Science Team Telecon (26/27 June 2023)

Ministry of Environment
National Institute of Environmental Research

Agenda

- Brief status report on ASIA-AQ and partner country negotiations
- DC-8 Status
- Update on flight planning discussions for Korea
- Discussion and questions

Partner country negotiations

Ministry of Environment
National Institute of Environmental Research

Thailand

- **Responses to stakeholder questions provided on 2 June. Thanks for quick responses.**
- **Instrument details provided in the response is attached to the end of these slides.**
- **Next meeting will include NASA representatives and is tentatively scheduled for week of 10-14 July.**

Malaysia

- **Proposal presentation on 2 June at the Ministry of Natural Resources, Environment, and Climate Change went well.**
- **A number of questions were raised regarding security, but the proposal was provisionally accepted.**
- **Next meeting will include NASA representatives, date is TBD.**

Philippines

- **A draft agreement has been offered by the Philippine Department of Environment and Natural Resources (DENR).**
- **The agreement is modeled on our current ASIA-AQ agreement with Korea.**
- **The draft has been vetted by the departments of defense, foreign affairs, space, and various environmental offices.**

ASIA-AQ Instruments – Awaiting PIFs

- **CHARON** - CHemical Analysis of aeRosol ON-line (CHARON)
  - PI/Investigator(s): Armin Wisthaler & Tomas Mikoviny

- **PTR-MS** - Proton Transfer Reaction Time of Flight Mass Spectrometer (PTRToF MS)
  - PI/Investigator(s): Armin Wisthaler & Tomas Mikoviny

- **CIT-CIMS** - California Institute of Technology Chemical Ionization Mass Spectrometer
  - PI/Investigator(s): Paul Wennberg & John Crounse

- **K-CIMS** - Korean EPD Chemical Ionization Mass Spectrometer
  - PI/Investigator(s): Joon-Young Ahn & Saewung Kim

- **LGR-AAT** – Los Gatos Research Ammonia Analyzer Trace
  - PI/Investigator(s): Gangwoong Lee & Joon-Young Ahn

- **MMS** – Meteorological Measurement System
  - PI/Investigator(s): Paul Bui & Rei Ueyama

ASIA-AQ Flight Planning - Google

drive.google.com/drive/u/0/folders/1Bnl1T5g-0mTbrMVzJlQorbpCtXIWD69U

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Name	Owner	Last modified	File size
Initial Flight Plant of King Air 350 in NIMS.pptx	me	4:35 PM me	78 KB
MERRA2-PBLH-diurnal-Jan-2010to2023.pptx	me	2:42 PM me	2.2 MB
12_videos_together.mp4	me	10:48 AM me	117.5 MB
GEOS-Chem PM2.5(Feb).pptx	me	Jun 18, 2023 me	1.1 MB
BLH_JoongRangGu_2016_2019.pptx	me	Jun 12, 2023 me	170 KB
Seoul_windroses_from_AWS.pptx	me	Jun 12, 2023 me	3.5 MB
Rokjin-PM_forecast_feb2019.pptx	me	Jun 11, 2023 me	7.6 MB
Samuel_STILT_footprints_NIMS_Korea.pptx	me	Jun 11, 2023 me	257 KB
asiaaq_MERRA2climatology.pdf	me	Jun 11, 2023 me	812 KB
HYSPLIT-backtraj-FEB 2023.pdf	me	Jun 11, 2023 me	60 KB
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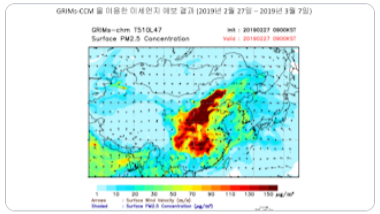
ASIA_AQ_GEMS_v1.pptx	me	Jun 7, 2023 me	32.1 MB

Rokjin-PM_forecast_feb2019.pptx

Details | Activity



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Type
PowerPoint

Size
7.6 MB

Storage used
7.6 MB

Location
ASIA-AQ Flight Planning

3 uploads complete

Initial Flight Plant of King Air 350 in NI...
MERRA2-PBLH-diurnal-Jan-2010to20...
12_videos_together.mp4

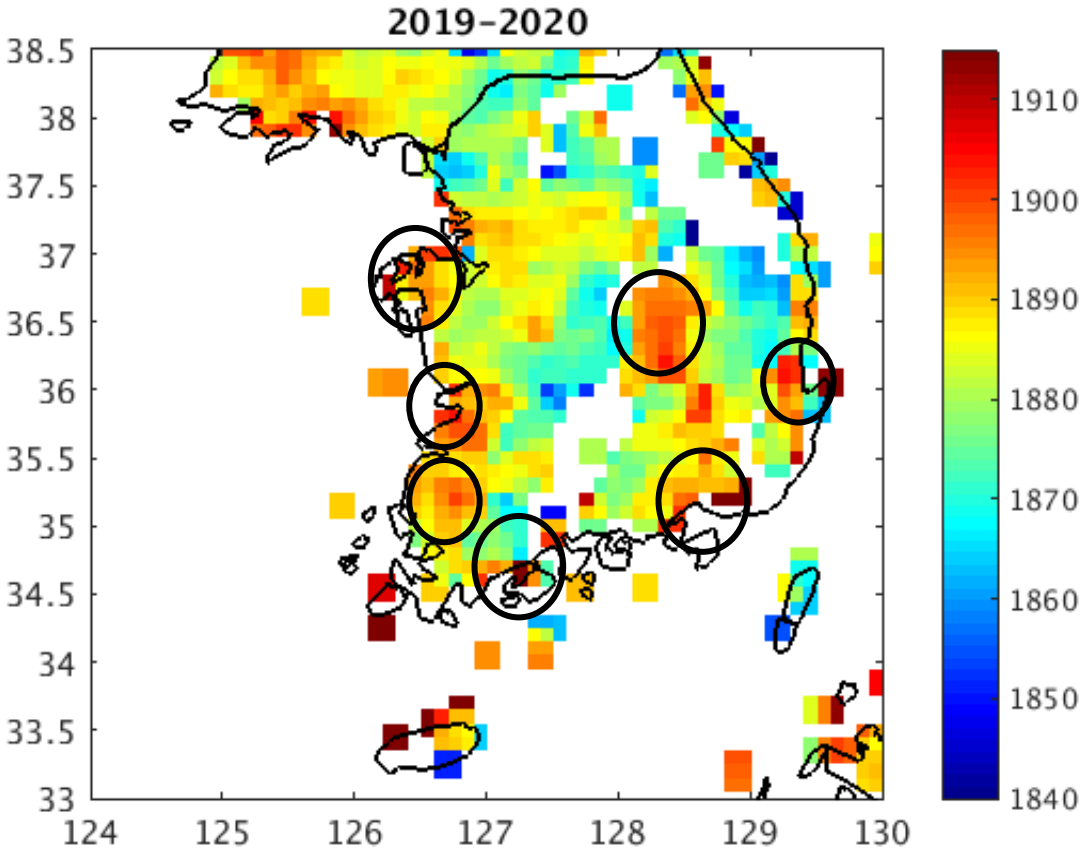
Materials useful for flight planning are being collected at the link below:

https://drive.google.com/drive/folders/1Bnl1T5g-0mTbrMVzJlQorbpCtXIWD69U?usp=sharing

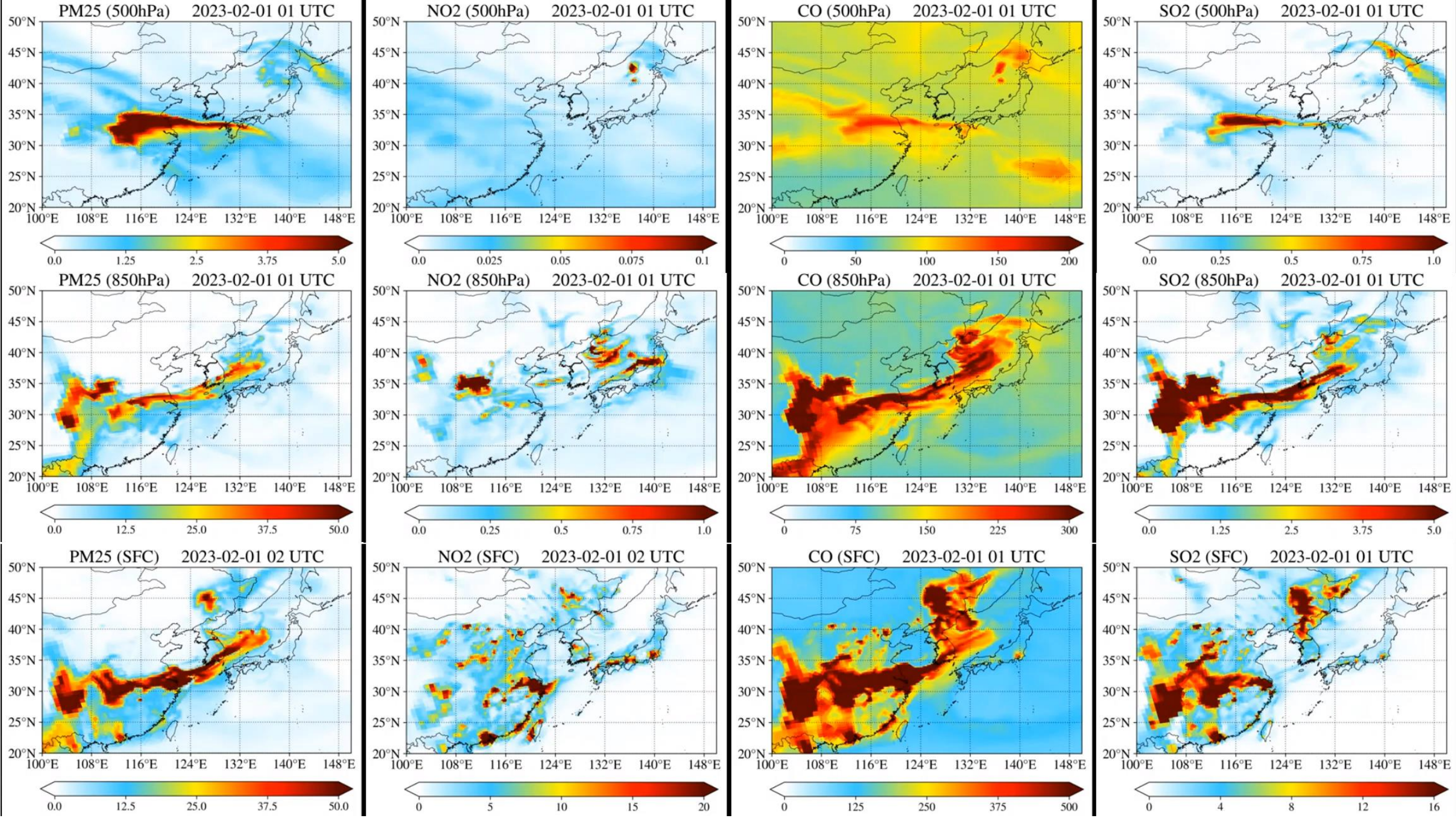
4:36 PM

Initial Flight Plan of King Air 350 in NIMS: Targeting observations of CH4 point source in Korea

TROPOMI XCH4 point source



- *The Black circle represents the main point sources of CH4 in Korea derived from TROPIMI, such as Daesan, Gunsan, Yeosu , Busan, Pohang, and Daegu, where high-density energy industries are located.*
- *Therefore, It seem to be essential to see the* methane (CH4) plumes using airborne imaging spectrometer (AVIRIS) data on *the GIII aircraft over the regions where TROPOMI identified CH4 point sources, if possible*
- *Subsequently, the King Air 350 aircraft will collect samples of GHGs and other chemical compositions, including carbon stable isotope ratio from these point sources.*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NO2 (500hPa) 2023-02-01 01 UTC
CO (500hPa) 2023-02-01 01 UTC
SO2 (500hPa) 2023-02-01 01 UTC
PM25 (850hPa) 2023-02-01 01 UTC
NO2 (850hPa) 2023-02-01 01 UTC
CO (850hPa) 2023-02-01 01 UTC
SO2 (850hPa) 2023-02-01 01 UTC
PM25 (SFC) 2023-02-01 02 UTC
NO2 (SFC) 2023-02-01 02 UTC
CO (SFC) 2023-02-01 01 UTC
SO2 (SFC) 2023-02-01 01 UTC
50°N
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35°N
30°N
25°N
20°N
100°E
108°E
116°E
124°E
132°E
140°E
148°E
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0 50 100 150 200
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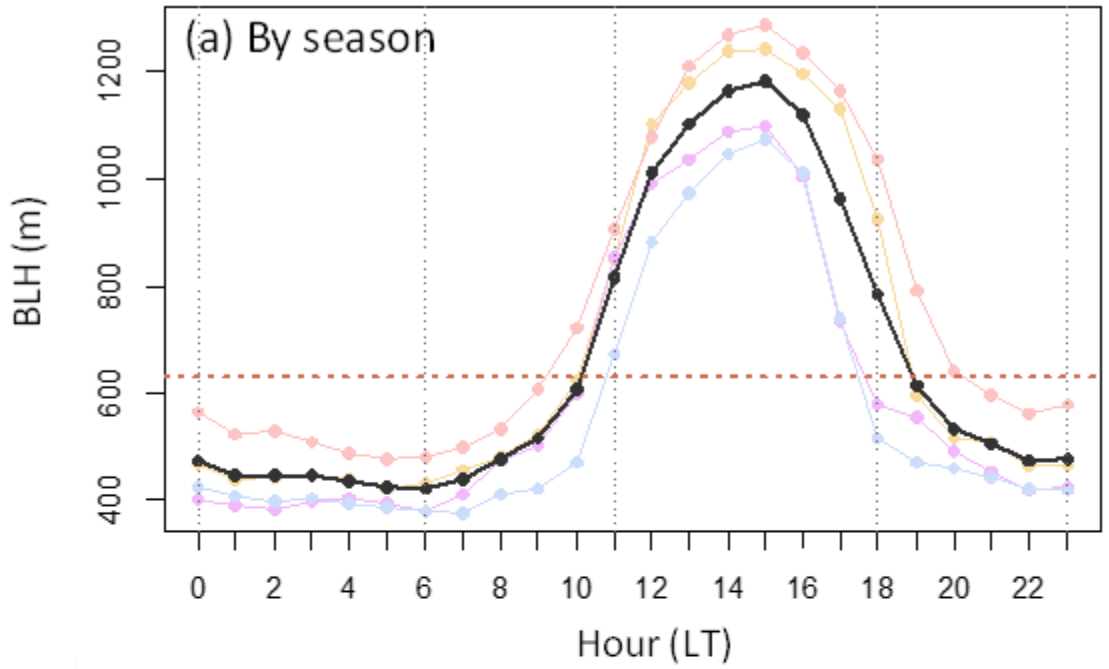
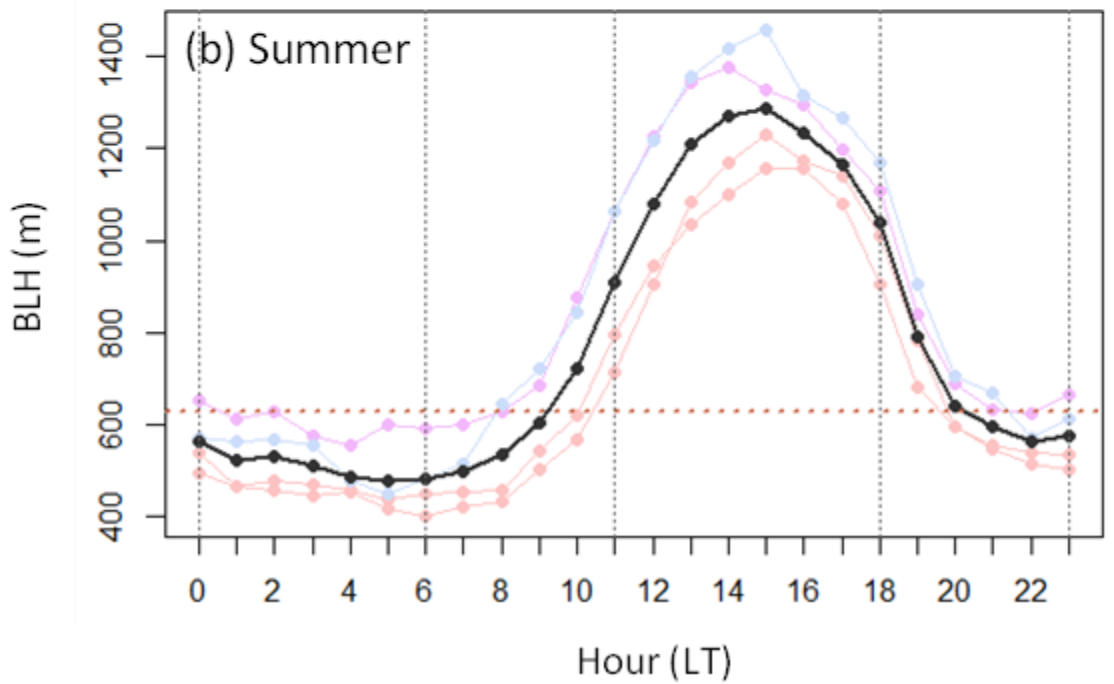
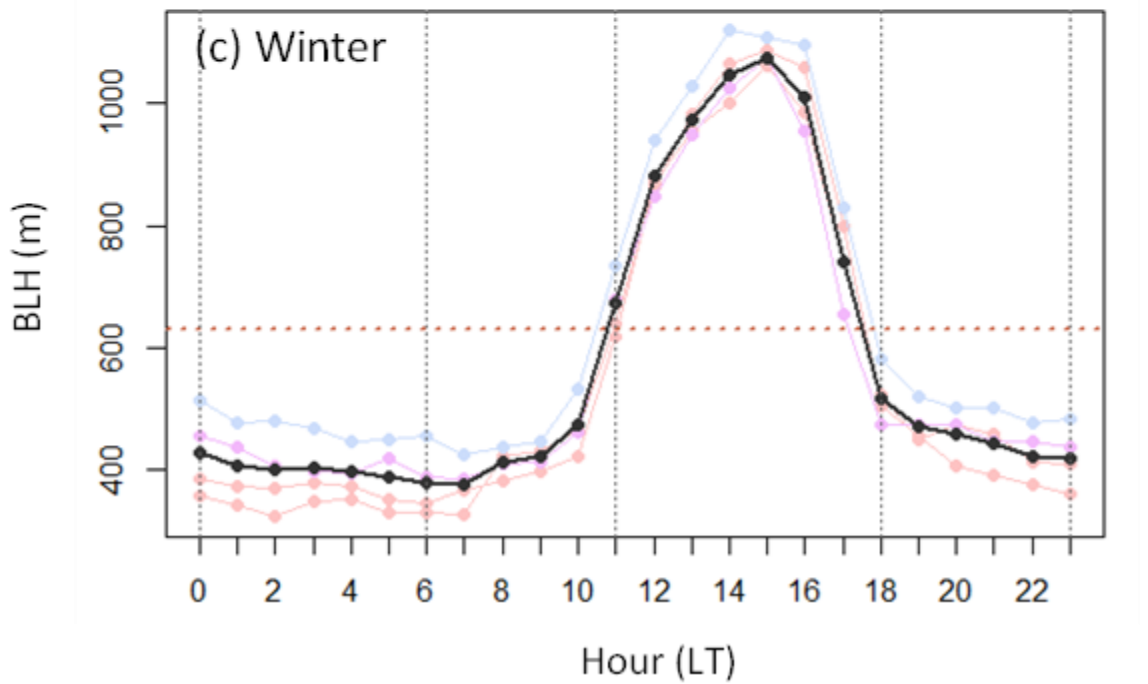
0.0 12.5 25.0 37.5 50.0
0.0 0.25 0.5 0.75 1.0
0 75 150 225 300
0.0 1.25 2.5 3.75 5.0
0.0 12.5 25.0 37.5 50.0
0 5 10 15 20
0 125 250 375 500
0 4 8 12 16

Boundary Layer Height at HUFS near Korea U. during 2016 ~ 2019

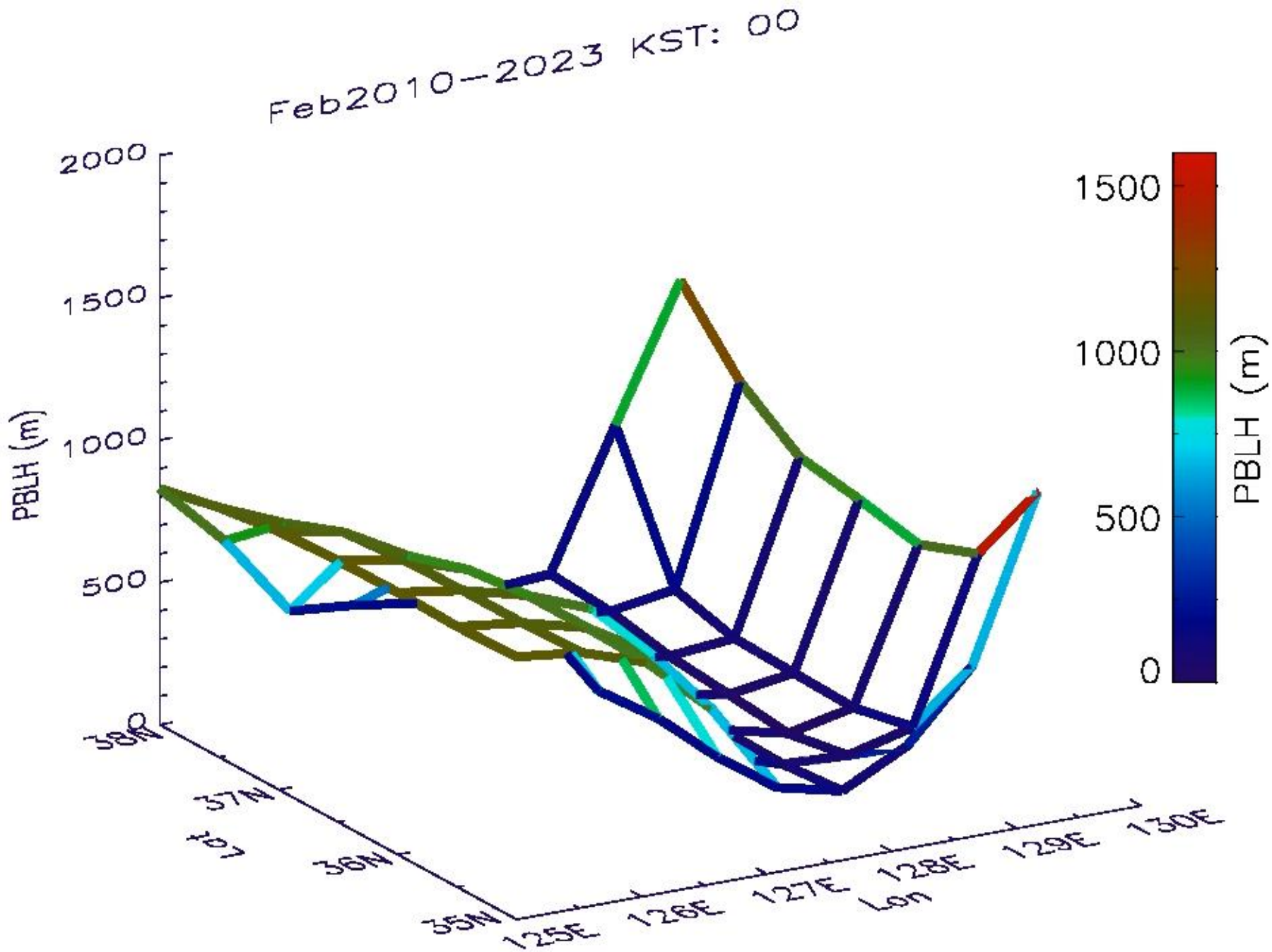
[KMA & M.-S. Park @ Sejong U.]







South Korea Map and Satellite Image


Feb2010-2023 KST: 00
PBLH (m)
2000
1500
1000
500
0
38N
37N
36N
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Lat
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126E
127E
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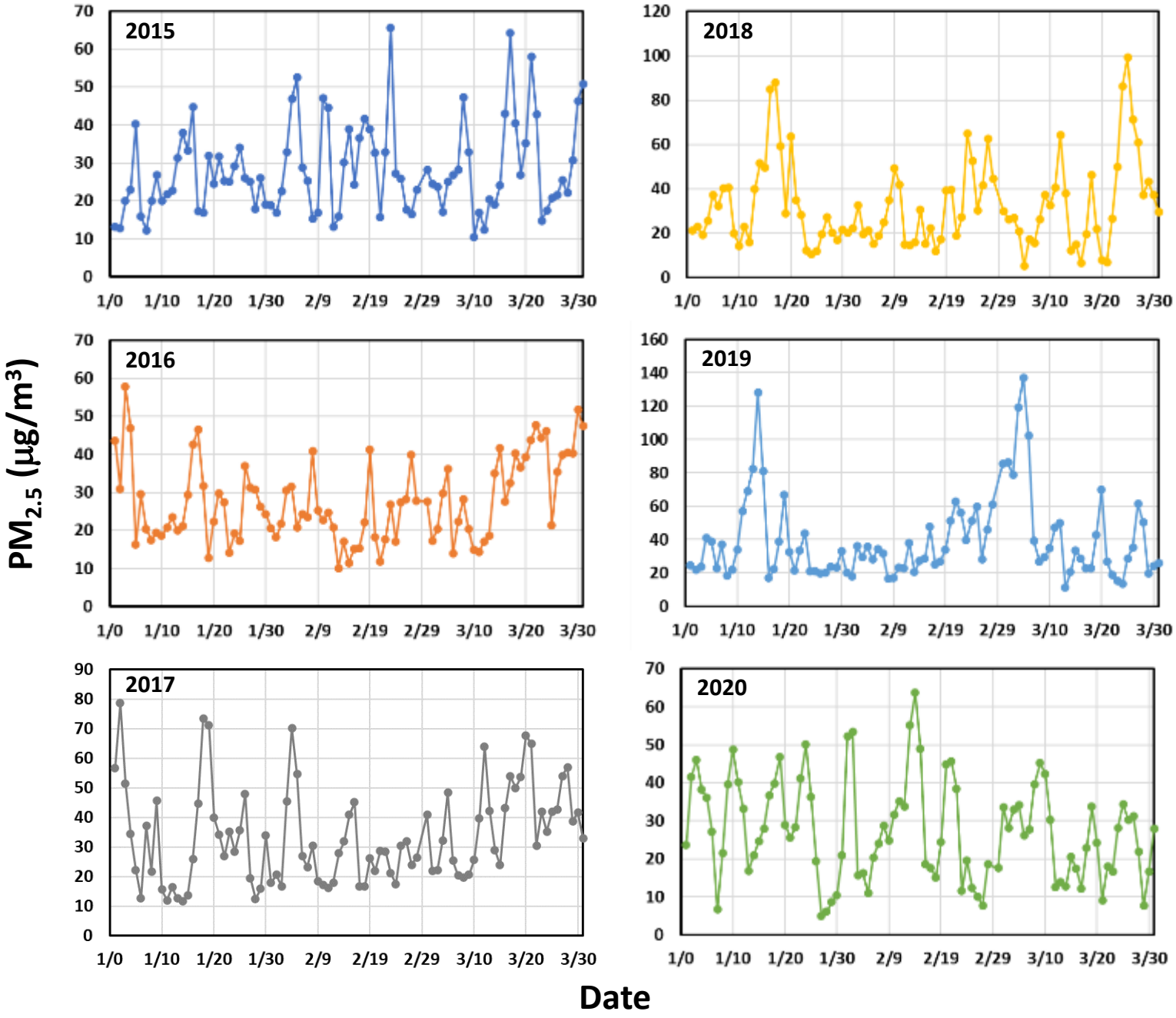
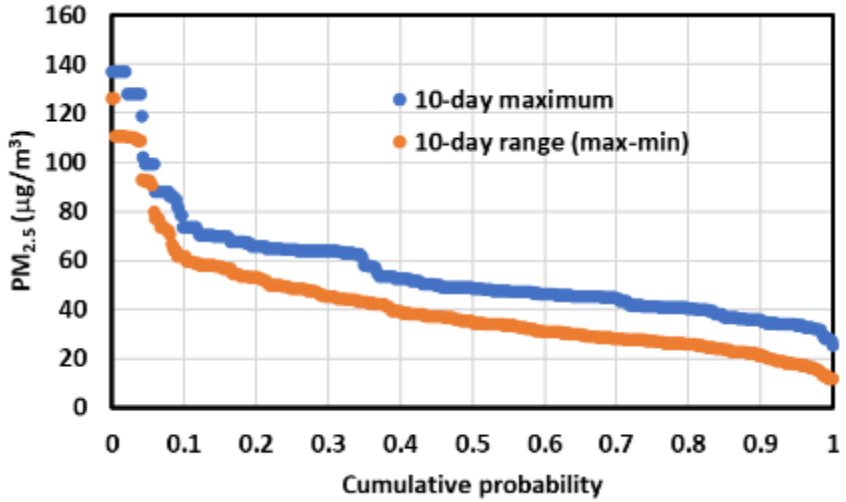
129E
130E
Lon
1500
1000
500
0
PBLH (m)



AirKorea Seoul daily average $PM_{2.5}$ variability for Jan-Mar 2015-2020

Seasonal time series for each year on left

Cumulative probability statistics based on a running 10-day window



Probability	Max $PM_{2.5}$	$PM_{2.5}$ range
10%	75 or greater	60 or greater
50%	48 or greater	35 or greater
90%	35 or greater	20 or greater

Documentation of ASIA-AQ airborne sensors

- This document provides instrument tables followed by a page for each sensor on the NASA DC-8, NASA GV, and NASA G-III aircraft.
- Slides provide information on the following:
  - Measurement technique
  - Team Members
  - Compounds/variables measured
  - Previous flight campaigns
- 17 of the instruments participated in the KORUS-AQ field study

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

Instrument Name/Technique	Parameters Measured	Investigator(s)
Chemiluminescence	*in situ* O_3, NO, NO_2	Ale Franchin and Frank Flocke (National Center for Atmospheric Research)
IR Absorption Spectrometry	*in situ* CO, CH_4, CO_2, N_2O	Glenn Diskin and Joshua Digangi (NASA Langley)
Diode Laser Hygrometer (DLH)	*in situ* water vapor	Glenn Diskin (NASA Langley)
Laser Induced Fluorescence	*in situ* CH_2O	Glenn Wolfe and Tom Hanisco (NASA Goddard)
Chemical Ionization Mass Spectrometer (CIMS)	*in situ* PANs, $ClNO_2$, Cl_2	Greg Huey (Georgia Institute of Technology)
Chemical Ionization Mass Spectrometer (CIMS)	*in situ* SO_2, HONO, HO_2NO_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)	*in situ* HNO_3, H_2O_2, organic peroxides, organic acids, etc.	Paul Wennberg and John Crounse (California Institute of Technology)
Los Gatos Research Ammonia Analyzer	*in situ* NH_3	Gangwoong Lee (Hankuk University of Foreign Studies, Korea)
Open-Path Ammonia Laser Spectrometer (OPALS)	*in situ* NH_3	Mark Zondlo (Princeton University)
Ethane Tunable Infrared Laser Direct Absorption Spectroscopy (TILDAS)	*in situ* C_2H_6	Dana Caulton (University of Wyoming)
Whole Air Sampler	*in situ* C_2-C_{11} alkanes, C_2-C_{10} alkenes, C_6-C_9 aromatics, C_1-C_5 alkylnitrates, etc.	Donald Blake (University of California, Irvine)
Trace Organic Gas Analyzer (TOGA)	*in situ* C_3-C_{10} hydrocarbons, C_1-C_7 OVOCs, HCN, CH_3CN, 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_2O	Kyung-Eun Min (Gwangju Institute for Science and Technology, Korea)
Proton Transfer Reaction-Time of Flight-Mass Spectrometer (PTR-ToF-MS)	*in situ* 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	*in situ* 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)	*in situ* black carbon mass and aerosol number size distributions	Sae-Hee Lim (Chungnam National University, Korea)
Single Particle Soot Photometer (SP2)	*in situ* black carbon mass	Handol Lee (Inha University, Korea)
Cloud Condensation Nuclei (CCN) counter and Scanning Mobility Particle Sizer (SMPS)	*in situ* 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	*in situ* 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_2O	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, NO_2, and O_3

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 (NO_2)
Ozone (O_3)

Most recent flight campaigns (Year, Aircraft):

ACCLIP (2022, GV)
TI3GER (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_2O	<0.1%	1%
LICOR	CO_2	0.05 ppmv	0.15 ppmv

Previous Field Campaigns:

- **FIREX-AQ, KORUS-AQ, SEAC^{4}RS, DISCOVER-AQ, DC3, ARCTAS, TC4, many others**
- **20+ projects since the early 80's**
- **NASA DC-8 & NASA P-3B aircraft**

Instrument rack during FIREX-AQ

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)

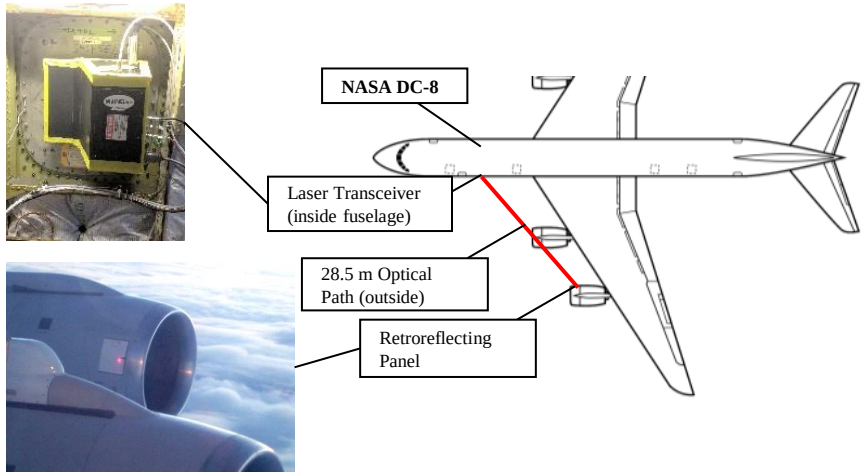
Species	Max. Measurement Rate	Precision (1σ) (1 sec)	Accuracy
H_2O(v)	Up to 100 Hz	0.1% or 0.05 ppmv	5% or 0.5 ppmv
RHw,* RHi		< 1%	10-15%

*Derived using project static pressure, temperature

Previous Field Campaigns:

- **9 different aircraft over last 2 decades**
  - **DC-8 - FIREX-AQ, ATom, KORUS-AQ, ASCENDS, SEAC^{4}RS, DC3, etc.**
  - **P-3B - DISCOVER-AQ, CAMP2EX, IMPACTS**
  - **WB-57 - MACPEX, POSIDON, ACCLIP, SABRE**
  - **Global Hawk - ATTREX**

Open-path laser absorption spectrometer



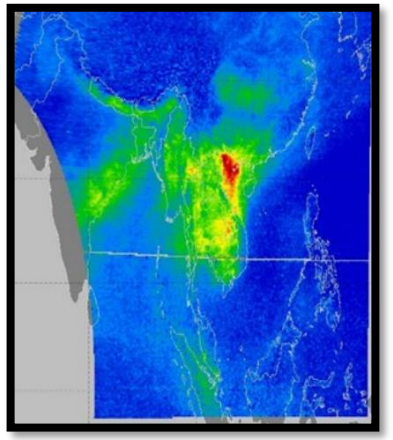
In Situ Airborne Formaldehyde (ISAF): Laser-Induced Fluorescence

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) airmass transport.



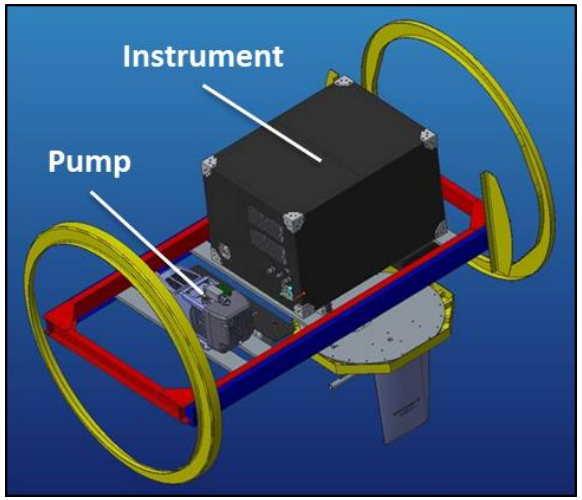
*GEMS HCHO, March 2021, van Gent et al.**

**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)	$CH_3C(O)OONO_2$
Peroxypropionyl Nitrate (PPN)	$C_2H_5C(O)OONO_2$
Peroxybutyryl Nitrate (PBN)	$CH_3CH(CH_3)C(O)OONO_2$, $CH_3CH_2CH_2C(O)OONO_2$
Peroxyacryloyl Nitrate (APAN)	$CH_2=CHC(O)OONO_2$
Peroxybenzoyl Nitrate (PBzN)	$C_6H_5C(O)OONO_2$
Nitryl Chloride	$ClNO_2$
Molecular Chlorine	Cl_2

Agency	Airborne Field Campaigns
NASA	INTEX (2006), ARCTAS (2008), DC3 (2012), SEAC^{4}RS (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)

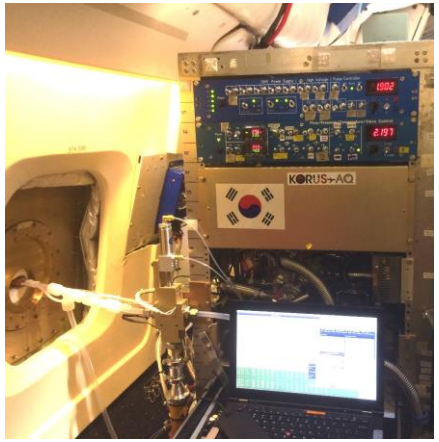
PI : Joon-Young Ahn (NIER)
Co-PI : Saewung Kim (UC, Irvine)

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)

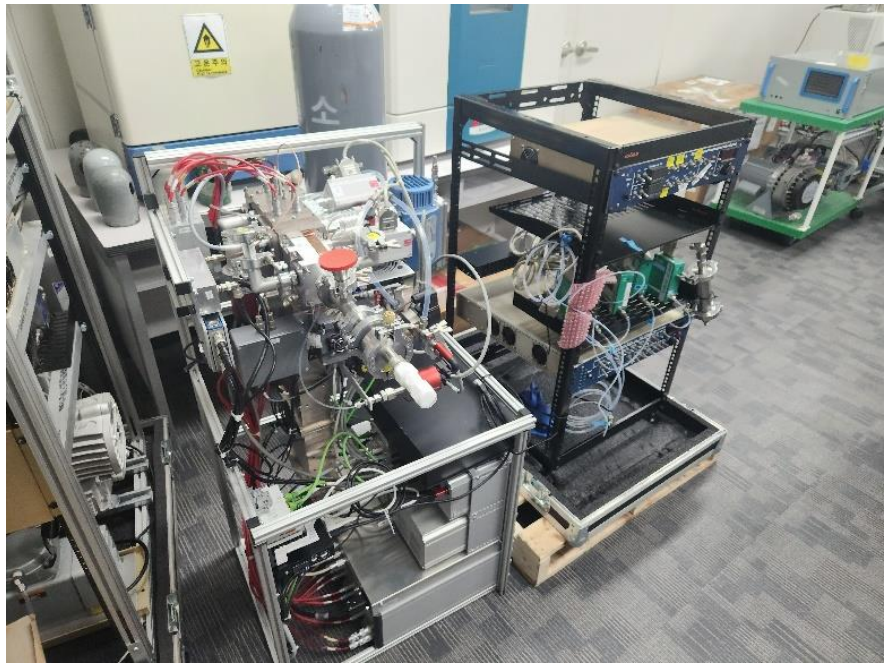
NIER (National Institute of Environmental Research)

Compounds Measured
SO_2
HONO
HO_2NO_2
Organic acids
HCl

On DC-8 during KORUS-AQ



In laboratory at NIER's Seoul Supersite



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

Caltech Chemical Ionization Mass Spectrometers (CIT-CIMS)

Team Members:

John Crounse (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:

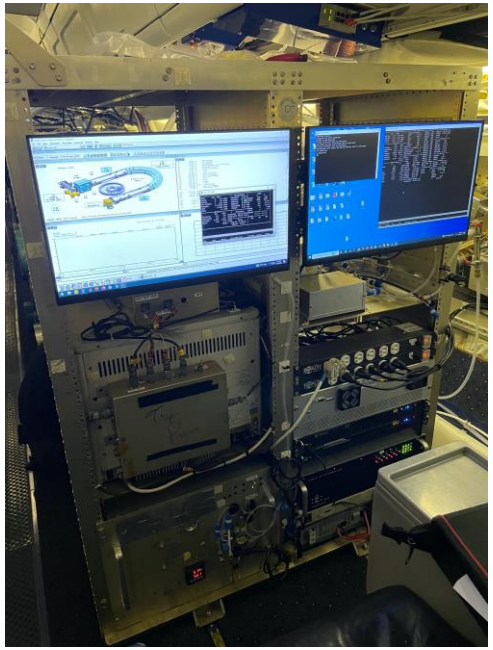
Acids (HNO_3, HO_2NO_2, formic and acetic acids)

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
SEAC^{4}RS (2013), DC-8
DC3 (2012), DC-8



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

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

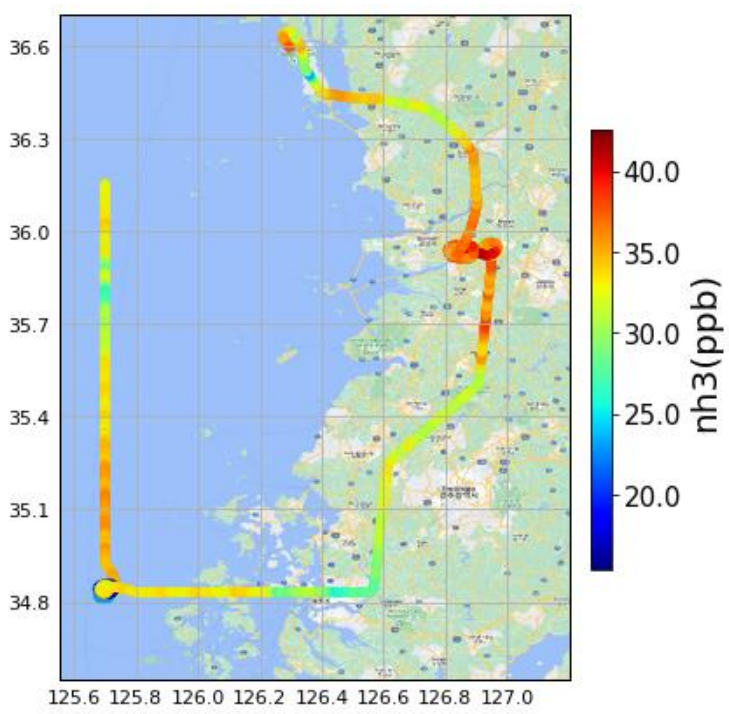
Institution : Hankuk University of Foreign Studies/National Institute of Environmental Research (HUFS)/(NIER)

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)

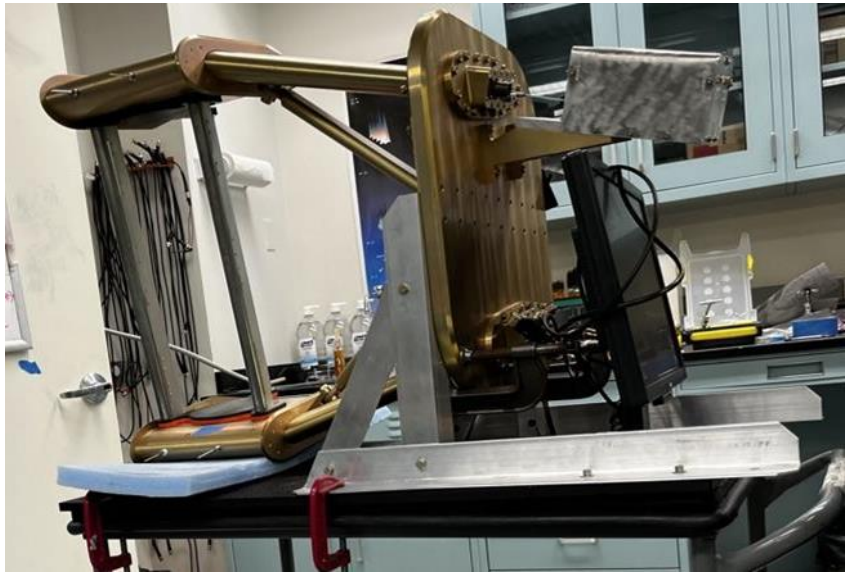
PI: Mark Zondlo (Princeton University)

Group Members: Nathan Li
Hongmin Yi
Dan Moore
James McSpiritt
Vladislav Sevostianov
Lars Wendt
Yunseo Choi

Measuring ammonia (NH_3)

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)

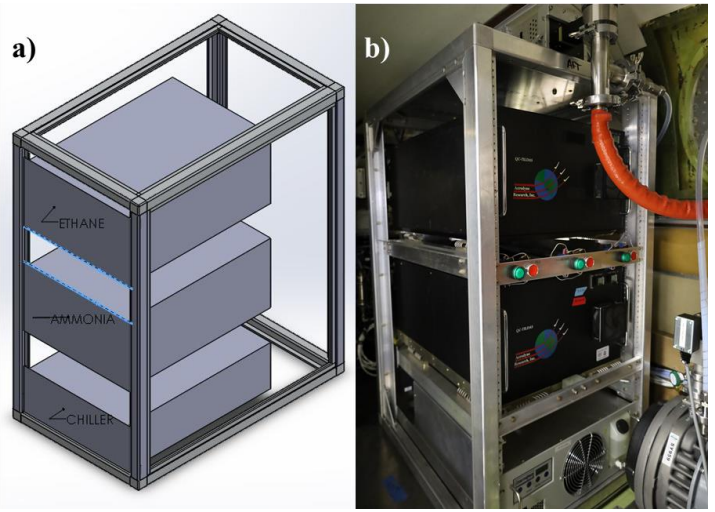
Team members:

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
- TRANS^{2}Am 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

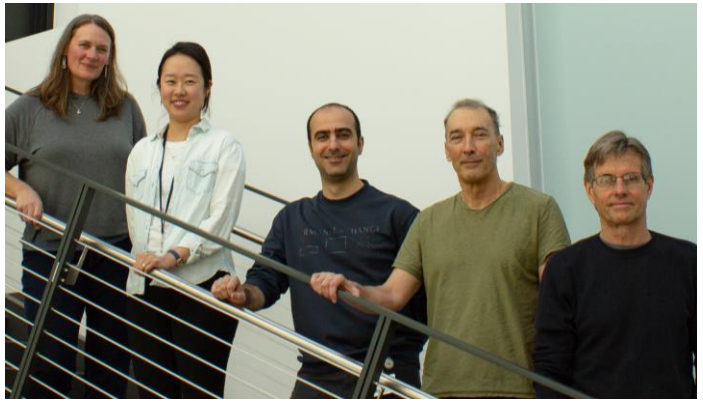
Team: Eric Apel (PI), Alan Hills, Rebecca Hornbrook, Daun Jeong, Behrooz Roozitalab (NCAR/ACOM, Boulder, Colorado, USA)

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), TI3GER (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)****:* C_3-C_{10} alkanes, alkenes, aromatics
2. ***Oxygenated VOCs****:* C_1-C_5 aldehydes, ketones, alcohols, esters, ethers, furans
3. ***Nitrogen-containing VOCs****:* including C_1-C_4 nitriles, nitrates
4. ***Sulfur-containing VOCs****:* C_1-C_3, e.g., DMS, CS_2, CH_3SH
5. ***Short- & Long-lived Halogenated VOCs****:* C_1-C_7 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)

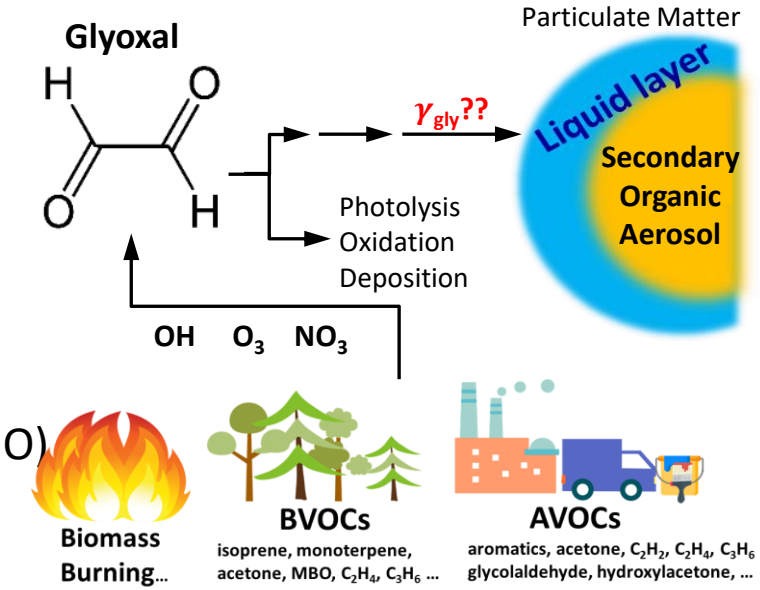
Measurement Targets

for sure

- Glyoxal (CHOCHO)
- Nitrogen Dioxide (NO_2)
- Water vapor (H_2O)

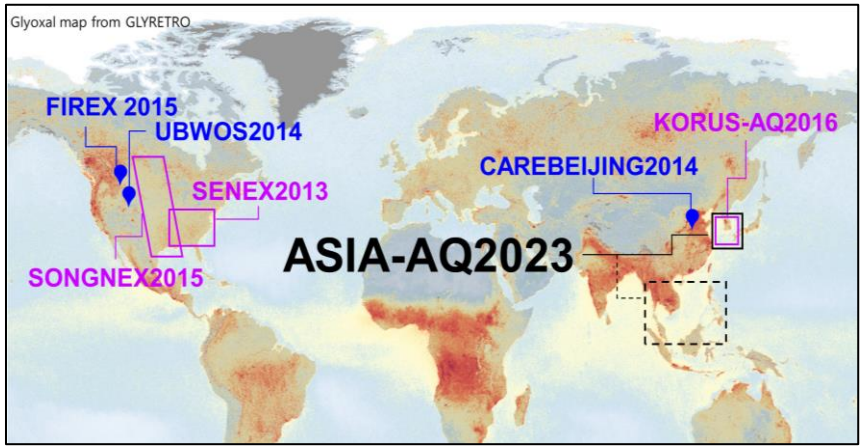
may also

- Methylglyoxal (CH_2COCHO)
- Formaldehyde (HCHO)
- Nitrous acid (HONO)



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)



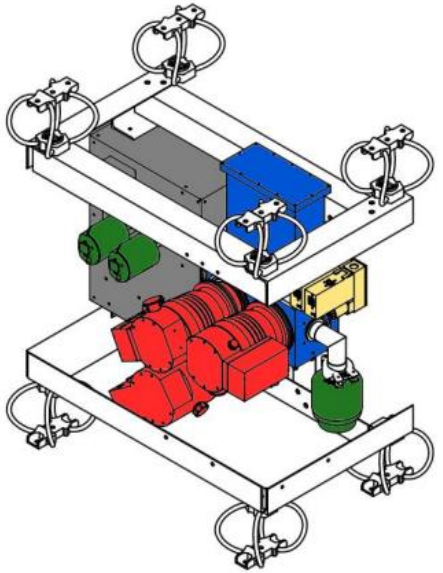
Proton Transfer Reaction, Time of Flight, Mass Spectrometer (PTR-ToF-MS)

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)
- **SEAC^{4}RS** (DC8, 2013)
- **DC3** (DC8, 2012)
- **DISCOVER-AQ** (P-3B, 2011-2014)
- **ARCTAS** (DC8, 2008)



Our ASIA-AQ Instrument Team:


Rich Moore
ASIA-AQ Lead


Luke Ziemba


Eddie Winstead


Carolyn Jordan


Michael Shook

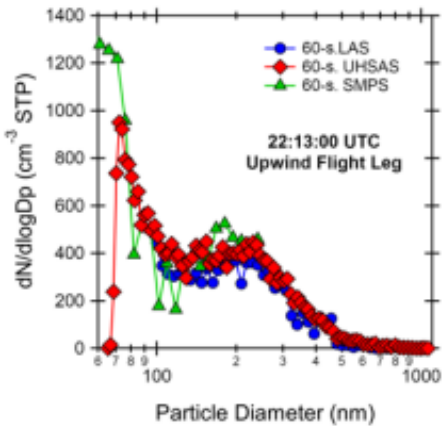

Francesca Gallo

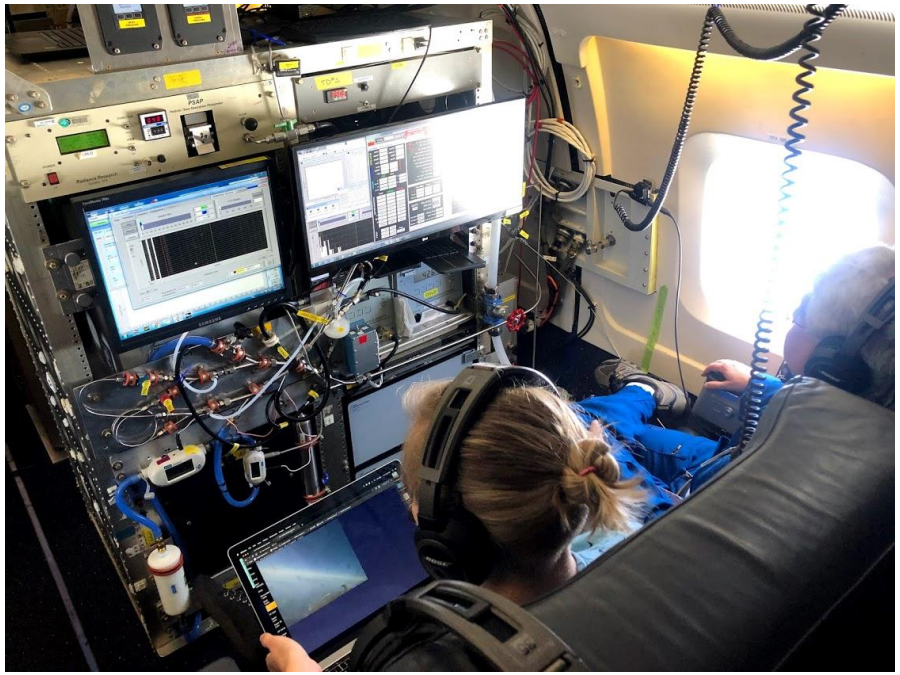

Claire Robinson

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	• 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

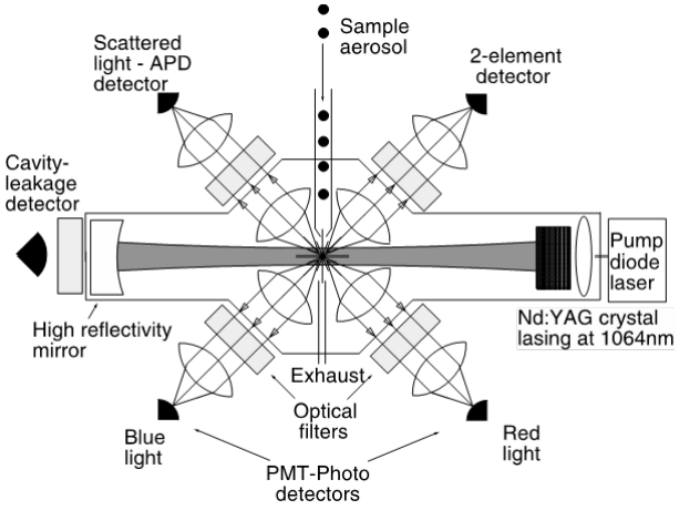
Single Particle Soot Photometer (SP2)

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)



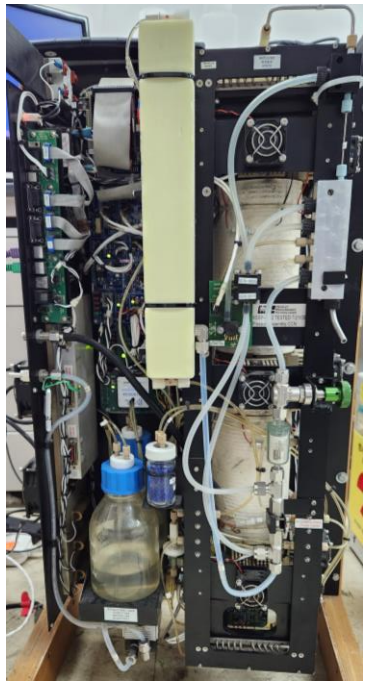
K-CCN

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

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)

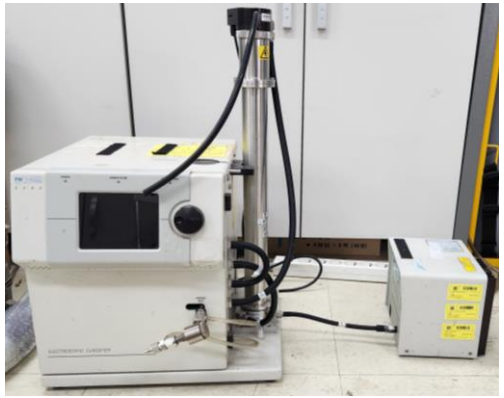
Aircraft / Field Campaign	Instruments
Beechcraft King Air (C90GT)	CPC3010, CCN-100
KORUS-AQ (NASA DC-8)	CPC3010, CCN-100
ASIA-AQ (NASA DC-8)	CPC3010, SMPS3936, CCN-100

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



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, PM_1 (D_{50} ~ 1 µm geo. dia.)):

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

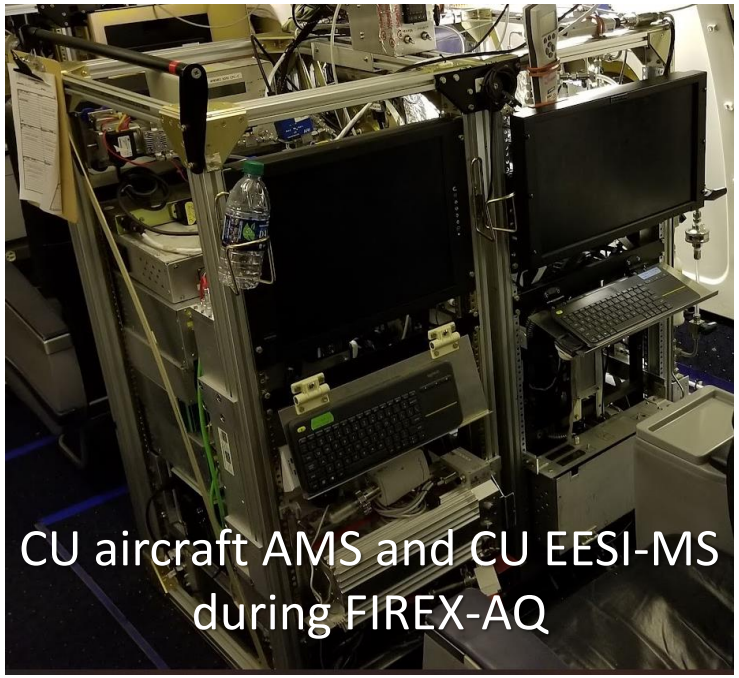
Bulk concentration, size distributions and volatility reported + detailed analysis of OA chemical properties (incl. source apportionment), organic nitrate, sulfate apportionment

Previous airborne campaigns:

NASA DC-8: ARCTAS (2008), DC3 (2012), SEAC^{4}RS (2013), KORUS-AQ (2016), ATom (2016-2018), FIREX-AQ (2019)

NSF GV: DC3-test (2012), TI^{3}GER (2022)

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


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

More details available at: https://espo.nasa.gov/firex-aq/instrument/HR-AMS

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-SIJAQ (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

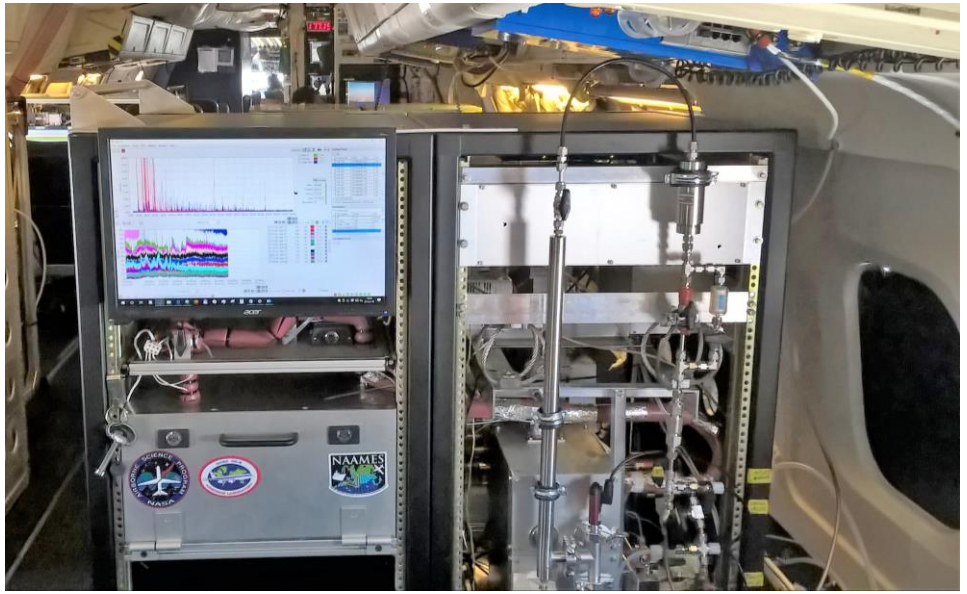
Armin Wisthaler (Univ. of Oslo, Univ. of Innsbruck)
Tomas Mikoviny (Univ. of Oslo)
Felix Piel (Univ. of Oslo)
Markus Müller (Ionicon Analytik)
Tobias Reinecke (Ionicon Analytik)
Wojciech K. Wojnowski (Univ. of Oslo)

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), SEAC^{4}RS (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 $= \int F(\lambda)\sigma(\lambda,T,p)\phi(\lambda,T,p)d\lambda$

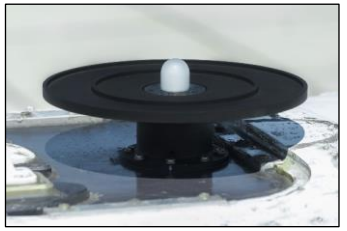
j [O3->O2+O(1D)]	*j* [CH3COCH3-> CH3CO+CH3]	*j* [BrO->Br+O]
j [NO2->NO+O(3P)]	*j* [CH3OOH->CH3O+OH]	*j* [Br2O->products]
j [H2O2->2OH]	*j* [CH3ONO2-> CH3O+NO2]	*j* [BrNO3->Br+NO3]
j [HNO2->OH+NO]	*j* [CH3COCH2CH3-> Products]	*j* [BrNO3->BrO+NO2]
j [HNO3->OH+NO2]	*j* [CH3CH2CH2CHO-> C3H7+HCO]	*j* [BrCl->Br+Cl]
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)*

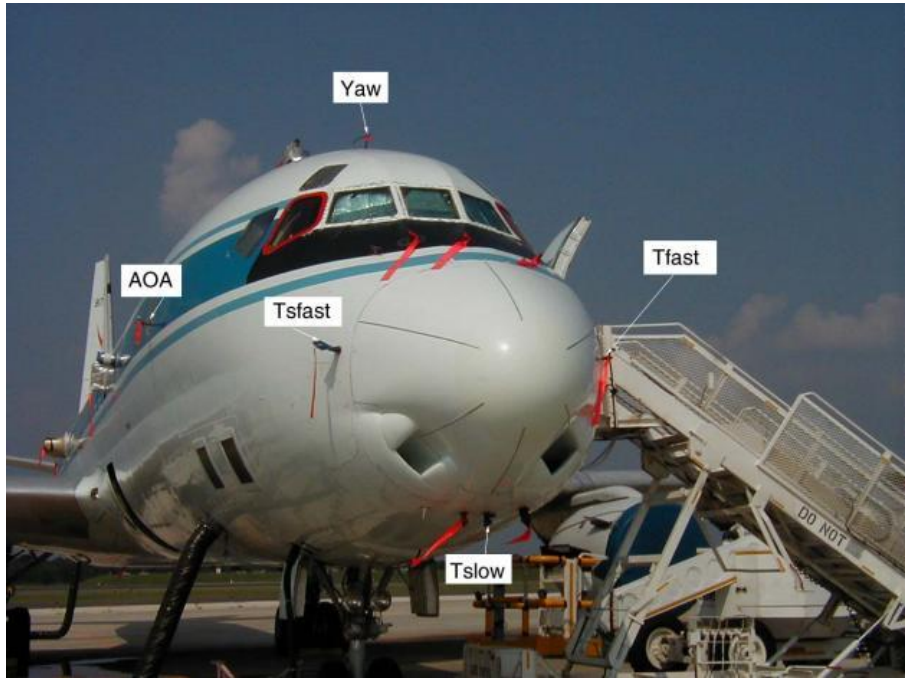
T. Paul Bui	NASA Ames Research Center
J. Dean-Day	Bay Area Env. Res. Institute
Ric Kolyer	NASA Ames Research Center
Cecilia Chang	Bay Area Env. Res. Institute
Rajesh Poudyal	Bay Area Env. Res. Institute

Primary Products 1-20 Hz	Accuracies	Precision
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:

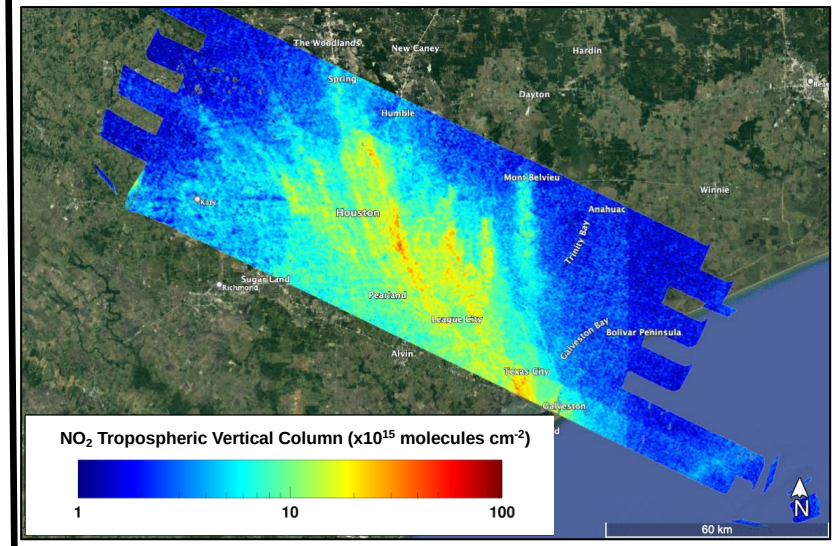
- PI: Scott Janz, NASA GSFC
- Jayne Boehmler, SSAI/NASA GSFC
- Sanxiong Xiong, SSAI NASA/GSFC
- Laura Judd, NASA LaRC
- Angelique Demetillo, NASA LaRC

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)

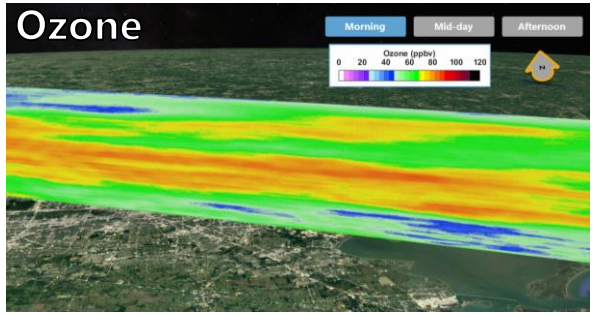
Measurements:

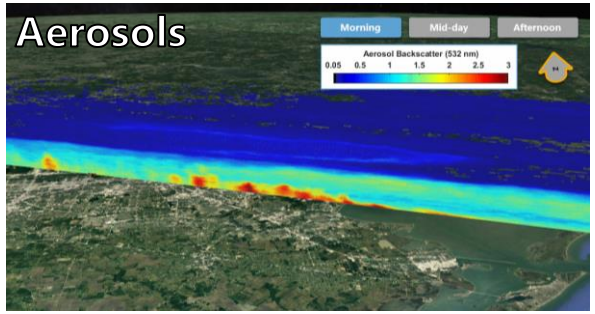
- Vertical profiles of ozone concentration
- Surface weighted ozone (0-2 km)
- Particulate backscatter profiles (355, 532, 1064 nm)
- Aerosol extinction profiles (355 and 532 nm)
- Aerosol Optical Thickness (AOT) (355 and 532 nm)
- Particle depolarization profiles (355, 532, 1064 nm)
- Extinction-to-backscatter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

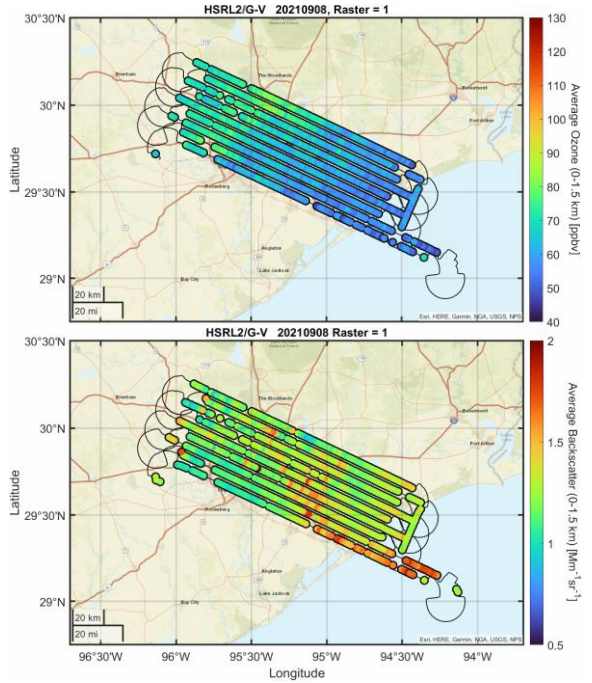
Campaigns:

- 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*







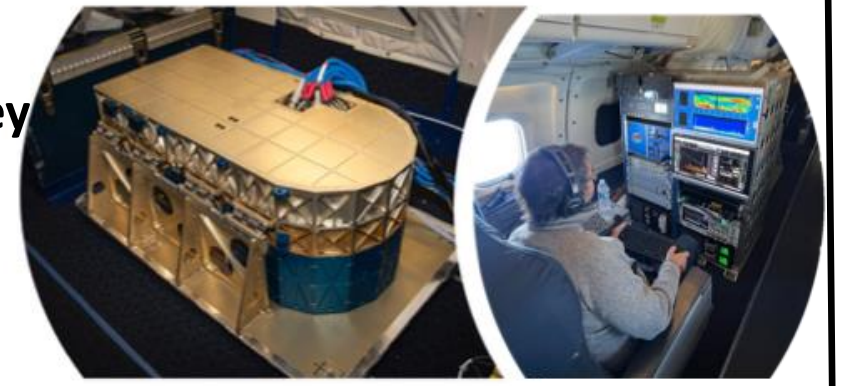
High-Altitude Lidar Observatory (HALO) – Methane DIAL and HSRL

HALO Team

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

NASA Langley Research Center

Instrument Head **HALO Rack**

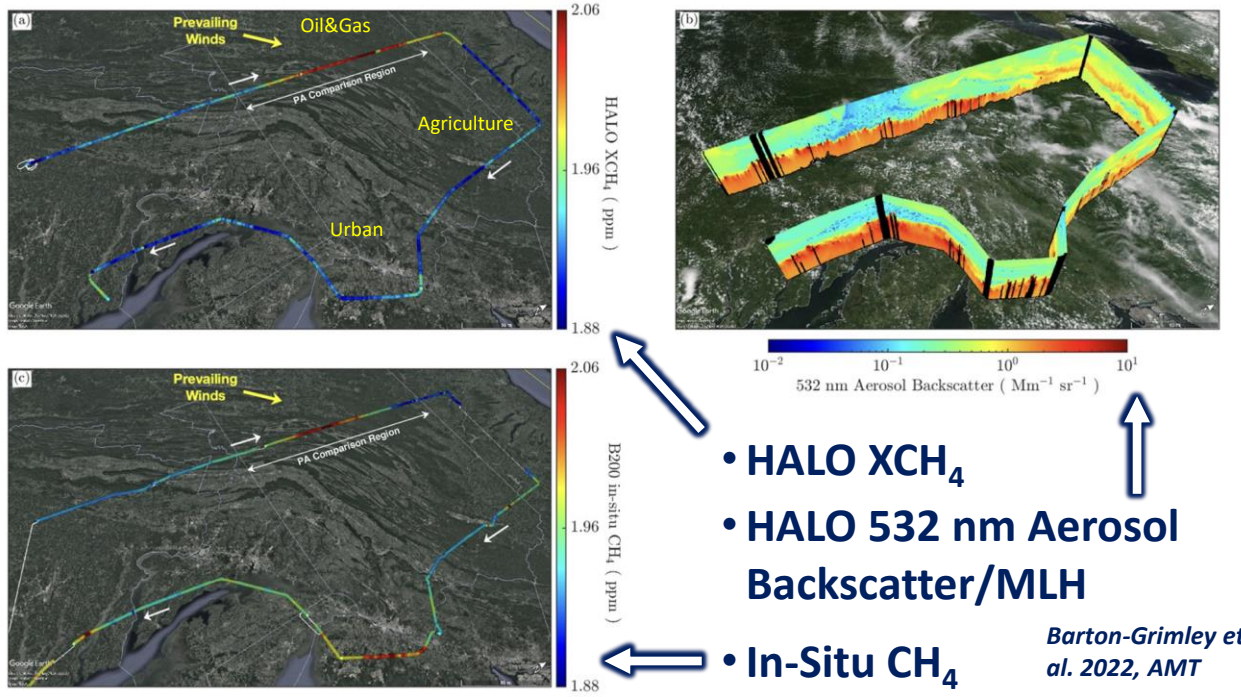


Measurement Attributes

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_2O/HSRL	**DC-8**
Synergies of Active Optical and Active Microwave Remote Sensing Experiment (SOA^2RSE)	2022	H_2O/HSRL	**P3**
Convective Processes Experiment –Aerosols and Winds (CPEX-AW)	2021	H_2O/HSRL	**DC-8**
Atmospheric Carbon and Transport – America (ACT-America)	2019	CH_4/HSRL	**C-130**
ADM-Aeolus Cal/Val	2019	H_2O/HSRL	**DC-8**
Long Island Sound Tropospheric Ozone Study (LISTOS)	2018	CH_4/HSRL	**B-200/UC-12**



- **HALO XCH_4**
- **HALO 532 nm Aerosol Backscatter/MLH**
- **In-Situ CH_4**

Barton-Grimley et al. 2022, AMT

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

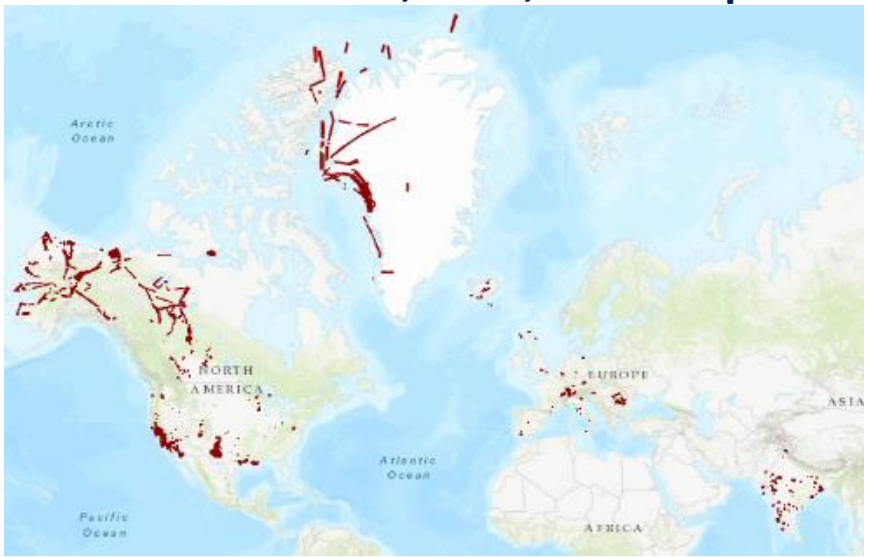
Measurement Attributes

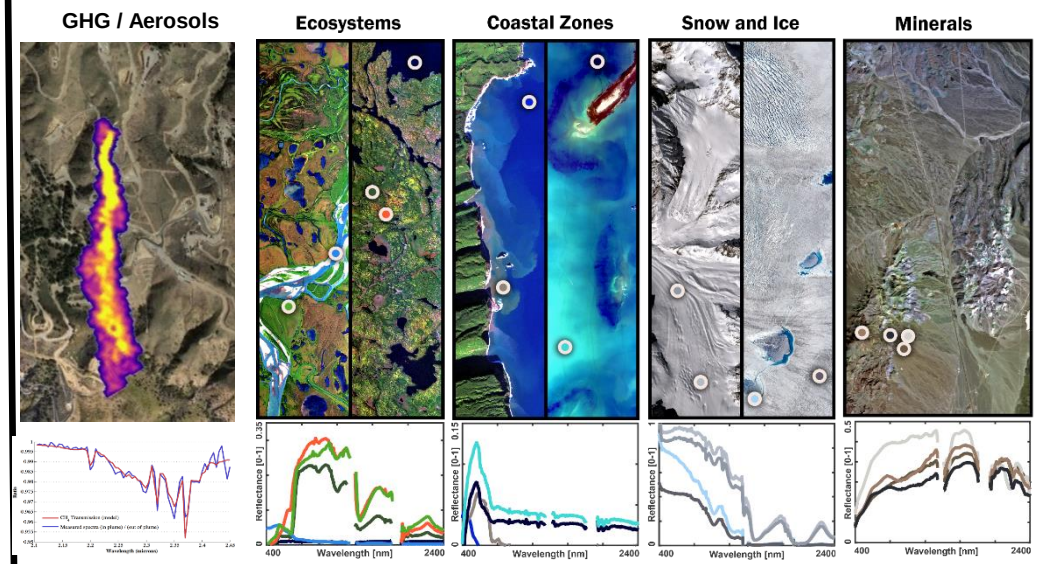
Imaging Spectroscopy: Earth System science

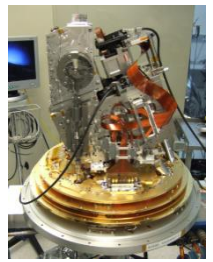
- *Very high SNR, Calibration, Full VSWIR (380-2500 nm @ 5 nm)*
- *34 degree Swath 1 to 7 m sampling*
- *Exceptional measurement quality for science (current state-of-the art)*

https://avirisng.jpl.nasa.gov

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





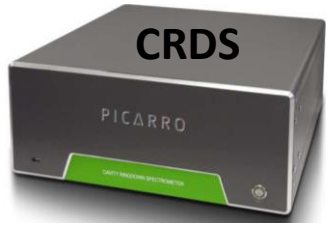


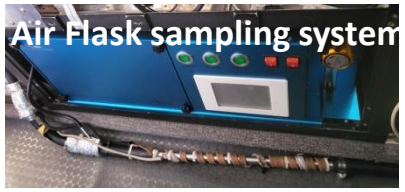
NIMS Aircraft Team

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 CO2, CH4, CO
δ13C-CO2, δ13C-CH4 (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
Dropsonde
M300 data collection





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.)

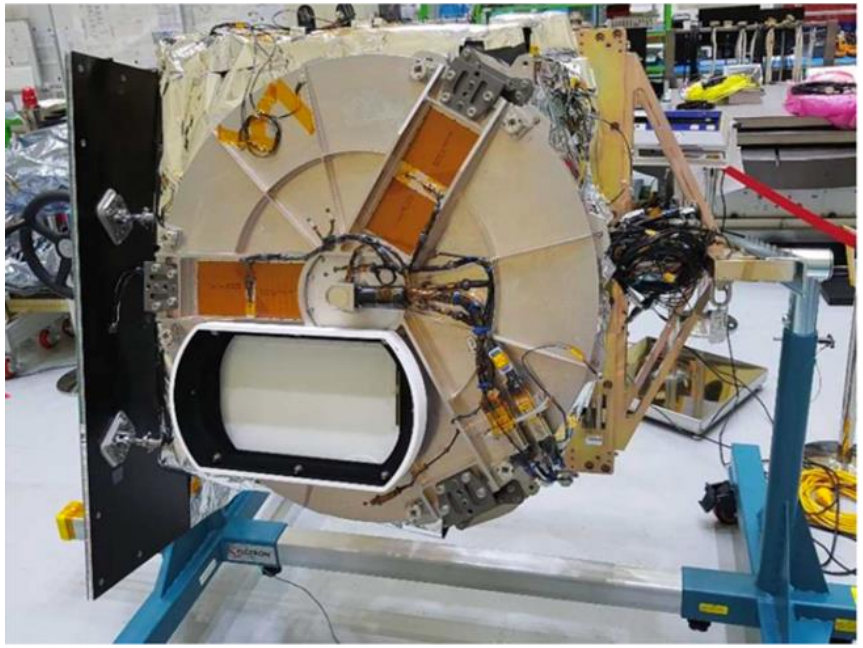
Team members (YSU)
Y. Cho, H. Cha, M. Kim, J. Lee, Y. Chae

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

Field Campaigns the instrument has contributed

- GMAP/SIJAQ (by NIER)



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)

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

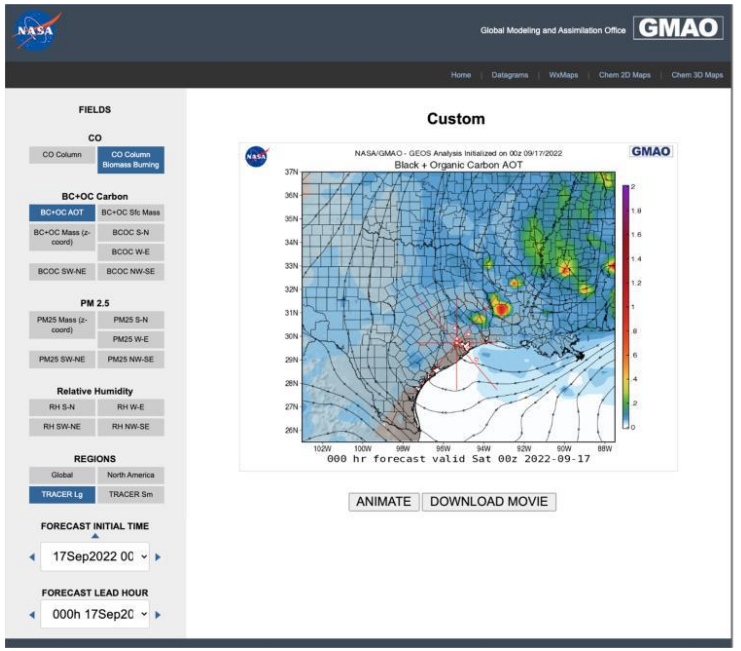
GEOS-CF Air Quality Forecast

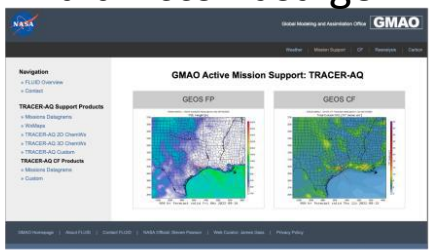
- 25 km resolution
- 1-day hindcast and 5-day forecast
- Full atmospheric chemistry with GEOS-Chem chemical mechanism

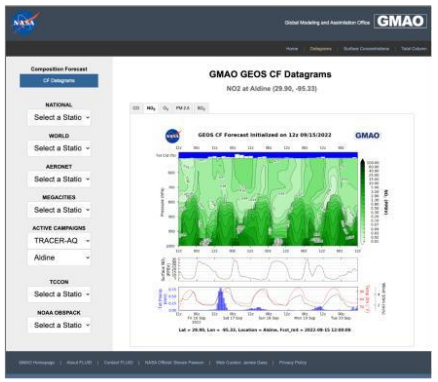
Field Campaigns the modeling team has contributed

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

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:

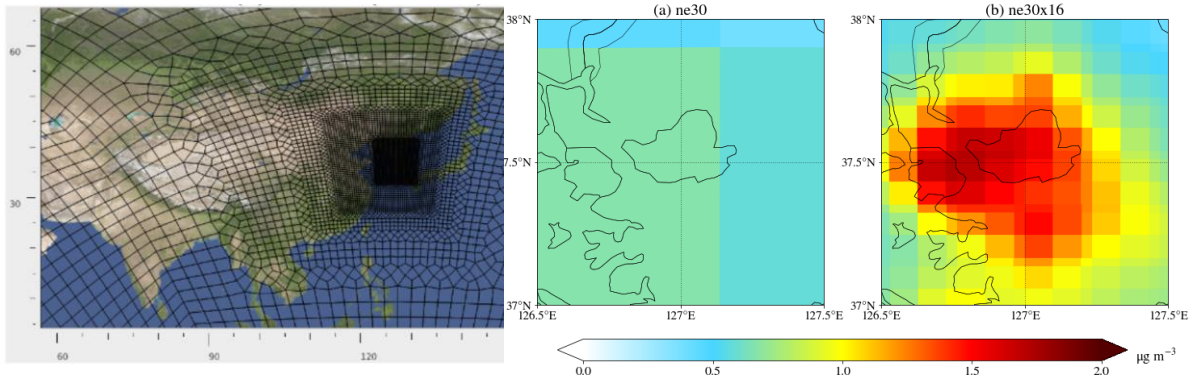
- MUSICAv0: Multi-scale Infrastructure for Chemistry and Aerosols – Global CAM-chem with regional refinement – with comprehensive chemistry, assimilation of MOPITT CO
- WRF-Chem and WRF-Tracer (domain to be determined) – aerosols and ozone chemistry, tracers for source regions and types
- FLEXPART driven 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

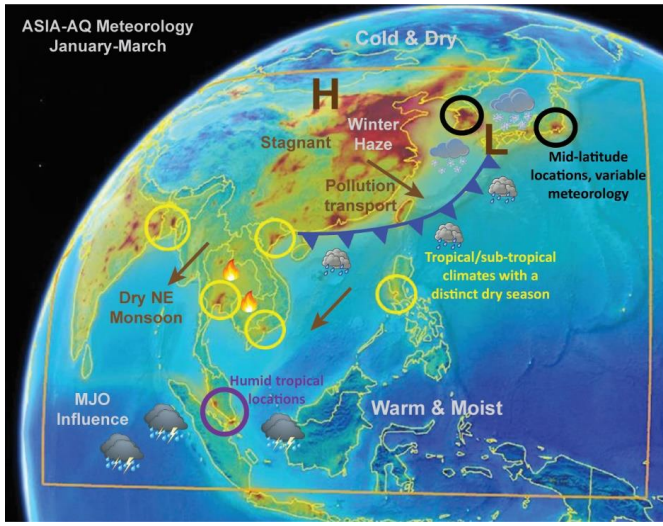


(left) MUSICAv0 model grid with 1/16-degree over Korea. Simulated black carbon concentrations using MUSICAv0 at (middle) standard 1-degree and (right) refined 1/16-degree (7 km) horizontal resolution during KORUS-AQ.

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)

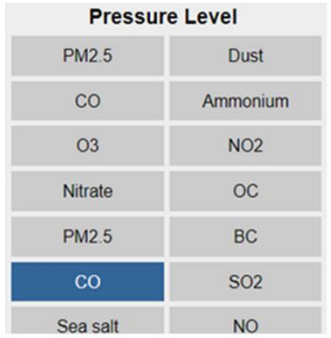
Weather Forecasting, Nowcasting, and Flight Planning Support using models, satellite and ground observations

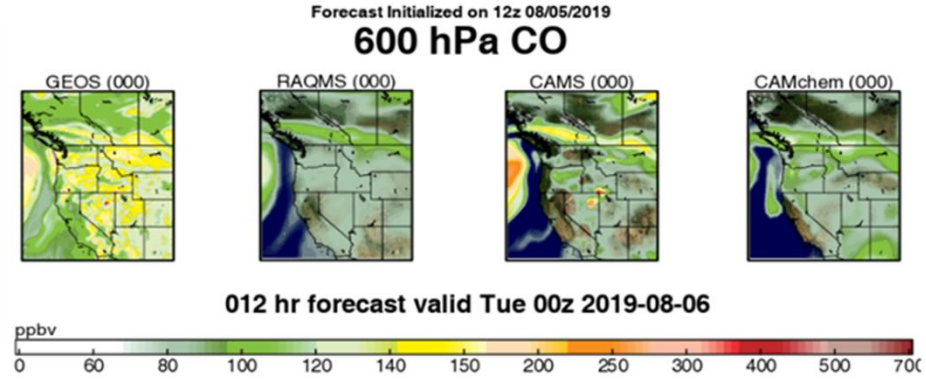


Previous field campaign support

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

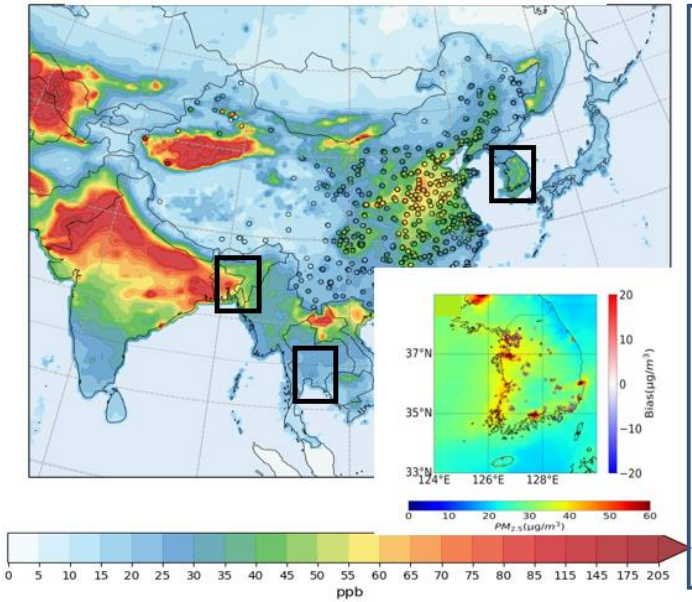




UIOWA Air quality forecasting and analysis in support of ASIA-AQ

PI: Greg Carmichael (UIowa)
Co-I: Jun Wang (UIowa)
Collaborator: Gonzalo Ferrada (UTenn)
PhD students (UIowa)

- **Hyerim Kim**
- **Chen Wang**

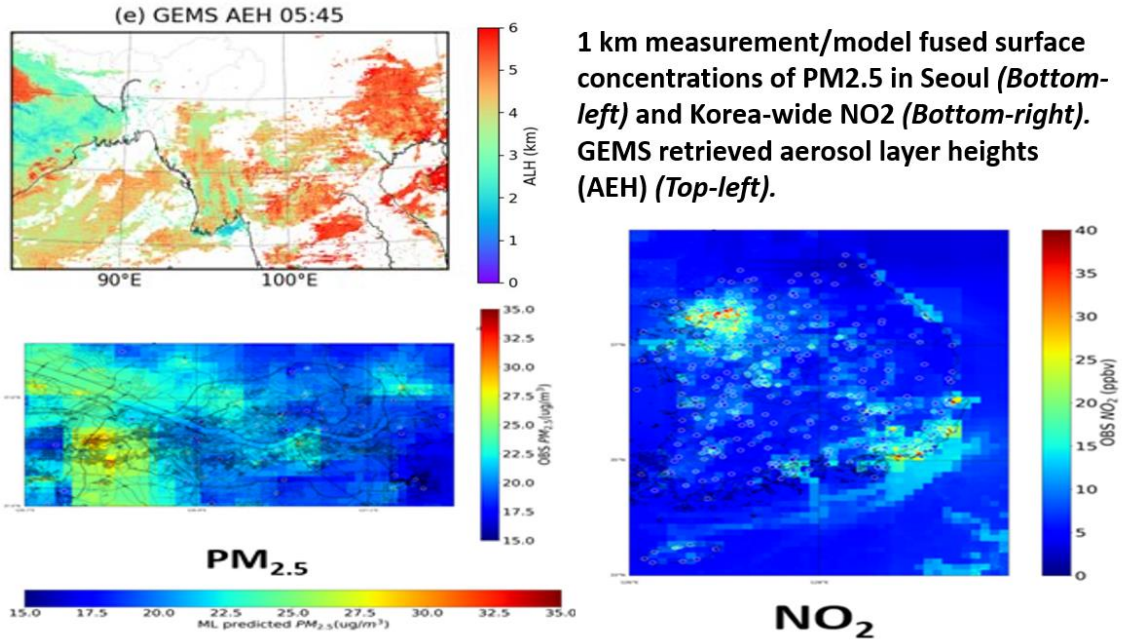


Proposed Tasks:

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.

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)



1 km measurement/model fused surface concentrations of PM2.5 in Seoul *(Bottom-left)* and Korea-wide NO2 *(Bottom-right).* GEMS retrieved aerosol layer heights (AEH) *(Top-left).*