



Supporting the use of satellite data in regional haze planning a 2018-2019 NASA HAQAST Tiger Team

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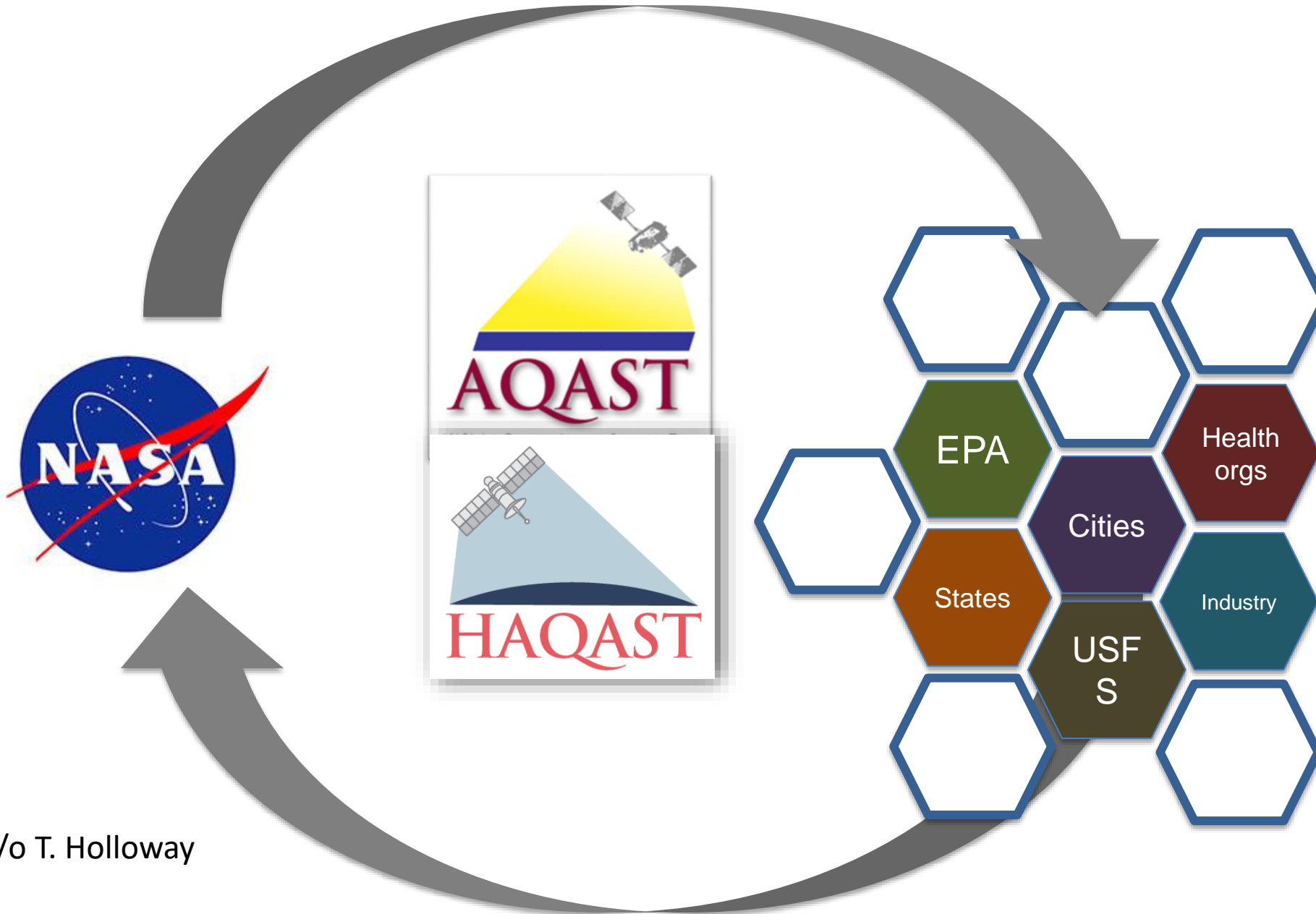
LDEO/Columbia University



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2016-2019



c/o T. Holloway

NASA Health and Air Quality Applied Sciences Team (HAQAST)



- 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)

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Each HAQAST member is involved in:

- Core projects
 - What the member proposed for base funding
 - All involve collaboration with stakeholders
- Tiger Teams
 - Cross-team collaborative projects to address emerging stakeholder needs
 - Two of four total TT projects are being presented today

4 New HAQAST Tiger Teams

- **Led by Susan Anenberg:** Using satellite remote sensing to derive global climate and air pollution indicators
- **Led by Arlene Fiore:** Supporting the use of satellite data in regional haze planning
- **Led by Jessica Neu:** Satellite-evaluated and satellite-informed O₃ distributions for estimating U.S. background O₃
- **Led by Susan O'Neill:** Air quality and health burden of 2017 California Wildfires

1-year, rapid turnaround projects addressing emerging air quality and health management stakeholder needs

HAQAST “Haze” TT Participants

HAQASTers: Arlene Fiore (LDEO/Columbia), Bryan Duncan (NASA GSFC), Daven Henze (University of Colorado – Boulder), Tracey Holloway (University of Wisconsin—Madison), Talat Odman and Ted Russell (Georgia Institute of Technology), Daniel Tong (George Mason University), Jason West (UNC), Mark Zondlo (Princeton University)

Stakeholder partners: *Maine* [Tom Downs], *Connecticut* [Michael Geigert, Kate Knight], *Texas Commission on Environmental Quality (TCEQ)* [Stephanie Shirley]; *Western States Air Resources Council (WESTAR) and Western Regional Air Partnership (WRAP)* [Tom Moore]; *Lake Michigan Air Directors Consortium (LADCO)* [Zac Adelman]; *Mid-Atlantic Regional Air Management Association (MARAMA)* [Julie McDill], *Northeast States for Coordinated Air Use Management (NESCAUM)* [Paul Miller]; *U.S. EPA* [Brett Gantt, Barron Henderson, Gail Tonneson]; **Other agencies are welcome to join throughout the project.**

We also anticipate outreach to health stakeholder communities, assuming the guidance developed under this project is relevant for assessing health burdens due to natural events (e.g., wildfires, dust)

How can satellite data be included in regional haze planning?

- (1) Weight-of-evidence for haze transport from specific sources (e.g., dust, fires, international, agricultural) to supplement analysis of IMPROVE data and models
- (2) Constraints on emission changes in upwind countries to underpin assessments of temporal trends in international transport
- (3) Evidence for spatial and temporal variability in agricultural ammonia emission inventories

→ Assist in the attribution of observed visibility-impairing $\text{PM}_{2.5}$ to natural and anthropogenic sources

Haze TT Project Overview: Address 3 (or more) applications of satellite data of direct relevance to regional haze planning

- Identify case studies of natural events (dust, wildfire), transport events from upwind agricultural or international (e.g. anthropogenic, agricultural and/or wildfires) sources for analysis with satellite data
- Select at least one upwind nation (e.g., Mexico or China) for emission trend analysis (OMI NO₂ & SO₂; CrIS and/or IASI NH₃)
- Examine spatial and seasonal trends in NH₃ from agricultural sources in the EUS

→ Goal: provide tangible, user-friendly examples

What do HAQAST members bring to the “Haze” Tiger Team?

80% Arlene Fiore (Columbia University; Haze TT lead)

- Develop at least one case study to interpret a high haze event
- Contribute to analysis of other “case study” events + international emissions
- 2004-2012 2x2.5 GEOS-Chem source perturbation simulations (described in Guo et al., ACP, in press: e.g., Natural, Canada+Mexico, rest of world, fires) with daily speciated PM_{2.5}
- 2014-2016 c48 and possibly c180 GFDL AM3 simulations (base case only so far)
- intercontinental transport, background ozone, interactions between regional PM_{2.5} and climate, 21st century projections
- Prior experience leading a HAQAST TT
- Co-I Pat Kinney will lead outreach to health stakeholders

75% Tracey Holloway (UW-Madison; overall HAQAST Team Lead)

- Prior experience creating user-friendly software
- Add capacity for regridding satellite AOD to CMAQ grid in WHIPS
- Evaluating models with satellite data
- Regional air quality modeling
- Linking with health communities

What do HAQAST members bring to the “Haze” Tiger Team?

25% Bryan Duncan (NASA GSFC)

- Contribute to satellite-based assessment of upwind international trends and comparison (where possible) with bottom-up inventories
- Oversee linking all documents/content to NASA AQ from space website
- Project Scientist for the Aura satellite mission
- Expertise in documenting air quality relevant trends from space (e.g., website)

25% Daven Henze (University of Colorado, Boulder)

- Contribute to satellite-based assessment of upwind international trends
- Multi-year GEOS-Chem simulations that incorporate top-down (satellite) constraints on emissions
- Expertise in receptor-oriented modeling for using remote sensing data to constrain emissions of trace gases and aerosols

40% Daniel Tong (George Mason University)

- Developed satellite-aided algorithm to pinpoint dust events from IMPROVE
- Developed dust emission model used for NOAA PM_{2.5} forecasting

What do HAQAST members bring to the “Haze” Tiger Team?

33% Ted Russell and Talat Odman (Georgia Tech)

- Contribute to case studies using satellite data to identify specific sources
- Regional air quality modeling
- PM and ozone source impact analysis (receptor, chemical transport and hybrid modeling approaches)
- wildland fire modeling
- exposure modeling
- modeling in the SE related to regulatory analyses.

10% Jason West (UNC-Chapel Hill)

- Contribute to satellite-based assessment of upwind international trends
- Regional air quality modeling, including dynamical downscaling of present & future PM_{2.5} from global chemistry-climate models

70% Mark Zondlo (Princeton University)

- Broad ammonia expertise, from in situ measurements to satellite products
- Contribute to satellite-based assessment of upwind international trends
- EUS analysis of spatial and seasonal patterns in ammonia

Deliverables for HAQAST “Regional Haze” TT

1. **Initial Phone meetings** between HAQAST participants and stakeholder partners
 - First chance to hear emerging questions & priorities for specific case studies and trend analyses
 - Help team prioritize efforts that are of broad interest
2. **Technical guidance documents**
 - At least 2 case studies (wildfire, and/or international transport events) with detailed instructions for how to obtain and visualize satellite products alongside IMPROVE and/or model data used in regional haze planning (Odman, Russell, Fiore)
 - Contribution of wind-blown dust emissions to local air quality (Tong)
 - Regridding satellite AOD for model evaluation (Holloway)
3. **Summary reports**
 - trends in international emissions inferred from space (Duncan, Henze, Zondlo, Fiore, West)
 - Temporal (seasonal) and spatial (by animal type) patterns of ammonia over the EUS(Zondlo)

Deliverables for HAQAST “Regional Haze” TT

4. Monthly team-wide phone calls

- Communication across team throughout the project helps promote efficient progress along a direction of most use for planning
- HAQAST PIs can address (some) emerging questions as they arise.
- Summary notes from phone meetings & draft docs will be available on team website (e.g., see 2017-2018 TT site <https://blog.ldeo.columbia.edu/atmoschem/haqast-tt-satellite-sips/>)

5. Web documentation housed @ airquality.gsfc.nasa.gov “Managers” Tab (Duncan)

6. Disseminate case studies

- One page memos
- Permanent archival of tech. guid. Docs (Columbia U academic commons)
- Meetings including AGU, HAQAST5
- Regional group phone meetings if opportunities arise

→ We are using a portion of our communications budget to support the overall HAQAST communications coordinator, Daegan Miller (~10% of his time)

NASA's air quality from space website “Managers” tab

(Example from a 2017-2018 TT)



AQ Managers

Publicly available NASA satellite data can help with State Implementation Plans (SIPs)

Background: NASA's Earth science program maintains a large fleet of earth-observing satellites, all of which offer free data products. A number of these can be used to illustrate NO_x emissions trends and their relevance to ozone attainment, as well as for weight-of-evidence under the EPA's Exceptional Events Rule. A collaborative team of NASA-funded scientists and public stakeholders has recently developed a suite of easy-to-follow technical guidance documents to support state and local air quality agencies that want to bring the power of NASA's satellites to bear on the documentation of exceptional events. This work is a product of the NASA **Health and Air Quality Applied Sciences Team (HAQAST)** Year 1 (2017-2018) Tiger Team "Supporting the Use of Satellite Data in State Implementation Plans (SIPs)"

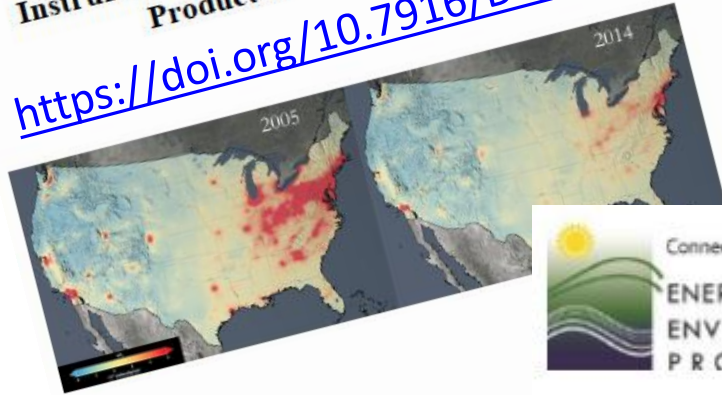
What, specifically, can NASA help me with? Our team has developed three guidance documents:

Thanks to Bryan Duncan and his team for hosting these!

Example: Technical Guidance Docs Completed under a 2017-2018 TT

A Brief Tutorial on Using the Ozone Monitoring Instrument (OMI) Nitrogen Dioxide (NO_2) Data Product for SIPs Preparation

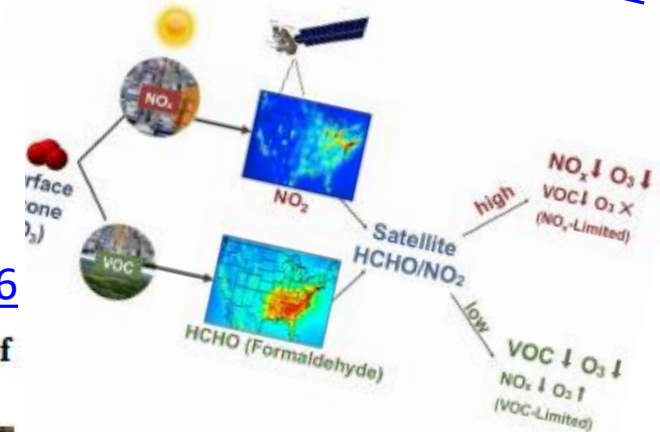
<https://doi.org/10.7916/D80K3S3W>



And archived
at Columbia
U Academic
Commons
Repository

Using satellite observed formaldehyde (HCHO) and nitrogen dioxide (NO_2) as an indicator of ozone sensitivity in a SIP

<https://doi.org/10.7916/D8M34C7V>



<https://doi.org/10.7916/D84B4HT6>

Guide to Using Satellite Images in Support of
Exceptional Event Demonstrations

Lead Author: Bryan N. Duncan (NASA)
Contributing Authors: Michael Geigert (CT DEEP)



Michael Geigert

CTDEEP

March 2018

Xiaomeng Jin and Arlene Fiore (LDEQ/Columbia)
Michael Geigert (CT DEEP)
Publication Date: June 12, 2018

Key Dates

- December 10-14 2018 – initial results for inclusion in AGU presentation
- January 3-4 2019 – team progress report at HAQAST5 (Phoenix, Arizona)
- Summer 2019 – Final HAQAST meeting in DC (NASA) to present team accomplishments