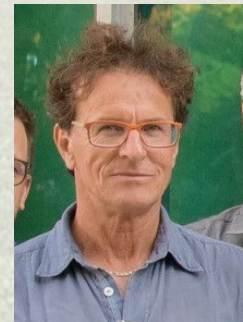


# Sondes Working Group: Ozone, Aerosol, and Water Vapor Sondes

Ryan Stauffer (2023), Dale Hurst (2021), and René Stübi (2021\*)

2020 NDACC Virtual Steering Committee Meeting

5 November 2020



A large white balloon is being prepared for launch in an open field. Two people are visible in the foreground, one standing and one sitting on a stool, both handling the balloon's ropes. The background features a line of trees, a white building, and several tall metal towers. The sky is clear and blue.

# Ozonesondes

# NDACC Ozonesonde Statistics (as of 28 Oct 2020)

SITE	Latitude	# Profiles	Archive Update	SITE	Latitude	# Profiles	Archive Update
Alert	82.5	?	Jun-19	Natal	-5.8	28	Dec-19
Eureka	80.0	?	Jun-19	American Samoa	-14.2	31	Aug-20
Ny-Aalesund	78.9	93	Sep-20	La Reunion	-20.9	32	Sep-17
Scoresbysund	70.4	50	Nov-19	Broadmeadows (new in 2018)	-20.9	52	Jan-19
Sodankyla	67.3	34	Oct-19	Lauder	-45.0	52	Jun-20
Legionowo	52.4	52	Oct-19	Macquarie Island (new in 2018)	-45.0	54	Oct-19
Lindenberg	52.2	60	Only WV	Dumont d'Urville	-66.6	10	Dec-19
De Bilt	52.1	56	Dec-19	Neumayer	-70.6	58	Oct-20
Uccle	50.8	145	Oct-19	Belgrano	-77.8	23	Oct-20
Praha	50.0	46	Apr-20	South Pole	-90.0	48	Aug-20
Hohenpeissenberg	47.8	126	Sep-20				
Payerne	46.8	150	Aug-20	<b>Total Profiles Last 12 Months:</b>		<b>1485</b>	
OHP Obs. de Haute Provence	43.9	39	Sep-20	Total Profiles 2019:		1507	
Boulder	39.9	59	Aug-20	Total Profiles 2018:		1541	
Wallops Island	37.9	37	Dec-19	Total Profiles 2017:		1319	
Izana	28.3	53	Aug-20	Total Profiles 2016:		1555	
Hilo	19.7	50	Aug-20				
Paramaribo	5.8	47	Dec-19				

- 26 of 28 station reports received (Alert and Eureka)
- Two stations are not up-to-date on NDACC DHF (Lindenberg and La Réunion/St. Denis)

- 1485 total measurement days, even without Alert and Eureka updates and COVID impacts at several sites
- La Réunion working through personnel changes at end of 2020. Lindenberg has promised ozonesonde data upload for a long time (WV is up-to-date)

# Ozonesonde WG Action Items

1. Lindenberg ozonesonde data is not archived.
  - Status: **Still No Data on Archive**
  - Archiving keeps getting pushed back one year. Now expected Spring 2021. Do we need to take action?
2. Obtain metadata files from **Alert**, **Broadmeadows**, **De Bilt**, **Izaña**, **Lindenberg**, and **Macquarie Island**
  - De Bilt data is being re-analyzed and a new metadata file will accompany a new data set.
3. Obtain updated metadata files from **Eureka**, **Dumont d'Urville**, **Neumayer**, **Ny Ålesund**, **OHP**, and **La Réunion Island/St. Denis**
  - No word on timeline for Canadian (remote access problems) or DDU station metadata updates.

# COVID Impacts on Data Collection

The following stations noted data collection was interrupted by the COVID pandemic:

1. Broadmeadows (1 flight missed week of 22 March)
2. Wallops Island (No flights from mid-March to mid-September)
3. Natal (No flights mid-March to early November)
4. OHP (No flights from mid-March to mid-May)
5. Samoa (Reduced flights mid-March to July; shipping problems with closed border)
6. La Réunion/St. Denis (No flights from mid-March to beginning of June)

# ASOPOS 2.0 Progress (Sonde WG Meetings)

- Ozonesonde WG Co-Chairs Stübi and Stauffer both members (and B. Johnson, previous Co-Chair)
- ASOPOS 2.0 to replace GAW No. 201 (Editors A. Thompson & H. Smit). Delivery to WMO by 15 Dec 2020. WMO publication ~6 months?
- Co-sponsorship by NDACC and IO<sub>3</sub>C is requested
- Sonde WG meetings within the Assessment of Standard Operating Procedures for OzoneSondes (ASOPOS) 2.0 Panel
  - Major authors' meeting in March 2020 with 3 manufacturers present. Full report draft completed mid-August 2020
  - Report reviewed by 6 volunteers (6 continents) from NDACC and IO<sub>3</sub>C (meeting on 28 October 2020)



*ASOPOS WMO/GAW Report no. 201*

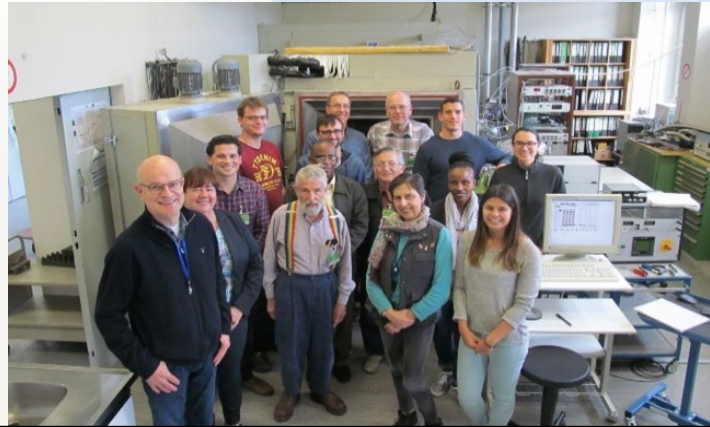


*ASOPOS 2.0 in Brussels, Sep 2019*

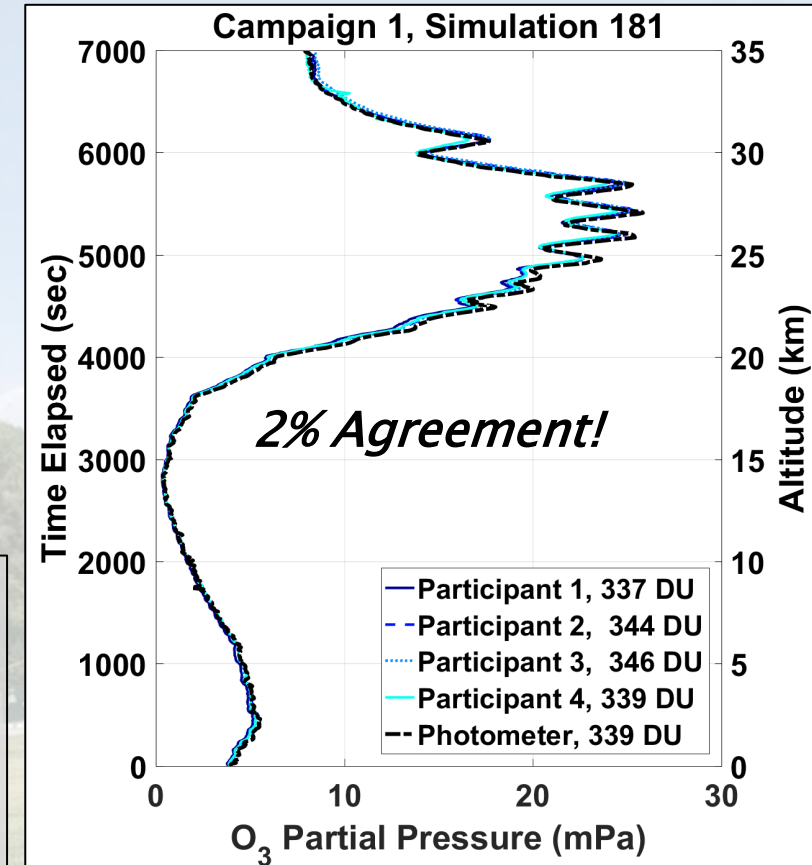
# Role of WCCOS in ASOPOS 2.0: Traceability for O<sub>3</sub> sondes



WCCOS in Jülich, Germany



JOSIE-SHADOZ 2017 Campaign Participants



Example simulated profile from JOSIE-SHADOZ 2017 with four ozonesondes (Thompson et al., 2019; BAMS)

O<sub>3</sub> sondes have been intercompared at the World Calibration Center for Ozonesondes (WCCOS) in Jülich, Germany, since 1996. Focus only on ECC sondes post-2000

Data reprocessing and ASOPOS/GAW Report no. 201 are based on JOSIE and BESOS field experiments prior to 2009. GAW no. 201 is a handbook with SOPs

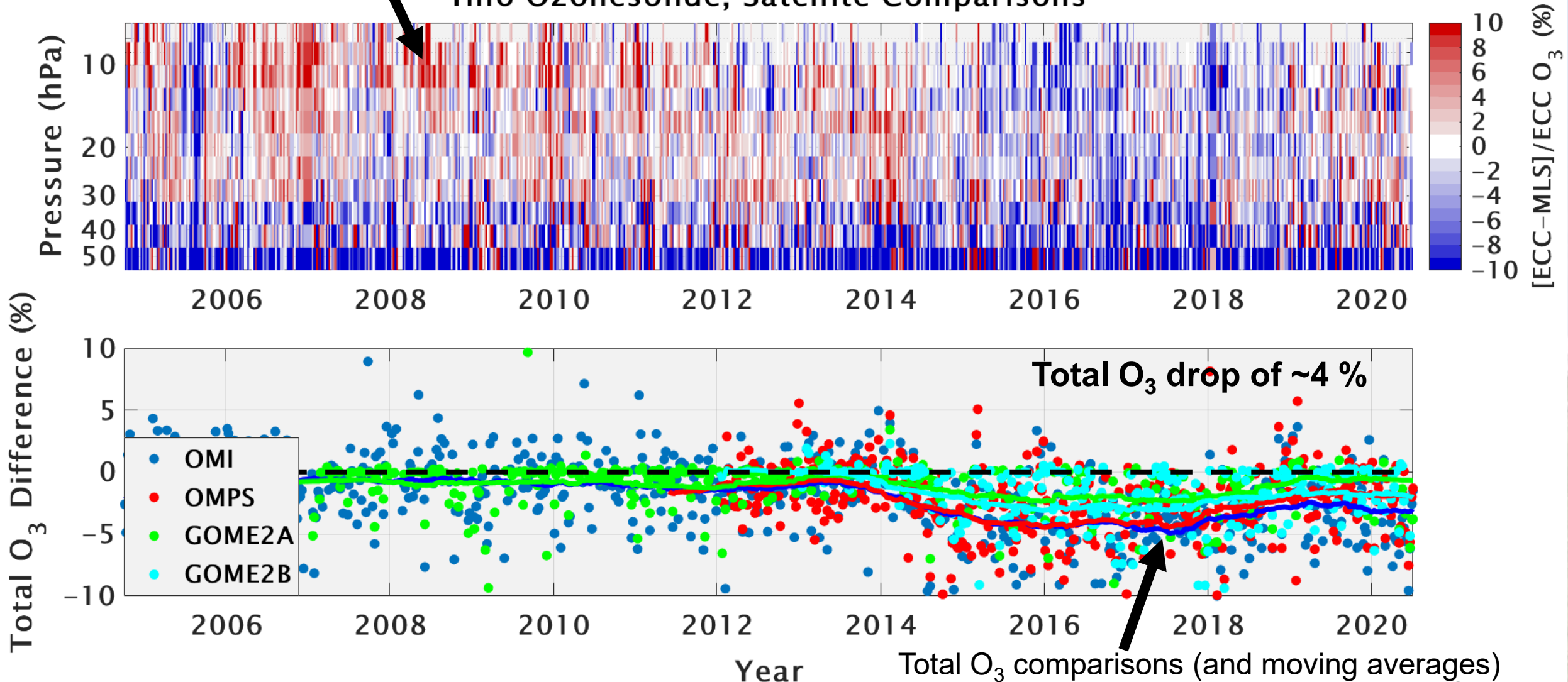
Key feature of ASOPOS 2.0 is chapters on measurements principles, uncertainties, new SOPs (JOSIE-SHADOZ 2017), data quality indicators, metadata

ASOPOS 2.0 recommends final data and reprocessing include traceability to WCCOS OPM (Ozone Photometer). **Must keep WCCOS running!**

# Data Quality Issues (Stratospheric O<sub>3</sub> Dropoff)

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

Hilo Ozonesonde, Satellite Comparisons





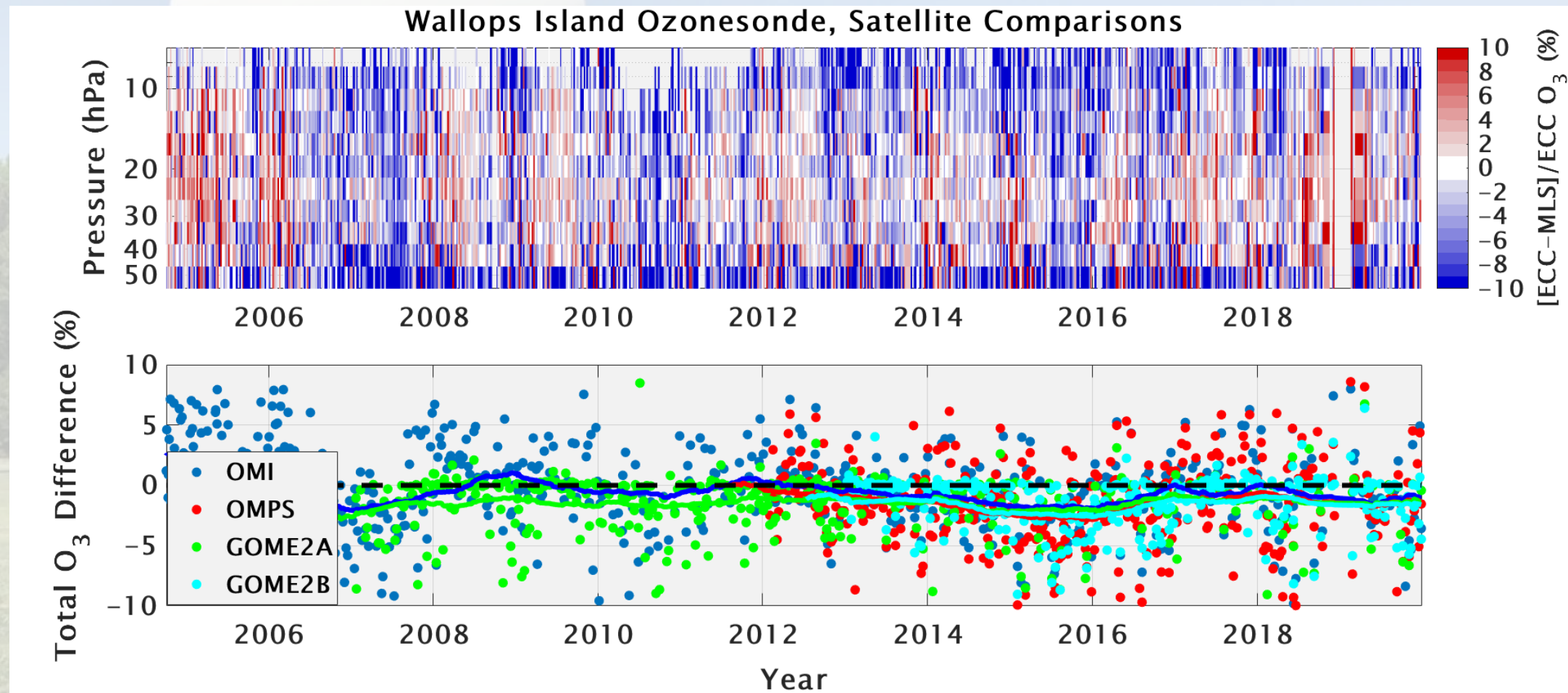
# Data Quality Issues (Stratospheric O<sub>3</sub> Dropoff)

## Affected NDACC Stations:

- Alert\*
- Eureka\*
- Hilo
- Samoa

See  
*Stauffer  
et al., 2020  
in GRL*

*\*Recent data  
show  
improvement*



The vast majority of NDACC stations \*do not show the drop-off behavior\*.  
Wallops Island example shown here

# ASOPOS 2.0 O<sub>3</sub> Dropoff Task Team

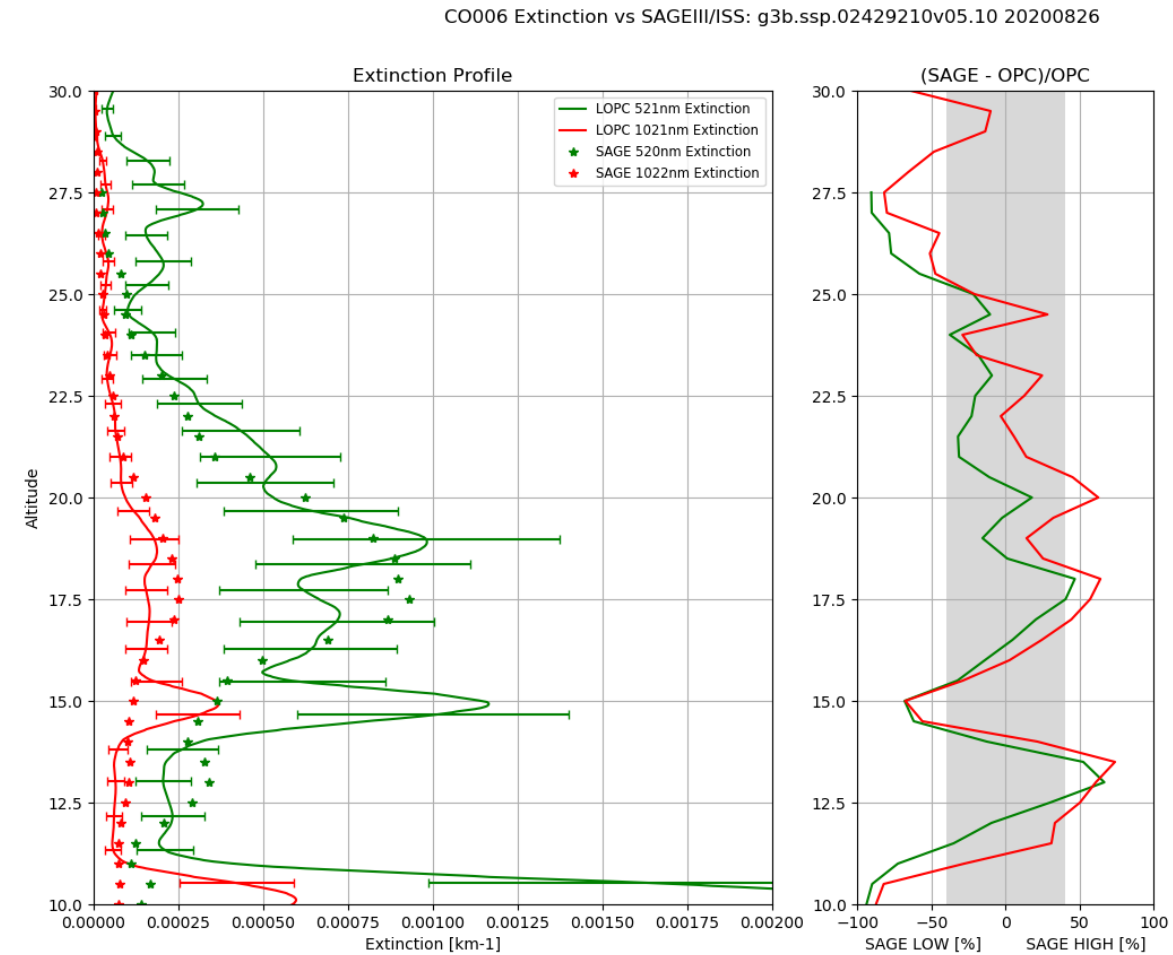
- The dropoff affects only the EnSci ozonesonde (not Science Pump), and there appears to be an unknown site-specific component
- We have formed an ASOPOS sub-group and are meeting ~once a month to address the dropoff (Co-Chairs Stauffer and R. van Malderen)
- **Four “Task Teams”**
  1. Metadata: Station surveys, ECC performance (D. Kollonige; NASA/GSFC)
  2. Data Analysis: Comparisons with satellite, lidar, Brewers/Dobsons, “flagging” of data (Stauffer, van Malderen; RMI Belgium)
  3. Laboratory Testing: Comparisons with older EnSci ECCs, pump flow, ion bridge, KI solutions (B. Johnson; NOAA GML)
  4. Communication: Outreach to stations and users, advice on use of affected data (H. Smit; FZJ)

A large white balloon is being prepared for launch in a grassy field. Two people are visible: one on the left holding the balloon's neck, and another on the right standing on a small stool, possibly adjusting the payload. The balloon is partially inflated and is attached to a string that runs across the field to an orange marker. In the background, there are several tall metal towers, a small white building, and a line of trees under a clear blue sky.

# **Aerosol Sondes (slide from T. Deshler and L. Kalnajs)**

# Aerosol Sondes (OPC and STAC)


- Stratospheric aerosol measurements using optical particle counters, continuing the Wyoming legacy at LASP, University of Colorado
- PIs: Lars Kalnajs and Terry Deshler
- New LASP Instruments
  - LOPC – LASP optical particle counter →
  - STAC – stratospheric total aerosol counter
- Portable Optical Particle Spectrometer (POPS) launched every other week at Boulder, occasionally at Lauder as part of NOAA's Earth Radiation Budget program and for validation of SAGE III/ISS



*LOPC sonde and SAGE-III/ISS aerosol extinction in the stratosphere (left) and percent differences (right)*

# Time to Reinvigorate Aerosol Sondes in NDACC?

- Given all of the recent work and soundings with the OPC and POPS, now may be a good opportunity to increase aerosol sonde representation in NDACC
- Sonde WG Co-Chairs can reach out to L. Kalnajs (CU) and T. Thornberry (NOAA/CSL; Boulder and Lauder profiles) to see if they are interested in archiving profiles at NDACC DHF
- What is the best approach to accomplish this?



# Water Vapor Sondes (slides from D. Hurst)

## Update on Frost Point Hygrometers (WV Sondes)

<u>Station</u>	<u>New Files</u>	<u>Data Files in Pubic Archive (as of 9 Oct 2020)</u>
Boulder, CO, USA	+15	02/1991 – 08/2020 (427 files)*
Hilo, HI, USA	+11	12/2010 – 08/2020 (108 files)
Lauder, New Zealand	+9	08/2004 – 07/2020 (176 files)
Lindenberg, Germany	+21	09/2006 – 09/2020 (251 files)
Ny-Ålesund, Svalbard	+2	12/2002 – 02/2004; 10/2013 – 04/2020 (45 files)
San José, Costa Rica	+11	07/2005 – 09/2020 (221 files)
<u>Sodankylä, Finland</u>	+8	<u>01/2005 – 04/2005; 03/2017 – 08/2020 (17 files)</u>
<b>Totals</b>	<b>+77</b>	<b>1245</b>

\* 92 additional files (04/1980 – 01/1991) available on request

*More WV Sonde files were submitted during the last year than in any previous year since 2016 when they were first added to the database*

# Update on Frost Point Hygrometers (WV Sondes)

**Of all non-NDACC sites launching frost point hygrometers, only Beltsville has moved forward with a consistent measurement program**

- Beltsville, MD (USA) has launched 23 CFH since early 2018

**Should NDACC ask Beltsville to become the 8<sup>th</sup> WV Sonde Site?**

## **Concerns about the availability of FP cryogen (HFC-23)**

- Kigali Amendment of the Montreal Protocol to reduce HFC emissions  
*Production freeze in 2024; first mandated production reduction in 2029*
- EU has already implemented its own 2020 ban on certain uses
- Other countries are following suit with earlier reductions
- Cost is certain to rise, is now difficult to purchase in some countries
- Testing dry ice and alcohol mixture, but change management needed, more intercomparisons

**Holger Vömel will discuss WV intercomparisons and overall strategy (sonde with lidar, FTIR, etc.) later today**



# Thank You

## Sonde Working Group Co-Chair Contact Info:

- Dale Hurst (WV): [dale.hurst@noaa.gov](mailto:dale.hurst@noaa.gov)
- Ryan Stauffer (O<sub>3</sub>): [ryan.m.stauffer@nasa.gov](mailto:ryan.m.stauffer@nasa.gov)
- René Stübi (O<sub>3</sub>): [rene.stuebi@meteoswiss.ch](mailto:rene.stuebi@meteoswiss.ch)

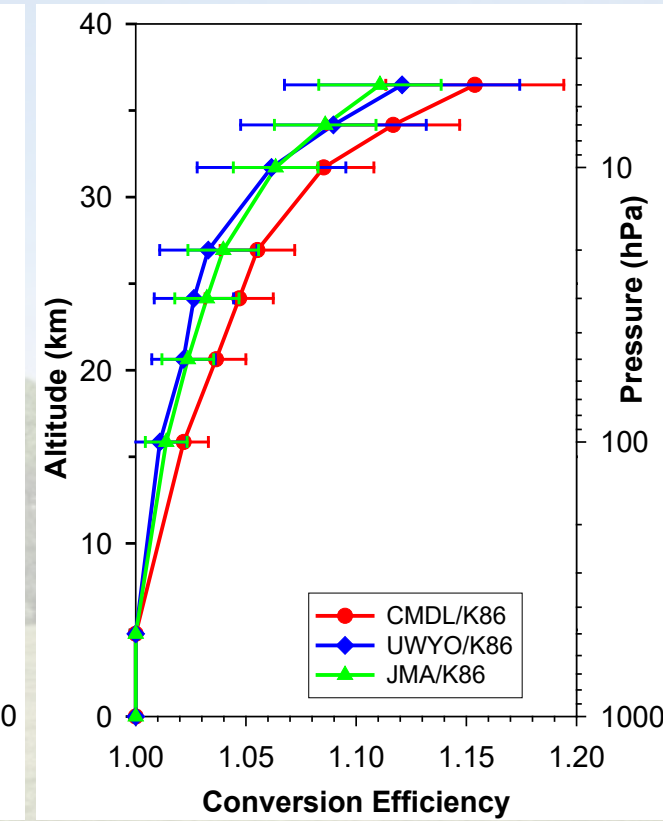
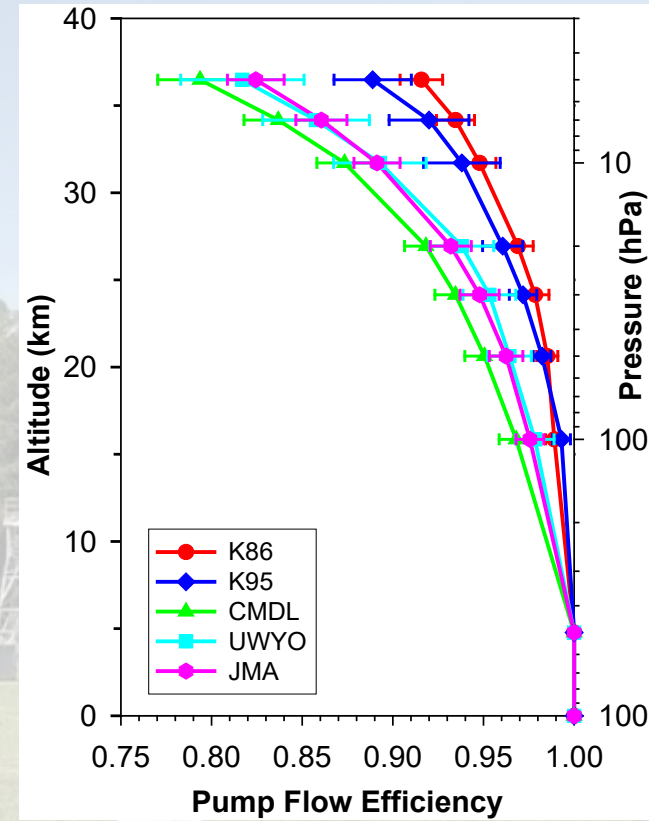
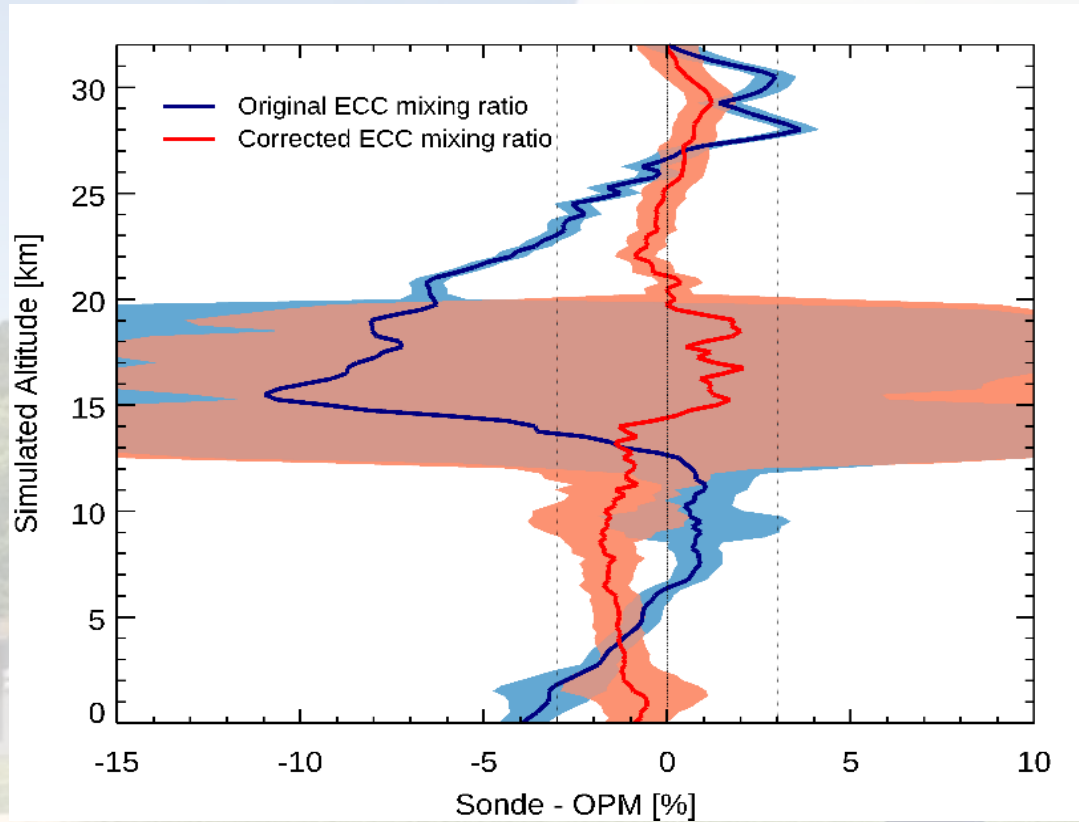
A large white balloon is being inflated in a grassy field. Two people are standing in the foreground, one holding a rope attached to the balloon's base. The background features a line of trees, a white building, and several metal towers. The sky is blue with some clouds.

# Extra Slides

# Other Miscellaneous Ozonesonde Items

1. **Broadmeadows**: Naming consistency. Station is listed as “Melbourne” on NDACC Website. Melbourne is used for Dobson site ~8 km from Broadmeadows
2. **OHP**: Data have been homogenized! Note that the ozonesondes still show a negative bias compared to the lidar at ~30 km
3. **La Réunion**: F. Posny will be succeeded in 2021 by a new PI yet to be announced
4. **Hohenpeissenberg**: DOIs for data archived at NDACC?
5. **Uccle**: “As we want to make the O3S-DQA corrected data available to the users via the NDACC website, next to our operationally corrected data, we would like to have the possibility to have 2 versions of each data file in NDACC”
6. **Legionowo**: Options for the use of purified ozone-free air instead of the ozone destruction filter?
7. **Sodankylä** : QC matters, homogenization of pre-flight preparation practices

# Latest ASOPOS Data Quality Assurance Activities



Correcting simulated  $O_3$  data using the ozonesonde time response in Vömel et al. (2020):  
<https://amt.copernicus.org/preprints/amt-2020-62/>

Showing that pump flow correction tables are compensating for changing ozonesonde conversion efficiency in Tarasick et al. (2020), in review



# Then there is one more thing: The Future of CCL, WCC and QA/SAC for O<sub>3</sub>S



After retirement of Herman Smit, head of WCCOS (2021) following changes are under negotiations at FZJ:

1. CCL for O<sub>3</sub>S as a worldwide unique facility, including technical staff, will stay at FZJ, Juelich.
2. Scientific lead of WCC and QA/SAC will move to KMI (Uccle, Belgium). PI := Roeland van Malderen
3. JOSIE as an unique intercomparison and calibration experiment will become a collaboration between FZJ and KMI: Providing and Monitoring the O<sub>3</sub>S calibration functions that are referenced to the OPM of the CCL/O<sub>3</sub>S.

Parallel the CCL/O<sub>3</sub>S at FZJ, Juelich will facilitate to check and intercompare the ozone-UV photometer equipment flown on the in-service aircraft of the IAGOS programme.

## Goal:

Both ozonesonde and IAGOS-ozone aircraft data will become traceable to the same reference Ozone UV Photometer (OPM) established at the CCL/O<sub>3</sub>Ss at FZJ

**CCL** = Central Calibration Laboratory = Env. Simulation Chamber + Ozone Reference (=OPM)

**WCC** = World Calibration Center

**JOSIE** = WCC + CCL

**QA/SAC** = Quality Assurance/Scientific Activity Center = ASOPOS and O<sub>3</sub>S-DQA (= Homogenisation of data)

# New TOAR-II Workgroup: Harmonization and Evaluation of Ground-based Instruments for Free Tropospheric Ozone Measurements (HEGIFTOM: 2021-2024)

## Key Objective:

Evaluation and harmonization of the different free tropospheric ozone datasets of the established measuring platforms.

## Major Deliverable:

Quality assessed ozone data sets, whereby each measurement gets also an uncertainty and a quality flag. Thereby, instrumental drifts will be characterized and evaluated.

## Included:

Testing ozone retrievals from new remote sensing techniques (MAX-DOAS, Pandora, etc) against the established techniques.

Chairs: Roeland van Malderen ([Roeland@meteo.be](mailto:Roeland@meteo.be)) and Herman Smit ([h.smit@fz-juelich.de](mailto:h.smit@fz-juelich.de))

<https://igacproject.org/hegiftom-focus-working-group>

Instrument	Time period	Coverage/Network	Groups
Ozonesondes	1965 - present	~55 sites worldwide (WOUDC, NDACC, SHADOZ)	RMI (Belgium), FZJ (Germany), ECC (Canada), NOAA (USA)
MOZAIC/IAGOS	1994 - present	Cruise altitude (10-12 km) & Airports worldwide	CNRS (France)
FTIR	1995 - present	NDACC, 13-15 sites having more than 10 years of data	BIRA (Belgium), NCAR (USA), AEMET (Spain)
Lidar		NDACC, TOLNET	LATMOS (France), NASA (USA), UAH (USA)
Dobson Umkehr	1956 - present	WOUDC	NOAA (USA), MeteoSwiss (Switzerland), BoM (Australia), NIWA (New Zealand), OHP (France)
Brewer Mark IV Umkehr		NEUBrew, EUBrew	NOAA (USA), Izaña Atmospheric Research Centre, Spain, Aristotle University of Thessaloniki (Greece), MeteoSwiss (Switzerland)
MAX-DOAS			BIRA (Belgium)
Pandora	2012 - present	45 official sites at 20200907, Pandonia Global Network (PGN)	NASA (USA), VTU (USA), LuftBlick (Austria)