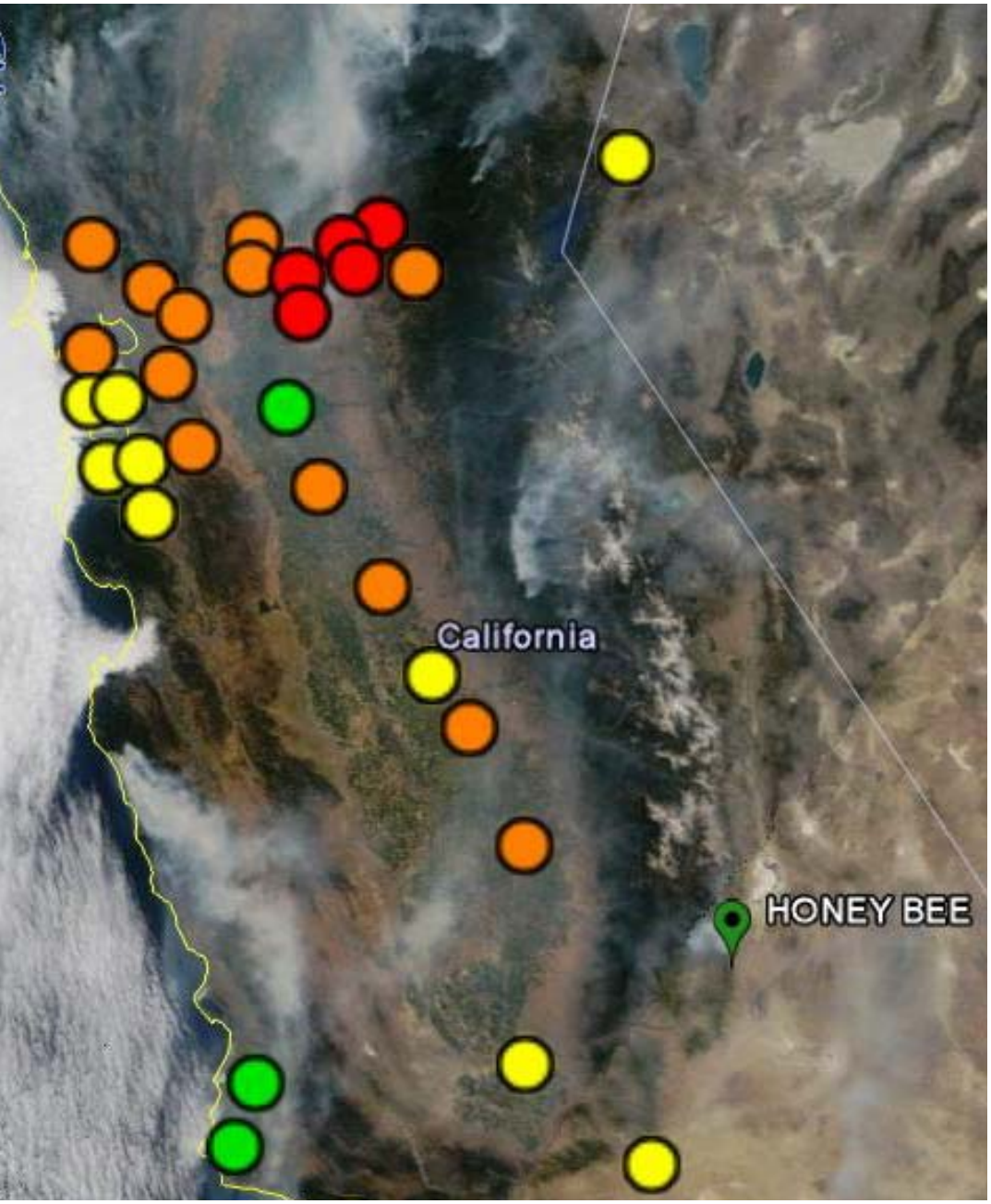


Use of NASA 3D-AQS Remote Sensing Data in Google Earth: a New Tool for Air Quality Forecasters

Amy K. Huff
Battelle Memorial Institute
huffa@battelle.org

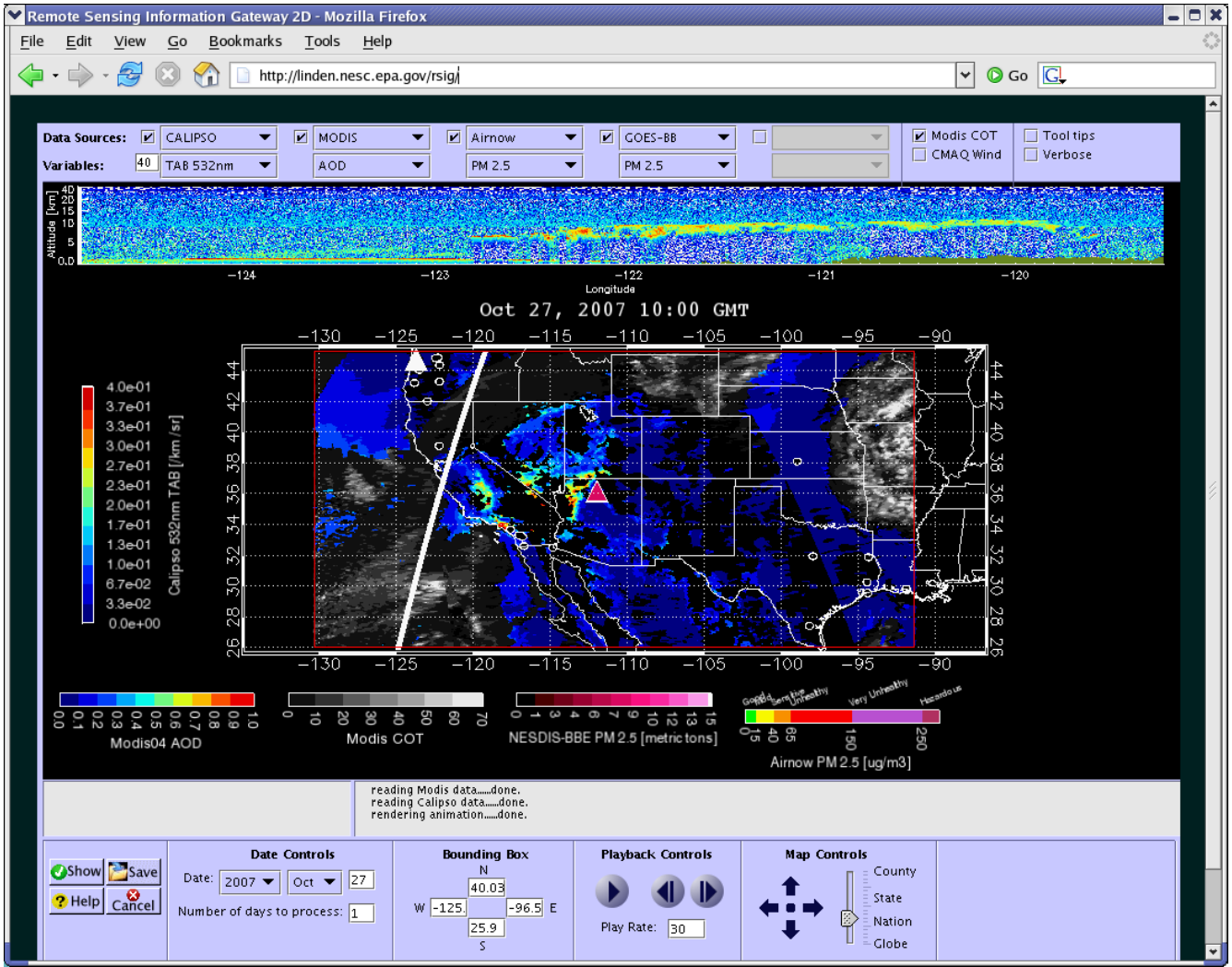
Update on the 3DAQS Project

- Goal: make NASA satellite data more accessible to the air quality community.
- AIRQuest datasets (2004-2008)*:
  - MODIS AOD matched to $PM_{2.5}$ monitors
  - GASP AOD matched to $PM_{2.5}$ monitors
  - MISR AOD matched to $PM_{2.5}$ monitors
  - OMI NO_2 (GSFC “Standard Product”) matched to NO_2 data from EPA network
- RSIG datasets (2004-2008):
  - MODIS AOD gridded to 12×12 km^2 CMAQ grid
  - GASP AOD gridded to 12×12 km^2 CMAQ grid
  - Ground-based UMBC lidar

*EPA is working to find a permanent home for the 3DAQS data in AIRQuest

Remote Sensing Information Gateway (RSIG)

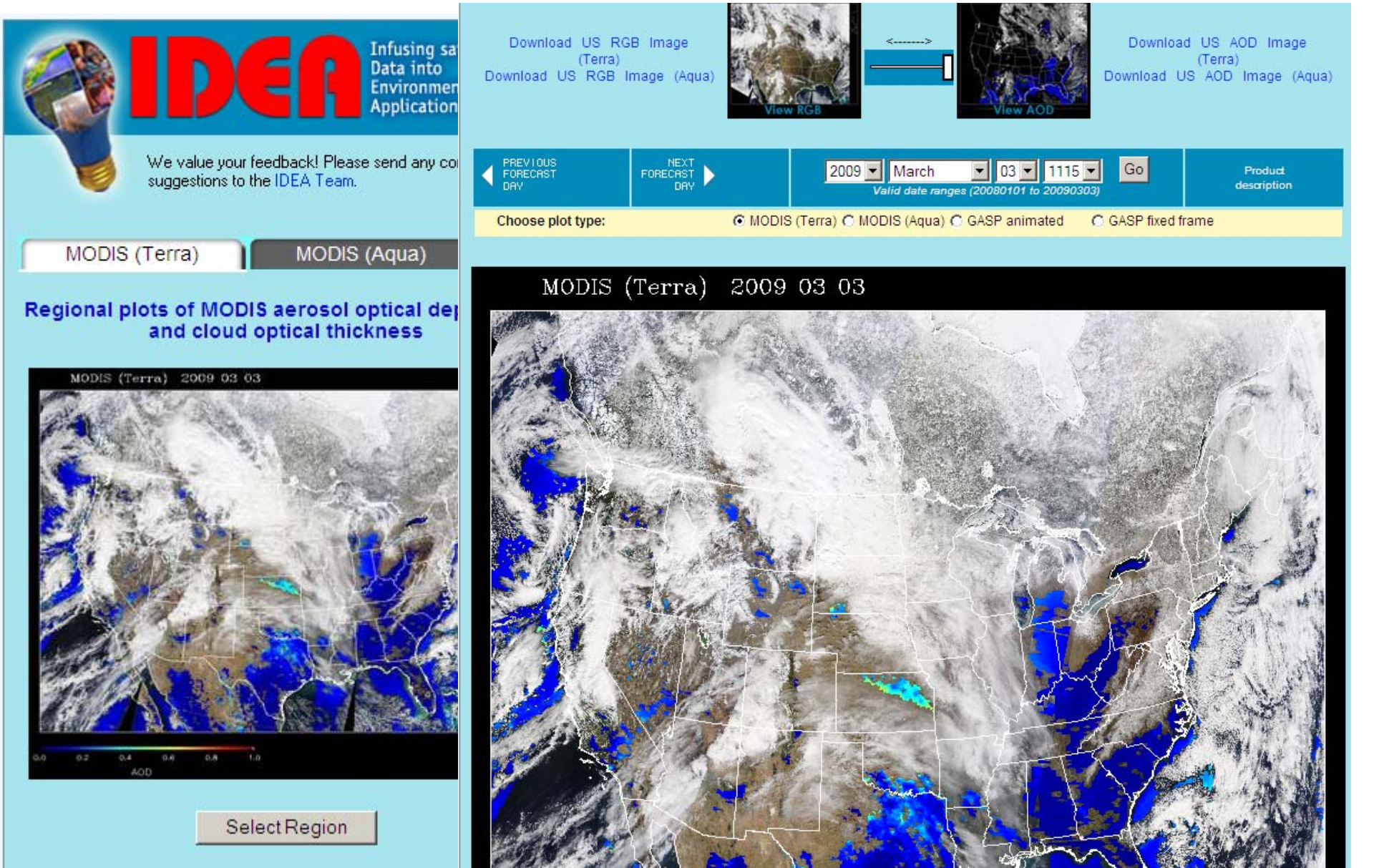
- RSIG allows users to visualize and download air quality data from many different sources.
- Visit the RSIG booth for more information!



IDEA

MODIS True Color, AOD Images and other Satellite Goodies

http://www.star.nesdis.noaa.gov/smcd/spb/aq/



U.S. Air Quality Weblog ("Smog Blog")

Daily Summaries of Air Quality in the U.S. using Remote Sensing Products

http://alg.umbc.edu/usaq/

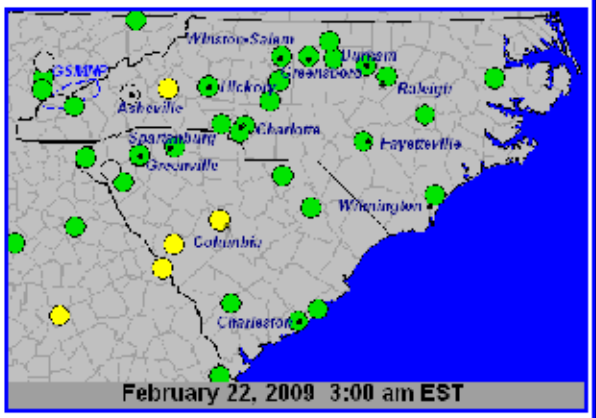
U.S. Air Quality

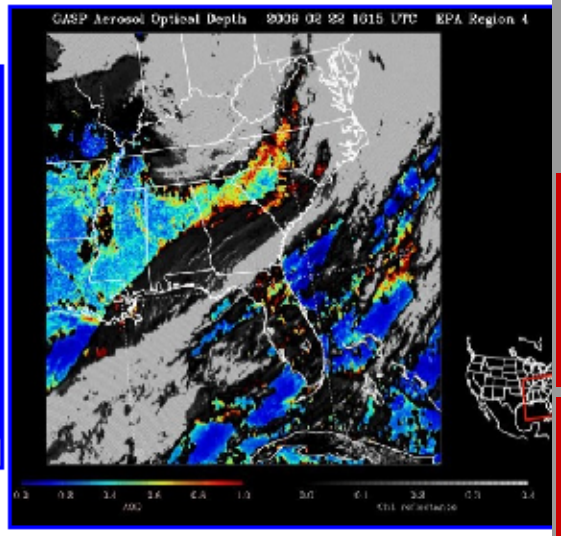
The Smog Blog

February 22, 2009

MODERATE AQ IN THE CAROLINAS; GOOD ELSEWHERE

It is a very good air quality day for the country with only elevated concentrations in **California's San Joaquin Valley** under heavy cloud cover and a few hours of mo concentrations in the Carolinas (left) and GASP was able to catch that line of haze fol frontal passage (right). The red line of nearly 1 AOD could not be confirmed on MOD the AOD product did not run on IDEA today (we're checking this out).





By Ray Hoff on February 22, 2009 6:33 PM | **Permalink** | **Comments (0)**

Main Data Sources

- UW MODIS Today USA Composite
- NASA MODIS Rapidfire Browse / Subsets
- EPA AirNow / ParticlesNow / (KML) / AirNowTech
- NOAA IDEA (operational product)
- NOAA NESDIS GASP / GASP-West / GASPER (pw only)
- NOAA Air Quality Forecast Guidance
- KNMI OMI Tropospheric NO2
- NOAA Hazard Mapping System Fire and Smoke Product / Smoke Text
- USDA MODIS Active Fire Maps
- NOAA NWS KML/GIS Links

What is Google Earth?

- It is a “virtual globe” program that allows you to “fly anywhere on Earth to view satellite imagery, maps, terrain, and 3D buildings, from galaxies in outer space to the canyons of the ocean.”
- It requires files in kml (keyhole markup language) or kmz (zipped kml) format.
- It is becoming extremely popular – more and more datasets are becoming available for use in Google Earth!

Why is Google Earth Useful for Air Quality?

- Google Earth is free and easy to use!
- You can overlay data sets for more accurate interpretation.
- It gives geographic reference for data and images: see satellite images, AQIs, back/forward trajectories in reference to cities and state borders.
- Google Earth allows you to zoom in/out of your area of interest: you are no longer at the mercy of regional satellite subsets.
- It displays 3D datasets (*i.e.*, CALIPSO).

MODIS Terra True Color Image

AERONET_Fresno Subset, June 23, 2008

[MODIS Rapid Response http://rapidfire.sci.gsfc.nasa.gov/subsets/]

What Do You Need to Get Started?

- Download Google Earth: http://earth.google.com/
- Minimum System Requirements (PCs):
  - Operating System: Windows 2000, XP, or Vista
  - System Memory (RAM): 256 MB
  - Hard Disk: 400 MB free space
  - Network Speed: 128 Kbits/sec
  - Graphics Card: 3D-capable with 16 MB of VRAM
- Check with your IT department to make sure it is ok for you to download and use the free version of Google Earth at work.

Air Quality-Related NRT kml/kmz Files

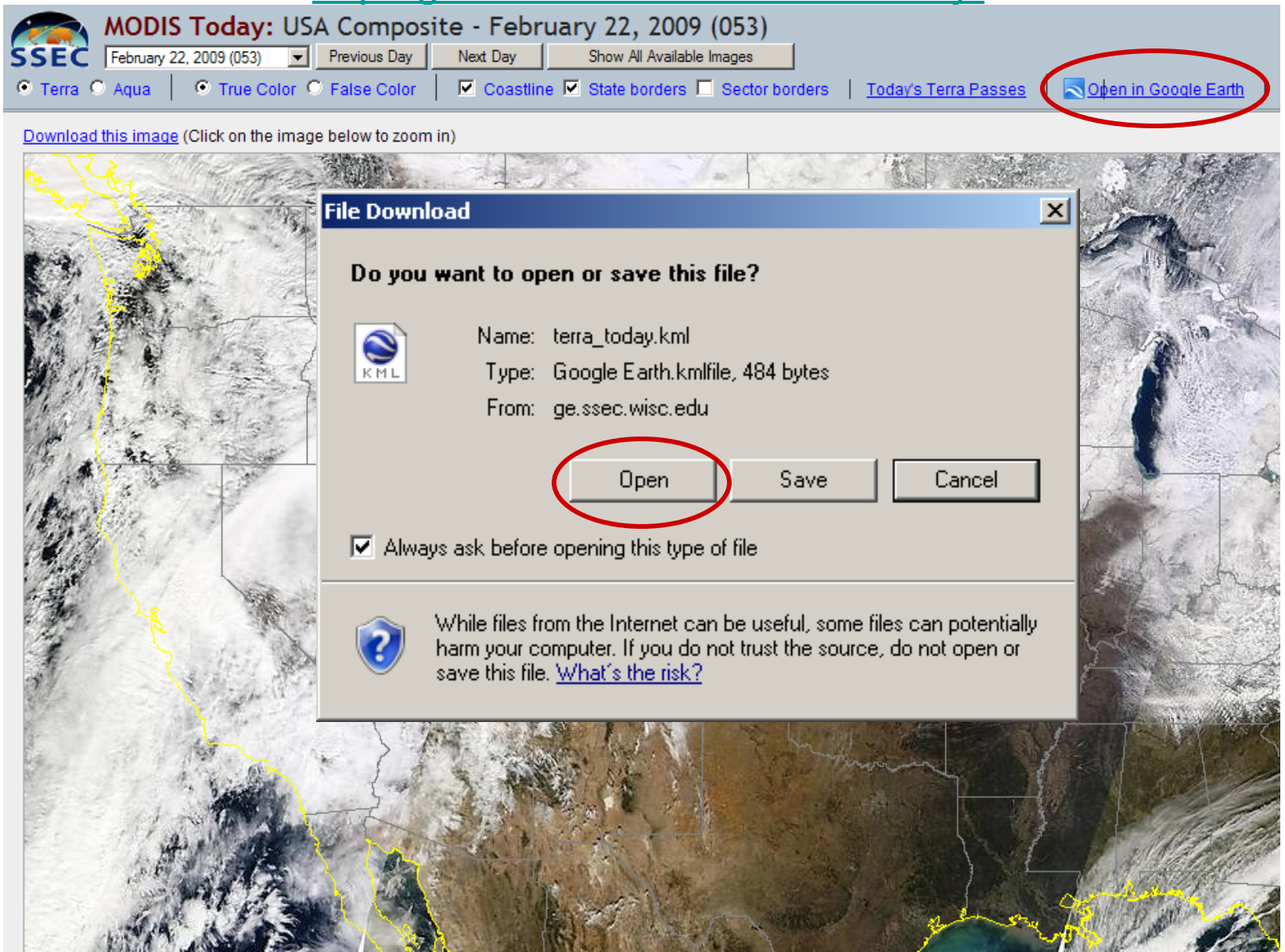
- MODIS true color images
- Current and Forecasted AQI Color Codes
- Current Fire Information
- OMI Tropospheric NO_2
- Backward and Forward Airmass Trajectories
- CALIPSO
- Meteorological Information (GOES, METARS)

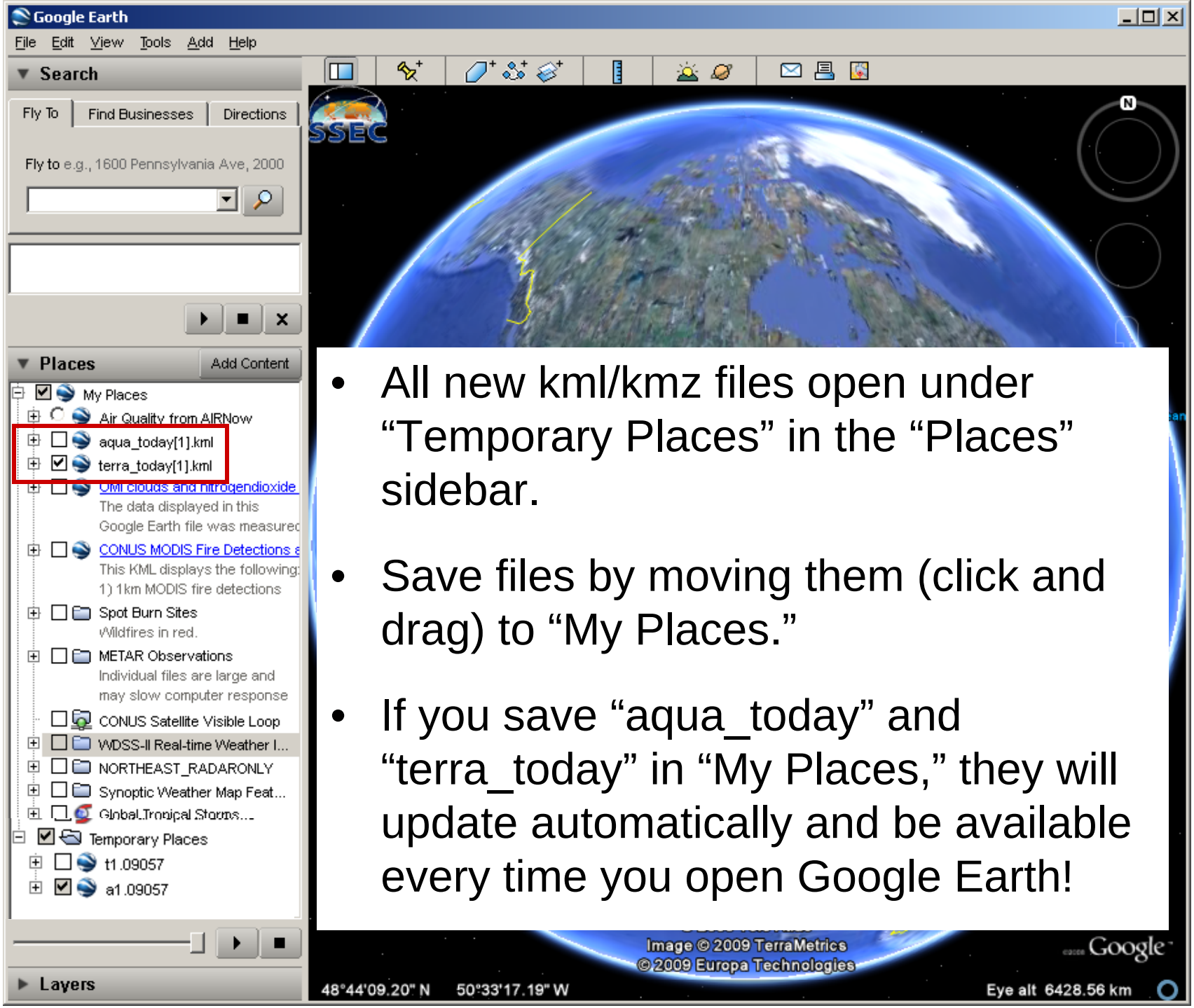
NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE

MODIS Today: USA Composite

Near Real-Time Terra and Aqua MODIS True Color Images for CONUS

http://ge.ssec.wisc.edu/modis-today/





- All new kml/kmz files open under “Temporary Places” in the “Places” sidebar.
- Save files by moving them (click and drag) to “My Places.”
- If you save “aqua_today” and “terra_today” in “My Places,” they will update automatically and be available every time you open Google Earth!

AQIs from AIRNow

Color-Coded Hourly AQI Values for USA

http://www.airnow.gov/index.cfm?action=google_earth.main

Local Forecasts & Conditions

National Overview
- Forecast
- Particles Now
- Ozone Now
- Action Days
- Archives
- International

AQI Summary

About AIRNow

Partners
- For Partners
- List of Partners

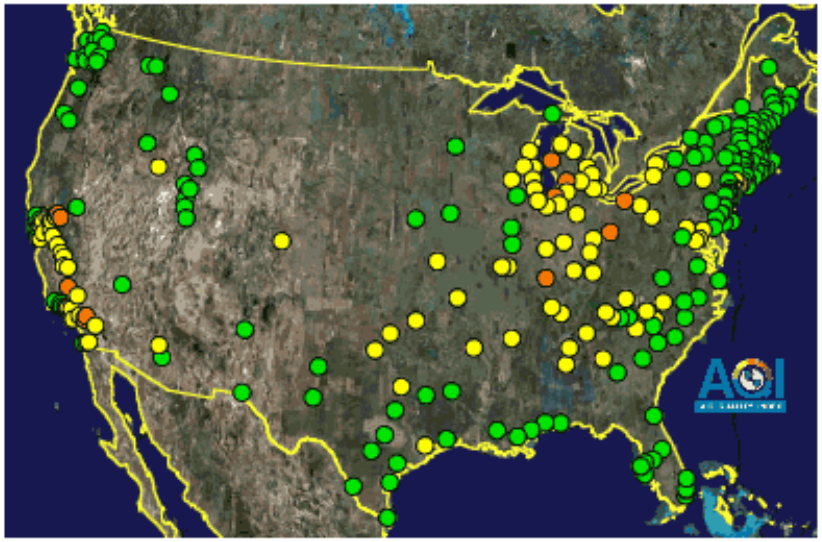
Air Quality Basics
- Air Quality Index
- Ozone
- Particle Pollution
- UV

The AQI for...
- Health Providers
- Kids
- Students
- Older Adults
- Teachers
- Weathercasters

Key Topics:
- Your Health
- Smoke from Fires

Air Quality Index (AQI) in Google Earth

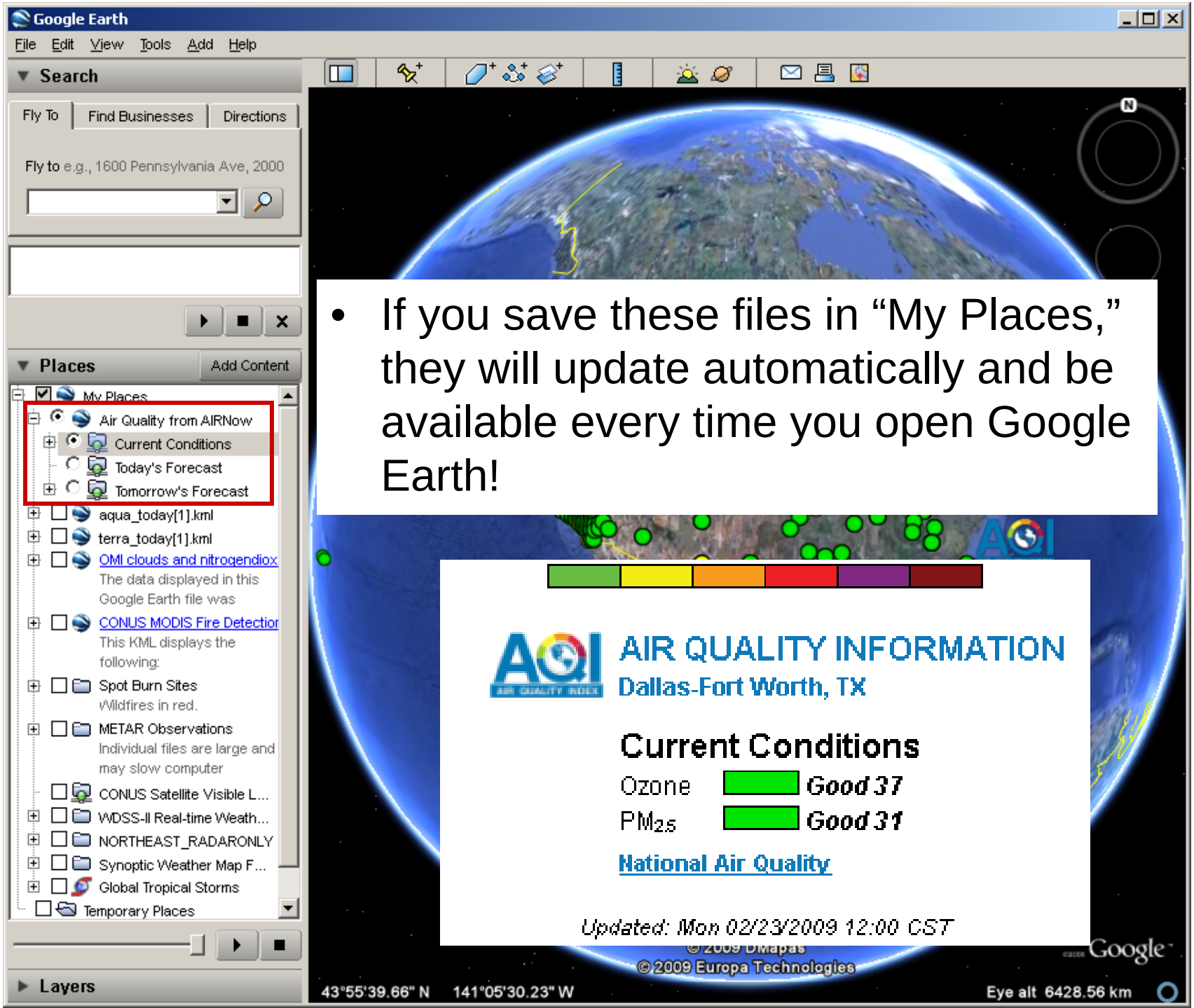
Air Quality Index (AQI) forecasts and current conditions are now available in Keyhole Markup Language (KML) format. This allows for AIRNow data to be displayed in 3D viewers such as Google Earth. Follow the instructions below to install and run the AIRNow KML files in Google Earth.



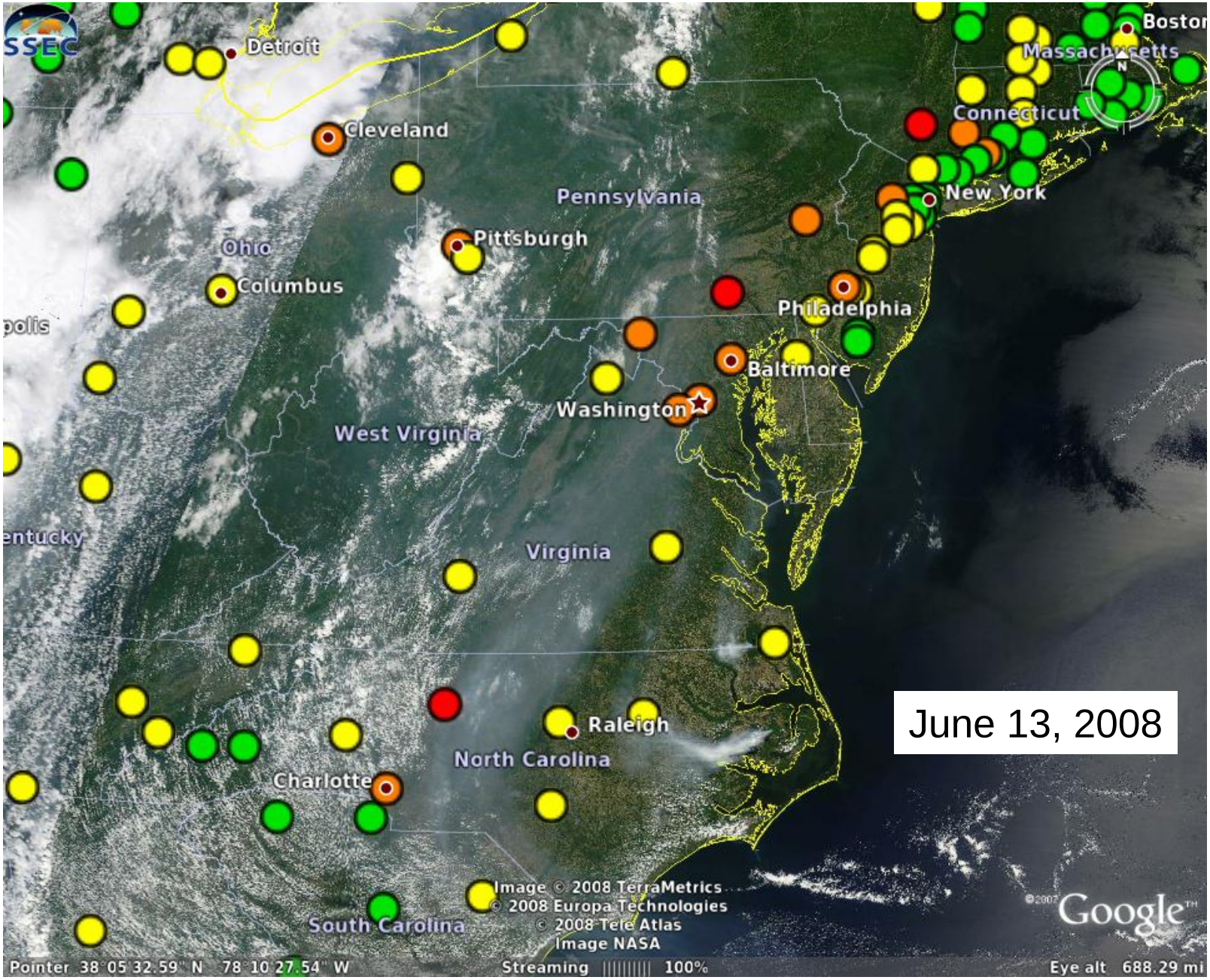
Example of AIRNow forecasts in Google Earth

Instructions for Google Earth:

1. If you already have the Google Earth software installed, simply click here to download the AIRNow KML files.
2. Depending on how your software is configured, clicking the link will either download the files to your computer or automatically launch Google Earth with the AIRNow data in the program.
3. If you do not have Google Earth installed, you can download it free from Google on the following website: http://earth.google.com/. Once installed, follow steps 1 and 2 above.


Google Earth
File Edit View Tools Add Help
Search
Fly To
Find Businesses
Directions
Fly to e.g., 1600 Pennsylvania Ave, 2000
Places
Add Content
My Places
Air Quality from AIRNow
Current Conditions
Today's Forecast
Tomorrow's Forecast
aqua_today[1].kml
terra_today[1].kml
OMI clouds and nitrogendiox
The data displayed in this Google Earth file was
CONUS MODIS Fire Detectior
This KML displays the following:
Spot Burn Sites
Wildfires in red.
METAR Observations
Individual files are large and may slow computer
CONUS Satellite Visible L...
WDSS-II Real-time Weath...
NORTHEAST_RADARONLY
Synoptic Weather Map F...
Global Tropical Storms
Temporary Places
Layers
• If you save these files in “My Places,” they will update automatically and be available every time you open Google Earth!
AIR QUALITY INFORMATION
Dallas-Fort Worth, TX
Current Conditions
Ozone Good 37
PM2.5 Good 31
National Air Quality
Updated: Mon 02/23/2009 12:00 CST
© 2009 DMapas
© 2009 Europa Technologies
Google
43°55'39.66" N 141°05'30.23" W
Eye alt 6428.56 km

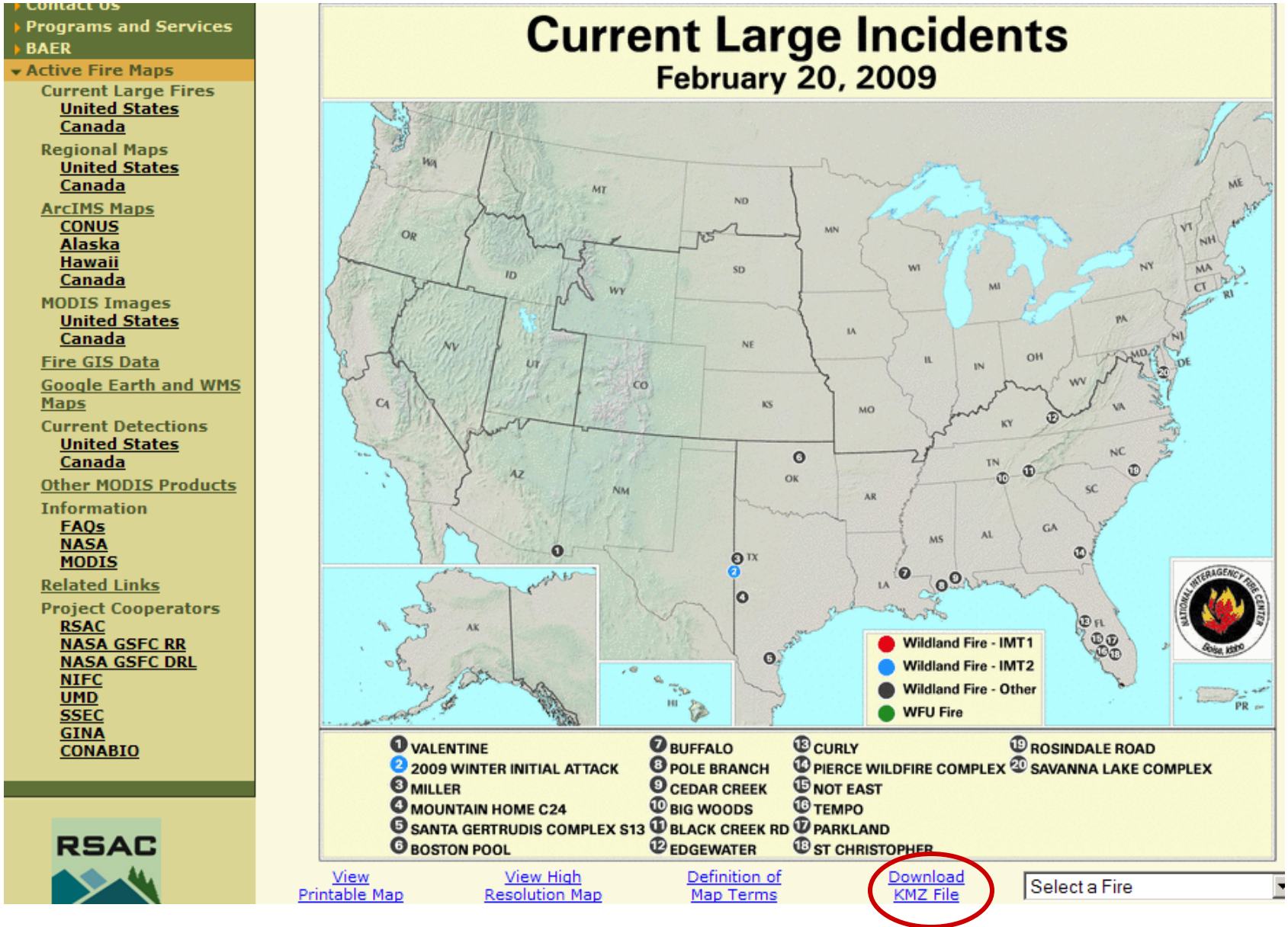
MODIS Terra True Color and AQIs: Regional View



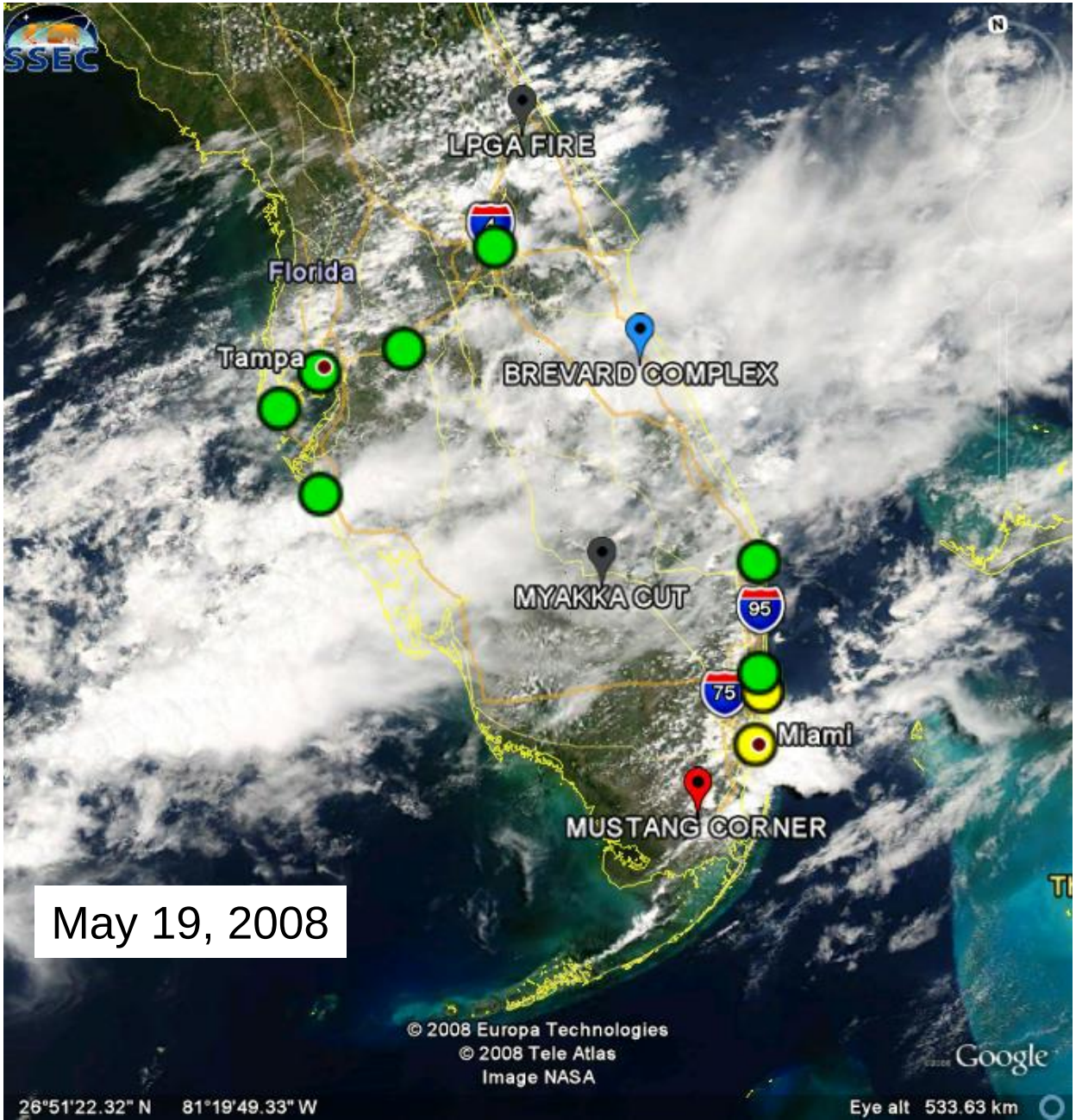
MODIS Active Fire Mapping Program

Fire Information from MODIS Complied by USDA

http://activefiremaps.fs.fed.us/



MODIS Terra True Color, AQIs, Major Fires



NOAA Hazard Mapping System Fire and Smoke Product

Fire Information from MODIS and GOES, Complied by NOAA

http://www.ssd.noaa.gov/PS/FIRE/hms.html

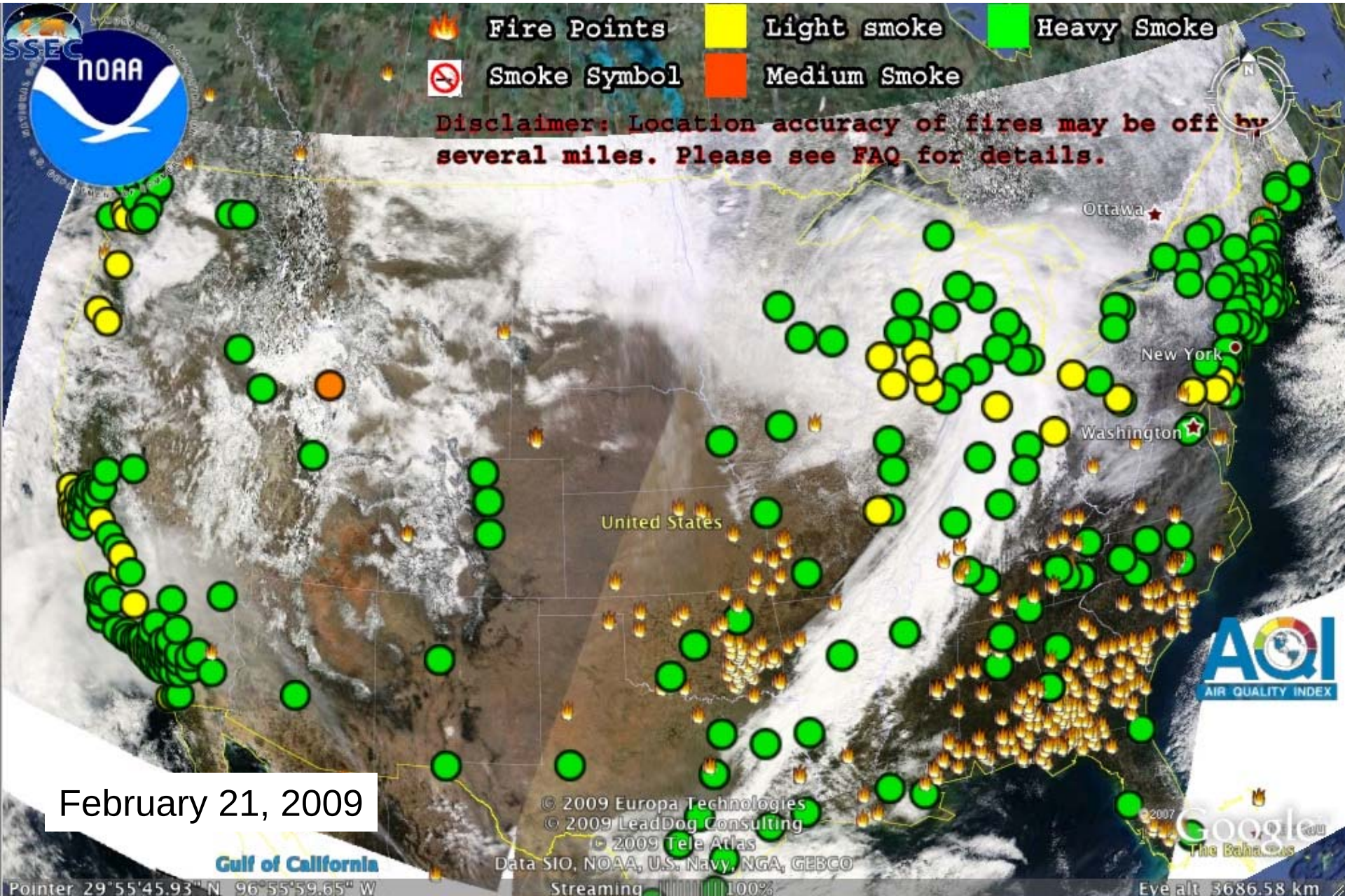
HMS Keyhole Markup Language (KML) Files

Last Update Thu Feb 26 15:17:07 UTC 2009

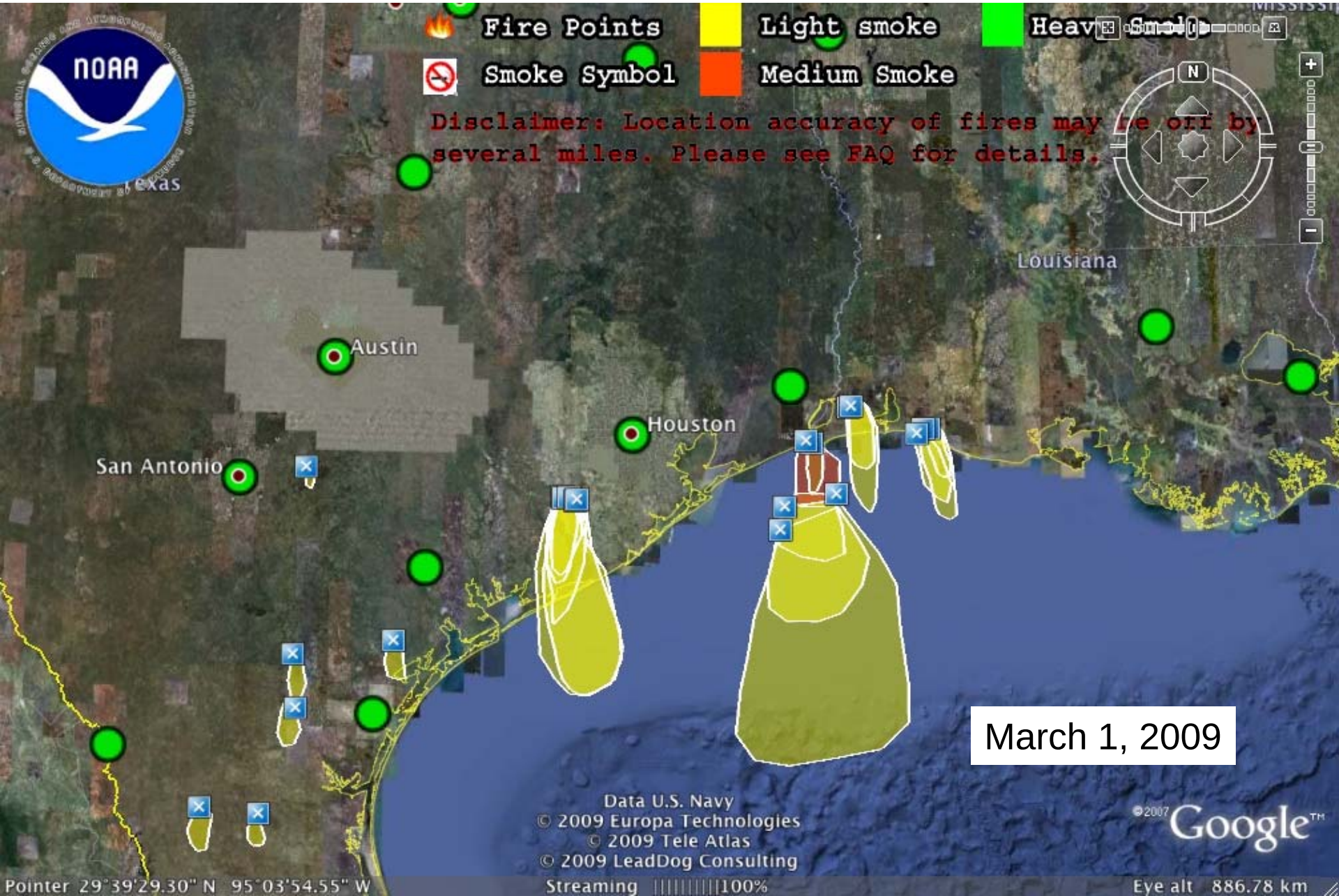
Most Recent HMS KML Files:

26 Feb 2009 -- FIRE SMOKE
25 Feb 2009 -- FIRE SMOKE
24 Feb 2009 -- FIRE SMOKE
23 Feb 2009 -- FIRE SMOKE
22 Feb 2009 -- FIRE SMOKE
21 Feb 2009 -- FIRE SMOKE
20 Feb 2009 -- FIRE SMOKE
19 Feb 2009 -- FIRE SMOKE
18 Feb 2009 -- FIRE SMOKE
17 Feb 2009 -- FIRE SMOKE
16 Feb 2009 -- FIRE SMOKE
15 Feb 2009 -- FIRE SMOKE
14 Feb 2009 -- FIRE SMOKE
13 Feb 2009 -- FIRE SMOKE
12 Feb 2009 -- FIRE SMOKE
11 Feb 2009 -- FIRE SMOKE
10 Feb 2009 -- FIRE SMOKE
09 Feb 2009 -- FIRE SMOKE
08 Feb 2009 -- FIRE SMOKE
07 Feb 2009 -- FIRE SMOKE
06 Feb 2009 -- FIRE SMOKE
05 Feb 2009 -- FIRE SMOKE

MODIS Aqua True Color, AQIs, HMS Fire Data



AQIs and HMS Smoke Plumes



OMI Tropospheric NO_2

Global Near Real-Time OMI NO_2 Tropospheric Column from KNMI

http://www.temis.nl/airpollution/no2col/no2regioomi_col3.php

Regional Tropospheric NO2 columns from OMI

TEMIS

Tropospheric NO2

NO2 observation for:

Region: World
Year: 2009
Month: February
Day: 19

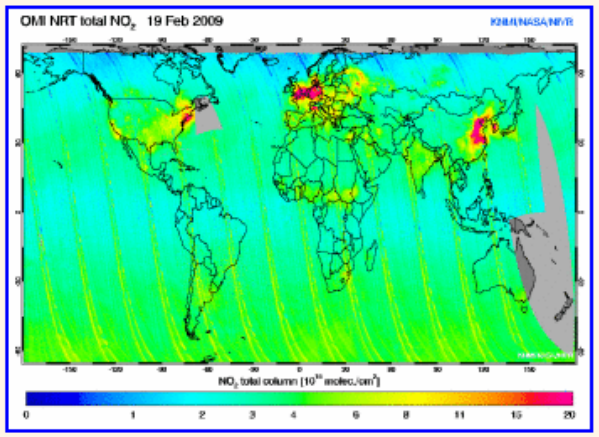
submit

Info on data anomalies

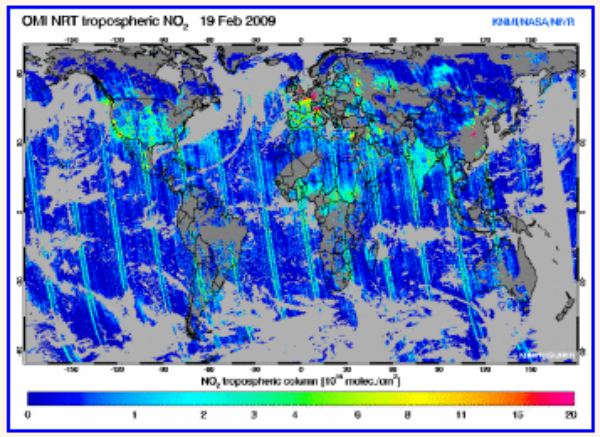
<-- previous day
<-- previous month

next day -->
next month -->

Regional NO2 of 19 February 2009



Total column



Tropospheric column

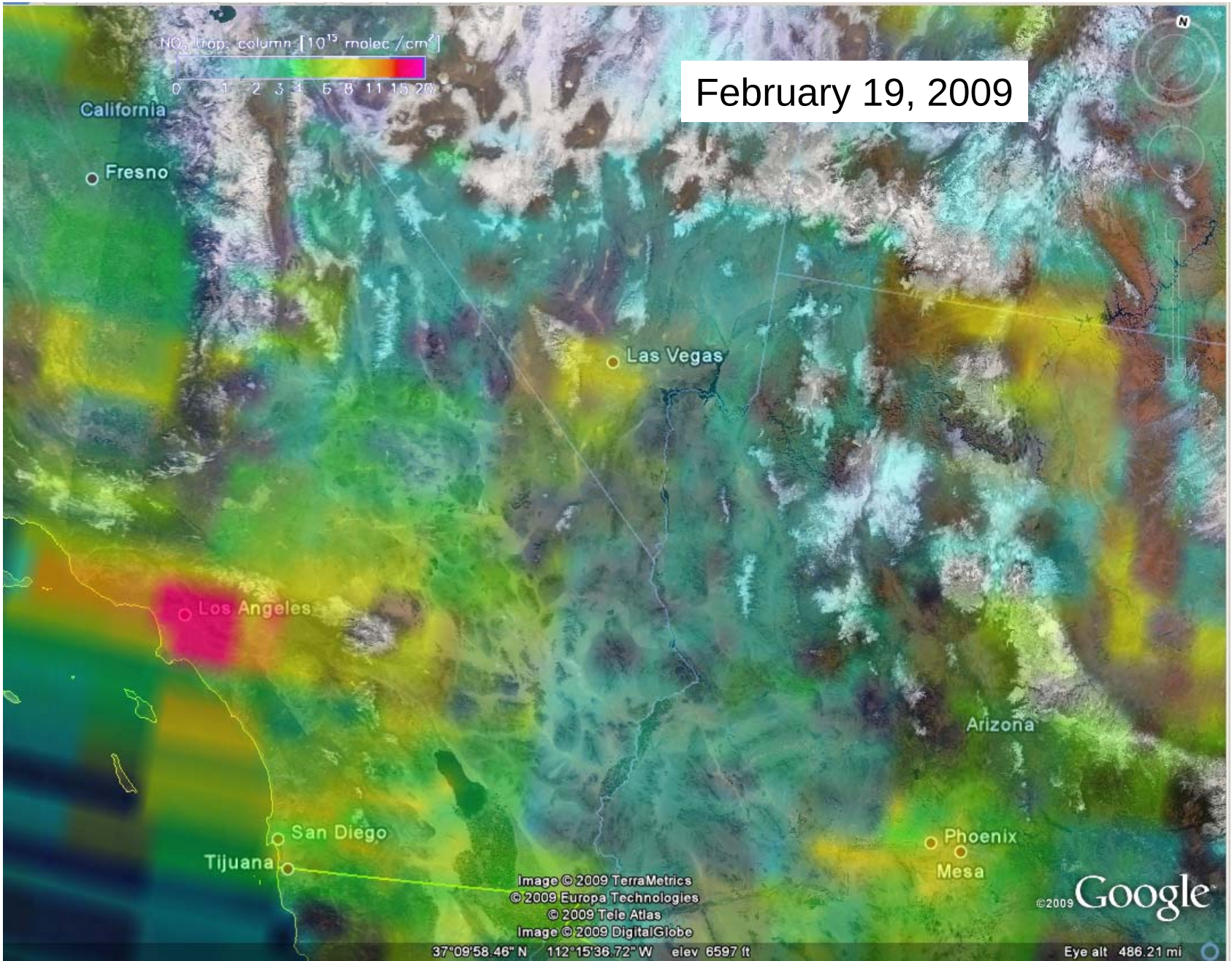
NO2 data file

Profile data is not available

Data file archive

Image in Google Earth

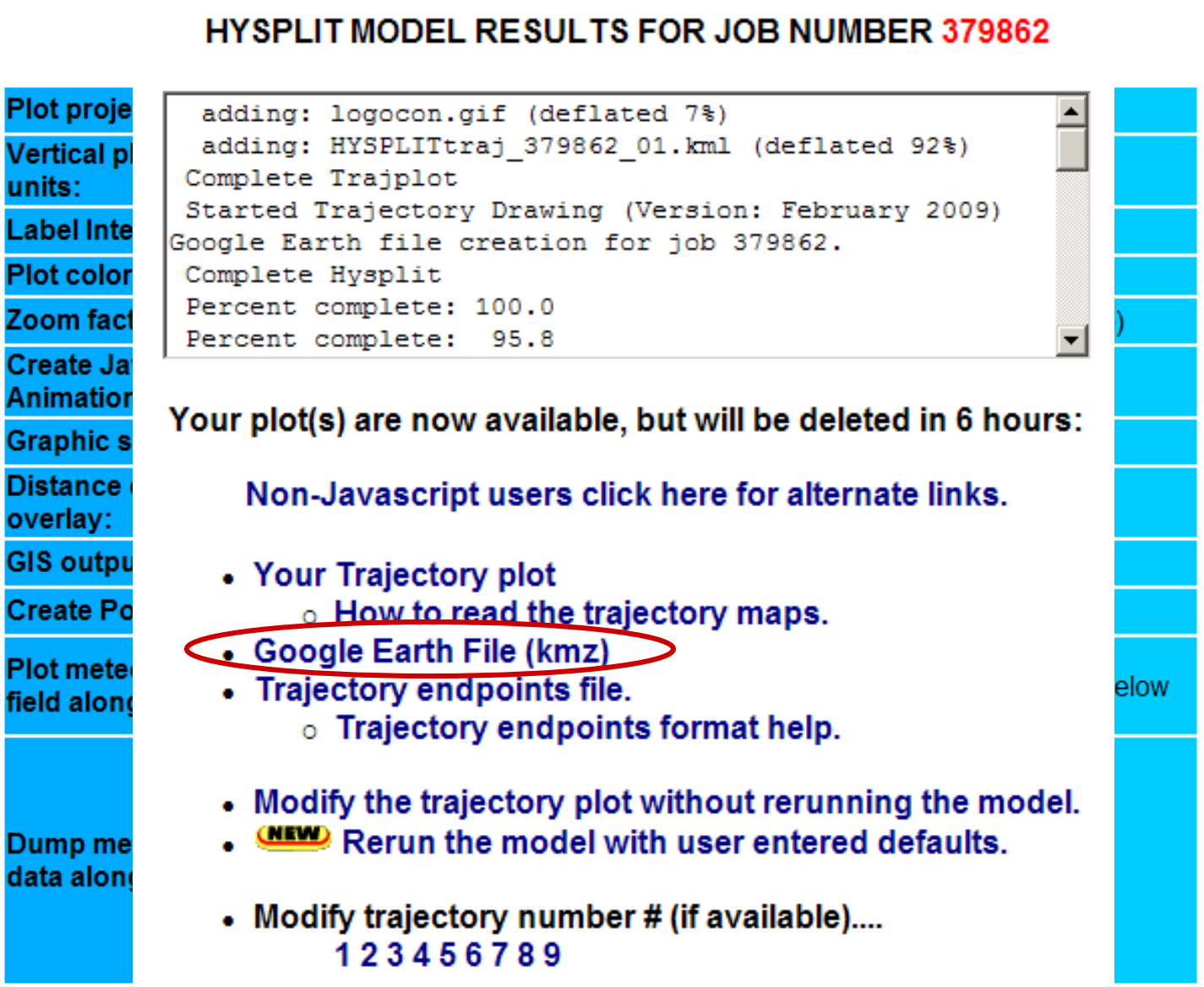
MODIS Aqua True Color and OMI Tropospheric NO_2



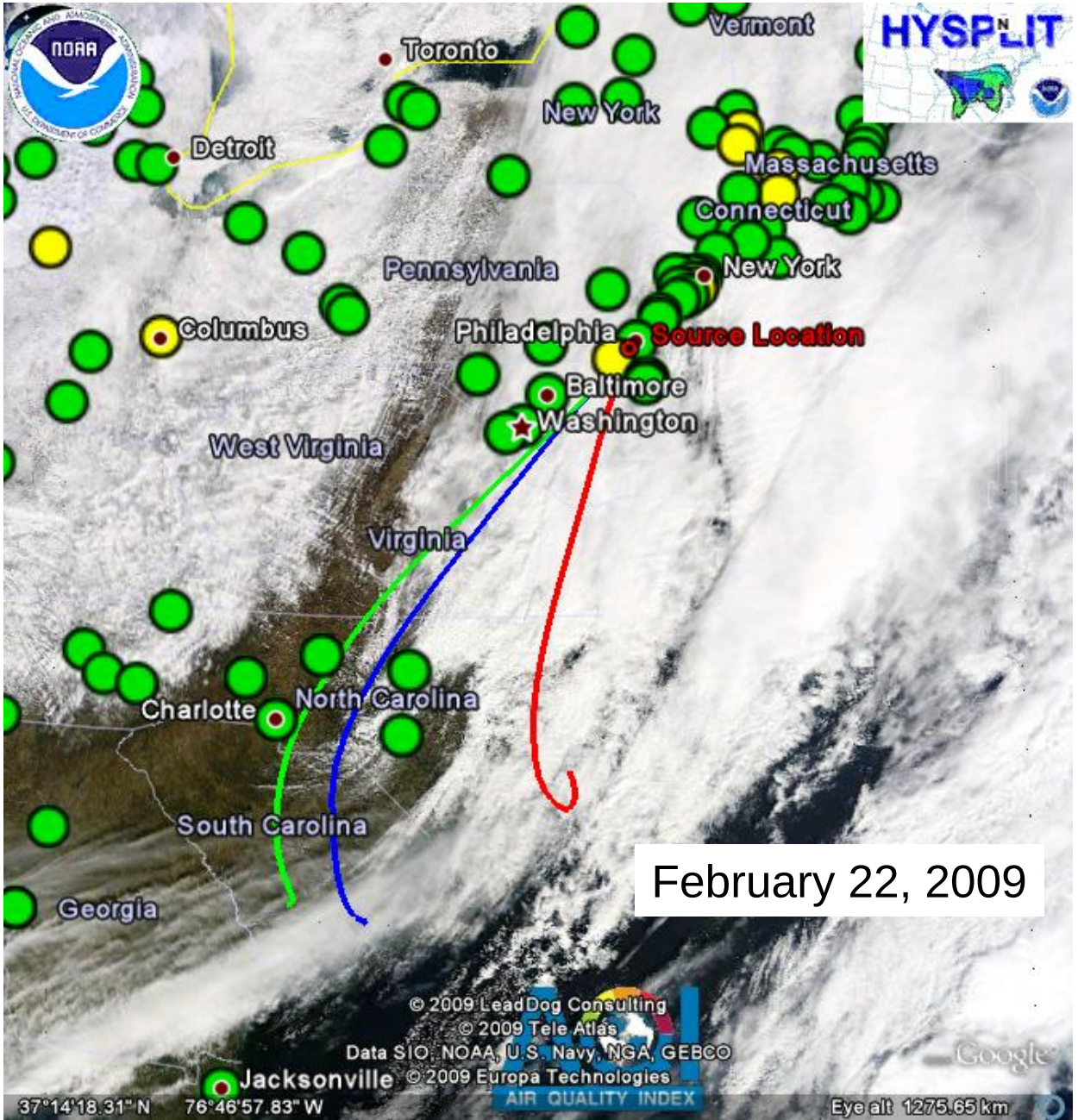
HYSPLIT Airmass Trajectory Analysis

Forward and Backward Trajectories from the HYSPLIT Model

http://www.ready.noaa.gov/ready/hysplit4.html



MODIS Terra True Color, AQIs, HYSPLIT

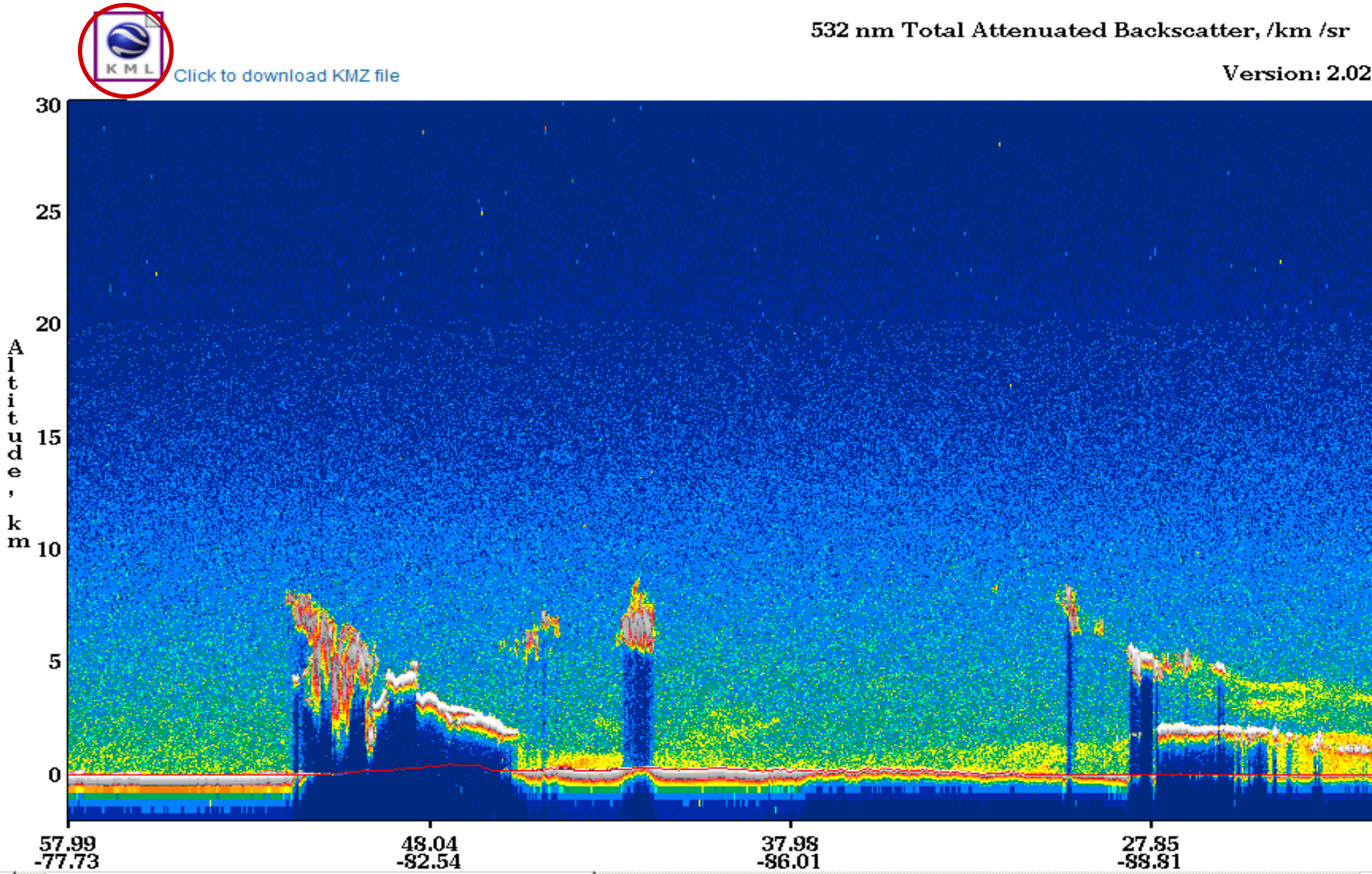


CALIPSO Expedited Browse Images

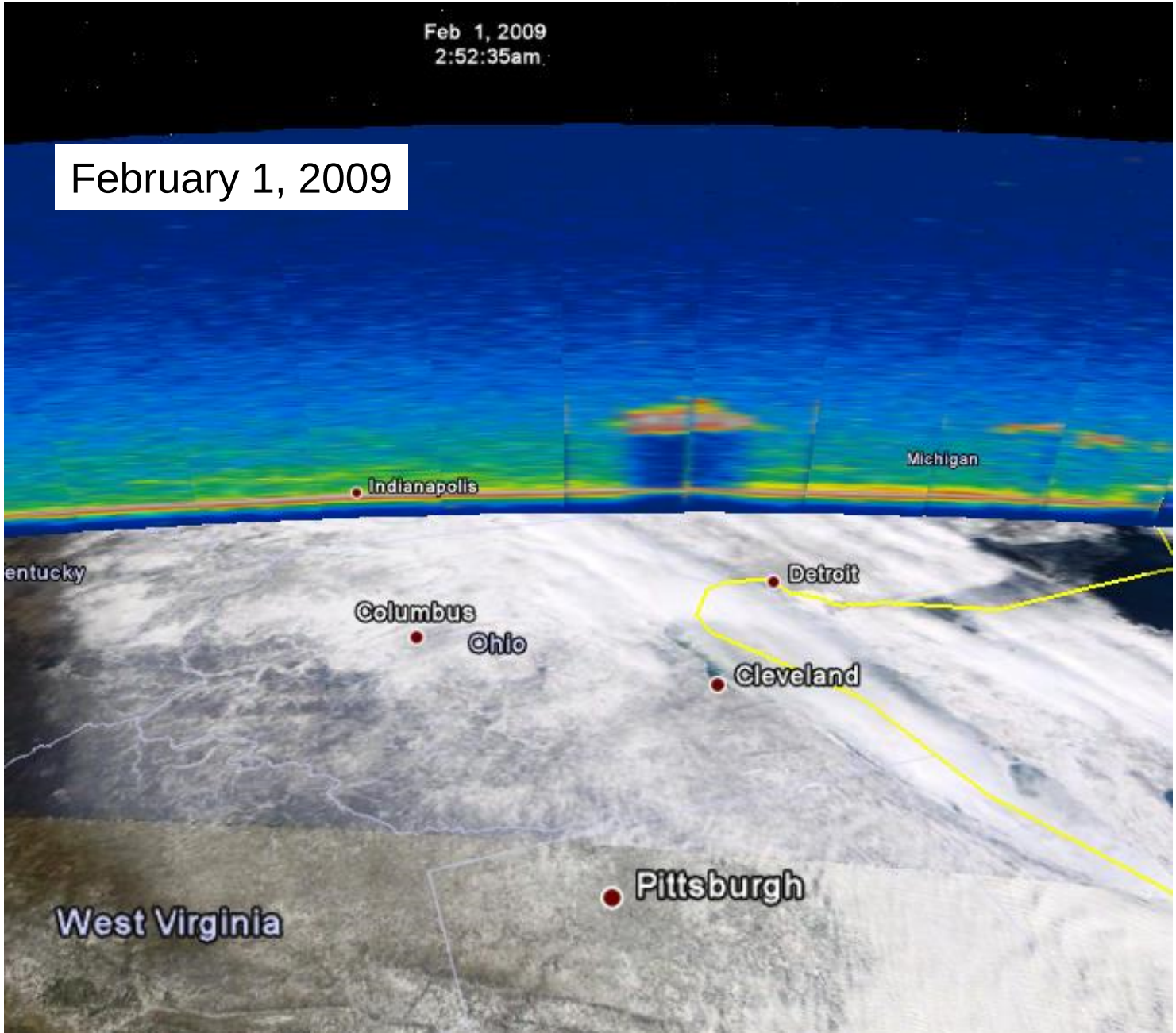
Vertical Profiles of Particulate Backscatter from the CALIPSO Satellite

http://www-calipso.larc.nasa.gov/products/lidar/browse_images/show_calendar.php

Click to download KMZ file



MODIS Terra True Color and CALIPSO



National Weather Service Data

Current, Past, Fire, and Forecasted Weather Files from NWS

http://www.srh.noaa.gov/gis/kml/

Current Weather

Watches & Warnings
Current Weather Warnings
Flash Flooding - Basins and Streams

Doppler Radar
Real Time Radar
Radar Locations

Surface Observations
Metar Obs
RAWS Obs
APRSWXNET Obs
MesoWest Obs
Other Surface Obs

Satellite
Infrared | Loop
Visible | Loop
Water Vapor | Loop

Remote Gages
River Gages: Observed
Snow Gages: w/ labels | w/o labels

Great Lakes
Wave Height
Ice
Water Temperature

Surface Fronts
Past and Present Synoptic Features

Forecasts

Your Local Weather Forecast

Your Local Weather Graphical Forecast

MOS Guidance

GFS Meteograms

GOES Sounding Skew-T

Tulsa area: Max | Min | POP

River Gage Forecasts

Past Weather

Doppler Radar
NWS Radar archive data

Normals, Means, Extremes
NCDC Climate Atlas of the United States
NCDC GIS Portal

Severe Weather
Storm Reports: Tornado, Wind and Hail
1950-2006 Database of Tornado, Large Hail, and Damaging Wind Reports

Rain/Snowfall
CoCoRaHS Observations
NOHRSC Snow Data

Hurricanes
Past Atlantic Storm Tracks
Past East Pacific Storm Tracks

Fire Weather

Current Spot Forecast Sites

Fire Weather Categorized Observations

MODIS fires

IMET Locations

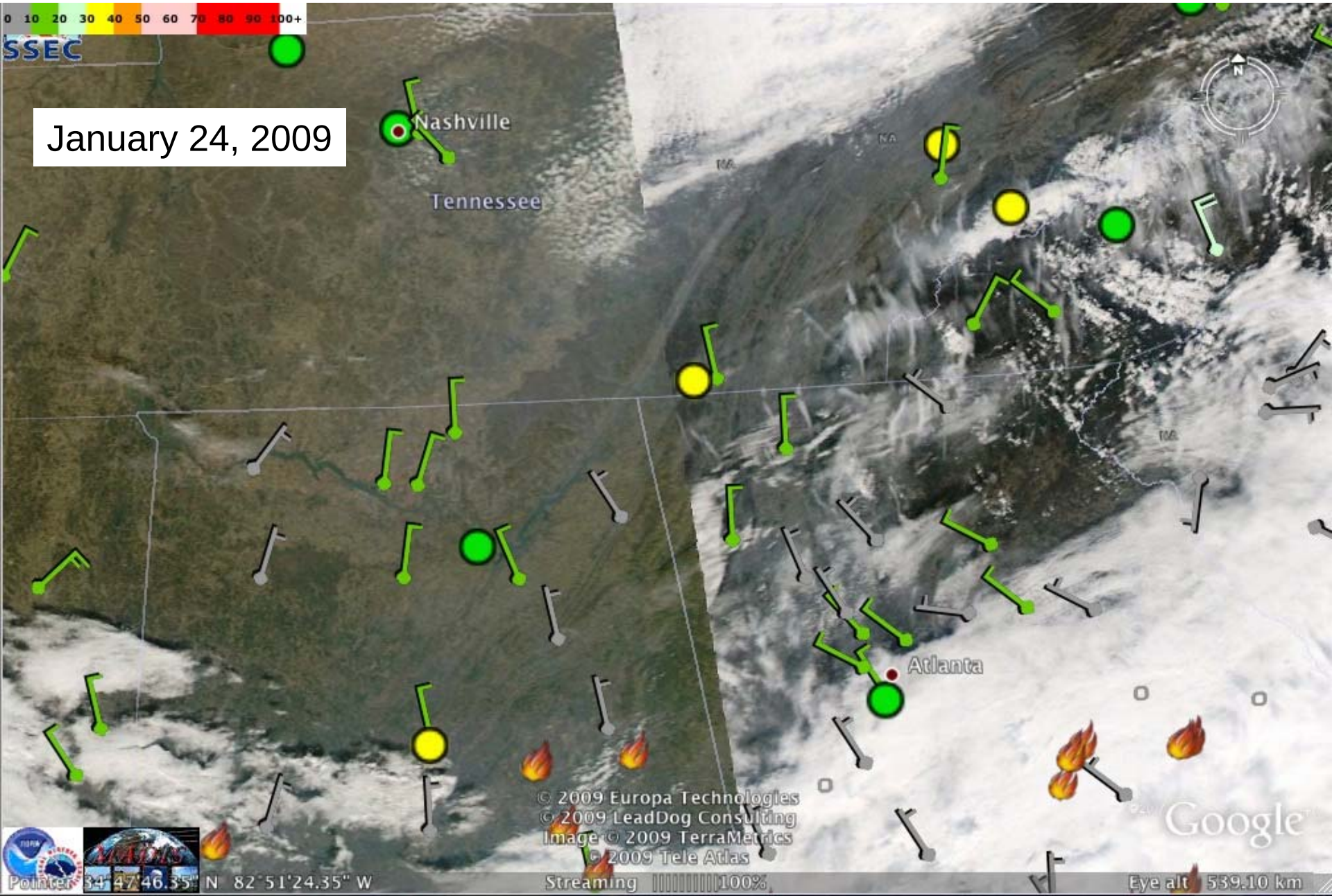
Not working

Additional Info

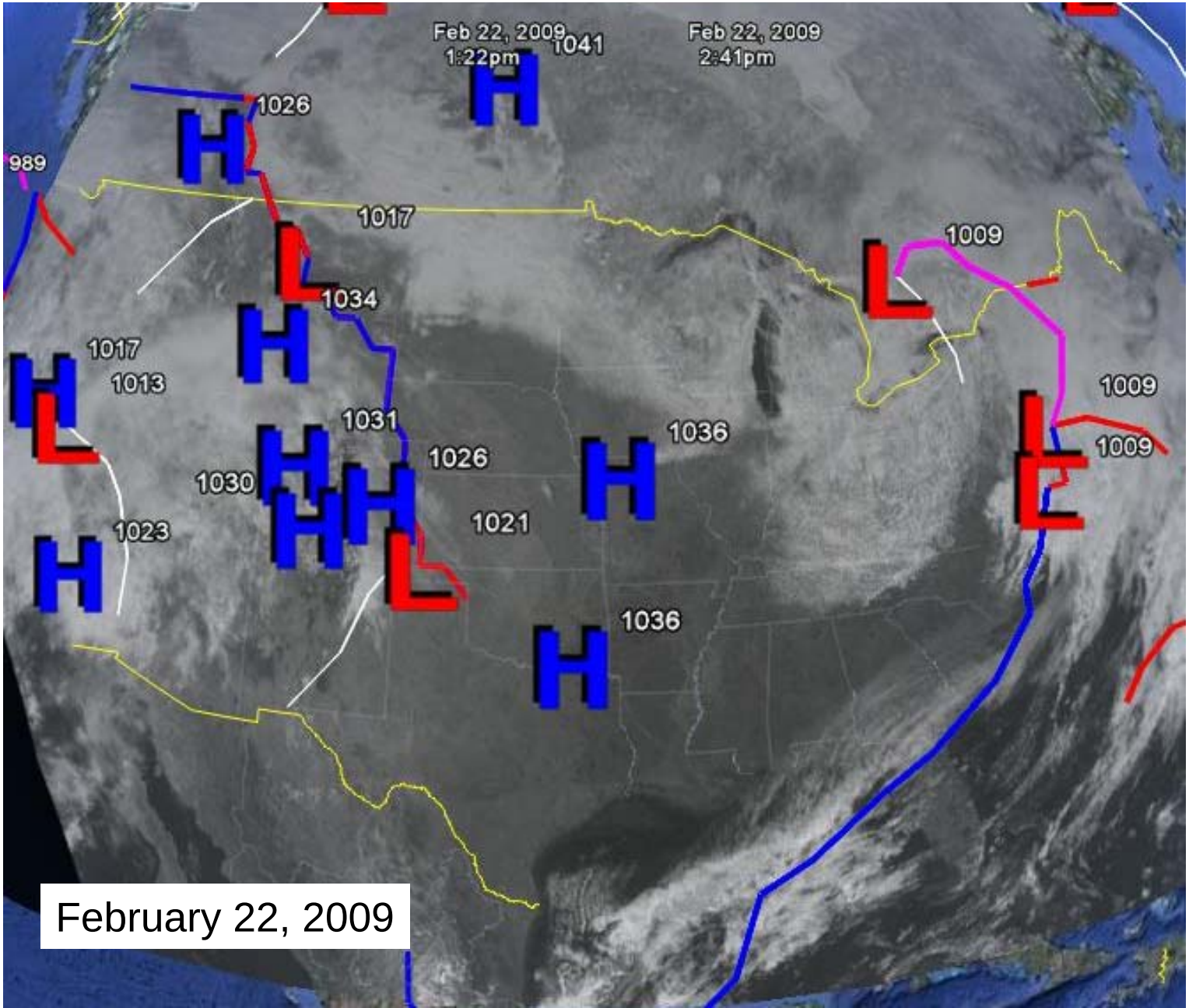
Coastal Estuarine Bathymetry

nowCOAST web mapping portal

MODIS Terra True Color, AQIs, Fires, METAR Winds



Visible Satellite Imagery and Synoptic Analysis



Near Real-Time AOD Files for Google Earth

- Currently, there are no near real-time AOD files available for Google Earth.
- 3D-AQS and NASA are working on it, and we hope to have a link from IDEA soon for AOD kmz files.
- AOD kmz files are available from Giovanni for *retrospective* analysis.

Take Home Messages

- Google Earth is free and easy to use, which is good for air quality forecasters and analysts!
- It's "one-stop shopping" for visualization of many useful air quality-related datasets – just open Google Earth, and the most current images are automatically available.
- There are A LOT of data sets available in Google Earth format – more and more everyday – keep an eye open for them!
- Google Earth is the "future" of visualization – it's not going away anytime soon.

NYTimes: "Google Earth Fills Its Watery Gaps," February 3, 2009
http://www.nytimes.com/2009/02/03/science/earth/03oceans.html?ref=science

Acknowledgements

- Ray Hoff, Ana Prados, and the 3D-AQS team
- Shobha Kondragunta, Hai Zhang, and NOAA NESDIS
- Jim Szykman and the RSIG team
- NASA Applied Sciences

3D-AQS

Three Dimensional Air Quality System

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

UNITED STATES DEPARTMENT OF COMMERCE