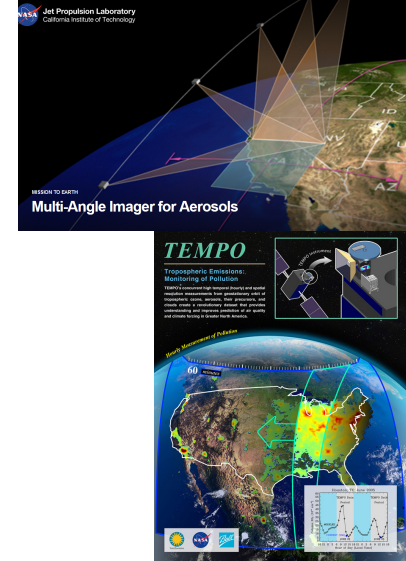
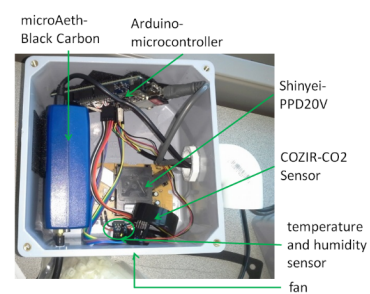




Sensing Opportunities

Armistead (Ted) Russell
Georgia Institute of Technology



2016-2019





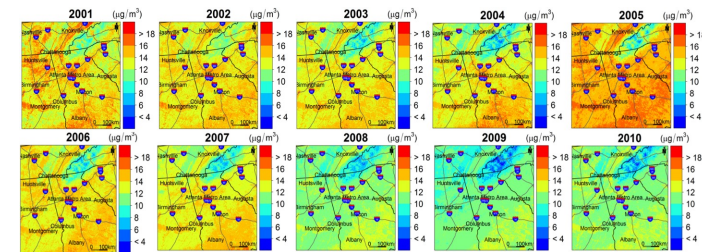
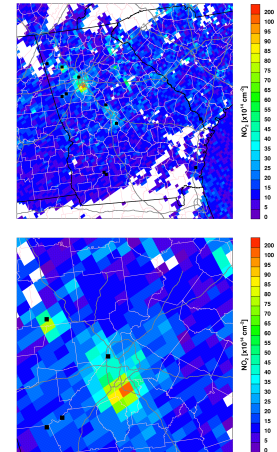
Objective

- Provide a catalyst for discussion of what are the potential “home runs” for HAQST-like efforts going forward
 - Past home runs using NASA earth science products
 - AQUEST, HAQAST and related
 - Current and future health and air quality issues where NASA (and other) earth science products can play critical roles

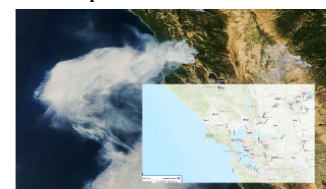
Home Runs

- Many impactful results, including
 - NO_x emissions (from NO_2 retrievals)
 - $\text{PM}_{2.5}$ exposure fields
 - Using AOD to estimate mass
 - Link with models, geographical data
 - Demonstrate trends
 - Exceptional events
 - Tracking fire plumes
 - (AOD, CO ...)

TropOMI NO_2 Columns on 2018-08-15



Guide to Using Satellite Images in Support of
Exceptional Event Demonstrations

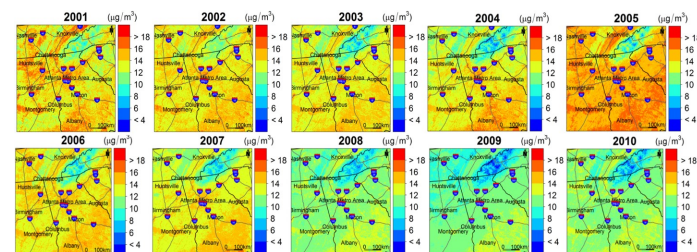
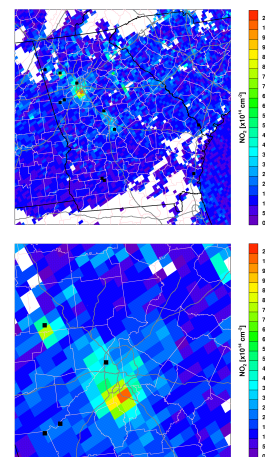


Michael Geigert
CTDEEP
March 2018

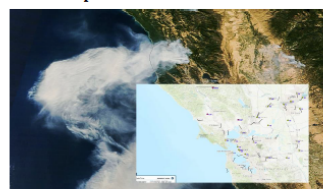
Home Runs

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 - **NO_x emissions*** (from NO₂ retrievals)
 - PM_{2.5} exposure fields
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 - (AOD, CO)

TropOMI NO₂ Columns on 2018-08-15



Guide to Using Satellite Images in Support of
Exceptional Event Demonstrations



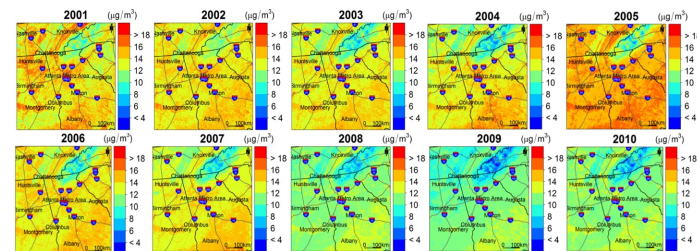
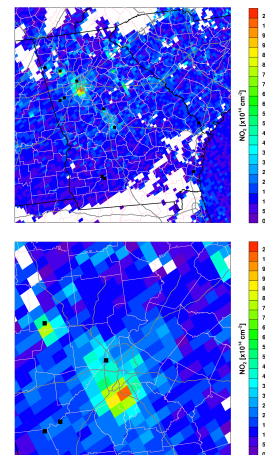
Michael Geigert
CTDEEP
March 2018

* Embraced/picked up by stakeholders

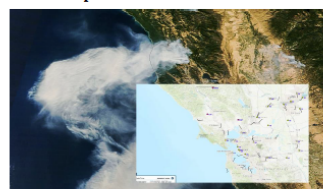
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TropOMI NO₂ Columns on 2018-08-15



Guide to Using Satellite Images in Support of
Exceptional Event Demonstrations



Michael Geigert
CTDEEP
March 2018

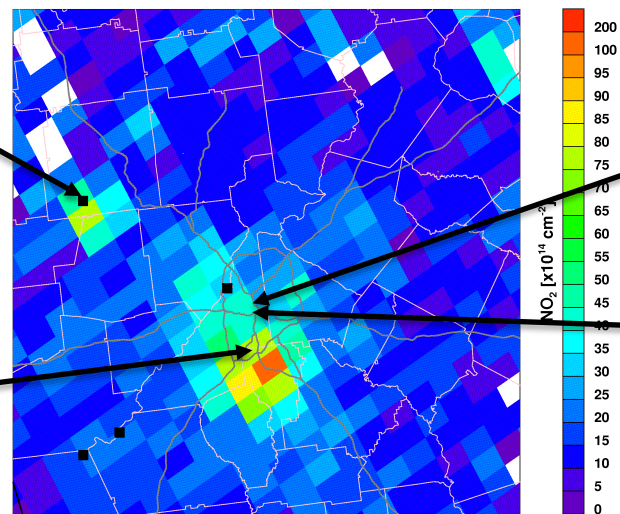
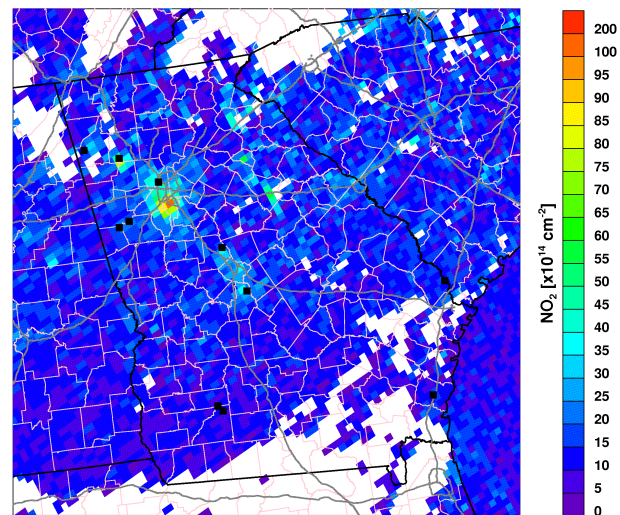
Should continue with, extend successes

➔ Further operationalize with stakeholders

NO_x Emissions

TropOMI NO₂ Columns on 2018-08-15

- Demonstrated trends
 - Compared to EI's
 - Used to help identify biases
- Capability successfully picked up by stakeholders



Opportunities?

- Some of my thoughts...
- Your thoughts



Wildfires

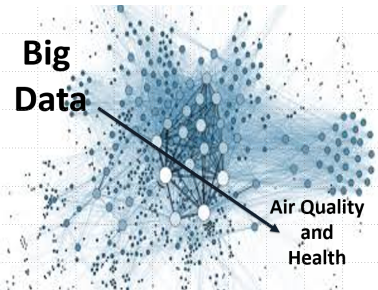
- Various current HAQAST activities, but further opportunities exist
 - Including further work with stakeholders
- Emissions
 - Fuel loading, fuel characteristics, meteorological impacts, burn area, ...
- Fire and plume dynamics
 - Historical
 - Health analyses, exceptional events, atmospheric chemistry
 - Prediction
 - Health protection
- Prevention
 - Minimizing adverse effects from prescribed burning
 - Managing burns





**Big
Data**

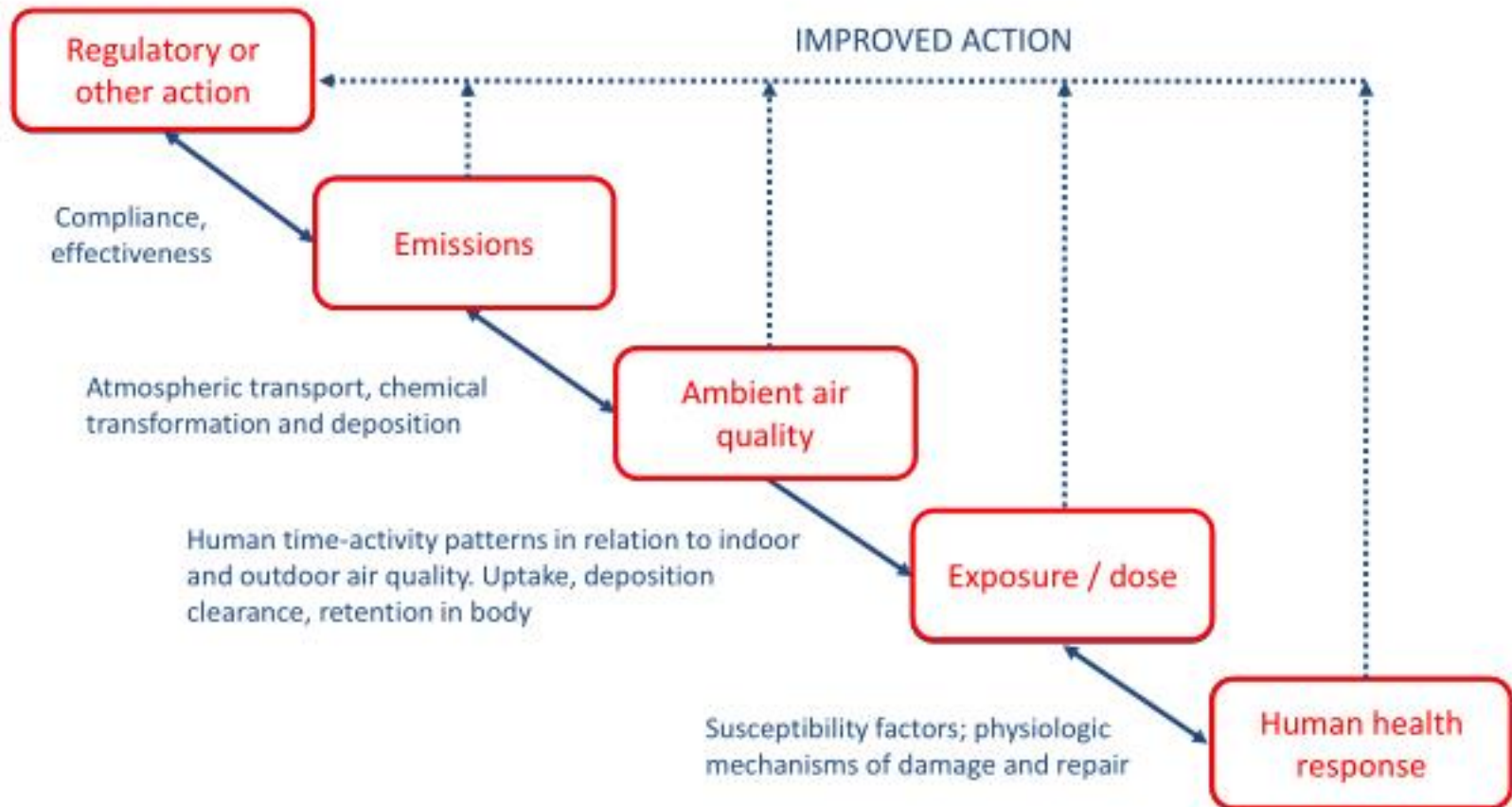
**Air Quality
and
Health**



Big Data

- Not currently part of the HAQAST portfolio (?)
- Growing abundance of data of many types
 - Satellite, aircraft, ground-based, emissions, land use, air quality model, ...
- More powerful algorithms/packages becoming available
- Outcomes
 - Pollutant fields for health analyses
 - Some work in this direction, but limited in terms of speciation, gaseous compounds
 - Reveal/capture relationships between emissions, air quality and other factors
 - Atmospheric chemistry, air quality management
 - Source and species specific impacts

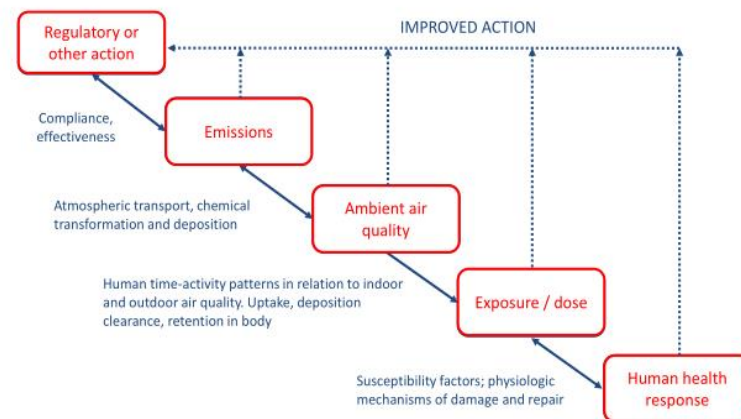
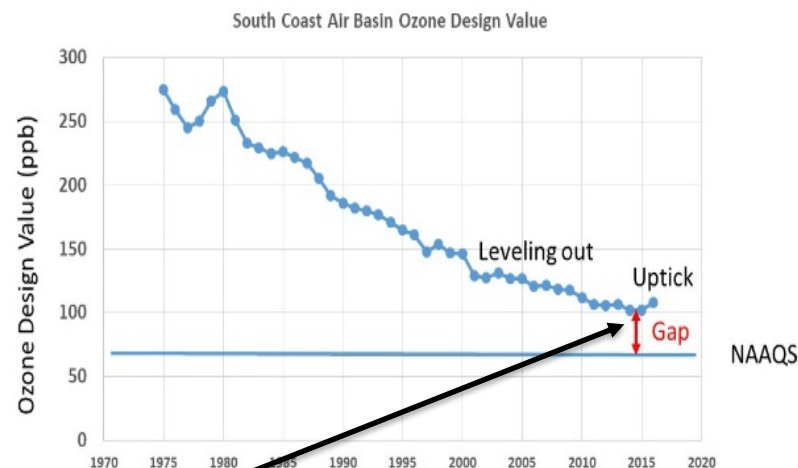
Trend Analysis and Accountability



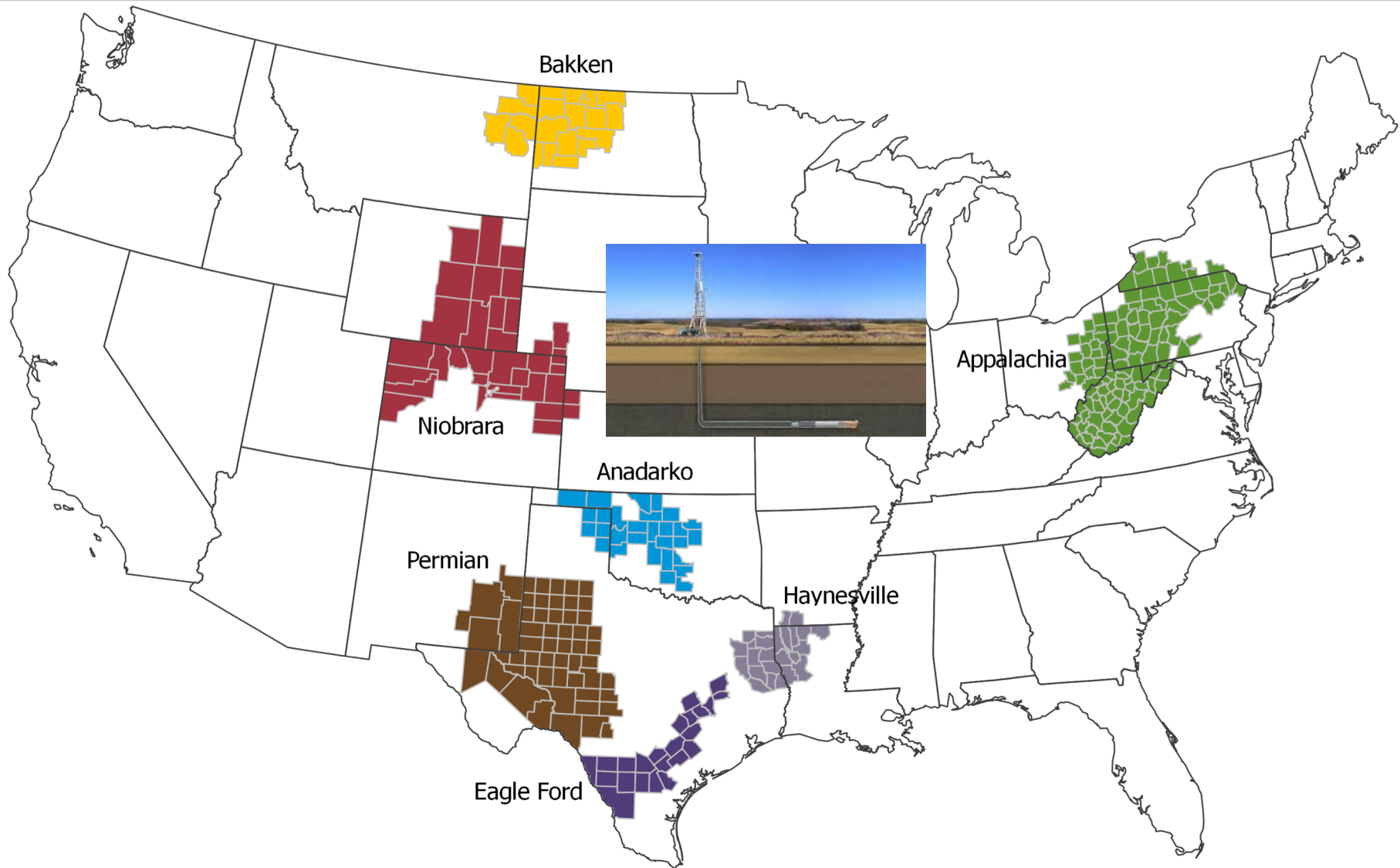
From HEI, 2003

Trend Analysis and Accountability

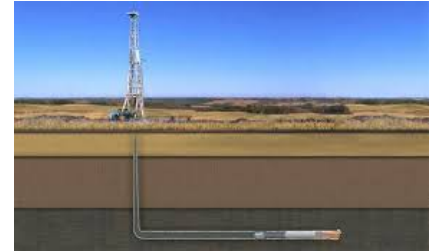
- Satellite observations very successfully used in pollutant trend analyses (esp. NO_x and $\text{PM}_{2.5}$)
 - Deeper dive for other species
 - Integrate between species
 - Source/species-specific impacts
 - Help address very detailed issues
- Accountability
 - Linking regulations to health and welfare benefits
 - Pick up on prior Tiger Team effort
 - HEI RFP currently out



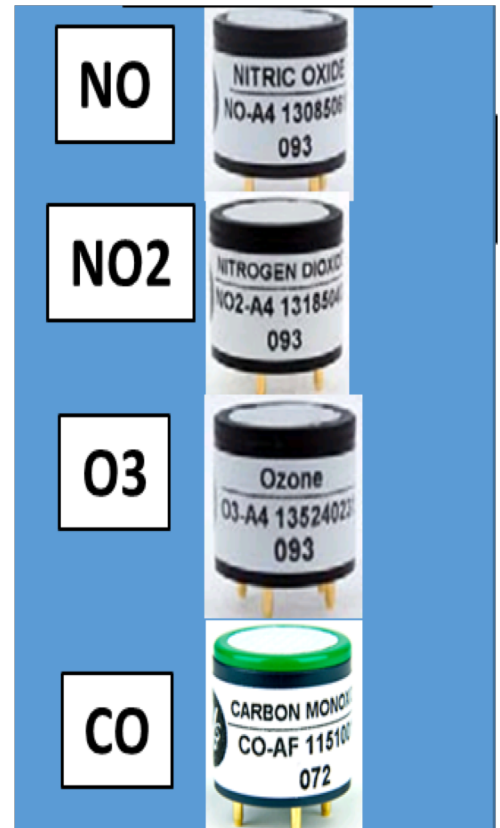
From HEI, 2003



Unconventional Oil and Gas Operation Impacts



- Emerging issue
 - Geographically-dispersed
 - Relatively low density of monitoring in impacted regions (particularly historically)
- Multiple types of remotely-sensed information of use
 - Species (NO_2 , AOD, HCHO...)
 - Flares (via light intensity, location)
 - ?
- Link to aircraft and modeling studies





Inexpensive Sensors (and drones)



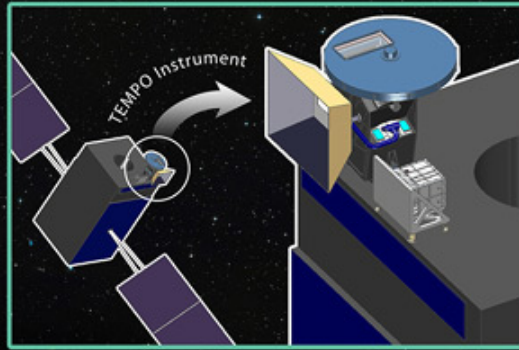
- Inexpensive sensors coming in to their own
 - Gas and PM sensor accuracy improving
 - Quite viable results
 - Readily deployed
 - Land & drone-based
 - Packages of multiple sensors
- Seeing increased use
 - More work on how to best integrate with satellite and aircraft missions
 - Can be used to enhance studies of fires, UOGD, ...
 - Contribute to “big data”



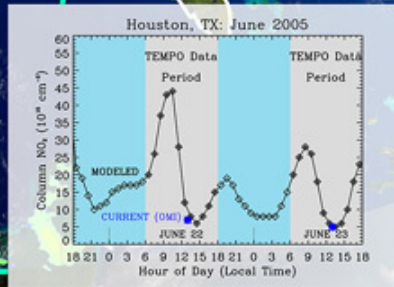
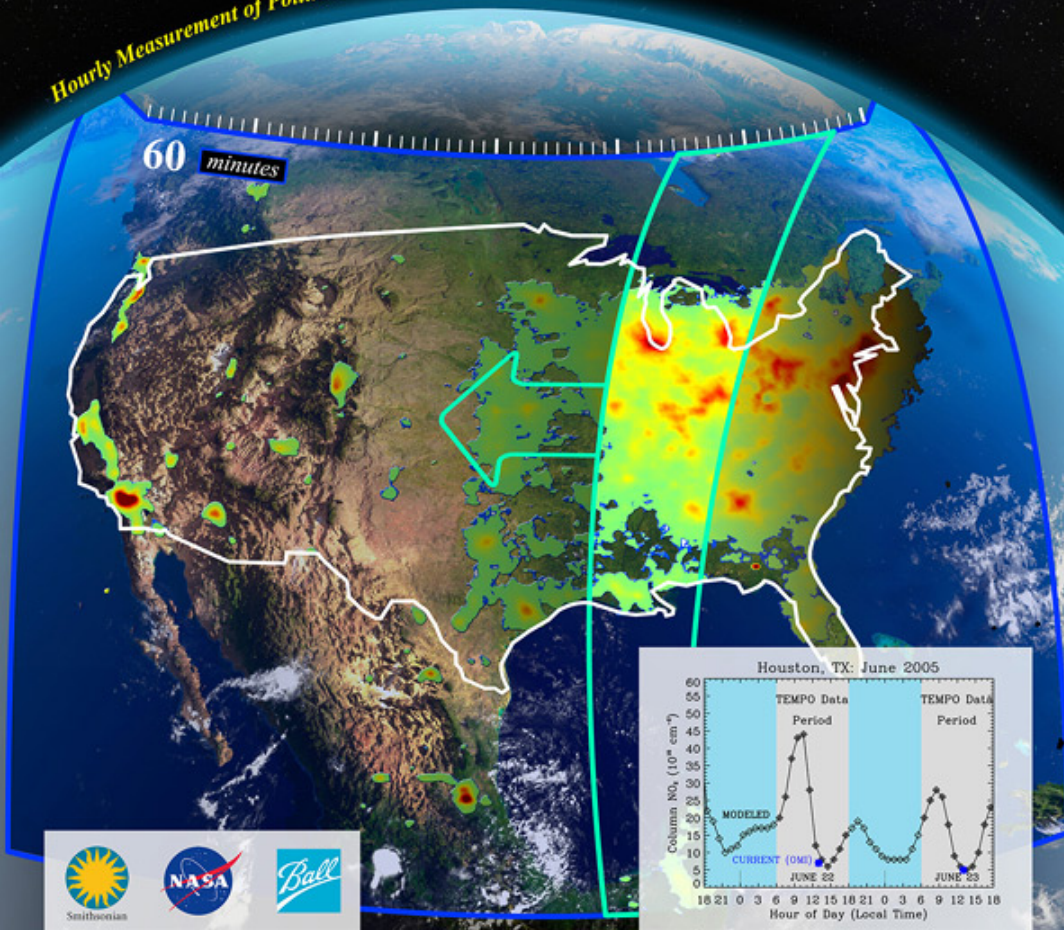
TEMPO

Tropospheric Emissions: Monitoring of Pollution

TEMPO's concurrent high temporal (hourly) and spatial resolution measurements from geostationary orbit of tropospheric ozone, aerosols, their precursors, and clouds create a revolutionary dataset that provides understanding and improves prediction of air quality and climate forcing in Greater North America.

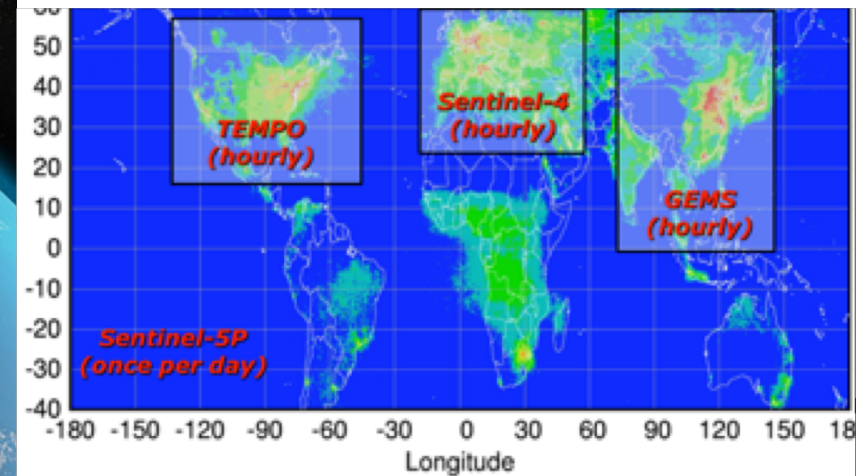


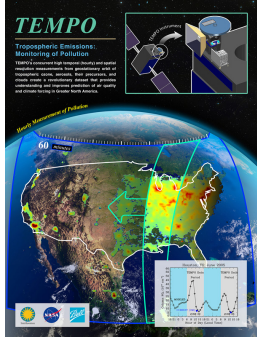
Hourly Measurement of Pollution



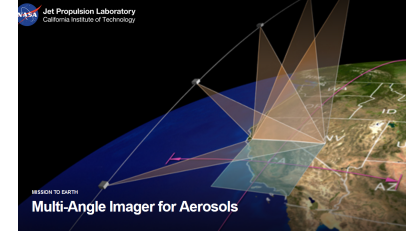
MISSION TO EARTH

Multi-Angle Imager for Aerosols





TEMPO, MAIA and Other Missions Globally



- Potential game changers...
- Need to be ready to get their information and how to use their observations to stakeholders quickly
 - A clear win for AQUEST/HAQUEST has been to develop an interest in the power of space-based observations and to help develop the capabilities to use the data in-house

Industry

- HAQAST can look to involve industry more
 - Potentially done via consultants

Summary

- Use of NASA earth science has had some clear home runs in the air quality and (related) health arenas
 - AQUEST/HAQUEST can/has played a critical role in facilitating their use by stakeholders: a clear win (that should remain a focus)
 - Continue to refine/extend these successes
- Opportunities going forward (including combinations)...
 - Fires
 - Big data
 - Trend analysis and accountability
 - Unconventional oil and gas operations
 - Inexpensive Sensors
 - TEMPO and MAIA
 - Industry
 - Others?