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

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The National Oceanic and Atmospheric Administration's (NOAA) electrochemical concentration cell (ECC) ozonesonde network has been performing vertical ozone profile measurements for nearly 40 years and in collaboration with SHADOZ (Southern Hemisphere ADditional OZonesondes) extends to nine sites worldwide. These measurements are used in a wide range of applications by many institutions and individuals. During this time period, many instrument configurations, sensor solutions, and processing changes have occurred. These changes have introduced systematic biases into the data record. In order to reduce uncertainty, recover original raw data, and analyze and calculate the remaining random uncertainties, the Ozonesonde Data Quality Assessment ($O_3$S-DQA) was initiated by the ozonesonde community. NOAA's network is unique due to the large number of sites, length of record, and unique sensor solutions and instrument types used. NOAA has generally followed the homogenization guidelines published in the WMO GAW Report #201 [2014]. However, the uniqueness of NOAA's data record required the development of our own transfer functions. The Boulder, Colorado station is used here to illustrate NOAA's reprocessing system and the methods used to evaluate and determine the appropriate corrections. Ozone soundings were processed from the raw data in order to recover and record the cell current and original measured backgrounds in the data files. The ozonesonde cell current backgrounds were screened for proper measurement methodology and adjusted where required. Faulty pressure sensors in various radiosondes required the application of pressure offsets. In Boulder, a pump flowrate correction was not applied prior to 1998; hence, a climatological value was used. The temperature of the ozonesonde pump was measured in multiple configurations; to normalize to the present configuration pump temperature transfer functions were applied. NOAA has developed transfer functions to remove biases created by sensor solution changes. NOAA has used 1% full buffer, 2% no buffer, and 1% 1/10th buffer sensor solutions. In order to determine appropriate transfer functions, the two earlier sensor solution types were compared to the 1% 1/10th buffer sensor solution and an ozone photometer via dual ozonesonde flights and atmospheric chamber simulations. The final piece of the data homogenization process was implementing a robust, bottoms up uncertainty calculation. The instrumental uncertainty of the ozonesonde measurement is a composite of the contributions of the individual uncertainties of the different instrumental parameters, namely, the measured sensor current, background current, conversion efficiency, pump temperature, and pump flowrate. The uncertainty calculation takes into account the added uncertainty of implementing transfer functions. This data homogenization effort greatly improves the agreement in total column ozone between ECC ozonesondes and colocated Dobson spectrophotometers and satellites (AURA's OMI and MLS and NOAA-9 through NOAA-19).