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1.0 Data Set Description

NSF/NCAR GV Trace Organic Gas Analyzer with TOFWERK (Thun, Switzerland) high-resolution Time-of-Flight Mass Spectrometer (TOGA-TOF) data collected during the Technological Innovation Into Iodine and GV Environmental Research (TI3GER) field campaign. The data files are in ICARTT V2.0 format.

- Data version: R1 as of April 6, 2023
- Data Status: FINAL
- Time period covered by the data: 2 April 2022 through 28 April 2022 (UTC)
- Physical location: NSF/NCAR GV flights based from Broomfield, Colorado, USA and Kona, Hawaii, USA.
- Additional Information:
 - TI3GER campaign information: https://www.eol.ucar.edu/field_projects/ti3ger
 - TOGA-TOF instrument: <https://www2.acom.ucar.edu/voc-measurements/measurement-instrumentation>

2.0 Instrument Description

The airborne TOGA-TOF instrument was developed at NCAR/ACOM to provide measurements of a large suite of C₁-C₁₀ VOCs, including non-methane hydrocarbons (NMHC; including alkanes, alkenes, and aromatic hydrocarbons), oxygenated VOCs (OVOCs) including aldehydes, ketones, alcohols, esters, and ethers, sulfur species including dimethyl sulfide (DMS), carbon disulfide (CS₂), and methanethiol (CH₃SH), nitrogen species including nitriles HCN, CH₃CN, propanenitrile, acrylonitrile, and methylacrylonitrile and alkyl nitrates, and a large number of chlorine, bromine, iodine, and fluorine halocarbons. VOCs are generally sampled for 35 seconds every 2 minutes continuously from take-off to landing. The TOGA-TOF instrument has been successfully deployed on FIREX-AQ (NASA/NOAA, 2019), TI3GER (NSF, 2022), and ACCLIP (NSF/NASA, 2022). Apart from the Time-of-Flight detector, TOGA-TOF instrument is very similar to the TOGA-Quad instrument with an Agilent quadrupole mass spectrometer detector, which has an excellent record of performance on the WE-CAN (NSF, 2018), ATom (NASA, 2016-2018), ORCAS (NSF, 2016), FRAPPÉ (NSF, 2014), CONTRAST (NSF, 2014), NOMADSS (NSF, 2013), DC3 (NSF/NASA, 2012), and TORERO (NSF, 2012) campaigns.

- Data Frequency: 35-s samples every 2 minutes.
- Data Precision and Accuracy: VOC specific, reported in the ICARTT file header.
- Detection limits: low ppt to sub-ppt and VOC specific, reported in the ICARTT file header.

3.0 Data Collection and Processing

- Data collection computer-controlled and monitored in flight by a TOGA-TOF operator
- TOGA sampling, pre-concentration and gas chromatography processes are monitored and recorded in a 1-Hz housekeeping file.
- TOF data files are saved in HDF5 format. High-resolution mass calibration and ion trace batch fitting are performed using Tofware (Aerodyne Research, Inc.). Chromatographic peak fitting is performed using TERN in Igor (Aerodyne Research, Inc.)

4.0 Data Format

- *In situ* gas-phase VOC observations are reported as dry volume mixing ratios (DVMR) in units of ppt (parts per trillion), or “arbppt” (arbitrary ppt) for species that have not been fully calibrated, as specified in the header for each species.
- Data file structure is ASCII following the ICARTT V2.0 specifications outlined in <https://www.earthdata.nasa.gov/esdis/esco/standards-and-practices/icartt-file-format>
- Detection limits are species specific and reported in species order in the header as LLOD_VALUE.
- Data below detection limits (LLOD_FLAG) are represented by -888.
- Missing/unavailable data are represented by -999.

5.0 Data Remarks

- Data are available for all research and ferry flights for most VOCs of interest, but due to instrument issues, some data are missing during the last two hours of flight FF01 (10 Apr 2022), between 21:54 and 23:39 UTC in the middle of RF04 (15 Apr 2022), and the last hour of RF04.
- VOCs not of importance to TI3GER science goals that were below detection limits for the majority of the campaign are not reported in the FINAL data, including short-lived fire tracers, and very short-lived anthropogenic gases.
- Due to instrument issues, CH₃OH (methanol), C₂H₅OH (ethanol), and iPropanol (isopropanol) are reported with missing/unavailable data flags for the campaign.