EARTH SCIENCE and Climate Monitoring

NASA Satellites Help Forewarn U.S. Forest Service of Trouble

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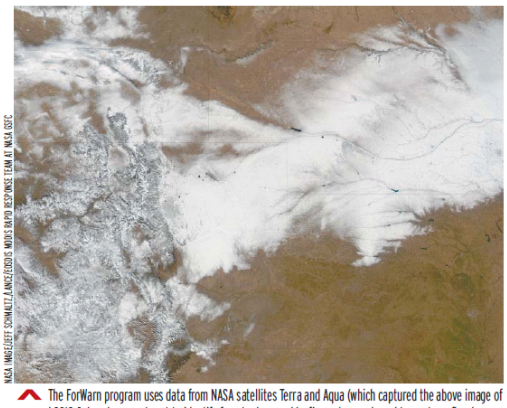
A new program called ForWarn is helping the U.S. Forest Service use satellite imagery to identify areas where trees have been damaged by fires, storms, droughts, pests, flood, invasive species or any other type of natural or human activity.

Through the ForWarn program, which was publicly unveiled March 1, the Forest Service uses data drawn from the Moderate Resolution Imaging Spectroradiometer (MODIS) onboard NASA's Terra and Aqua Earth-observing satellites to publish maps updated every eight days that highlight changes in the health of forests in the 48 contiguous U.S. states. The Forest Service is using those maps to help focus the work of anyone who monitors forest damage using aircraft or ground-based observation.

For years, Forest Service employees traveling in light aircraft have surveyed the nation's forests and created maps that highlight areas where trees have been harmed or destroyed. The regional aircraft survey teams also try to determine the probable cause of any forest damage. The Forest Service compiles those regional surveys into a single national map.

The ForWarn program complements that activity, said William Hargrove, Eastern Forest Environmental Threat Assessment Center lead ForWarn researcher. While the satellite imagery produced by the ForWarn program has much lower resolution than aerial photography, the broad scale and frequent repetition of ForWarn observations helps to focus the efforts of aerial survey teams by showing them where and when to look for forest damage, he added.



NASA/MODIS/LANCE/EOSDIS RAPID RESPONSE TEAM AT NASA GSFC

The ForWarn program uses data from NASA satellites Terra and Aqua (which captured the above image of a record 2012 Colorado snowstorm) to identify forests damaged by fires, storms, droughts, pests or floods.

The ForWarn program stems from work that began in 2005 when U.S. Forest Service officials asked NASA for satellite data to help identify areas where trees in the Eastern United States were being killed by gypsy moths, an invasive pest that devours leaves and is responsible for killing roughly 400,000 hectares of trees annually in the United States. The success of that effort helped to spur interest among NASA and Forest Service officials in expanding the use of satellite data to monitor forest health, said Duane Armstrong, chief of the Applied Science and Technology Project Office at NASA Stennis Space Center in Mississippi.

Officials from the Forest Service's Eastern Forest Environmental Threat Assessment Center in North Carolina and Western Wildland Environmental Threat Assessment Center in Oregon developed ForWarn with help from researchers at NASA Stennis. Researchers compare data drawn from satellites with aerial imagery, news reports and observations made on the ground to identify the telltale signs of various causes of forest damage. "We look at different patterns over time to help us identify the cause of forest disturbances," Armstrong said. Tree damage caused by storms, for example, exhibits different characteristics from tree damage caused by pests, he added.

Since 2010, the Forest Service have been operating a prototype version of ForWarn while working to expand the program and develop tools to allow Internet users to view current and archived data. Since the prototype version was released in 2010, ForWarn has been used to identify the impact on U.S. forests caused by Mississippi River flooding, severe hurricanes and the drought that struck the Southeastern United States in 2011, Hargrove said.

During the two-year prototype phase, Forest Service officials noticed the program offered benefits beyond identifying the location of forest disturbances. The maps produced every eight days provide the Forest Service with information on the winter snowpack, an important component of forest ecology in the Western United States. In addition, ForWarn helps Forest Service officials monitor how extremely hot or cold temperatures and extremely low or high levels of precipitation are affecting the forests, Hargrove said.

Another unexpected result of the ForWarn program was its ability to highlight changes in other types of plants. Forest Service officials noticed that the algorithm they use to detect problems in forests also can be used to pinpoint changes in crops and rangelands. In the future, the U.S. Department of Agriculture is likely to explore that capability, Hargrove said.

Going forward, Forest Service officials plan to investigate ways to make the task of creating ForWarn products less labor intensive. "We still rely on human eyes to look at these maps every eight days," Hargrove said. "We hope to be able to get the system itself to begin to automatically identify areas of local disturbance."

Forest Service officials also would like to use historical MODIS data to enable forest managers to view forest damage and recovery over many years. Ideally, the Forest Service would use the ForWarn algorithm to process data gathered since MODIS observations began in 2000. "That history would be extremely useful," Hargrove said. "It would help forest managers interpret the changes they are seeing in the current growing season."

Information from the ForWarn program is publicly available on the Internet. The ForWarn website uses a tool called the Forest Change Assessment Viewer to allow users to view, analyze and share current and archived maps that highlight various forest conditions.

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