Earth Observations for Air Quality and Land Applications

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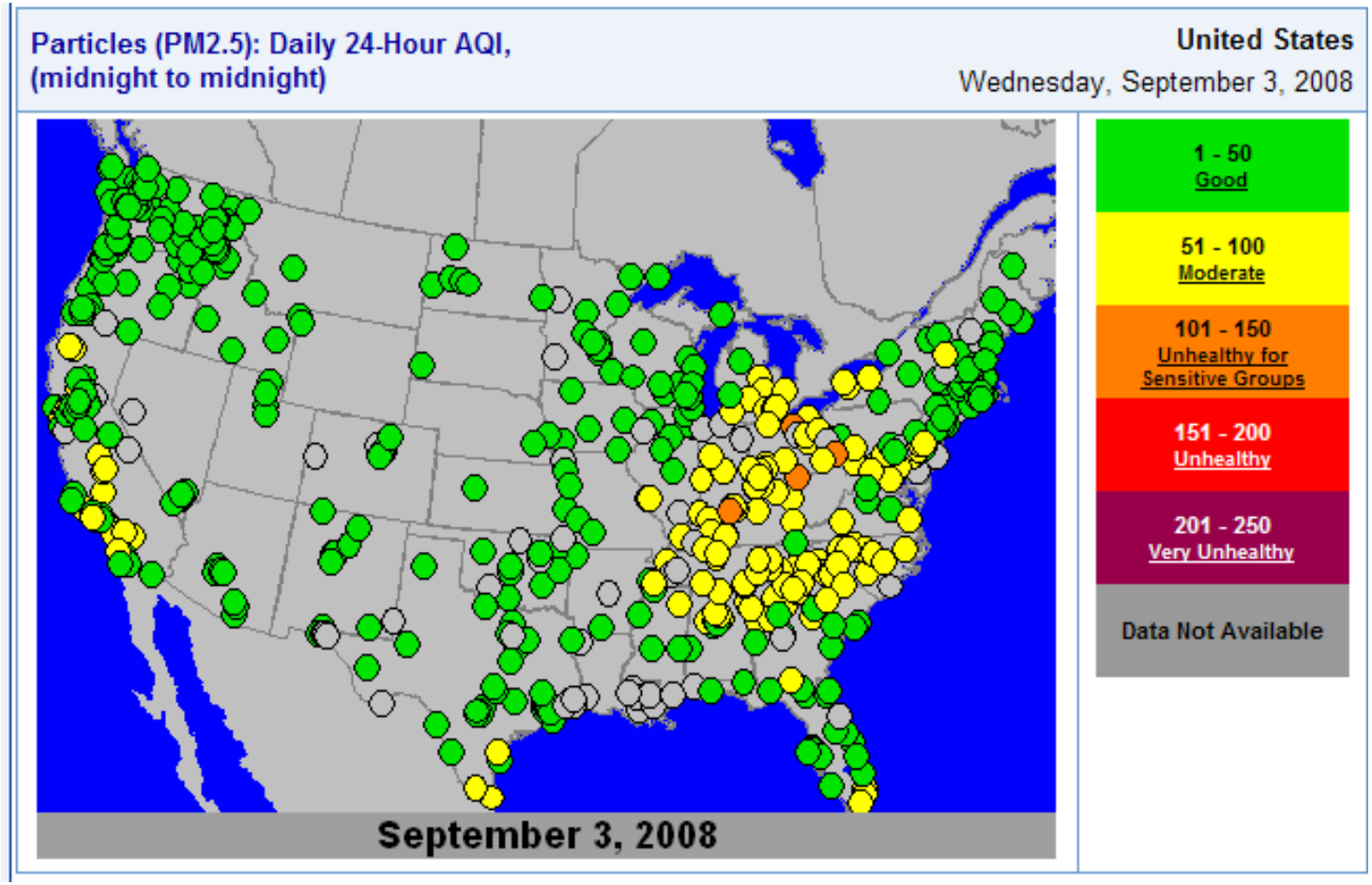
Air Quality

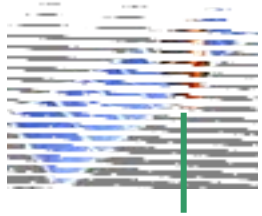
- Public health officials care about air quality at the surface, where we live and breathe.
- Many governments measure ambient concentrations of hazardous pollutants, such as PM_{10}, $PM_{2.5}$, O_3, and NO_2.
- Why do we need satellite data?



Land Cover

- We have topographical maps, aerial photography, land use records.
- Why do we need satellite data?

Why Use Satellite Measurements?

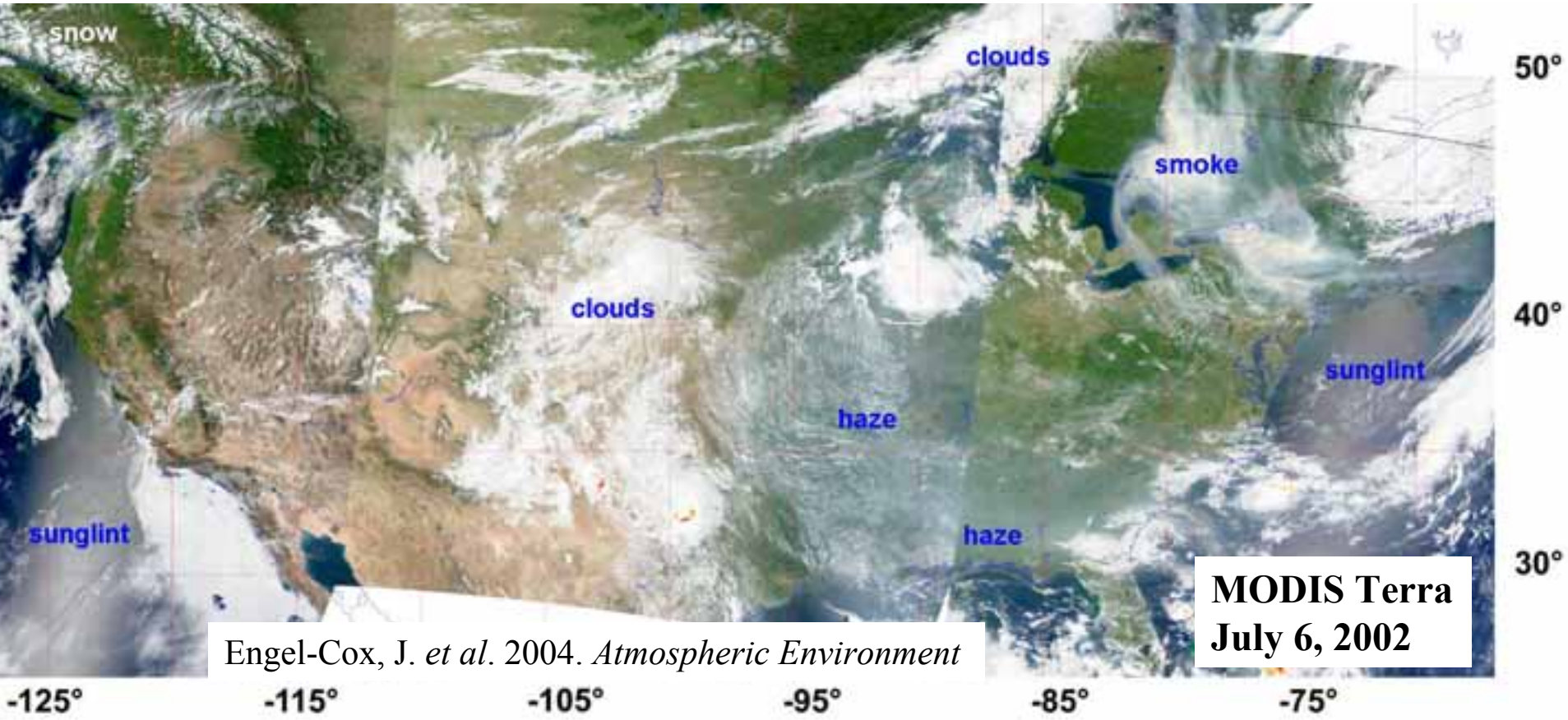


- Overview of information on the hemispheric, regional, national, and local scales – the "big picture" of air quality and land cover.
- Visual appeal for policymakers and the public: a picture is worth a thousand words!
- Provide air quality information in areas where there are no ground-based monitors.
- Advance warning of impending air quality events, especially fires and dust storms.
- Monitoring of land cover changes, such as erosion, burn scars and deforestation.

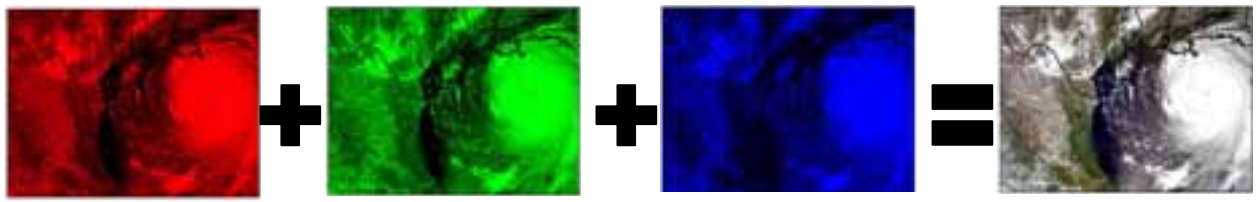
Limitations of Satellite Measurements

- Spatial resolution of measurements is too large for some applications.
- Temporal resolution of polar-orbiting satellites: observations are made only 1-2 times per day.
- Lack of specificity about some pollutants: best for PM, qualitative for NO_2,and O_3 is still experimental.
- Satellites measure pollutants in a vertical column of air – no direct measurements of air quality at surface.

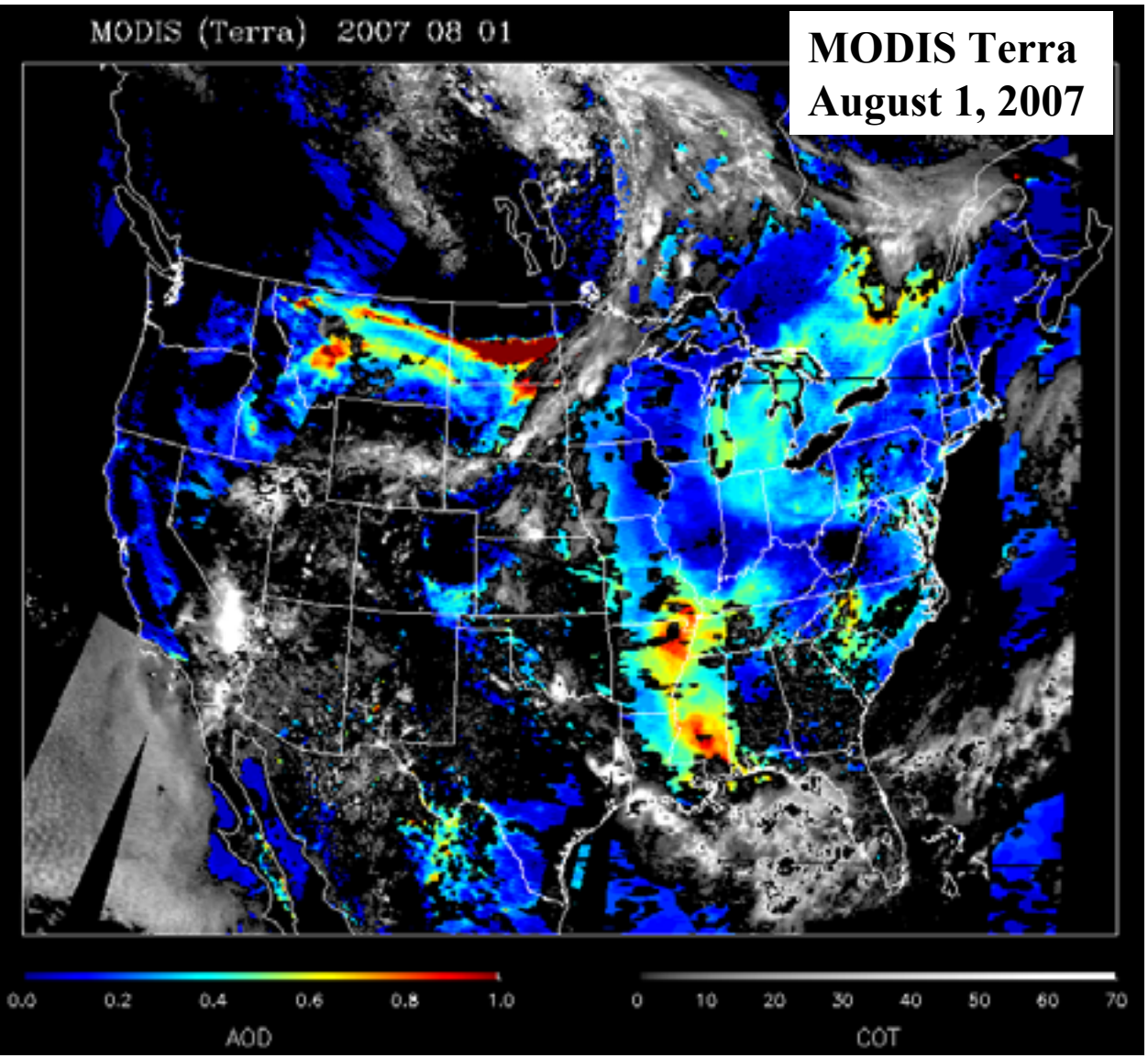
True Color Image



- A true color Image is NOT a picture!
- Image made using Red+Green+Blue bands of instrument

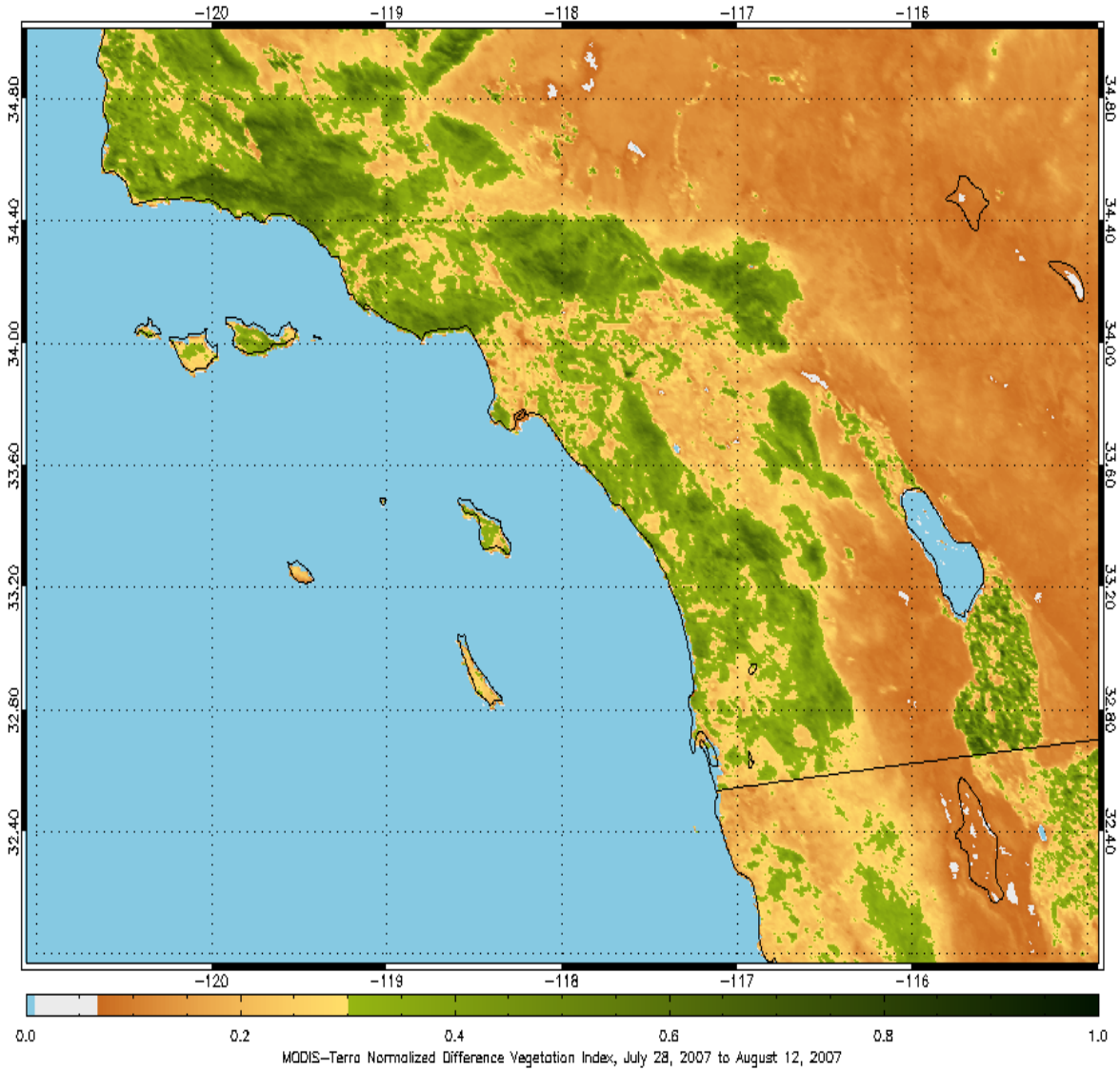


Aerosol Optical Depth (AOD) Image



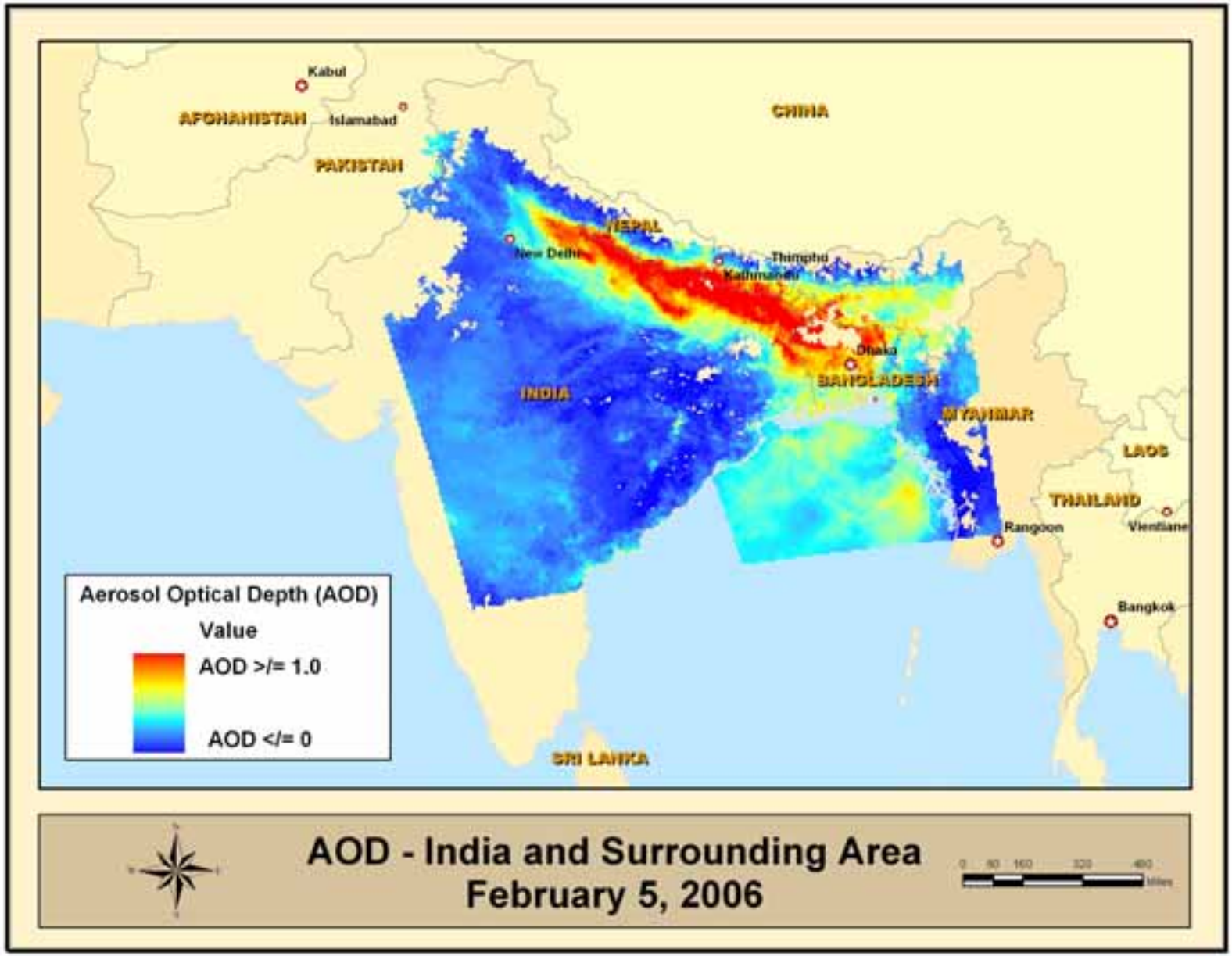
- AOD is proportional to particulate concentration
- AOD is dimensionless; values typically range from 0 (clear, no haze) to 1 (very hazy, smoky, or dusty) in the US
- Clouds block the measurement of AOD!

Normalized Difference Vegetation Index (NDVI) Image



- NDVI measures plant growth, vegetation cover, and biomass production
- Green colors indicate high amounts of vegetation (trees, grasses, plants)
- NDVI values near zero indicate non-vegetative features (rocks, soil, water, snow, urban areas)

Image Prepared from MODIS Data in HDF Format using ENVI and ArcView GIS Software



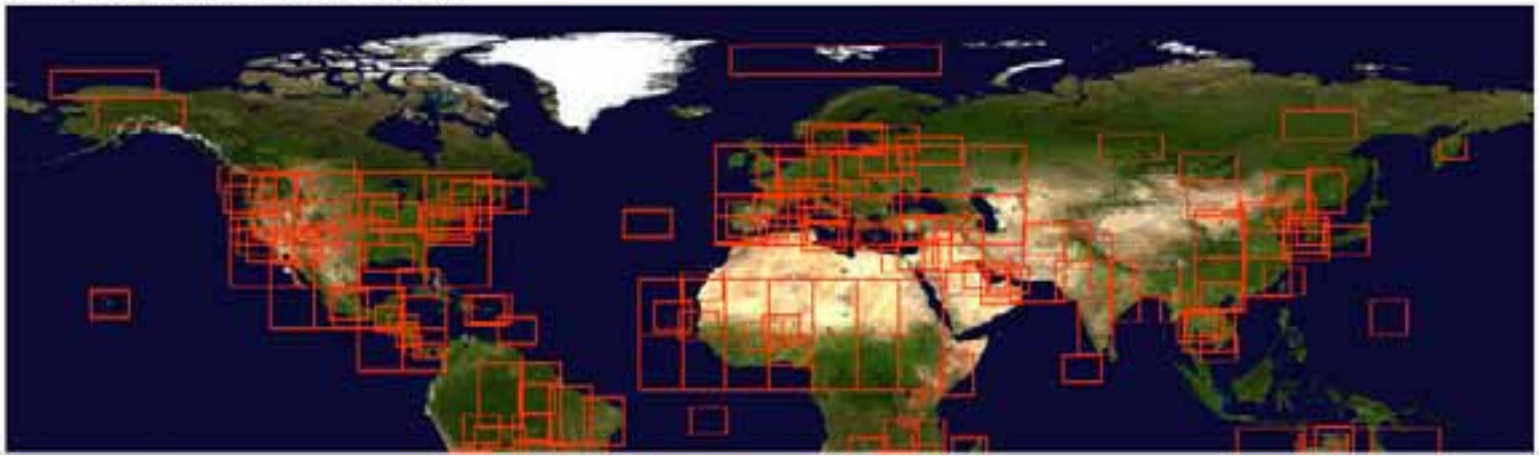
NASA MODIS Rapid Response System - Subsets

http://rapidfire.sci.gsfc.nasa.gov/subsets/

Subsets

This page contains a number of image subsets that are automatically generated in near-real-time for various applications users. Most subsets are available as true-color images. Some additional band combinations may be be available for specific applications. Geographic areas can be selected from the maps or from the list below. For each geographic area the archive imagery is available online.
Subsets for a few projects can also be accessed through these specific URLs:
http://rapidfire.sci.gsfc.nasa.gov/aeronet
http://rapidfire.sci.gsfc.nasa.gov/fas
http://rapidfire.sci.gsfc.nasa.gov/servir
http://rapidfire.sci.gsfc.nasa.gov/jason
http://rapidfire.sci.gsfc.nasa.gov/uae

Select a subset:
(click on the map or pick from the list below)



NASA MODIS Rapid Response System - Subsets

http://rapidfire.sci.gsfc.nasa.gov/subsets/

AERONET_Ispra Subsets

prev next

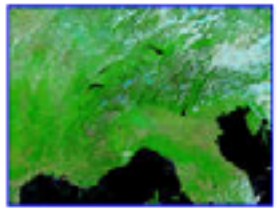
Date: 2008/252 - 09/08/08

Go back to the main subset page

MODIS Terra
True color

Pixel size:
2km | 1km | 500m | 250m

MODIS Terra
721



Pixel size:
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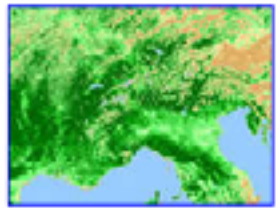
MODIS Terra
NDVI

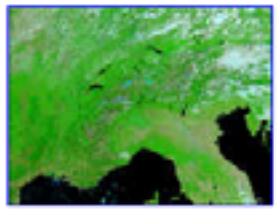


Pixel size:
2km | 1km | 500m | 250m

MODIS Aqua
True color

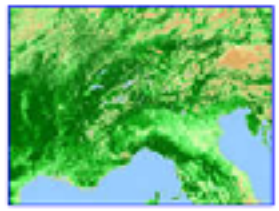
Pixel size:
2km | 1km | 500m | 250m

MODIS Aqua
721



Pixel size:
2km | 1km | 500m | 250m

MODIS Aqua
NDVI



Pixel size:
2km | 1km | 500m | 250m

Display alternate dates available for this subset (may load slowly)

NASA MODIS Rapid Response System - Subsets

http://rapidfire.sci.gsfc.nasa.gov/subsets/

AERONET_Ispra Subset - Terra 1km True Color image for 2008/252 (09/08/08) prev next

Vectors selected: none

Change vector options: none submit

View alternate pixel size: 2km | 500m | 250m |

View alternate band combination: Bands 7-2-1 | NDVI |

View Aqua image | See all images available for this area this day |

Display metadata (including time of input data)

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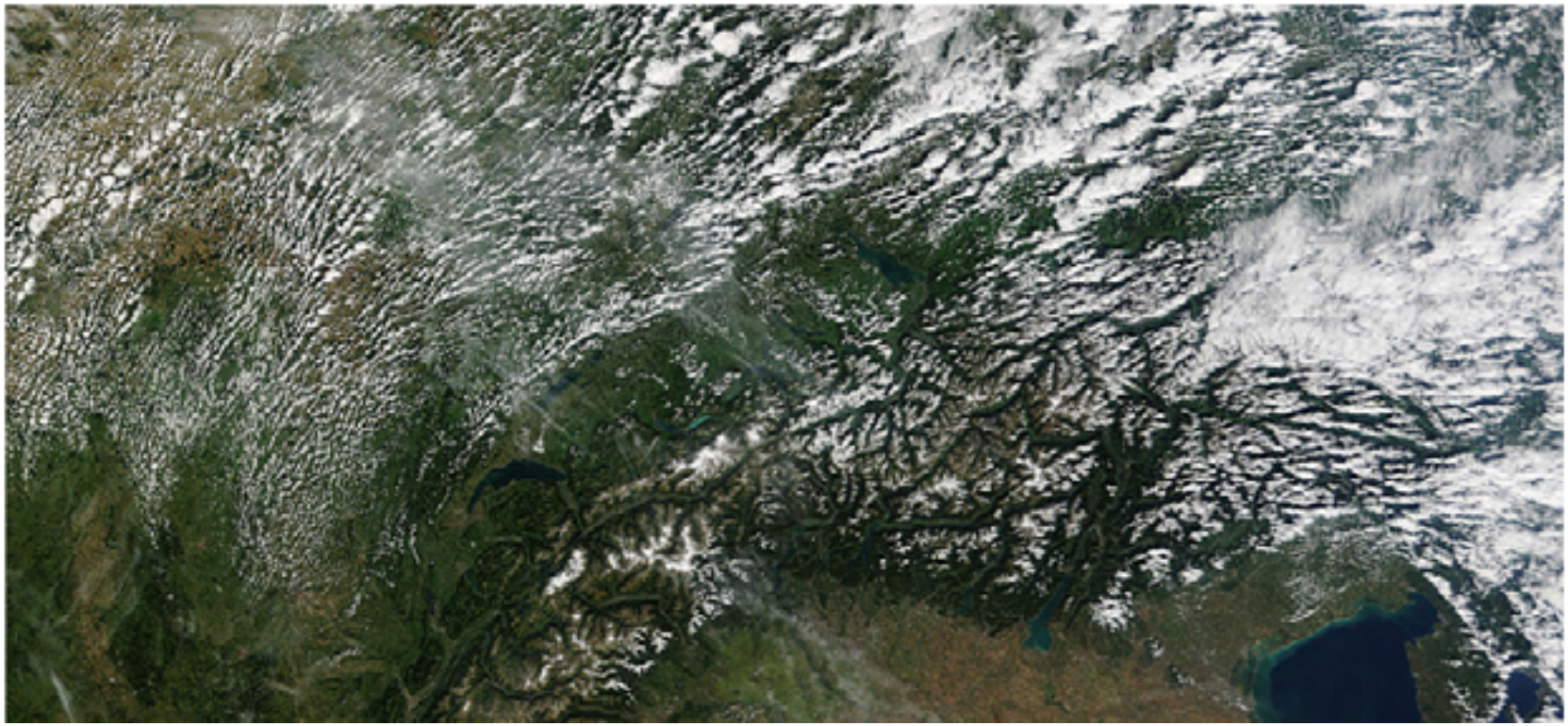
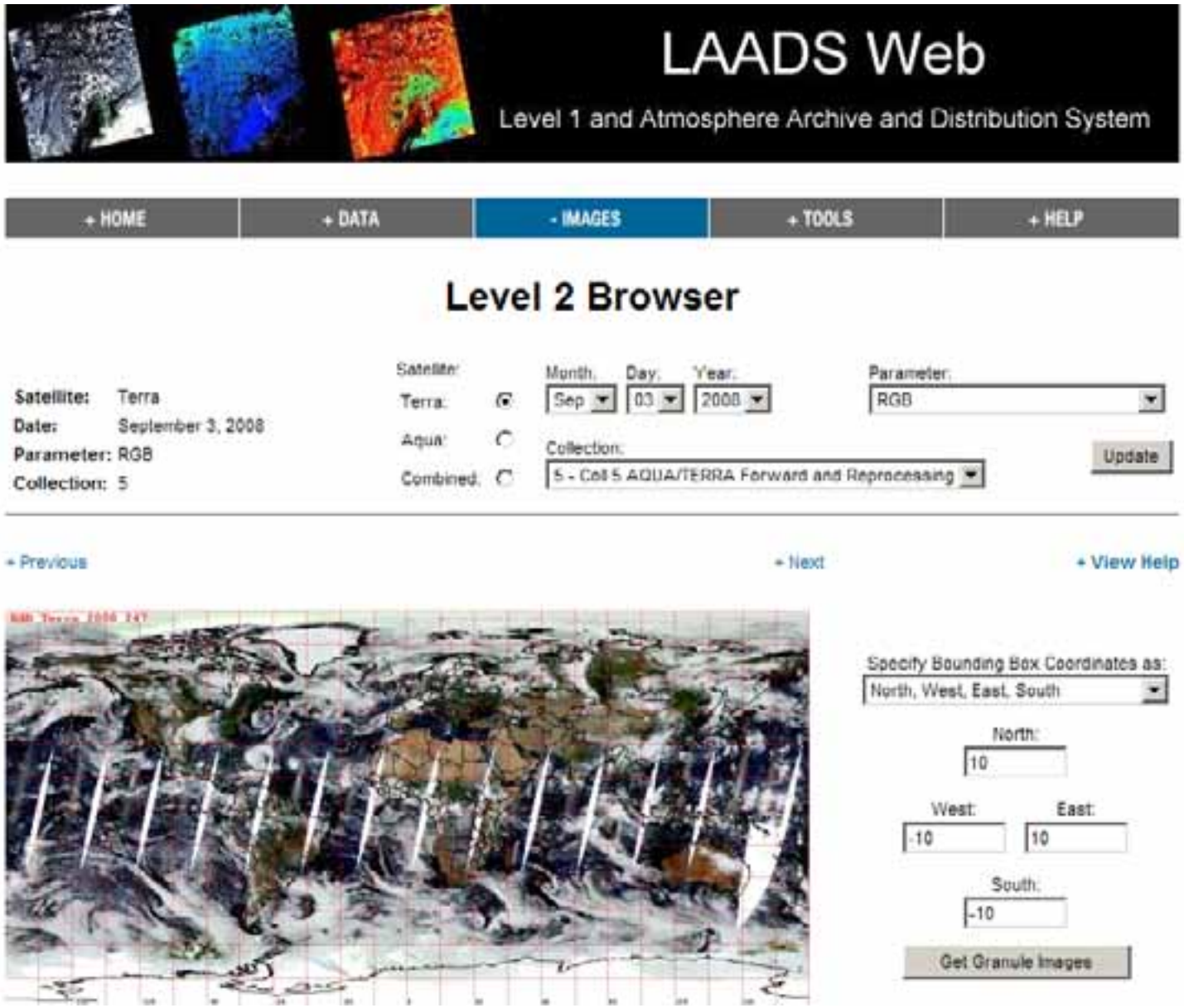
Download GeoTIFF file



NASA LAADS Web Level 2 Browser

http://ladsweb.nascom.nasa.gov/browse_images/l2_browser.html



NASA LAADS Web Level 2 Browser

http://ladsweb.nascom.nasa.gov/browse_images/l2_browser.html

Level 2 Browser

Satellite: Terra
Date: September 3, 2008
Parameter: RGB
Collection: 5

Satellite:
Terra: (•)
Aqua: ( )
Combined: ( )

Month: Sep | Day: 03 | Year: 2008

Parameter: RGB

Collection: 5 - Coll 5 AQUA/TERRA Forward and Reprocessing

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Click on the thumbnail image to view a higher resolution image.

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Displaying results 9 - 10 of 10.

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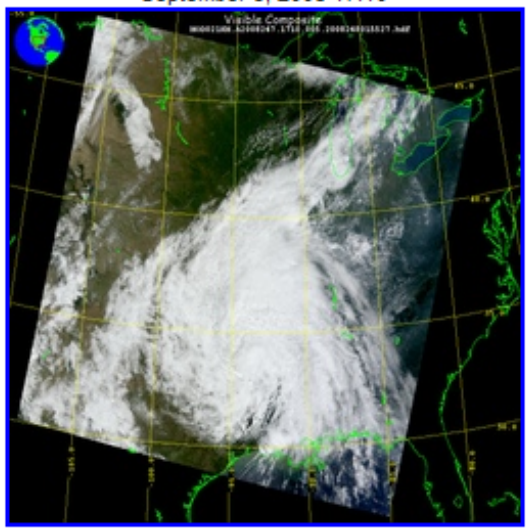

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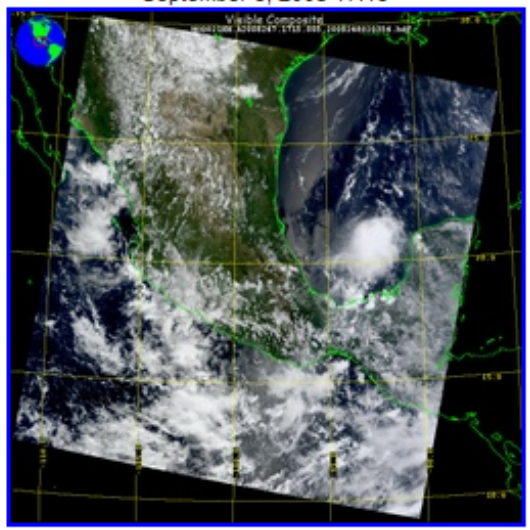

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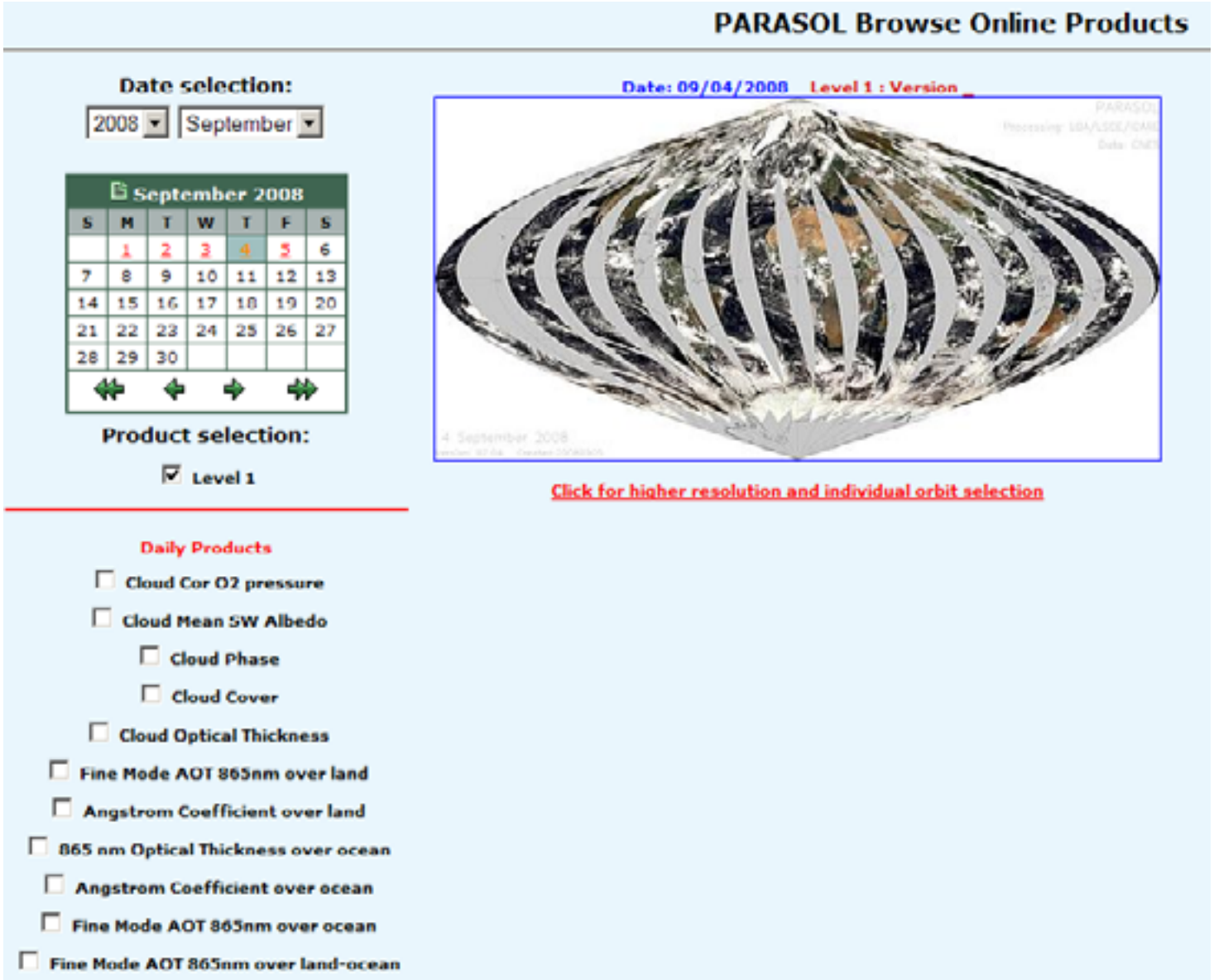

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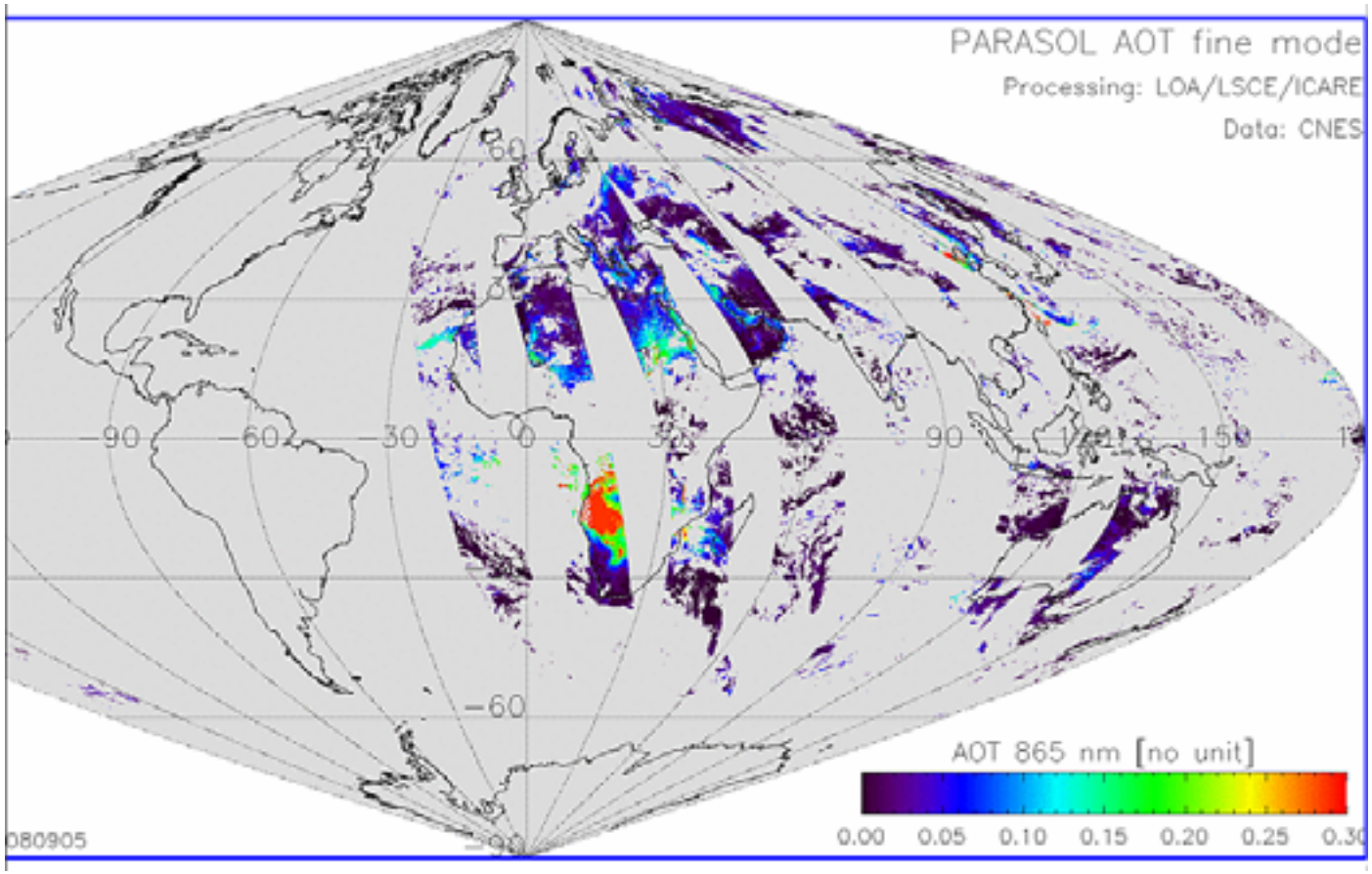
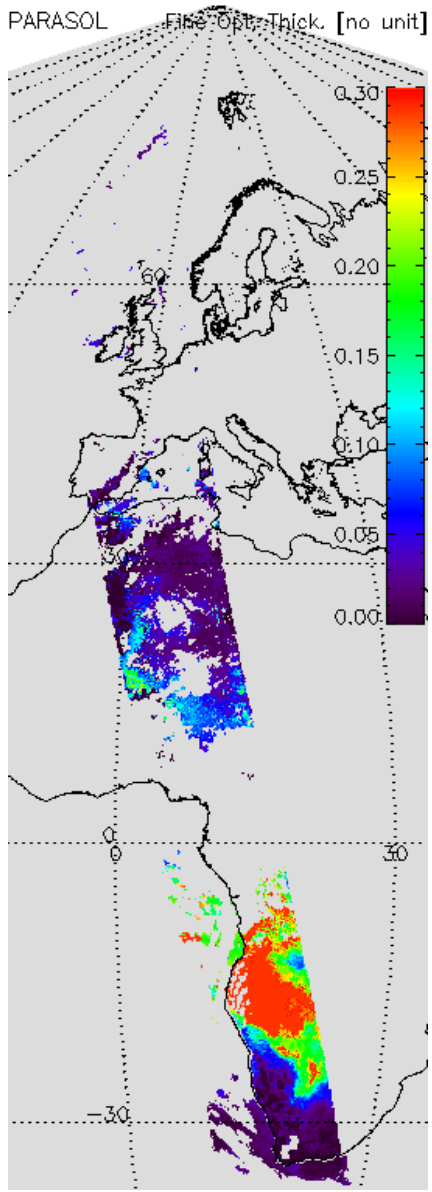
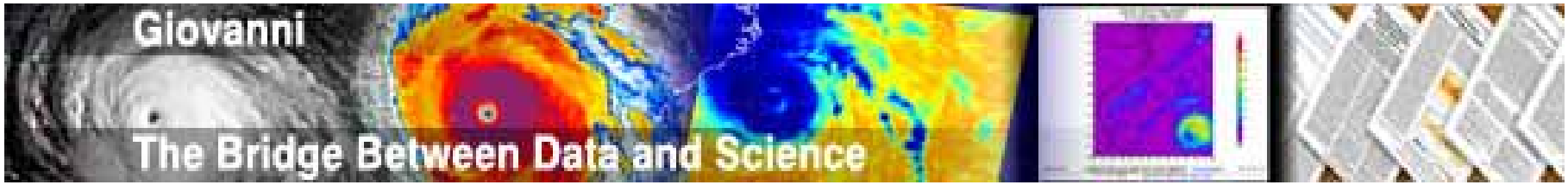




NASA Giovanni

http://disc.sci.gsfc.nasa.gov/techlab/giovanni/



Global Air Quality Data Sets

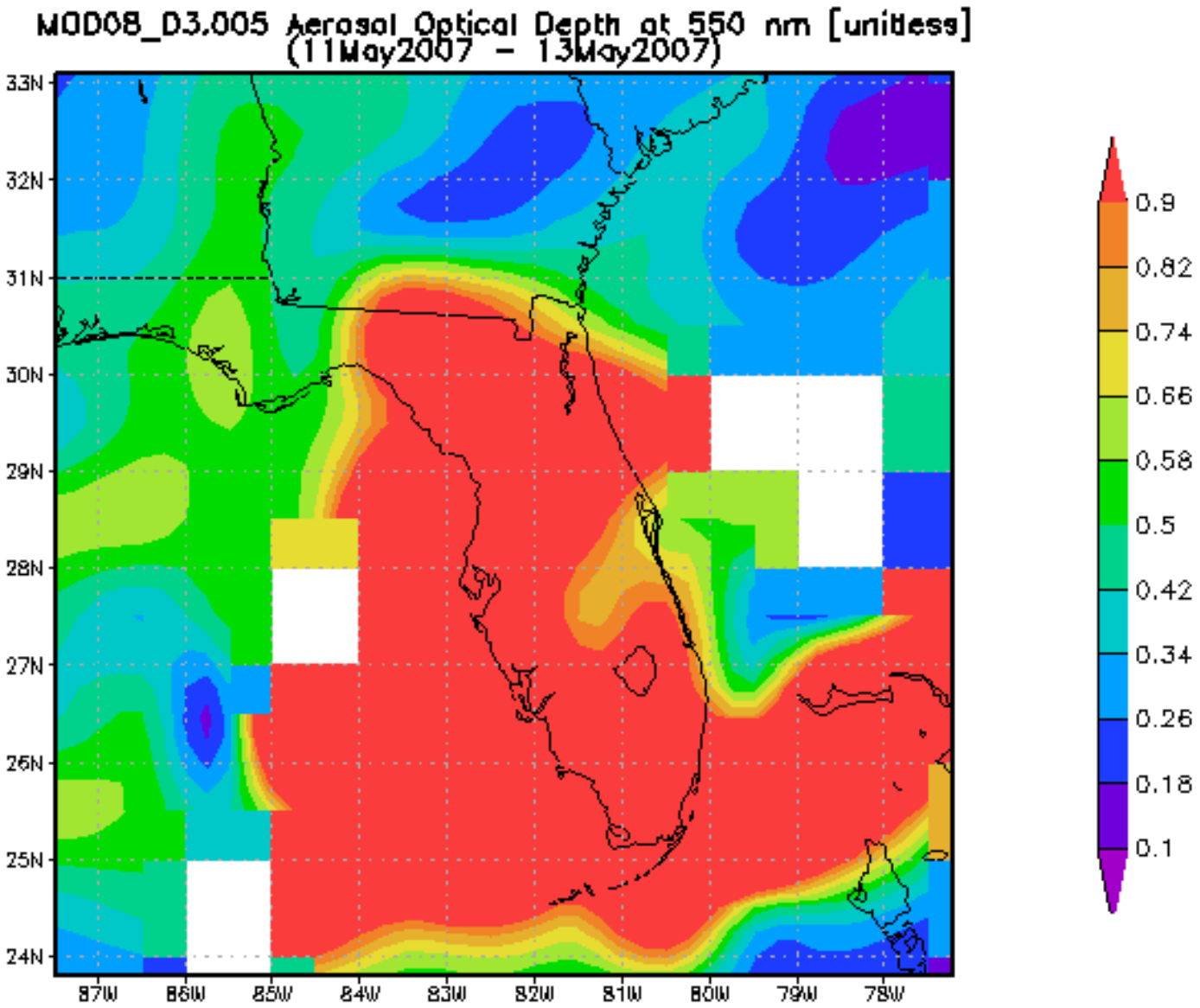
- MODIS **Aerosol Optical Depth** (1° x 1°)
- OMI **UV Aerosol Index and AOD** (1° x 1°)
- OMI **NO_2 Tropospheric column** (0.25° x 0.25°)

Eurasia Land Cover Data Sets (1° x 1°)

- MODIS **Enhanced Vegetation Index**
- MODIS Terra and Aqua **NDVI**
- AMSR-E **Soil Moisture Mean**

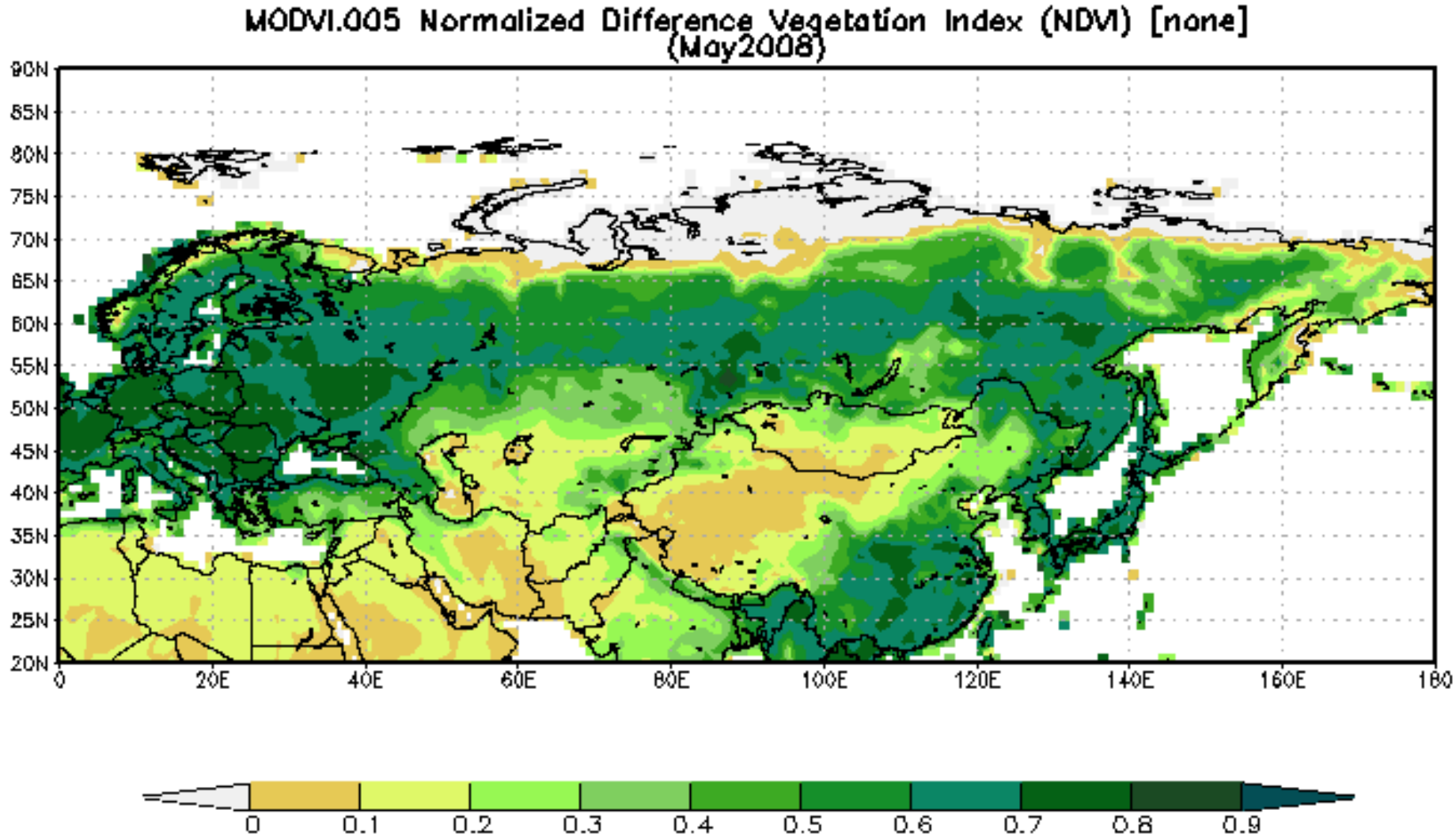
NASA Giovanni: Air Quality

http://disc.sci.gsfc.nasa.gov/techlab/giovanni/



NASA Giovanni: Land Cover

http://disc.sci.gsfc.nasa.gov/techlab/giovanni/



Satellite Application for Air Quality: SERVIR-Air

- A new component of the Regional Visualization & Monitoring System (SERVIR) project
- Developing a regional air quality information system with near-real time information on air quality conditions for Mesoamerica and the Caribbean
- Using satellites, ground-based monitors, forecast data
- Consistent regional and local view of air quality
- Direct result of input from Graz symposium!!

SERVIR
Sistema Regional de Visualización y Monitoreo

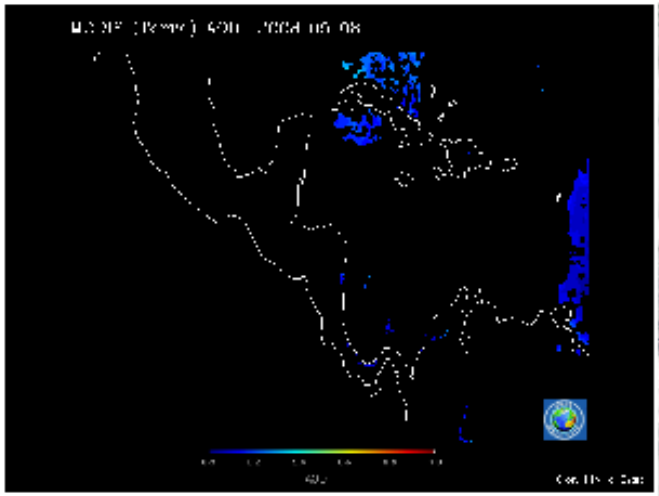
Mesoamerican and Caribbean Smog Blog

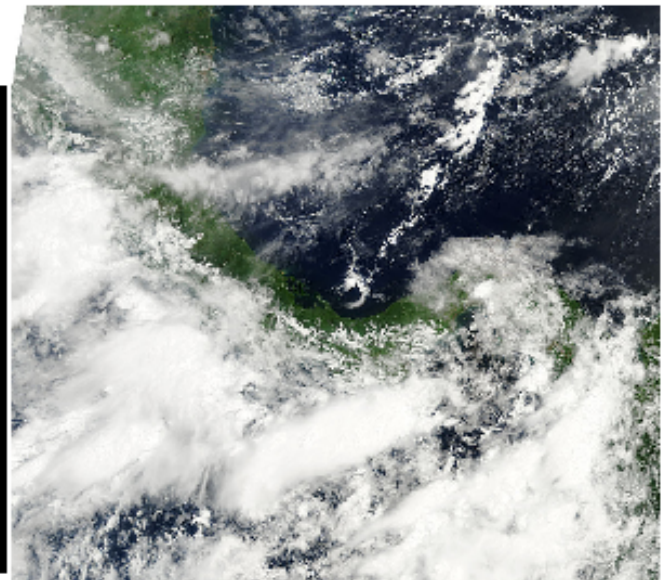
Diary of air quality in Central America and the Caribbean using satellite, ground-based, and forecast data. Analysis by CATHALAC, University of Panama, UMBC, and Battelle.

Good Air Quality; More Tropical Storms Form in the Atlantic

By Amy Huff on September 3, 2008 7:00 PM | Permalink | TrackBacks (0)

As we begin September in Mesoamerica and the Caribbean, air quality appears to be good across the region. We have a new product for the MAC Smog Blog, near real-time images of MODIS aerosol optical depth (AOD) from the Terra and Aqua satellites, provided by Hai Zhang of UMBC. Today's MODIS Terra AOD image for the SERVIR region (below on left) shows very low AOD values, corresponding to low levels are particulates in the atmosphere. The black areas in the image are places where no data were available, likely due to widespread cloud cover. It has been very cloudy this week, as Ray indicated in his last post, and clouds block the measurement of AOD. Today's MODIS Terra true color image for the CAmerica_3_04 region from NASA's Rapid Response website (below on right) indicates the cloud cover that is typical





Search

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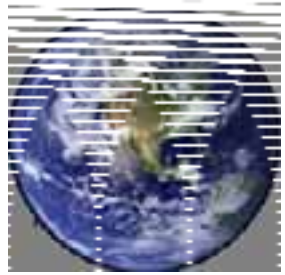
About the Mesoamerican ar Caribbean Smog

Caribbean Air Q weblog, currently ref to as "the MAC Smog is a daily diary o quality spanning Mexico in the nort Panama in the south eastward to include Caribbean Sea. I prepared by autho posters using inform from NASA satellites, monitoring networks other resources available.

Take Home Messages

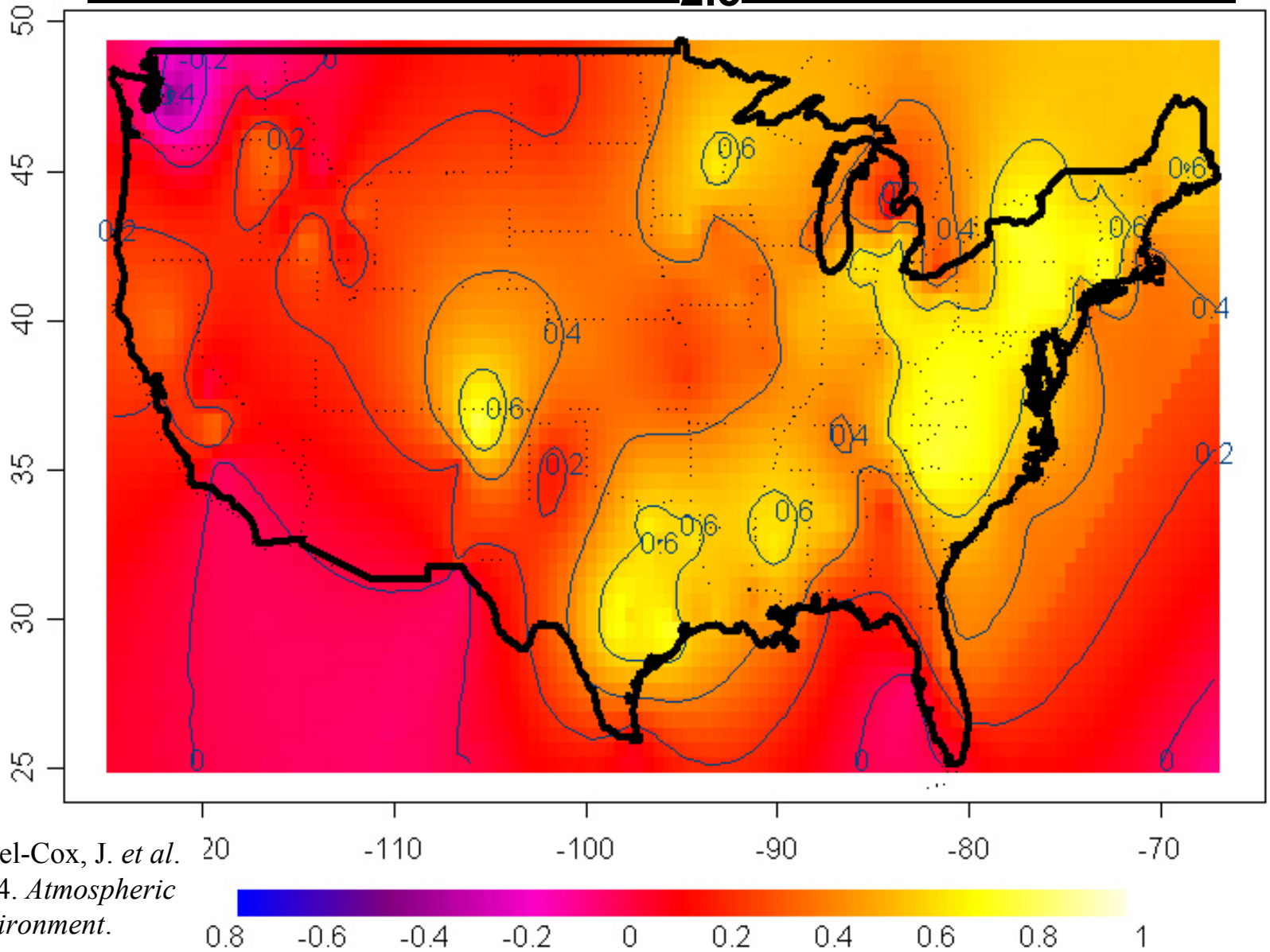


- Many different applications for air quality and land cover satellite data.
- Many satellite data sets:
  - Download data and process yourself
  - Use processed images available on the internet
  - Most internet data sites are user-friendly – it is easy to access images, with a little practice (training on Thursday afternoon!)
- NASA wants to identify 7-8 project ideas from the participants at the Graz symposium for follow-up and possible funding:
  - Applications of NASA satellite data
  - Processing of NASA satellite data
  - Training to learn interpretation and use of NASA satellite data

Acknowledgements

- Lawrence Friedl and NASA Applied Sciences
- Dan Irwin and the SERVIR-Air team

Correlation between AOD and Daily Ground-Based $PM_{2.5}$ Measurements



Engel-Cox, J. *et al*. 2004. *Atmospheric Environment*.