Upgrading the Toolbox: NASA Resources to Support Air Quality Management

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Webinar Objectives

By the end of this webinar, participants will have the necessary information to begin accessing some NASA resources that enhance the applications of health and air quality managers.

Specifically, participants will be introduced to:
1. a user-friendly NASA visualization tool for satellite data.
2. a NASA website that gives an overview of how satellite data aid health & air quality managers.
3. the NASA GEOS-CF global air quality forecast system.
4. the NASA Applied Remote SEnsing Training (ARSET) program.
5. the NASA Health & Air Quality Applied Sciences Team (HAQAST) program.

All NASA data and resources presented here are free and publicly-available.
NASA satellite missions are predominately designed for scientific research.

However, some datasets are useful for health and air quality managers.

MAIA is the 1st health-based NASA mission.
Potentially Useful Space-based Observations

- Aerosols (AOD, fire detection) → can be used to infer “nose-level” PM$_{2.5}$ with atmospheric models
- Ozone (O$_3$) → no information on “nose-level” concentrations
- Nitrogen dioxide (NO$_2$) → most straightforward to observe & excellent tracer of combustion
- Carbon monoxide (CO) → another tracer of combustion
- Sulfur dioxide (SO$_2$)
- Ammonia (NH$_3$)  
  \[ \text{precision and accuracy not suitable for most health studies} \]
- Formaldehyde (HCHO)
- Surface UV → not a pollutant, but …
Unique Advantages of Satellite Data:
Spatial Coverage & Changes over Time

Images courtesy of NASA.

Satellite data are validated with independent observations (e.g., AQS, NASA field campaigns) and emissions (e.g., CEMS)
An Exciting Time: Evolving Technology & New Satellites

OMI NO₂

TROPOMI NO₂

Spatial Resolution = 3.5 x 7.0 km²

November 28, 2017

Images courtesy Lok Lamsal (NASA)
An Exciting Time:
Evolving Technology & New Satellites

For example, horizontal resolution.

GOME (1996)
40 x 40 km² & greater

OMI (2004)
13 x 24 km² & greater

TROPOMI (2017)
~3.5 x 5.5 km²

TEMPO (2022)
2 x 5 km² & greater
“Tools” for the AQ Manager’s “Toolbox”

Integrated Approach to Air Pollution Monitoring

“Each of these technologies has strengths and limitations that need to be considered when integrating them to develop a robust and diverse global air quality monitoring network.”

Figure from Cromar et al. (2019)
Just 5 Easy Steps to Begin Accessing NASA Data

#1: User-friendly visualization tool.
#2: Overview of how satellite data aid health and air quality managers.
#3: Check out AQ forecasts for your favorite world city.
#4: On-line and in-person training on how to work with satellite data.
#5: Work with satellite data experts on your health and air quality applications.

www.haqast.org
Step#1: Worldview (https://worldview.earthdata.nasa.gov/)

Browse images by
1. Hazards and Disasters
2. Science Discipline
3. Featured Event

AND

Make your own maps.

HAQAST tutorial on using Worldview:
https://www.youtube.com/watch?v=7BLyz8AI5vg&t=0s

The Worldview tool from NASA's Earth Observing System Data and Information System (EOSDIS) provides the capability to interactively browse over 900 global, full-resolution satellite imagery layers and then download the underlying data.
Step#1: Worldview (https://worldview.earthdata.nasa.gov/)

Featured Events
Step#1: Worldview (https://worldview.earthdata.nasa.gov/)

Step through pre-made images on each topical event.

Add your own layers of data.
Step#1: Worldview ([https://worldview.earthdata.nasa.gov/](https://worldview.earthdata.nasa.gov/))

One Pre-Made Plot:
Aerosol Optical Depth (unitless): indicator of thickness of smoke
Step #2: AQ Website (https://airquality.gsfc.nasa.gov)

“Pollutants” tab
Lots of info, ready-made images & animations

“Impacts” tab
Overview of how air pollution affects human health & agriculture

“Resources” tab
• Webtools for data access
• Factsheets
• AQ websites
• Outreach

Sidebar links to NASA Programs
• Food Security
• AQ Forecasts
• ARSET
• HAQAST
• Applied Sciences
Step #2: AQ Website (https://airquality.gsfc.nasa.gov)

U.S. Air Quality Trends

The U.S. Air Quality Trends show improvements in air quality in recent years. This is due to the implementation of stricter environmental regulations and technological advancements.

Managers tab:

Examples of HAQAST projects, such as on US air quality trends.
Step#3: Global AQ Forecasts*
(https://gmao.gsfc.nasa.gov/weather_prediction/GEOS-CF/)

- Ozone (O₃)
- Nitrogen Dioxide (NO₂)
- Fine Particulate Matter (PM₂.₅)

*Product of NASA Global Modeling and Assimilation Office (GMAO)
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Step#3: Global AQ Forecasts
(https://gmao.gsfc.nasa.gov/weather_prediction/GEOS-CF/)

Download the forecasts and make your own plots.

AND

Use the FLUID visualization tool.
Step #3: AQ Forecasts (https://fluid.nccs.nasa.gov/cf/)

Pick a world region.

Pick a pollutant.

Access forecasted concentrations of pollutants using the FLUID visualization tool.
Step #3: AQ Forecasts (https://fluid.nccs.nasa.gov/cf/)

Pick a pollutant.

Pick a world city, surface monitor station, etc.

Access pre-made images of forecasts for selected world cities.

FLUID is currently undergoing further development to make available many other pollutants.
ARSET has many useful online trainings, tutorials, and other resources.
Step#5: HAQAST (https://haqast.org/)

Work directly with scientists to use NASA satellite data and AQ models on your health and AQ applications.
Questions?

Use the question function at the lower right of your screen

Be sure to check out our upcoming webinars. For all info, visit haqast.org/haqast2020