



Update on NASA Air Quality Forecasts, Health Air Quality Index, etc.

Bryan Duncan & Lok Lamsal, *NASA Goddard Space Flight Center*

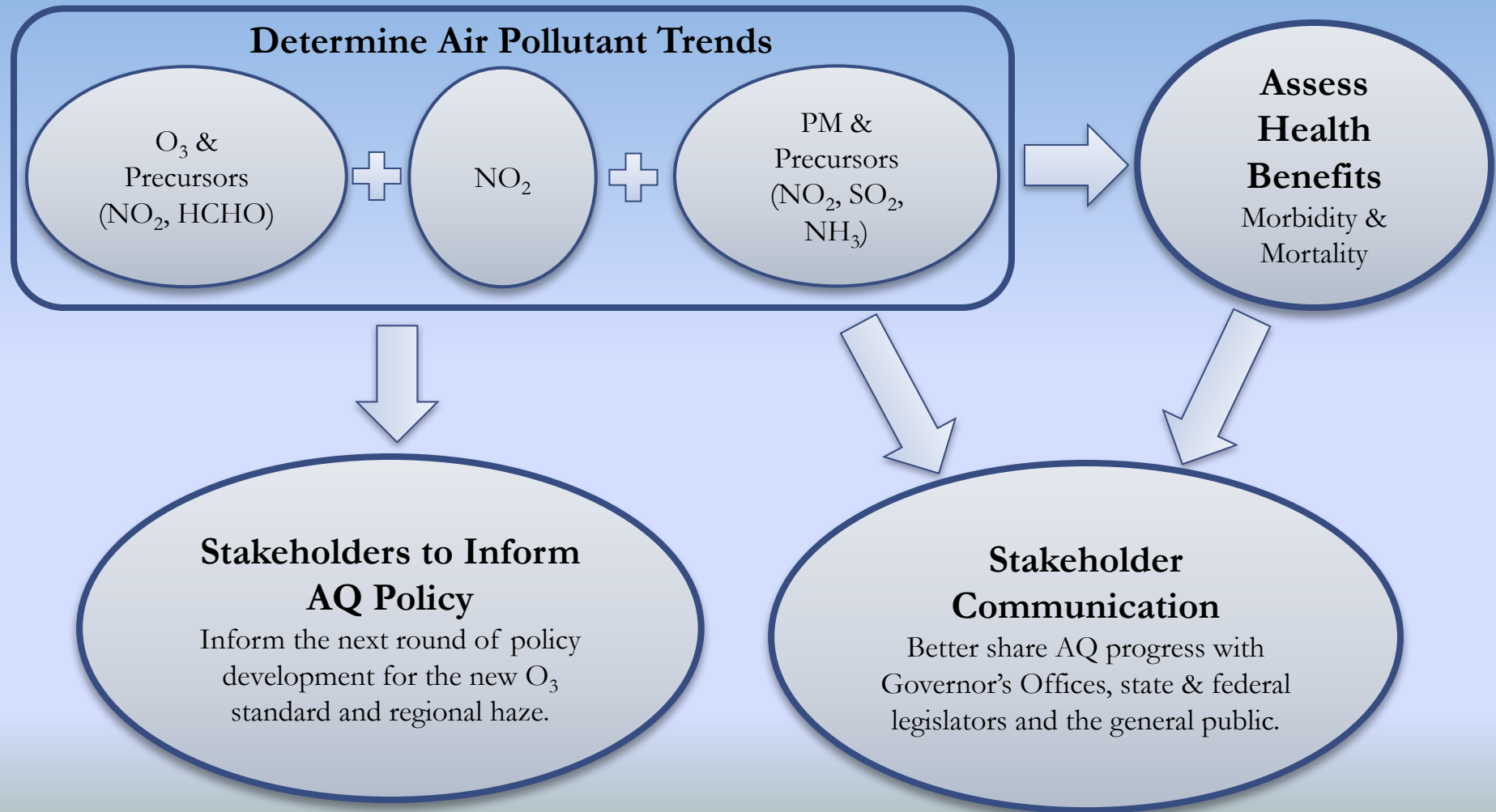
Kevin Cromar, *New York University*

NASA GMAO: Christoph Keller, K. Emma Knowland

New Stakeholders

Holli Ensiz	<i>Dept. of Interior Bureau of Ocean Energy Management (BOEM)</i>
Susan Alexander	<i>The University of Alabama in Huntsville</i>
Rima Habre	<i>University of Southern California</i>

HAQAST TT: Demonstration of the Efficacy of Environmental Regulations in the Eastern U.S.



Website draft: <https://airquality.gsfc.nasa.gov>

- Work in progress, but comments are welcome on content.
 - Need more content on health, PM_{2.5}
- Ginger Butcher will address layout once content is settled.



Welcome to the website! Our goal is to show how satellite data of air pollution may be used for health, air quality, and agricultural/food security applications.

On this site, you'll find:

- **downloadable factsheets** on how satellite data are used in health research and air quality applications, including food security
- **downloadable images and animations** of air pollutants observed from space, including ones that demonstrate the efficacy of the U.S. Clean Air Act
- **numerous resources for data users**
- general information on air pollution
- **answers to frequently-asked questions (FAQs)**

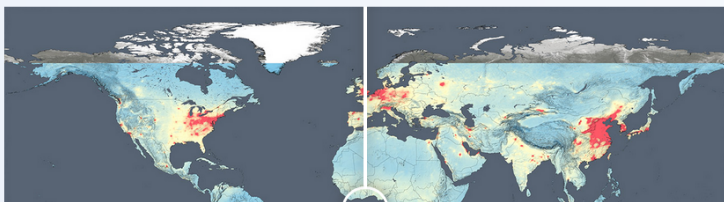


We also provide examples of how health researchers and air quality managers are currently using satellite data. For further examples, please visit the website of the **NASA Health and Air Quality Applied Sciences Team (HAQAST)**, which has the goal to facilitate the use of NASA satellite data by the health and air quality communities.



Science writer, **Emily Underwood**, interviewed a number of HAQAST scientists and describes how they are using satellite data for health applications in her article, entitled "**Measuring Air Pollution's Health Impacts from Space**".

Before and After: World Nitrogen Dioxide Levels, 2005-2016



NASA Food Security Initiative



NASA's **Food Security Initiative** promotes the use of Earth observations and Earth science data, models, and knowledge provide essential information and tools to support global food security.

ARSET



NASA Applied Remote Sensing Training (**ARSET**) - The ARSET program offers free webinars and in-person trainings on the use of



Clean Air Act from Space: Environmental Regulations in the Eastern U.S. are Working

Ambient air quality, though gradually improving in the U.S., is still an environmental health risk today. NASA satellite data from 2005 to 2017 provide evidence that air pollution in the U.S. has decreased following amendments to the Clean Air Act of 1963, and quantifies the benefits that air quality improvements can have for human health.

U.S. Legislation

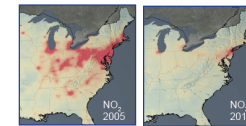
The Clean Air Act's policies regarding emissions standards for stationary sources and motorized vehicles as well as funding for additional air quality research have improved domestic air quality. Moreover, additional changes to this legislation, including the 1990 amendment to further restrict the rate of pollutant emissions and further enforce penalties for violations have improved U.S. public health.

Satellite Data

First used to detect air pollutants in 2004, NASA's Aura satellite now provides daily collections of quality, reliable data and modeling systems at a temporal-spatial level that can assist with decision-making. The spatial coverage afforded by satellite data offers increased statistical power that strengthens inference of the relation between pollutants and health outcomes.

Satellites provide information that ground-level research cannot, including:

- Increased statistical data,
- Short-term as well as long-term data,
- Equal and consistent across the U.S. and the world, and
- Tracking of air pollutants as they move from one location to another.



Pollution is linked to *1 of every 9 deaths globally*, making it a larger environmental health risk than AIDS, tuberculosis, and malaria combined (Landrigan et al., 2017).

NASA satellite data affirm that the presence of harmful atmospheric pollutants in the U.S. has been decreasing from 2005-2017. During this time period:

- NO_x has decreased by 40-60%.
- Surface PM_{2.5} has decreased by 30-40%, and
- SO₂ has decreased by as much as 90% over power plants.

While the U.S. generally has a lower air quality-induced mortality rate than that of the rest of the world, air pollutants are still prevalent enough to harm human health. Exposure to ambient PM_{2.5} remains the fifth highest mortality risk factor in the U.S., and just in 2015, it resulted in roughly 88,400 deaths. Ambient ozone resulted in an additional 11,700 deaths (Cohen et al., 2017). NASA's data show that U.S. legislation is promoting positive air quality, but further legislation is necessary to ensure that this trend continues.

Satellite Continental and Oceanic Atmospheric Pollution Experiment (SCOAPE)

DoI Bureau of Ocean Energy Management (BOEM) – NASA Agreement

→ **Goal:** *Scope out the feasibility of using satellite data to monitor offshore/near coastal air quality.*

- **Deliverable #1:** Report on the current state of satellite air quality data products over the GOM. We will work with retrieval experts to see if the retrievals over open water can be improved.
- **Deliverable #2:** A mini-campaign in the GOM in 2019 when onshore flow predominates. BOEM wants a demonstration of how satellite data correspond to surface data.



SCOAPE-related Presentations

- Don't miss presentation by Holli Ensz (BOEM; POC)
- Posters by Debra Kollonige (NASA; Project Manager) & Anne Thompson (NASA; Co-PI)

Global Health Air Quality Index (HAQI) Forecasts

- NASA GMAO AQ forecasts are not ready for the public, but check out <https://airquality.gsfc.nasa.gov/forecast>
- Don't miss Kevin Cromar's presentation on HAQI formulation.
- Evaluation & subsequent model debugging ongoing, but lack AQ data in most world cities. Developing relationships with several partner cities:
 - Rio de Janeiro (received their AQ data and emissions inventory)
 - Jakarta (series of meetings in March; submitted collaboration proposals)
- Numerous stakeholders cannot work with AQ forecast output as is, so we put in proposal (PI Keller) to ROSES A.39: *“Development of a centralized, easy-to-use data access and visualization platform for NASA GMAO air quality model output”*.
- Writing global AQ forecast system description paper.

Aura Science Team Meeting

(<https://aura.gsfc.nasa.gov/>)

When?

January 22-24, 2019

Where?

Pasadena, CA

Deadlines?

Abstracts due November 1, 2018

Registration (free):

<https://mls.jpl.nasa.gov/aura2019>



Year 2 Progress Update, PI Duncan

A Satellite-Based Global Health Air Quality Index (HAQI): Development and Assessment

- Work with NASA GMAO (*Christoph Keller, Emma Knowland*) to develop and evaluate global AQ forecast system (not in original proposal; requested by stakeholder - UNICEF)
 - Evaluation & subsequent model debugging ongoing, but lack AQ data in most world cities.
 - Developing relationships with several partner cities: Rio de Janeiro (received their AQ data and emissions inventory), Jakarta (series of meetings in March; submitted collaboration proposals).
 - Numerous stakeholders cannot work with AQ forecast output as is, so we put in proposal (PI Keller) to ROSES A.39: “Development of a centralized, easy-to-use data access and visualization platform for NASA GMAO air quality model output”.
 - Writing global AQ forecast system description paper.
- Development of Health Air Quality Index (HAQI) – *Kevin Cromar* (Co-I; NYU)
 - Completed.
- Novel applications of satellite data
 - Working with NASA GSFC’s new Food Security Office to develop a theme on the impact of air pollution on crop yields.
- Secured Interagency Agreement with Dept. of Interior Bureau of Ocean Energy Management (BOEM)
 - Developing report on feasibility of using satellite data to monitor offshore air quality in ONG areas.
- 5 stakeholder talks; maintain AQ website (<https://airquality.gsfc.nasa.gov>); maintain Ozone Garden at GSFC Visitor Center – mentoring two summer interns; 4 AQ publications

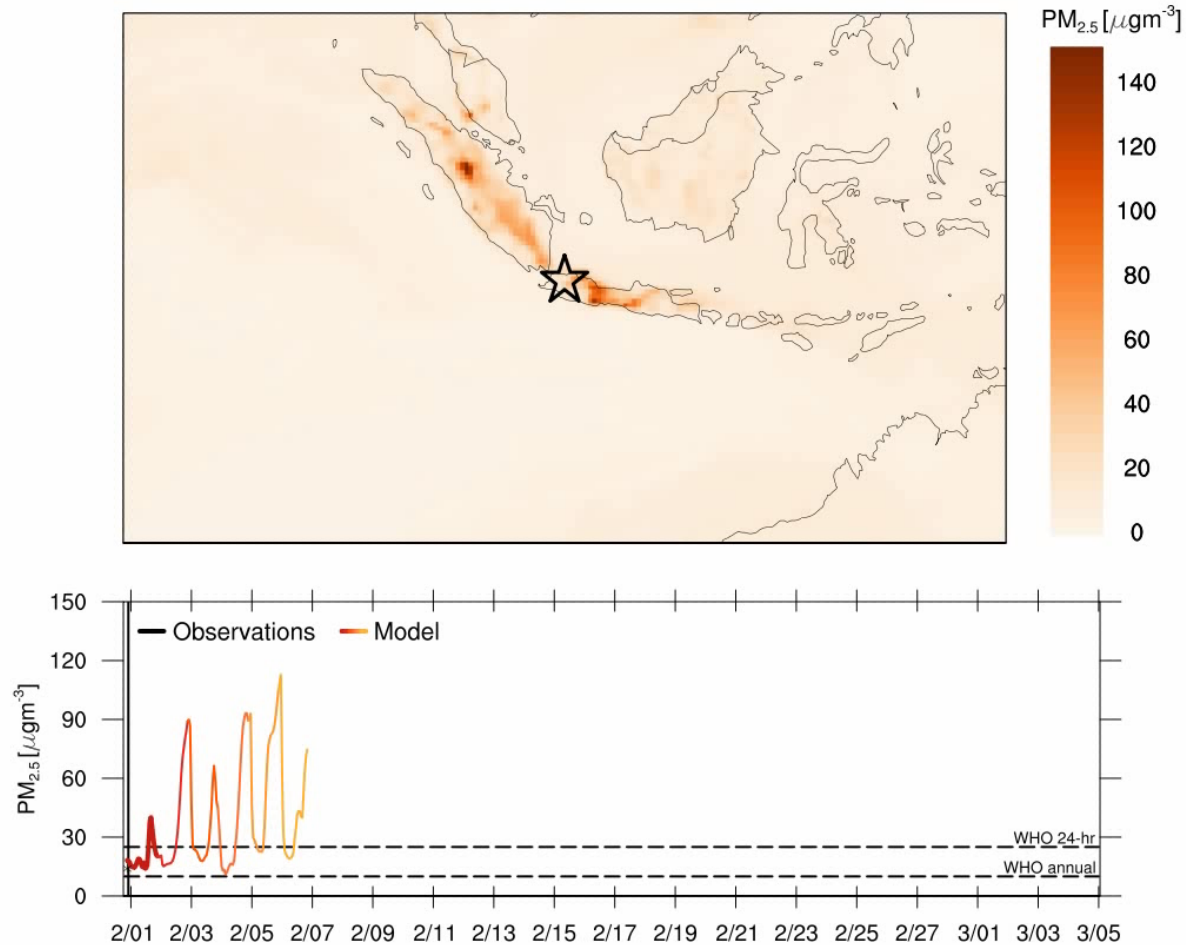
Tiger Team Participation

- TT Duncan & West: Efficacy of Environmental Regulations on AQ & Health
 - Expanding & populating AQ website; updated OMI NO₂ & SO₂ animations.
 - Developing factsheets for various audiences.
 - Overview article completed.
 - Beginning final report to stakeholders.
- TT Fiore: Satellite Data in SIPS.
 - Completed tutorial on using OMI NO₂ for SIPS.
 - Placed 3 tutorials on AQ website under “AQ Managers” tab.

Extra Slides

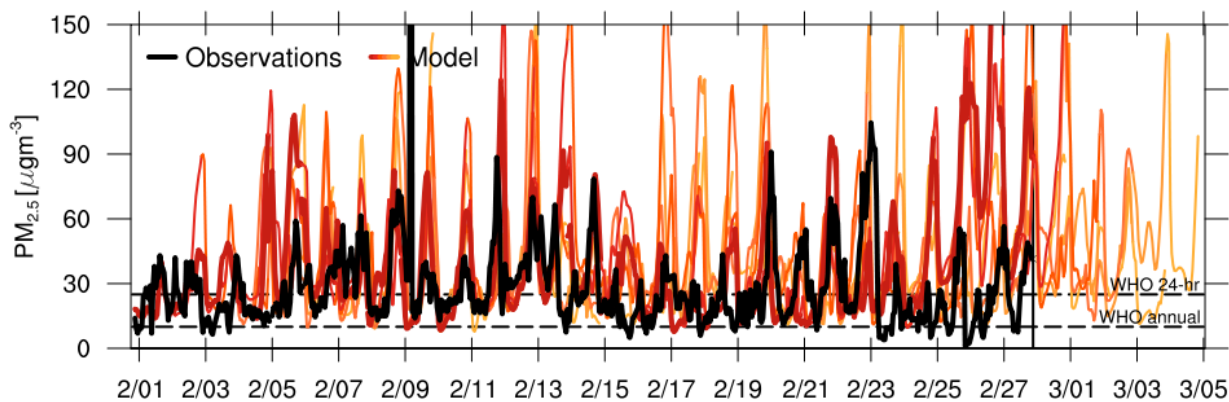
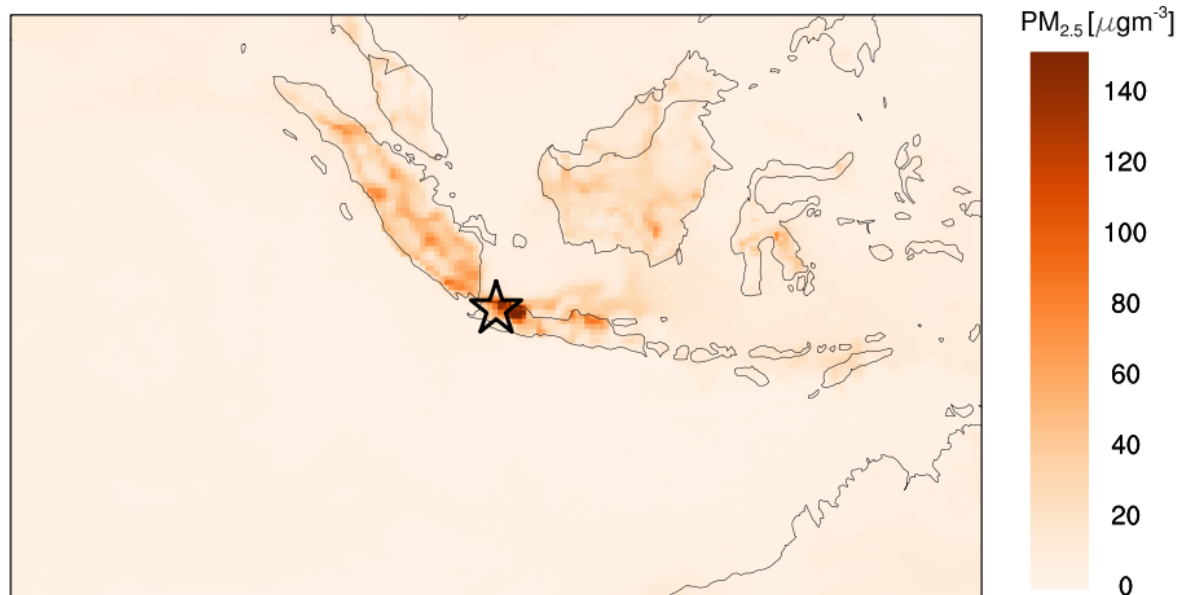
NASA Forecasts: PM_{2.5} vs US Embassy Monitor

Jakarta, Indonesia, 2018-02-01 00:00 UTC



NASA Forecasts: PM_{2.5} vs US Embassy Monitor

Jakarta, Indonesia, 2018-02-27 23:45 UTC



HAQAST TT: Demonstration of the Efficacy of Environmental Regulations in the Eastern U.S.

- **Lead HAQAST PIs:** Bryan Duncan (NASA; 80%) & Jason West (UNC; 100%)
- **AQ/Health Management Contacts**
 - Susan Wierman (MARAMA)
 - Tad Aburn (MDE)
 - John Walker (EPA)
 - Fuyuen Yip (CDC/NCEH)
 - Paul Miller (NESCAUM)
 - Anne Gobin (CT DEEP)
- **Other HAQAST Participants**
 - Mark Zondlo (Princeton U.; 60%)
 - Yang Liu (Emory U.; 40%)
 - Ted Russell (Georgia Tech; 34%)
 - Arlene Fiore (Columbia U.; 10%)
 - Daven Henze (U. Colorado; 10%)
 - Daniel Tong (George Mason U.; 5%)
 - Pat Kinney (Boston U.)
 - Susan Anenberg (George Washington U.)
 - Lok Lamsal (NASA)