

## EARTHBOUND

# Keeping Watch

When disasters strike, NASA helps save people and property



NASA

August 2018 wildfires in California's Mendocino National Forest

By Matt Alderton

**I**F YOU'RE LOOKING FOR heaven on Earth, the Bahamas might be it. Located just 50 miles from Florida, the archipelago nation is known for its idyllic beaches, pristine waters, hospitable people and superior snorkeling.

But on Sept. 1, paradise became purgatory when Hurricane Dorian made landfall on Elbow Cay in the northern Bahamas' Abaco Islands. For 40 hours, the Category 5 storm pummeled homes, businesses and infrastructure, leaving dozens dead and causing an estimated \$7 billion in damage.

When the storm finally passed, Bahamians emerged from attics, basements and bathrooms to a global humanitarian community that was mobilizing to support them. From rescue helicopters and relief boats to doctors and blood donors, the response was fast and far-reaching.

On the front lines were usual suspects like the American Red Cross and Mercy Corps. Behind the scenes, however, was a chorus of unsung heroes channeling relief to those who most needed it. Among them: NASA, whose Earth Science Disasters Program provides free and open satellite imagery to assist with disaster prediction, preparation, response and recovery.

Using data from the European Union's Sentinel-1 Copernicus satellite, image analysts at NASA's Jet Propulsion Laboratory near Pasadena, Calif., identified the areas that were hardest hit by Dorian, then created and publicly shared an interactive map for use by Bahamian officials, first responders and relief workers. NASA also provided high-resolution flood maps to help response teams reach victims who were stranded in floodwaters.

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## OBSERVATION TO ACTION

Some people might be surprised to see a space agency at the table during terrestrial crises. But NASA has a robust Earth science mission that dates to 1960 and the launch of TIROS-1, America's first weather satellite.

Twenty-six years later, the NASA Advisory Council called for a "robust, long-term implementation strategy for the study of Earth from space." Following the tragic failure of the space shuttle Challenger earlier in 1986, scientists were searching for a way to restore NASA's reputation and secure its future. Earth science seemed the ticket, and in 1991 NASA launched Mission to Planet Earth, whose centerpiece was satellites

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— DAVE APPLGATE,  
U.S. Geological Survey  
associate director for  
natural hazards

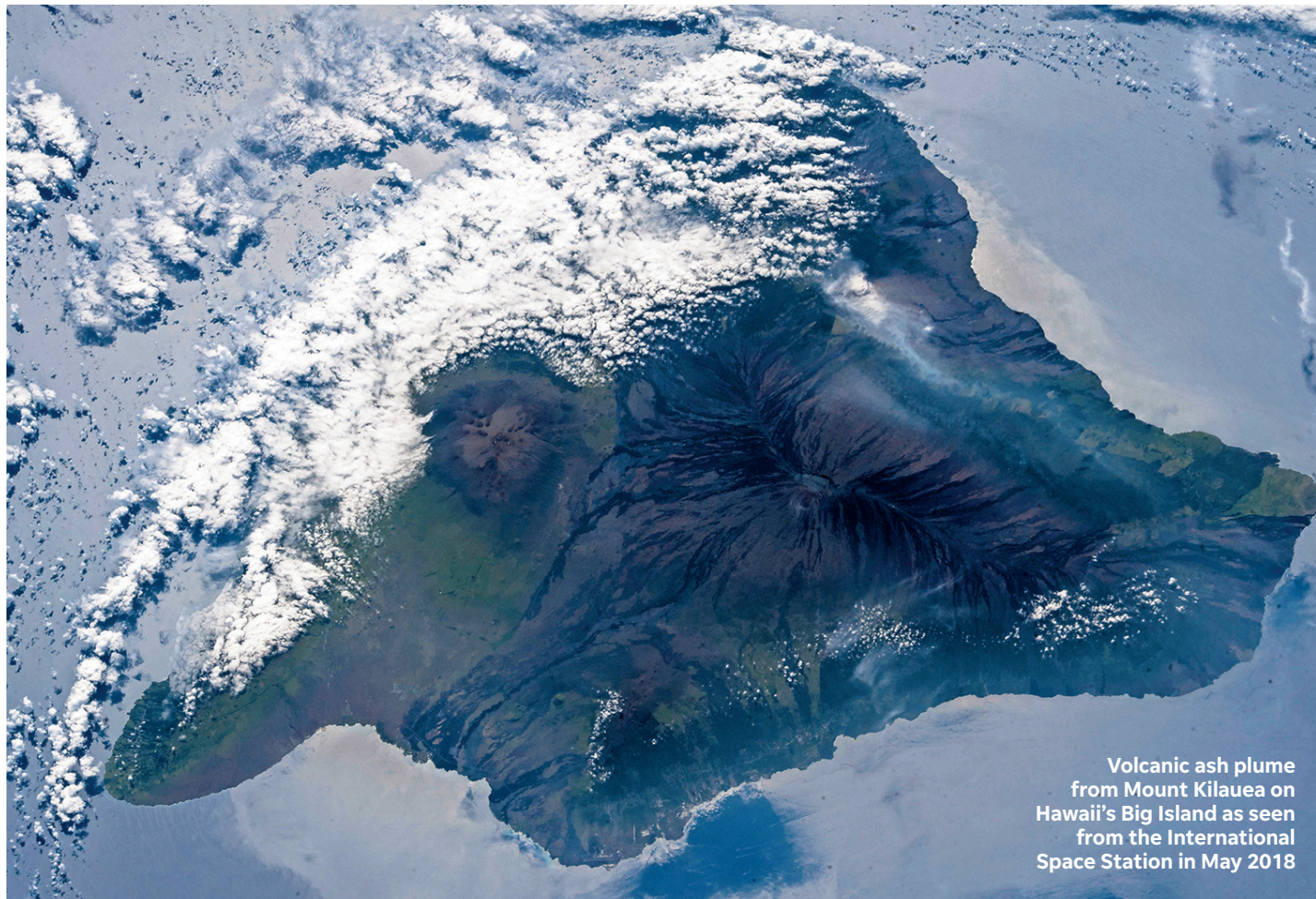
in support of disasters like the 2010 Deepwater Horizon oil spill in the Gulf of Mexico and the 2015 Gorkha earthquake in Nepal. Since 2016, however, its operations have been permanent and ongoing under the direction of program manager David Green, who says NASA is effective during disasters because of its space expertise.

"At any given moment on any given day we're looking at the entire planet — the land, the water, the coasts. We know the history of how the planet has changed and how it's behaving today. And when we put that into models, our analysis tells us how things will evolve and change in the future," Green explained. "During disasters, we need to understand why and how events are happening. ... Only NASA with its systems view of the planet can put all the pieces of the story together."

monitoring and measuring the Earth's systems.

About a decade ago, NASA established its Earth Science Disasters Program with the realization that Earth observations could not only preserve the planet, but also protect its inhabitants.

In its early days, the Disasters Program provided maps, imagery and analysis on an ad-hoc basis



Volcanic ash plume from Mount Kilauea on Hawaii's Big Island as seen from the International Space Station in May 2018

NASA

## SMART SATELLITES

NASA's Earth Observing System (EOS) satellite network can yield valuable information during a range of natural and man-made disasters, including earthquakes, tsunamis, wildfires, floods, landslides, hurricanes, tornadoes, blizzards, tropical cyclones, volcanic eruptions, oil spills and industrial accidents.

But the satellites do more than observe the Earth; they also analyze it. Satellites comprising NASA's Global Precipitation Measurement (GPM) mission, for instance, use advanced radar to estimate how much water might be carried in a hurricane "and how that swirl of clouds and winds actually impacts the amount of rain that's delivered to a coast or community," Green said.

Meanwhile, the Soil Moisture Active-Passive (SMAP) mission can forecast the effects of rainfall on the ground. "SMAP tells us, for example, if the soil is already saturated or if it's really dry," Green continued. "The impact is obviously very different when rain hits a dry surface or a saturated one. Trees might fall over or they might not. Buildings might get

flooded or they might not."

A third mission, the Joint Polar Satellite System (JPSS), uses infrared sensors to see at night. "When Puerto Rico was pounded by Hurricane Maria in 2017, we could see the amount of rain, we could see what was happening on land and we could see when the power went off," Green said. "And as the recovery was starting to happen, we could see the lights come back on. We put all these satellites together to tell the story of what was happening."

## SCIENCE TO THE RESCUE

NASA's clients are as diverse as the disasters to which they respond. Frequent partners include the Federal Emergency Management Agency (FEMA) and the U.S. Department of Agriculture (USDA), not to mention state, local and international authorities, all of whom can access free and open datasets via NASA's Disasters Mapping Portal — an online tool where Green's team publishes "story maps" that contextualize disaster-related data for stakeholders.

"We might work with FEMA or a state partner to determine areas that are

vulnerable or exposed, which can inform preparedness or mitigation," Green said. "When a hurricane happens, we'll work with them to provide situational awareness. And when the response agencies step away, we might work with a different set of partners on recovery and restoration."

The United States Geological Survey (USGS) works with NASA to monitor earthquakes and volcanoes. After the July 2019 earthquakes in Ridgecrest, Calif., for instance, NASA provided before-and-after synthetic aperture radar images to help USGS map associated surface ruptures. A year earlier, during the monthslong eruption of Hawaii's Kilauea Volcano, NASA worked with USGS to livestream video from drones to civil defense officials, who used the footage for situational awareness and at least one search-and-rescue operation.

"NASA's longstanding commitment to free and open access to satellite data has significant benefit, particularly for public safety applications," said Dave Applegate, USGS associate director for natural hazards.