NASA Earth Science Division
Applied Sciences Program

Report on Earth Science & Air Quality Training Modules & Events, January – September 2009

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NASA Earth Science Division's Applied Sciences Program maintains a website with Earth Science and Air Quality training modules and materials at: *http://aerocenter.gsfc.nasa.gov/asrs/*

Currently, this effort has generated 16 education modules to support Earth Science & Air Quality applications activities. The modules are freely available to individuals and institutions wishing to learn about satellite remote sensing and applications to decision making. The current modules are:

1. *Principles of Earth Remote Sensing*
2. *Satellite Remote Sensing Instrumentation*
3. *Satellite Orbits and Global Coverage*
4. *Overview of NASA Earth Science Satellite Data*
5. *NASA satellite Data Formats*
6. *Visually Exploring the Earth with NASA Satellite Data*
7. *Online Tools for Data Access, Visualization and Analysis*
8. *Critical Thinking About and Limitations of Remote Sensing Satellite Data Retrievals*
9. *Principles of Earth Remote Sensing – Spectra*
10. *Principles of Earth Remote Sensing – Angular information*
11. *Principles of Earth Remote Sensing – Polarization*
12. *The GES DISC Giovanni Tool for Data Access, Visualization and Analysis*
13. *Visualizing NASA Satellite Data With Google Earth*
14. *Comparing NASA Satellite Data With Models – NAAPS*
15. *Data Assimilation and Data Fusion*
16. *Short Demonstration of NEO, Aeronet Synergy, and Google Earth*

The following is a list of training events conducted January-August 2009.

Online Visualization and Analysis of Atmospheric Processes Utilizing NASA Satellite Data in Giovanni

2009 American Meteorological Society (AMS) Conference
Sunday, January 11, 2009
Atlanta, Georgia
Trainers: Steve Lloyd, Hualan Rui, Zhong Liu, Suhung Shen, Sundar Christopher and Pawan Gupta

Summary
In January 2009, Giovanni team members Zhong Liu, Steve Lloyd, Hualan Rui, and Suhung Shen, and Sundar Christopher and Pawan Gupta from UAH conducted a 1-day NASA Earth Science training activity on the Sunday prior to the AMS annual conference. This training activity was first planned and a training schedule submitted to AMS for approval in the Spring of 2009. Over the summer and Fall of 2009 Giovanni team members worked to consolidate this one-day comprehensive workshop on NASA Satellite data products and functions available in Giovanni with a focus on meteorology, climate and air quality. Additionally, UAH scientists prepared general (not focusing on Giovanni or any specific web tools) training modules on NASA Earth Science data for air quality applications including Case Studies. Four of the trainers for this activity included Giovanni Science Team members, thereby providing attendees not just with the background on how to access and visualize data through Giovanni, but also with their expertise on the relevant NASA science products and their application to meteorology and air quality. The workshop additionally benefited from the air quality expertise of Sundar Christopher and Pawan Gupta at UAH. The training activity used several of the modules proposed for Year I developed by Sundar Christopher, Steven Lloyd and Ana Prados. Giovanni Team members developed additional training modules specific to Giovanni which have been posted on the project website and are freely available to the public. These training modules have also been successfully used in workshops and demos conducted during Year I.

The first part of the training covered the basics of remote sensing, NASA Data formats, and NASA missions relevant to meteorology. This was followed by an introduction to Giovanni analytical functions and precipitation, cloud, and climate relevant data products including Case Studies. The third part of the workshop was an introduction to relevant data sets for air quality and applications of the data products using sample Case Studies. The final part of the workshop was a guided hands-on activity.

There were about 25 attendees at the workshop with varied professional backgrounds, primarily meteorologists, forecasters, and research scientists at both the Masters' and Ph.D. levels. Relative to other training activities conducted during Year I, there were more researcher oriented users and less applied science users during this training, which is consistent with the typical attendees at the AMS annual conference.

The survey and conversations with attendees on the day of the workshop indicate broad interest in the data products and tools for both research and applications, with a few reporting that Giovanni was not applicable to their research activities. Most attendees found that the course level was just right (not too easy or too difficult). Attendees suggested two main improvements to the training activity 1) resolution of internet connectivity problems. This was a function of the internet connection, not the Giovanni server 2) the need for more time for hands-on activities. As a result of this attendee feedback we have increased and thus optimized the amount of time spent on hands-on activities relative to instruction time, and increased the number of breaks provided throughout the day.

Remote Sensing Tools for Air Quality Forecasting

2009 EPA National Air Quality Conference
Monday, March 2, 2009
Addison, Texas
Trainers: Ana Prados and Amy Huff

SUMMARY
On March 2, 2009 Ana Prados and Amy Huff conducted a 1-day satellite training at the EPA 2009 National Air Quality Conference in Dallas, Texas. The training consisted of (see agenda below) an overview of Satellite remote sensing, followed by hands on activities for case study analysis. The first hands on exercise focused on using satellite imagery to help provide AQI forecasts, with all imagery for the analysis already provided to the attendees. This activity employed imagery available in real-time. The second hands on exercise involved the use of the Giovanni web tool for retrospective analysis of a choice of two air quality events. In this case, participants followed a set of instructions for producing and interpreting images, as well as using some of the Giovanni analysis tools. The last exercise involved the use of Google Earth for analysis of current air quality conditions. Participants had the opportunity to download all materials prior to the conference. Additionally, each participant was given a CD with all instruction materials, including instruction presentations, files with imagery for case study analysis, instruction sheets for the Giovanni exercise, and a document with a list of resources for access and information on NASA Earth Science data products.

The training provided several new items compared to last years' training. 1) Step by step instructions guiding participants through a hands on activity involving Giovanni for retrospective air quality event analysis 2) Background information and a hands on exercise on how to use Google Earth for visualization of remote sensing data for air quality. According to the surveys, there was a lot of interest in Google Earth, and some participants said they planned to use it to help with their forecasts. Giovanni was also found to be useful by a number of participants, for retrospective event analysis.

Most participants (see question 1 from survey) were either forecasters or environmental analysts. The degree of satisfaction with the course was very high. A large fraction of the participants (80%) indicated that they would be using the satellite images and/or tools for their work. Of the remaining participants, five indicated they may use the data, while only two indicated they would not be using it for their work. The survey results also indicated that there was interest in the satellite imagery both for examining current conditions, and for retrospective air quality event analysis. One attendee indicated he/she found the tools useful for retrospective analysis, but not for realtime analysis of air quality events. Other attendees however indicated that they found the datasets useful for real-time analysis (i.e., forecasting). The hands on activities in particular were found to be very useful by many of the attendees.

In the suggestions for improving the course, it appears that a few attendees were lost with Activity 1 and would have liked more direction. One attendee suggested hands-on activities along with the instructor. However, other attendees found the pace of the course to be appropriate.

We have frequently found that there are many levels of expertise and interest among attendees regarding satellite data products. Thus, one of the challenges in the design of training activities is the ability to teach at a level that is suitable for most attendees. To help address this concern and provide direction for future trainings, we added a new question to the survey, which asked participants whether they found the training workshop to be too difficult, too easy, or just right. Most attendees found the level of the course to be just right; only a few attendees indicated it was too easy, and none of the attendees found the course too difficult. This further confirms that there was a large degree of satisfaction with the course and that the teaching materials were appropriate for this audience.

Applications of Satellite Remote Sensing Data for Air Quality Modelers and Developers

Community Modeling and Analysis System (CMAS) Center
April 2-3, 2009.
Chapel Hill, North Carolina
Trainers: Ana Prados and Richard Kleidman

Summary

On April 2-3, 2009 a satellite training was conducted by Ana Prados and Richard Kleidman at the University of North Carolina Institute for the Environment, Chapel Hill, NC. This activity first developed during the 2008 CMAS annual conference based on the interest expressed by CMAS director Adel Hana in providing a satellite training activity for modelers.

The purpose of this particular workshop was to provide a pilot training activity on the available remote sensing data sets and tools for visualization and analysis of air quality events, and to provide some limited hands-on training on the use of various tools. The goal was to use feedback from the trainees to help inform the development of a longer 2-3 day training in the Fall of 2009 around the time of the annual CMAS conference and in parallel with other training activities regularly offered at CMAS.

There were about 14 attendees at this workshop with various degrees of competency and knowledge regarding satellite datasets. All attendees were provided with computers by UNC staff. The computers were preloaded with all needed files and applications for the hands-on activities, including the satellite datasets and model output.

On Day 1, the training activity began with an introduction (see agenda below) to the available remote sensing data products for air quality analysis. This was followed by a review of available remote sensing materials, so that attendees could become

acquainted with the various training materials already developed by the trainers, and potentially available for the 2-3 Fall day long training. We then provided an overview of the MODIS and MISR algorithms and available data products relevant to air quality, followed by and a hands on activity in the use of tools for visualization and analysis of Level 2 data. The remainder of Day 1 was devoted to an overview of the various online tools available for visualization, download and analysis of NASA Earth Science Data: IDEA, Giovanni, Fire Products, the AERONET Synergy tool, and a brief introduction to Google Earth. VIEWS/TSS and RSIG were then discussed by Uma Shankar (UNC) and EPA scientists respectively since these two tools allow (or will in the near future) direct comparison of satellite data to high resolution air quality model output.

Day 2 was devoted to hands on activities, with a focus on comparing imagery generated in Giovanni with model output. The last hour of Day 2 was an informal discussion with all attendees on their impressions and suggestions for the upcoming Fall training activity.

There overall degree of satisfaction with the workshop was good, based on the group discussion and the survey results and many indicated this would be a useful training to add to the regularly offered suite of CMAS training courses. One objection raised by a number of the attendees, which is also reflected in the survey results, was that too much material was covered and that they were unable to complete all of the hands-on activities. Some of the attendees also found some of the tools difficult to use. The workshop was planned as a survey course that would give everyone exposure to the available materials but not allow for mastery. Although we realized the compressed schedule was not optimal we felt this approach would enhance our ability to gauge the utility of the various datasets and tools for use in the Fall training. Unfortunately, this information was not adequately passed on to the attendees prior to the workshop.

All attendees who completed the survey had little knowledge of satellite products and all indicated that there was an improvement in their understanding of satellite data products for air quality applications (survey question 1). The discussion on Day 2 was also very informative and we are in the process of incorporating that feedback into the Fall training Agenda. Some of the feedback from Day 2 included 1) learning the tools in a slightly different order, leaving the more difficult applications for the end of the workshop or skipping them altogether 2) specific aspects of the retrieval algorithm to be covered in greater detail were discussed 3) Work closely over the next few months to develop jointly Case Studies for model/satellite comparison 4) Incorporate into the CMAS website information on the online tools available for remote sensing visualization and analysis so that attendees can become familiarized with the web tools prior to the Fall training. We have already incorporated some of the feedback from Day 2 into our recent trainings, specifically into the 7-Seas training conducted by Richard Kleidman in Singapore. We also learned which of the tools the attendees found most useful, Giovanni and the Synergy tools in particular were found to be useful to their specific application area.

Many of the attendees also recognized the difficulty in providing a training for users with many levels of expertise, and this was one of the main topics of discussion during Day 2. Some suggested that two parallel trainings or separate trainings may be necessary in the future, but acknowledged the constraints and considerable resources needed to put that together.

In summary we feel that this was a successful activity that will enable us to provide a 2.5 day training activity in the Fall tailored to air quality modelers. The two main goals for the Fall training workshop, currently scheduled for October 14-16, 2009 are 1) Provide modelers with the needed remote sensing background on the relevant data products and their application to air quality 2) an introduction to visualization and analysis tools to facilitate comparisons of remote sensing data with CMAQ model output.

Satellite Remote Sensing

International Symposium on Remote Sensing of Environment (ISRSE) Symposium
Sunday, May 2, 2009
Stresa, Italy
Trainer: Ana Prados

Materials used at the ISRSE Training on Satellite Observations for Air Quality are available online at:
http://aerocenter.gsfc.nasa.gov/asrs/materials/index.php?id=workshops

7SEAS Remote Sensing Workshop

Done in conjunction with planning for 2011 NASA Earth Science Field Campaign
May 11 – 14, 2009
National University of Singapore
Trainers: Richard Kleidman and Jun Wang

This was a three and a half day training held in sequence with the 2009 7SEAS planning meeting. There were approximately 20 – 25 attendees from the various countries that will be represented in the 7SEAS studies. Approximately half had also attended the 7SEAS planning meeting. This was an extremely diverse group of attendees ranging from actively teaching professors, to graduate and undergraduate students to professionals working in the fields of air quality and meteorology. This group also had a wide range of English abilities. As a result the pace was much slower than a typical workshop. Fortunately since we also had Jeff Reid and Ed Hyer from the NRL in attendance we were able to have 3 people assisting the attendees at any one time.

The last half day was a series of review and practice activities to allow the attendees more time to become acquainted with the various tools and websites presented during the previous three days. This “extra” half day is extremely valuable and can be the

difference between attendees feeling competent enough to use what they have learned after the workshop or not.

Self-Evaluation (R. Kleidman):
My own sense of this workshop was that it was in general quite successful. The attendees were exposed to many concepts and tools that they had not seen before. Since many of the attendees work in applied meteorology fields, such as air, quality the inclusion of presentations by Jun Wang and Ed Hyer was important to tailoring the materials to the needs of the students. The biggest difficulty with the workshop was the broad range of abilities. In normal circumstances the slowest students would have been lost or the material would have presented at such a slow pace that the middle and upper ability students would lose out. As stated before we were able to overcome these potential problems due to the large number of scientists in attendance from the U.S.
In the future we can adjust for this in one of two ways: 1) Send out materials to all attendees prior to the workshop and require mastery at a basic level prior to the workshop. 2) Have a one day addition prior to the formal start of the workshop and require the attendance of those lacking certain basic proficiencies.

Air Quality Analysis in Central America

Detección Remota con Imágenes Satelitales para Analizar la Calidad del Aire en Centroamérica
Spanish-language Training at National University, Costa Rica
July 20-22, 2009
San Jose, Costa Rica
Trainers: Ana Prados, Amy Huff

Summary
A total of 16 scientists, mainly from National University of Costa Rica (UNA), participated in the training. The total number of participants was limited by available space in the School of Environmental Sciences Computer Laboratory, where the training was conducted. The hosts at National University noted that nearly 40 people requested to take the course, demonstrating the overwhelming interest in use of satellites for air quality analysis.

Dr. Amy Huff of Battelle and Dr. Ana Prados of UMBC/JCET led the course, with assistance from Ms. Betzy Hernandez of CATHALAC. The course included lectures and interactive activities designed to give participants “hands-on” experience with various air quality satellite images and tools. All course materials were created by Amy Huff, except those related to Giovanni (Chapter 7 and Activity 5), which were created by Ana Prados. All course materials were in Spanish, and lectures were given in Spanish (Prados and Hernandez) or in English with instantaneous Spanish translation (Huff).

Major topics of the satellite course included:

- Satellite Remote Sensing of Earth
- Satellite Tools for Air Quality Analysis

- Where to Find Satellite and Remote Sensing Images on the Internet
- How Satellite Data Complement Ground-Based Monitor Data
- Advantages and Limitations of using Satellites for Air Quality Analysis
- Analysis of Air Quality Events using Satellite Images – Case Studies
- Using Giovanni for Analysis of Air Quality Events
- The Central American and Caribbean "Blog de Calidad del Aire"

World Bank NASA Satellite Training

Special Training Event Requested by World Bank
September 25, 2009
Washington, DC
Trainer: Ana Prados

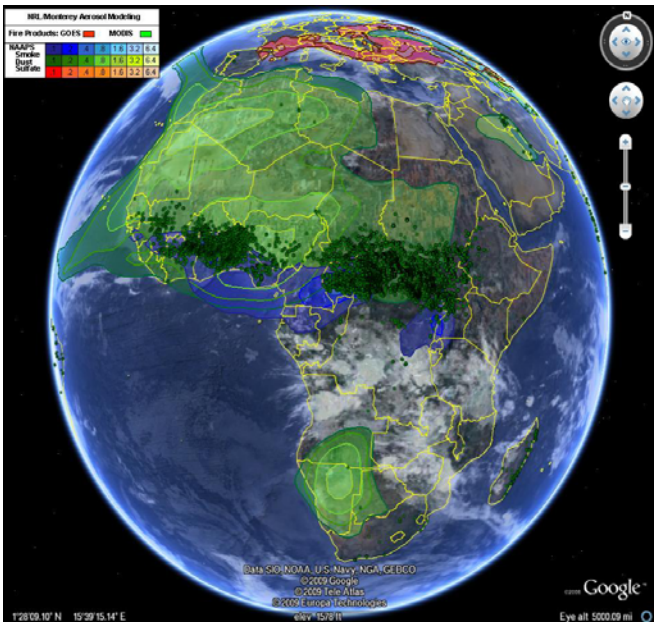
Summary

Ana Prados conducted a one-day training on September 25th, 2009 for World Bank employees supporting or managing projects in Asia, Africa, and Latin America. During the training event, participants completed several hands-on case studies. The attendees learned about NASA satellite data characteristics, methods to interpret NASA satellite imagery, and the application of satellite observations to dust, industrial and smoke pollution events around the world.

Many of the attendees reported on the relevance of NASA data products for decision making support in their projects/countries of interest, such as urban air quality and water pollution due to atmospheric emissions. Attendees also reported that the training activity provided the tools to explore additional NASA data sets and/or areas of application.

Figures below provide brief illustrations of images used in the case studies.

Images corresponding to one of the training Case Studies, provided by NRL Fire Locating and Modeling of Burning Emissions (FLAMBE) project, which incorporates NASA Satellite real-time observations in its model predictions.



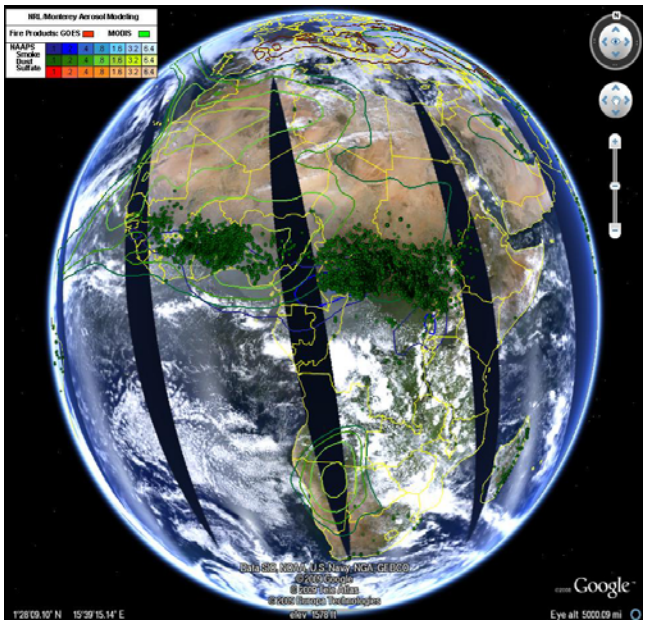


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Figure 1 Figure 2

Figure 1 shows MODIS fire locations and modeled pollution.
Figure 2 shows MODIS fire locations and true color imagery