



ATMOSPHERIC CHEMISTRY OBSERVATIONS & MODELING

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, CO₂, 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

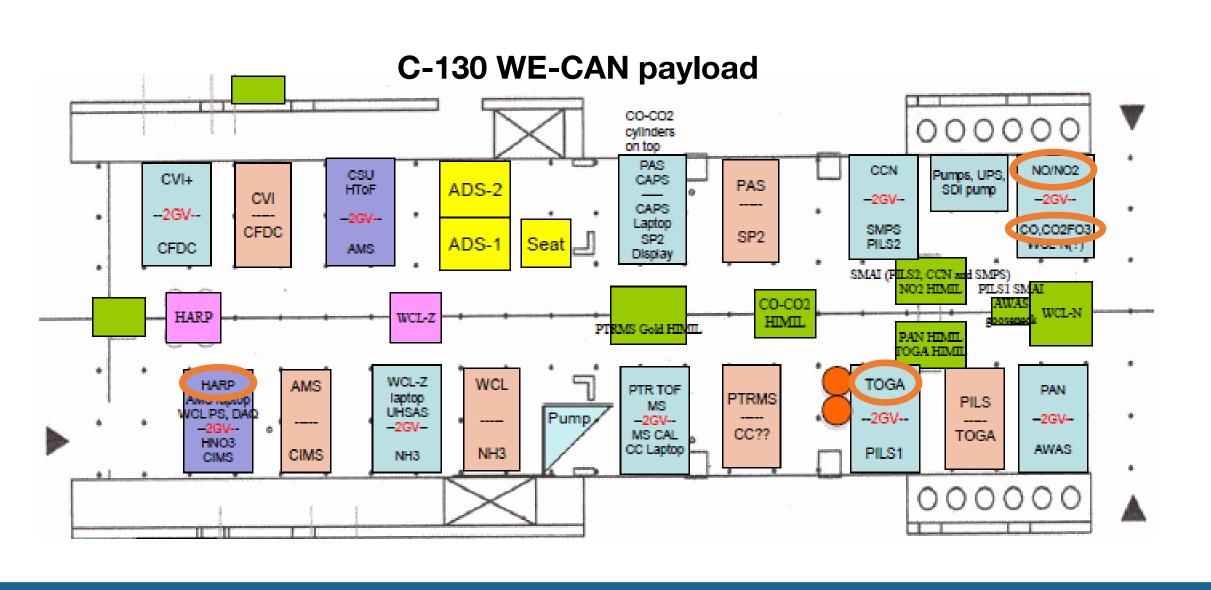
Investigators may request ACOM instruments for campaigns. We strongly encourage early contact with the ACOM instrument PIs to provide clarity on instrumentation requirements and availability, assistance on campaign design and to build strong scientific relationships.

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			







ACKNOWLEDGMENTS

Our instrumentation capabilities are only possible due to the strength of the ACOM engineering team (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.

NCAR/ACOM Community Requestable Chemical Instrumentation



ACOM airborne observational groups

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



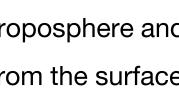
Credit: Shawn Honomic



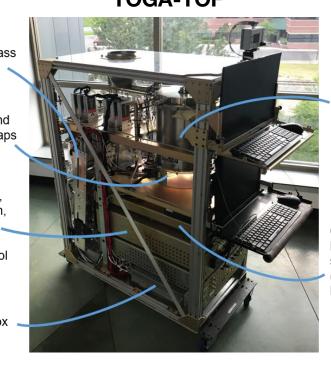
Volatile organic compounds (VOCs) from a wide array of sources are present in the atmosphere, both directly emitted and formed in situ from the atmospheric degradation of precursor species, with lifetimes that range from a few minutes to hundreds of years. The NCAR TOGA-TOF instrument with a TOFWERK 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

NMHCs	OVOCs	OVOCs	Halogenated
Alkanes	Aldehydes	Ethers/Furans (cont'd)	Methyl chlo
Propane	Formaldehyde	2,4-Dimethylfuran	Dichlorome
Isobutane	Acetaldehyde	2,5-Dimethylfuran	Chloroform
<i>n</i> -Butane	Propanal	2-Ethylfuran	Tetrachloro
Isopentane	Isobutanal	3-Ethylfuran	Chloroethar
n -Pentane	Butanal	2-Vinylfuran	1,1-Dichlor
2-Methylpentane	Acrolein	3-Vinylfuran	1,2-Dichloro
3-Methylpentane	Methacrolein	1,3-Dioxolane	1,1,1-Trichl
n -Hexane	2-Butenal (Crotonaldehyde)		1,1,2-Trichl
n -Heptane	Furfural	Nitrogen-containing VOCs	Chloroethe
2,2,4-Trimethylpentane	3-Furaldehyde	Nitriles	1,1-Dichlor
n- Octane	Ketones	Hydrogen cyanide	trans-1,2-D
Alkenes	Acetone	Chlorine cyanide	cis-1,2-Dick
Propene	MEK	Acetonitrile	Trichloroet
1-Butene & Isobutene	MVK	Propanenitrile	Tetrachloro
cis-2-Butene	2,3-Butanedione	Acrylonitrile	1,2-Dichlor
trans-2-Butene	Alcohols	Methylacrylonitrile	Chlorobenz
Isoprene	Methanol	Nitrates	Methyl bror
α-Pinene	Ethanol	Methyl nitrate	Dibromome
β-Pinene & Myrcene	2-Propanol	Ethyl nitrate	Bromoform
Camphene	MBO (2-Methyl-3-buten-2-ol)	Isopropyl nitrate	Methyl iodi
Limonene & 3-Carene	Esters	n - Propyl nitrate	Diiodometh
Tricyclene	Methyl formate	tert -Butyl nitrate	Ethyl iodide
Aromatics	Methyl acetate	2-Butyl+Isobutyl nitrate	Chloroiodor
Benzene	Methyl propionate	n-Butyl nitrate	Bromodichl
Toluene	Ethyl acetate	Other	Dibromoch
Ethylbenzene	Ethers/Furans	Pyrrole	CFC-11
p-Xylene & m-Xylene	Ethylene oxide	Nitromethane	CFC-113
o-Xylene	Furan		CFC-114
Styrene	THF (Tetrahydrofuran)	Sulfur-containing VOCs	HCFC-22
Ethynylbenzene	MTBE (Methyl tert -butyl ether)	Carbonyl sulfide	HCFC-141b
	2-Methylfuran	Carbon disulfide	HCFC-142b
	3-Methylfuran	Methanethiol	HFC-125
	2,3-Dimethylfuran	DMS (Dimethyl sulfide)	HFC-134a
		Carbon suboxide	PCBTF

	Halogenated VOCs	l troj
	Methyl chloride	-
	Dichloromethane	f
	Chloroform	froi
	Tetrachloromethane	
	Chloroethane	
	1,1-Dichloroethane	
	1,2-Dichloroethane	
	1,1,1-Trichloroethane	
	1,1,2-Trichloroethane	TOFWER
/OCs	Chloroethene	High-reso
	1,1-Dichloroethene	Time-of-F
	trans-1,2-Dichloroethene	spectrom
	cis-1,2-Dichloroethene	opeouein
	Trichloroethene	
	Tetrachloroethene	
	1,2-Dichloropropane	H ₂ O, Sa
	Chlorobenzene	Cryofoc
	Methyl bromide	
	Dibromomethane	Electror
	Bromoform	Power s
	Methyl iodide	Data ac
	Diiodomethane	Digital/a
_	Ethyl iodide	interface
te	Chloroiodomethane	Watlow
	Bromodichloromethane	
	Dibromochloromethane	
	CFC-11	
	CFC-113 CFC-114	F
	HCFC-114	
Cs	HCFC-22 HCFC-141b	
	HCFC-141b HCFC-142b	
	110F0-1420	



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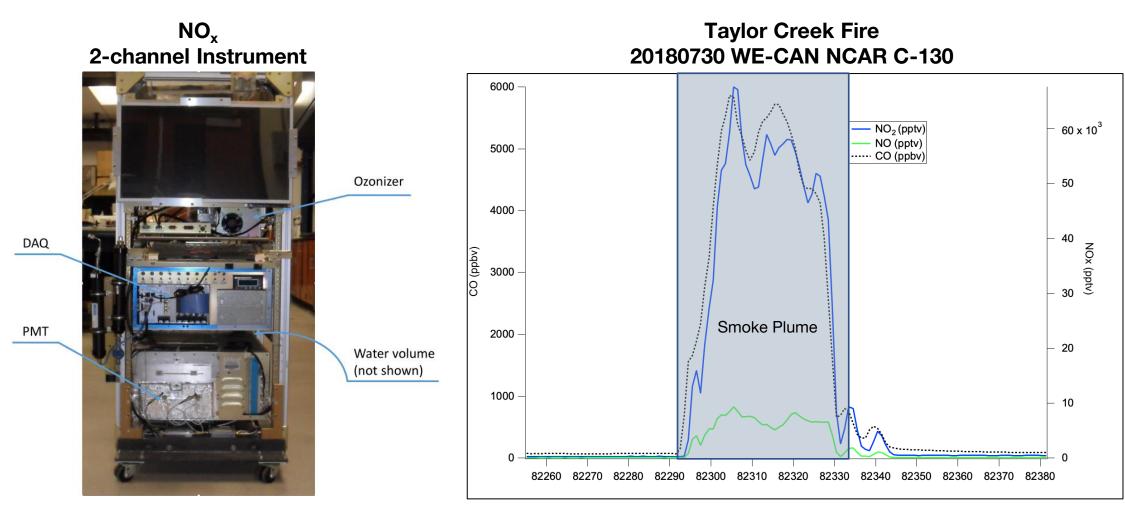




Chemiluminescence NO,

 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 (NO₂) which is detected via photon counting. One sample channel is used to measure nitric oxide (NO) and the second measures NO₂. The high precision, 1 Hz measurements are among the most sensitive techniques available.







om the surface to 16 km or higher.

TOGA-TOF

namic dilution system, 350°C P (maintains ambient $\dot{R}H$ and CO_2 levels)

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		СО	0.5 Hz	
Dzone	Aerodyne	400 360 340 340		Air Mass Signatures 12 Stratospheric influe Vertical transport fr Marine tropospheri Local convective ver
icarro	Aero-Laser	Potential Te		- 6 - 4 Please visit Te Campos' post

Alessandro Franchin

Samuel Hall

HARP Airborne Platform for Environmental Research Airborne Radiation Package

HARP – Actinic Flux

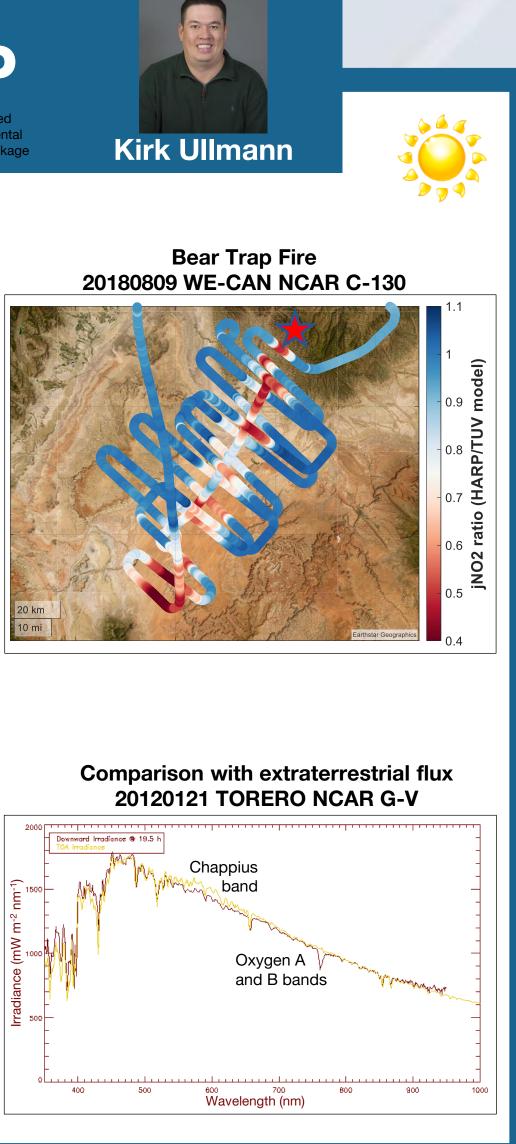
Sunlight is *the* driver of photochemical reactions including the evolution of ozone, biomass burning emissions and greenhouse gases. These gases control the evolution of aerosols that impact actinic flux through absorption and scattering.

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

HARP – Irradiance

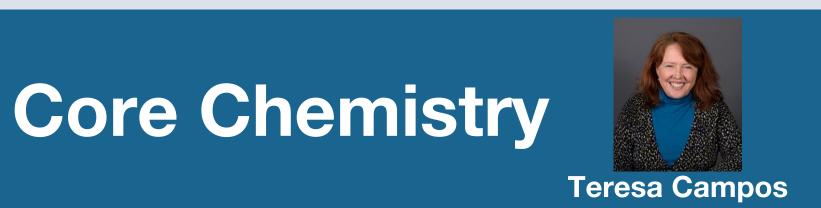
Irradiance flux determines radiative cloud, aerosol and surface properties that drive local and climatic energy distributions.

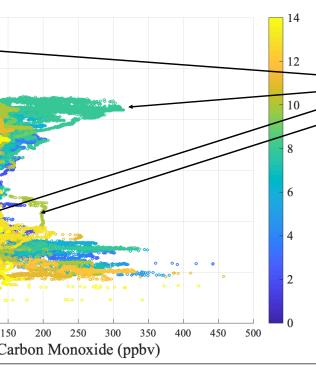
HARP – Irradiance measures spectrally-resolved (~400-2200 nm) 1 Hz flux. Data is analyzed in collaboration with Sebastian Schmidt at CU Boulder.



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







luence t from lower trop eric source ertical transport

Campos' poster for more detail