Challenges and Opportunities of Visualizing NASA's Earth Observations

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Frontiers of Visualization Meeting

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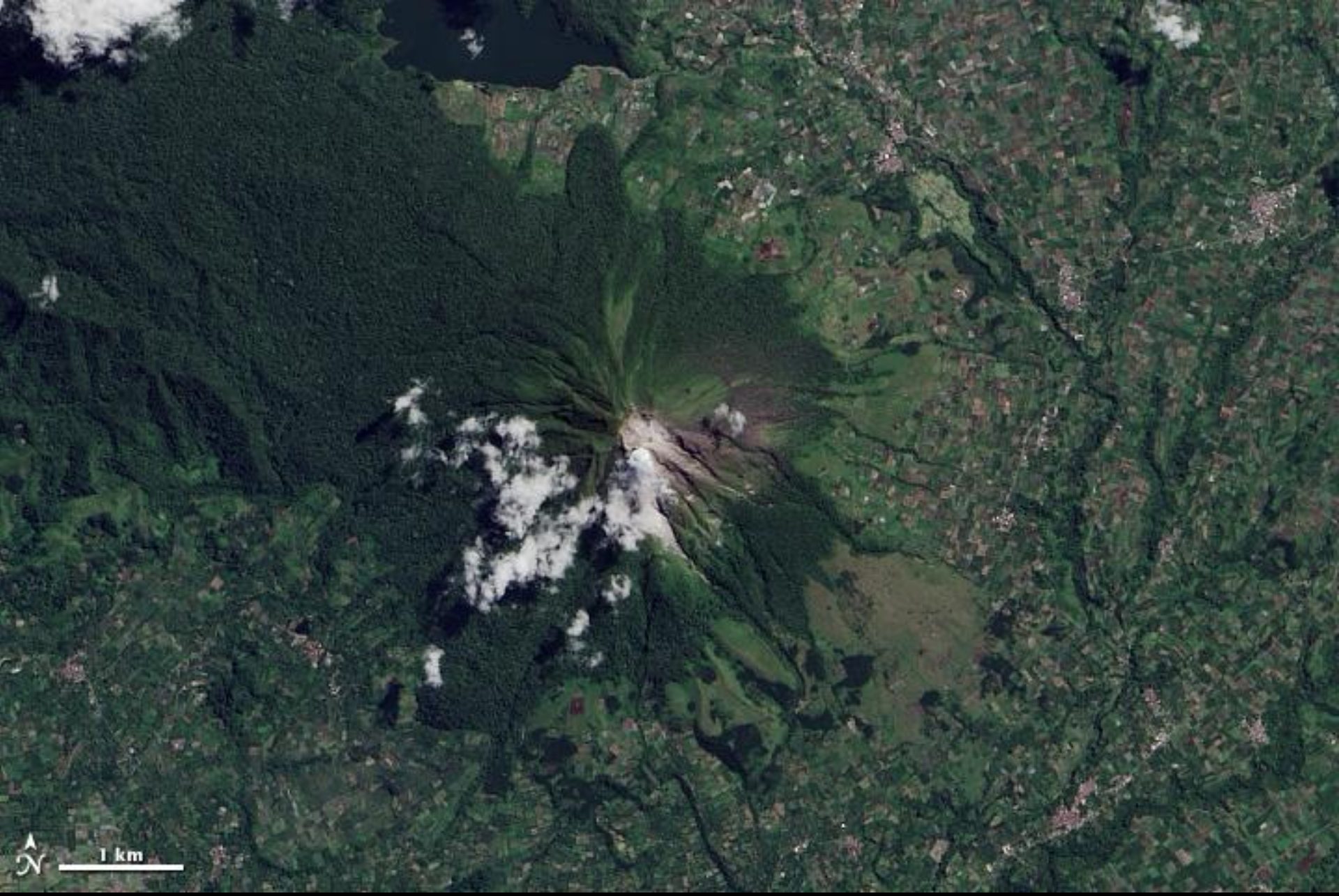
Background: NASA Earth Observatories and Observations


Aquarius
OSTM/Jason 2 (NOAA)
Jason
QuikSCAT*
TRMM
EO-1
Landsat-7 (USGS)
Aqua
ACRIMSAT
Terra
SORCE
GRACE (2)
Aura
CALIPSO
CloudSat
NPP



EO-1 / Advanced Land Imager (ALI), Sinabung, Indonesia, June 7, 2013
http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=83080

EO-1 / Advanced Land Imager (ALI), Sinabung, Indonesia, Feb 6, 2014
http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=83080

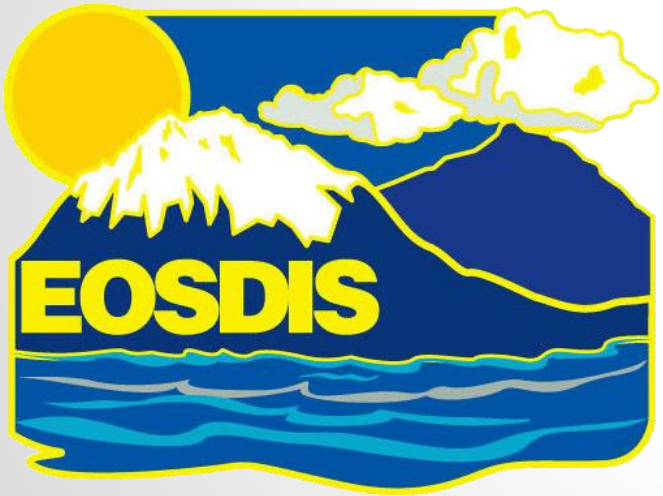
Terra and Aqua
Moderate-resolution Imaging Spectroradiometer (MODIS)
Normalized Difference Vegetation Index (NDVI)
California, Jan 17-Feb 1, 2014
http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=83124

Aqua / Advanced Microwave Scanning Radiometer-EOS (AMSR-E), Sea Ice Minimum, Sept 9, 2011
http://earthobservatory.nasa.gov/IOTD/view.php?id=53108

Problem Analysis: Using the Observations

NASA Earth Science Data and Information System Project

- The ESDIS Project is responsible for the Earth Observing System Data and Information System (EOSDIS), one of the largest civilian Science Information Systems in the world



- Ingests, processes, archives (~8.5 TB/day, 9.8 PB total) and distributes (> 22 TB/day) science data for NASA's flagship Earth science missions
- http://earthdata.nasa.gov/

Using the Observations: The Good

- Rich and diverse data sets
  - Long history (1970s-present)
  - Global coverage
  - Many products (~7000) applicable to wide range of scientific domains
- (Almost) all data is online

Using the Observations: The Challenges (1)

- Across data products, there are different
  - Data formats (e.g., HDF, NetCDF, GeoTIFF)
  - Processing levels (e.g., 0, 1, 1A, 1B, 1T, 2, 2G)
  - Spatial resolutions
  - Spatial coverages
  - Coordinate systems

Using the Observations: The Challenges (2)

- Data volume
  - Sheer number of products + parameters
  - Large file sizes for certain products

- Almost all of the sample NASA imagery shown earlier was crafted by in-house experts – need to enable exploration, analysis, decision support by non-experts and “outsiders”

New Solutions:
Visual Exploration and Discovery at NASA

New Solutions:
Global Imagery Browse Services (GIBS) and Worldview

Driving Goal:

To transform how end users interact with and discover EOSDIS data; make it visual

Approach:

- The **Global Imagery Browse Services (GIBS)** provide standardized access to full resolution imagery generated from NASA products; imagery is stored as tiles for fast access

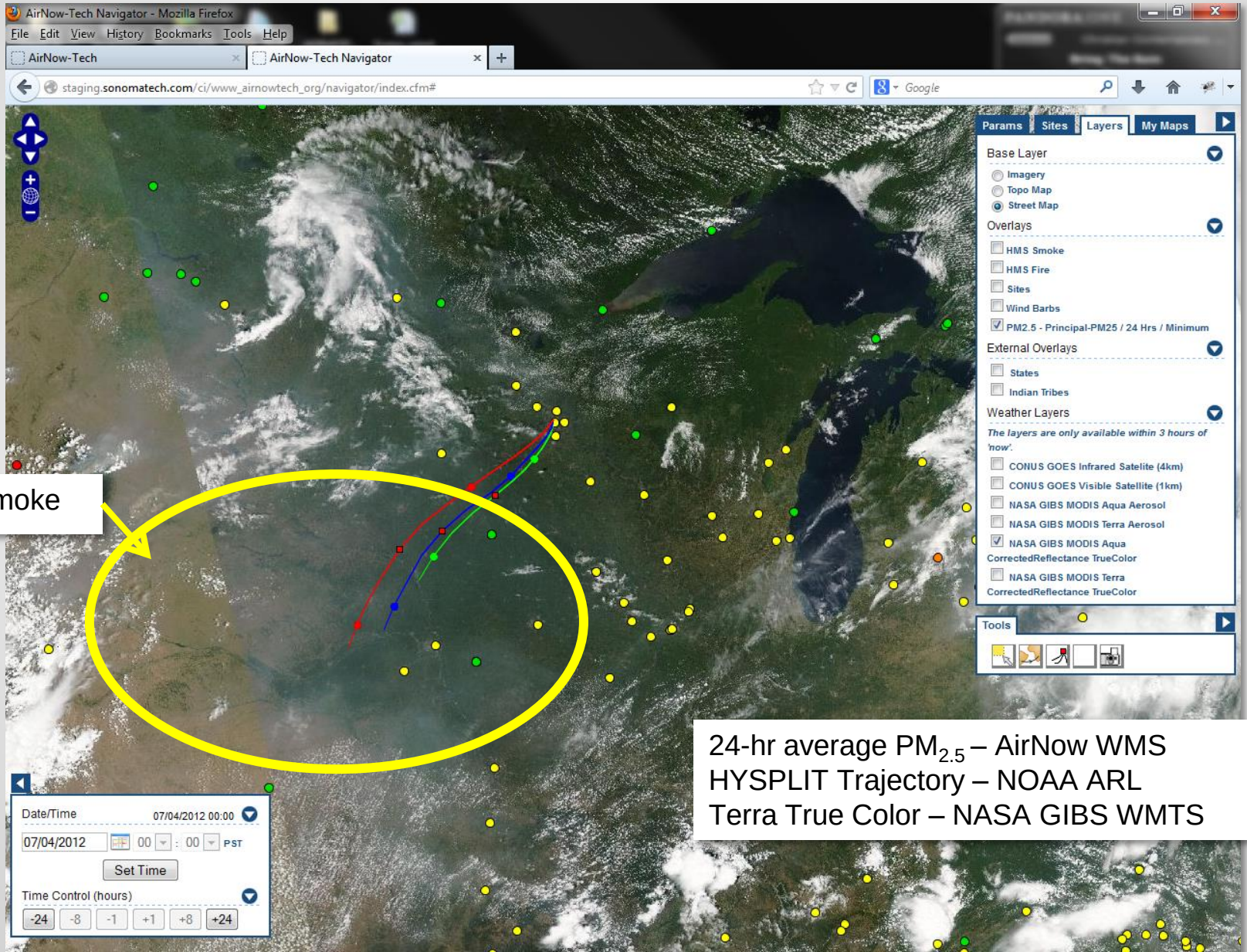
- **Worldview** provides a highly responsive interface to explore GIBS imagery in a Google Maps-like manner and download the underlying data

Open-Access Servers

Client

EPA AirNow Tech Navigator

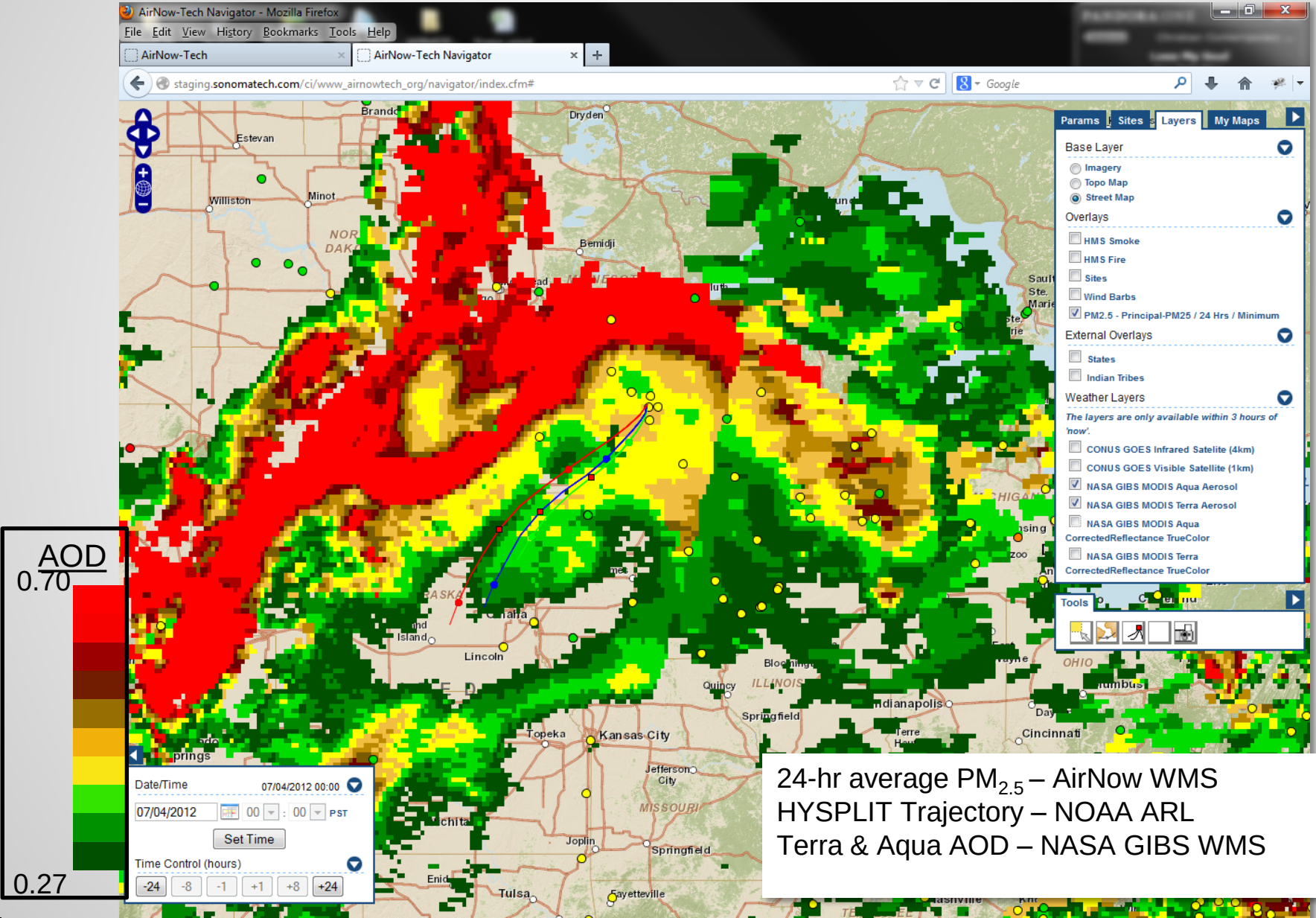
Combining EPA Ground Stations with NASA Satellite Imagery



24-hr average $PM_{2.5}$ – AirNow WMS
HYSPLIT Trajectory – NOAA ARL
Terra True Color – NASA GIBS WMTS

EPA AirNow Tech Navigator

Combining EPA Ground Stations with NASA Satellite Imagery



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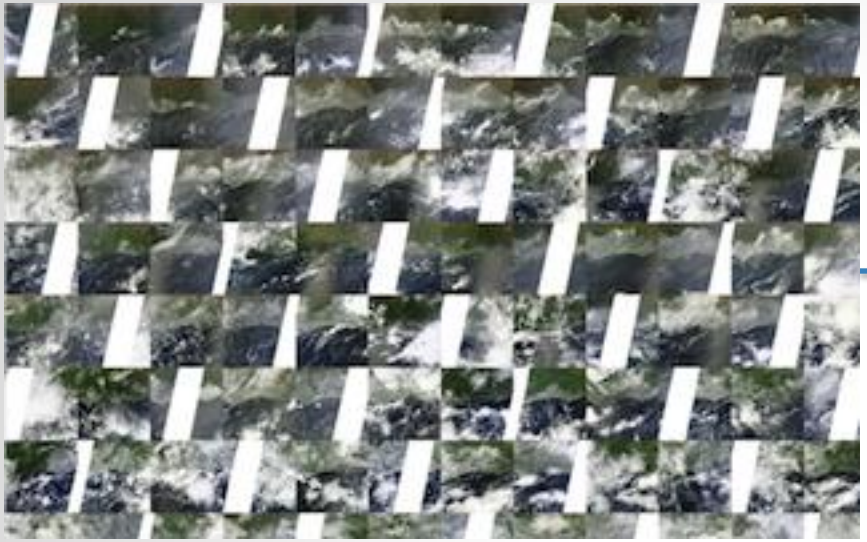
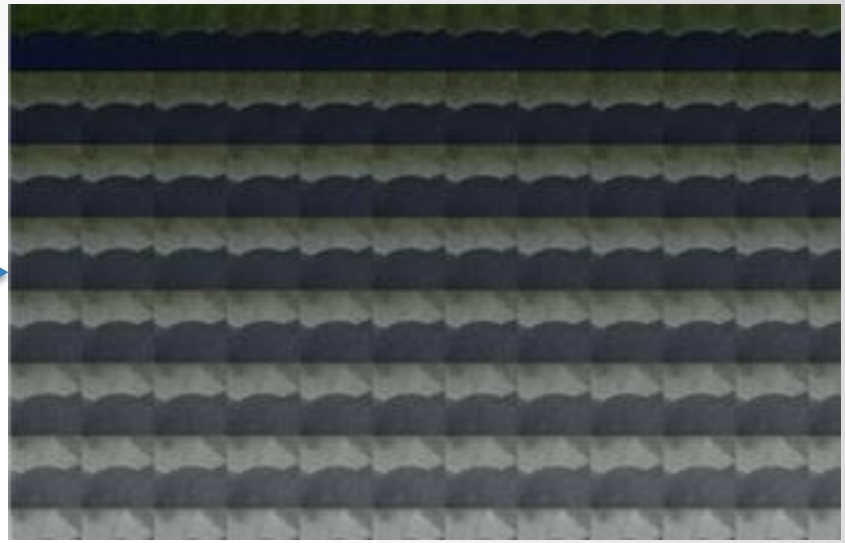
MapBox: Building a Cloud-Free Atlas

Harvesting Daily NASA Imagery to Find Cloud-Free Pixels



Sort



Merge

Takeaways

- Data Challenges
  - Lots of data
  - Heterogeneous datasets
  - Difficulty in using datasets
- Visualization Challenges
  - Loss of precision and flexibility when converting data to 8-bit imagery
  - Risk of users doing science with imagery
  - Nontrivial amount of effort to rasterize data into imagery
  - Updating standards to deal with time-varying data sets
- General Wishlist
  - Uniform access to data / data services for analysis
  - Instantly rasterize-able data (i.e., no pre-caching) for better precision and flexibility

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- Thomas Huang
- Joe Roberts
- Christian Alarcon

Questions / Feedback

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GIBS

https://earthdata.nasa.gov/gibs

https://github.com/nasa-gibs

Worldview

https://earthdata.nasa.gov/worldview

https://github.com/nasa-gibs/worldview