

Sondes Working Group: Ozonesonde Updates

Ryan Stauffer (2022) and René Stübi (2021*);
Roeland Van Malderen (New WG Co-Chair; 2024)
2021 NDACC Virtual Steering Committee Meeting

14 September 2021



← Dale Hurst (2024)
talk on Water Vapor
Sondes is next!

NDACC Ozonesonde Statistics (as of 7 Sep 2021)

SITE	Latitude	# Profiles	Archive Update	SITE	Latitude	# Profiles	Archive Update
Alert	82.5	39	Jun-19	Natal	-5.8	12	Mar-21
Eureka	80.0	59	Jun-19	American Samoa	-14.2	43	Jul-21
Ny-Aalesund	78.9	59	Jun-21	La Reunion	-20.9	26	Dec-20
Scoresbysund	70.4	51	Sep-21	Broadmeadows (new in 2018)	-20.9	51	Aug-21
Sodankyla	67.3	31	Oct-19	Lauder	-45.0	54	Jun-21
Legionowo	52.4	52	Aug-20	Macquarie Island (new in 2018)	-55.0	54	Aug-21
Lindenberg	52.2	56	Only WV	Dumont d'Urville	-66.6	13	Dec-19
De Bilt	52.1	52	Dec-20	Neumayer	-70.6	63	Aug-21
Uccle	50.8	145	Dec-20	Belgrano	-77.8	24	Sep-21
Praha	50.0	48	Apr-21	South Pole	-90.0	52	Aug-21
Hohenpeissenberg	47.8	129	Jul-21				
Payerne	46.8	148	Dec-20	Total Measurement Days Last 12 Months:		1546	
OHP Obs. de Haute Provence	43.9	42	Jun-21	Total Measurement Days 2020:		1485	
Boulder	39.9	62	Aug-21	Total Measurement Days 2019:		1507	
Wallops Island	37.9	32	Nov-20	Total Measurement Days 2018:		1541	
Izana	28.3	53	Aug-21	Total Measurement Days 2017:		1319	
Hilo	19.7	52	Aug-21	Total Measurement Days 2016:		1555	
Paramaribo	5.8	44	Nov-20				

- All 28 ozonesonde station reports received!
- Five stations are considered not up-to-date on NDACC DHF (approaching 2 years old or more)

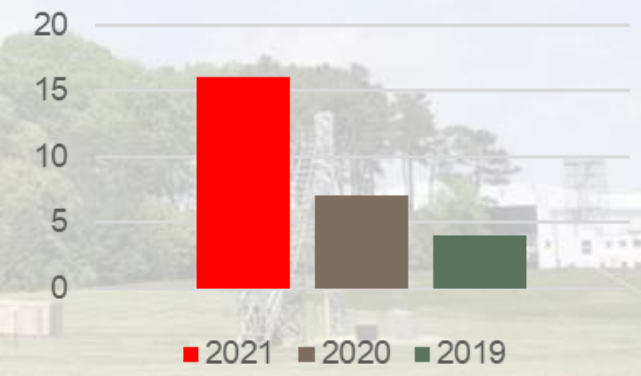
- 1546 total measurement days in this round of reporting, above the previous 5-year average
- Lindenberg has promised ozonesonde data upload for several years now (WV is up-to-date). Upload is expected this calendar year (Communique from station PI P. Oelsner)

Ozonesonde Data Submission (as of 7 Sep 2021)

Long-Term Ozone sonde measurements NDACC			Ames Format							
Last update: September 2021			2014	2015	2016	2017	2018	2019	2020	2021
	Filename	Active								
Alert	alyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Belgrano		yes	█	█	█	█	█	█	█	█
Boulder	bdyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Broadmeadows		yes	█	█	█	█	█	█	█	█
DeBilt	dbyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Dumont	duyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Eureka	euyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Hilo	hiyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Hohenpeissenberg	hoeyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Izana	izyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
La Réunion	reyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Lauder	layymmdd.bnn	yes	█	█	█	█	█	█	█	█
Legionowo	lgyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Macquarie		yes	█	█	█	█	█	█	█	█
Natal	nayymmdd.bnn	SHADOZ	█	█	█	█	█	█	█	█
Neumayer	nmyymmdd.bnn	yes	█	█	█	█	█	█	█	█
NyAlesund	nyyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
OHP	ohyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Paramaribo	pmyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Payerne	payymmdd.bnn	yes	█	█	█	█	█	█	█	█
Prague	pgyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Samoa	sayymmdd.bnn	yes	█	█	█	█	█	█	█	█
Scoresbysund	scyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Sodankylä	soyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
South Pole	spyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Uccle	ucyyymmdd.bnn	yes	█	█	█	█	█	█	█	█
Wallops	wayymmdd.bnn	yes	█	█	█	█	█	█	█	█



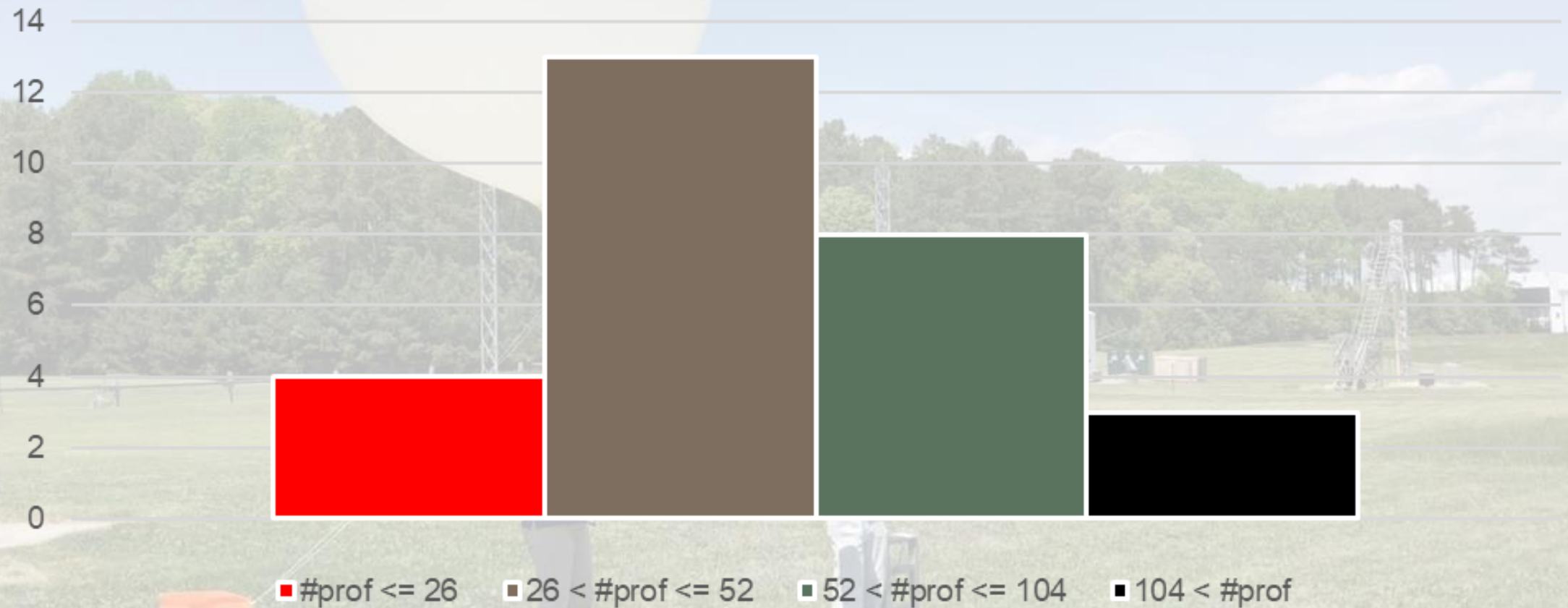
Year of recent data in DHF



Not Included: Lindenberg

2020-2021 Reporting Period Ozonesonde Data

Stations vs. number of O3 profiles on 2020 - 2021 period



Sonde WG Action Items

1. Lindenberg ozonesonde data is not archived.
 - Status: **Still No Data on Archive**
 - **Data upload expected in 2021. Will contact PI and determine if action outlined in Data Delinquency Protocol must be taken**
2. (and 3) Obtain metadata files from **Alert, De Bilt, Eureka, DDU, Ny Ålesund, and OHP.**
 - 2020 Update: De Bilt data is being re-analyzed and a new metadata file will accompany a new data set. New file has been promised in 2021 Site Report.
 - **Will follow up on De Bilt metadata after SC meeting**

Sonde WG Action Items (Aerosol Sondes)

5. R. Stübi contacted T. Deshler regarding interest in archiving aerosol sonde data in the NDACC DHF, or seeking NDACC affiliation. **Will update the SC as the conversation progresses**
6. Review Data Protocol Requirements, especially regarding aerosol sondes: R. Stübi has added ozonesonde updates to the sonde data protocol document. **We will add more information on aerosol sondes from discussions with T. Deshler, L. Kalnajs, and T. Thornberry**

COVID Impacts on Recent Data Collection

Fewer COVID-related impacts to data collection were noted in this reporting period:

- 1. Broadmeadows:** One profile missed in December 2020. Only minor COVID disruptions noted.
- 2. Wallops Island:** Four scheduled August 2020 and one September 2020 were cancelled due to COVID-19 restrictions. One March 2021 flight was cancelled due to low instrument inventory awaiting resupply procurement.
- 3. Natal:** 07/2020–10/2020; 04/2021. INPE closed facilities including the CRN Natal, Brazil, station due to the COVID-19 pandemic. As of the date of the report, facilities still have not fully reopened.
- 4. Samoa:** Some flights delayed due to closed borders. Back to nominal operations.

Discussion on Station PI Remarks

- 1. Scoresbysund** (N. Jepsen, DMI): “Meteo Modem has won the recent tender for supplying radiosondes to the DMI radiosounding stations. So sometimes during next year we’ll have to switch to use the Modem radiosonde and corresponding interface to do the ozone soundings. I’m not sure if this could present a problem. So far the data output from the system is not satisfactory.” => **contact OHP and La Réunion for experiences with Modem radiosondes**
- 2. Sodankylä** (R. Kivi, FMI): QC matters, homogenization of pre-flight preparation practices => **Communications with ASOPOS 2.0**
- 3. Hohenpeissenberg** (W. Steinbrecht, DWD): “Raw data archive at NDACC, to make sure data are preserved and future reprocessing is possible.” ***Is there a capability to archive raw data at NDACC?***

Other Miscellaneous Ozonesonde WG Items

1. **Desire to add hdf files to ozonesonde NDACC archive:**

- Is Ames file metadata in-line with ASOPOS 2.0 recommendations?
- Co-chairs will explore file conversion w/R. Querel and I. Boyd, and will be in touch with station PIs

2. **Ozonesonde WG webpage is out-of-date (http://www-das.uwyo.edu/~deshler/NDACC_O3Sondes/NDACC_O3sondes_WebPag.htm).**

Co-chairs will work on updating and finding new website host

3. **La Réunion**: F. Posny succeeded in 2021 by new PI Jérôme Brioude (Co-I Stéphanie Evan)

4. **Hohenpeissenberg**: New station Co-I Voltaire Velazco. PI remains Wolfgang Steinbrecht

ASOPOS 2.0 Progress (Sonde WG Meetings)

- Sonde WG meetings are essentially held within the Assessment of Standard Operating Procedures for OzoneSondes (ASOPOS) 2.0 Panel
- Ozonesonde WG Co-Chairs Stübi and Stauffer both members (plus new Co-Chair R. Van Malderen and previous Co-Chair B. Johnson)
- ASOPOS 2.0 to replace GAW No. 201 (Editors A. Thompson & H. Smit)
- Co-sponsorship by NDACC and IO₃C



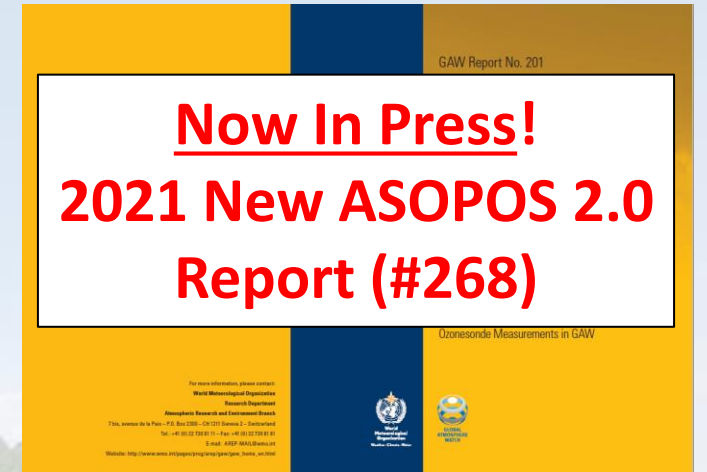
ASOPOS WMO/GAW Report no. 201



ASOPOS 2.0 in Brussels, Sep 2019

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- ASOPOS 2.0 to replace GAW No. 201 (Editors A. Thompson & H. Smit)
- Co-sponsorship by NDACC and IO₃C
- **Submitted to GAW Office in Summer 2021: Will be WMO/GAW Report no. 268. Stay tuned!**



ASOPOS WMO/GAW Report no. 201



ASOPOS 2.0 in Brussels, Sep 2019

ASOPOS 2.0 Report: Contents



“Ozonesonde Measurement Principles and Best Operational Practices”

Editors: H. G. J. Smit (FZ-Jülich) & A. M. Thompson (NASA/Goddard Space Flight Center)



Preface (WMO-GAW (Global Atmospheric Watch). Co-sponsored by IO3C, NDACC, GRUAN

Chapter 1 Introduction: Thompson, Smit, D. Kollonige

Chapter 2 Technical description of instrument: Smit

Chapter 3 Data Quality Objectives & Uncertainties: D. Tarasick, G. Morris, B. Johnson, R. Querel

Chapter 4 SOP's: Sonde Preparation, Operation, Data Archiving: R. Van Malderen, P. von der Gathen

Chapter 5 Data Quality Indicators (DQI's): H. Vömel & R. Stauffer

Annex-A Measurement Guidelines (MG's) (Handbook for Preparing & Launching O₃-sonde)

Annex-B MetaData

Annex-C Practical Guidelines for Determining Uncertainties

Annex-D Guidelines for Data Homogenization

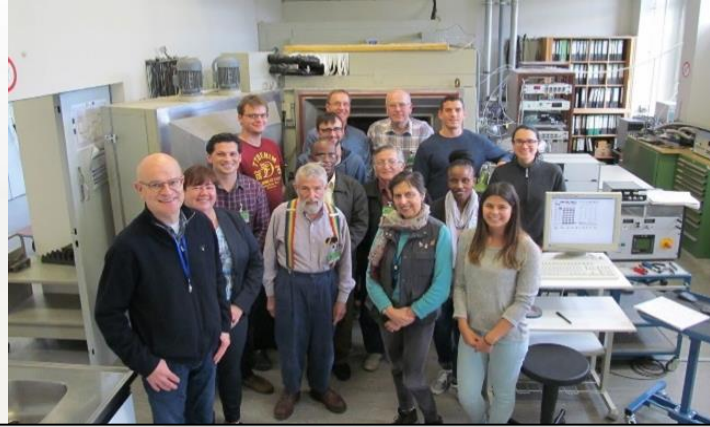
Annex-E Acronyms *Capacity-building & Inclusion – Ozonesonde Reviewers from 6 Continents*

Annex-F ASOPOS Panel & Reviewers: M. Cazorla, G. Coetzee, M. Fujiwara, S. Oltmans, W. Steinbrecht, M. Tully

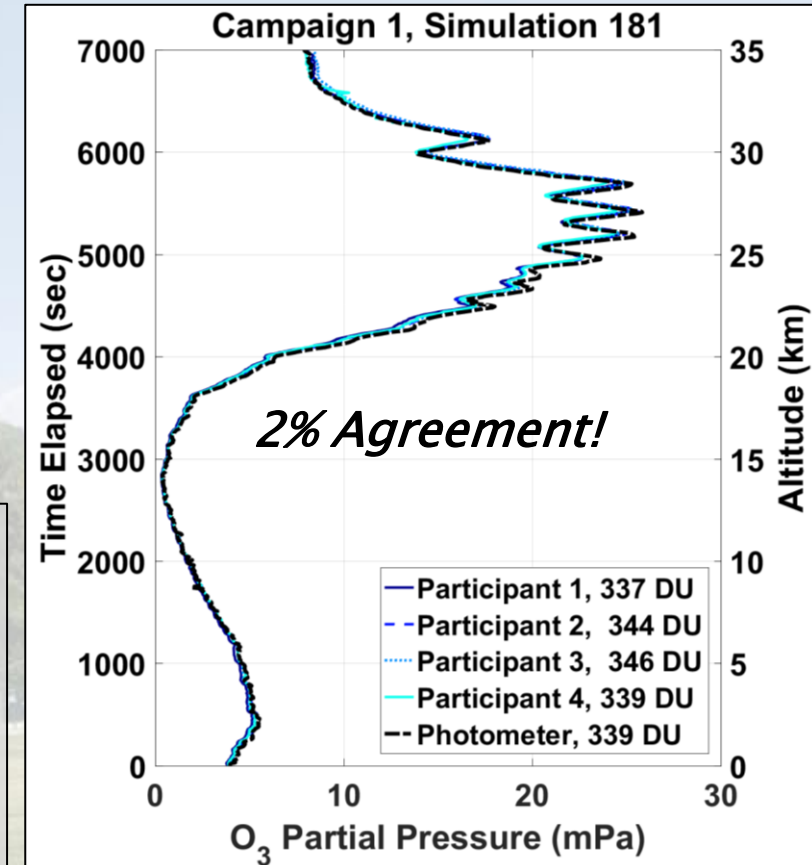
Role of WCCOS in ASOPOS 2.0: Traceability for O₃ sondes



WCCOS in Jülich, Germany



JOSIE-SHADOZ 2017 Campaign Participants



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

O₃ 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. New ASOPOS 2.0 is a handbook with SOPs and include info from JOSIE-SHADOZ 2017 experiment

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

(From Herman Smit) Then there is one more thing: The Future of CCL, WCC and QA/SAC for O₃S

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

1. Central Calibration Laboratory (CCL) for O₃S 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 a unique intercomparison and calibration experiment will become a collaboration between FZJ and KMI: Providing and Monitoring the O₃S calibration functions that are referenced to the OPM of the CCL/O₃S.

Parallel to the CCL/O₃S 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/O₃Ss at FZJ

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

WCC = World Calibration Center

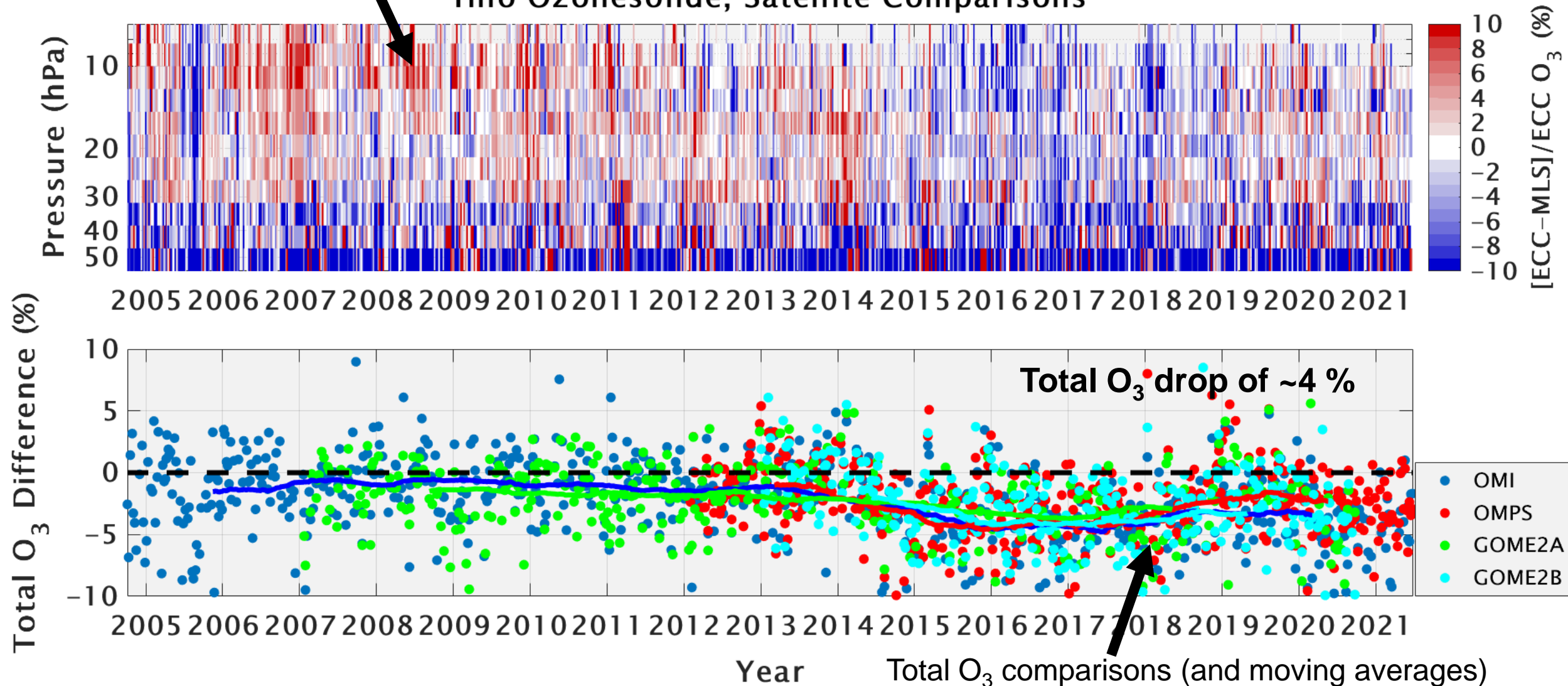
JOSIE = **WCC + CCL**

QA/SAC = Quality Assurance/Scientific Activity Center = ASOPOS and O₃S-DQA (= Homogenisation of data)

Data Quality Issues (Stratospheric O₃ Dropoff)

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

Hilo Ozonesonde, Satellite Comparisons



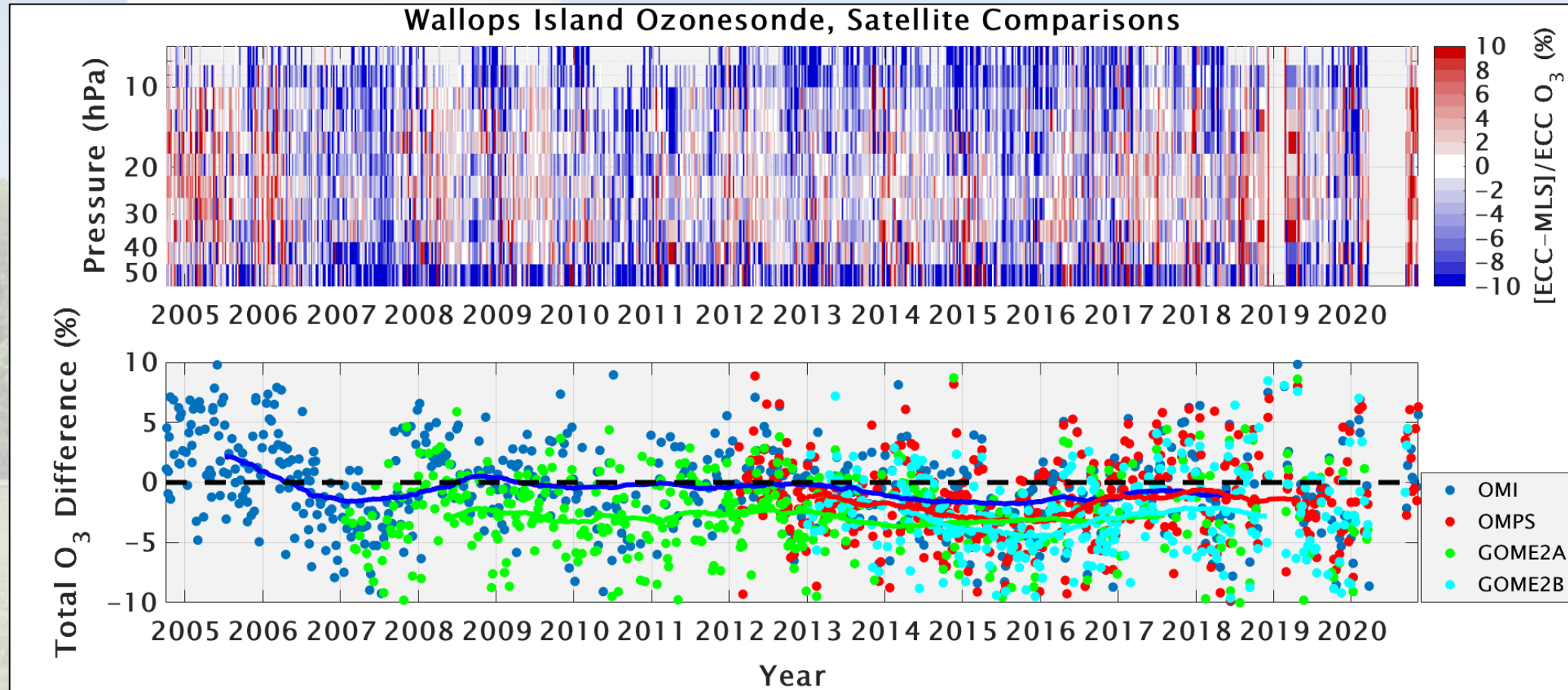
Data Quality Issues (Stratospheric O₃ Dropoff)

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 with stable ozonesonde time series shown here

Updates to Solving the “Dropoff”

- The dropoff affects only the EnSci ozonesonde (not Science Pump; SPC), but each ozonesonde type is subject to variations in production and performance (recent SPC high background currents)
- Dropoff occurs around EnSci serial number ~25500. We have found a change to the ion bridge construction near this production date
- Sites using a 1.0% KI, low buffer solution (Hilo and Samoa) are more affected than other solution types. The problem also appears to be dependent on delay between initial ozonesonde conditioning and launch – both are site-specific components

Thank You

Sonde Working Group Co-Chair Contact Info:

- Ryan Stauffer (O₃): ryan.m.stauffer@nasa.gov
- René Stübi (O₃): rene.stuebi@meteoswiss.ch
- Roeland Van Malderen (New O₃ Rep): roeland@meteo.be
- Dale Hurst (WV): dale.hurst@noaa.gov

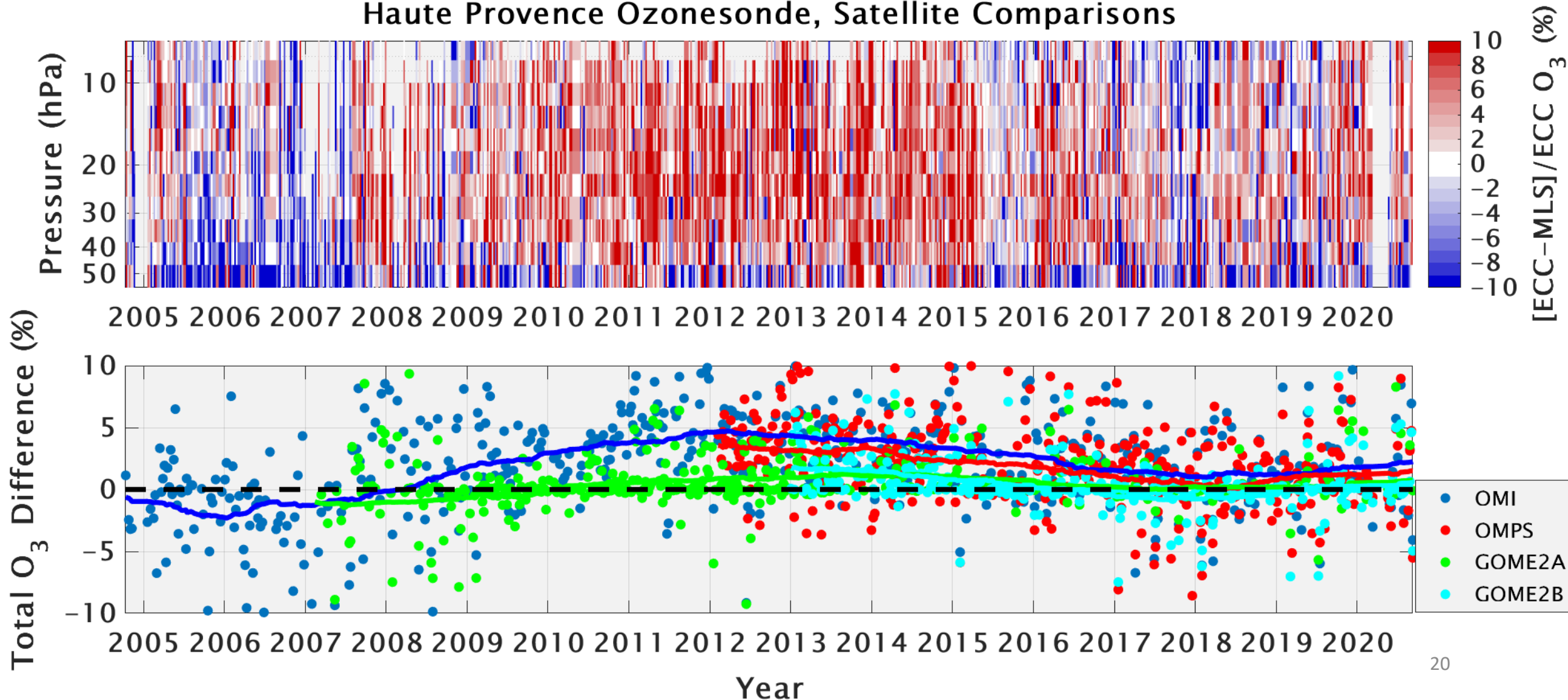
A large white balloon is being inflated in a grassy field. Two people are standing in the foreground, one holding the balloon's neck. In the background, there are several metal towers, a white building, and a line of trees under a blue sky with light clouds. The text "Extra Slides" is overlaid in the center of the image.

Extra Slides

Homogenization Improves Ozonesonde Time Series

Not Homogenized! These ozonesonde data were downloaded from NDACC in May 2021. Here I use the Ozone partial pressure data column in the files

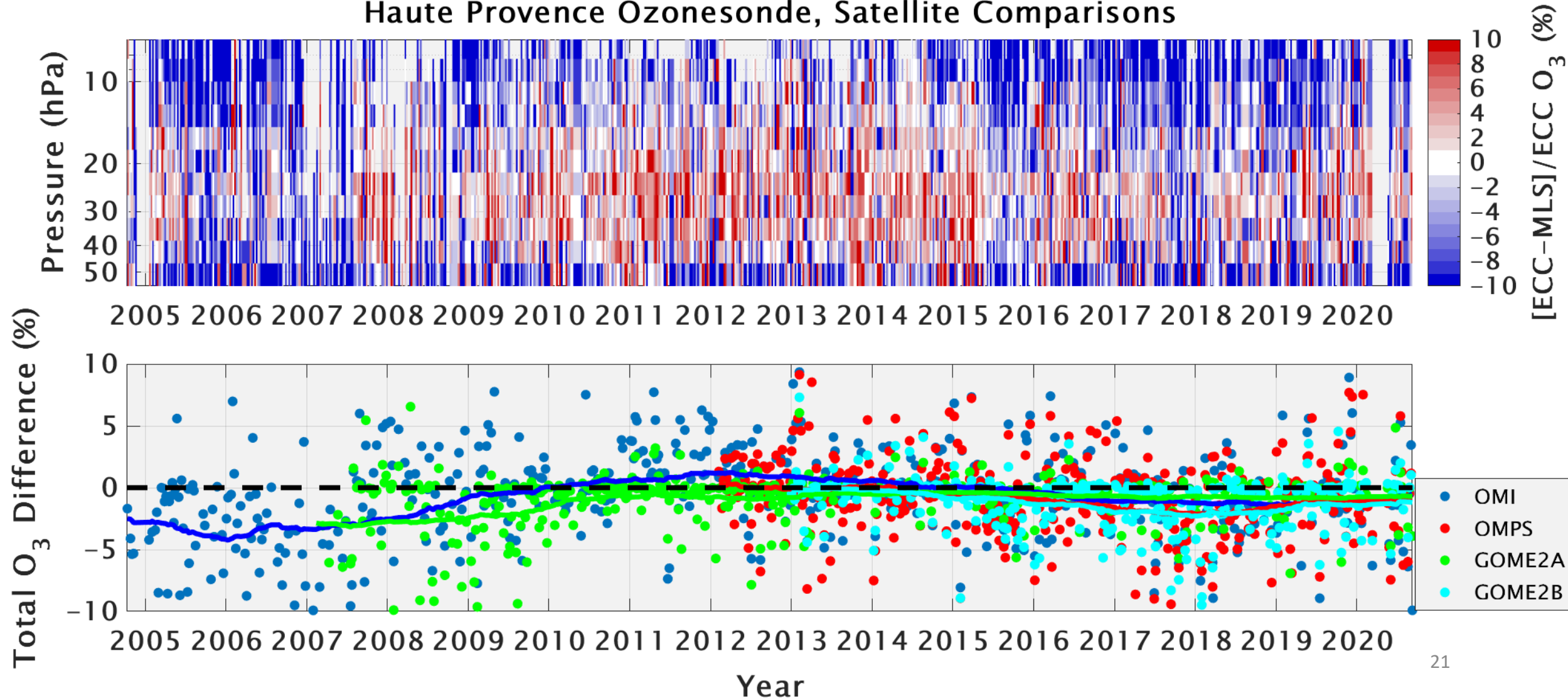
Haute Provence Ozonesonde, Satellite Comparisons



Homogenization Improves Ozonesonde Time Series

Homogenized Data! These ozonesonde data were downloaded from NDACC in May 2021. Here I use the Corrected Ozone partial pressure data column in the files

Haute Provence Ozonesonde, Satellite Comparisons

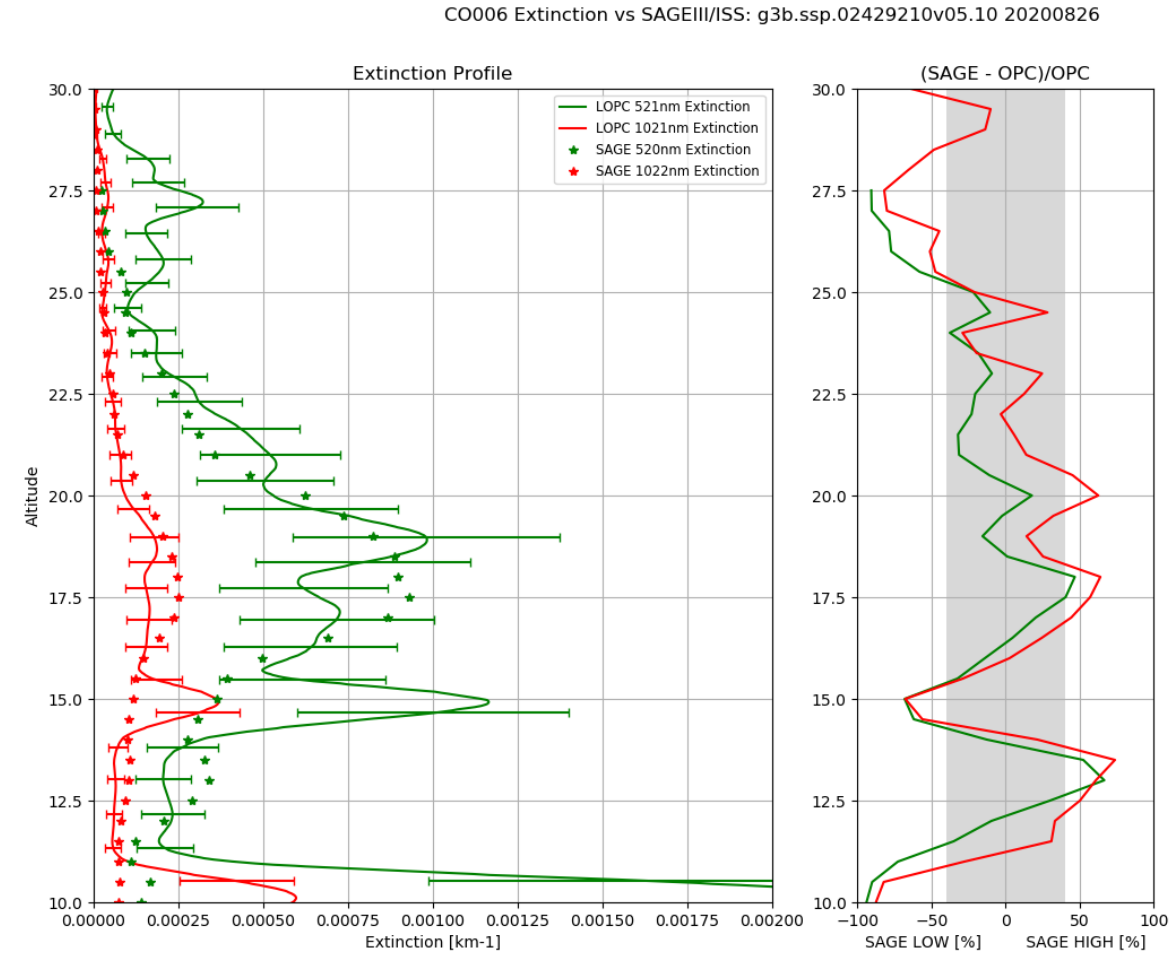


A large white balloon is being inflated in a grassy field. Two people are standing in the foreground, one holding the balloon's neck. In the background, there are several tall metal towers, a white building, and a clear blue sky. The scene is outdoors and appears to be a field station or research site.

Aerosol Sondes (slides from T. Deshler and L. Kalnajs, repeated from last year's SC Meeting presentation)

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?

New Publications Reported by Station PIs

- Tarasick, D.W., I. Galbally, O.R. Cooper, M.G. Schultz, G. Ancellet, T. LeBlanc, T.J. Wallington, J. Ziemke, X. Liu, M. Steinbacher, J. Stählerin, C. Vigouroux, J. Hannigan, O. García, G. Foret, P. Zanis, E. Weatherhead, I. Petropavlovskikh, H. Worden, J.L. Neu, M. Osman, J. Liu, M. Lin, M. Granados-Muñoz, A.M. Thompson, S.J. Oltmans, J. Cuesta, G. Dufour, V. Thouret, B. Hassler, A.M. Thompson and T. Trickl (2019), TOAR- Observations: Tropospheric ozone from 1877 to 2016, observed levels, trends and uncertainties, *Elem Sci Anth*, 7(1), p.39. DOI: <http://doi.org/10.1525/elementa.376>.
- Moeini, O., D.W. Tarasick, C.T. McElroy, J. Liu, M.K. Osman, A.M. Thompson, M. Parrington, P. Palmer, B. Johnson, S.J. Oltmans, and J. Merrill (2020), Estimating boreal fire-generated ozone over North America using ozonesonde profiles and a differential back trajectory technique, *Atmos. Environ. X.*, 7, 100078, <https://doi.org/10.1016/j.aeaoa.2020.100078>.
- Stauffer, R. M., Thompson, A. M., Kollonige, D. E., Witte, J. C., Tarasick, D. W., Davies, J., H. Vömel, G.A. Morris, R. Van Malderen, B.J. Johnson, R.R. Querel, H.B. Selkirk, R. Stübi, H.G.J. Smit (2020), A post-2013 dropoff in total ozone at a third of global ozonesonde stations: Electrochemical concentration cell instrument artifacts? *Geophysical Research Letters*, 47, e2019GL086791. <https://doi.org/10.1029/2019GL086791>
- Bourgeois, I., Peischl, J., Thompson, C. R., Aikin, K. C., Campos, T., Clark, H., Commane, R., Daube, B., Diskin, G. W., Elkins, J. W., Gao, R.-S., Gaudel, A., Hints, E. J., Johnson, B. J., Kivi, R., McKain, K., Moore, F. L., Parrish, D. D., Querel, R., Ray, E., Sánchez, R., Sweeney, C., Tarasick, D. W., Thompson, A. M., Thouret, V., Witte, J. C., Wofsy, S. C., and Ryerson, T. B. (2020), Global-scale distribution of ozone in the remote troposphere from the ATom and HIPPO airborne field missions, *Atmos. Chem. Phys.*, 20, 10611–10635, <https://doi.org/10.5194/acp-20-10611-2020>.
- Vömel, H., Smit, H. G. J., Tarasick, D., Johnson, B., Oltmans, S. J., Selkirk, H., Thompson, A. M., Stauffer, R. M., Witte, J. C., Davies, J., van Malderen, R., Morris, G. A., Nakano, T., and Stübi, R.: A new method to correct the electrochemical concentration cell (ECC) ozonesonde time response and its implications for “background current” and pump efficiency, *Atmos. Meas. Tech.*, 13, 5667–5680, <https://doi.org/10.5194/amt-13-5667-2020>, 2020.
- Wohltmann, I., P. von der Gathen, R. Lehmann, M. Maturilli, H. Deckelmann, G.L. Manney, J. Davies, D. Tarasick, N. Jepsen, R. Kivi, N. Lyall and M. Rex (2020), Near complete local reduction of Arctic stratospheric ozone by record chemical loss in spring 2020, *GRL*, 47, e2020GL089547. <https://doi.org/10.1029/2020GL089547>
- Yang, X., A-M. Blechschmidt, K. Bogner, A. McClure–Begley, S. Morris, I. Petropavlovskikh, A. Richter, H. Skov, K. Strong, D. Tarasick, T. Uttal, M. Vestenius, X. Zhao (2020), Pan-Arctic surface ozone: modelling vs measurements, *Atmos. Chem. Phys.*, 20, 15937–15967, <https://doi.org/10.5194/acp-20-15937-2020>.
- Tarasick, D.W., H.G.J. Smit, A.M. Thompson G.A. Morris, J.C. Witte, J. Davies, T. Nakano, R. van Malderen, R.M. Stauffer, T. Deshler, B.J. Johnson, R. Stübi, S.J. Oltmans and H. Vömel (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>.
- Griffiths, P.T., L.T. Murray, G. Zeng, Y.M. Shin, N.L. Abraham, A.T. Archibald, M. Deushi, L. Emmons, I.E. Galbally, B. Hassler, L.W. Horowitz, J. Keeble, J. Liu, O. Moeini, V. Naik, F.M. O’Connor, D. Tarasick, S. Tilmes, S.T. Turnock, O. Wild, P.J. Young and P. Zanis (2021), Tropospheric Ozone in CMIP6 Simulations, *Atmos. Chem. Phys.*, 21, 4187–4218, <https://doi.org/10.5194/acp-21-4187-2021>.

New Publications Reported by Station PIs 2

- Steinbrecht, W. J. Davies, D.W. Tarasick, P. von der Gathen, H. Deckelmann, N. Jepsen, R. Kivi, N. Lyall, M. Palm, J. Notholt, B. Kois, P. Oelsner, R. Dirksen, M. Allaart, A. Pieters, M. Gill, R. van Malderen, A. Del Cloo, P. Skrivankova, R. Süßmann, E. Mahieu, G. Romanens, R. Stübi, G. Ancellet, S. Godin-Beekmann, K. Strong, B. Johnson, P. Cullis, I. Petropavlovskikh, J. Hannigan, J. L. Hernandez, A. D. Rodriguez, T. Nakano, T. Leblanc, C. Torres, O. Garcia, M. Schneider, T. Blumenstock, M. Tully, N. Jones, R. Querel, D. Smale, S. Strahan, A. Inness, R. Engelen (2020), Unusually Low Ozone in the Free Troposphere throughout late Spring and Summer 2020 in the Northern Extratropics, *GRL*, 48, e2020GL091987. <https://doi.org/10.1029/2020GL091987>.
- Meng, L., J. Liu, D.W. Tarasick and Y. Li (2021), Biases of Global Tropopause Altitude Products in Reanalyses and Implications for Estimates of Tropospheric Column Ozone. *Atmosphere* 2021, 12, 417, <https://doi.org/10.3390/atmos12040417>.
- Wohltmann, I., P. von der Gathen, R. Lehmann, M. Maturilli, H. Deckelmann, G.L. Manney, J. Davies, D. Tarasick, N. Jepsen, R. Kivi, N. Lyall, M. Rex (2021), Chemical evolution of the exceptional Arctic stratospheric winter 2019/2020 compared to previous Arctic and Antarctic winters, *JGR*, accepted.
- Wilka, C., S. Solomon, D. Kinnison and D. Tarasick (2021), An Arctic Ozone Hole in 2020 If Not For the Montreal Protocol, *Atmos. Chem. Phys.* [preprint], <https://doi.org/10.5194/acp-2020-1297>, accepted.
- Chang, Kai-Lan, Owen R. Cooper, Audrey Gaudel, et al., Impact of the COVID-19 economic downturn on tropospheric ozone trends: an uncertainty weighted data synthesis for quantifying regional anomalies above western North America and Europe, submitted to *JGR*.
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New Publications Reported by Station PIs 3

- Kumar, P., J. Kuttippurath, P. von der Gathen, I. Petropavlovskikh, B. Johnson, A. McClure-Begley, P. Cristofanelli, P. Bonasoni, M. E. Barlasina, and R. Sanchez, The Increasing Surface Ozone and Tropospheric Ozone in Antarctica and Their Possible Drivers, *Environmental Science & Technology* 2021 55 (13), 8542-8553, doi:10.1021/acs.est.0c08491
- von der Gathen, P., Kivi, R., Wohltmann, I., Salawitch, R. J., and Rex, M., Climate change favours large seasonal loss of Arctic ozone, *Nature Communications*, 12, 3886 (2021). <https://doi.org/10.1038/s41467-021-24089-6>
- Wing R., Steinbrecht W., Godin-Beekmann S., McGee T. J., Sullivan J. T., Sumnicht G., Ancellet G., Hauchecorne A., Khaykin S., Keckhut P. Intercomparison and evaluation of ground- and satellite-based stratospheric ozone and temperature profiles above Observatoire de Haute-Provence during the Lidar Validation NDACC Experiment (LAVANDE) *Atmospheric Measurement Techniques*, European Geosciences Union, 2020, 13 (10), pp.5621-5642. (10.5194/amt-13-5621-2020)
- Van Malderen, R., De Muer, D., De Backer, H., Poyraz, D., Verstraeten, W. W., De Bock, V., Delcloo, A., Mangold, A., Laffineur, Q., Allaart, M., Fierens, F., and Thouret, V.: Fifty years of balloon-borne ozone profile measurements at Uccle, Belgium: a short history, the scientific relevance and the achievements in understanding the vertical ozone distribution, *Atmos. Chem. Phys.*, <https://doi.org/10.5194/acp-2020-724>, 2021.

Total of 23 publications reported by station PIs

QUALITY ASSURANCE RESEARCH: JOSIE-2017



OZONESONDE QUALITY ASSURANCE

The JOSIE-SHADOZ (2017) Experience

ANNE M. THOMPSON, HERMAN G. J. SMIT, JACQUELYN C. WITTE, RYAN M. STAUFFER, BRYAN J. JOHNSON, GARY MORRIS, PETER VON DER GATHEN, ROELAND VAN MALDEREN, JONATHAN DAVIES, ANKIE PITERS, MARC ALLAART, FRANÇOISE POSNY, RIGEL KIVI, PATRICK CULLIS, NGUYEN THI HOANG ANH, ERNESTO CORRALES, TSHIDI MACHININI, FRANCISCO R. DA SILVA, GEORGE PAIMAN, KENNEDY THIONG'O, ZAMUNA ZAINAL, GEORGE B. BROTHERS, KATHERINE R. WOLFF, TATSUMI NAKANO, RENE STÜBI, GONZAGUE ROMANENS, GERT J. R. COETZEE, JORGE A. DIAZ, SUKARNI MITRO, MAZ NORIZAN MOHAMAD, AND SHIN-YA OGINO

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2021 New
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ASOPOS 2.0
Assessment for
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OzoneSondes

JOSIE

Jülich OzoneSonde
Intercomparison Expt

2017-SHADOZ: QA-Operations

PHOTO. Capacity-Building

Publications on O3S Performance:

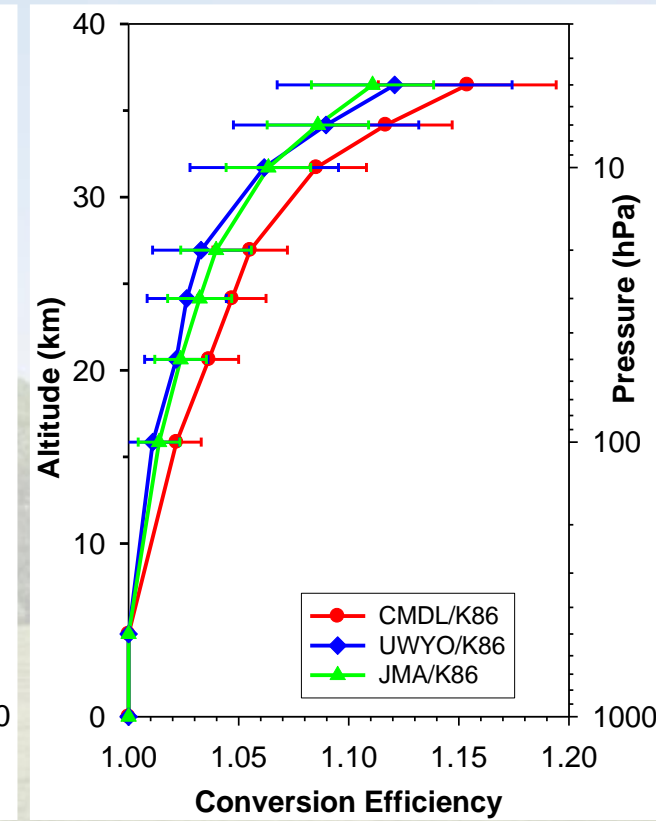
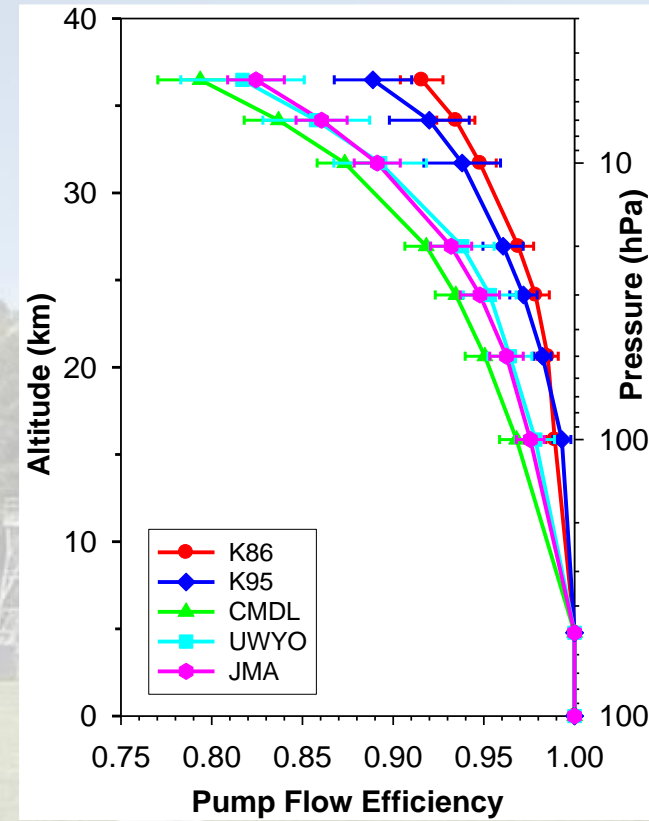
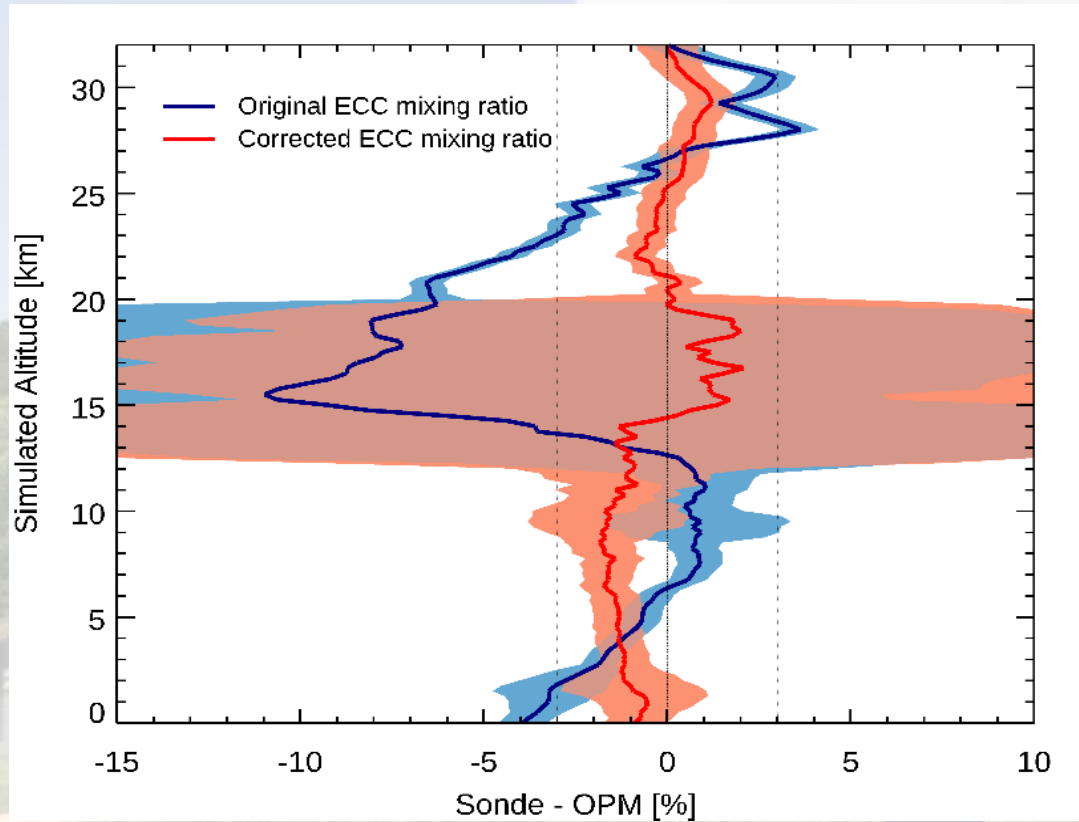
- JOSIE 2017-SHADOZ: Thompson et al., BAMS, 2019
- Uncertainty Budget: Tarasick et al., ESS, 2021
- Resolving fast and slow time response: Vömel et al., AMT, 2020
- TCO-Drop : Stauffer et al., GRL, 2020

Publications on Homogenization:

- Tarasick et al., AMT, 2016
- Van Malderen et al., AMT, 2016
- Witte et al., JGR 2017, 2018, 2019
- Thompson et al., JGR, 2017
- Deshler et al., AMT, 2017
- Sterling et al., AMT, 2018

Ten peer-reviewed publications are foundation of ASOPOS 2.0 Report

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/>

Pump correction tables are compensating for changing ozonesonde conversion efficiency in Tarasick et al. (2021):
<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019EA000914>

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) and Herman Smit (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) ³⁰