The International Charter Space and Major Disasters
NEWSLETTER

December 2022/ Issue 25

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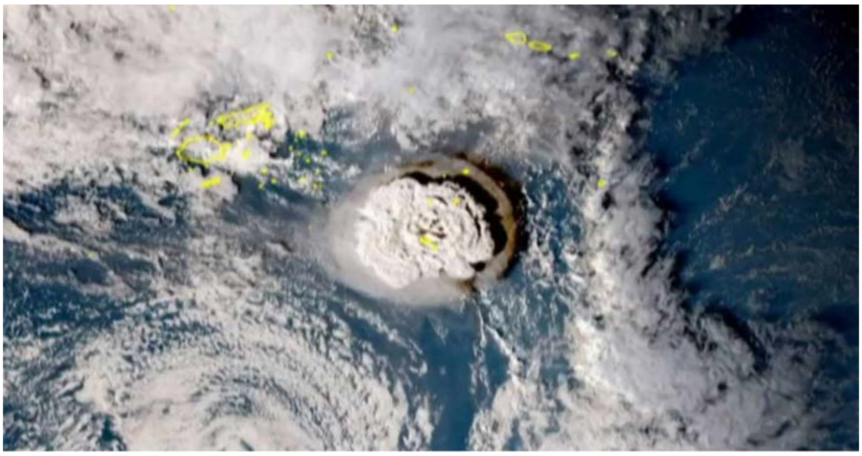
National Oceanic and Atmospheric Administration and United States Geological Survey–Charter Leadership

NOAA and USGS took the responsibility of the Charter leadership in May 2022.

BLACK SKY

The International Charter Welcomes BlackSky Technology Inc. as a data contributor



The Charter Activated by the Violent Eruption of an Underwater Volcano

SATELLITE DATA TO SUPPORT DISASTER RESPONSE WORLDWIDE

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National Oceanic and Atmospheric Administration (NOAA) and United States Geological Survey (USGS) – Charter Leadership

The National Oceanic and Atmospheric Administration (NOAA) alongside the United States Geographic Survey (USGS) assumed the responsibility of leading the Charter in April 2022 from the Instituto Nacional de Pesquisas Espaciais (INPE), Brazil. Due to the ongoing COVID-19 pandemic, the United States hosted the 47th meeting of the Charter virtually. All 17 agencies participated in the meeting.

NOAA and USGS have seen many successes during their leadership period, including:

- Inclusion of three new Universal Access Authorized Users: Honduras, Kenya, and Panama
- The introduction of the "Charter Excellence Award"
- New policy recommendations on Authorized User Applications from International territories

The leadership of the Charter rotates every six months. The next lead, beginning October 2022, will be Korea Aerospace Research Institute (KARI) the aeronautics and space agency of South Korea.

Charter Members during the 47th Boarding Meeting for the International Charter Space and Major disasters

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Black Sky Integration

The International Charter welcomes BlackSky Technology Inc. as a data contributor, hoping to take advantage of their rapidly-taskable and the growing constellation of optical imaging satellites in low-Earth orbit.

BlackSky Technology, Inc. is based in Herndon, Virginia, with a major engineering hub in Seattle, Washington. Initially a sister company to Spaceflight, Inc. under Spaceflight Industries (formerly Andrews Space in Seattle), the company branched out in mid-2020 following the acquisition of Spaceflight, Inc. by Mitsui. BlackSky is unique in its approach to global Earth observation and monitoring, favoring smaller satellites built primarily with COTS products, deployed to varied-inclination LEO orbits in a strategically configured constellation, allowing for most of the populated Earth to be imageable multiple times a day by one of their satellites. With its artificial intelligence, machine learning algorithms, and user-facing platform Spectra, BlackSky is chasing the goal of sub-hourly tasking for most of the globe, delivering real-time geospatial intelligence and site monitoring. This is aided partly by BlackSky's global network and its partner ground stations, strategically placed to achieve the goal of dawn-to-dusk monitoring.

If the Charter might be activated for a global response, the additional capabilities of their AI/ML platform allow for tip-and-cue tasking of the constellation for events of all types, creating scenarios in which BlackSky might already have captured scenes of an event or area of interest where the Charter might be operating. This, for example, was experienced first-hand by BlackSky analysts following the news about the Beirut harbor explosion in mid-2020. Analysts woke up to the news in the USA, only to find that when they went to task for an image of the harbor, the platform had already captured and processed images on the ground (Figure1). The focus of on-site monitoring rather than extensive area mapping allows BlackSky users to easily monitor for changes over time at defined locations within the platform.

Their current generation of satellites is known as the "Global" constellation and consists of 14 commercially operational imaging satellites capable of approximately 1.0 m GSD at Nadir. Additional current generation satellites are tentatively planned for launch within 2022, with the next generation of satellites including higher-resolution optical payloads among other capabilities, likely launching in 2023.

BlackSky intends to offer imagery applicable to Charter users who aid in emergent global disasters, providing near-real-time optical imagery via rapid tasking and delivery. They are excited to further explore the application of its unique capabilities for humanitarian cases through its Charter partnership and look to utilize those insights for other types of aid in the future.

BlackSky aims to contribute to the Charter as an image provider in the coming weeks, following the finalization of technical requirements as needed per the Charter platform.

Figure 1. An image captured by the BlackSky Global-4 satellite shows the site of the Beirut chemical explosion at 8:22 a.m. local time on August 5. Image resolution is about 1 meter (3 feet) per pixel. (BlackSky Global Monitoring Photo)

CSA and NASA Cooperate to Deliver Training at the 2021 Indigenous Mapping Workshop "Turtle Island"

As one of the initial founders of the Charter, the Canadian Space Agency (CSA) and its Earth Observation (EO) satellites have been regular contributors of data for many Charter disaster activations around the globe. CSA's RADARSAT Constellation Mission (RCM) provides emergency responders with rapid revisit capabilities, reliable coverage, and excellent maps of various disasters. Several Charter activations have occurred over Canadian terrestrial and marine areas, including some over indigenous people's lands. One example was Alberta's 2016 Fort McMurray fire, which directly impacted the Indigenous population. Training about disaster-related EO capabilities is an important element of the CSA's outreach activities.

To forward this goal CSA is a member of CEOS' Working Group of Capacity Development and Democratization (WG CapD). Last year, EO experts from the CSA, the Government of Canada, and colleagues at NASA's Applied Science group came together for several capacity development sessions at the annual Indigenous Mapping Workshop (IMW). Held online, the IMW 2021 was organized by the Firelight Group for more than 800 participants from North America's Indigenous communities and other parts of the world. Workshop sessions on EO emergency response covered introductions to satellite radar imagery and satellite mapping of the flood, wildfire, and ice emergencies. The methods for providing timely and effective disaster response were discussed as well. The capabilities of CSA's RADARSAT Constellation Mission were presented and were well received by the participants. Some of the training with Indigenous practitioners in the field of geomatics included hands-on exercises using satellite imagery of actual emergencies and sharing the traditional knowledge of the Indigenous communities. Engagement with colleagues in the Indigenous geospatial community was a valuable two-way learning process and an exciting introduction for the presenters to indigenous geospatial know-how.

Looking forward to the future, improving connections between the IMW and the Charter members, including two-way EO capacity development with First Nations internationally, is an avenue well worth exploring. Incorporating how Indigenous communities are affected by disasters into the Charter's response mechanisms holds the promise to enrich the Charter's capabilities. More activities related to the Charter are planned for IMW 2022.

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The Charter Activated by the Violent Eruption of an Underwater Volcano

On Saturday, January 15th, 2022, the underwater volcano Hunga-Tonga-Hunga-Ha'apai erupted. The island formed by the volcano in 2015 has completely disappeared. The eruption covered neighboring islands with ash and caused tsunamis on the Pacific coast.

The eruption lasted eight minutes; it was so loud it was heard "like a distant thunderclap" over the Fiji Islands more than 800km (500 miles) away, officials said in the Fijian capital of Suva.

It was also heard as far away as Alaska and sent plumes of gas, ash, and smoke several kilometers into the atmosphere. The United States Geological Survey (USGS) recorded it as equivalent to a magnitude 5.8 earthquake.

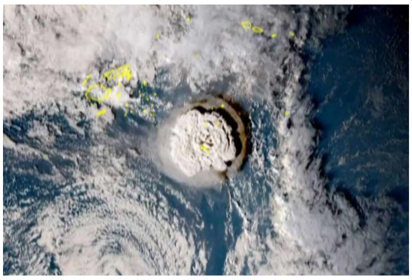

Figure 1. View taken from space showing the eruption of the Hunga-Tonga-Hunga-Ha'apai underwater volcano on one of the uninhabited islands of the archipelago.

The International Charter "Space and Major Disasters" was activated when the eruption occurred (January 15th- Activation #744). Earth observation satellites were tasked to gather images of the volcanic eruption and the islands of the Tonga archipelago. The project manager for this activation was UNITAR (United Nations Institute for Training and Research). For more details, please see https://youtu.be/ywAwVWvx2P0.

The four Value Added products shown below were produced by SERTIT-Icube following a CNES request to show before/after situations following the major disaster in Tonga. The recent images on the right were acquired by the Pléiades satellites. In contrast, other satellite data providers produced the reference images on the left (see the explanatory legend of these images).

Figure 2. Before-after view of the island formed by the volcano that has completely disappeared.

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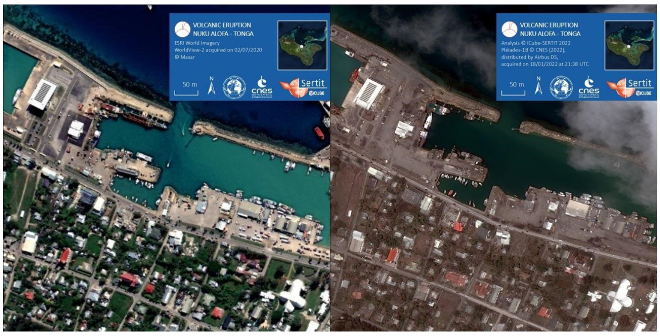


Figure 3. Before-after view of the port in the capital of Tonga, Nuku'alofa.

Figure 4. Before and after view of Vaiola Hospital in Nuku'alofa, capital of Tonga.

Figure 5. Before-after view of Nomuka Island, located a few tens of kilometers northeast of the volcano.

Moreover, the violent volcanic eruption was accompanied by a major tsunami, which spread throughout the Pacific Ocean, reached the coast of Peru, and caused two deaths as well as several devastating oil spills. The passage of the tsunami wave, which propagated at ~800 km/h (500 miles/ hour.), could only be detected if the passage of an altimeter satellite was co-located, at the same place, at the same time. The current constellation of nine altimeter satellites in orbit increased the chances of following the tsunami's propagation on the ocean's surface. Thus, 20 different altimeter profiles were detected during this tsunami, showing troughs and peaks of -/+ 40 cm.

Figure 6. Value Added Product for damage assessment in Atata Island provided by UNITAR/UNOSAT

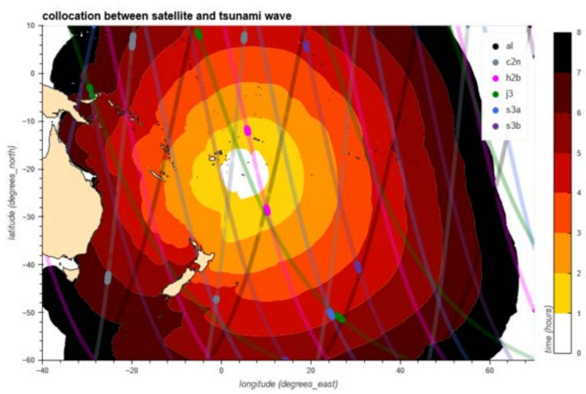


Figure 7. Modeled temporal evolution of the position of the tsunami wavefront as it moves away from the epicenter (white area), and position of the altimetric constellation in the 8 hours following the eruption (different colors depending on the satellite). The short and thick lines show the colocation within 5 minutes between the tsunami wave and the altimetric traces (Credits: CNES/CLS; CEA for the propagation model.

Pléiades Neo, a new high-resolution contributor on the way

CNES, one of the founding Charter members, which provides SPOT and Pléiades data, will soon add Pléiades Neo as a new Charter data contributor (2nd semester 2022).

Pléiades Neo is a new constellation of very high-resolution optical satellites. It is composed of four agile identical satellites (two launched in 2021 and the next two launched at the end of 2022). The constellation was funded, designed, and manufactured by Airbus Defence and Space for both civil and defense usage. The Pléiades Neo technical characteristics are presented hereafter:

- Sun-synchronous orbit, descending node, 620km altitude
- 30 cm native resolution for a 14 km swath (First European 30 cm constellation)
- Accurate geolocation: 3.5m native location accuracy
- Mono, stereo, and tri-stereo acquisition capability
- Six spectral bands: Deep Blue, Blue, Green, Red, Red Edge, Near-infrared, and Panchromatic (the new Deep blue and Red-edge are for maritime and vegetation applications)
- The constellation will cover up to 2 million km² every day (500,000 km2/day/sat)
- Each point of the Earth will be revisited twice a day thanks to the four satellites (between 30° and 46° off-Nadir)
- Unrivaled cloud cover: less than 10% expected for 70% of the images thanks to an accurate weather forecast updated at and for each orbit
- Fast tasking, acquisition, and delivery cycle (tasking plan updated every 25 minutes)
- Cloud-based ground segment architecture for production and easy access in OneAtlas
- 10-Year mission lifetime

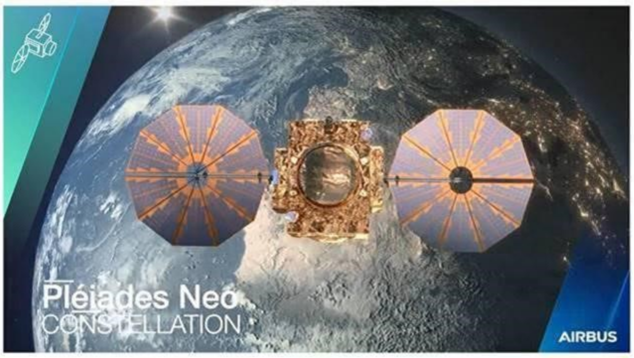
Consisting of four identical satellites, the Pléiades Neo constellation will work for hand in hand with the existing Pléiades satellites and the rest of the Airbus Earth observation satellite fleet. The highly compact Pléiades Neo spacecraft has a lightweight, next-generation silicon carbide optical instrument.

Taking reactivity one step further: Pléiades Neo is the first commercial EO satellite that will benefit from laser optical and Ka-band links with the Airbus SpaceDataHighway* (EDRS) geostationary satellites to enable urgent acquisitions in just 30 to 40 minutes following a tasking request to respond to the most critical situations swiftly.
For Charter activities, the benefits of this new constellation are numerous. The latency of satellite tasking after activation will be improved, and the cloud cover will be reduced for acquisition. Images will then be delivered in a short timeframe to provide a fast response to major disasters. The high-resolution imagery will help rapid-mapping value adders when interpreting images allowing for a better post-disaster damage assessment, especially in dense urban areas.

The stereo mode can improve Digital Elevation models in case of displacement of continental surfaces (landslides, eruption, etc.).

The two famous Pléiades satellites (1A and 1B, launched respectively in 2011 and 2012) provided hundreds of 50-cm resolution images for Charter activations and should be operated until 2024.
For more information, please see the commercial video: Pléiades Neo 30cm satellite imagery is now available for purchase - YouTube

** EDRS – the European Data Relay Satellite System, a European constellation (from ESA) of geostationary satellites whose role is to ensure the relay between satellites in low earth orbit and ground stations. Thus, the satellites can permanently transmit their data to the ground stations via the EDRS satellites without waiting to fly over them.*



Artist view of a Pléiades Neo satellite (Airbus Defence and Space)

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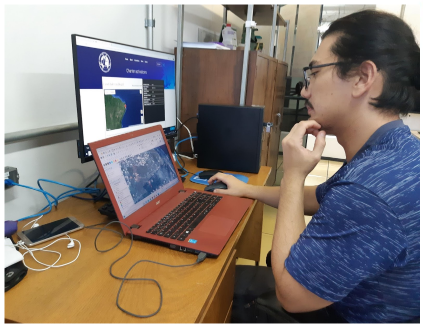
A Value Added Provider (VAP) Learning exercise

INPE not only performs and executes our national satellite missions and responsibilities but also holds a distinctive postgraduate program. It covers areas such as Remote Sensing, Meteorology, Astrophysics, and Earth System Science. Many students looking for a master's or a doctorate from all over Brazil join these area's programs. In 2022 INPE had more than 20 students joining the Remote Sensing Program.

The Remote Sensing Program at INPE includes topics in image processing with expertise in handling GIS software and satellite images. Students spend about one year taking fundamental classes in remote sensing, learning theory, and applying different techniques, such as how the radiometric spectrum acts on different targets, and applying it in different Earth science subjects of study, like agriculture, forest management, oceanography, etc.

Side by side with theoretical knowledge, the Program also supports the students in many hands-on and practical activities that challenge them with real applications. Critical environmental issues like land use changes and mapping, forest disturbances, fire and drought, and natural disasters are some critical work these students might be involved with. Taking that into consideration, students were invited to collaborate in the role of producing valuable maps, becoming our mentored Value Added Product designers. Starting in Activation 751 (Flood and Landslide in Petropolis - Brazil) and throughout all the other Brazilian Activations, their interest grew to a point where as many as 15 students were interested in contributing as volunteers. The landslide disaster in Pernambuco, northeast Brazil (Activation 758) was their premiere occasion (see photo). With all their help, more than 50 Value Added Products (VAPs) were promptly provided.

This kind of cooperation demonstrated how the academic community could act and serve the community. Most importantly, two purposes could be targeted. At the same time, they worked to refine their skills at the academic level. They were also encouraged to deliver crucial information to assist and support disaster relief actions.



Graduate students using image processing software, and images such as those obtained by CBERS-4A and Amazonia-1 to compose maps used as VAPs for Disasters Charter (Credits: INPE Photo)

Celebrating 50 Years of Landsat Earth Observations

In 1972, an experimental satellite named Earth Resources Technology Satellite (ERTS) was launched by the National Aeronautics and Space Administration (NASA) with the goal of being the first dedicated satellite to usher in a new era of Earth observation.

Orbiting hundreds of miles above the Earth, ERTS, later renamed as the first Landsat, peered down upon the land and provided an eye-opening view of the planet not previously available. This initial implementation of Landsat included the first Earth observation satellite sensor, the Multispectral Sensor (MSS), which provided 60-meter resolution data in the visible green, visible red, and two infrared bands. The MSS was a prototype sensor that was secondary to the primary payload, including a Return Beam Vidicon camera, like a television camera. Nevertheless, the MSS was quickly shown to be a superior instrument, and a new generation of satellite Earth imaging was born.

Analysts were thrilled and amazed to see the land and infrastructure features that were discernible from the first Landsat scenes over areas such as Dallas, Texas (Figure1). Roads, airports, farm fields, and other structures were easily identified from hundreds of miles above. Soon, scientists and government agencies were using Landsat to measure global food supply, locate mineral deposits, estimate timber volume, tracking flooding, snow-melt runoff, and glaciers around the world.

As the archive of Landsat data grew and with the provision of repeated visits to each point on Earth multiplied, scientists started to identify changes in land resources over time. Urban growth, forest destruction, fluctuating rivers and reservoirs, burned area assessments, and disaster management all became uses for which satellite-based observations could assist.

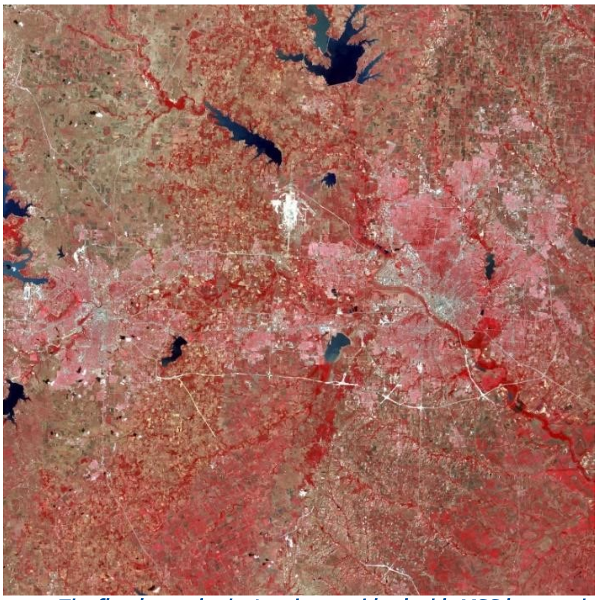


Figure 1: The first image in the Landsat archive is this MSS image, showing the Dallas-Fort Worth area of Texas on July 25, 1972. The resolution is 60 meters per pixel in this false-color image, where shades of red indicate vegetated land, grays and whites are urban or rocky surfaces, and several reservoirs and water bodies are identifiable in shades of blue.

The Landsat program, jointly operated by NASA and the US Geological Survey (USGS), has employed a series of satellites to carry out 50 years of Earth observation. Landsat 2, 3, and 4 followed Landsat 1 in 1975, 1978, and 1982, respectively. Launched in 1984, Landsat 5 set an official Guinness World Record for the "longest-operating Earth observation satellite," delivering high-quality, global data for 28 years and ten months, far beyond its three-year design life. Landsat 6 failed to achieve orbit in 1993. The remainder of Landsat satellites has accomplished successful launches and data collection: Landsat 7 in 1999, Landsat 8 in 2013, and Landsat 9 in September 2021.

In 2008, a substantial policy change that made Landsat data freely available to the global community was implemented and fostered the extensive use of these data and set a precedent for open data policies in the Earth observation community. Since that time, not only have individual users had free access to specific Landsat data and imagery, but open public access has encouraged geospatial and data processing firms, such as Amazon, ERSI, Google, and Microsoft, to host the entire massive Landsat archive and to develop advanced access, retrieval, and visualization application for the data.

Landsat has played an active role in assessing damage from natural and man-made disasters. Equipped with near-infrared and thermal infrared sensors, Landsat 5 was the first civilian satellite to confirm the gravity of the April 26, 1986, Chernobyl disaster near Pripyat, Ukraine. Landsat data has continued to support disaster management by leveraging the huge global archive of data that can then be compared against post-event imagery of a disaster area to assess damage to infrastructure and natural resources.

Landsat has contributed to several International Charter activations over the years and is still very useful in assessing damages from floods, wildfires, earthquakes, volcanic eruptions, and ocean storms. Both Landsat 8 & 9 were used in a recent (July 2022) activation for a wildfire in Tunisia (Figure 2).

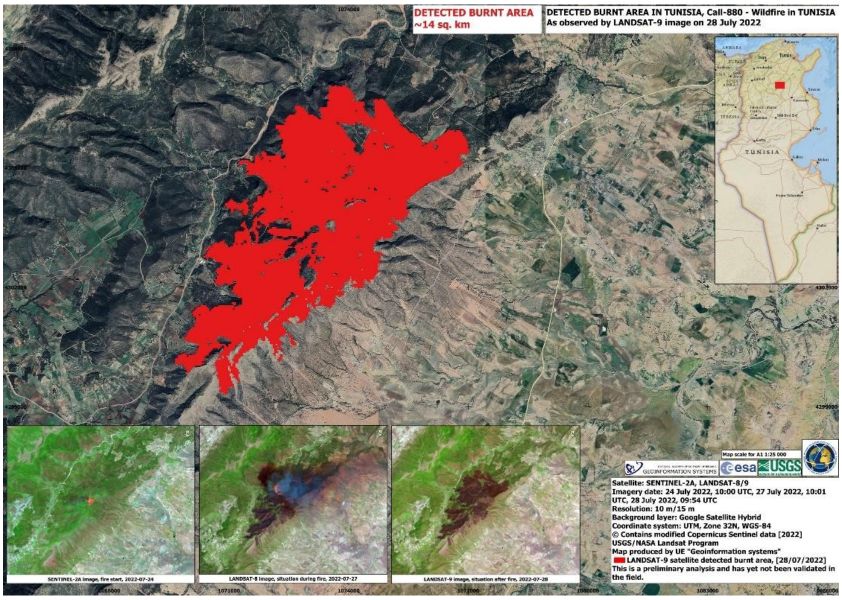


Figure 2. Pre-event imagery from Sentinel -2A was compared with post-event collections from Landsat 8 and 9, which showed both active fire/smoke (center) and burn scars (right), allowing the burned area to be identified and mapped.

Looking beyond the current Landsat 8 and 9 satellites to another mission by the end of the decade, a joint NASA-USGS design team has identified an affordable, next-generation concept for the Landsat Next mission. It is expected to provide higher spatial resolution and twice the number of spectral imaging bands of Landsat 8 and 9. Compatibility with the existing Landsat archive will be maintained, and additional commercial and international partnerships are expected to be forged. One thing is for sure. Landsat Earth observation's legacy will continue to inspire scientists and researchers to push the limits of how land cover change, whether intentional or not, can be assessed using this vast collection of images of our planet.

Acknowledgment: Some information for this article was sourced directly from the USGS Six-part Series, Highlighting the 50th Anniversary of Landsat, and we'd like to acknowledge those authors' contributions.