Analysis, Determination and Reprocessing Methods Used For Homogenization of the NOAA Long-term ECC Ozonesonde Time Series

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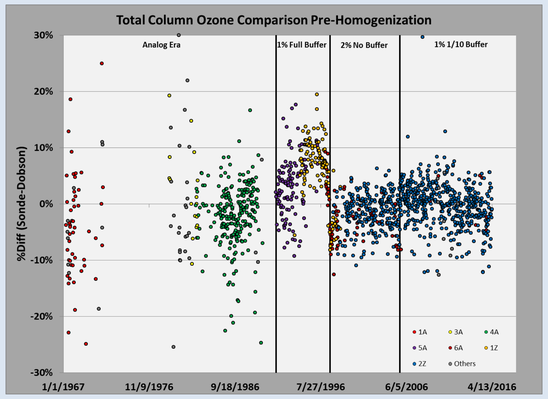
1. Ozonesonde Data Homogenization

$$P_{O_3} = 0.043085 * T_P * \Phi_P * [I_M - I_{BG}]$$

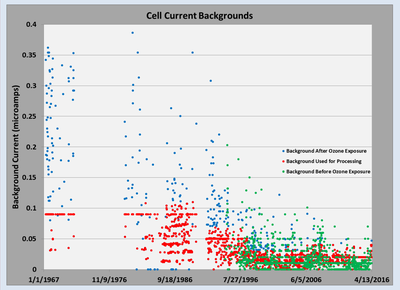
Homogenize to 2Z Sondes and 1% 1/10th Buffer Solution

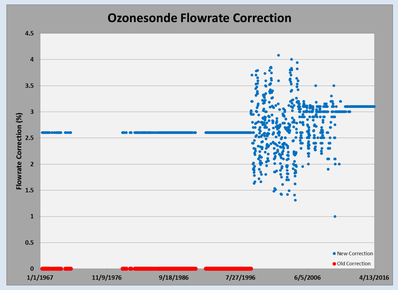


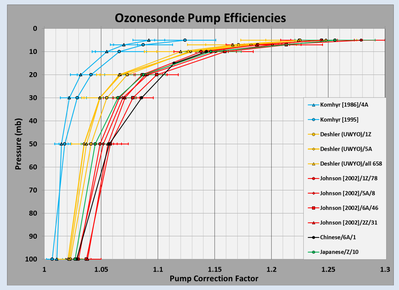
2. Background, Flowrate and Pump Temperature Corrections

Solution	Approximate Date	Average Background and Uncertainty
1% Full Buffer Analog	1/1/1979-12/15/1989	0.09±0.02
1% Full Buffer Digital	6/11/1991-8/21/1997	0.05±0.02
2% No Buffer	8/21/1997-12/1/2005	0.015±0.015
1% 1/10th Buffer	12/1/2005-Present	0.02±0.01

- Reduce background systematically based on solution and era
- Apply Climatological Flowrate Correction
- Use Correct Pump Efficiency
- Correct Pump Temperature based on homogenization guidelines

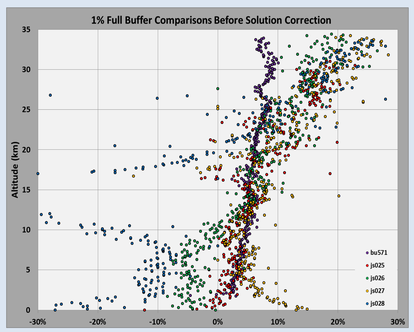


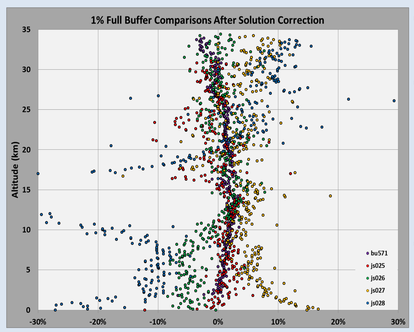




3. Correction for 1% Full Buffer Solution

$$P_{0_3corr} = P_{0_3meas}\,(1.0 - 0.4 * Total\ Column\ Ozone)$$

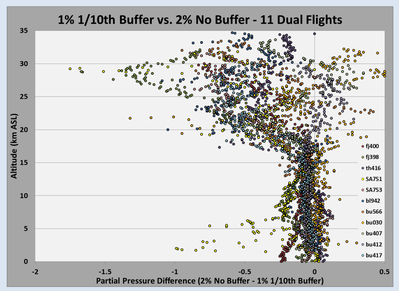


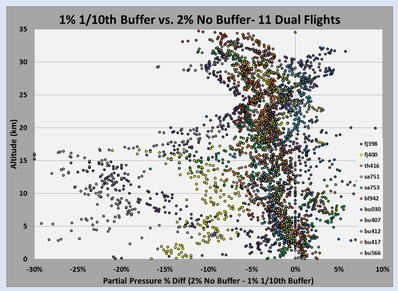


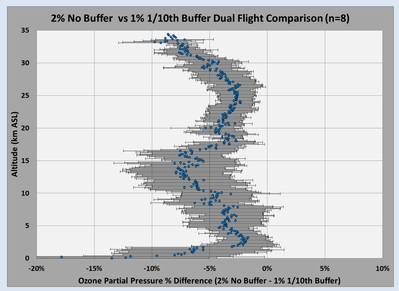
- Higher buffer concentrations result in large positive bias
- Bias increases during flight as buffer concentration increases in the cell and more total ozone is measured
- Experimentally determined transfer function based on theoretical principles

4. Correction for 2% No Buffer Solution

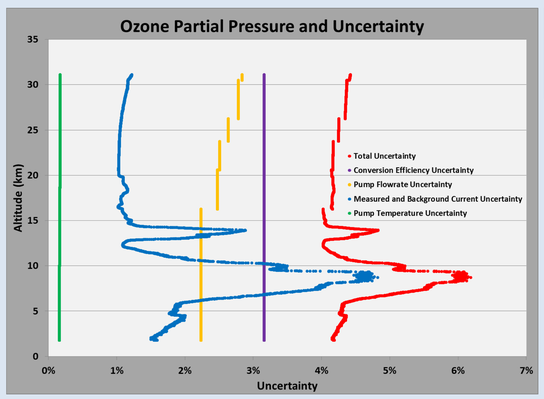
- 2% No Buffer Solution shows negative bias when compared to satellite and Dobson
- 11 Dual Flights conducted comparing 2% No Buffer to 1% 1/10th Buffer at various stations
- Apply proportional correction throughout profile ~2%







5. Uncertainty Calculation

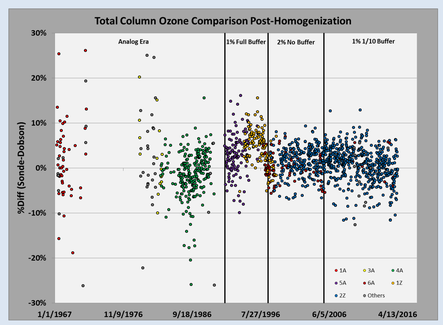


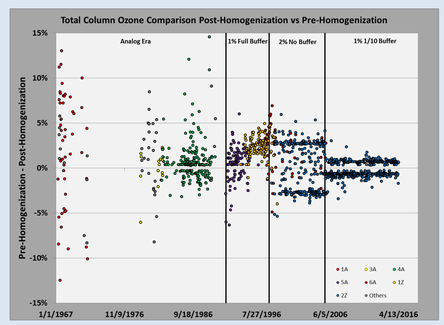
$$\frac{\Delta P_{O_3}}{P_{O_3}} = \sqrt{\frac{(\Delta I_{Meas})^2 - (\Delta I_{BG})^2}{(I_{Meas} - I_{BG})} + \left(\frac{\Delta \eta_C}{\eta_C}\right)^2 + \left(\frac{\Delta \Phi_P}{\Phi_P}\right)^2 + \left(\frac{\Delta T_P}{T_P}\right)^2}$$

- Bottom-up robust uncertainty calculation
- Based on uncertainties of each individual variable in ozone partial pressure calculation
- Transfer functions add uncertainty and are accounted for

6. Comparison and Future Considerations

- Develop transfer function for 2Z – 1% 1/10th to Ozone Photometer
- Compare Old Processing Method to New Processing Method vs. Satellite Profile Measurements
- Develop Transfer Functions for other sonde type and solution type changes





References:

1. Smit H., Johnson B., Oltmans S., Deshler T., Tarasick D., Schmidlin F., Stuebi R., Davies J. (2012). Guide Lines for Homogenization of Ozone Sonde Data. Version 2.0. SI2N/O3S-DQA
2. Johnson. B.J.. S.J. Oltmans. H. Voemel. H.G.J. Smit. T. Deshler. and C. Kroeger (2002) ECC Ozonesonde pump efficiency measurements and tests on the sensitivity to ozone of buffered and unbuffered ECC sensor cathode solutions. JGR