



SHADOZ Notes

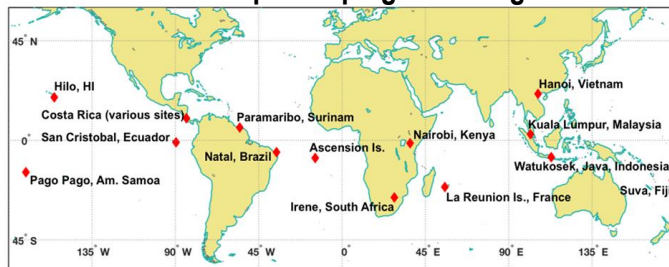
Southern Hemisphere Additional OZonesondes

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>



❖ NOAA Visits Fiji Station in April 2023 ❖

The week of 15 April 2023 **Bryan Johnson** (PI for NOAA SHADOZ stations; NOAA/GML) and **Patrick Cullis** (NOAA Technician; NOAA/CIRES) traveled to **Suva, Fiji**, to visit the SHADOZ station on the **University of South Pacific (USP)** campus and their colleagues: **Dr. Francis Mani** (Station PI; USP) and **Miriama Vuiyasawa** (Station operator; USP). During their week-long trip, **Johnson and Cullis**: 1) assisted with moving the ozonesonde prep station from a small building outdoors to a new lab space within the university's chemistry building, 2) upgraded equipment, and 3) reviewed Standard Operating Procedures (SOPs). The new lab space is pictured below (*Photo left and middle*) with Johnson and Vuiyasawa prepping ozonesondes (*Photo left*) for the ozonesonde test launches that week (*More on Visit Next Page*).



Photos: (left) [left-to-right] Bryan Johnson (NOAA/GML) assists Miriama Vuiyasawa (USP) with ozonesonde prep in their new lab space **(middle)** in the chemistry building on the USP campus in Suva, Fiji. **(right)** Vuiyasawa and Johnson fill a balloon with helium for one of their test ozonesonde launches during the week of 15-20 April 2023. **Photo credit:** Patrick Cullis (NOAA/CIRES).

❖ Fiji Station Visit (Cont'd)

The Fiji trip included the USP and NOAA teams launching 1 dual (*Photo left*) and 2 single ozonesondes to test current SOPs and the new equipment on 18, 19 and 20 April, respectively. Overall, the profiles (*Figure right*) from the launches looked great and the trip was a success.

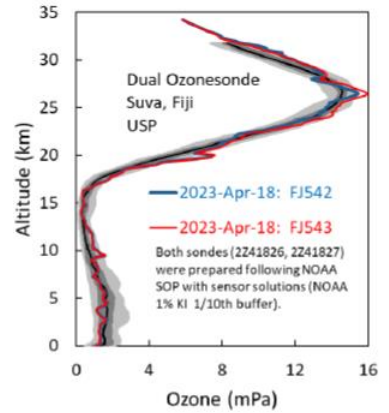


Figure: (right) O₃ profiles from dual launch on 18 April. Red/blue lines are new profiles over record of Fiji (gray). **Figure:** Bryan Johnson (NOAA).

Photo: (left) Bryan Johnson (*left*) and Miriama Vuiyasawa (*right*) get ready to launch the dual ozonesonde payload on 18 April 2023. **Photo credit:** Patrick Cullis (NOAA/CIRES).

❖ NASA GSFC HOSTS 2023 SHADOZ REGIONAL STATION VIRTUAL MEET-UPS ❖

In March-June 2023, the NASA GSFC SHADOZ team organized and hosted for the third consecutive year 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. Pivoting off the success of the last two years, the NASA GSFC team is 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) the use of 25 years of SHADOZ ozonesonde data in ozone trends studies, 2) upcoming webinars based on the new *WMO/GAW Report 268* (https://library.wmo.int/index.php?lvl=notice_display&id=21986#.YaFNSbpOlc8), 3) data quality assurance efforts and 4) the SHADOZ data archive and website. (*Photos from each meeting are below.*)

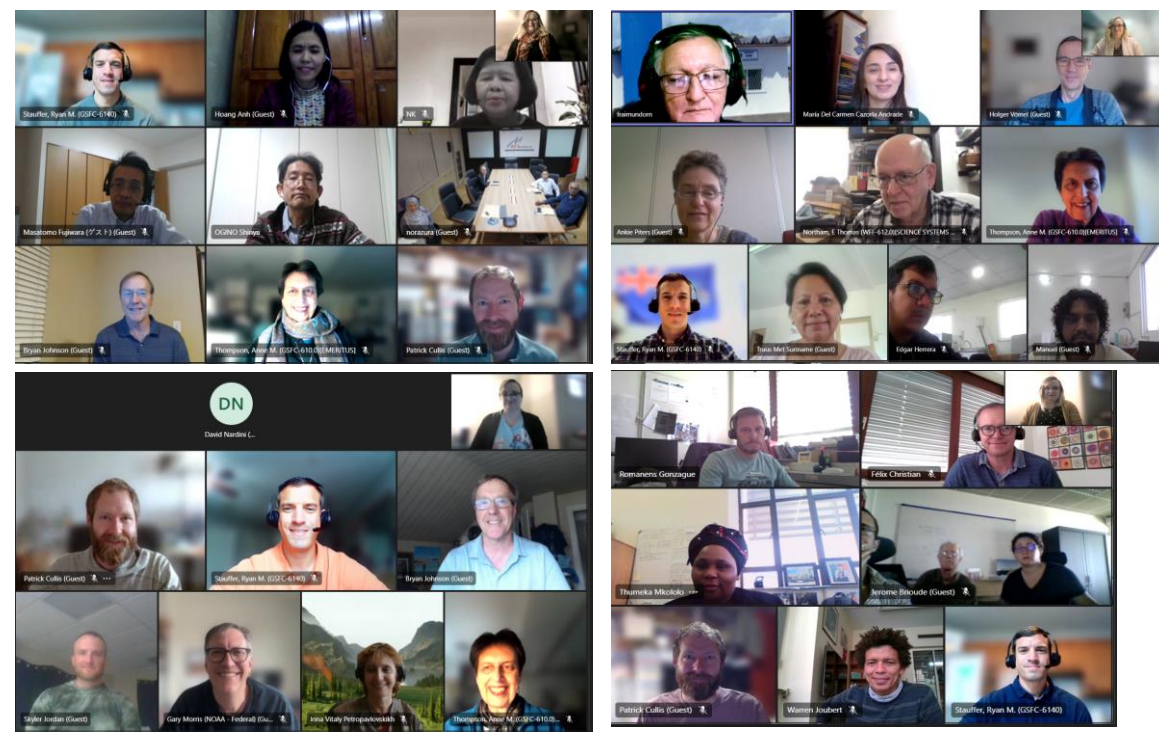


Photo: Screenshots of the attendees for all 4 Regional Meet-ups (starting top right and clockwise): the Equatorial Americas (April 2023), African Region (June 2023), NOAA Pacific (May 2023), and Southeast Asia (March 2023) stations. **Photo credit:** Debra Kollonige.

❖ SHADOZ Regional Stations Spotlight: African Region ❖

❖ Irene, South Africa ❖

The Irene ozonesonde programme is one of the South African Weather Service (SAWS), Cape Point Global Atmosphere Watch (GAW) regional programs. Other regional activities include three total column ozone observations using Dobson spectrophotometers and six UV-B monitoring networks around South Africa. The Cape Point GAW station monitors carbon monoxide (CO), surface ozone, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), total gas mercury (TGM), radon (Rn222) and meteorological parameters (temperature, humidity, wind speed and wind direction).

Irene station is located approximately sixteen kilometers from Pretoria (25.9°S, 28.2°E) and had its first ascent on 4 June 1989 with routine operations thereafter under Dr. Gerrie Coetzee (SAWS; retired) as its Principal Investigator (PI) until 2020. The current SHADOZ Irene team includes Dr. Warren Joubert (SAWS/GAW) as PI, Dr. Thumeka Mkololo (SAWS) as station manager, and the Tshidi Machinini (SAWS) as the station operator. Currently, soundings are conducted every second Wednesday, with the launch time as close as possible to 10:00 am (local time). SAWS has recently started ozonesonde recovery. The aim is to recover and reuse the sondes while following the suggested ASOPOS 2.0 standard operating procedures (SOPs). Reusing ozonesondes will save costs and increase the frequency of launches, leading to more ozonesonde data from the station.



Photo: (top left) Tshidi Machinini inflating the balloon with hydrogen gas at Irene. **(top right)** Tshidi Machinini launching an ozonesonde at Irene. **(right)** Thumeka Mkololo preparing for a launch during their first ozonesonde recovery experiment at Beaufort West. **Photo credits:** Thumeka Mkololo (SAWS), Gerrie Coetzee (SAWS; retired), and Casper Labuschagne (SAWS) respectively.



❖ La Reunion Island, France ❖

The Réunion Island (France) station (21.1°S, 55.5°E) has been a part of the SHADOZ network from the beginning of the project in 1998 with over 25 years of ozonesonde launches and Dr. Françoise Posny (Université de La Réunion-retired) as the PI until 2021. The current SHADOZ team at Réunion Island is composed of Jerome Brioude (associate professor; PI), Stephanie Evan (research scientist; Co-I) and Jean Marc Metzger (engineer; operator). Beside ECC ozonesondes, the Reunion Island station is also a part of Global Climate Observing System (GCOS) Reference Upper-Air Network (GRUAN) and Balloon Baseline Stratospheric Aerosol Profiles (B2SAP) activities.

❖ SHADOZ Regional Stations Spotlight: African Region ❖

❖ La Reunion Island, France (Cont'd)

The team launches frost point hygrometers (FPH) for stratospheric water vapor measurements and aerosol optical particle counters (POPS) every 3 months. One of their current scientific goals is to better understand the aftermath of the 2022 Hunga Tonga-Hunga Ha'apai major volcanic eruption in the South Pacific including its effects on global stratospheric water vapor and ozone.

Photo: (right) The Réunion Island team (left-to-right: Kevin Lamy, Jerome Brioude, Françoise Posny (retired in 2021), Jean Marc Metzger, and Stephanie Evan) celebrates their 1000th ozonesonde launch in 2022. **Photo credit:** Valentin Dufлот.



❖ Nairobi, Kenya ❖

The Nairobi (Kenya) station is located at the Kenyan Meteorological Department (KMD) headquarters in Nairobi (1.3°S, 36.8°E) and is a part of the GAW ozone programme. The current SHADOZ ozone sounding team consists of PI, Christian Félix (Meteoswiss), and data manager, Gonzague Romanens (Meteoswiss), along with the GAW station manager, Rose Lekalesoi (KMD), and the ozone sounding supervisor, Rose Lekalesoi (KMD). In addition to weekly ozonesonde launches beginning in 1998, there are surface ozone (since 2012) and total column ozone measurements (Dobson #018 [since 1999] and Brewer #071 [since 2019] spectrophotometers) at the Nairobi site.

To assist with continuity of high-quality long-term measurements, the Meteoswiss team visits the Nairobi station regularly with their most recent trip in early July 2023. All measurements (Dobson, Brewer, surface ozone, AWS, and ozone soundings) and their instruments are now operational and calibrated after 7 days of hard work on site in collaboration with KMD, Meteoswiss, and the Physical Meteorological Observatory in Davos (PMOD) World Radiation Centre (WRC). The Meteoswiss team trained the current KMD staff to ensure the ASOPOS 2.0 recommended standard operating procedures (SOPs) are followed for ozonesonde preparations and launches.

Photo: Kenyan Meteorological Department (KMD) team photo taken during the last visit by Meteoswiss to the station. Team members include (left-to-right): Josiah Kariuki (Dobson operator) from KMD, Beffine Amondji (Dobson/ozone sounding operator/student), Silas Wamani Isa (Dobson/ozone sounding operator/student), Veronicah Wanjiku (Dobson/ozone sounding operator/student), and Syprose Nyadida (Dobson/ozone sounding supervisor) from KMD. **Photo credit:** Gonzague Romanens (Meteoswiss).



❖ SHADOZ at 2023 TOAR-II Workshop ❖

- Presentations during TOAR Workshop from SHADOZ and ASOPOS Colleagues include:
 - **Anne Thompson and Ryan Stauffer.** Use of Profile and Satellite Data for OPT Trends: Insights from SHADOZ.
 - **Roeland VanMalderen et al.** Progress Report on HEGIFTOM (Harmonization and Evaluation of Ground-based Instruments for Free-Tropospheric Ozone Measurements).

❖ SHADOZ at 2023 NOAA Global Monitoring Annual Conference ❖

- 23-24 May, the NASA GSFC SHADOZ team (Ryan Stauffer, Debra Kollonige [attended in-person] and Anne Thompson) participated in NOAA's 51st GMAC (<https://gml.noaa.gov/gmac/index.html>) hybrid (in-person and virtual) meeting:
 - **Stauffer et al.** "Dynamical Drivers of Free-Tropospheric Ozone Increases Over Southeast Asia"
 - **Kollonige et al.** "Southern Hemisphere Additional Ozonesondes (SHADOZ) 2023 Project and Data Archive Updates"
 - **Thompson et al.** "Tropical Tropospheric Ozone Trends (1990-2022): An Integrated Satellite, Sonde & Aircraft View"
- Other presentations during GMAC from SHADOZ and ASOPOS Colleagues include:
 - **Bryan Johnson (NOAA/GML) et al.** "Advancements in Volumetric Flow Rate Measurements of Ozonesonde Pumps at Reduced Pressures"
 - **David Tarasick (ECCC) et al.** "Improving Data Quality in Long-term Canadian Ozone Sounding Records"

❖ Recent noteworthy ozonesonde publications ❖

- Smit, H. G. J., et al. (2023). New Insights From The Jülich Ozone-Sonde Intercomparison Experiments: Calibration Functions Traceable To One Ozone Reference Instrument, EGUSphere [preprint], submitted, <https://doi.org/10.5194/egusphere-2023-1466>.
 - Stauffer, R. M., Thompson, A. M., Kollonige, D. E., Tarasick, D. W., Van Malderen, R., Smit, H. G. J., et al. (2022). An examination of the recent stability of ozonesonde global network data. *Earth and Space Science*, 9, e2022EA002459. <https://doi.org/10.1029/2022EA002459>.
 - Thompson, A. M., Smit, H. G. J., Kollonige, D. E., Stauffer, R. M. (2022). Chapter 4: "Ozonesondes", in *Field measurements for Passive Environmental Remote Sensing: Instrumentation, Intensive Campaigns and Satellite Applications*, ed. N. R. Nalli, Elsevier. <https://www.sciencedirect.com/science/article/abs/pii/B9780128239537000113>.
 - Thompson, A. 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
 - Hubert, D., et al. (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., et al. (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, et al. (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:

11-15 September 2023:

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

12-13 September 2023:

SAGE-III/ISS Science Team Meeting

14-16 November 2023:

IAGOS Users Workshop

11-15 December 2023:

American Geophysical Union (AGU) Fall Meeting

Attention Data Users:

- Questions about SHADOZ should be directed to PI, Ryan Stauffer, 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.

► SHADOZ GSFC Science Team ◀



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