

TRANS²-Am 2022 project summary

The Transport and Transformation of Ammonia (TRANS²-Am) campaign was focused on sampling emissions (primarily methane, ethane, and ammonia) associated with intensive animal farming operations in Colorado. In addition to instrumentation supported by the King Air facility, many of the air chemistry and aerosol measurements for this campaign were designed around multiple user-supplied instruments, including an Aerodyne Ethane Trace Gas Monitor, a Picarro G2401-m gas analyzer, Aerodyne nitric acid and ammonia analyzers, and a Particle-into-Liquid Sampler.

The project took place in both 2021 and 2022. The 2022 portion continued with the same general locations and procedures as TRANS²Am-21. The project was based out of Laramie, WY, with 9 research flights taking place from 16 August - 2 September 2022. The flights took place over north-central to northeastern Colorado, with two primary types of research flight profiles used. Most flights profiled emissions sampling directly around agricultural sites in this area. Several flights followed an alternate profile, performing vertically stacked north-south legs spaced from west to east to track emissions transport in upslope wind conditions.

The UWKA facility webpage for the project, including general flight summaries and detailed flight notes, can be found here: <http://flights.uwyo.edu/projects/trans2am22/>

Instrumentation:

Facility instrumentation:

Data from the following University of Wyoming instruments are included in this dataset.

- Applanix AV 410 GPS/Inertial Measurement Unit

- Reverse-flow static air temperature

- Rosemount 102 static air temperature

- Heitronics KT1585 IR temperature

- EdgeTech Vigilant model 137 chilled mirror hygrometer

- Rosemount 1501 HADS static air pressure (*see data quality note below*)

- Weston static air pressure

- CPT-6140 static air pressure

- CPT-9000 static air pressure

- Rosemount 1332 cabin air pressure

- Rosemount 0858 for indicated airspeed, angle of attack, and sideslip angle to derive winds

- Co-pilot indicated airspeed

- King KRA 405 Radar Altitude (to 2000 ft)

- DMT Passive Cavity Aerosol Spectrometer Probe (PCASP-100X)

Further information on the King Air instrumentation, along with a summary list of variables in processed UWKA flight-level data, can be found at: <https://www.uwyo.edu/atsc/uwka/in-situ-instrumentation.html>

Instrument Notes:

Applanix: The Applanix IMU/GPS measurements and associated parameters (aircraft location and attitude, three-dimensional winds) were post-processed following the project using updated values for the instrument's installed location within the cabin, and using reference measurements obtained during calibration maneuvers during the CHACHA-22 field deployment.

Static pressure: The HADS static pressure sensor is typically used for the base measurement pressure measurement and for all dependent parameters. However, this sensor module failed at the start of the 2022 research operations, so the Mensor CPT 6140 static pressure sensor is used as the base measurement for these flights.

Radiation: The Heitronics KT 15.85 surface temperature probe was not functioning correctly for several flights; measurements are unavailable for 17, 18, and 19 August 2022.

Moisture: The chilled mirror hygrometer was not functioning correctly during one flight; dewpoint and derived moisture parameters are unavailable for 29 August 2022.

PCASP: Two PCASPs were operated during TRANS²Am-22, installed on the inboard right and outboard right instrument pylon positions. Variable names in the processed data files are appended with `_IBR` and `_OBR`, respectively. The primary PCASP for the project was the inboard right, serial no. 1013-0502-29, with the secondary being the outboard right, serial no. 39798-0200-26.

Based on post-project analysis, the 5th size channel was removed from the primary PCASP size distribution in the processed dataset. This is because of an overlap between the high- and mid-gain amplifier stages, causing double-counting of particles. The overlap is discussed in Section 3.4 of Cai et al. (2013). This reduces the number of channels from 30 to 29. Removal of the 5th versus the 6th channel was arbitrary, the number concentration between the two bins was within 3%. The particle sizing table for this instrument following post-project analysis is included as separate documentation.

Additionally, analysis of the secondary PCASP indicated undersizing by up to two channels in the post-project calibrations as compared to the pre-project calibrations. With inadequate certainty regarding this instrument's sizing of aerosol particles during TRANS²Am-22, only total particle number concentrations are included in the processed dataset for this instrument.

Reference: Cai, Y., J.R.Snyder and P. Wechsler, 2013: Calibration of the passive cavity aerosol spectrometer probe for airborne determination of the size distribution, *Atmos. Meas. Tech.*, **6**, 2349-2358.