NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
http://www.nasa.gov

The Earth Observer. July - August 2005. Volume 17 . Issue 4.

The Earth Observer

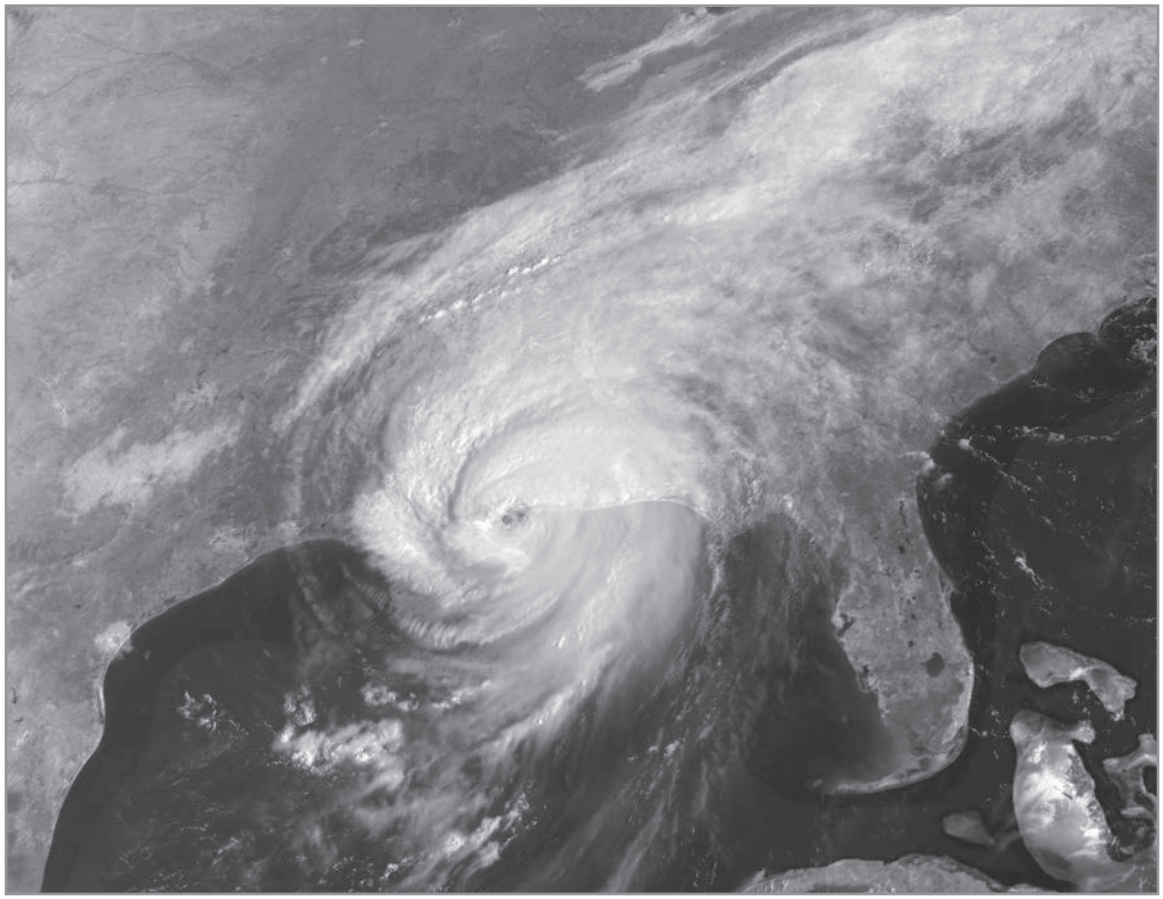
Editor's Corner

Michael King
EOS Project Scientist

Welcome to this the first issue of our all-new The Earth Observer. You will note some changes in the format, and also changes in the arrangement of articles. We hope you find them pleasing. The front portion of the newsletter is now devoted to highlighting interesting feature articles and articles on research results. Meeting and workshop reports can be found toward the back. The newsletter team is working diligently to come up with interesting articles. You can help by contacting Alan Ward, Executive Editor, *alan_ward@ssaihq.com*, or Charlotte Griner, Technical Editor, *clgriner@earthlink.net*. We look forward to having your article in a future issue.

On June 16, 2005, NASA Headquarters released a report that compiled the results of its recent Earth Science Senior Review held April 26-29 to review proposals for extending a dozen Earth science missions—ACRIMSAT, Earth Radiation Budget Experiment (ERBE), Global Positioning System (GPS) Atmospheric Limb Sounding Mission [referred to as GPS Science in figures], Gravity Recovery and Climate Experiment (GRACE), Ice Clouds and land Elevation Satellite (ICESat), Jason, Quick Scat- continued on page 2

Hurricane Katrina moved ashore over southeast Louisiana and southern Mississippi early on August 29, 2005, as an extremely dangerous Category 4 storm. With winds of 135 miles per hour (217 kilometers per hour), a powerful storm surge, and heavy rains, Katrina pounded the U.S. Gulf Coast, triggering extensive life-threatening flooding. This GOES image shows the storm as it moved over southern Mississippi at 9:02 a.m. The eye of the storm was due east of New Orleans, Louisiana. Images courtesy GOES Project Science Office.



In This Issue

terometer (QuikSCAT), Stratospheric Aerosol and Gas Experiment (SAGE) [combined SAGE II and SAGE III], Terra, Total Ozone Mapping Spectrometer (TOMS), Tropical Rainfall Measuring Mission (TRMM), and the Upper Atmosphere Research Satellite (UARS). Representatives of each mission gave a presentation before the panel. The proposals to extend these missions were all evaluated both in terms of their scientific value and the relevance of each proposal to NASA Earth Science Strategic Objectives. The panel also took into consideration the health of the instruments and spacecraft as they made their evaluation. A completely separate review of each mission was conducted to review education and public outreach activities.

In addition to coming up with an absolute assessment of each individual mission, each member of the review team was asked to also assign a ranking for each mission relative to all the others in order from strongest (1) to weakest (12). This relative ranking alone, however, isn't conclusive enough as it doesn't really indicate whether or not the twelve proposals are almost equal in terms of their scientific value or whether some are much more compelling than others. To clarify this, the team also compiled a second ranking where they assigned each proposal a score based on future scientific value. The following rating scale was used:

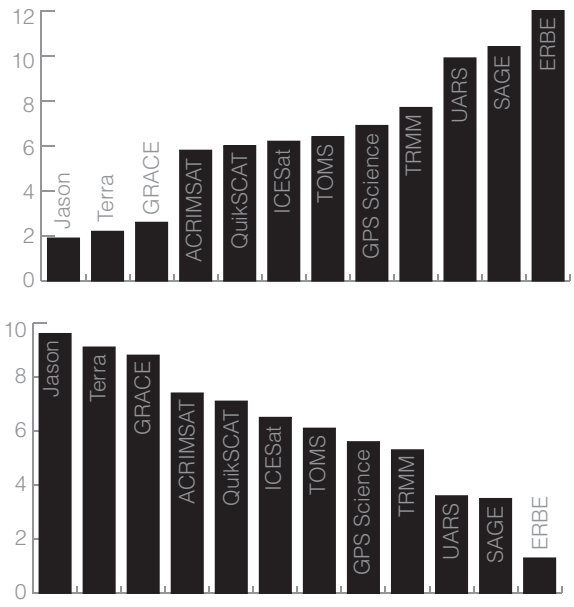
10-8 Compelling
7-4 Excellent, but less compelling
3-0 Modest

The average value for both the relative rankings and the rankings in terms of future scientific value are shown in bar graphs in Figures 1 and 2 respectively. In general, missions that received a high relative ranking also tended to be assessed as having a high amount of future scientific value. For example, Jason, Terra, and GRACE were the top three in terms of relative ranking and all three were assessed as compelling in terms of future scientific value. The proposals that the committee viewed as more modest in terms of future value in general tended to be older missions such as ERBE and UARS that are very likely near the end of their useful life anyway. SAGE also scored low, but it should be noted that SAGE II and SAGE III were presented in the same proposal, which may have impacted the assessment of these missions.

Meanwhile, our Earth observing missions continue to collect new data. ICESat completed its seventh science operations period on June 23rd. The Geosciences Laser Altimetry System (GLAS) instrument is approaching 900 million measurements around the Earth using all three of its lasers. Reprocessing efforts continue to improve data quality and to enhance scientific return. I congratulate the ICESat team for yet another successful operations period.

The Tropospheric Emission Spectrometer (TES) is operational again after being shut down for a short time to assess excessive wear that had been detected on

Figure 1: (top) Relative rank of each mission, with 1 being the highest and 12 the lowest.
Figure 2: (bottom) Rank based on absolute scientific value (10-8 compelling; 7-4 excellent but less compelling, and 3-0 modest)



some of the bearings. The TES team has stopped doing limb scans to preserve the life of the instrument, and is assessing how the instrument has performed since it has resumed operation. Meanwhile, despite earlier setbacks that limited the scope of the mission, the High Resolution Dynamics Limb Sounder (HIRDLS) team has demonstrated that they can still obtain ozone and temperature retrievals. Both of these teams are to be commended for their hard work to respond to these setbacks.

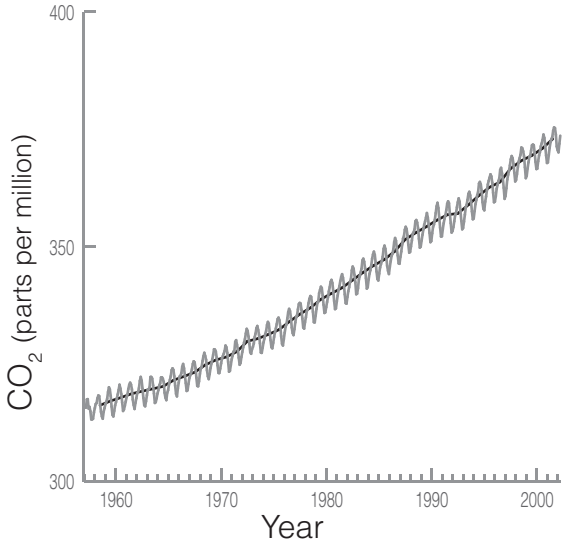
On a more personal note, I wish to congratulate Ernie Hilsenrath on his recent retirement from NASA Goddard after over 40 years of service. Hilsenrath has been involved in numerous atmospheric chemistry experiments over the years—from the ground, aircraft, balloons, rockets, the space shuttle, and Earth observing satellites. He has been in charge of a calibration facility at Goddard that has provided calibration resources for all backscatter ultraviolet (BUV) instruments currently in orbit and those that are planned for the future. Hilsenrath also studied ozone climatology from TOMS and from the Shuttle BUV instruments. Most recently, Hilsenrath served as U.S. Principal Investigator for the Ozone Monitoring Instrument (OMI) that flies on Aura and as one of two Deputy Project Scientists for the Aura mission.

Joanna Joiner will replace Hilsenrath as Deputy Project Scientist for Aura. Joiner currently serves on the OMI science team and is also actively involved with the Aqua Atmospheric Infrared Sounder (AIRS) science team in experiments that have improved weather forecasts by assimilating AIRS data. Since joining NASA Goddard in 1991, her research has focused on the development of retrieval and data assimilation techniques for microwave, infrared, and ultraviolet/visible remote sensing instruments. Joiner also served as an associate editor for the Quarterly Journal of the Royal Meteorological Society from 2000-2003. I congratulate Joanna on her new position and look forward to working with her.

Lastly, I am saddened to announce the recent passing of two prominent Earth scientists—Peter Hobbs (University of Washington—UW) and Charles David Keeling (Scripps Institute of Oceanography). In more than 40 years at UW, Hobbs embarked on many scientific adventures. "His discoveries about ice crystals in clouds are a cornerstone of modern weather-prediction models," said UW meteorologist Cliff Mass, a former student of Hobbs' and his longtime running partner. Hobbs also studied the role of aerosol pollutants in dampening the effects of global warming. His measurements in Kuwait quelled fears that smoke from the oil fields might change the planet's climate. Hobbs was also co-author, with J. Michael Wallace, of the nation's top meteorology textbook, *Atmospheric Science: An Introductory Survey*, and he finished working on a new edition shortly before he died. He continued to work on his research projects right up until his final days.

Keeling was best known for his precise measurements of atmospheric carbon dioxide, taken at the Mauna Loa Observatory and charted in the Keeling curve, one of the most recognizable images in modern science. In many ways, Keeling's research has set the stage for today's profound concerns about climate change and represents one of the most important environmental datasets of the 20th Century. Keeling received the National Medal of Science, the United States' highest award for lifetime achievement in scientific research, the Tyler Prize for Environmental Achievement, and many other awards for his work. ■

The Keeling Curve. Measurements of CO_2 taken from atop Mauna Loa in Hawaii from 1958 to 2002. Keeling's graph clearly shows a cyclical increase and decrease within each year, corresponding to the seasonal change in uptake of CO_2 by vegetation. It also shows an overall increasing amount of CO_2 over time, from about 315 parts per million (ppm) in 1958 to about 367 ppm by 2000.



EOS Senior Project Scientist Visits East Africa

Michael King, michael.d.king@nasa.gov, EOS Senior Project Sciencist, NASA Goddard Space Flight Center

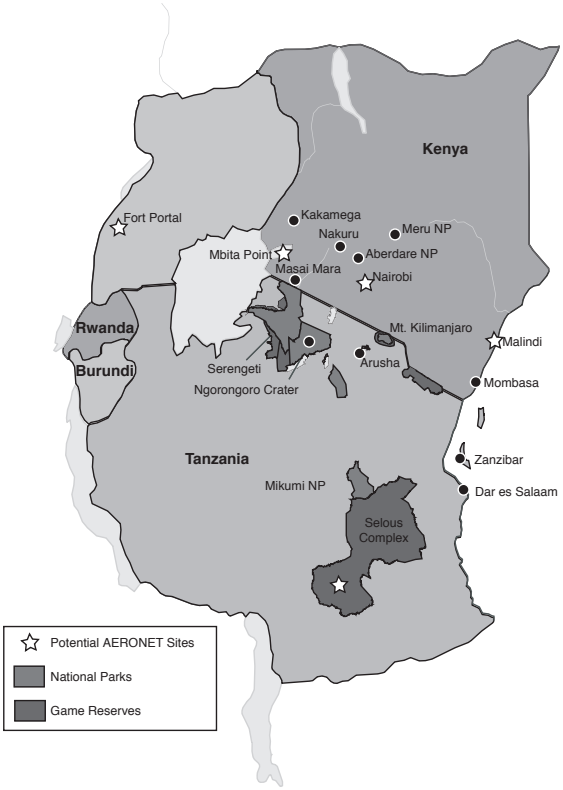
EOS Senior Project Scientist Michael King visited East Africa from February 26-March 18 to:

- meet with local partners in environmental science;
- discuss potential field experiments on air quality in the region;
- expose regional scientists, ecological managers, and meteorological services to the capability of NASA's Earth remote sensing satellite, airborne, and surface data; and
- visit potential sites to deploy NASA's Aerosol Robotic Network (AERONET) sun photometers.

Throughout Kenya and Tanzania, King traveled with Charles Gatebe, an Assistant Research Scientist at the University of Maryland, Baltimore County's (UMBC) Goddard Earth Science and Technology Center (GEST). Also, during the first week in Nairobi, Ali Omar, NASA Langley Research Center, a co-investigator on NASA's Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) mission, and Brent Holben, principal investigator for the AERONET, participated in some of the meetings, a conference in Mombasa, and visitations of various scientific institutions.

Figure 1 shows the locations of principal site visits, conferences, presentations, and meetings held during King's recent trip to Kenya and Tanzania.

Figure 1. Locations of principal site visits, conferences, presentations and meetings held during Michael King's recent trip to Kenya and Tanzania.



Nairobi

The first leg of the trip was a three-day visit to Nairobi, during which Michael King, Charles Gatebe, and Ali Omar visited the following locations:

- Kenya Meteorological Department (KMD);
- University of Nairobi:
  - o College of Education & External Studies (CE&ES); and
  - o College of Architecture & Engineering (CAE);
- United Nations Environment Programme (UNEP);
- Kenya Agricultural Research Institute (KARI);
- International Centre of Insect Physiology and Ecology (ICIPE);
- Regional Centre for Mapping of Resources for Development (RCMRD); and
- Kenya Wildlife Service (KWS).

The highlights of each visit are summarized below.

Kenya Meteorological Department (KMD)

At KMD, the group met with Prof. Laban Ogallo, Project Coordinator for Inter-Governmental Authority on Development (IGAD) Climate Prediction and Application Centre (ICPAC, *www.dmcn.org*), an organization that acted as our liaison for our visit to East Africa. This organization has diplomatic status and the ability to enter into a letter agreement with NASA on the siting and distribution of AERONET sun/sky radiometers throughout 10 countries in the Greater Horn of Africa. He also invited them to speak at a conference in Mombasa (elaborated on below).

While at KMD, the group also visited with the Deputy Director and senior staff, where Charles Gatebe gave a seminar on airborne measurements that he has made of bidirectional reflectance of natural ecosystems in southern Africa. These included a very clear and well-illustrated presentation on angular reflectance properties of marine stratocumulus clouds. Gatebe showed results for Etosha Pan, Namibia, savanna in South Africa (Skukuza), and over the ocean with sunglint. The purpose of this presentation was to expose the staff to the unique capabilities of NASA's Cloud Absorption Radiometer (CAR) which has recently been integrated on a South African Weather Service Aircraft (Aerocommander 690A) and could be used to make similar measurements in Kenya, Tanzania, and/or Uganda. KMD is Kenya's liaison to the Kenya Civil Avia-

tion authorities with whom NASA would need to collaborate if they wish to plan an airborne field campaign in Kenya in future years. Finally, Gatebe showed details on the capability of AERONET for characterizing aerosol optical properties anywhere in the world.

University of Nairobi

The group visited two different campuses of the University of Nairobi. They first visited the College of Education & External Studies (CE&ES) which is actually a campus of the University of Nairobi that focuses especially on education of teachers and distance learning, and then visited the main campus. At CE&ES, the group met with the Principal, Prof. Henry Mutoro, and Department Chairmen of various academic departments and discussed the Award-winning NASA Earth Observatory Web site (*earthobservatory.nasa.gov*) and the Odyssey of the Mind (OM) program. NASA has sponsored an Odyssey of the Mind Environmental problem for the past 3 years; the NASA environment problem alone reaches 1.5-2 million Elementary, Middle School, and High School students worldwide, but until now this has not included any students in East Africa.

The CE&ES officials expressed interest in helping to start OM participation in Kenya, so Diana King (Michael's wife) stayed with the college faculty and further detailed the Odyssey of the Mind program and NASA's outreach material. Meanwhile, Michael King, Charles Gatebe, and Ali Omar traveled to the main campus of the University of Nairobi to visit the College of Architecture & Engineering (CAE) and met with the Deputy Vice Chancellor (Academic) and Principal of the CAE. They also gave a University-wide public lecture on NASA's Earth remote sensing capabilities, with special emphasis on observations over East Africa (see **Figure 2**).

United Nations Environment Programme (UNEP)

The group visited UNEP and had a very pleasant meeting and interchange with Alexander Alusa, Deputy Director of the Regional Office for Africa, UNEP. They discussed NASA's Earth remote sensing capability, much of which Alusa was familiar with, and what NASA is doing to study vector-borne diseases like Rift Valley Fever and Malaria, and drought monitoring in Africa.

Kenya Agricultural Research Institute (KARI)

At KARI, the group met with senior staff, all of whom were research scientists who had received their Ph.D.'s in the United States. The senior staff was interested in using remote sensing for rather specific applications like drought monitoring and studying the health of agriculture, horticulture, and soils. Charles Gatebe again gave an impromptu seminar on the bidirectional reflectance properties of various terrestrial surfaces that have been observed from the NASA-built Cloud Absorption Radiometer (*car.gsfc.nasa.gov*). Michael King also followed with a discussion of the spectral and seasonal variation in land surface albedo as derived from Moderate Resolution Imaging Spectroradiometer (MODIS) data worldwide, and how it varies with time of year and ecosystem, again with a special emphasis on East Africa and its growing season.

International Centre of Insect Physiology & Ecology (ICIPE)

At ICIPE, the group met with Hans Herren, Director General, and all of his department heads. ICIPE is a first rate international research organization that specializes in human health, animal health, plant health, and environmental health. In all of these arenas insects play a very important role, and thus the study of insect- (or *vector*-) borne diseases is important. ICIPE conducts research on a number of different *vectors*—mosquitoes, tsetse flies, and sand flies. This agency is operated under charter from the United Nations with its corresponding international staff and diplomatic status. They make extensive use of remote sensing data for studying maize, and they have funding from NASA to use satellite remote sensing in GIS applications to study mosquito vectors. They also have extensive experience

Figure 2. Electroinc Theater presentation on NASA's Earth remote sensing capability, with special emphasis on East Africa (University of Nairobi). Photo by Charles Gatebe.

Figure 3. Mbita Point Research and Training Centre on the shores of Lake Victoria, Kenya (ICIPE).

in ecological and biostatistics modeling. In spite of the fact that Dichlorodiphenyltrichloroethane (DDT) has been eliminated in the U.S. because of its harmful effect on the environment, particularly on birds and marine organisms, the U.S. has recently recommended that DDT be used in Africa to combat mosquitoes that carry malaria. Acting on this recommendation, Uganda started spraying DDT in February.

Because of many wars in Africa, many people are moving from villages to rural areas where sand flies that live in termite mounds are prevalent but for which these people have no previous experience. As a result, many people are contracting sand flies. Furthermore, since many soldiers in Iraq have contracted sand fly bites with its associated visceral bleeding, the U.S. is now investing heavily in treatment. Although the funds go to the environmental health division, the work is focusing on plant health, which accounts for 50% of ICIPE's funding. Plants are given a high research priority since 60% of plants need insects for pollination, and insects need habitat such as soil. If there were no insects in soil, you would have a desert.

Finally, the group discussed establishing several AERONET sites in East Africa, including possible locations in Kenya, Tanzania, Uganda, and Eritrea. ICIPE informed them that they had an extraordinary research site on the shores of Lake Victoria, known as the Mbita Point Research and Training Centre (see **Figure 3**). The location is not only ideal geographically, but there are housing facilities for scientists, an auditorium for science seminars and discussions, and a site manager. Subsequent to this discovery, Brent Holben and Ali Omar made arrangments to drive to Mbita Point, where they stayed overnight, gave a scientific seminar on AERONET, and generally approved this as a location for an AERONET sun/sky radiometer.

Kenya Wildlife Service (KWS)

Kenya Wildlife Service is charged with the protection and conservation of the country's biodiversity in protected national parks and reserves. The group met with the Director, Julius Kipng'etich, Assistant Director (Protected Areas), Joachim Kagiri, and the Head of Geographic Information Systems (GIS), Wycliffe Mutero. Mutero was especially interested in access to NASA's MODIS and Landsat data to study the environmental encroachment around various National Parks in Kenya. The KWS officials were so pleased in making contact with NASA representatives, and in the prospect that they would locate an AERONET sun photometer in one or more of the national parks for air quality monitoring, that they gave them free passes for access to all national parks in Kenya, normally worth $30/person/day. When all was said and done, this turned out to be worth over $1000 as group members visited a number of parks throughout Kenya.

Figure 4. Nairobi National Park with its resident Burchell's Zebras is right on the edge of downtown Nairobi, clearly visible in the background. Photo by Michael King.

After visiting the offices and staff of the KWS, the group entered Nairobi National Park itself (see **Figure 4**). This is truly a National Park, with resident Burchell's Zebra, hippopotamus, lion, rhino, Common Giraffe, and the like, but also immediately adjacent to the urban city of Nairobi. This is an ideal site for an AERONET sun photometer because of its close proximity to an urban center, but not within the urban city itself. It is also managed by KWS and is restricted access, so it is well protected from people. As long as the sun photometer can be situated high enough to get a panoramic view of the horizon in all directions, and to avoid curious exploration from resident Olive Baboons, this is an ideal location for establishing an AERONET site.

Mombasa

The next leg of the East Africa trip was a trip to Mombasa, Kenya. On March 3, the group traveled from Nairobi to Mombasa, so they could attend the *Greater Horn of Africa 15th Climate Outlook Forum for March-May 2005 Rainfall Season*. Earlier, Prof. Ogallo (KMD) had invited the group to address this conference that was attended by the Heads of the Meteorological Departments from 10 different countries in the Greater Horn of Africa. This turned out to be a most extraordinary opportunity to showcase NASA's Earth remote sensing capability, again with a special emphasis on East Africa. Charles Gatebe also had another chance to describe the AERONET sun photometer network, and Ali Omar gave a presentation on CALIPSO and the validation needs of this satellite project. Gatebe pointed out that AERONET is widely distributed worldwide (250 stations or so), but that at present, none existed in the whole of East Africa.

Because of Gatebe's presentation, the group learned from conference attendee, Giovanni Laneve, University of Rome, that he had recently purchased a Cimel sun photometer directly from Cimel Eléctronique in Paris, a fact totally unknown to Brent Holben or any of the AERONET project staff. They had not yet installed the sun photometer, but they intended to install it soon at

their nearby San Marco Station in Malindi. The group visited San Marco the next day (see **Figure 5**) and saw this instrument and its future site location on the roof of one of the buildings. The following day, Laneve was flying through Nairobi on his way back to Rome, and had a chance to have a two-hour meeting with Brent Holben—who happened to be making a two-day visit to Kenya at the same time Laneve was passing through. This was most fortuitous, and is important for establishing AERONET in East Africa.

While at the conference, the group also met a professor from the University of Dar es Salaam's Institute for Marine Sciences on Zanzibar. Although they had planned to visit Zanzibar as an alternative Indian Ocean site for deploying AERONET, they had not established any contacts in Zanzibar. Therefore, this chance meeting at the conference was very helpful.

Following the conference presentation and networking, the group departed to drive up the coast to Malindi and spent one night not far from San Marco Station.

Broglio Space Centre (BSC), Malindi

The Broglio Space Centre, better known as San Marco, is located just north of Malindi on the Indian Ocean. It is operated by the University of Rome under contract with the Italian Space Agency who, in turn, have a cooperative agreement with the Kenya Ministry of Defense. NASA and ESA regularly use San Marco for orbit insertion and tracking support. Twice a week San Marco launches ozonesondes to intercompare ozone profiles with NASA's TOMS and SAGE II satellites. As mentioned above, the group learned they had recently acquired a Cimel sun photometer which will be added to the AERONET federation of sun/sky radiometers. Since this station purchased a Cimel sun photometer without its satellite broadcast and transmission capability, NASA plans to purchase this auxiliary equipment for them so that the data can be transmitted to Goddard and processed along with the rest of the worldwide AERONET stations. Furthermore, San Marco has agreed to periodically send their radiometer to Goddard for calibration and servicing, so that the data quality and accuracy can be assured.

The group found an even bigger surprise at BSC. They learned that San Marco had acquired, and was operating, an X-band direct broadcast receiving station that permits Terra/MODIS and Aqua data to be acquired in real time during satellite overpass. NASA organizes workshops and distributes data free to process MODIS [Terra and Aqua] and Advanced Infrared Sounder (AIRS) [Aqua] data globally to a large array of direct broadcast receiving stations. However, prior to this trip, NASA knew of only one direct broadcast receiving station in all of Africa, located at the Satellite Applications Centre in Hartebeeshoek, South Africa. The BSC receives the data during all satellite overpasses, writes the data out on tape, and ships the tapes to Rome. BSC does not distribute the data to anyone in East Africa, and at least in San Marco, they are not using any of the free software that NASA distributes for working with these data. No organization in the Greater Horn of Africa has access to these data, or even knows that they are being collected. Michael King made this finding known to both Goddard and University of Wisconsin personnel who work with, and distribute software to, these direct broadcast receiving stations. The KMD has also been informed so that they can collaborate on getting a high-speed Internet connection to San Marco to support distribution of these data in real time.

Kiriti Secondary School, Nyeri

At the request of Charles Gatebe, the group visited the Kiriti Secondary School in Nyeri, near Aberdare National Park and near Gatebe's ancestral home. His brother is the Vice Principal of this school, where Michael King spoke before 700 school children on NASA's Earth science programs and science findings, as always

Figure 5. The 6.1 m X-band antenna of the Remote Sensing Centre, Broglio Space Center, Malindi. This dish can receive EOS Terra/MODIS and Aqua data in direct broadcast mode. Photo by Charles Gatebe.

Figure 6. Electronic Theater presentation on NASA's Earth remote sensing capability, with special emphasis on East Afirca (Kiriti Secondary School). Photo by Charles Gatebe.

with a special emphasis on East Africa (see **Figure 6**). This public school is in the Parliamentary District of Prof. Wangari Maathai, the Kenyan winner of the 2004 Nobel Peace Prize. Although she was out of the country during this visit, her personal assistant visited the school and talked with the group from NASA. He was quite pleased that they visited this public school on Saturday to meet with the kids and discuss the environment, and he was trying to make arrangements for Michael King to speak in a public forum at the National theater in Nairobi with Prof. Maathai and the Minister of the Environment, but unfortunately it could not be arranged. Nevertheless, this visit and interaction with the school teachers and students was most satisfying.

Aberdare National Park

The group visited the two guest lodges that reside in Aberdare National Park, *Treetops* and *The Ark*. *Treetops* is a hotel designed for game viewing but is especially famous because in 1952, Elizabeth of England came as a Princess and became Queen of England when she was notified that her father, King George VI, had died during the night. *Treetops* is a three-story structure that stands on stilts. Guests look out over a large waterhole bordered by salt blocks, placed there to help attract the animals of Aberdare National Park. The group went on a game drive in the Park as one is not allowed to walk on your own. They were not only looking for game, but also possible locations to site an AERONET sun photometer.

Although well known as a game-viewing hotel by a watering hole, *Treetops* is not nearly as nice a hotel, nor does it offer as good a game viewing, as its companion hotel in Aberdare, *The Ark*. The group spent their second night in Aberdare National Park at *The Ark*—one is only allowed one night's lodging in *Treetops*. *The Ark* was larger and a more comfortable lodge, and is located deeper in the forest. The site would be a far better location for an AERONET sun/sky radiometer, but it is unlikely that a sun photometer will be placed in Aberdare National Park since it is only 100 miles north of Nairobi, where there are plans to deploy a sun photometer at neighboring Nairobi National Park.

Gatebe family home, Nyeri

Michael King and his wife also visited the Gatebe family farm where Charles grew up and where his oldest brother Maina still resides. This is a 12-acre working farm in a very nice location neighboring the Aberdare Country Club, the transfer hotel for *The Ark* Hotel in Aberdare National Park. After walking the grounds and river valley of this farm, the group had lunch and then participated in a Kikuyu ceremony with 27 members of Gatebe's family (including brothers, sister, in-laws, nephews, and nieces) and friends. King was

Figure 7. Ceremony to make Michael King a Kenyan Elder, Gatebe family home, Nyeri, Kenya. Photo by Charles Gatebe.

made a Kenyan Elder in a ceremony in which Gatebe's family and friends did a dance and performance for King that was most remarkable (see **Figure 7**). King was then presented with a special cane and flywhisk like the ones that Jomo Kenyatta, the first President of the independent Republic of Kenya, often carried.

Meru National Park

On March 7, the group traveled from Aberdare National Park to Nanyuki, located near the base of Mount Kenya, where they met with Nicholas Georgiadis, Director of the Mpala Research Centre, and his GIS Analyst, Nasser Olwero. They have been using MODIS Normalized Difference Vegetation Index (NDVI) data from both Terra and Aqua, together with computer models, to assess the state of health and maturity of maize crops in central Kenya. Their motivation for doing this is quite practical; they want to do a better job forecasting exactly when the maize is fully ripe so they can have a better chance at stopping elephants from entering the fields and eating the mature maize, thereby reducing the farmers' yields and income for that year. By using NASA satellite data they were able to gain skill in forecasting maize crop maturation. As a result of these discussions, they also learned about some of the other MODIS datasets that

Figure 8. Meru National Park. Photo by Michael King.

might be helpful for their efforts—such as temperature and surface albedo.

After leaving Nanyuki, the group drove on to Meru National Park where they spent the night in a lodge at the location previously occupied by George and Joy Adamson, the author of *Born Free*. Joy had described the location of this lodge as ideal leopard country, but both she and George were later murdered. This is the least visited of Kenya's National Parks, and it possesses extensive grassland and scattered trees with spectacular views of the surrounding area (see **Figure 8**). However, the road to Meru National Park is undoubtedly the worst road they had ever encountered. The park's relative inaccessibility, coupled with its high cost for accommodations in this area, make this an unsuitable location for AERONET sun photometers.

Lake Nakuru National Park and Egerton University

It took much of the day on March 8 for the group to drive from Meru to Lake Nakuru National Park, located within the Eastern Rift Valley of equatorial East Africa. They arrived there just before the gates of the National Park closed for the night, and spent two nights within the Park. On March 9 the group visited Egerton University where Michael King gave a University-wide public lecture on NASA's Earth remote sensing capabilities, with special emphasis on observations over East Africa. Egerton University is the oldest institution of higher education in Kenya. Some 200 faculty members and students attended the lecture. Following this, the group met with the Deputy Vice-Chancellor (Academic Affairs), Dean of the Faculty of Science, and selected Faculty.

Following meetings in the Vice-Chancellor's Conference Room, the group proceeded to the Biodiversity Conservation Centre where Charles Gatebe and Michael King were each asked to plant a ceremonial tree (see **Figure 9**). (This is a tradition begun by Prof. Wangari Maathai, 2004 Nobel Peace Prize recipient.) King planted an Acacia Tree in this botanical garden where the U.S. Ambassador to Kenya and Mwai Kibaki, the President of Kenya, have each planted ceremonial trees.

Western University College of Science and Technology, Kakamega

On March 10 the group traveled to Kakamega to visit the Western University College of Science and Technology. Kakamega is in the Lake Victoria basin and close to Kakamega Forest. This pocket of virgin tropical rainforest is one of the remnants of the vast forest that once stretched across the girth of Africa from the Congo Basin. The Deputy Principal (Academic Affairs) was quite excited with this visit and had advertised Michael King's public lecture quite extensively. King therefore gave a University-wide lecture on NASA's Earth remote sensing capabilities, with special emphasis on observations over East Africa. One of the attendees is a professor at both Western University College and the University of Nairobi, and had previously attended the lecture in Nairobi. Local high school students attended in addition to faculty and students from the University, and many were quite interested in the little known fact that a mountainous region near Kifuka in the Democratic Republic of the Congo (latitude 2.75°S, longitude 27.75°E) is the *hot spot* of the planet when it comes to lightning strikes, with a maximum annual lightning flash rate density of 158 flashes km^{-2} yr^{-1}. King showed, among many animations, an animation from the Optical Transient Detector (OTD) and the Lightning Imaging Sensor (LIS) on theTropical Rainfall Measuring Mission (TRMM) at 0.5° x 0.5° resolution that showed daily lightning occurrence, averaged over 6 years. This was of great regional interest. Following the lecture King went to the Kakamega Forest for the late afternoon, and Charles Gatebe stayed and answered questions from an interested audience for over 2 hours!

Masai Mara National Reserve

The group's final destination in Kenya was Masai Mara National Reserve at the north end of the great Serengeti Plain of Tanzania and Kenya. This is an extensive,

Figure 9. Michael King planting an Acacia abyssinica tree in the Biodiversity Conservation Centre, Egerton University, Njoro, Kenya. Photo by Charles Gatebe.

Figure 10. Mara Serena Lodge overlooking the Serengeti Plain, Masai Mara National Reserve, Kenya. Photo by Michael King.

open grassland with scattered trees, lowland hills, and the Mara River, that would seem to be an ideal location for an AERONET sun photometer, either in the Masai Mara National Reserve or in neighboring Serengeti National Park, Tanzania. The *Mara Serena Lodge* where they stayed would make an ideal location for deploying an AERONET sun photometer since it is above the plains and has a panoramic view of the horizon in all directions (see **Figure 10**). The Cimel sun photometer could be deployed from the roof of one of the cottages, thereby keeping it secure from curious baboons and destructive elephants. However, given the Mbita Point Research and Training Center and its location on Lake Victoria, there is no need to deploy the AERONET sun photometer in Masai Mara. If Mbita Point were to fall through for any reason, however, the Mara Serena Lodge would be an ideal location to deploy these sensors.

Ngorongoro Conservation Area, Tanzania

On March 13, the group moved from Kenya to Tanzania. They flew from Masai Mara in a small plane to Wilson Airport, Nairobi, cleared immigration and continued on to Mt. Kilimanjaro Airport, Tanzania. The group was met at Kilimanjaro Airport and transported to Ngorongoro Conservation Area, where they spent the night on the rim of the Ngorongoro Crater, a World Heritage Site (see **Figure 11**). Though Ngorongoro Crater is only about 300 km from Masai Mara, it took much of the day to make the transfer because of the international border crossing and immigration requirements.

Although the Ngorongoro Crater is itself an extraordinary location for an AERONET sun photometer, all four lodges that exist within the conservation area are located on the rim of the caldera, some 650 m above the floor of the collapsed volcano. The caldera is some 20 km in diameter and the skies are often clear. The rim, however, is often shrouded by morning mist and late afternoon cloudiness, thereby making it unsuitable as an AERONET location. The caldera itself modifies the airflow and creates orographic effects and makes unsuitable weather conditions for aerosol monitoring. Hence, in spite of its spectacular location and unofficial designation as the *eighth wonder of the world*, Ngorongoro Crater is not a suitable site for deploying AERONET sun photometers.

Figure 11. Ngorongoro Crater as seen from the Ngorongoro Sopa Lodge, Ngorongoro Conservation Area, Tanzania. Photo by Michael King.

Tanzania Wildlife Research Institute (TAWIRI)

Enroute from Ngorongoro Conservation Area to Dar es Salaam, the group drove to and through Arusha, the headquarters of the Tanzania Wildlife Research Institute (TAWIRI). They met with George Sabuni, Director of Research, and discussed their desire to deploy AERONET sun photometers within either Game Reserves or National Parks of Tanzania. Sabuni indicated that there was a research station within the Serengeti National Park that was the original research site of TAWIRI, and had facilities for visiting researchers, a tower, and housing. Since it was becoming clear that Malindi, Nairobi, and Mbita Point in Kenya were all likely locations for locating AERONET sun photometers, the consensus was that a location further south than Serengeti National Park would be preferable. Therefore the group did not visit the proposed site at Serengeti National Park.

Based on previous experience with satellite observations of aerosol properties worldwide, it was abundantly clear that there was far more biomass burning and seasonal aerosol episodes in southern Tanzania, northern Mozambique, Malawi, and Zambia, than there were in northern Tanzania or Kenya. As a consequence, the group expressed a desire to locate a sun photometer in a southern Game Reserve or National Park. Sabuni indicated that the Selous Complex in southern Tanzania met these criteria, and that he would work with them to deploy AERONET to this location (see **Figure 1**).

University of Dar es Salaam

The next visit was to the University of Dar es Salaam, the largest public university in Tanzania. The group met with Prof. Godfrey Mbise, the Chairman of the Physics Department, and later the Chief Academic Officer, Prof. M. H. H. Nkunya. Although the group never gave a formal presentation to faculty and students at this university, they did describe at length to Prof. Mbise the AERONET system of ground-based sun photometers, and the wealth of material on the Earth's land, water, ice, and atmosphere that are available from NASA satellite resources. The group had plans to visit the Institute of Marine Sciences in Zanzibar the next day. The Deputy Vice-Chancellor made it clear that this institute was in fact part of the University of Dar es Salaam and this visit to his office was a necessary step if NASA wanted to establish a letter agreement or memorandum of understanding with the University of Dar es Salaam.

Tanzania Meteorological Agency

The group's visit to the Tanzania Meteorological Agency was at first somewhat disorganized, as it was not clear

Figure 12. Michael King briefing the Director of Forecasting and Senior Staff of the Tanzania Meteorological Agency on NASA's Earth science observational capabilities, including vegetation, air quality, lightning, and fire monitoring. Photo by Charles Gatebe.

Figure 13. Palace Museum and House of Wonders, the former ceremonial palace for Sultan barghash, Stone Town, Zanzibar. Photo by Michael King.

who they were supposed to meet. As it turns out, they met with P. F. Tibaijuka, Director of Forecasting, and two senior members of his staff. Michael King was most surprised to learn that Tibaijuka was totally unaware that NASA had any Earth observing capability, as he was mostly connected with the World Meteorological Organization who distributed and encouraged the use of NOAA operational satellite data. King gave him an in-depth briefing on NASA's Earth science capability, with special emphasis on Africa. This was an identical presentation to what King had previously shown in large-audience lectures at the University of Nairobi, Kiriti Secondary School, Egerton University, and Western University College of Science and Technology. King demonstrated a wide range of applications: fire monitoring capability, lightning flash frequency, aerosol seasonal and spatial distribution, land-use and land-cover change, surface albedo variability during the wet and dry season, urban growth and expansion, and carbon monoxide seasonality. While King was showing him and his staff this enormous capability, Charles Gatebe went to his computer located just behind them (see **Figure 12**) and brought up NASA's Earth Observatory Web site (*earthobservatory.nasa.gov*) and Rapid Response Web site (*rapidfire.sci.gsfc.nasa.gov*). Tibaijuka was most excited by being able to pull up satellite overpasses from Terra obtained only 3 hours before hand in the nearby Serengeti National Park. He was also most intrigued by the NDVI images of drought near Lake Victoria, and made sure that these web sites were bookmarked on his computer. Although the Tanzania Meteorological Agency did not previously know of NASA's Earth remote sensing capability, they expressed considerable appreciation for this brief education and exposure.

That evening, at their hotel, group members heard music and dancing outside their room on the street below, and looked out from the balcony, only to see two cars driving into their hotel, one with the Commander of the Military of Tanzania, and the second car with the President of the Country. There was a party in an open-air environment next door to the hotel, and group members could look over and see the President of Tanzania throughout dinner. This is quite different than one's experience in the United States with the President of the United States and the Secret Service.

Institute of Marine Sciences, Zanzibar

On March 17 the group visited the Institute of Marine Sciences in Stone Town, Zanzibar, a two-hour ferry ride north from Dar es Salaam (see **Figure 13**). The Institute does marine sciences research, but was most interested in hosting an AERONET sun photometer should a decision be made to locate one in Zanzibar. Now that they have a contact in Malindi, Kenya, however, also located on the Indian Ocean, the deployment of an AERONET sun photometer to this island is unlikely. In general, the Institute of Marine Sciences does *in situ* fisheries and marine research, and has very little experience with remote sensing from satellite or aircraft, but the group shared with them that NASA's remotely sensed satellite data offers the capability to monitor *chlorophyll-a* concentrations and sea surface temperature of the world oceans and water bodies.

Summary and Conclusions

This was a most effective trip to East Africa in many regards, and the group fully expects that NASA will be able to establish numerous new AERONET sites in Kenya, Tanzania, Uganda, and Eritrea. Several sites in Kenya were identified: Malindi (San Marco), Nairobi (Nairobi National Park), and Mbita Point (Lake Victoria, ICIPE). Several other potential sites were eliminated after visiting the areas in person: Ngorongoro Crater and Meru National Park. The trip also resulted in the establishment of many new contacts throughout this region and opens up some new opportunities. Through the contact established at TAWIRI, for example, it is likely that an AERONET site will be established in southern Tanzania at the Selous Complex. Through Brent Holben and Ali Omar's contacts a site at Fort Portal, Uganda (cf. **Figure 1**) will likely be established. During their travels, the group also discovered that there is a direct broadcast receiving station at the

Broglio Space Centre, Malindi that was previously unknown to NASA, and made contacts and worked the feasibility of doing airborne reflectance mapping of Kenya.

Michael King gave presentations on NASA's Earth science capabilities to 700 secondary school children and 3 general audience University-wide lectures. In every one of the University-wide lectures in which King described the global environment and its changes as observed from space, he was asked a direct question about why the U.S. was not a signatory on the Kyoto Protocol and why the U.S. government was not listening to Earth scientists. This is a very delicate international political question that represents the fact that Kenya was taking an active part in supporting this Protocol and participating in the global community's concerns about environmental degradation, and the U.S. intransigence on this important problem was hard for Kenyan's to understand.

Finally, King exposed the Tanzanian Meteorological Agency to the fact that NASA does in fact do Earth remote sensing, otherwise unknown to them. They were most fascinated with the ability to see fires, droughts, and vegetation stress within 1-2 hours of satellite overpass, directly on the computers in their office. All in all, the trip was a highly successful visit for NASA and regional scientists and environmental monitors. Although the group never had a chance to meet with the Vice President of Kenya or Prof. Wangari Maathai, the Nobel Prize Winner is very much aware of NASA's Earth science observations. Her staff was most interested in the fact that Goddard was located in Greenbelt, Maryland, and Prof. Maathai's environmental movement for which she won, in part, the Nobel Peace Prize, is known as the *Green Belt Movement*. ■

Announcement

The Atmospheric Sciences Data Center (ASDC) at NASA Langley Research Center in collaboration with the Clouds and the Earth's Radiant Energy System (CERES) Science Team announces the release of the following data sets:

CER_CRS_Aqua-FM3-MODIS_Beta1
CER_CRS_Aqua-FM4-MODIS_Beta1

The Clouds and Radiative Swath (CRS) product contains one hour of instantaneous CERES data for a single scanner instrument. The CRS contains all of the CERES SSF product data. For each CERES field of view (FOV) on the SSF, the CRS also contains vertical flux profiles evaluated at five levels in the atmosphere: the surface, 500 hPa, 200 hPa, 70 hPa, and the top of atmosphere (TOA). After an initial pass through the radiative transfer model, the input parameters to the model are adjusted and a constrained pass through the model is made for both clear sky and total sky. If the FOV is overcast, clear sky fluxes are still calculated.

File Temporal Coverage: Instantaneous
File Spatial Coverage: CERES FOV
Applicable Studies:
- *In situ* Flux comparison over particular region.
- Flux comparison with radiative transfer model.
- Interpretation of radiation cloud and aerosol property variability.
- Comparison of radiation, aerosol and cloud properties with model other than the general circulation model (GCM) (i.e., LES, CRM).
- Cloud and aerosol radiative forcing estimate or comparison with other estimate.

Information about the CERES products, including products available, documentation, relevant links, sample software, tools for working with the data, etc. can be found at the CERES data table: *eosweb.larc.nasa.gov/PRODOCS/ceres/table_ceres.html*

Preserving Landsat's Legacy

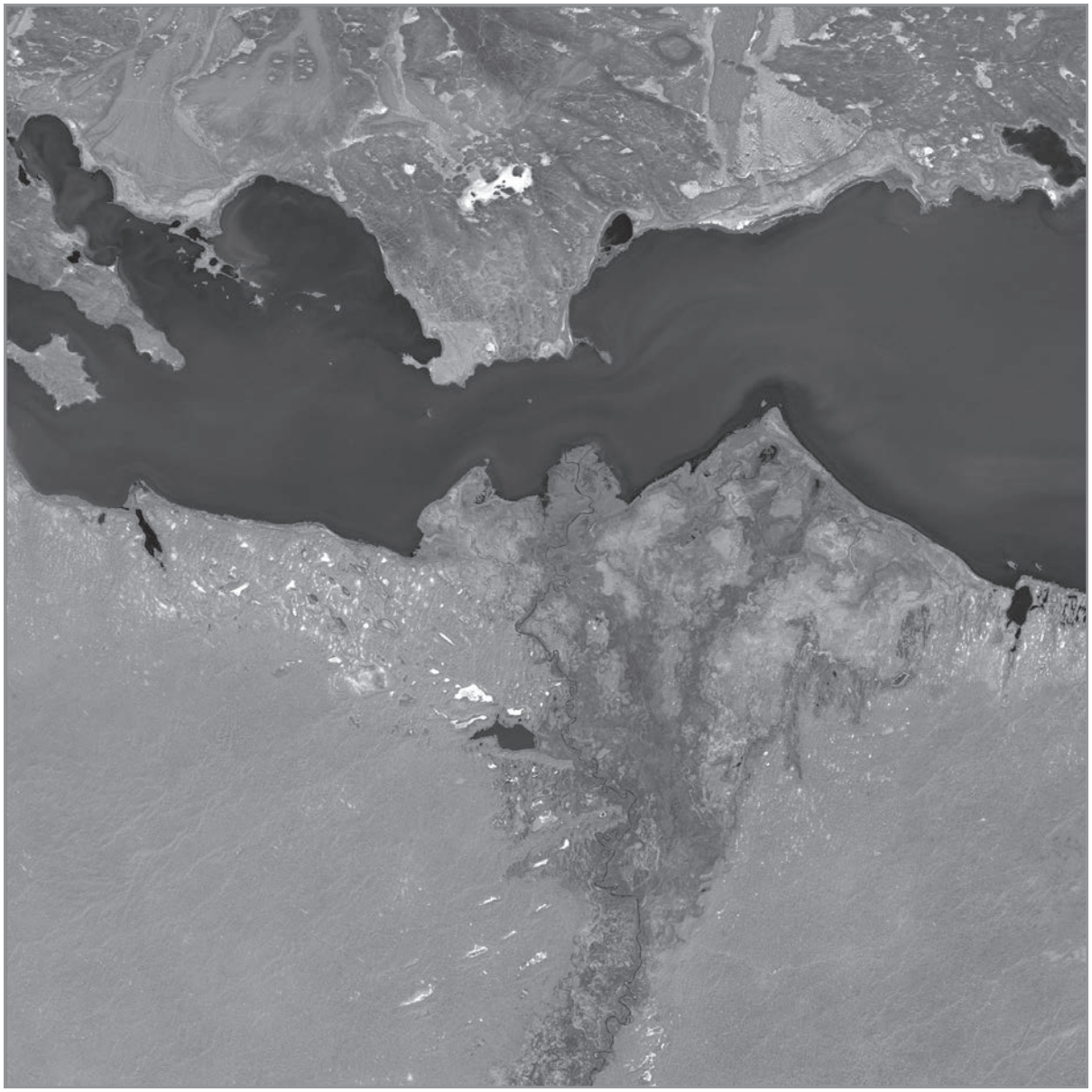
Laura Roccio, lrocchio@ltpmail.gsfc.nasa.gov, NASA Goddard Space Flight Center

Since the Landsat project's inception in 1965, Landsat has stood at the forefront of space-based Earth observation and has been the trailblazer for remote sensing as we know it today. But the forty-year history of Landsat has been tumultuous. The program has been variously administrated by a multitude of government agencies and a private company; consequently, the program documentation has become widely disseminated over the course of the seven Landsat missions.

In an effort to gather Landsat's technical documentation, the NASA Landsat Project Science Office (LPSO) is teaming with the U.S. Geological Survey and the NASA Goddard Space Flight Center Library to create an archive of essential Landsat documentation. The archive, dubbed the *Landsat Legacy*, will house technical-, policy- and science-related documents with an emphasis on internal technical papers. Journal articles and other privately copyrighted materials are outside the scope of the project. It is the project's ultimate goal to have an online freely accessible archive of Landsat documentation that can be used by the general public by late 2006.

In order to gather the forty years worth of documentation, the LPSO is soliciting those who have been involved with the Landsat program for Landsat-related materials that have been stored in personal archives.

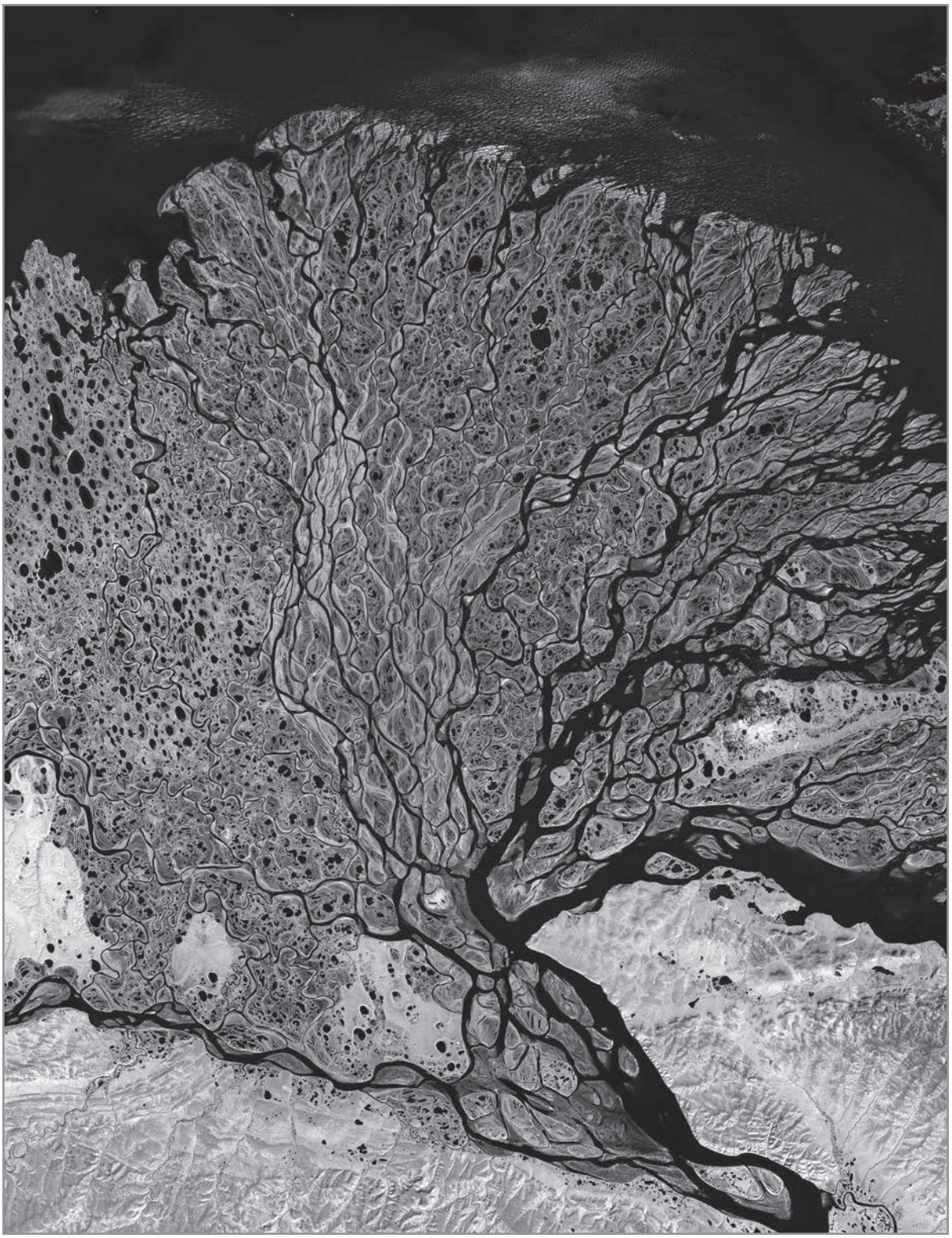
A Landsat 7 image of the Karatal River delta. The Karatal River is a major tributary to Kazakhstan's closed Lake Balkhash. The lake is situated in a tectonically created land depression. The early Landsat missions helped identify many formerly unknown tectonic faults. Image credit: NASA Landsat 7 Team.



The registration process involves entering basic information about these documents into a web-based registration system. The LPSO will review the registration records, select appropriate materials, and subsequently contact potential donors to arrange a method of document submission. Once pertinent documents have been scanned, cataloged and archived, the Landsat Legacy document repository will provide a valuable resource for future generations of Landsat data users.

For more information about the Landsat Legacy project please visit *library.gsfc.nasa.gov/landsat*. ■

This image was acquired by Landsat 7's Enhanced Thematic Mapper plus (ETM+) sensor on February 27, 2000. The Lena River, some 2,800 miles (4,400 km) long, is one of the largest rivers in the world. The Lena Delta Reserve is the most extensive protected wilderness area in Russia. It is an important refuge and breeding ground for many species of Siberian wildlife. Image credit: NASA Landsat 7 Team.



Software Learns to Recognize Spring Thaw

Natalie Godwin, Natalie.Godwin@jpl.nasa.gov, Jet Propulsion Laboratory

Spring thaw in the Northern Hemisphere was monitored by a new set of eyes this year—an Earth-orbiting NASA spacecraft carrying a new version of software trained to recognize and distinguish between snow, ice, and water from space.

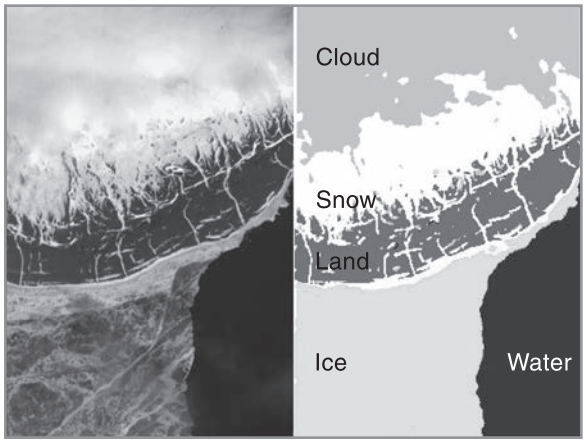
Using this software, the Space Technology 6 Autonomous Sciencecraft Experiment autonomously tracked changes in the cryosphere, the section of Earth that is frozen, and relayed the information and images back to scientists.

The software, developed by engineers at NASA's Jet Propulsion Laboratory, Pasadena, CA, controls the Earth Observing-1 spacecraft. NASA's Goddard Space Flight Center, Greenbelt, MD, manages the satellite. The software has taken more than 1,500 images of frozen lakes in Minnesota, Wisconsin, Quebec, Tibet and the Italian Alps, along with sea ice in Arctic and Antarctic bays.

Other spacecraft only capture images when they receive explicit commands to do so, but for the last year Earth Observing-1 has been making its own decisions. Based on general guidelines from scientists, the spacecraft automatically tracks events such as volcano eruptions, floods and ice formation. The most recent software upgrade allows the spacecraft to accurately recognize cryosphere changes such as ice melting.

Scientists spent several months developing software for Earth Observing-1 to detect changes in snow, water and ice. The new software is capable of learning by itself, and it took only a few hours for scientists to train it to recognize cryosphere changes. In fact, the new software has learned to classify the images so well that scientists plan to use it for the remainder of the mission.

On the left, Resolute Bay seen by the Hyperion instrument aboard Earth Observing-1. On the right, a visual representation of the analysis done by JPL's new software. Credit: NASA/JPL



"This new software is capable of a rudimentary form of learning, much the way a child learns the names of new objects," said Dominic Mazzoni, the JPL computer scientist who developed the software. "Instead of programming the software using a complicated series of commands and mathematical equations, scientists play the role of a teacher, repeatedly showing the computer different images and giving feedback until it has correctly learned to tell them apart."

On Earth Observing-1, the software searches for specific cryospheric events and reprograms the spacecraft to capture additional images of the event.

"The software has exceeded all of our expectations," said Steve Chien, JPL principal investigator for the Autonomous Sciencecraft Experiment. "We have demonstrated that a spacecraft can operate autonomously, and the software has taken literally hundreds of images without ground intervention."

Similar software has been used to distinguish between different types of clouds in images captured by JPL's Multi-angle Imaging SpectroRadiometer, an instrument on NASA's Terra spacecraft. Automatically identifying types of clouds from space will help scientists better understand Earth's global energy balance and predict future climate trends.

Future versions of the software also might be used to track dust storms on Mars, search for ice volcanoes on Jupiter's moon Europa, and monitor activity on Jupiter's volcanically active moon Io. NASA's New Millennium Program developed both the satellite and the software. The program is responsible for testing new technologies in space.

For more information on the Autonomous Sciencecraft Experiment on the Internet, visit: *ase.jpl.nasa.gov*.

For more information on the New Millennium Program on the Internet, visit: *nmp.jpl.nasa.gov*.

For information about the Earth Observing-1 spacecraft on the Internet, visit: *eo1.gsfc.nasa.gov*. ■

NASA Offers a Real-Time 3-D Look at the Inside of Hurricanes

Rob Gutro, rgutro@pop900.gsfc.nasa.gov, NASA Goddard Space Flight Center

Seeing how rain falls from top to bottom and how heavy the rain falls throughout parts of a tropical cyclone is very important to hurricane forecasters. NASA has sped up the process of obtaining the data within three hours, and making it appear in 3-D. The new process now gives information quickly enough for forecasters to use.

Scientists at NASA have developed a way to process radar data from NASA and the Japan Aerospace Exploration Agency's (JAXA) Tropical Rainfall Measuring Mission (TRMM) satellite that can help with forecasting changes in a hurricane's intensity.

"What's important is that the vertical rain structure data used to take a longer time to process," said Jeffrey Halverson, Meteorologist and TRMM Education and Outreach Scientist. With hurricane forecasts, events change quickly, and meteorologists need data as fast as possible. This new process gives them data within three hours from the time the satellite has flown over a tropical cyclone."

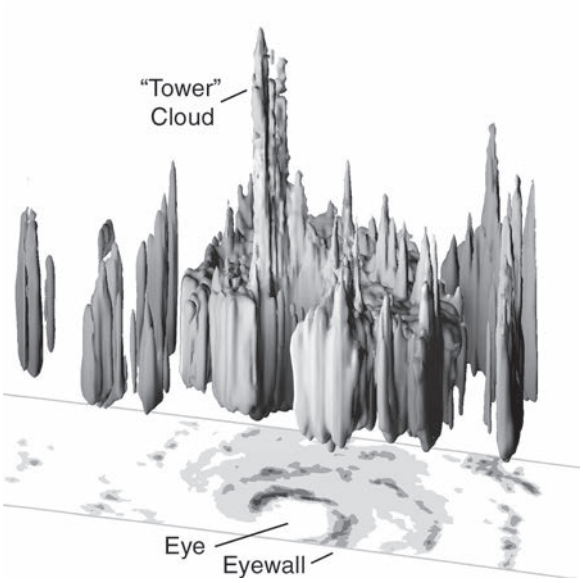
TRMM is a unique satellite that is able to estimate rainfall measurements from space, and rainfall is a key ingredient in hurricanes. The heaviest concentrations of rainfall for example are found around the eye or center of the hurricane. Scientists can tell, based on the intensity of the rain, whether the hurricane is strengthening or weakening.

In 2004, research confirmed that when larger towering clouds reach a certain height surrounding the hurricane's open eye, in what is called the *eye-wall*, they can be associated with a strengthening storm. TRMM can identify these *hot towers* of piled up clouds and can help make forecasts more accurate.

Because the TRMM satellite covers the tropical areas of the entire globe, the Precipitation Radar (PR) instrument takes snapshots of storms as it passes by. Every time it passes over a named tropical cyclone anywhere in the world, the PR will send data to create these 3-D *snapshots* of the storms.

The hurricane snapshot gives forecasters information on how heavy the rain is falling from different parts of the storm, such as the eye-wall versus the outer rainbands, for example. It also gives a 3-D look at the cloud heights and *hot towers* inside the storm. Higher hot towers around the eye usually indicate a strengthening storm.

The snapshot also gives valuable information about how the storm is put together. For example, when scientists see that the body of the hurricane may be tilted inward toward the hot towers, it could give clues as to whether a wind shear, or a sudden change in direction of winds near the top of the storm, may impact the storm's strength. Normally, when a hurricane runs into a strong wind shear, it weakens.



This TRMM Precipitation Radar overflight of Hurricane Bonnie shows an 11 mile high "tower" cloud (or hot tower) perched on the eyewall of the storm. Image credit: NASA TRMM team.

Forecasters and the general public can access the data and look into the eye of a storm by going to the TRMM website at *trmm.gfsc.nasa.gov.*

"We hope this new data product will help the community to better assess the structure and intensity of tropical cyclones," Halverson said. ■

Sensor Web Simulation Investigates Technique to Improve Prediction of Pollution Across the Globe

Gretchen Cook-Anderson, gretchen_cookanderson@ssaihq.com, NASA Goddard Space Flight Center

For asthmatics and for anyone with respiratory problems, air pollution can significantly impair simple everyday activities. NASA is trying to tie together satellites and stations on the ground to develop a *sensor web* to track this pollution and improve air quality forecasts.

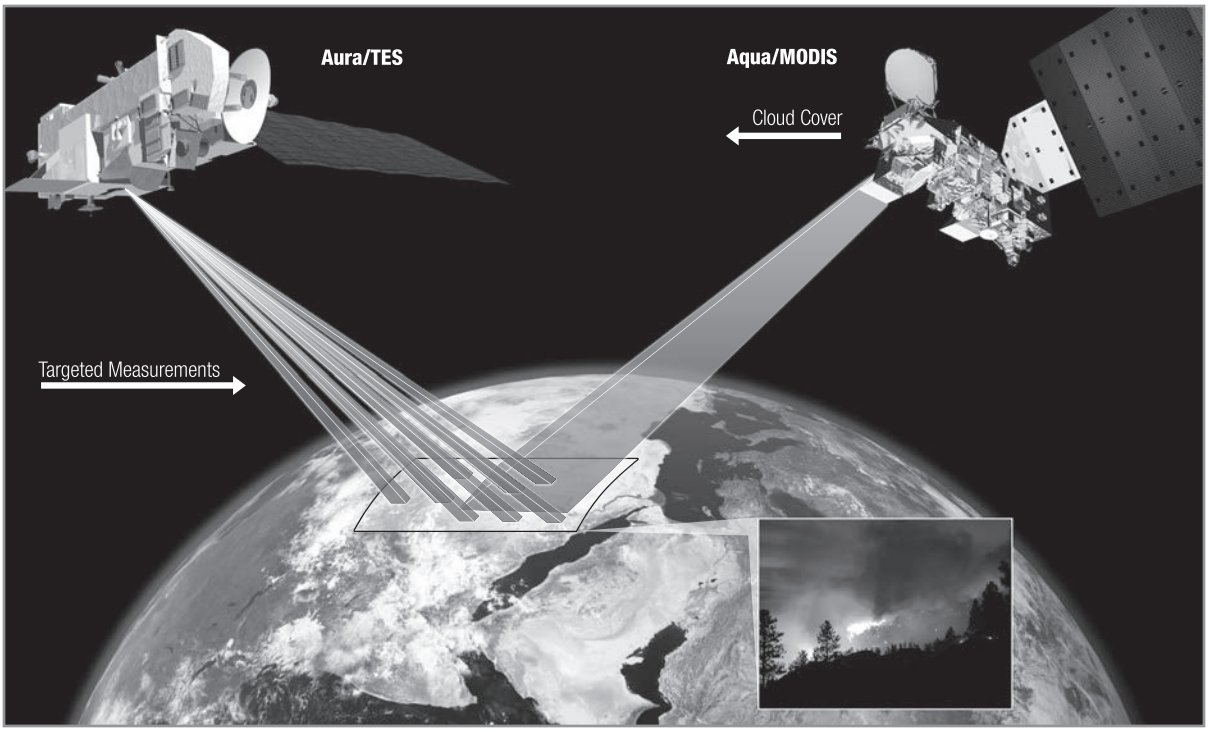
Understanding how tropospheric or near-surface-level ozone is produced, distributed and transported from city to city, region to region and continent to continent is an important step toward improving the complex mathematical computer models used to forecast air pollution. Such models can be used to provide alerts days in advance so that people sensitive to pollutants can modify planned outdoor activities to minimize their exposure.

The troposphere is where we all live, work, play and breathe! It's the region of the atmosphere where our weather occurs and it extends from the Earth's surface to roughly the cruising altitude of a passenger jet - about 40,000 feet. In some cases air pollutants have natural causes such as lightning induced wildfires that can emit large plumes of particulates into the troposphere. Fossil fuel burning in industrial areas and vehicular traffic in metropolitan areas are also major pollutant sources. Complex chemical interactions and atmospheric processes can transport these pollutants across thousands of miles.

To improve our ability to track the transport of pollutants from their various sources to populated cities and towns around the globe, NASA technologists are exploring an innovative technology called the *sensor web*. This interconnected *web of sensors* coordinates observations by spacecraft, airborne instruments and ground-based data-collecting stations. Instead of operating independently, these sensors collect data as a collaborative group, sharing information about an event as it unfolds over time. The sensor web system is able to react by making new, targeted measurements as a volcanic ash plume is transported to air traffic routes, or when smoke of a wildfire is carried aloft, then dispersed over large metropolitan areas. The sensor web has the potential to improve the response time of our observing systems by reconfiguring their sensors to react to variable or short-lived events and then transmit that information to decision makers so that appropriate alerts can be issued to those people living in the impacted areas.

To test the value and benefit of using dynamic sensor web measurement techniques and adaptive observing strategies, NASA technologists have formulated ex-

To test the value and benefit of using dynamic sensor web measurement techniques and adaptive observing strategies, NASA technologists have formulated experiments using instruments on two NASA Earth observing satellites, Aqua and Aura that fly in formation high above Earth. As an example, Aura's Tropospheric Emission Spectrometer (TES) and Aqua's Moderate Resolution Imaging Spectroradiometer (MODIS) work in tandem to make observations of the same targeted area.



periments involving two NASA Earth observing satellites that fly in formation high above Earth—Aura and Aqua, along with sophisticated atmospheric chemistry models that can forecast the global distribution and concentration of one particular pollutant—carbon monoxide (CO).

"The sensor web behaves as a search-and-rescue team," said Principal Investigator Stephen Talabac, lead technologist with the Science Data Systems Branch at NASA's Goddard Space Flight Center, Greenbelt, MD. "Each sensor collects data as part of a team of cooperating sensors. It is able to respond to the needs of the team members. The sensors on one satellite react to data and information sent to it from other sensors on other satellites that have different but complementary capabilities. The sensors then change their observing strategy accordingly, to target and then collect data for a particular event." Talabac offered the analogy of a search-and-rescue team whereby the unique skills of firefighters, police officers, and paramedics are brought together to form and then implement a plan to find and rescue a person in need of help.

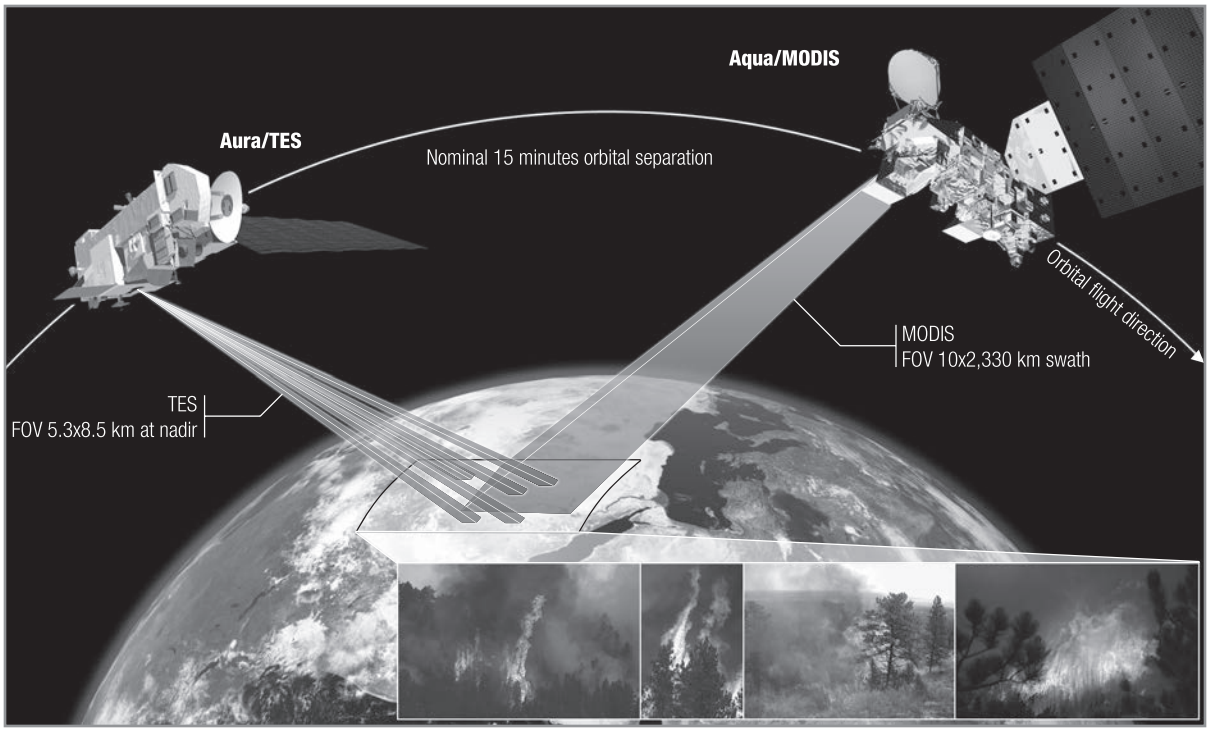
Computer forecast models can also help decide where the sensors should make observations. If a model forecasts high concentrations of CO, the sensor web's instruments can be commanded to make targeted observations of those locations. The actual sensor measurements can then be fed back into the computer model to improve the accuracy of the forecast. Talabac's team hopes to illustrate how such a model-driven sensor web could be used to enhance current measurement techniques, and bring to bear multiple complementary instruments to respond to rapidly changing environmental conditions.

"These simulations fall into the category of *proof of concept*, to assess the feasibility of what is also planned for the next generation observing systems to enable real, full-fledged sensor web measurements," explained Talabac. "We hope to demonstrate that such an approach, or *targeted intelligent data collection techniques*, can bring about more efficient use of our Earth observation satellites and their sensors."

In September 2005, Talabac's team will use an atmospheric chemistry computer model to predict global CO distribution. The team will also make measurements using Aura's Tropospheric Emission Spectrometer (TES), at key locations to improve the model prediction. In the future the team hopes to be able to use their prototype software to recommend regions where the TES instrument could be commanded to look and make real measurements at key locations predicted by the model.

"Our goal here is improve our ability to monitor and assess the Earth's environment," Talabac added. "With the sensor web, policy and decision makers will have access to the most useful and timely information available to help maintain a high quality of life and to potentially save lives." ▬

This image shows Aura and Aqua satellites working as a space-based "search-and-rescue" team to observe forest fires using sensor web experiment measurements.



Volcanic Blast Location Influences Climate Reaction

Mike Bettwy, michael_bettwy@ssaihq.com, Goddard Space Flight Center

When a volcano erupts, it does more than just create an ash cloud that darkens and cools a region for a few days. Instead, the most dramatic effect is actually high above us, where spewed volcanic material is not quickly washed out by rain.

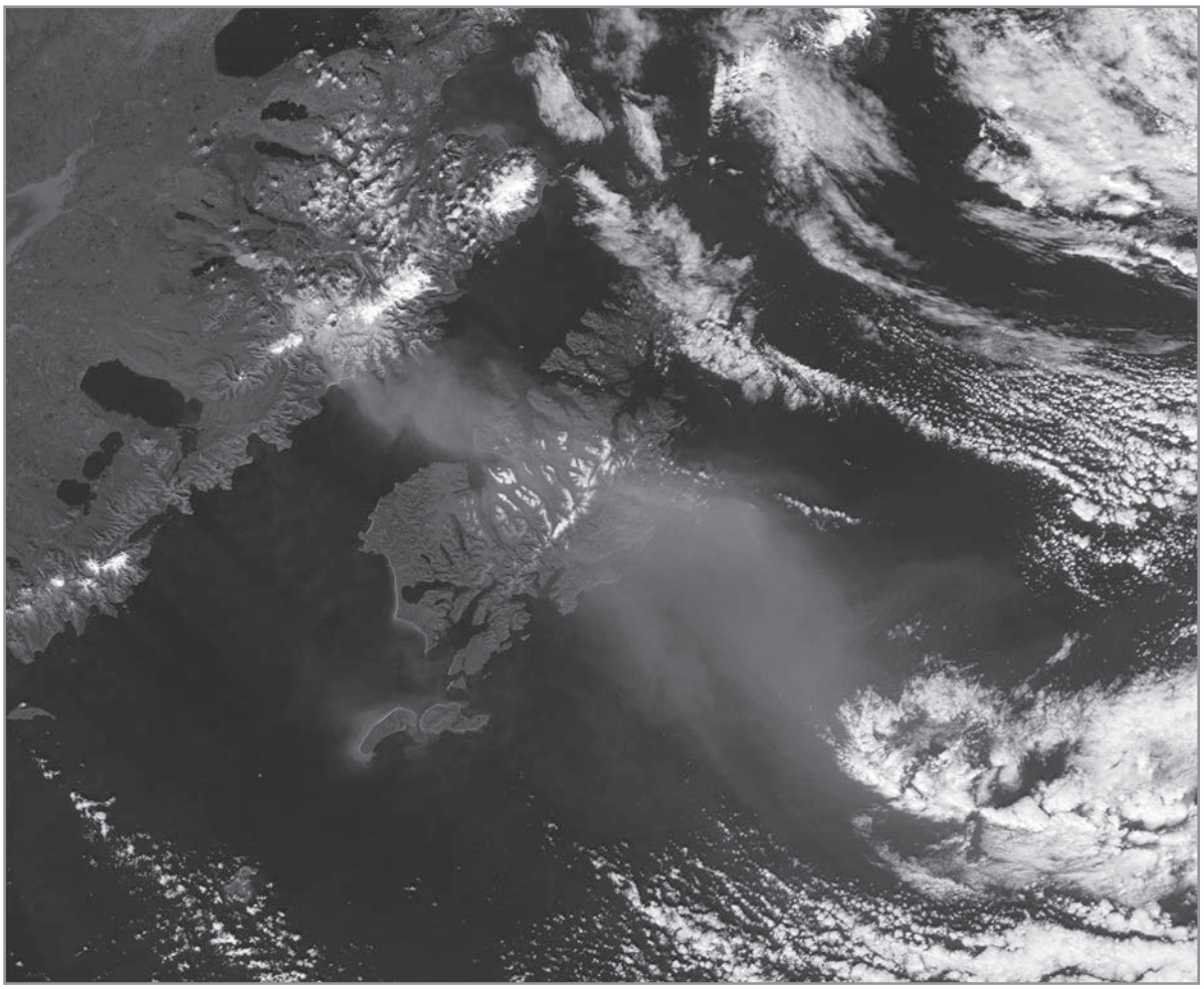
If the volcanic eruption is strong enough it will inject material into the stratosphere, more than 10 miles above the Earth's surface. Here, tiny particles called aerosols form when the volcano's sulfur dioxide combines with water vapor. Despite their size, these aerosols work to alter interactions between the atmosphere and sun, affecting climate patterns.

Now, new research funded by NASA and the National Science Foundation, focusing on the eruption of Mount Katmai, Alaska, in June 1912, shows that location is also important, as major volcanic eruptions far north of the equator affect the world's climate much differently than volcanoes in the tropics.

The Mount Katmai eruption was one of the largest in the world during the 20th century. It actually refers to the eruption of Katmai and the larger explosion of Novarupta, just west, that spewed tons of sulfur dioxide gas into the atmosphere. Novarupta also released an incredible amount of molten rock (magma) that drained under Katmai causing its summit to collapse, forming a massive crater (caldera). The ash fall from the eruption covered an area of more than 3,000 square miles to a depth of a foot or more, while its ash cloud, carried by winds high in the atmosphere, spread a haze as far away as Africa.

"Studying such events will help us be better prepared for the next major eruption while giving scientists clues on the type of climate shifts and changes to expect," said Luke Oman, a researcher at Rutgers University's Department of Environmental Sciences, New Brunswick, N.J., and lead author of the study

This image captured by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite on September 21, 2003, shows a cloud of volcanic ash over Kodiak Island, Alaska, created by strong winds that picked up old, loose volcanic ash. Credit: NASA GSFC



that appeared in the July 2005 issue of the *Journal of Geophysical Research—Atmospheres*.

By using one of the most modern General Circulation computer climate Models (GCMs) at NASA's Goddard Institute for Space Studies (GISS), New York, N.Y., the researchers studied the Mount Katmai volcanic eruption. They made a computer simulation of Katmai's eruption and an eruption three times as large to study their climate impacts.

Unlike earlier studies on volcanic eruptions in the tropics, this research did not show a change in an important climate pattern called the "Arctic Oscillation" (AO) following the Mount Katmai eruption.

AO is a climate pattern defined by winds circulating counterclockwise around the Arctic at about 55°N latitude (about even with Moscow). The air can spin more slowly and spill cold air down toward the equator into the mid-latitudes, or it can spin faster and keep the cold up north.

"Large tropical volcanic eruptions tend to spread aerosols around the globe, but with high-latitude eruptions like Katmai, they remain north of 30°N latitude, where they are heated less efficiently by outgoing, or longwave radiation," said Oman. "As a result, the lower stratosphere does not warm enough to influence the AO."

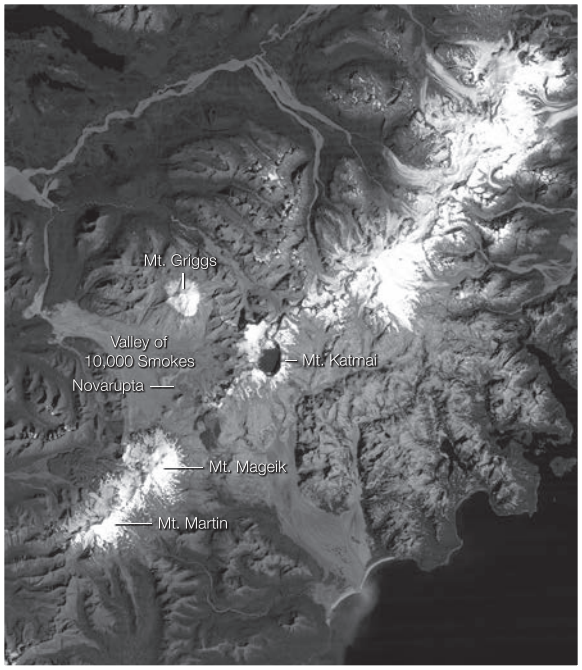
Eruptions in the tropics, like Mount Pinatubo in 1991, create aerosols that block heat from the sun in the lower atmosphere, or troposphere, cooling temperatures in the subtropics. In turn, the reduced north to south temperature gradient results in a "positive" phase of the AO, with generally warmer winters over the Northern Hemisphere.

"In our research, although the Mount Katmai eruption was found to have some role in the winter climate, including distinct cooling in southern Asia, the most significant climate effect was during the summer when strong cooling over the Northern Hemisphere landmasses caused a decrease in the Asian monsoon circulation," said Oman.

Normally, northern India experiences large amounts of cloudiness and rain due to the summer monsoon, the seasonal shift in winds that develops out of the temperature contrast between the Indian Ocean and Asia. But the eruption worked to lessen this gradient, weakening the monsoon, bringing reduced cloudiness, warmer temperatures and less precipitation across northern India west into the Persian Gulf.

"This study not only offers further evidence that the location and intensity of an eruption largely determine the Earth's overall climatic response, it also helps us see how well our computer models perform," said co-author Gavin Schmidt of NASA GISS.

To verify our knowledge about the effects of volcanoes, researchers often investigate historic intense eruptions that brought major climate swings, like the Laki, Iceland eruption of 1783 that dimmed and reddened the sun while resulting in a very warm summer in Europe and one of the coldest winters on record for the Northeast United States and Europe in 1783-1784. Using a variety of techniques, including the measurement of acid fallout over polar areas from ice cores and analyzing annual growth rings in trees, researchers can confirm first hand the impact of such ancient eruptions. ■



The Katmai National Park and Preserve is located in mainland Alaska where the Alaska Peninsula first begins to reach southwestward into the Bering Sea. Very little was known about this area, at least to European people, as recently as a hundred years ago, but on June 6, 1912, the region entered the record books as it gave rise to the century's largest volcanic eruption in North America. So poorly known was the area, however, that it was unclear at first which of the many volcanic peaks in the area had erupted. Scientists studying ash flow and deposit patterns were able to determine the "King of Volcanoes" had been Novarupta, not Mount Katmai as people had assumed at first.

This satellite image shows the Valley of 10,000 Smokes region of the park and the surrounding volcanoes. The valley's name came from the writings of a National Geographic Explorer, Robert Griggs, who visited the area in the years following the eruption. From his perspective on a nearby mountain (named for him), he surveyed the ash-filled valley stretching out below and described thousands of smoking fissures etching the ash field. Today, only a small circular dome marks the origin of the eruption from the Novarupta crater. But the remains of the record-breaking ash fall are still visible across the valley floor. So rich is the area in peaks that many have some unassuming names as "Unnamed 2," "Volcano 1," and "Cone 3110."

The Novarupta eruption lasted for two days, and it perturbed weather patterns throughout the world. A foot of ash or more covered as much as three thousand square miles, and nearly ten times that area received at least an inch of ashfall. The mean temperature in the last six months of 1912 in the northern hemisphere was lowered by the reflective dust ejected up by the eruption. Recently, NASA and the National Science Foundation funded a group of scientists to study the effect of the 1912 eruption and others on global climate patterns.

Using a model developed by the Goddard Institute for Space Studies, *www.giss.nasa.gov*, the scientists concluded that eruptions of high-latitude volcanoes don't influence climate through the same processes as eruptions of tropical volcanoes, such as Mt. Pinatubo in 1991. To read the press release, visit the Website of Goddard Institute for Space Studies at *www.giss.nasa.gov*.

The Thematic Mapper Plus (TM) instrument on Landsat 5 acquired this scene on September 3, 1994. NASA image created by Jesse Allen, Earth Observatory, using data obtained from the University of Maryland's Global Land Cover Facility.

NASA Science Mission Directorate – Earth Science Education Update

Ming-Ying Wei, mwei@hq.nasa.gov, NASA Headquarters
Theresa Schwerin, theresa_schwerin@strategies.org, IGES

2004 NASA Explorer Institutes Report Summary Online

NASA Explorer Institutes (NEI) is a new national program for science centers, museums, planetariums, libraries, parks, aquaria, nature centers, botanical gardens, youth groups and community-based organizations. The report contains summary information and conclusions from the pilot workshops, focus groups and the NEI Planning and Evaluation Conference, which united representatives of the workshops, focus groups and NASA education. URL: *education.nasa.gov/divisions/informal/overview/F_Explorer_Institutes_ Report.html*

GLOBE Plans for the Next Generation

The GLOBE Program Office in Boulder, CO, working closely with its funding agencies and the worldwide GLOBE community, has released a *white paper* on the evolution and next steps of the GLOBE program, a plan described as the Next Generation GLOBE (NGG). NGG is being formally introduced at the 2005 GLOBE Annual Conference, July 31-August 5, in Prague, by the Director as well as by representatives from NASA and National Science Foundation (NSF). NGG should be fully functional by the 2006 GLOBE Annual Conference.

GLOBE is an international science and education program based at the University Corporation for Atmospheric Research (UCAR) and funded by NASA and NSF.

For more information on NGG visit *globe.gov/fsl/html/templ.cgi?ngg_ jun2005&lang=en&nav=1*.

NASA Earth Explorers

A NASA-funded research team that includes high school and post secondary students is studying the potential benefits of green roofs on high-rises, skyscrapers and other buildings. Could plant-covered roofs be the answer to our environmental and economic problems? Look for NASA Earth Explorers at *www.nasa.gov/home* (click on For Educators or For Students, and look for *Meet This Month's NASA Earth Explorer!* or find an article under *Educational Features*). Versions of the article appearing in the For Students K-4 and For Students 5-8 sections are specially written for those grade levels. To access the full collection of Earth Explorers articles, go to *science.hq.nasa.gov/education/earth_explorers/*. An index of articles by topic, maintained by the Institute for Global Environmental Strategies, can be found at *strategies.org/EarthExplorers/EEIndex.htm*.

PicturePosts: Using Cameras to See Change at Local Parks

Many of us don't realize just how much our landscape changes every day. The Friends of Menotomy Rocks Park (*www.friendsofmenotomy.org*, Arlington, MA) and Friends of Fresh Pond Reservation (*www.friendsoffreshpond.org/index.htm*, Cambridge, MA) have created a system to help see and measure changes in local parks. They have installed two *PicturePosts* in each park that help visitors take pictures of the landscape when they visit.

The accumulated sequences of pictures will be used to document the encroachment of invasive species, and to see growth and natural changes of plants. The pictures will also be shared with scientists using satellite imagery to monitor landcover change over regional, national, and global scales, and be used by local classrooms prior to or after visits to the parks.

So what is a *PicturePost*? It is a secure post anchored in the ground, with a round disk and an octagonal plate attached to the top. It allows a digital camera to rest on a steady surface with the back edge of the camera supported by one edge of the octagon. Each post has specific information inscribed on it, so with the click of the camera, the location of the set of images is automatically marked. To see the pictures and time-lapse movies that have been collected so far of Menotomy Rocks Park and Fresh Pond Reservation, go to *www.picturepost.smugmug.com*.

This project has been the result of a number of participating groups and projects. The beginning discussions started through a NASA-funded education grant at the Museum of Science in Boston, entitled *Measuring Vegetation Health*. For more information, see *www.picturepost.smugmug.com/gallery/635128* or contact John Pickle at *jpickle@mos.org*.

NASA Earth Science Education Roadmap Update

Presentations from the 2005 community meeting in Orlando are now available on the roadmap website at *eo.ucar.edu/roadmap*, along with those previously posted from the November 2004 community meetings at Asilomar.

Work continues on revision of the NASA Earth science education roadmap in response to community comments following the May 2005 meeting in Orlando. The plan is to place the Earth science education roadmap document online for community comment in late August/early September before making final revisions and submitting to NASA at the end of September. The document will be available at *eo.ucar.edu/roadmap*.

The roadmap will be a 10-year plan that guides the NASA Earth science education program and ensures that future generations of Earth explorers have the knowledge and ability required to understand and protect our home planet and contribute to NASA's Vision for Space Exploration.

The Earth science education roadmap process is being led by a steering committee chaired by Roberta Johnson, University Corporation for Atmospheric Research. NASA leadership for the Earth science education roadmap is provided by Ming-Ying Wei, Program Manager, Earth Science Education, and Paula Coble, Program Scientist, Earth Science Education.

Adopt-A-Scientist Pilot E-Mentoring Project

Mentors are sought for a pilot e-mentoring program being developed at the American Institute of Physics that will allow high school physics students to conduct e-mail interviews with scientists to gain an understanding of the opportunities available through science. The goal is to entice more young people to consider the sciences as a potential career choice.

Scientists will be provided with a list of questions in advance to allow them to prepare answers, reducing the time required for each e-mail interview. Each scientist will be asked as many questions as they are willing to answer. The expected time commitment is only a couple of hours for the entire fall term.

A small group of students will interview the scientist, then report back to the class on what they learned. Each group will be interviewing a scientist from a different category, so the class will receive a broad description of what it means to be a scientist and realize the variety of options available.

For more information, contact AIP at (301) 209-3690 or e-mail *education@aip.org*.

DLESE Ambassador Program Fall Training

The Digital Library for Earth System Education (DLESE) Community Services will conduct training workshops for new DLESE K-12 Ambassadors at each National Science Teachers Association (NSTA) regional convention this fall. Specifically, they will be held on the Saturday afternoons of October 22 in Hartford, CT; November 12 in Chicago, IL; and December 3 in Nashville, TN. The workshops will prepare selected teachers for outreach efforts in their states. Each teacher who undergoes the training agrees to make at least one presentation a year for the next two years at conferences and workshops in their state. If you or a teacher you know would like more information about becoming an Ambassador in your state, please contact Bryan Aivazian at *bryana@trib.com*.

DLESE is a community effort involving educators, students, and scientists working together to improve the quality, quantity, and efficiency of teaching and learning about the Earth system at all levels. For more information on DLESE, visit *www.dlese.org*.

New National Center for Space, Earth, and Flight Sciences Education

As of June 1, 2005, a new National Center for Space, Earth, and Flight Sciences Education (NCSEFSE) began overseeing all programs previously under the Department of Space Science Education and Research (SSER) at Challenger Center for Space Science Education, and gained responsibility for growing a suite of new national programs. NCSEFSE is the newest national facility operated by the Universities Space Research Association (USRA). All transferred programs will continue at the new national center without interruption and the levels of support will remain unchanged.

For more information, contact NCSEFSE c/o USRA, 1101 17th Street, NW, Suite 1004, Washington, DC 20036; tel.: (202) 689-1295; Fax: (202) 689-1297, e-mail: *ncsefse@usra.edu.*

EOS Scientists in the News

Rob Gutro, rgutro@pop900.gsfc.nasa.gov, NASA Earth Science News Team

Sea Ice May Be on Increase in the Antarctic: A Phenomenon Due to a Lot of "Hot Air?", August 16; *PhysOrg.com, Terra Daily*. A new NASA-funded study, conducted by **Thorsten Markus** (NASA GSFC), **Dylan Powell** (University of Maryland-Baltimore County), and **Achim Stossel** (Texas A&M University) discovered that predicted increases in precipitation due to warmer air temperatures from greenhouse gas emissions may actually increase sea ice volume in the Antarctic's Southern Ocean.

NASA Scientists Closer to Timely Space Weather Forecasts, August 16; *SpaceRef.com, PR Newswire, Forbes, American Chronicle*. NASA research by **Karel Schrijver**, **Marc DeRosa** (both Lockheed ATC), and **Dick Fisher** (NASA HQ) is making big strides in learning how to forecast "all clear" periods when severe space weather is unlikely. Such forecasts are important because radiation from particles from the sun associated with large solar flares can be hazardous to unprotected astronauts, airplane occupants and satellites.

Weather Turns Cooler but Stormy, August 15; *KABC News Radio, 790 AM, Los Angeles*. **Bill Patzert** (NASA JPL) is interviewed about the recent cooler, but more volatile weather.

Volcanic Blast Location Influences Climate Reaction, August 11. *Innovations Report, I-Newswire, RedNova.com*. New research funded by NASA and NSF, led by **Gavin Schmidt** (NASA GISS), **Reto Ruedy** (NASA GISS), **Luke Oman** (Rutgers University), Alan Robock (Rutgers University), and **Georgiy Stenchikov** (Rutgers University), shows that major volcanic eruptions far north of the equator affect the world's climate much differently than volcanoes in the tropics.

Dryden Aircraft Part of NOAA Hurricane Study, August 9; *Los Angeles Daily News*. NASA's ER-2 flew over Hurricane Emily during NASA's Tropical Cloud Systems and Processes (TCSP) research mission. Includes quotes from NASA ER-2 pilot **David Wright** (NASA Dryden) and research meteorologist **Jeff Halverson** (NASA GSFC).

Severe Weather Pattern Takes Toll, August 8; *Los Angeles Times*. **Bill Patzert** (NASA JPL) is interviewed for an article discussing recent storms unique to desert and mountain regions in California.

Atlantic Hurricane Forecast Revised, August 3; *KABC News Radio, 790 AM, Los Angeles*. **Bill Patzert** (NASA JPL) is interviewed about the revised forecast for 2005 Atlantic hurricane activity.

Southern California Spared Warm Coastal Winds, July 27; *Pasadena Star News*. **Bill Patzert** (NASA JPL) is quoted in a story discussing the factors related to California's climate. The story included a Pacific TOPEX/Poseidon image from November 1997 and the most recent Pacific Jason image from July 2005 to illustrate the contrast between an El Niño and present ocean conditions.

What's Behind the Heat / Tropical Heat Wave Hits L.A. / Western Heat Wave / Southern California Heat Wave, July 26; *KPCC Radio, 89.3 FM*. July 22; *Los Angeles Daily News, Los Angeles*. July 20; *ABC News*. July 19; *KABC News Radio, 790 AM*. **Bill Patzert** (NASA JPL) is interviewed about the prolonged heat wave across the West, including much of California. The ABC World News Tonight segment was with Peter Ember.

Experts Say There is Enough Water - For Now, July 24; *North County Times*. **Bill Patzert** (NASA JPL) is interviewed in a story dealing with the history of California's water supply.

Ocean Warming Harms Wildlife, July 23; *San Jose Mercury News*. **Bill Patzert** (NASA JPL) discusses why scientists are still unsure about the causes behind the declines in ocean life, but that warmer sea temperatures may to blame.

"Satellites & the City": NASA Scientists Encourage Satellite Observations to Improve Our Understanding of Urban Effects on Climate and Weather, July 21; *PhysOrg.com, WorldChanging.com*. A new study, led by **J. Marshall Shepherd** (NASA GSFC) and **Menglin Jin** (University of Maryland-College Park), suggest that satellite-observed urban information is extremely useful for advancing our ability to simulate urban effects in climate models, and that satellite data is the only feasible way to represent the expanse of global urban surfaces and related changes to the Earth's surface, vegetation and aerosols.

Field Tests Unite Weather and Climate Models, July 20; *The Washington Times, Business Week magazine, Japan Herald, Supercomputing Online*. Researchers from NASA

including **Arlindo daSilva** (NASA GSFC) and several other government and academic institutions have created four new supercomputer simulations that for the first time combine their mathematical computer models of the atmosphere, ocean, land surface and sea ice.

Methane's Impacts on Climate Change May Be Twice Previous Estimates, July 18; *Science Daily, Space Daily, PhysOrg.com, I-Newswire*. To better predict our future climate, a study by **Drew Shindell** (NASA GSFC) suggests scientists need to examine greenhouse gases, especially methane, when they are emitted at Earth's surface, instead of looking at them after they have been mixed into the atmosphere.

NASA Satellites Measure and Monitor Sea Level, July 7; *The Washington Post, Kansas City Star, Yahoo! News*. New satellite measurements are allowing scientists to better predict the rate at which sea level is rising and the cause of that rise, shows research by **Waleed Abdalati** (NASA HQ), **Steve Nerem** (University of Colorado), and **Eric Rignot** (NASA JPL).

Winner of Rainfall Prediction Contest Sees a Wet Future, July 6; *San Diego Union Tribune*. A panel of meteorologists, including **Bill Patzert** (NASA JPL) issue rainfall predictions for the rainy season.

NASA Offers A Real-Time 3-D Look At The Inside Of Hurricanes, July 5; *World Scientist, Science Daily, Terra Daily*. Seeing how rain falls from top to bottom and how heavy the rain falls throughout parts of a tropical cyclone is very important to hurricane forecasters, and NASA has sped up the process of getting this data within three hours, while making it appear in 3-D, says **Jeff Halverson** (NASA GSFC).

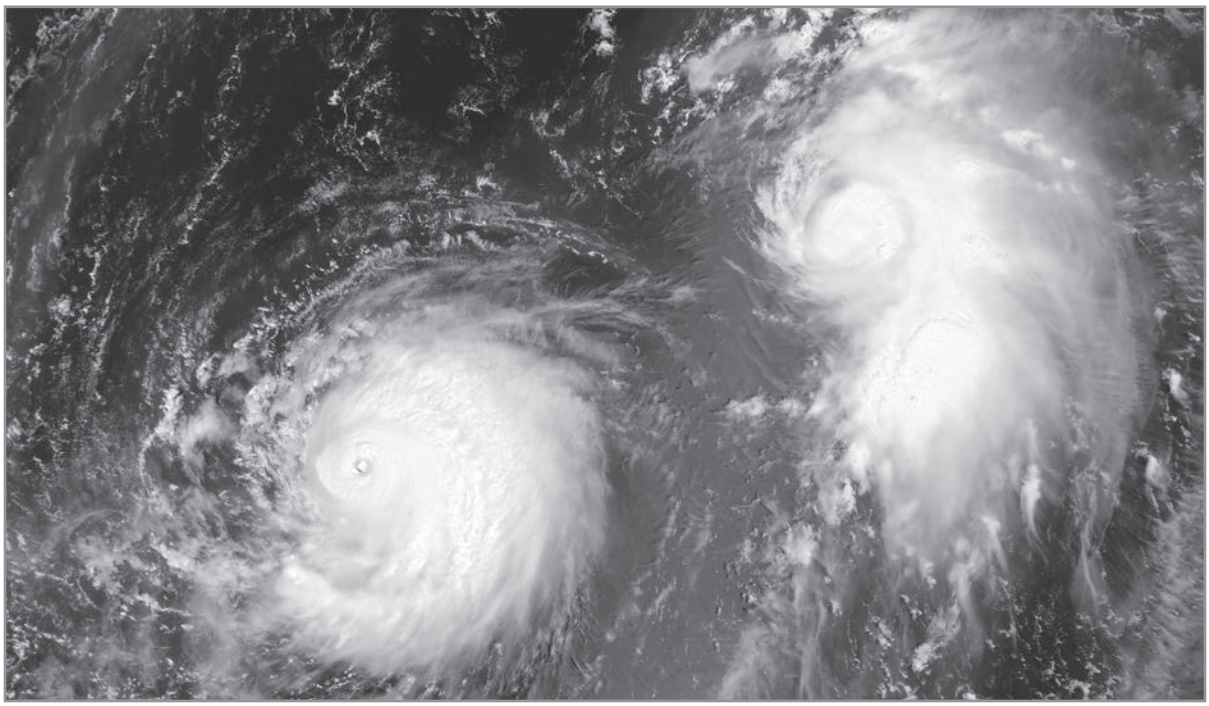
Scientists Hope NASA's ER-2 Will Offer Hurricane Insight, July 4; *Space News*. **Ramesh Kakar** (NASA HQ) and **Robert Rogers** (NOAA Hurricane Research Division) discuss a hurricane field study by flying over tropical air waves and disorganized clusters of thunderstorms using instruments similar to those on existing satellites, using NASA's ER-2.

Rain Eases Drought for Now, July 1; *Riverside Press-Enterprise*. **Bill Patzert** (NASA JPL) discusses how recent rains have relieved the recent drought, at least temporarily.

Sensor Web Simulation Investigates Technique to Improve Prediction of Pollution Across the Globe, July 1; *Science Daily, Terra Daily*. To improve our ability to track the transport of pollutants from their various sources to populated cities and towns around the globe, NASA technologists, including **Stephen Talabac** (NASA GSFC), are exploring an innovative technology called "sensor web."

Interested in getting your research out to the general public, educators and the scientific community? Please contact Rob Gutro on NASA's Earth-Sun Science News Team at Robert.J.Gutro.1@gsfc.nasa.gov and let him know of your upcoming journal articles, new satellite images or conference presentations that you think the average person would be interested in learning about. ■

Typhoon Mawar (left) is posing photogenically with Tropical Cyclone Guchol in this satellite image. Both storms are far out in the northwestern Pacific Ocean, some 900 kilometers from Tokyo. They are traveling in parallel with each other, both headed roughly northwest at comparable speeds. Mawar is expected to strike mainland Japan, whereas Guchol will not. The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite captured this image at 10:10 a.m. local time, on August 22, 2005. NASA image courtesy Jeff Schmaltz, MODIS Land Rapid Response Team at NASA GSFC.



▼ Resembling a work of modern art, variegated green crop circles cover what was once shortgrass prairie in southwestern Kansas. The most common crops in this region—Finney County—are corn, wheat, and sorghum. Each of these crops was at a different point of development when the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) captured this image on June 24, 2001, accounting for the varying darker shades. Healthy, growing crops are gray. Corn would be growing into leafy stalks by late June. Sorghum, which resembles corn, grows more slowly and would be much smaller and therefore, possibly paler. Fields that have been recently harvested and plowed under or lie fallow for the year appear lighter.

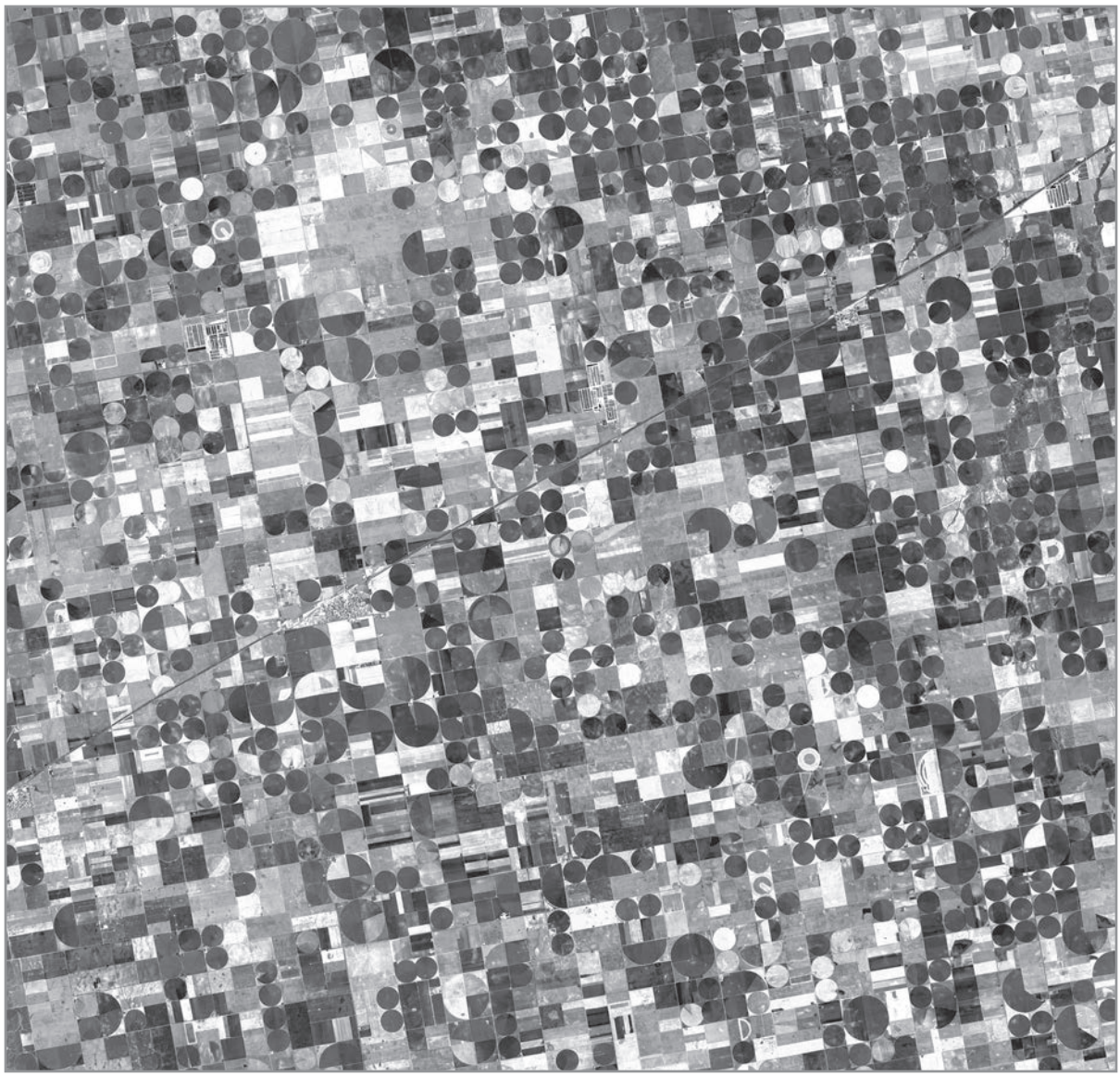
Like crops throughout large sections of the U.S. Midwest, these crops are partly fed by water from the Ogallala Aquifer, a giant layer of underground water. One of the largest underground repositories in the world, the Ogallala Aquifer lies under about 450,000 square kilometers of the Great Plains—an area that includes parts of eight U.S. states. The water is between 30 and 100 meters below ground, and the amount of water in the aquifer varies greatly from region to region.

Though the aquifer is a reliable source of water for irrigated cropland, there are some concerns that it could eventually run dry. Most of the water in the aquifer is "fossil water" from the last ice age. The rivers and streams that initially fed the aquifer have long since disappeared in the geologic development of the West after the last ice age. Water now takes a long time to trickle down through the soil to recharge the aquifer, though the rate varies from region to region. Like a bank account, if more water is taken from this underground bank than is deposited into it, it could run dry. For this reason, efforts are being made to conserve the water of the Ogallala Aquifer.

One conservation measure is using water more wisely so less is drawn out of the aquifer. Farmers in this region have adopted a more efficient irrigation method, central pivot irrigation. Central pivot irrigation draws water out of a single well in the center of the field. Long pipes perched on wheels rotate around the pivot, showering the crops with water. Because the water falls directly on the crops instead of being shot into the air as occurs with traditional sprinklers, less water is lost to evaporation and more goes to nourishing the growing plants. Central pivot irrigation also creates perfectly circular fields, as seen in this image. The fields shown here are 800 and 1,600 meters (0.5 and 1 mile) in diameter.

The large image is centered near 37.4°N latitude, 100.9°W longitude, and covers an area of 37.2 x 38.8 km.

NASA/GSFC/METI/ERSDAC/JAROS, and U.S./Japan ASTER Science Team



Announcement

ESIP Federation Elects New Leadership

San Diego, California, June 27, 2005—The Federation of Earth Science Information Partners ("Federation") elected a new slate of officers at its annual meeting in San Diego, California. The new officers will serve through the next summer conference in 2006.

The Federation's President, Thomas Yunck of NASA's Jet Propulsion Laboratory, was elected to a second term. He outlined his vision for the coming year, speaking of the Federation's evolution and the 10-year journey from its conception in the National Research Council, to its prototype at NASA, to its full operation with diverse backing from NASA, NOAA, USGS and EPA. He highlighted many exciting new developments, including the Federation's work with ESRI on the Earth Information Exchange portal. Yunck stated, "The Earth Information Exchange will provide operational data services, decision support tools, educational materials and an advanced science research environment." He added, "This initiative represents the pulling together of vast public, academic and private resources and makes them available through a single gateway. This will be a defining year for the Federation in which it becomes a premier information source for Earth science and environmental decision making."

New officers include:
President, Thomas Yunck, Jet Propulsion Lab
Vice President, Tamara Ledley, TERC
Type I Representative, Bruce Barkstrom, NASA Langley Research Center
Type II Representative, Michael Goodman, NASA Marshall Space Flight Center
Type III Representative, Bruce Caron, The New Media Studio

Committees:
Chair of Finance and Appropriations, Chuck Hutchinson, University of Arizona
Chair of Partnership, Howard Burrows, Autonomous Undersea Systems Institute
Chair of Constitution and Bylaws, Patricia Reiff, Rice University
Chair of Commercial Development, Hung Pham, RITI
Vice Chair of Commercial Development, Dave Jones, StormCenter Communications
Chair of Community Engagement, LuAnn Dahlman, TERC
Vice Chair of Community Engagement, Danny Hardin, University of Alabama in Huntsville
Chair of Education, Alan Gould, University of California, Berkeley's Lawrence Hall of Science
Vice Chair of Education, Margaret Mooney, University of Wisconsin
Chair of Information Technology and Interoperability, Karl Benedict, University of New Mexico
Vice Chair of Information Technology and Interoperability, Tommy Jasmin, University of Wisconsin
Chair of Products and Services, Rob Raskin, Jet Propulsion Lab
Vice Chair of Products and Services, Mohan Ramamurthy, Unidata

All officers and committee chairs will serve one-year terms on the Federation's Executive Committee. They will be involved in policy development and planning for the Federation.

The Federation is a consortium of Earth science data centers, scientists, technologists, educators, and applications developers. The Federation promotes increased accessibility, interoperability and usability for Earth science data and derivative products. Initiated by NASA in 1997, the Federation provides data, products and services to decision makers and researchers in public and private settings.

EOS Science Calendar

September 20-23
Aura Science Team Meeting, Greenbelt, Md. Contact: Anne Douglass, *Anne.R.Douglass@nasa.gov*

September 27-29
AIRS Science Team Meeting, Greenbelt, MD. Contact: Angela Smythe, *angela.smythe@jpl.nasa.gov*. URL: *airs.jpl.nasa.gov*.

October 3-7
International EOS/NPP Direct Broadcast Meeting, Benevento, Italy. Contact: *dbmeeting@backserv.gsfc.nasa.gov*

October 13-14
GRACE Science Team Meeting, Austin, TX. Contact: Srinivas Bettadpur, *srinivas@csr.utexas.edu*. URL: *www.csr.utexas.edu/grace/GSTM*

November 1-3
CERES Science Team Meeting, Hampton, VA. Contact: Sashi Gupta, *S.K.Gupta@larc.nasa.gov*.

November 7-11
Aura Validation Workshop, Netherlands. Contact: Anne Douglass, *Anne.R.Douglass@nasa.gov*.

Global Change Calendar

September 19-22
Sensors, Systems, and Next-Generation Satellites XI (RS03), Bruges, Belgium. URL: *spie.org/conferences/calls/05/ers/*

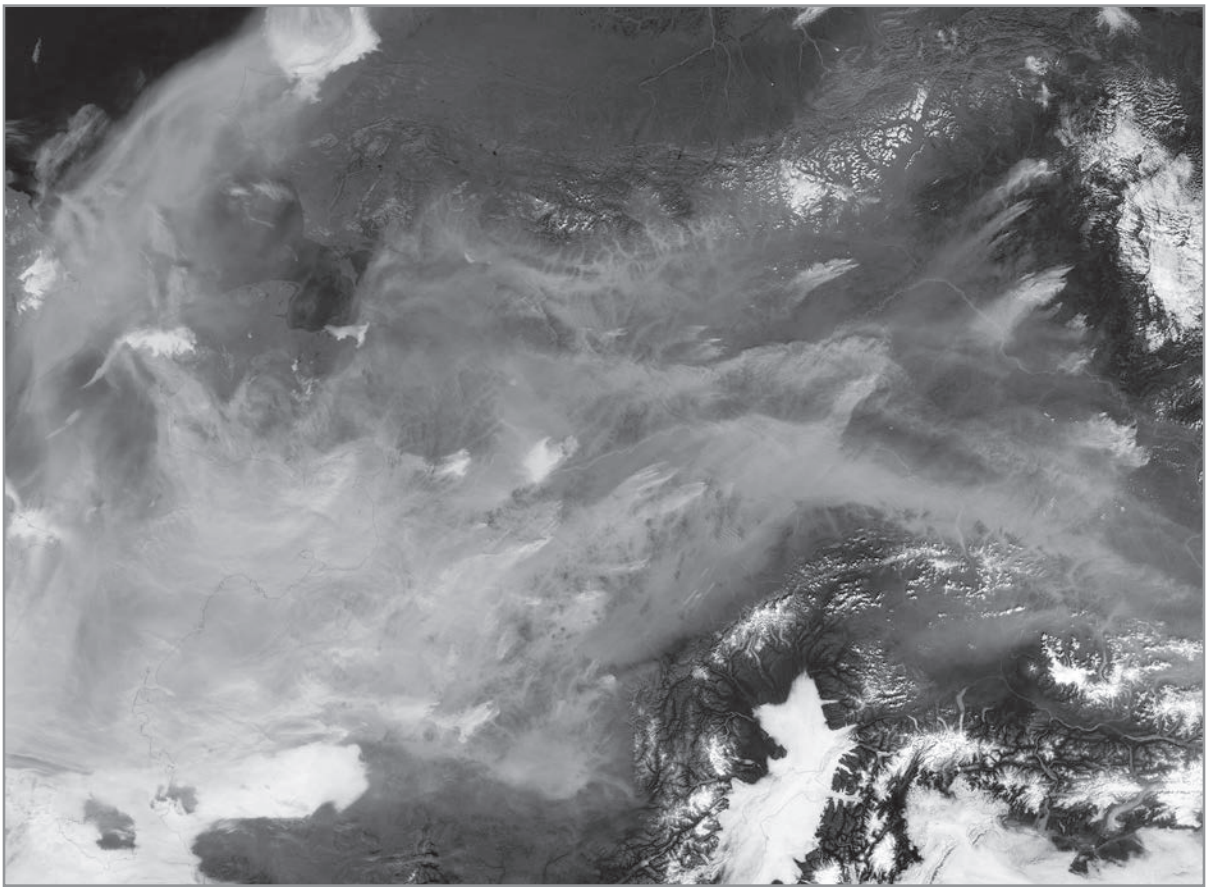
December 5-9
American Geophysical Union (AGU) Fall Meeting, San Francisco, CA. URL: www.agu.org/meetings/fm05/

January 29-February 2
American Meteorological Society (AMS) 86th Annual Meeting, Atlanta, GA. URL: *www.ametsoc.org/meet/annual/index.html*

▼ On August 14, 2005, the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite captured this stunning image of forest fires raging across the width of Alaska. Smoke from scores of fires filled the state's broad central valley and poured out to sea. Hemmed in by mountains to the north and the south, the smoke spreads westward and spills out over the Bering and Chukchi Seas (image left). More than a hundred fires were burning across the state as of August 14.

Air quality warnings have been issued for about 90% of the interior, according to the August 12 report from the Alaska Department of Environmental Conservation's Division of Air Quality. Conditions have ranged from "very unhealthy" to "hazardous " over the weekend in many locations, including Fairbanks. A large area of high atmospheric pressure spread over much of the state, keeping temperatures high and reducing winds that would clear the air. The high-resolution image has a spatial resolution of 250 meters per pixel. The MODIS Rapid Response System provides this image at additional resolutions.

NASA image courtesy the MODIS Rapid Response Team, Goddard Space Flight Center.



Code 610
National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Md 20771

PRSRT STD
Postage and Fees Paid
National Aeronautics and Space Administration
Permit G27

(affix mailing label here)

The Earth Observer

The Earth Observer is published by the EOS Project Science Office, Code 610, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771, telephone (301) 614-5561, FAX (301) 614-6530, and is available on the World Wide Web at *eos.nasa.gov/earth_observer.php* or by writing to the above address. Articles, contributions to the meeting calendar, and suggestions are welcomed. Contributions to the calendars should contain location, person to contact, telephone number, and e-mail address. To subscribe to *The Earth Observer*, or to change your mailing address, please call Steve Graham at (301) 614-5561, or send a message to *steven.m.graham.2@gsfc.nasa.gov*, or write to the address above.