



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>



SHADOZ Site	Principal Investigator (PI), Station Chiefs and Operators
Ascension Is., U.K.	Anne Thompson (PI; anne.m.thompson@nasa.gov) & Ryan Stauffer (NASA/GSFC) Peter Crane & Patrick Benjamin, Amy Hill & James Bates (US Air Force AFSPC E-ROS/Wolf Creek)
San Pedro, Costa Rica	Henry Selkirk (PI; henry.b.selkirk@nasa.gov ; NASA/USRA), Holger Vömel (NCAR), Jorge Andres Diaz & Ernesto Corrales (UCR)
Hanoi, Vietnam	Shin-Ya Ogino (PI; ogino-sy@jamstec.go.jp ; JAMSTEC), Nguyen Thi Hoang Anh, Tran Thu Huang & Lai Thanh Nga (AMO)
Hilo, HI, USA	Bryan Johnson (PI; bryan.johnson@nasa.gov ; NOAA/GMD), David Nardini & Darryl Kuniyuki (NOAA/MLO)
Irene, South Africa	Gert J. R. Coetzee (PI; gerrie.coetzee@weathersa.co.za ; SAWS), Tshidi Machinini (SAWS)
Kuala Lumpur, Malaysia	Maznorizan Mohamad (PI; maz@met.gov.my), Zamuna Zainal, Nur Aleesha Abdullah & Ab Rahman Buang (MMD)
La Réunion Is., France	Françoise Posny (PI; francoise.posny@univ-reunion.fr), Jean-Marc Metzger (U. Réunion)
Nairobi, Kenya	Christian Félix (PI; christian.felix@meteoswiss.ch), René Stübi & Gonzague Romanens (Meteoswiss), Kennedy Thiongo (KMD)
Natal, Brazil	Francisco R. da Silva, Tercio L. B. Penha & Maria Paulete (INPE)
Paramaribo, Surinam	Ankie Piter (PI; ankie.piter@knmi.nl) & Marc Allart (KNMI), Sukarni Mitro & George Paiman (MDS)
Pago Pago, Am. Samoa	Bryan Johnson (PI; NOAA/GMD), LTJG Diane M. Perry (NOAA/ASO)
San Cristóbal, Ecuador	Bryan Johnson (PI; NOAA/GMD), Manuel Carvajal, (INAMHI), Maria Cazorla (USFQ)
Suva, Fiji	Bryan Johnson (PI; NOAA/GMD), Matakite Maata, Francis Mani & Miriama Vuiyasawa (USP)

❖ Hanoi, Vietnam ❖

In October 2018, Anne Thompson visited the Hanoi, Vietnam SHADOZ site operated by AMO (Aerological - Meteorological Observatory) of the National Hydro-Meteorological Service of Vietnam. The trip coincided with an annual site visit from SHADOZ Co-I Dr Shin-Ya Ogino (JAMSTEC - Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan). Hanoi soundings were initially established by Profs Masato Shiotani (Kyoto Univ.) and Masatomo Fujiwara (Hokkaido Univ.) 14 years ago. Data handling and operations are organized by Dr Shin-Ya Ogino. Anne toured the facility, observed sonde preparation procedures, and witnessed a launch demonstration. Lectures on SHADOZ reprocessing and ongoing evaluation research were given at AMO and at the Hanoi University of Science and Technology.



AMO staff responsible for sonde prep and launch. Dr. Nguyen Thi Hoang Anh (2nd from right) heads AMO's International Cooperation Division and participated in the recent joint JOSIE-SHADOZ campaign.



AMO staff training with an EN-SCI KTU-2 system in 2004. Vaisala RS-41 radiosondes and EN-SCI sensors with 0.5% Half Buffer solution are currently used.



Figure 1 below shows smoothed contours of the monthly annual cycle of ozone in ppb at Hanoi derived from 2005-2017 ozonesonde records. Relatively high ozone (> 60 ppb, red contours) from February through April is observed throughout the lower troposphere. The Figure 2 profile from the 20 March 2018 launch shows similarly elevated ozone typical for that month. Winds are strong (> 30 m/s, right panel), persistent throughout the free troposphere, and from the southwest, suggesting pollution transport from Thailand.

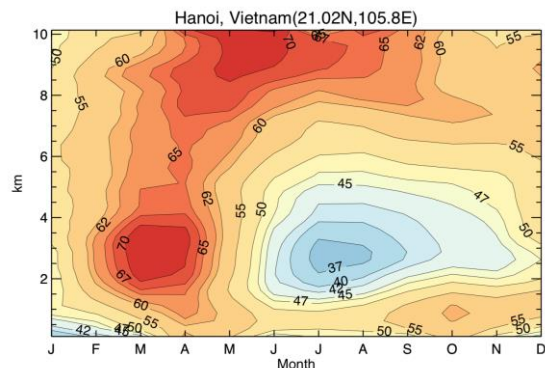


Fig. 1

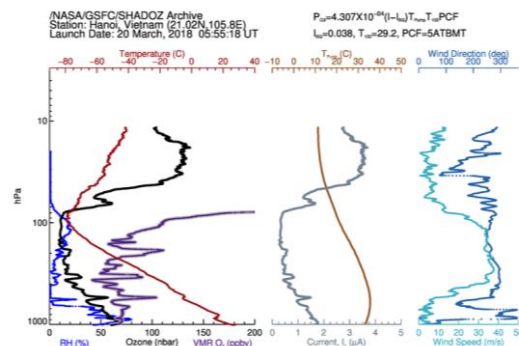


Fig. 2

Photo L: Dr. Shin-Ya Ogino (JAMSTEC) repairing sondes shipped without cells.

Photo R: Anne with Tran Thu Huang (AMO) at the balloon filling station (also services weather balloon launches).

❖ JOSIE Workshop ❖



The JOSIE-SHADOZ workshop was held 17-18 September 2018 at WMO (World Meteorological Organization) headquarters in Geneva, Switzerland to review key results of the 2017 intercomparison campaign (see Newsletter #23, Thompson et al., *BAMS*, <https://doi.org/10.1175/BAMS-D-17-0311.1>). SHADOZ station PIs, data managers, and other ozonesonde experts (group photo above) discussed lessons learned, capacity building activities, and station updates. A supplementary meeting was held with members of the ASOPOS (Assessment for Standards in Operating Procedures for OzoneSondes) panel to advance homogenization methods for sonde records introduced in the first publication of "Guidelines for Homogenization of OzoneSonde Data" (download at <https://tropo.gsfc.nasa.gov/shadoz/Links.html>).

❖ Accolades ❖



- ❖ George Brothers received the NASA Earth Science Division Special Recognition Award for dedicating nearly 50 years of his career to top-quality ozone measurements at NASA Wallops Flight Facility and Natal, Brazil – a SHADOZ site. George conducted field measurements in the 1980s and 1990s when his annual deployments to Palmer Station, Antarctica, tracked the growth of the ozone hole. George's meticulous ozonesonde records, handwritten over the years, are the key to reprocessing.

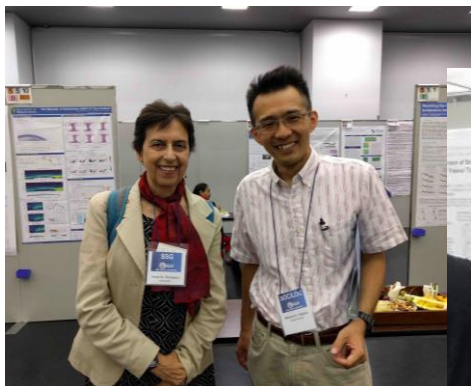


- ❖ SHADOZ PI Anne Thompson is the recipient of NASA/Goddard's 2018 prestigious Nordberg award. Anne was honored for her +20 years service in tropospheric chemistry research, outreach, and mentoring. Her research has resulted in more than 260 papers. Her work includes air/sea exchange of trace gases, the importance of stratosphere-troposphere exchange for ozone, and the interconnection of atmospheric composition and climate.



❖ SPARC General Assembly ❖

Several SHADOZ members attended the SPARC (Stratosphere-troposphere Processes And their Role in Climate) 2018 General Assembly held from 1-5 October 2018 in Kyoto, Japan. Prof. Masatomo Fujiwara (Hokkaido University; photo bottom left with Anne Thompson), Co-I of the Watukosek-Java, Indonesia, SHADOZ site, chaired the session "Advances in Observation and Reanalysis Datasets". In that session, Jacquie Witte presented work on SHADOZ reprocessing and uncertainties, Anne Thompson presented an overview of the JOSIE-SHADOZ joint campaign, and Ryan Stauffer presented MERRA-2 model evaluation results that incorporated all SHADOZ network data records – see noteworthy SHADOZ publications below. Ryan was one of a handful of scientists who won an Early Career Scientists (ECS) award for Best Poster presentation.



Anne Thompson and Prof. Masatomo Fujiwara (Hokkaido Univ.)



Jacquie Witte, Ryan Stauffer, and Anne Thompson in front of Ryan's award - winning poster.

Ryan Stauffer (2nd from left) and fellow ECS accepting their SPARC award for best poster.



Recent noteworthy SHADOZ publications

Thompson, A. M., et al. (2018). Ozone-sonde Quality Assurance: The JOSIE-SHADOZ (2017) Experience. Bull. Amer. Meteor. Soc. <https://doi.org/10.1175/BAMS-D-17-0311.1>

Stauffer, R. M., Thompson, A. M. & Witte, J. C. (2018). Characterizing Global Ozone-sonde Profile Variability from Surface to the UT/LS with a Clustering Technique and MERRA-2 Reanalysis. J. Geophys. Res., 123. <https://doi.org/10.1029/2018JD028465>

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 ozone-sonde. 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>

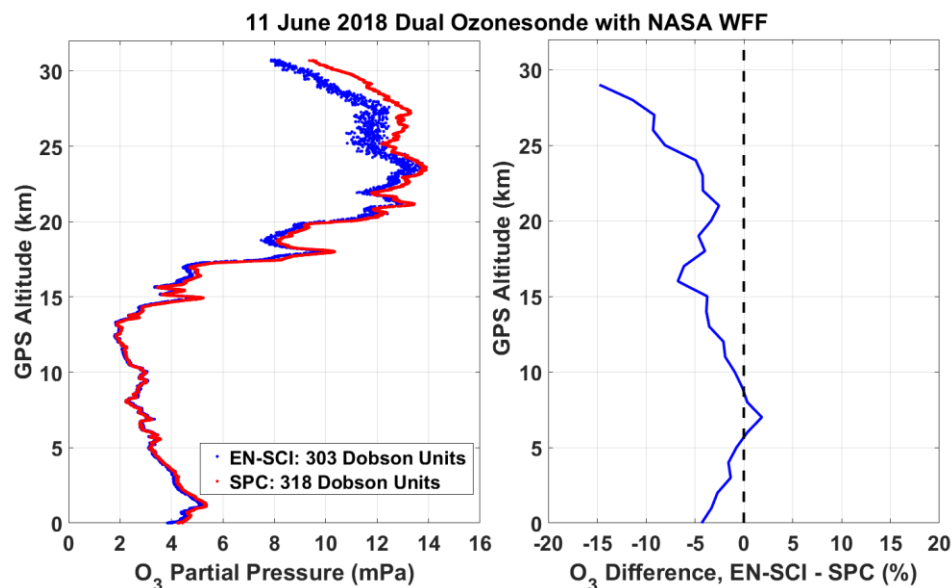
Witte, J. C., A. M. Thompson, et al. (2017). First reprocessing of Southern Hemisphere ADDitional OZonesondes (SHADOZ) profile records (1998-2015) 1: Methodology and evaluation. J. Geophys. Res., 122. <https://doi.org/10.1002/2016JD026403>

❖ SHALLOTS Campaign ❖

SHADOZ team members at NASA Goddard Space Flight Center organized the SHALLOTS (SHADOZ parallel Ozone-sonde Test Study) field campaign to address offsets observed in stratospheric ozone profiles among several SHADOZ sites (Thompson et al., 2017). Comparisons between sondes and satellite overpasses of ozone reveal discontinuities in stratospheric and total ozone since 2016 at the Ascension, Costa Rica, and Samoan sites that all use the same ECC sonde type. The SHADOZ-JOSIE intercomparison campaign (see Newsletter #23) and Hilo dual launch (Newsletter#24) could not consistently explain the offsets observed in the reprocessed SHADOZ data (Witte et al., 2017; 2018).

SHALLOTS was initiated to study the ECC instrument and sensing solution issues more closely. A series of dual sonde launches was conducted in June and July 2018 with groups from NASA Wallops Flight Facility (WFF) (photo gallery below), Howard University (Maryland site) and the Univ. Maryland-Baltimore County (UMBC). Dual launches compared profiles from two ECC types and from older and newer batches of the EN-SCI sonde with recommended preparation procedures. The Maryland launches operated during the OWLETS-2 (Ozone Water-Land Environmental Transition Study; <https://www-air.larc.nasa.gov/missions/owlets>) campaign that used sondes, lidar and aircraft to study pollution over the upper Chesapeake Bay area.

On the right is an example of a dual sonde launch at WFF. The offset in the stratosphere (above 20 km) is apparent between the EN-SCI profile from the GSFC-Greenbelt group (blue) compared to the Science Pump Corp. (SPC) profile (red) that was prepared by the WFF group. However, a second Greenbelt-EN-SCI vs WFF SPC launch produced the opposite result. We are analyzing statistics from eight additional dual launches in SHALLOTS to help interpret the SHADOZ offsets and to derive transfer functions that might be needed for selected post-2016 SHADOZ data.



Katherine "Rhonie" Wolff (L) and WFF Meteorological Operations crew with balloon getting ready to launch.



George Brothers, with a dual sonde of EN-SCI and SPC ECC sensors.



SHALLOTS crew at WFF: L-R George Brothers, Anne Thompson, Jacquie Witte, Katherine Wolff, Ryan Stauffer