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SPoRTscast [1]

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Weather has always been difficult to predict. For centuries, people relied on myths and folklore to reckon the weather. Some sayings, like the rhyme "Ring around the moon, rain by noon. Ring around the sun, rain before night is done," actually contain some truth. Because ice crystals in clouds can cause haloes around the sun or moon, these rings are a genuine indication that wet weather is on the way. But other folklore legends, such as interpreting a groundhog's shadow to mean six more weeks of winter, are pure fiction.

Weather forecasters improve short-term predictions using data from NASA's Earth Observing System satellites.

- About Global Hydrology Resource Center (GHRC) [2]

Weather forecasters can now forego the folkloric guesswork and instead rely on a variety of ground and space-based instruments to make predictions. But accurate forecasts require a steady stream of satellite data, and modern meteorologists must combine traditional forecasting methods with the latest remote sensing techniques.

To help forecasters better incorporate satellite data into their decision-making process, NASA partnered with the National Weather Service (NWS) to form the Short-term Prediction Research and Transition Center (SPoRT), based at the Global Hydrology and Climate Center in Huntsville, Ala. SPoRT provides a central location where NASA and scientists can interact with weather service meteorologists and supply them with data products specifically suited to their needs.

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Because fluffy, fair weather cumulus clouds (top) grow vertically, they can quickly develop into the powerful, threatening-looking cumulonimbus clouds (bottom) that often precede severe thunderstorms. The tops of fair weather cumulus clouds usually range from about 5000 to 8000 meters (3000 to 5000 feet) high, while the tops of towering cumulonimbus clouds can extend over 12,000 meters (39,000 feet) into the air. (Images courtesy of NOAA Photo Library; Ralph F. Kresge, photographer)

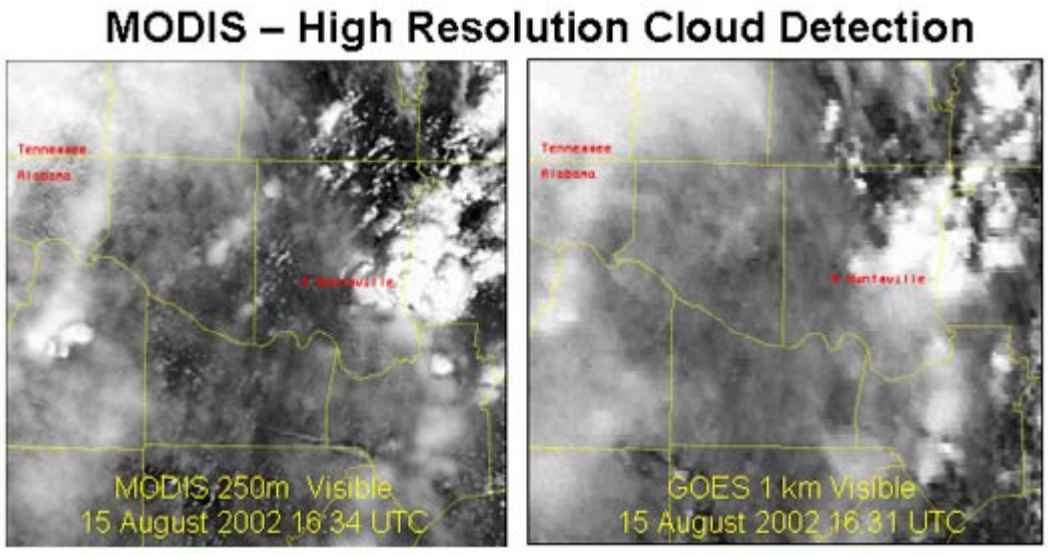
SPoRT atmospheric scientist Gary Jedlovec and his colleagues rely on feedback from forecasters to create specialized data products. "We asked them, 'what are your forecast issues and problems?' We didn't just send data to them to see what they thought," said Jedlovec. "We wanted to match up a product or a data set with a particular problem."

What forecasters wanted was data in near-real time, meaning they need access to the data very soon after it is received from the satellite. "If it takes six hours for forecasters to receive the data, particularly in the case of clouds or thunderstorms that change on a short time scale, the information is not going to be of much value to them," said Jedlovec. Forecasters also requested higher-resolution imagery that would help them estimate cloud cover and height, fog, sea and land surface temperatures, and precipitation.

Although the weather service had already been receiving imagery from the Geostationary Operational Environmental Satellite (GOES) mission, some of the products had low resolution. In particular, resolution for the atmospheric water vapor product was about 50 kilometers (31 miles), which is slightly larger than the north-to-south width of Oklahoma's panhandle. Jedlovec was familiar with NASA's Earth Observing System (EOS) satellites and knew they could be used to provide products with the improved resolution that forecasters needed.

NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) instrument, for instance, provides measurements with 250 to 1,000 meter resolution, resulting in imagery with much finer detail. By detecting a broader range of energy reflected or emitted by the Earth, MODIS can observe weather variables and physical characteristics of land and ocean surfaces that can't be detected by GOES.

MODIS gives forecasters improved data for cloud thickness and land and sea surface temperatures - all of which contribute to evolving weather. For instance, harmless, fluffy cumulus clouds can rapidly evolve into towering cumulonimbus clouds that often result in powerful storms. And land and ocean surface temperatures affect wind direction along the coasts. "If forecasters have timely, accurate, high-resolution sea and land surface temperature information, they can better understand and predict land and sea breeze circulations, which affect cloud cover and also influence where thunderstorms will occur," said Jedlovec.



The MODIS image on the left shows greater cloud and surface detail than the GOES image on the

right. MODIS resolution is fine enough to show developing cloud lines (small white spots near the center of the left image) and provides crisper observations of the cloud cover. (Image courtesy of SPoRT)

For instance, on July 18, 2005, SPoRT provided forecasters with MODIS imagery that showed severe weather conditions developing over Huntsville. The imagery indicated atmospheric conditions that were likely to produce storms, and indeed, a severe storm formed over the city, dropping more than 2.5 inches of rain in 30 minutes. During stormy weather, high-resolution MODIS data help forecasters more accurately pinpoint and follow storm development.

The SPoRT team also produced a nighttime fog product. Fog develops when air near the surface cools, condensing atmospheric moisture into small water droplets suspended near the ground. Due to reduced visibility, fog can create hazardous travel conditions. Because MODIS can observe subtle changes in temperature and cloud cover, the SPoRT fog product helps forecasters identify regions of developing fog at night and early in the morning.

Fog obscures the landscape around Interstate 40 in the Smoky Mountains west of Asheville, North Carolina. NASA's Short-term Prediction Research and Transition (SPoRT) Center developed a fog product from MODIS data that helps forecasters identify regions of developing fog at night and early in the morning. (Image courtesy of NOAA Photo Library; Ralph F. Kresge, photographer)

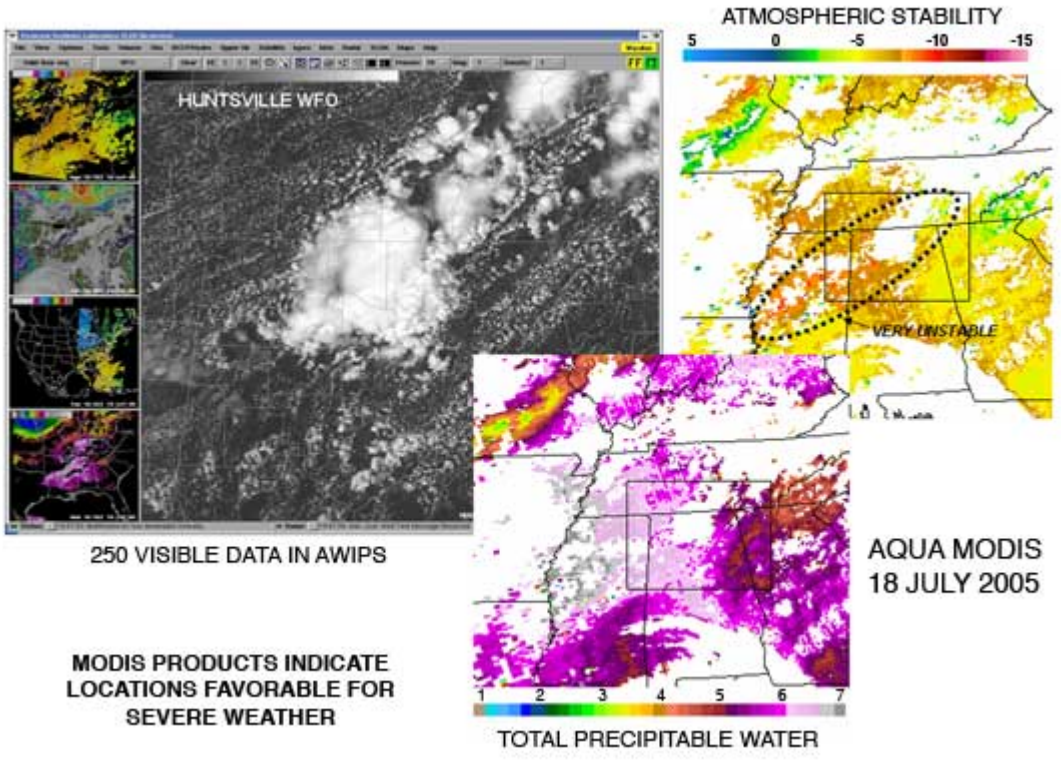
Meteorologists also need accurate information about rainfall, so in May 2005, SPoRT began supplying several NWS Forecast Offices data from NASA's Advanced Microwave Scanning Radiometer-EOS (AMSR-E), which measures water vapor, precipitation, and other hydrologic factors in the Earth's environment. By monitoring marine weather phenomena before they reach land, forecasters can better anticipate the impact of storm systems too far off shore to be detected by land-based radars. "Forecasters are now using real-time precipitation data from AMSR-E to monitor offshore rain systems approaching coastal Florida," said Jedlovec. AMSR-E data are archived at NASA's Global Hydrology Resource Center (GHRC) in Huntsville, which handles data management and distribution for the SPoRT project.

In addition to MODIS and AMSR-E imagery, the SPoRT team also plans to include data from NASA's Atmospheric Infrared Sounder (AIRS) in its products by the fall of 2005. Unlike the MODIS and AMSR-E products, which are provided directly to forecasters, AIRS data will be incorporated into weather service models used to predict regional weather. "We believe that AIRS data will improve model predictions of temperature, moisture, clouds, and precipitation in the 0 to 24-hour time range," said Jedlovec. In addition, using MODIS sea surface temperatures in models is expected to improve the prediction of wind and temperature along major U.S. coastlines.

But simply sending data to forecasters isn't enough. So a key part of SPoRT's mission is training forecasters

how to use the data. "We show them how to access and interpret the data," said Jedlovec. SPoRT also holds bi-weekly meetings with the Huntsville NWS Forecast Office, providing a forum for NASA scientists and NWS forecasters to share ideas for additional uses of the data.

When severe weather strikes, forecasters don't have time to visit satellite web sites, download data, and hope that it's relevant to the weather situation at hand. By working closely with forecasters, SPoRT designed data imagery that works specifically within existing weather service computer and display systems. "Forecasters can overlay all their other data right on top of the imagery, which enables them to make direct comparisons and detect changes," said Jedlovec.



NASA's Short-term Prediction Research and Transition (SPoRT) Center collaborates with the National Weather Service to provide data from NASA's Earth Observing System satellites. This example is from the MODIS instrument on Aqua, collected on July 18, 2005 over Alabama and Tennessee. The large upper left image reveals an intense thunderstorm over Huntsville, Alabama, and shows how MODIS data are displayed through the National Weather Service's Advanced Weather Information Processing System (AWIPS). The smaller color insert pictures show MODIS data products that indicate regions favorable for thunderstorm development and possible severe storms (indicated by the dotted oval area in the upper right image). In a mere 30 minutes, this storm produced more than 6.35 centimeters (2.5 inches) of rain over a portion of Huntsville. (Image courtesy of Gary Jedlovec)

Although SPoRT interacts primarily with southeastern weather service offices, where precipitation and coastal circulations are important weather factors, it also provides unique products to the NWS office in Great Falls, Montana. "Once word got out that we were providing real-time MODIS data products to some NWS Forecast Offices, the science operations officer in Great Falls contacted us to see how they could get the data," Jedlovec said. In response, SPoRT generated a MODIS snow product that helped forecasters in Montana understand the distribution of snow cover, how it recedes as it melts, and how it contributes to regional flooding. "They can now view daily snow cover changes, as well as detect possible ice and log jams that could exacerbate flood conditions caused by snowmelt," said Jedlovec.

Incorporating MODIS and AMSR-E data into forecasts is also preparing meteorologists to work with products generated by future satellites. The Geostationary Operational Environmental Satellite R series (GOES-R), scheduled to launch in 2012 as a joint development effort between NASA and the National Oceanic and Atmospheric Administration (NOAA), will provide more accurate data and improve forecasters' detection of meteorological phenomena. Another collaborative venture between NASA, NOAA, and the Department of Defense will result in a suite of National Polar Operational Environmental Satellite System (NPOESS) satellites,

which will collect atmospheric, land, and ocean weather data.

"As soon as the data, products, and imagery are made available from NPOESS and GOES-R, offices with experience using MODIS data will instantly know how to use data from these new satellites," Jedlovec said. "And the weather service will be able to get the data every 15 minutes, instead of only four times a day like they do with MODIS and AMSR-E data."

While supplying MODIS and AMSR-E data to NWS Forecast Offices nationwide is outside the SPoRT mandate, Jedlovec and his colleagues are working with the weather service and NOAA to begin sending EOS satellite data to additional offices. "We've established a model and documented a procedure so that this approach can be more easily implemented in other locations," he said.

SPoRT not only generated specialized products and offered training, but streamlined the data delivery process. Rather than sending data to individual offices, SPoRT delivers data to a regional weather service hub, where it can be downloaded by many offices. "We only have to send data to one place to serve 25 different weather service offices in the southeastern U.S.," said Jedlovec.

Interacting directly with forecasters has allowed the SPoRT team to develop high-resolution satellite data products that smoothly integrate into existing weather service forecasting processes in an efficient and timely way. "By giving the data directly to forecasters within the NWS decision support system, it really saves a lot of time. It's right there instantly for them in a format they are familiar with," Jedlovec said.

References

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Related Link(s)

- Global Hydrology Resource Center [3]
- NASA Marshall Space Flight Center Earth Science Office [4]
- Short-term Prediction Research and Transition Center (SPoRT) [5]

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