Out of the SHADOZ:
Impacts and uncertainties of ozonesonde reprocessing

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NOAA GMAC: 23-24 May, 2017

Road Map

1. What/Why of Ozonesondes
2. SHADOZ intro
3. Objective
4. Motivation
5. Methods
6. Results
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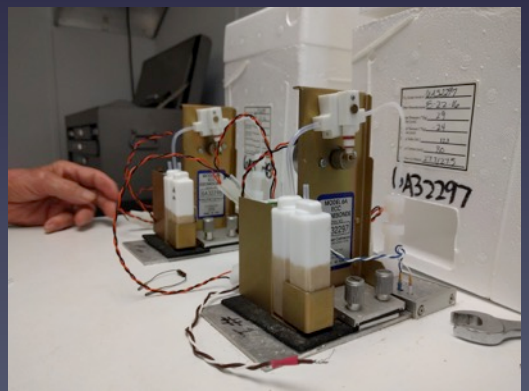
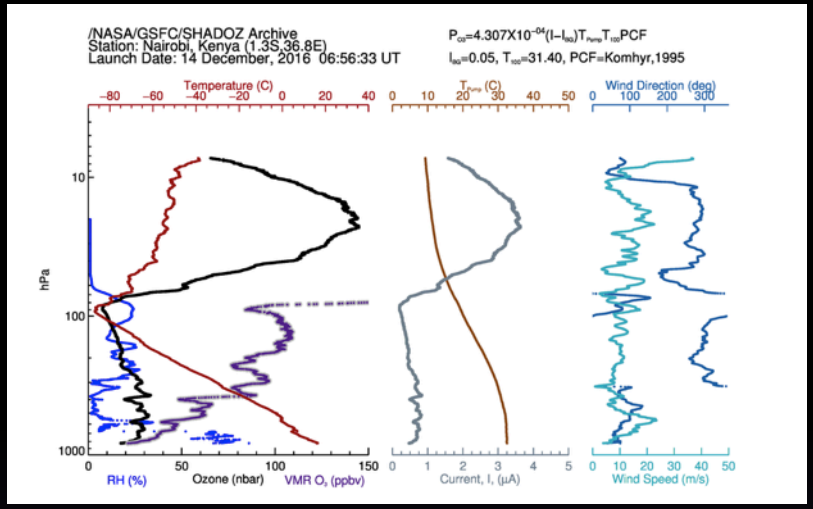
8. Key Points

What: Ozonesondes 101

- Light-weight, balloon-borne instruments
  - (usually flown once) that measure O3 and are interfaced with a radiosonde for P-T-U, GPS+.
- Developed in the 1960's by Walter Komhyr and operationally flown in the 1970's.
- ECC type ozonesondes = Electrochemical Concentration Cell sondes.
  - Measures the current resulting from the release of electrons as ozone reacts with the potassium iodide (KI) solution.



More Ozonesonde Goodness



- High vertical resolution ~150m.
- Captures features in measurement-deficient regions of the atmosphere: boundary layer, UT/LS, in the case of SHADOZ – QBO/ENSO.
- *"Neither snow, nor rain, nor heat, nor gloom of night, stays these couriers from the swift completion of their appointed rounds."* - *Herodotus, 503 B.C. (Inscribed on the General Post Office facility in New York City.) (Source: USPS)*

SHADOZ = Southern Hemisphere Additional Ozonesondes

- PI: Anne M. Thompson (NASA/GSFC)
- Main archive of ozonesonde profile data in sub/tropical and remote locations.
- 1998-present. Currently > 7000 profiles.
- Open access primary source:
  - https://tropo.gsfc.nasa.gov/shadoz

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Objective

Homogenize the SHADOZ data records

- There are inhomogeneities in the ozonesonde ozone data records due to changes in
  1. Operating procedures
  2. ECC manufacturer/Solution
  3. Ozonesonde/radiosonde system

- Ozonesonde measurements are sensitive to these changes.
- We can easily observe the discrepancies in a given records time series due to one or a combination of these changes.

In the SHADOZ Era

7 ECC/Solution pairs used

1. SPC / 1% Full buffer
2. ENSCI / 0.5% Half buffer

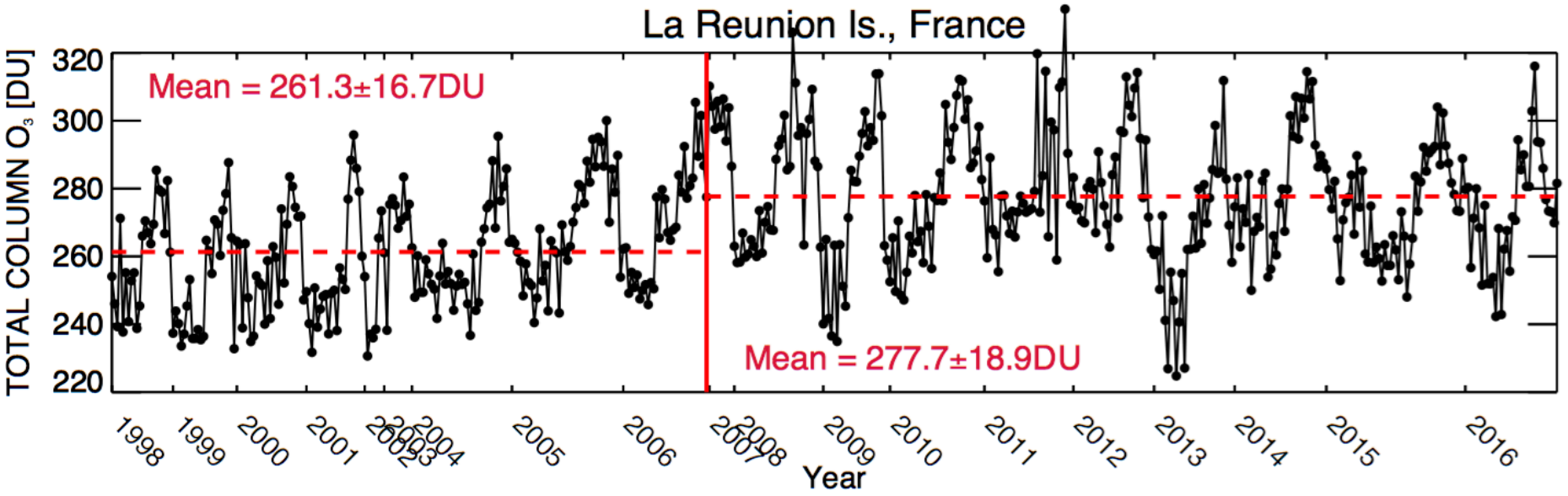
WMO recommended standards

3. SPC / 0.5% Half buffer
4. ENSCI / 1% Full buffer
5. ENSCI / 2% Unbuffered
6. ENSCI / 1%, 1/10th buffer
7. ENSCI / 0.5% Full Buffer

6 Radiosonde/Ozonesonde Systems:

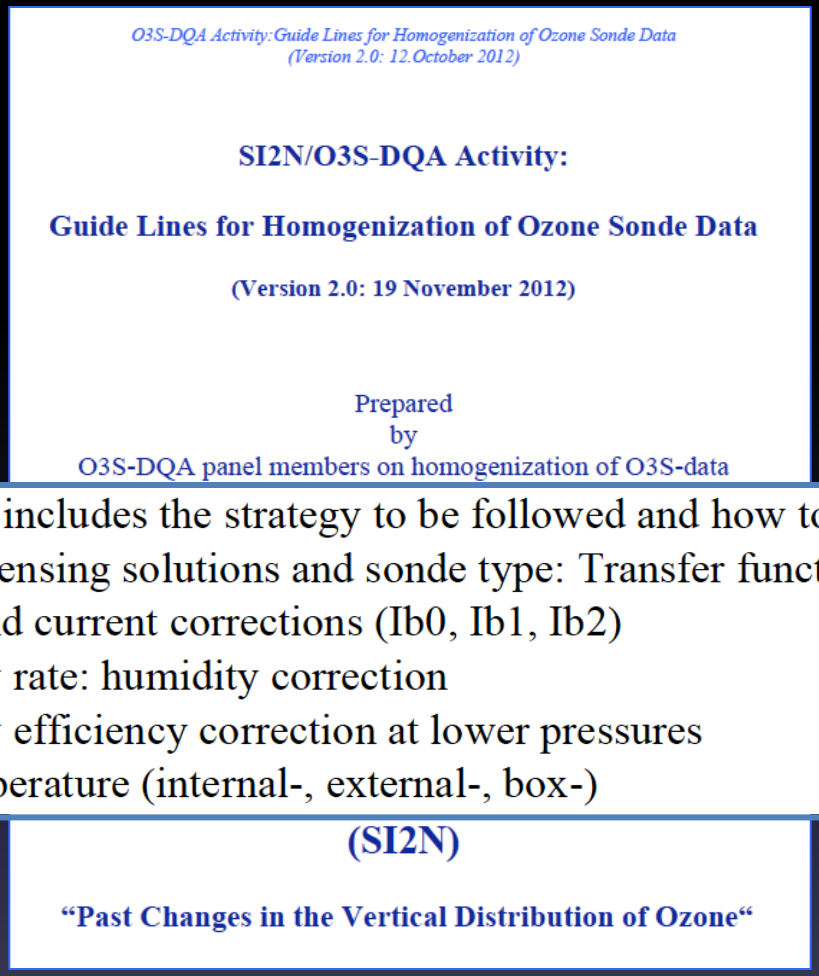
- 3 Long-term (Since 1990's)
  I. Vaisala
  II. MODEM
  III. Lockheed Martin Sippican (LMS)
- 1 Mid-term (since mid-2000)
  I. IMET
- 2 Short-term (Since 2014)
  I. ChangFeng
  II. Graw

Motivation



- 2007 – Change in solution! From WMO Standard 0.5% HALF buffer to the non-standard 0.5% FULL buffer.

Method: The ozonesonde reprocessing bible



O3S-DQA Activity: Guide Lines for Homogenization of Ozone Sonde Data
(Version 2.0: 12.October 2012)

SI2N/O3S-DQA Activity:

Guide Lines for Homogenization of Ozone Sonde Data

(Version 2.0: 19 November 2012)

Prepared
by
O3S-DQA panel members on homogenization of O3S-data

These guidelines includes the strategy to be followed and how to deal/correct for :

- Different sensing solutions and sonde type: Transfer functions
- Background current corrections (Ib0, Ib1, Ib2)
- Pump flow rate: humidity correction
- Pump flow efficiency correction at lower pressures
- Pump temperature (internal-, external-, box-)

(SI2N)

"Past Changes in the Vertical Distribution of Ozone"

WMO

GLOBAL ATMOSPHERE WATCH

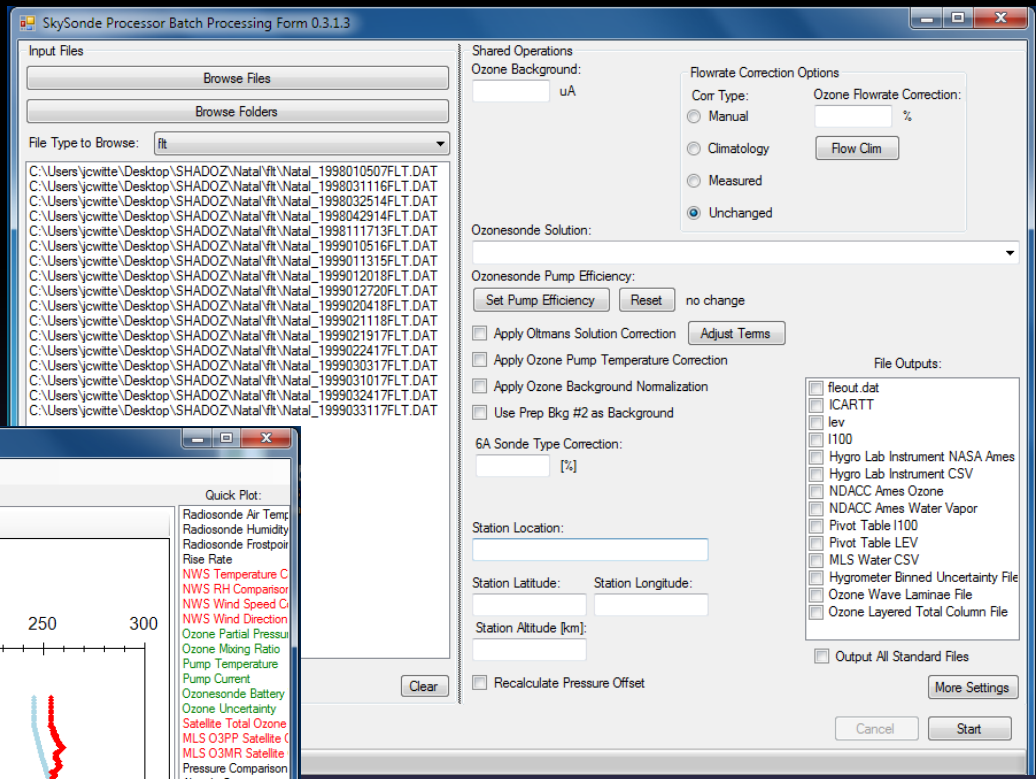
NDACC

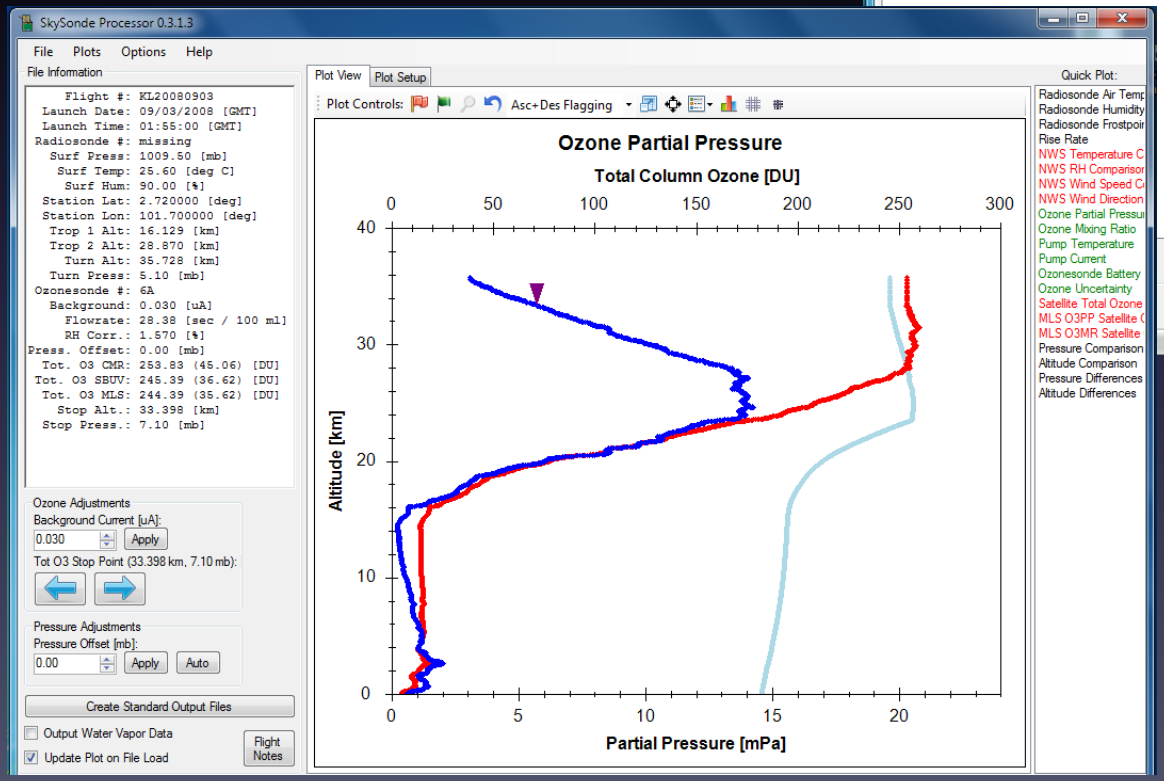
SPARC
Stratosphere-troposphere Processes And their Role in Climate

http://www-das.uwyo.edu/%7Edeshler/NDACC_O3Sondes/NDACC_O3sondes_WebPag.htm

Method: Skysonde Reprocessing Tools

Creator: Allen Jordan
NOAA/ESRL/GMD





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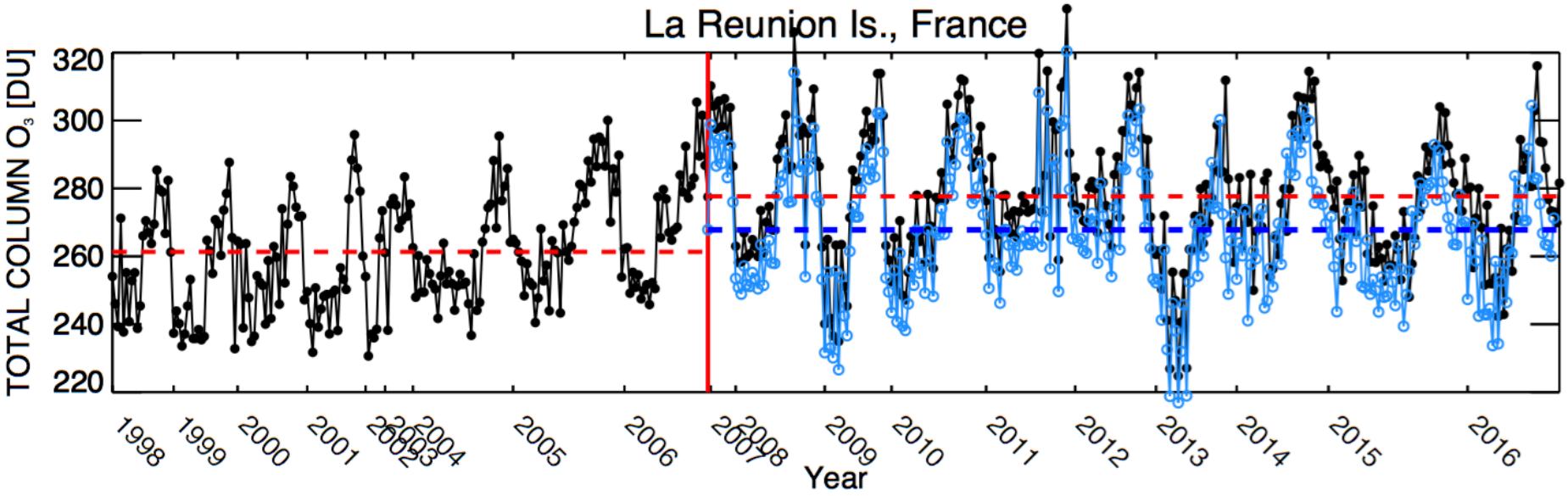
Results: Reunion revisited



261.3 ± 16.7 DU

277.7 ± 18.9 DU

267.8 ± 18.2 DU

Recall: Y2007 - Change in solution recipe.

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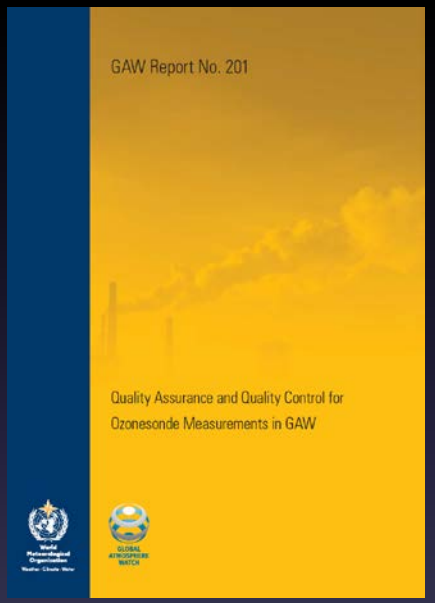
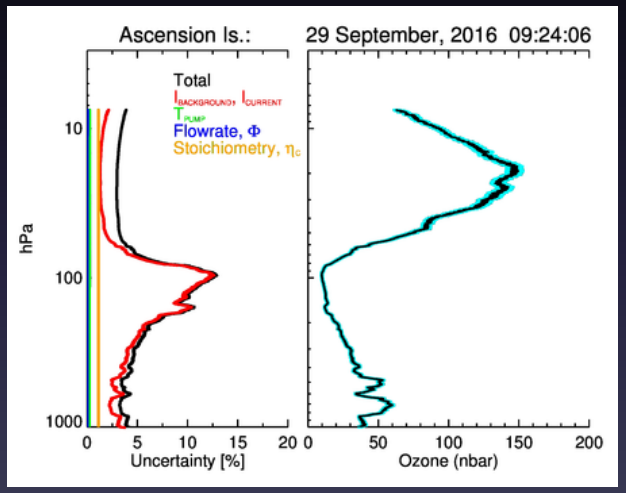
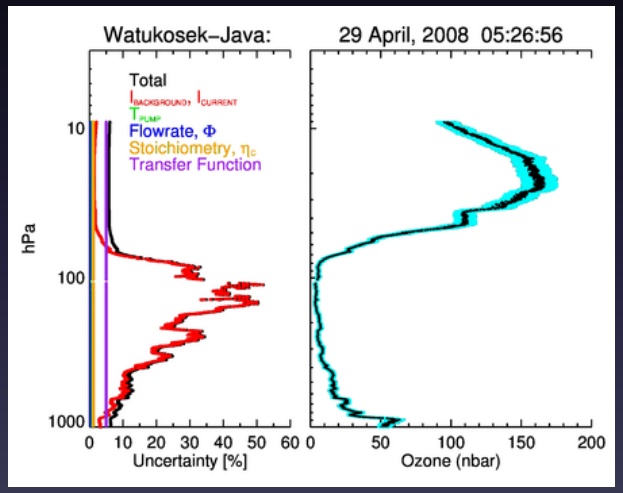
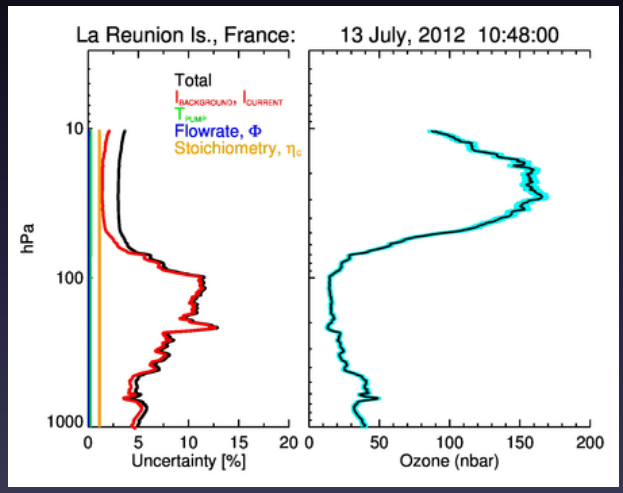


1st application – hot off the presses

$$P_{O3} = \frac{4.307\times10^{-4}(I_{Current} - I_{Bground})T_{PUMP}\Phi}{\eta_C}$$







- Background current uncertainty is significant, particularly at tropical sites where low ozone can be at the detection limits of the ozonesonde. *Signal to noise is the biggest issue.*

Key Points

- This is the first major reprocessing of SHADOZ ozonesonde data records.

- The effect of reprocessing is observed throughout the profile and the magnitude of change is highly variable and station dependent. A tailored approach is required.

Witte et al., First reprocessing of SHADOZ 1: Methodology and evaluation, JGR, accepted, doi:10.1002/2016JD026403 *2017.*

JOSIE-2017 Tropical Ozonesonde Intercomparison Campaign
Juelich, Germany
09Oct - 03Nov, 2017

WCCOS (World Calibration Center for Ozone Sondes)