

HIAPER-TOGA (Trace Organic Gas Analyzer): Eric C. Apel (apel@ucar.edu), Rebecca Hornbrook (rsh@ucar.edu), Alan Hills (hills@ucar.edu)

Instrument Description and Background:

TOGA will measure volatile organic compounds (VOCs), providing insights into key FRAPPE themes. Specific data will be obtained for radical precursors, tracers of anthropogenic and biogenic activities, tracers of urban and biomass combustion emissions, products of oxidative processing, precursors to aerosol formation, and compounds important for aerosol modification and transformation. TOGA measures a wide range of VOCs with high sensitivity (ppt or lower), frequency (2.0 min.), accuracy (15% or better), and precision (<3%). Over 50 species are routinely measured throughout the full GV or C130 altitude range.

Hardware, Instrument Control, Data Acquisition

TOGA is contained in a standard HIAPER rack, weighs less than 200 kg and consumes ~1 kW of power (Figure 1). The major components of the instrument are the inlet, cryogenic preconcentrator, gas chromatograph, mass spectrometer detector, zero air/calibration system, and the control/data acquisition system. All processes and data acquisition are computer controlled.

The inlet is a constant mass flow design which mitigates the intrusion of aerosols and allows for calibrations and system blanks through it.

The cryogenic preconcentrator consists of a custom-built dewar that allows rapid cooling and heating of traps used for water removal, sample enrichment and cryofocusing. Flow switching between traps is done via a heated (50°C) Valco 10-port valve.

A quadrupole mass spectrometer in selected ion monitoring mode is used to quantify individual compounds. High speed electronics allow the simultaneous measurement of several peaks with ~ 1 second peak width. A custom gas chromatograph exhibiting rapid temperature control and a Restek MXT-624, 8 meter, 0.18 mm i.d. column is used for chromatography.

System blanks and calibrations are made using a catalytic-clean air generator/dynamic dilution system with accurate ($\pm 1\%$) and precise ($\pm 1\%$) calibration gas delivery. The system operates continuously, allowing for frequent calibrations and zeros during the flight.

Instrument control and data acquisition software are LabVIEW-based (National Instruments), and provide

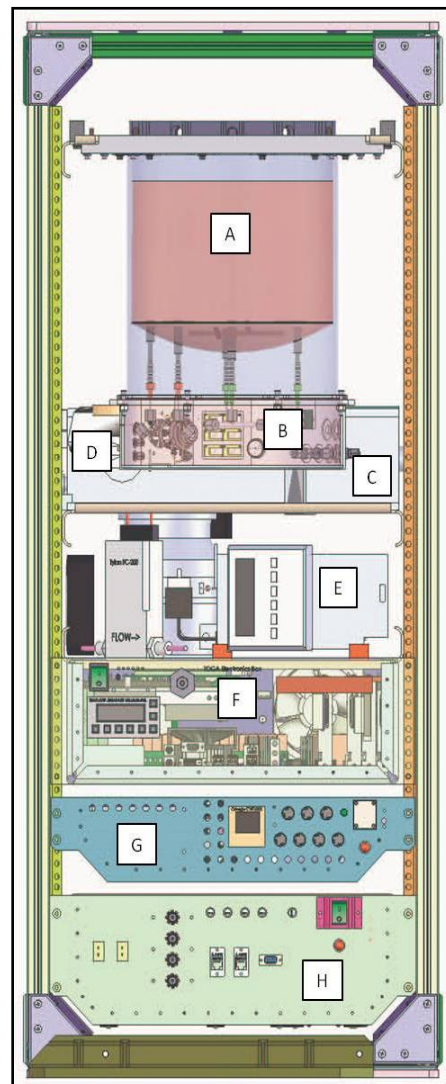


Figure 1. Diagram of the HAIS/TOGA showing the major instrument components: (A) LN2 dewar, (B) Heated space holding cryogenic enrichment traps and switching valves, (C) Mass spectrometer vacuum chamber, (D) Mass spectrometer, (F) Electronics box, (G) Zero air generator/dilution system, (H) Power box and UPS

comprehensive control of all TOGA-HIAPER functions. Gas flows, temperatures, pressures, logic states, and the aircraft serial stream constitute the parameter set which is displayed on the GUI and archived. The code performs the intricate time sequencing necessary for air sampling, preconcentration (water removal, organic compound pre-concentration, cryofocusing), GC injection and oven temperature programming.