DCOTSS

NASA Earth Venture Suborbital 3
Dynamics and Chemistry of the Summer Stratosphere

UAS Chromatograph for Atmospheric Trace Species

UCATS

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The UCATS instrument and data

UCATS is a 3-channel gas chromatograph with ozone and water vapor sensors for unmanned aerial systems (UAS) and piloted aircraft

- Gas chromatographs: ~2-second "snapshot" of ambient air

  1. $CHCl_3$, CCl_4, and C_2HCl_3 every 150 seconds

  2. CFC-12, halon 1211, CFC-11, and CFC-113 every 75 seconds

  3. N_2O and SF_6 every 75 seconds; all channels use Electron Capture Detectors (ECDs)

- Ozone - 2B Model 211 (UV absorption) modified for aircraft, 0.5 Hz

- Water vapor – Port City IR tunable diode laser (TDL) absorption; different lines and analysis techniques for different H_2O ranges, 1 Hz

UCATS instrument (further details)

Sampling lines from inlet under ER-2 Q-Bay. Some ram pressure is generated from a downstream restrictive orifice.

Ozone – Teflon line direct to instrument, pump downstream of cell. Data throughout troposphere and stratosphere.

GC and water – shared stainless steel and Dekaron sampling lines. GC air samples are compressed by a KNF diaphragm pump and held at constant pressure; H_2O samples air flow before GC pump, with separate pump downstream of cell. GC data in stratosphere and upper troposphere for DCOTSS.

UCATS instrument (continued)

Hintsa et al., UAS Chromatograph for Atmospheric Trace Species (UCATS) - a versatile instrument for trace gas measurements on airborne platforms, Atmos. Meas. Tech. 14, 6795–6819, doi:10.5194/amt-14-6795-2021 (2021).
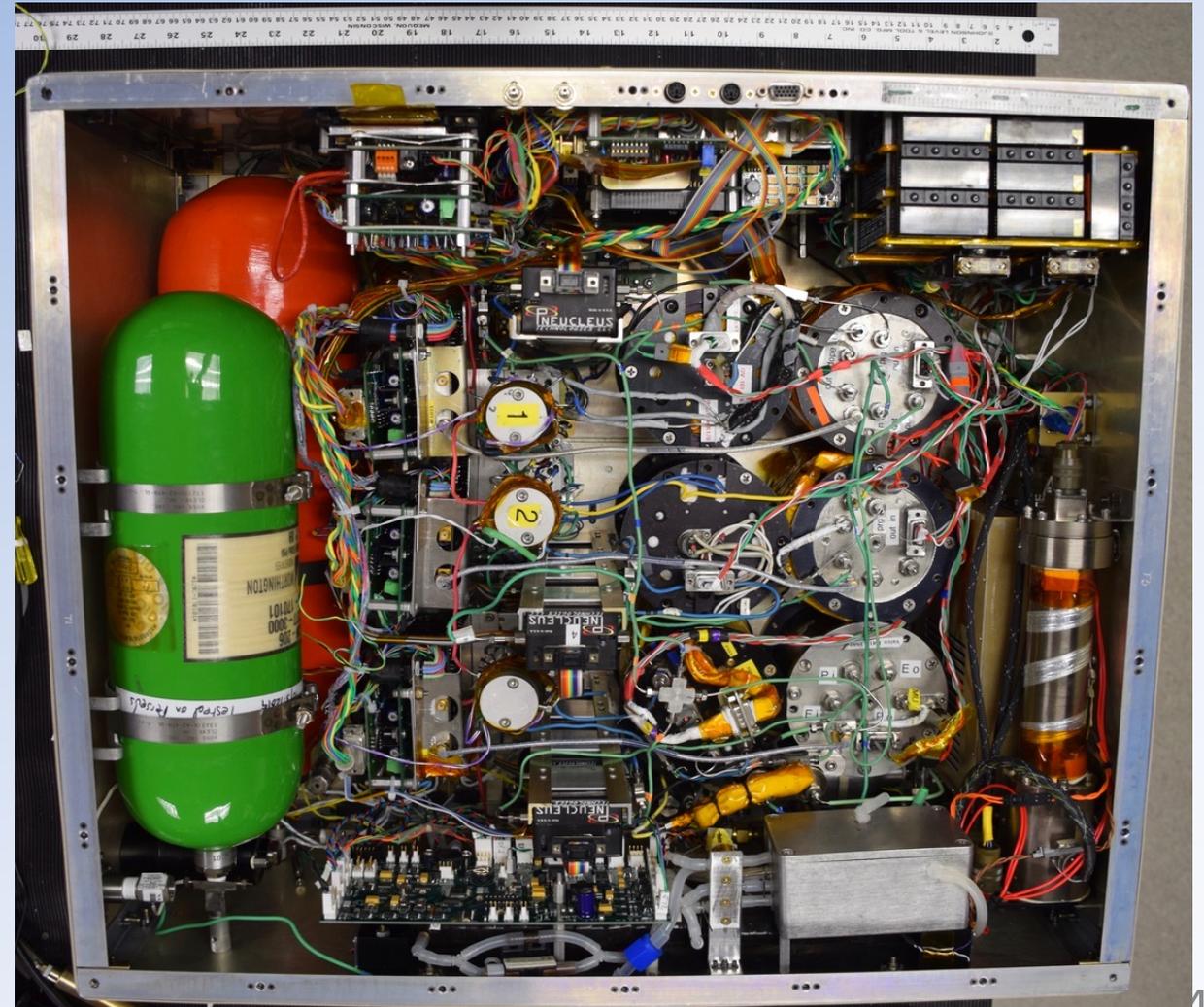
File Structure & Content

- UCATS generates 3 files: GC, ozone, and water

- All files are in ICARTT format; file size 20-40 kB for GC, 200-500 kB for ozone and water

- Archived files for test flights, transit flights, and science flights along ER-2 flight track.

- GC – data for all flights except July 12 transit flight; all molecules except C_2HCl_3 (not detected)

- Ozone – all flights, two with only partial data

- Water – sampling problems in stratosphere; will have archived data for ER-2 ascents and descents only

Data Limitations & Considerations

- N_2O, SF_6 – 0.5% precision, CFCs, halon-1211, $CHCl_3$, and CCl_4 – ~1% precision; all GC molecules should have accuracy better than 0.5% of full scale

- Ozone – precision 1% or 2 ppb, whichever is larger, accuracy ~2%

- Water vapor – accuracy and precision ~5% + 1 ppm

- If you use this data in a publication or report, we would appreciate that you contact the principal investigators (PIs). The PIs can discuss the quality of the data and any potential problems with its analysis. Please contact the PIs for more information.

Tentative Archival Timeline

- All data will be uploaded to the public archive in January-February 2022.

- Feel free to contact the PIs for preliminary data.

- Additional products, timeline TBD:

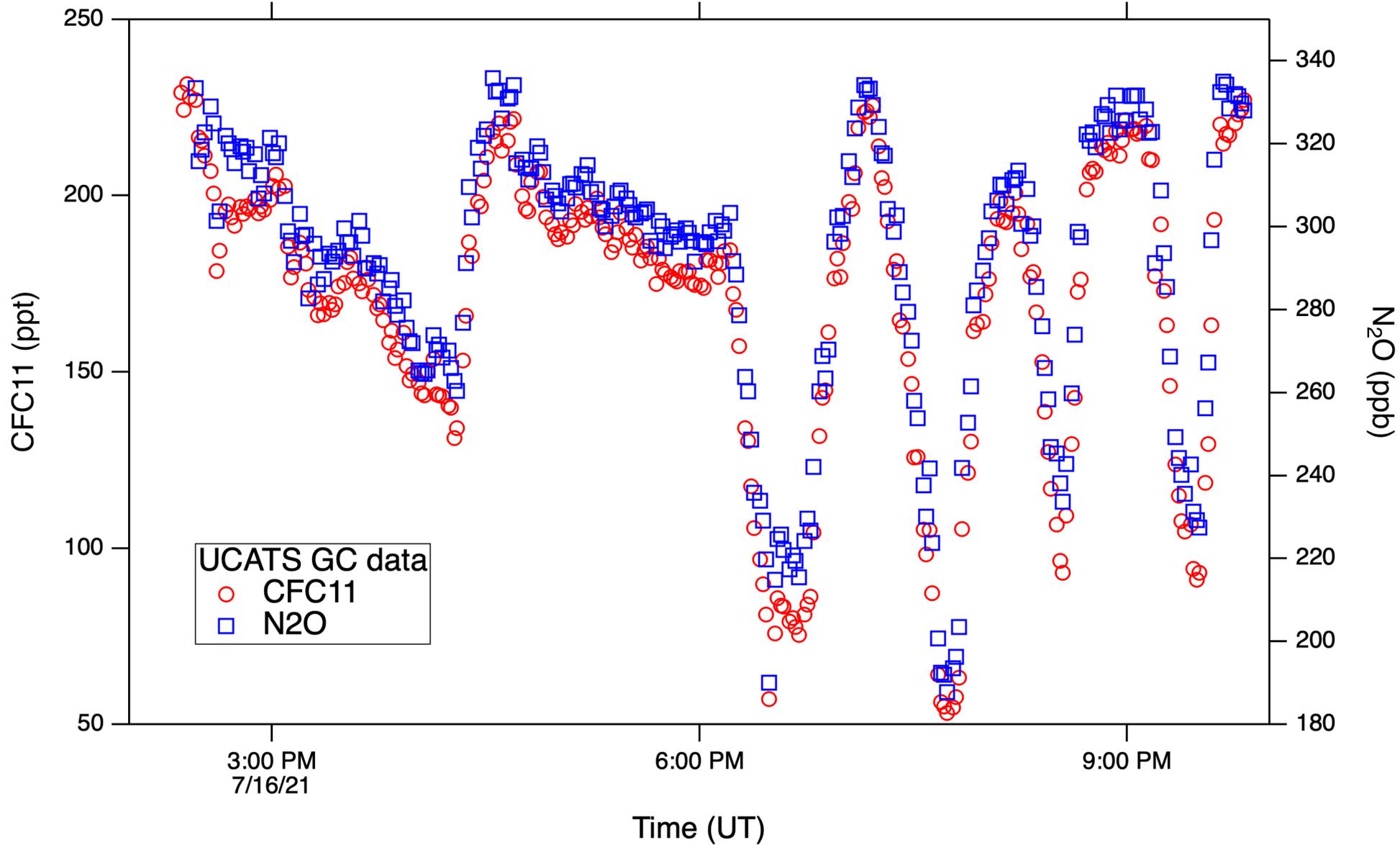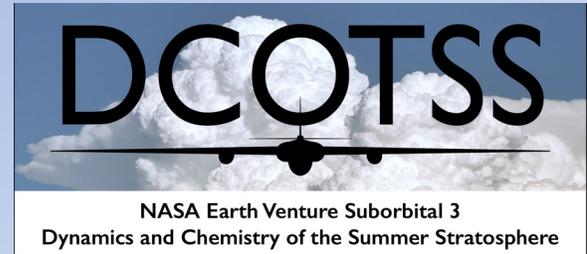   Total organic chlorine (collaboration w/AWAS and models)

    SF_6 mean age of air from midlatitude surface (appropriate for recent convection, tropospheric air), and from tropics (appropriate for air through tropical tropopause, Brewer-Dobson circulation)

Upcoming Conference Presentations
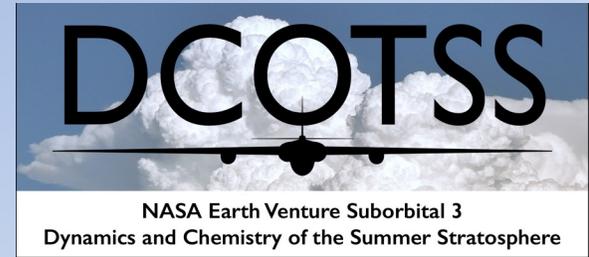
- 2021 AGU Meeting: The UAS Chromatograph for Atmospheric Trace Species (UCATS) - a versatile instrument for airborne platforms, rebuilt for the Dynamics and Chemistry of the Summer Stratosphere (DCOTSS) Mission, Poster #A15N-1878, December 13, 15:00-17:00.

UCATS GC data, 20210716, ER-2 flight

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Preliminary Data!

DCOTSS 2021
UCATS CFC11 fit to N2O
$CFC11 = K0 + K1*N2O + K2*N2O^2$
K0 = -186.5 ± 6.5
K1 = 1.241± 0.046
K2 = -7.3e-05 ± 8.1e-05