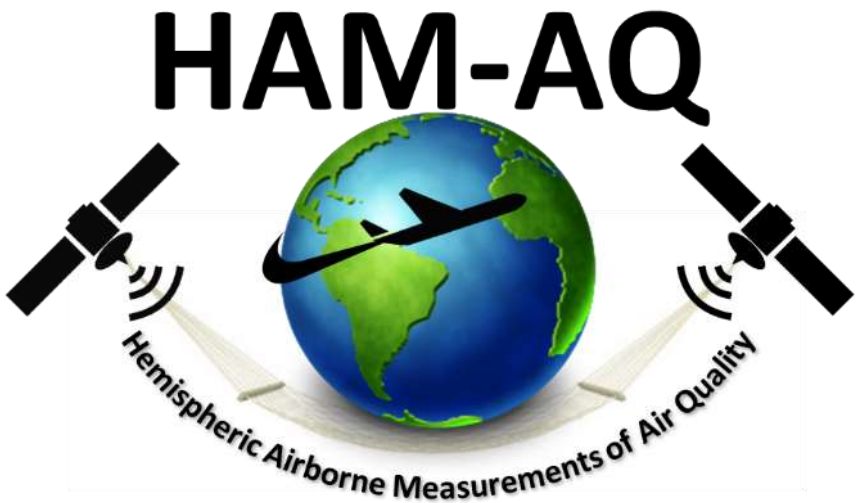
ACAM Research Opportunity

Hemispheric Airborne Measurements of Air Quality (HAM-AQ)

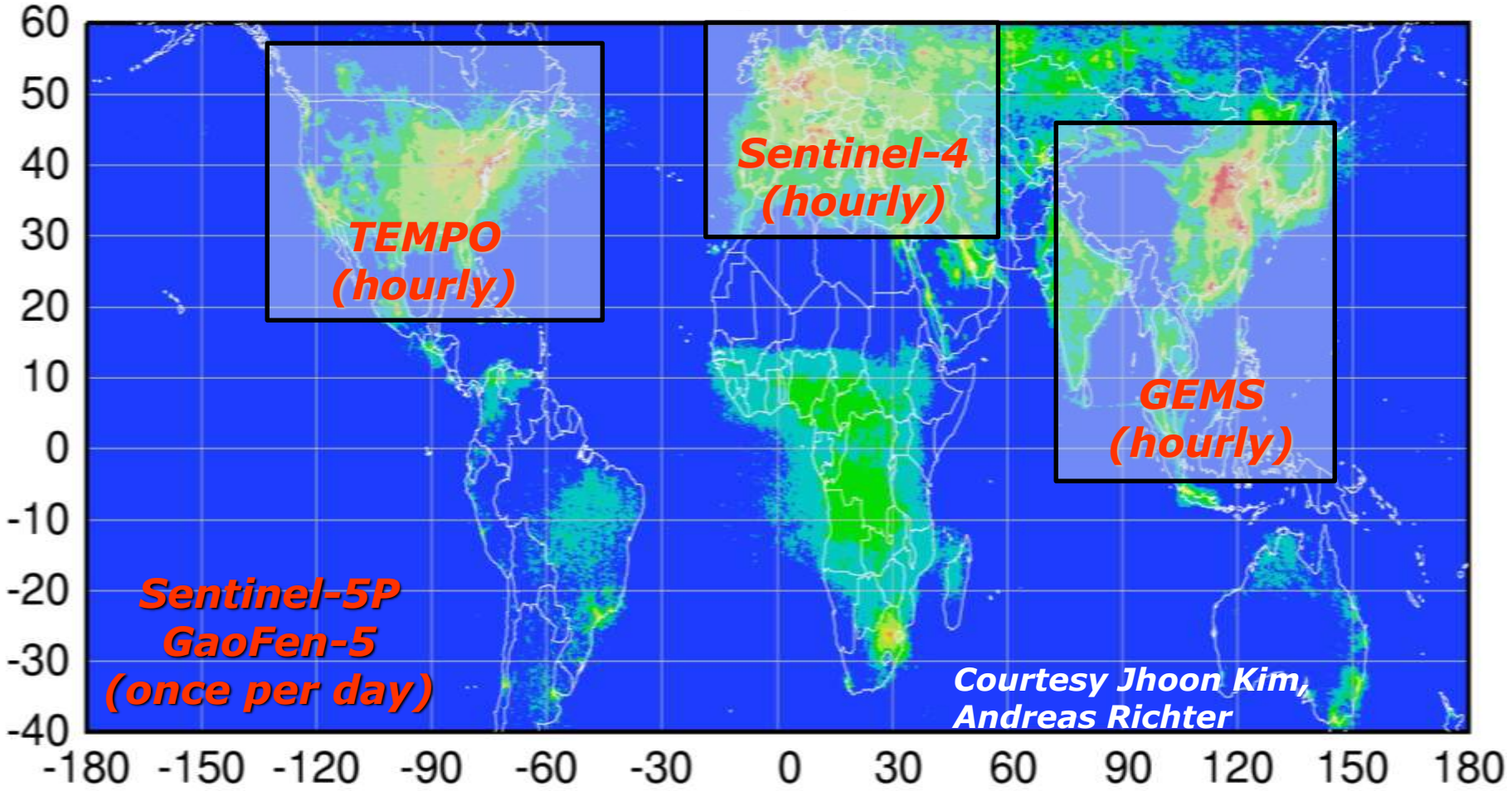


Purpose: Propose an international team to conduct ground-based and airborne research focused on air quality in the northern hemisphere

Potential funding source: NASA Earth Venture Suborbital-3

Duration: 5-years (nominally 2019-2023)

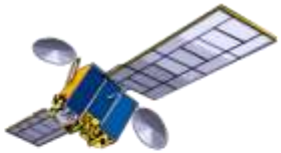
Global pollution monitoring constellation:
Tropospheric chemistry missions funded for launch



Policy-relevant science and environmental services enabled by common observations

- Improved emissions, at common confidence levels, over industrialized Northern Hemisphere
- Improved air quality forecasts and assimilation systems
- Improved assessment, e.g., observations to support United Nations Convention on Long Range Transboundary Air Pollution

A Global Air Quality Observing System is emerging that requires strong connections between observations from multiple perspectives. The global reach of this system demands strong international collaboration in the collection of and sharing of data.



Broad spatial coverage for key atmospheric constituents (aerosols, ozone, precursors)
Daytime coverage (Geostationary orbit)
Limited temporal coverage (Low Earth orbit)
Limited vertical resolution

Satellite Calibration and Validation
Retrieval/Algorithm development
Model error evaluation
Data assimilation
Diagnostic modeling studies
Correlative information
Small scale structure and processes

Comprehensive in situ atmospheric composition
Passive and Active remote sensing
Detailed vertical structure
Limited temporal and spatial coverage

Source-receptor relationships for pollution
Inverse modeling for emissions
Aerosol radiative forcing
Detailed chemical processing

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Draft HAM-AQ Science Questions

Overarching question: Are observations from the international constellation being effectively combined to assess air quality in the northern hemisphere?

1) How are satellites comparing with ground-based remote sensing and in situ measurements? What are the factors influencing areas of poor agreement (e.g., vertical distribution, aerosol loading, etc.)?

2) Are emissions inventories adequate to explain distributions of precursors (e.g., NO_x, CH_2O, SO_2) and resulting impacts on O_3 and $PM_{2.5}$?

3) Are satellite diagnostics providing reliable information on ozone production (CH_2O:O_3) and the relative roles of NOx and VOCs (CH_2O:NO_2)?

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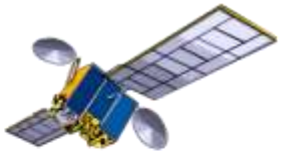

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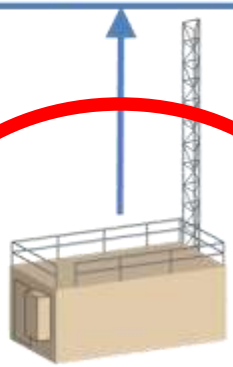

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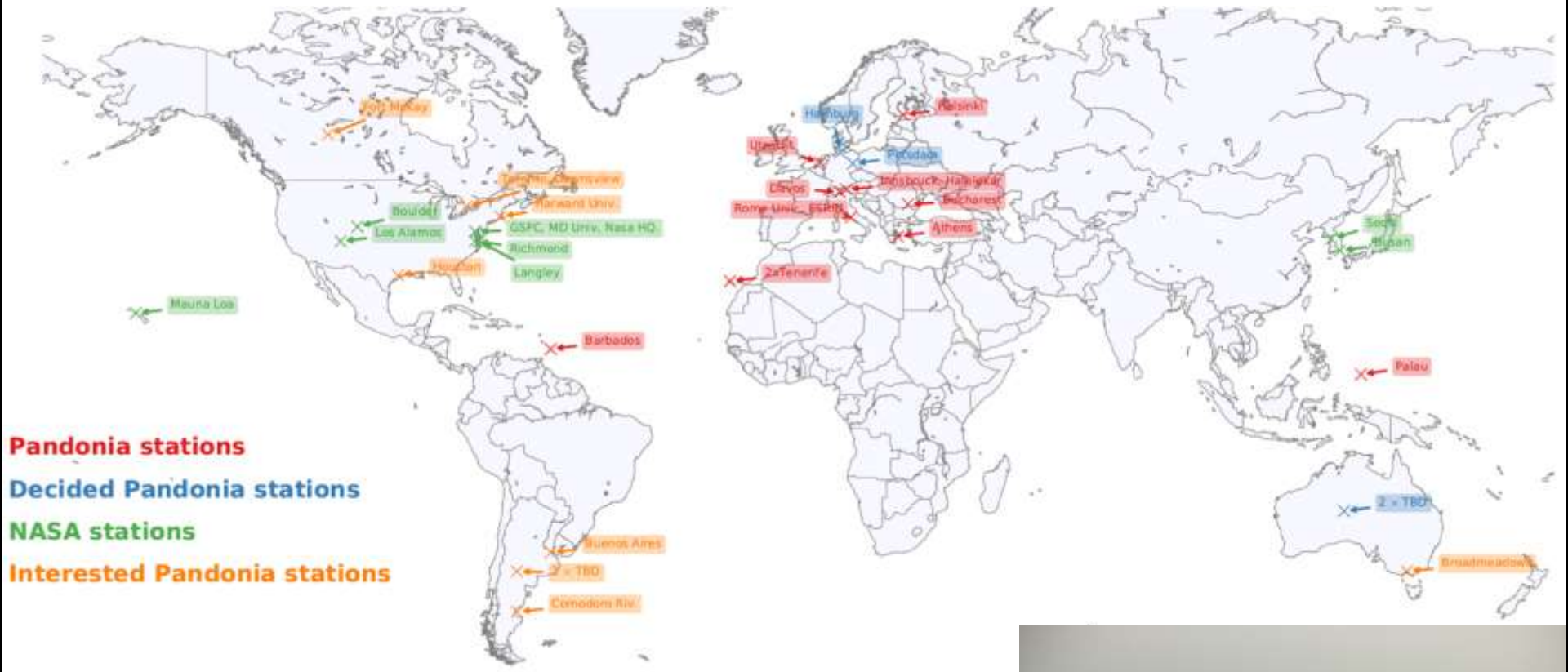
Current status of the Pandonia network, a critical component for constellation science and validation



Pandora spectrometers provide critical ground truth through continuous direct-sun monitoring of trace gas columns for O_3, NO_2, and CH_2O.

Pandora network coordinator: Robert Swap, NASA GSFC
Pandora principal investigator: Jay Herman, NASA GSFC

Current status of the Pandonia network, a critical component for constellation science and validation

What plans are being developed for Asia?

If we were to obtain a large number of Pandora spectrometers, what is the interest in hosting these instruments?

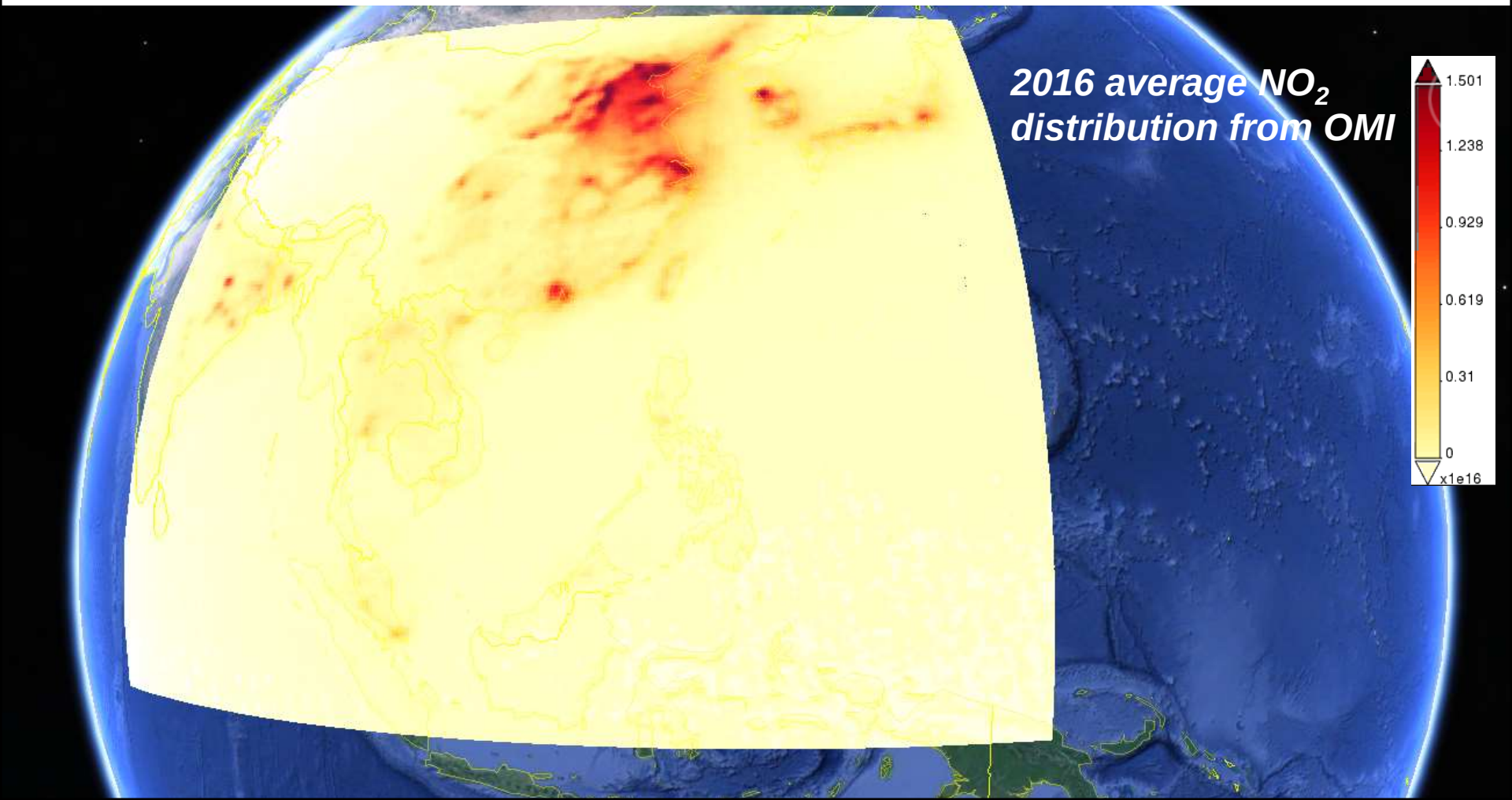
We need to work together to identify the right host sites. IGAC-MANGO could help here.

ACAM countries falling within the GEMS field of regard

We seek partners for the purpose of hosting Pandora spectrometers across many countries. NASA would provide the instrument, installation, data processing, data archival, and full data sharing for all participants.

GEMS field of regard as viewed from 0N, 128E

We will propose to locate Pandora spectrometers at 20 locations. To make the best site selections, we need to know the location of research sites and national air quality networks that would provide complementary information for interpreting the Pandora and satellite observations (see site selection criteria).



Pandora site selection criteria:

Basic needs:

Unobstructed horizon (for direct sun viewing)
Basic power (can plug into standard power receptacle)
Internet connection (for remote control and data download)

Desired local measurements:

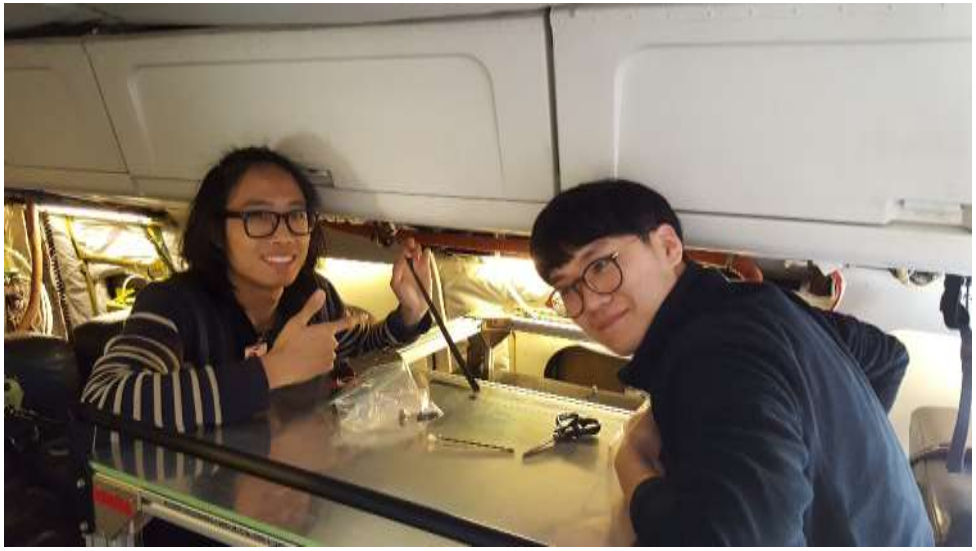
in situ O_3
in situ NO_2
Aerosol optical depth (e.g., AERONET)

Other useful other measurements/considerations:

In situ CH_2O, SO_2, CO, etc.
In situ $PM_{2.5}$
Mixing height (ceilometer, MPL, sounding station, etc.)
Airspace conditions enabling overflight

*Willingness to share data is strongly encouraged and will affect site selection.

NASA DC-8 Airborne Measurements



DC-8 participation:

3 or 4 deployments of the DC-8 would be planned, targeting areas where interpretation of satellite observation needs to be improved.

Deployments would be planned to underfly both GEMS in Asia and TEMPO in North America.

There is room on the DC-8 for up to 10 foreign instrument teams.

Representation from as many countries as possible is desired.

Foreign investigators would need to provide their own instrument and personnel.

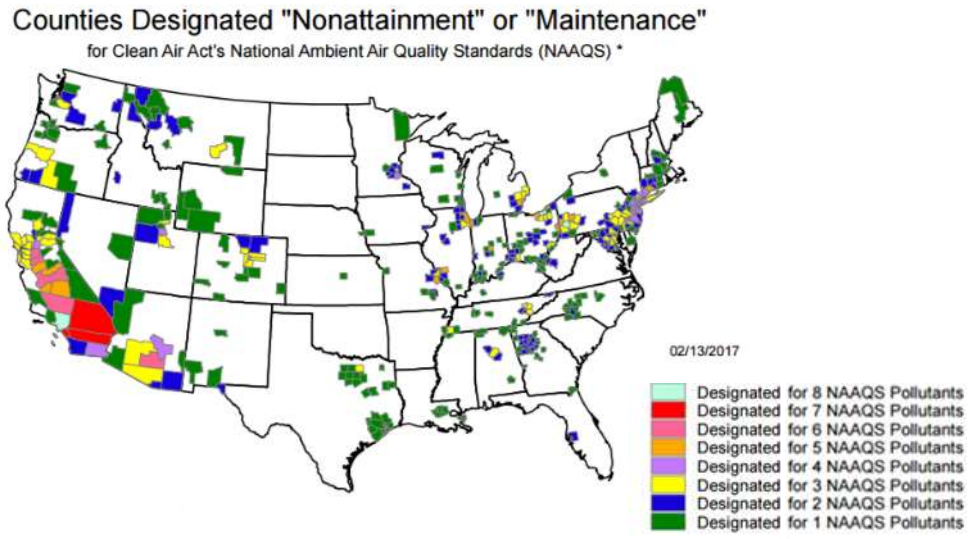
Integration on the DC-8 aircraft, instrument shipping, and reimbursement of travel costs for deployment participants would be provided.

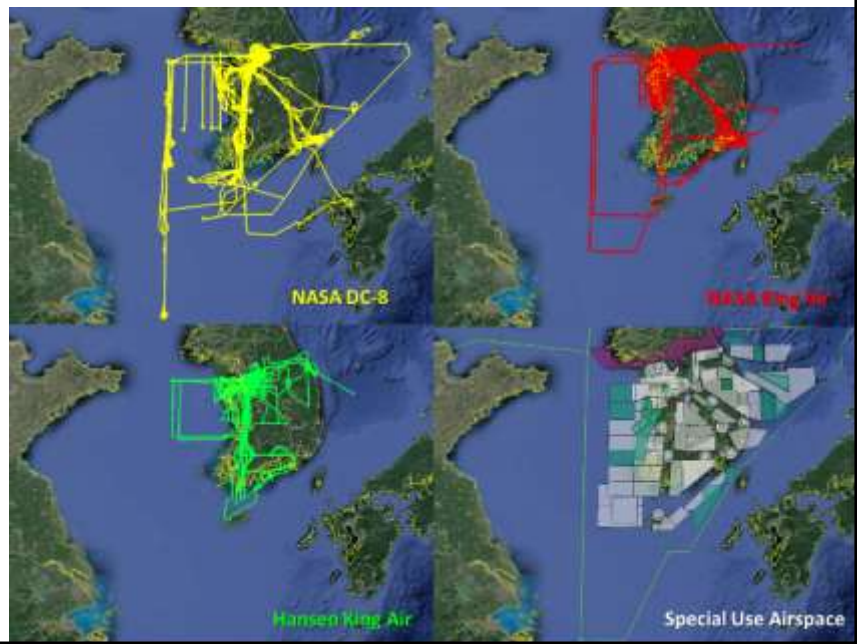
Possible DC-8 deployment locations to explore air quality problems:

In North America, deployments to the northeastern US, southeastern US, or west coast of California would be most likely.

In Asia, we are very interested in a follow-up deployment to Korea to evaluate changes after the KORUS-AQ study.

We need help from established scientists in other Asian countries who can confidently advocate for DC-8 overflight in the 2021-2023 timeframe. It is never too soon to start!





Air Quality Model participation:

HAM-AQ observations would provide an excellent opportunity for model comparison and evaluation and is strongly aligned with efforts under the MAP-AQ framework (Guy Brasseur).

Pandora and other ground data will be continuously updated and publically available.

Data from the DC-8 will be made publically available within six months of each deployment.

Other collaborating activities:

HAM-AQ needs to recognize and enhance ongoing air quality work by other groups.

HAM-AQ will also provide a framework for proposing other collaborative measurements and cooperating field efforts.

Previous air quality studies (DISCOVER-AQ and KORUS-AQ) included large collaborating efforts from other funding groups:

US EPA (Environmental Protection Agency)
Korea's NIER (National Institute of Environmental Research)
Numerous State air quality agencies (Maryland, California, Texas, Colorado)
US NSF (National Science Foundation)
AERONET
GEO-CAPE
And others…

ACAM Working Group 3 provides an ideal forum for discussing possible collaborating activities.

Nominal Timeline for the 5-year Project

Fall 2017 – Notice of Intent to Propose

Winter 2017/2018 – Proposal Due

Summer/Fall 2018 – Selections Announced

Spring 2019 – GEMS Launch

2019 – Install Pandora Instruments

2021/2022 – Anticipated GEMS Launch (TBD)

2021-2023 – Flight Campaigns in North America and Asia

****If satellite launches are experiencing delays, a request will be made to shift the project to 2020-2024 instead of 2019-2023.***

Ways to get involved in HAM-AQ:

Become a Pandora site host

Conduct DC-8 airborne measurements

Model analyses of observations

Overflight negotiations for your country

Propose a collaborating activity

Please talk to me if you are interested or have suggestions!

Jim Crawford (James.H.Crawford@nasa.gov)