



Out of the SHADOZ: Impacts and uncertainties of ozonesonde reprocessing

Jacquie Witte, Anne M Thompson, Bryan J Johnson,
Chance Sterling, Allen Jordan, Masatomo Fujiwara,
Françoise Posny, and Ninong Komala

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Road Map

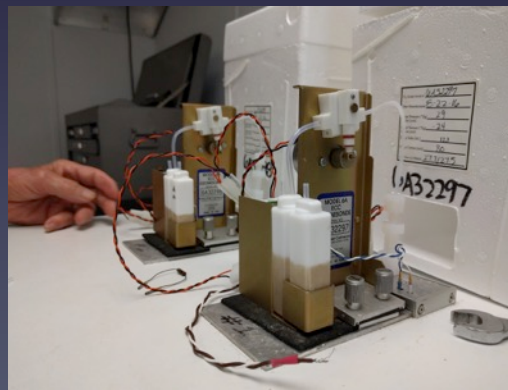
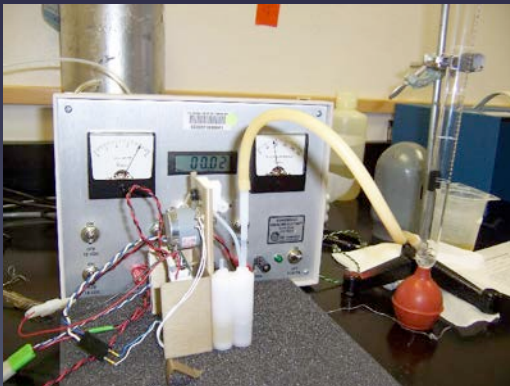


1. What/Why of Ozonesondes
2. SHADOZ intro
3. Objective
4. Motivation
5. Methods
6. Results
7. Tackling uncertainties
8. Key Points

What: Ozonesondes 101

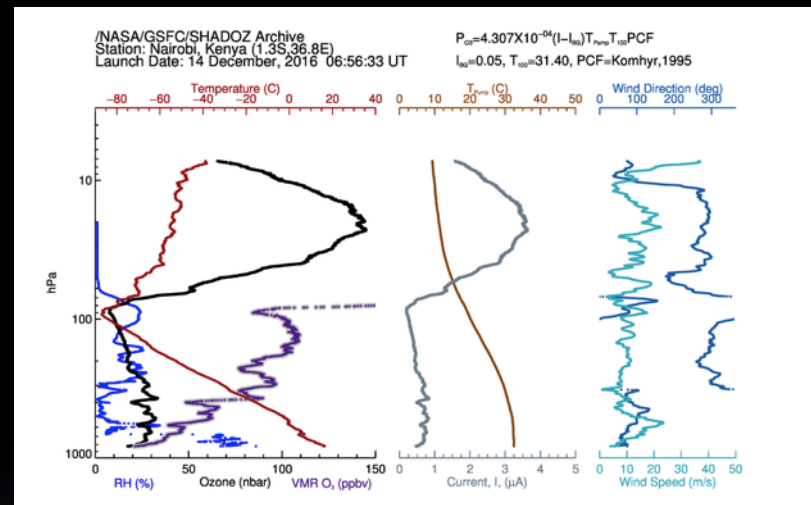
NOAA/GMD/Mauna Loa

- 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

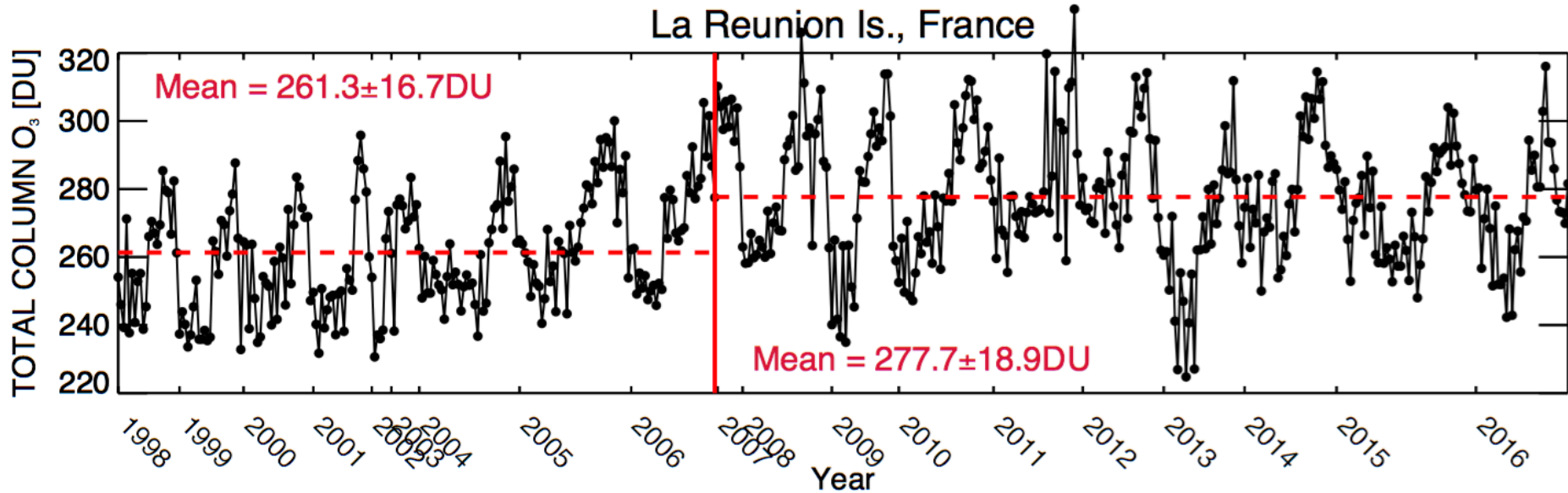
1. SPC / 1% Full buffer
2. ENSCI / 0.5% Half buffer
3. SPC / 0.5% Half buffer
4. ENSCI / 1% Full buffer
5. ENSCI / 2% Unbuffered
6. ENSCI / 1%, 1/10th buffer
7. ENSCI / 0.5% Full Buffer

WMO recommended standards

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

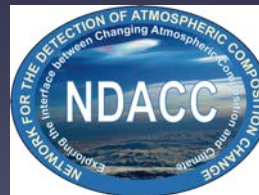
O3S-DQA panel members on homogenization of O3S-data

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)

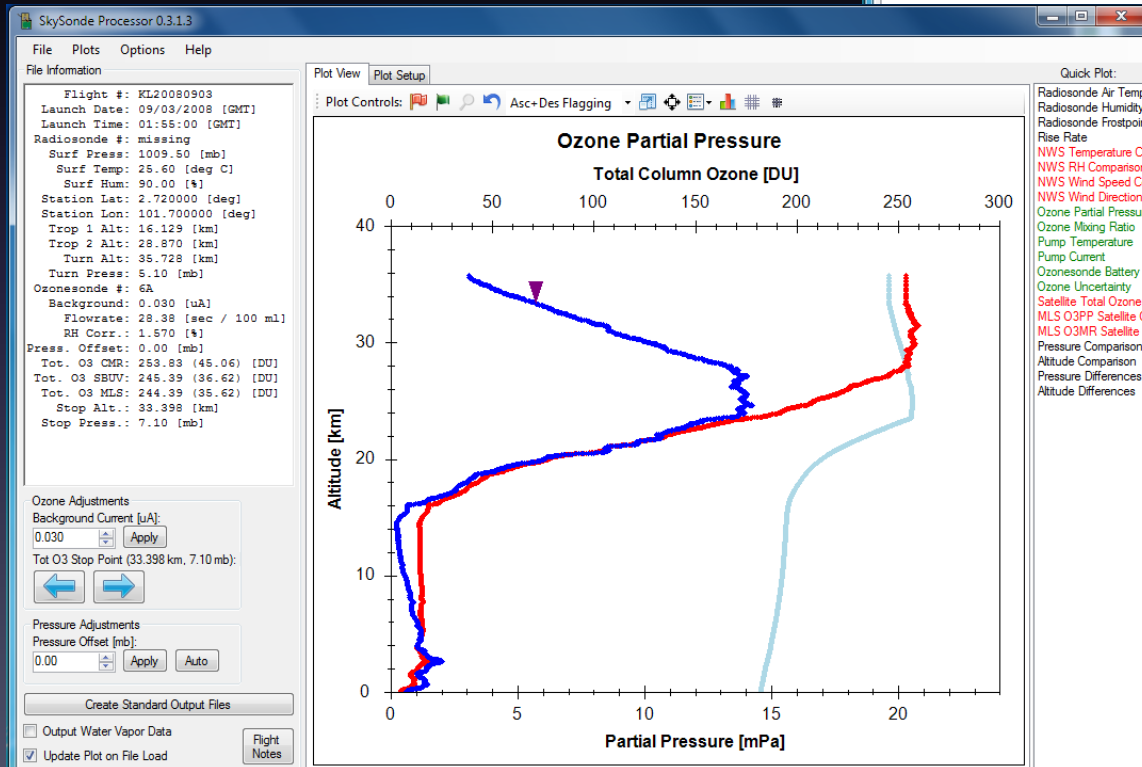
“Past Changes in the Vertical Distribution of Ozone“



SPARC
Stratosphere-troposphere
Processes And their Role In Climate

Method: Skysonde Reprocessing Tools

Creator: Allen Jordan
NOAA/ESRL/GMD



The "SkySonde Processor Batch Processing Form 0.3.1.3" window is used for configuring the reprocessing of multiple files. It features an "Input Files" section with "Browse Files" and "Browse Folders" buttons, and a "File Type to Browse" dropdown set to "flt". A list of files is shown, including various .DAT files from the SHADOZ dataset.

The "Shared Operations" section includes an "Ozone Background" field set to "uA". The "Flowrate Correction Options" section has "Corr Type" set to "Manual" and "Ozone Flowrate Correction" set to "%". The "Ozonesonde Solution" is set to "Unchanged".

The "Ozonesonde Pump Efficiency" section has "Set Pump Efficiency" and "Reset" buttons, with the current value set to "no change". There are checkboxes for "Apply Oltmans Solution Correction", "Apply Ozone Pump Temperature Correction", and "Apply Ozone Background Normalization".

The "6A Sonde Type Correction" section has a field for the percentage correction, currently set to "%".

The "Station Location" section has fields for "Station Latitude" and "Station Longitude". The "Station Altitude [km]" field is also present.

The "File Outputs" section has checkboxes for various output files, including "fleout.dat", "ICARTT", "lev", "I100", "Hygro Lab Instrument NASA Ames", "Hygro Lab Instrument CSV", "NDACC Ames Ozone", "NDACC Ames Water Vapor", "Pivot Table I100", "Pivot Table LEV", "MLS Water CSV", "Hygrometer Binned Uncertainty File", "Ozone Wave Laminar File", and "Ozone Layered Total Column File". There is also a checkbox for "Output All Standard Files".

Buttons for "Clear", "More Settings", "Cancel", and "Start" are located at the bottom of the window.

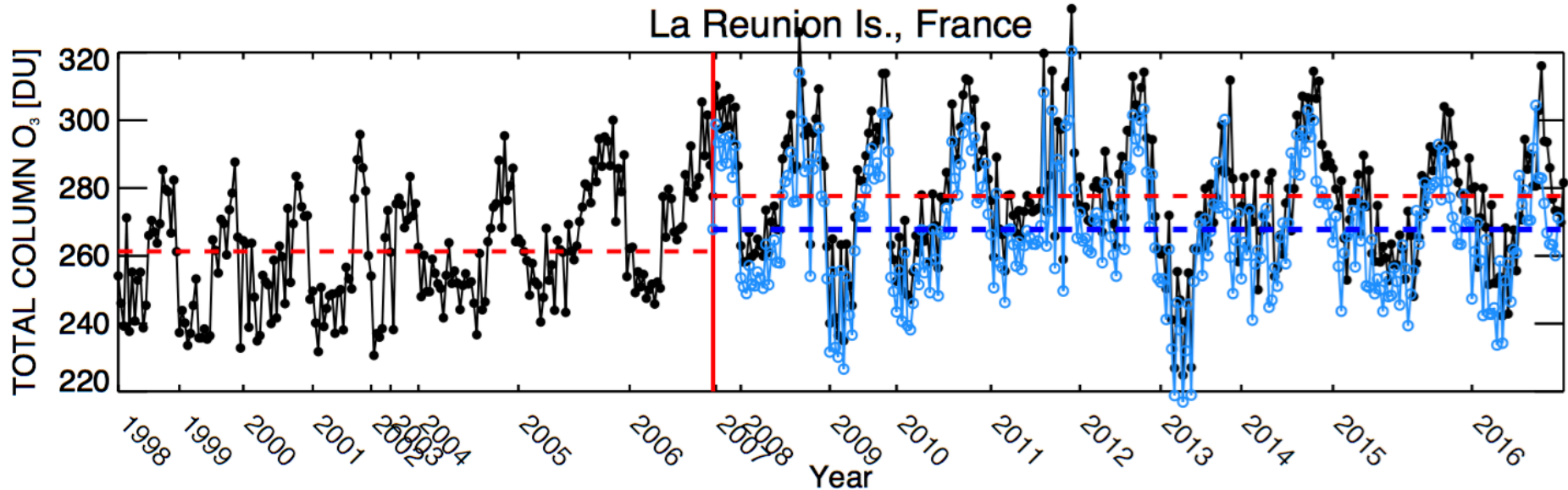


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Results: Reunion revisited



261.3 ± 16.7 DU

277.7 ± 18.9 DU

267.8 ± 18.2 DU

Recall: Y2007 - Change in solution recipe.



Road Map



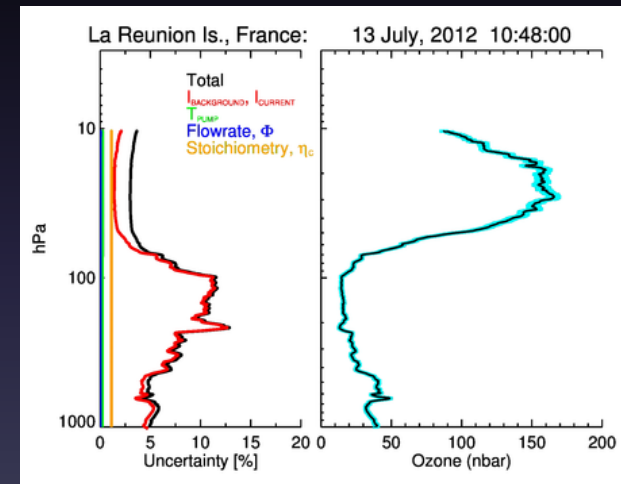
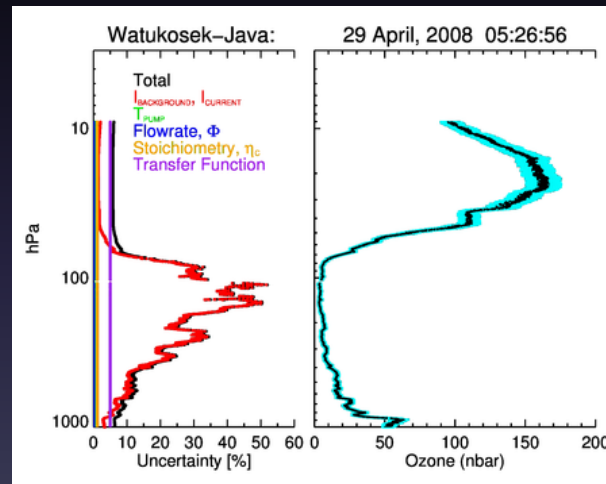
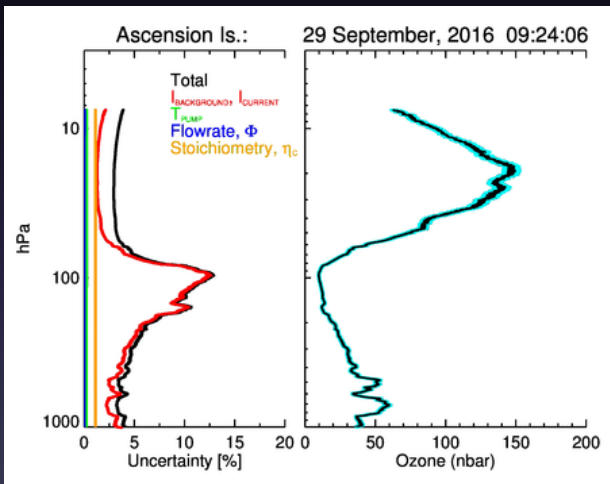
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1st application – hot off the presses



$$P_{O_3} = \frac{4.307 \times 10^{-4} (I_{\text{Current}} - I_{\text{Background}}) T_{\text{PUMP}} \Phi}{\eta_c}$$



- **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.

NASAWFF



Suva, Fiji



Quito, Ecuador

JOSIE-2017 Tropical Ozone-sonde Intercomparison Campaign

Juelich, Germany

09Oct - 03Nov, 2017



WCCOS (World Calibration Center for Ozone Sondes)