

Sondes Working Group: Ozonesonde Updates

Ryan Stauffer (NASA/GSFC; 2025) and Roeland Van Malderen (RMI; 2024+)

2024 NDACC Steering Committee Meeting

12 November 2024; Santiago, Chile



NDACC Ozone Sonde Stations (28 Active)

- 18 in Northern Hemisphere, 10 in Southern Hemisphere
- NDACC O₃sonde stations have archived 53,524 files at the NDACC DHF as of 10 Nov 2024 (51,228 from active stations)
- Data remains archived for inactive stations (e.g., Thule, Summit, McMurdo)



Map by D. Kollonige, Sondes WG page within SHADOZ website

NDACC 2024 O3Sonde WG Updates

NDACC Ozonesonde Statistics (as of 10 Nov 2024)

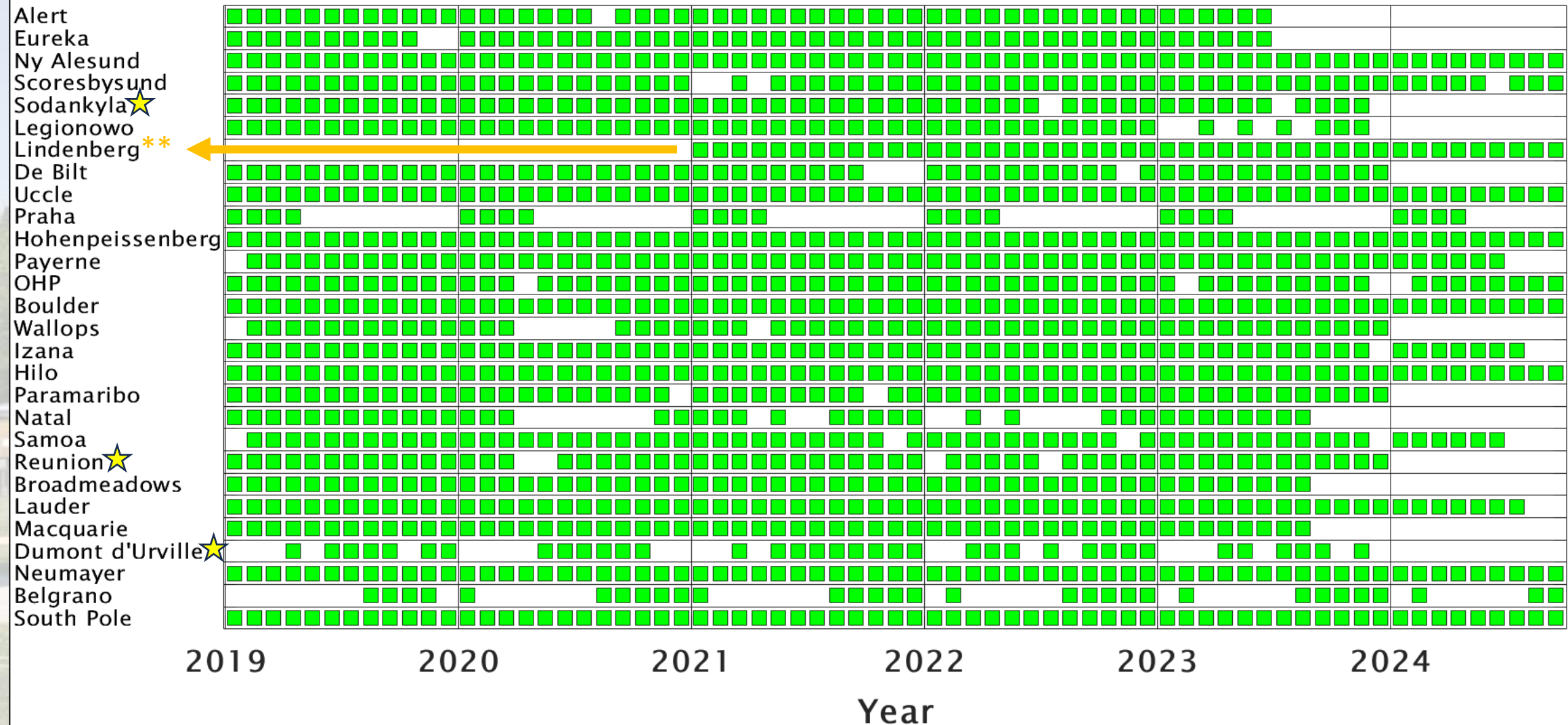
SITE	Latitude	# Profiles	Archive Update	SITE	Latitude	# Profiles	Archive Update
Alert	82.5	52	202306	Natal	-5.8	47	202308
Eureka	80.0	52	202306	American Samoa	-14.2	33	202406
Ny-Aalesund	78.9	68	202409	La Reunion	-20.9	34	202312
Scoresbysund	70.4	38	202410	Broadmeadows	-20.9	39	202308
Sodankyla	67.3	31	202311	Lauder	-45.0	57	202407
Legionowo	52.4	51	202311	Macquarie Island	-55.0	52	202308
Lindenberg	52.2	54	202411	Dumont d'Urville	-66.6	11	202311
De Bilt	52.1	50	202312	Neumayer	-70.6	68	202411
Uccle	50.8	145	202409	Belgrano	-77.8	25	202410
Praha	50.0	48	202404	South Pole	-90.0	48	202410
Hohenpeissenberg	47.8	130	202410				
Payerne	46.8	146	202406	Total Measurement Last 12 Months:		1544	
OHP	43.9	32	202409	Total Measurement Days 2023:		1515	
Boulder	39.9	51	202410	Total Measurement Days 2022:		1455	
Wallops Island	37.9	45	202312	Total Measurement Days 2021:		1546	
Izana	28.3	46	202407	Total Measurement Days 2020:		1485	
Hilo	19.7	51	202409	Total Measurement Days 2019:		1507	
Paramaribo	5.8	40	202312	Total Measurement Days 2018:		1541	

- All 28 Station Reports Received!
- All stations have uploaded data through at least June 2023
- Lindenberg likely opting to wait on HDF and versioning guidance

- 1544 total reported measurement days in this year's reports
- Collected profiles are slightly above the long-term average, but overall data collection is quite steady and strong

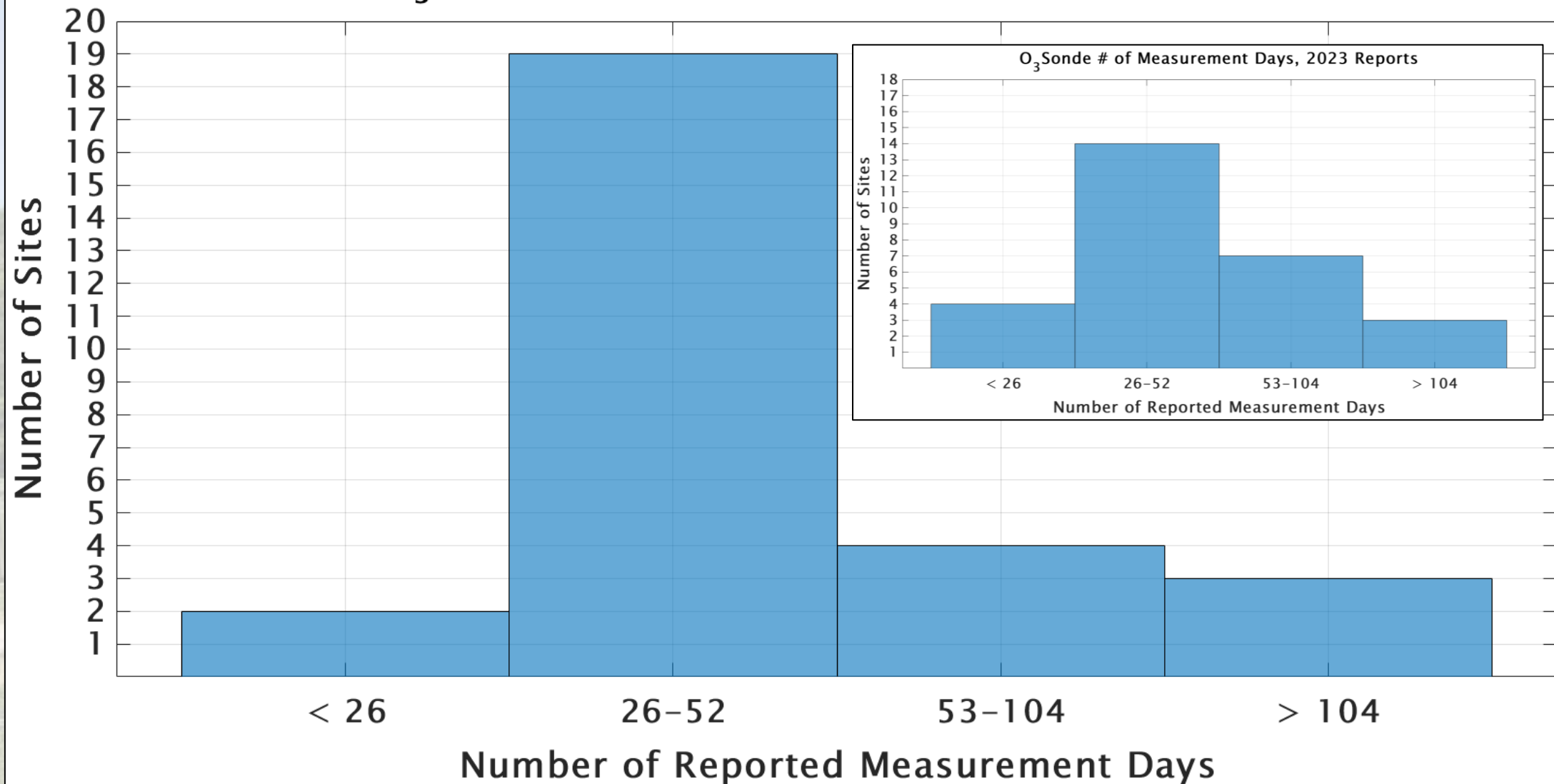
O₃ Sonde Recent DHF Status

NDACC Ozonesonde Archive Status (10 Nov 2024)



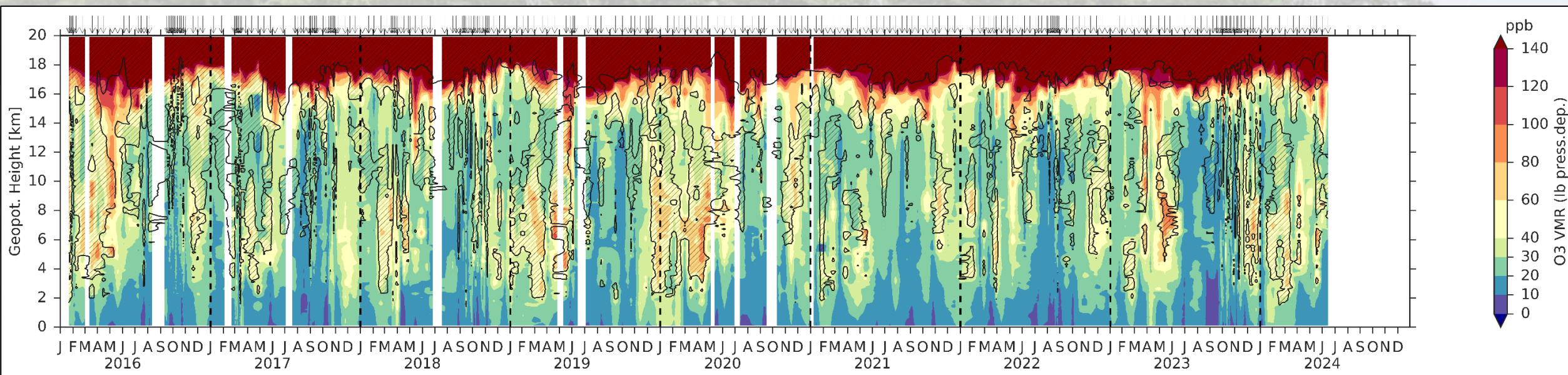
2023-2024 Reporting Period Ozonesonde Data

O₃ Sonde # of Measurement Days, 2024 Reports



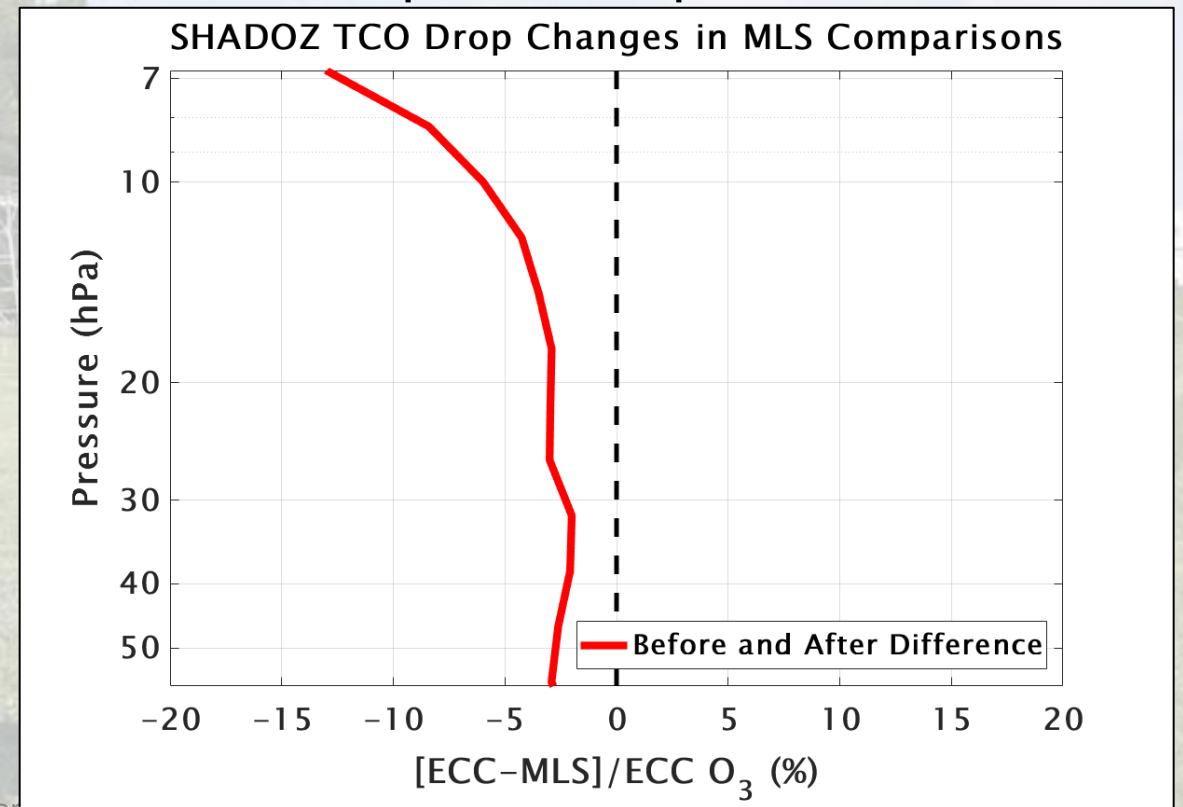
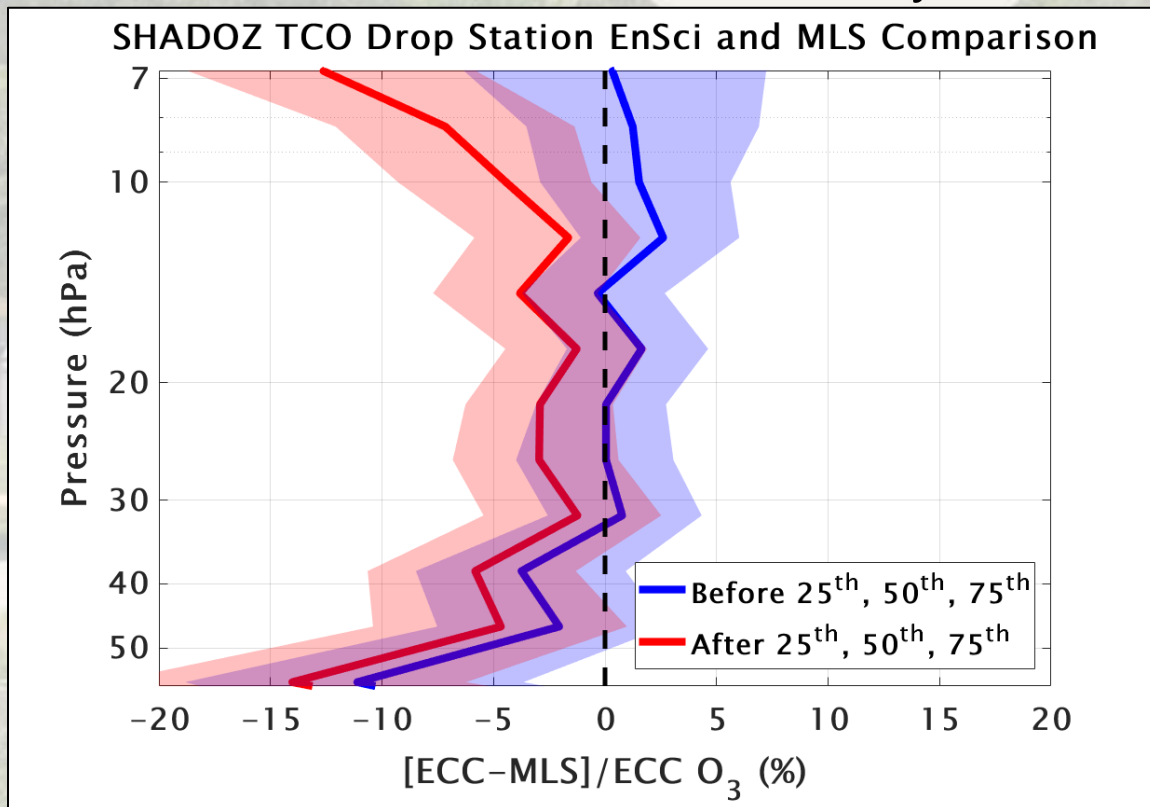
Palau a Candidate NDACC O₃/WV Sonde Station?

- Palau is the latest SHADOZ station, with SHADOZ V06 data coming to the archive by end of 2024 →
- **PI Katrin Müller** (AWI). RS41/SPC ozonesonde and campaign CFH WV sondes, also FTIR, Pandora...
- Data published in Müller et al. (2024a,b; ACP). Will pursue as new NDACC-affiliated station (**+ACTION ITEM**)



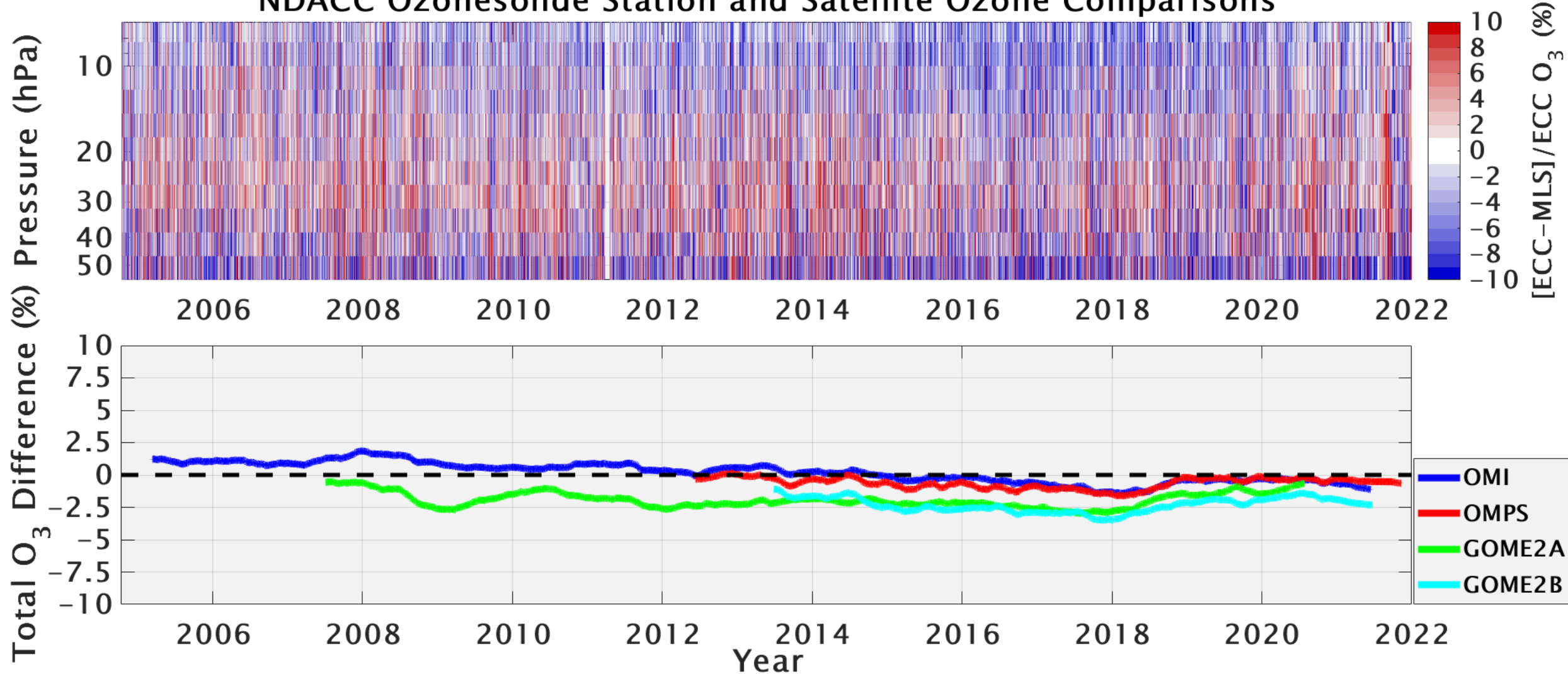
Data Quality: Stratospheric Drop vs. Aura MLS

- Identified En-Sci S/N 25250 as a changepoint in ozonesonde TCO comparisons
- Examining comparisons with Aura MLS O₃ (below) shows differences in stratospheric comparisons before and after this S/N
- We know this is linked to changes to stratospheric pump efficiencies and that tropical stations are most affected ← likely a consequence of ozone profile shape



In Spite of En-Sci Issues, NDACC Excels!

NDACC Ozonesonde Station and Satellite Ozone Comparisons

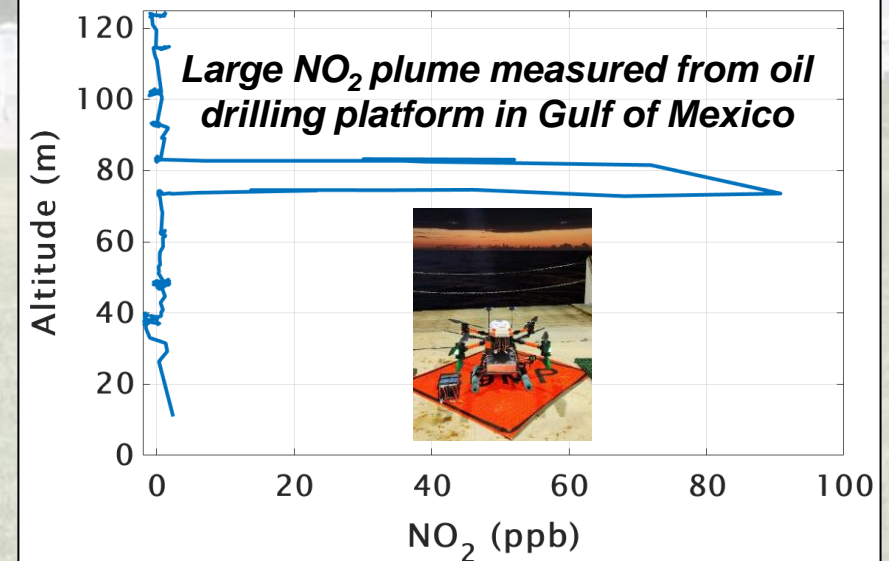


New Balloon-Borne O₃ Reference Coming Soon?

- NASA/GSFC internal R&D funding secured to develop optical ozonesonde (“mini-ROZE”; Hannun et al., 2020; AMT) in 2025
- Compact and lightweight (~3 kg) design would allow it to serve as a reference for ECC ozonesondes on balloon flights
- Similar techniques used to develop a novel NO₂ sonde which was demonstrated on balloon flights and a UAV platform in the Gulf of Mexico in June →



SCOAPE-II NO₂ Sonde 01 UTC 9 June 2024



QOS July 2024 O₃Sonde Side Meeting

- **14 July O₃Sonde Data Users Workshop/NDACC Side Meeting** in Boulder, CO, USA attracted **~30 in-person** attendees with a dozen presentations, but extremely limited virtual participation (*understandable, it was a Sunday*)
- **Topics:**
 - ASOPOS 2.0 WMO/GAW Report no. 268 and virtual webinars
 - GEOMS-HDF Data Format (Ian Boyd virtual presentation and demonstration)
 - Data Quality Assurance (Time response correction, En-Sci “dropoff”)
 - Ozonesonde science with station highlights and ozonesonde long-term trends
 - Lingering Issues: ASOPOS 2.1 on “background currents”/time response, “dropoff”, QA/QC, and capacity-building
- QOS was convenient to gather in-person, but will organize a dedicated virtual WG meeting in 2025 to increase station participation (**+ACTION ITEM**)

Issues raised in 2024 Ozonesonde Station Reports

- **Scoresbysund:** MeteoModem Ames2160 output when connected to an ozonesonde does not pass NDACC format control. Vaisala radiosondes/interface cards are instead used w/En-Sci ozonesondes
- **OHP:** Handling of switching from pressure measurement (VAISALA RS80) to pressure retrieval from MODEM radiosonde (GPS altitude measurements)
- **Australian Stations:** The operational team were unable to obtain supply of SPC ozonesondes and so ordered EnSci instead. An intercomparison campaign was flown consisting of 15 dual SPC/EnSci flights. Data from the two manufacturers do not appear to agree very well. Therefore, at this stage, only SPC data will be submitted to the NDACC database.
- **Lauder:** Transition to GEOMS-HDF and associated data tools, data versioning, and adoption of ASOPOS 2.0 SOPs
- **ALL:** Science Pump Corporation ozonesondes are *extremely* difficult to procure

Roadmap: metadata & data format(S-5)



1. Representatives from all archives (WOUDC, NDACC, SHADOZ) denoted GEOMS-HDF as their new standard, with **same, new, template for all archives!**



2. **Update existing (EVDC) GEOMS-HDF template** for ozonesondes to new template



✓ Include all recommended metadata and additional data fields according to WMO-GAW #268



✓ Conversion table from metadata fields in WOUDC, NDACC, SHADOZ to metadata fields in new template (consistency in metadata content and meaning!)



✓ Include metadata fields that might be needed for a future, new processing of ozonesonde data



3. **Convert existing ascii-files to GEOMS-HDF format**, making use of new template

✓ Locally, we can provide scripts/code

✓ Centrally, at EVDC → test by Ian Boyd



✓ Lacking metadata fields might need to be provided/filled in in a webform provided by the EVDC (once/for every sounding)

Roadmap: metadata & data format(S-5)



4. **Store (EVDC) GEOMS-HDF** data files in ozonesonde archives (WOUDC, NDACC, SHADOZ, etc.)

✓ As different versions (e.g. operational vs. homogenized (from HEGIFTOM))

✓ Rapid delivery option at e.g. NDACC

5. **Update radiosonde manufacturer sounding software** to accommodate the additional metadata fields & to compute the additional data fields and uncertainties!



✓ Interactions with Vaisala, their new ozone sounding software update (launch: end of 2024) will be compliant with those recommendations!



✓ Direct conversion of sounding output file from software to GEOMS-HDF (the EVDC scripts will be adapted).

Sondes Action Items Progress Summary

1. **ASOPOS 2.0 Report Webinars (and other) News Items (S-1)**
2. **Ensure all stations have chosen a license type for their data:** Belgrano, Broadmeadows, Dumont d'Urville, Lauder, Lindenberg, Macquarie Island, McMurdo (inactive), Neumayer, Ny Alesund, OHP, Scoresbysund, Sodankyla, La Reunion, Thule (inactive). OHP and Scoresbysund metadata need to be updated (**S-2**; ongoing)
3. **Determine what future role aerosol sondes will have in NDACC (S-3)**
4. **Consider whether or not to add Reunion Island WV sonde as an NDACC-affiliated site (S-4)**
5. **GEOMS HDF and AMES data formats. Progress continuing (**S-5**; ongoing)**

Thank You

Sonde Working Group Co-Chair Contact Info:

- Ryan Stauffer (O₃): ryan.m.stauffer@nasa.gov
- Roeland Van Malderen (O₃): roeland@meteo.be
- Elizabeth Asher (WV, next talk): elizabeth.asher@noaa.gov

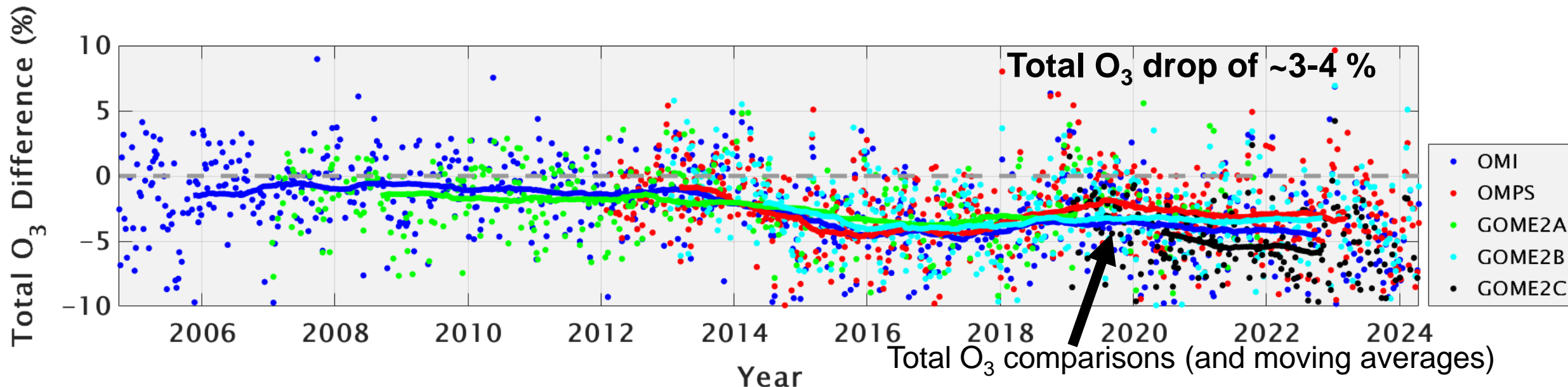
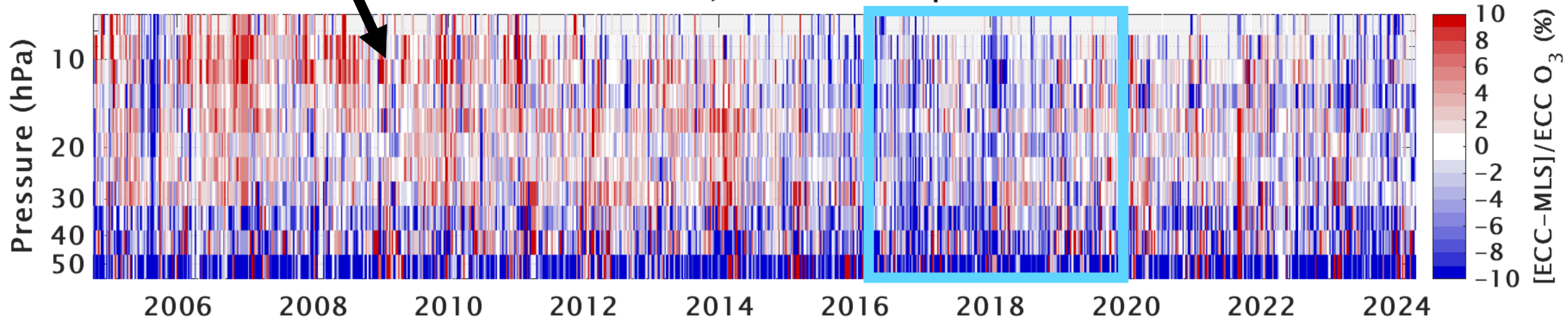
A large white balloon is being prepared for launch in a grassy field. Two people are visible: one in a blue shirt and grey pants holding the balloon's neck, and another in a grey shirt and white pants standing nearby. The balloon is attached to a string that runs across the field to an orange marker. In the background, there are several metal towers, a white building, and a line of trees under a blue sky with light clouds.

Extras

Data Quality Issues (Stratospheric O₃ Dropoff)

Comparisons with Aura MLS on MLS pressure levels. **Red** = sonde higher, **Blue** = sonde lower

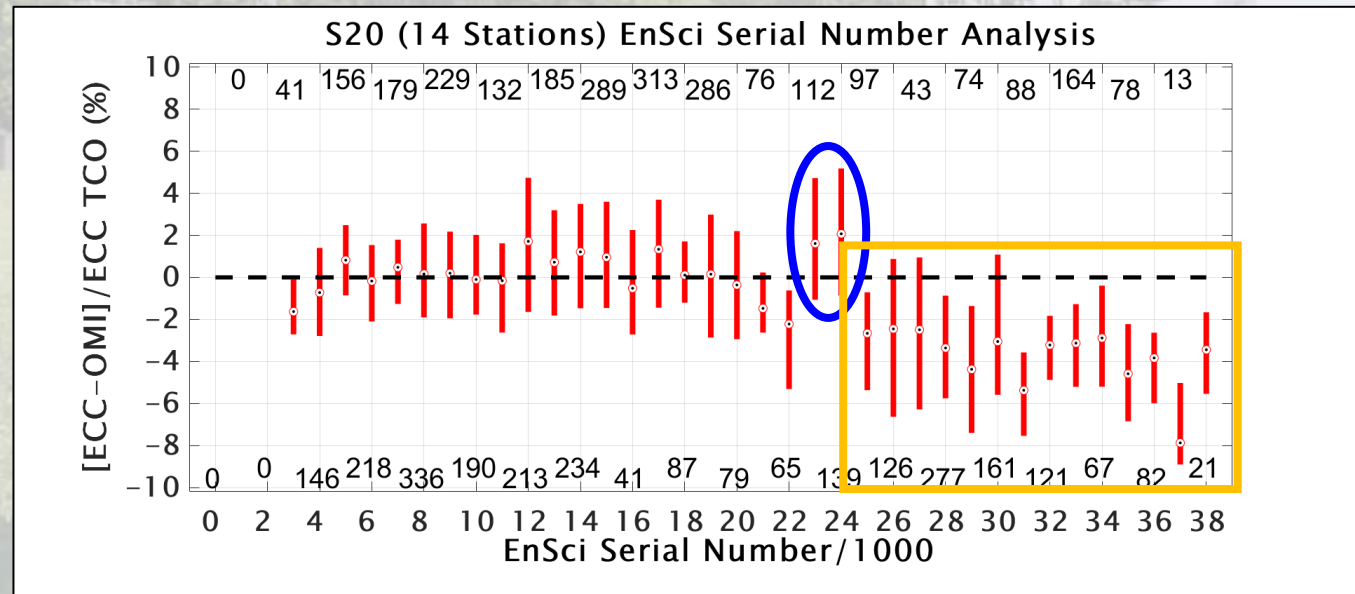
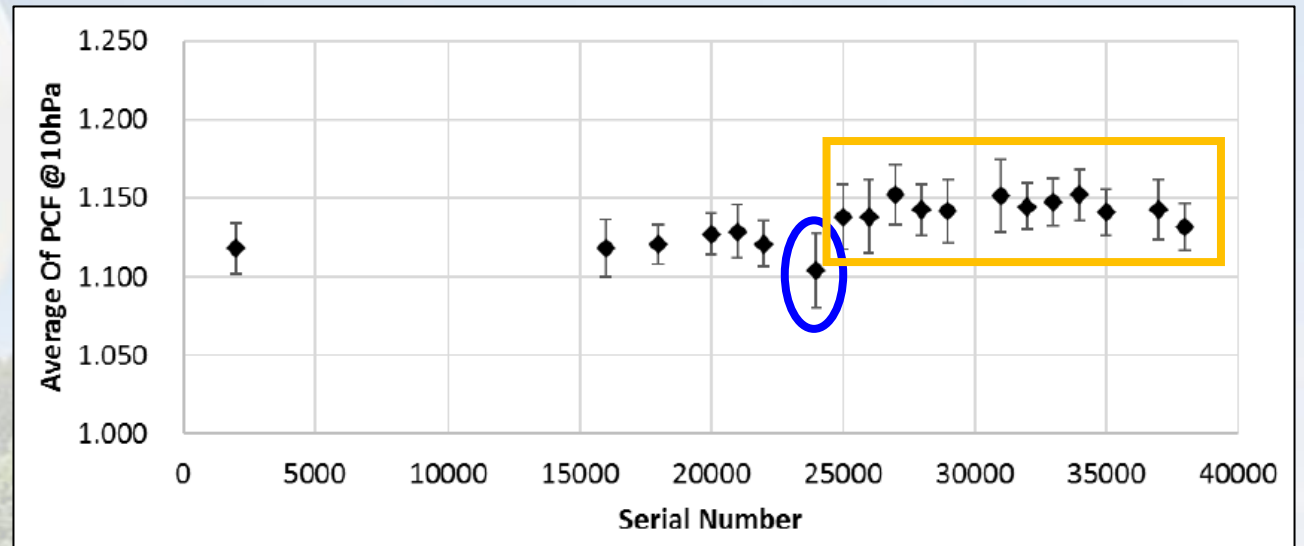
Hilo Ozonesonde, Satellite Comparisons



Total O₃ comparisons (and moving averages)

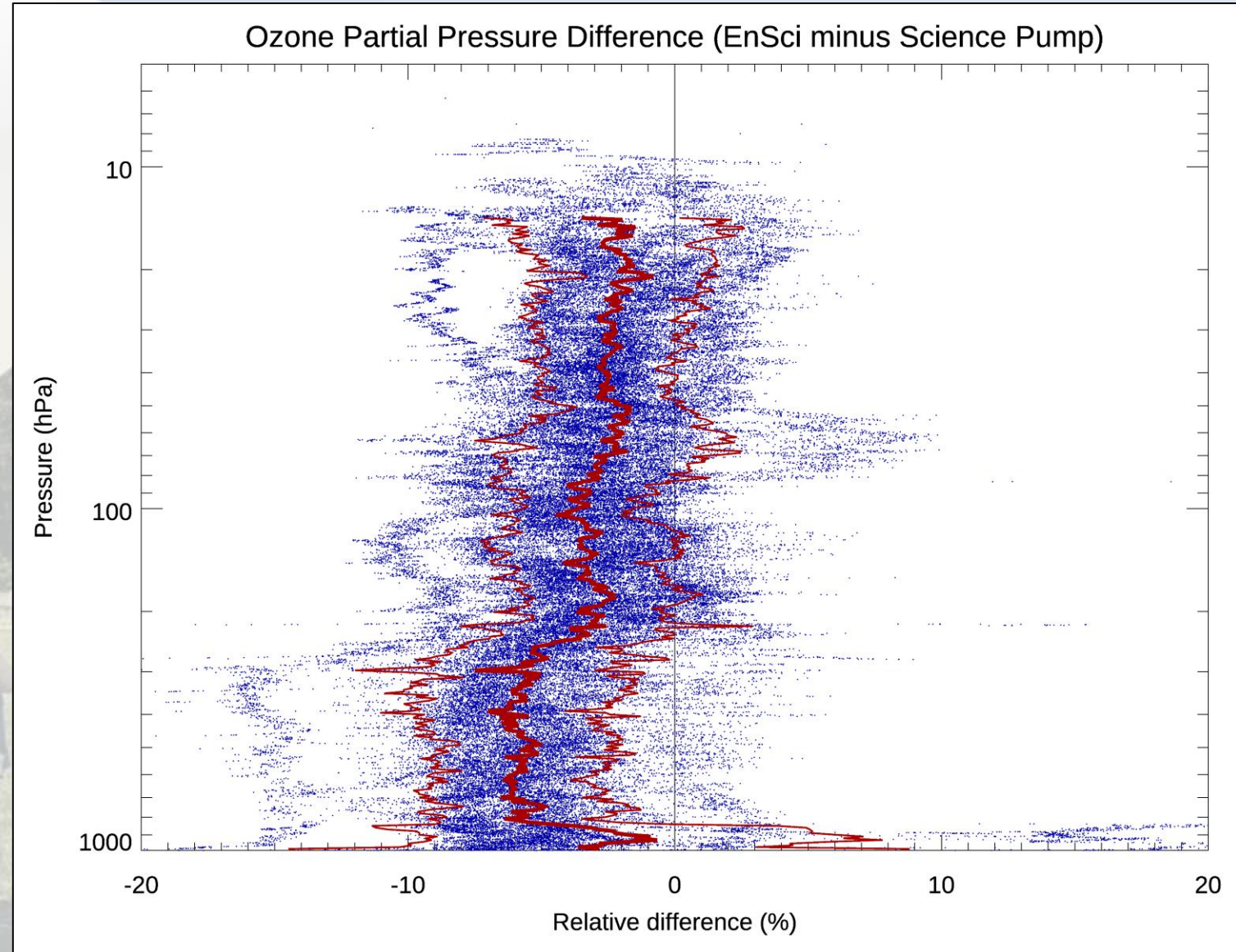
Changes to the EnSci Pump Efficiencies

- Nakano and Morofuji (2023; <https://doi.org/10.5194/amt-16-1583-2023>) shows that EnSci pump efficiency corrections that are coincident with the ozonesonde TCO dropoff, including a period of high-biased ozonesonde measurements
- Reprocessing ozonesonde data using this data set has resolved the “dropoff” at least at some stations
- Paper with “dropoff” updates: <https://doi.org/10.1029/2022EA002459> (Stauffer et al., 2022)



AUS En-Sci/SPC Dual Flights (Preliminary)

- Courtesy of Matt Tully (BOM; Broadmeadows and Macquarie Island O3sonde)
- 15 dual En-Sci/SPC ozonesonde flights, comparisons in % difference shown →
- Bias (En-Sci lower) is fairly consistent with altitude. Does not appear as if stratospheric pump efficiency is the main cause of difference



NDACC Sondes Working Group Webpage

- Hosted within the SHADOZ ozonesonde network website
- Link from NDACC home page is live!
- To include information on potential Ames format changes, GEOMS HDF progress, DQA activities, etc.
- NDACC News Item: <https://ndacc.larc.nasa.gov/news/2023/08/new-sonde-working-group-webpage>

SHADOZ -- Southern Hemisphere Additional OZonesondes
An Archive of sub/tropical and remote ozonesonde data

HOME | PI CONTACTS | DATA ARCHIVE | NEWSLETTER | PAPERS | LINKS | **NDACC**

NDACC Sonde Working Group

- The NDACC Sonde Working Group is responsible for the activities pertaining to ozonesondes, water vapor and aerosol sondes.
- The working group representatives on the steering committee are:
[Dr. Ryan M. Stauffer](mailto:ryan.m.stauffer@nasa.gov), NASA Goddard Space Flight Center, Greenbelt, MD, USA; ryan.m.stauffer@nasa.gov
[Dr. Roeland Van Malderen](mailto:roeland.vanmalderen@meteo.be), Royal Meteorological Institute, Uccle, Belgium; roeland.vanmalderen@meteo.be
[Dr. Elizabeth \(Lizzy\) Asher](mailto:elizabeth.asher@noaa.gov), NOAA Global Monitoring Laboratory (GML), Boulder, CO, USA; elizabeth.asher@noaa.gov
- There are 28 active NDACC ozonesonde stations (see [Map](#) and [Table](#) below for locations and station data contacts).
- There are 8 active NDACC water vapor sonde stations (see [Map](#) and [Table](#) below for locations and station data contacts).
- The data for the NDACC ozonesonde and water vapor sonde stations can be found at the [NDACC Data Housing Facility \(DHF\)](#) and is listed by the station.
- There are 3 active Balloon Baseline Stratospheric Aerosol Profiles (B2SAP) aerosol sonde sites in the northern and southern hemisphere mid-latitudes and tropics: **Boulder, Colorado, USA; Hilo, Hawaii, USA; Lauder, New Zealand**. More information on aerosol sondes can be found at the [B2SAP site](#) and the data is available [here](#). The primary contact for this data is: Alexandre Baron (NOAA CSL; alexandre.baron@noaa.gov) with Lizzy Asher (elizabeth.asher@noaa.gov) as the secondary contact.

NDACC Active Ozone and Water Vapor Sonde Stations

180° W 150° W 120° W 90° W 60° W 30° W 0° 30° E 60° E 90° E 120° E 150° E 180° E

90° N
75° N

Eureka Alert Ny-Aalesund

https://tropo.gsfc.nasa.gov/shadoz/NDACC_SondeWorkingGroup.html

Thanks to D. Kollonige, NASA/GSFC