



Colorado

Kansas

RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Oklahoma

New Mexico

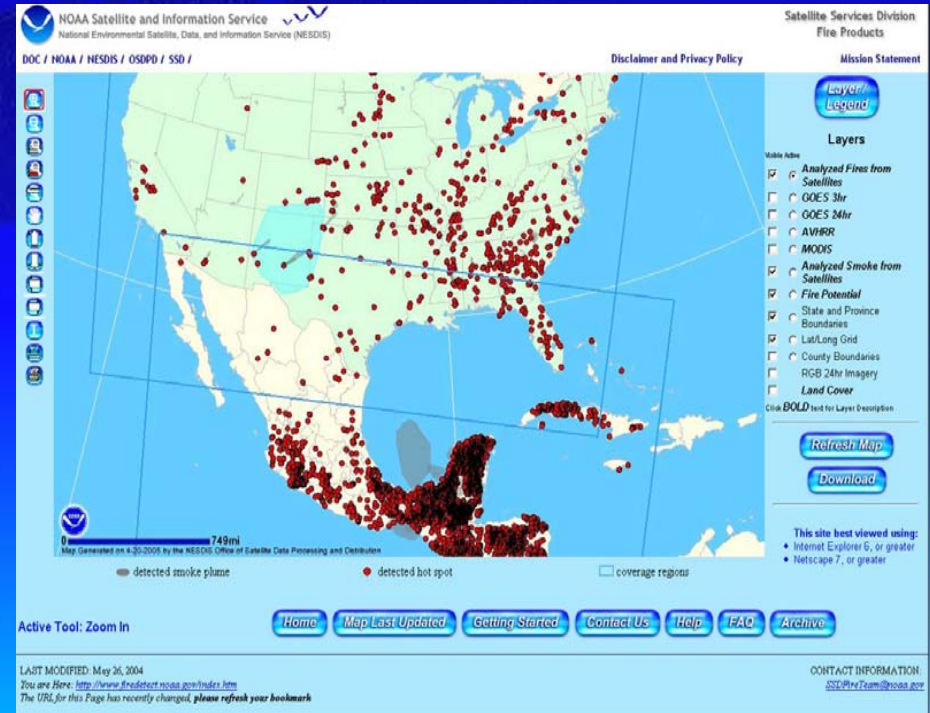
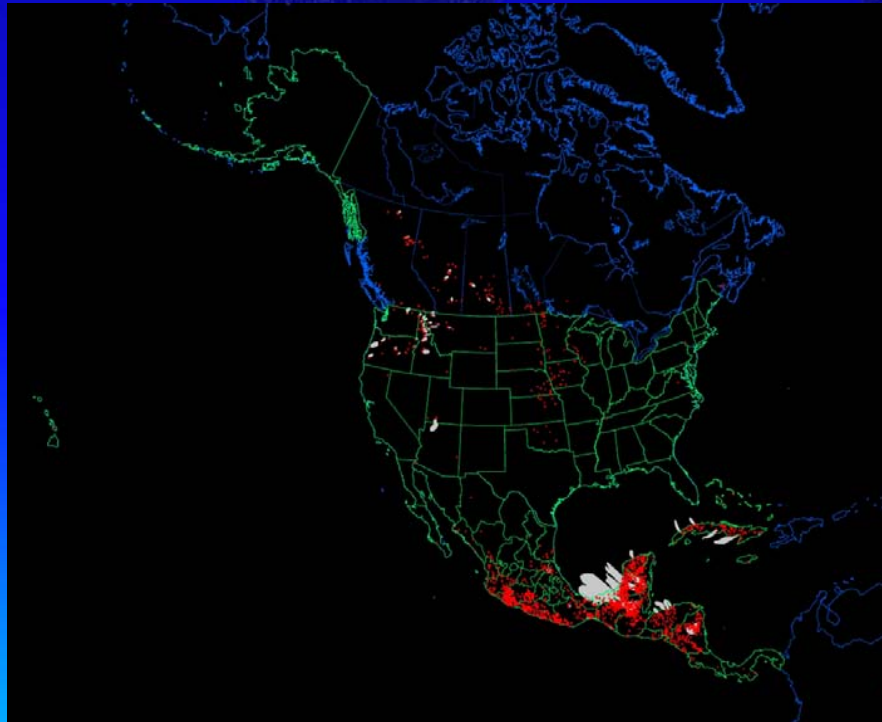
Mark Ruminski
Roland Draxler
Shobha Kondragunta
Jian Zeng

Texas



RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

HMS GRAPHICAL OUTPUT



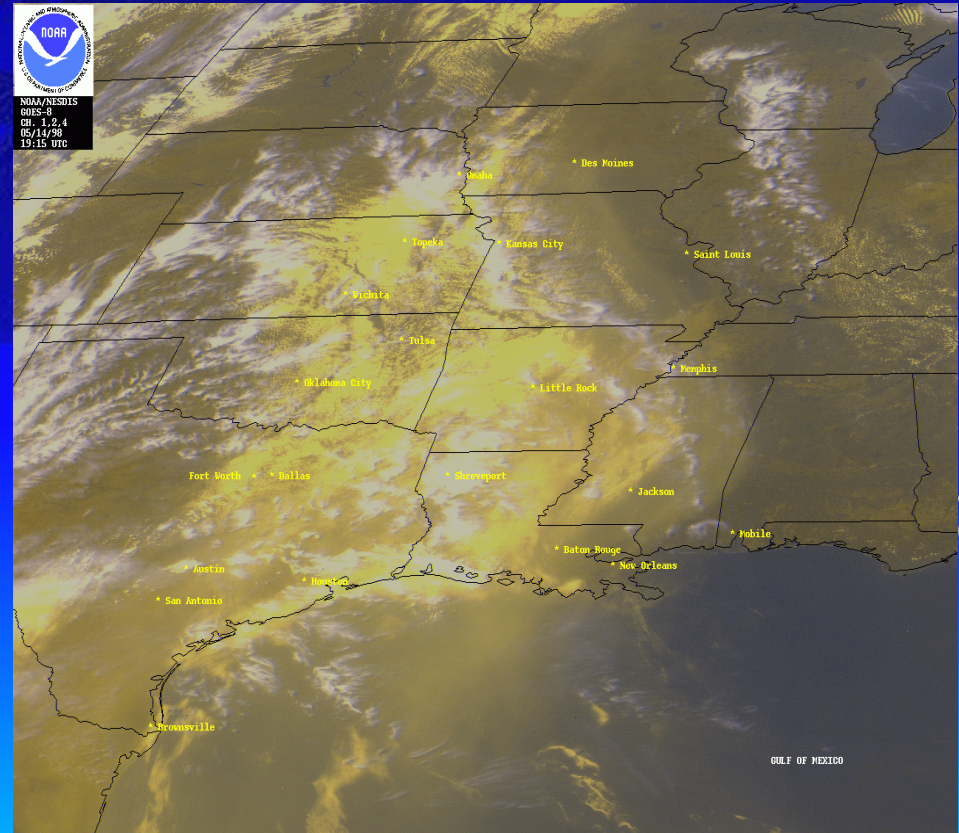


RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

NOAA/NESDIS began fire/smoke analysis in 1998

Massive smoke episodes have detrimental affect on health, transportation and industry

Large wildfires pose threat to life and property. Early detection and extinction saves money





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

- HMS Incorporates 7 satellites – 2 geostationary and 5 polar orbiting
- Over 100 looks per day in areas of overlap
- POES spacecraft provide 2 orbits/day in mid latitudes, more frequent over Alaska/Canada





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

AUTOMATED FIRE DETECTION ALGORITHMS USED

- **Wildfire – Automated Biomass Burning Algorithm (WF-ABBA) for GOES**
- **Fire Identification, Mapping and Monitoring Algorithm (FIMMA) for NOAA AVHRR**
- **MODIS MOD14 for MODIS (Terra and Aqua)**





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

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





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

HMS GOES Imagery Animation and Drawing Utility

Area Channel Select 0 80 Start Zoom In Plot Hotspots Draw

Plot States Power Plants 0 100 Stop Zoom Out Color Tables Erase

Plot Counties False Detects 0 100 Advance 1 Frame Full View HYSPLIT Points Make RGB

Roads/Light Hotspots on/off 0 100 Backup 1 Frame Time Looping Save Analysis EXIT

LATITUDE AND LONGITUDE OF CURSOR
43.733, -89.556

LATITUDE AND LONGITUDE OF SATELLITE DETECTED HOTSPOTS

GOES-WEST JDAY = 127 TIME = 13:00 UTC

sab@nl ENVI HMS G Thu May 06, 18:01:54

Algorithms can mistake highly reflective clouds for fires





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Area Channel Select 0 91 Start Zoom In Plot Hotspots Draw

Plot States Power Plants 78 86 Stop Zoom Out Color Tables Erase

Plot Counties False Detects 0 82 Advance 1 Frame Full View HYSPLIT Points Make RGB

Roads/Light Hotspots on/off 0 82 Backup 1 Frame Time Looping Save Analysis EXIT

LATITUDE AND LONGITUDE OF CURSOR
45.844, -110.717
LATITUDE AND LONGITUDE OF
SATELLITE DETECTED HOTSPOTS

GOES-EAST JDAY=153 TIME=00:45 UTC

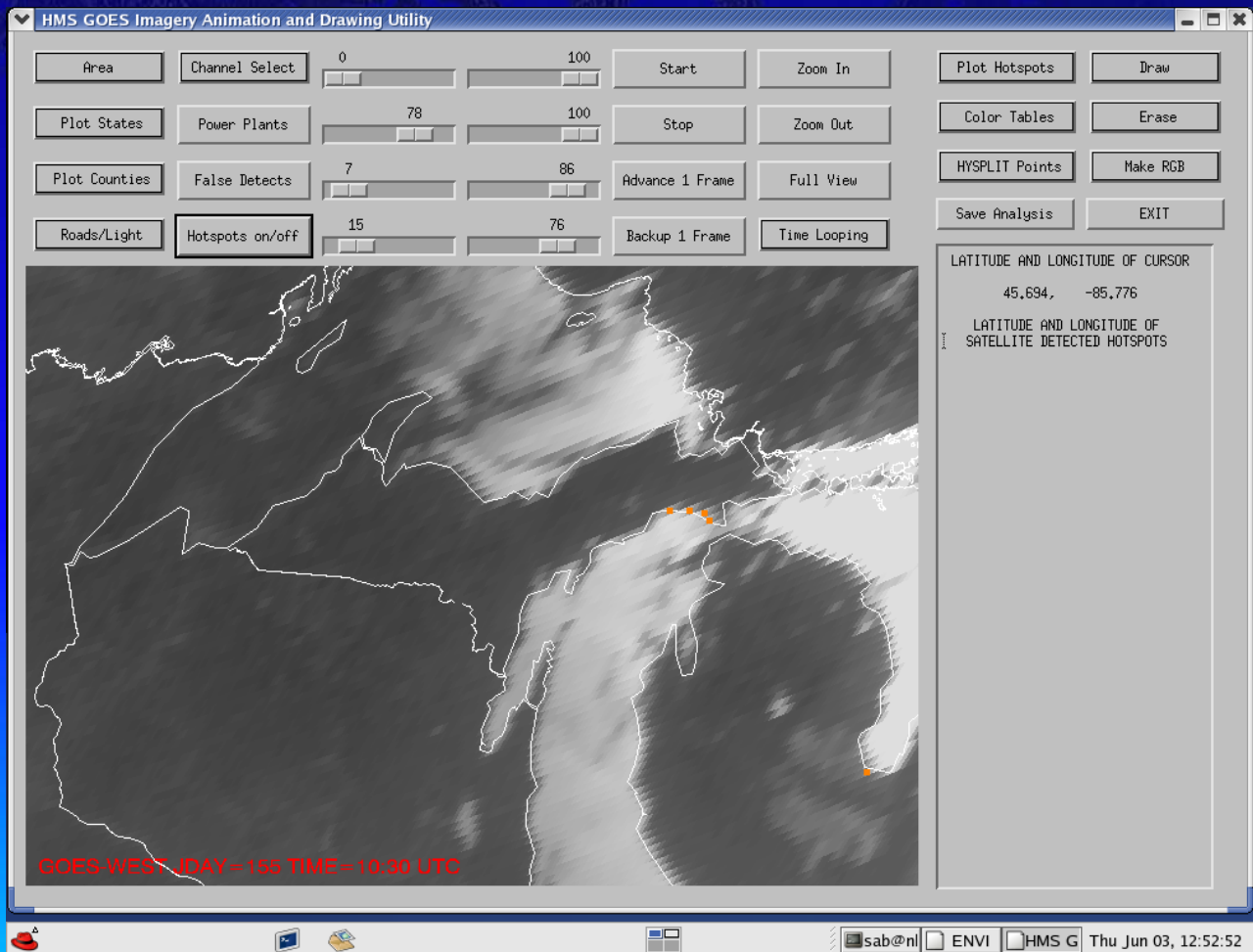
[sab@r] [ENVI] HMS G Tue Jun 01, 02:54:43

Algorithms can mistake highly reflective clouds for fires





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

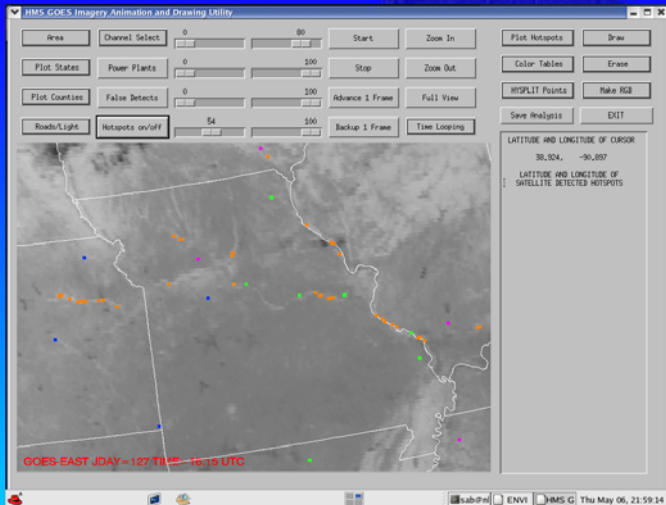
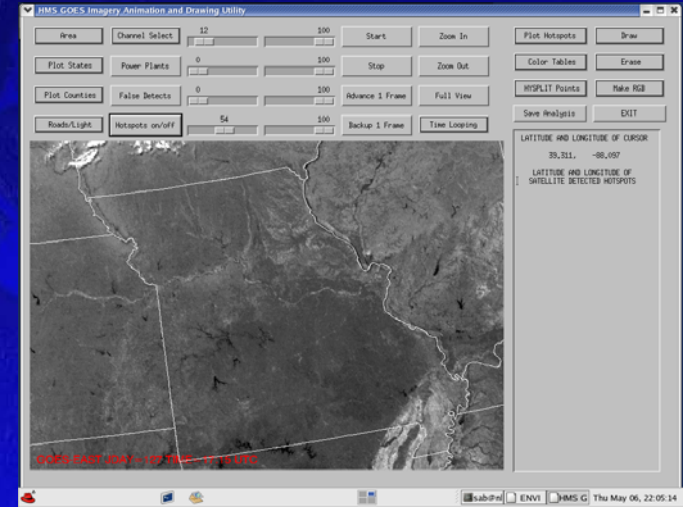
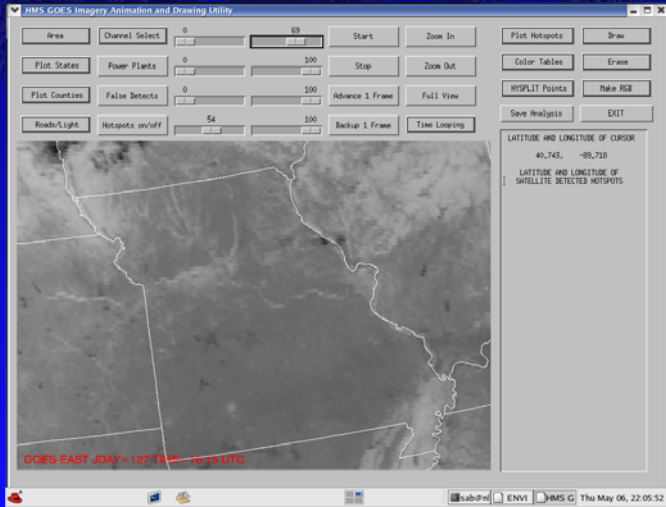


**Sunlight off
water surfaces
at high sun
angles can
generate false
detects**





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

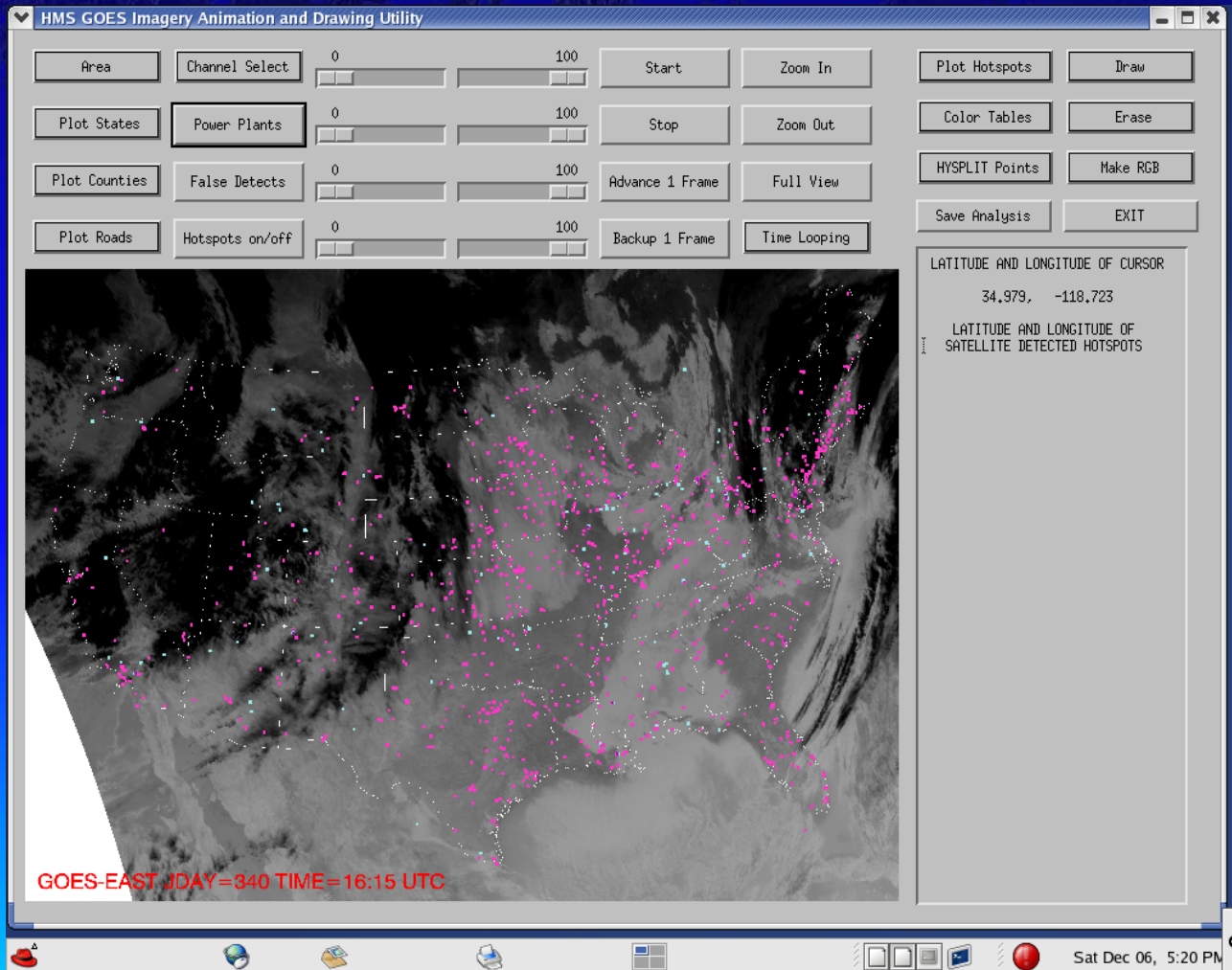


Urban heat islands and land type can appear to be fires to the algorithms under proper conditions





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM



**HMS GUI with
power plants
and known
false alarm
locations**





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

**Need to get a good handle on the fires to
produce a good analysis of smoke emissions
(where there's smoke there's fire!)**

Smoke analysis consists of:

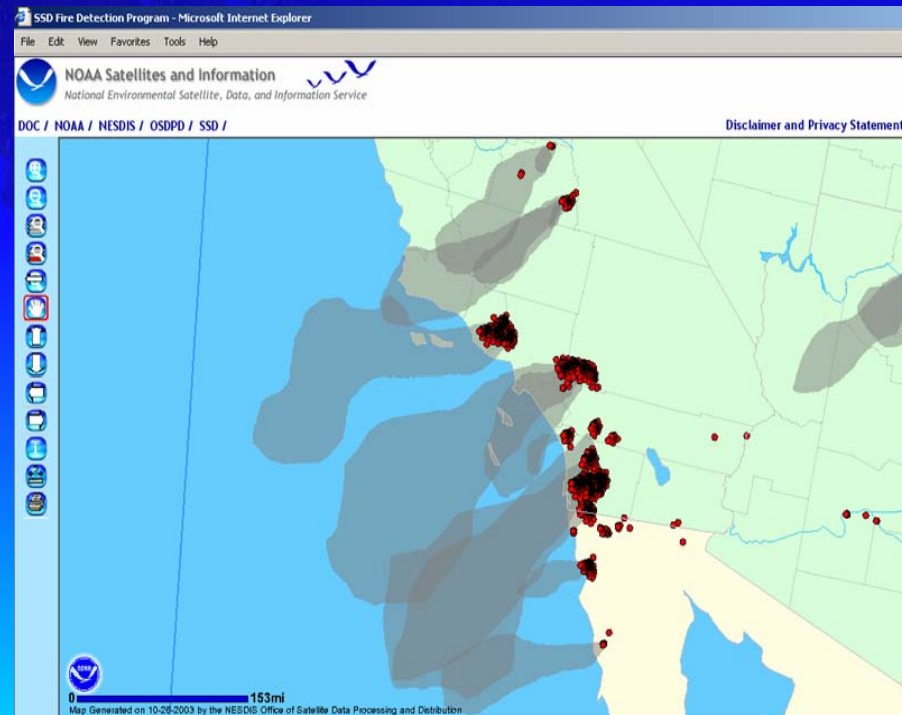
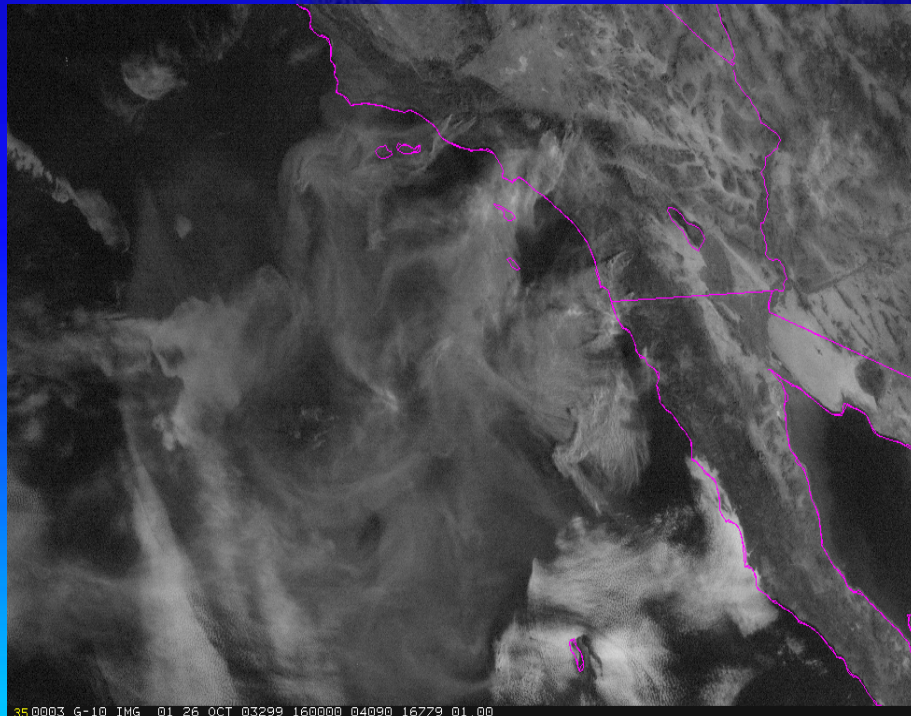
- **Graphic of smoke extent**
- **Input to dispersion and transport model**
- **Text product describing smoke and blowing dust**





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Individual GIS smoke plume shapefiles are tagged with observation start/end times





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Analysts provide input to the HYbrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) Model

Locations of smoke emitting fires are added to file

Each point represents 1 square km

Number of points selected determined by areal coverage of hotspots and/or amount of smoke observed





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

HYSPLIT switched from using constant emission rate for all input locations to using BlueSky framework in 2005

Most recent constant emission rate used was 15 kg/ha/hr



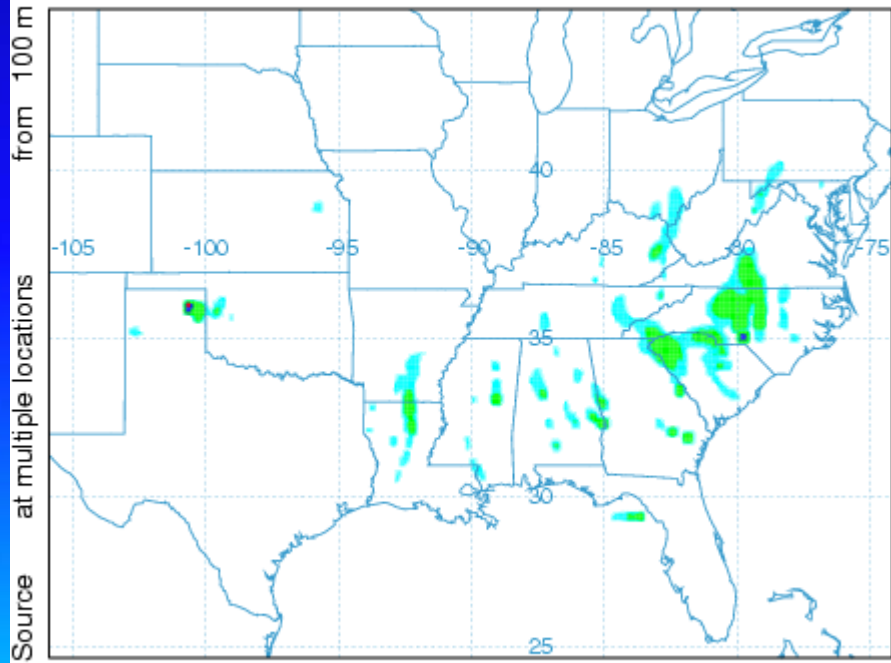


RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

BlueSky emissions much larger than constant rates that HYSPLIT had been using

BLUE SKY EMISSIONS

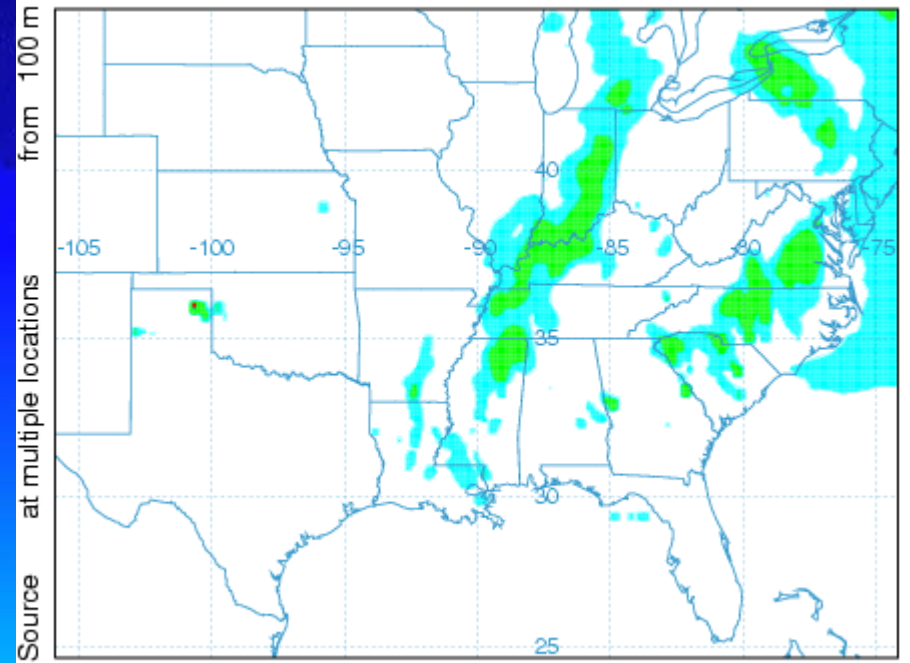
Concentration (mass/m³) averaged between 0 m and 5000 m
Integrated from 0500 12 Apr to 0600 12 Apr 06 (UTC)
PM₂₅ Release started at 0600 11 Apr 06 (UTC)



1.0E+01 5.0E+00 1.0E+00 5.0E-01 7.2E+00 Maximum at square
8.8E-24 Minimum

CONSTANT EMISSIONS (15 kg/ha/hr)

Concentration (mass/m³) averaged between 0 m and 5000 m
Integrated from 0500 12 Apr to 0600 12 Apr 06 (UTC)
PM₂₅ Release started at 0600 11 Apr 06 (UTC)



1.0E+00 5.0E-01 1.0E-01 5.0E-02 5.1E-01 Maximum at square
3.3E-08 Minimum

AQMI METEOROLOGICAL DATA

AQMI METEOROLOGICAL DATA



RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Variable emission duration implemented in April 2006

Start/End time of emissions indicated by analyst

Previous assumption was that fires were emitting for 24 hours with a decay rate of 75%/day

Majority of analyzed fires have no detectable smoke plume

The majority of fires that do have a smoke plume have a limited duration (much less than 24 hours)

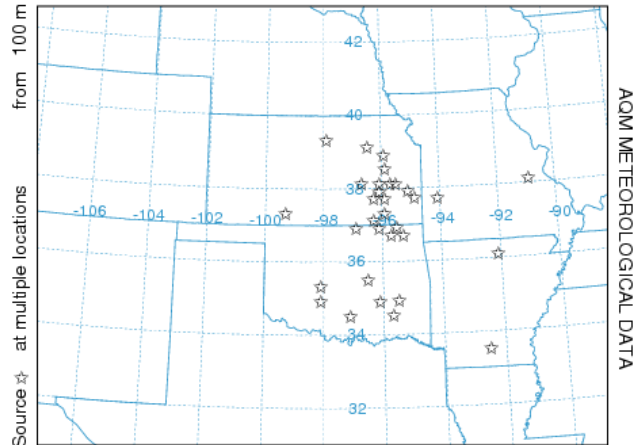




RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

VARIABLE FIRE SIMULATION

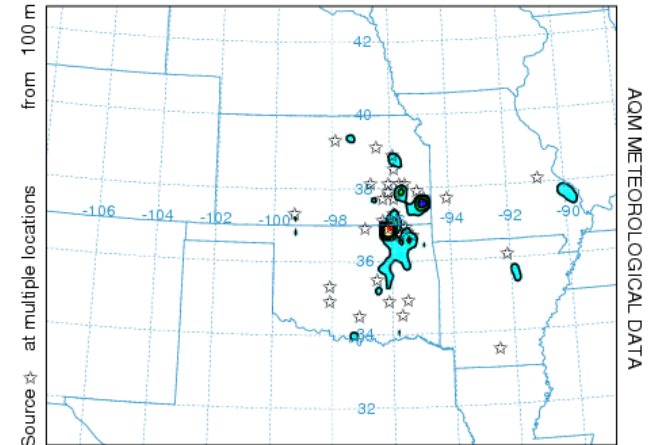
Concentration ($\mu\text{g}/\text{m}^3$) averaged between 0 m and 5000 m
Integrated from 1100 19 Apr to 1200 19 Apr (UTC)
PM25 Release started at 0600 19 Apr 06 (UTC)



1.0E+01 5.0E+00 2.0E+00 1.0E+00
1.0E+00 Maximum at square
2.1E-17 Minimum

CONSTANT FIRE SIMULATION

Concentration ($\mu\text{g}/\text{m}^3$) averaged between 0 m and 5000 m
Integrated from 1100 19 Apr to 1200 19 Apr (UTC)
PM25 Release started at 0600 19 Apr 06 (UTC)



1.0E+01 5.0E+00 2.0E+00 1.0E+00
1.8E+01 Maximum at square
2.7E-17 Minimum



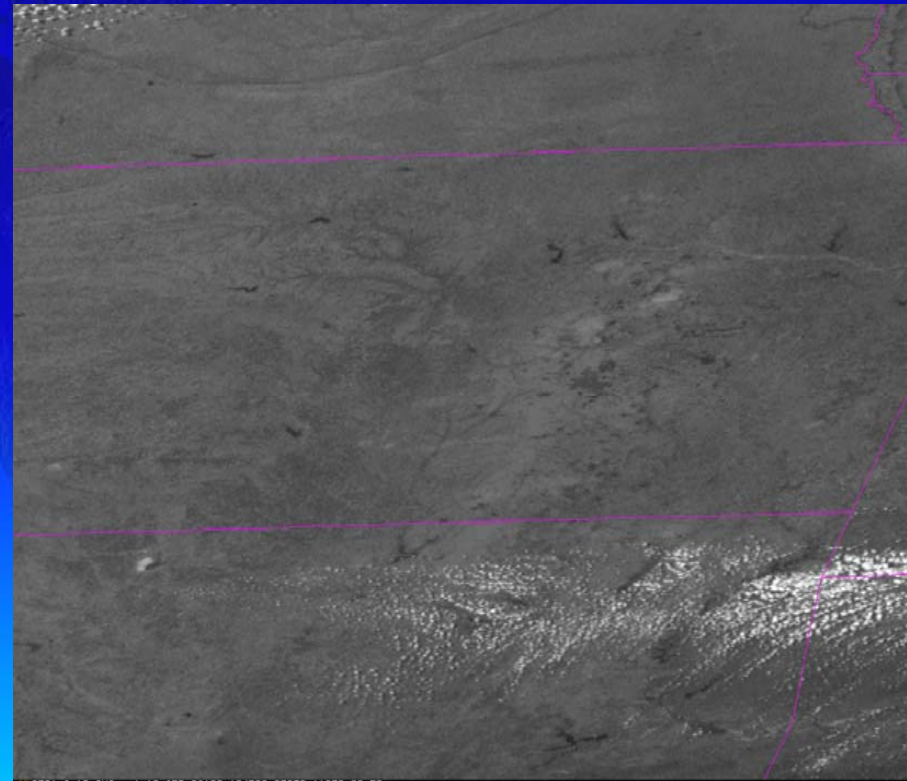
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

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



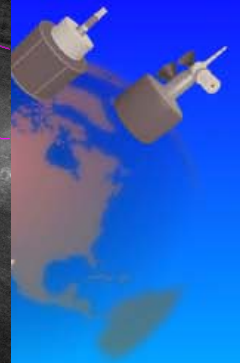
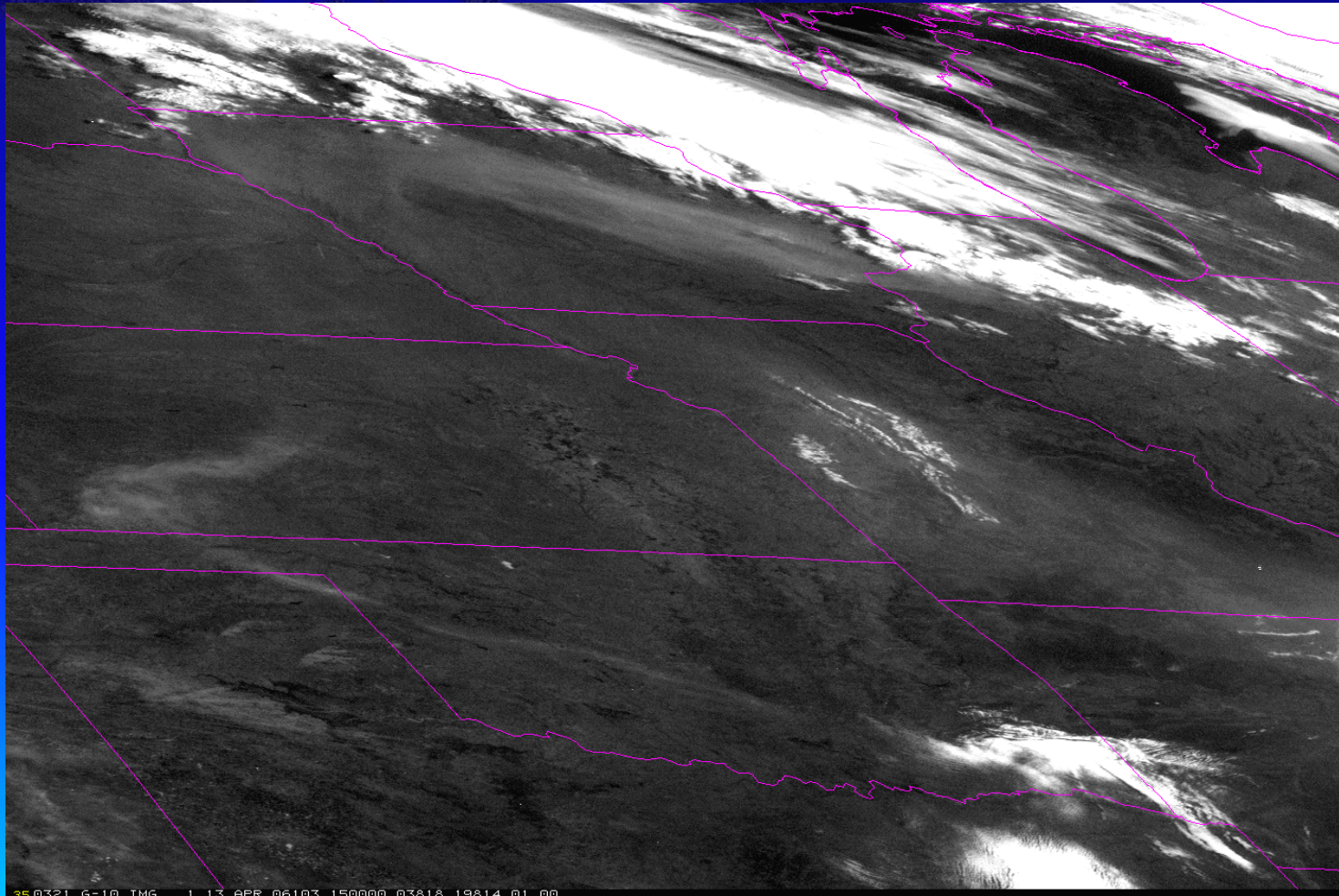


RECENT CHANGES TO THE HAZARD MAPPING SYSTEM





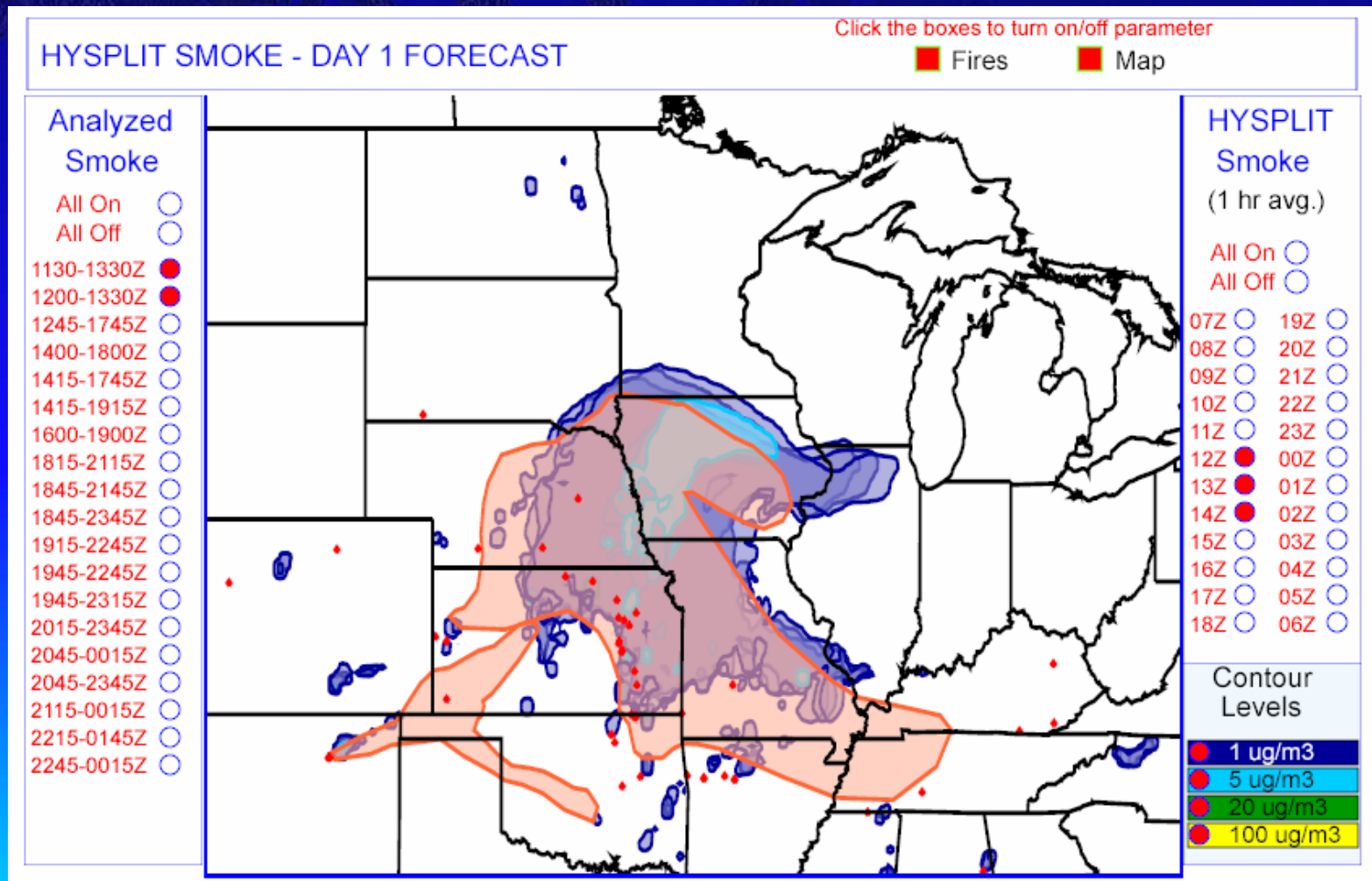
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM



35 0321 G-10 IMG 1 13 APR 06103 150000 03818 19814 01.00



RECENT CHANGES TO THE HAZARD MAPPING SYSTEM





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Long range transport of smoke does not adhere to political or geographic boundaries

HMS analysis includes Central America during the peak burn season in that region

Responsibility for Central American analysis has very recently been transferred to the Mexican National Weather Service





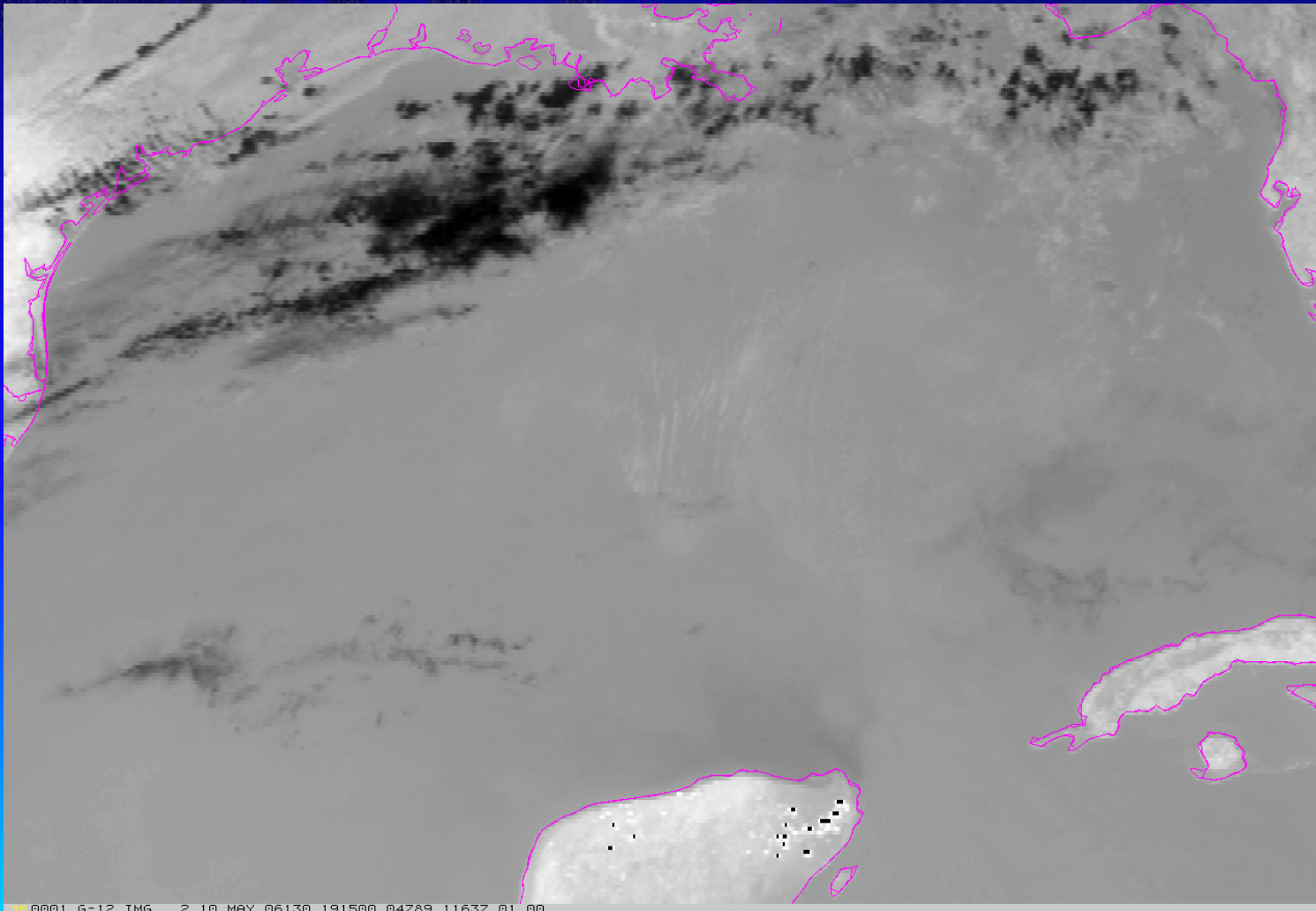
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

**Hurricane Wilma felled a vast number of
trees and vegetation in the Yucatan
producing fuel for potentially disastrous fires**





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

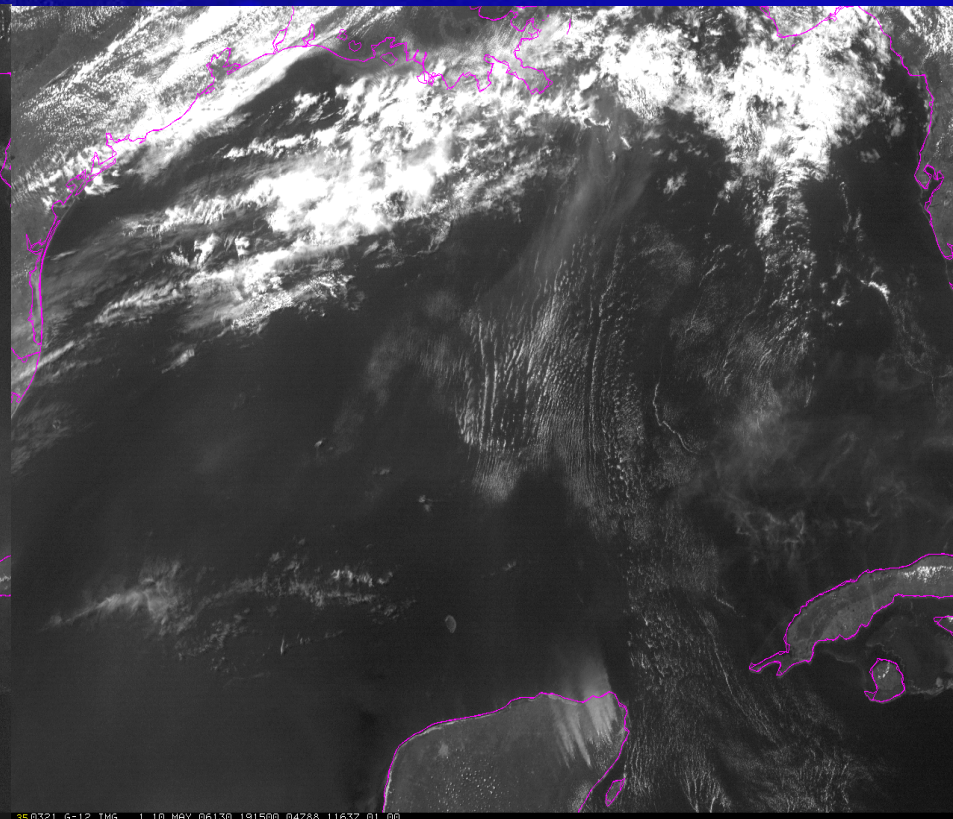
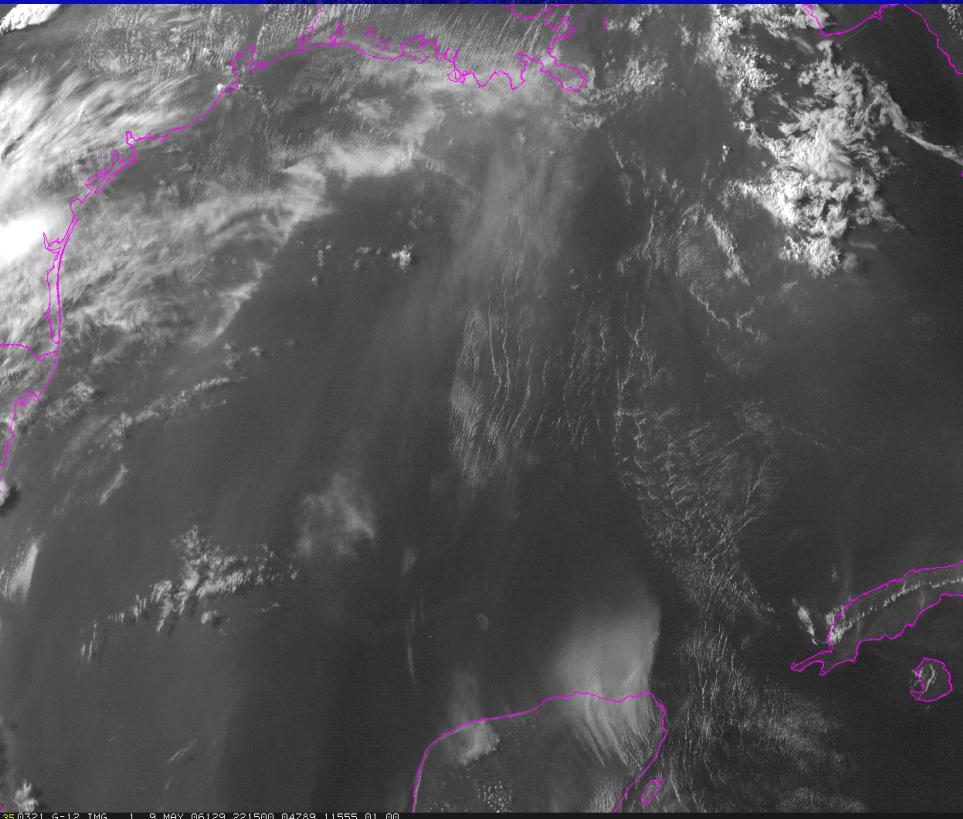




RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

May 9, 2006

May 10, 2006





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Currently we are just drawing smoke outlines

Very soon we will begin drawing contours of smoke concentration

Contours will be largely influenced by the GOES Aerosol and Smoke Product (GASP)





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Properties of GASP:

Produced $\frac{1}{2}$ hourly

Fully automated

Utilizes GOES visible band brightness values

Aerosol Optical Depth (AOD) is converted to concentration using a mass extinction coefficient of $7.9 \pm 4.5 \text{ m}^2/\text{g}$





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

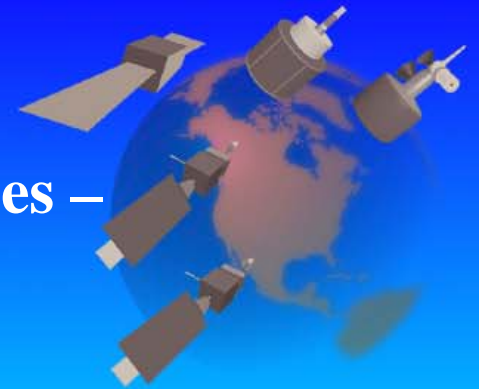
Limitations of GASP (and analyst drawn contours):

There is no vertical structure

Due to dependence on visible imagery, only available during daylight

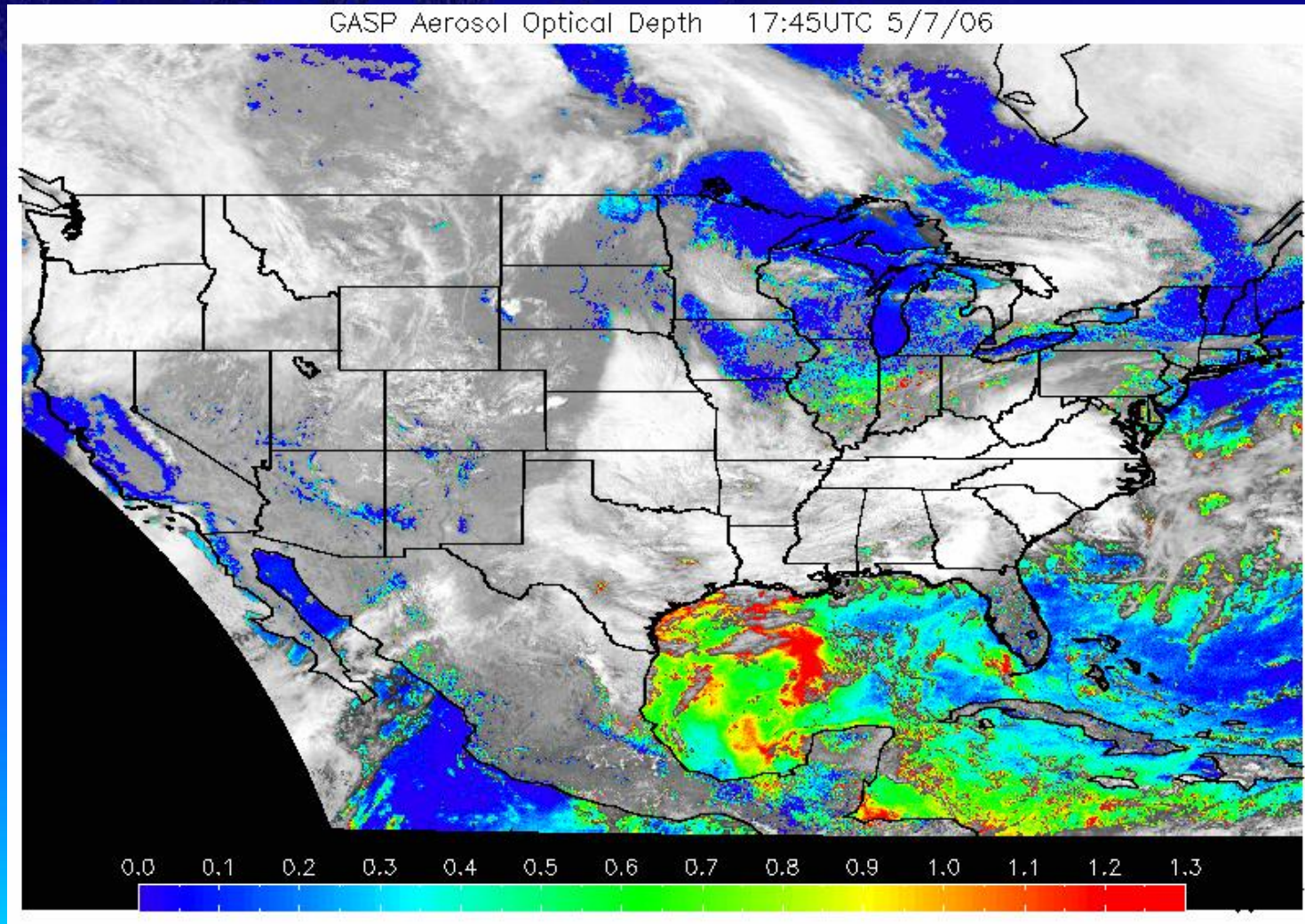
Clouds hinder detection

GASP does not distinguish between aerosol types – analysts attempt to





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

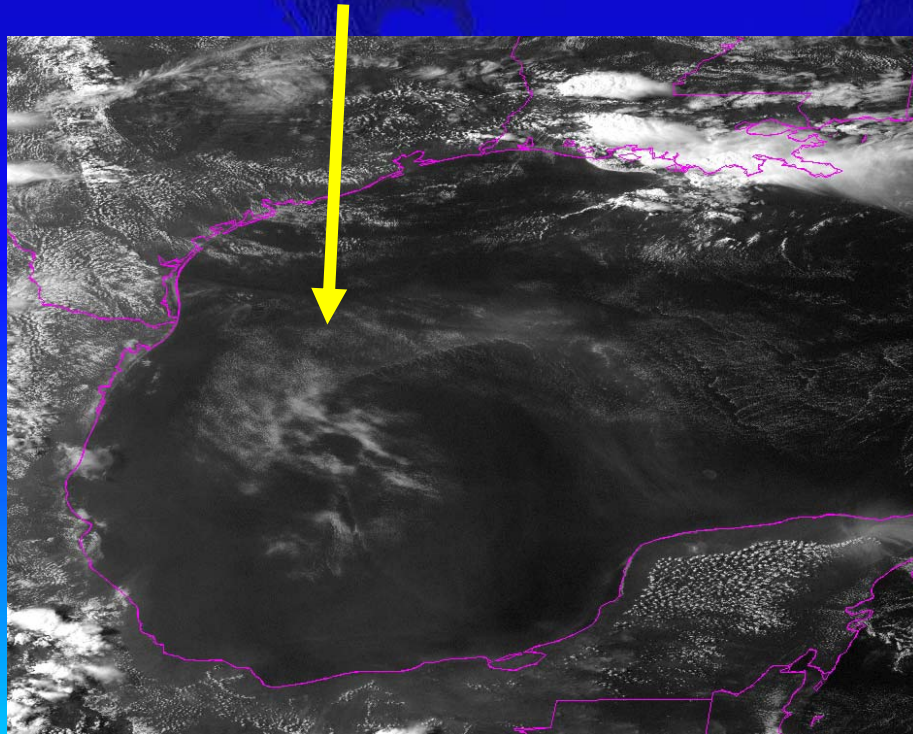




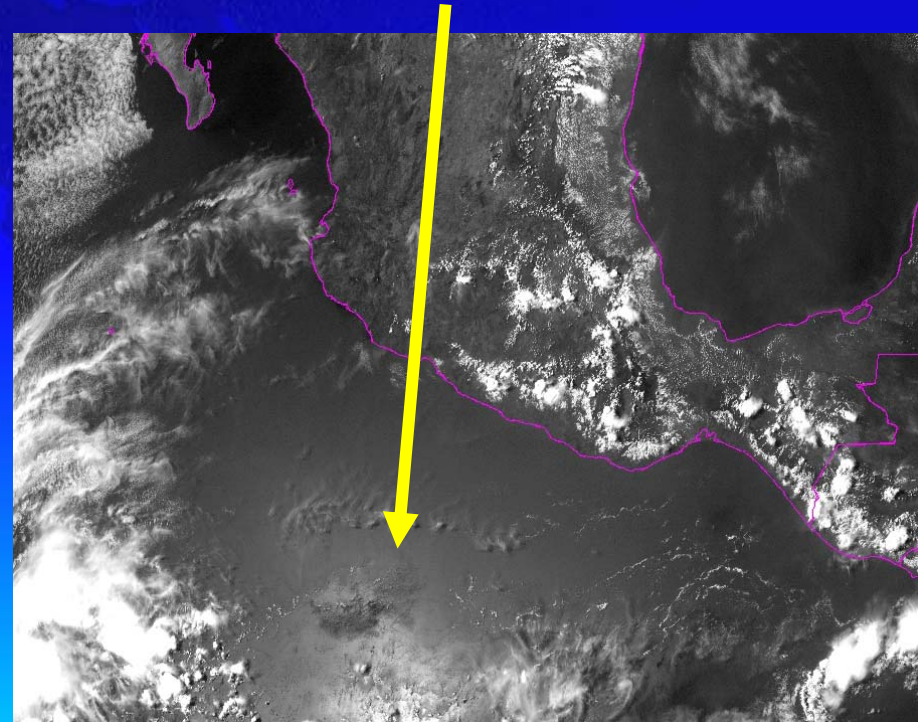
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Clouds and sun glint are difficult for GASP to resolve

Clouds mixed with smoke



Sun glint





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

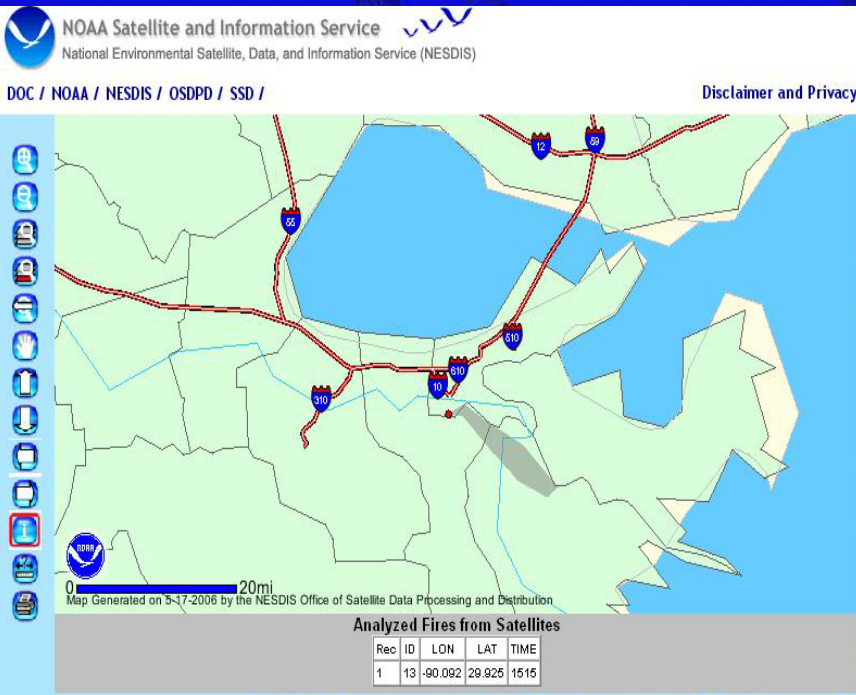
- All products available on the Web at:
www.ssd.noaa.gov/PS/FIRE/
- Includes links to
 - archived products
 - automated algorithms
 - GIS page
 - HYSPLIT smoke forecasts
 - near real time imagery
 - manual quality controlled analysis





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Smoke plume





RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Additional contributors who have made the system possible

**Donna Mcnamara
George Stephens
John Simko
Jamie Kibler
Tim Kasheta
Po Li**

**UMd/NASA MODIS fire team
CIMMS GOES fire team
Yi Song
Ivan Csiszar
Rob Fennimore
Tad Franson**

