

ASIA-AQ DC-8 Instrument Payload and Investigators (Trace Gas Measurements)

Instrument Name/Technique	Parameters Measured	Investigator(s)
Chemiluminescence	<i>in situ</i> O ₃ , NO, NO ₂	Ale Franchin and Frank Flocke (National Center for Atmospheric Research)
IR Absorption Spectrometry	<i>in situ</i> CO, CH ₄ , CO ₂ , N ₂ O	Glenn Diskin and Joshua Digangi (NASA Langley)
Diode Laser Hygrometer (DLH)	<i>in situ</i> water vapor	Glenn Diskin (NASA Langley)
Laser Induced Fluorescence	<i>in situ</i> CH ₂ O	Glenn Wolfe and Tom Hanisco (NASA Goddard)
Chemical Ionization Mass Spectrometer (CIMS)	<i>in situ</i> PANs, ClNO ₂ , Cl ₂	Greg Huey (Georgia Institute of Technology)
Chemical Ionization Mass Spectrometer (CIMS)	<i>in situ</i> SO ₂ , HONO, HO ₂ NO ₂ , organic acids, HCl	Joon-Young Ahn (National Institute for Environmental Research, Korea) and Saewung Kim (University of California, Irvine)
Chemical Ionization Mass Spectrometer (CIMS)	<i>in situ</i> HNO ₃ , H ₂ O ₂ , organic peroxides, organic acids, etc.	Paul Wennberg and John Crouse (California Institute of Technology)
Los Gatos Research Ammonia Analyzer	<i>in situ</i> NH ₃	Gangwoong Lee (Hankuk University of Foreign Studies, Korea)
Open-Path Ammonia Laser Spectrometer (OPALS)	<i>in situ</i> NH ₃	Mark Zondlo (Princeton University)
Ethane Tunable Infrared Laser Direct Absorption Spectroscopy (TILDAS)	<i>in situ</i> C ₂ H ₆	Dana Caulton (University of Wyoming)
Whole Air Sampler	<i>in situ</i> C ₂ -C ₁₁ alkanes, C ₂ -C ₁₀ alkenes, C ₆ -C ₉ aromatics, C ₁ -C ₅ alkyl nitrates, etc.	Donald Blake (University of California, Irvine)
Trace Organic Gas Analyzer (TOGA)	<i>in situ</i> C ₃ -C ₁₀ hydrocarbons, C ₁ -C ₇ OVOCs, HCN, CH ₃ CN, C ₁ -C ₂ halocarbons, etc.	Eric Apel and Rebecca Hornbrook (National Center for Atmospheric Research)
Cavity Enhanced Spectrometer for Atmospheric Research (CAESAR)	CHOCHO, NO ₂ , H ₂ O	Kyung-Eun Min (Gwangju Institute for Science and Technology, Korea)
Proton Transfer Reaction-Time of Flight-Mass Spectrometer (PTR-ToF-MS)	<i>in situ</i> speciated nonmethane hydrocarbons and OVOCs	Armin Wisthaler and Tomas Mikoviny (University of Oslo)

ASIA-AQ DC-8 Instrument Payload and Investigators (Aerosol measurements)

Instrument Name/Technique	Parameters Measured	Investigator(s)
Optical particle counters, nephelometers, soot photometer	<i>in situ</i> aerosol number, size distribution, optical and microphysical properties	Luke Ziemba and Richard Moore (NASA Langley)
Single Particle Soot Photometer (SP2) and nano-Scanning Mobility Particle Sizer (nano-SMPS)	<i>in situ</i> black carbon mass and aerosol number size distributions	Sae-Hee Lim (Chungnam National University, Korea)
Single Particle Soot Photometer (SP2)	<i>in situ</i> black carbon mass	Handol Lee (Inha University, Korea)
Cloud Condensation Nuclei (CCN) counter and Scanning Mobility Particle Sizer (SMPS)	<i>in situ</i> CCN number concentration and aerosol number size distributions	Seong-Soo Yum (Yonsei University, Korea)
High Resolution-Time of Flight-Aerosol Mass Spectrometer (HR-ToF-AMS)	size-resolved submicron aerosol chemical composition	Jose Jimenez and Pedro Campuzano-Jost (University of Colorado)
High Resolution-Time of Flight-Aerosol Mass Spectrometer (HR-ToF-AMS)	size-resolved submicron aerosol chemical composition	Taehyoung Lee (Hankuk University of Foreign Studies)
Chemical Analysis of aeRosol ON-line (CHARON) particle inlet coupled to PTR-MS	<i>in situ</i> speciated organic aerosol composition	Armin Wisthaler and Tomas Mikoviny (University of Oslo)
Bulk aerosol filter collection	soluble aerosol composition	Jack Dibb (University of New Hampshire)
Transmission Electron Microscopy (TEM) filter analysis	single particle chemical composition	Kouji Adachi (Meteorological Research Institute, Japan)

ASIA-AQ DC-8 Instrument Payload and Investigators (Meteorological measurements)

Instrument Name/Technique	Parameters Measured	Investigator(s)
Charged-coupled device Actinic Flux Spectroradiometers (CAFS)	upwelling and downwelling actinic flux (4π sr)	Sam Hall and Kirk Ullman (National Center for Atmospheric Research)
Meteorological Measurement System (MMS)	3D winds	T. Paul Bui (NASA Ames)

ASIA-AQ GV Instrument Payload and Investigators

Instrument Name/Technique	Parameters Measured	Investigator(s)
GCAS (GEO-CAPE Airborne Simulator)/UV Spectrometer	Trace gas column densities of NO ₂ and CH ₂ O	Laura Judd (NASA Langley) and Scott Janz (NASA Goddard)
HSRL/DIAL (High Spectral Resolution Lidar/Differential Absorption Lidar)	Vertically resolved profiles of aerosol backscatter, aerosol extinction, and ozone	John Hair (NASA Langley)

ASIA-AQ GIII Instrument Payload and Investigators

Instrument Name/Technique	Parameters Measured	Investigator(s)
High Altitude Lidar Observatory (HALO)	Vertically resolved profiles of water vapor and aerosols; methane column densities	Amin Nehrir (NASA Langley)
Airborne Visible/Infrared Imaging Spectrometer (AVIRIS)	Large point source emissions of CO ₂ and CH ₄	Charles Miller and Michael Eastwood (NASA JPL)

Chemiluminescence detection of NO, NO₂, and O₃

Team Members:

Alessandro Franchin, NCAR

Kirk Lesko, NCAR

Frank Flocke, NCAR

Andrew Weineimer, NCAR

NCAR (National Center for Atmospheric Research)

Measured compounds:

Nitric Oxide (NO)

Nitrogen Dioxide (NO₂)

Ozone (O₃)

Most recent flight campaigns (Year, Aircraft):

ACCLIP (2022, GV)

TIGER (2022, GV)

FIREX-AQ (2019, Twin Otter)

WE-CAN (2018, C-130)

KORUS-AQ (2016, DC-8)



IR Absorption Spectrometry Trace Gas Suite

Team Members:

Glenn Diskin (PI), NASA LaRC

Josh DiGangi (Co-I), NASA LaRC

Yonghoon Choi (Scientist), AMA

Mario Rana (Technician), AMA

Dave Eckberg (Technician), NASA LaRC

Johnny Mao (Technician), NASA LaRC

NASA LaRC (Langley Research Center)

AMA (Analytical Mechanics Associates - NASA Contract)

Instrument	Species	Precision (1σ) (1 sec)	Accuracy
DACOM	CO	<1% or 1 ppbv	2%
	CH ₄	<0.1%	1%
	N ₂ O	<0.1%	1%
LICOR	CO ₂	0.05 ppmv	0.15 ppmv

Previous Field Campaigns:

- FIREX-AQ, KORUS-AQ, SEAC⁴RS, DISCOVER-AQ, DC3, ARCTAS, TC4, many others
- 20+ projects since the early 80's
- NASA DC-8 & NASA P-3B aircraft



Diode Laser Hygrometer (DLH)

Team Members:

Glenn Diskin (PI), NASA LaRC

Josh DiGangi (Co-I), NASA LaRC

Yonghoon Choi (Scientist), AMA

Mario Rana (Technician), AMA

Dave Eckberg (Technician), NASA LaRC

Johnny Mao (Technician), NASA LaRC

NASA LaRC (Langley Research Center)

AMA (Analytical Mechanics Associates - NASA Contract)

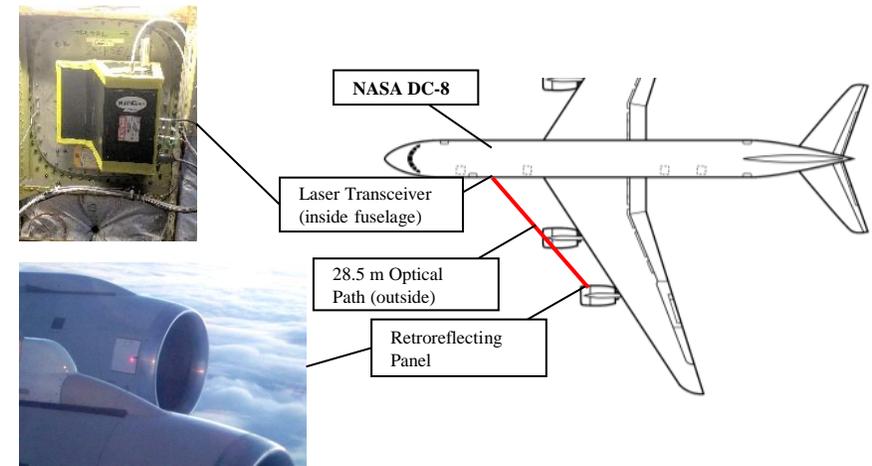
Species	Max. Measurement Rate	Precision (1σ) (1 sec)	Accuracy
H ₂ O(v)	Up to 100 Hz	0.1% or 0.05 ppmv	5% or 0.5 ppmv
RHw,* RH _i		< 1%	10-15%

*Derived using project static pressure, temperature

Previous Field Campaigns:

- 9 different aircraft over last 2 decades
 - DC-8 - FIREX-AQ, ATom, KORUS-AQ, ASCENDS, SEAC⁴RS, DC3, etc.
 - P-3B - DISCOVER-AQ, CAMP2EX, IMPACTS
 - WB-57 - MACPEX, POSIDON, ACCLIP, SABRE
 - Global Hawk - ATTREX

Open-path laser absorption spectrometer



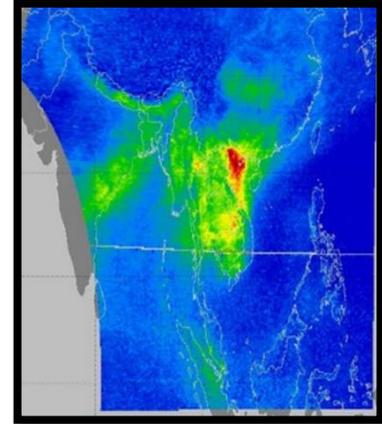
In Situ Airborne Formaldehyde (ISAF): Laser-Induced Fluorescence

ISAF Team

Name	Role	Institution
Glenn Wolfe	PI	NASA Goddard Space Flight Center
Thomas Hanisco	Co-PI	NASA Goddard Space Flight Center
Jason St. Claire	Scientist	University of Maryland, Baltimore County (UMBC)
Erin Delaria	Scientist	NASA Post-Doc
Jin Liao	Scientist	University of Maryland, Baltimore County (UMBC)
Reem Hannun	Scientist	University of Pittsburgh
Steven Smith	Technician	SciGlob
Abby Sebol	Student	University of Maryland

ISAF Measurements

ISAF measures in situ formaldehyde (HCHO). HCHO is a gas found throughout the lower atmosphere. It is a byproduct of the atmospheric degradation of hydrocarbons like methane. It is also directly emitted by combustion. Measurements of HCHO inform our understanding of 1) hydrocarbon emissions, 2) pollution-forming chemistry, and 3) air mass transport.



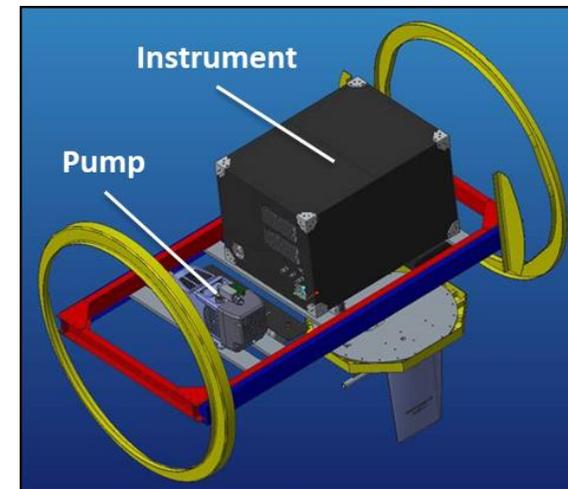
*GEMS HCHO, March 2021, van Gent et al.**

**https://atmos2021.esa.int/iframe-agenda/files/Contribution_138_final_extabs.pdf*

ISAF Previous Flight Campaigns

Mission	Year	Platform	Science Focus
DC3	2012	NASA DC8	Continental convection
SENEX	2013	NOAA P3	Biosphere-urban interactions
SEAC4RS	2013	NASA DC8	Clouds, convection, chemistry
CONTRAST	2014	NCAR GV	Remote ocean convection
WINTER	2015	NCAR C130	Wintertime near-surface chemistry
SONGNEX	2015	NOAA P3	Oil and natural gas
ATom	2016 - 2018	NASA DC8	Global oxidation and composition
FIREX-AQ	2019	NASA DC8	Biomass burning
SARP	2021	NASA DC8	Student training
ACCLIP	2022	NASA WB57	Asian Monsoon outflow

ISAF Design



ISAF installation for ACCLIP

Dimensions: 17.5" x 15.5" x 24"
 Weight: 100 lb
 Power: 600 W
 Detection Limit: 50 pptv
 Sample Rate: 1 Hz

Georgia Tech-Chemical Ionization Mass Spectrometer (GT-CIMS)

Gregory Huey	Principle Investigator (PI)
David Tanner	Co-PI
Linda Arterburn	Graduate Student
Andrew Neuman	Consultant
James Roberts	Co-Investigator

Peroxyacetyl Nitrate (PAN)	$\text{CH}_3\text{C}(\text{O})\text{OONO}_2$
Peroxypropionyl Nitrate (PPN)	$\text{C}_2\text{H}_5\text{C}(\text{O})\text{OONO}_2$
Peroxybutyryl Nitrate (PBN)	$\text{CH}_3\text{CH}(\text{CH}_3)\text{C}(\text{O})\text{OONO}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(\text{O})\text{OONO}_2$
Peroxyacryloyl Nitrate (APAN)	$\text{CH}_2=\text{CHC}(\text{O})\text{OONO}_2$
Peroxybenzoyl Nitrate (PBzN)	$\text{C}_6\text{H}_5\text{C}(\text{O})\text{OONO}_2$
Nitryl Chloride	ClNO_2
Molecular Chlorine	Cl_2

Agency Airborne Field Campaigns

NASA INTEX (2006), ARCTAS (2008), DC3 (2012),
SEAC⁴RS (2013), KORUS-AQ (2016),
ATom (2016-2018), FIREX-AQ (2019)

NSF ANTCI (2005), DC3 (2012),
CONTRAST (2014), FRAPPE (2014),
ACCLIP (2022)



Chemical Ionization Mass Spectrometer (CIMS)



PI : Joon-Young Ahn (NIER)

Co-PI : Saewung Kim (UC, Irvine)

Team Members :

Seung-Myung Park (NIER)

Kim Hyun Woong (NIER)

Jae-Yun Lee (NIER)

Byun Myounghwa (NIER)

Cyril McCormick (UC, Irvine)

Katherine Paredero (UC, Irvine)

Jason Novelly (UC, Irvine)

NIER (National Institute of Environmental Research)

List of Field Campaigns

- KORUS-AQ (2016, NASA DC-8) later upgraded to include Time-of-Flight (ToF) detector
- Center for FRIEND Project (2022-2023) providing characteristics of high-concentration ultrafine dust generation through international measurement in Northeast Asia
- ASIA-AQ (2024, NASA DC-8) joint with UC, Irvine

Compounds Measured

SO₂

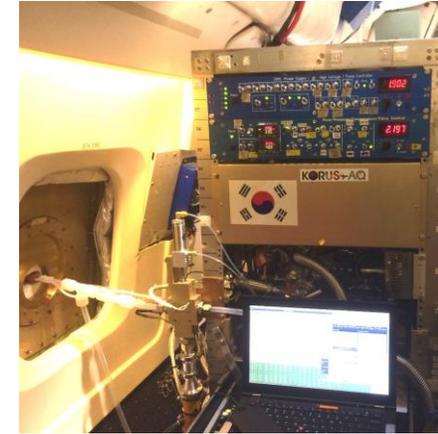
HONO

HO₂NO₂

Organic acids

HCl

On DC-8 during KORUS-AQ



In laboratory at NIER's Seoul Supersite



Caltech Chemical Ionization Mass Spectrometers (CIT-CIMS)

Team Members:

John Crouse (co-PI), Caltech

Paul Wennberg (co-PI), Caltech

Katherine Ball (co-I), Caltech

Young Ro Lee (co-I), Caltech

Caltech (California Institute of Technology)

Measured Compounds:

Acids (HNO_3 , HO_2NO_2 , formic and acetic acids)

VOC oxidation products (phenol, cresol, isoprene and other VOC oxidation products)

Hydrogen peroxides (H_2O_2 , CH_3OOH)

Previous Field Campaigns:

AEROMMA (2023), DC-8

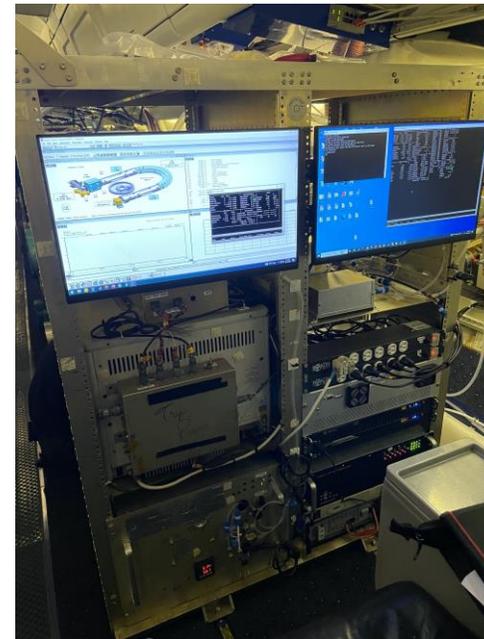
FIREX-AQ (2019), DC-8

Atom (2016-2019), DC-8

KORUS-AQ (2016), DC-8

SEAC⁴RS (2013), DC-8

DC3 (2012), DC-8



Los Gatos Research Ammonia Analyzer – Trace (LGR - AAT)



PI : Gangwoong Lee
Co-PI : Joon-Young Ahn

Institution : Hankuk University of Foreign Studies/National Institute of Environmental Research (HUFS)/(NIER)

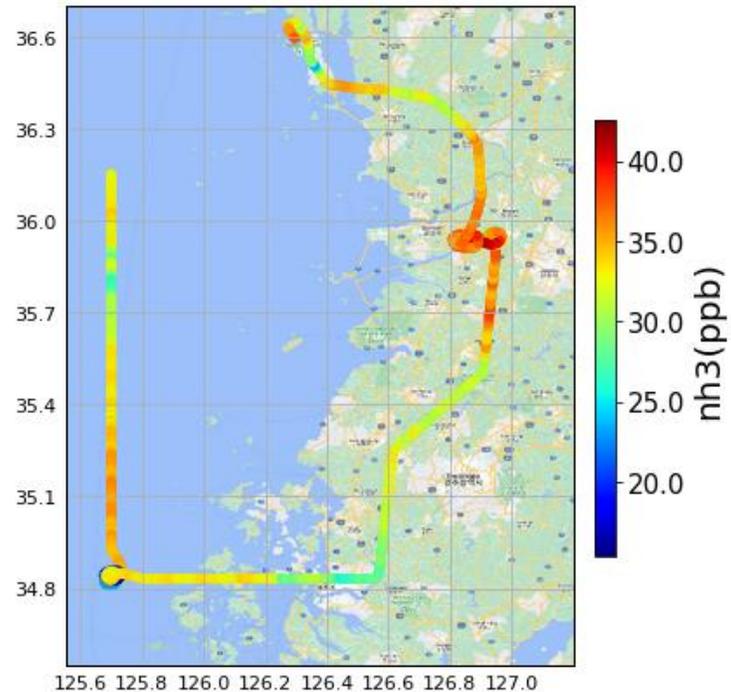


Team Members :
Jeonghwan Kim (Ph.D. student, HUFS)
Jimin Lee (Master student, HUFS)

Instrument	Parameters	Precision
LGR-AAT	NH ₃	1σ; 0.1 s/ 1 s/ 10 s 0.7 ppb/ 0.2 ppb/ 0.08 ppb

List of Field Campaigns measured by LGR-AAT

- Center for FRIEND Project (2021-2022), capacity building for airborne measurements of PM_{2.5} precursors
- ASIA-AQ (2024)



Open-Path Ammonia Laser Spectrometer(OPALS)

PI: Mark Zondlo (Princeton University)

Group Members: Nathan Li

Hongmin Yi

Dan Moore

James McSpirtt

Vladislav Sevostianov

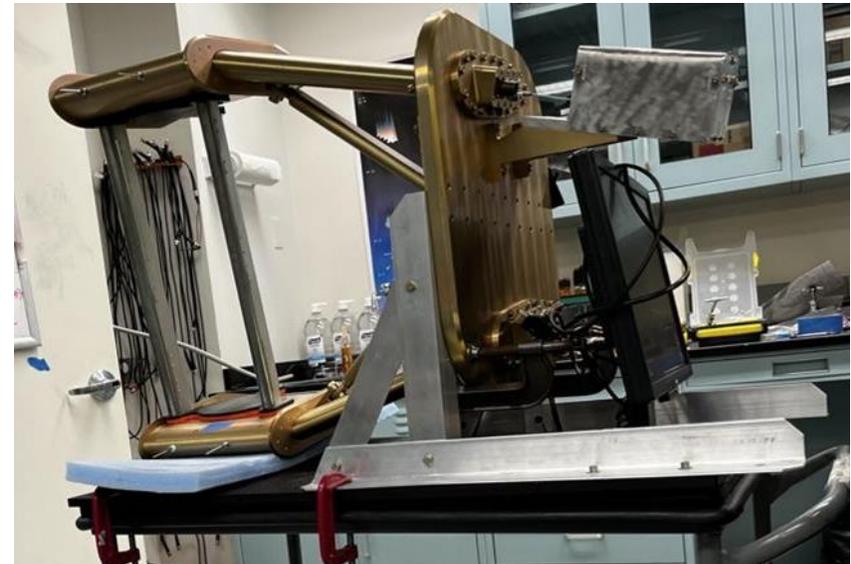
Lars Wendt

Yunseo Choi

Measuring ammonia (NH₃)

OPALS is a recently developed instrument flying for the first time on the DC-8 during AEROMMA (2023)

Open-path cell in the laboratory



Ethane Tunable Infrared Laser Direct Absorption Spectroscopy (TILDAS)

Team members:

Dana Caulton (PI), University of Wyoming

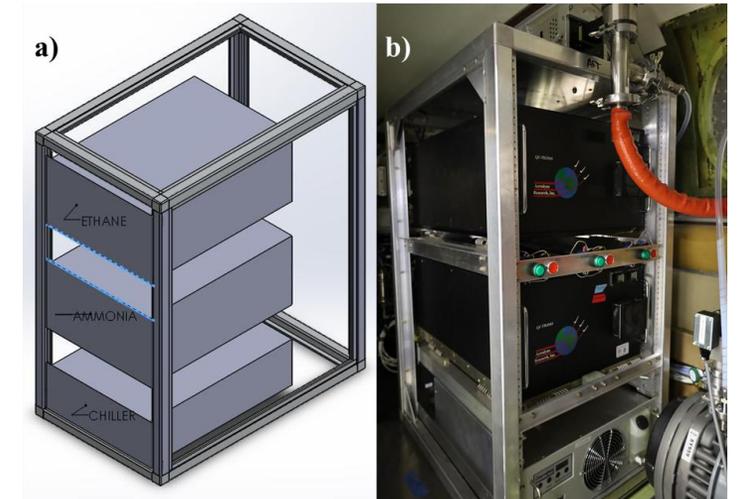
Victoria Wright (Grad Student)



- 1 Hz Ethane (C_2H_6) in ppb
- ~80 ppt precision

Previous flight campaigns:

- APART-lite 2019: University of Wyoming King Air, Colorado
- TRANS²Am 2021 + 2022: University of Wyoming King Air, Colorado



Whole Air Sampling (WAS) with gas chromatography analysis

Principal investigator:

Prof. Donald R. Blake
University of California, Irvine (UCI)

Team members:

Barbara Barletta, Nicola Blake,
Simone Meinardi, Isobel Simpson

List of measured species:

- Volatile organic compounds (~100 VOCs):
- Hydrocarbons (ethane, benzene, etc.)
 - Halocarbons (CFCs, HCFCs, HFCs, etc.)
 - Alkyl nitrates (methyl nitrate, etc.)
 - Sulfur compounds (OCS, DMS)

List of field campaigns (NASA DC-8):

ABLE-3A (1988), ABLE-3B (1990),
PEM-West A (1991), TRACE-A (1992),
PEM-West B (1994), PEM-Tropics A (1996),
PEM-Tropics B (1999), TRACE-P (2001),
INTEX-NA (2004), INTEX-B (2006),
TC4 (2007), ARCTAS (2008), DC3 (2012),
SEAC4RS (2013), KORUS-AQ (2016),
ATom (2016-2018), FIREX-AQ (2019)



Exchanging WAS sampling canisters



WAS sampling aboard the NASA DC-8

TOGA-TOF - VOC Measurements on the NASA DC-8 during ASIA-AQ

TOGA-TOF: Trace Organic Gas Analyzer with Time-of-Flight Mass Spectrometer; continuous online fast GC/MS

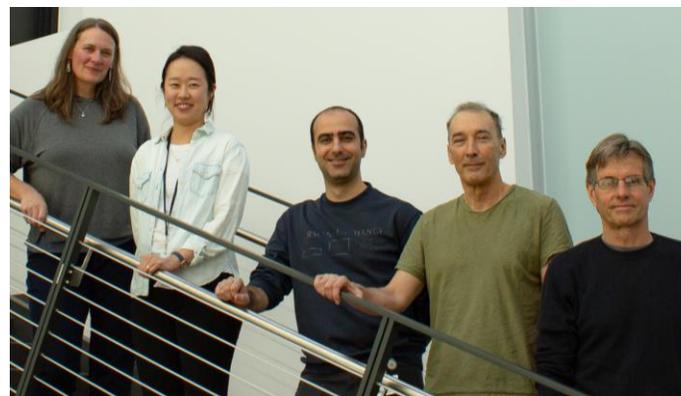
Team: Eric Apel (PI), Alan Hills, Rebecca Hornbrook, Daun Jeong, Behrooz Roozitalab (NCAR/ACOM, Boulder, Colorado, USA)

TOGA-TOF (and earlier-generation TOGA) have been deployed on the following aircraft and missions:

1. **NASA DC-8:** FIREX-AQ (2019), ATom 1-4 (2016-2018)
2. **NSF/NCAR Gulfstream V:** ACCLIP (2022), TIGER (2022) ORCAS (2016), CONTRAST (2014), DC3 (2012), TORERO (2012)
3. **NSF/NCAR C-130:** WE-CAN (2018), WINTER (2015), FRAPPÉ (2014), NOMADSS (2013)

VOCs measured (at ppt to sub-ppt levels):

1. **Non-methane hydrocarbons (NMHC):** C₃-C₁₀ alkanes, alkenes, aromatics
2. **Oxygenated VOCs:** C₁-C₅ aldehydes, ketones, alcohols, esters, ethers, furans
3. **Nitrogen-containing VOCs:** including C₁-C₄ nitriles, nitrates
4. **Sulfur-containing VOCs:** C₁-C₃, e.g., DMS, CS₂, CH₃SH
5. **Short- & Long-lived Halogenated VOCs:** C₁-C₇ containing Br, I, Cl, & F atoms



Rebecca Hornbrook Daun Jeong Behrooz Roozitalab Alan Hills Eric Apel



CAESAR-Blue(Cavity Enhanced Spectrometer for Atmospheric Research)

a.k.a. K-ACES(Korean-Airborne Cavity Enhanced Spectrometer) or ACES (Airborne Cavity Enhanced Spectrometer)



Potential Participating Team

by GIST ATMOS Lab

Gwangju Institute of Science and Technology
Atmospheric Trace MOlecuel Sensing Lab.



Team members

- Prof. Kyung-Eun Min (PI)
- Woohui Nam (Ph.D. Student)
- Heejoo Kang (M.S. Student)

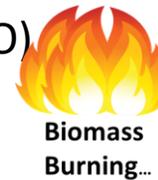
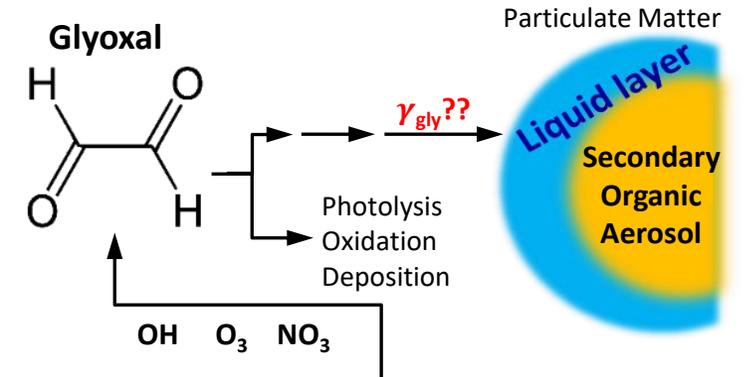
Measurement Targets

for sure

- Glyoxal (CHOCHO)
- Nitrogen Dioxide (NO₂)
- Water vapor (H₂O)

may also

- Methylglyoxal (CH₂COCHO)
- Formaldehyde (HCHO)
- Nitrous acid (HONO)



Biomass
Burning...



BVOCs

isoprene, monoterpene,
acetone, MBO, C₂H₄, C₃H₆ ...



AVOCs

aromatics, acetone, C₂H₂, C₂H₄, C₃H₆
glycolaldehyde, hydroxyacetone, ...

List of Missions Performed

- SENEX 2013 (NOAA WP-3D, Southeast US)
- UBWOS 2014 (Horsepool, UT, US)
- CARE-Beijing 2014 (Wangdu, China)
- SONGNEX 2015 (NOAA WP-3D, Western US)
- FIREX 2016 (Missoula, MT, US)
- KORUS-AQ 2016 (NOAA DC-8, Korea)



GIST ATMOS Lab.
[https://atmoslab.gist.ac.kr]

Proton Transfer Reaction, Time of Flight, Mass Spectrometer (PTR-ToF-MS)

 **Armin Wisthaler** (Univ. of Oslo, Univ. of Innsbruck)

 **Tomas Mikoviny** (Univ. of Oslo)

 **Felix Piel** (Univ. of Oslo)

 **Markus Müller** (Ionicon Analytik)

 **Tobias Reinecke** (Ionicon Analytik)

 **Wojciech K. Wojnowski** (Univ. of Oslo)

Measurements of gas-phase organic compounds:

Benzene (C_6H_6)

Isoprene (C_5H_8)

Methanol (CH_3OH)

Acetone (CH_3COCH_3)

Etc.

Toluene ($C_6H_5CH_3$)

Monoterpenes ($C_{10}H_{16}$)

Acetaldehyde (CH_3CHO)

Acetonitrile (CH_3CN)

 **FIREX-AQ** (DC8, 2019)

 **ND-MAX/ECLIF 2** (DC8, 2018)

 **NAAMES** (C-130, 2015-2018)

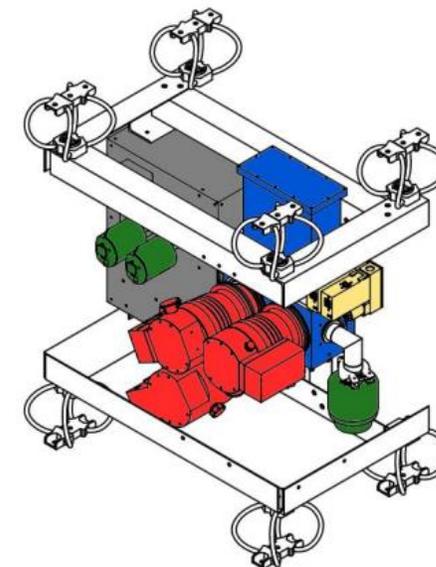
 **KORUS-AQ** (DC8, 2016)

 **SEAC⁴RS** (DC8, 2013)

 **DC3** (DC8, 2012)

 **DISCOVER-AQ** (P-3B, 2011-2014)

 **ARCTAS** (DC8, 2008)



LARGE



Our ASIA-AQ Instrument Team:



Rich Moore
ASIA-AQ
Lead



Luke
Ziemba



Eddie
Winstead



Carolyn
Jordan



Michael
Shook



Francesca
Gallo

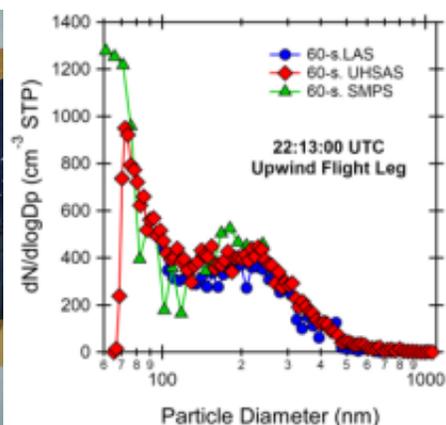


Claire
Robinson

LARGE "Classic" Payload Targeting In Situ Aerosol Microphysical & Optical Properties:

- Community Aerosol Isokinetic Inlet
- Aerosol Number Concentration (CPCs with and w/o thermal-denuder at 350°C)
- Aerosol Size Distribution (SMPS, Optical Particle Sizer, Aerodynamic Particle Sizer)
- Aerosol Scattering Coefficient @ 450, 550, and 700 nm (Dry, 80%RH Nephelometers)
- Aerosol Absorption Coefficient @ 467, 530, and 660 nm (PSAP)
- Black Carbon Mass Concentration (SP2)
- Cloud Condensation Nuclei Concentration (CCN Counter)
- Wing Probes (coarse aerosol size distribution and cloud flag)

Numerous prior campaigns on multiple NASA aircraft: DC-8, P-3B, C-130, HU-25



Single Particle Soot Photometer (SP2-D) & nano-Scanning Mobility Particle Sizer (nano-SMPS)



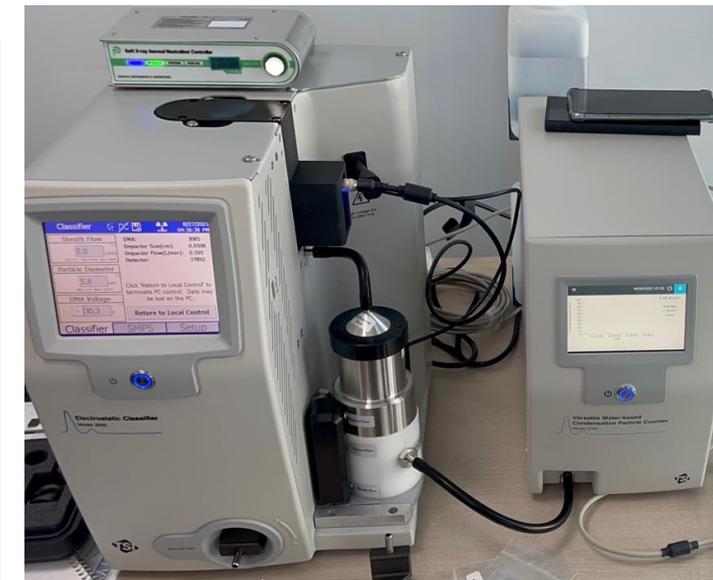
PI : Saehee Lim
Institution : Chungnam National University (CNU; <https://plus.cnu.ac.kr/>)
Team Members :
 Nagi Yoo (Master student, CNU)
 Changdong Yoon (MS-PhD student, Korea University)
 etc.

Measurement List	Parameters
SP2	<ul style="list-style-type: none"> Refractory black carbon (rBC) - mass and number concentrations rBC-size distributions (~80-500 nm) rBC mixing state (thickly-coated rBC number fraction and/or coating thickness of rBC particles)
Nano-SMPS	Aerosol number size distributions (~3 to 120 nm)

List of Field Campaigns measured by these instruments

- Both SP2 and nano-SMPS have been deployed at ground site measurements.

These type of instruments have been deployed on aircraft routinely by other groups



Single Particle Soot Photometer (SP2)



PI : Handol Lee

Institution : Inha University

Team Members :

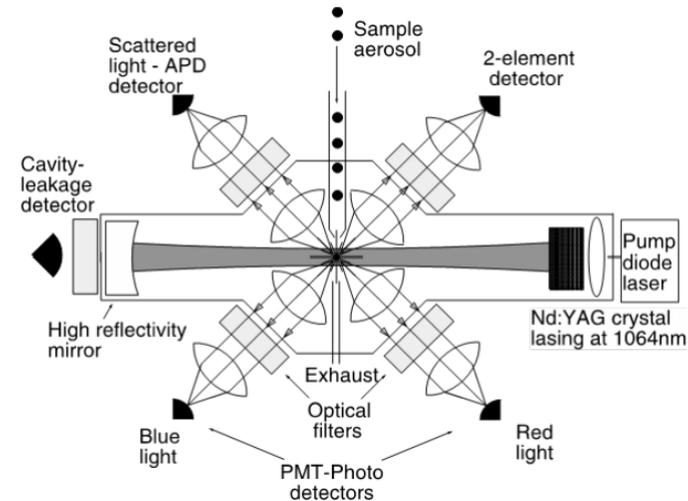
Minwoo Baek (Master student, Inha Univ.)

Jaebeom Park (Master student, Inha Univ.)

Instrument	Measurement
Single Particle Soot Photometer (SP2)	Black carbon mass concentration and coating thickness (~70 nm – 500 nm)

List of Field Campaigns measured by SP2 in Aircraft

- GMAP-SIJAQ (GEMS Map of the Air Pollution - Satellite Integrated Joint Monitoring of Air Quality) (National Institute of Environmental Research, 2021 - 2023)
- ASIA-AQ (The Airborne and Satellite Investigation of Asian Air Quality) (NASA & National Institute of Environmental Research, 2024)



K-CCN

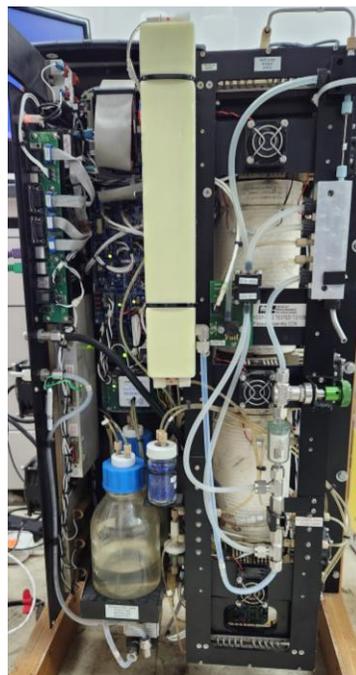
Condensation Particle Counter (CPC)
Scanning Mobility Particle Sizer (SMPS)
Cloud Condensation Nuclei Counter (CCNC)

Instrument	Measured species
Condensation Particle Counter (CPC3010)	Condensation nuclei (CN) number concentration
Scanning Mobility Particle Sizer (SMPS3936, Electrostatic Classifiers 3080 + CPC3010)	Aerosol number size distribution
Cloud Condensation Nuclei Counter (CCN-100)	Cloud condensation nuclei (CCN) number concentration



PI : Seong Soo Yum
Institution : Yonsei University (YS)
 (<http://cloud.yonsei.ac.kr>)
Team Members :
 Minsu Park (Research Professor, YS)
 Pyosuk Seo (Ph.D. student, YS)
 Chanwoo Ahn (Ph.D. student, YS)

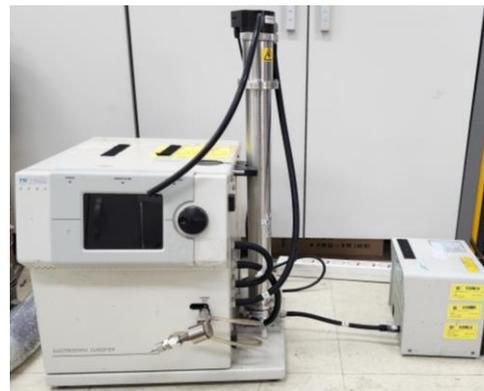
Aircraft / Field Campaign	Instruments
Beechcraft King Air (C90GT)	CPC3010, CCN-100
KORUS-AQ (NASA DC-8)	CPC3010, CCN-100
ASIA-AQ (NASA DC-8)	CPC3010, SMPS3936, CCN-100



CCN-100



CPC3010



SMPS3936+CPC3010

High Resolution, Time of Flight, Aerosol Mass Spectrometer

Team members (CU-Boulder):

Jose L. Jimenez (PI)
Pedro Campuzano-Jost (co-I)
Guy Symonds
Dongwook Kim
Doug Day
Donna Sueper

Measurement Products (reported up to 5Hz, PM₁ (D₅₀ ~ 1 μm geo. dia.)):

Species: Organic Aerosol (OA) , Sulfate, Nitrate, Ammonium, NR-Chloride, MSA, Seasalt, Perchlorate, Bromine, Iodine

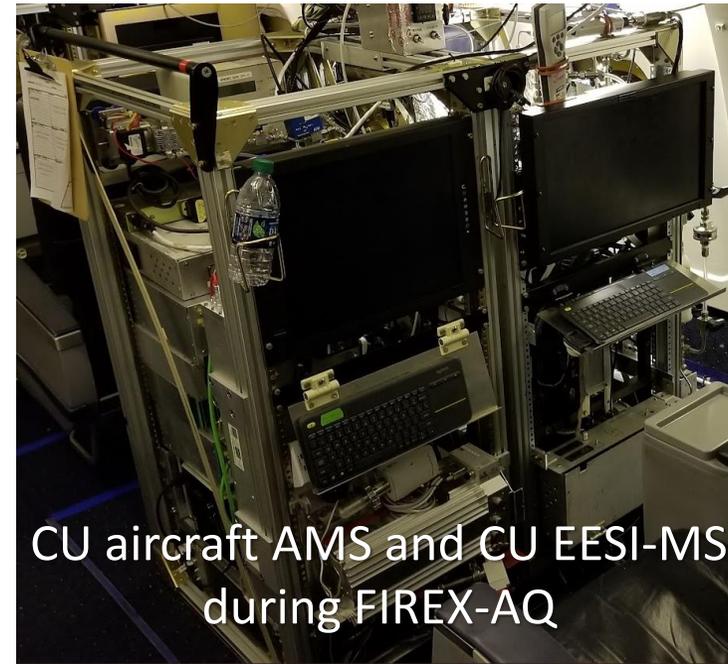
Bulk concentration, size distributions and volatility reported + detailed analysis of OA chemical properties (incl. source apportionment), organic nitrate, sulfate apportionment

Previous airborne campaigns:

NASA DC-8: ARCTAS (2008), DC3 (2012), SEAC⁴RS (2013), KORUS-AQ (2016), ATom (2016-2018), FIREX-AQ (2019)

NSF GV: DC3-test (2012), TI³GER (2022)

NSF-C130: MILAGRO (2006), INTEX-B (2006), WINTER (2015)



CU aircraft AMS and CU EESI-MS during FIREX-AQ

High Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS)



PI : Taehyoung Lee

Institution : Hankuk University of Foreign Studies (HUFS)
(www.hufsaql.com)

Team Members :

Taehyun Park (Postdoctoral researcher, HUFS)

Seokwon Kang (Ph.D. student, HUFS)

Jihee Ban (Ph.D. student, HUFS)

Kyung Hoon Kim (Ph.D. student, HUFS)

Jeongin Song (Ph.D. student, HUFS)

Juhan Kim (Master student, HUFS)

Measurement List	Compounds
PM _{1.0}	Organics (OM)
	Inorganics (Cl ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , NH ₄ ⁺ , K ⁺)
	H:C, O:C, OM:OC, Oxidation state
	Organic Nitrogen (W-mode)
	Biomass Burning Markers (f_{60} , f_{73}), etc

List of Field Campaigns measured by HR-ToF-AMS in Aircraft

- MAPS-Seoul (The Megacity Air Pollution - Seoul) (National Institute of Environmental Research, 2014 - 2015), King Air
- Korea United States Air Quality Study (KORUS-AQ) (NASA & National Institute of Environmental Research, 2016), DC-8
- GMAP-SIJ AQ (GEMS Map of the Air Pollution - Satellite Integrated Joint Monitoring of Air Quality) (National Institute of Environmental Research, 2021 - 2023), 1900D
- ASIA-AQ (The Airborne and Satellite Investigation of Asian Air Quality) (NASA & National Institute of Environmental Research, 2024), DC-8



Chemical Analysis of aeRosol ON-line (CHARON) PTR-ToF-MS

 **Armin Wisthaler** (Univ. of Oslo, Univ. of Innsbruck)

 **Tomas Mikoviny** (Univ. of Oslo)

 **Felix Piel** (Univ. of Oslo)

 **Markus Müller** (Ionicon Analytik)

 **Tobias Reinecke** (Ionicon Analytik)

 **Wojciech K. Wojnowski** (Univ. of Oslo)

Measurements of particle phase organic compounds:

Polycyclic Aromatic Hydrocarbons (PAHs)

Levoglucosan

$C_xH_yO_z$

Previous Flight Campaigns:

 **FIREX-AQ** (DC8, USA, 2019)

 **SARP** (DC8, USA, 2018)



UNH SAGA Filter sampling of bulk aerosol for offline analysis

Jack Dibb
University of New Hampshire

Analytes of Interest:
To be determined through discussion
with in-country partner(s)

Previous Flight Campaigns:

**FIREX-AQ (2019), Atom (2016-2018), KORUS-AQ (2016),
WINTER (2015), SEAC⁴RS (2013), DC3 (2012),
ARCTAS (2008), TC4 (2007), INTEX-B (2006),
POLAR AVE (2005), INTEX NA (2004), DICE (2003),
TRACE-P (2001), TOPSE (2000), PEM-TROPICS B (1999),
SONEX (1996), PEM-TROPICS (1997), SUCCESS (1996),
PEM-WEST B (1994), PEM-WEST A (1991)**



Aerosol Sampler for Transmission Electron Microscopy (AS-TEM)

Kouji Adachi
(Meteorological Research
Institute, Japan)

Measured parameters:

Particle compositions, mixing states, and shapes of individual aerosol particles such as sulfate, nonvolatile organic matter, salts, dust, soot, elemental components, etc.

Previous Field Campaigns:

- FIREX-AQ (NASA DC-8)
- IWC2022 (NASA DC-8)
- CPEX-CV (NASA DC-8)
- BBOP (DOE G1)



AS-TEM collects filter samples during flight for TEM analysis in the lab (offline measurements).

CAFS (Charged-Coupled Device Actinic Flux Spectroradiometer)

Measurement: hemispherically integrated downwelling and upwelling radiation



Samuel Hall, PI



Kirk Ullmann, Co-I

Additional team members:

- Steve Gabbard
- Steve Shertz
- Courtney Owen
- Kirk Lesko

National Center for Atmospheric Research
Boulder, Colorado, USA

<https://www2.acom.ucar.edu/sections/arim>

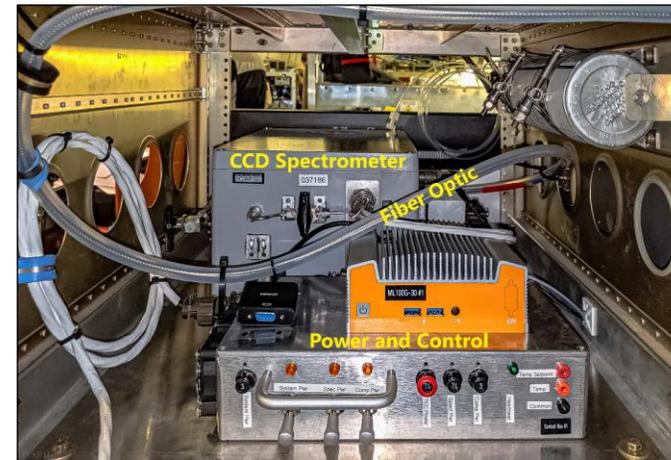
Calculated photolysis frequencies = $\int F(\lambda)\sigma(\lambda, T, p)\phi(\lambda, T, p)d\lambda$

j [O3->O2+O(1D)]	j [CH3COCH3->CH3CO+CH3]	j [BrO->Br+O]
j [NO2->NO+O(3P)]	j [CH3OOH->CH3O+OH]	j [Br2O->products]
j [H2O2->2OH]	j [CH3ONO2->CH3O+NO2]	j [BrNO3->Br+NO3]
j [HNO2->OH+NO]	j [CH3COCH2CH3->Products]	j [BrNO3->BrO+NO2]
j [HNO3->OH+NO2]	j [CH3CH2CH2CHO->C3H7+HCO]	j [BrCl->Br+Cl]
j [CH2O->H+HCO]	j [CH3CH2CH2CHO->C2H4+CH2CHOH]	j [HOBr->HO+Br]
j [CH2O->H2+CO]	j [HO2NO2->HO2+NO2]	j [BrONO2->Br+NO3]
j [CH3CHO->CH3+HCO]	j [HO2NO2->OH+NO3]	j [BrONO2->BrO+NO2]
j [CH3CHO->CH4+CO]	j [CH3CH2ONO2->Products]	j [Cl2+hv->Cl+Cl]
j [C2H5CHO->C2H5+HCO]	j [Br2->Br+Br]	j [ClO->Cl+O]
j [CHOCHO->products]		j [ClONO2->Cl+NO3]
j [CHOCHO->HCO+HCO]		j [ClONO2->ClO+NO2]
j [PAN->products]		j [CHBr3->Products]
j [CH3COCHO->products]		... plus iodine species

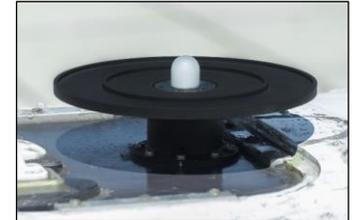
Recent campaigns

MISSION	YEAR	LOCATION(S)	NASA AIRCRAFT
FIREX-AQ	2019	Boise, ID, Salina, KS	DC-8
KORUS-AQ	2016	Osan, S. Korea	DC-8
ATom	2016-18	Pacific, Atlantic	DC-8
SEAC4RS	2013	Houston, TX	DC-8
DC3	2012	Salina, KS	DC-8, GV
ARCTAS I	2008	Fairbanks, AK	DC-8
TC4	2007	San Jose, CR	DC-8, WB-57
CRAVE	2006	San Jose, CR	WB-57
AVE_Houston-05	2005	Houston, TX	WB-57
PAVE	2005	Pease, NH	DC-8
AVE_Houston-04	2004	Houston, TX	WB-57

Instrument



Optical inlets



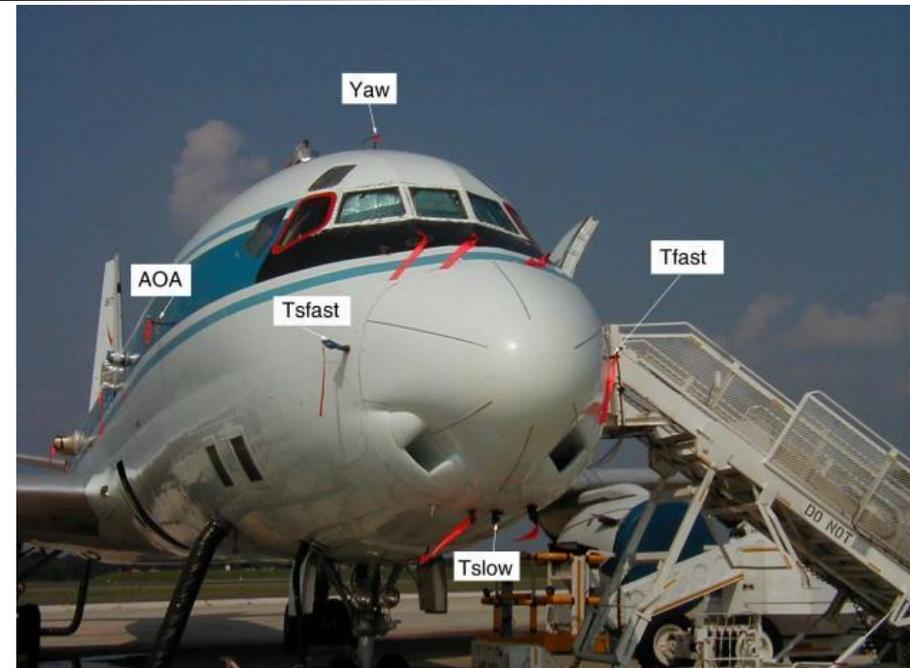
Meteorological Measurement System (*in situ* 3D Winds)

T. Paul Bui **NASA Ames Research Center**
J. Dean-Day **Bay Area Env. Res. Institute**
Ric Kolyer **NASA Ames Research Center**
Cecilia Chang **Bay Area Env. Res. Institute**
Rajesh Poudyal **Bay Area Env. Res. Institute**

<u>Primary Products 1-20 Hz</u>	<u>Accuracies</u>	<u>Precision</u>
Static Pressure	± 0.3 mb	0.003 mb
Static Temperature	± 0.3 K	0.05 K
Horizontal Wind	± 1.0 ms ⁻¹	0.1 ms ⁻¹
Vertical Wind	± 0.3 ms ⁻¹	0.05 ms ⁻¹

Other Products:
 potential temperature, true-air-speed, turbulence index, Reynolds number, GPS positions, velocities, accelerations, pitch, roll, heading, Angle-of-Attack, Angle-of-Sideslip, dynamic & total pressures, total temperatures.

2022-2023	SABRE	WB-5
2021-2022	ACCLIP	WB-57
2021-2022	DCOTSS	ER-2
2019	FIREX-AQ	DC-8
2018	HIWC	DC-8
2017-2018	ATOM	DC-8
2016	POSIDON	WB-57
2015	VIRGAS	WB-57
2011-2015	ATTREX	G.Hawk
2013-present	AJAX	AlphaJet



... others at: <https://airbornescience.nasa.gov/mms>

GEOCAPE Airborne Simulator (UV/Visible airborne spectrometer)

GCAS Team:

- PI: Scott Janz, NASA GSFC
- Jayne Boehmler, SSAI/NASA GSFC
- Sanxiong Xiong, SSAI NASA/GSFC
- Laura Judd, NASA LaRC
- Angelique Demetillo, NASA LaRC

Previous campaigns (aircraft)-year

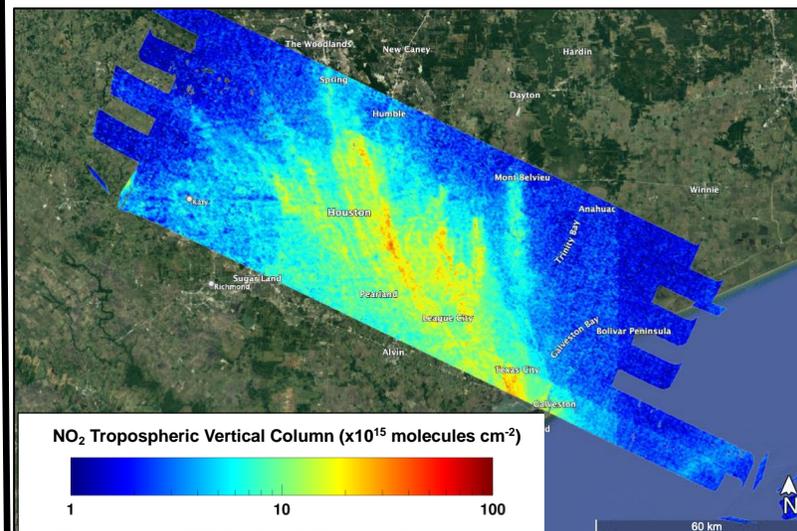
- DISCOVER-AQ (B200)-2011-2014
- GOES-R Validation (ER2)-2017
- LISTOS (B200)-2018
- FIREX-AQ (ER2)-2019
- MOOSE (GIII)-2021
- TRACER-AQ (GV)-2021

GCAS measures high spectral and spatial resolution UV and Visible light. With this information, the primary products are below aircraft columns of nitrogen dioxide (NO₂) and formaldehyde (HCHO)

<https://doi.org/10.5194/amt-11-5941-2018>

<https://doi.org/10.5194/amt-13-6113-2020>

<https://doi.org/10.1117/12.2062058>



↑ Example flight data of NO₂ from 8 Sept 2021 in Houston



Payload on GV in 2021

HSRL-2: High Spectral Resolution Lidar on the G-V for ASIA-AQ

Co-PI's: Johnathan Hair / Taylor Shingler

Institute: NASA Langley Research Center

Team Members:

- Chris Hostetler (Research Scientist)
- Rich Ferrare (Research Scientist)
- Tony Notari (Optical Engineer)
- David Harper (Electrical Engineer)
- Marta Fenn (Data Analyst)
- Amy Jo Scarino (Data Analyst)
- Tony Cook (Optical Engineer)

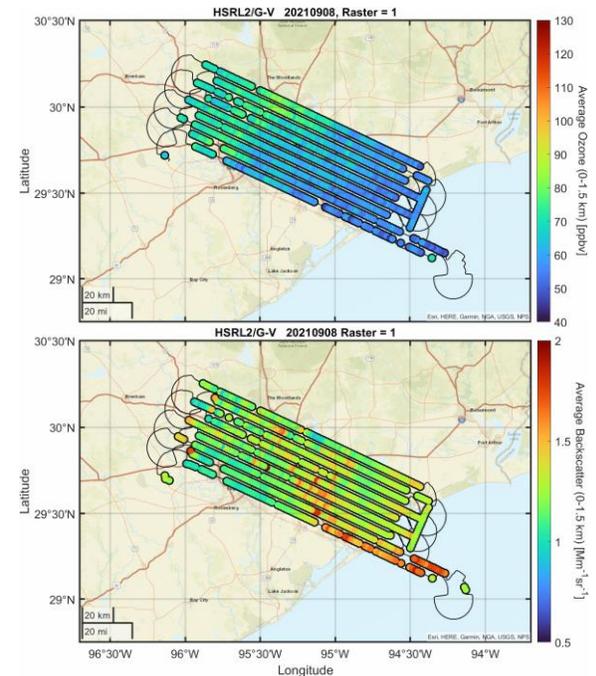
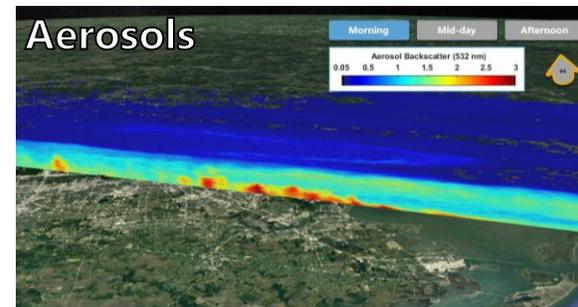
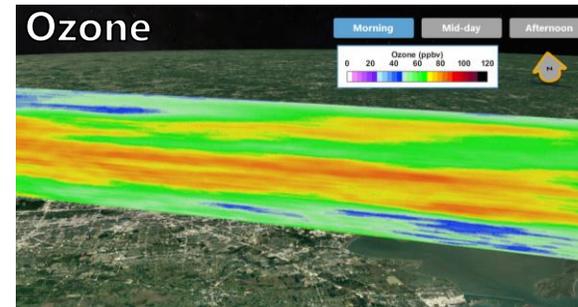
Measurements:

- Vertical profiles of ozone concentration
- Surface weighted ozone (0-2 km)
- Particulate backscatter profiles (355, 532, 1064 nm)
- Aerosol extinction profiles (355 and 532 nm)
- Aerosol Optical Thickness (AOT) (355 and 532 nm)
- Particle depolarization profiles (355, 532, 1064 nm)
- Extinction-to-backscatter ratio profiles (355 and 532 nm)
- Aerosol Classification (type: smoke, dust, urban, marine)
- Mixed Layer Heights (MLH)
- Cloud top height, cloud extinction

Campaigns:

- STAQS (2023) G-V
- ACTIVATE (2020-2022) King Air
- CALIPSO-NVF (2022) King Air
- TRACER-AQ (2021) G-V
- CAMP2EX (2019) P3
- ACEPOL (2017) ER-2
- ORACLES (2016-2018) ER-2, P3
- KORUS-AQ (2016)*
- DISCOVER-AQ (2012-2014) King Air
- TCAP (2012) King Air

* Predecessor instrument

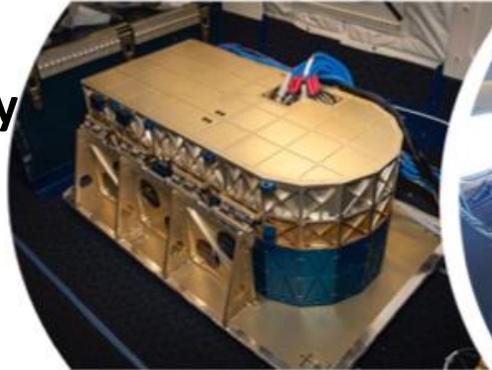


High-Altitude Lidar Observatory (HALO) – Methane DIAL and HSRL

HALO Team

Amin Nehrir
Rory Barton-Grimley
Jim Collins
Brian Collister
Ewan Crosbie
David Harper
Anthony Notari

Instrument Head



HALO Rack



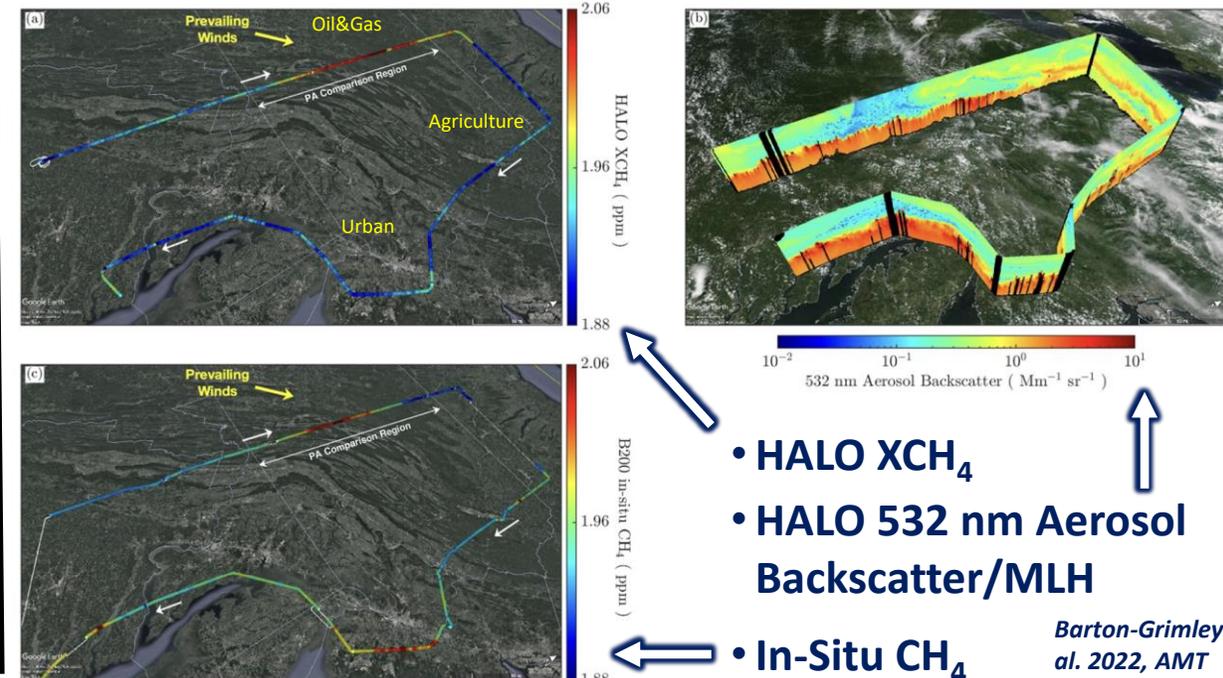
NASA Langley Research Center

Measurement Attributes

Parameter	Wavelength (nm)	Approximate Precision	Nominal G-III Horizontal Resolution	Nominal Vertical Resolution
Dry air column mole fraction (XCH ₄)	1645	~18 ppb ~10 ppb ~4 ppb	0.1 km 0.2 km 2 km	N/A
Aerosol Backscatter	532/1064	0.2 Mm ⁻¹ sr ⁻¹	2 km	15 m
Aerosol Extinction	532	10 Mm ⁻¹	12 km	300 m
Depolarization	532/1064	0.01	2 km	15 m
Aerosol Optical Depth	532	0.01	12 km	N/A
Aerosol Type (e.g., marine, dust, smoke)	N/A	Qualitative	12 km	300 m
Aerosol Mixing Layer Height (MLH)	N/A	100 m	2 km	N/A

Recent Campaigns

Campaign	Year	HALO Configuration	Aircraft
Synergistic TEMPO Air Quality Science – Greenhouse Gasses (STAQS)	2023	CH ₄ /HSRL	G-III 
Convective Processes Experiment – Cabo Verde (CPEX-CV)	2022	H ₂ O/HSRL	DC-8 
Synergies of Active Optical and Active Microwave Remote Sensing Experiment (SOA ² RSE)	2022	H ₂ O/HSRL	P3 
Convective Processes Experiment –Aerosols and Winds (CPEX-AW)	2021	H ₂ O/HSRL	DC-8 
Atmospheric Carbon and Transport – America (ACT-America)	2019	CH ₄ /HSRL	C-130 
ADM-Aeolus Cal/Val	2019	H ₂ O/HSRL	DC-8 
Long Island Sound Tropospheric Ozone Study (LISTOS)	2018	CH ₄ /HSRL	B-200/UC-12 



Airborne Visible/Infrared Imaging Spectrometer Next Generation (AVIRIS-NG)

AVIRIS-NG Team (NASA Jet Propulsion Laboratory)

Robert Green
Charles Miller
Andrew Thorpe
Michael Eastwood
David Thompson
Philip Brodrick
Ian McCubbin

Measurement Attributes

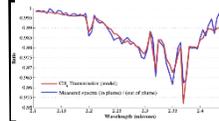
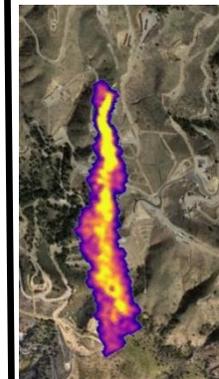
Imaging Spectroscopy: Earth System science
Very high SNR, Calibration, Full VSWIR (380-2500 nm @ 5 nm)
34 degree Swath 1 to 7 m sampling
Exceptional measurement quality for science
(current state-of-the art)

<https://avirisng.jpl.nasa.gov>

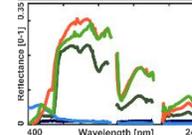
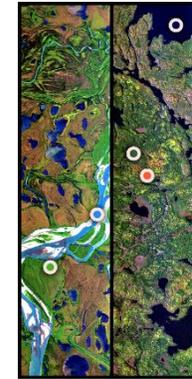
Previous Flight Campaigns over North America, Greenland, India, and Europe



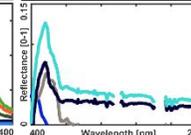
GHG / Aerosols



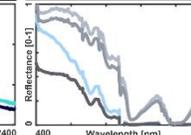
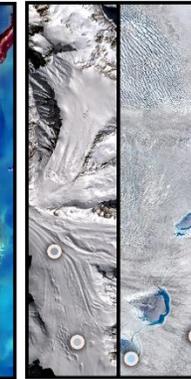
Ecosystems



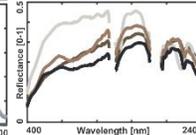
Coastal Zones



Snow and Ice



Minerals

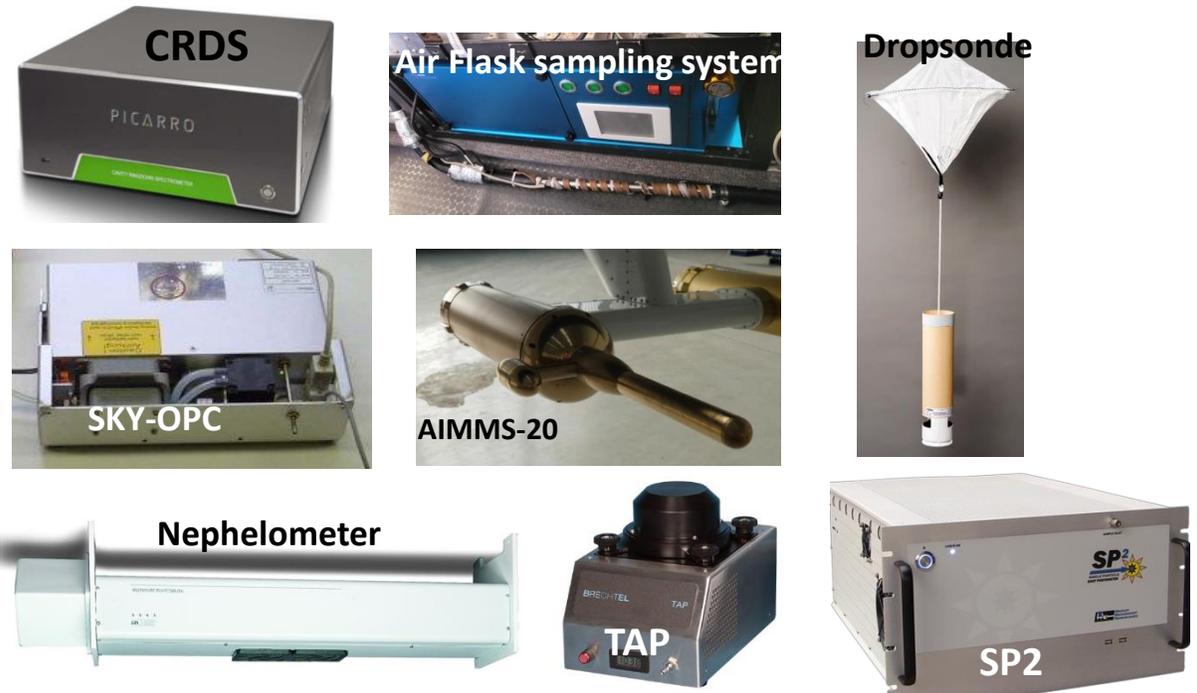


NIMS Aircraft Team

Name (Institution)	Name (Institution)
Sangwon Joo (PI) (NIMS)	Heejung Yoo (NIMS)
Sumin Kim (NIMS)	YoungSuk Oh (NIMS)
Shanlan LI (NIMS)	Soojeong Lee (NIMS)
Daegeun Shin (NIMS)	Jin-Kyu Hong (Yonsei Univ.)
Samuel Takele Kenea(NIMS)	Doyoon Kwon (Yonsei Univ.)
	Youngjoo Choi (Hankuk Univ. of Foreign Studies)

Measured Species/variables
In-situ CO ₂ , CH ₄ , CO
δ ¹³ C-CO ₂ , δ ¹³ C-CH ₄ (Flask sampling will be analyzed)
Aerosol size distribution (32 channels over range of 0.25~32um)
Light-scattering coefficient of aerosols particles
Black carbon mass, number and sizes
Aerosol absorption coefficients
P, T, RH, U, V, W wind, GPS
Vertical profiles of P, T, RH, WS/WD

Instrument/Technique
Picarro/CRDS-2401
Portable air flask sampling system for Carbon isotope
Grimm/Sky-OPC
TSI/Integrating Nephelometer
DMT/Single Particle soot photometer (SP2)
Brechte/Tricolor absorption photometer (TAP)
Aventech /AIMMS-20
Droponde
M300 data collection



Observatory (NIER) - 1900D Platform

Participating team members



PI : Jin-Soo Park (Ph.d. NIER)

Co-PI : Jong-ho Kim (Prof. Hanseo Univ.)

**Institution : NIER, National Institute of Environmental Research
Hanseo Univ. Hanseo University
HUFS, Hankuk University of Foreign Studies
MNU, Mokpo National University
Open Space Co.
ART+ Research Center**

Team Members :

Jinsoo Choi (Ph.d., NIER)	JoonYoung Ahn (Ph.d., NIER)
Hyunjae Kim (Ph.d., NIER)	Seung Myung Park (Ph.d., NIER)
Minyoung Sung (NIER)	Hyun-Woong Kim (NIER)
Siyoung Choi (NIER)	Jae-Yun Lee (NIER)
Soyoung Jung (NIER)	Myounghwa Byun(NIER)
Jiyun Jung (NIER)	Taehyoung Lee (Prof. HUFS)
Taehyun Park (Ph.d., HUFS)	Min-Suk Bae (Prof. MNU)
Jeongho Kim (Open Sapce co.)	Jaeho Cho (ART+ Research Center)
Hyeok Chung (Ph.d., ART+ Research Center)	

List of Field Campaigns

- MAPS-Seoul (2014 - 2015, King Air)
- KORUS-AQ (2016, King Air)
- ACCLIP (2022, Beechcraft 1900D)
- ASIA AQ (2024, Beechcraft 1900D)

List of measured species:

	Analyzer	Measure Compounds
Gaseous matter	PTR-ToF-MS	VOCs
	CRDS NH ₃	NH ₃
	CRDS (CO,CO ₂ ,CH ₄)	CO, CO ₂ , CH ₄
	NO ₂ analyzer	NO ₂
Particulate Matter	CIMS	HNO ₃ , SO ₂
	HR-ToF-AMS	Organics(OM), Inorganics (Cl ⁻ , NO ₃ ⁻ , SO ₄ ²⁻ , NH ₄ ⁺ , K ⁺) etc.
	PCASP	Size distribution
Weather & location	SP2	BC(Black Carbon) in individual aerosol particle
	AIMMS-30 (Air data probe)	Weather (temperature, humidity, pressure, wind speed , wind direction), Location information etc.

Picture of instrument



<Calibration of measuring instrument>



<Installation on Aircraft>

GEMS

PI: Jhoon Kim (Yonsei Univ.)

Co-PI: J.H. Kim(PNU), H. Lee, K. Han, U. Jeong (PKNU), R. Park (SNU), S. Park(UNIST), Y. Choi(Ewha Univ.)

Team members (YSU)

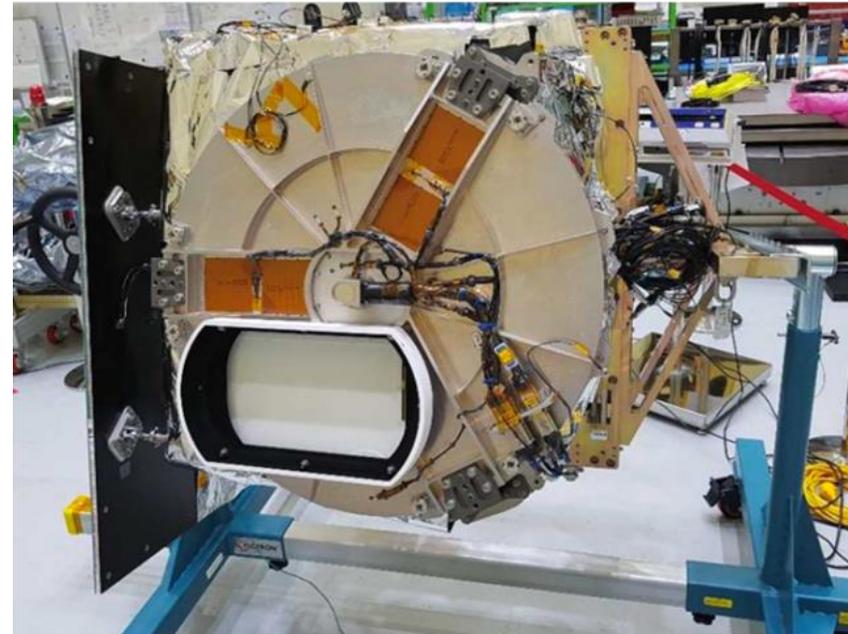
Y. Cho, H. Cha, M. Kim, J. Lee, Y. Chae

Field Campaigns the instrument has contributed

- GMAP/SIJAQ (by NIER)

List of measured Species/variables

- Trace gas total column density (NO_2 , O_3 , HCHO, CHOCHO, H_2O , SO_2 , BrO, HONO ...)
- Aerosol Optical Depth, Single Scattering Albedo, Aerosol Effective Height
- Cloud Fraction, Height, and surface reflectance



GEOS Forecasts

PI: Patricia Castellanos (NASA GSFC)

Team: Arlindo da Silva (NASA GSFC), Allison Collow (UMBC), Huisheng Bian (UMBC), Carl Malings (MSU), Pamela Wales (MSU), Emma Knowland (MSU), Christoph Keller (MSU)

Field Campaigns the modeling team has contributed

- KORUS-AQ
- Atom
- ORACLES
- CAMP2Ex
- TRACER-AQ
- ACCLIP

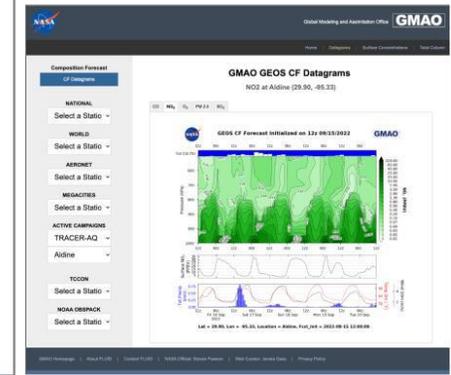
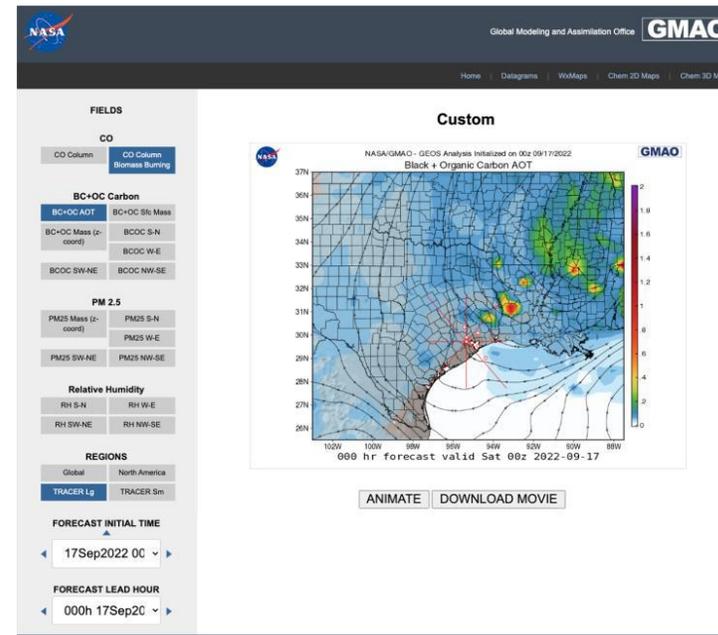
GEOS-FP Meteorology & Aerosol Forecast

- 12 km resolution
- 10-day forecast
- 6-hourly meteorological analysis, 3-hourly aerosol analysis
- Assimilates AERONET, MODIS, & VIIRS 550 nm AOD

GEOS-CF Air Quality Forecast

- 25 km resolution
- 1-day hindcast and 5-day forecast
- Full atmospheric chemistry with GEOS-Chem chemical mechanism

fluid.nccs.nasa.gov



MUSICA for ASIA-AQ: Urban to Global Modeling

Louisa Emmons, National Center for Atmospheric Research (NCAR), Boulder, Colorado

Benjamin Gaubert, Duseong Jo, Wenfu Tang,
Rajesh Kumar, Gabriele Pfister, Rebecca Buchholz,
Shawn Honomichl, David Edwards, Helen Worden (NCAR)
Christine Wiedinmyer (Univ. Colorado)
Christoph Knote (Univ. Augsburg, Germany)

Will use multiple models:

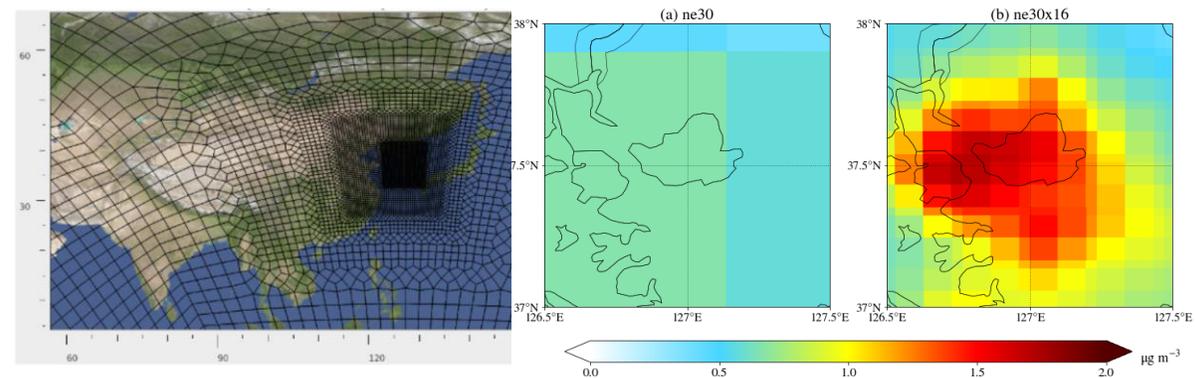
- MUSICA_{v0}: Multi-scale Infrastructure for Chemistry and Aerosols – Global CAM-chem with regional refinement – with comprehensive chemistry, assimilation of MOPITT CO
 - WRF-Chem and WRF-Tracer (domain to be determined) – aerosols and ozone chemistry, tracers for source regions and types
 - FLEXPART driven by WRF – Lagrangian plume transport
- Also guidance from real-time satellite products (MOPITT CO, TROPOMI, GEMS)

Past Flight Planning Support:

- FIREX-AQ (2019)
- KORUS-AQ (2016)
- FRAPPE/DISCOVER-AQ-Colo. (2014)
- SEAC4RS (2013)
- NOMADSS (2013)

Current global and US air quality forecasts with WACCM and WRF-Chem:

<https://www2.acom.ucar.edu/acresp/forecasts-and-near-real-time-nrt-products>

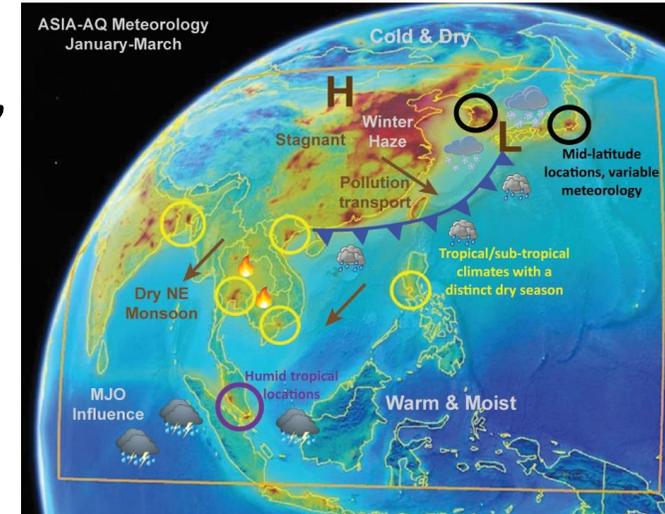


(left) MUSICA_{v0} model grid with 1/16-degree over Korea. Simulated black carbon concentrations using MUSICA_{v0} at (middle) standard 1-degree and (right) refined 1/16-degree (7 km) horizontal resolution during KORUS-AQ.

UCLA/NRL Weather and Air quality forecasting, nowcasting and observational context

PI: Pablo Saide (UCLA)
Co-PI: David Peterson (NRL)
Co-I: Christopher Camacho (NRL),
Postdoc: Manas Mohanty (UCLA),
Theodore McHardy (NRL)
PhD student: Julie Christopoulos (UCLA)

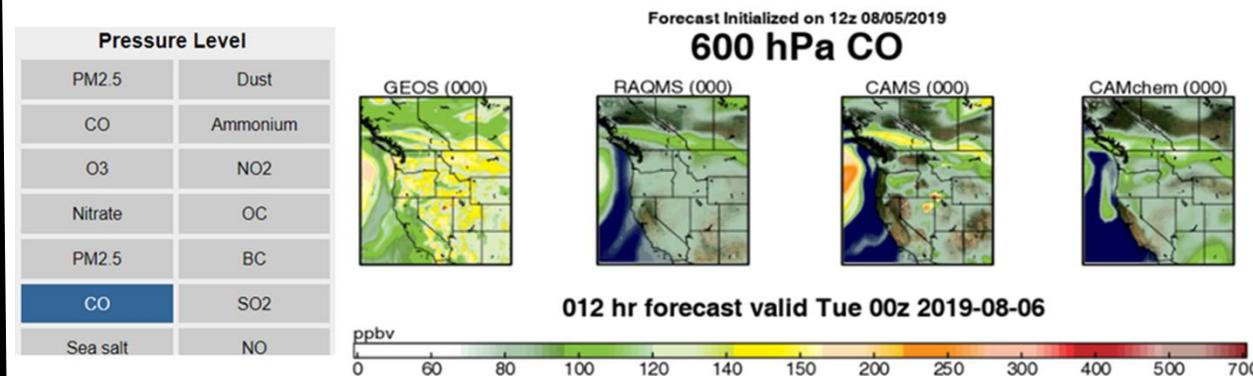
Weather Forecasting,
Nowcasting, and
Flight Planning
Support using
models, satellite and
ground observations



Previous field campaign support

Campaign	Year	Sponsor
SEAC4RS	2013	NASA
KORUS-AQ	2016	NASA
REThinC	2017, 2018	US Navy
ORACLES	2016, 2017, 2018	NASA
FIREX-AQ	2019	NASA/ NOAA
DCOTSS	2021, 2022	NASA
ACCLIP	2022	NASA/ US Navy

Air quality forecasts, including experimental
forecasts (WRF-Chem) and standardizing
what's available from the community



UIOWA Air quality forecasting and analysis in support of ASIA-AQ

PI: Greg Carmichael (Ulowa)

Co-I: Jun Wang (Ulowa)

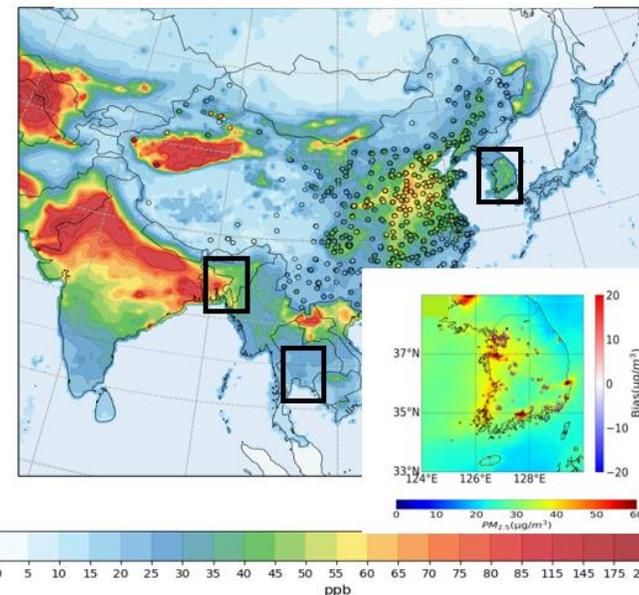
Collaborator: Gonzalo Ferrada (UTenn)

PhD students (Ulowa)

- Hyerim Kim
- Chen Wang

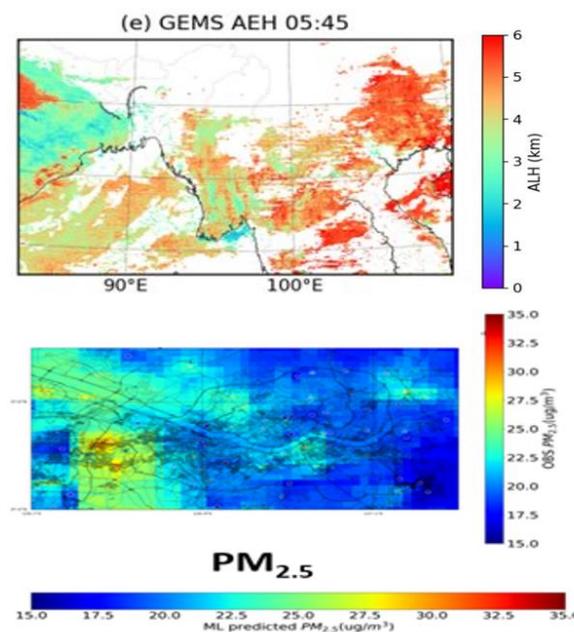
Past Flight Planning Support:

- FIREX-AQ (2019)
- ORACLES (2016,17,18)
- KORUS-AQ (2016)
- SEAC4RS (2013)
- ARCTAS (2008)
- INTEX-B (2006)
- INTEX-NA (2004)
- TRACE-P (2001)



Proposed Tasks:

1. Provide high resolution regional atmospheric composition and emission source tracer forecasts to support mission planning and execution;
2. Provide updated high-resolution top-down emissions estimates in the pre-mission phase and new aerosol retrievals in near real time (e.g., plume heights) utilizing GEMS observations;
3. Conduct analysis of high spatial resolution pollutant distributions and source contributions for regions targeted in ASIA-AQ by integrating ASIA-AQ observations with available air quality monitoring data, satellite retrievals, and model predictions.



1 km measurement/model fused surface concentrations of PM_{2.5} in Seoul (*Bottom-left*) and Korea-wide NO₂ (*Bottom-right*). GEMS retrieved aerosol layer heights (AEH) (*Top-left*).

