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HAQAST Tiger Team: Satellite data in State Implementation Plans (SIPs)

Arlene M. Fiore

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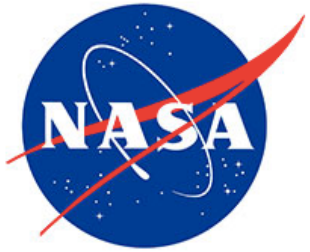
haqast.org



2016-2019

How can satellite data be included in State Implementation Plans (SIPs)?

(1) Weight-of-evidence that a particular strategy is anticipated to succeed in attainment, or to show that transported pollution is confounding attainment efforts

(2) Constraints on air pollution modeling included in SIPs

(3) Evidence supporting “exceptional events” demonstrations

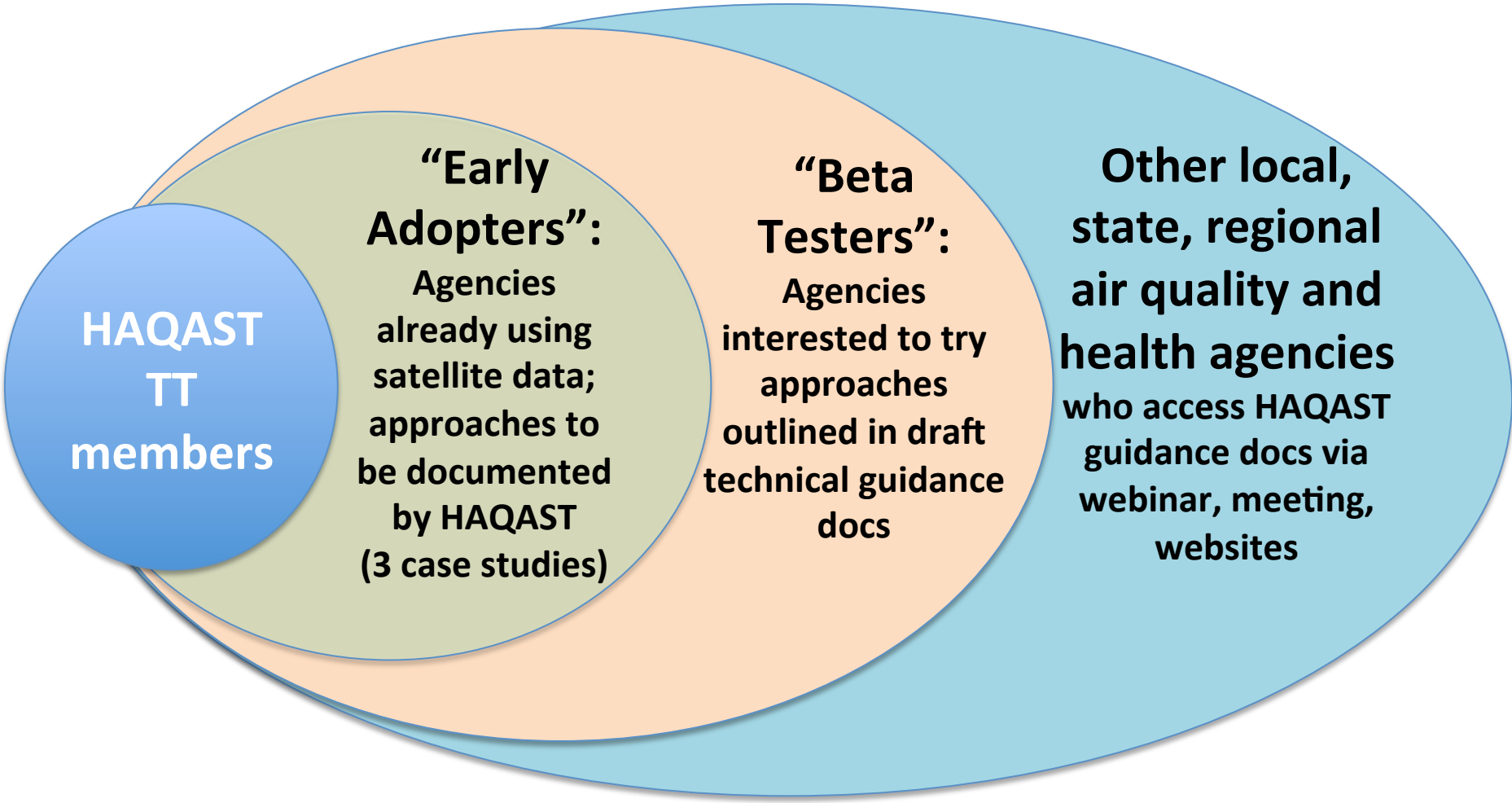
HAQAST "Satellite-data-in-SIPs" Tiger Team Objectives

(1) Identify at least three different applications of satellite data to showcase in a user-friendly, technical guidance document.

(2) Share widely so interested agencies can benefit from lessons learned by other agencies facing similar challenges.

(3) Provide a forum for regular communication, enabling HAQAST PIs to address (some) emerging questions as they arise.

Who is involved, and in what capacity?



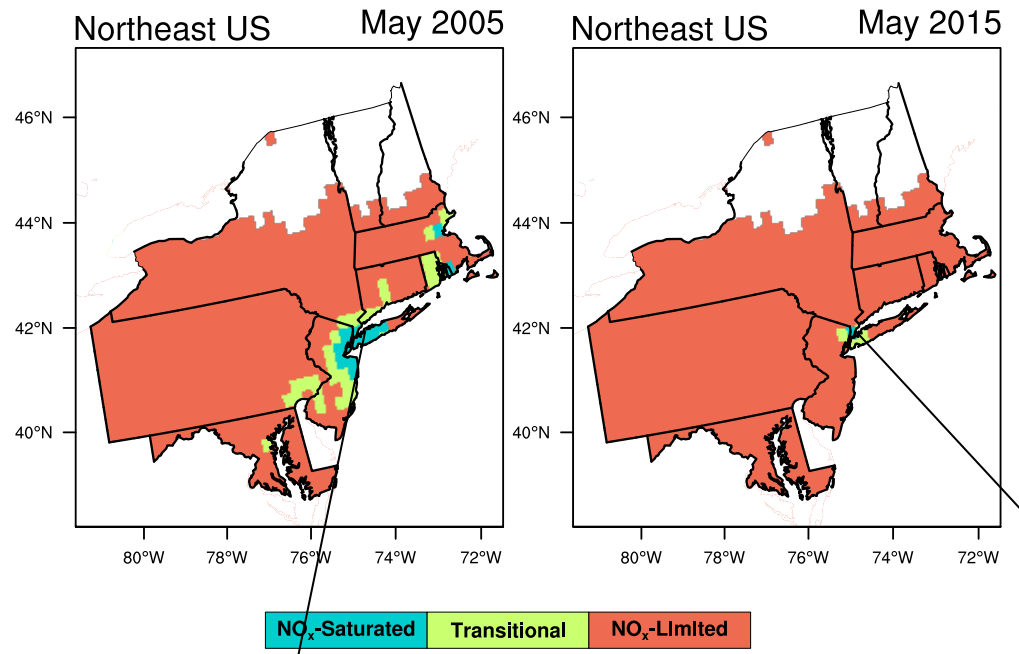
HAQAST "SIP" TT Participants

HAQAST (10 institutions): Arlene Fiore (LDEO/Columbia), Bryan Duncan (NASA GSFC), Jessica Neu (NASA JPL), Daven Henze (University of Colorado – Boulder), Talat Odman and Ted Russell (Georgia Institute of Technology), Patrick Kinney (Boston University), Daniel Tong (George Mason University), Mark Zondlo (Princeton University), Jonathan Patz and Tracey Holloway (University of Wisconsin —Madison), Jeremy Hess (University of Washington).

Stakeholder partners (9+ groups): ***South Coast Air Quality Management District*** *(California)* [Sang-Mi Lee], ***Connecticut*** [Kurt Kebschull, Michael Geigert, Kiernan Wholean], ***Mid-Atlantic Regional Air Management Association (MARAMA)*** [Susan Wierman], ***Northeast States for Coordinated Air Use Management (NESCAUM)*** [Paul Miller]; ***Georgia Environmental Protection Division (GA EPD)*** [Jim Boylan, Tao Zeng]; ***Texas Commission on Environmental Quality (TCEQ)*** [Mark Estes]; ***Bay Area Air Quality Management District*** [Steve Soong; Saffet Tanrikulu]; ***U.S. EPA*** [Barron Henderson, Gail Tonneson, Pat Dolwick]; ***OTC*** [Joseph Jakuta]. **Other agencies welcome!**

Email Arlene (amfiore@ldeo.columbia.edu) to join!

CASE STUDY #1: How can I use satellite-based indicators for ozone sensitivity to NO_x vs. VOC emissions in a SIP?



HAQAST member Arlene Fiore & Xiaomeng Jin (LDEO/Columbia) provided $HCHO/NO_2$ trends and maps used by CT DEEP in their SIPs.

2005-2015 monthly $HCHO:NO_2$ over New York City

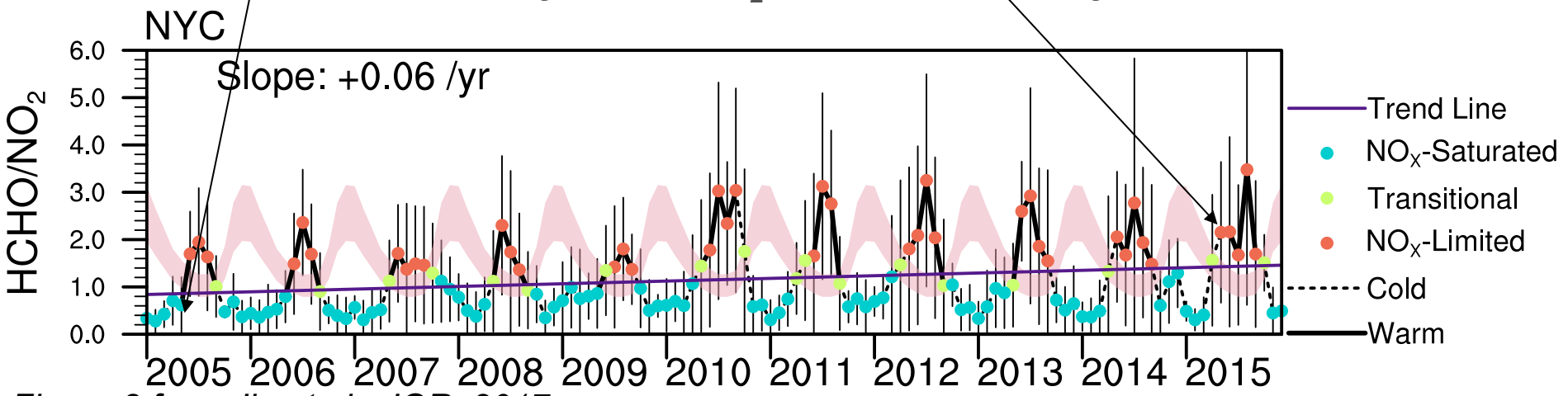


Figure 8 from Jin et al., JGR, 2017

CASE STUDY #1: *Using satellite observed formaldehyde (HCHO) and nitrogen dioxide (NO_2) as an indicator of ozone sensitivity in a SIP*

Lead authors: Arlene Fiore, Xiaomeng Jin (Columbia/LDEO), Michael Geigert (CT DEEP)

Content:

1) **Example of use in CT SIPs (including the figures)**
2) **Background on use of satellite formaldehyde-to-nitrogen dioxide (HCHO:NO_2) columns as an indicator for ozone sensitivity to NO_x vs. VOC emissions**
3) **Approach for connecting satellite-derived HCHO:NO_2 to specific ozone formation regimes (NO_x-limited, NO_x-saturated, or transition)**
4) **"How-to" conduct your own analysis**
5) **Limitations, and where to go with questions**

Status: **Draft completed**; two rounds of comments from stakeholders (more detail to lower bar for first-time users); Georgia EPD beta-tested → more revisions before **wider dissemination (and continued revisions; possibly add a user Q&A section)**.

→ **Include supporting information on web (HCHO:NO_2 values for regimes)?**
→ **Generating new research questions (in-person meeting)**

CASE STUDY #2: How can I find info on satellite NO_2 trends for use in a SIP? Over my region? City?

AURA EOS Project OZONE HOLE WATCH

Air Quality

Observations from Space

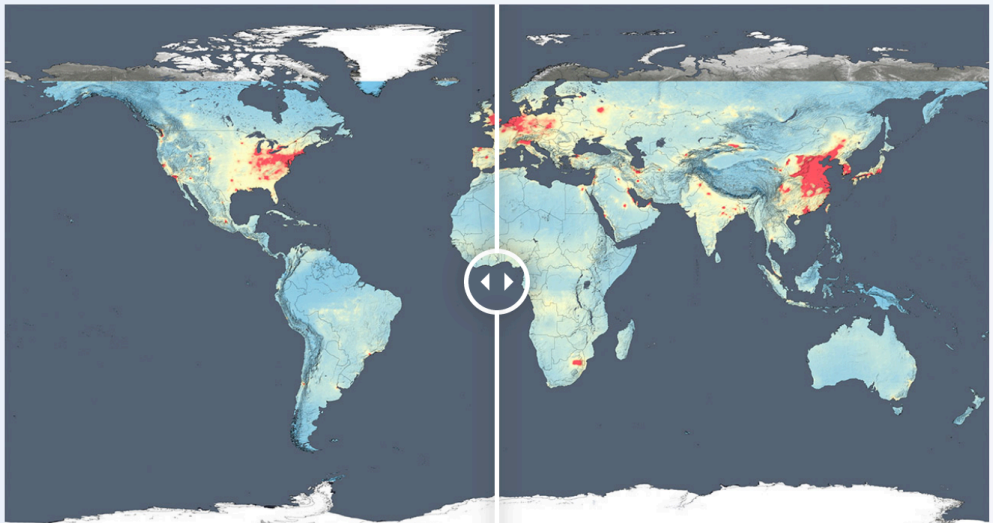
Search this site

Home | Data | News | Maps | Publications | Resources

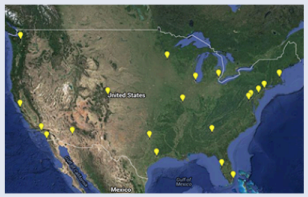
Welcome to the website! Currently, the website is devoted to one air pollutant, nitrogen dioxide (NO_2), which is unhealthy to breathe and a necessary ingredient for the formation of unhealthy levels of surface ozone, another important pollutant. Our intended audience is health and air quality managers, but there is a lot of content that will be of interest to many people, including plots of data for almost 200 world cities!

What is the air quality like in your city and country? Just click on the "Data" tab above and then "World Regions" to see.

Before and After: World Nitrogen Dioxide Levels, 2005-2014



Air Quality Data on the Top 20 US Cities



Click above to quickly find recent data products and imagery for the Top 20 US Cities.

Air Quality for 195 World Cities

Click above to quickly find recent data products and imagery for the

HAQAST member Bryan Duncan & Lok Lamsal (NASA GSFC) provided NO_2 trends that TCEQ used in a TX SIP.

***Our technical guidance docs will be posted under a "SIPs" tab on this site.**

Air quality from space website: airquality.gsfc.nasa.gov

CASE STUDY #2: *A Brief Tutorial On Using The Ozone Monitoring Instrument (OMI) Satellite Nitrogen Dioxide (NO_2) Data Product*

Lead authors: Bryan Duncan and Lok Lamsal (NASA GSFC)

Content:

1) General background on the use of satellite data for health and air quality applications

- *Converting column density or AOD to surface concentration or emission flux*
- *Inferring surface trends*
- *Estimating emission and surface deposition fluxes*
- *Looking Forward*

2) OMI NO_2

- *Accessing the data*
- *Other satellite products available for NO_2*

3) End-User Resources

Status: Draft completed; Comments received from stakeholders;

Revisions in Progress

CASE STUDY #3: How can I incorporate satellite data into boundary conditions used by my regional model?

image credit:: https://www.nasa.gov/mission_pages/aura/main/index.html

Artist's concept of the Aura spacecraft

Credits: NASA

HAQAST member Jessica Neu (NASA JPL) is generating boundary conditions for use by SCAQMD in their SIP modeling. BAAQMD also interested.

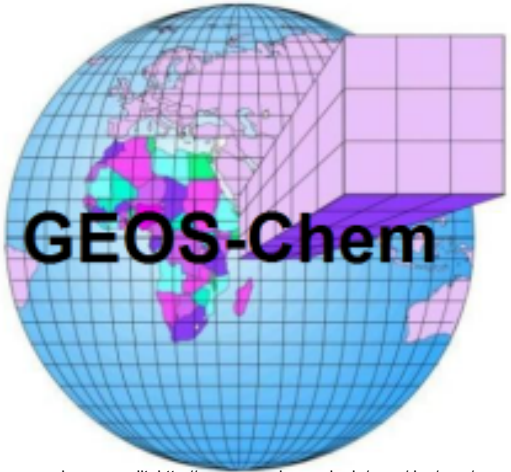


image credit: http://acmg.seas.harvard.edu/geos/doc/man/

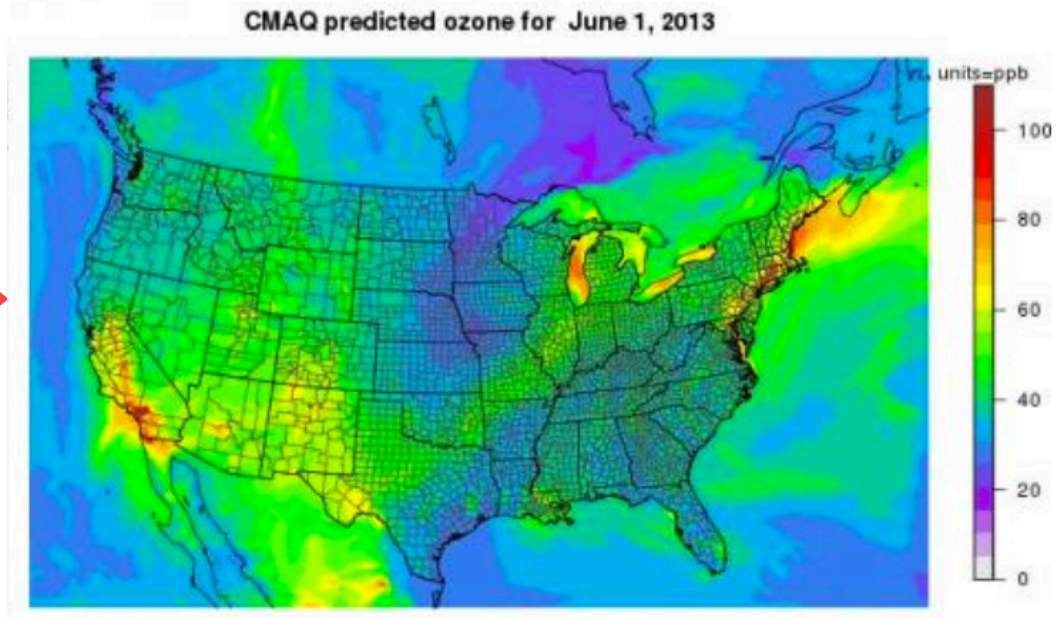
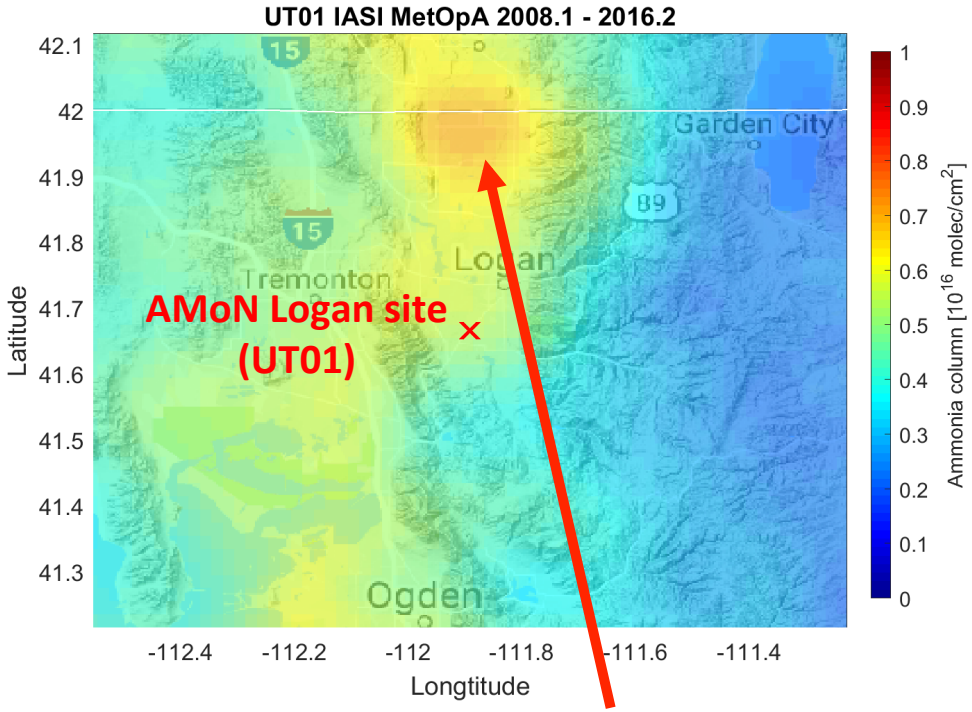


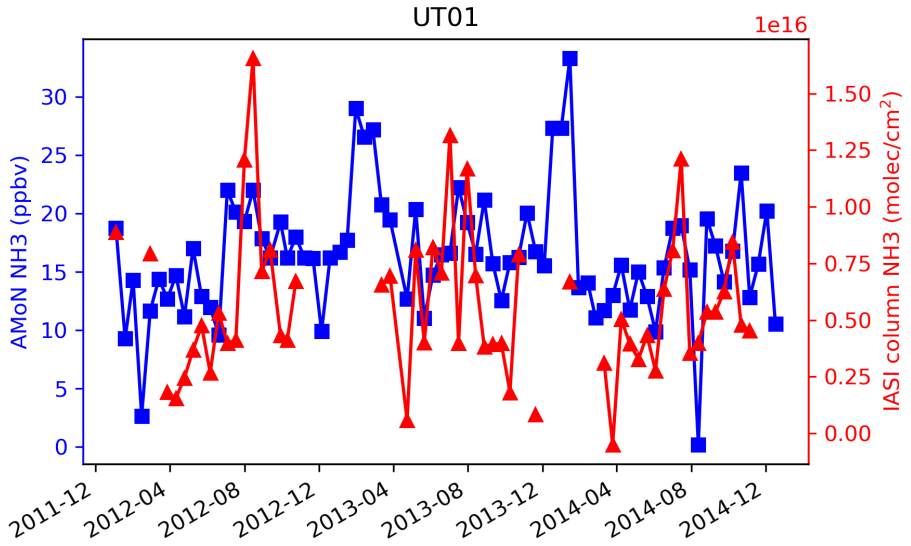
image credit: https://www.epa.gov/cmaq/cmaq-models-0

Emerging Question: What are the spatiotemporal trends of NH_3 in Cache Valley, Utah?

Spatial map of IASI NH_3 for 2008-2016:



IASI satellite NH_3 within ±30 km co-averaged over same time as AMoN site:



NH_3 maximized in northern portion of Valley

- Cache Valley among the worst $PM_{2.5}$ in nation due to large agricultural activities
- Highest annual NH_3 in AMoN network but limited spatiotemporal information

- Weak correlation likely due to high spatiotemporal variability, extreme values (among poorest correlation of all AMoN sites)

HAQAST members
Mark Zondlo, Xuehui Guo, and Da Pan (Princeton) for EPA Region 8

Deliverables for HAQAST "Satellite Data in SIPs" TT

1. **Initial Phone meetings** between HAQAST participants and 'early-adopters'
   → **Completed (3). Some overlap emerged (exceptional events; ammonia; NO_2 trends, changes in ozone sensitivity to precursor emissions)**

2. **Address emerging questions**
   → **Ongoing throughout project period**

3. **Technical guidance documents**
   → **Ozone sensitivity & NO_2 trends drafted, circulating for editing and testing**

4. **Present at least one case study at HAQAST3 NOV 28-29**

5. **Monthly team-wide phone calls (all welcome!)**
   -- some dedicated to discussion of a single case study or emerging need (e.g., September call on fire influence → add as a 4th technical guidance doc)

6. **Web documentation to be housed** @ airquality.gsfc.nasa.gov

7. **Disseminate case studies** via HAQAST and/or NASA websites and partner with regional air quality management groups (NESCAUM, MARAMA) and health agencies to share case studies via regional teleconferences and/or in-person meetings.

Email amfiore@ldeo.columbia.edu for current draft docs and/or to join the team!