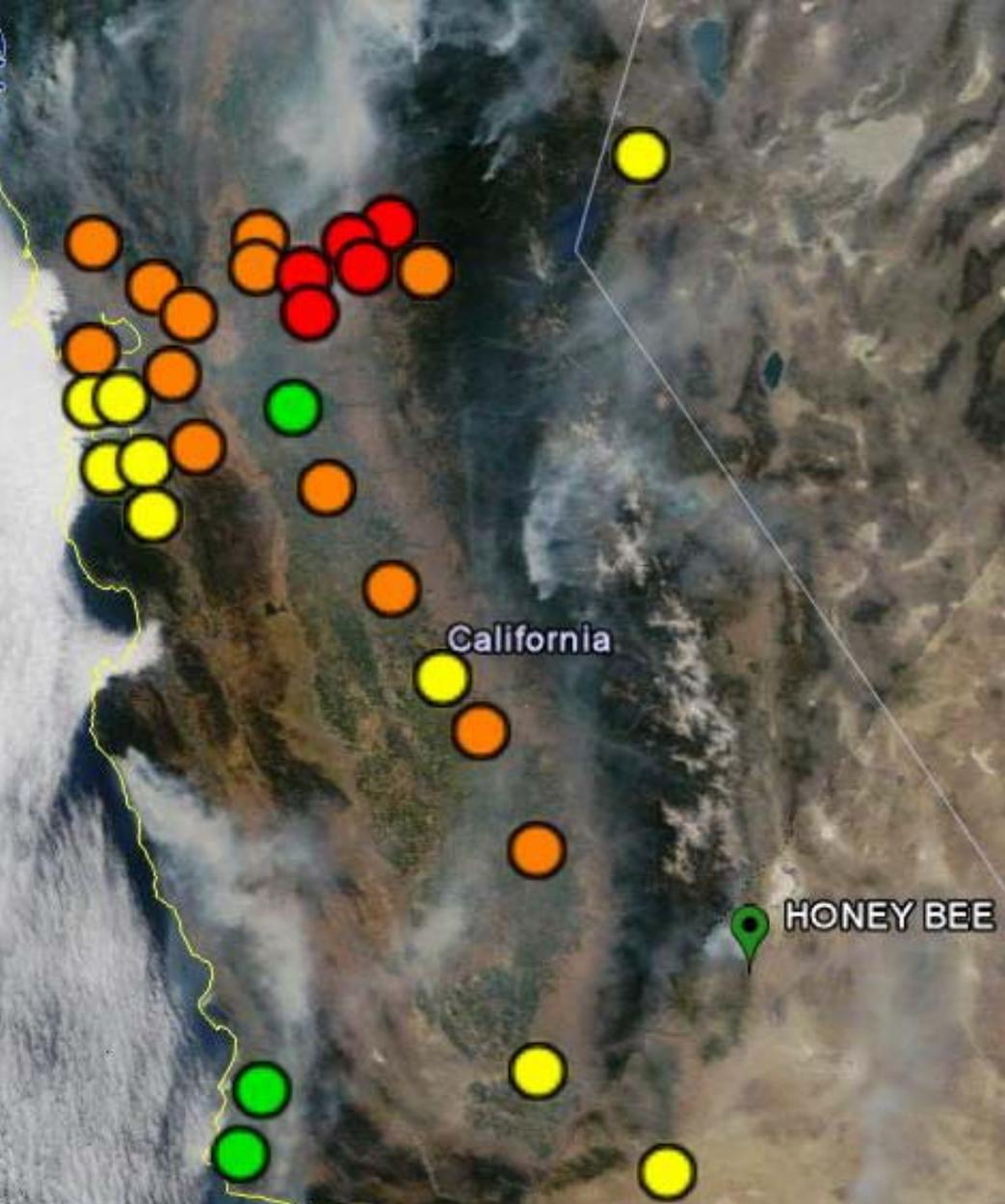


Visualizing Near Real-Time Satellite, Air Quality, and Meteorological Data Sets in Google Earth for Air Quality Forecasting

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Battelle Memorial Institute
huffa@battelle.org



Terra MODIS True Color, AQIs
and Major Fires in Google Earth
June 23, 2008

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 a Good Choice for Forecasters?

- 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).



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
- Satellite, air quality, and meteorological near real-time kml/kmz files!



MODIS Today: USA Composite

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

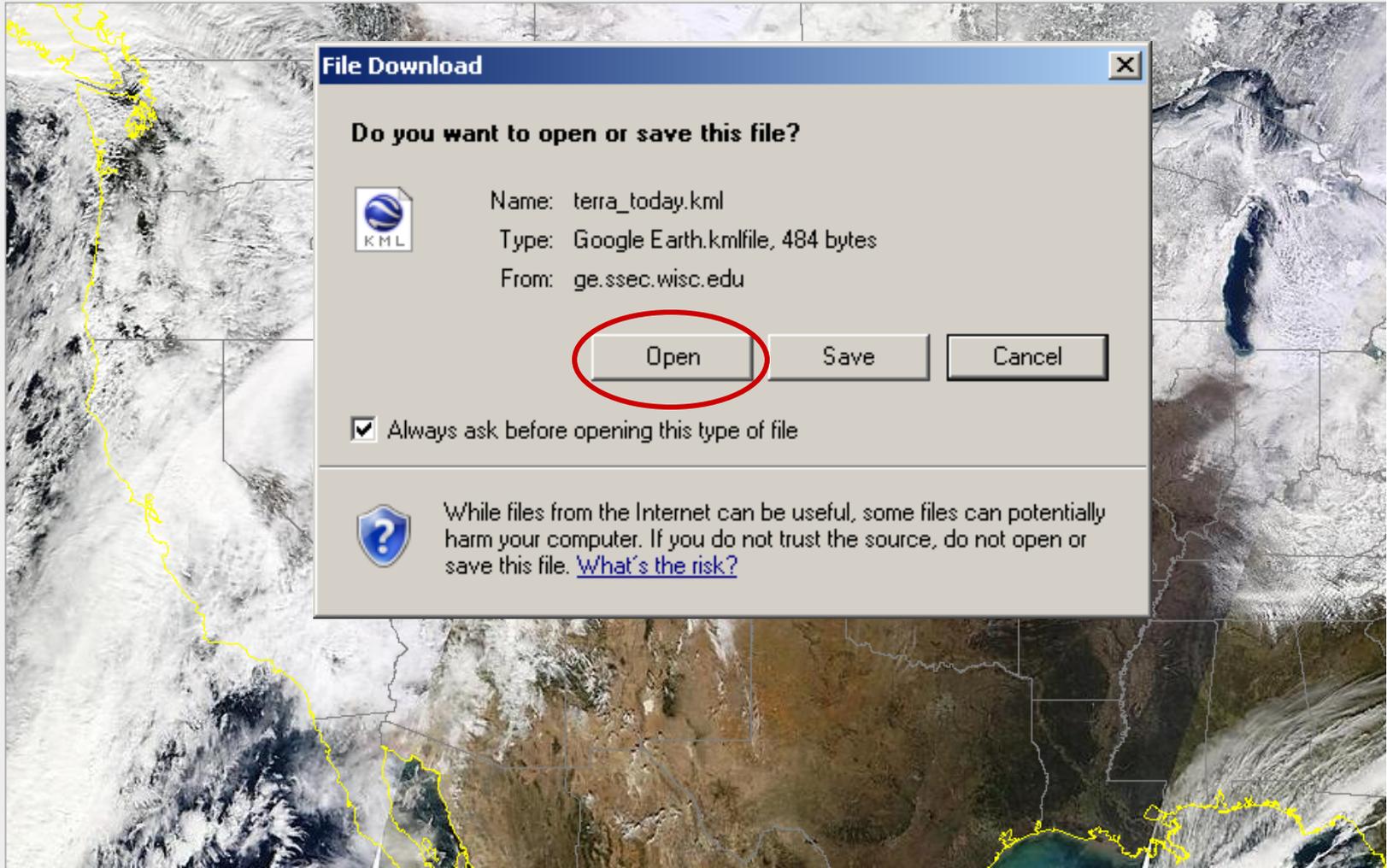
<http://ge.ssec.wisc.edu/modis-today/>

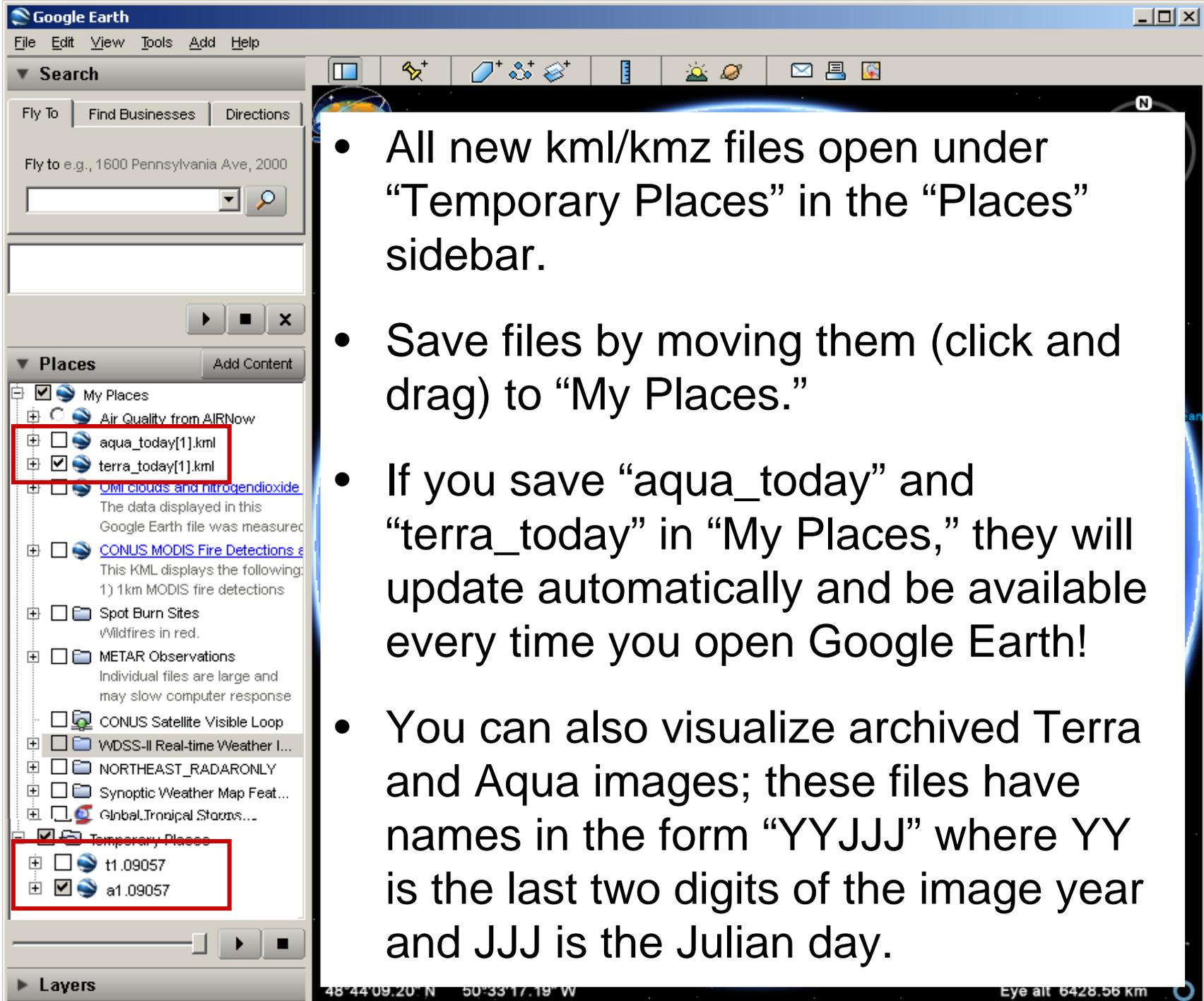
 **MODIS Today: USA Composite - February 22, 2009 (053)**

February 22, 2009 (053) Previous Day Next Day Show All Available Images

Terra Aqua True Color False Color Coastline State borders Sector borders | [Today's Terra Passes](#) [Open in Google Earth](#)

[Download this image](#) (Click on the image below to zoom in)





The screenshot shows the Google Earth interface. The 'Places' sidebar on the left is expanded to show 'My Places' and 'Temporary Places'. In 'My Places', two files are highlighted with a red box: 'aqua_today[1].kml' (unchecked) and 'terra_today[1].kml' (checked). In 'Temporary Places', two files are also highlighted with a red box: 't1.09057' (unchecked) and 'a1.09057' (checked). The main map area is mostly obscured by a large white text box containing a list of instructions.

- 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!
- You can also visualize archived Terra and Aqua images; these files have names in the form “YYJJJ” where YY is the last two digits of the image year and JJJ is the Julian day.

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...

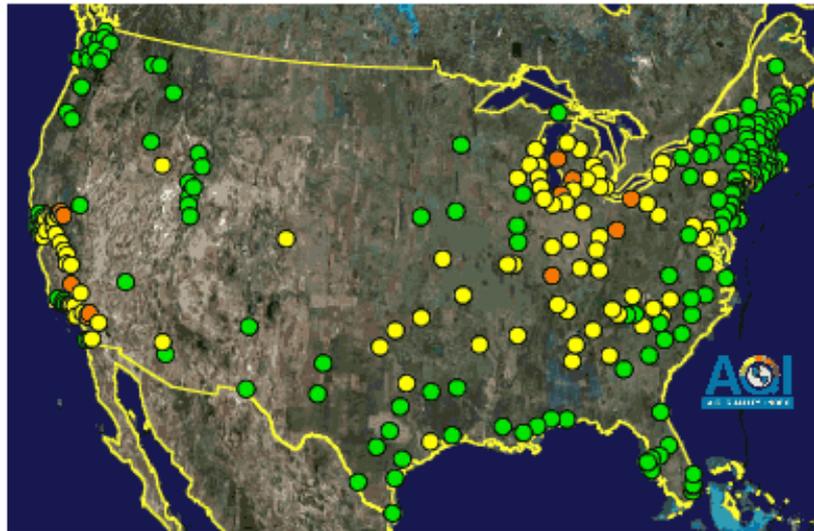
[Health Providers](#)
[Kids](#)
[Students](#)
[Older Adults](#)
[Teachers](#)
[Weathercasters](#)

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.

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
 - [Oml clouds and nitrogendiox](#)
The data displayed in this Google Earth file was
 - [CONUS MODIS Fire Detection](#)
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



• If you save these files in "My Places," they will update automatically and be available every time you open Google Earth!

AQI AIR QUALITY INFORMATION
Dallas-Fort Worth, TX

Current Conditions

Ozone ■ *Good 37*

PM_{2.5} ■ *Good 31*

[National Air Quality](#)

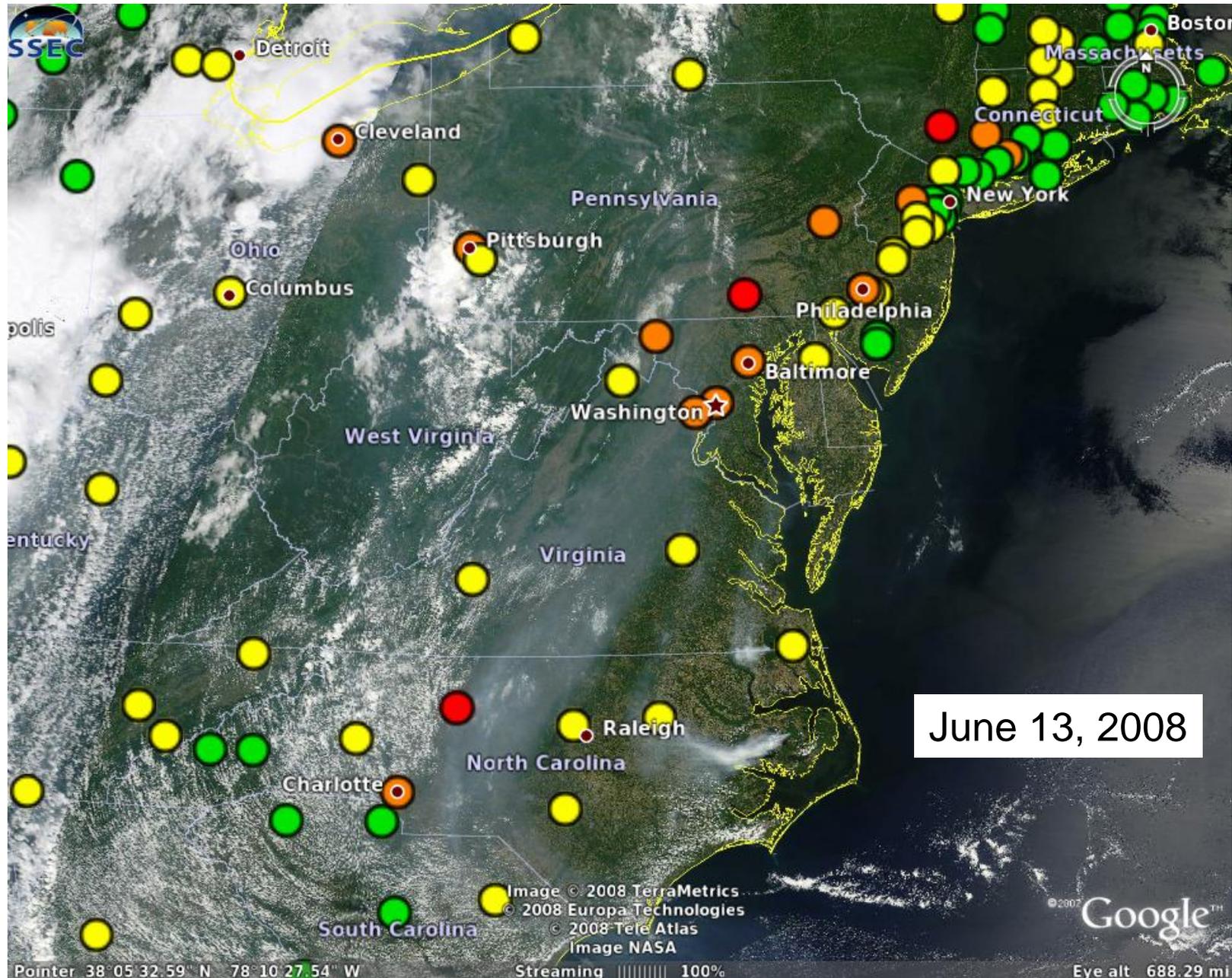
Updated: Mon 02/23/2009 12:00 CST

© 2009 DMapas
© 2009 Europa Technologies

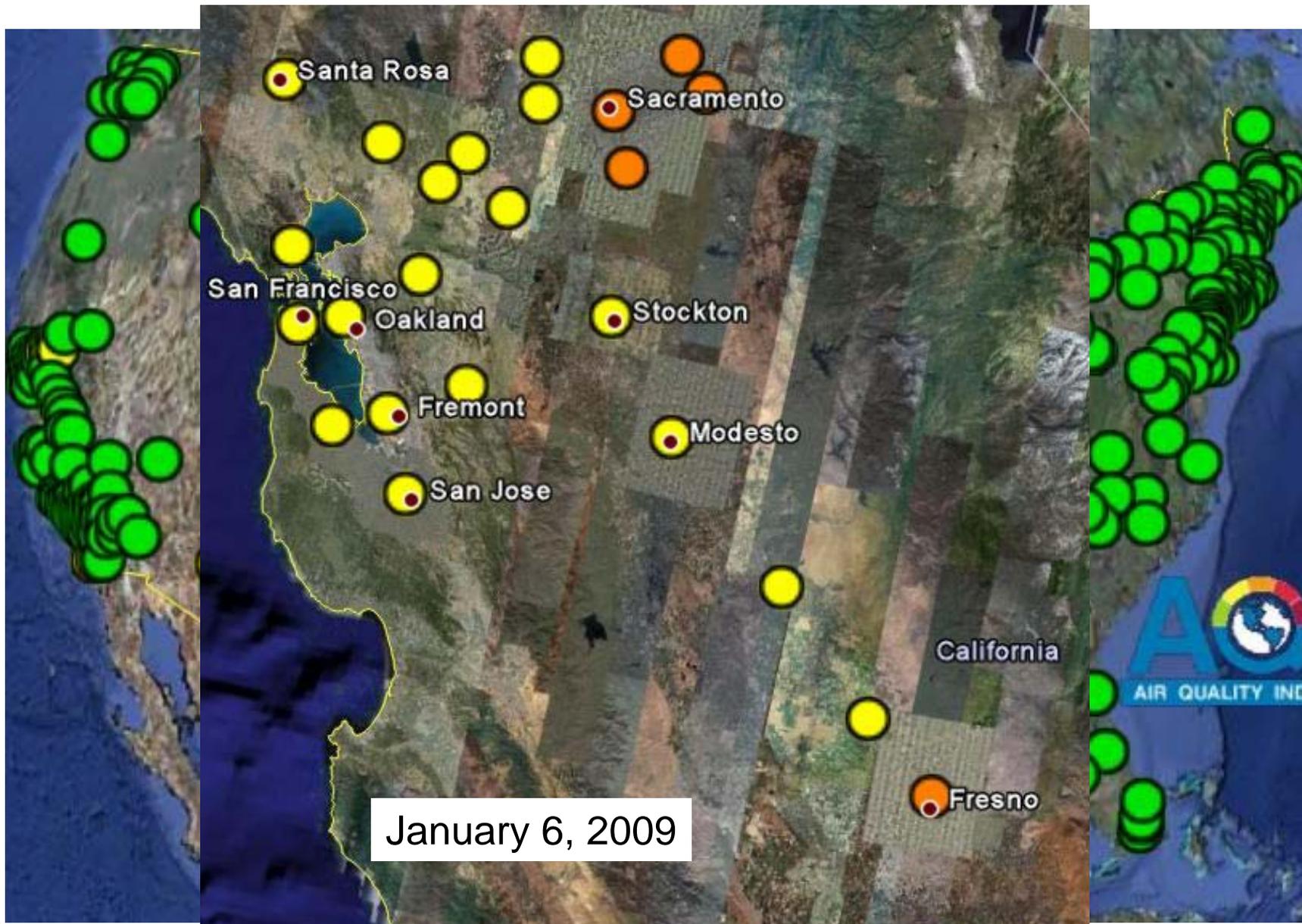
Google

43°55'39.66" N 141°05'30.23" W Eye alt 6428.56 km

MODIS Terra True Color and AQIs: Regional View



Tomorrow's AQI Forecast

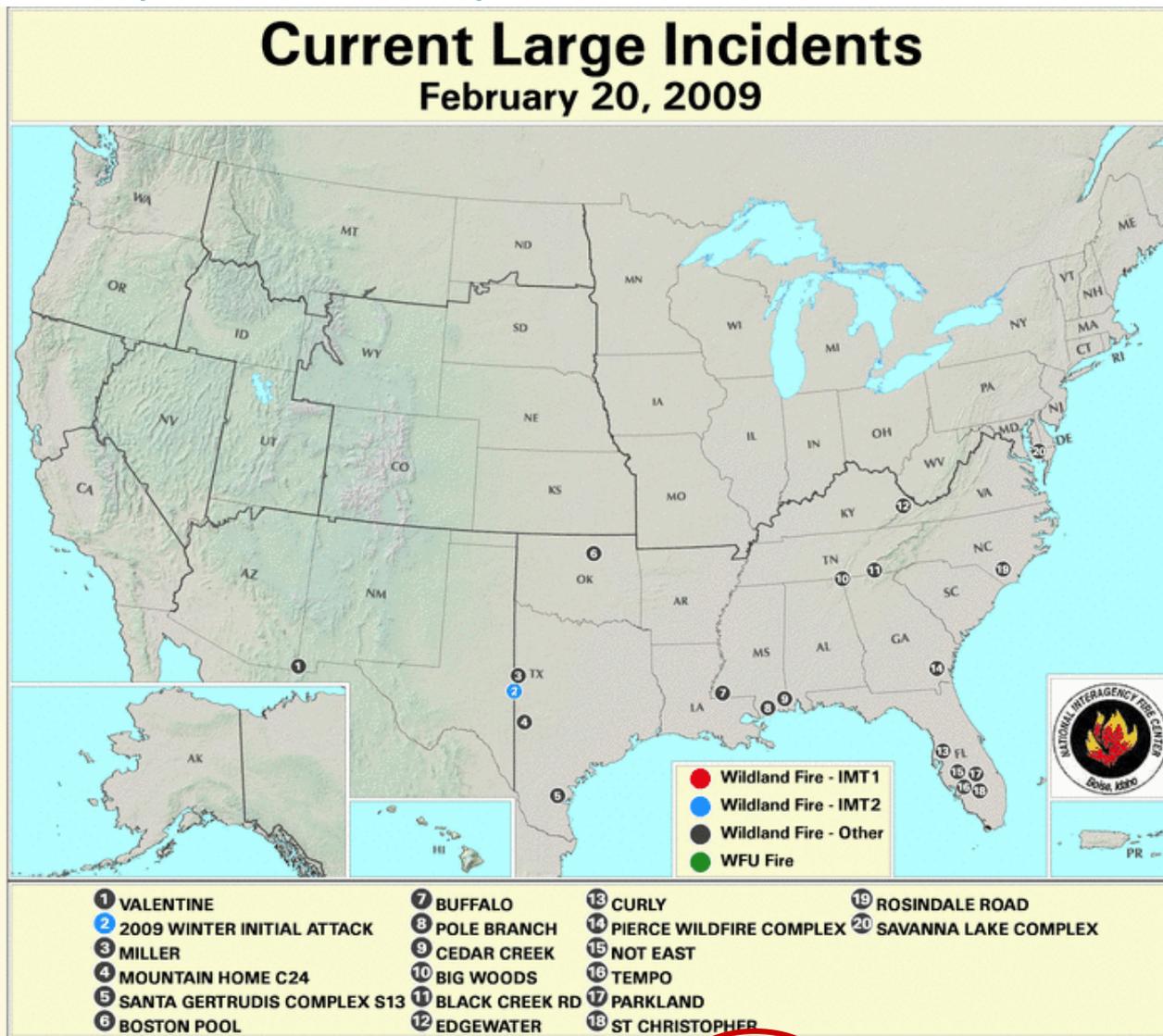


MODIS Active Fire Mapping Program

Fire Information from MODIS Compiled by USDA

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

- ▶ [Contact Us](#)
- ▶ [Programs and Services](#)
- ▶ [BAER](#)
- ▼ [Active Fire Maps](#)
 - [Current Large Fires](#)
 - [United States](#)
 - [Canada](#)
 - [Regional Maps](#)
 - [United States](#)
 - [Canada](#)
 - [ArcIMS Maps](#)
 - [CONUS](#)
 - [Alaska](#)
 - [Hawaii](#)
 - [Canada](#)
 - [MODIS Images](#)
 - [United States](#)
 - [Canada](#)
 - [Fire GIS Data](#)
 - [Google Earth and WMS Maps](#)
 - [Current Detections](#)
 - [United States](#)
 - [Canada](#)
 - [Other MODIS Products](#)
 - [Information](#)
 - [FAQs](#)
 - [NASA](#)
 - [MODIS](#)
 - [Related Links](#)
 - [Project Cooperators](#)
 - [RSAC](#)
 - [NASA GSFC RR](#)
 - [NASA GSFC DRL](#)
 - [NIFC](#)
 - [UMD](#)
 - [SSEC](#)
 - [GINA](#)
 - [CONABIO](#)



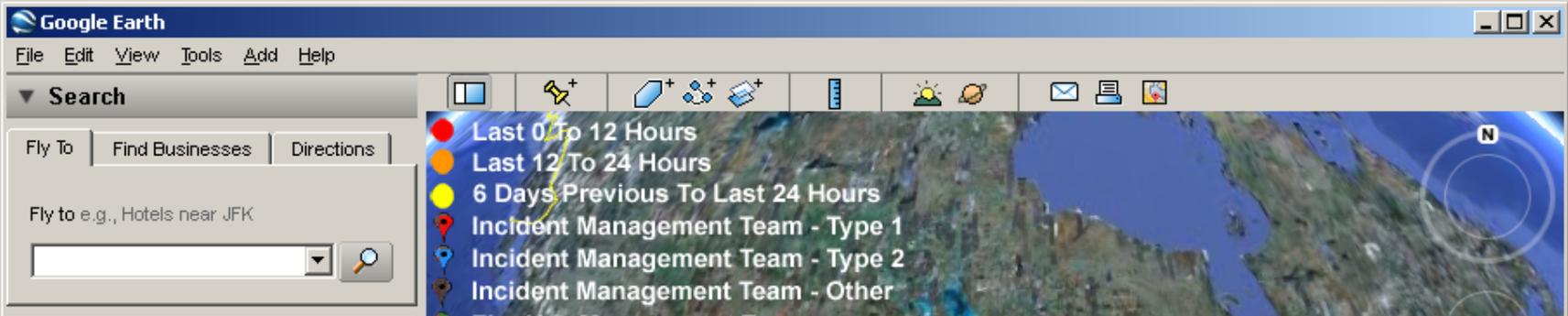
[View Printable Map](#)

[View High Resolution Map](#)

[Definition of Map Terms](#)

[Download KMZ File](#)

Select a Fire



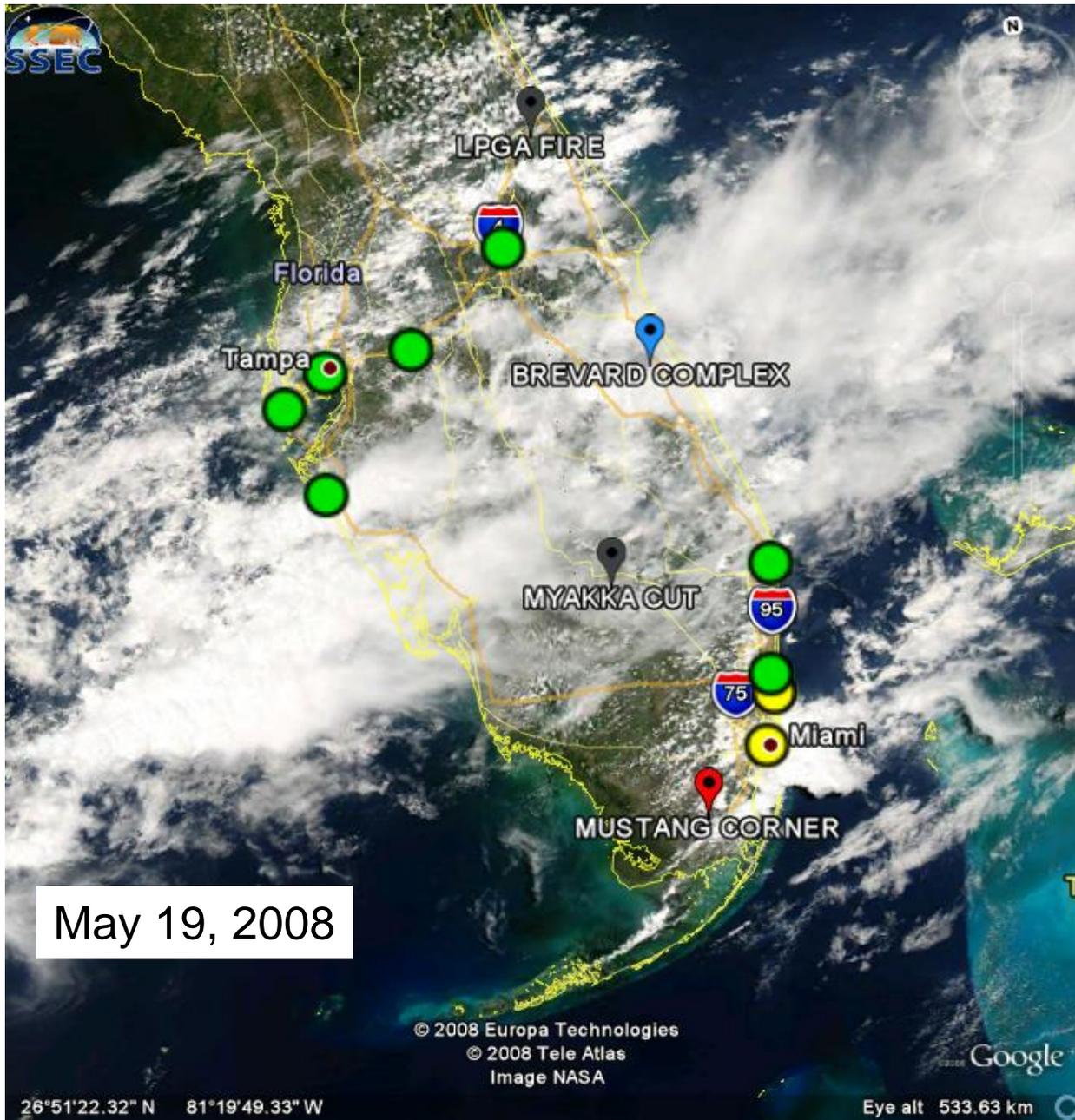
- These files will NOT update automatically!
- You need to open a new kmz file each time you want to visualize current fire data.

A screenshot of Google Earth showing a detailed view of a fire incident. A white information box is overlaid on the map, providing the following details:

2009 WINTER INITIAL ATTACK
Report Date: 02/01/2009
Latitude: 31.420
Longitude: -99.813
Fire Location: The State of Texas
Fire Size: 631 acres (255.4 ha)
Percent Contained: 0.0%
Expected Containment: Unknown
Fire Type: Wildland Fire
Team Type: Incident Management Team - Type 2
See <http://www.nifc.gov/news/sitreprt.pdf> for more information
Directions: [To here](#) - [From here](#)

The map shows a satellite view of a region in Texas, with yellow and orange markers indicating fire locations. The information box also includes a logo for 'USDA Forest Service MODIS Active Fire Map' and a URL 'http://activefiremap.com'. The bottom of the screen shows the coordinates '40°56'51.67" N 105°09'24.65" W' and 'Eye alt 3690.78 km'. The 'Places' panel on the left is still visible, with 'CONUS MODIS Fire Detections' selected.

MODIS Terra True Color, AQIs, Major Fires



NOAA Hazard Mapping System Fire and Smoke Product

Fire Information from MODIS and GOES, Compiled by NOAA

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

HMS Keyhole Markup Language (KML) Files

The HMS
the Sate
polar (A
(MODIS
quality

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

The m
throug

Relate

Most Recent

HMS KML

Files:

26 Feb 2009 -- [FIRE SMOKE](#)
25 Feb 2009 -- [FIRE SMOKE](#)

- S
- N

The mo

Analysis
Fires a
Smoke, v

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MODIS w

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](#)

Search

Fly To Find Businesses Directions

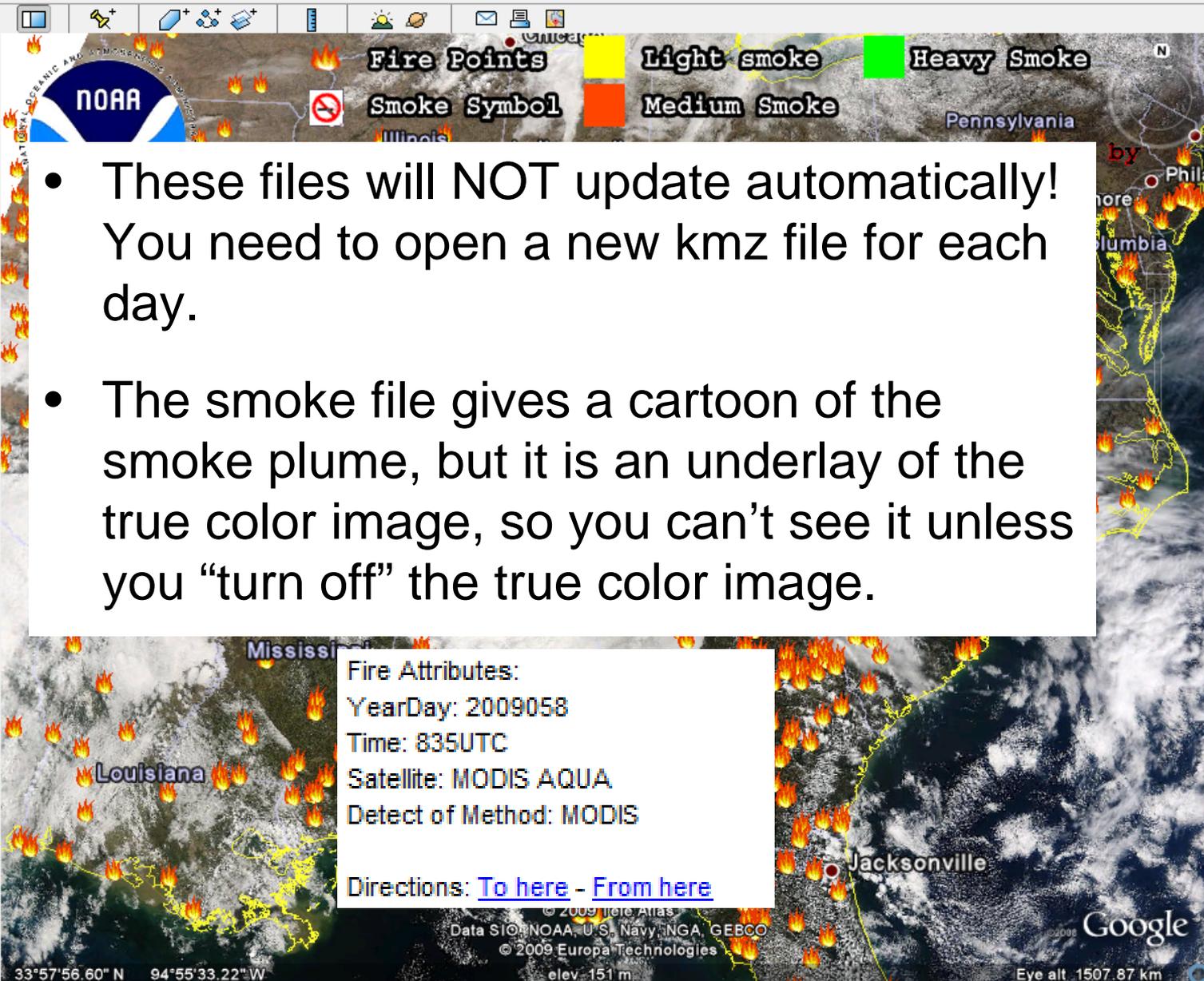
Fly to e.g., Reservoir Rd. Clayville, NY

Places Add Content

- Today's Forecast
- Tomorrow's Forecast
- Temporary Places
- terra_today.kml
- MODIS REALTIME IMAGERY
Terra MODIS real-time imagery from SSEC, UW-Madison
- latestfire.kml
- latestsmoke.kml
- fire20090225.kml
- smoke20090225.kml

Layers

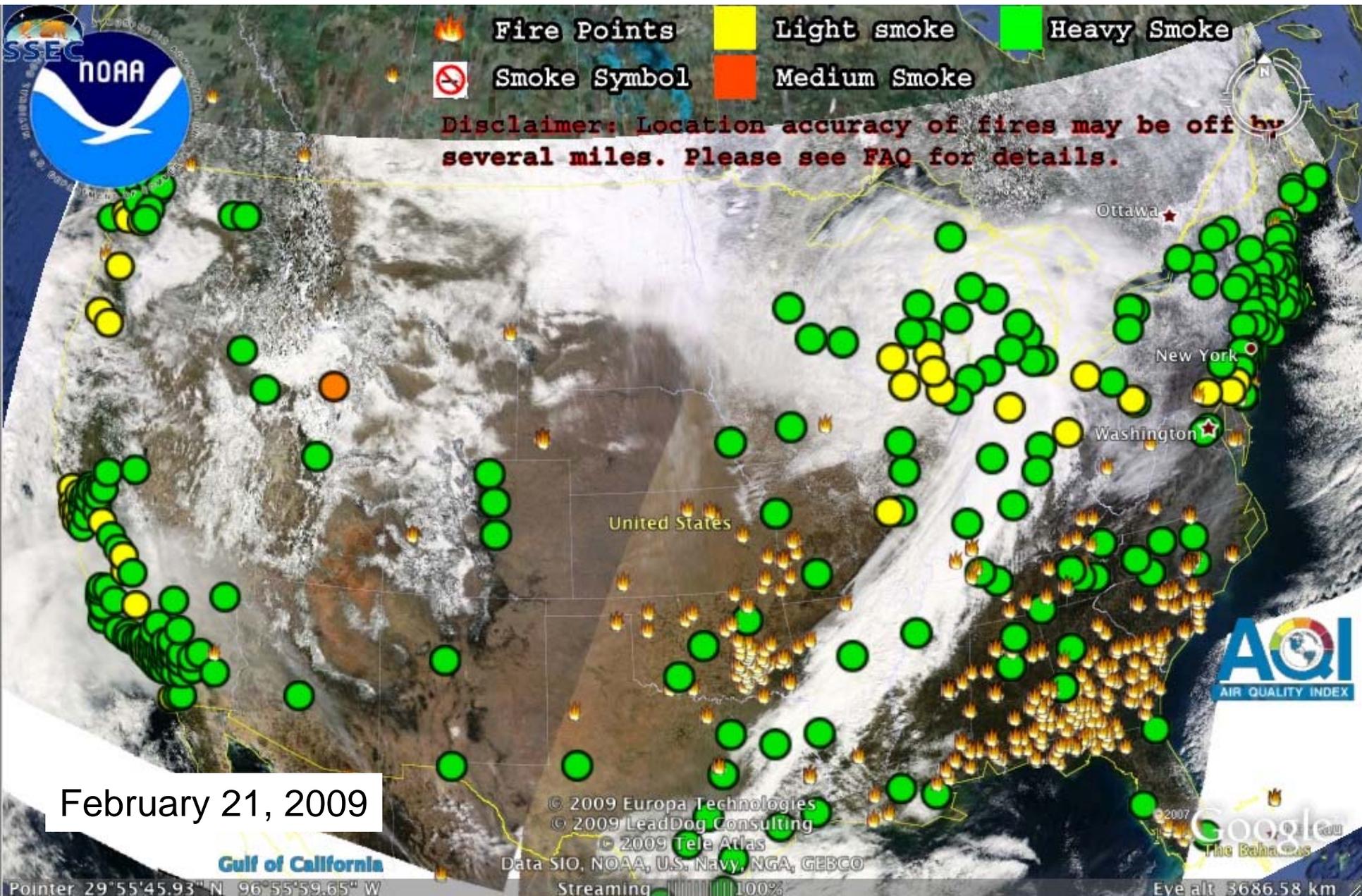
- Primary Database
- Geographic Web
- Roads
- 3D Buildings
- Street View
- Borders and Labels
- Traffic
- Weather
- Gallery
- Global Awareness
- Places of Interest
- More
- Terrain



- These files will NOT update automatically! You need to open a new kmz file for each day.
- The smoke file gives a cartoon of the smoke plume, but it is an underlay of the true color image, so you can't see it unless you "turn off" the true color image.

Fire Attributes:
YearDay: 2009058
Time: 835UTC
Satellite: MODIS AQUA
Detect of Method: MODIS
Directions: [To here](#) - [From here](#)

MODIS Aqua True Color, AQIs, HMS Fire Data



February 21, 2009

OMI Tropospheric NO₂

Global Near Real-Time OMI NO₂ Tropospheric Column from KNMI

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



Tropospheric NO₂

Regional Tropospheric NO₂ columns from OMI

12

[<-- previous day](#)

[next day -->](#)

[<-- previous month](#)

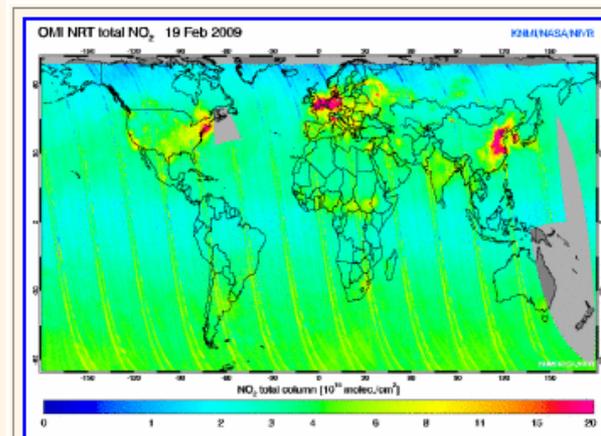
[next month -->](#)

NO₂ observation for:

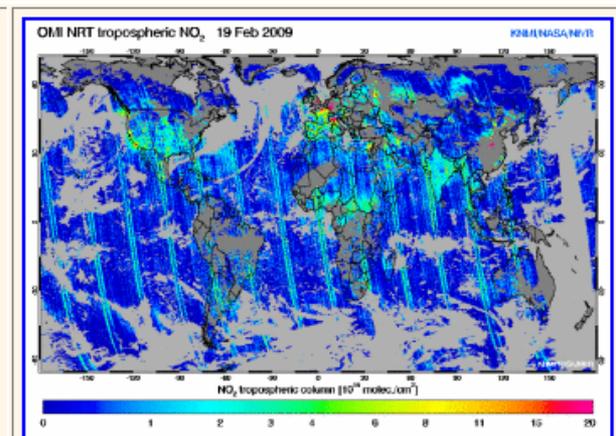
N Region:
Year:
Re Month:
M Day:

[Info on data anomalies](#)

Regional NO₂ of 19 February 2009



Total column



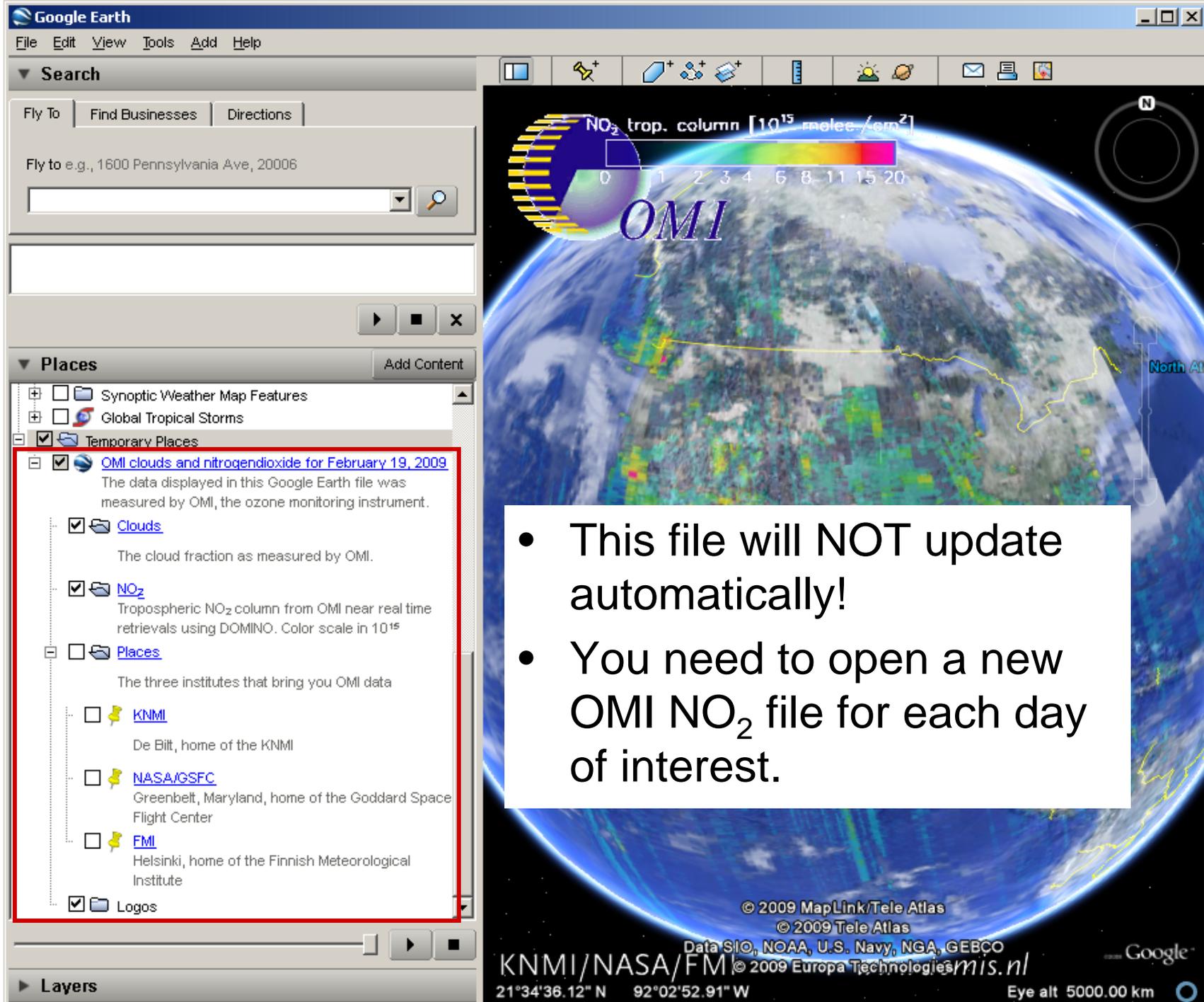
Tropospheric column

[NO₂ data file](#)

Profile data is not available

[Data file archive](#)

[Image in Google Earth](#)



- This file will NOT update automatically!
- You need to open a new OMI NO₂ file for each day of interest.

HYSPLIT Airmass Trajectory Analysis

Forward and Backward Trajectories from the HYSPLIT Model

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

HYSPLIT MODEL RESULTS FOR JOB NUMBER 379862

Plot proje
Vertical pl
units:
Label Inte
Plot color
Zoom fact
Create Ja
Animation
Graphic s
Distance
overlay:
GIS output
Create Po
Plot mete
field along
Dump me
data along

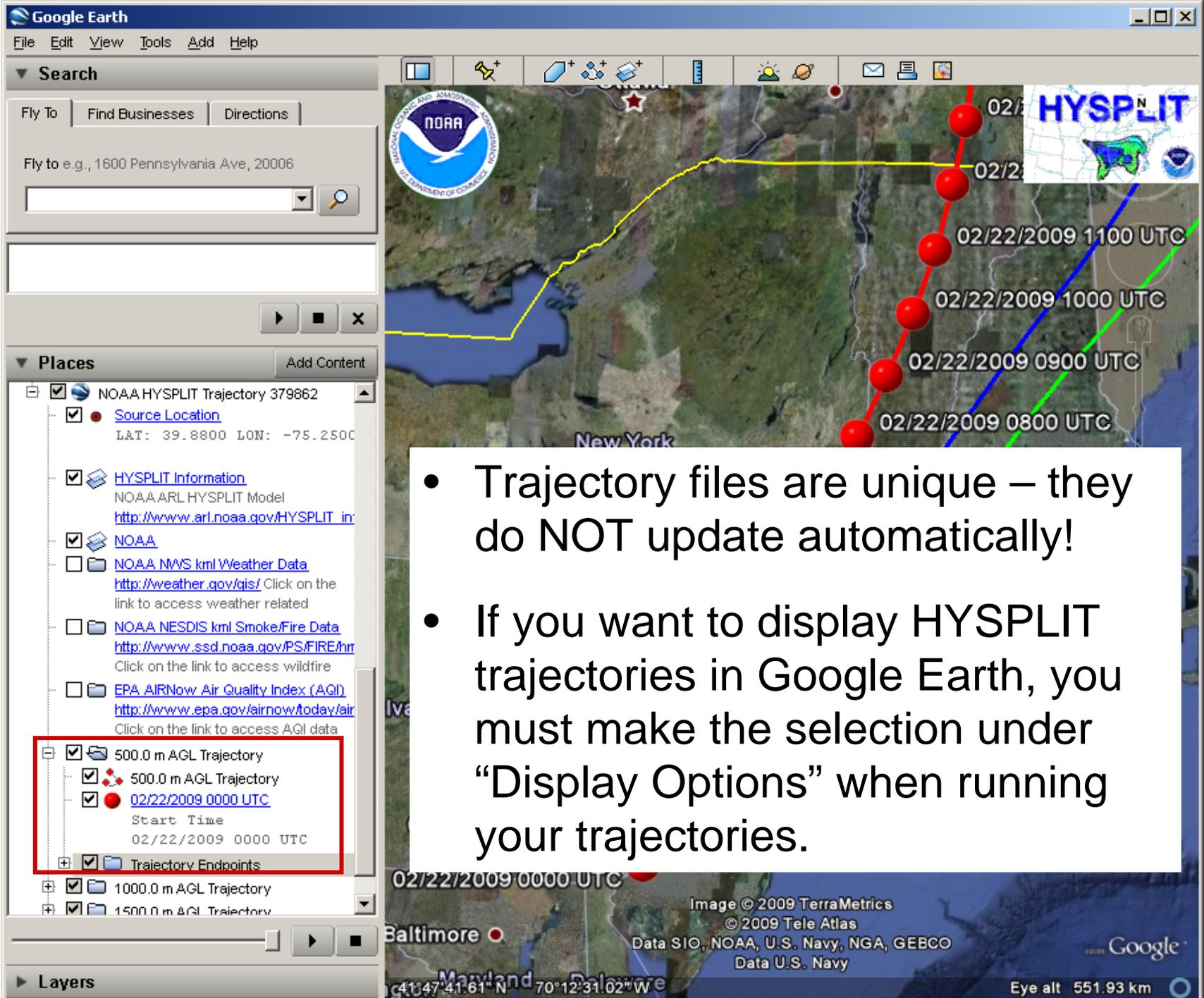
```
adding: logocon.gif (deflated 7%)
adding: HYSPLITtraj_379862_01.kml (deflated 92%)
Complete Trajplot
Started Trajectory Drawing (Version: February 2009)
Google Earth file creation for job 379862.
Complete Hysplit
Percent complete: 100.0
Percent complete: 95.8
```

Your plot(s) are now available, but will be deleted in 6 hours:

Non-Javascript users click here for alternate links.

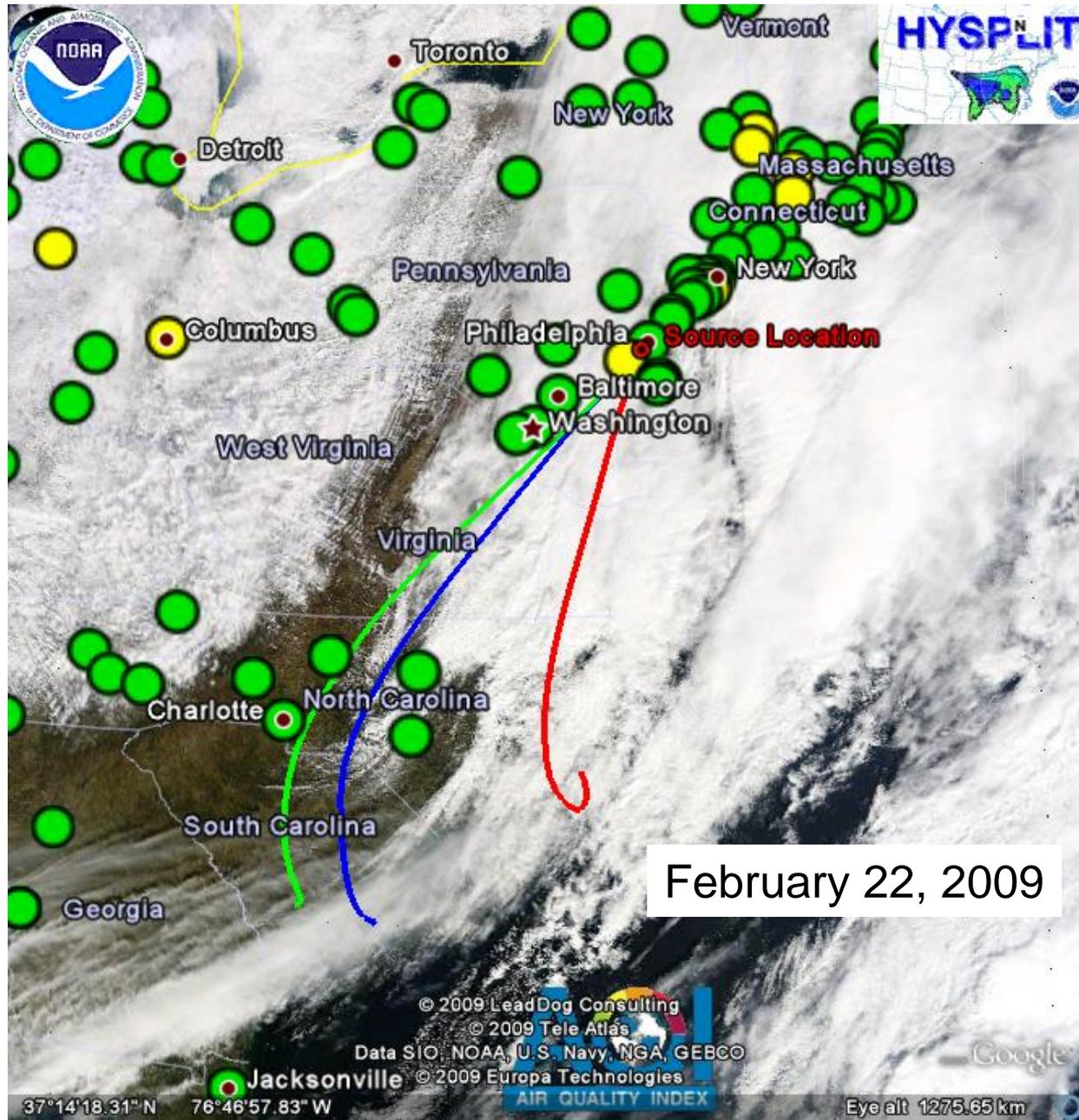
- Your Trajectory plot
 - How to read the trajectory maps.
- **Google Earth File (kmz)**
- Trajectory endpoints file.
 - Trajectory endpoints format help.
- Modify the trajectory plot without rerunning the model.
- **NEW** Rerun the model with user entered defaults.
- Modify trajectory number # (if available)....
1 2 3 4 5 6 7 8 9

elow



- Trajectory files are unique – they do NOT update automatically!
- If you want to display HYSPLIT trajectories in Google Earth, you must make the selection under “Display Options” when running your trajectories.

MODIS Terra True Color, AQIs, HYSPLIT



National Weather Service Data

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

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

Current Weather	Forecasts	Past Weather
Watches & Warnings Current Weather Warnings Flash Flooding - Basins and Streams	Your Local Weather Forecast Your Local Weather Graphical Forecast	Doppler Radar NWS Radar archive data
Doppler Radar Real Time Radar Radar Locations	MOS Guidance GFS Meteograms	Normals, Means, Extremes NCDC Climate Atlas of the United States NCDC GIS Portal
Surface Observations Metar Obs RAWS Obs APRSWXNET Obs MesoWest Obs Other Surface Obs	GOES Sounding Skew-T Tulsa area: Max Min POP River Gage Forecasts	Severe Weather Storm Reports: Tornado, Wind and Hail 1950-2006 Database of Tornado, Large Hail, and Damaging Wind Reports
Satellite Infrared Loop Visible Loop Water Vapor Loop		Rain/Snowfall CoCoRaHS Observations NOHRSC Snow Data
Remote Gages River Gages: Observed Snow Gages: w/ labels w/o labels		Hurricanes Past Atlantic Storm Tracks Past East Pacific Storm Tracks
Great Lakes Wave Height Ice Water Temperature	Fire Weather Current Spot Forecast Sites Fire Weather Categorized Observations MODIS fires IMET Locations	Additional Info Coastal Estuarine Bathymetry nowCOAST web mapping portal
Surface Fronts Past and Present Synoptic Features		



Not working



MODIS Terra True Color, AQIs, Fires, METAR Winds

0 10 20 30 40 50 60 70 80 90 100+

SSEC

January 24, 2009

Nashville

Tennessee

Atlanta

© 2009 Europa Technologies
© 2009 LeadDog Consulting
Image © 2009 TerraMetrics
© 2009 Tele Atlas

Google

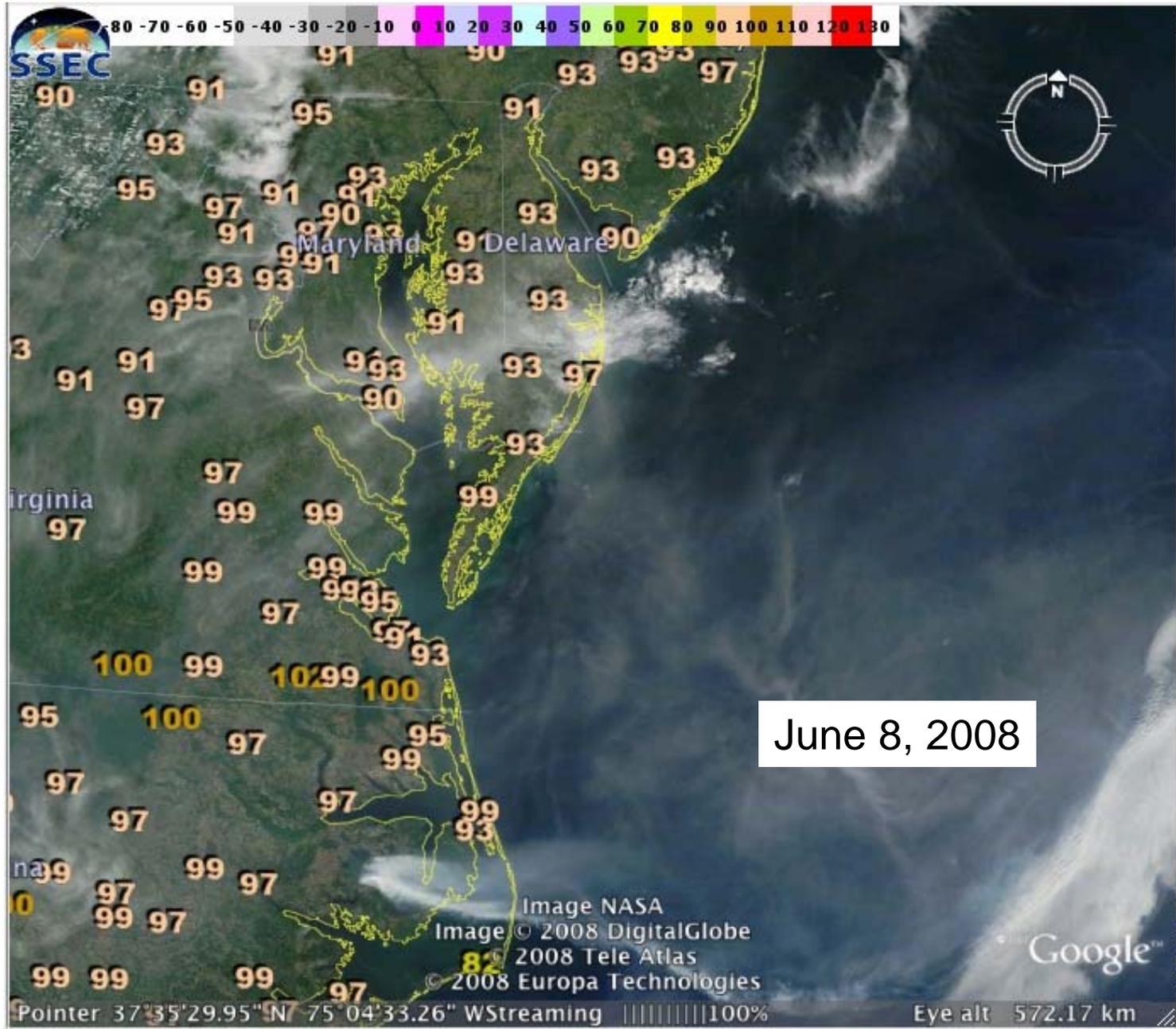


Pointers 34° 47' 46.35" N 82° 51' 24.35" W

Streaming 100%

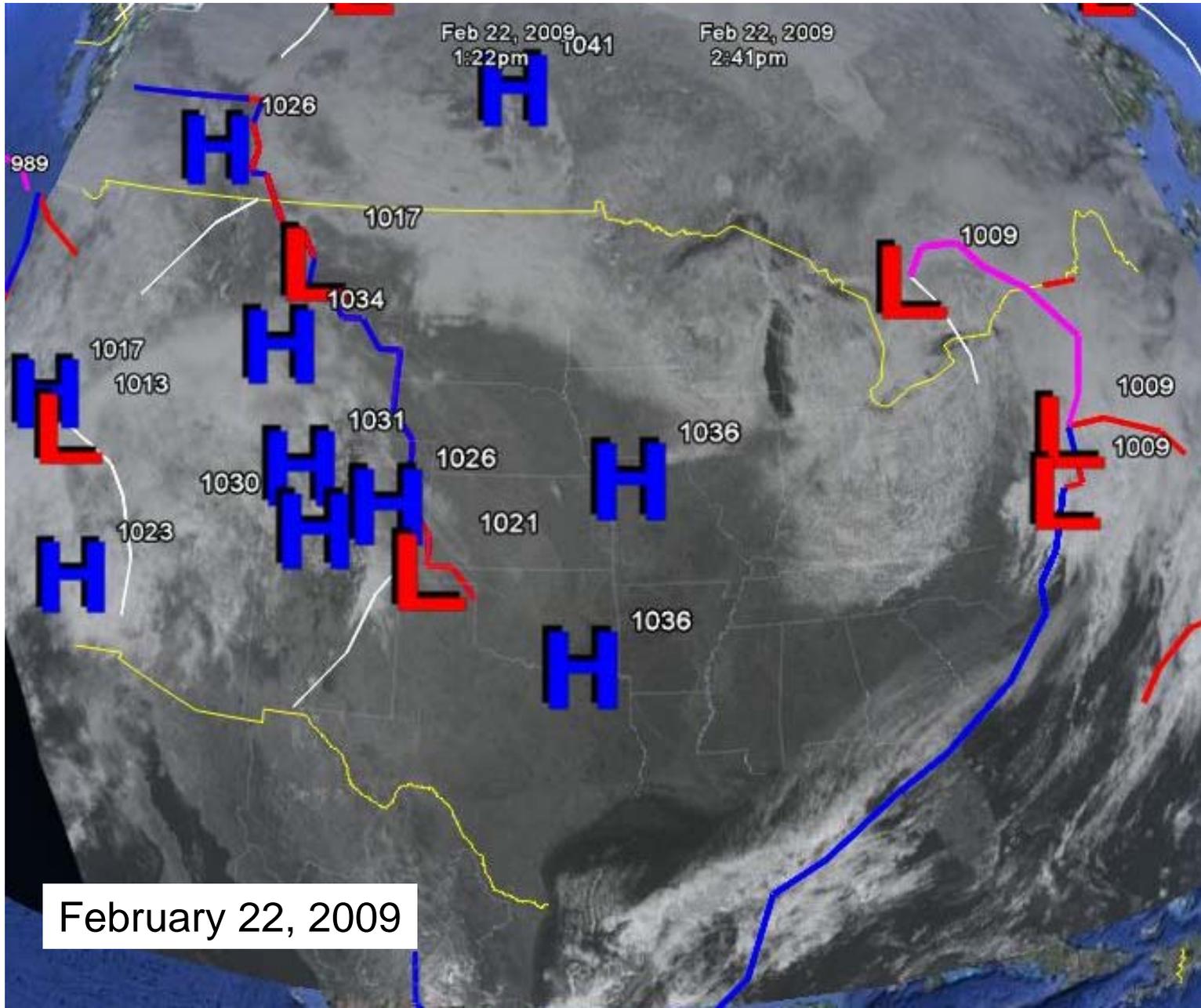
Eye alt 539.10 km

MODIS Terra True Color, METAR Temperatures (°F)



June 8, 2008

Visible Satellite Imagery and Synoptic Analysis



Search

Fly To Find Businesses Directions

Fly to e.g., 1600 Pennsylvania Ave, 20006

Search input field with magnifying glass icon

Places

Add Content

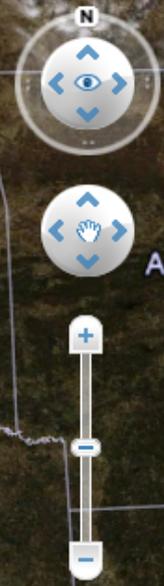
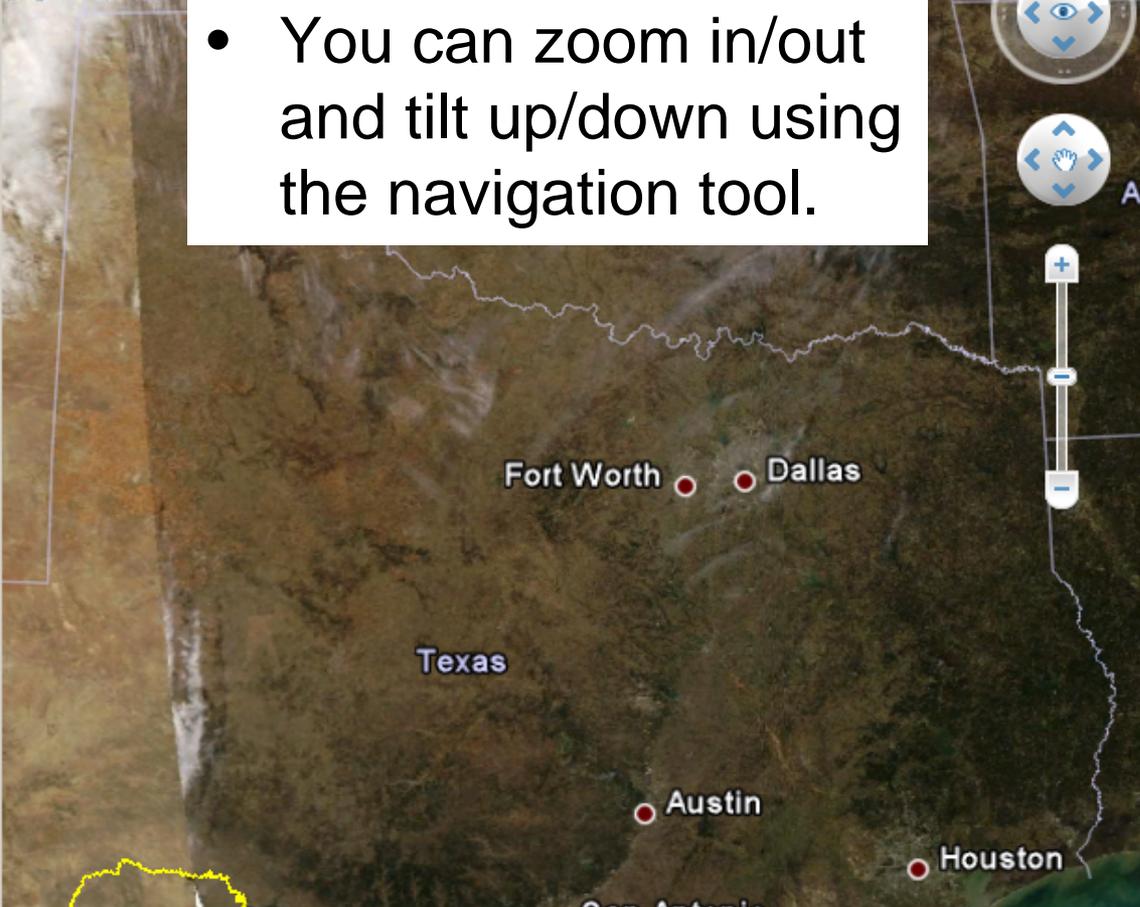
- Air Quality from AIRNow
- aqua_today[1].kml
- terra_today[1].kml
- OMI clouds and nitrogen dioxide for Nov

Layers

- Primary Database
- Geographic Web
- Roads
- 3D Buildings
- Street View
- Borders and Labels
 - Borders
 - Populated Places
 - Alternative Place Names
 - Labels
- Traffic
- Weather
- Gallery
- Global Awareness
- Places of Interest
- More
- Terrain



- You can zoom in/out and tilt up/down using the navigation tool.



- You can adjust Google Earth's display settings using the options under "Layers."

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/>

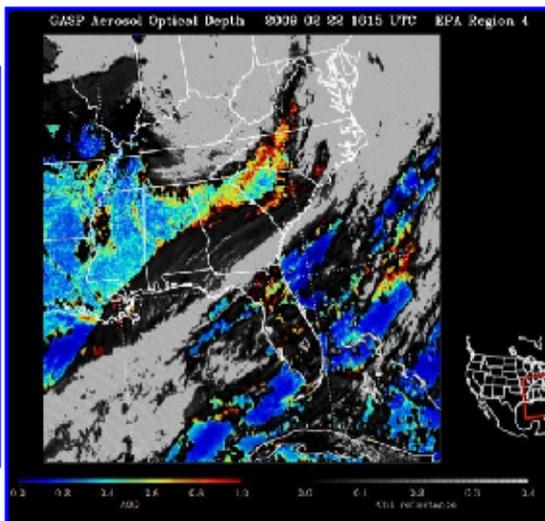
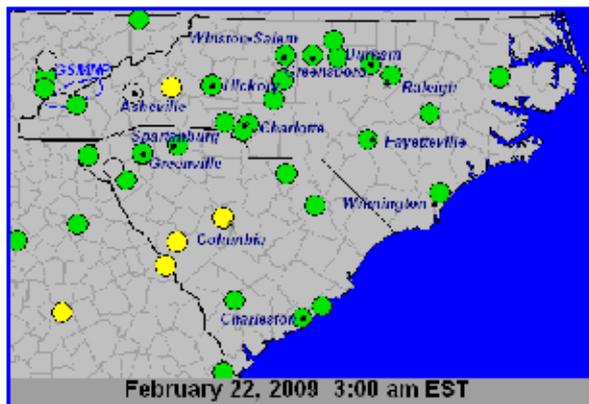
U.S. Air Quality

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 moderate concentrations in the Carolinas (left) and GASP was able to catch that line of haze following frontal passage (right). The red line of nearly 1 AOD could not be confirmed on MODIS as the AOD product did not run on IDEA today (we're checking this out).



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](#)

IDEA

MODIS True Color and AOD Images and other Satellite Goodies

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

The screenshot shows the IDEA web interface. At the top, there are links for "Download animated GASP image" and "Download GASP image". Below these are two satellite image thumbnails: "View RGB" (True Color) and "View AOD" (Aerosol Optical Depth). To the left of the RGB image are links for "Download US RGB Image (Terra)" and "Download US RGB Image (Aqua)". To the right of the AOD image are links for "Download US AOD Image (Terra)" and "Download US AOD Image (Aqua)". A central slider control is positioned between the two images. Below the images is a navigation bar with "PREVIOUS FORECAST DAY" and "NEXT FORECAST DAY" buttons. The date selection menu shows "2009", "February", "21", and "1115", with a "Go" button. Below the date menu is a "Choose plot type:" section with radio buttons for "MODIS (Terra)", "MODIS (Aqua)", "GASP animated", and "GASP fixed frame". The "MODIS (Aqua)" option is selected. On the right side of the interface, there are logos for "USA" and "RA", and a "Product description" link.

- 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 forecasters!
- 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>

Shameless Plug

- Ana and Amy are presenting in the remote sensing session on Wednesday morning:
 - 8:00 Ana: [NASA Satellite Tools for Event Analysis](#)
 - 8:30 Amy: [Google Earth for Forecasters](#)
- We will cover much of the same material on Wednesday as we did in the training today.
- Tell your friends who couldn't make it to the training to join us on Wednesday!



Activity 3: Analysis of Current Air Quality Conditions using Google Earth

- Goal: learn how to open and work with satellite, air quality, and meteorological datasets in Google Earth.
- Please work in groups of 2-3:
1 laptop owner and 1-2 others.
- Use the Activity 3 worksheet to guide your work.
- Feel free to explore beyond the suggested exercises!
- All the webpages you need are given in the “Useful Air Quality URLs.ppt” file, or you can work off the Smog Blog (<http://alg.umbc.edu/usaq/>).