



NASA's ARSET Program: Building Capacity to Utilize Aura data for Air Quality Applications

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**NASA Goddard Space Flight Center
GESTAR/USRA/JCET/UMBC**

EOS Aura Science Team Meeting, September 15-18, 2014
10th year anniversary celebration!

NASA Applied Sciences and Capacity Building



National and international activities to engage and train users applying NASA Earth Science satellites and modeling data in their decision making activities



NASA Satellite Images Will Help Farmers Conserve Water

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By VINNEE TONG

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Flood irrigation in a Los Banos alfalfa field.

Vinnee Tong

NASA Applied Science : Capacity Building Program



Applied Remote SEnsing Training, ARSET (GSFC)

On-line and hands on basic/advanced trainings tailored to end-users organizations

DEVELOP (LaRC national office)

Dual student/local government capacity building using collaborative projects

SERVIR Coordination Office (MSFC)

Building international capacity with hubs in

- East Africa
- Hindu Kush - Himalaya
- Mesoamerica

Gulf of Mexico Initiative, GOMI (SSC)

Building Gulf region's capacity for local environmental management

NASA Earth Science Applied Sciences Program



Applications to Decision Making: Thematic Areas



**Agricultural
Efficiency**



Air Quality



Climate



**Disaster
Management**



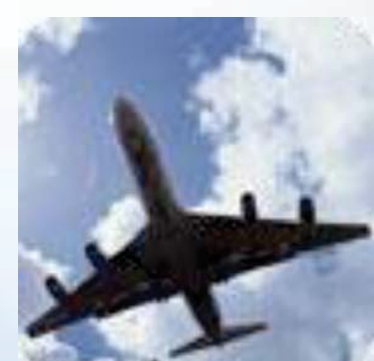
**Ecological
Forecasting**



Public Health



**Water
Resources**



Weather

Applied Remote Sensing Training Program (ARSET)



GOAL:

Increase utilization of NASA observational and model data for decision-support

Online and hands-on courses:

- **Who:** policy makers, environmental managers, modelers and other professionals in the public and private sectors.
- **Where:** U.S and internationally
- **When:** throughout the year. Check websites.
- Do NOT require prior remote- sensing background.
- Presentations and hands-on guided computer exercises on how to access, interpret and use NASA satellite images for decision-support.



NASA Training for California Air Resources Board, Sacramento

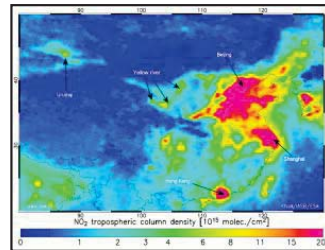
Applied Remote Sensing Training Program (ARSET)



Health & Air Quality

- 2008 – present
- 34 Trainings
- 1000+ end-users
- Analysis of dust, fires and urban air pollution.
- Long range transport of pollutants
- Satellite and regional air quality model inter-comparisons.
- Support for air quality forecasting and exceptional event analysis

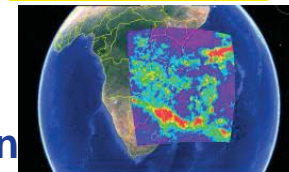
Nitrogen Dioxide over China



Water Resources and Flood Monitoring

- April 2011 – present
- 9 Trainings
- 500+ end-users
- Flood/Drought monitoring
- Severe weather and precipitation
- Watershed management
- Climate impacts on water resources
- Snow/ice monitoring
- Evapotranspiration (ET), ground water, soil moisture, and runoff.

Satellite derived precipitation



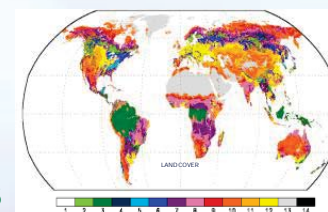
Inundation mapping



Land Use/Change and Ecology

- First webinar just completed and in-person courses planned
- Focus on NGOs and Federal agencies
- GIS applications
- Land use/change and vegetation indices
- Fire products

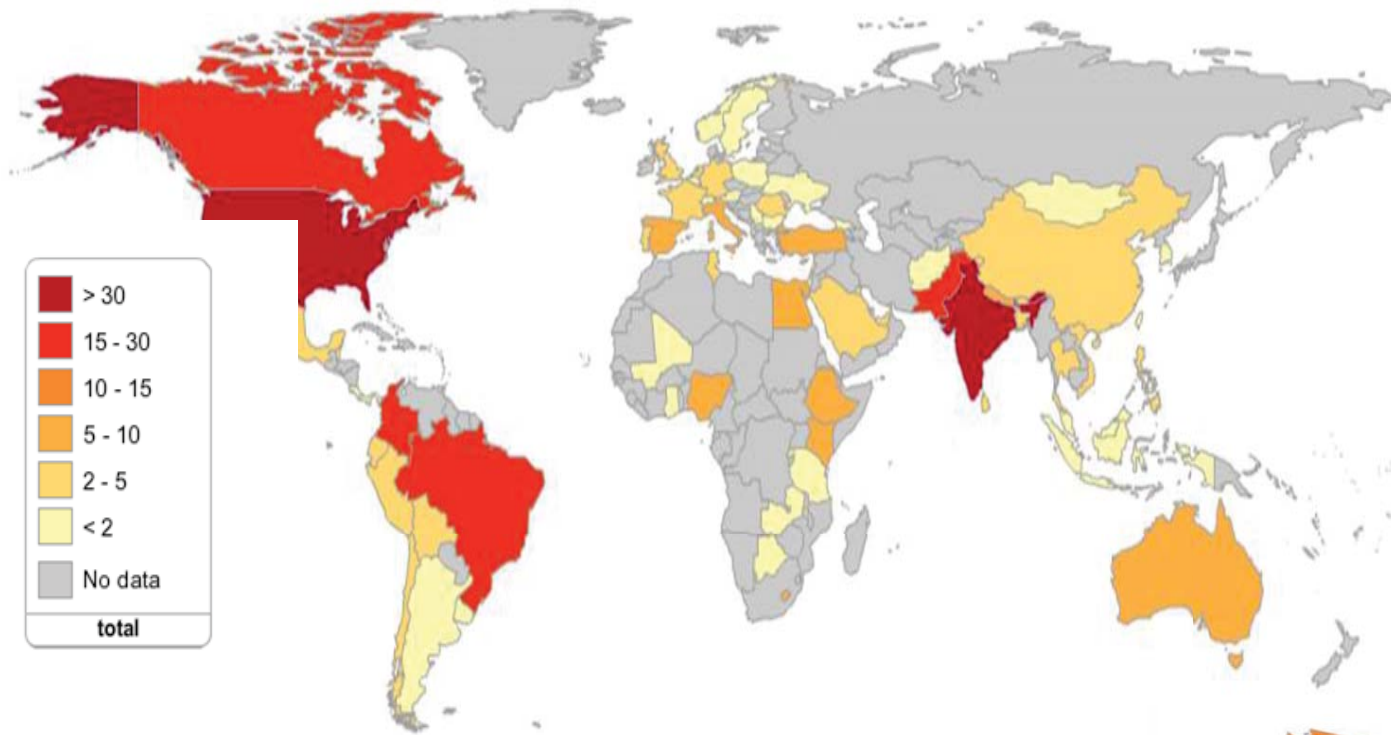
Land Cover



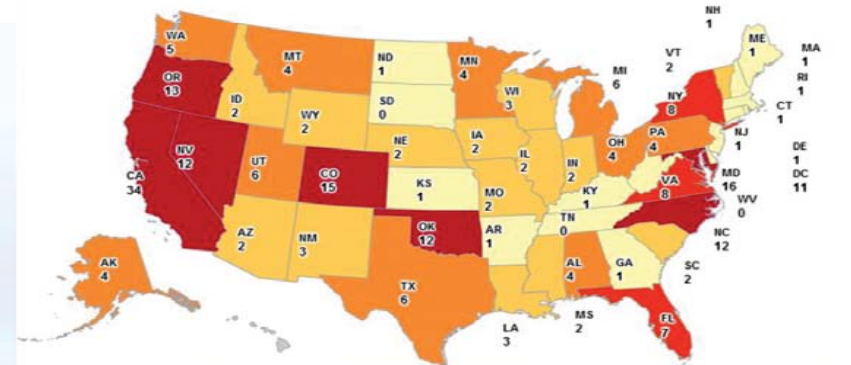
ARSET: 2009 – 2013



1500+ end-users reached
552 organizations



Number of participating organizations per country: Air Quality, Water Resources, Flood Monitoring.



Gradual Learning Approach



Basic Training

Webinars

Hands-on

Assumes no prior knowledge of RS



Advanced Training

Hands-on

Webinar course generally required
Focused on a specific
application/problem/Data: for example
dust or smoke monitoring in a specific
country or region

Online Training

The screenshot shows a web browser window with a chat interface on the left and a presentation slide on the right. The chat window is titled 'CHAT - Supervised' and contains a message from Rich Kleidman: 'If you will not be attending the in person course and want more information about any of these tools - aerosol or data synergy tool - please send Rich an e-mail and I will direct you to exercises you can use to practice using the tools.' The presentation slide is titled 'Radiance -to- Aerosol Products' and features a large red arrow pointing right. Below the arrow is a map titled 'ODIS-Terra, May 2, 2007' showing satellite data over a region of the United States. The map includes a color scale for 'No Retrievals' and labels for 'High' and 'Low' values.

In-Person Training





**What is covered in a typical ARSET
Air Quality Training?**

Or

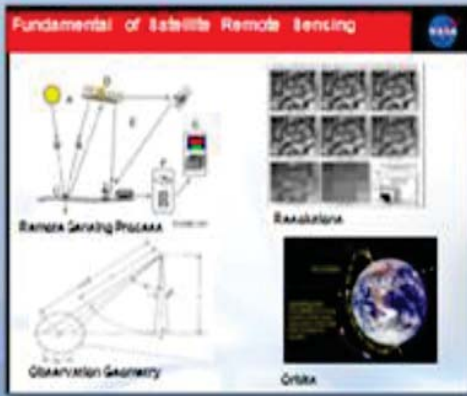
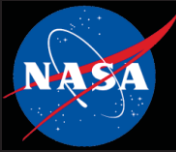
How is ARSET using AURA data

Types of Training Modules



- **Trace Gas (OMI) imagery access and interpretation:**
 - Giovanni, MIRADOR
 - NASA AVDC
- **Case Studies in the application of Aura data for a specific area of interest, e.g. Texas (Spring 2014), LADCO region (Midwest, 2013), NESCAUM/MARAMA (Fall 2013), California Air Resources Board (2010, 2011)**
- **Benefits and limitations of Aura remote sensing products**

Satellite Data & Applications



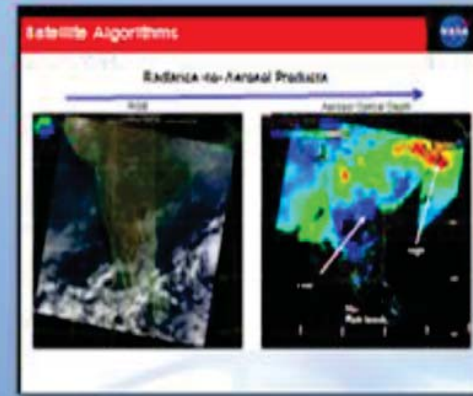
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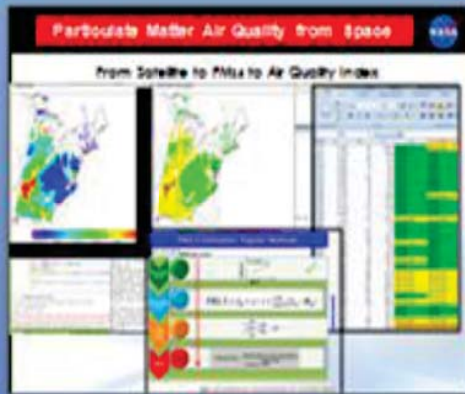
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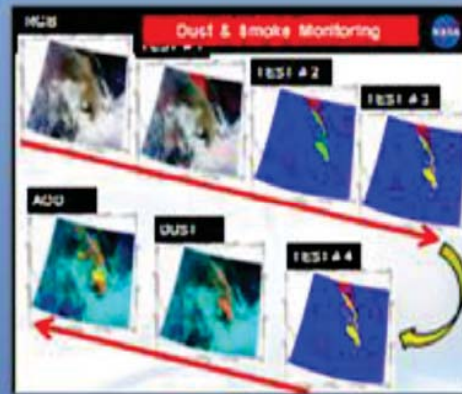
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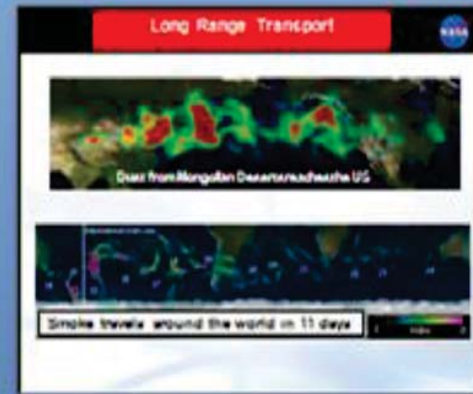
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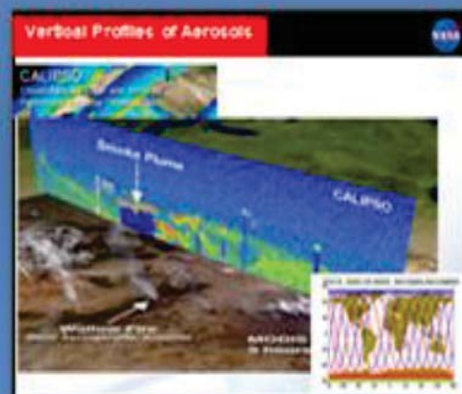
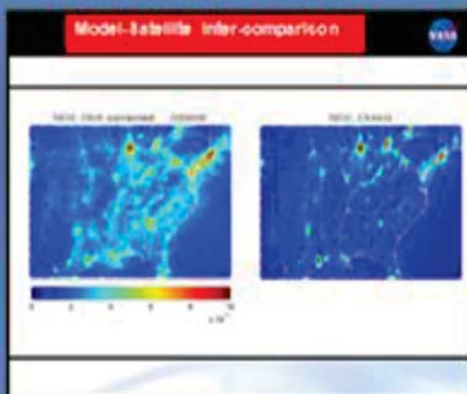
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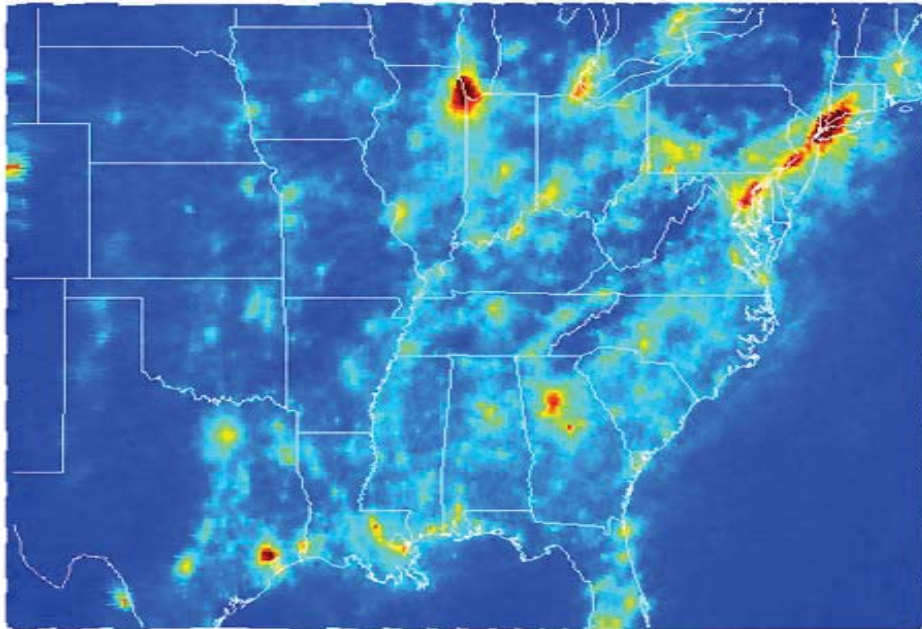


- MODIS
- OMI
- CALIPSO
- MISR
- VIIRS
- TRMM

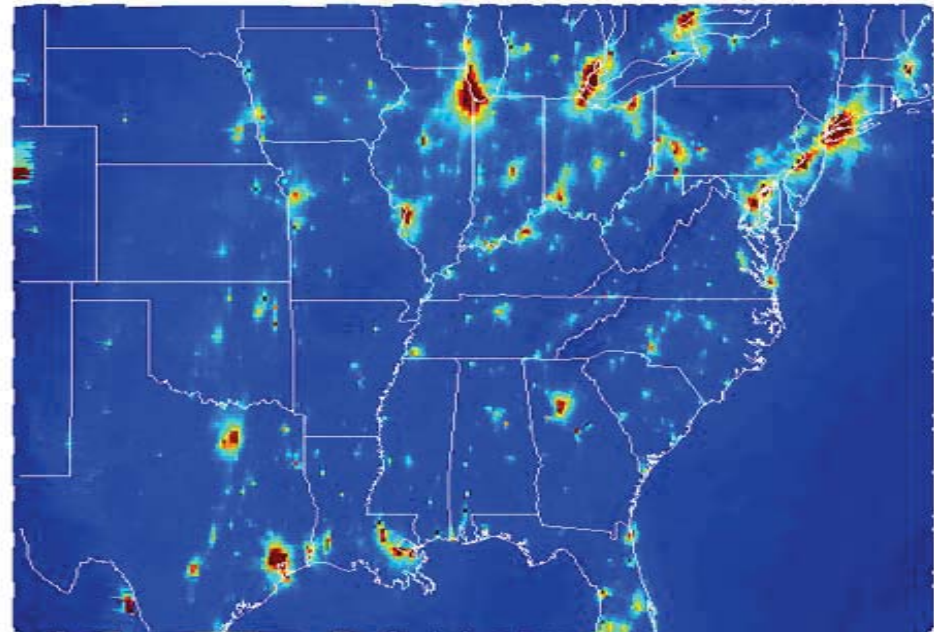
Model-Satellite Inter-comparison:



OMI NO2

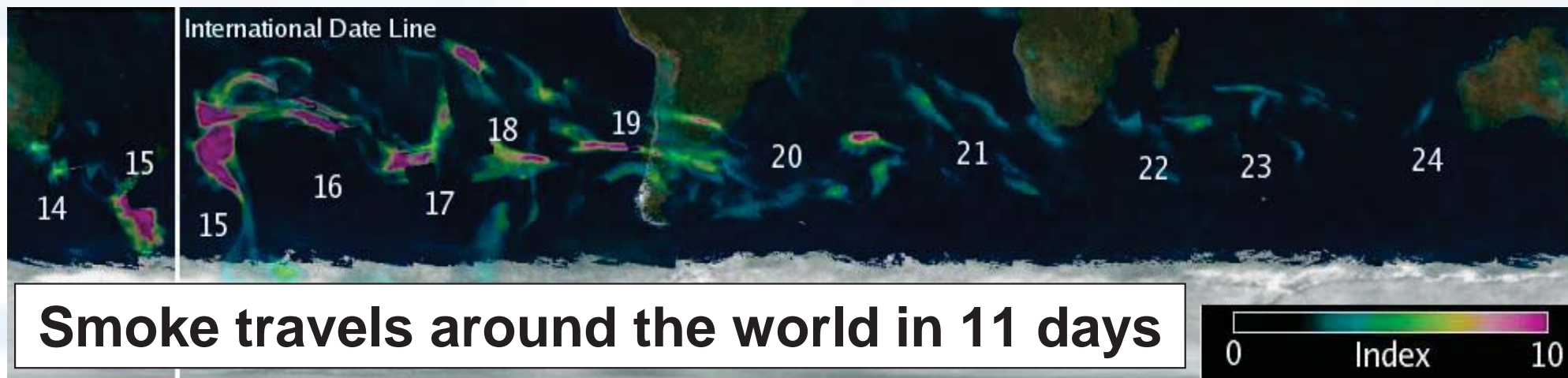


CMAQ NO2



- This application has been covered multiple times during ARSET trainings at the CMAS annual conference (2009 – 2013)
- **The RSIG EPA tool, which provided access to NASA and CMAQ data will be taught at a training at EPA RTP next week**

Long Range Transport: Accessible via Worldview and Giovanni

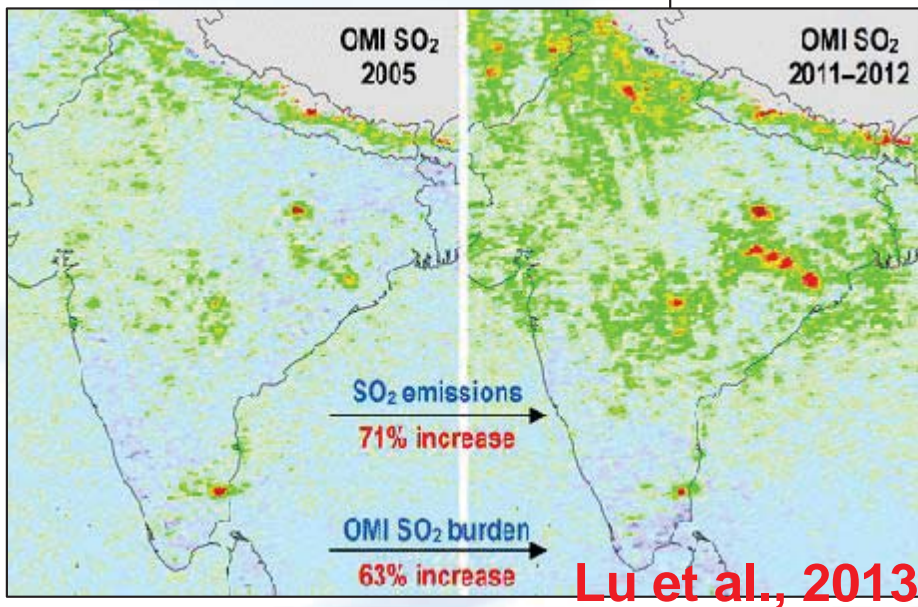
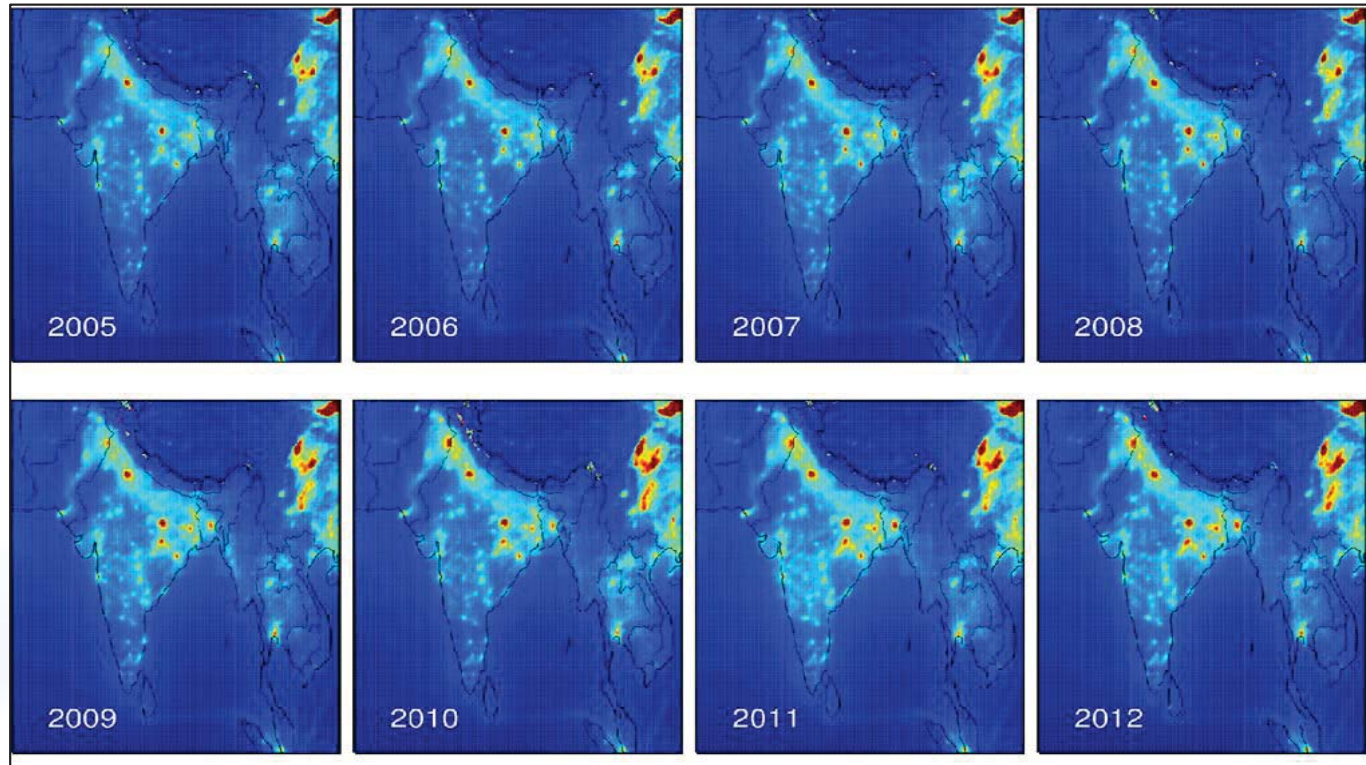


OMI Aerosol Index has been extensively used to track absorbing aerosols transport around the globe

Air Quality Trends: Webinar for the Indian Subcontinent, March 2014



OMI NO₂ Trends



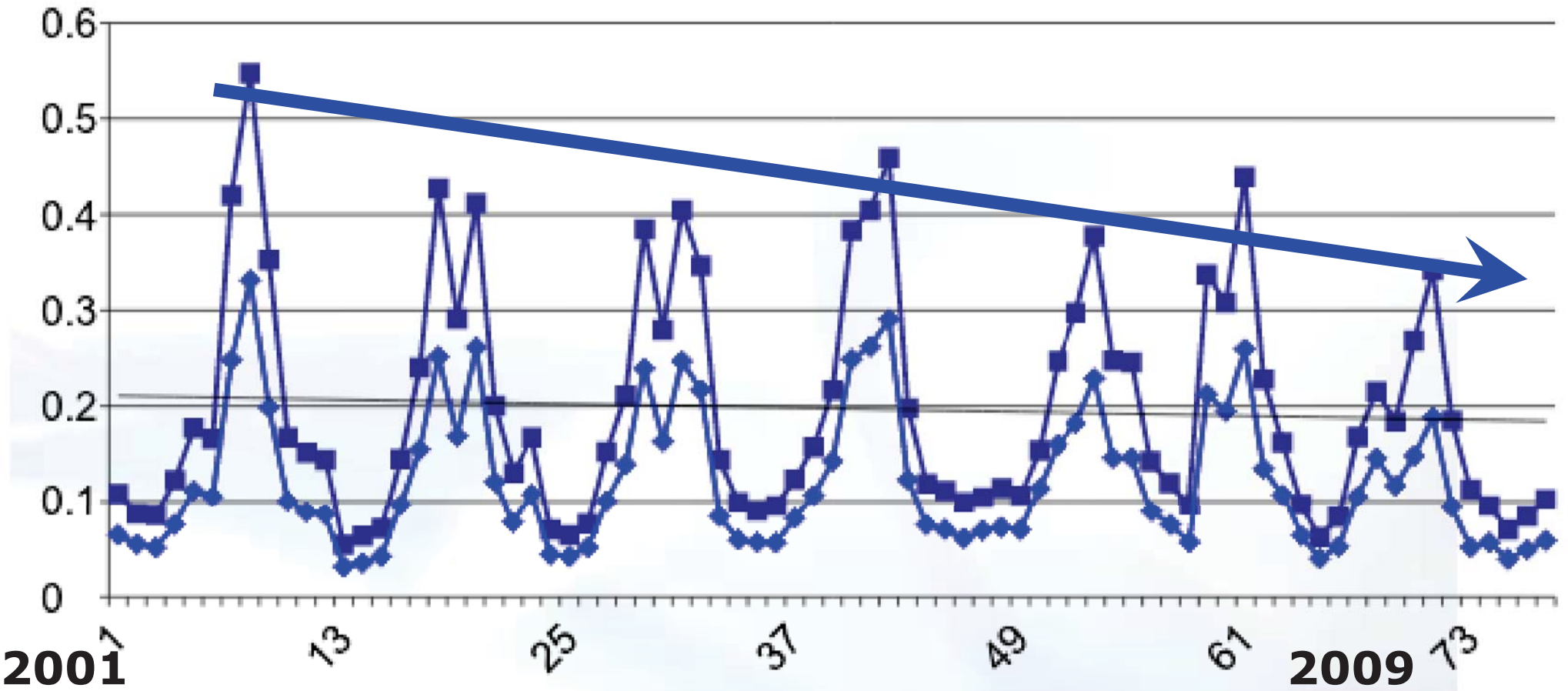
courtesy: Lok Lamsal

OMI SO₂ Trends



Level 2G and Level 3 data access and analysis modules are developed based on NASA online GIOVANNI tool

Air Quality Trends



- We provide examples of current or recent research applications
- Developed interactive exercises using Giovanni & L2 data for more advance users

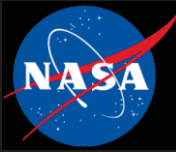
Data User Guide



Bryan N. Duncan, Ana I. Prados, Lok N. Lamsal, Yang Liu, David G. Streets, **Pawan Gupta**, Ernest Hilsenrath, Ralph A. Kahn, J. Eric Nielsen, Andreas J. Beyersdorf, Sharon P. Burton, Arlene M. Fiore, Jack Fishman, Daven K. Henze, Chris A. Hostetler, Nickolay A. Krotkov, Pius Lee, Meiyun Lin, Steven Pawson, Gabriele Pfister, Kenneth E. Pickering, R. Bradley Pierce, Yasuko Yoshida, Luke D. Ziemba, **Satellite data of atmospheric pollution for U.S. air quality applications: Examples of applications, summary of data end-user resources, answers to FAQs, and common mistakes to avoid**, Atmospheric Environment, Volume 94, September 2014, Pages 647-662, ISSN 1352-2310, <http://dx.doi.org/10.1016/j.atmosenv.2014.05.061>.

(<http://www.sciencedirect.com/science/article/pii/S1352231014004270>)

An ARSET/AQAST Collaboration



Training Modules in English and Spanish

Updates on upcoming workshops

Data Product Tables

Links to popular NASA web tools for decision support

The screenshot shows the ARSET website interface. At the top, there is a navigation bar with links for "Earth Science Division", "Applied Sciences", and "ASP Water Resources". The main header features the NASA logo and the text "ARSET Applied Remote Sensing Training". A search bar is located on the right side of the header. Below the header, there is a horizontal menu with categories: "DISASTERS", "ECO FORECASTING", "HEALTH & AIR QUALITY", and "WATER RESOURCES". On the left side, there is a sidebar menu titled "ARSET" with sub-links for "Webinars", "Workshops", "Personnel", and "Links". The main content area is titled "Applied Remote Sensing Training" and contains the following text:

The goal of the NASA Applied Remote SEnsing Training (ARSET) is to increase the utility of NASA earth science and model data for policy makers, regulatory agencies, and other applied science professionals in the areas of Health and Air Quality, Water Resources, Eco Forecasting, and Disaster Management.

The two primary activities of this project are in-person courses and webinars.

In-Person Courses

ARSET in-person courses are a combination of lectures and computer hands-on activities that teach professionals how to access, interpret, and apply NASA data at regional and global scales with an emphasis on case studies. The program generally works with a host organization and other groups within their geographical region to tailor the curriculum and exercises to the needs of the projected attendees.

Webinars

Webinars are offered throughout the year in all four application areas and they usually last 4-5 weeks, 1 hour per week. They are intended for those new to remote sensing. For more information please go to the webinars section of the website.

Skills Taught:

- Search, access, and download of NASA data products and imagery
- Appropriate use and interpretation of satellite imagery.
- Visualization and analysis of NASA imagery using NASA, EPA, and NOAA webtools and other resources such as GIS, Google Earth, Panoply, RSIG, and HDFLook