HAQAST 2019 Review

Prepared by

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haqast.org

Connecting NASA Data and Tools With Health and Air Quality Stakeholders

WWW.HAQAST.ORG  TWITTER.COM/NASA_HAQAST
What is “hay-kast”?

• Health and Air Quality Applied Sciences Team
• NASA-funded Applied Sciences Team
• 3-year funded project (thru summer ’19-’20)
• 13 Members and 70+ co-investigators
• Mission: Connect NASA science with air quality and health applications
• ~ $15 Million Total Cost
• Three types of work:
  1. Outreach & engagement
  2. Tiger team projects (collaborative)
  3. Member projects

HAQAST Investigator Susan Anenberg (left), NASA HQ Program Manager John Haynes (middle), and HAQAST Communications Lead Daegan Miller (right) at HAQAST4 in Madison, WI
HAQAST: Who We Are

Tracey Holloway *Team Lead*, UW-Madison
Bryan Duncan NASA GSFC
Arlene Fiore Columbia University
Minghui Diao San Jose State University
Daven Henze University of Colorado, Boulder
Jeremy Hess University of Washington, Seattle
Yang Liu Emory University
Jessica Neu NASA Jet Propulsion Laboratory
Susan O’Neill USDA Forest Service
Ted Russell Georgia Tech
Daniel Tong George Mason University
Jason West UNC-Chapel Hill
Mark Zondlo Princeton University
HAQAST: Who We Are

HAQAST Leadership Team

Tracey Holloway
HQAST Team Lead

Daegan Miller
HQAST Communications Lead

Page Bazan
HQAST Communications Specialist
HAQAST Meetings

Photos from HAQAST6 Meeting July 2019 in Pasadena, CA
HAQAST Meetings: In Person Attendance

Local vs Visiting Registrants

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<tr>
<th>HAQAST1 Emory University, Atlanta, GA</th>
<th>HAQAST2 University of Washington, Seattle, WA</th>
<th>HAQAST3 Lamont-Doherty Earth Observatory, Palisades, NY</th>
<th>HAQAST4 University of Wisconsin, Madison, WI</th>
<th>HAQAST5 Arizona State University, Tempe, AZ</th>
<th>HAQAST6 Hilton Pasadena, CA</th>
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Offering an option to join the HAQAST conferences remotely more than doubles the average HAQAST conference audience size…

… but the type of engagement is fundamentally different
HAQAST.org Promotes NASA Tools for Stakeholders

- Website ([www.haqast.org](http://www.haqast.org)) features NASA tools and data
- Tools section designed in consultation with ARSET
- Developed how-tos for two of the most useful tools for HAQAST stakeholders, Worldview and Giovanni; includes short video tutorials

Click on **Getting Started** for a brief primer to the benefits and limitations of satellite data. Clicking on the title takes you directly to the tool's NASA page. Tutorials available (online, pdf, and video formats). Very brief descriptions of each tool.
HAQST.org New Users

- New Users Aug 1, 2017 – July 31 2019 (by month)

- New Users Aug 1, 2017 – July 31 2019 (by day)
Over 65 total papers published to date

Collaborative Publications

HAQAST publications by calendar year

Multiple PIs involved; single PI involved
• Assume that all HAQAST members will participate equally in the Tiger Team process

• Members and Co-I expertise could support many different projects

• After projects were selected, people are reallocated to contribute to selected teams

• In 2017, $1.5 Million allocated to support 4 Tiger Teams. Feedback from participants suggests that teams are successful and productive.

• In 2018, $1.6 Million allocated for 4 new Tiger Teams.
• **Led by Susan O’Neill:** assess the effects of wildfire smoke on the air quality and human health burden resulting from October 2017 California wildfires

• **Led by Arlene Fiore:** Supporting the use of satellite data in regional haze planning

• **Led by Jessica Neu:** improve the quantification of background O$_3$ in SIPs

• **Led by Susan Anenberg:** developing satellite-derived air pollution and climate indicators at the global scale
Tiger Team: PIs O’Neill & Diao

Air Quality and Health Burden of 2017 Northern California Wildfires

Overview

• Fire Emission Inventory (MODIS, VIIRS, GOES-16)
• Air Quality Modeling (WRF/CMAQ/Dispersion)
• Satellite Observations to Improve (Data Fusion) and Evaluate Model Predictions
• Health Impact Analysis
• Over 80 people involved from 30+ agencies
• Seven sub-teams

Outcomes

• Completed training video “The Basics of Satellite Data for Smoke and Fire”.
• Demonstrated utility of GOES-16 fire detections as a data calculation stream. Extrapolating to 2018 – Camp Wildfire.
• Webpage – Communications, Data Hosting/Organization/Analyses
• 6 conference talks
• Draft paper outline

Overview

- Assist in the attribution of observed visibility-impairing PM to natural and anthropogenic sources
- Provide tangible, user-friendly examples of using satellite data for haze applications

Outcomes

- Communication: listening sessions with 5 stakeholder partner agencies; monthly calls with 10+ stakeholder agencies, meeting notes, compiled stakeholder needs
- Sent analysis of model attribution at SW IMPROVE sites to stakeholder partners at TCEQ and EPA
Overview

• Provide a coordinated set of boundary conditions for ozone, background ozone, and natural ozone for 2016 from multiple global models that are evaluated with or informed by satellite data.

• Establish ‘best practices’ for evaluating the models used for boundary conditions with satellite ozone measurements, and for evaluating satellite-informed simulations with independent datasets.

Outcomes

• Have identified region and year for BC generation in concert with stakeholders.

• First set of BCs being generated from 3 different model versions.

• Protocols for evaluating BCs being established

• AIRS/OMI data along the Western boundary of CMAQ being processed for BC evaluation
Overview

• Transfer knowledge and global-scale datasets tracking indicators for ozone and NO$_2$ concentration, PM$_{2.5}$ and ozone disease burden in cities, and wildfire occurrence.

• Scope the potential for using satellite remote sensing to track global airborne dust storms and pollen season start date and duration.

Outcomes

• Launched website www.haqastindicators.org, which hosts team updates and disseminates information on air quality and climate change topics.

• Two full-team telecons (third in Nov 2019), three investigator telecons, and May 2019 stakeholder meeting in DC.

• Liu shared global wildfire spot dataset with Lancet Countdown and will now be new climate indicator in their upcoming report.

• GWU published PM2.5 disease burdens for 250 cities worldwide in Scientific Reports. Results shared with C40 cities who will use them to provide info to mayors on cobenefits of city GHG mitigation. Results also on tiger team webpage.

• Global Burden of Disease Study partnering with GWU and NASA (Bryan Duncan and Lok Lamsal) to estimate global burden of NO$_2$ on asthma. Will be using the supplemental funding to complete this. Results from initial analysis published in Lancet Planetary Health on TT webpage.

• Made air pollution and health video for NASA Science on the Sphere which includes city air pollution disease burden estimates from Tiger Team.
“Individual” PI Projects

Common Themes in PI Projects

1. Developing user tools
2. Comparing satellite data with other forms of data
3. Data Fusion: combining satellite data with other forms of data

HAQAST Team Lead Tracey Holloway (left) with PIs Arlene Fiore (middle) and Jason West (right)
Kevin R. Cromar and Bryan N. Duncan have partnered with the NASA Global Modeling and Assimilation Office (GMAO) to entrain stakeholders (e.g., city governments) into GMAO’s global air quality forecast system effort. Cromar, Duncan, and GMAO personnel are engaging city governments in low to middle income countries (LMIC) to:

• communicate health risks of air pollution.
• encourage health studies in these locations rather than only relying on concentration response functions from wealthier countries to assess risks and health impacts.

This effort will not only benefit local residents, but also Americans living abroad in these areas.

Figure. Factsheet being distributed to world cities via c40 Cities, UNEP and WHO.
• Georgia Tech has developed SIPFIS, a WebGIS-assisted online analysis tool that provides easy access to the predictions of prescribed fire impacts in southeastern USA (Hu et al., 2019, doi:10.3390/ijerph16111981).

• The air quality impacts are predicted daily using the HiRes-X forecasting system being developed as part of Georgia Tech’s core NASA-HAQAST project.

• SIPFIS consists of a data-fetching component, a data-archiving component, and a data visualization and analysis component.

• Analyses include comparing the locations and areas of permitted burns to those of satellite-detected fires and prescribed burn forecasts.

• SIPFIS can be used in tasks such as checking community-level smoke exposures, screening for fire-related exceptional events, supporting analyses for air quality forecasts, and assessing the impacts of prescribed burns.

• SIPFIS expands prescribed fire impact information beyond just air quality impacts, by providing estimates of human exposure and health effects.

PI Updates: Russell

Predicting the Impacts of Prescribed Fires

Predictions of prescribed fire contribution to PM$_{2.5}$ levels for 3/10/2018

Increase in emergency department visits due to asthma for 3/10/2018
Use of satellite-informed PM$_{2.5}$ concentrations in an international integrated assessment tool (LEAP-IBC) for the CCAC

Climate and Clean Air Coalition (CCAC):

- Initiated in 2012, funding sources include US Department of State: now 61 countries, 71 NGOs, 93 actors

- **Short Lived Climate Pollutant (SLCP) Supporting National Action Planning (SNAP) Toolkits** – provide countries a means of evaluating the impacts of short-lived climate pollutants (emission reduction strategies)

**Our project:** Provide satellite-constrained estimates of PM$_{2.5}$ sources for the LEAP-IBC toolkit, now used in 25 CCAC member nations

**User Application:** Pop-weighted PM$_{2.5}$ in Bangladesh

GEOS-Chem adjoint, PM$_{2.5}$ from AOD-derived products (van Donkelaar et al., 2016)
PI Updates: Zondlo

**Satellite NH$_3$ for improving ground-based networks**

- High-resolution maps of IASI NH$_3$ at 2 km horizontal resolution (oversampling)
- Most AMoN sites located far away from the largest NH$_3$ source regions
- Air and Waste Management Assoc. trade journal Environmental Monitor
- NASA Earth Observatory Image of the Day:
  - “The seasonal rhythms of ammonia” – Dec. 10, 2018

IASI NH$_3$ oversampling method (Sun et al., *AMT*, 2018)
PI Project Updates: Holloway

New Applications for Satellite Data

• Connecting satellite data—especially for NO₂, HCHO, and AOD—with novel user applications in air management and health.

• In a 2018 study, we compared satellite-based NO₂ with per capita wealth in the 100 largest global cities. We see evidence for the “Kuznets Curve” where poorer cities get more polluted as the increase in wealth, and richer cities get cleaner.

• Other projects include:
  • Working with EPA to evaluate models with satellite HCHO data
  • Working with HAQAST colleagues to understand data fusion impacts on health estimates

Montgomery & Holloway, JARS, 2018
Our team estimated global surface ozone concentrations through a statistical fusion of global ozone measurements and models.

Our first estimate was used in the Global Burden of Disease 2017 assessment, which estimated 470,000 deaths globally from ozone.

We then improved this by:
- Adding recent ozone measurements from China.
- Using the Bayesian Maximum Entropy method to merge multi-model ozone with observations in space and time.
- Adding fine spatial structure (0.1 degrees) using the NASA GEOS-5 Nature Run.

Our new estimates have been delivered for use in GBD2019.
Satellite-aided Dust Forecasting

Goal:
Novel method to improve dust forecasting nationally and globally.

Satellite Products:
- MODIS/VIIRS Albedo;
- MODIS/VIIRS BRDF;
- MODIS/VIIRS AOD;

PI Project Updates: Tong

FV3-Chem Dust Forecasting

MODIS AOD
• PI Daniel Tong featured in Lauren Schwartzman’s critically acclaimed documentary film, Dust Rising.

• The film traces the effect of dust on human health and the environment.

• For screenings and to find out more, visit dustrisingfilm.com
HAQAST in the News: DustWatch App

- Smartphone app provides early warning notifications for dust storms
- Developed by a team of youth citizen scientists using NASA/NOAA data
- Also provides data on visibility, high wind conditions, air quality index (AQI), and dust concentration. Plus guides and educational materials.
- Featured in an article on NASA.gov, “Students Create App to Warn of Dangerous Dust Storms”
- Available for iOS. More info at: dustapp.org

The DustWatch team (left to right) Alex Xie, Jeffrey Tong, Edgar Nzokwe, Bill Tong, and Kevin Liu. Image: Feng Zhang from NASA.gov
Thank You!

Visit HAQAST.org
• NASA data, tools & tutorials
• Info about and resources from our meetings
• Links to all our PIs’ research and publications

Photo from HAQAST 6 meeting in Pasadena, CA