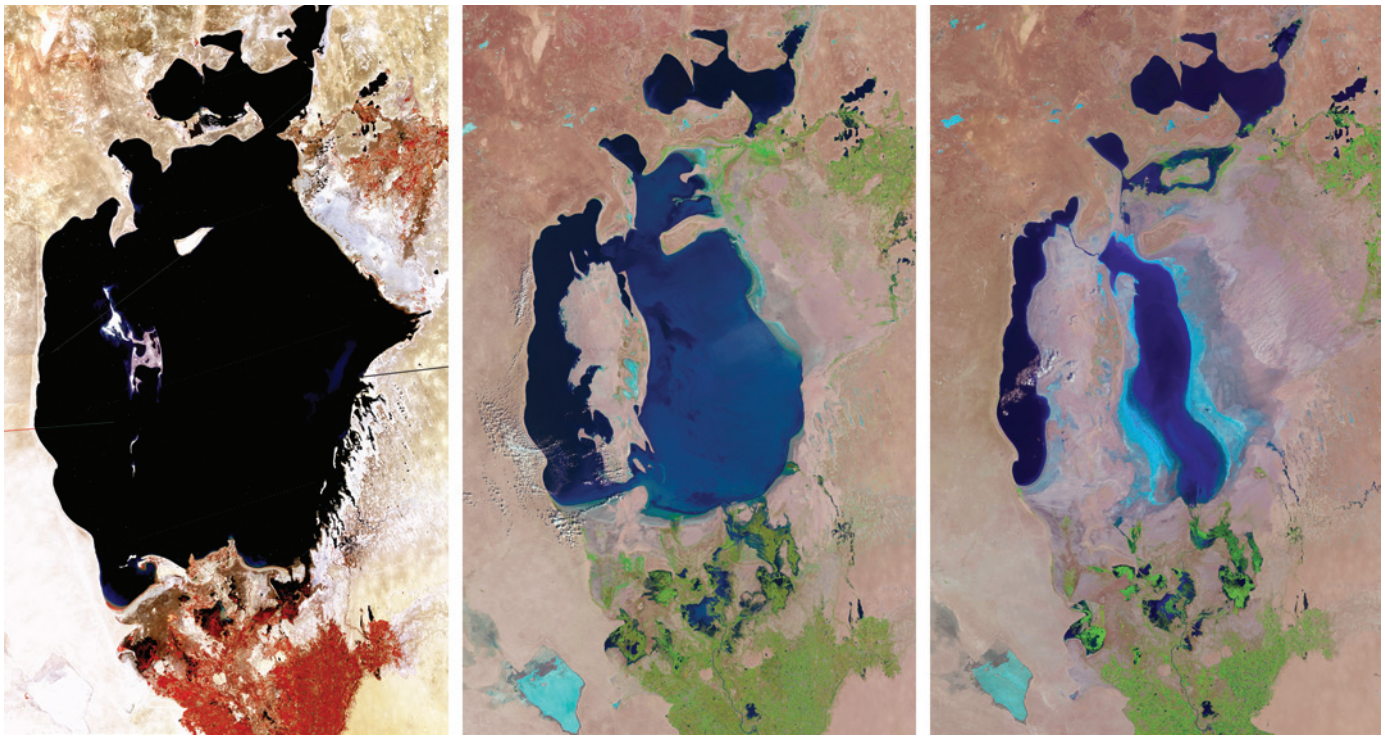
NEWS IN FOCUS

USGS EROS DATA CENTER



Images from the Landsat satellite series show the Aral Sea in central Asia shrinking significantly from 1977 to 2010 because of water diversion.

EARTH SCIENCE

Landsat 8 to the rescue

NASA prepares to launch satellite that will continue historic record of global change.

BY JEFF TOLLEFSON

When Landsat 5 fell silent on 6 January, scientists across the globe mourned its passing but gave thanks for its fortitude. The satellite had lasted a record-breaking 28 years, snapping images of the changing planet from melting glaciers to burning rainforests, while its successors faltered. Landsat 6 failed during launch and Landsat 7, at 13 years old, is partially blind and has limited fuel. With the passing of Landsat 5, the future of the world's longest-running — and perhaps most influential — set of data on global change rests with Landsat 8, which is scheduled to launch next week from Vandenberg Air Force Base in California.

"Landsat 8 is the most important NASA Earth-observing mission in over a decade," says Greg Asner, an ecologist at the Carnegie Institution for Science in Stanford, California, who uses Landsat data to track tropical-forest trends. After making do for years with ageing and impaired orbiters, "we are getting our eyes back in the sky", says Asner. "Those eyes are going to be extremely good."

From the first launch in 1972, Landsat was designed to provide a global record of land-cover and land-use change. The earliest satellites captured images at several visible-light and near-infrared frequencies, all with a resolution of 80 metres. Landsats 4 and 5 reached 30-metre resolution and could see farther into the infrared, to aid studies of soil moisture and vegetation. Landsat 7 added a multi-spectral sensor that can achieve 15-metre resolution. Through careful calibration, the programme has built up a continuous 40-year record of observations at the original frequencies, spanning a period of huge change for the planet.

The latest mission, commissioned in 2002, had a tortuous birth. NASA originally intended to buy data from a privately owned satellite, then formulated a plan to mount Landsat sensors on a separate set of polar-orbiting satellites. Only in 2005 did the administration of then-president George W. Bush call for an independent craft, formally known as the Landsat Data Continuity Mission.

The size of a large jeep, the US$855-million spacecraft will circle Earth at an altitude of about 700 kilometres, carrying sensors of even higher precision than its predecessors. Instead of scanning the terrain below it with a ▶

mirror and sending the signal to a few sensors, it will capture instantaneous views of a 185-kilometre swathe of Earth, using some 7,000 sensors for each bandwidth. The result is more data from each location and better image quality. "The data are much more sensitive to change across the landscape and over time," says Jim Irons, project scientist for the mission at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "Maybe we will be able to better differentiate corn from sorghum, for example, or maple trees from oak trees."

The spacecraft will also be the first in the Landsat series to collect data in an 'ultra-blue' band, particularly useful for studying oceans and atmospheric aerosols. Another new data stream will be a shortwave infrared band that is sensitive to cirrus clouds, which are powerful players in Earth's climate.

Landsat has endured major changes in ideology and organization during its lifetime, notably in the 1980s and 1990s, when Congress gave control of the satellites and all data to a private company. Images sold for several thousand dollars each, limiting analysis to an elite corps of scientists. The government regained control in 2001, however, and from 2008 the US Geological Survey, which oversees the data, opened up the archive as a free global resource. Access exploded. Whereas the agency once sold around 15,000 images a year, annual downloads now average about 3 million.

"It provided for data democracy," says Mike Wulder, a research scientist at the Canadian Forest Service in Victoria and a member of the Landsat science advisory team. "Landsat really is a global resource."

The data helped to spark a digital revolution among remote-sensing specialists, who have developed tools to exploit massive computing resources and stitch together high-resolution records of global change over time and space. Other space-borne imagers, such as the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra and Aqua satellites, can take snapshots of larger areas at a single pass, but with much lower resolutions.

With Landsat, "we can get the detail and the enormous geographic coverage", says Asner. "This alone puts Landsat at the very forefront in land-cover and land-use change monitoring."

Landsat 8 is scheduled to begin operations 90 days after entering orbit, although the first images could arrive within three or four weeks. The satellite might not live as long as its predecessor, which NASA engineers have put forward as a candidate to Guinness World Records, but Irons believes that Landsat 8 will make its own mark. "I do not think it hyperbole to suggest that all seven billion of us will benefit from the Landsat continuity mission." ■

NUCLEAR ENERGY

Quake fears rise at Japan's reactors

Commissioners say that geological faults make some reactors too dangerous to restart.

BY DAVID CYRANOSKI

Plans to restart some of Japan's 50 nuclear reactors, which have been idle since the Fukushima Daiichi disaster in March 2011, have hit an obstacle — and his name is Kunihiko Shimazaki. Buoyed by a new cabinet keen on nuclear power, the nuclear industry wants to get the plants back online to meet the country's energy demands. But before it can do so, Shimazaki and a group of 16 other geophysicists working for the country's Nuclear Regulation Authority (NRA) must confirm the industry's claims that the plants do not face a serious earthquake threat.

To judge by his initial reports, Shimazaki won't accept the claims lightly. On 28 January, Shimazaki, an NRA commissioner who warned in 2004 that Fukushima's coast was more vulnerable to tsunamis than regulators had claimed, angered proponents of nuclear energy by reporting his group's conclusion that there is probably an active fault under the Tsuruga nuclear plant, which was due to restart. If, as expected, the NRA endorses that finding, the plant won't be allowed to operate.

But the team's evaluations have been questioned, and not just by the nuclear industry. Seismologists dispute whether the faults that Shimazaki's researchers are finding meet the NRA's definition of 'active', meaning that they have generated an earthquake in the past 120,000 years or so. In some cases, say the critics, the fractures are not dangerous and some may not even be faults at all.

"They are being overly cautious just to avoid criticism," says Koji Okumura, a palaeoseismologist at Hiroshima University who was on an expert subcommittee of the cabinet's Nuclear Safety Commission until it was replaced by the NRA in September 2012. "They think they're like Superman coming in to save us from the bad guys."

Shimazaki's team is evaluating five plants, comprising 12 reactors in total, plus the shuttered Monju experimental fast breeder reactor (see 'Finding faults'). Four of the five plants are due to restart; at the fifth, two of the four reactors are already running. What the team is finding is often at odds with the industry's assessment.

The Tsuruga plant's reactors, for example, are 250 metres from a known fault. Excavations by the plant's owner, the Japan Atomic Power Company, showed that the ground had shifted across the fault, suggesting that the fault had been active. But the company's experts had concluded that the movement had happened before the 120,000-year threshold.

When Shimazaki's experts examined the company's trench, they found signs of more recent movement, and evidence that an extension of the fault runs directly beneath one of the reactors. "If you look at the displacement and slant, it looks like it's a continuation" of a fracture running under the reactor, he says.

Problems also turned up in a survey by the Kansai Electric Power Company (KEPCO) of its Oi plant, which houses Japan's only two running reactors. The plant is bisected by a fault, which KEPCO says is inactive. But Shimazaki says that crucial data from the original trench dug by KEPCO's researchers are missing. And in December, Shimazaki announced that his group had found an active fault near the Higashidori plant, at which one reactor is idle, one is under construction and two more are planned. A full report is expected soon, but the Tohoku Electric Power Company, which operates the plant, says that it will produce data proving that the faults are not active.

NATURE.COM
For more on Japan's earthquake and nuclear crisis see:
nature.com/japanquake