



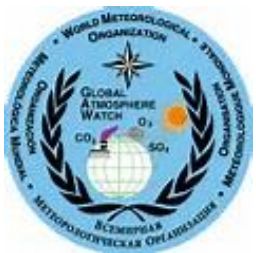
International Ozonesonde Activities

Anne Thompson

NASA/Goddard Space Flight Center, USA

Ozone Research Managers Meeting, Geneva

28 March 2017





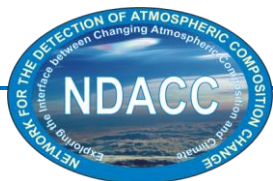
Four Dominant Themes of Sonde Activities (2014-2017)

- Regular interactions through workshops on networks & technical issues through NDACC, GRUAN, WMO-affiliated O3S-DQA, QOS, etc.
- **Major Data Re-processing underway since 2012. Complete (or nearly) at 30 of 60 stations. Next step: JOSIE-2017 for more “transfer functions”**
- On-going satellite validation & comparisons with ground-based ozone instruments.
- Data collection & archiving goals: Regular, “quality” soundings with timely data delivery to WOUDC.



Community Interactions on Networks, Techniques and Data Standards

- On-going: Sonde Working Group of NDACC active in O3S-DQA (“Ozonesonde Data Quality Assessment”) efforts to promote consensus-based Standard Operating Procedures (SOP) & data re-processing recommendations (WMO, 2012; 2014)
- 2016-2017: SHADOZ & GRUAN collaborated on Technical Document to certify ozonesondes for GRUAN (in draft with GRUAN WG).
- QOS-2016: O3S-DQA Workshop (35 attendees) evaluating re-processing progress, further needs

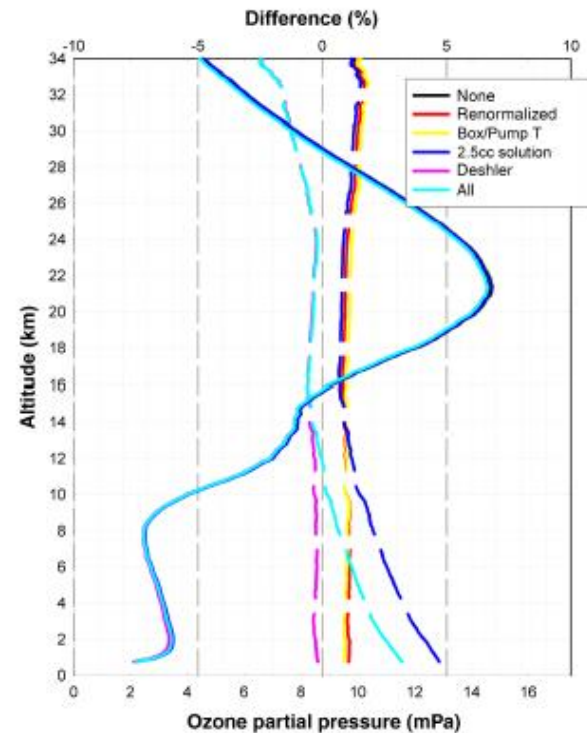


Re-Processing Progress (2015-2017).

1. Examples of Completed Studies

- Uccle, de Bilt: Van Malderen, Allaart et al., **AMT**, 2016
- Ten Canadian stations, D. W. Tarasick et al., **AMT**, 2016, shows changes to a decade of Edmonton soundings (2000-2009) and contributing factors.

Tarasick et al.: A re-evaluated Canadian ozonesonde record



Edmonton: reprocessed 2000-2009

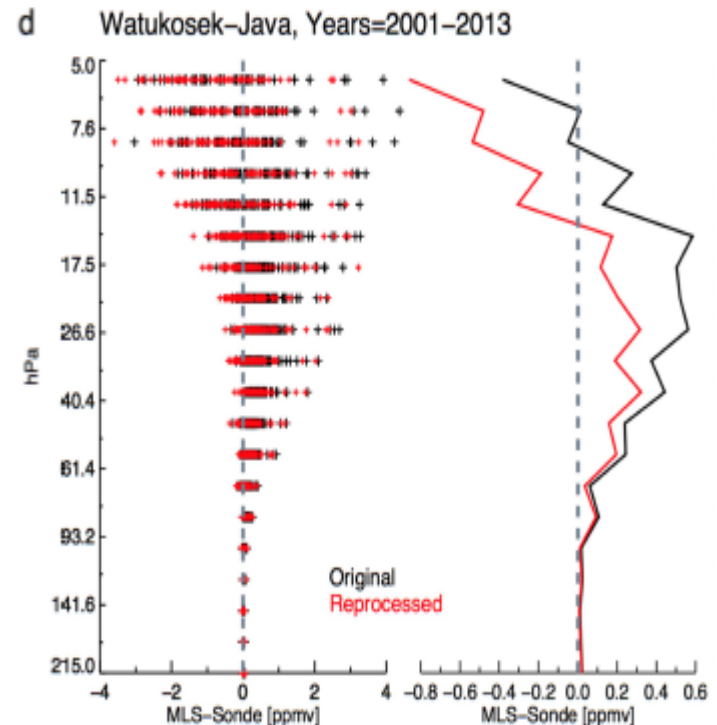
Figure 4. As Fig. 1 but for the 2000s. “Deshler” shows the average change introduced by the correction for the use of standard 1% KI solution in ENSCI sondes (Sect. 2.5). Overall changes to the record are minor.

Re-Processing Progress (2015-2017).

2. Datasets in Process*

- C. Sterling, B. Johnson et al., NOAA sites at Boulder, Samoa, Hilo, Fiji, in preparation, 2017
- J. Witte, A. Thompson et al., SHADOZ stations, **JGR**, in review, 2017.
- * General Ozone-sonde Uncertainties Paper. Smit, Tarasick, et al., **AMT**, in preparation, 2017.

- From Witte et al. “homogenized” Java data. MLS comparison





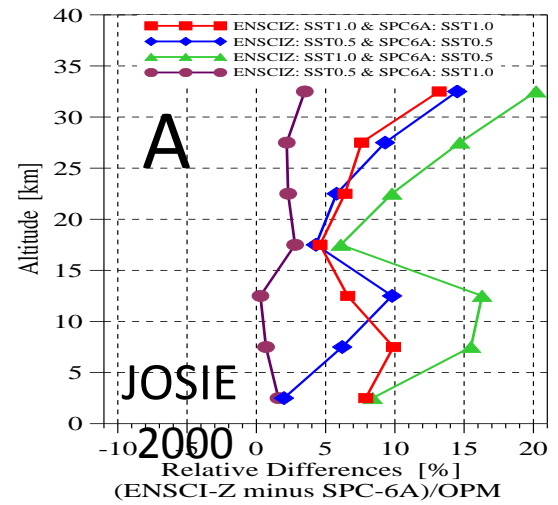
Re-Processing Progress (2015-2017).

3. Still Needed – Transfer Functions for Untested Sensing Solution – Instrument Combinations

- JOSIE compares four sondes employing different sensing solutions-instrument type combinations in World Calibration Centre for Ozonesondes in Jülich. JOSIE = Jülich Ozonesonde Inter-comparison Experiment
- JOSIE-2017 will test combinations listed **next slide**, representing all current ECC operational systems



JOSIE CHAMBER ABOVE.
JOSIE-2000 RESULTS BELOW

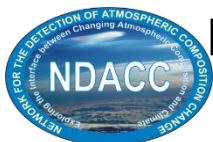




“Transfer Function” Permits Technique-Independent Construction of a Station Time-series

Station	Solution(s) *= Current	ECC
Ascension	1% Full Buffer, 0.5% Half Buffer*	SPC, ENSCI*
Costa Rica (various loc)	0.5% Half Buffer, 1% 1/10 th *	ENSCI
Fiji (Suva)	1% Full Buffer, 2% Unbuffered, 1% 1/10 th Buffer*	ENSCI
Hanoi	1% Full Buffer, 2% Unbuffered, 1% 1/10 th Buffer 0.5% Half Buffer*	SPC, ENSCI*
Hilo	2% Unbuffered, 1% 1/10 th Buffer*	ENSCI
Irene	1% Full Buffer	SPC
Kuala Lumpur	1% Full Buffer , 0.5% Half Buffer*	SPC, ENSCI*
Lauder	0.5% Half Buffer	ENSCI
Nairobi	1% Full Buffer	ENSCI
Natal	1% Full Buffer	ENSCI, SPC*
Paramaribo	1% Full Buffer	SPC
Reunion	0.5% Half Buffer	SPC, ENSCI*
Samoa (Pago Pago)	1% Full Buffer, 2% Unbuffered, 1% 1/10 th Buffer*	ENSCI
San Cristobal	2% Unbuffered, 1% 1/10 th Buffer*	ENSCI
Watakosek-Java	2% Unbuffered	ENSCI

- Combinations listed are used in SHADOZ; also represent all current ECC operational systems





JOSIE-2017 Configuration Proposed with Tropical Site Capacity Building. Each Group in One Session, 9-20 Oct. or 23 Oct-3 Nov 2017



	SHADOZ sites represented	Radiosonde / ECC / Solution	Station PI/Data Provider
1	Reunion	MODEM / ENSCI / 0.5%	F. Posny (CNRS)
2	Natal, Punta Arenas	LMS / SPC / 1%	E. T. Northam (Wallops) Claudio Casiccia (UMAG)
3	Irene, Paramaribo	Vaisala / SPC / 1%	GJR Coetzee (SAWS) A. Piters & M. Allaart (KNMI)
4	Costa Rica, Fiji, Samoa, San Cristobal, Hilo	IMET / ENSCI / 1% 1/10 th & 2% Unbuffered	R. Selkirk (USRA) B. Johnson (NOAA)
5	Nairobi	Vaisala / ENSCI / 1%	R. Stuebi (MeteoSwiss)
6	Hanoi, Lauder	Vaisala / ENSCI / 0.5%	Shin-Ya Ogino (JAMSTEC), R. Querel (NIWA)
7	Ascension	IMET / ENSCI / 0.5%	A.M. Thompson (NASA)
8	Kuala Lumpur	Changfeng / ENSCI / 0.5%	Maznorizan Mohamad (MMD)

Support Requested (8 total)**

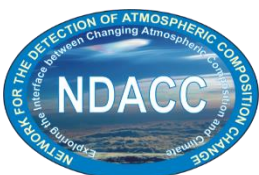
Cassicia or DaSilva

Coetzee, 1 MDS (Paiman)

Corrales (CR), 1 Fiji Or San Cristobal

Shalenje (KMD)
1 AMO (Hanoi)

1 MMD (KL)

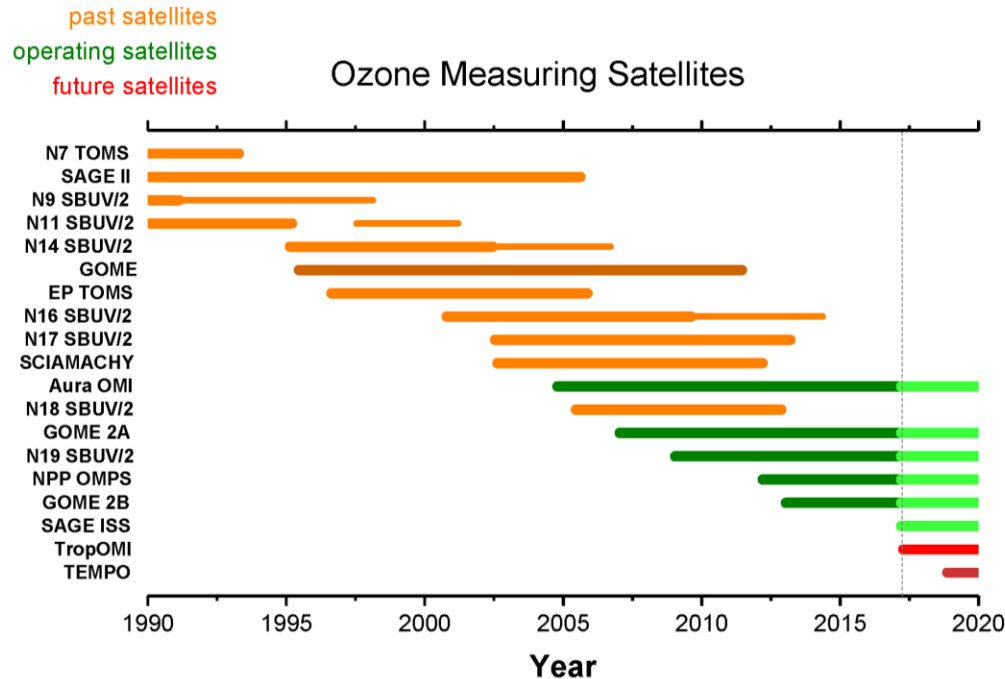


** Proposed to Vienna Convention Trust Fund for Travel.
Balance of JOSIE expenses cost-share with FZ-Jülich, NASA, NOAA





Sonde Support of Growing Ozone Satellite Fleet. Latest – ISS-SAGE III. TropOMI Coming Up! (Figure, R. McPeters, NASA)

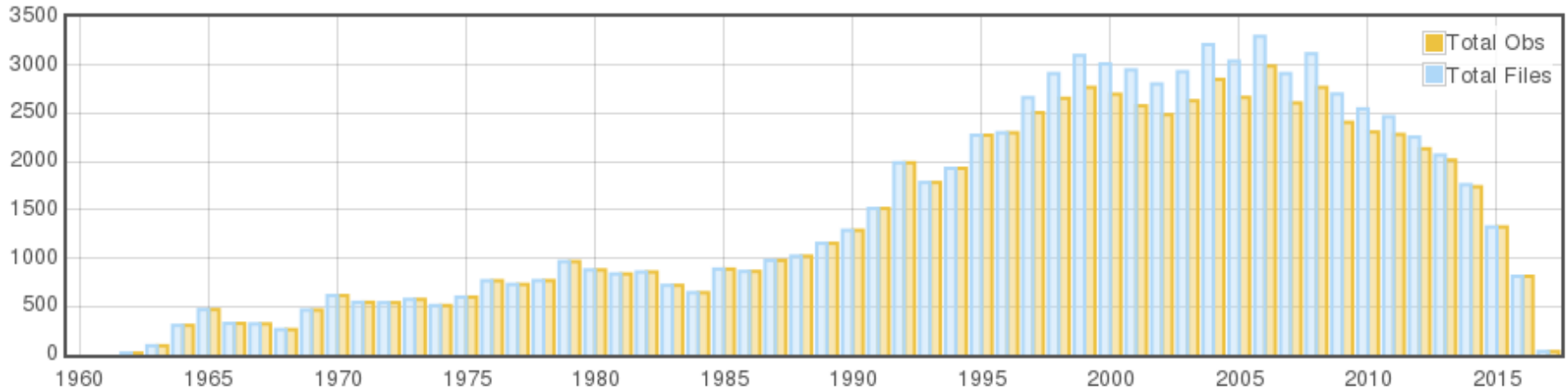


- Hubert et al. (*AMT*, 2016) uses 72 sounding station data for limb-sounding “drift” detection. Presses for re-processing to 5% uncertainty or better. Similar requirement for SPARC LOTUS activity (mid-low stratospheric ozone trends)



Data Collection & Archiving Activities

Data Distribution For: OzoneSonde



Total Observations in Range: 78009

Save Graph

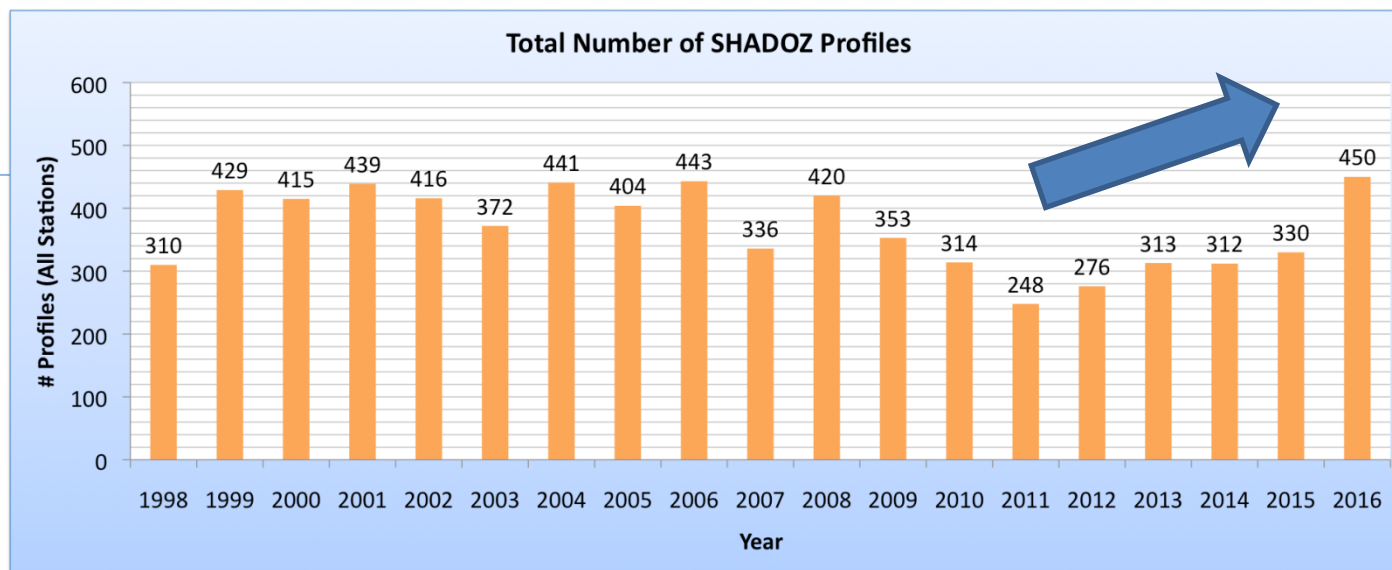
- From woudc.org, Chart is total record from 1960 to 2017
- Global ozonesonde profiles records summary. Note that 2015-2016 may still have data undelivered, but a decline to fewer than 2000 profiles/year seems the “new normal” compared to 2500 profiles/yr a decade ago.
- Why are there so few sondes? Fewer stations? Less frequent? Fewer campaigns? (NASA-NOAA-Environ. Canada collected up to 700 profiles/yr on 5 campaigns from 2004-2011)



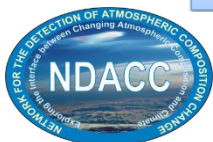
Example of “International Activities” for SHADOZ, 2015-2017



- Active in NDACC and now affiliated with GRUAN. Ozonesondes in GRUAN Technical Report to be released (J. Witte et al., 2017)
- O3S-DQA. (1) First major Re-processing of SHADOZ profiles. V 6.0 release in 2017. (2) Documenting publications in process (3) Adoption of Protocols for Standard Meta-data via “Checkout List”
- **THANKS TO GSFC, NOAA, WFF** – more data collected with visits, training.



> 450
sondes
for 2016!



Data transmit -> WOUDC, with NDACC, AVDC links.
2017 > 7000 P-T-U & O₃ profile sets





Summary of International Ozonesonde Activities – Status 2017



- Ozonesonde Community has made great advances in data re-processing to address the range of instrument types & KI solution recipes used in the electrochemical concentration cell instrument across stations globally and within single stations over decades of operations.
 - Publications document process, more in preparation
 - Yet to come: JOSIE-2017 for additional “transfer functions”
 - Still to address: Radiosonde changes – propagation to affect ozone can be significant in mid-stratosphere
- Ozonesonde “experts” fully engaged in:
 - Connecting and expanding network affiliations
 - Trends and related analysis with modelers, etc
- Everyone wants sonde data – high usage statistics, endless requests. Central archives provide ready access to records.



Special to Ozone Research Managers

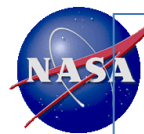
- Please support ozonesondes and engage your scientists in activities of the international community.
 - Opportunities to learn and for training
 - Opportunities to share knowledge
- AMT thanks sponsors (NASA, NOAA) and collaborators from more than 15 institutions for SHADOZ
- Thank you for Attention!



Extras on SHADOZ DETAILS & JOSIE-2017



- Note that 10 of 14 SHADOZ stations have a Dobson or Brewer but we need help getting the data. Not all Brewer data in WOUDC.
- JOSIE-2017 slides self-explanatory

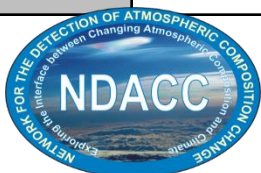


SHADOZ Connections. Note 10 Dobsons/ Brewers/SAOZ of 14 Stations



Topic of Study	Station*	Co-I/Sponsor**	SHADOZ start yr	Site start year	Network affiliation **	Ancillary data	Nominal profiles/yr	Other profiles (#/year)
Long-term Validation / Trends (Data available prior to 1995)	Kuala Lumpur	Maz. bt Mohamad, & Z Zainul, Malaysian Met., S. Yonemura, Japan	1998	1992		Brewer	26	
	Watukosek	Ni. Komala, LAPAN & M. Fujiwara, Hokkaido Univ.	1998	1998	SOWER	Brewer	26	CFH (campaign)
	Am. Samoa	B Johnson, P Cullis, C. Sterling, NOAA	1998	1986	NDACC / GAW	Dobson / surface CO2, CH4, CO, CFCs, O3	52	
	Natal	E T Northam, C Ashburn, F Bliven, NASA/WFF; F Raimundo Silva, INPE	1998	1979	NDACC	Brewer	52	
	Hilo	B. Johnson, D. Hurst, NOAA	1998	1982	NDACC / GAW	MLO: Dobson, FTIR, O3 lidar, surface CO2, CH4, CO, CFCs, O3	52	FPH-WV (12)
	Irene	G.J.R. Coetzee, S. African Weather Serv.	1999	1990		Dobson	26	
	La Reunion	Françoise Posny, Univ. Réunion/CNRS	1998	1998	NDACC	SAOZ, O3 Lidar	26	
Processes in the FT, TTL, and LS	Fiji	B. Johnson, NOAA; M Makite, USP	1998	1997			26	
	San Jose***	H B Selkirk, NASA/GSFC, G Morris & Holger Vömel; J. Andres Diaz (UCR)	2006	2006	NDACC	Surface O3, SO2	36	CFH (12); SO2 (12)
	San Cristobal	J. Parades & INAMHI. B. Johnson (NOAA); Thx to M Cazorla - USFQ	1999	1998	GRUAN / SOWER		52	CFH (campaign)
	Paramaribo	A. Piters, M. Allaart, KNMI; Surinam Met. S. Sallons, G Paimon	1999	1999	NDACC	Brewer	52	
	Ascension Is.	A. M. Thompson, GSFC, w/ USAF	1998	1990	NOAA/GMD	Surface O3 CO2, CH4, CO, CFCs	52	
	Nairobi	R Stuebi, G Levrat, MeteoSwiss & John Nguyo, KMD	1999	1996		Dobson, surface O3	52	
	Ha Noi	H. Gia Hiep, AMO, S. Ogino, JAMSTEC, M. Fujiwara, Hokkaido U., M. Shiotani, RISH	2005	2004	SOWER	Brewer	26	CFH (campaign)

- Colors for stations indicate geographic region: blue-Western Pacific, rose-Atlantic/Africa, & lavender-Equatorial Americas. White = subtropics
- *** Station formerly referred to as Alajuela / Heredia



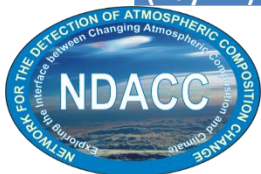


SHADOZ JOSIE-2017 Session Schedule for 2 Weeks.

Session 1 – 9-20 Oct. Session 2 – 23 Oct- 3 Nov. 2017



Day	Lecture	Tutorial	Activity
Sunday (Day#01)			Arrival
Monday (Day#02)	Principles of an ozone sounding		Installation Ground Equipment 3-5 days preparation of O3S
Tuesday (Day#03)	Standard Operating Procedures (SOPs)	Preparation of an ozone sonde in practice	Test of O3S-simulation run
Wednesday (Day#04)	Post-flight data processing	Post-flight data processing in practice	First O3S simulation run Evaluation of first results
Thursday (Day#05)	Chemistry of O3+KI		Two O3S simulation runs
Friday (Day#06)	Pumpflow efficiency		Two O3S simulation runs
Saturday (Day#07)	Uncertainty analysis	Uncertainty analysis in practice	
Sunday (Day#08)			Sight seeing
Monday (Day#09)	Radiosonde-PTU & GPS/Wind/Altitude		Mid-term evaluation meeting on the results of O3S
Tuesday (Day#10)	Background current		Two O3S simulation runs
Wednesday (Day#11)	Total ozone column/normalisation		Two O3S simulation runs
Thursday (Day#12)	QA/QC-evaluation	QA/QC-evaluation in practice	Last O3S simulation run
Friday (Day#13)			Final evaluation meeting Packing
Saturday (Day#14)			Departure

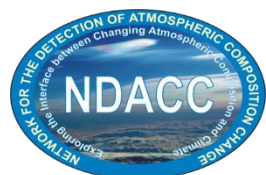




SHADOZ Radiosonde Types



Station	Radiosonde * = Current
Ascension	LMS, IMET*
Costa Rica (various loc)	Vaisala/Strato
Fiji (Suva)	Vaisala/Strato, IMET*
Hanoi	MEISEI, Vaisala/Strato, Vaisala*
Hilo	Strato/Vaisala, IMET*
Irene	Vaisala
Kuala Lumpur	Vaisala, MODEM, ChangFeng*
Lauder	Vaisala
Nairobi	Vaisala
Natal	LMS
Paramaribo	Vaisala
Reunion	Vaisala/Strato, MODEM*
Samoa (Pago Pago)	Vaisala/Strato, IMET*
San Cristobal	Vaisala/Strato, Vaisala*
Watakosek-Java	MEISEI, Strato/Vaisala*



LMS = Lockheed Martin Sippican

Strato = NOAA/H. Vömel Processing Software.

NOAA/SkySonde has replaced Strato. for IMETs except for CR.





Proposed JOSIE-2017 Coach/Referees Team

Coaches 2x2weeks:

1. Bryan Johnson (NOAA)
2. Anne Thompson (NASA)
3. Rene Stuebi (MeteoSwiss)
4. Jacquelyn Witte (SSAI/NASA)

Referees:

1. Jonathan Davies (EC)
2. Roeland van Malderen (IRM)
3. Peter von der Gathen (AWI)

Alternate Coaches/Referees

1. Gary Morris (St. Edwards U.)
2. Rigel Kivi (FMI)
3. Masatomo Fujiwara (Hokkaido U.)

JOSIE-2017: Two Groups each work two weeks 9-20 Oct 2017 (4 Types/stations)
or 23 Oct – 3 Nov 2017 (4 Types/stations)

Followup Participant Workshop: First Half of 2018

Handbook and Protocol for JOSIE-2017 to follow JOSIE-2000:

http://www.fz-juelich.de/iek/iek-8/EN/Expertise/Infrastructure/JOSIE/JOSIE_node.html

