

NASA Air Quality Program Outreach Initiatives

NASA Applied Sciences Program, Air Quality Team Meeting
Potomac, Maryland, June 14-16, 2007

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NASA Air Quality Program Outreach Initiatives: Overview



-
- Satellites for Air Quality 101: Seminars for the air quality community
 - Air Quality Training: Curriculum for multi-day workshops
 - “Smog Stories” / Air Quality News Pegs: Image interpretation for the general public
 - SERVIR-Air: The 3D-AQS project goes south
 - A few thoughts on outreach initiatives

Satellites for Air Quality 101

- Developed as seminar for Air & Waste Management Association conferences
- Revised to be full training materials with slides and speaker notes
- Presented as train-the-trainer to NASA GSFC

Satellites for Air Quality 101

Satellites for Air Quality

How NASA Sensors Can Help You Monitor Air Pollution

Presented by:

Jill Engel-Cox
Battelle Memorial Institute
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Sponsored by:



Satellites for Air Quality: How NASA Sensors Can Help You Monitor Air Pollution

Prepared by Jill Engel-Cox, Battelle Memorial Institute, for NASA Earth-Sun System Applied Sciences Program, under Subaward Agreement #CG0616 to the Joint Center for Earth Systems Technology, March 20, 2007. Modifications and distribution allowed if credits are retained.

[Notes to Trainer: This presentation is a 30 minute seminar on satellite remote sensing for monitoring air pollution, suitable for presentation at a NASA booth at environmental conferences or other gatherings of environmental professionals. It was designed for an audience who knows about air quality and other environmental issues but is not knowledgeable about remote sensing. Templates of an announcement flyer and sign-up sheet have been provided as companion materials with this presentation.]

Background: In the last 10 years, the number of satellite sensors and the websites to obtain satellite images and data have increased significantly. Over that time, there has been considerable research documenting how satellite data are useful to monitoring air quality. Several tools to provide information to the air quality community are now available and more are being developed. ...

Satellites for Air Quality 101



Overview

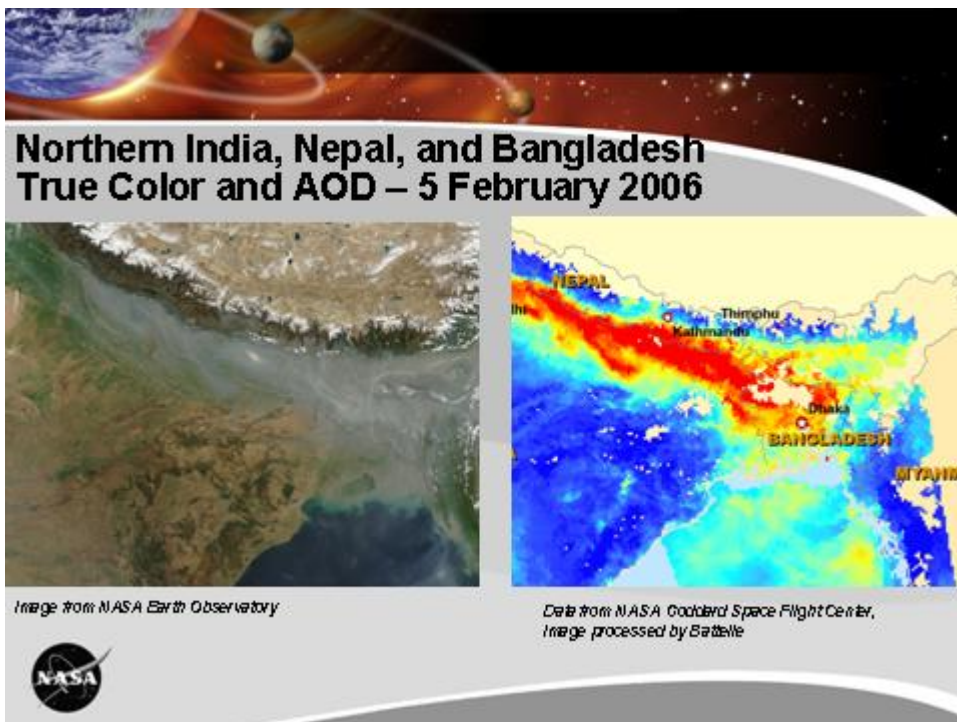
- Satellite terminology and technology
- Image analysis
- Case studies
- Where to get data, information, and help
- Potential and limitations



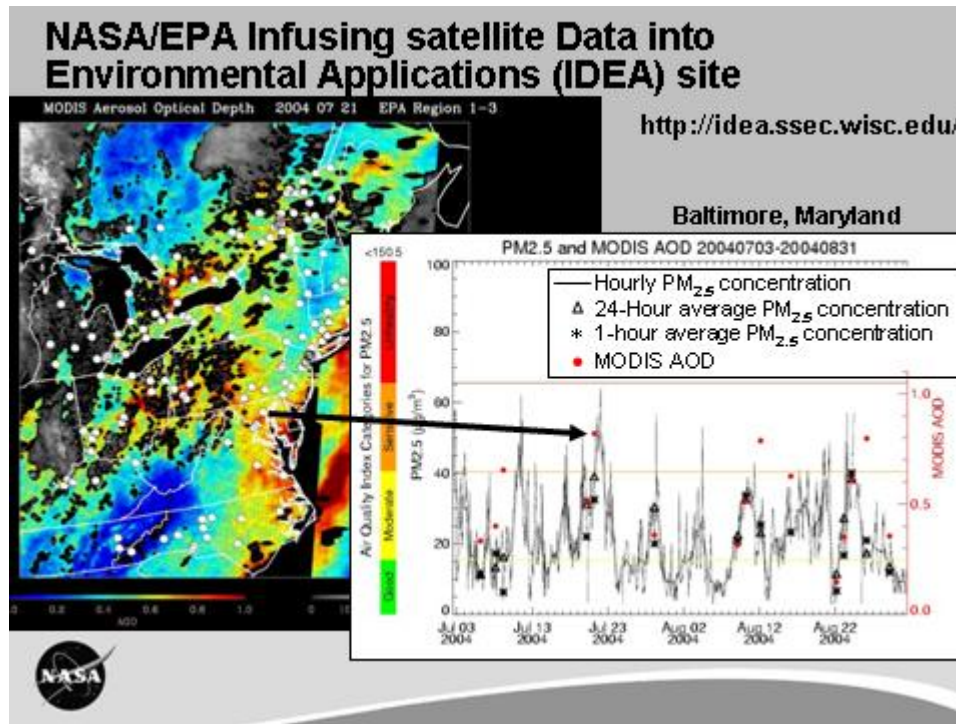
Satellites for Air Quality 101




Satellites for Air Quality 101



Satellites for Air Quality 101




Satellites for Air Quality 101



Potential and Limitations of Satellites and Air Pollution

- Limitations
 - Lack of specificity about some pollutants (best for fine particles, but other pollutants are possible)
 - Resolution and temporal scales sometimes too large
 - Vertical layer sometimes not clear (sum over column of air)
 - Large complex datasets difficult to acquire and use
- Advantages
 - Greater detail over regions especially those with no ground monitors
 - Synoptic and transboundary view (time and space)
 - Adds value when combined with other data and models
 - Visual appeal

 *New satellite sensors and tools will help address some limitations, especially if the air quality community stays involved.*

Air Quality Training

- Curriculum for multi-day workshops
 - Designed for environmental audience new to satellite remote sensing
 - Satellite remote sensing basics
 - Image interpretation and data acquisition
 - Hands-on project tailored to audience
- Potential training sessions at
 - UN Symposium on “Space Tools and Solutions for Monitoring the Atmosphere in Support of Sustainable Development” in Graz, Austria, September 2007
 - SERVIR headquarters at the Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC) in the Republic of Panama, Fall 2007
 - Tentative 3-4 day class in Asia, Spring 2008



"Smog Stories" / Air Quality News

A cross-agency U.S. Government Web site. [List of AIRNow partner agencies](#)

[About AIRNow](#) | [Contact Us](#) | [FAQs](#) | Search:

GO

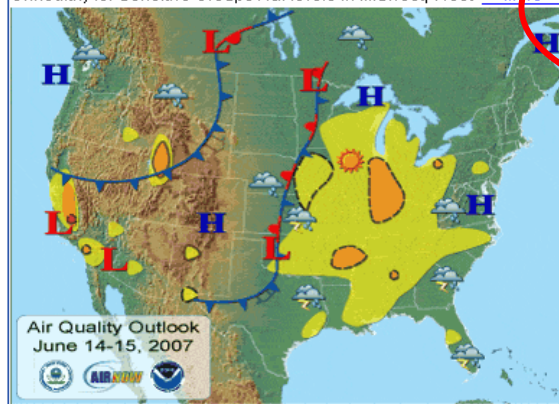
AIRNOW Quality of Air Means Quality of Life

National Overview

June 14th, 2007

National Outlook for June 14-15

Unhealthy for Sensitive Groups AQI levels in Midwest, West [More](#)



[National Forecast](#) | [Ozone Now](#) | [Particles Now](#) | [Map Center](#)



Local Air Quality Conditions and Forecasts

Alabama [Select by map](#)

Today's Highest AQI Forecasts

Bakersfield, CA	!	OZONE
Birmingham, AL	!	OZONE
Chicago, IL	!	OZONE
Cleveland-Akron-Lorain, OH	!	PM2.5
Evansville, IN	!	OZONE
More	! - city declared an Action Day	

Note: EPA established a tighter fine particle [standard](#) in the fall of 2006 to better protect public health. [More Information](#)

Air Quality News

June 14 - A smog advisory is in effect in some regions of southern Ontario. [More](#)

[More News](#)

Partners

For Partners
[List of Partners](#)

Air Quality Basics

Air Quality Index
Ozone
Particles
UV

The AQI for:

Health Providers
Older Adults
Weathercasters

Key Topics

Your Health
Smoke From Fires
International Air Quality

The Learning Center

Kids (K-10)
Students
Teachers

Resources

Publications
Publications (En Español)
FAQ
Movies
What You Can Do
NAQ Conferences
About the Data

Accessibility
Privacy and Security

E-mail Notification

Sign-up for e-mail, cell phone or pager
[EnviroFlash](#) air quality notices

Historical Information

[Air Compare](#)
Compare Air Quality of U.S. Cities

Good Up High, Bad Nearby



Web Cams [EXIT AIRNOW](#)



[View Other Visibility Cams](#)

AIRNow is a government-backed program. Through AIRNow, EPA, NOAA, NPS, news media, tribal, state, and local agencies work together to report conditions for ozone and particle pollution. [State, Local and Tribal Partners](#).



- Incorporate NASA images into AIRNow Air Quality News
→ www.airnow.gov
- Building on daily monitoring of U.S. Air Quality (Smog Blog)
→ alg.umbc.edu/usaq
- Pilot project this summer/fall
→ Develop procedure
→ Produce and distribute ~10 news 'pegs'

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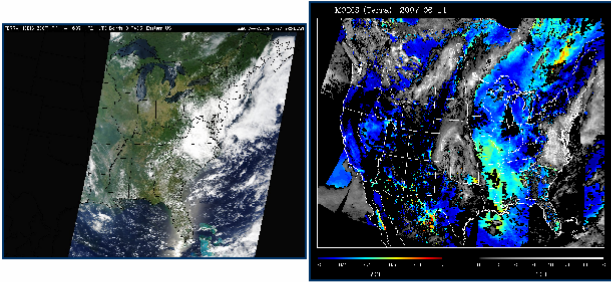
U.S. Air Quality
The Smog Blog

UMBC
UNIVERSITY
OF MARYLAND

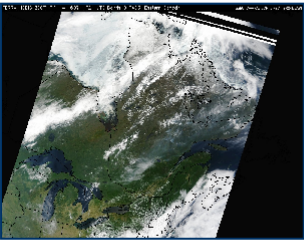
June 14, 2007

CENTRAL AND SOUTHERN HAZE, SMOKE IN CANADA

Haze is building up in the central and southern U.S., particularly Missouri, Arkansas, Louisiana, Mississippi, and Alabama. Aerosol optical depth values were about 0.6 and [fine particle concentrations were moderate](#).



The smoke plume in Canada is also clearly seen in the MODIS aerosol optical depth image above (AOD around 0.8). The MODIS true color image below shows the extent of the smoke across Quebec and Newfoundland.



Posted by Jill Engel-Cox at 10:26 PM

About U.S. Air Quality

USAQ is a daily diary of air quality in the U.S. using information from NASA satellites, ground-based lidar, EPA monitoring networks, and other monitors. Interpretation and analysis is provided by the staff of the University of Maryland, Baltimore County Atmospheric Lidar Group.

Search

Search this site: Search

Recent Entries

- Central and southern haze, smoke in Canada
- Cloudy and Hazy Skies
- Still hazy in the southeast
- Partly Cloudy Skies and Rising Boundary Layer
- Slightly higher AOD in the southeast
- Remaining hazy in the southeast
- Haze in the southeast
- AQ Improved
- Moderate to Unhealthy AQ in the East
- Warm Sunny Day

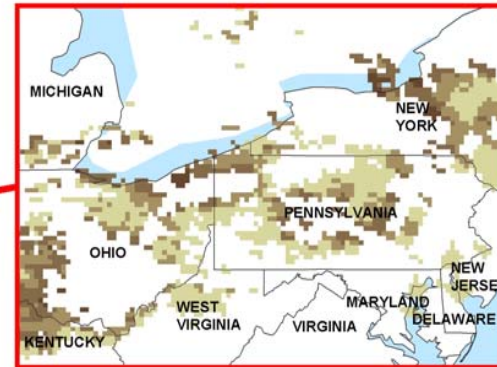
Main Data Sources

- UW MODIS Direct
- NASA MODIS Rapidfire Browse / Subsets
- EPA AirNow / ParticlesNow / AirNowTech
- NASA/EPA/NOAA/UW IDEA
- NOAA NESDIS GASP / GASP-West / GASPER (pw only)
- NOAA Air Quality Forecast Guidance
- NASA DMI Tropospheric NO2
- NOAA Hazard Mapping System Fire and Smoke Product / Smoke Text
- Clean Air Partners Monitoring Sites MD-DC-NoVA
- UMBC-ALG Webcam
- NPS DC Webcam/McMillan Reservoir AQ

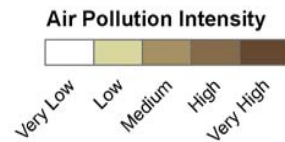
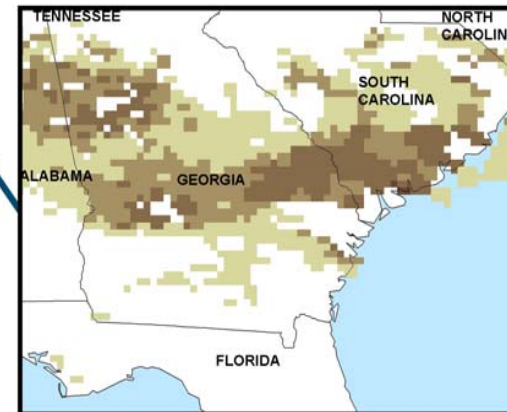
Help Files

- MODIS Red Green Blue Image (MODIS Direct)
- MODIS Red Green Blue Image (Rapidfire)
- MODIS Aerosol Optical Depth (IDEA)
- GDES Aerosol/Smoke Product (GASP)
- Air Quality Index Fine Particles (AQI PM2.5)
- Hazard Mapping System Fire and Smoke Product (HMS)
- UMBC Polar-ELF LIDAR Product

Smog Stories" / Air Quality News



High pressure and stagnant conditions along the East Coast created conditions for air quality problems on Sunday, June 17. Areas of brown show air pollution as measured by NASA satellites, for air pollution in the Northeast (above) and Southeast (below).



SERVIR Air

- SERVIR is satellite visualization and monitoring system for Mesoamerica
- Focus on disasters, ecosystems, biodiversity, weather... *not air quality*
- Partner with 3D-AQS to bring air quality info into SERVIR
 - Case study
 - Mesoamerica air quality blog
 - Training & student exchange
 - Transfer of real-time systems
 - Improved ground monitors (EPA)
 - Communication & outreach

SERVIR The Mesoamerican Regional Visualization and Monitoring System

FRI, JUNE 15, 2007

● Español
● English

[SERVIR Data](#) | [Online Maps](#) | [GEOSS Decision Support](#) | [3-D Visualizations](#)

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Your "One Stop Shop" for Regional Data, Dynamic Maps, Decision Support, and Interactive Visualizations

Mesoamerica Today, Friday, June 15, 2007
Go to [SERVIR Realtime Image Viewer](#) >>
View GOES Images of A Specific Country
Make Your Own GOES Animation
Latest GOES image
k3atf3: r3fG: nasa.gov

15 Jun 2007
20:15 UTC

Cloud free, very warm surface temperatures | Weak, warm cloud tops, low altitude | Intense, cold cloud tops, high altitude

[SERVIR Realtime Image Viewer >>](#)
View and animate current and historical imagery

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SERVIR Movies
Click images to view movies

First 21 Named Storms of 2005 Atlantic Hurricane Season

A Vision of the Future (18.2 MB)

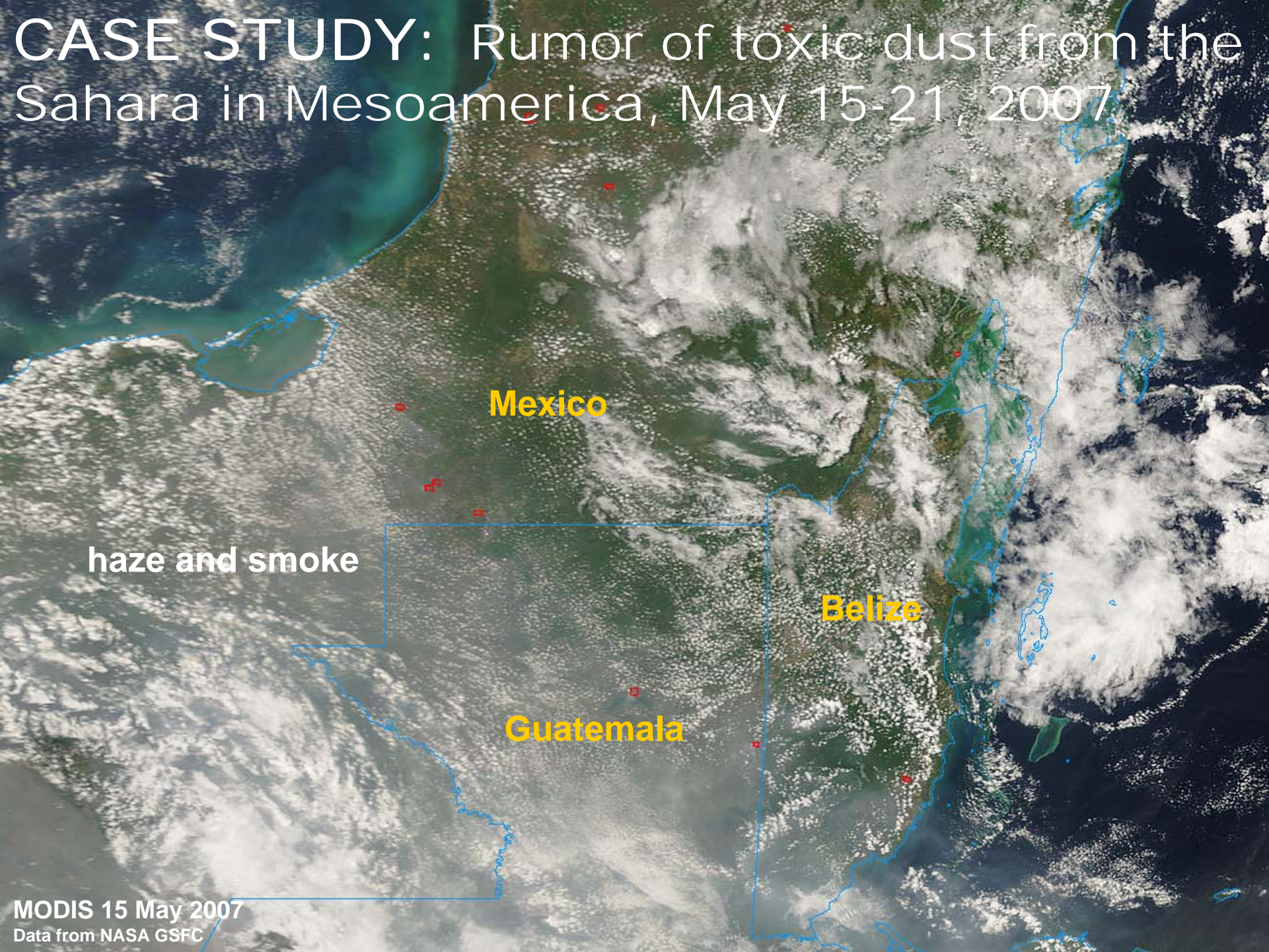
Video Tierra ceniza... o bosques saludables

Time Lapse of Fires (17.89 MB)

Fade from Day to Night (20 KB)

<http://servir.nsstc.nasa.gov>

CASE STUDY: Rumor of toxic dust from the Sahara in Mesoamerica, May 15-21, 2007



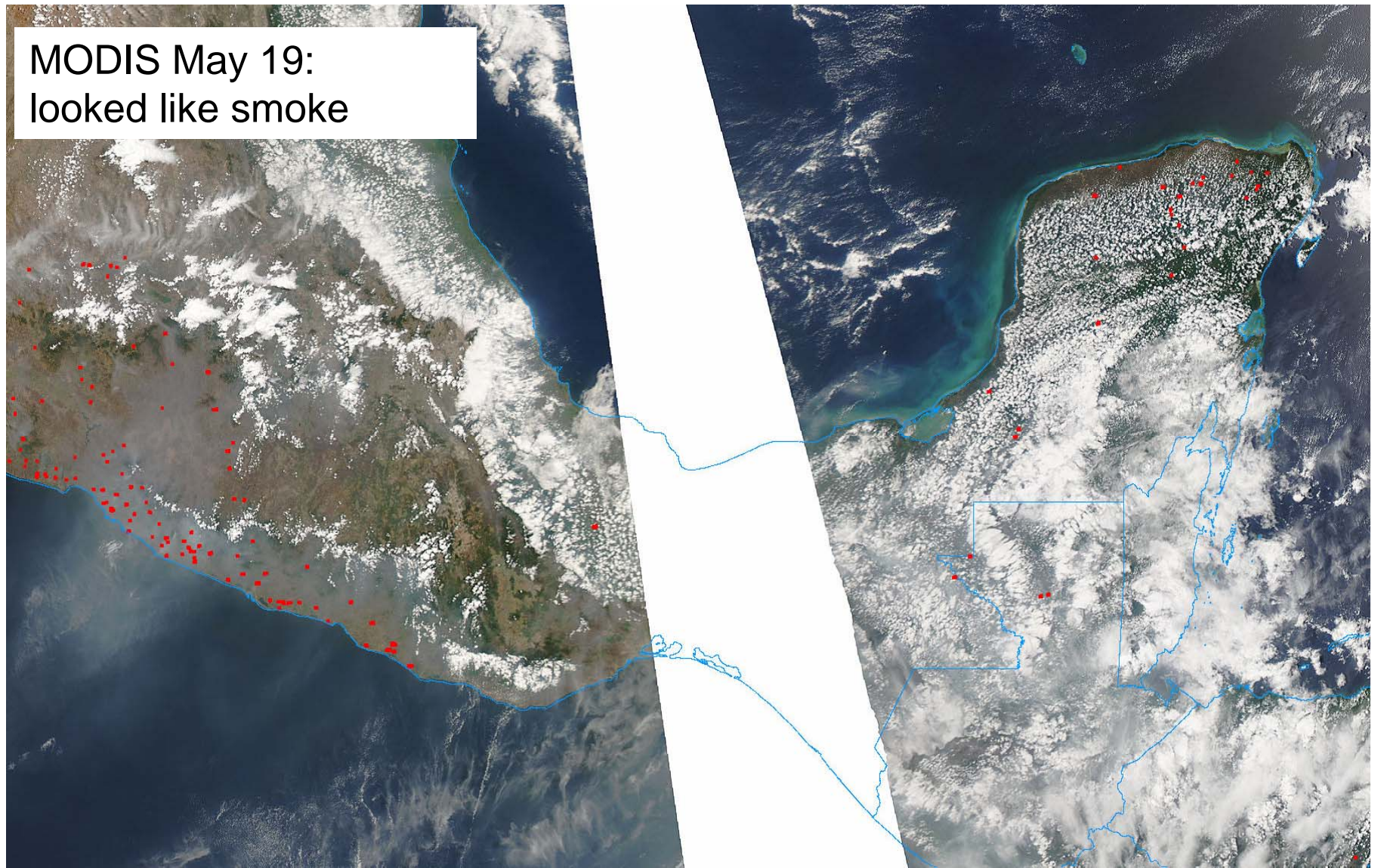
haze and smoke

Mexico

Belize

Guatemala

MODIS May 19:
looked like smoke



MODIS May 19:
looked like smoke

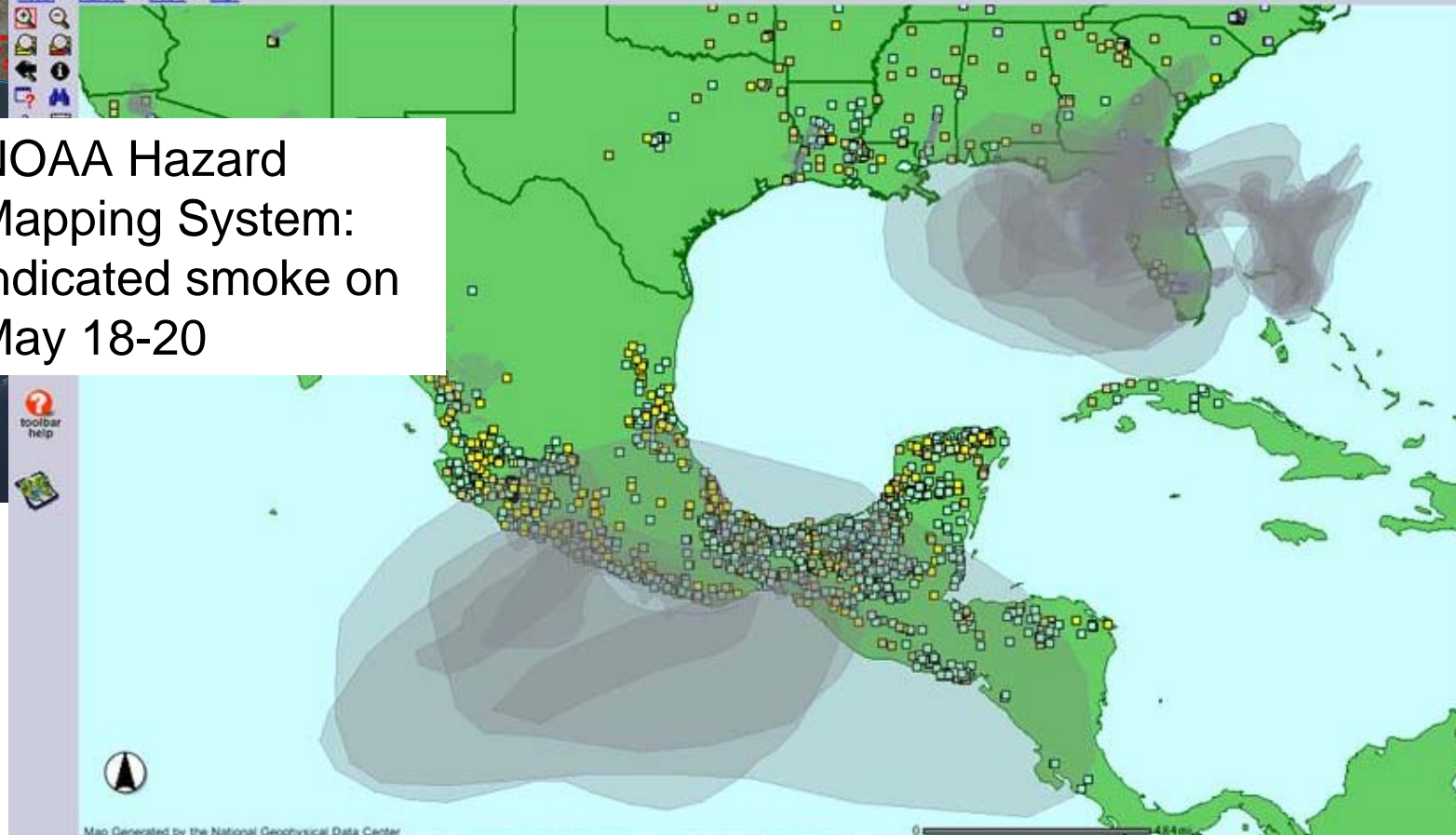


NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)

Satellite Fire Detections
National Geophysical Data Center

NOAA > NESDIS > NODC > Maps

[privacy policy](#)



legend layers

- Legend**
- Analyzed Smoke
 - HMS**
 - AVHRR Analysis
 - AVHRR NOAA-15
 - AVHRR NOAA-16
 - AVHRR NOAA-17
 - GOES Analysis
 - GOES-EAST
 - GOES-WEST
 - MODIS Analysis
 - MODIS AQUA
 - MODIS TERRA
 - States

May 18 2007

May 20 2007

Custom Range

Map Generated by the National Geophysical Data Center
Data constrained to the time period between 2007-05-18 00:00:00 and 2007-05-20 23:59:59 (UTC).

NOAA Hazard
Mapping System:
indicated smoke on
May 18-20

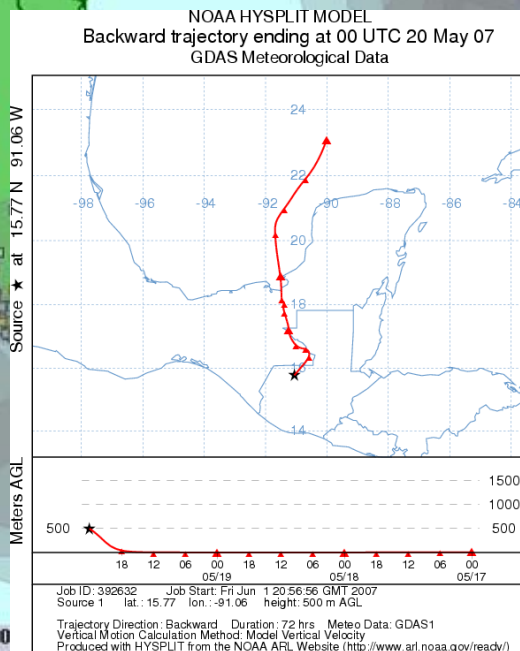
MODIS May 19:
looked like smoke



NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)

Satellite Fire Detections
National Geophysical Data Center

NOAA Hazard
Mapping System:
indicated smoke on
May 18-20



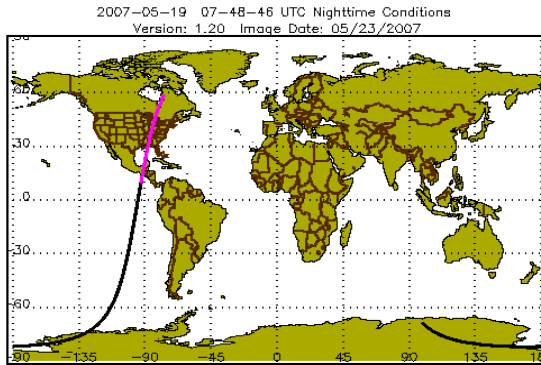
- Legend
- Analyzed Smoke
 - HMS
 - AVHRR Analysis
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 - AVHRR NOAA-16
 - AVHRR NOAA-17
 - GOES Analysis
 - GOES-EAST
 - GOES-WEST
 - MODIS Analysis
 - MODIS AQUA
 - MODIS TERRA
 - States

May 18 2007
May 20 2007
Custom Range

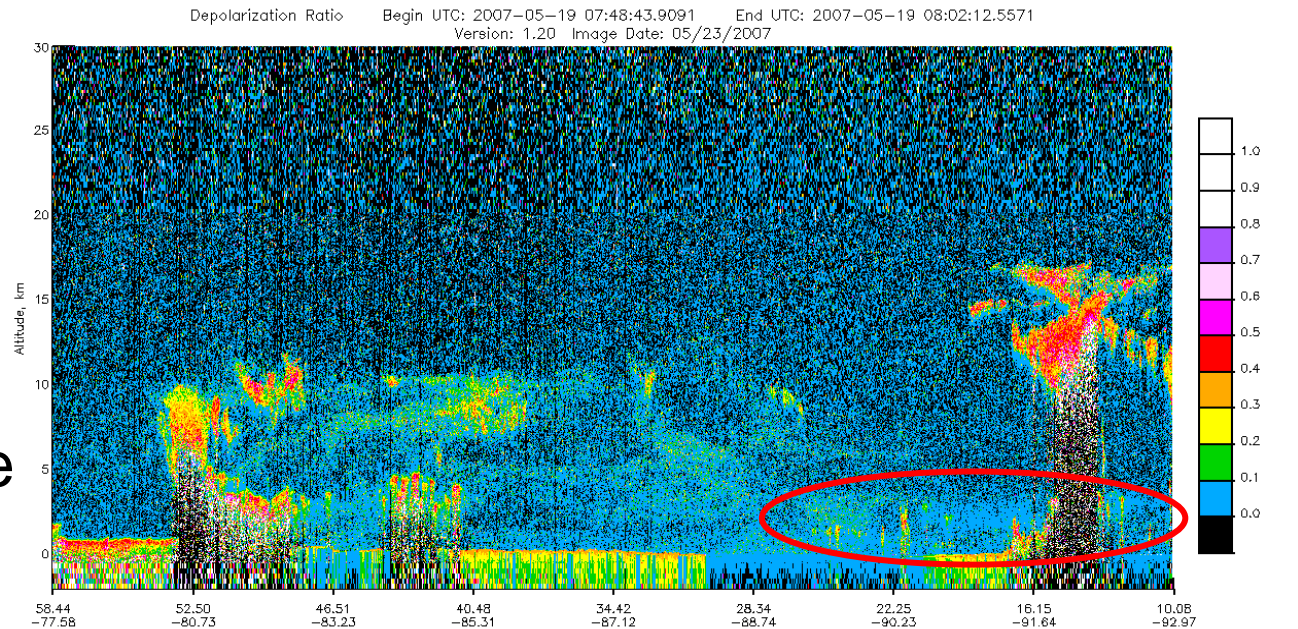
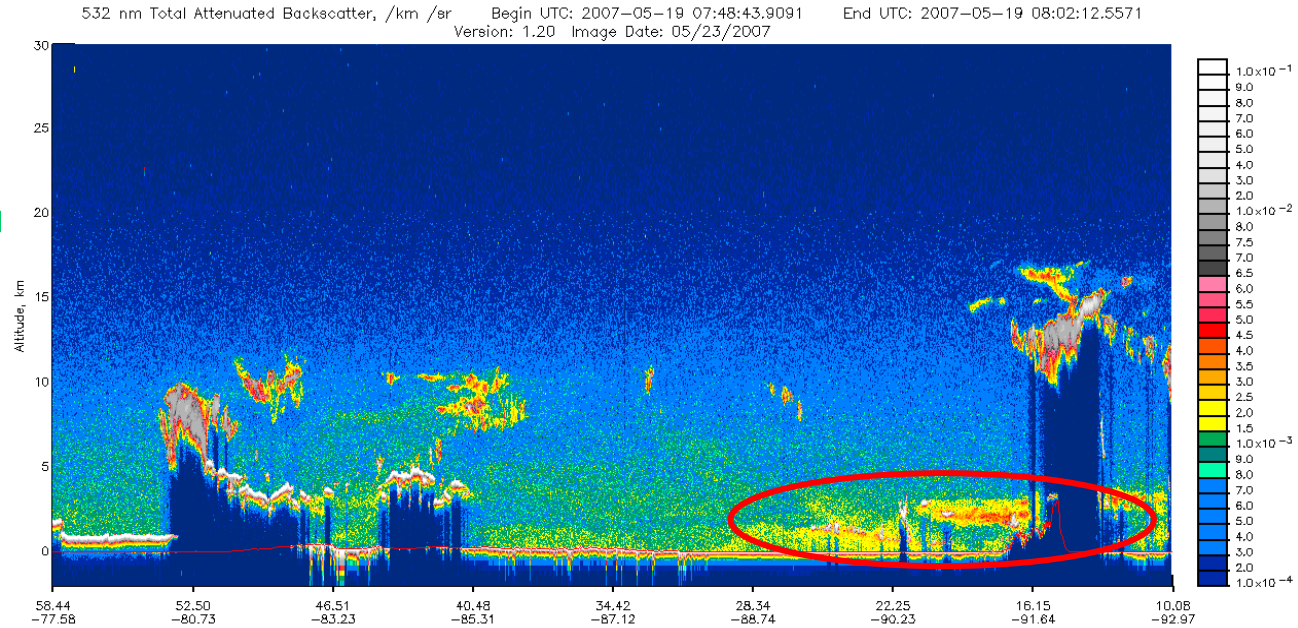
NOAA HYSPLIT:
pointed to local sources

And in the 3D view...

- CALIPSO images from May 18 over Costa Rica and Nicaragua

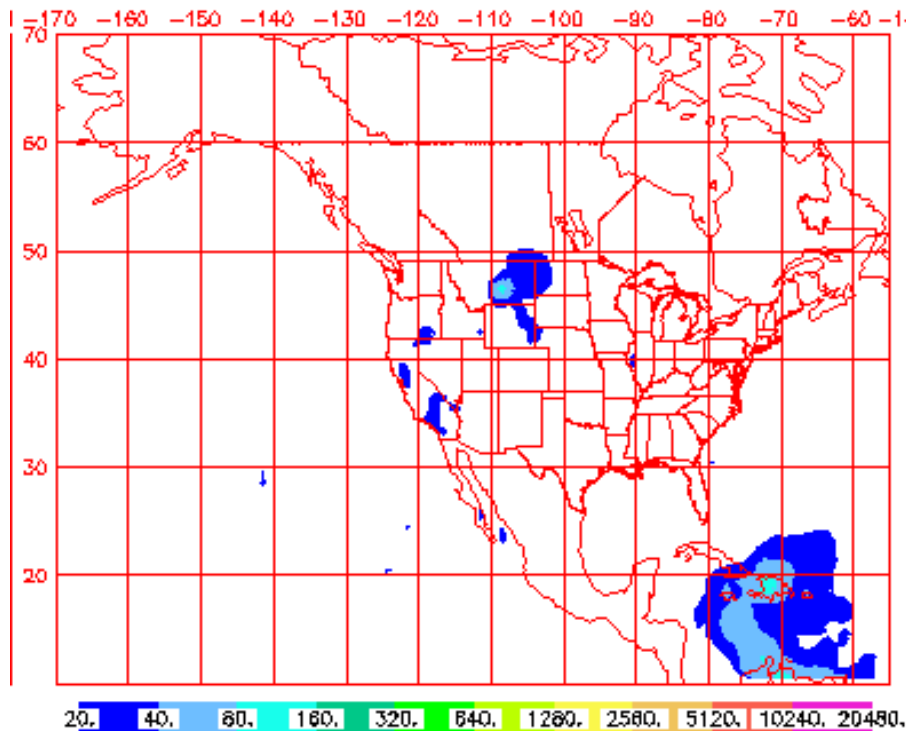


- Depolarization ratio supports case for smoke



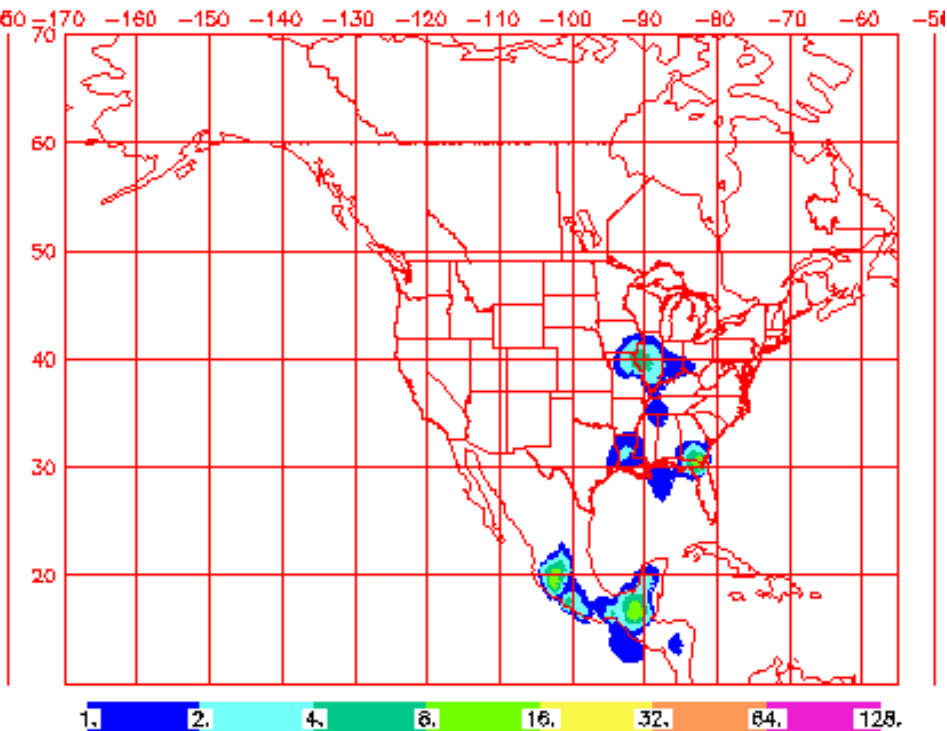
What about the rumors of Saharan dust?

NAAPS Surface Concentration ($\mu\text{g}\cdot\text{m}^{-3}$)
for 06:00Z 21 May 2007 Dust



2.000E+01: 2.048E+04 [1.162E-25, 0.088E+01, 5.480E+00] NIKRO-C/ M^3

NAAPS Surface Concentration ($\mu\text{g}\cdot\text{m}^{-3}$)
for 06:00Z 21 May 2007 Smoke



1.000E+00: 1.280E+02 [4.753E-20, 1.888E+01, 2.085E-01] NIKRO-C/ M^3

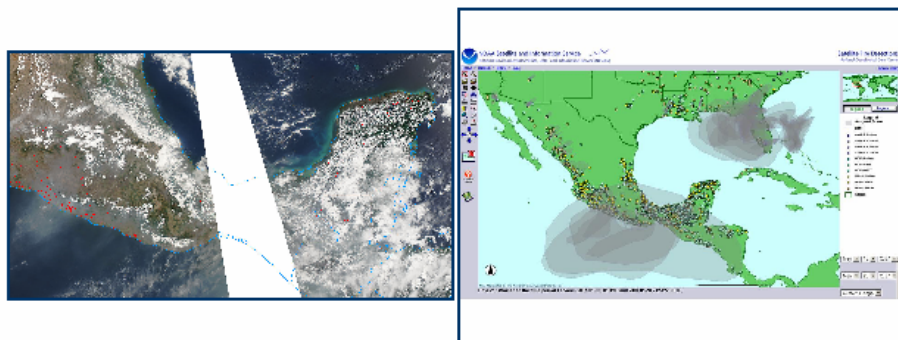
NRL model says there's smoke, and maybe dust to the east..

May 21, 2007

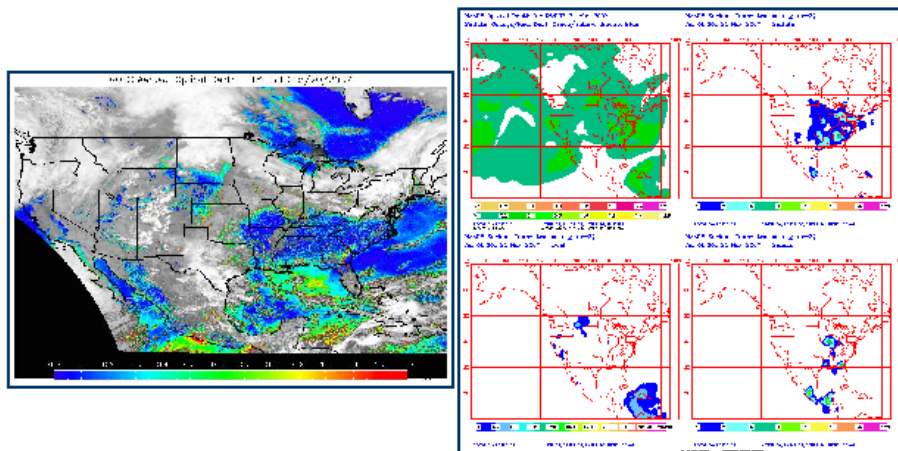
SPECIAL FEATURE: FIRES AND SMOKE IN MESOAMERICA

On May 21, we received an email from colleagues with questions about air pollution that parts of MesoAmerica (specifically, Honduras, Costa Rica and Nicaragua) were experiencing, starting on Friday May 18. There was concern about toxics and about the possibility of Saharan dust crossing the Atlantic. We'd been watching the northern Gulf of Mexico pretty closely, since it had been very smoky from the fires in Florida. So, we looked a little further south to see if we could figure out what was happening.

MODIS true color images told us there were many fires in Central America that entire week; for example, on [May 15](#) and [May 16](#). The MODIS image from May 19 showed significant smoke and clouds in the entire northern part of the region (left image below). This is confirmed by the NOAA NESDIS smoke and fire detection Hazard Mapping System (right).



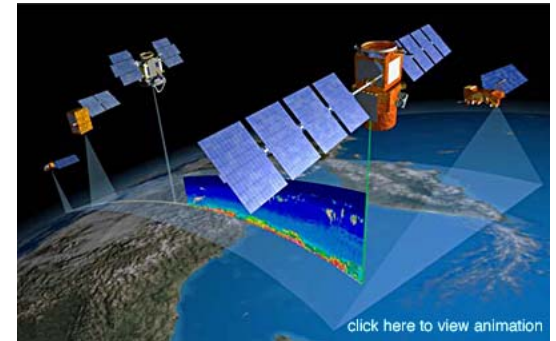
The GOES aerosol optical depth images from May 20 showed quite a bit of smoke and haze across the Gulf of Mexico, Caribbean Sea, and off Pacific coast (left image). The NRL model indicated smoke on May 21 (right image, bottom right panel). The back trajectories varied depending on start time and location, but 72 hours runs pointed to mostly local sources (e.g., see HYSPLIT for [May 19](#) and [May 20](#)). NASA's Earth Observatory did a story on these [fires in Mexico and Central America](#), including an image of the fires on May 21.



Conclusion:
Air pollution in Mesoamerica
May 18-21 was dominated by
locally generated smoke

A few thoughts on Satellite Remote Sensing and Outreach

- Pay attention at least a little every day
- Apply basic rules:
 - Occam's razor (or *lex parsimoniae*): All things being equal, the simplest solution tends to be the best one
 - Chatton's anti-razor (paraphrased): If three (satellites) are not enough to verify an affirmative proposition about things, a fourth must be added, and so on
- A picture is worth 1000 words
 - But a few words can really help explain what the heck you're looking at
- Tell a story: be timely and relevant
- Share data, techniques, images, information
 - More people using and demanding environmental information = greater understanding of air quality



Questions?

