Title: CU AirSOF during 2018 BB-FLUX

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1.0 Data set description

Abstract: The 2018 Biomass Burning Fluxes of Trace Gases and Aerosols (BB-FLUX) campaign aimed to quantify emission fluxes of CO, CO_2, and other gases, characterize plume injection heights, study radical sources and plume chemistry that leads to secondary production of O_3, and explore synergistic benefits of remote sensing and in-situ observations to quantify speciated total emission fluxes from wildfires. The University of Colorado Solar Occultation Flux instrument (CU AirSOF) uses a Fourier transform infrared spectrometer to measure vertical column densities (VCDs) of various trace gas species. The column measurement integrates over plume heterogeneities, and when combined with information about the wind speed and direction allows for the quantification of fluxes on the scale of entire wildfires. This dataset contains the VCDs for nine different trace gases, and it is the companion dataset of the *in situ* species that were also measured on the University of Wyoming King Air during BB-FLUX.

Data version: R0, 2023-01-18

Data status: Final data

Temporal coverage:

Begin datetime: 2018-07-21 00:00:00

End datetime: 2018-09-15 23:59:59

Spatial coverage

Maximum (North) Latitude: 47.00 N

Minimum (South) Latitude: 39.00 N

Minimum (West) Longitude: -123.00 E

Maximum (East) Longitude: -109.00 E

Platform: NSF/U Wyoming King Air. Latitude, longitude, and altitude for each flight are included in the data files.

Data frequency: Continuous data, includes start, mid, and stop times

Data source: University of Colorado Airborne Solar Occultation Flux (CU AirSOF)

Web address: https://volkamergroup.colorado.edu/timeline/field/bb-flux

Data set restrictions: Use of these data require prior ok from PI. Funding from NSF AGS-1754019 must also be acknowledged.

2.0 Instrument description

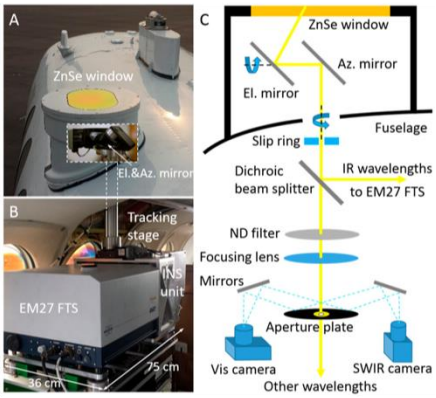

Figure 1 from Kille et al. (2022), showing the instrument installation on the King Air, as well as the optics in the solar tracker.

The University of Colorado Airborne Solar Occultation Flux instrument (CU AirSOF) consists of a custom built digital solar tracker coupled to a Fourier transform infrared spectrometer (FTIR). The solar tracker uses two cameras, one in the visible and the second in the IR, to maintain a tracking lock on the sun in both clear skies and when under optically thick wildfire plumes. The solar tracker was installed in a roof mounted port on the University of Wyoming King Air aircraft, looking through a zinc selenide window. Light from the direct solar beam was sent to Bruker EM27 FTIR (0.5 cm^{-1} resolution) and spectra were acquired on either a mercury cadmium telluride detector (700 to 1600 cm^{-1}) or indium antimonide (1600 to 5000 cm^{-1}) detector using the Bruker OPUS software package. Spectra were acquired approximately every 2 seconds. Details on the solar tracker, SOF design, and SOF performance during BB-FLUX can be found in the references below.

3.0 Data collection and processing

The measured spectra were analyzed using SFIT4 (v0.9.4.4), which uses optimal estimation to retrieve the vertical column density of various gases in the atmosphere. The spectral ranges used for the retrievals, as well as the total uncertainty for each species are given in the table below. Full details on the retrievals, as well as ground-based comparisons with a high-resolution FTS and comparisons of column and *in situ* enhancement ratios in wildfires plumes can be found in Kille et al. (2022). Comparisons between SOF and TROPOMI CO columns are given in Rowe et al. (2022).

Species	**Formula**	**Window (cm^{-1})**	**Uncertainty (%)**
Carbon monoxide	CO	4214–4254 (overtone) 2104-2137 (fundamental)	6.1
Ammonia	NH_3	940–980	4.7
Ethene	C_2H_4	940–980 (same window as NH_3)	10
Methanol	CH_3OH	1022–1055	23
Ethane	C_2H_6	2970–3000	5.8
Formaldehyde	CH_2O	2804–2834	26
Hydrogen cyanide	HCN	3316–3351	30
Formic acid	HCOOH	1096–1126	6.4
Sum of peroxyacylnitrates		775–810	9.8

4.0 Data format

Data are archived as ICARTT v2.0 files. See https://www.earthdata.nasa.gov/s3fs-public/imported/ESDS-RFC-029v2.pdf for the full file specification. The files contain metadata

in a header followed by the measurement data as comma separated columns. Times are stored as seconds since midnight UTC on the first day of the measurement. The measurement start date is listed in the header.

The short names, units, NASA standard names, and long descriptions for the parameters are given in the table below in the same order as they appear in the data files.

Short name	Units	Standard name	Description
Time_Start	seconds_past_midnight	Time_Start	Measurement start
Time_Stop	seconds_past_midnight	Time_Stop	Measurement stop
Time_Mid	seconds_past_midnight	Time_Mid	Measurement midpoint
Latitude	degN	Platform_Latitude	King Air latitude
Longitude	degE	Platform_Longitude	King Air longitude
AltitudeMSL	meters	Platform_AltitudeMSL	King Air altitude msl, WGS84
CO_VCD	molec/cm2	Gas_CO_VertCol_S_CNDAMB	CO vertical column density
NH3_VCD	molec/cm2	Gas_NH3_VertCol_S_CNDAMB	NH_3 vertical column density
C2H4_VCD	molec/cm2	Gas_C2H4_VertCol_S_CNDAMB	C_2H_4 vertical column density
CH3OH_VCD	molec/cm2	Gas_CH3OH_VertCol_S_CNDAMB	CH_3OH vertical column density
C2H6_VCD	molec/cm2	Gas_C2H6_VertCol_S_CNDAMB	C_2H_6 vertical column density
CH2O_VCD	molec/cm2	Gas_CH2O_VertCol_S_CNDAMB	CH_2O vertical column density
HCN_VCD	molec/cm2	Gas_HCN_VertCol_S_CNDAMB	HCN vertical column density
HCOOH_VCD	molec/cm2	Gas_HCOOH_VertCol_S_CNDAMB	HCOOH vertical column density
PAN_VCD	molec/cm2	Gas_PAN_VertCol_S_CNDAMB	PAN vertical column density

Flags for missing data are provided in the headers for each file. Missing data are represented by negative numbers large enough to never be construed as actual data using only 9s for the digits.

5.0 Data remarks

For fires with low fluxes, the CO column retrieved from the CO fundamental region is used, as this provides a better contrast with the background. The data files contain a note listing which CO measurement was used.

ICARTT files are plain text ASCII files and are compatible with a range of data analysis programs.

Additional contacts: Kyle Zarzana (kyle.zarzana@colorado.edu) and Natalie Kille (natalie.kille@colorado.edu).

6.0 References

Baidar, S., N. Kille, I. Ortega, R. Sinreich, D. Thomson, J. Hannigan, and R. Volkamer: Development of a Digital Mobile Solar Tracker, Atmos. Meas. Techn., 9, 963-972, doi:10.5194/amt-9-963-2016, 2016.

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7.0 Appendix

GCMD keywords:

- EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC CHEMISTRY > CARBON AND HYDROCARBON COMPOUNDS > ATMOSPHERIC CARBON MONOXIDE
- EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC CHEMISTRY > NITROGEN COMPOUNDS > AMMONIA
- EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC CHEMISTRY > HALOCARBONS AND HALOGENS > METHANOL
- EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC CHEMISTRY > CARBON AND HYDROCARBON COMPOUNDS > ETHANE
- EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC CHEMISTRY > CARBON AND HYDROCARBON COMPOUNDS > FORMALDEHYDE

- EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC CHEMISTRY > CARBON AND HYDROCARBON COMPOUNDS > HYDROGEN CYANIDE
- EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC CHEMISTRY > CARBON AND HYDROCARBON COMPOUNDS > FORMIC ACID
- EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC CHEMISTRY > NITROGEN COMPOUNDS > PEROXYACETYL NITRATE
- EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC CHEMISTRY > NITROGEN COMPOUNDS > PEROXYACYL NITRATE
- EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC CHEMISTRY > CARBON AND HYDROCARBON COMPOUNDS > NON-METHANE HYDROCARBONS/VOLATILE ORGANIC COMPOUNDS
- EARTH SCIENCE > ATMOSPHERE > ATMOSPHERIC CHEMISTRY > TRACE GASES/TRACE SPECIES
- EARTH SCIENCE > ATMOSPHERE > AIR QUALITY > EMISSIONS