TITLE: Fast sulfur dioxide (SO_2)

AUTHORS:

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1.0 DATA SET OVERVIEW:

Fast (25 Hz) and decimated 10 second sulfur dioxide (SO_2) data for the Pacific Atmospheric Sulfur Experiment (PASE). Collected on the NCAR C-130 in Aug-Sept, 2007 from Kiritimati (Christmas) Island, Republic of Kiribati.

2.0 INSTRUMENT DESCRIPTION:

SO_2 measurements were obtained in negative ion mode with an Atmospheric Pressure Ionization Mass Spectrometer (APIMS, Thornton 2002). An isotopically labeled standard (S-34 SO_2) is added continuously to the sample air at the inlet. Water vapor is removed from the sample air with a Nafion® air drier, and ozone, generated from a UV lamp, is added to the sample flow. In the presence of ozone SO_2 reacts with CO_3^-, ultimately producing SO_5^-(m/e 112). Ions at mass 112 (ambient SO_2) and mass 114 (S-34 SO_2) are monitored sequentially.

Signal intensities are recorded as total ion counts in a 20 ms interval at each mass. The ambient SO_2 concentration is calculated from the signal ratio (mass 112/ mass 114), the flow rate and concentration of labeled standard, and the total sample air flow rate. SO_2 concentrations are reported as parts-per-trillion by volume (pptv) or pL/L.

3.0 DATA COLLECTION AND PROCESSING:

Isotopically labeled SO_2 calibration gas was calibrated against two SO_2 permeation tubes maintained at Drexel University. Calibration results for the standard are 134 ppb +/- 8%. The manufacturer's nominal concentration for this cylinder was 250

ppb, however calibration data from 2004 (140 ppb), discovered in the lab at Drexel, confirms the current calibration data. Including flow rate uncertainty, precision of the mean SO_2 concentration is therefore about 12%.

Instrument backgrounds (blanks) are obtained by passing sample air through a coil of 1/4" copper tubing, effectively removing SO_2 from the ambient sample stream. Background count rates at masses 112 and 114 are subtracted from total counts before calculating the SO_2 concentration. Periods of blank measurement are recorded as NaN in the final data file.

Fast (25 Hz) data was further decimated to 10 second intervals as a convenience for users who do not require high rate data.

4.0 DATA FORMAT:

25 Hz data for each flight is supplied in a series of files which roughly correspond to each individual flight leg. In addition to SO_2 concentration data and the UCAR time stamp, each 25 Hz file also includes the time stamp in text format (MM/DD/YYYY hh:mm:ss.sss) and Matlab datenumber decimal format:

```
PI/DATA CONTACT = Bandy, Alan (Drexel Univ.), Blomquist, Byron (Univ. Hawaii)
DATA COVERAGE = START: 0813221052; STOP: 0813225448 UTC
PLATFORM/SITE = C-130
INSTRUMENT = Atmospheric Pressure Ionization Mass Spectrometer (APIMS)
LOCATION = mobile
DATA VERSION = 1.0 (11 DEC 2007)
REMARKS = Pacific Atmospheric Sulfur Experiment (PASE)
REMARKS = SO2 in parts per trillion by volume, pptv = pL/L
REMARKS = Time in UTC, Missing data = NaN
UTC   Timestamp   MatlabTime  SO2
UTC   UTC   UTC   pptv
20070813221052.2120     8/13/07 22:10:52.212    733267.9242154168 59
20070813221052.2520     8/13/07 22:10:52.252    733267.9242158796 66
20070813221052.2920     8/13/07 22:10:52.292    733267.9242163425 51
...
```

File names are structured as (for example): `RF03_20070813T221052_SO2_v1.txt`, where flight number and start time are indicated as shown. Time format in the file name is yyyymmddThhmmss (ISO 8601 format).

10 second data for each flight is supplied in a single file of similar structure. These files contain time stamp data in UCAR format and text string format (readable by most spreadsheet programs, Igor Pro, etc.).

```
PI/DATA CONTACT = Bandy, Alan (Drexel Univ.), Blomquist, Byron (Univ. Hawaii)
DATA COVERAGE = START: 0813182823; STOP: 0814021331 UTC
PLATFORM/SITE = C-130
INSTRUMENT = Atmospheric Pressure Ionization Mass Spectrometer (APIMS)
LOCATION = mobile
DATA VERSION = 1.0 (11 DEC 2007)
REMARKS = Pacific Atmospheric Sulfur Experiment (PASE)
REMARKS = SO2 in parts per trillion by volume, pptv = pL/L
REMARKS = Time in UTC, Missing data = NaN
UTC   Timestamp   SO2
UTC   UTC   pptv
20070813182823.2210     8/13/07 18:28:23.221    43
20070813182833.2200     8/13/07 18:28:33.220    36
20070813182843.2180     8/13/07 18:28:43.218    34
...
```

In addition to ascii data files, pdf notebook files for each flight contain notes and plots of each data segment to facilitate a "quick look" at individual flight legs.

5.0 DATA REMARKS:

6.0 REFERENCES:

Thornton, Donald C., Alan R. Bandy, Fang H. Tu, Byron W. Blomquist, Glenn M. Mitchell, Wolfgang
Nadler, Donald H. Lenschow, Fast airborne sulfur dioxide measurements by atmospheric pressure
ionization mass spectrometry (APIMS), J. Geophys. Res., 107, 4632, doi: 10.1029/2002JD002289R, 2002.