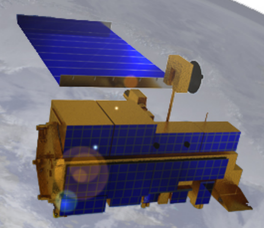
The MODIS Rapid Response Project:
A New Suite of Remote Sensing Products in Support of Decision Making
http://rapidfire.sci.gsfc.nasa.gov

Jacques Descloitres[*†], Jeff Schmaltz*[*†], Jackie Kendall*[*†], Louis Giglio*[*†], Chris Justice[†‡], Holli Riebeek*[*†]*

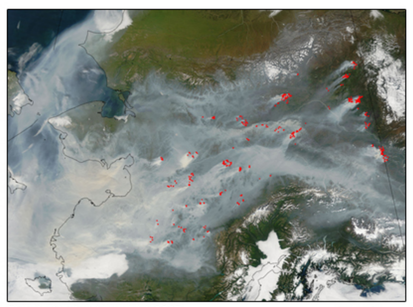
[†] NASA Goddard Space Flight Center, [*] Science Systems and Applications (SSAI), [‡] University of Maryland

The MODIS Rapid Response System specializes in daily digital satellite imagery and data products, generated and distributed in close to real-time. Our current geographical coverage includes most of the Earth's land surface and a portion of the oceans.From our public web interface, we provide digital images in JPEG format in varying sizes,spatial resolution and band combinations. You can browse and download our JPEG imagery for free.In addition to our public JPEGdistribution, we offer custom image, data processing and distribution services to meet to specialapplications, research, and publication needs. For more information on custom MODIS Rapid Response System products and services, please contact us at **contact@rapidfire.sci.gsfc.nasa.gov.**

Flying onboard NASA's Terra and Aqua satellites, the Moderate Resolution Imaging Spectroradiometer (MODIS) sees the entire Earth four times perday: twice at night and twice during the day, Terra in the morning and Aqua in the afternoon. Because MODIS collects twice daily images, it is a valuable tool for tracking rapidly changing events like fires, dust storms, floods, smoke transport, severe storms, and volcanic eruptions. The MODIS Rapid Response System was set up to provide MODIS data of such events to a variety of users within hours after the satellites pass over the event. Initially, designed to provide fire locations to the U.S. Forest Service, the system now serves a number of applications.



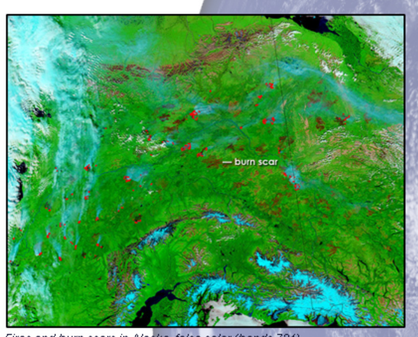
Fires



Fires in Alaska, August 14, 2005

In 2004 and 2005, lightning ignited hundreds of fires across interior Alaska and Yukon Territory. As the fires raced over millions of acres of hard-to-access land, fire managers tracked the over-all situation with daily MODIS Rapid Response images. MODIS detected thermal anomalies, marked with red dots, which showed where fires were actively burning. MODIS was attributed with the first detection of 44 of the 282 fires that occurred in Yukon Territory in 2004. In one instance, Canadian fire managers used MODIS fire detections operationally to plan an alternative target for an airplane fire retardant drop. The images also show burn scar area and smoke transport.

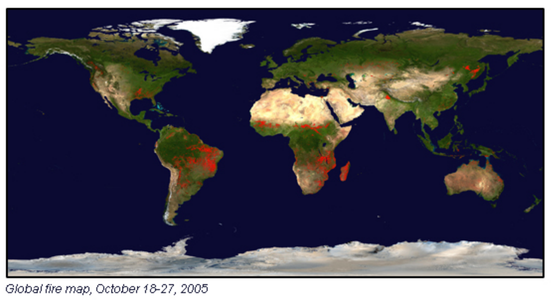
Using MODIS Rapid Response products, the Remote Sensing Applications Center, a branch of the USDA Forest Service, makes daily active fire maps for the continental United States. The maps show fire managers the big picture, which helps them decide how to allocate resources. The Burn Area Emergency Response (BAER) Program also uses MODIS corrected reflectance images and active fire locations from the Rapid Response System to map burned areas and plan for their restoration.



Fires and burn scars in Alaska, false color (bands 721), August 10, 2005

To further support fire applications, we are currently adapting a post-fire burned area detection algorithm developed by Louis Giglio to generate near-real-time burn scar products in the Rapid Response System. The algorithm looks for abrupt changes in a time-series of observations assembled from daily, corrected reflectance imagery to identify burned pixels. It has been prototyped over several hundred MODIS tiles with very good results in a wide range of environments.

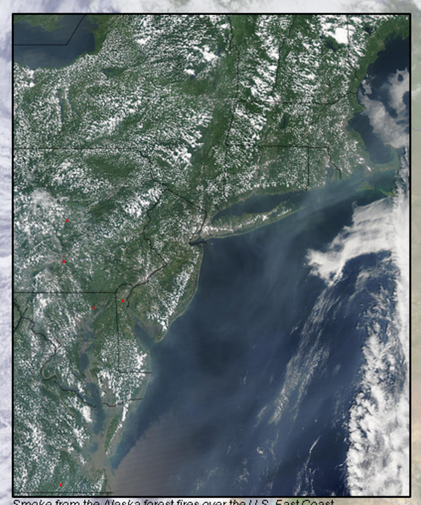
The new burn scar product will be generated daily or every few days to provide a "rolling" composite product that can be used in applications such as fire management that require information that is updated in close to real time. In addition to identifying burned pixels and providing the date that the burn occurred, post-fire vegetation index (VI), VI change difference (pre-fire minus post-fire), and quality assurance flags will be provided.



Global fire map, October 18-27, 2005

MODIS Rapid Response provides global fire detections in 10-day composite maps, such as the map shown here. Fire locations are also delivered to the University of Maryland, where they are redistributed to fire applications users through the Web Fire Mapper at http://maps.geog.umd.edu/

Air Quality

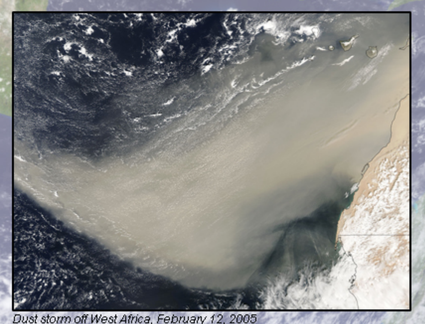


Smoke from the Alaska forest fires over the U.S. East Coast, July 21, 2004

Eruption of Mout Etna, October 12, 2002

Fire has a much broader impact than the number of acres it burns. Large fires, such as thoseburning in Alaska in 2004 and 2005, pump out thick smoke that can affect air quality hundreds of kilometers away. The microscopic particles dispersed in smoke and other pollutants can cause health problems such as burning eyes, runny nose, bronchitis, and can aggravate chronic problems like heart and lung disease. Poor air quality also affects visibility and can impede both air and ground transport. For these reasons, government environmental agencies routinely monitor air quality and issue warnings when necessary.

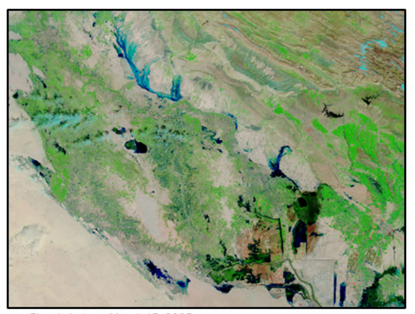
MODIS Rapid Response images have been used by county and state officials to track the source of pollutants entering their region. MODIS is helpful because it provides both fire locations and daily global coverage, allowing officials to see where the fires are and where smoke is being transported.The images have also been used to track other aerosols like dust storms, haze, and volcanic ash. Since volcanic ash can destroy a jet engine, the Air Force Weather Agency uses MODIS Rapid Response imagery to monitor ash emissions from volcanic eruptions. The United States Air Force Weather Agency and the U.S. Naval Research Laboratory have also relied on MODIS Rapid Response images to monitor and predict dust storms in the Middle East and Southwest Asia, which can interfere with troop and equipment movement and with aircraft safety.



Dust storm off West Africa, February 12, 2003

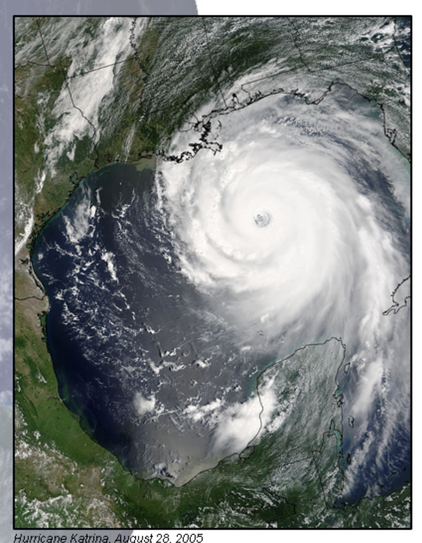
Floods

All but destroyed during the 1990s, the Iraqi wetlands gradually began to refill in 2004 and 2005.During the spring floods, as much as 50 percent of the wetlands were inundated. Using daily MODIS Rapid Response imagery, the United Nations Environment Program (UNEP) has been monitoring the return of the wetlands. The imagery is useful for tracking flooding throughout the world. The Dartmouth Flood Observatory uses Rapid Response imagery to create maps showing the extent of flooding around the world. The maps they generate are available to governments and relief organizations for flood response and planning.



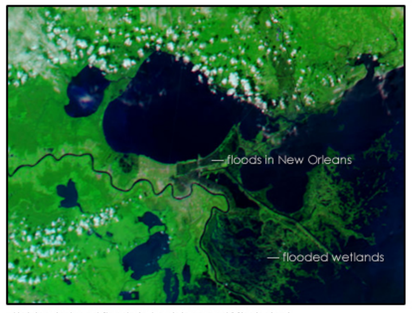
Floods in Iraq, March 15, 2005

Disaster Response: Hurricane Katrina



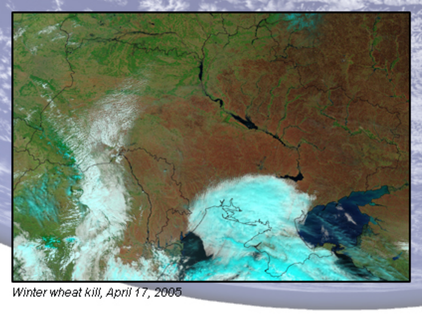
Hurricane Katrina, August 28, 2005

When Hurricane Katrina came ashore on August 29, 2005, it brought unprecedented devastation. The U.S. Army, working in support of the Federal Emergency Management Agency, requested daily MODIS Rapid Response images of the impacted area. The images provided an overview of the flooding caused by the storm's massive storm surge and heavy rains. Such images show the scale of the disaster, provide a quick look at where aid might be required, and show where pollutants might end up as a result of flooding. The images are also being used by Weyerhaeuser to assess Katrina's impact on forests.



Katrina-induced floods in Louisiana and Mississippi, September 2, 2005

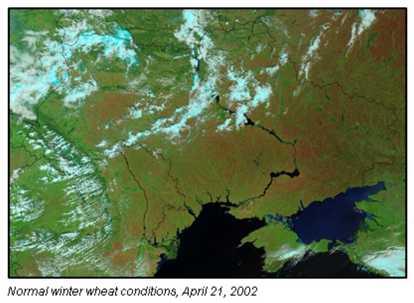
Agriculture



Winter wheat kill, April 17, 2005

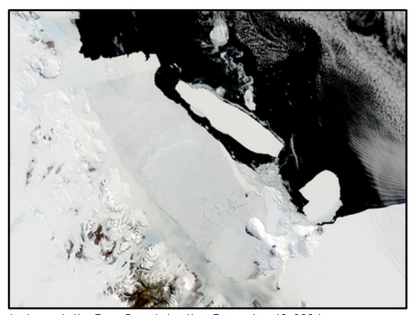
Ice crusted fields in the Ukraine in February and March 2003, smothering winter grains. The severe winter left fields brown, the crops dead. These and similar images of the disaster help analysts at the United States Department of Agriculture's Foreign Agricultural Service (FAS) determine the impact of bad weather on crops. As part of Global Agriculture Monitoring (GLAM), a collaboration between NASA, FAS, and the University of Maryland, MODIS Rapid Response delivers daily images to FAS to help them monitor the impact of climate hazards, such as drought, large-scale flooding, and snow storms, on agricultural production.

These images help FAS improve the accuracy and timeliness of the crop yield predictions, which are needed to make decisions affecting U.S. agriculture, trade policy, and food aid. MODIS products allow FAS analysts to distinguish between different crops like wheat and rice, and permit analysts to measure other features like surface temperature and snow cover. Analysts can gauge the overall health of agriculture by comparing current data with previous years. To learn more, visit http://www.pecad.fas.usda.gov/glam.cfm



Normal winter wheat conditions, April 21, 2002

Ice

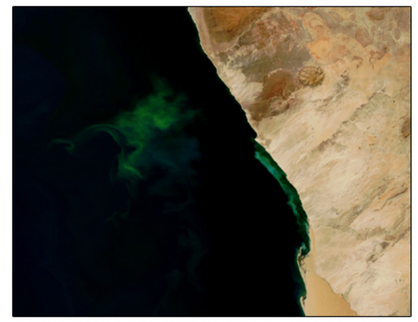


Icebergs in the Ross Sea, Antarctica, December 10, 2004

On two polar orbiting satellites, MODIS has several opportunities to image ice at high latitudes every day.During the 2004-2005 research season, true-color MODIS images became essential to decision makers in the United Stated Antarctic Program. Several large icebergs made planning a shipping route through the sea ice to McMurdo Station difficult. Planners and the captains on the ice breakers used MODIS Rapid Response imagery to track the icebergs' movements near the shipping channel. The imagery were also used to monitor sea ice conditions early in the season. Other organizations, including the Canadian Ice Service, have used MODIS Rapid Response imagery to monitor ice in both the Arctic and the Antarctic.

Oceans

Oceanspace at the University of Cape Town, South Africa, relied on satellite data to monitor ocean resources in South Africa for decision makers and scientists. Specifically, Dr. Scarla Weeks used MODIS Rapid Response images to detect plumes of sulfur off the coast of Namibia. Anaerobic bacteria on the ocean floor produce hydrogen sulfide gas. When the gas reaches the surface, it reacts with oxygen in the upper layers of the ocean producing pure sulfur. The sulfur is visible in MODIS imagery as green plumes in the ocean. Hydrogen sulfide gas is highly toxic to fish, and large die-offs often accompany hydrogen sulfide upwelling.



Hydrogen sulfide eruption and phytoplankton off the coast of Namibia, August 9, 2005

Blue Marble, center, by Reto Stöckli and Robert Simmon, NASA's Earth Observatory at GSFC