NCAR/ACOM Community Requestable Chemical Instrumentation

NCAR
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

ATMOSPHERIC CHEMISTRY
OBSERVATIONS & MODELING

ACOM airborne observational groups

https://www2.acom.ucar.edu/observations/community-requestable-instrumentation

Who we are

The **ACOM instrumentation and engineering** groups collectively form a key community resource that provides:

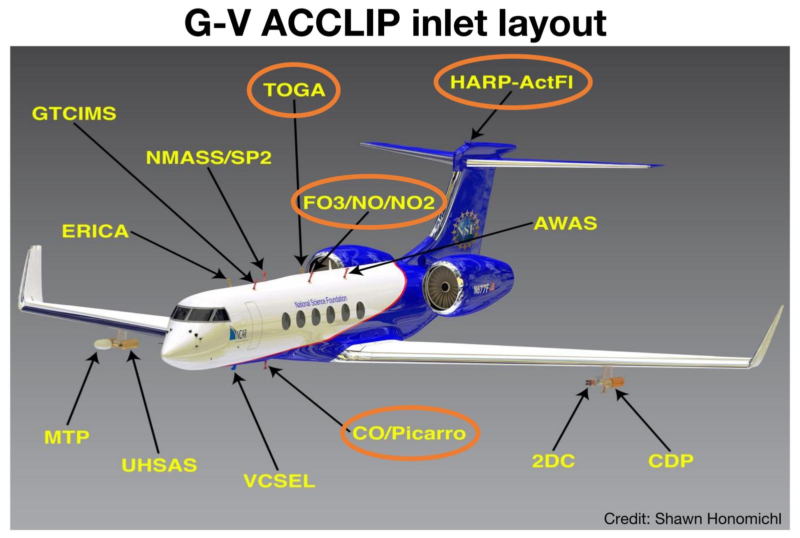
- *Requestable instrumentation and associated personnel* for NSF-supported campaigns through the Lower Atmosphere Observing Facility
- *Essential data* for air quality, climate, dynamical and satellite validation campaigns (NO_x, O_3, VOCs, CO, CO_2, chemical tracers, actinic flux)
- *Extensive instrumentation experience* in design, fabrication and deployment on research aircraft
- *Extensive campaign experience* including mission design, flight planning, post-campaign data analysis and modeling
- Scientific expertise for publications tied to mission goals and discoveries

Investigators may request ACOM instruments for campaigns. We strongly encourage early contact with the ACOM instrument PIs to provide clarity on instrumentation requirements and availability, assistance on campaign design and to build strong scientific relationships.

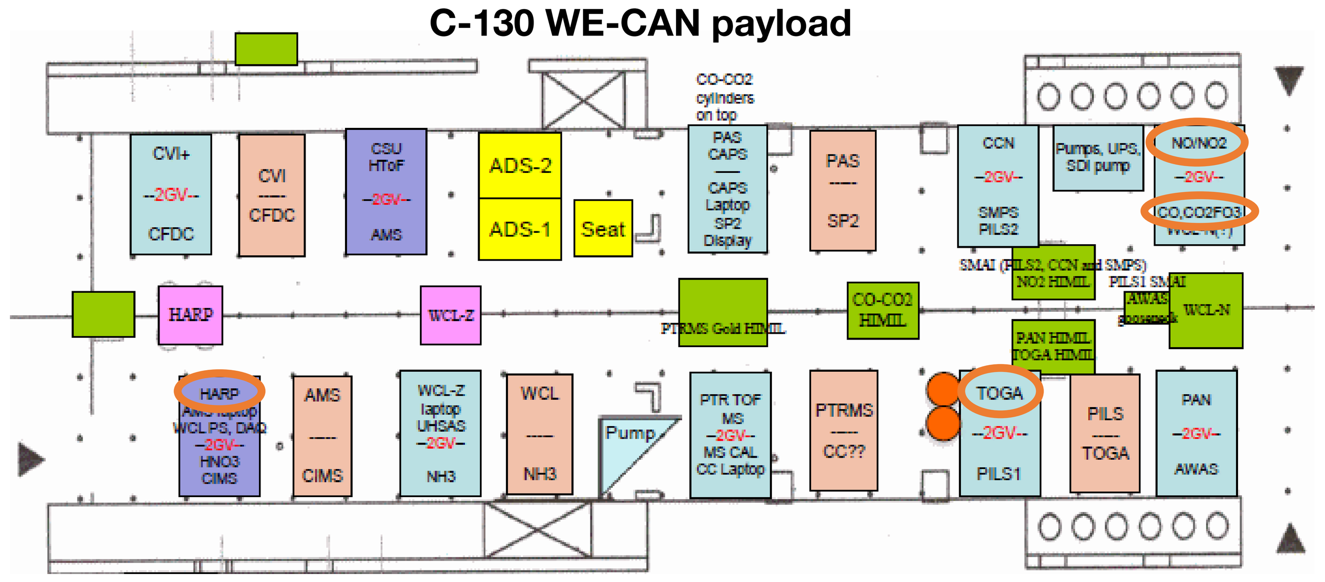
Please also visit the poster by Brett Palm and Alessandro Franchin for a description of ACOM's developing wing-pod CIMS and NO_x-LIF instrumentation.

Recent ACOM airborne projects	
Future	GOTHAAM, SCENICS, AQUARIUS,...
2024	CAESAR, SOS-SLC
2023	MAIR-E
2022	ACCLIP, TI3GER
2021	Methane-AIR
2018	WE-CAN, BB-FLUX
2016	ORCAS
2015	WINTER, CSET
2014	FRAPPÉ, CONTRAST
2013	NOMADSS
2012	DC3, TORERO
2011	ICE-T, HIPPO-4, HIPPO-5
2010	PREDICT, WAMO, HIPPO-3
2009	MIRAGE, HIPPO-1, HIPPO-2
2008	START08, VOCALS
2007	PACDEX, PASE, ICE-L

G-V ACCLIP inlet layout



C-130 WE-CAN payload



TOGA


Eric Apel

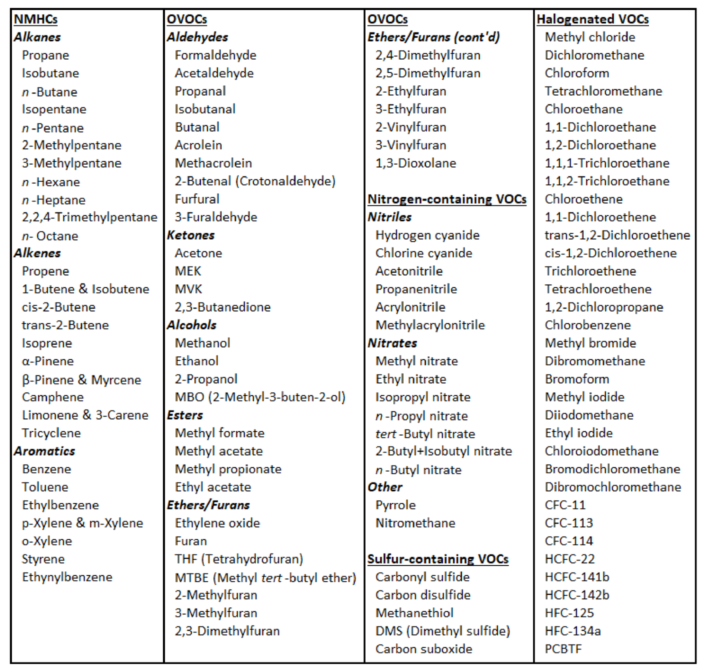

Daun Jeong


Alan Hills

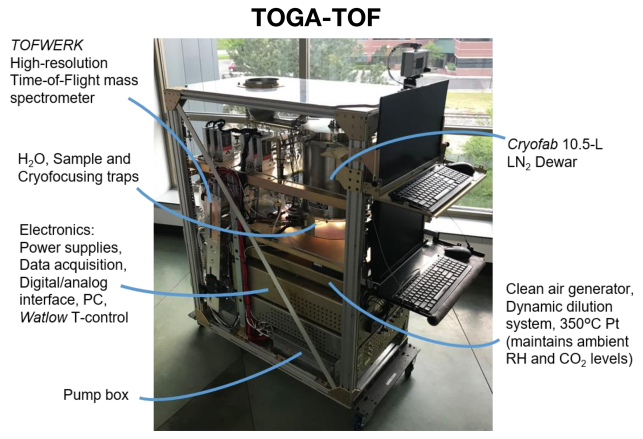

Rebecca Hornbrook

NCAR Trace Organic Gas Analyzer

Volatile organic compounds (VOCs) from a wide array of sources are present in the atmosphere, both directly emitted and formed in situ from the atmospheric degradation of precursor species, with lifetimes that range from a few minutes to hundreds of years. The NCAR TOGA-TOF instrument with a TOFWERK Time-of-Flight mass spectrometer measures a large suite of 100+ VOCs with high sensitivity (low to sub-ppt), frequency (2 minutes or better), accuracy (20% or better), and precision (<3%) throughout the troposphere and lower stratosphere from the surface to 16 km or higher.



TOGA-TOF



Core Chemistry

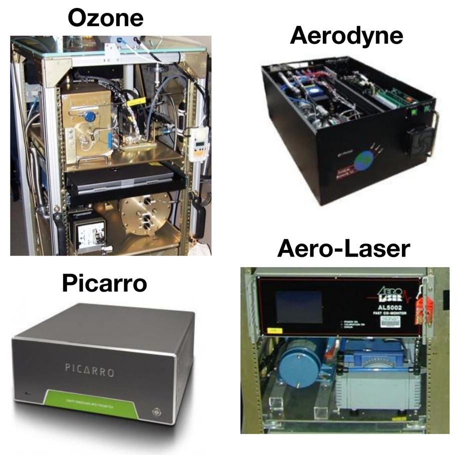

Teresa Campos

Chemical tracers

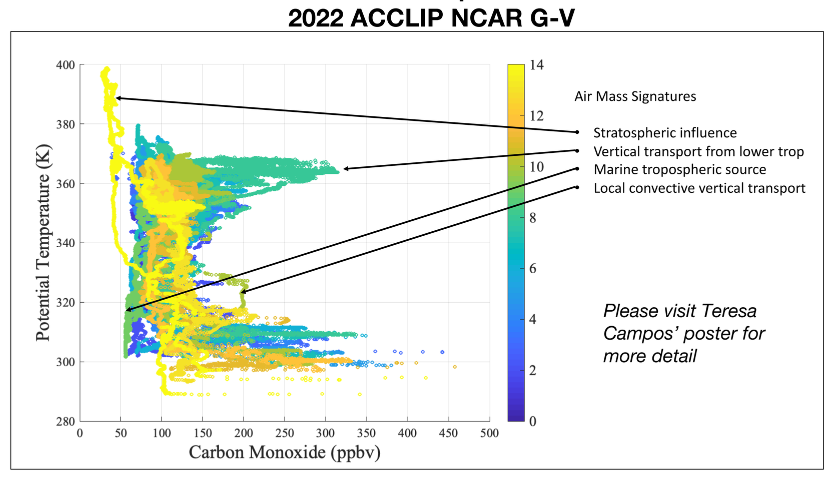
The core measurement suite encompasses tracers for emissions, transport, greenhouse gases and chemical evolution with connections to air quality, composition, weather and climate. Hence they are among the most highly requested instruments for a broad range of chemical, meteorological, dynamical and microphysical studies.

The instruments include:

Instrument	Trace gases	Rate
Picarro G2401-mc	CO, CO_2, Methane and H_2O	0.5 -0.8 Hz
Aerodyne QCL TILDAS	CO, N_2O and H_2O	1 Hz
Chemiluminescence ozone	O_3	1 - 5 Hz
Aero-Laser Vacuum-UV Resonance Fluorescence	CO	0.5 Hz



Vertical CO profiles
2022 ACCLIP NCAR G-V



NO_x

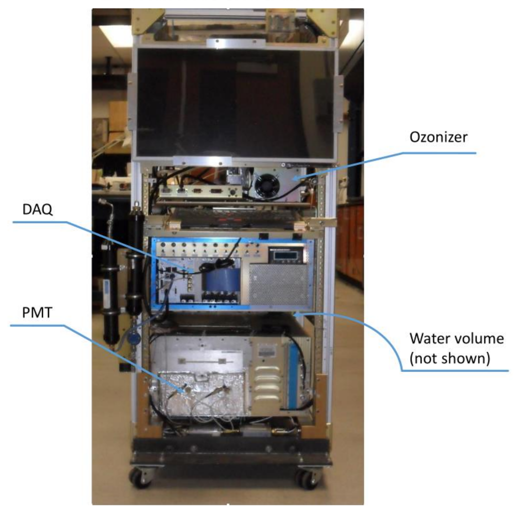

Alessandro Franchin

Chemiluminescence NO_x

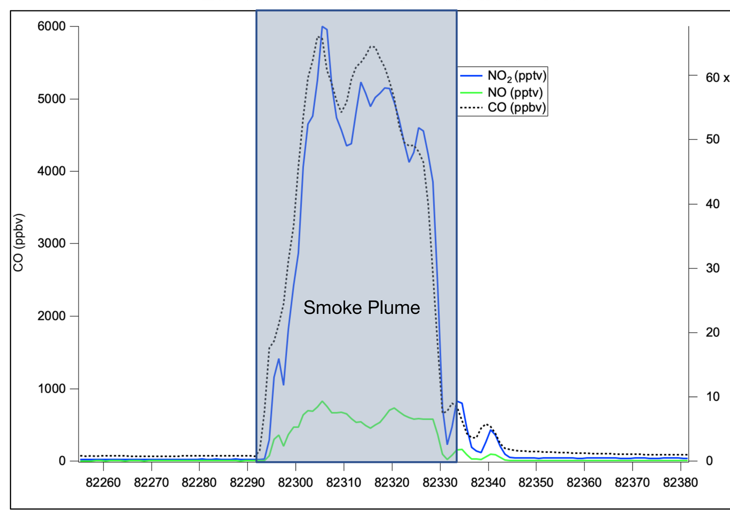
NO_x is an important driver of air quality and climate. It affects ozone chemistry, short-lived climate forcers, and aerosol radiative impact. It is active in reactive nitrogen partitioning and interactions between anthropogenic and biogenic emissions.

The 2-channel NO_x instrument is based on the chemiluminescence detection of NO via reaction with O_3 to form excited nitrogen dioxide (NO_2) which is detected via photon counting. One sample channel is used to measure nitric oxide (NO) and the second measures NO_2. The high precision, 1 Hz measurements are among the most sensitive techniques available.

NO_x
2-channel Instrument



Taylor Creek Fire
20180730 WE-CAN NCAR C-130



HARP


Samuel Hall

High-performance Instrumented Airborne Platform for Environmental Research Airborne Radiation Package

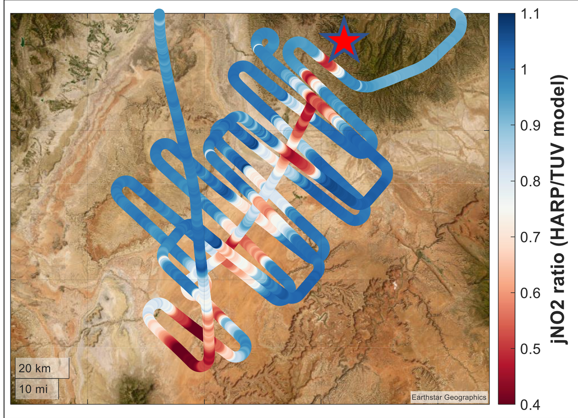

Kirk Ullmann

HARP – Actinic Flux

Sunlight is *the* driver of photochemical reactions including the evolution of ozone, biomass burning emissions and greenhouse gases. These gases control the evolution of aerosols that impact actinic flux through absorption and scattering.

HARP – Actinic Flux measures spectrally-resolved (~280-650 nm), 1 Hz actinic flux for calculation of ~40 photolysis frequencies (e.g. $j[O_3 \rightarrow O_2 + O(^1D)]$, $j[NO_2 \rightarrow NO + O(^3P)]$)

Bear Trap Fire
20180809 WE-CAN NCAR C-130

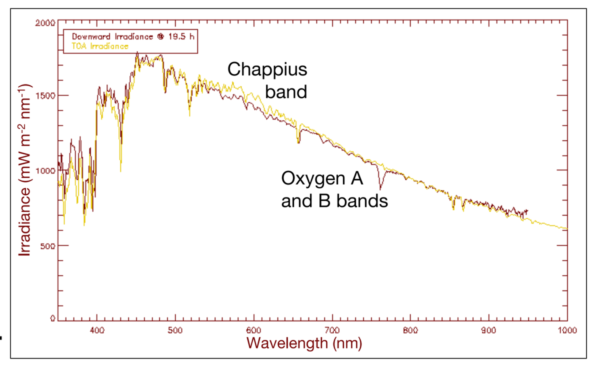


HARP – Irradiance

Irradiance flux determines radiative cloud, aerosol and surface properties that drive local and climatic energy distributions.

HARP – Irradiance measures spectrally-resolved (~400-2200 nm) 1 Hz flux. Data is analyzed in collaboration with Sebastian Schmidt at CU Boulder.

Comparison with extraterrestrial flux
20120121 TORERO NCAR G-V



Additional chemical instruments are available for request from EOL and university collaborators
https://www.eol.ucar.edu/research-facilities/airborne-instrumentation

ACKNOWLEDGMENTS

Our instrumentation capabilities are only possible due to the strength of the ACOM engineering team (Steve Shertz, Steve Gabbard, Courtney Owen, Kirk Lesko) who assist with the design, construction, testing and troubleshooting. Thanks to the RAF staff and crew who coordinate and enable integration on the aircraft and provide critical field support. NCAR is operated by the University Corporation for Atmospheric Research under the sponsorship of the National Science Foundation (NSF). Special thanks to Frank Flocke and John Orlando for input to this poster.