

# Orbiting watchtowers



“When FIRMS gives us evidence of a fire and its exact coordinates, that is very valuable information.”

**Rafael Manzanero**  
Friends for Conservation  
and Development

by Natasha Vizcarra

When Rafael Manzanero checks his e-mail from the remote village of San Jose Succotz in Belize, he scans his inbox for the words “fire alert” and “NASA.” The e-mails appear in his inbox three hours after NASA’s Terra and Aqua satellites

sense fire in the Chiquibul National Park. Manzanero heads a nonprofit that watches over the park, the largest protected forest in Belize and home to the biggest Mayan archaeological site in the country. Oceans away, researcher Veerachai Tanpipat also watches out for such e-mails from his office in the busy city of



Resource manager Rafael Manzanero stands atop the great temple at Caracol Archaeological Reserve, located inside the Chiquibul National Park. (Photograph by J. Houston courtesy Rare)

Bangkok. Tanpipat helped the Thai government monitor forest fires that blanketed the city of Chiang Mai in dense haze in 2007.

Manzanero and Tanpipat are among thousands of subscribers to the NASA Fire Information for Resource Management System (FIRMS), which uses remote sensing and geographic information systems (GIS) to help managers of protected areas respond faster to fires. While the technology helps Manzanero and Tanpipat keep an eye on vast and remote forests in their countries, they are also uncovering a tension between forest conservation and an old way of farming that wildlands can no longer support.

### Under the shade, I flourish

In Belize's Chiquibul National Park, towering broadleaf trees like the Nargusta, the Santa Maria, and the mahogany grip the Earth with thick, buttressed trunks. Their canopies grow so dense that only mild rays of sunlight break through to the ground. Belize's flag bears the image of such a tree, and the words *Sub umbra floreo*, or "Under the shade, I flourish." Manzanero oversees Friends for Conservation and Development (FCD), which helps the government manage the 264,000-acre park and the extensive cave system underneath it. "The words symbolize the importance of Belize's timber resources to the country's early colonists," Manzanero said.

The slogan also explains quite succinctly why Belize's rainforests are so special—the forest and its wildlife literally flourish under the shade. Below the canopies, shrubs and small plants thrive in the understory. Because the forest is so moist, the climate so temperate, and the tree canopies so thick, it is not prone to naturally-

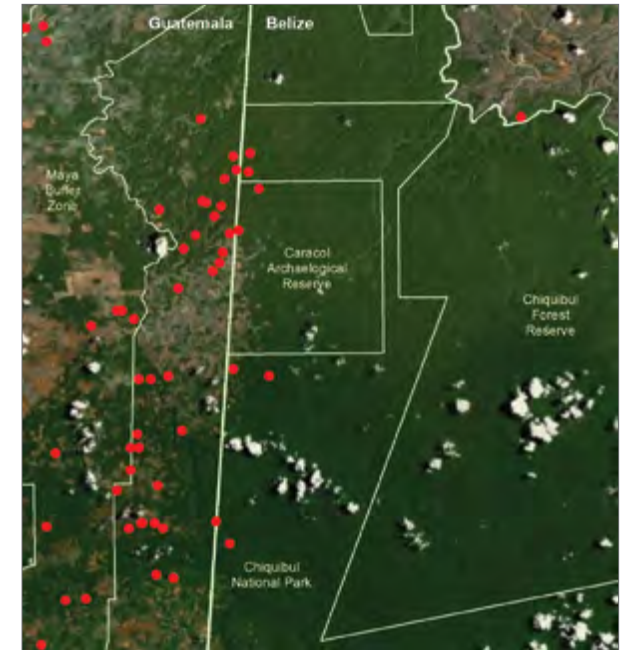
caused fires. Drier forests elsewhere in the world are vulnerable to lightning, spontaneous combustion, or even sparks from rock falls. "Any fire in the Chiquibul would have likely been caused by humans," Manzanero said.

Fire in the Chiquibul is very bad news. "It causes a domino effect of changes in the ecosystem and opens the area to other illegal activities," Manzanero said. When Manzanero gets an e-mail from FIRMS about fire in the park, he worries not just about the fire burning uncontrolled. He also worries about the fire razing through ancient Mayan monuments, or worse, sparking territorial conflict with neighboring Guatemala. "Nationals from Guatemala illegally cross the Belize border and hack away at the forest," Manzanero said. Trespassers take animals and ornamental plants to sell on the black market, and steal artifacts from the Caracol Archeological Reserve, a Mayan site deep within the Chiquibul, and from forty miles of cave passages that wind up in Guatemalan territory. "When the dry season arrives they set fire to the cuttings and plant black beans, pumpkins, and corn," Manzanero added.

### Furtive farming

Manzanero was describing an old agricultural practice called slash and burn. Subsistence farmers cut young trees and plants just before the dry season and burn the dried "slash" just before the rainy season. Then they plant directly in the ash-covered and nutrient-rich soil and hope for a kind season of rain to water their crops.

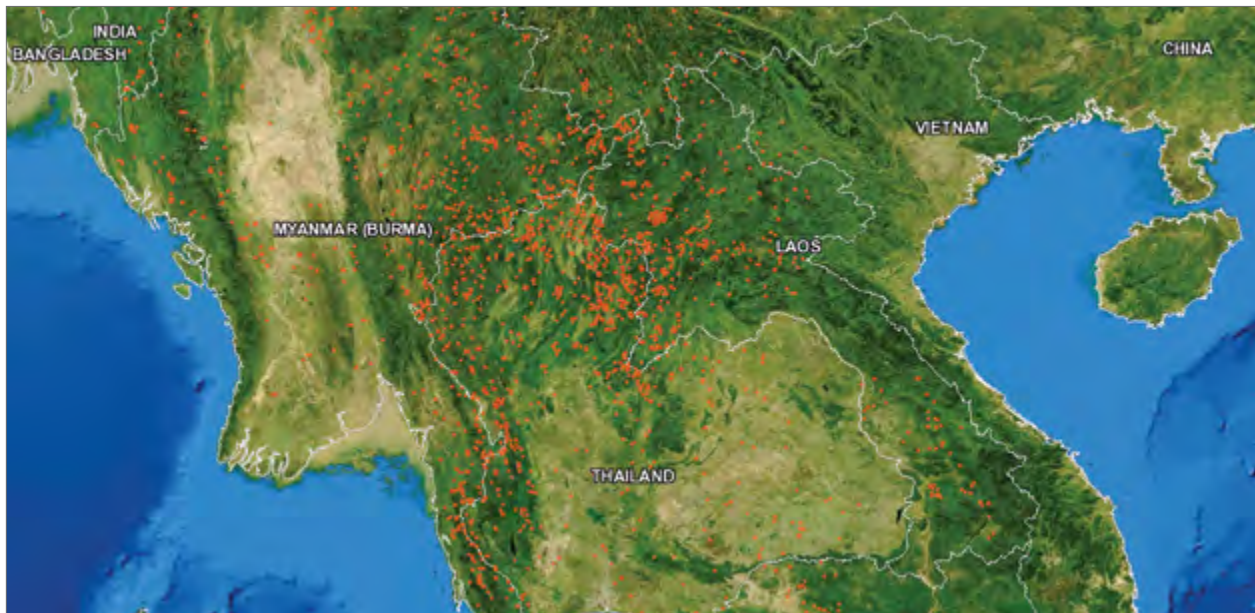
Unfortunately, slash and burn farming destroys forests and encroaches on Belize's protected areas. When a cleared area stops giving farmers a good yield of crops, the farmers move on and



This image from the NASA Fire Information for Resource Management System (FIRMS) shows hotspots or possible fires, indicated in red, in the Chiquibul National Park near the Guatemalan border. Park officials and conservationists used this map and the hotspot coordinates to validate fires, which had been set by slash and burn farmers crossing the border. (Courtesy FIRMS/map by M. Wong)

clear a new part of the forest. The abandoned fields take a long time to heal, and the practice gouges huge holes in the forest canopy. "A broken tree canopy disturbs the Chiquibul's delicate and moisture-dependent ecosystem," Manzanero said. "A burnt area takes forty to forty-five years to recover and it would probably never grow the same kind of forest cover."

In 2008, Manzanero signed up for FIRMS fire alerts, paying special attention to part of the park close to the Guatemalan border. "When the dry season begins in February, I get e-mails about hotspots, or areas of possible fires," he



This image from the Fire Information for Resource Management System (FIRMS) Web Fire Mapper shows hotspots on March 8, 2007, in eastern Myanmar, northern Thailand, and western Laos. The fires brought low-lying haze to Thailand which lingered for two months. (Courtesy Web Fire Mapper, FIRMS, NASA LANCE)

said. FIRMS hotspots need validation. When a satellite senses intense heat and radiation on the ground, it cannot tell if it is a fire or just hot metallic rocks, but it will tag the area as a hotspot. In the Chiquibul, hotspots are often reported in remote areas, far from forest trails. When it looks too difficult to reach on foot, the park manager sends a plane to check it out. “Whenever our people conduct surveillance near the Guatemalan border, they are vulnerable to situations of threat and danger,” Manzanero said. “So when FIRMS gives us evidence of a fire and its exact coordinates, that is very valuable information.”

### Trial by fire

In Thailand, Tanpipat faced challenges similar to Manzanero’s. Slash and burn farmers were illegally planting crops in protected parks, but

the fires caused a totally different set of problems. When fires razed forests in northern Thailand in 2007, Tanpipat worked as a government consultant and had just finished setting up fire alerts for Thailand’s forest parks. News reports said farmers and Pak-wan tree and mushroom gatherers who were clearing brush and plants caused the fires.

Unfortunately, a weather phenomenon trapped the smog right over Chiang Mai, the largest city in northern Thailand, making a lot of people sick. Tanpipat said, “It wasn’t a normal year and it was very hot. High air pressure over China caused air to sink over northern Thailand, trapping the smoky air. The smoke just hung over northern Thailand for two months.” It was so bad in some areas that people could not see past half a mile. An air quality measurement of 120 micrograms per cubic meter of particulates is considered

hazardous to humans. When measurements hit 240 and 290 micrograms per cubic meter, the number of people admitted to hospitals for respiratory problems surged by 20 percent.

“The Thai government set up a war room where FIRMS hotspots data played an important role,” Tanpipat said. “A fire situation report based on FIRMS data was presented to the Deputy Prime Minister and his decision-making team every day.” The data helped officials decide which fires to respond to and who could get there the fastest. Members of the fire monitoring team were signed up for the e-mail alerts, especially those who worked in the field. “The rains finally came two months after the fires started and that released the smog that was trapped over Chiang Mai,” Tanpipat said. By that time, the Thai media had written so much about hotspots that ordinary people in Thailand knew what these were.

### Alerts on fire

Manzanero’s and Tanpipat’s stories are not unique. According to the United Nations Global Fire Monitoring Center, humans cause the majority of the world’s forest fires. Although it is not clear how many acres of forests are lost to slash and burn, it is known that about 250 million people practice it worldwide. In addition, people burn acres of forests for grazing and hunting. FIRMS fire alerts currently help natural resource managers, policy makers, and scientists protect forests from slash and burn farming, and other causes of fire, in over 120 countries.

The Aqua and Terra satellites carry the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument, which was originally designed for Earth science research, but has proven to detect many other surface features, including the

thermal signal of a fire. FIRMS project manager Diane Davies said, “FIRMS transitioned from serving the NASA community to serving a global community. In this sense, this is a success story.” This success included getting the data quickly to users and in a way that was practical for them. Davies said, “We know that many of our users have poor internet access. This was the main reason we developed the e-mail alert service.” Davies used to monitor fires in Namibia’s Etosha National Park using satellite data and knew how hard it was to access remote sensing data from the field. She helped develop the first version of the FIRMS fire alerts for protected areas in Bolivia, Madagascar, Namibia, Paraguay, and South Africa. Since FIRMS was launched in January 2007, subscribers to the fire alerts have grown from 580 to 4,064. The United Nations Food and Agriculture Organization (FAO) began offering FIRMS data in 2010 through its Global Fire Information Management System (GFIMS) Web site.

Like Manzanero and Tanpipat, subscribers are discovering that the fire alerts highlight other aspects about human life affected by the fires. Subscribers use the alerts to educate farmers about the environmental impacts of fire, create fire maps for decision-makers and the general public, and to improve air quality studies. Subscribers have even used them to keep an eye on humanitarian situations. Using a fire as a proxy for conflict situations, policymakers monitored possible “genocide fires” in the Darfur region of Sudan. “Our goal is to get fire information into the hands of users so it can be used for informing decisions,” Davies said.

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About the remote sensing data used	
Satellites	Terra and Aqua
Sensor	Moderate Resolution Imaging Spectroradiometer (MODIS)
Data sets	Level 2 Fire Product MOD14 (Terra), MYD14 (Aqua)
Resolution	1 kilometer
Parameters	Fire and thermal anomalies
Data access	NASA Earth Data Web site

### About the scientists



Diane Davies is the program manager for the NASA Fire Information for Resource Management System (FIRMS). Her research interests focus on making satellite data easily accessible to users. She has a master’s degree in land resource management from Cranfield University and a degree in geography from Nottingham University, both in the United Kingdom. NASA funded her research. (Photograph courtesy D. Davies)



Rafael Manzanero is the executive director of Friends for Conservation and Development in Belize. His research interests are environmental ethics, protected areas management, and environmental education. Manzanero has a degree in forestry and conservation from the University of Montana in Missoula. (Photograph by J. Houston, courtesy Rare)



Veerachai Tanpipat is a remote sensing and geographic information system consultant at the Hydro and Agro Informatics Institute. His research interests include forest fire detection and flood monitoring. He has a degree in remote sensing and geographic information systems from the Asian Institute of Technology in Thailand. (Photograph courtesy V. Tanpipat)

### References

- Davies, D. K., S. Ilavajhala, M. M. Wong, and C. O. Justice. 2009. Fire Information for Resource Management System: Archiving and distributing MODIS Active Fire Data. *IEEE Transactions on Geoscience and Remote Sensing* 47(1): 72–79, doi:10.1109/TGRS.2008.2002076.
- Tanpipat, V., K. Honda, and P. Nuchaiya. 2009. MODIS Hotspot Validation over Thailand. *Remote Sensing* 1(4): 1,043–1,054, doi:10.3390/rs1041043.

### For more information

- NASA Fire Information for Resource Management System (FIRMS)  
<http://earthdata.nasa.gov/firms>
- United Nations Food and Agricultural Organization Global Fire Information Management Systems (GFIMS)  
<http://www.fao.org/nr/gfims/en>