

Tropospheric Emissions:
Monitoring of Pollution



Development of TEMPO Data at NASA SPoRT for Air Quality and Public Health Applications

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Short-term Prediction Research and Transition (SPoRT) Center



Mission: Transition unique NASA and NOAA observations and research capabilities to the operational weather community to improve short-term weather forecasts on a regional and local scale

SPoRT prepares the *community* of *end users and mission scientists* for next generation satellite missions and capabilities through an interactive R2O/O2R paradigm

Current/Future Activities:

- Successful partnerships to prepare NWS forecasters for GOES-R and JPSS through use of experimental proxy products
- Expanding partnerships to other government agencies and new NASA missions





Pre-launch R2O/O2R Activities



← → ↻ <https://weather.msfc.nasa.gov/sandbox/tempo/>



Home Research Applications Submissions Team

Keys to successful day 1 readiness

- Data in the end users' display system
- Targeted training
- Assessments to gather feedback from users for the mission scientists

Pre-launch R2O/O2R activities can provide valuable input to data processors, mission scientists, algorithm developers, and guide baselining of products/capabilities

Tropospheric Emissions: Monitoring of Pollution

Introduction



The TEMPO mission is currently on-schedule and on-budget for an expected launch date in 2020 or 2021, and will be hosted on a commercial geostationary communications satellite with a Field of Regard (FOR) over North America for allowing hourly daytime monitoring capabilities. For each geospatial scene in the FOR, the TEMPO grating spectrometer instrument will measure the solar backscattered radiance in the ultraviolet (290–490 nm) and visible (540–740 nm) with a spectral resolution and sampling of 0.6 and 0.2 nm, respectively, for retrieving aerosol and cloud parameters, along with the major elements in tropospheric ozone (O_3) chemistry cycle consisting of nitrogen dioxide (NO_2), sulfur dioxide (SO_2), formaldehyde (H_2CO), glyoxal ($C_2H_2O_2$), water vapor (H_2O), and UVB radiation. The high spatial resolution of 2.1 km x 4.7 km at the center of the FOR will allow for unprecedented air-quality monitoring at sub-urban scales.

TEMPO Early Adopters

TEMPO Early Adopters are working towards identifying the myriad of capabilities and applications of TEMPO, recognizing the needs of the end-user community, and planning how these needs can be met prior to the TEMPO launch.

Objectives

1

Identify key end users and end-user applications in the areas of air-quality modeling; planning and assessment; emissions; and health, agricultural, and environmental impacts to establish a feedback loop for the TEMPO Science Team to provide products to meet these end-user requirements.

2

Use current systems (space-borne, surface networks, model/synthetic calculations) to emulate future TEMPO capabilities, and better prepare the air quality agencies for the post-launch data, while also realizing the regional and local applications of the data.

3

Define processing and delivery needs from NASA for operational forecasting, episode analysis, and trend evaluation by air quality agencies.

NASA SPoRT Collaboration

The SPoRT Center was established in 2002 for transitioning unique satellite observations and research capabilities to end users to improve short term forecasting and decision support. SPoRT team members work within a research to operations/operations to research paradigm to introduce experimental products to the operational environment via active involvement of end users. Involving the end users in the process ensures the products being developed by the researchers meet the end users' needs. This highly successful paradigm will be utilized for transitioning real-time TEMPO data products to end user communities in an effort to assess the impact on operations and develop end-user tailored products. Prior to TEMPO launch, SPoRT will apply the paradigm to (1) establish relationships with end users, and (2) deliver TEMPO proxy products in a format compatible with their decision support or display systems, and (3) gather feedback from the end users through targeted assessment of the products. These pre-launch activities will engage



<https://weather.msfc.nasa.gov/sport/>

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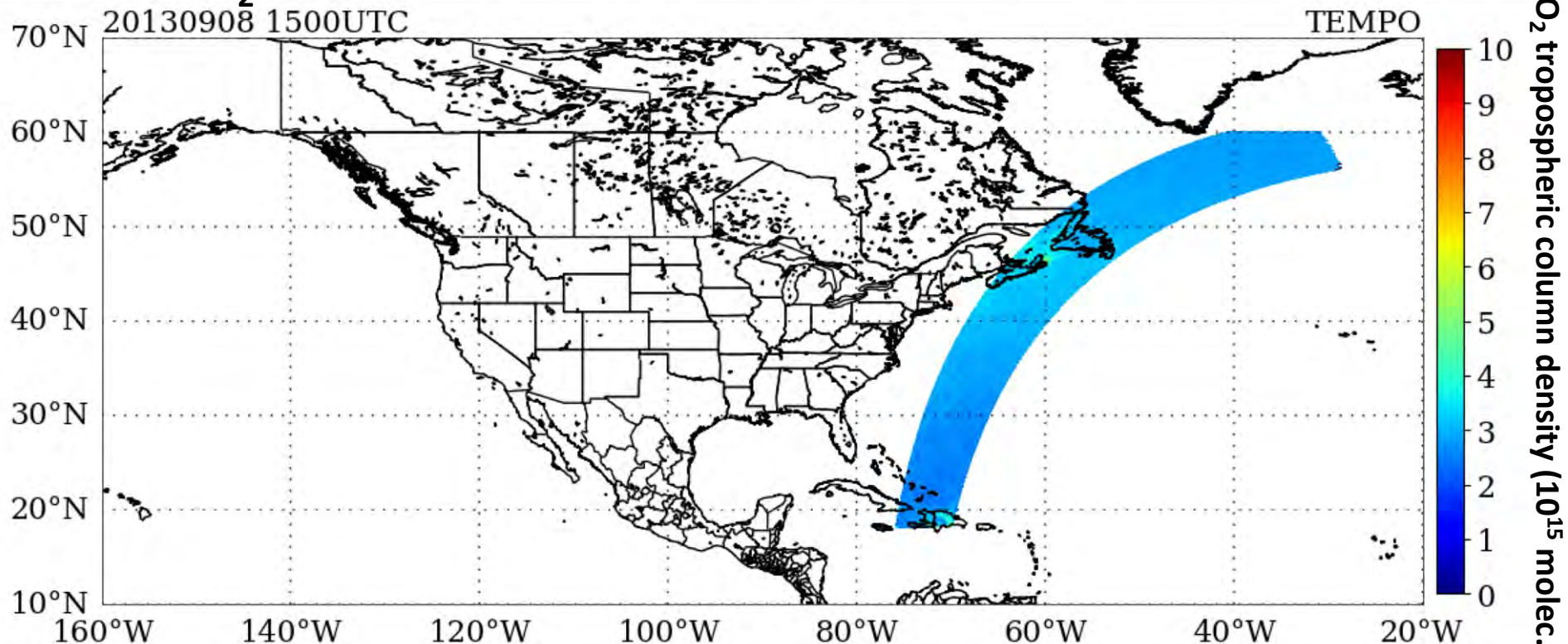


Synthetic TEMPO data



TEMPO NO₂

20130908 1500UTC



- Synthetic TEMPO proxy data generated using simulated gaseous and aerosol composition from GEOS-NR
- Goal: Utilize TEMPO proxy data for applications to accelerate operational use of real TEMPO products after launch in early 2022



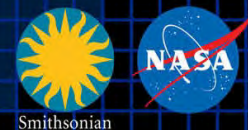
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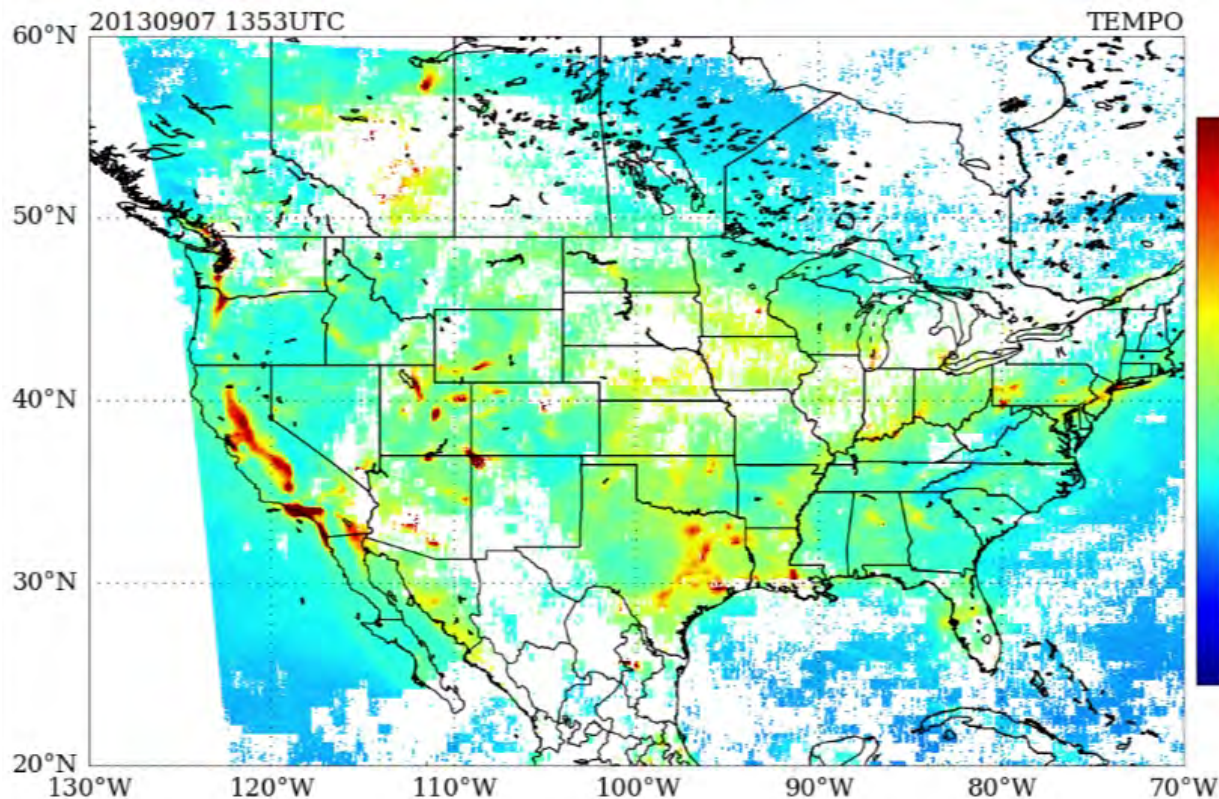
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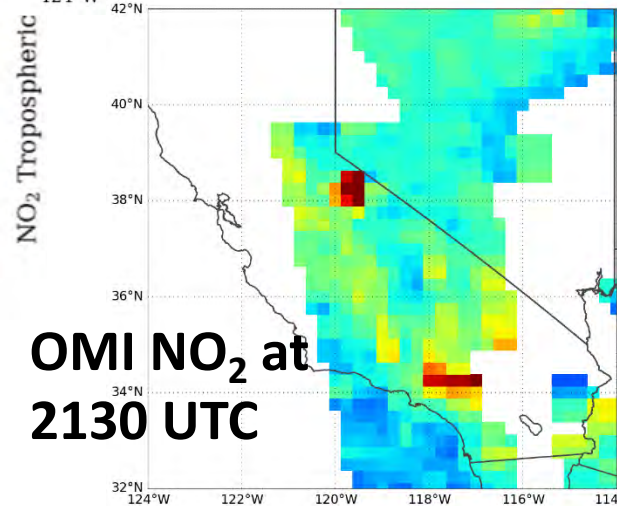
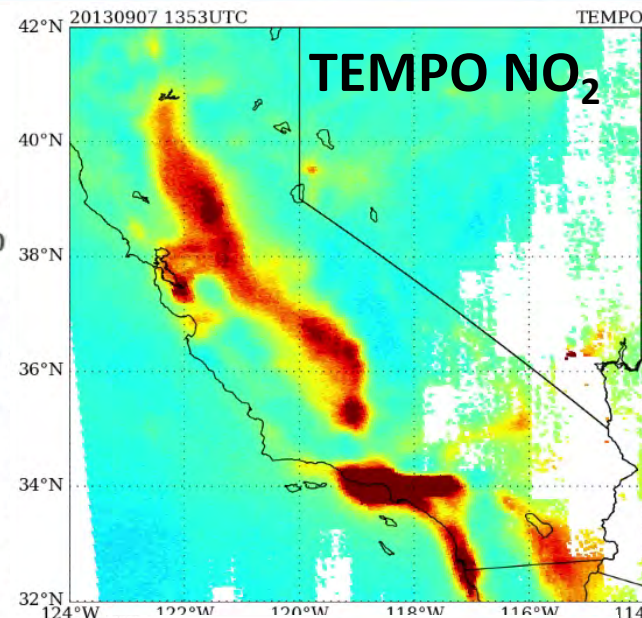
Synthetic TEMPO data



TEMPO NO₂



- Diurnally varying mobile source emissions and smoke plumes shown in TEMPO proxy data



OMI NO₂ at
2130 UTC



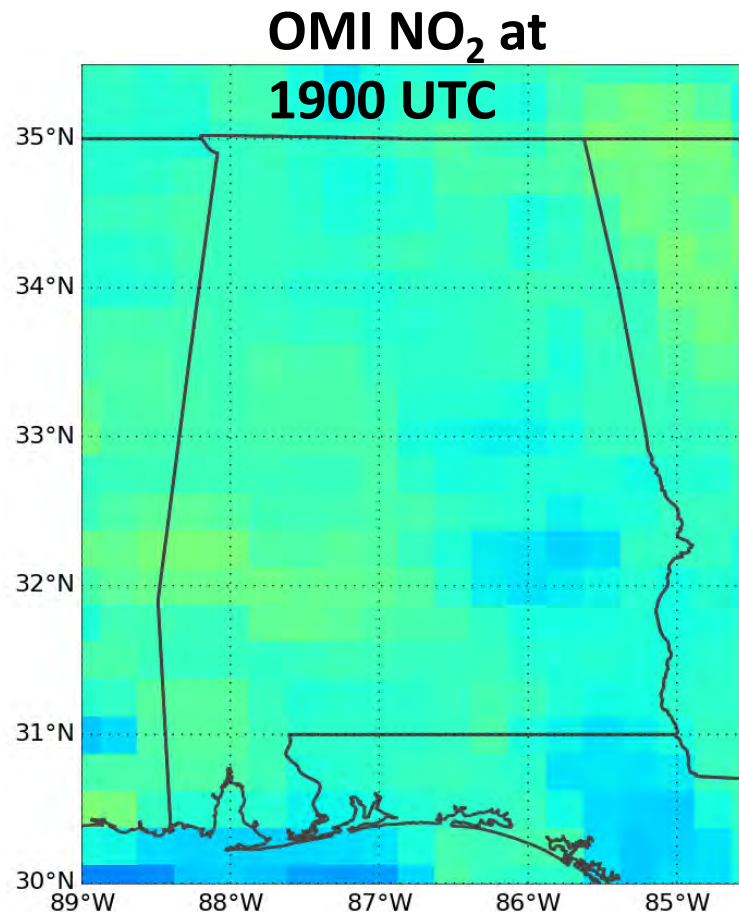
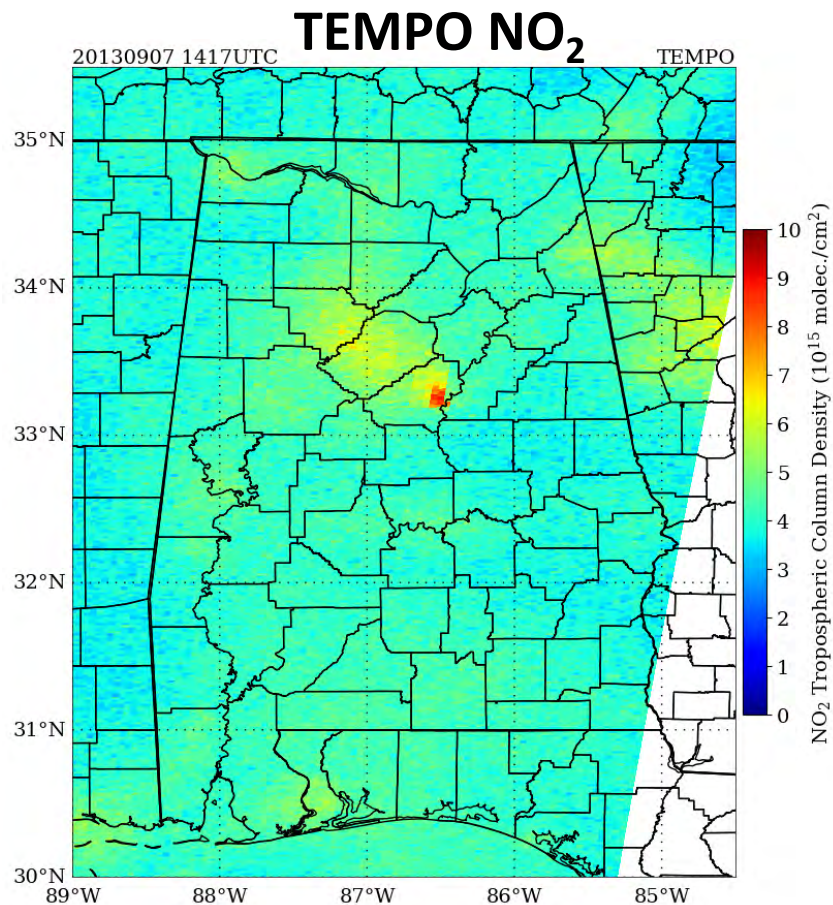
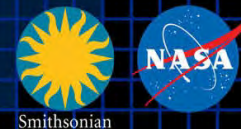
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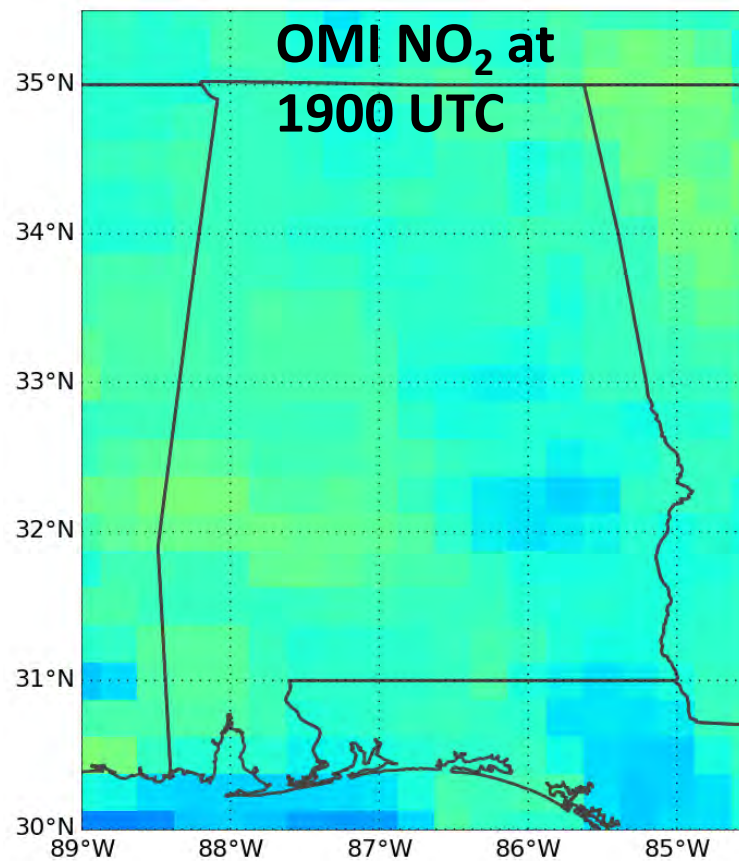
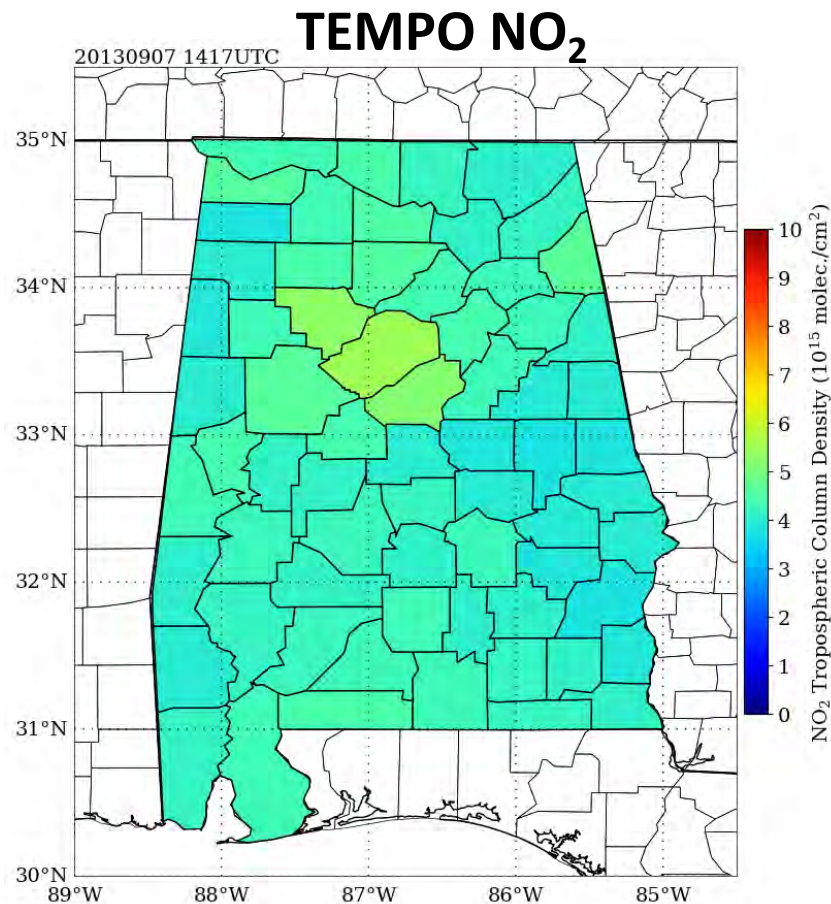
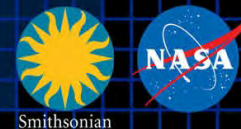
Synthetic TEMPO data



- NO₂ point source emission from Alabama Power Gaston Plant is apparent in morning TEMPO scan, no signal in later OMI scan



Synthetic TEMPO data



- TEMPO at county level, broader scale NO₂ field shows at county level, but NO₂ emission from Alabama Power Gaston Plant is no longer apparent



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Google Cloud Platform



← → ↻ https://console.cloud.google.com/storage/browser?folder=&organizationId=8

Google Cloud Platform TEMPO-HAQ

Browser CREATE BUCKET REFRESH DELETE

Filter by prefix...

Buckets

☐	Name	Default storage class	Location
☐	tempo_al_county	Multi-Regional	Unit
☐	tempo_l2	Multi-Regional	Unit

← → ↻ https://console.cloud.google.com/storage/browser/tempo_l2?project=tempo-haq&folder=&organizationId

Google Cloud Platform TEMPO-HAQ

Bucket details EDIT BUCKET REFRESH BUCKET

tempo_l2

Objects Overview Permissions Bucket Lock

Upload files Upload folder Create folder Manage holds Delete

Filter by prefix...

Buckets / tempo_l2

☐	Name	Size	Type
☐	TEMPO_L2_V01_20130908T130001Z_S001G01.nc	55.49 MB	application/x-netcdf
☐	TEMPO_L2_V01_20130908T130557Z_S001G02.nc	55.49 MB	application/x-netcdf
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← → ↻ https://console.cloud.google.com/storage/browser/tempo_al_county?project=tempo-haq&folder=&organizationId

Google Cloud Platform TEMPO-HAQ

Bucket details EDIT BUCKET REFRESH BUCKET

tempo_al_county

Objects Overview Permissions Bucket Lock

Upload files Upload folder Create folder Manage holds Delete

Filter by prefix...

Buckets / tempo_al_county

☐	Name	Size	Type
☐	TEMPO_HAQ_AL_20130908_1300.txt	3.67 KB	text/plain
☐	TEMPO_HAQ_AL_20130908_1400.txt	3.65 KB	text/plain
☐	TEMPO_HAQ_AL_20130908_1500.txt	3.64 KB	text/plain

Preparing and storing L2 products and formatted text files of gas concentrations and meteorology at county level for public health stakeholders (e.g., Alabama Hospital Association, Alabama Quality Assurance Foundation)



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ESRI Visualization for TEMPO



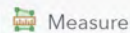
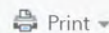
← → ↺ <https://msnseswms.ndc.nasa.gov/portal/home/webmap/viewer.html?layers=230b26ea6f7048eabce956f83eb00ce6> ☆



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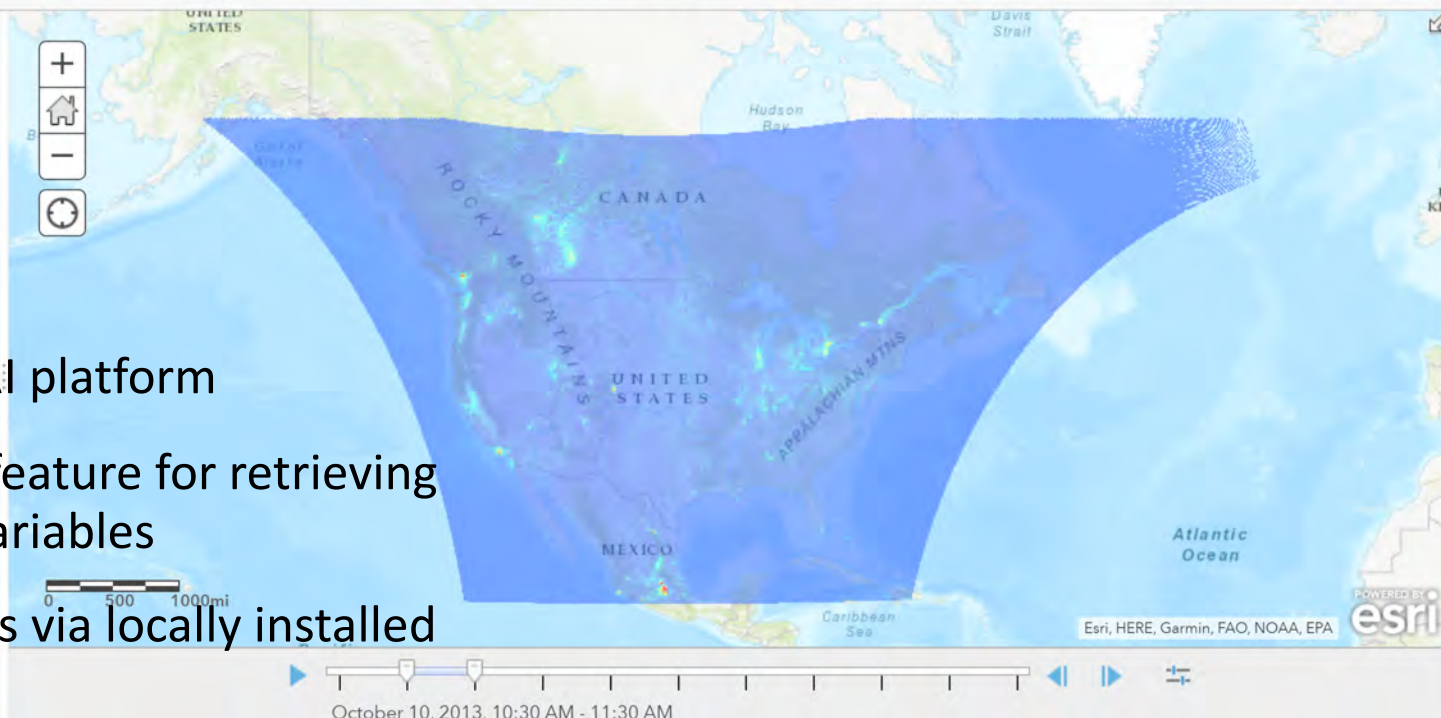


Contents

☒ sporttempo



▶ Topographic



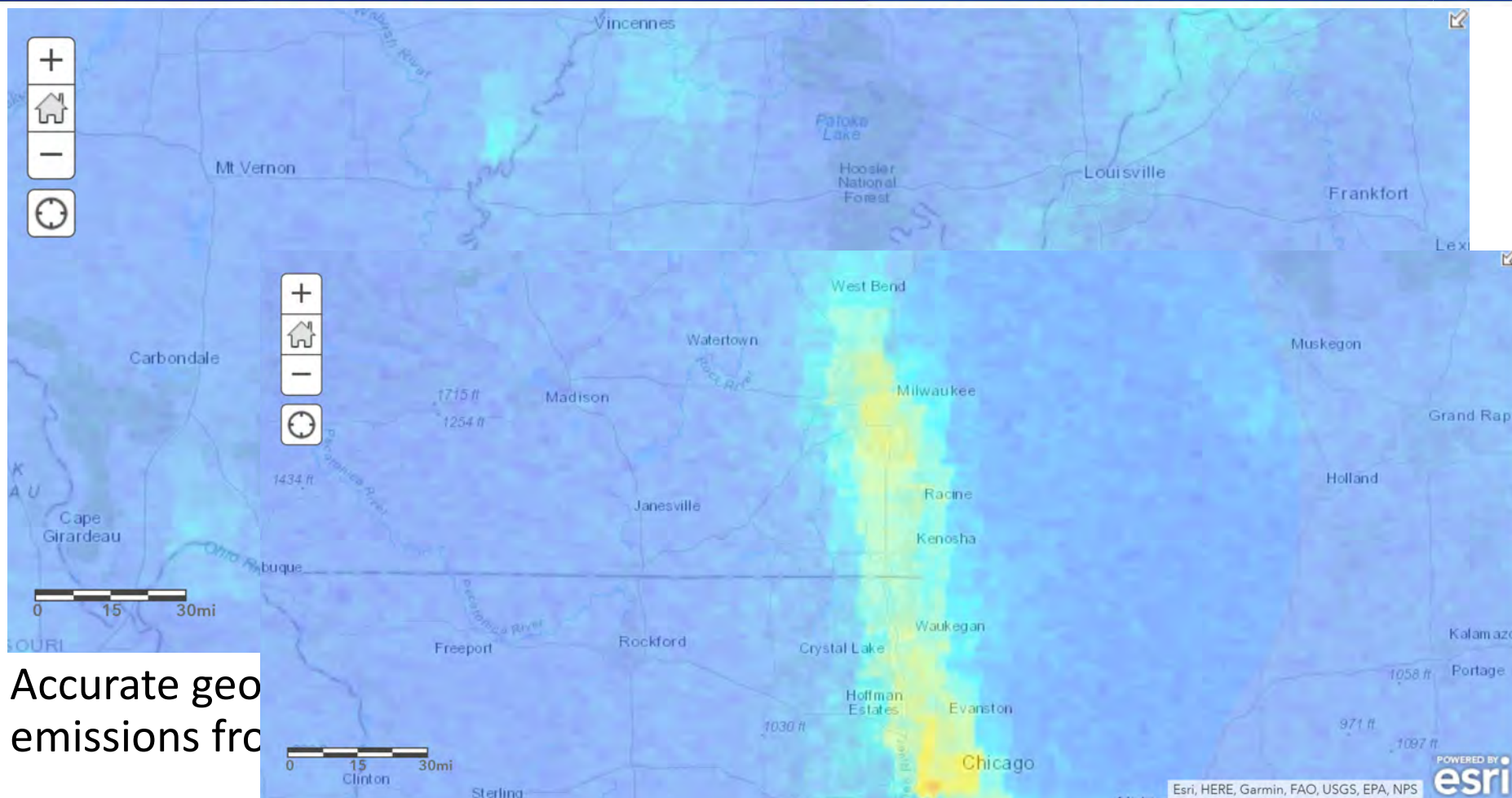
Advantages of ESRI platform

- 1) Point and click feature for retrieving raw geophysical variables
- 2) Perform analysis via locally installed ArcGIS
- 3) Can ingest GRIB, NetCDF (CF compliant), GeoTIFF





ESRI Visualization for TEMPO



<https://weather.msfc.nasa.gov/sport/>

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Fully ingest TEMPO proxy dataset from July 2013-June 2014 into ESRI platform for allowing effective analysis of L2 products

Setup FTP server for distributing proxy data to community, LDM solution for future real-time data

Goal: Engage with end users/stakeholders on assessing TEMPO applications and preferred visualization frameworks prior to launch

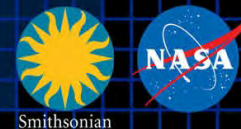
Plans to use TEMPO data, low-cost sensor network over northern AL, and hospital claims data for public health study

Proposed study to start ingesting upcoming GEMS data into NASA modeling system over South Asia, which will help identify future capabilities of TEMPO

TEMPO public health conference at University of Alabama in Huntsville with conference date of 10/10/19



Thanks!



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The public health conference aims to promote multidisciplinary understanding of TEMPO mission data products, scientific and technological components of the TEMPO mission, and applications of the TEMPO data products to health-related endeavors.

