Title: Detector for Oxidized Hg Species (DOHGS) Data

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1.0 Date Set Overview:

These data were collected onboard the National Science Foundation (NSF)/National Center for Atmospheric Research (NCAR) C-130 research aircraft with the University of Washington's aircraft mercury (Hg) instrument – the Detector for Oxidized Hg Species (DOHGS) – as part of the NSF-sponsored Nitrogen, Oxidants, Mercury and Aerosol Distributions, Sources and Sinks (NOMADSS) field campaign. The NOMADSS deployment period was 1 June to 15 July, 2013. The operations base was the Smyrna Airport in Smyrna, Tennessee. Additional information on the NOMADSS campaign, and the contribution of NOMADSS to the "umbrella" Southeast Atmosphere Study (SAS), can be found at https://www.eol.ucar.edu/field_projects/sas.

2.0 Instrument Description:

The UW-DOHGS instrument uses a novel difference-based method to measure speciated atmospheric Hg. Designed for aircraft operations, we recently deployed the DOHGS on the NSF/NCAR C-130 during the 2010 Western Airborne Mercury Observations (WAMO) experiment and during NOMADSS.

Measurements of Total atmospheric Hg (THg) (called "Total Mercury" (TM) in the DOHGS data files) and Gaseous Elemental Mercury (GEM) are made separately on two channels; the difference between these measurements, TM minus GEM, yields measurement of Reactive Mercury (RM). On both channels, Hg is quantified by pre-concentration on gold (Au) traps followed by thermal desorption with detection by Cold Vapor Atomic Fluorescence Spectrometry (CVAFS). Two paired Au traps are used in each CVAFS analyzer, permitting continuous sampling, whereby each trap alternately collects and desorbs. The pressure within the CVAFS sample cells is controlled to eliminate dependence of the measured fluorescence intensity on aircraft cabin pressure. Analytical specifications relevant to the NOMADSS dataset are listed below. A more detailed description of the DOHGS is provided in Lyman and Jaffe (2011), with updates described in Ambrose et al. (2013).

- Measurement frequency: 150 s (2.5 min)
- Resolution: Sampling is continuous; measurements are integrated over 150 s

- Mean precision (1σ) at 2.5 min resolution: TM, 0.034 ng/m^3; GEM, 0.030 ng/m^3; RM (ng/m^3), 0.025 × TM (here, TM must be expressed in ng/m^3; e.g., with TM = 1.5 ng/m^3, mean RM precision = 0.037_5 ng/m^3)
- Mean overall uncertainty (at TM and GEM concentrations >10 × LOD): TM, 7%; GEM, 7%; RM (ng/m^3), $[(0.047 \times RM)^2 + (0.024 \times TM)^2 + (0.025 \times TM)^2]^{0.5}$ (here, RM and TM must be expressed in ng/m^3; e.g., with TM = 1.5 ng/m^3 and RM = 0.10 ng/m^3, mean overall RM uncertainty = 0.052_2 ng/m^3)
- Mean LOD (3σ): TM, 0.066 ng/m^3; GEM, 0.066 ng/m^3; RM, 0.111 ng/m^3.

3.0 Data Collection and Processing:

Instrument parameters including sample flow rates; the cabin, sample line and sample cell pressures; and the cabin temperature were measured at 1 kHz, averaged to 2.5 min, and recorded on a personal computer (PC) using a custom program written in LabVIEW (National Instruments; version 10.0). Raw 0.1 Hz fluorescence data were captured on the same PC from the serial outputs of the CVAFS using HyperTerminal (Hilgraeve, Inc.; version 5.1) and later reprocessed for Hg quantitation using a custom program written in MatLab (MathWorks; version 7.4.0 (R2007a)). Additional details on calibration and data processing are provided in Ambrose et al. (2013). All Hg measurements made during NOMADSS are corrected for instrument blanks determined on each flight day. Measurements are reported as Hg mass concentrations at standard temperature and pressure (273.15 K, 1013.25 mbar).

4.0 Data Format:

Data are archived separately for each flight, in compliance with ICARTT format standards (Version 1.1) as described by Aknan et al. (2013). Details on ICARTT format are accessible at http://www.esrl.noaa.gov/csd/groups/csd7/measurements/icartt_format_info.html. Each data file contains an ICARTT-compliant data header, which also reports the measurement uncertainties for each flight. Each file contains the following data columns for the 2.5-minute DOHGS measurements: Start time (UTC), Stop time (UTC), TM concentration (ng m^{-3}), GEM concentration (ng m^{-3}), RM concentration (ng m^{-3}), and RM uncertainty (ng m^{-3}). In accordance with the ICARTT format, the flag for missing data is -9999, the flag for values below the lower limit of detection is -8888, and the flag for values above the upper limit of detection is -7777 (N/A for DOHGS data). Our final NOMADSS data files (version R0) were completed on 18-December-2013 and are named as "DOHGS-mercury_C130_2013MMDD_R0.ict". The final data file for RF-11 was revised on 14-July-2014 and named as "DOHGS-mercury_C130_20130629_R1.ict".

5.0 Data Remarks: N/A

6.0 References:

Ambrose, J. L.; Lyman, S. N.; Huang, J.; Gustin, M. S.; Jaffe, D. A. Fast Time Resolution Oxidized Mercury Measurements during the Reno Atmospheric Mercury Intercomparison Experiment (RAMIX). *Environ. Sci. Technol.* **2013**, *47*, 7285–7294; doi.org/10.1021/es303916v.

Lyman, S. N.; Jaffe, D. A. Formation and fate of oxidized mercury in the upper troposphere and lower stratosphere. *Nat. Geosci.* **2011**, *5*, 114–117; doi:10.1038/NGE01353.