

NASA space data can cut disaster response times, costs

November 22 2019, by Jessica Merzdorf



In this comparison of two images from 2009 and 2011, the 2011 floodwaters show up as dark blue spreading across the historic city of Ayutthata, Thailand, just north of Bangkok. The 2011 floods killed hundreds of people and displaced millions. Credit: LANCE/EOSDIS MODIS Rapid Response Team, NASA's Goddard Space Flight Center

According to a new study, emergency responders could cut costs and save time by using near-real-time satellite data along with other decision-making tools after a flooding disaster.

In the first NASA study to calculate the value of using [satellite data](#) in disaster scenarios, researchers at NASA's Goddard Space Flight Center in Greenbelt, Maryland, calculated the time that could have been saved if ambulance drivers and other [emergency responders](#) had near-[real-time information](#) about flooded roads, using the 2011 Southeast Asian floods as a case study. Ready access to this information could have saved an average of nine minutes per emergency response and potential millions of dollars, they said.

The study is a first step in developing a model to deploy in future disasters, according to the researchers.

With lives on the line, time is money

In 2011, heavy monsoon rains and La Niña conditions across Southeast Asia's Mekong River basin inundated and destroyed millions of acres of crops, displacing millions of people and killing hundreds. NASA Goddard's Perry Oddo and John Bolten investigated how access to near-real-time satellite data could have helped in the aftermath of the floods, focusing on the area surrounding Bangkok, Thailand.

The Mekong River crosses more than 2,000 miles in Southeast Asia, passing through parts of Vietnam, Laos, Thailand, Cambodia, China and other countries. The river is a vital source of food and income for the roughly 60 million people who live near it, but it is also one of the most flood-prone regions in the world.

In previous work, they helped develop an algorithm that estimated floodwater depth from space-based observations, then combined this

data with information on local infrastructure, population and land cover. They used this algorithm to calculate the disaster risk for the region, considering the vulnerability and exposure for various land cover types, and mapped where the costliest damage occurred. Assessing cost of damage can help emergency managers see what areas may be most in need of resources and also aid flood-mitigation planning and develop disaster resilience. The team used this tool to support disaster recovery after the 2018 failure of the Xepian-Xe Nam Noy hydropower dam in Laos.

In the current study, the researchers investigated the value of near-real-time information on flooded roadways—specifically, how much time could have been saved by providing satellite-based flood inundation maps to emergency responders in their drive from station to destination.

Flood depth information was calculated from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS), and land cover from the NASA-USGS Landsat satellites. Infrastructure, road and population data came from NASA's Socioeconomic Data and Applications Center (SEDAC) and OpenStreetMap, an open-access geographic data source.

"We chose data that represented what we would know within a couple hours of the event," said Perry Oddo, an associate scientist at Goddard and the study's lead author. "We took estimates of flood depth and damage and asked how we could apply that to route [emergency response](#) and supplies. And ultimately, we asked, what is the value of having that information?"

First, the researchers used OpenRouteService's navigation service to chart the most direct routes between emergency dispatch sites and areas in need, without flooding information. Then they added near-real-time flooding information to the map, generating new routes that avoided the most highly flooded areas.

The direct routes contained about 10 miles' worth of flooded roadways in their recommendations. In contrast, the routes with flood information were longer, but avoided all highly flooded areas and contained just 5 miles of affected roadways. This made the flood-aware routes about 9 minutes faster than their baseline counterparts on average.

"The response time for emergency responders is heavily dependent on the availability and fidelity of the mapped regions," said John Bolten, associate program manager of the NASA Earth Science Water Resources Program, and the study's second author. "Here we demonstrate the value of this map, especially for emergency responders, and assign a numeric value to it. It has a lot of value for planning future response scenarios, allowing us to move from data to decision-making."

A 9-minute reduction in response time may seem insignificant, but previous research has pegged that value in the millions of dollars, the team said. While Oddo and Bolten did not include explicit financial calculations in their model, one previous study in Southeast Asia showed that reducing emergency vehicles' response time by just one minute per trip over the course of a year could save up to \$50 million.

Working together to save lives

The study represents a first step toward a model that can be used in future disasters, the team said.

NASA has participated in research and applications in Southeast Asia for over 15 years via several Earth Science efforts, including NASA's Disasters, Water Resources and Capacity Building Programs. Through these efforts, NASA works with regional partners—including the Mekong River Commission (MRC), the Asian Disaster Preparedness Center (ADPC) and other agencies—to provide Earth observation data and value-added tools for local decision makers in the Mekong River

basin.

Oddo and Bolten have not only developed tools for partners, but also shared their results with Southeast Asian decision makers.

"The NASA Earth Sciences Applied Sciences Program works by collaborating with partners around the world," Bolten said. "This isn't just research; our partner groups desperately need this information. The work we've laid out here demonstrates the utility of satellite observations in providing information that informs decision making, and mitigates the impact of flooding disasters, both their monetary impact and perhaps loss of life."

More information: Perry C. Oddo et al, The Value of Near Real-Time Earth Observations for Improved Flood Disaster Response, *Frontiers in Environmental Science* (2019). [DOI: 10.3389/fenvs.2019.00127](https://doi.org/10.3389/fenvs.2019.00127)

Provided by NASA's Goddard Space Flight Center

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