Giovanni:
The Bridge Between Data and Science

Suhung Shen,

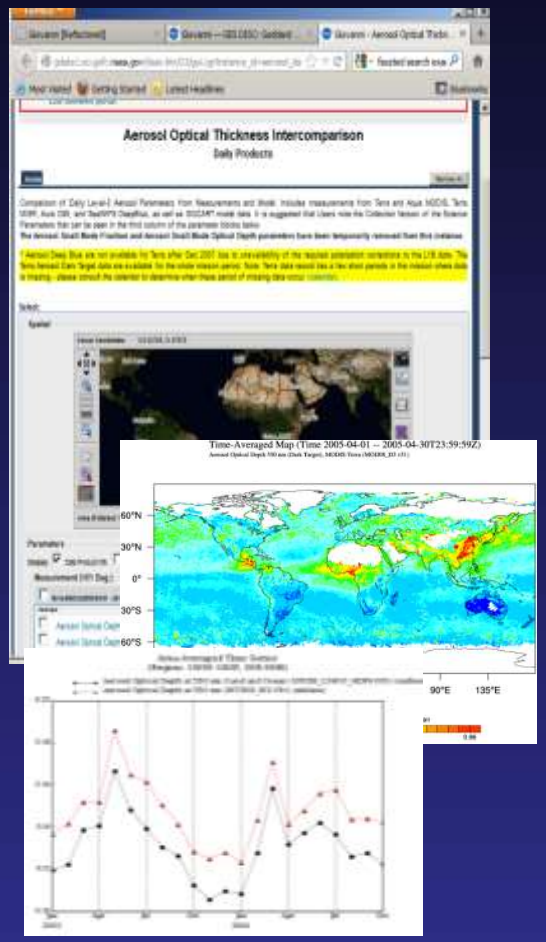
Christopher Lynnes, Steven Kempler
Giovanni Team

NASA Goddard Earth Sciences Data and Information Services Center

http://giovanni.gsfc.nasa.gov/

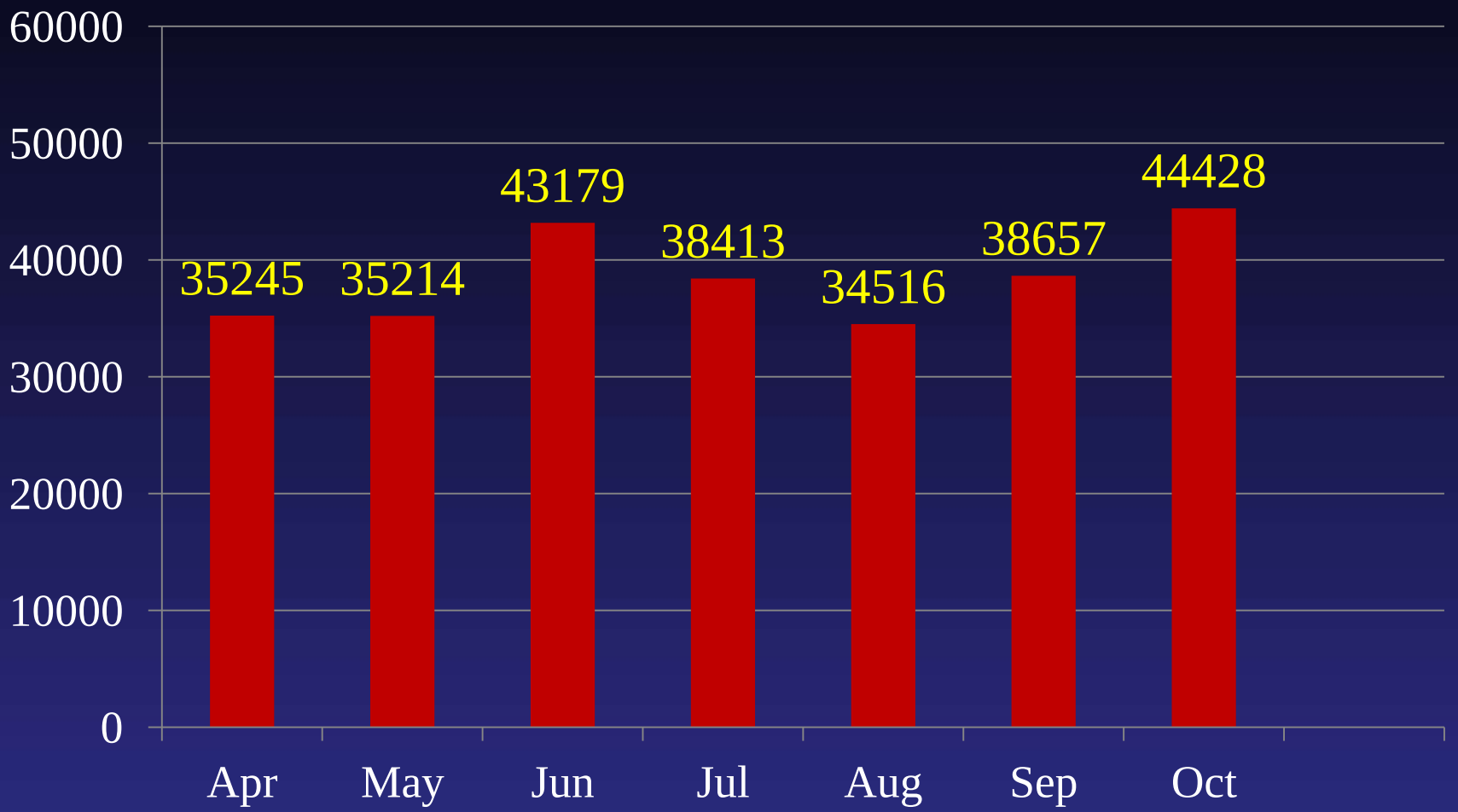
Goddard Interactive Online Visualization ANd aNalysis Infrastructure (Giovanni)

http://giovanni.gsfc.nasa.gov



- With a few mouse clicks, obtaining information easily on the atmosphere, ocean and land around the world.
- No need to learn data formats to retrieve & process data.
- Try various parameter combinations measured by different instruments.
- All the statistical analysis is done via a regular web browser.

Monthly Plots Generated with Giovanni in last 7 months (Apr-Oct 2012)



Giovanni Allows Scientists to Concentrate on the *Science*

The Old Way:

Pre-Science

- Find data
- Retrieve high volume data
- Learn formats and develop readers
- Extract parameters
- Perform spatial and other subsetting
- Identify quality and other flags and constraints
- Perform filtering/masking
- Develop analysis and visualization
- Accept/discard/get more data (sat, model, ground-based)

DO SCIENCE

- Exploration
- Initial Analysis
- Use the best data for the final analysis
- Derive conclusions
- Write the paper
- Submit the paper

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct

Web-based Services:

Giovanni

Mirador

- Read Data
- Extract Parameter
- Subset Spatially
- Filter Quality
- Reformat
- Reproject
- Visualize
- Explore
- Analyze

The Giovanni Way:

- Minutes
- Days for exploration

Use the best data for the final analysis
Derive conclusions
Write the paper
Submit the paper

DO SCIENCE

GES DISC tools allow scientists to ***compress*** the time needed for pre-science preliminary tasks: *data discovery, access, manipulation, visualization, and basic statistical analysis*.

Scientists have ***more time to do science.***

Image credit: Gregory Leptoukh

Giovanni Features

Single Parameter :

- Lat–Lon map of time-averaged
- Time-series of area-averaged
- Hovmöller diagram/cross section map
- Histogram
- Vertical profile
- Zonal mean
- Animations Lat–Lon map
- Climatology & Anomaly analysis

Multi-parameters:

- Scatter plots with regression statistics
- Temporal correlation maps
- Lat–Lon map overlain of time-averaged
- Time-series differences
- Lat–Lon map differences
- Regridding if different spatial resolution

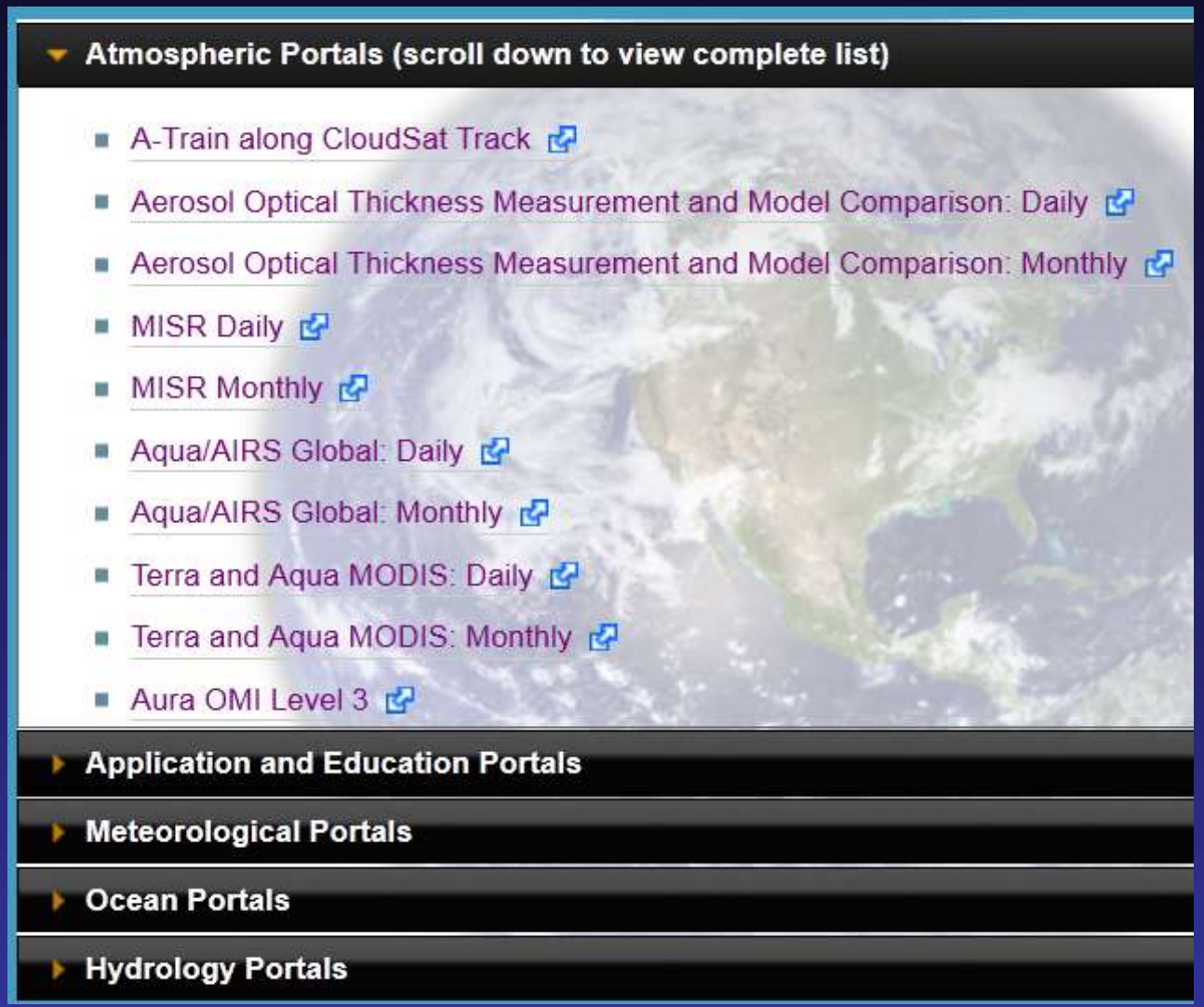
Other Features:

- Output: ASCII, HDF, netCDF for data; png and kmz for images
- Input: HDF, NetCDF, GRIB
- Input data from local and remote systems: FTP, HTTP, OPeNDAP, WCS, and GDS.
- Provides WMS and WCS to other web server to get maps or data from Giovanni

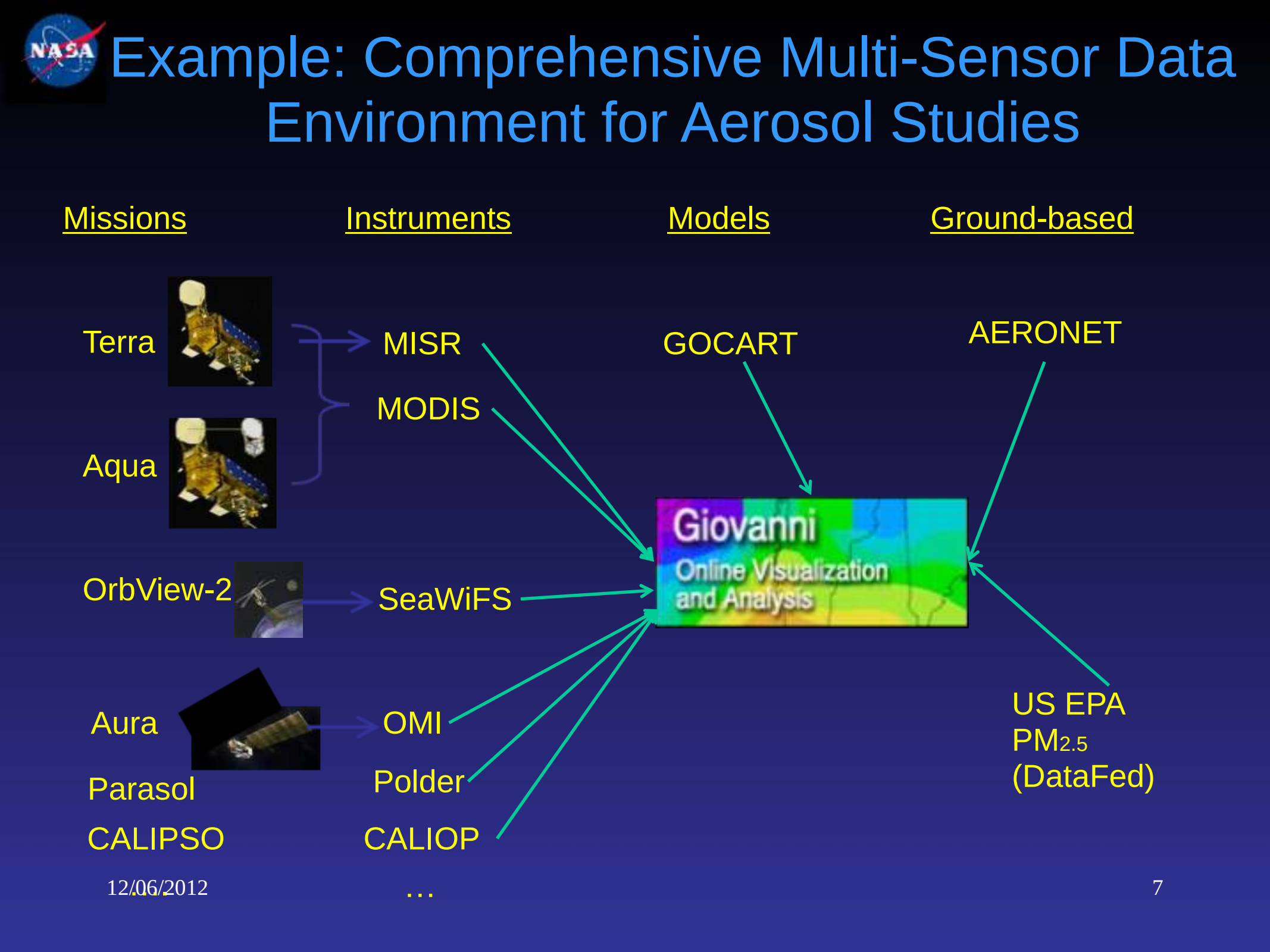
Giovanni now

- 40+ customized **Giovanni portals** serving various missions and projects
- 1600+ geophysical parameters/variables from satellites and models

- Atmospheric Portals
- Application and Education Portals
- Meteorological Portals
- Ocean Portals
- Hydrology Portals

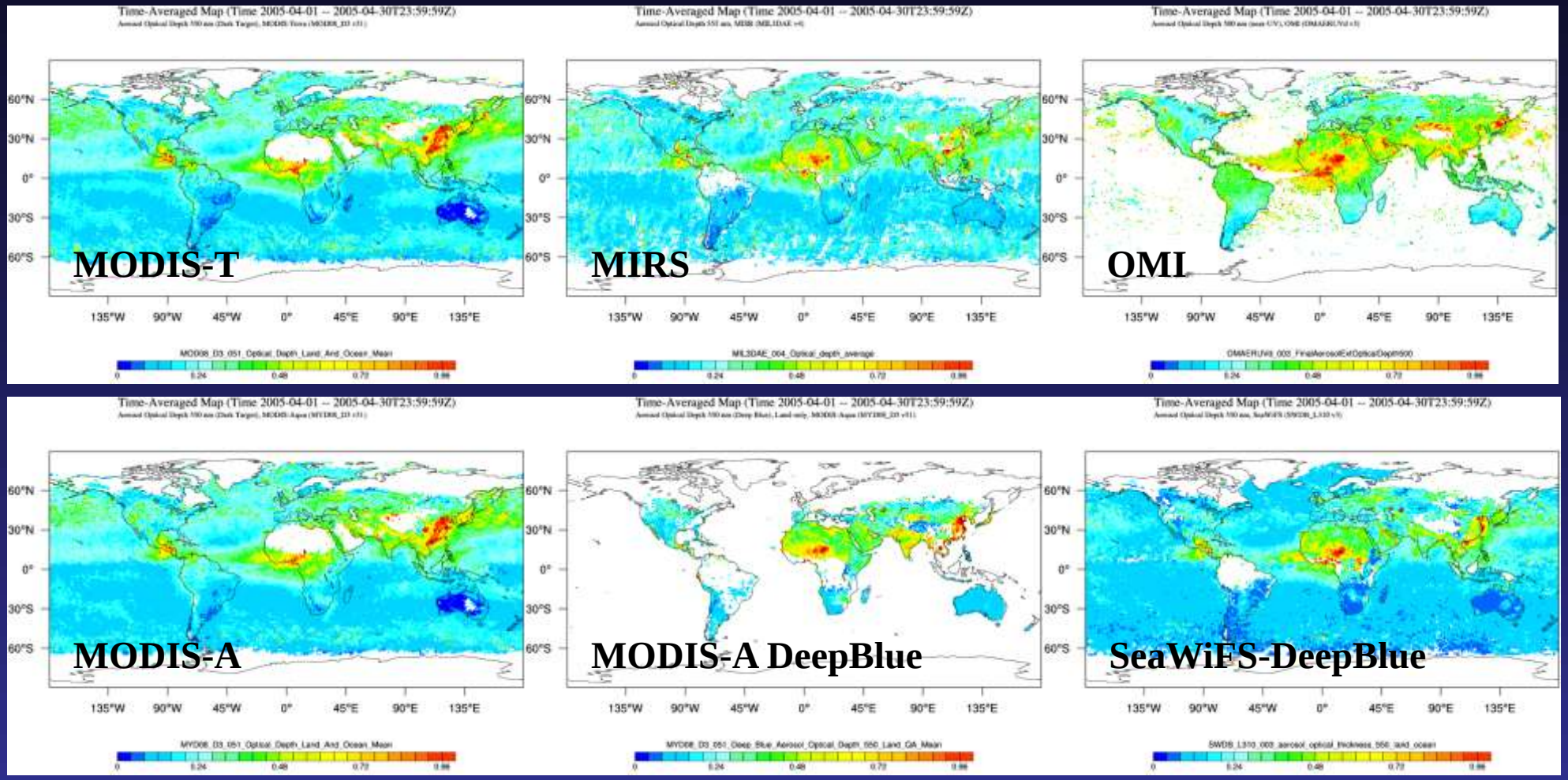


Example: Comprehensive Multi-Sensor Data Environment for Aerosol Studies



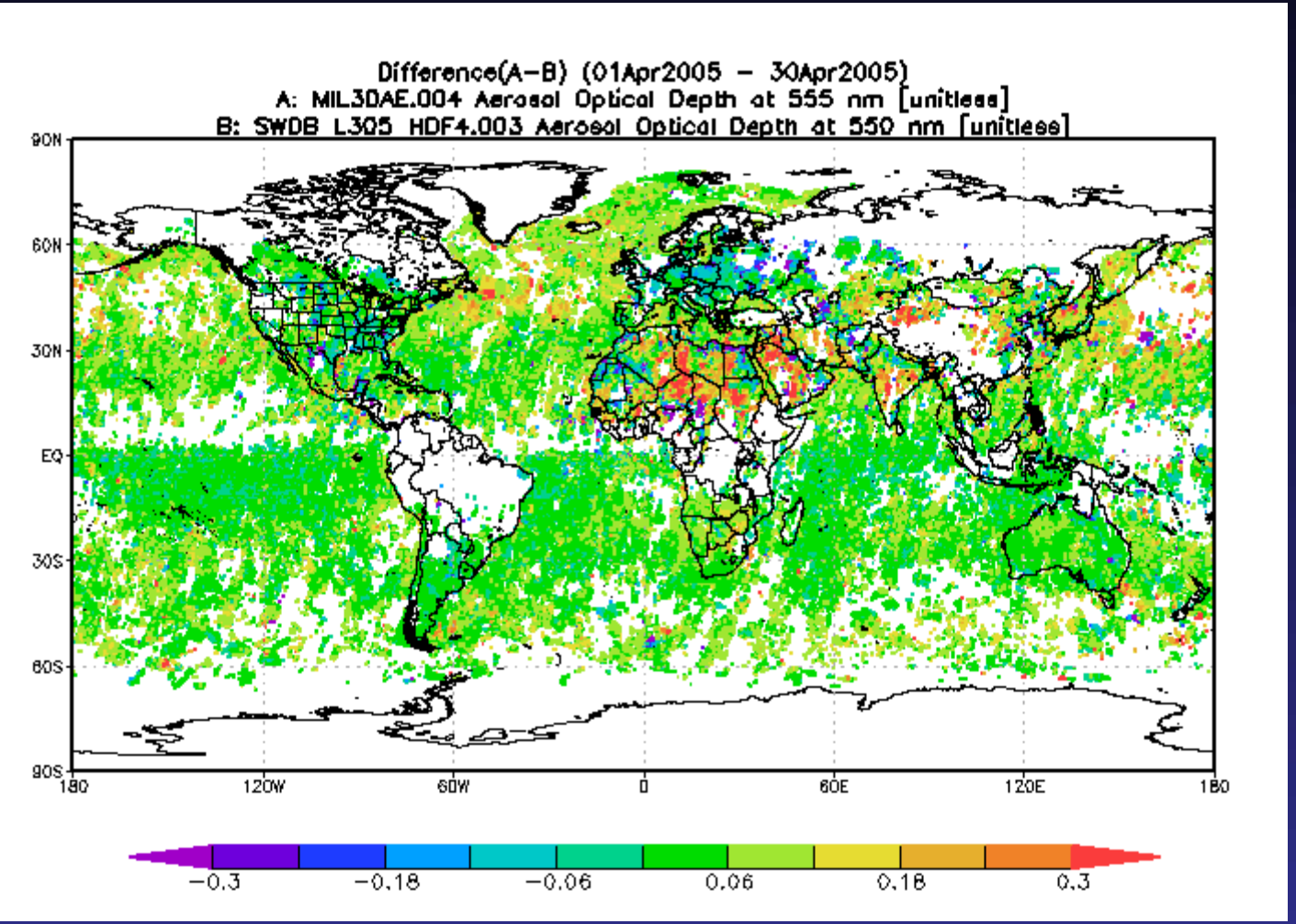
Inter-comparisons of Aerosols

Apr 1-30 2005 averaged daily aerosols from MODIS, MISR, OMI, and SeaWiFS at 550 nm, and OMI at 500nm



Spatial Pattern of Differences

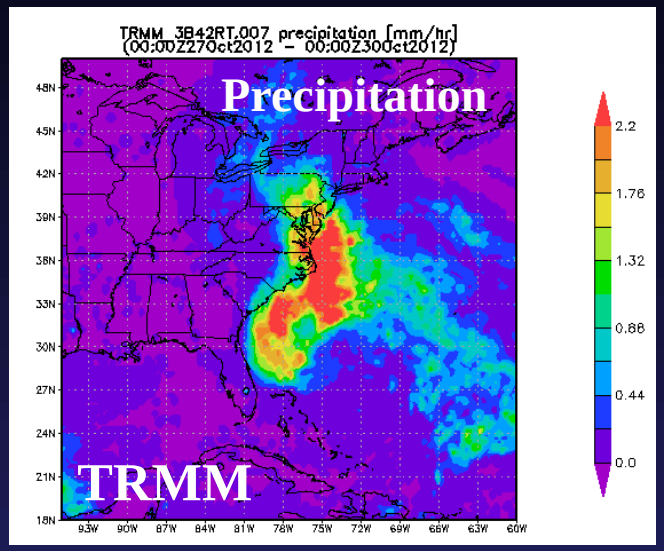
Averaged daily aerosol optical depth difference between SeaWiFS DeepBlue and MISR (Apr 1-30 2005)

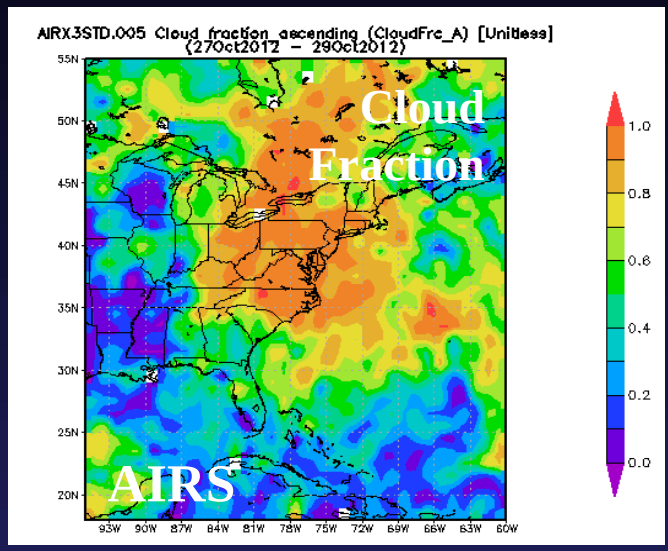


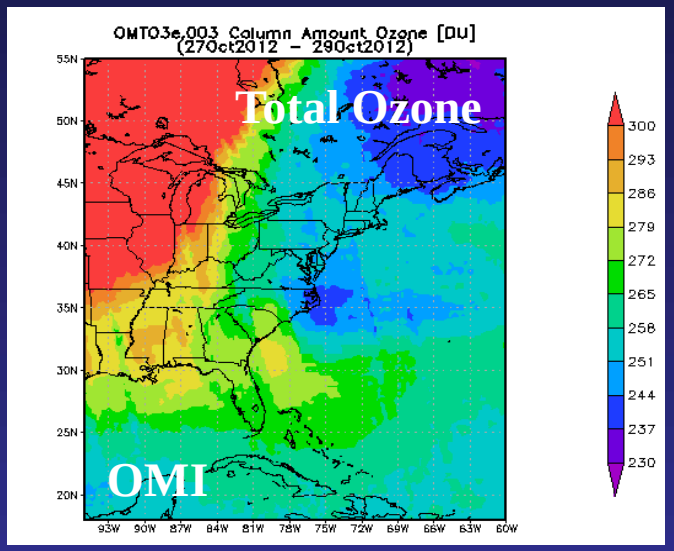
Signatures of Hurricane Sandy

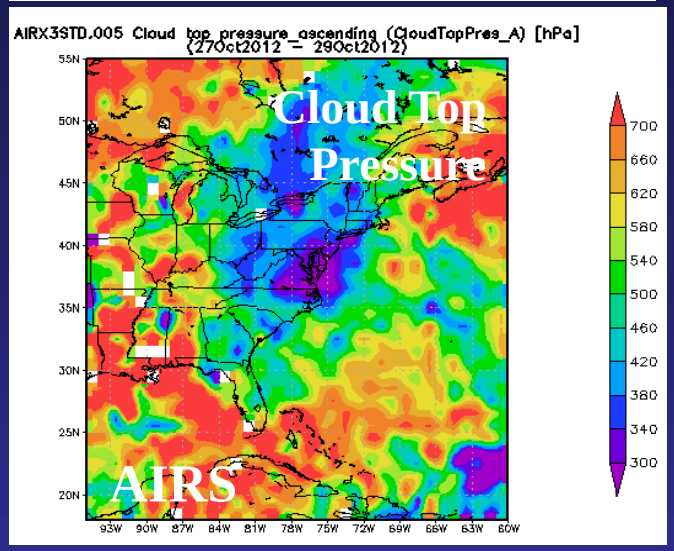
2012 Oct. 27-29

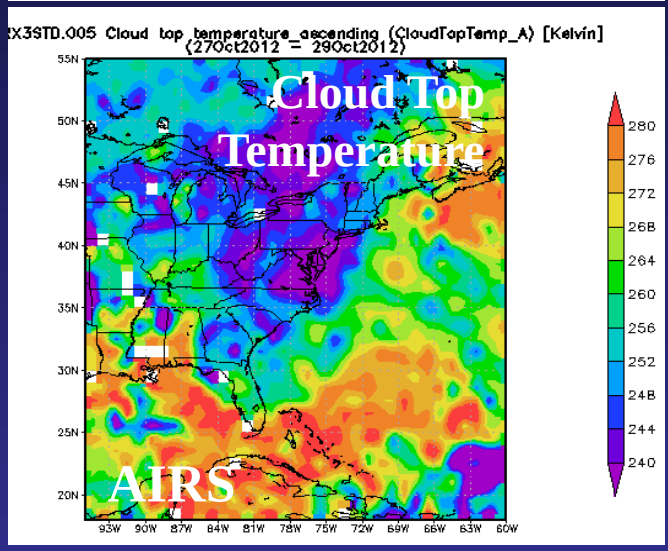
Data are NASA Satellite Observations from TRMM, AIRS, and OMI











Hurricane Sandy, know as Frankenstorm, 2012.10. 24-31, estimated total damage is more $50 billion

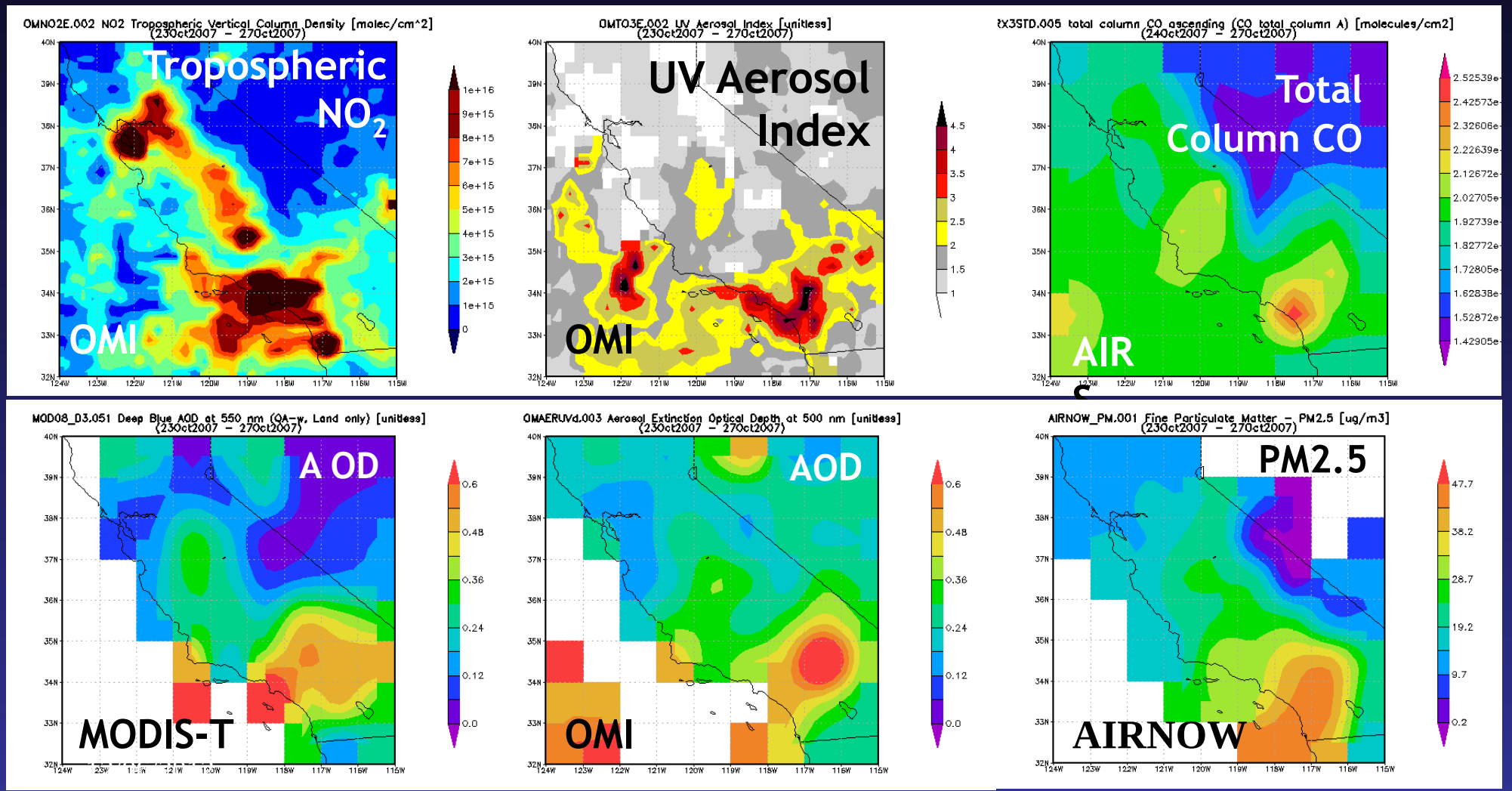
California's Wildfire

Smoke from California fire observed from MODIS-Aqua on Oct 24 2007 20:45UTC. Image credit: NASA EOSDIS Rapid Response image gallery.

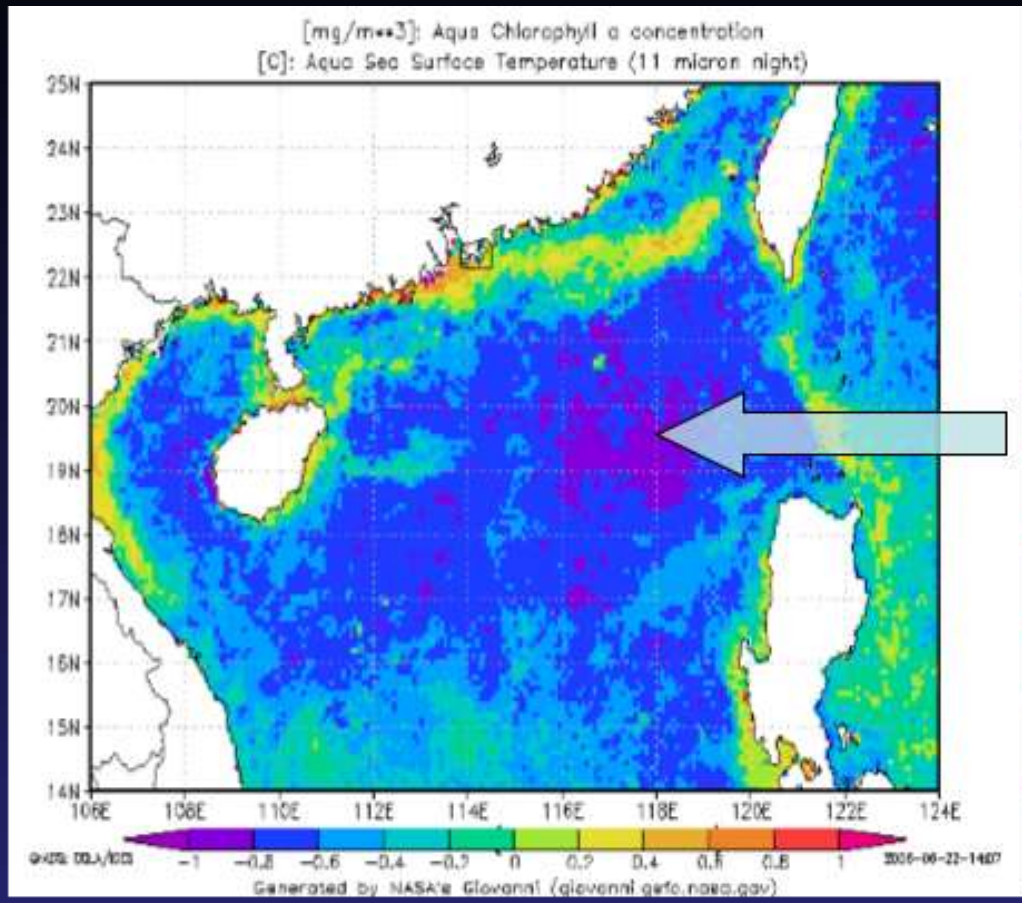
California's Wildfire Visualization

23-27 October 2007

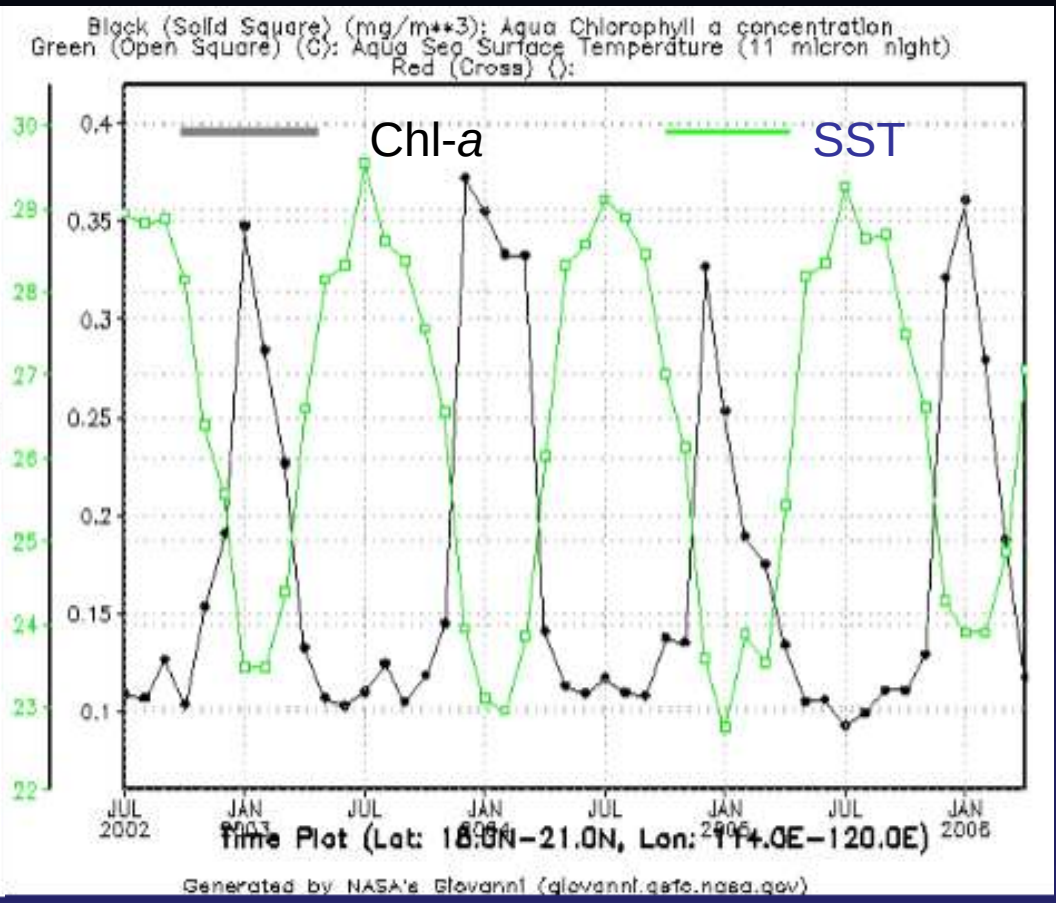
Data from NASA's Aura OMI (Tropospheric NO_2 , UV Aerosol Index and aerosol extinction optical depth), Aqua AIRS (Total Column CO), Terra MODIS (aerosol optical depth 550nm - deep blue), and AIRNOW (PM2.5 from ground measurement)



Correlations between Chlorophyll-a and SST in the northern East China Sea using MODIS-Aqua



Temporal correlation map



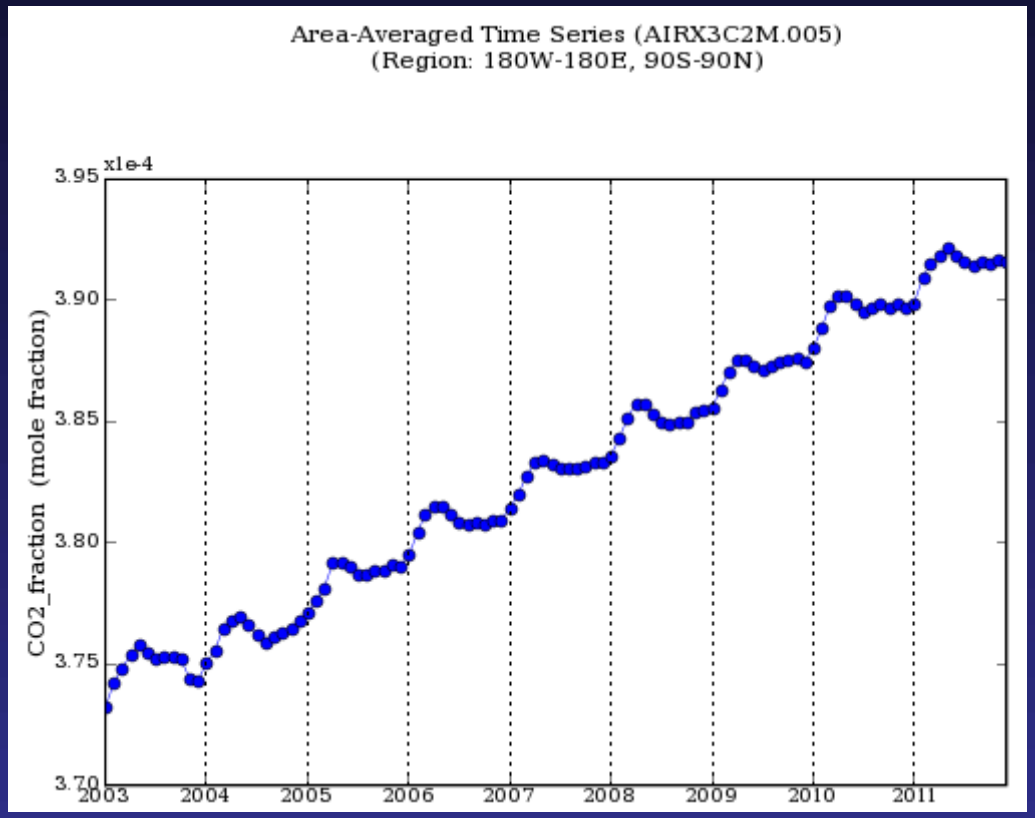
Time-series

Case-1 waters with nutrient-rich cold water due to upwelling are well identified by strong negative correlation between chlorophyll and sea surface temperature.
In Case 2 coastal waters nutrients are carried in by warm water from river and runoff therefore resulting in positive correlation between chl and SST.

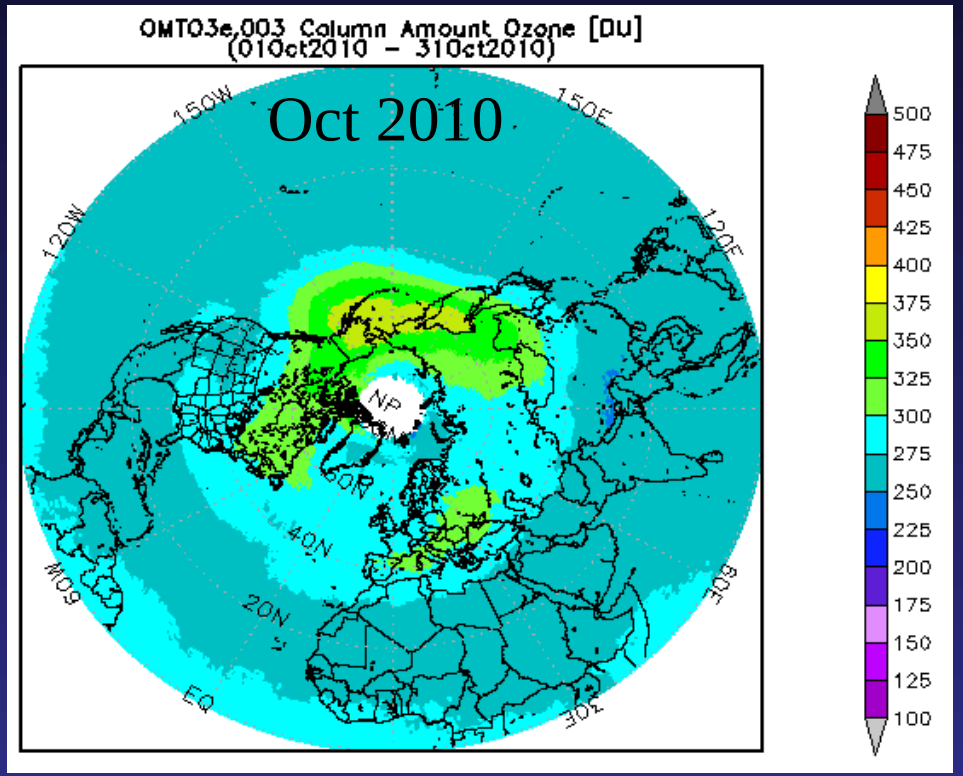
Greenhouse Gases Data in Giovanni

H_2O (AIRS/Aqua, MODIS, MERRA), CO_2 (AIRS/Aqua),
CH_4 (AIRS/Aqua, TES, UARS), O_3 (OMI/Aura, TES/Aura, UARS, TOMS),
N_2O (MLS/Aura)

Global CO_2 from AIRS

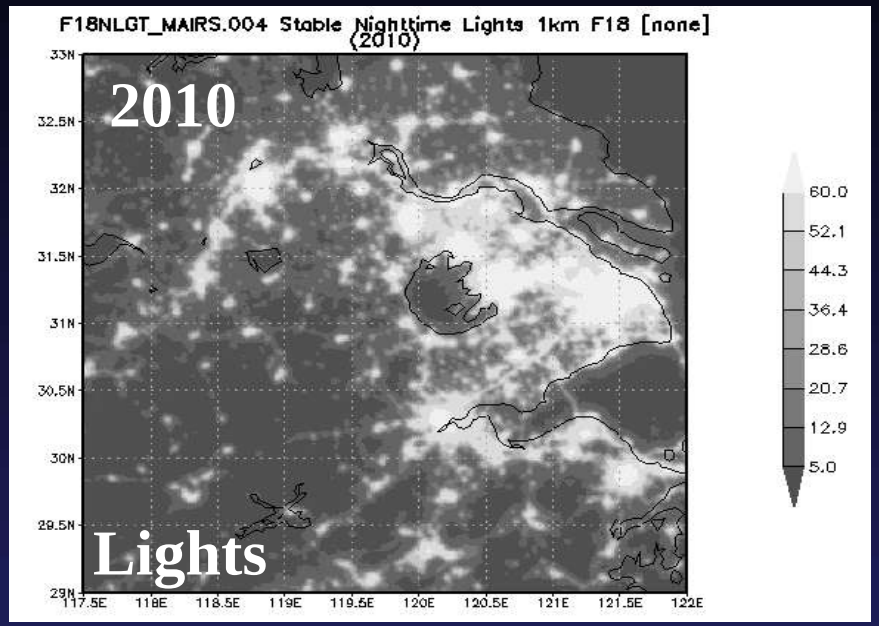


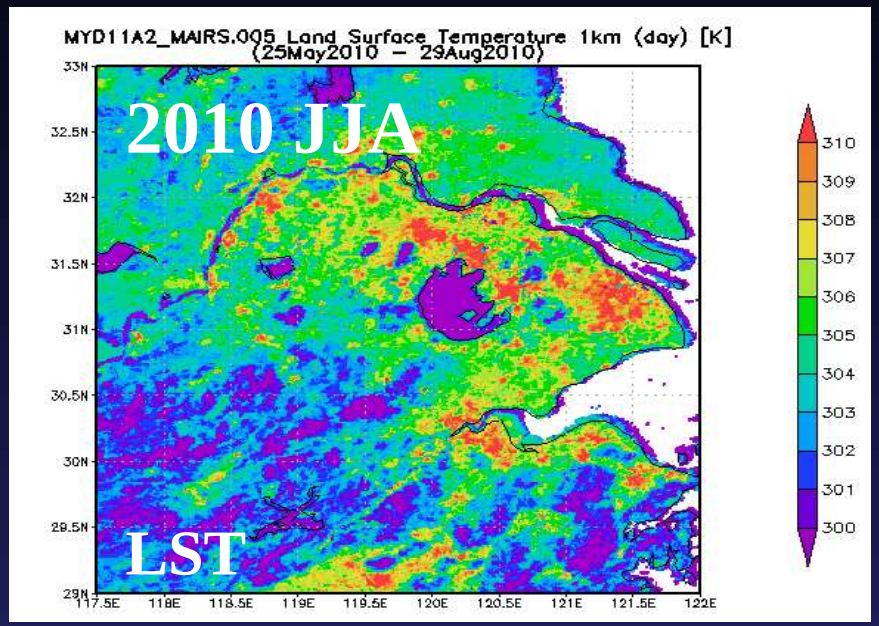
N. Hemisphere O_3 from OMI

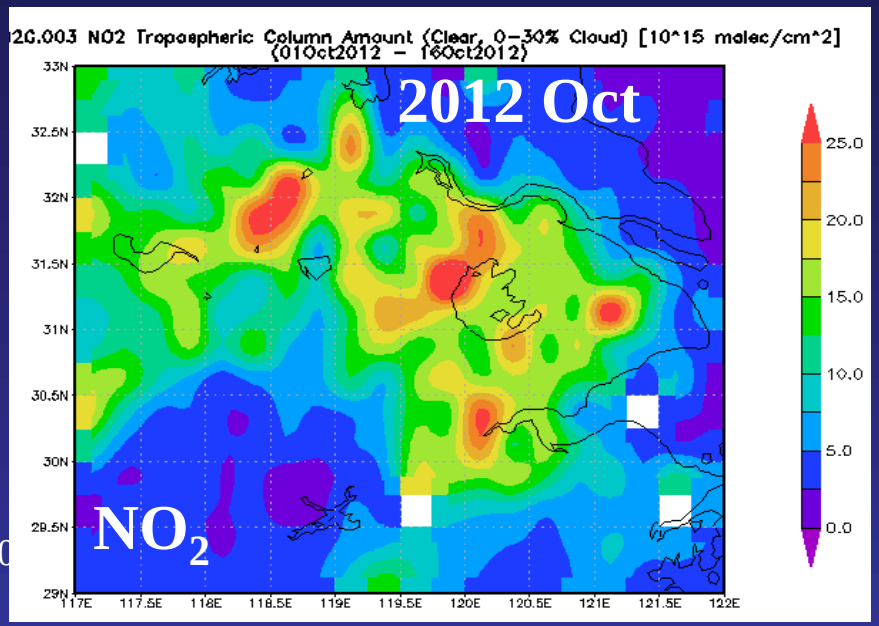


Studying Urbanization and Air Quality

Yangtze River Delta region, Eastern China

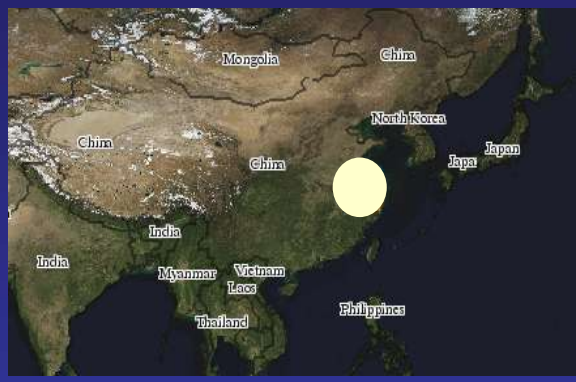






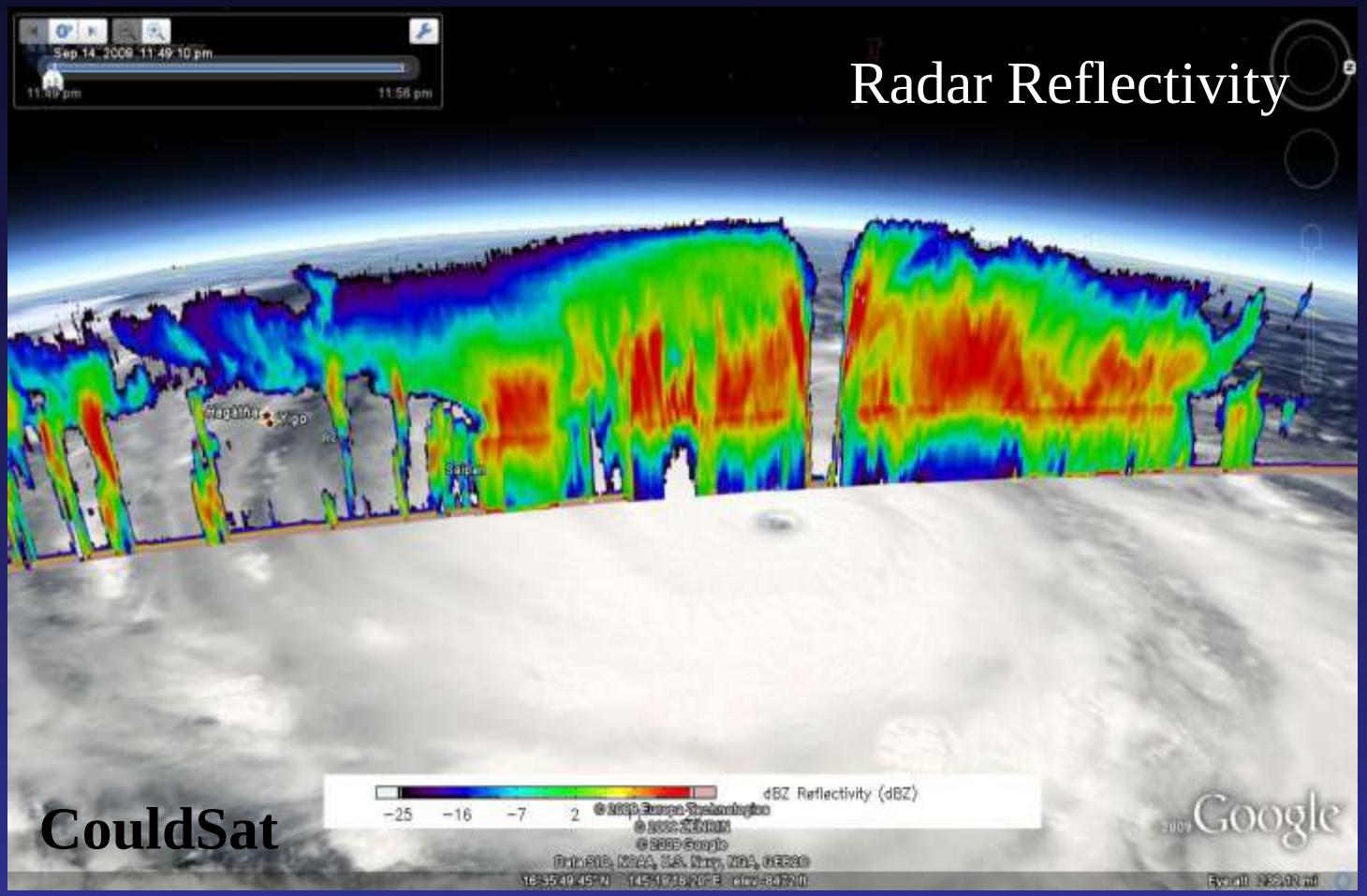
Data in Giovanni:

- Nightlight (DMSP/OLS)
- LST(MODIS)
- NDVI (MODIS)
- NO_2(OMI /Aura)
- SO_2(OMI/Aura)



Viewing Cloud Properties Along CloudSat Track in Giovanni A-train

Typhoon Choi-Wan (2009.09.15)

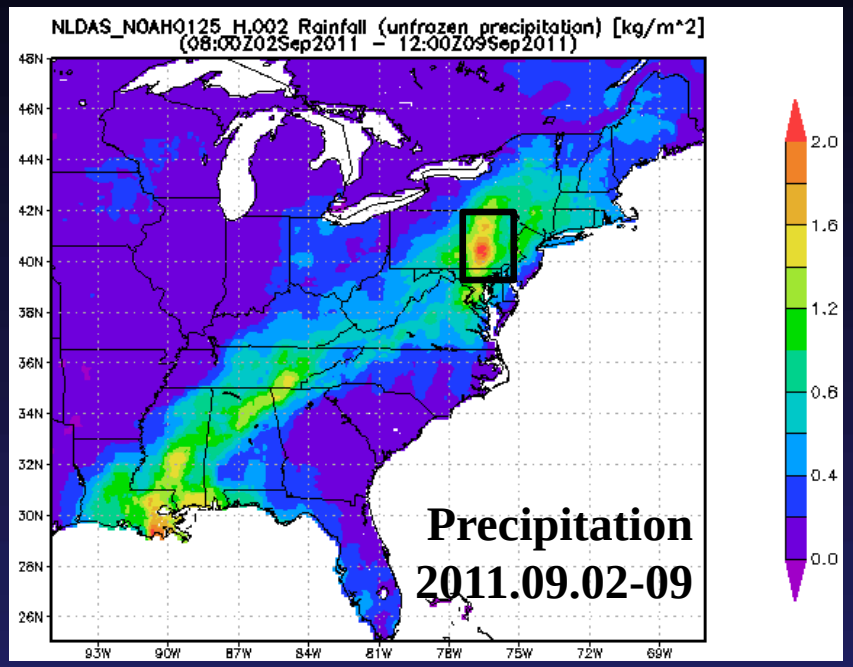


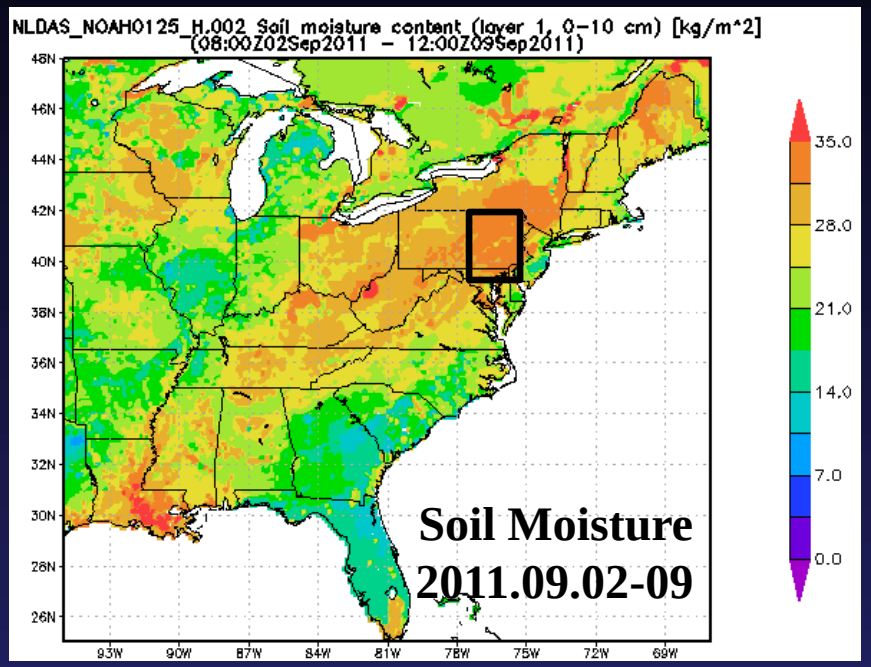
Sensors:
CloudSat
MODIS
AIRS
MLS
CALIPSO
AMSR-E
OMI

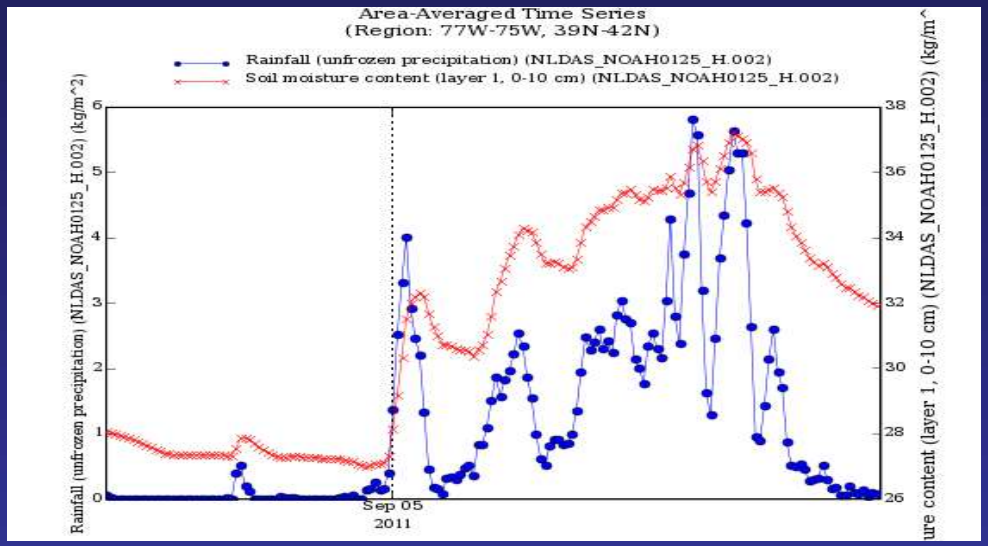
Models:
MERRA
ECMWF

NLDAS Model Reveals Soil Moisture Change

Tropical Storm Lee , Sep 2011



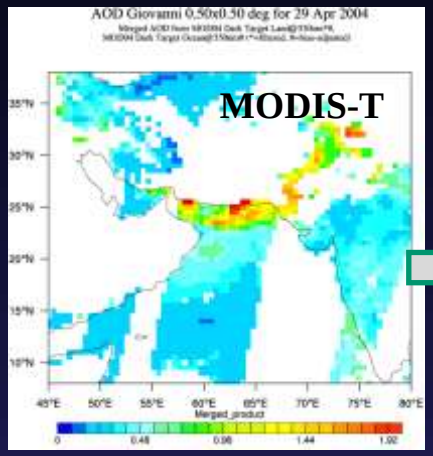


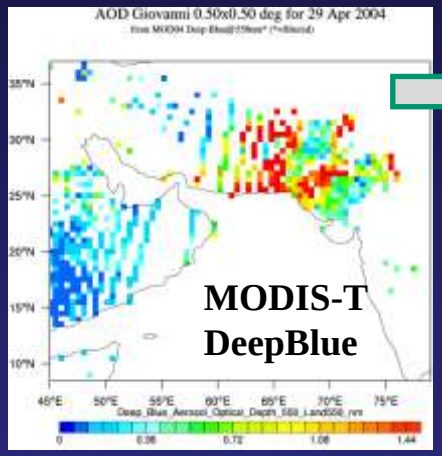


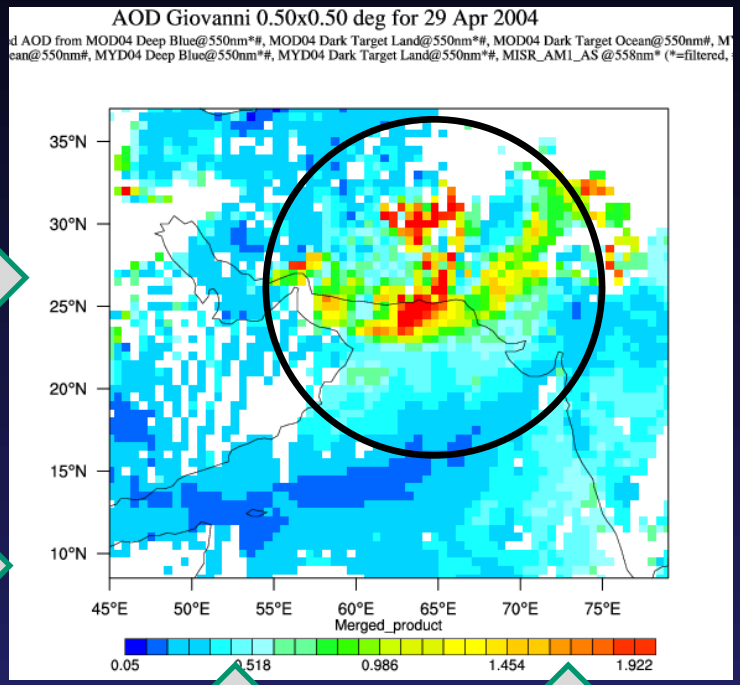
Assimilation Model Data in Giovanni:

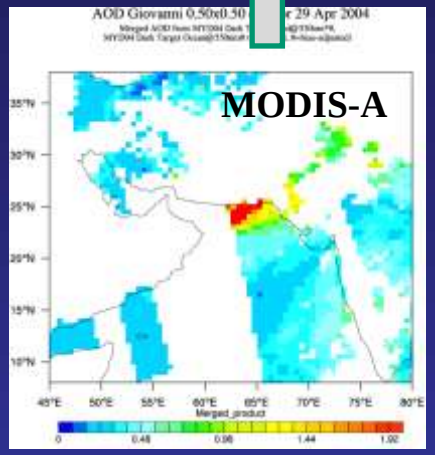
- MERRA: atmospheric
- GLDAS: global land
- NLDAS: N. America land
- GOCART: aerosol
- NOBM: ocean color

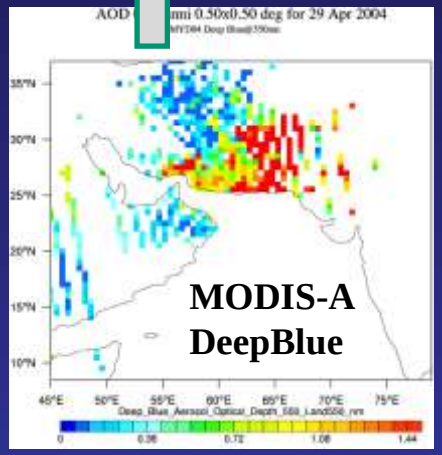
Giovanni Aerostat: Aerosols Comparison and Merging









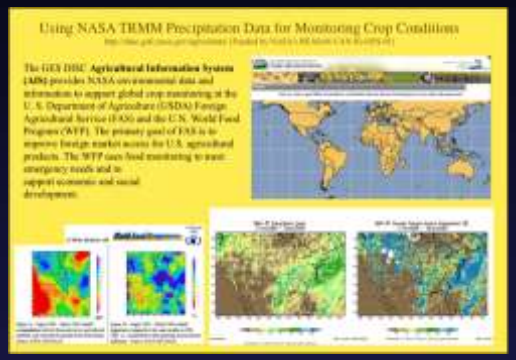


April 29 2004

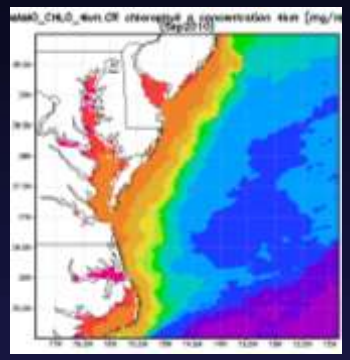
Options:

- QA filtering
- Bias adjustment bases on AERONET

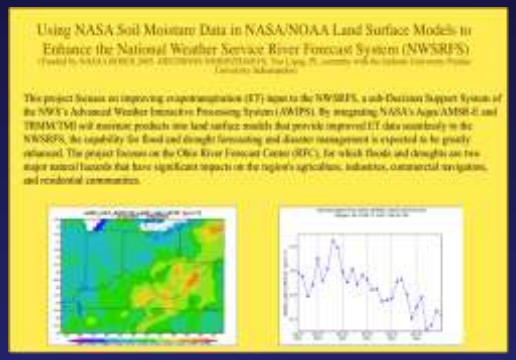
Giovanni Applications Projects



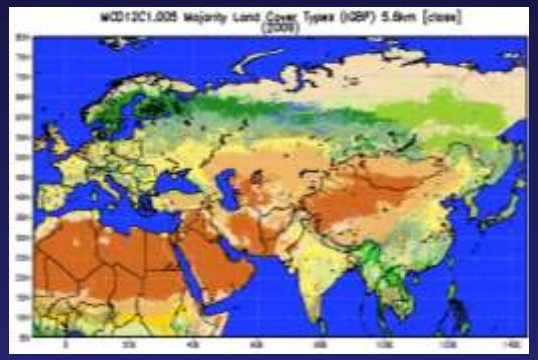
TRMM precipitation data for Monitoring Crop Conditions



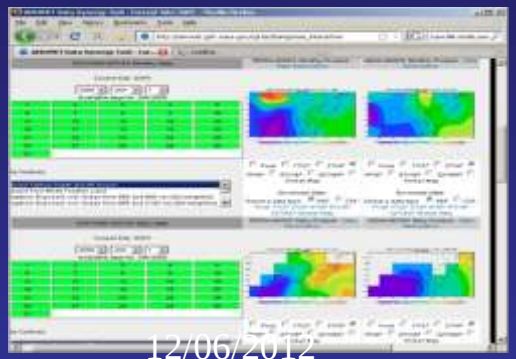
Ocean color data to monitoring water quality



Soil Moisture data to enhance NWSRFS



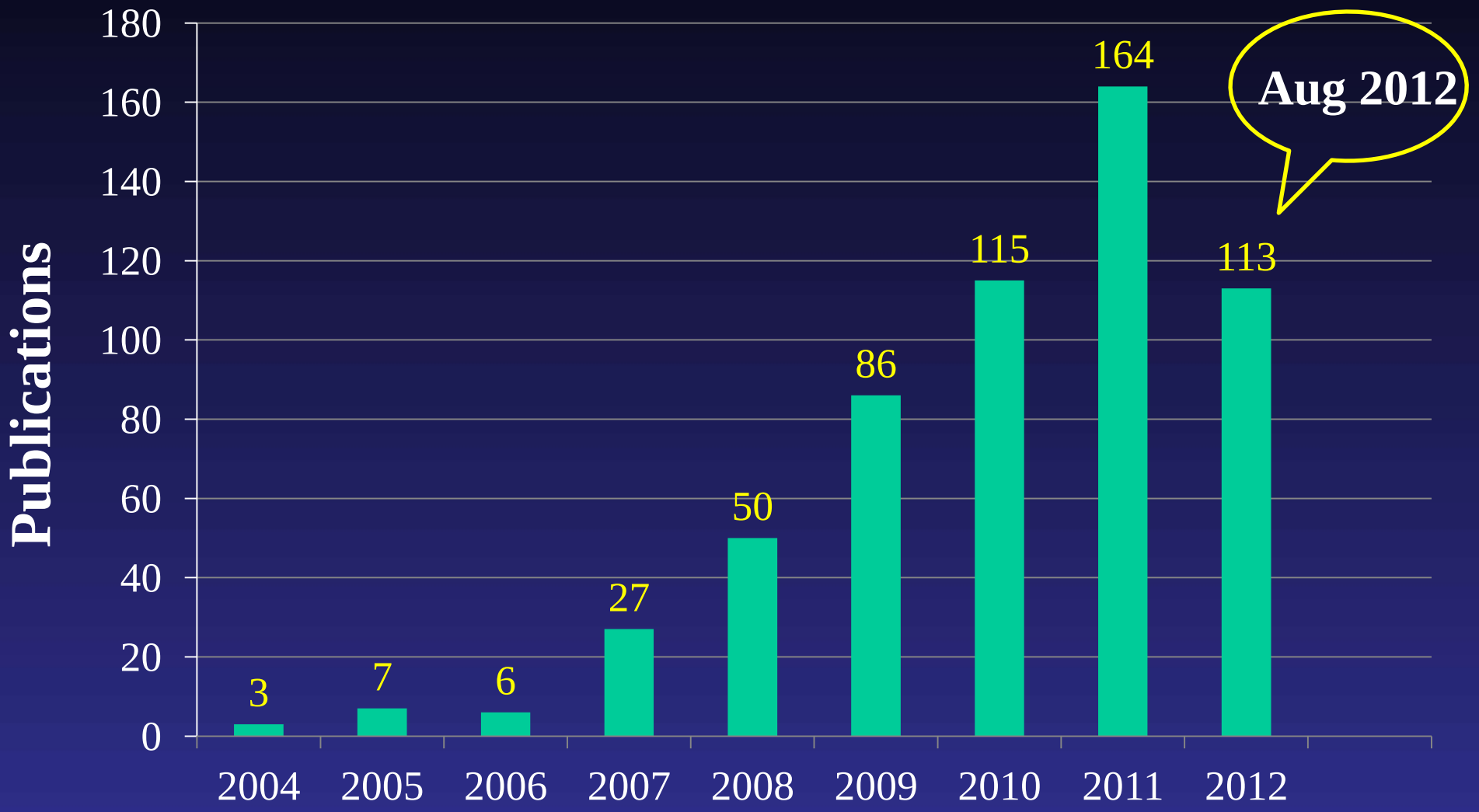
Land data to support NEESPI/MAIRS



Aerosol data in AERONET data synergy tool

Data in Giovanni to support Climate Change Education

Peer-reviewed publications using and acknowledging Giovanni (as of Aug, 2012)



Science Quality of Giovanni Results

- Giovanni operates mostly on the standard data products
- Giovanni results are the same as produced using the standard data out-side of Giovanni
- We implement Science Team recommendations
- We provide (some) warnings and caveats
- We perform sensitivity studies together with scientists in the corresponding fields
- Provide “Product Lineage” showing processing steps
- Provide links to product document

If any question regarding data and results, please send e-mail to GES DISC help desk: gsfc-help-disc@lists.nasa.gov

Evolving from G3 to G4

Challenges to Giovanni:

- Improve performance
- Demand more data and functionalities
- Difficult to find an interested variable

Giovanni-3

- Harmonized data & inventory
- Separate portals
- 2005 -

Agile Giovanni (G4)

- Omnibus (all-in-one) portal
- Faceted variable navigation
- Faster services
- Interactive plotting
- Better documentation
- 2012 -

Next Giovanni: "Omnibus" portal

40+ G3 Portals

Bookmark Selections

Keyword search

Facetd Search

show # variables in a facet

Giovanni

The Bridge Between Data and Science

v 4.0 (Beta) Release Notes Browser Compatibility Known Issues

Select Plot

Lat-Lon Map | Scatter Plot | Time Series | Interactive Scatter Plot | Correlation Map

Select Date Range (UTC)

Format: YYYY-MM-DD

Valid Range: 1997-09-03 to 2012-11-20

Select Bounding Box

Format: West,South,East,North

-180.000, -90.000, 180.000, 90.000

Select Variables

Measurements

- Angstrom Exponent (0)
- Component Aerosol Optical Depth (2)
- Pixel Counts (0)
- Total Aerosol Optical Depth (3)

Instruments

- GoCART Model (9)
- MISR (1)
- MODIS (6)
- OMI (4)
- SEAWIFS (24)

Platforms

- Aqua (0)
- Aura (4)
- GoCART Model (0)

Number of matching Variables: 5 of 60

Total Variable(s) included in Plot: 0

Please select at least 1 variable

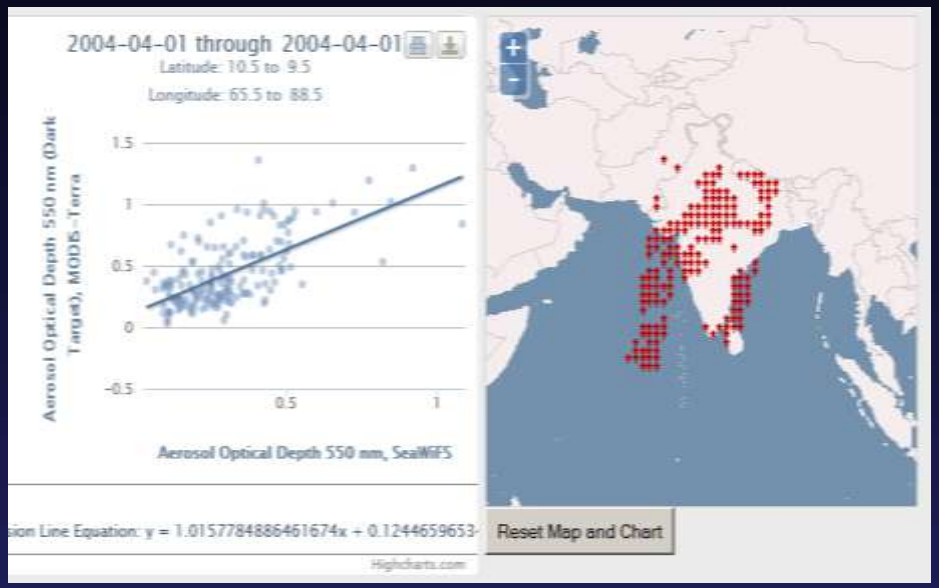
Keyword : aerosol optical depth | Search | Reset

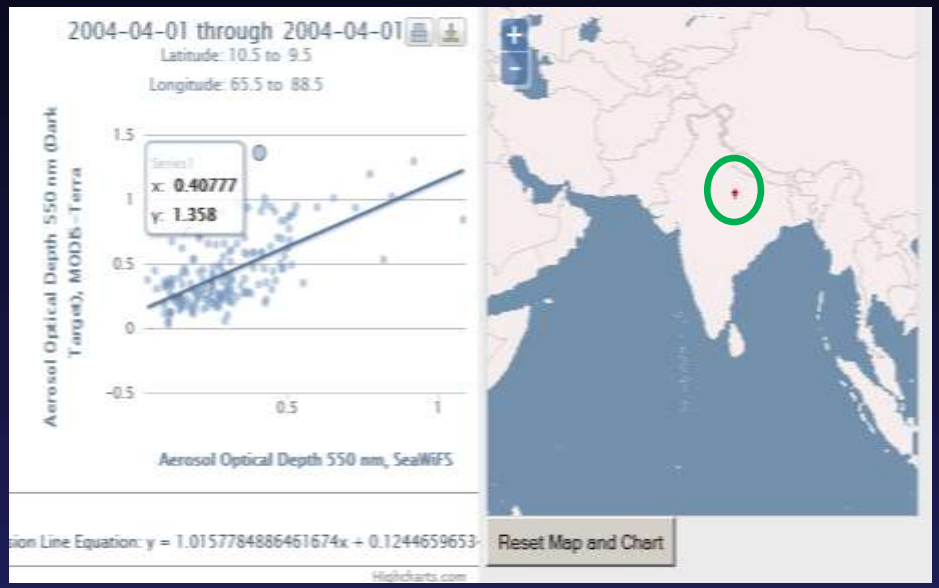
Variable Name	Resolution	Begin Date	End Date
Aerosol Optical Depth 555 nm, MISR (MIL3DAE v4)	0.5 x 0.5 deg.	2000-02-25	2012-02-29
Aerosol Absorption Optical Depth 388 nm (near-UV), OMI (OMAERUVd v3)	1 x 1 deg.	2004-10-01	2012-10-17
Aerosol Absorption Optical Depth 500 nm (near-UV), OMI (OMAERUVd v3)	1 x 1 deg.	2004-10-01	2012-10-17
Aerosol Optical Depth 388 nm (near-UV), OMI (OMAERUVd v3)	1 x 1 deg.	2004-10-01	2012-10-17
Aerosol Optical Depth 500 nm (near-UV), OMI (OMAERUVd v3)	1 x 1 deg.	2004-10-01	2012-10-17

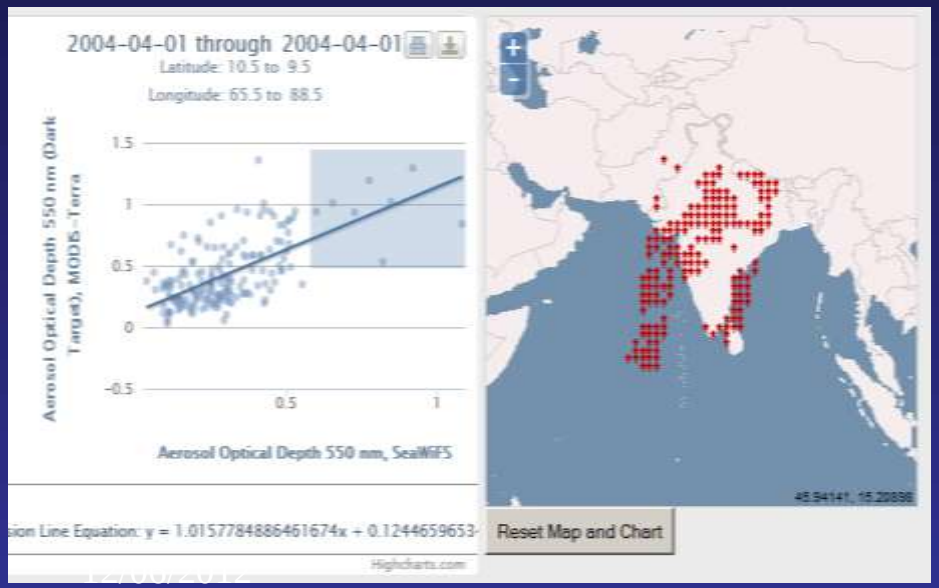
Help | Reset | Clear | Feedback! | Plot Data

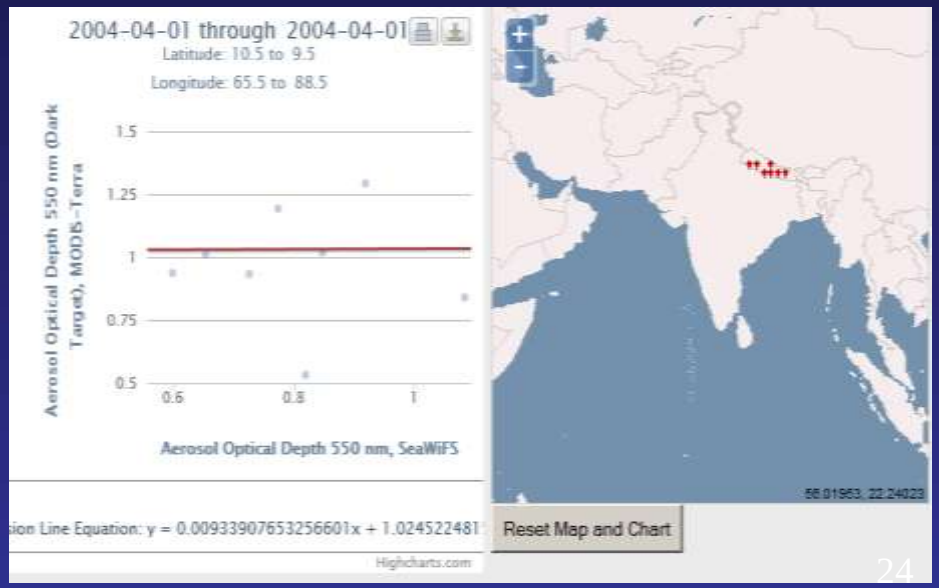
New Features: Interactive Scatter Plot

Comparison of Aerosols from SeaWiFS (Deep Blue) and MODIS-Terra (Dark Target) on 2004.04.01







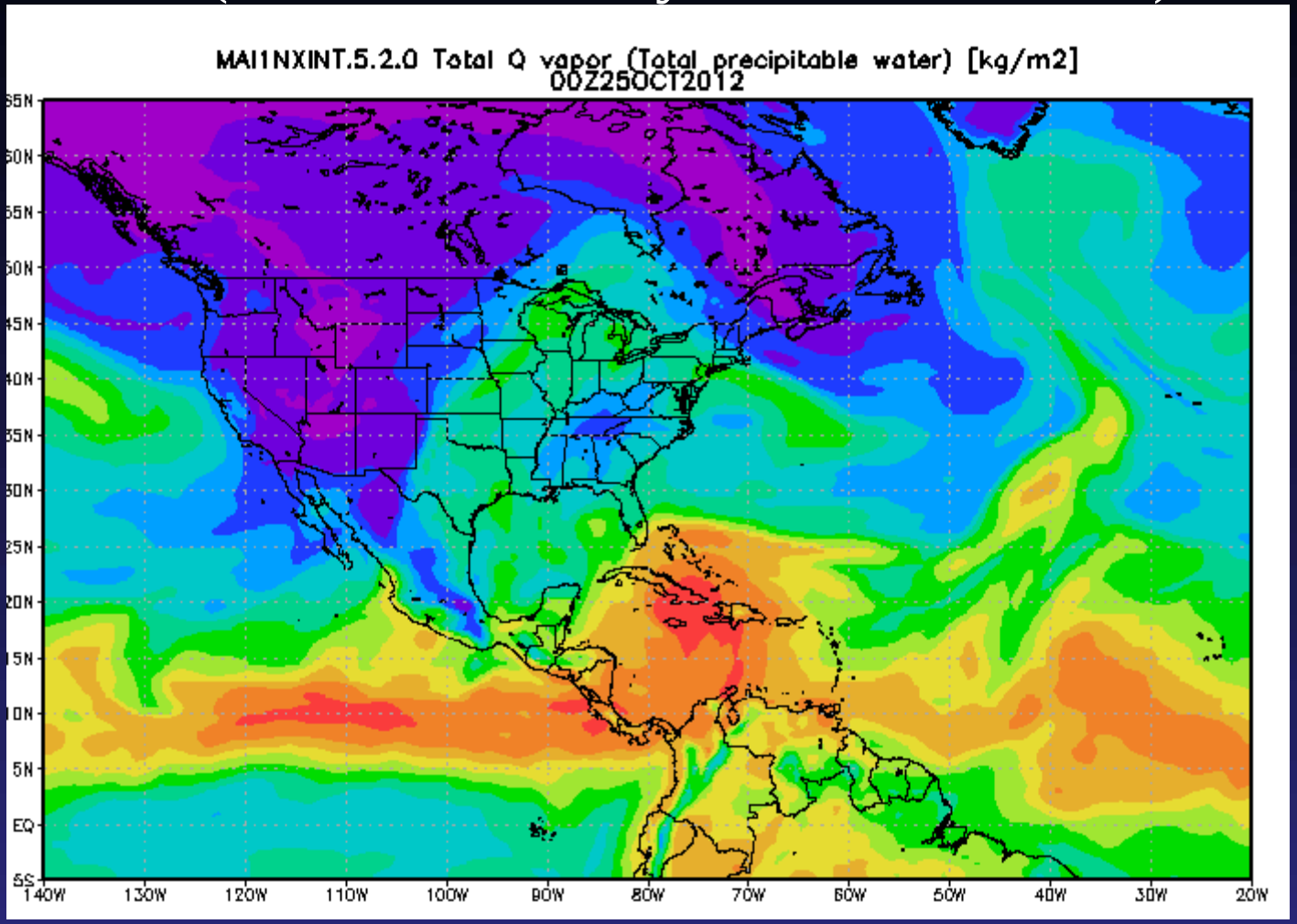


Summary

- **Giovanni has many faces:**
  - Access large amount of satellite, model and ground-based data from multiple archives
  - Supports science, applications, and education
  - Supports various formats
  - Makes working with data easy
  - Is a tool to help explore and understand the data, Not a data producer
- **System Characteristics:**
  - Uses interoperability standards
  - Supports standard data formats
  - Acts as a server and a client

Animation: Total Precipitable Water from MERRA

(Hurricane Sandy Oct 25-30 2012)



http://giovanni.gsfc.nasa.gov/