Sondes Working Group: Ozonesonde Updates

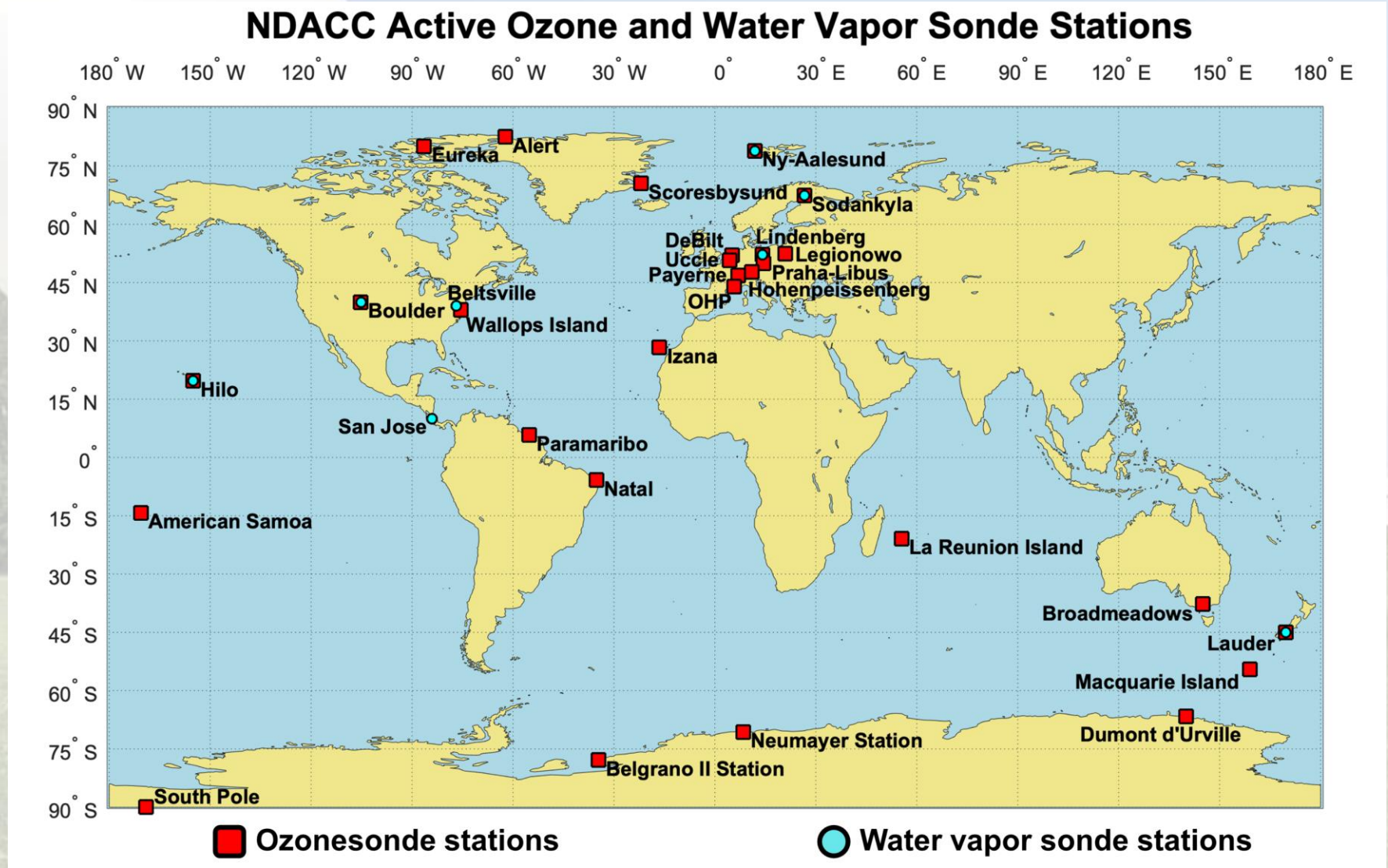
Ryan Stauffer (NASA/GSFC; 2025) and Roeland Van Malderen (RMI; 2024+)

2024 NDACC Steering Committee Meeting

12 November 2024; Santiago, Chile

NDACC Ozonesonde Stations (28 Active)

- **18 in Northern Hemisphere, 10 in Southern Hemisphere**
- **NDACC O_3sonde 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

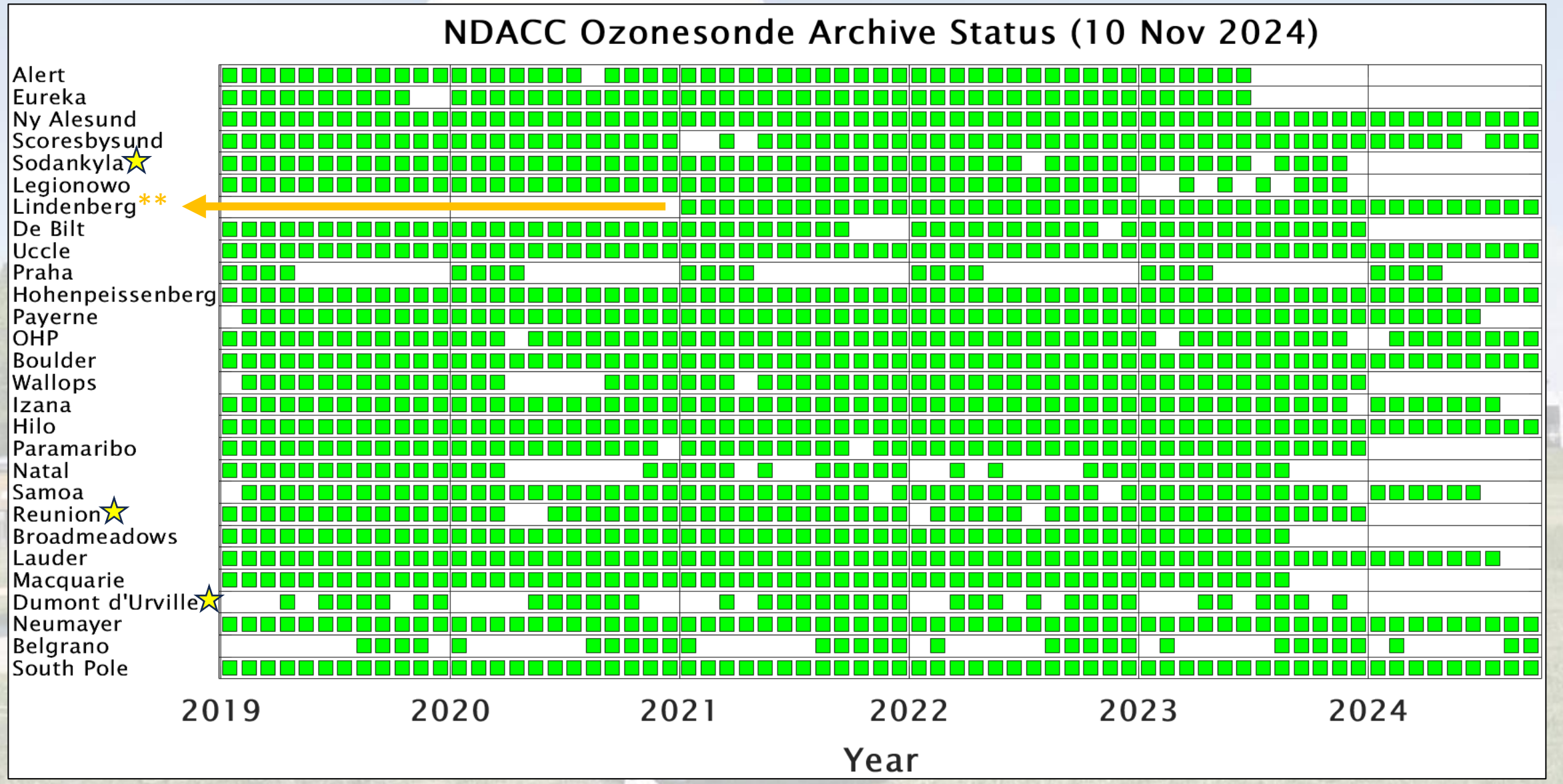
NDACC Ozonesonde Statistics (as of 10 Nov 2024)

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	

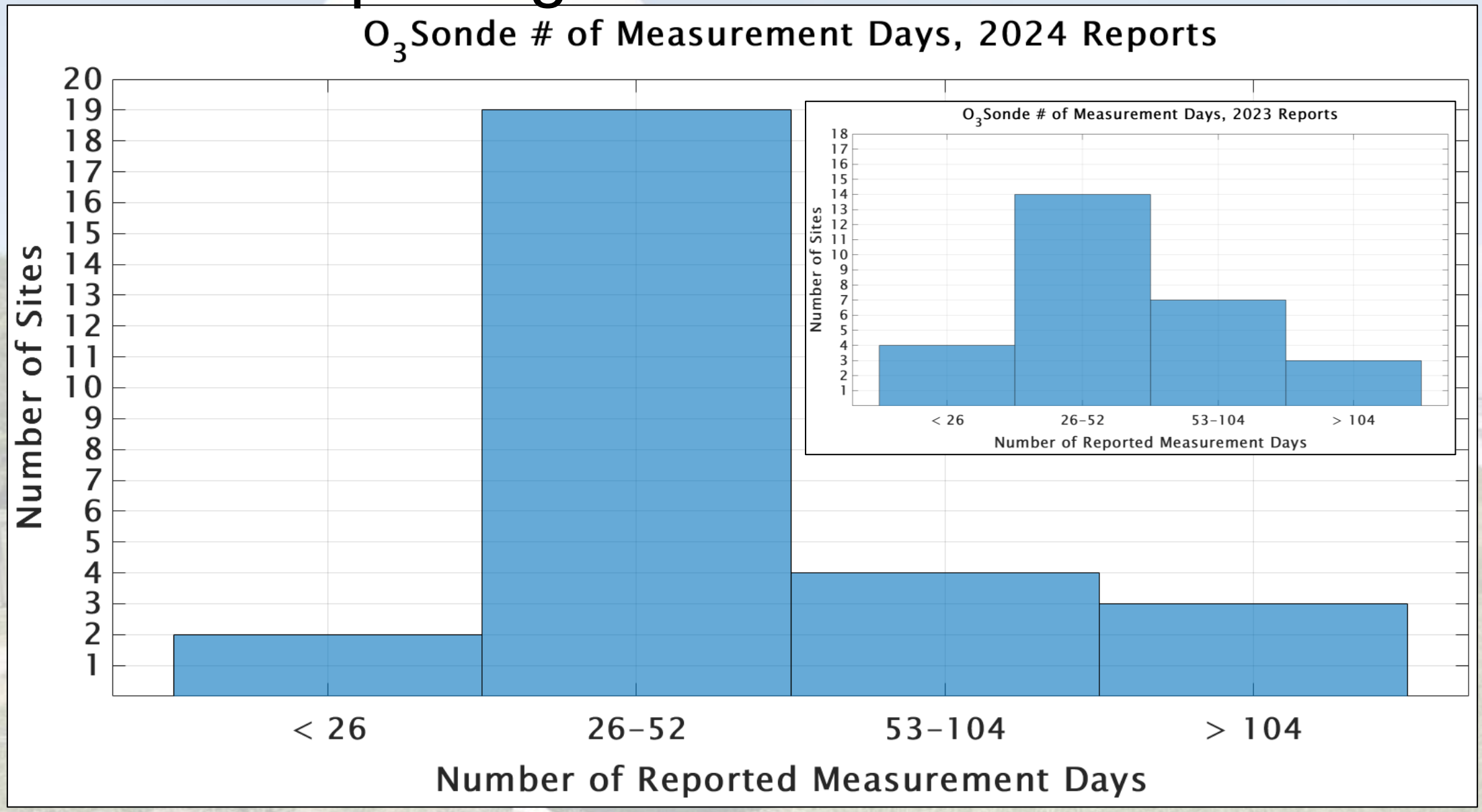
- **All 28 Station Reports Received!**
- **All stations have uploaded data through at least June 2023**
- **Lindenberg likely opting to wait on HDF and versioning guidance**

- **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**

O_3 Sonde Recent DHF Status

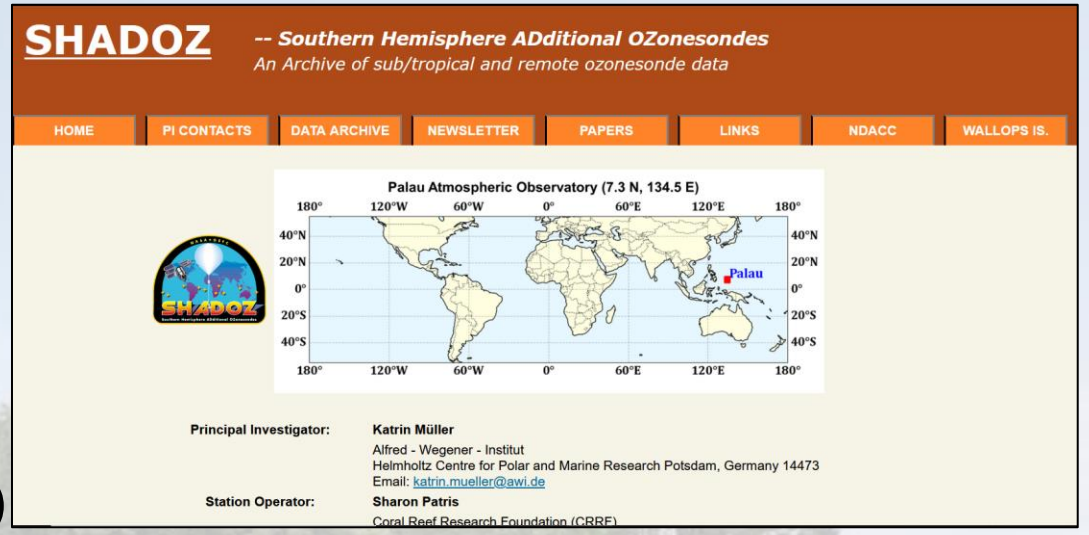


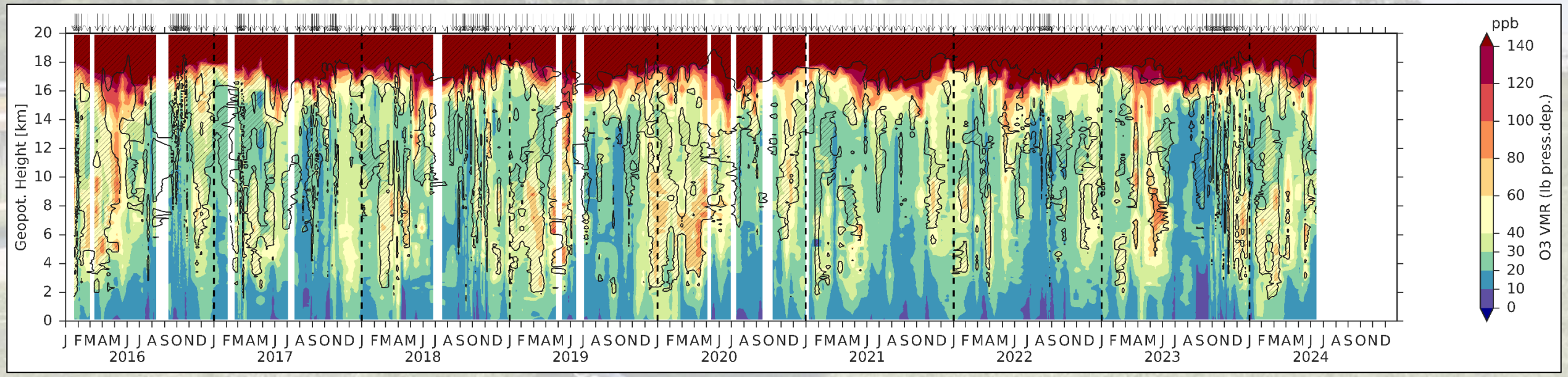
2023-2024 Reporting Period Ozonesonde Data



Palau a Candidate NDACC O_3/WV Sonde Station?

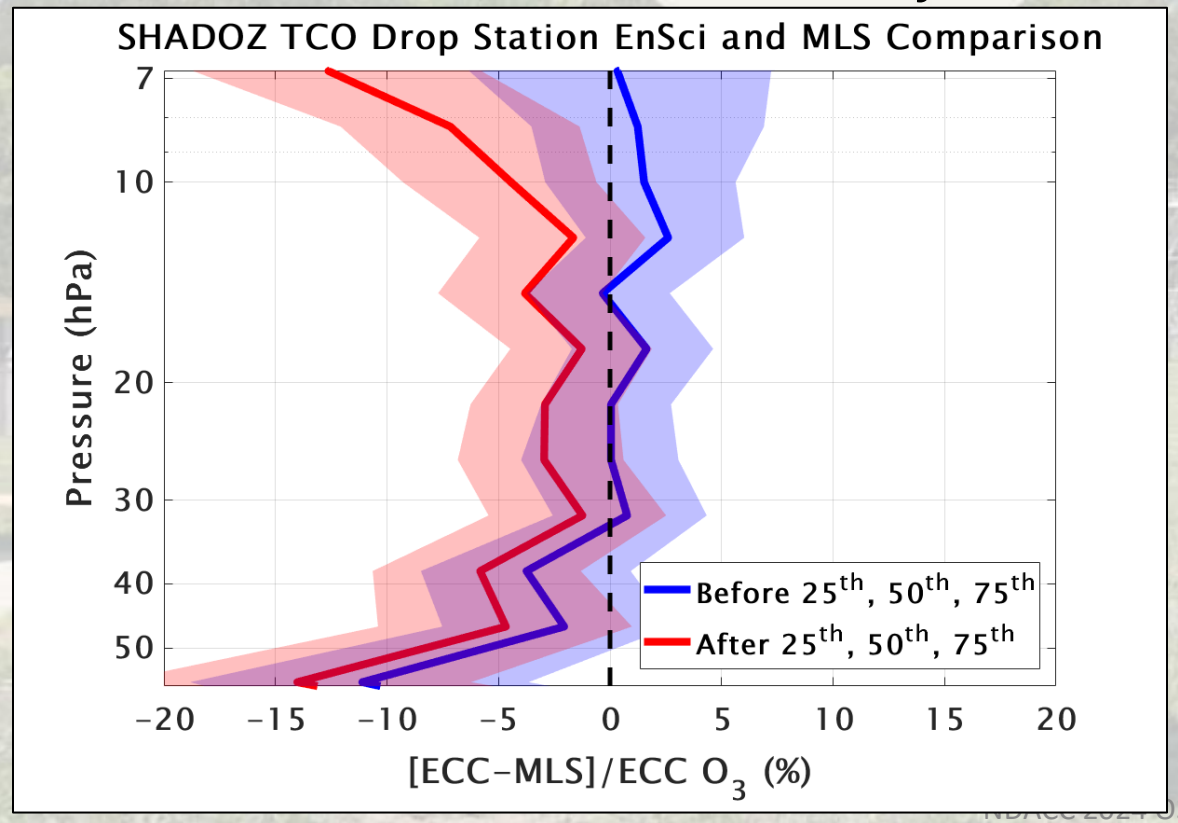
- Palau is the latest SHADOZ station, with SHADOZ V06 data coming to the archive by end of 2024 →
- **PI Katrin Müller** (AWI). RS41/SPC ozonesonde and campaign CFH WV sondes, also FTIR, Pandora…
- Data published in Müller et al. (2024a,b; ACP). Will pursue as new NDACC-affiliated station (**+ACTION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

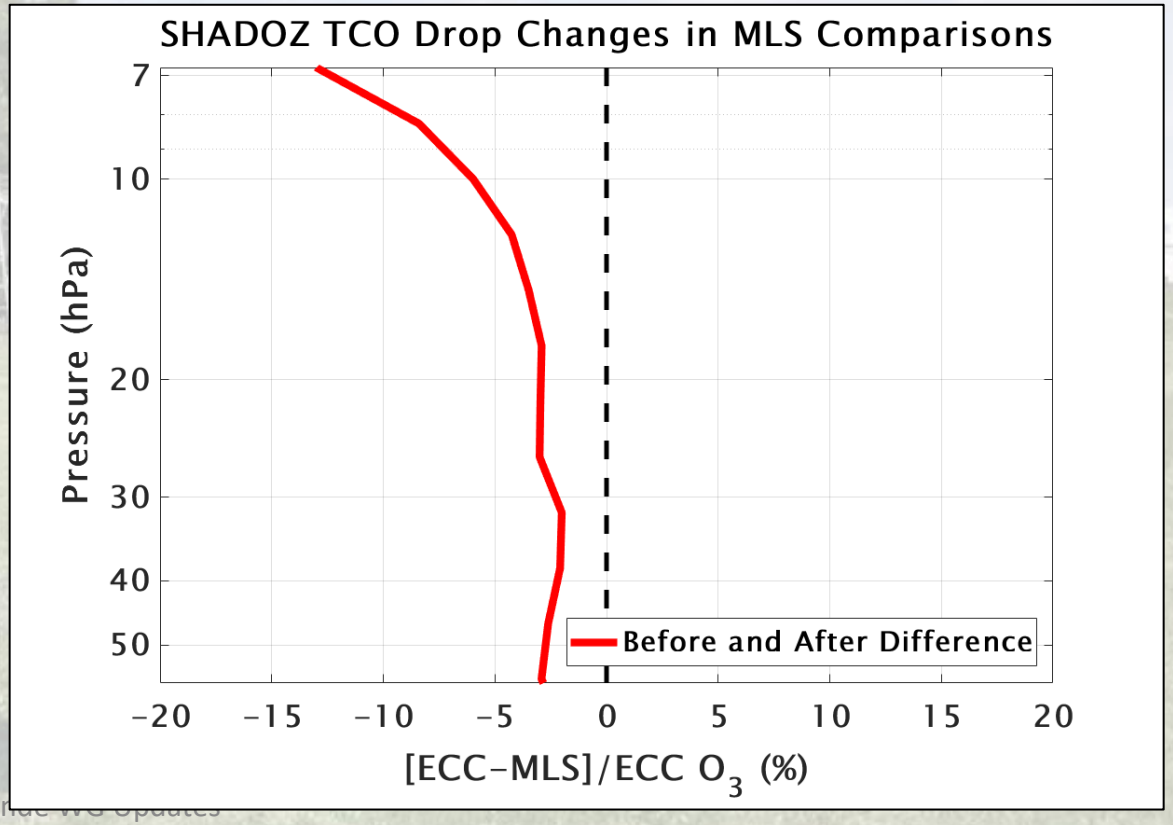




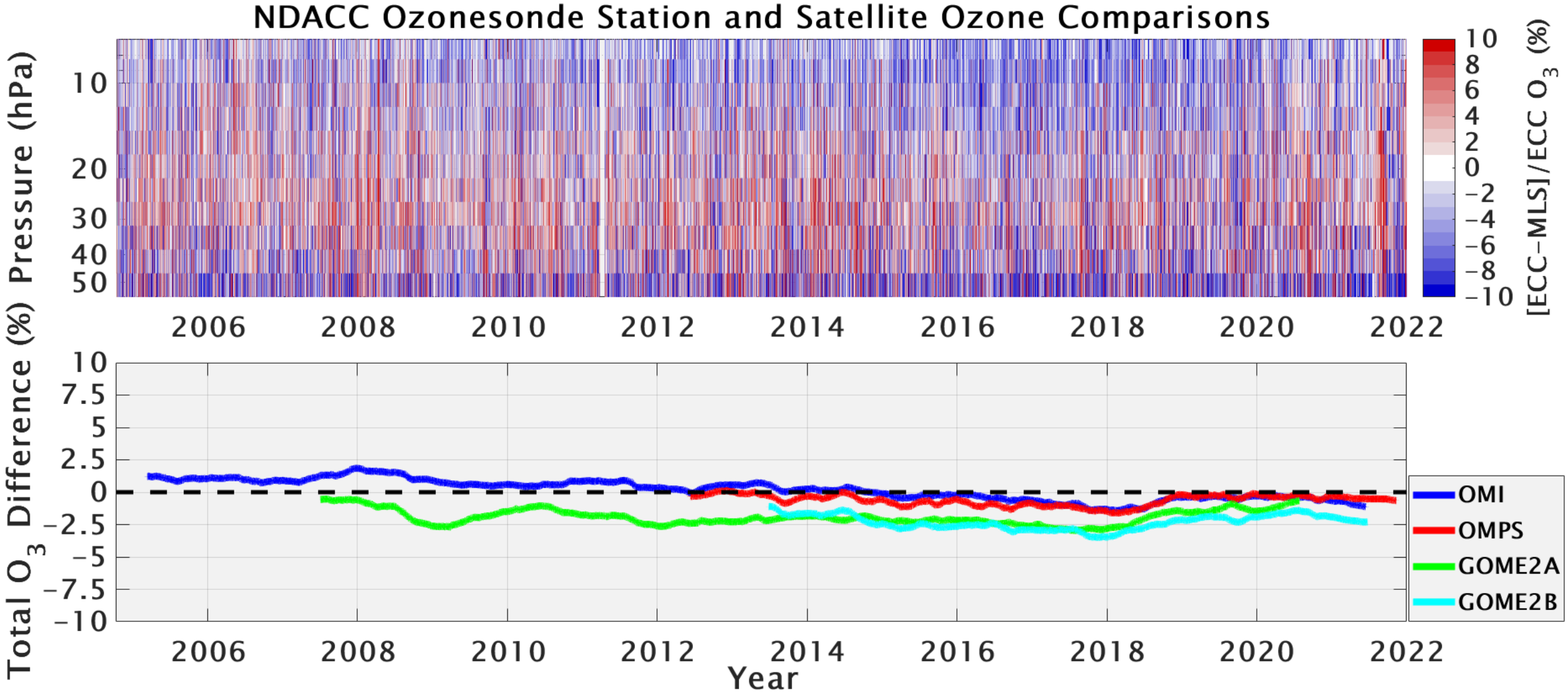
Data Quality: Stratospheric Drop vs. Aura MLS

- Identified En-Sci S/N 25250 as a changepoint in ozonesonde TCO comparisons
- Examining comparisons with Aura MLS O_3 (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!

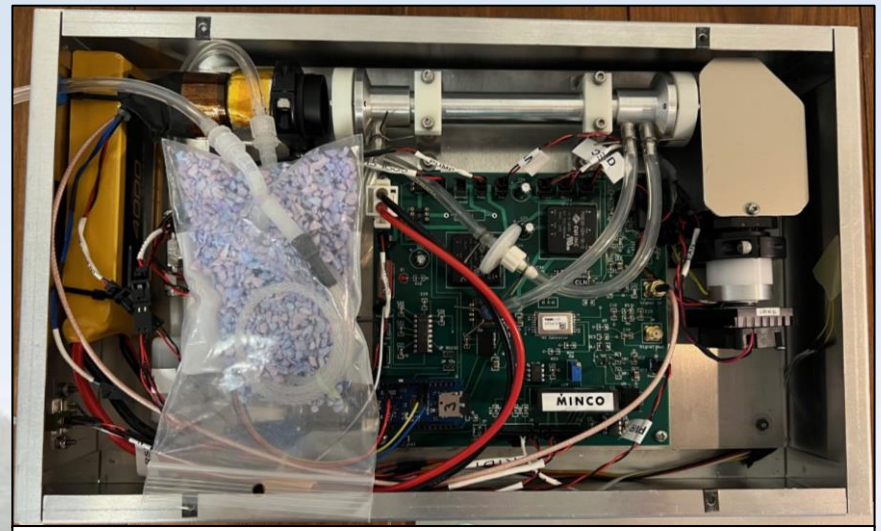


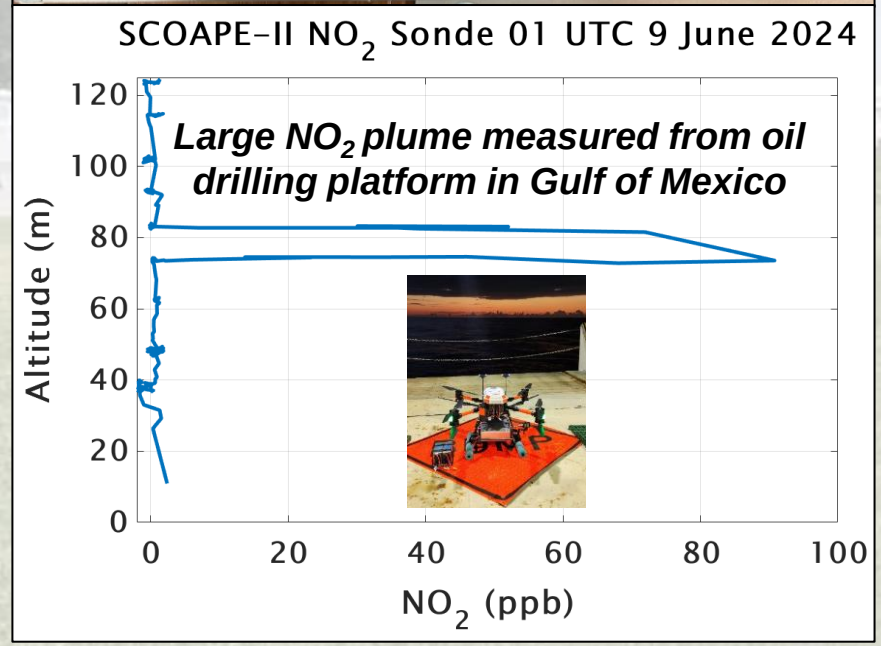
New Balloon-Borne O_3 Reference Coming Soon?

- 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 NO_2 sonde which was demonstrated on balloon flights and a UAV platform in the Gulf of Mexico in June →





QOS July 2024 O_3Sonde Side Meeting

- **14 July O_3Sonde 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

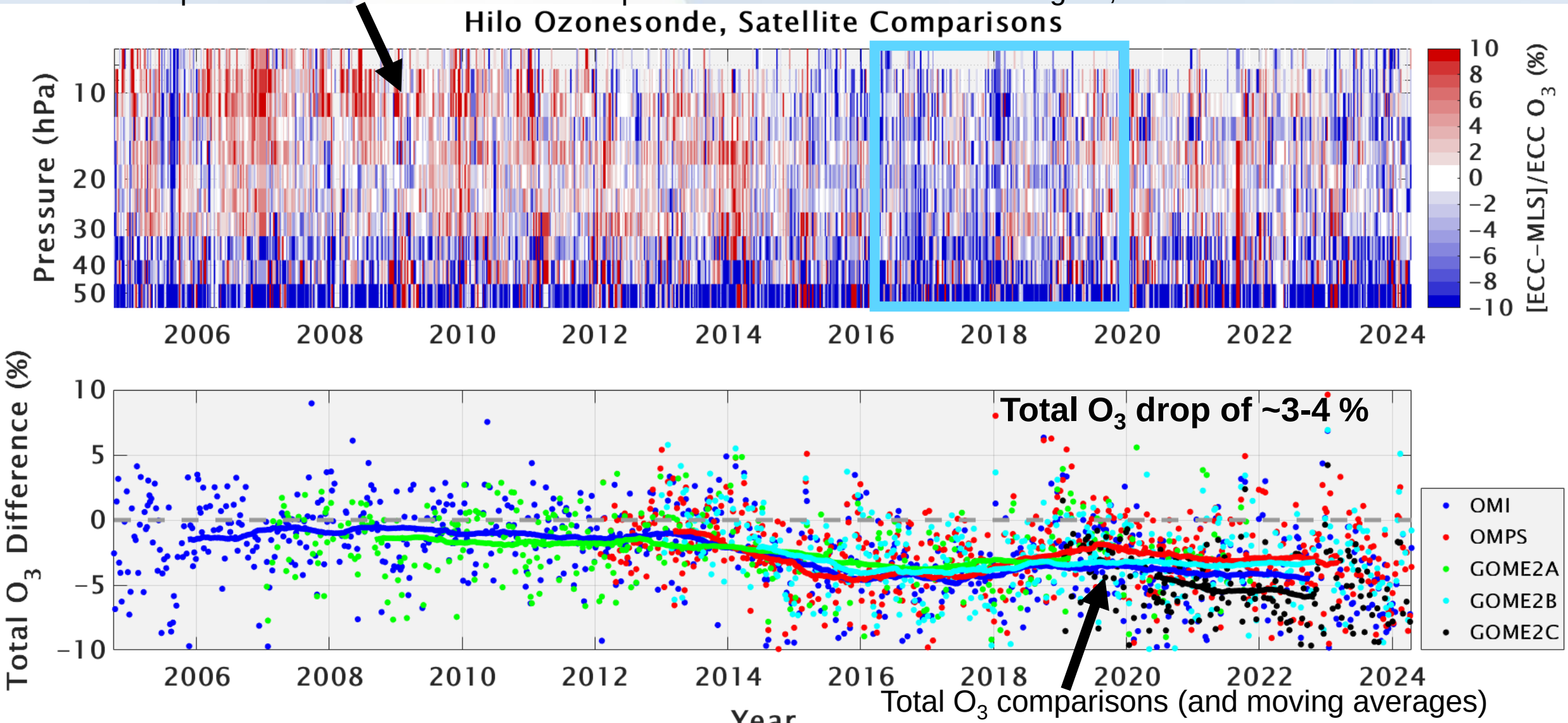
Sonde Working Group Co-Chair Contact Info:

- Ryan Stauffer (O_3): ryan.m.stauffer@nasa.gov
- Roeland Van Malderen (O_3): roeland@meteo.be
- Elizabeth Asher (WV, next talk): elizabeth.asher@noaa.gov

Extras

Data Quality Issues (Stratospheric O_3 Dropoff)

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

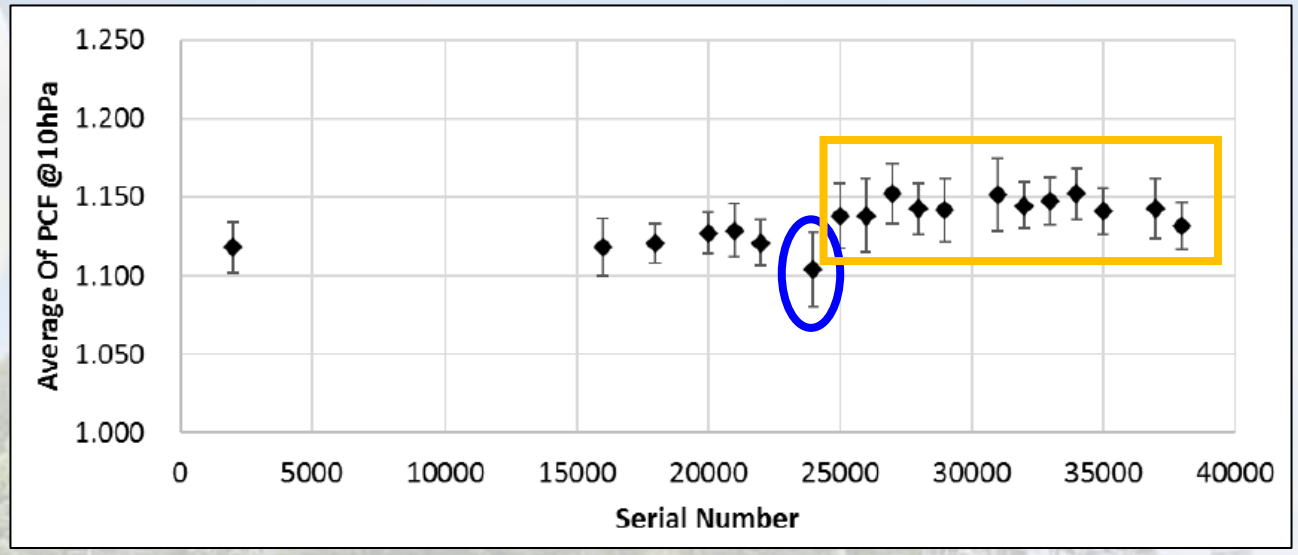


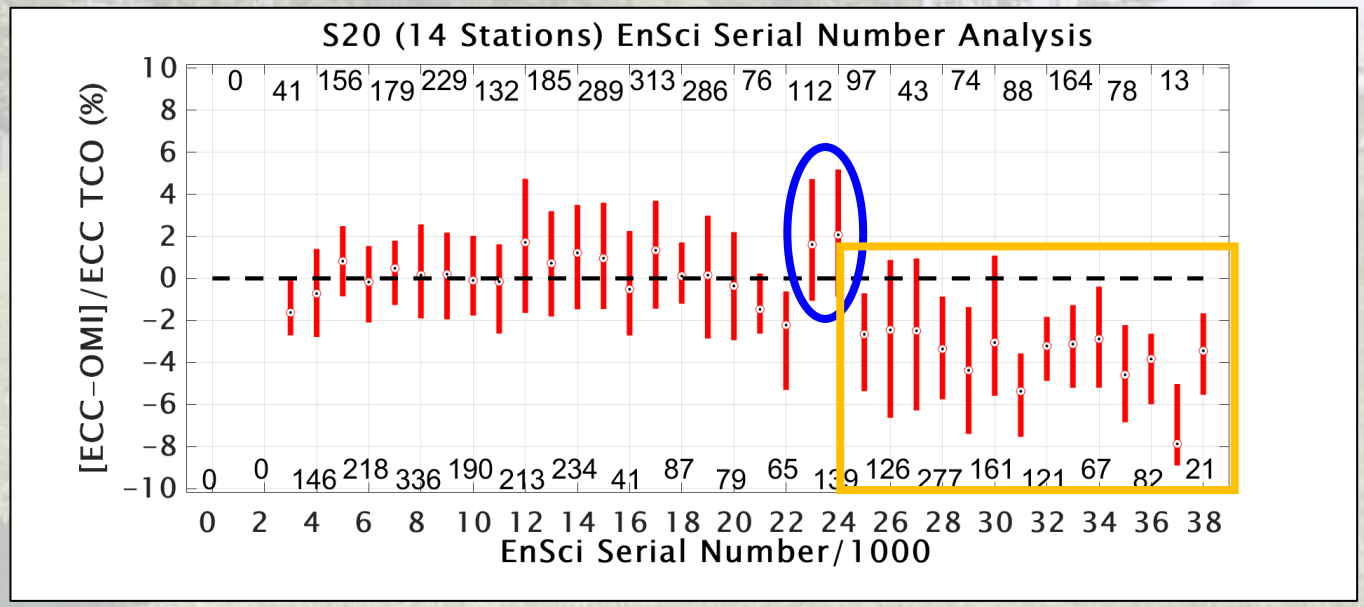
Changes to the EnSci Pump Efficiencies

- 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

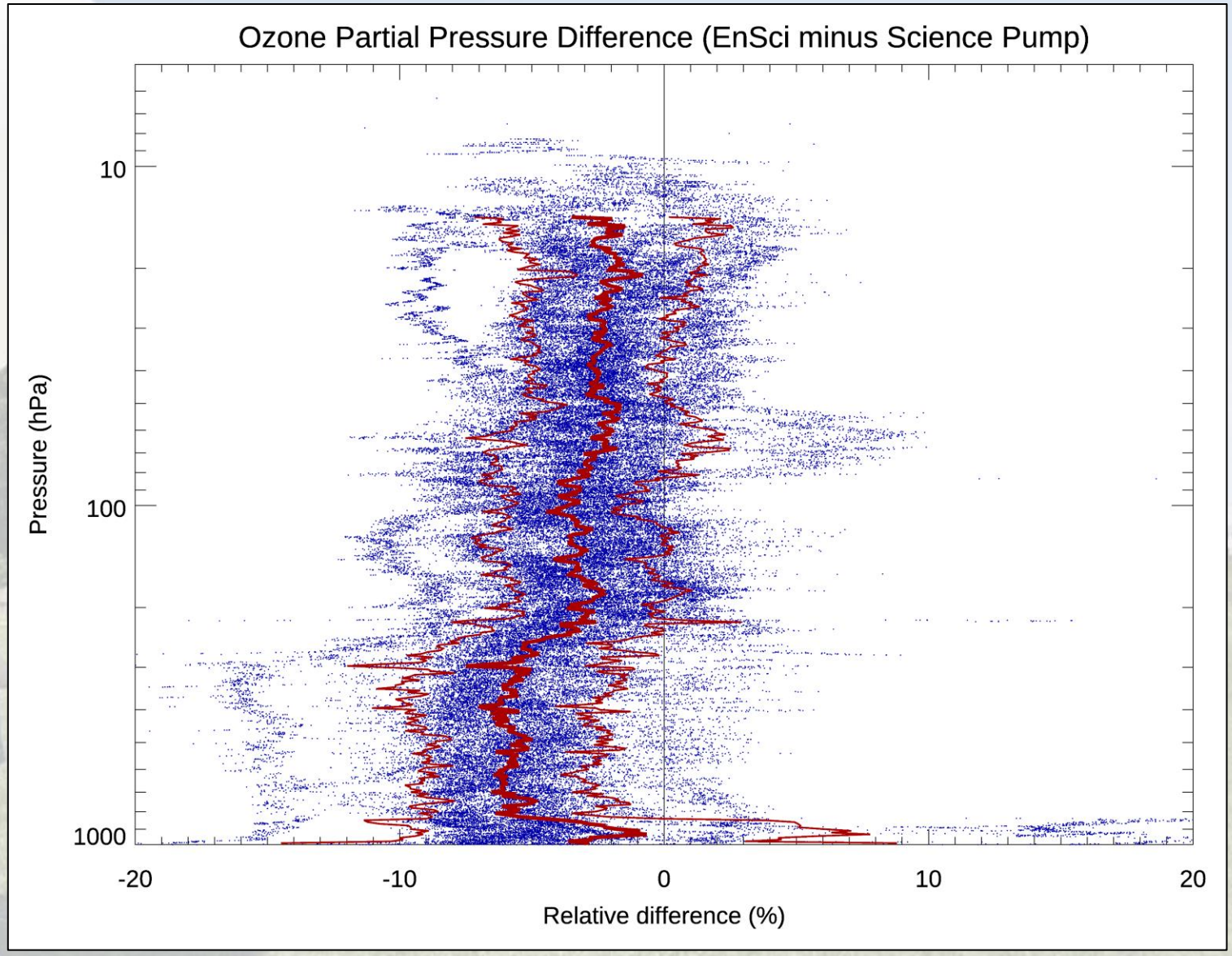
- Paper with “dropoff” updates: https://doi.org/10.1029/2022EA002459 (Stauffer et al., 2022)





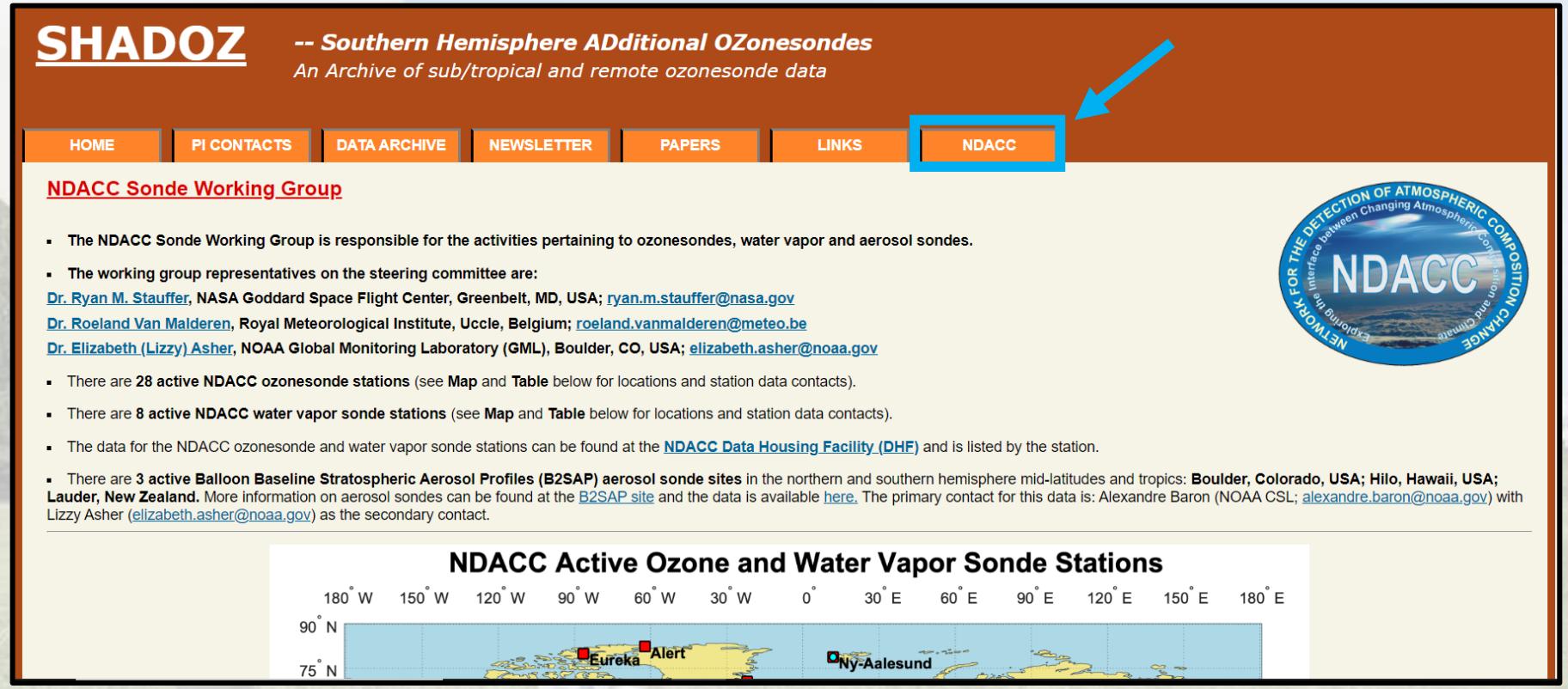
AUS En-Sci/SPC Dual Flights (Preliminary)

- 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**



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

Thanks to D. Kollonige, NASA/GSFC