesonde standard operating procedures from the new **WMO/GAW Report 268** ([https://library.wmo.int/index.php?lvl=notice\\_display&id=21986#YaFNSbpOlc8](https://library.wmo.int/index.php?lvl=notice_display&id=21986#YaFNSbpOlc8)), 2) data quality assurance efforts and 3) metadata and data processing goals for the SHADOZ archive. Preparations for the remaining 2022 Meet-ups with the NOAA Pacific and African region stations are now underway. 2

## ❖ SHADOZ at 2022 NOAA Global Monitoring Annual Conference ❖

- On May 25<sup>th</sup>, **Ryan Stauffer** and **Debra Kollonige** presented on SHADOZ's 25<sup>th</sup> Anniversary accomplishments and archive/outreach updates, respectively, at NOAA's 50<sup>th</sup> GMAC (<https://gml.noaa.gov/gmac/index.html>) hosted virtually (eGMAC):
  - Stauffer**, talk: "SHADOZ's Silver Anniversary: 25 Years of Accomplishments from the Premier Tropical Ozonesonde Network".
  - Kollonige**, poster: "Southern Hemisphere Additional Ozonesondes (SHADOZ) Project Update: 2022 Archive and Outreach Activities".
- Other presentations during eGMAC from **SHADOZ and ASOPOS Colleagues** include:
  - Bryan Johnson (NOAA/GML)**, poster: "South Pole Station Ozonesondes: Variability in the 2019-2021 Springtime Antarctic Ozone Holes".
  - Holger Vömel (NCAR)**, talk: "Injection of Unprecedented Amounts of Water Vapor Into the Stratosphere by the Eruption of Hunga Tonga-Hunga Ha'apai".
  - Roeland Van Malderen (RMI)**, poster: "Harmonization and Evaluation of Ground-based Instruments for Free-Tropospheric Ozone Measurements by TOAR-II Focus Working Group (HEGIFTOM)".
- At the GMAC conference, new **SHADOZ Digital Object Identifiers (DOIs)** for V06 ozonesonde-radiosonde data and V01 uncertainty data were introduced to meeting attendees. The following can now be used by data users when referencing the use of SHADOZ data:
  - <https://doi.org/10.57721/SHADOZ-V06>
  - <https://doi.org/10.57721/SHADOZ-V01-UNC>

### ❖ Recent noteworthy ozonesonde publications ❖

- Thompson, A. M., Stauffer, R. M., Wargan, K., Witte, J. C., Kollonige, D. E., & Ziemke, J. R. (2021). Regional and seasonal trends in tropical ozone from SHADOZ profiles: Reference for models and satellite products. *Journal of Geophysical Research: Atmospheres*, 126, e2021JD034691, <https://doi.org/10.1029/2021JD034691>.
  - WMO/GAW Report No. 268, 2021: Smit, H. G. J., Thompson, A. M., and ASOPOS panel, *Ozonesonde Measurement Principles and Best Operational Practices*, ASOPOS (Assessment of Standard Operating Procedures for Ozonesondes) 2.0, WMO Global Atmosphere Watch report series, No. 268, World Meteorological Organization, Geneva. [https://library.wmo.int/index.php?lvl=notice\\_display&id=21986#YaFNSbpOlc8](https://library.wmo.int/index.php?lvl=notice_display&id=21986#YaFNSbpOlc8)
  - Hubert, D., Heue, K.-P., Lambert, J.-C., Verhoelst, T., Allaart, M., Compornolle, S., Cullis, P. D., Dehn, A., Félix, C., Johnson, B. J., Keppens, A., Kollonige, D. E., Lerot, C., Loyola, D., Maata, M., Mitro, S., Mohamad, M., PETERS, A., Romahn, F., Selkirk, H. B., da Silva, F. R., Stauffer, R. M., Thompson, A. M., Veeckind, J. P., Vömel, H., Witte, J. C., and Zehner, C. (2021). TROPOMI tropospheric ozone column data: geophysical assessment and comparison to ozonesondes, GOME-2B and OMI, *AMT*, 14, 7405–7433, <https://doi.org/10.5194/amt-14-7405-2021>.
  - 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>.
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- 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:

### 26-30 September 2022:

Network for Detection of Atmospheric Composition Change (NDACC) Annual Steering Committee Meeting

### 24-28 October 2022:

Stratosphere-troposphere Processes And their Role in Climate (SPARC) 7<sup>th</sup> General Assembly

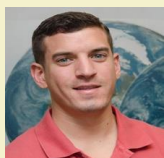
### 12- 16 December 2022:

American Geophysical Union (AGU) Fall Meeting

### Attention Data Users:

- Questions about SHADOZ should be directed to PI, Ryan Stauffer, [ryan.m.stauffer@nasa.gov](mailto:ryan.m.stauffer@nasa.gov). 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, [debra.e.kollonige@nasa.gov](mailto:debra.e.kollonige@nasa.gov).

### ► SHADOZ GSFC Science Team ◀



**Dr. Ryan M. Stauffer**  
Principal Investigator (PI)  
[ryan.m.stauffer@nasa.gov](mailto:ryan.m.stauffer@nasa.gov)



**Dr. Debra E. Kollonige**  
Data Archiver/Webmaster  
[debra.e.kollonige@nasa.gov](mailto:debra.e.kollonige@nasa.gov)



**Dr. Anne M. Thompson**  
SHADOZ Founding PI  
[anne.m.thompson@nasa.gov](mailto:anne.m.thompson@nasa.gov)

SHADOZ Site	Principal Investigator (PI), Station Chiefs and Operators
Ascension Is., U.K.	Ryan Stauffer (PI, <a href="mailto:ryan.m.stauffer@nasa.gov">ryan.m.stauffer@nasa.gov</a> ; NASA), Peter Crane & Patrick Benjamin, Leroy Hudson (US Space Force SSC E-ROS/Wolf Creek)
San Pedro, Costa Rica	Ryan Stauffer (PI; NASA), Elian Conejo, Alfredo Alan (UCR), Holger Vömel (NCAR)
Hanoi, Vietnam	Shin-Ya Ogino (PI, <a href="mailto:ogino-sy@jamstec.go.jp">ogino-sy@jamstec.go.jp</a> ; JAMSTEC), Nguyen Thi Hoang Anh (AMO)
Hilo, HI, USA	Bryan Johnson (PI, <a href="mailto:bryan.johnson@nasa.gov">bryan.johnson@nasa.gov</a> ; NOAA/GML), Patrick Cullis (NOAA/CIRES), David Nardini & Matthew Martinsen (NOAA/MLO)
Irene, South Africa	Warren Joubert (PI, <a href="mailto:warren.joubert@weathersa.co.za">warren.joubert@weathersa.co.za</a> ; SAWS), Tshidi Machinini (SAWS)
Kuala Lumpur, Malaysia	Ahmad Fairudz B Jamaluddin (PI; <a href="mailto:fairudz@met.gov.my">fairudz@met.gov.my</a> ), Mohan Kumar Sammathuria, Mohd Firdaus Bin Jayaha (MMD)
La Réunion Is., France	Jerome Brioude (PI; <a href="mailto:jerome.brioude@univ-reunion.fr">jerome.brioude@univ-reunion.fr</a> ), Stephanie Evan (Co-I), Jean-Marc Metzger & Kevin Lamy (U. Réunion)
Nairobi, Kenya	Christian Félix (PI; <a href="mailto:christian.felix@meteoswiss.ch">christian.felix@meteoswiss.ch</a> ), René Stübi & Gonzague Romanens (Meteoswiss), Rose N. Lekalesoi (KMD)
Natal, Brazil	Francisco R. da Silva (PI; <a href="mailto:fraimundo@crn.inpe.br">fraimundo@crn.inpe.br</a> ), Tercio L. B. Penha, Moisés F. de Queiroz, & Kelvem L. de Freitas (INPE)
Paramaribo, Surinam	Ankie PETERS (PI; <a href="mailto:ankie.peters@knmi.nl">ankie.peters@knmi.nl</a> ) & Miriam den Hoed (KNMI), Radjkoemar Nanda (MDS)
Pago Pago, Am. Samoa	Bryan Johnson (PI; NOAA/GML), Patrick Cullis (NOAA/CIRES), Gregory Friedman (NOAA/ASO), Gatavai Talamoa (NOAA)
San Cristóbal, Ecuador	María Cazorla (PI, <a href="mailto:mcazorla@usfq.edu.ec">mcazorla@usfq.edu.ec</a> ; USFQ)
Suva, Fiji	Bryan Johnson (PI; NOAA/GML), Patrick Cullis (NOAA/CIRES), Francis Mani & Miriama Vuyiasawa (USP)
Watakosek, Java, Indonesia	Ninong Komala (PI; <a href="mailto:ninongk@yahoo.com">ninongk@yahoo.com</a> ), Habib Khirzin Al-Ghozali, Dian Yudha (LAPAN)