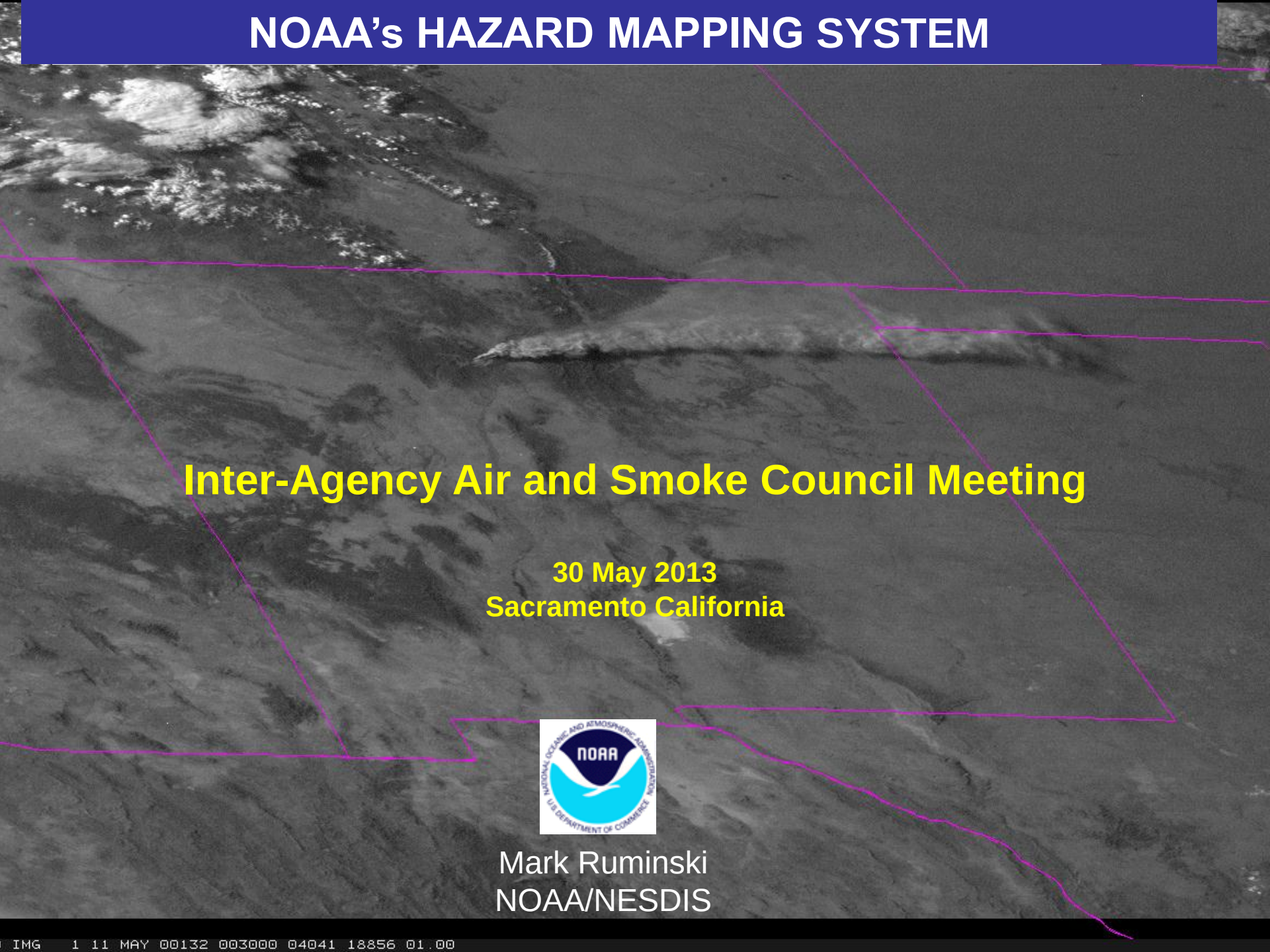
NOAA's HAZARD MAPPING SYSTEM



Inter-Agency Air and Smoke Council Meeting

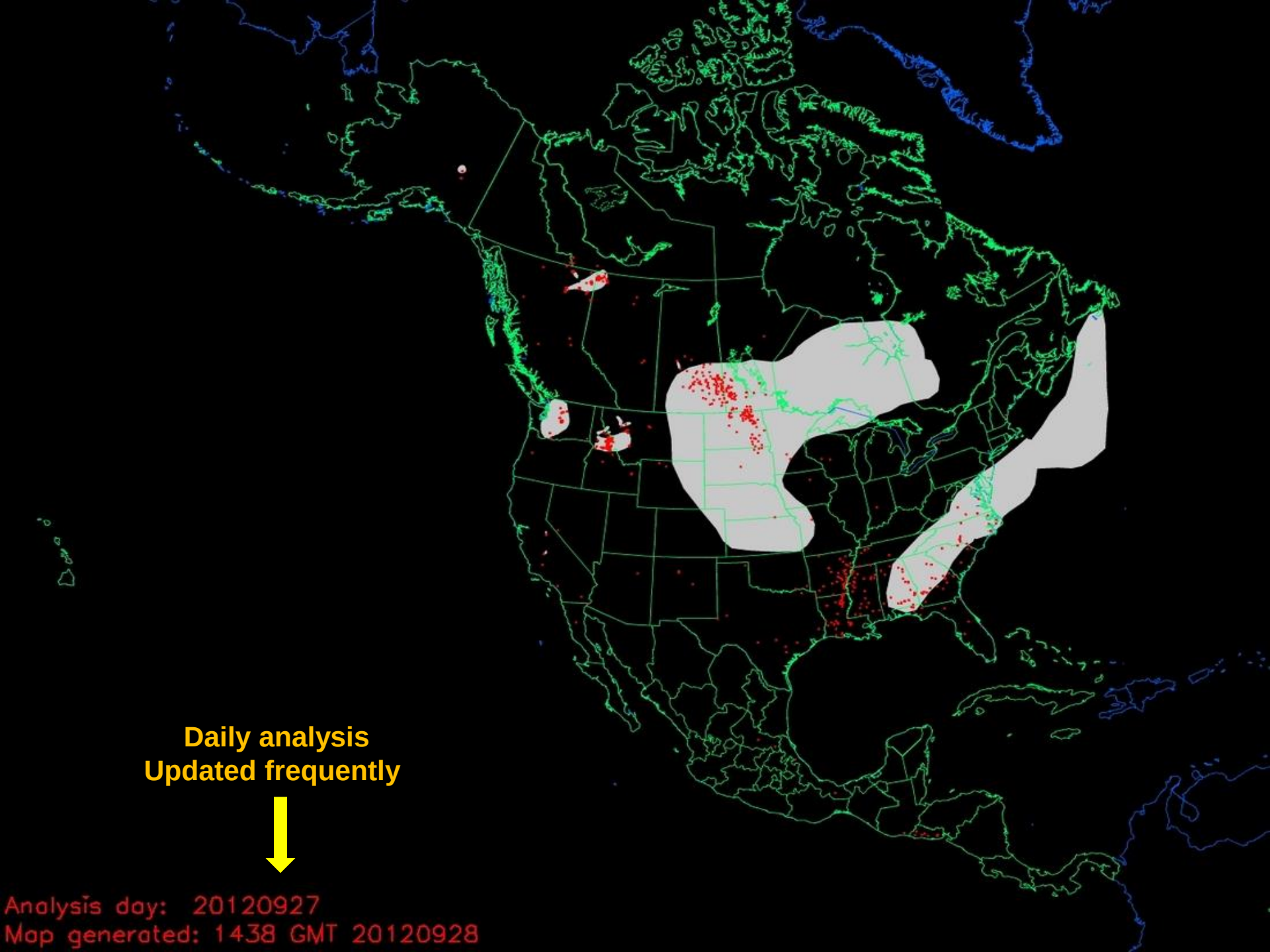
30 May 2013
Sacramento California

Mark Ruminski
NOAA/NESDIS

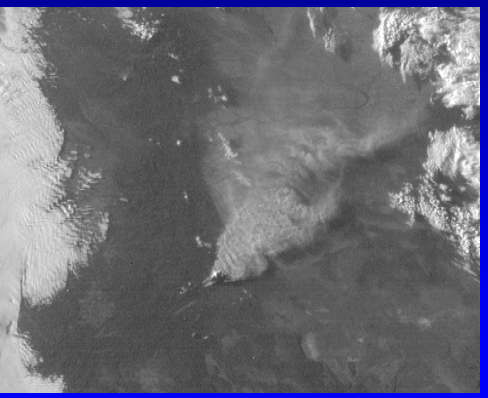
IMG 1 11 MAY 00132 003000 04041 18856 01.00

OVERVIEW

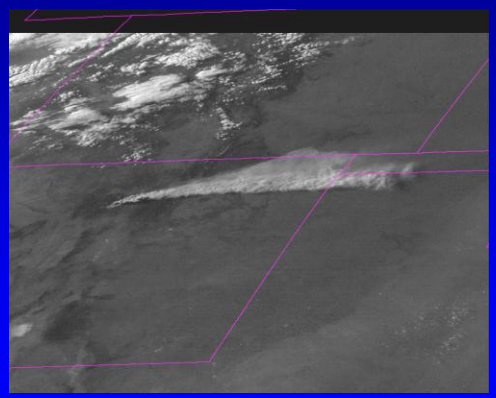
- **HMS basics (sensors, coverage area, frequency, etc)**
- **Fire detection – automated and manual methods**
- **Smoke detection – manual only**
- **Smoke detection limitations**
- **Smoke vs other aerosols (blowing dust, haze, SO2, etc)**
- **NWS smoke forecast initialization**


Daily analysis
Updated frequently
Analysis day: 20120927
Map generated: 1438 GMT 20120928

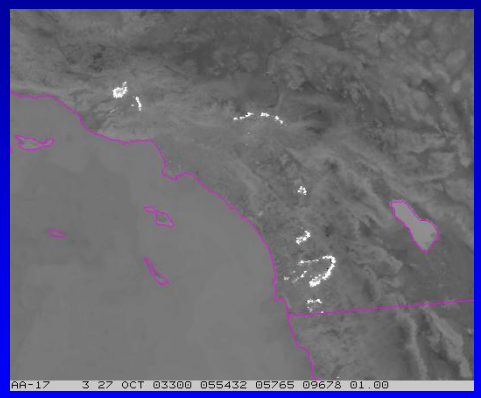
HAZARD MAPPING SYSTEM



GOES-WEST



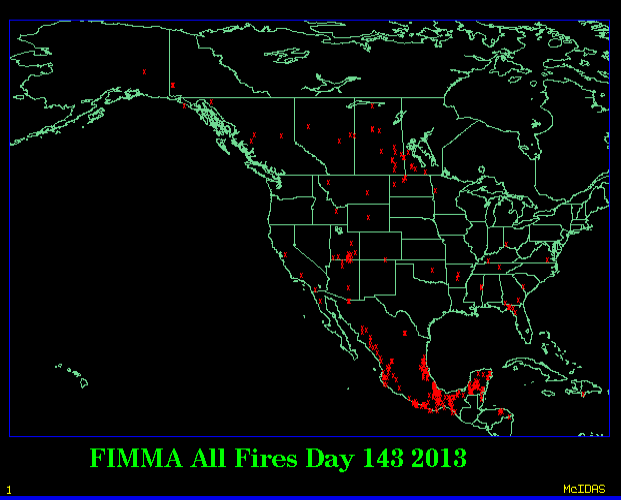
GOES-EAST

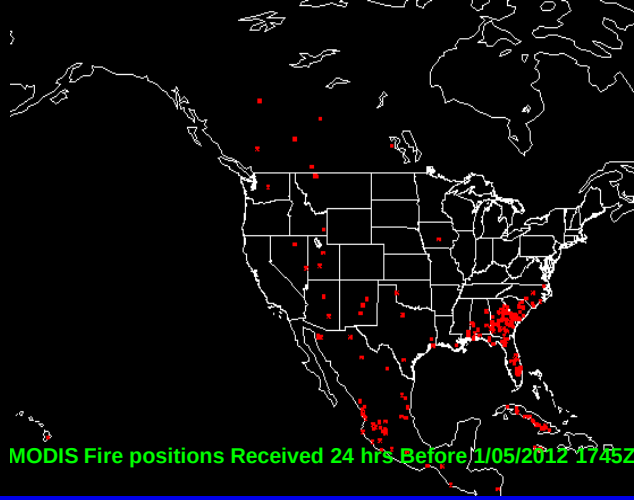


NOAA-AVHRR

MODIS

- HMS Incorporates 2 geostationary (GOES-East/West) and 7 polar orbiting (Terra/Aqua and NOAA-15,18,19 and METOP-A/B)
- Over 200 looks per day in areas of overlap
- POES spacecraft provide 2 orbits/day in mid latitudes, more frequent over Alaska/Canada
- Analysis performed year-round for contiguous US, Hawaii and Central America, seasonally for Alaska and Canada (> 7.5 million miles^2),
- Central America Analysis performed by SMN





Automated fire detection algorithms are employed for each of the sensors:

WildFire Automated Biomass Burning Algorithm (WF-ABBA) for GOES

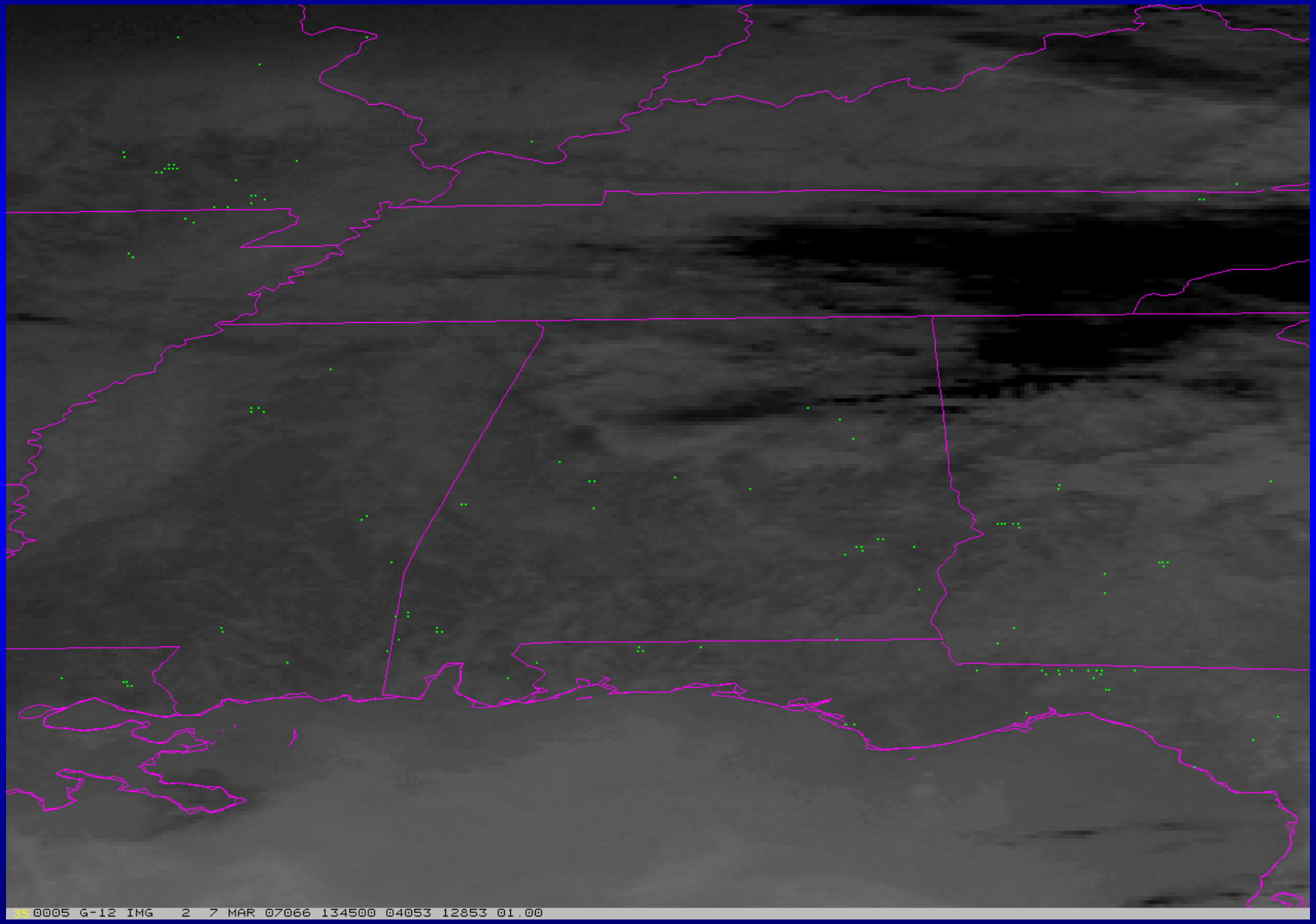
Fire Identification Mapping and Monitoring Algorithm (FIMMA) for AVHRR

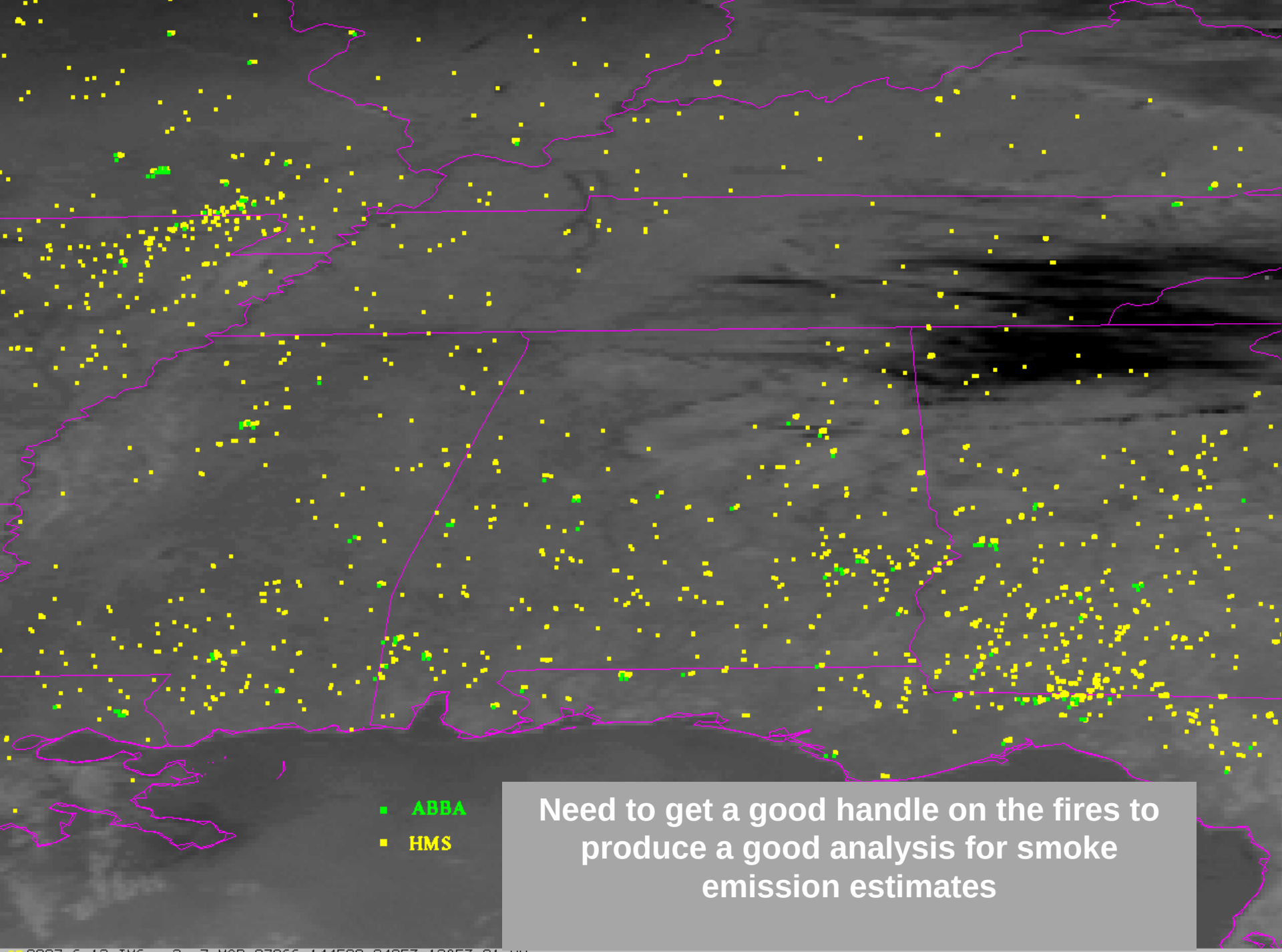
MOD14 product for MODIS

HAZARD MAPPING SYSTEM

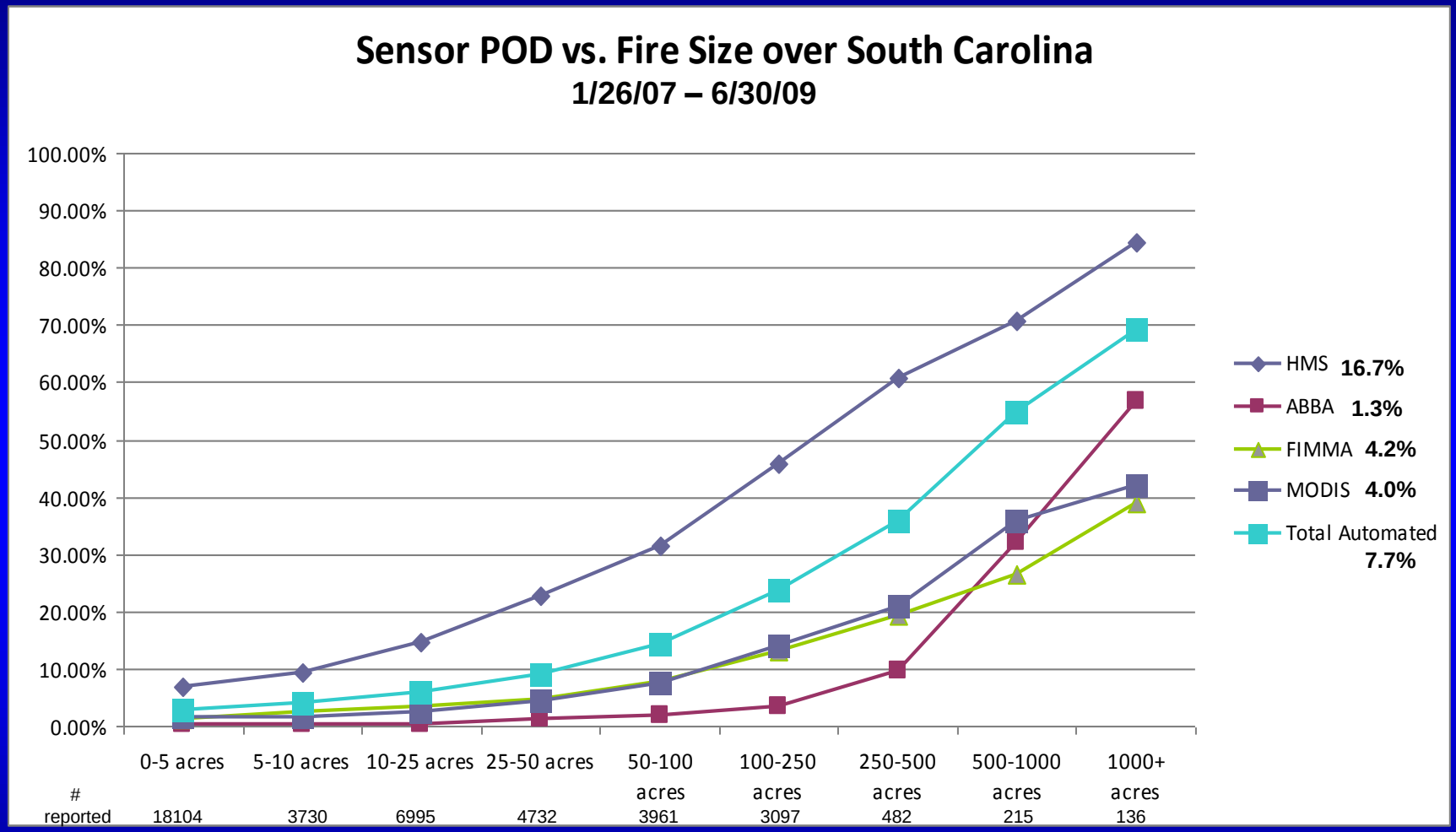
Since we employ the automated algorithms why have an analyst in the loop?

Automated products are quality controlled for false detections and fires added that the algorithms have not detected

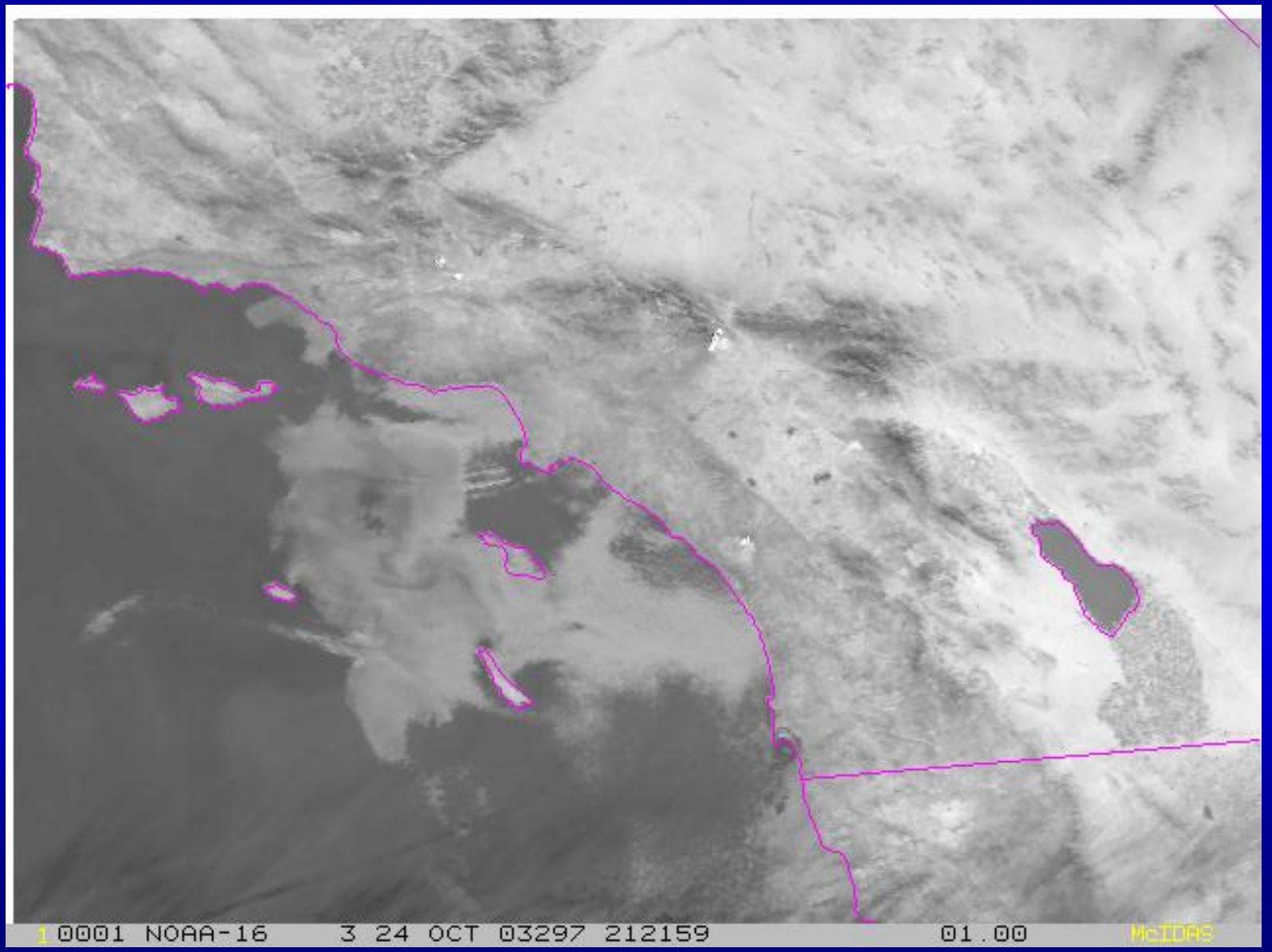



ABBA
HMS
Need to get a good handle on the fires to produce a good analysis for smoke emission estimates
0007 G-12 IMG 2 7 MAR 07066 144500 04053 12853 01.00

STATISTICAL RESULTS



7 Day AVHRR Animation of Southern California Fires in Oct 2003



HAZARD MAPPING SYSTEM

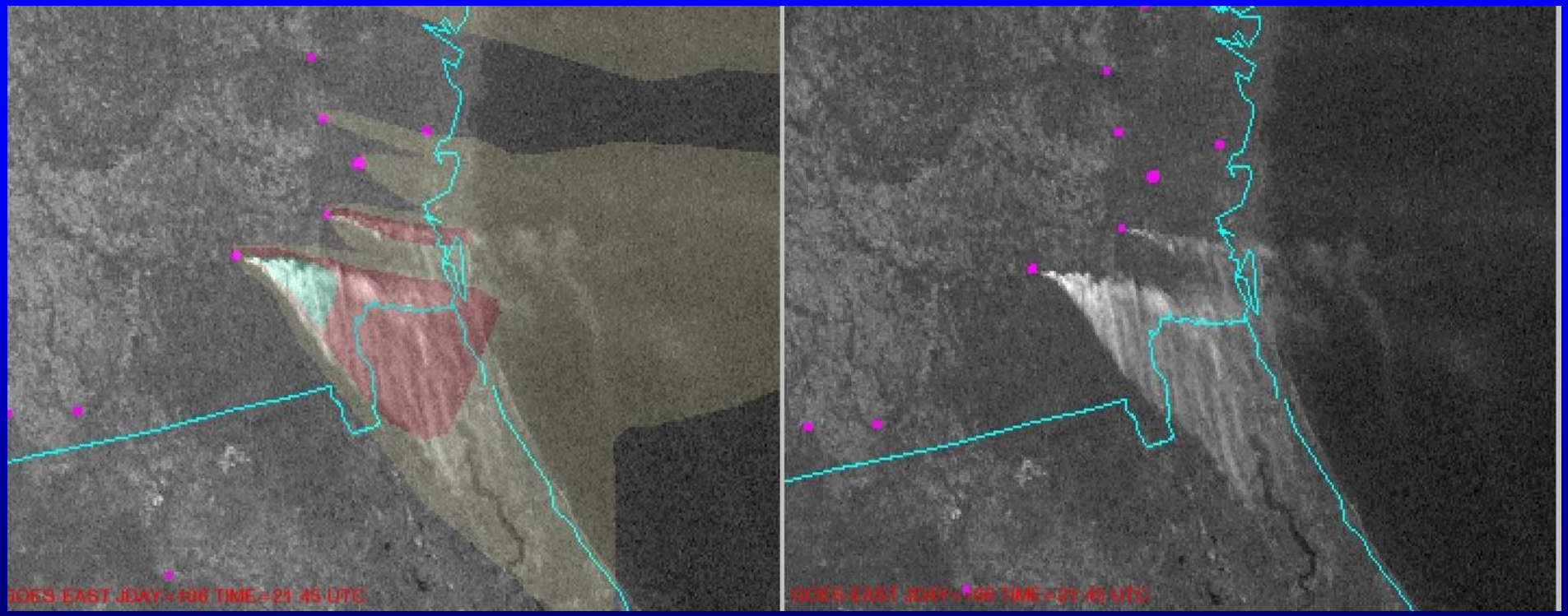
SMOKE PLUMES ARE ALL MANUALLY DRAWN

- Analysts specify a smoke concentration for each plume outlined - 5, 16 or 27 µg/m^3 for light, medium and thick smoke
- Determination of smoke concentration values are aided by the GOES Aerosol and Smoke Product (GASP)
- The value represents the mid-point in a range of value
- Time of plume is included with metadata

HAZARD MAPPING SYSTEM

GOES-12 VISIBLE IMAGE
16 April 2007 2145Z

- represents analyzed fire location

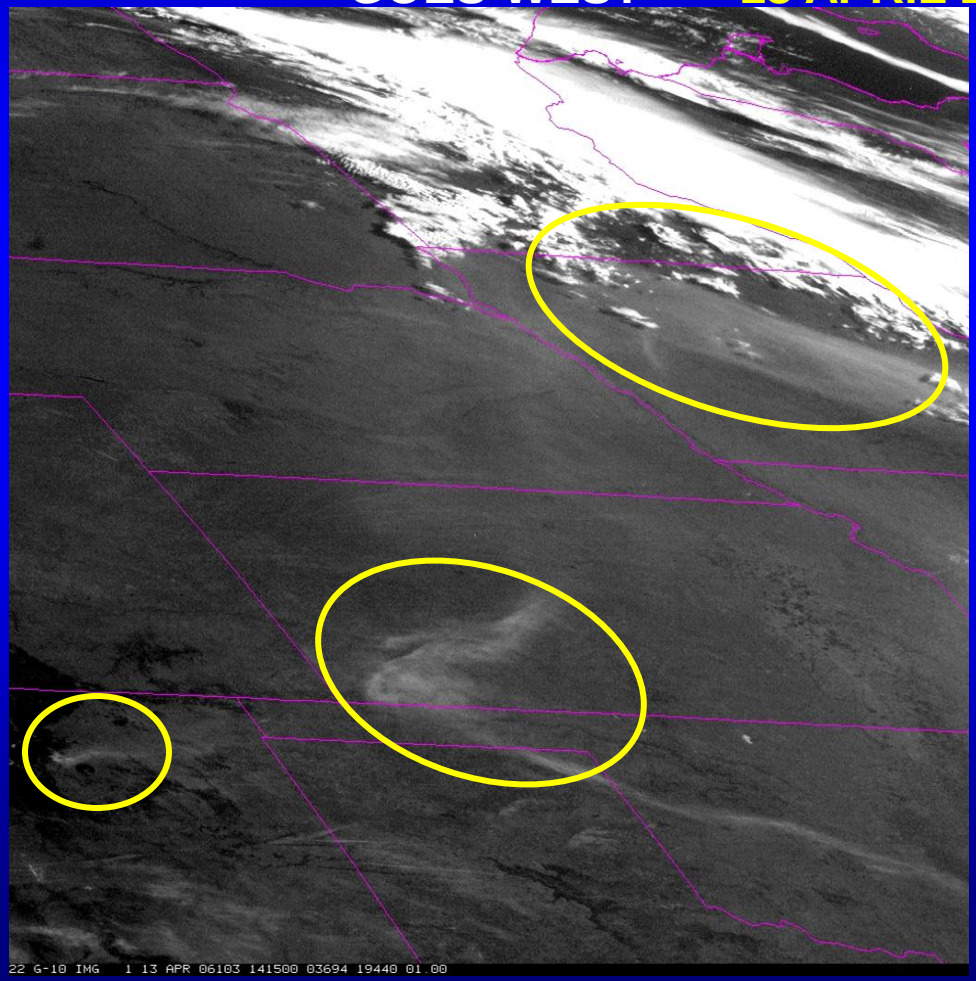


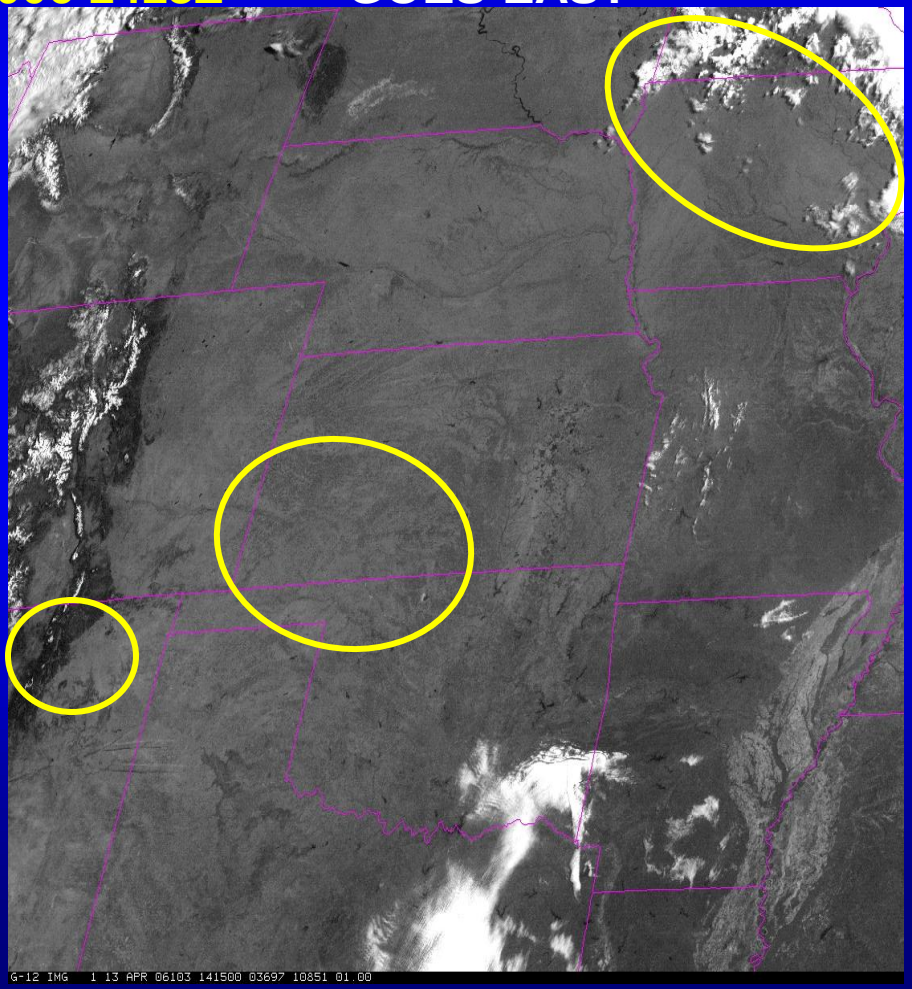
SMOKE DETECTION USING VISIBLE BAND IMAGERY:

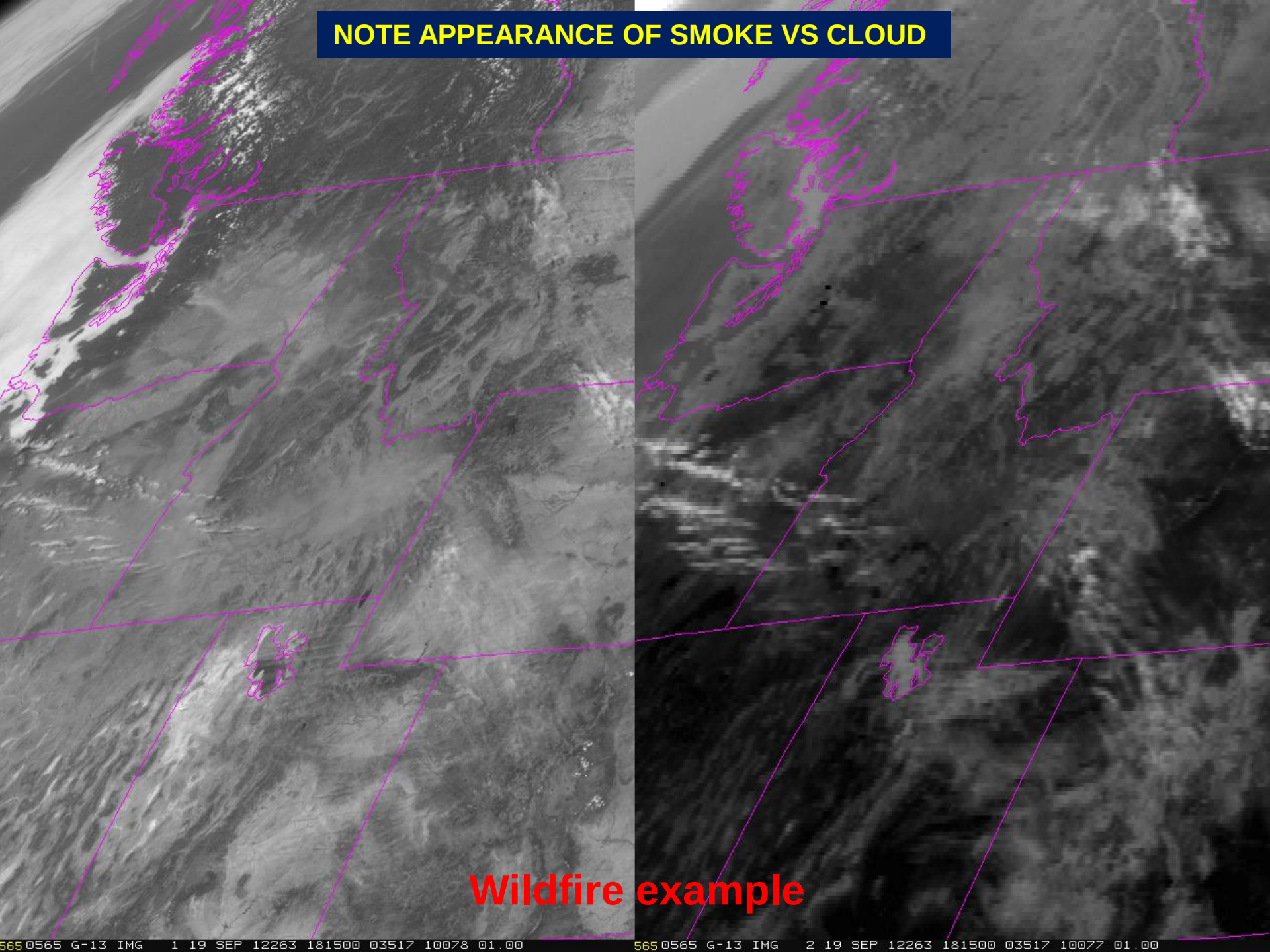
Sun/Satellite Viewing Geometry Makes the Difference

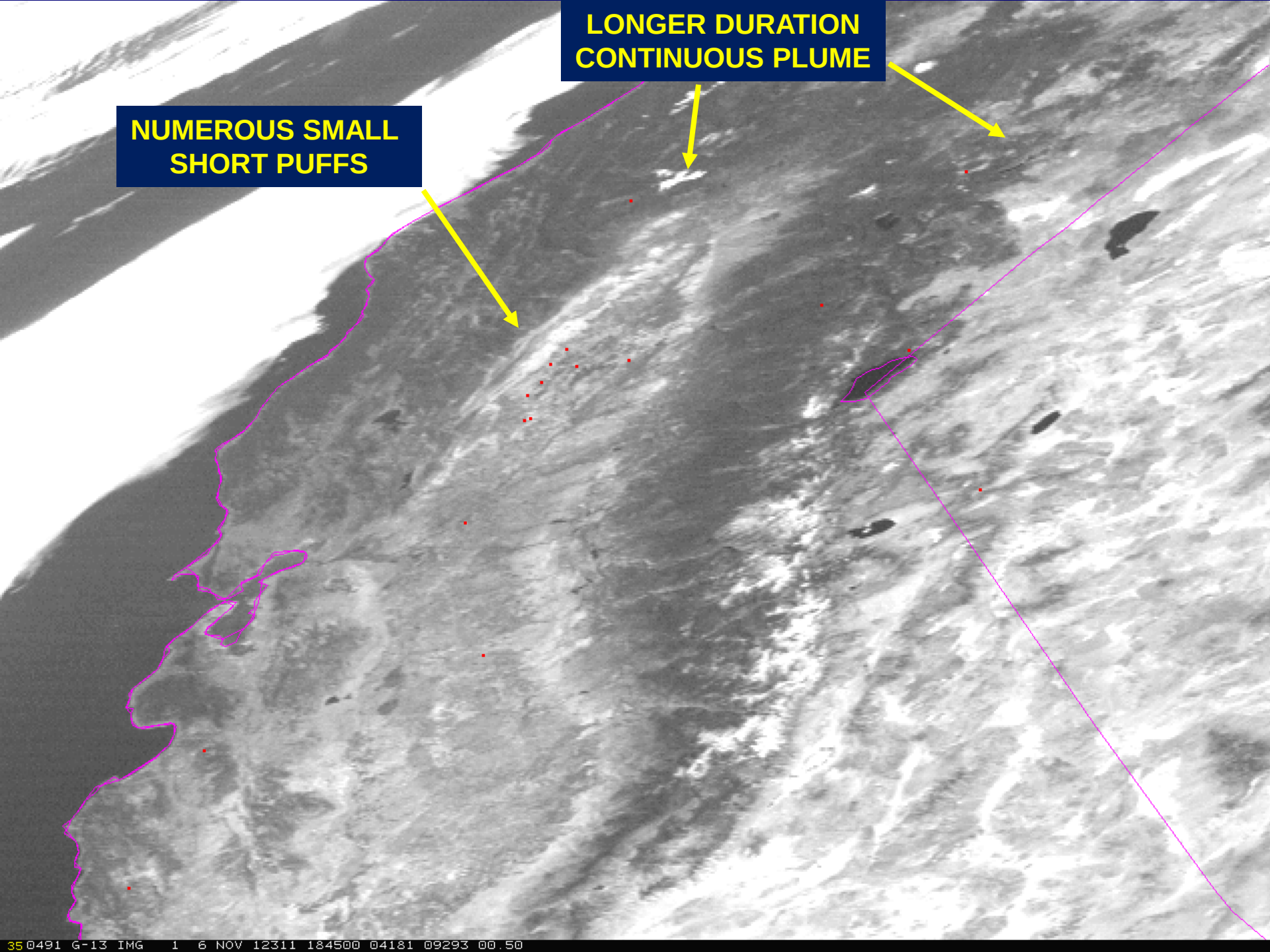
GOES-WEST: BEST FOR VIEWING SMOKE IN MORNING
GOES-EAST: BEST FOR VIEWING SMOKE IN EVENING

GOES-WEST **13 APRIL 2006 1415Z** **GOES-EAST**

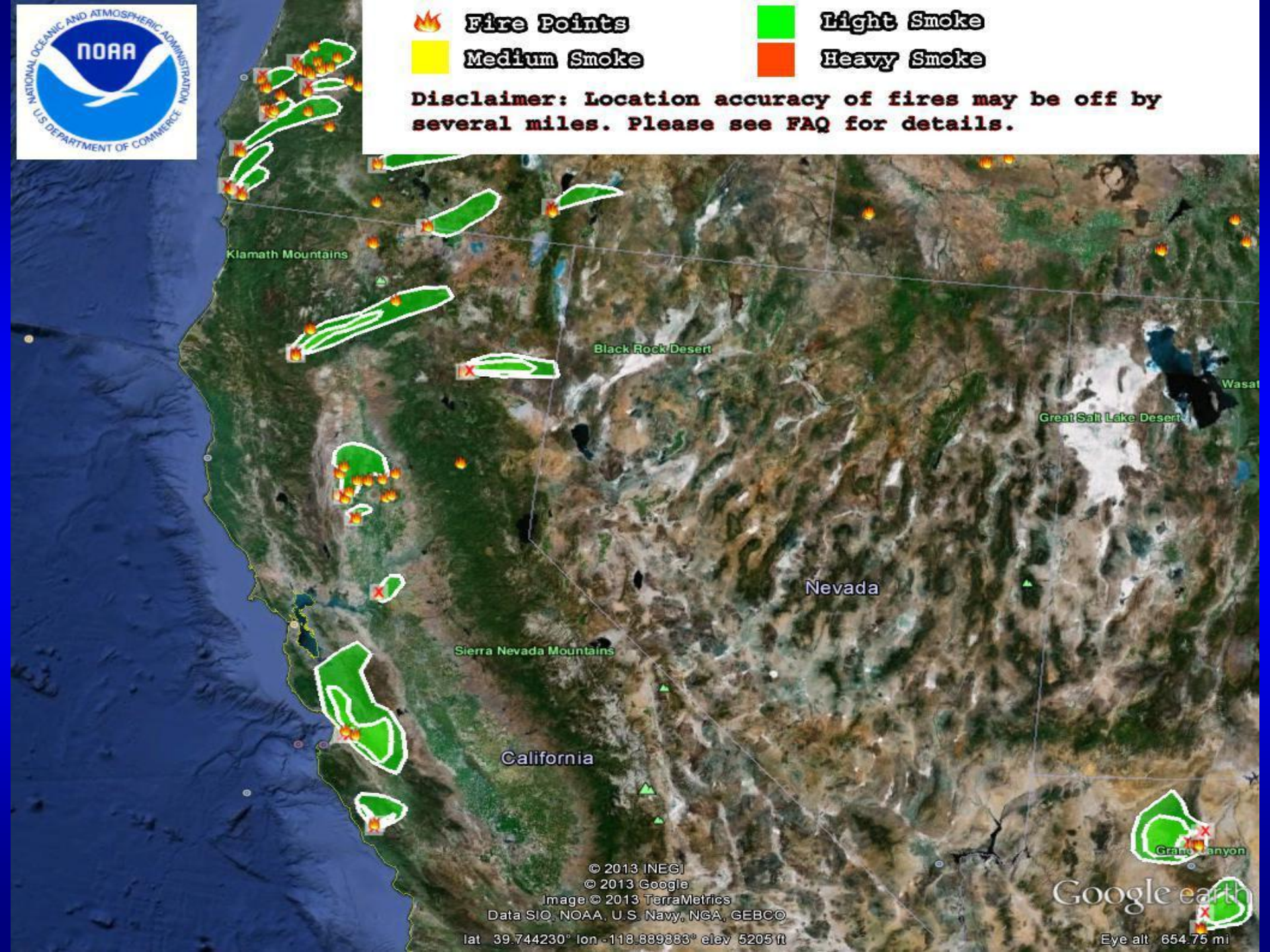


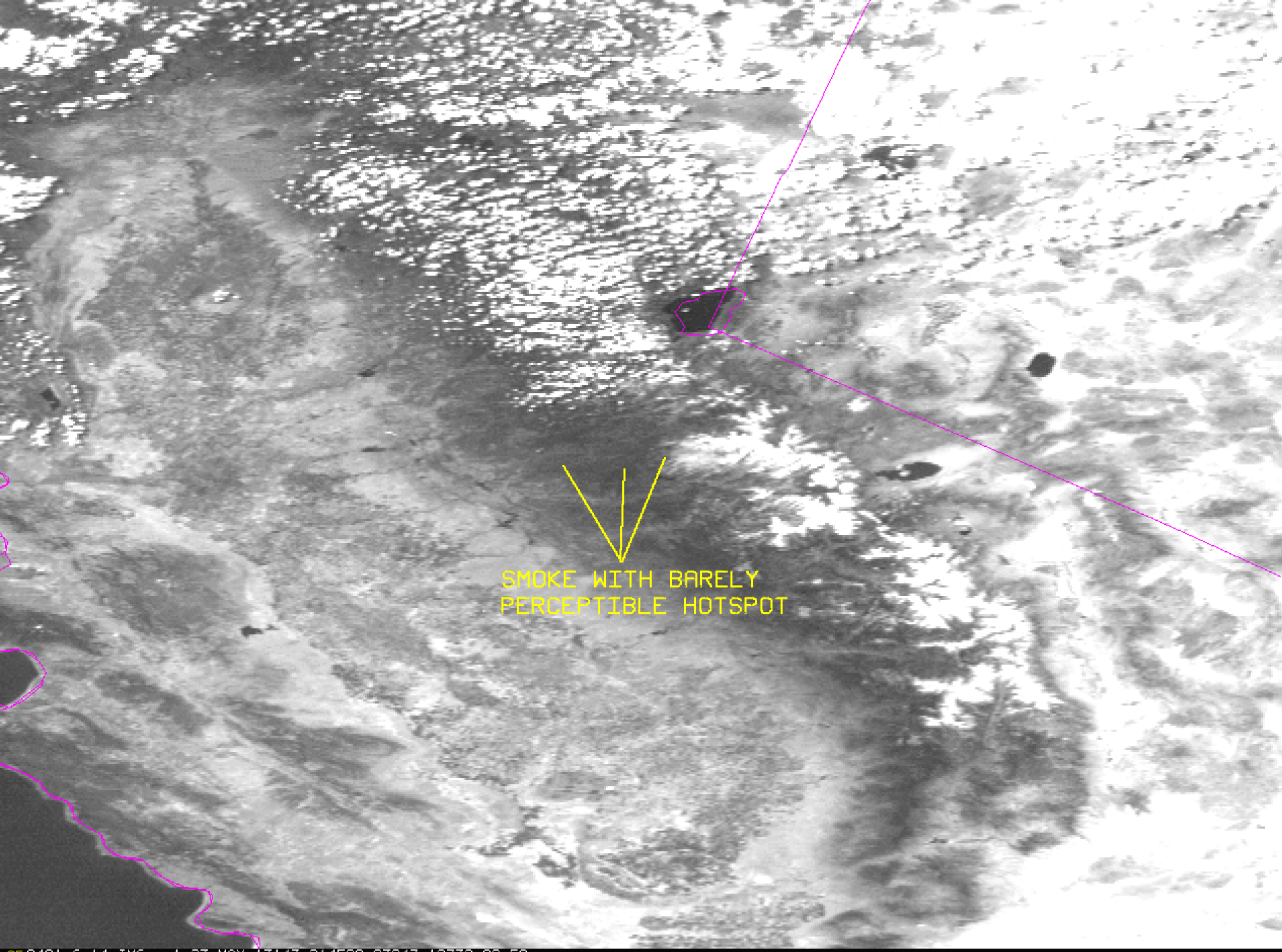



NOTE APPEARANCE OF SMOKE VS CLOUD
Wildfire example
565 0565 G-13 IMG 1 19 SEP 12263 181500 03517 10078 01.00
565 0565 G-13 IMG 2 19 SEP 12263 181500 03517 10077 01.00



35 0491 G-13 IMG 1 6 NOV 12311 184500 04181 09293 00.50


Fire Points
Light Smoke
Medium Smoke
Heavy Smoke
Disclaimer: Location accuracy of fires may be off by several miles. Please see FAQ for details.
Klamath Mountains
Black Rock Desert
Great Salt Lake Desert
Nevada
Sierra Nevada Mountains
California
© 2013 INEGI
© 2013 Google
Image © 2013 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
lat 39.744230° lon -118.889883° elev 5205 ft
Google earth
Eye alt 654.75 mi



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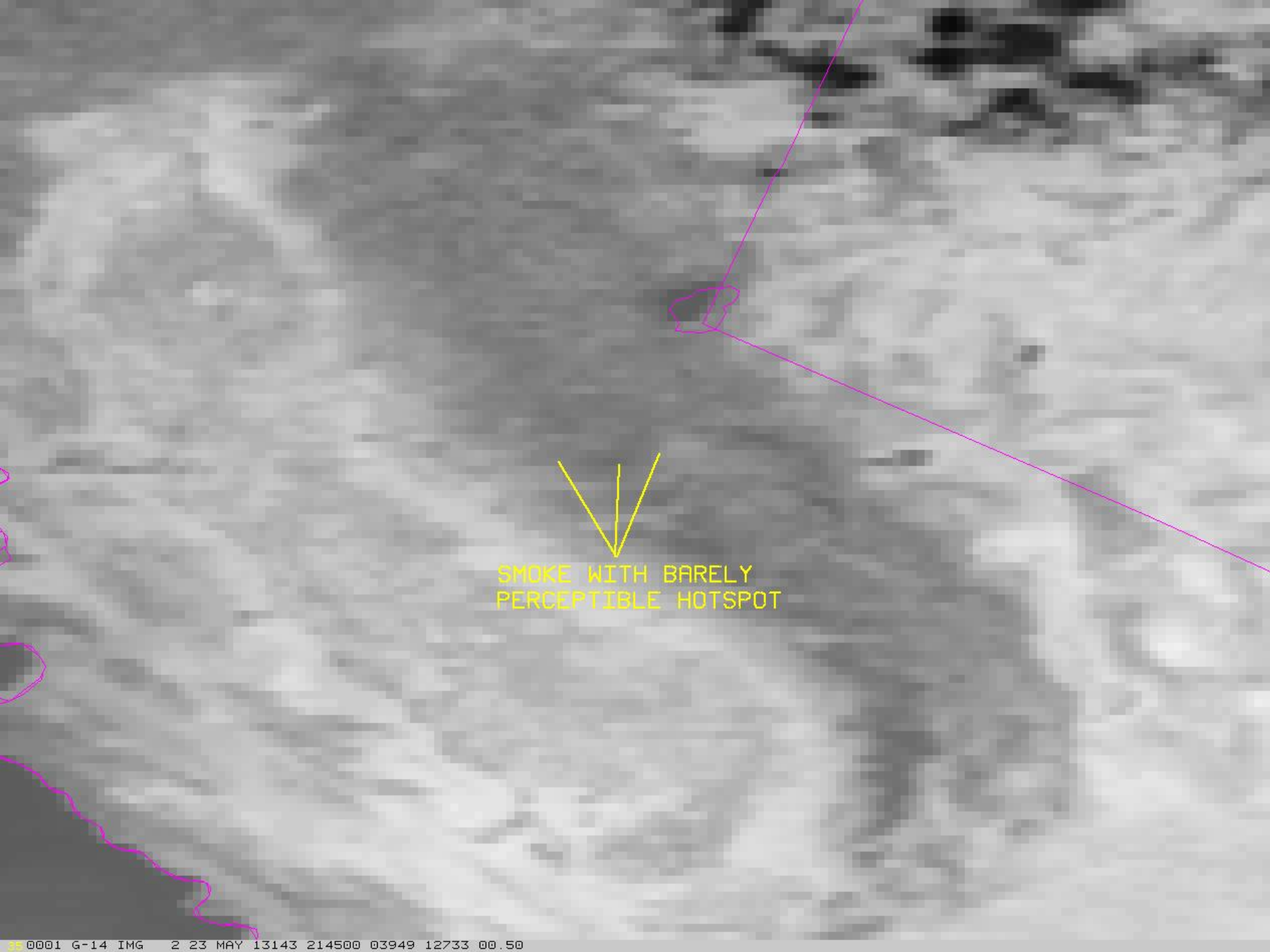
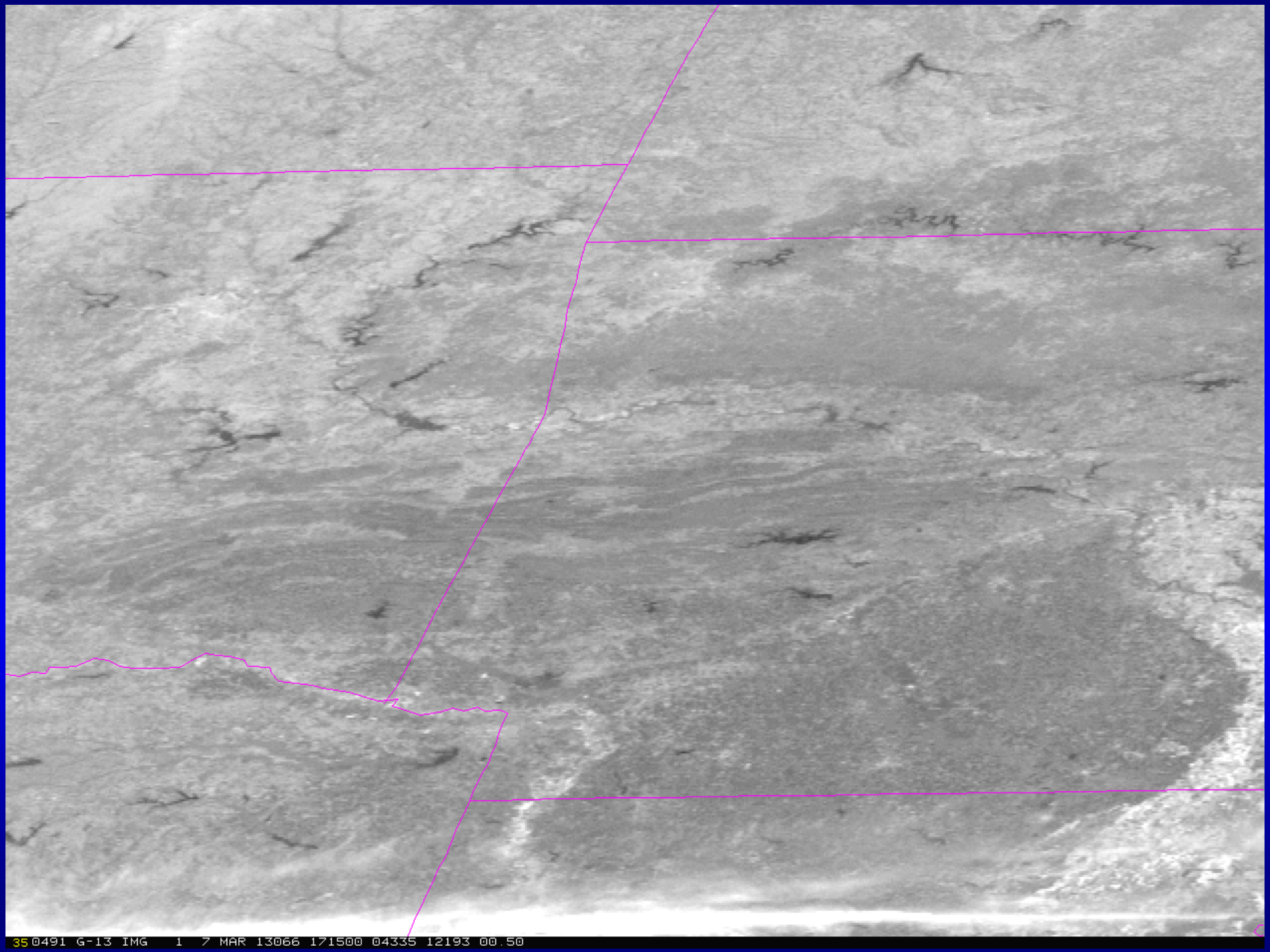


0001 G-14 IMG 2 23 MAY 13143 214500 03949 12733 00.50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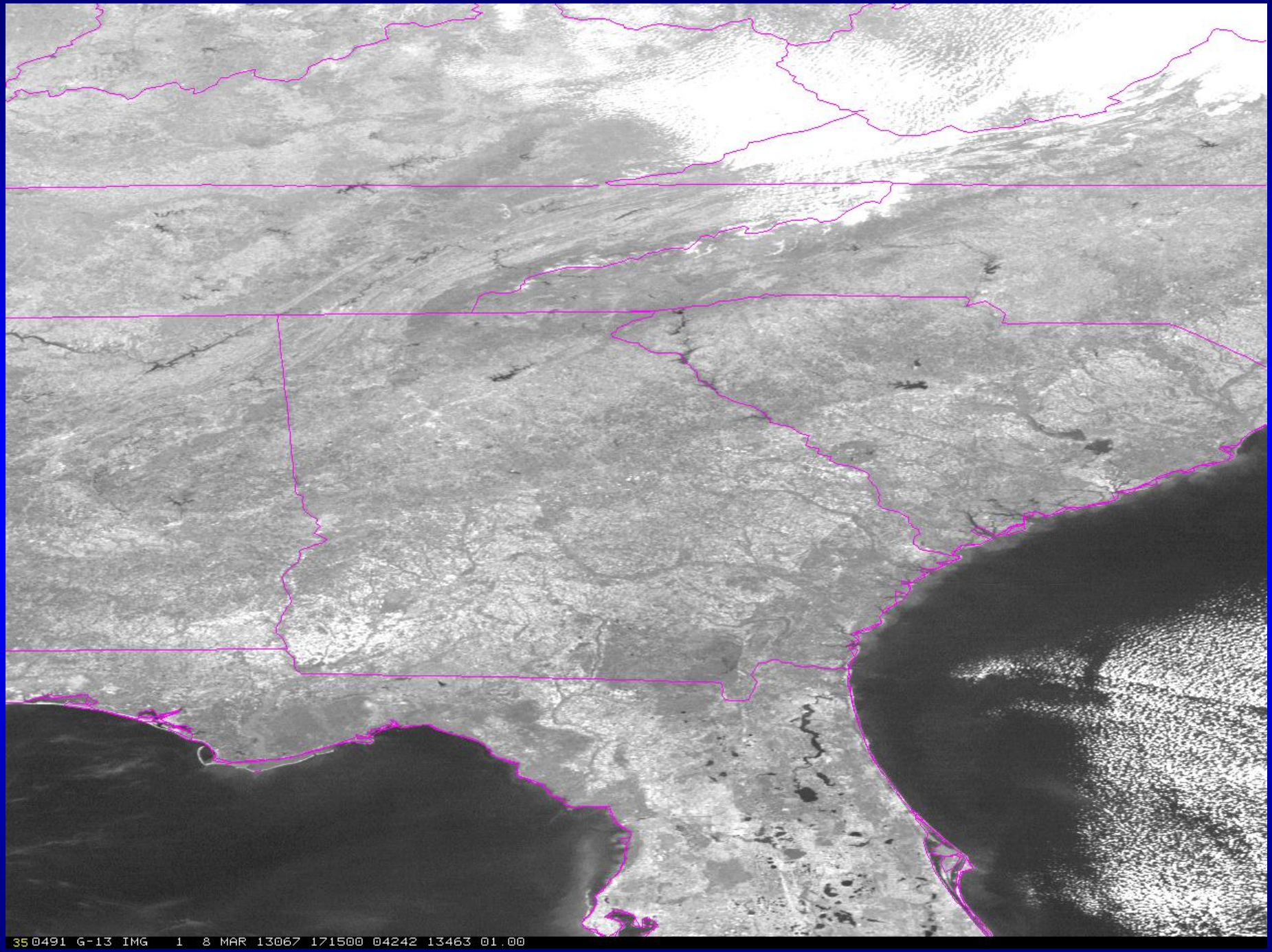
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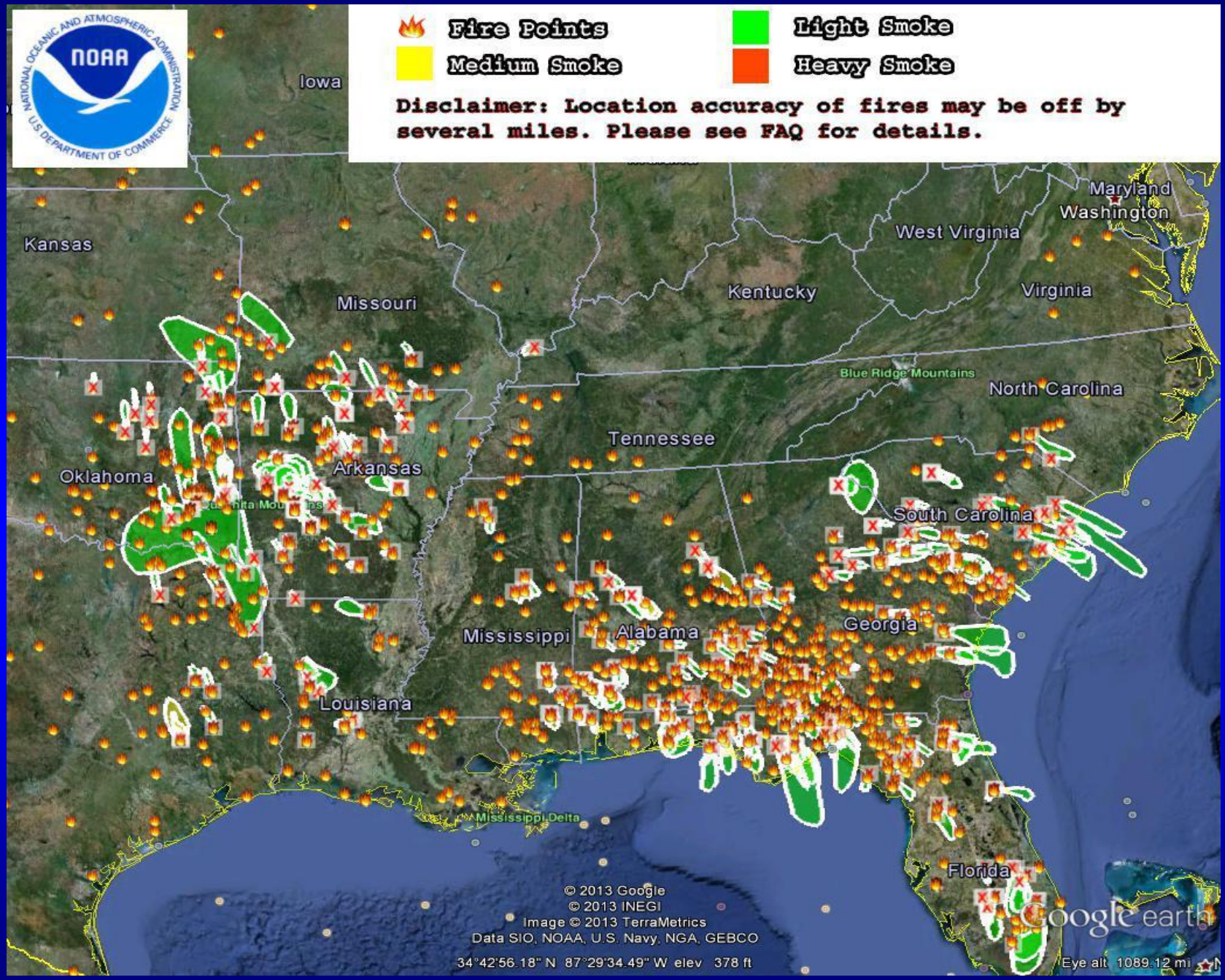
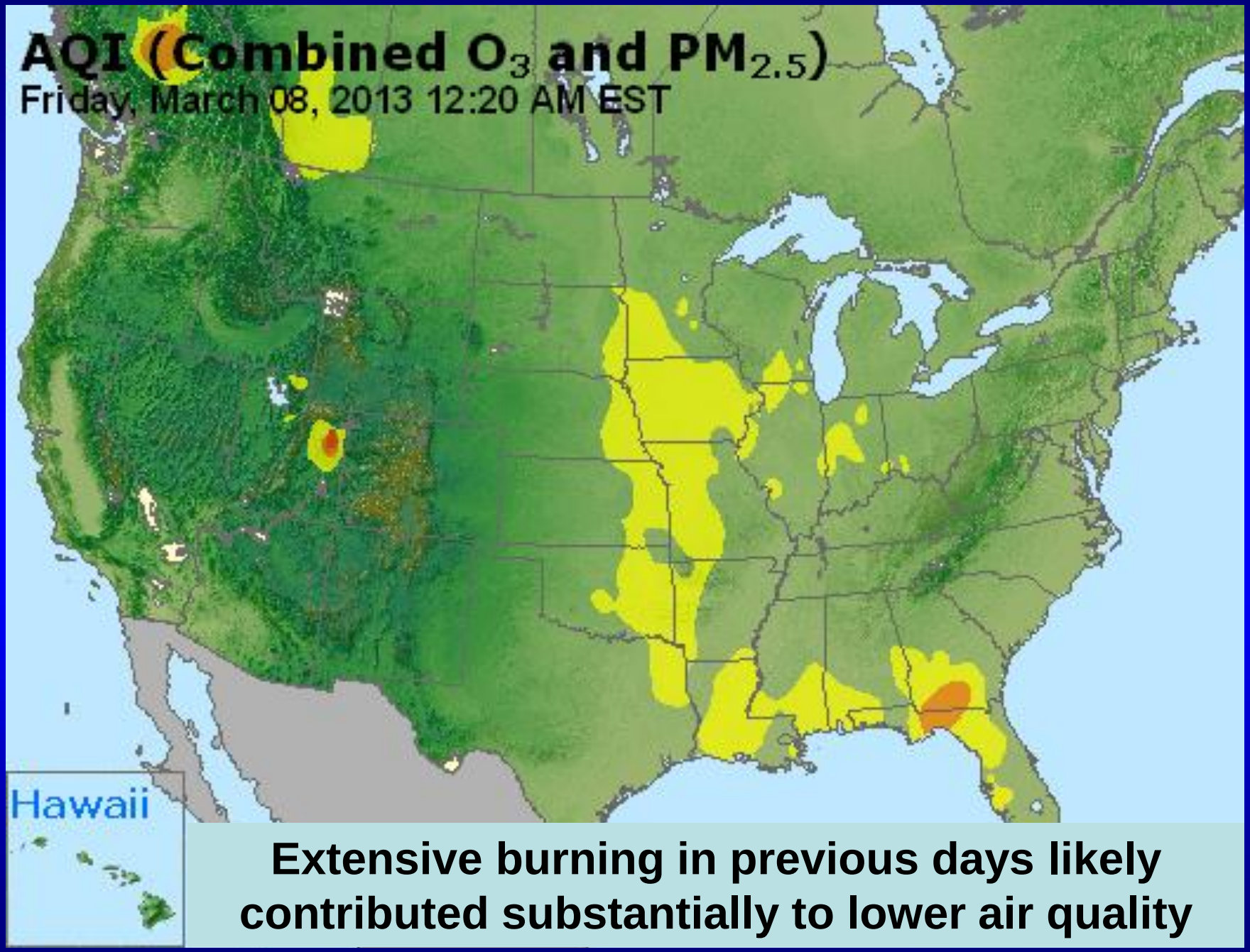
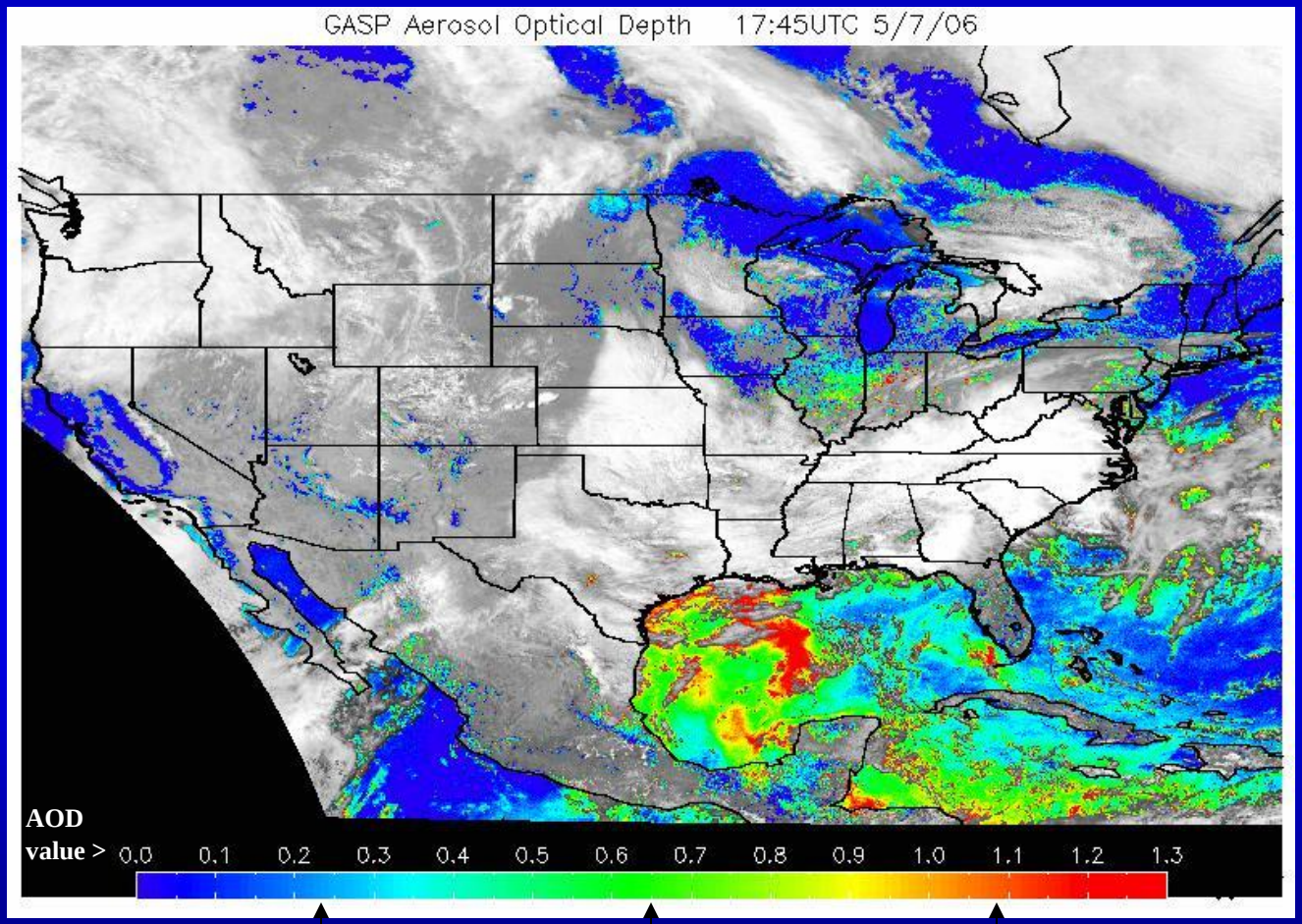

Fire Points
Light Smoke
Medium Smoke
Heavy Smoke
Disclaimer: Location accuracy of fires may be off by several miles. Please see FAQ for details.
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
Iowa
Kansas
Missouri
Kentucky
West Virginia
Maryland
Washington
Virginia
Blue Ridge Mountains
North Carolina
Tennessee
Oklahoma
Arkansas
South Carolina
Mississippi
Alabama
Georgia
Louisiana
Mississippi Delta
Florida
© 2013 Google
© 2013 INEGI
Image © 2013 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
34°42'56.18" N 87°29'34.49" W elev 378 ft
Google earth
Eye alt 1089.12 mi



Extensive burning in previous days likely contributed substantially to lower air quality

HAZARD MAPPING SYSTEM

AEROSOLS



HAZARD MAPPING SYSTEM

Limitations of GASP (and analyst drawn contours):

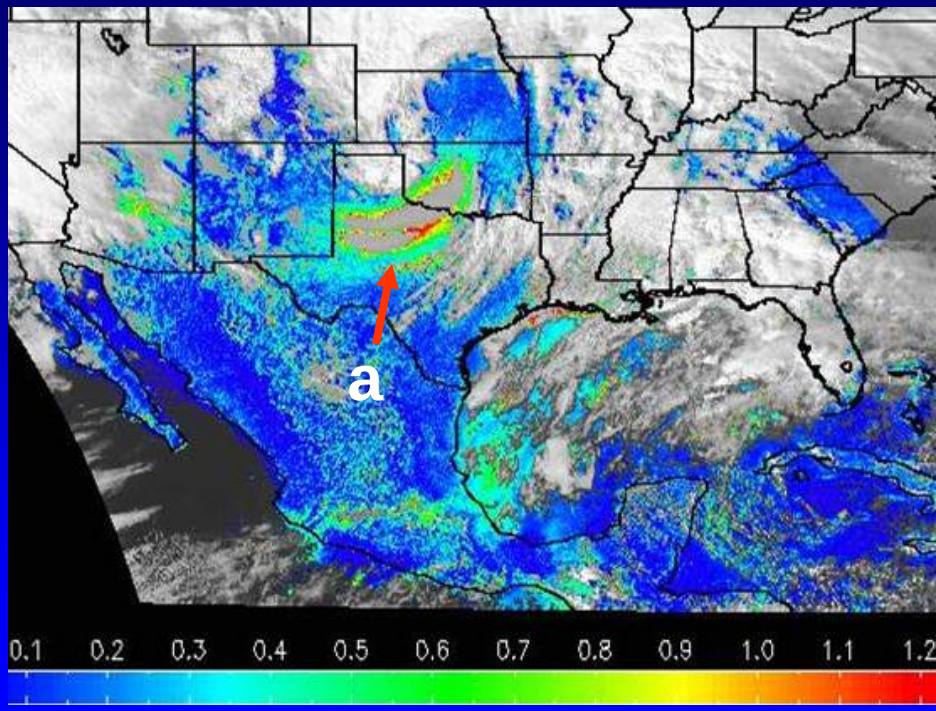
There is no vertical structure

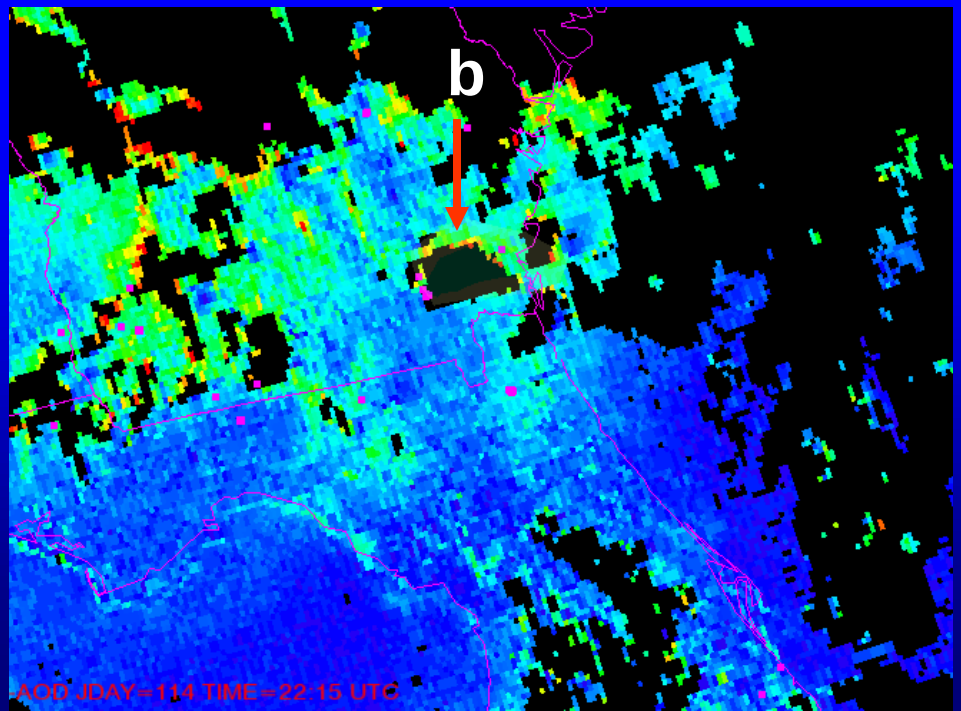
Due to dependence on visible imagery, only available during daylight

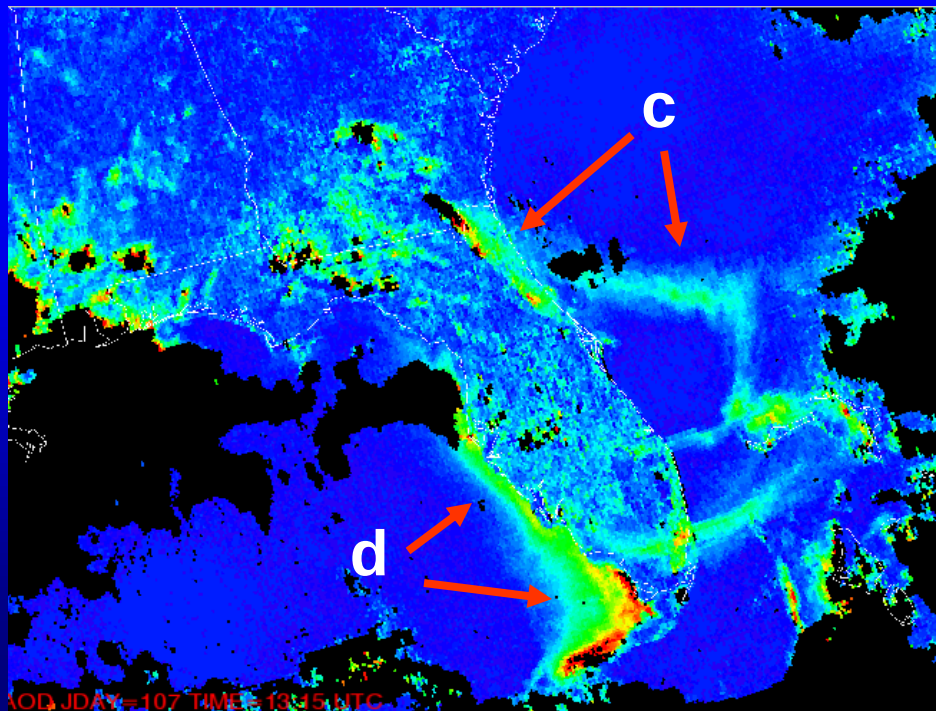
Clouds hinder detection

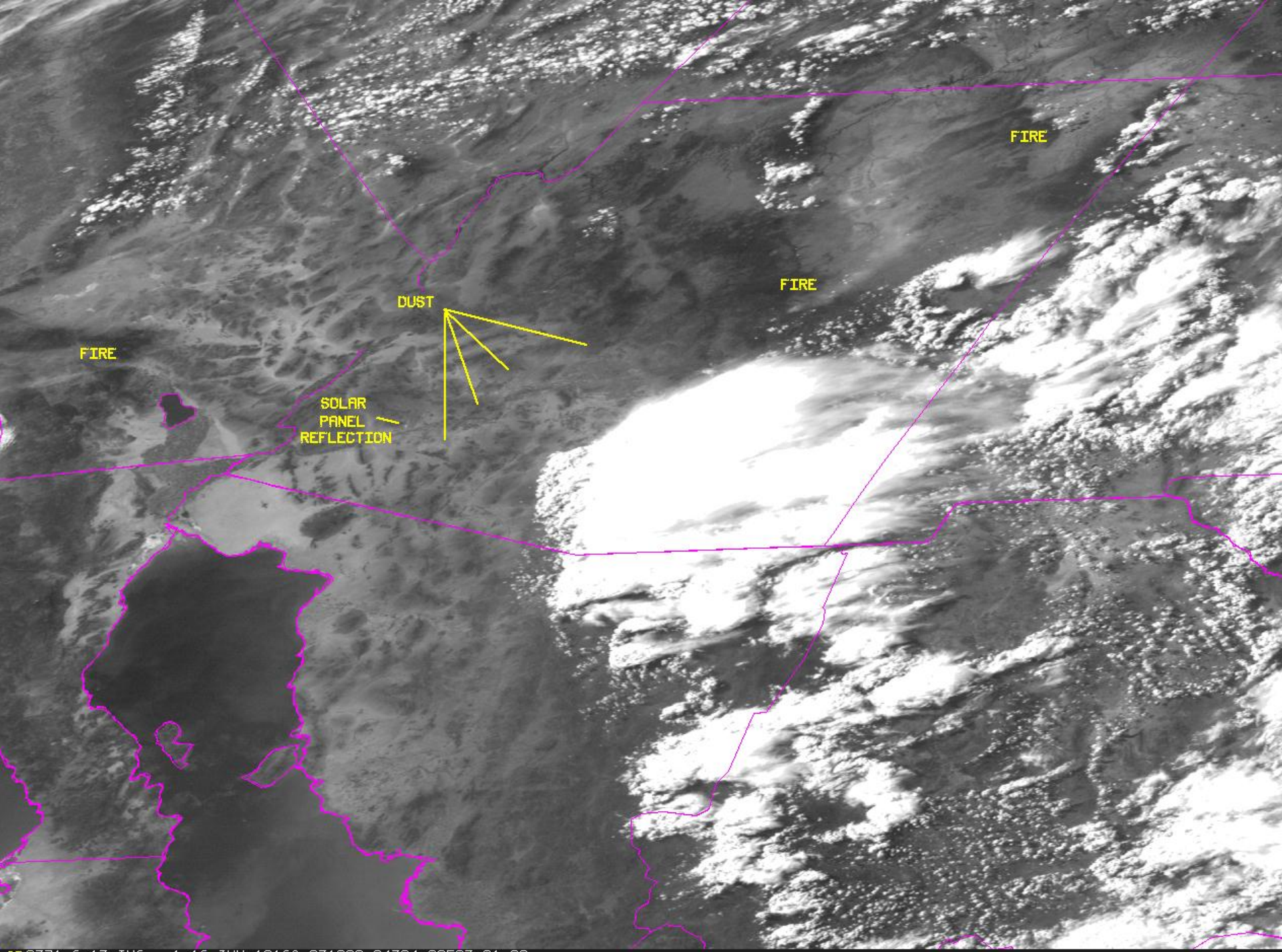
GASP does not distinguish between aerosol types – analysts attempt to

(a) dust storm
(b) dense smoke
(c) moderate smoke
(d) sea surface feature









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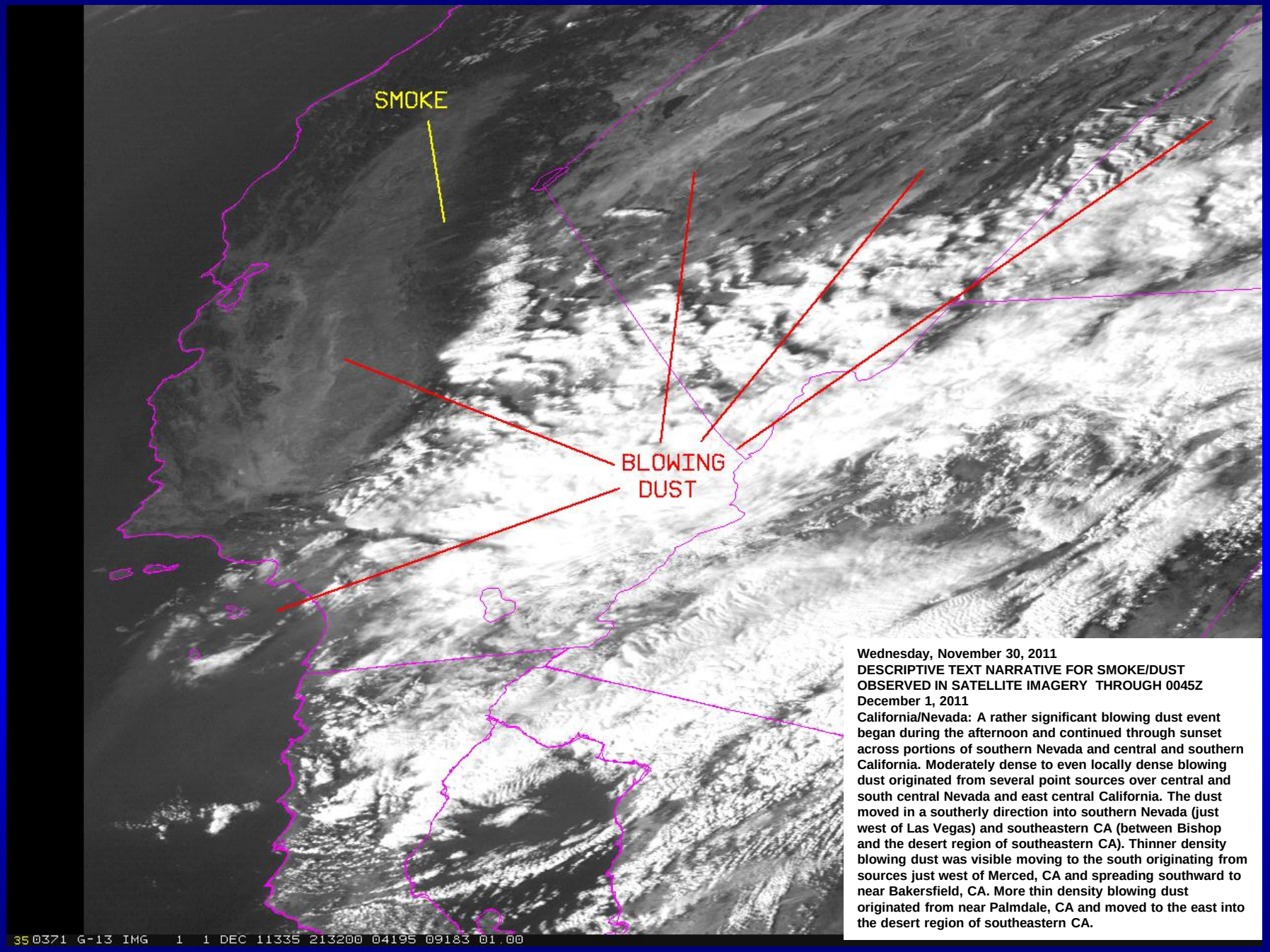
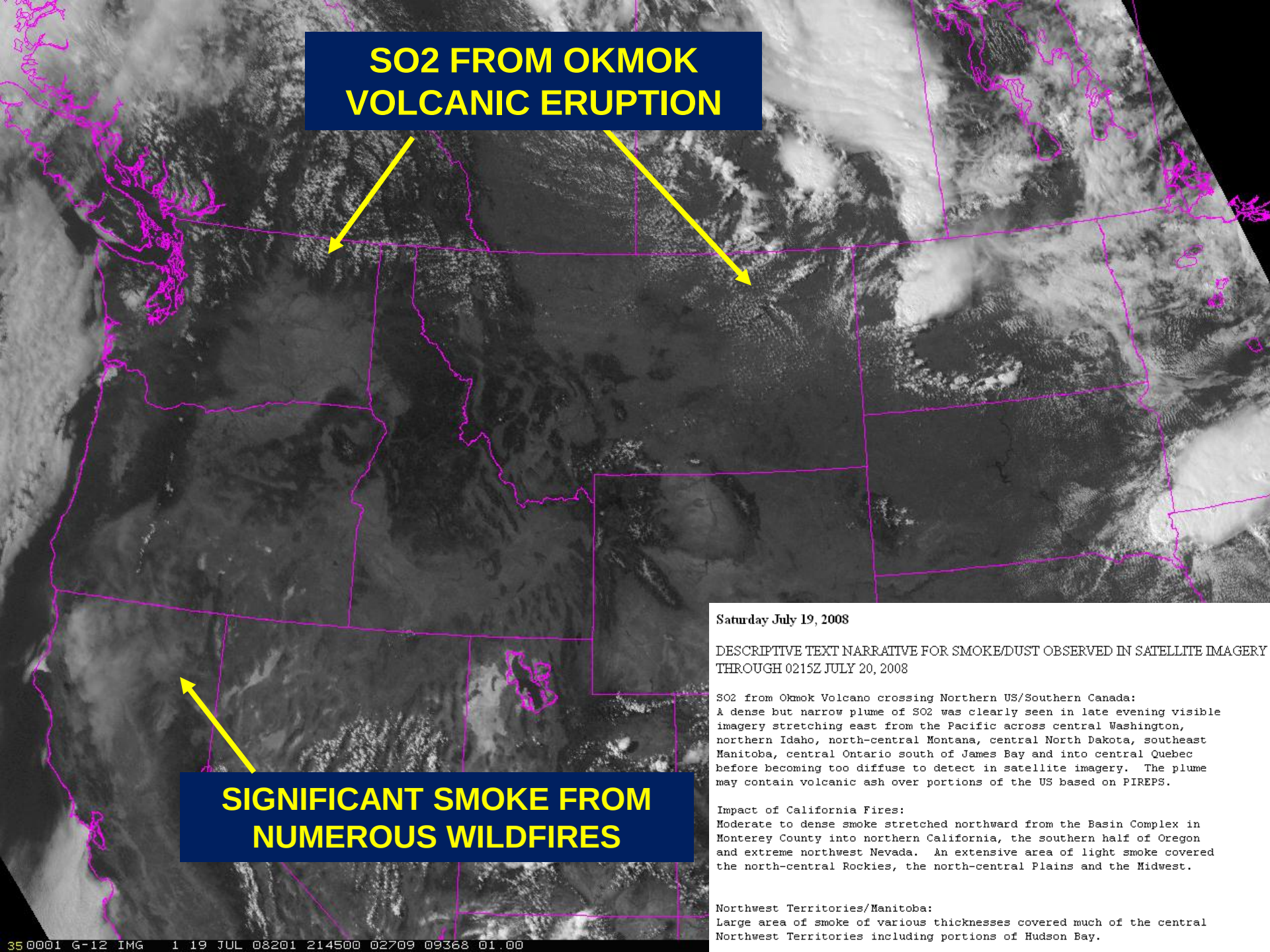


Wednesday, November 30, 2011
DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY THROUGH 0045Z December 1, 2011

California/Nevada: A rather significant blowing dust event began during the afternoon and continued through sunset across portions of southern Nevada and central and southern California. Moderately dense to even locally dense blowing dust originated from several point sources over central and south central Nevada and east central California. The dust moved in a southerly direction into southern Nevada (just west of Las Vegas) and southeastern CA (between Bishop and the desert region of southeastern CA). Thinner density blowing dust was visible moving to the south originating from sources just west of Merced, CA and spreading southward to near Bakersfield, CA. More thin density blowing dust originated from near Palmdale, CA and moved to the east into the desert region of southeastern CA.



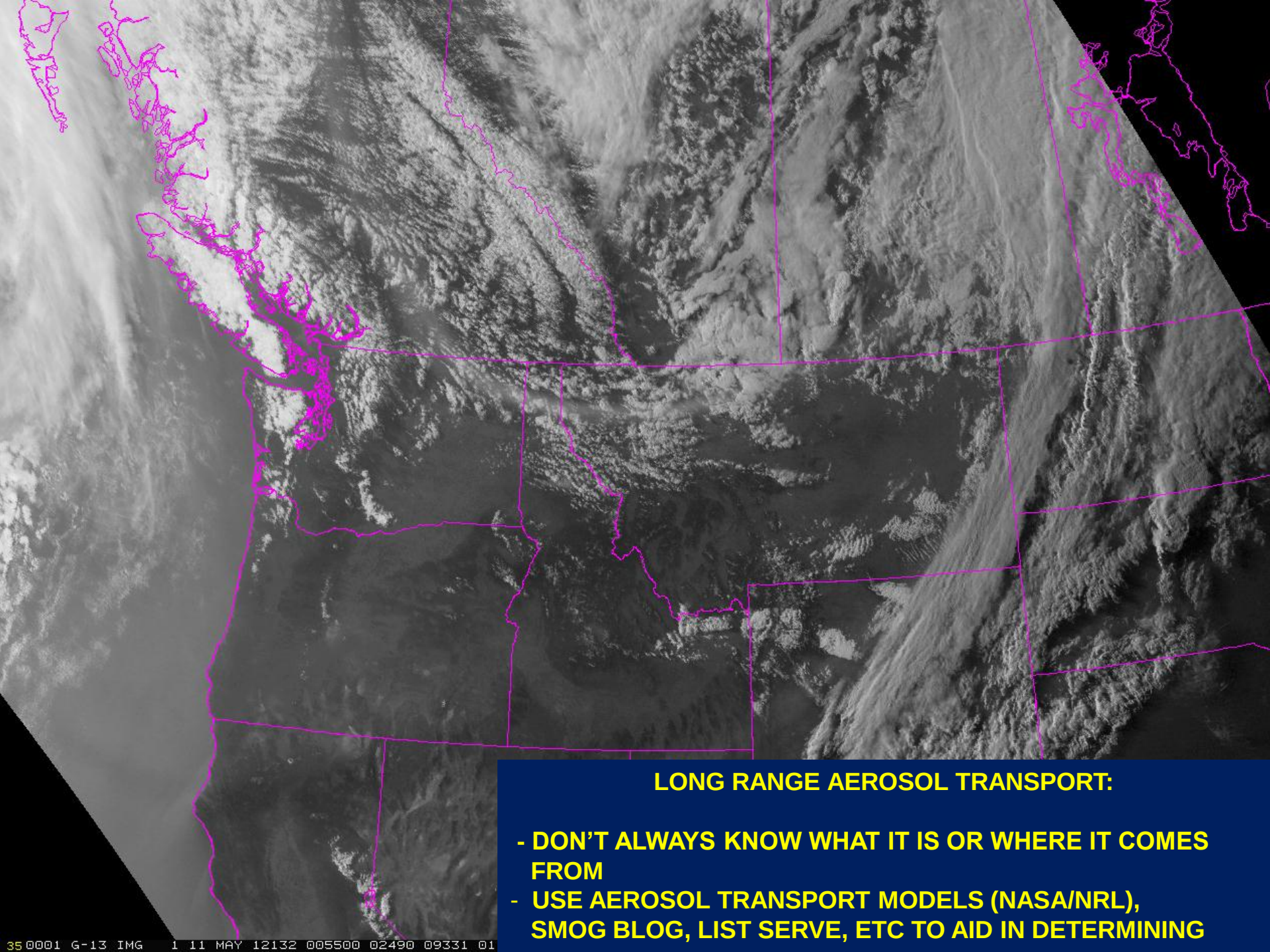
Saturday July 19, 2008

DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY THROUGH 0215Z JULY 20, 2008

SO2 from Okmok Volcano crossing Northern US/Southern Canada:
A dense but narrow plume of SO2 was clearly seen in late evening visible imagery stretching east from the Pacific across central Washington, northern Idaho, north-central Montana, central North Dakota, southeast Manitoba, central Ontario south of James Bay and into central Quebec before becoming too diffuse to detect in satellite imagery. The plume may contain volcanic ash over portions of the US based on PIREPS.

Impact of California Fires:
Moderate to dense smoke stretched northward from the Basin Complex in Monterey County into northern California, the southern half of Oregon and extreme northwest Nevada. An extensive area of light smoke covered the north-central Rockies, the north-central Plains and the Midwest.

Northwest Territories/Manitoba:
Large area of smoke of various thicknesses covered much of the central Northwest Territories including portions of Hudson Bay.


LONG RANGE AEROSOL TRANSPORT:
- DON'T ALWAYS KNOW WHAT IT IS OR WHERE IT COMES FROM
- USE AEROSOL TRANSPORT MODELS (NASA/NRL), SMOG BLOG, LIST SERVE, ETC TO AID IN DETERMINING
35 0001 G-13 IMG 1 11 MAY 12132 005500 02490 09331 01

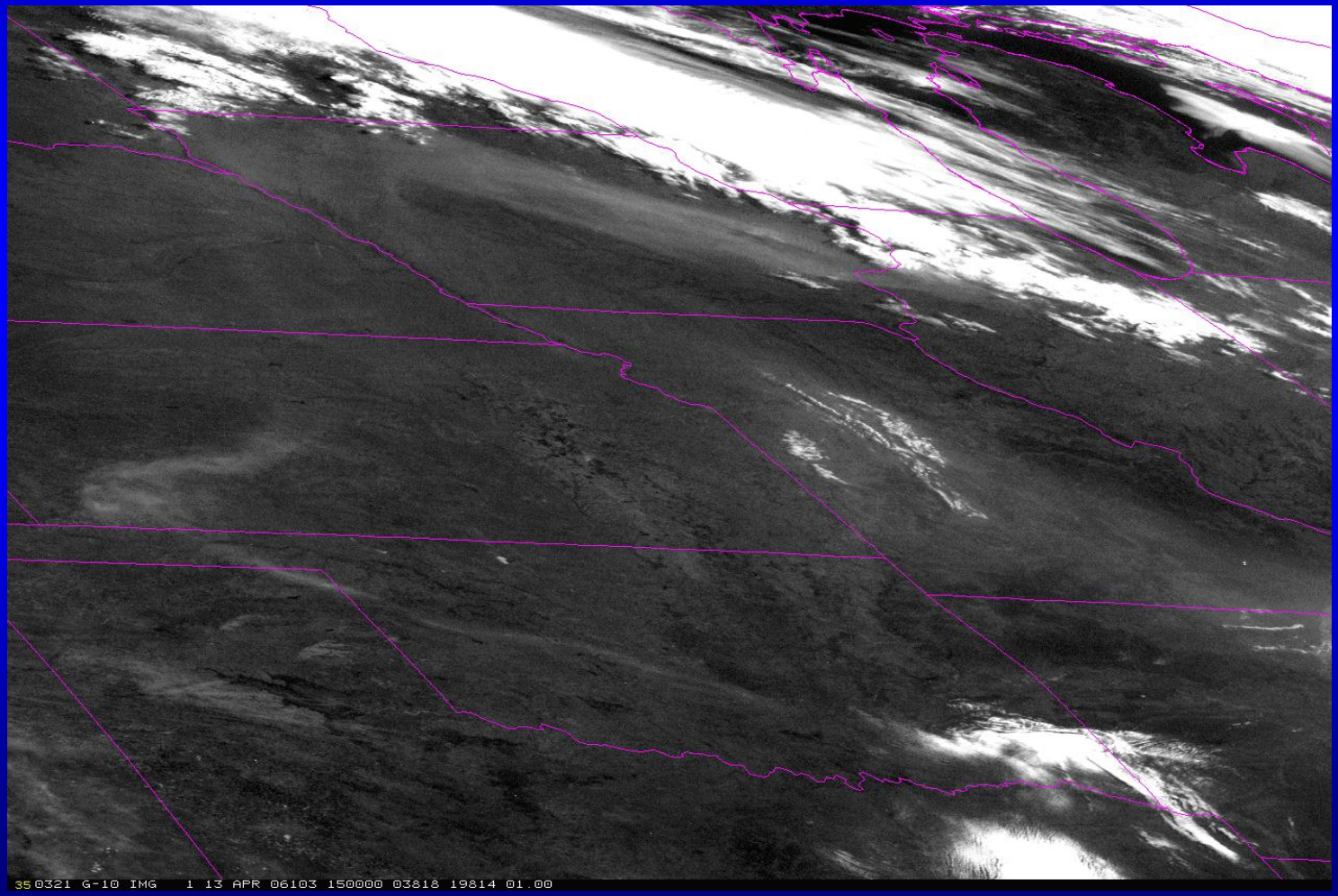
HAZARD MAPPING SYSTEM

Even short duration fires with limited smoke can produce regionally significant emissions under the right atmospheric conditions and with a large number of fires

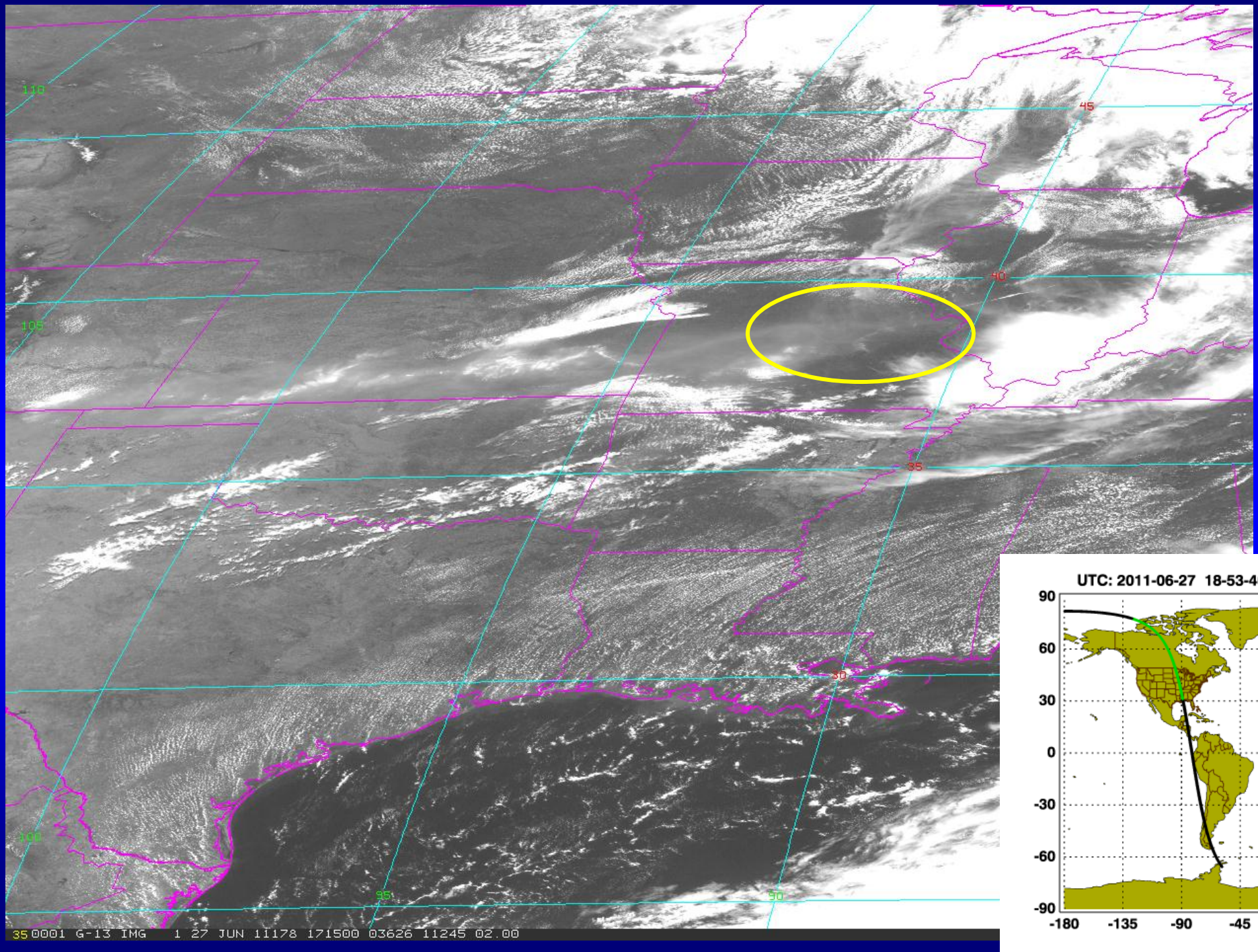
HAZARD MAPPING SYSTEM

Large number of agricultural/prescribed burns

HAZARD MAPPING SYSTEM



CALIPSO AND GROUND LIDAR CAN HELP WITH HEIGHT DETERMINATION AND AEROSOL SPECIATION...


110
105
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55
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45
40
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30
35 0001 G-13 IMG 1 27 JUN 11178 171500 03626 11245 02.00
UTC: 2011-06-27 18-53-46
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60
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0
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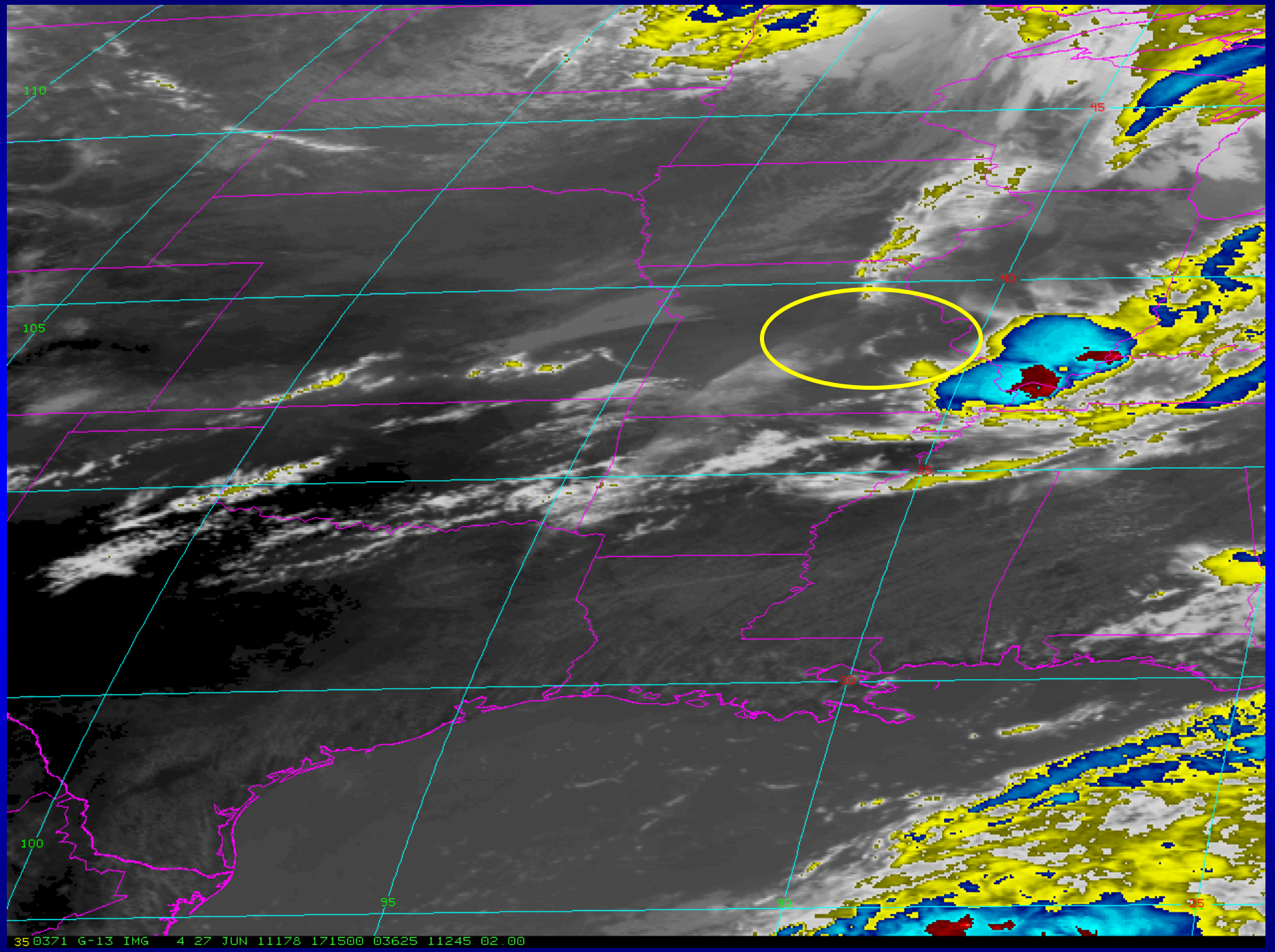
-60
-90
-180
-135
-90
-45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90
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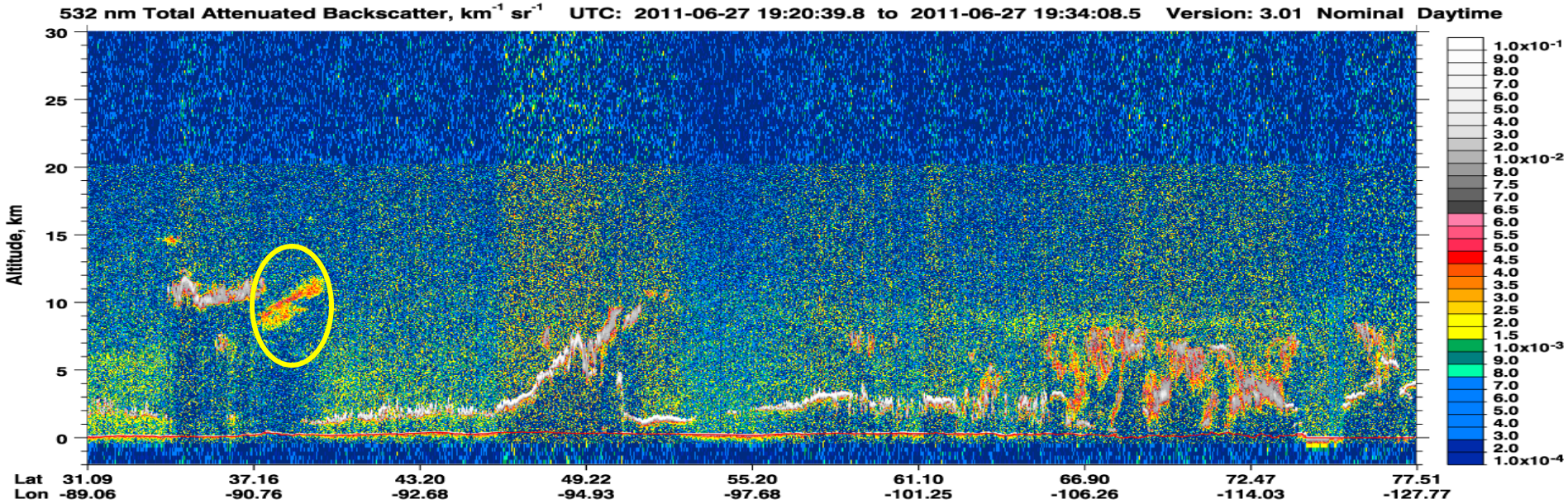
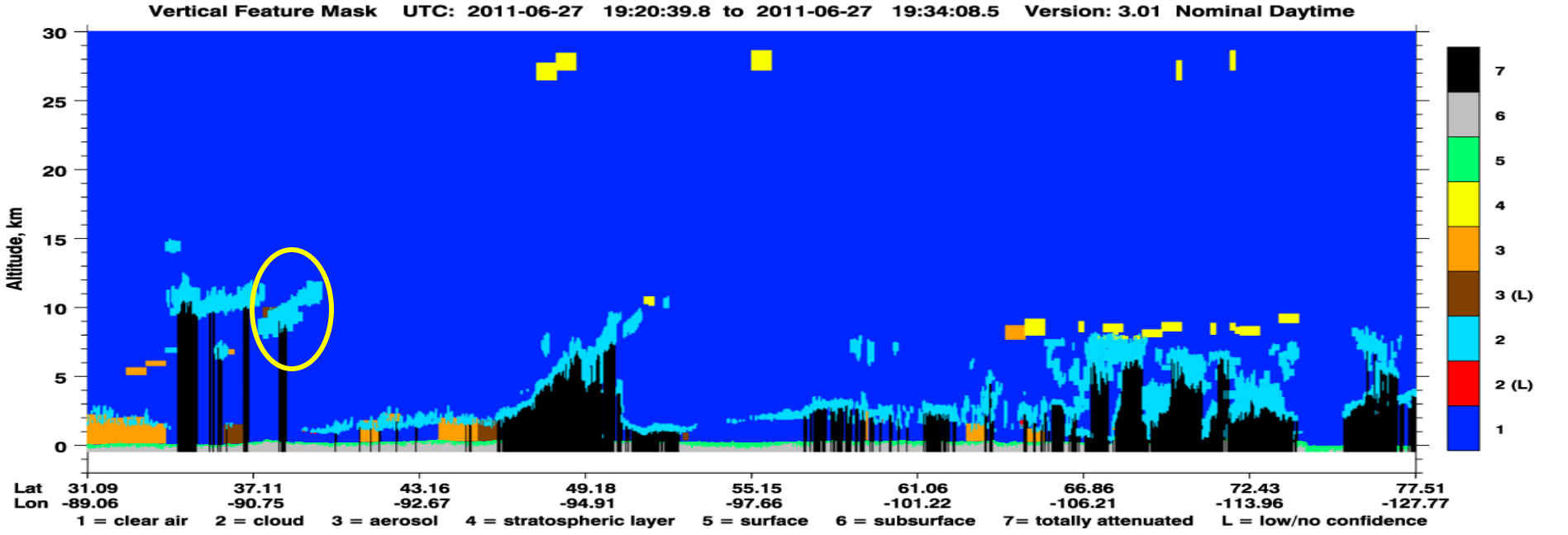
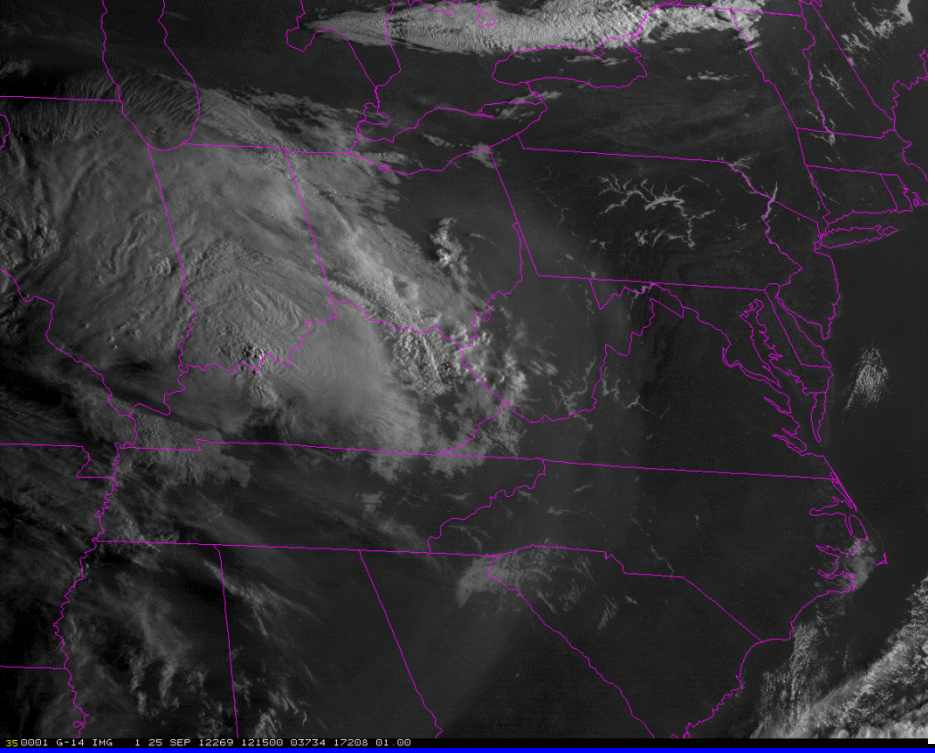
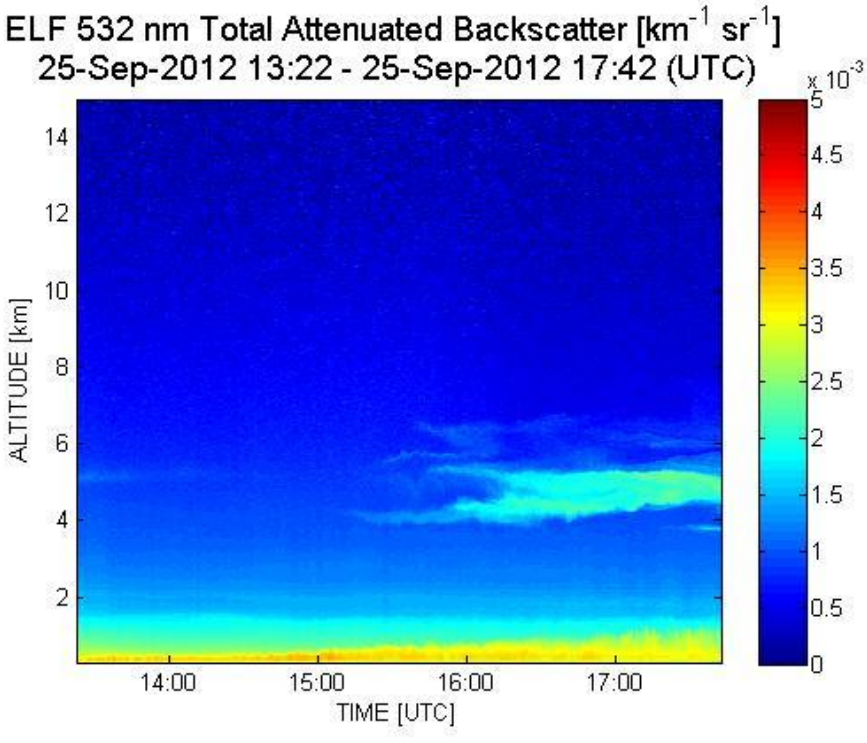
40
35
0371 G-13 IMG 4 27 JUN 11178 171500 03625 11245 02.00

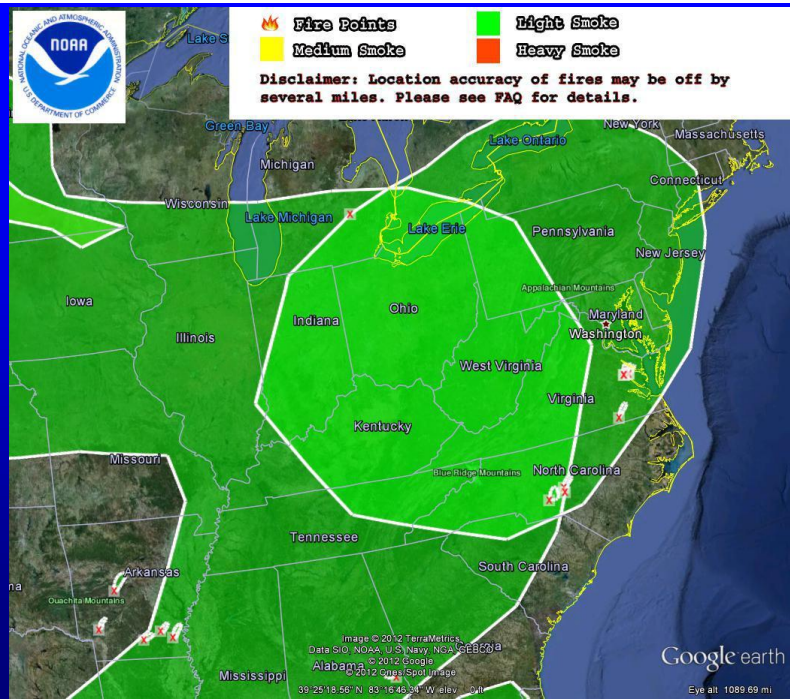

532 nm Total Attenuated Backscatter, km-1 sr-1 UTC: 2011-06-27 19:20:39.8 to 2011-06-27 19:34:08.5 Version: 3.01 Nominal Daytime
Altitude, km
30
25
20
15
10
5
0
1.0x10-1
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0x10-2
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0x10-3
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0x10-4
Lat 31.09 37.16 43.20 49.22 55.20 61.10 66.90 72.47 77.51
Lon -89.06 -90.76 -92.68 -94.93 -97.68 -101.25 -106.26 -114.03 -127.77


Vertical Feature Mask UTC: 2011-06-27 19:20:39.8 to 2011-06-27 19:34:08.5 Version: 3.01 Nominal Daytime
Altitude, km
30
25
20
15
10
5
0
7
6
5
4
3
3 (L)
2
2 (L)
1
Lat 31.09 37.11 43.16 49.18 55.15 61.06 66.86 72.43 77.51
Lon -89.06 -90.75 -92.67 -94.91 -97.66 -101.22 -106.21 -113.96 -127.77
1 = clear air 2 = cloud 3 = aerosol 4 = stratospheric layer 5 = surface 6 = subsurface 7= totally attenuated L = low/no confidence





GOOD CROSS VALIDATION BETWEEN SATELLITE AND UMBC ELF LIDAR FOR LARGE SCALE CONTINENTAL SMOKE EVENT ON SEP 25 2012

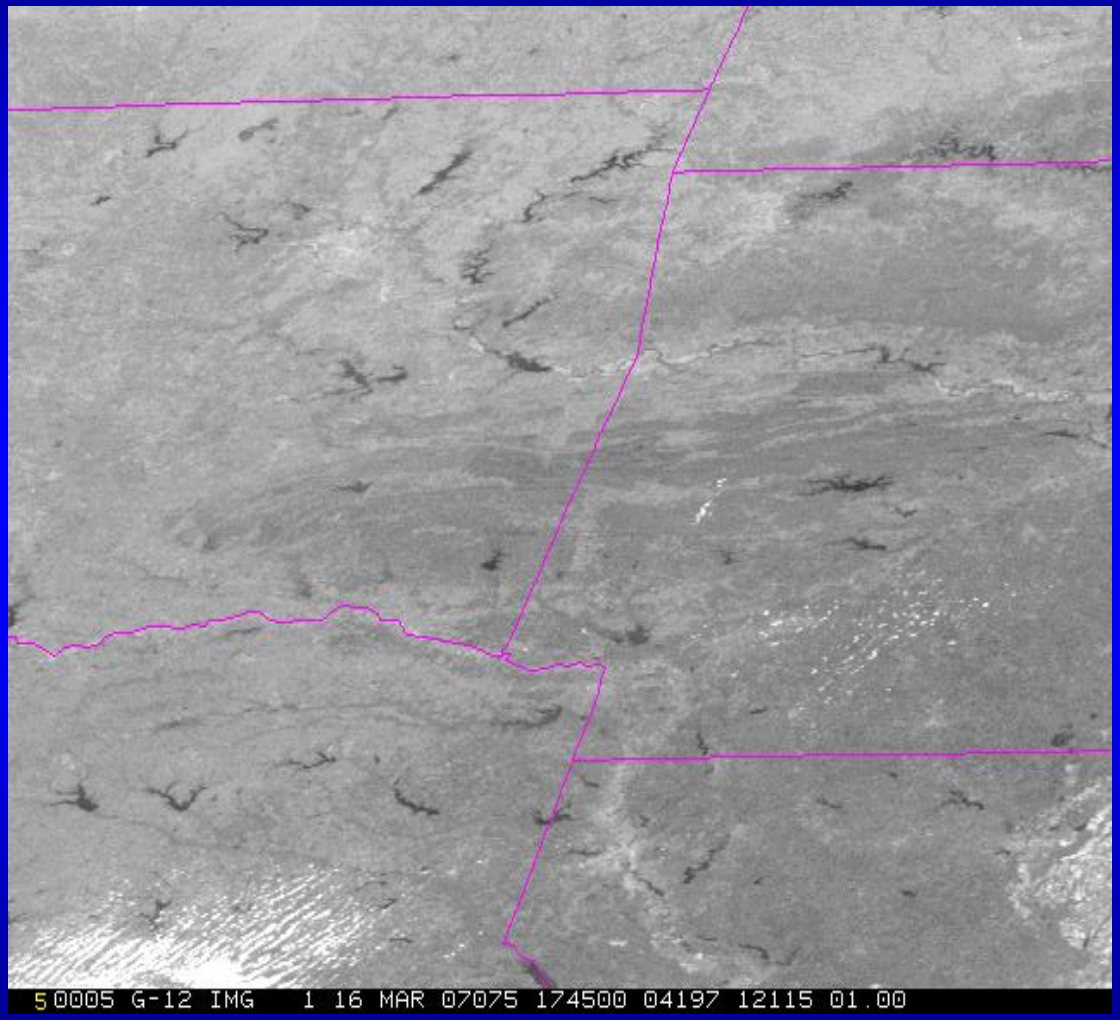


HAZARD MAPPING SYSTEM

Analyst input to the HYbrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) Model which is used in the National Weather Service (NWS) Air Quality Forecast:

- **Locations of smoke emitting fires**
- **Each point represents 1 square km**
- **Start time and duration of smoke emissions**

HAZARD MAPPING SYSTEM



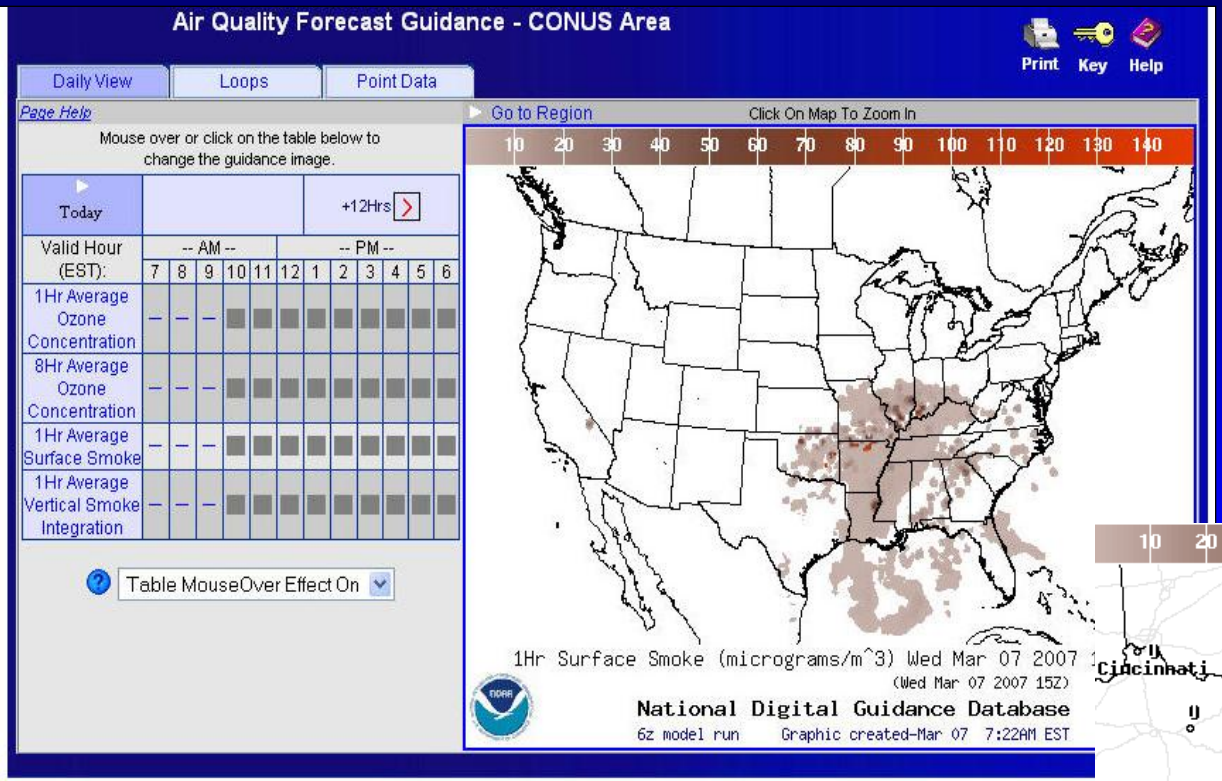
Note the differences in the smoke plumes:

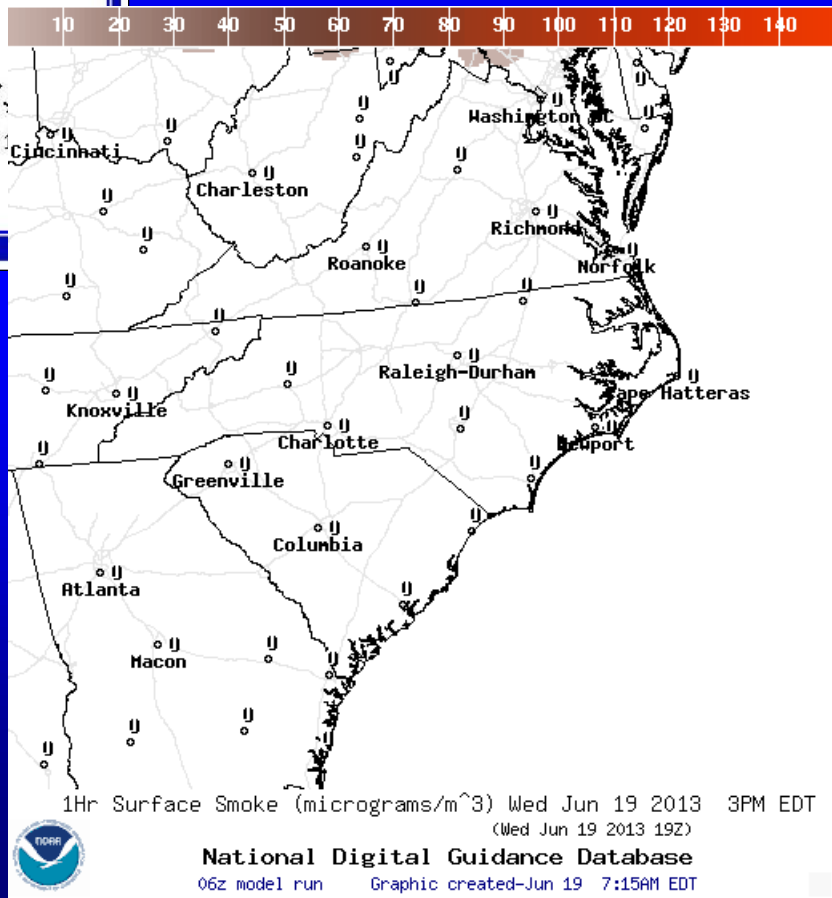
Start times

Smoke density

Amount of smoke

Dynamics within plume

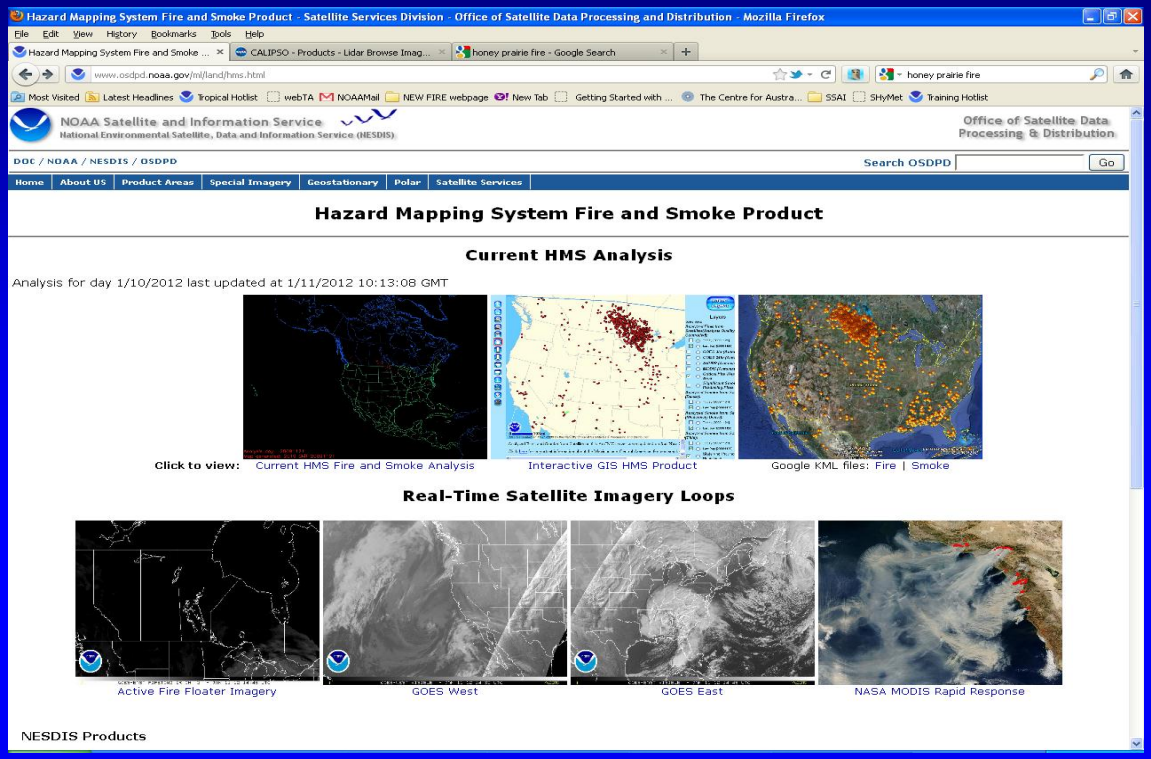




NWS Air Quality Forecast Guidance using HYSPLIT is run by NWS at 10Z on the following day using the 06Z NAM run for meteorology.

airquality.weather.gov/

PRODUCT ACCESS

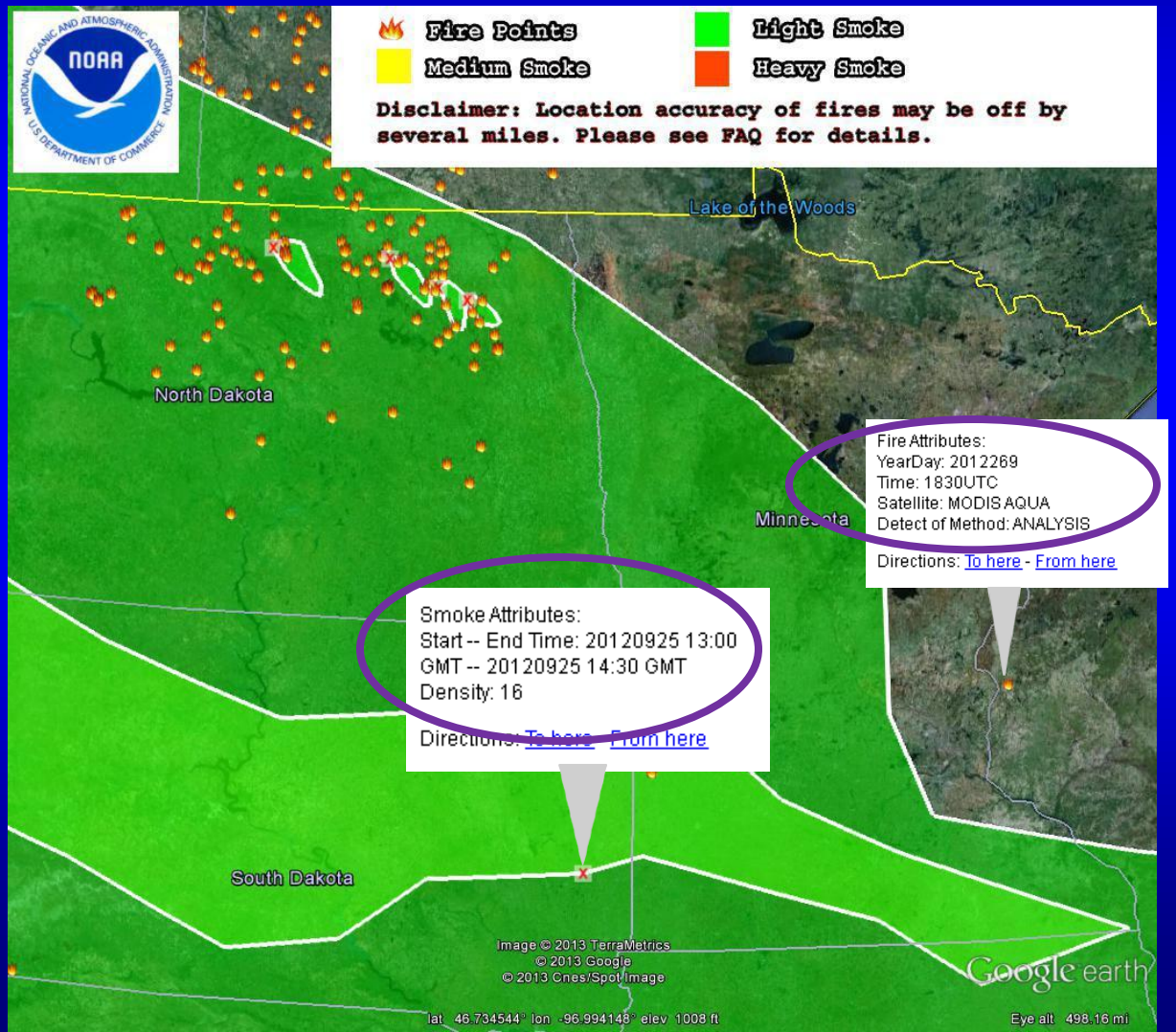


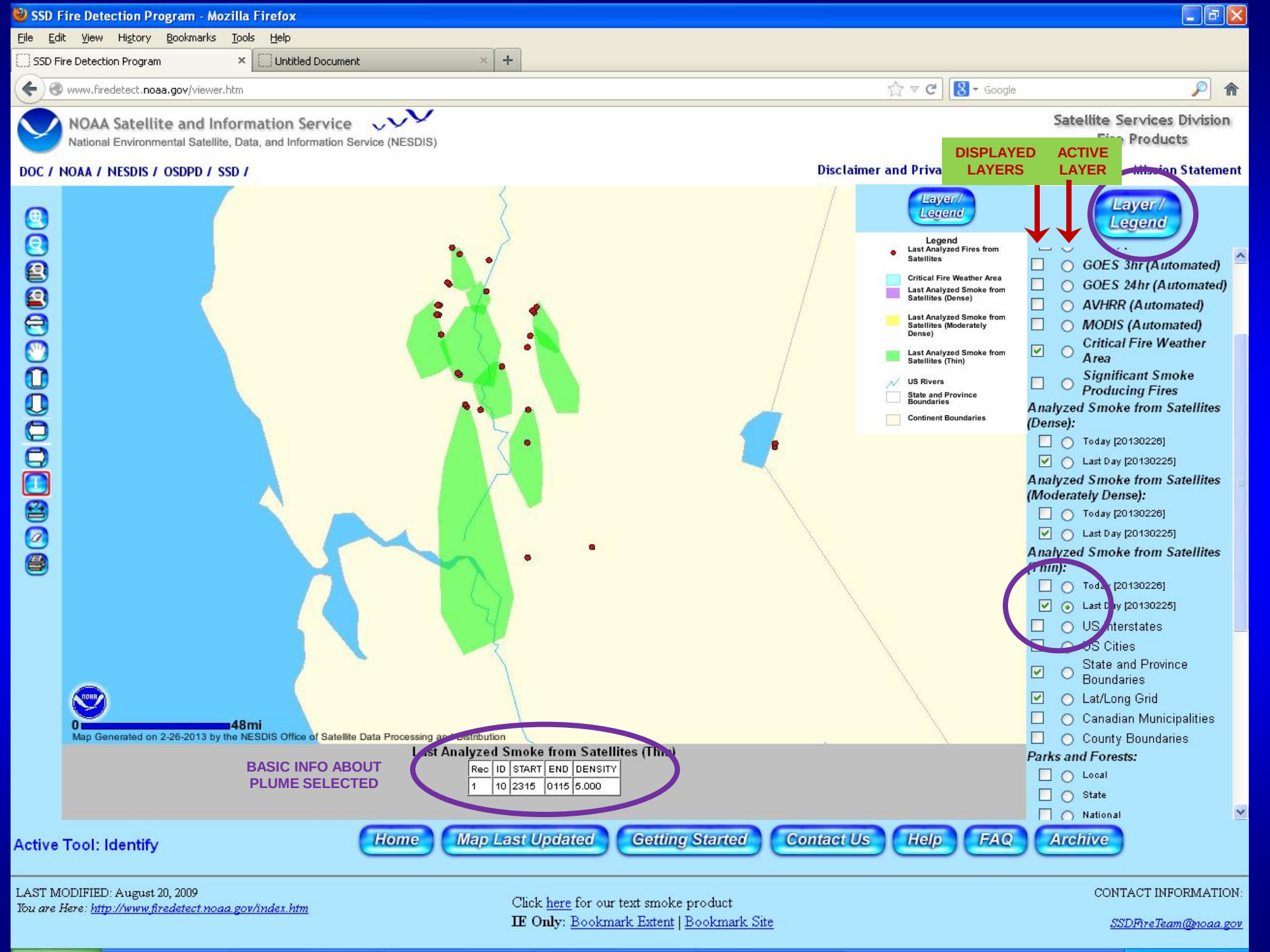
www.osdpd.noaa.gov/ml/land/hms.html

- **Includes links to**
  - **archived products**
  - **GIS page**
  - **near real time imagery**
  - **automated algorithms**
  - **smoke forecasts**
  - **manual quality controlled analysis**

GOOGLE EARTH KML DISPLAY

(NOTE – SMOKE DENSITY COLOR DOES NOT MATCH LEGEND)




SSD Fire Detection Program - Mozilla Firefox
File Edit View History Bookmarks Tools Help
SSD Fire Detection Program
Untitled Document
www.firedetect.noaa.gov/viewer.htm
NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)
Satellite Services Division
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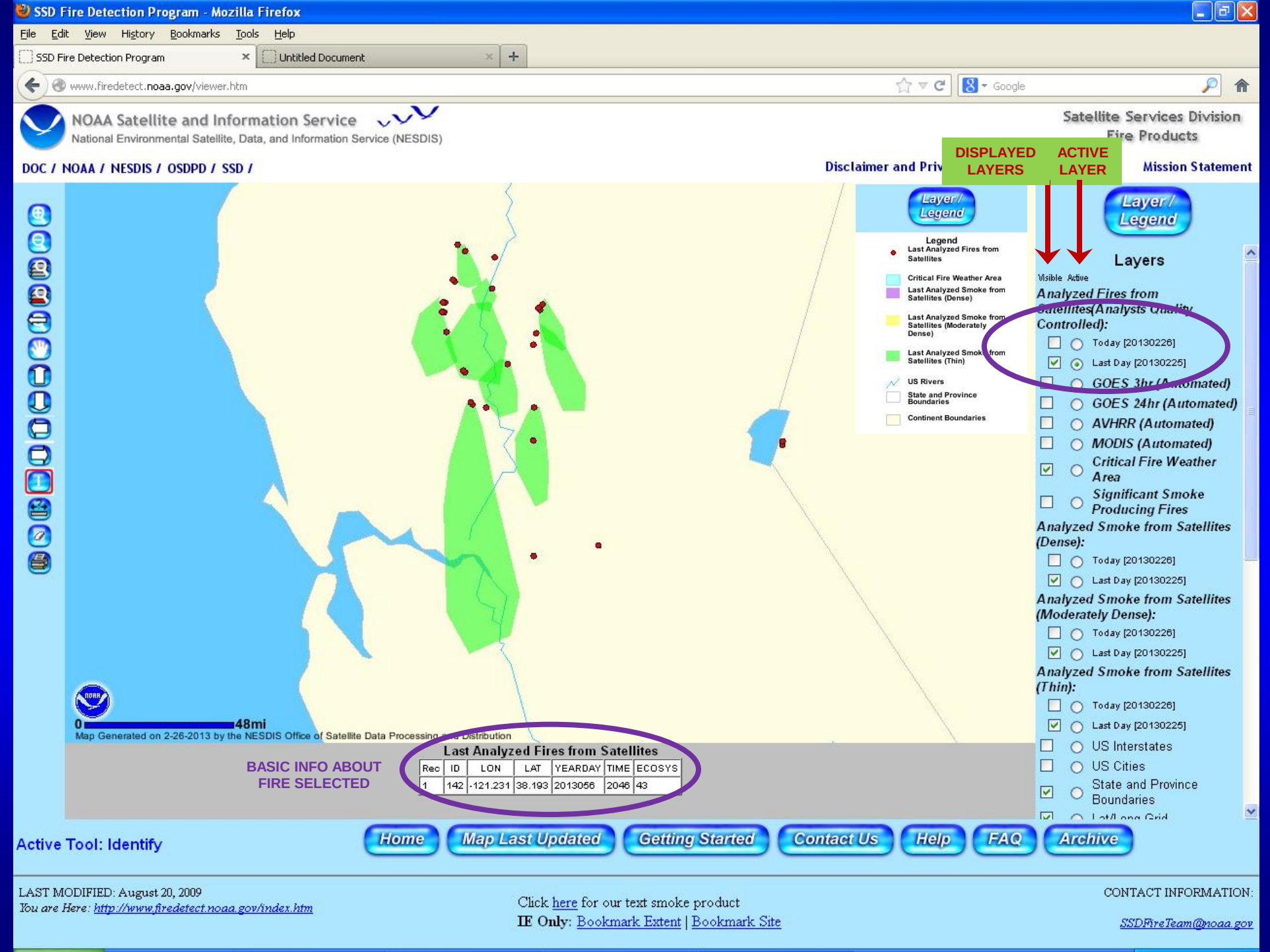
Mission Statement
DISPLAYED LAYERS
ACTIVE LAYER
Layer / Legend
Legend
Last Analyzed Fires from Satellites
Critical Fire Weather Area
Last Analyzed Smoke from Satellites (Dense)
Last Analyzed Smoke from Satellites (Moderately Dense)
Last Analyzed Smoke from Satellites (Thin)
US Rivers
State and Province Boundaries
Continent Boundaries
GOES 3hr (Automated)
GOES 24hr (Automated)
AVHRR (Automated)
MODIS (Automated)
Critical Fire Weather Area
Significant Smoke Producing Fires
Analyzed Smoke from Satellites (Dense):
Today [20130226]
Last Day [20130225]
Analyzed Smoke from Satellites (Moderately Dense):
Today [20130226]
Last Day [20130225]
Analyzed Smoke from Satellites (Thin):
Today [20130226]
Last Day [20130225]
US Interstates
US Cities
State and Province Boundaries
Lat/Long Grid
Canadian Municipalities
County Boundaries
Parks and Forests:
Local
State
National
0 48mi
Map Generated on 2-26-2013 by the NESDIS Office of Satellite Data Processing and Distribution
BASIC INFO ABOUT PLUME SELECTED
Last Analyzed Smoke from Satellites (Thin)
Rec ID START END DENSITY
1 10 2315 0115 5.000
Active Tool: Identify
Home
Map Last Updated
Getting Started
Contact Us
Help
FAQ
Archive
LAST MODIFIED: August 20, 2009
You are Here: http://www.firedetect.noaa.gov/index.htm
Click here for our text smoke product
IE Only: Bookmark Extent | Bookmark Site
CONTACT INFORMATION:
SSDFireTeam@noaa.gov


SSD Fire Detection Program - Mozilla Firefox
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Untitled Document
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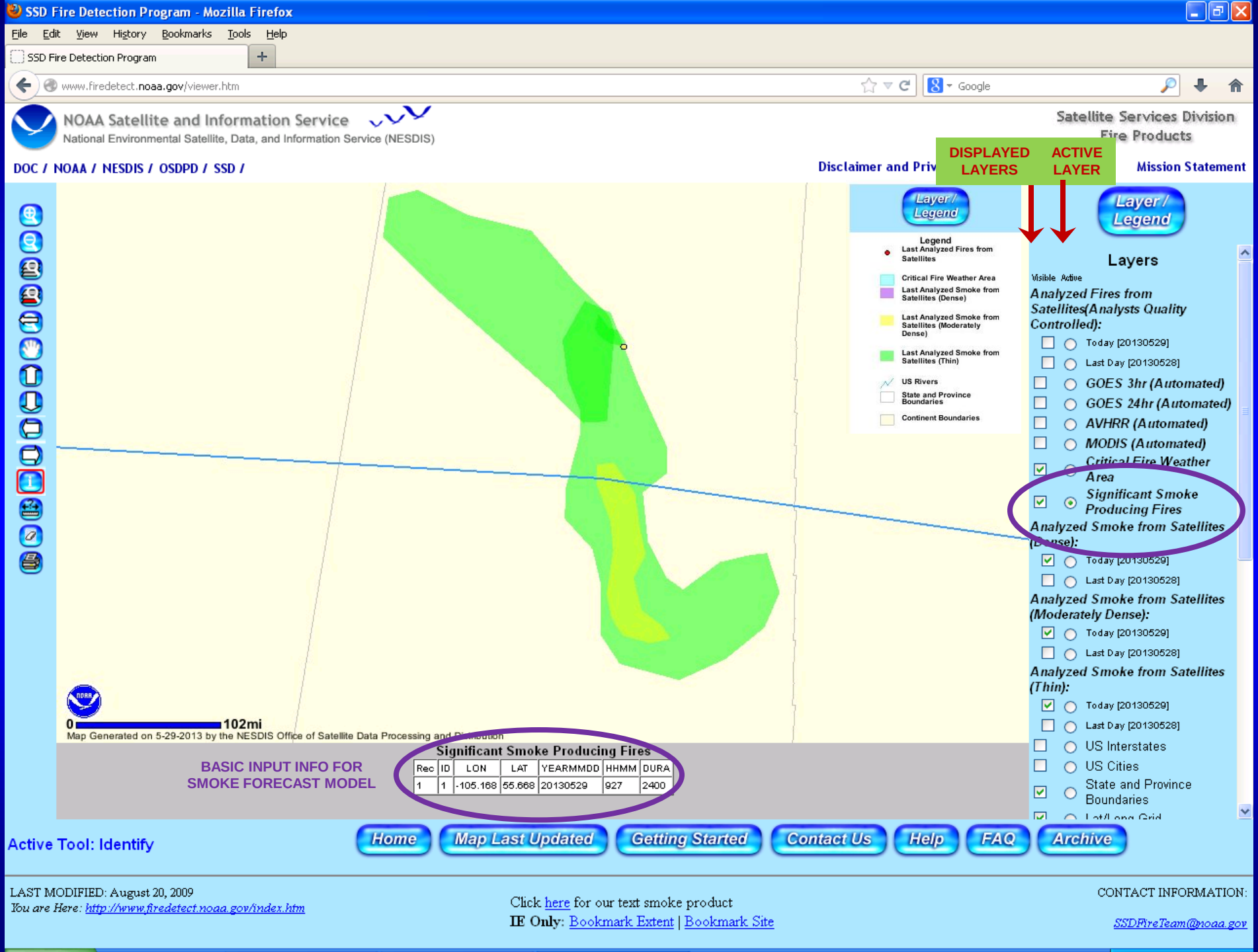
ACTIVE LAYER
Layer / Legend
Legend
Last Analyzed Fires from Satellites
Critical Fire Weather Area
Last Analyzed Smoke from Satellites (Dense)
Last Analyzed Smoke from Satellites (Moderately Dense)
Last Analyzed Smoke from Satellites (Thin)
US Rivers
State and Province Boundaries
Continent Boundaries
Layers
Visible Active
Analyzed Fires from Satellites(Analysts Quality Controlled):
Today [20130226]
Last Day [20130225]
GOES 3hr (Automated)
GOES 24hr (Automated)
AVHRR (Automated)
MODIS (Automated)
Critical Fire Weather Area
Significant Smoke Producing Fires
Analyzed Smoke from Satellites (Dense):
Today [20130226]
Last Day [20130225]
Analyzed Smoke from Satellites (Moderately Dense):
Today [20130226]
Last Day [20130225]
Analyzed Smoke from Satellites (Thin):
Today [20130226]
Last Day [20130225]
US Interstates
US Cities
State and Province Boundaries
0 48mi
Map Generated on 2-26-2013 by the NESDIS Office of Satellite Data Processing and Distribution
BASIC INFO ABOUT FIRE SELECTED
Last Analyzed Fires from Satellites
Rec ID LON LAT YEARDAY TIME ECOSYS
1 142 -121.231 38.193 2013056 2046 43
Active Tool: Identify
Home
Map Last Updated
Getting Started
Contact Us
Help
FAQ
Archive
LAST MODIFIED: August 20, 2009
You are Here: http://www.firedetect.noaa.gov/index.htm
Click here for our text smoke product
IE Only: Bookmark Extent | Bookmark Site
CONTACT INFORMATION:
SSDFireTeam@noaa.gov


SSD Fire Detection Program - Mozilla Firefox
File Edit View History Bookmarks Tools Help
SSD Fire Detection Program
www.firedetect.noaa.gov/viewer.htm
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ACTIVE LAYER
Layer / Legend
Legend
Last Analyzed Fires from Satellites
Critical Fire Weather Area
Last Analyzed Smoke from Satellites (Dense)
Last Analyzed Smoke from Satellites (Moderately Dense)
Last Analyzed Smoke from Satellites (Thin)
US Rivers
State and Province Boundaries
Continent Boundaries
Layers
Visible Active
Analyzed Fires from Satellites(Analysts Quality Controlled):
Today [20130529]
Last Day [20130528]
GOES 3hr (Automated)
GOES 24hr (Automated)
AVHRR (Automated)
MODIS (Automated)
Critical Fire Weather Area
Significant Smoke Producing Fires
Analyzed Smoke from Satellites (Dense):
Today [20130529]
Last Day [20130528]
Analyzed Smoke from Satellites (Moderately Dense):
Today [20130529]
Last Day [20130528]
Analyzed Smoke from Satellites (Thin):
Today [20130529]
Last Day [20130528]
US Interstates
US Cities
State and Province Boundaries
0 102mi
Map Generated on 5-29-2013 by the NESDIS Office of Satellite Data Processing and
BASIC INPUT INFO FOR SMOKE FORECAST MODEL
Significant Smoke Producing Fires
Rec ID LON LAT YEARMMDD HHMM DURA
1 1 -105.168 55.668 20130529 927 2400
Active Tool: Identify
Home
Map Last Updated
Getting Started
Contact Us
Help
FAQ
Archive
LAST MODIFIED: August 20, 2009
You are Here: http://www.firedetect.noaa.gov/index.htm
Click here for our text smoke product
IE Only: Bookmark Extent | Bookmark Site
CONTACT INFORMATION:
SSDFireTeam@noaa.gov

THANK YOU

QUESTIONS OR COMMENTS?