JAXA

THE EARTH FROM ALOS

NEW PERSPECTIVES FROM SPACE

Spectacular Scenes

The three "eyes" of ALOS

Revealing the Earth's mysteries

Three-dimensional satellite photos

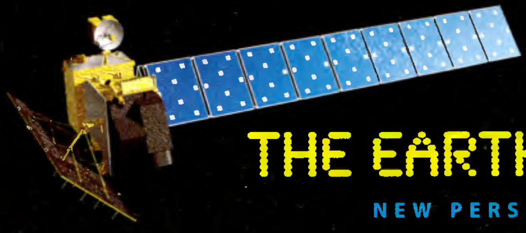
Walks through Old Paris

Documenting ALOS

ALOS on the Internet

The cover image of the Baltic Sea was observed by the Advanced Land Observing Satellite (ALOS), launched by the Japan Aerospace Exploration Agency (JAXA) on January 24, 2006. The excessive growth of plankton is clearly shown by the white swirling patterns.

JAXA
Japan Aerospace Exploration Agency

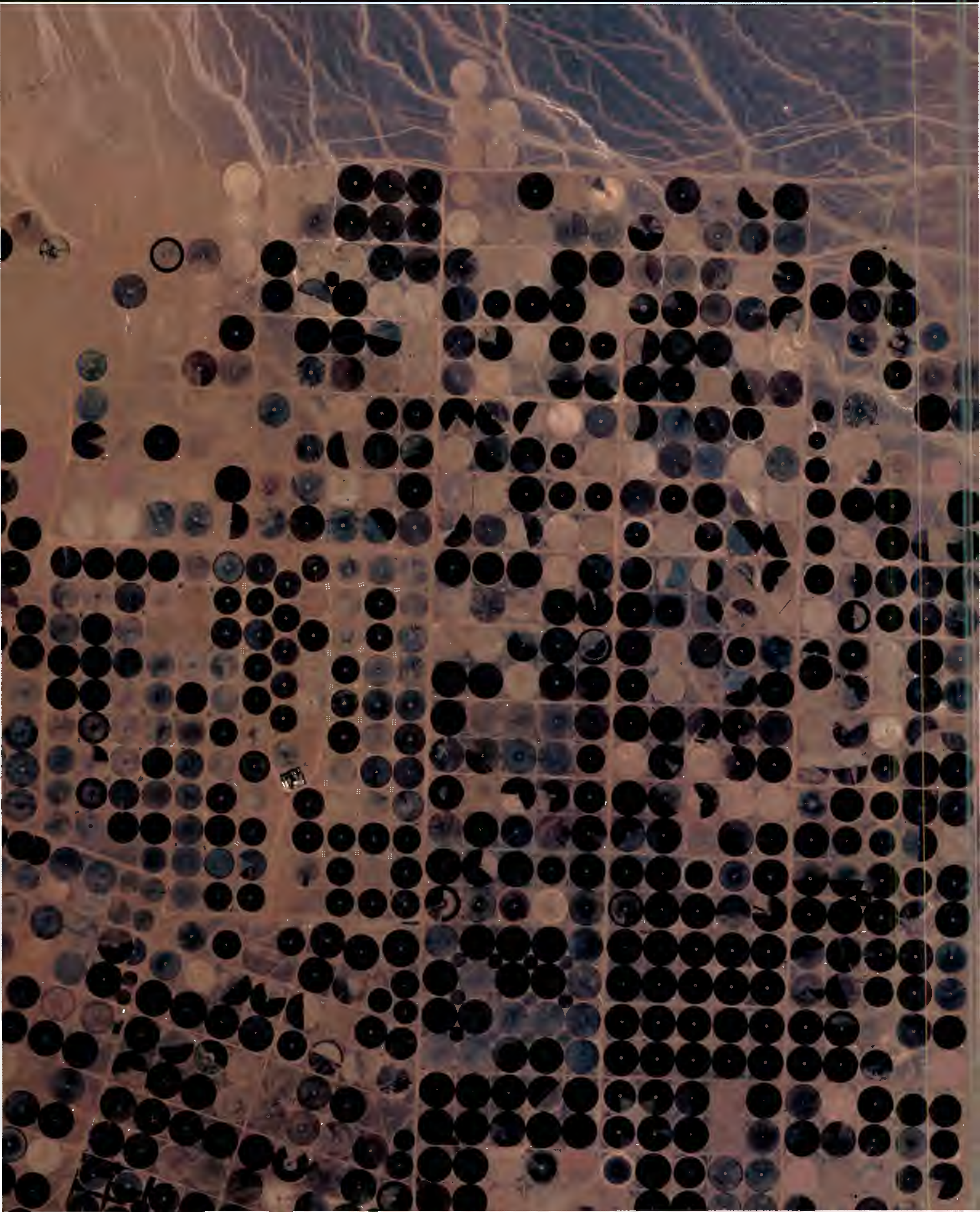


THE EARTH FROM ALOS

NEW PERSPECTIVES FROM SPACE

SPECTACULAR SCENES

THE TRUE FACES OF THE EARTH, AS RECORDED BY THE ADVANCED LAND OBSERVING SATELLITE (ALOS)



Irrigation circles in Saudi Arabia

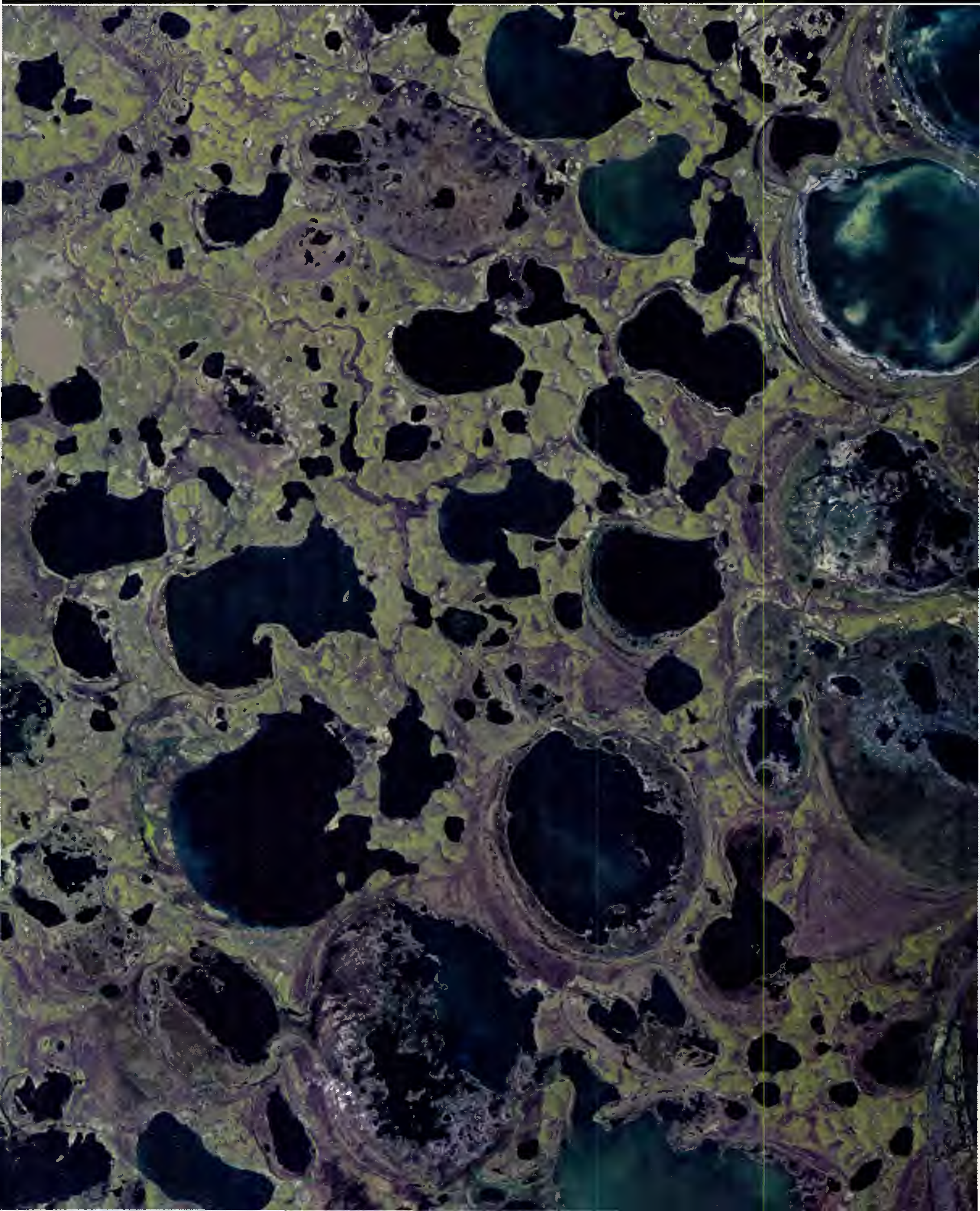
The various large and small circles are irrigation circles in the mountainous Tabuk region of Saudi Arabia. Water is drawn from an aquifer to cultivate wheat, but there are concerns that the aquifer is being exhausted.

2006/12/4 AVNIR-2

Innumerable lakes and marshes in Siberia

The Kolyma River lowlands in summer, in the Saha Republic, Russia. In winter it is completely covered with ice and snow, which melt in summer to reveal innumerable lakes.

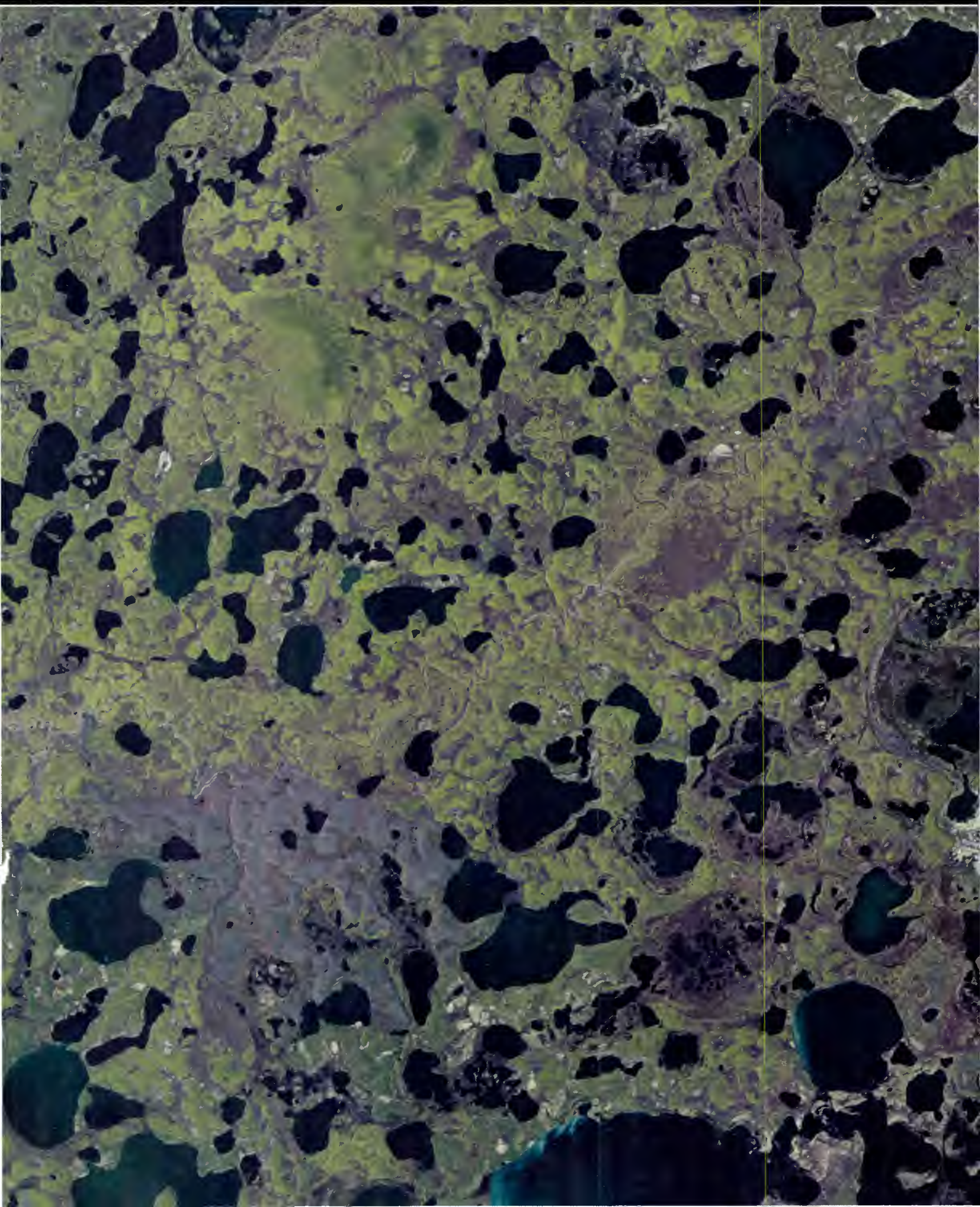
2006/9/8 AVNIR-2



Plankton in the Baltic Sea

The sea near the island of Rügen in the Baltic Sea, north of Germany. The white swirling pattern indicates excessive plankton growth, which can easily lead to oxygen depletion of the water. (Top)

2006/7/13 AVNIR-2



Artificial islands in Dubai

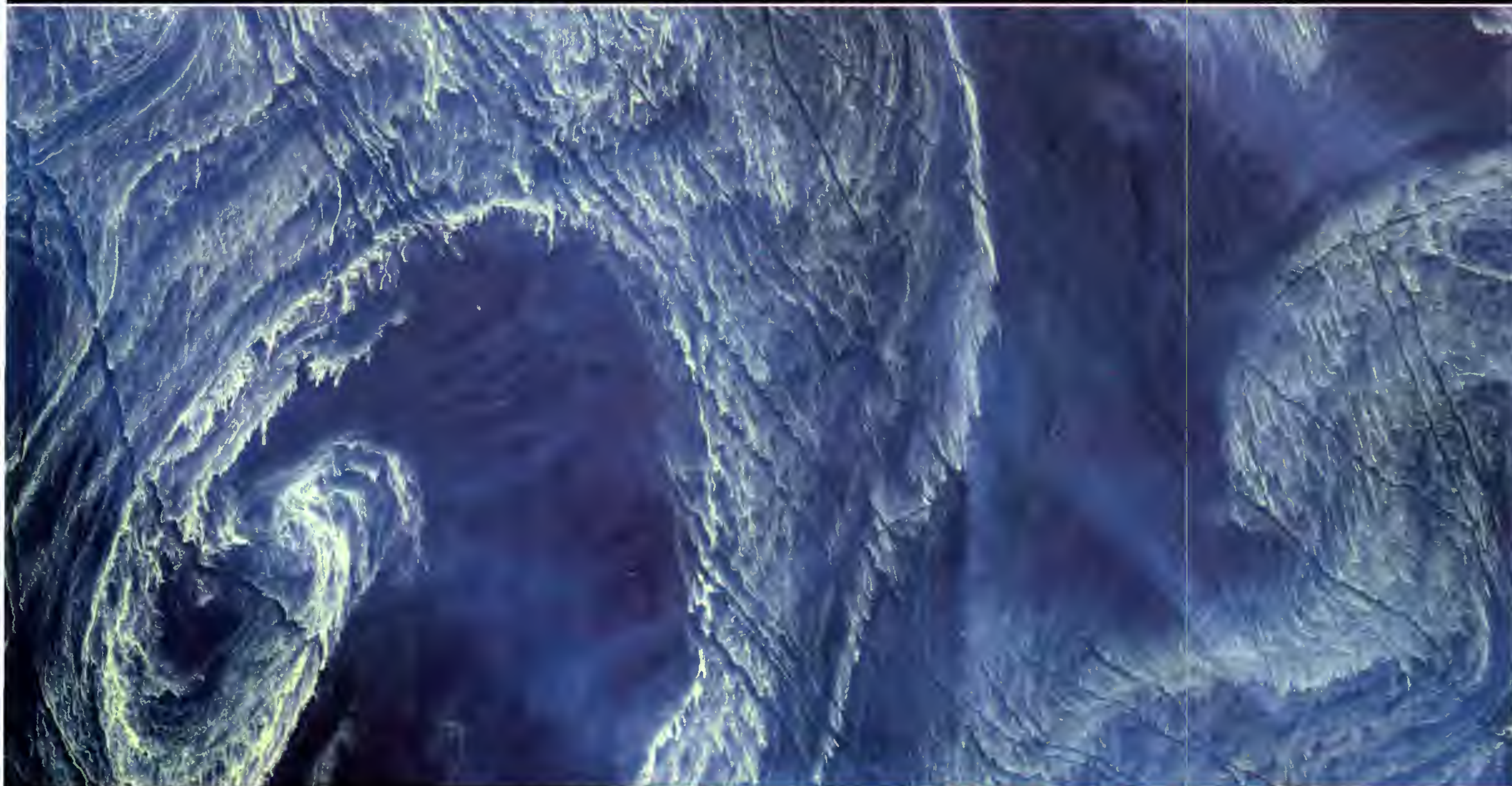
Dubai is one of the United Arab Emirates. Artificial islands project into the sea. The palm-tree-shaped island in the center is lined with more than 4,000 luxury villas.

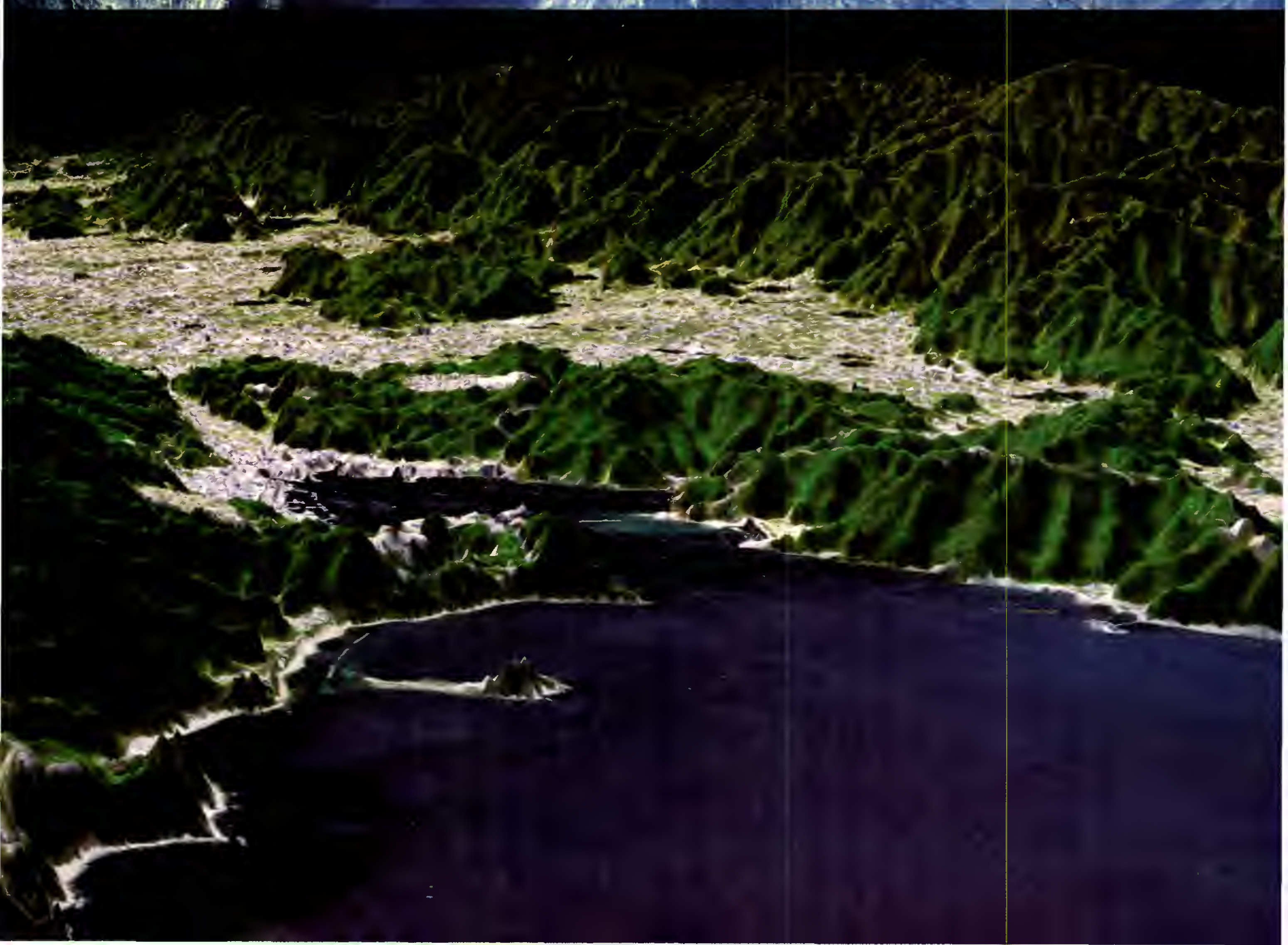
2006/9/23 AVNIR-2

Naruto Straits

Images from PRISM and AVNIR-2 were combined to create a bird's-eye view of Awaji Island. The Onaruto Bridge, which connects to Naruto City, Tokushima prefecture, is shown near the bottom of the picture, with the Yuzuruha mountain range stretching away to the right. (Bottom)

2006/4/28 PRISM AVNIR-2





Uluru (Ayers Rock)

Uluru, located near the center of the Australian continent, was formed 230 million years ago. It is 350 meters in height with a circumference of approximately 10 km, making it one of the largest monolithic rocks in the world.

2006/9/12 PRISM

Sakhalin 2 is a large-scale natural gas development project in the Sea of Okhotsk, with an estimated annual production of 9.6 million tons. The liquefied natural gas plant is clearly visible at the bottom left.

2006/11/3 AVNIR-2

Kyoto Basin

The Kyoto Basin contains Kyoto City, Uji City, Nagaoka-kyo City, Oyamazaki Town, and Kizu Town. Formerly a lake bottom, the land rose and formed a basin. Several rivers join together and form the Yodo River.

2006/10/9 AVNIR-2

Agricultural land in Argentina

Agricultural land in the Entre Rios Province of northern Argentina. The region is famous for production of citrus fruit, corn and soybeans. Large-scale fields are divided by orderly, straight lines.

2006/10/15 AVNIR-2

Spiral patterns in the North Pacific Ocean

Spiral patterns in the Philippine Sea in the North Pacific, south-west of Okinotori Island. The appearance of the spiral pattern is probably due to ripples being influenced by ocean currents, which then reflect sunlight.

2006/3/25 AVNIR-2

Hachirogata

Hachiro Lake, at the base of the Oga Peninsula in Akita prefecture. This was the second largest lake in Japan, but in 1957 the lake began to be filled in, and most of the lake has been turned into rice paddies. Roads form a grid-like pattern of lines. (Top)

2006/5/27 AVNIR-2

Las Vegas

The city of Las Vegas in the state of Nevada, USA, which is home to famous big casinos, spreads across a basin ringed by mountains in the Nevada desert. Approximately 500,000 people live there. (Bottom)

2006/11/16 AVNIR-2

Israel-Egypt border

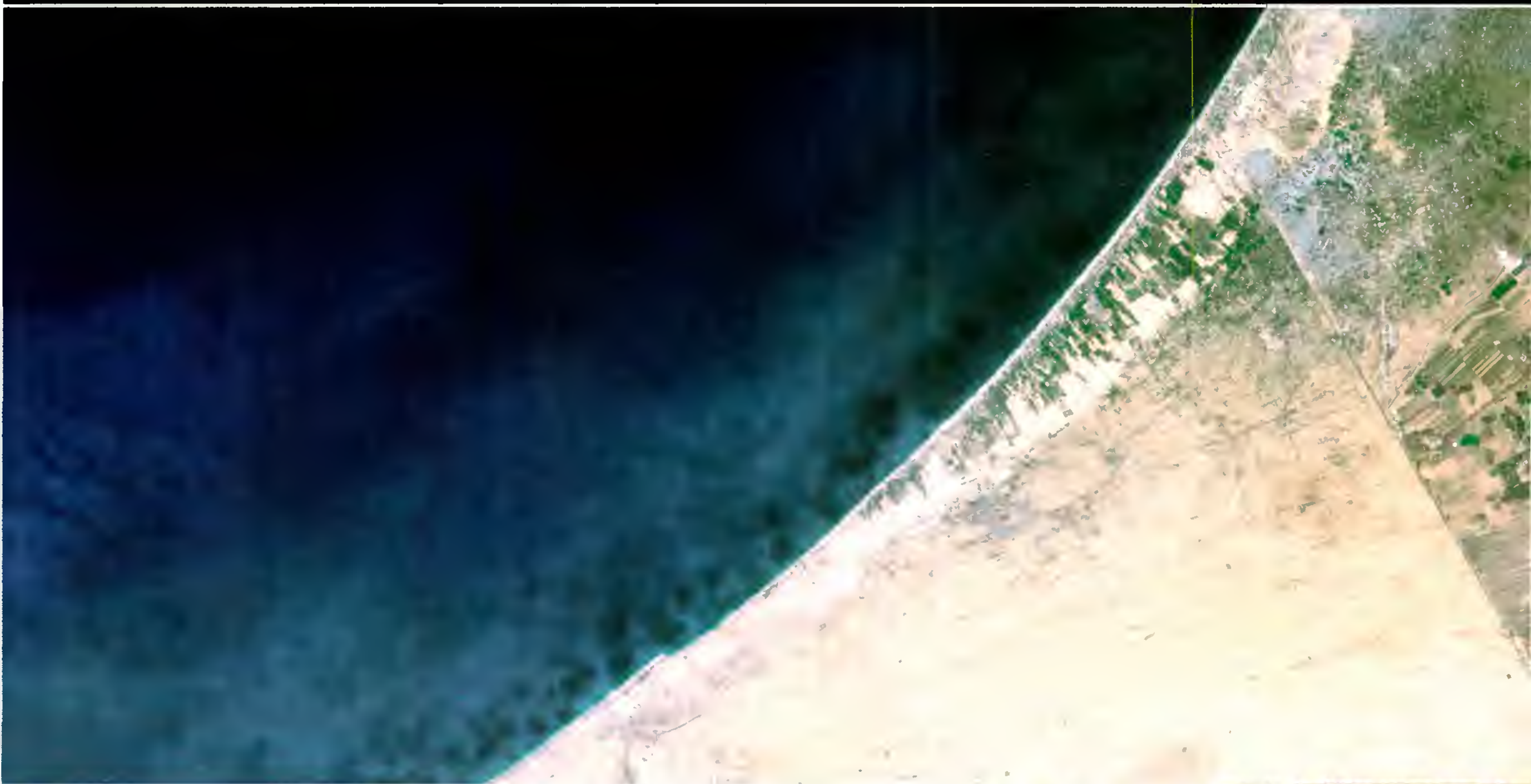
The Israel-Egypt border region, including the Palestinian Authority and the Gaza Strip. The fence along the border restricts the movement of sheep and other animals, making a clear difference in the condition of the land. (Top)

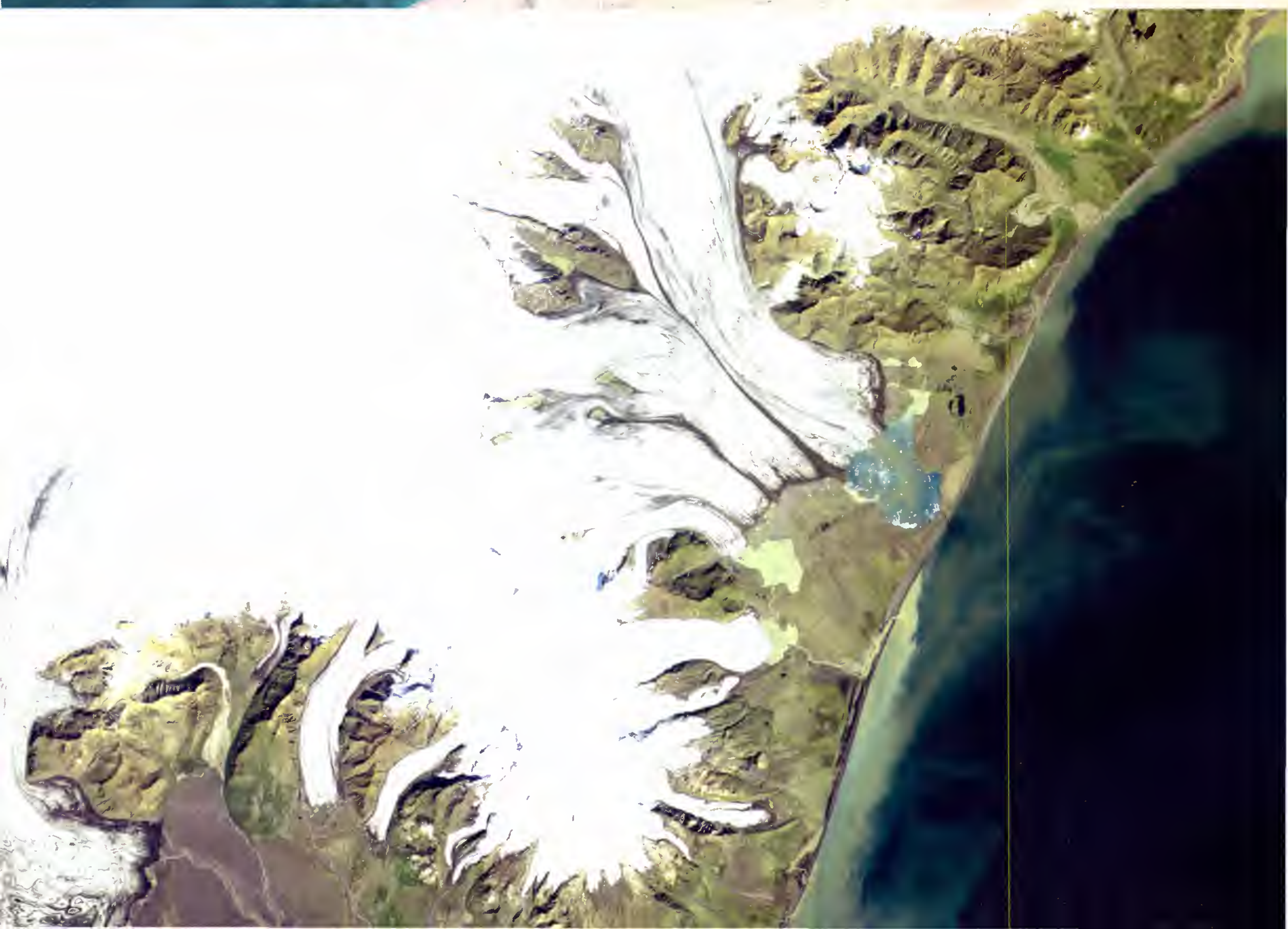
(2006/10/17 AVNIR-2)

Glaciers in Iceland

The south-west edge of the Vatnajökull Glacier in Iceland, the largest glacier in Europe. The glacier has retreated significantly in recent years due to the effects of global warming. (Bottom)

2006/8/19 AVNIR-2





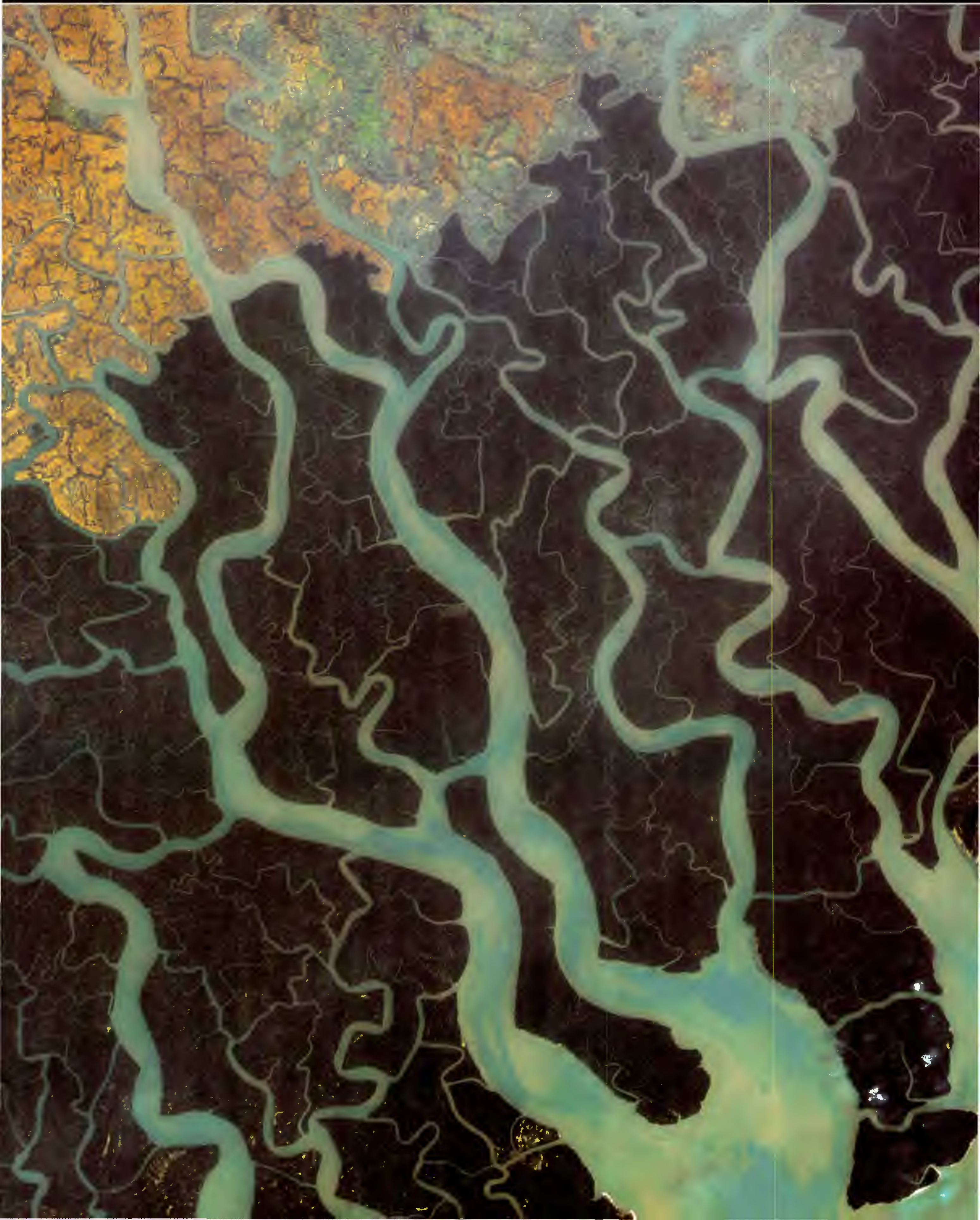
The images on pages 4 to 23 were all observed by the Advanced Land Observing Satellite (ALOS), launched by the Japan Aerospace Exploration Agency (JAXA) on January 24, 2006. Using its three sensors, PALSAR, PRISM and AVNIR-2, ALOS captured these images of the true face of Japan and the world.

ALL IMAGES COURTESY OF JAXA

Mangrove forest in the Ganges delta

The black area is the Sundarbans, the world's largest mangrove forest, which spreads across the mouth of the Ganges River (India) at the Bay of Bengal. The brown areas are rice paddies.

2006/12/6 12/23 AVNIR-2



THE THREE "EYES" OF ALOS

USING THEIR UNIQUE ABILITIES TO CONTINUOUSLY MONITOR THE EARTH

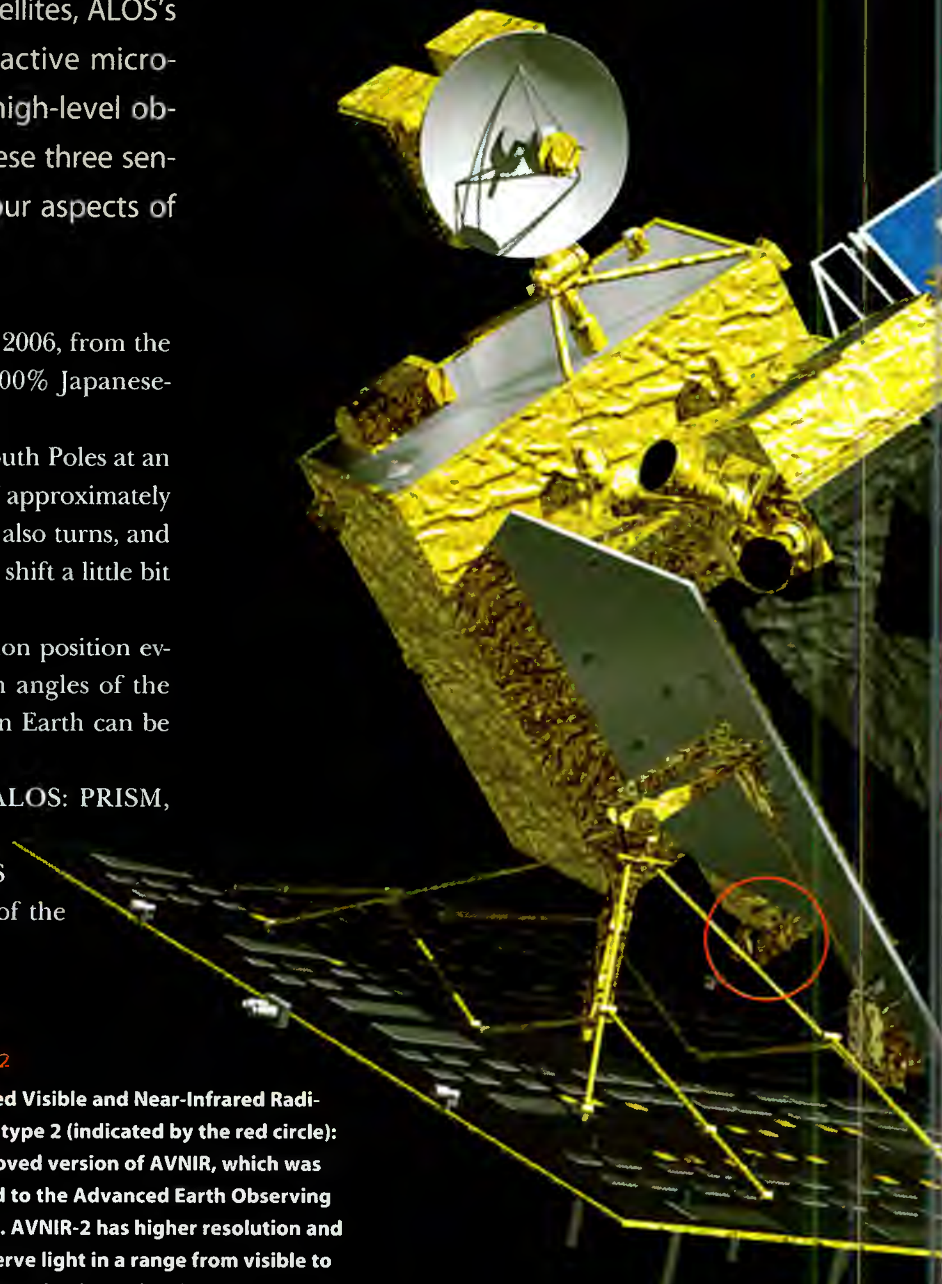
The Advanced Land Observing Satellite (ALOS) uses three types of sensors to observe the Earth, each with world-leading capabilities, and they can obtain various types of information about the Earth's surface. Compared to conventional land observation satellites, ALOS's two types of optical sensor and active microwave sensor provide extremely high-level observation functions. ALOS uses these three sensors systematically to fulfill the four aspects of its mission.

ALOS was launched on January 24, 2006, from the Tanegashima Space Center, and is 100% Japanese-built.

ALOS travels over the North and South Poles at an altitude of 691.65 km with a period of approximately 100 minutes. While it orbits, the Earth also turns, and so from the ground its path appears to shift a little bit with each orbit.

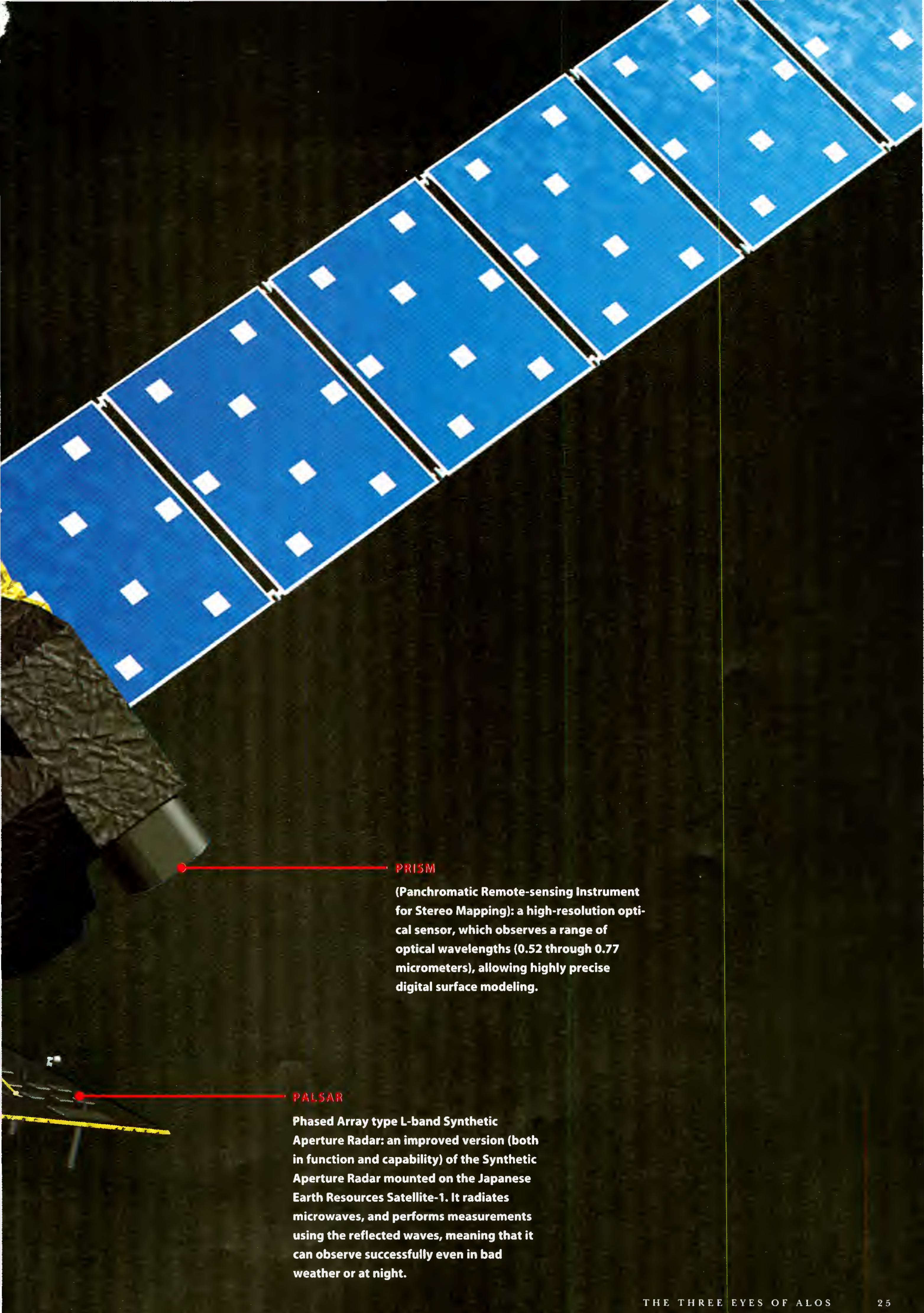
ALOS returns to the same observation position every 46 days. However, the observation angles of the sensors can be changed, so any spot on Earth can be observed within two days.

Three sensors are mounted on ALOS: PRISM, AVNIR-2 and PALSAR. Using the unique abilities of each sensor, ALOS continuously monitors the condition of the Earth.



AVNIR-2

Advanced Visible and Near-Infrared Radiometer, type 2 (indicated by the red circle): an improved version of AVNIR, which was attached to the Advanced Earth Observing Satellite. AVNIR-2 has higher resolution and can observe light in a range from visible to near-infrared. It is used mainly in the observation of continental and coastal areas, in the generation of classification maps.



PRISM

(Panchromatic Remote-sensing Instrument for Stereo Mapping): a high-resolution optical sensor, which observes a range of optical wavelengths (0.52 through 0.77 micrometers), allowing highly precise digital surface modeling.

PALSAR

Phased Array type L-band Synthetic Aperture Radar: an improved version (both in function and capability) of the Synthetic Aperture Radar mounted on the Japanese Earth Resources Satellite-1. It radiates microwaves, and performs measurements using the reflected waves, meaning that it can observe successfully even in bad weather or at night.

REVEALING THE EARTH'S MYSTERIES

ALOS became fully operational in October 2006, using its three sensors to monitor and measure the face of the planet we all share. Valuable imagery from ALOS is utilized in a growing range of fields including map-making and monitoring the global environment, and in observing natural disasters and drift ice.

Maps ALOS changes the history of maps

Drift Ice Early discovery of changes in sea ice

Natural Disasters From Japan to Asia, and the rest of the world

The Environment Keeping an eye on global warming and the forests from space

Resources Using oil slicks to find oilfields on the continental shelf

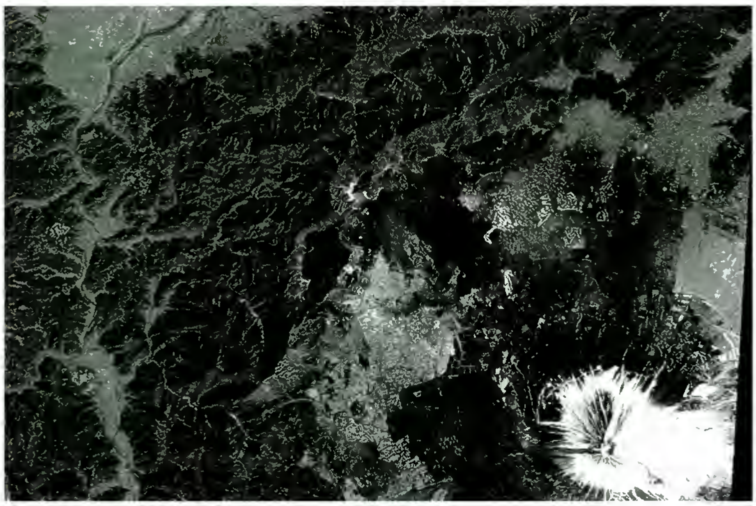
Education Smiling children in Afghanistan

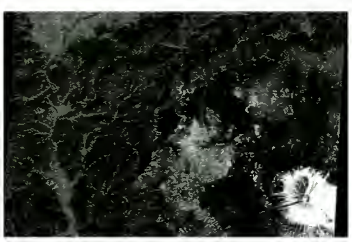
Archaeology Helping preserve the Nazca lines

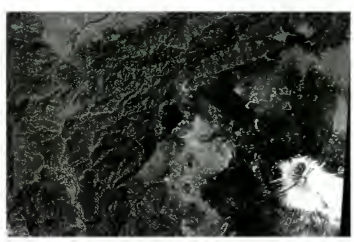
Agriculture The three sensors monitor agricultural land and crops

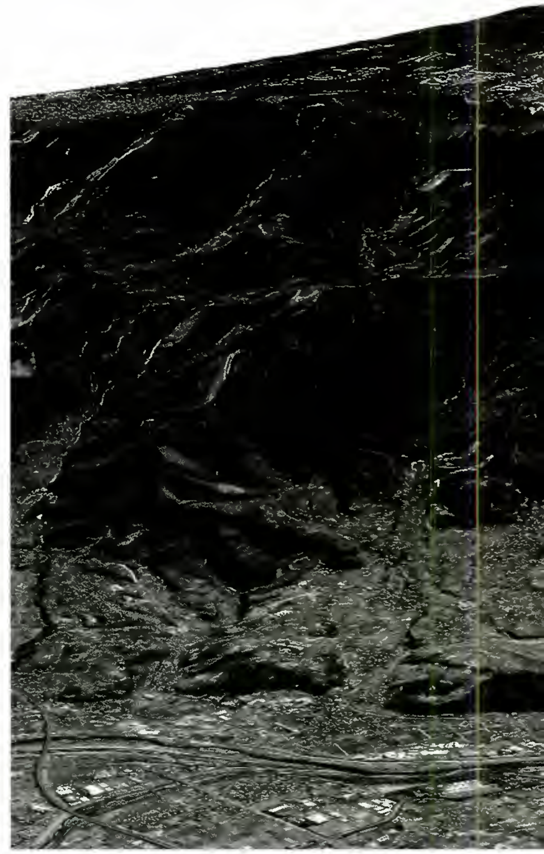
The first 1:25,000 scale map of Japan was created in 1910.

This kind of map is the basis for all maps of Japan, and the process for creating them is likely to change greatly with the appearance of ALOS.


Forward stereo image


Downward stereo image


Rear stereo image



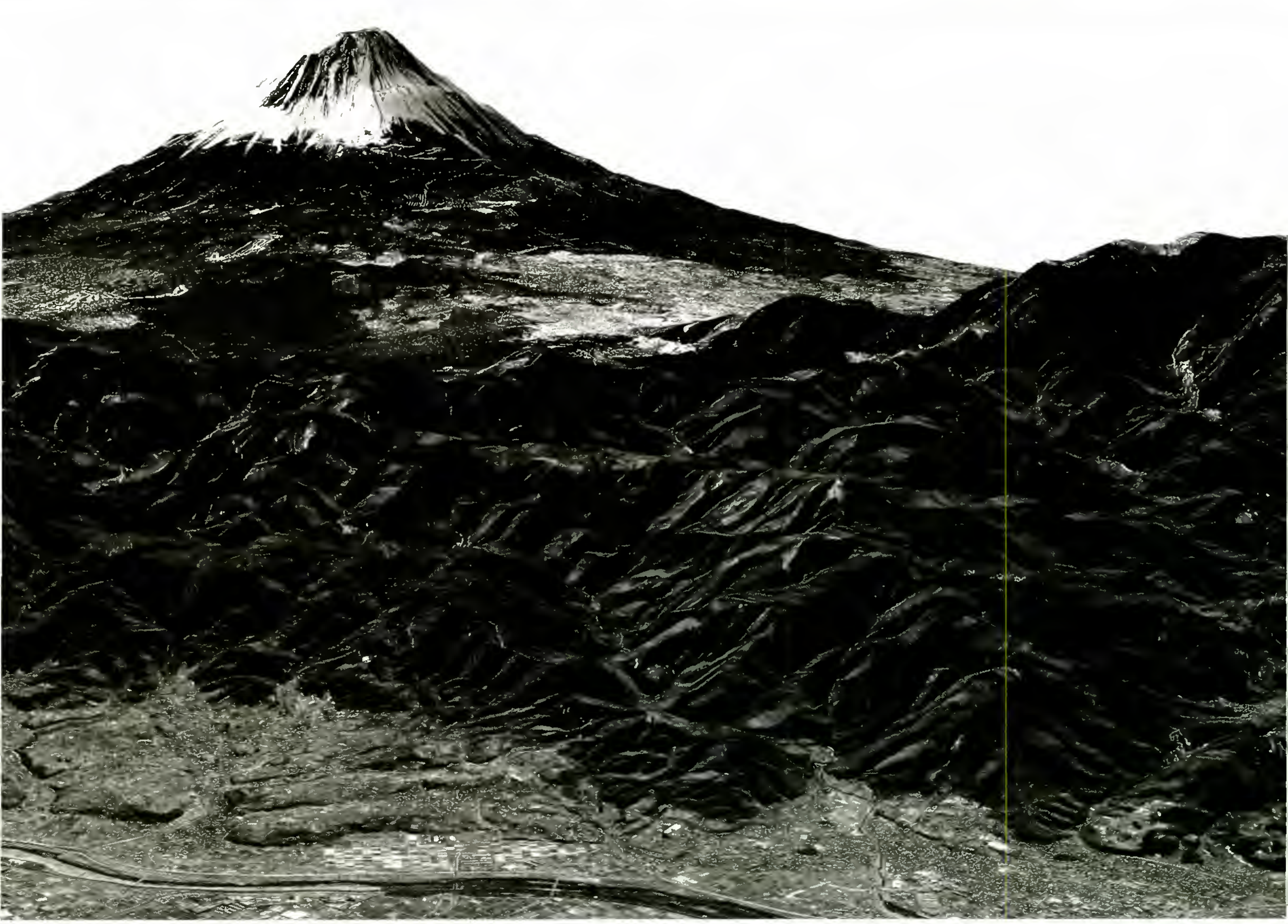
The 1:25,000 scale topographical map is the largest scale topographical map that covers all of Japan. Currently, approximately 4,300 sheets are created, and based on these maps, maps at 1:50,000 and other scales are made, such as road maps, climbing maps, and so on. Maps for car navigation and on the Internet are also drawn using these 1:25,000 maps.

"Using observation data from ALOS, map-making will definitely change," said Hiroaki Tanaka, Manager of the Topographic Technology Development Office, Topographic Department, at the Geographical Survey Institute, which is in charge of technological development for creating 1:25,000 scale topographical maps.

Currently, the GSI uses 5-square-kilometer photos taken from aircraft at an altitude of 3,000 to 4,500 meters to make the 1:25,000 scale maps. However, explains Mr. Tanaka, "It is expensive to make topographical maps from photos taken from aircraft, so there is a limit to the extent to which we can continue to make and correct these maps using this method."

Updating the maps for the entire country requires significant time and cost, so urban areas are updated every 3 years, and mountain areas are updated every 10 or more years. However, because the 1:25,000 scale

The stereo mapping sensor PRISM can simultaneously observe forward, straight down, and at a reverse angle (the three images below left), so by observing a given point stereoscopically, highly accurate elevation data can be obtained. The bird's eye view of Mt. Fuji, below, was obtained using such elevation data. To facilitate comparison with the actual Mt. Fuji, it is drawn with the vertical direction exaggerated relative to the horizontal.



JAXA (ALL 4 PHOTOS)

maps are the basis for all maps of Japan, considering the convenience for users, it is necessary to immediately reflect changes in topography, roads, rail lines and places such as schools, and also name changes.

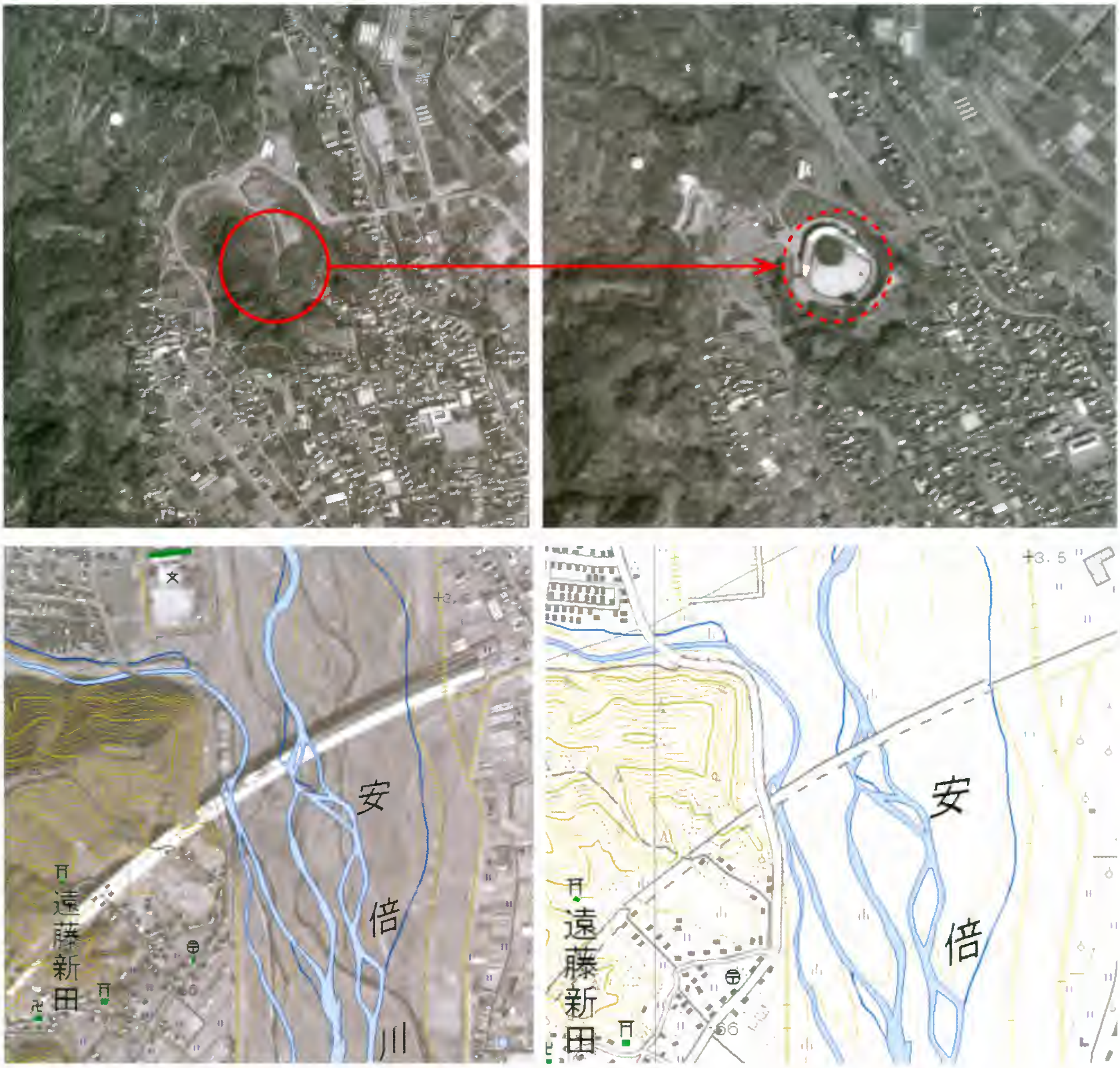
Mr. Tanaka said that using satellite data to make topographical maps had been investigated in the past. However, the quality of altitude data necessary for making maps was low, and the observation data was expensive, so until now it has not been used.

ALOS has made it possible to use satellite data in the basic maps. Indeed, making these 1:25,000 scale topographical maps is one of the mission tasks ALOS was designed for. The high-resolution optical stereo vision sensor called PRISM is the workhorse for making topographical maps. PRISM can observe an area 35.70 km across, far larger than an aircraft can, at a high resolution (2.5 meters). It can also simultaneously take pictures forward, straight down, and at a reverse angle, and the height of each point on the ground can be measured using this data.

"ALOS returns to the same point on Earth every 46 days," says Mr. Tanaka of the GSI. "This is a tremendous advantage for making topographical maps. Because the same point can be measured at regular in-

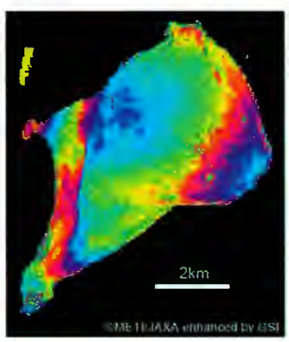
MAPS

ALOS CHANGES THE HISTORY OF MAPS



GEOGRAPHICAL SURVEY INSTITUTE (ALL 4 PHOTOS)

When large construction projects are completed, topographical maps can be corrected, using images observed by PRISM. The two images above show an aerial photograph taken before construction of a stadium (left), and the PRISM image after construction was completed (right). The level of detail, which is similar to that in the aerial photograph, shows that this kind of observation is possible with ALOS. The image at the lower left shows an ALOS PRISM image overlaid on an existing topographical map. A bridge that is not shown on the map is visible in the image from ALOS. At lower right is a topographical map corrected to show the bridge.



Surface changes on Io To (Iwo-jima), based on PALSAR data shown in red. Areas have shifted by several to roughly 20 cm relative to the island center.

GEOGRAPHICAL SURVEY INSTITUTE (LEFT)

The Geographical Survey Institute utilizes ALOS's images for various types of thematic maps such as crustal and ground deformation maps.

KEN SHIMIZU

tervals, a computer can be used to analyze differences from the previous measurements, quickly identifying places that need to be corrected. If we attempted to use aircraft in the same way to repeatedly photograph the same place, we would incur huge costs in aircraft fuel and so on."

Distant islands and mountain areas, which could not easily be reached by aircraft for reasons of distance or flight conditions, can be measured by ALOS with the same frequency as other areas. There are still many parts of the world, where there are areas suffering negative effects from land use and disaster response problems, for which there are no detailed maps. It will likely be an important contribution to make observation data from ALOS available internationally.

In addition to the topographical maps, the GSI is investigating using ALOS's various kinds of observation data to make other maps. For example, disaster situation maps for Japan and overseas could be used to quickly assess disaster situations. Other possibilities include maps showing movements of the Earth's crust, maps related to specific issues or topics and so on.

The GSI has already attempted to measure changes in the surface of Io To (Iwo-jima) using images taken by PALSAR, which is a microwave sensor that can measure minute changes in the Earth's surface. "Using PALSAR observation data, slight upheaval and subsidence can be precisely measured," said Satoshi Fujiwara, Assistant Director of International Observations, GSI Planning Department.

Using PALSAR, one of the sensors on ALOS, the Japan Coast Guard and JAXA are conducting joint research on the movements of ice floes in the Sea of Okhotsk.

The goal is to use the features of PALSAR, which can take measurements even in bad weather, to prevent accidents at sea involving fishing boats.

The winter ice floes that visit Hokkaido and the coast of the Sea of Okhotsk create beautiful scenery for tourists to look at, but they are a nuisance for local shipping. A single mistake can cause a serious accident at sea.

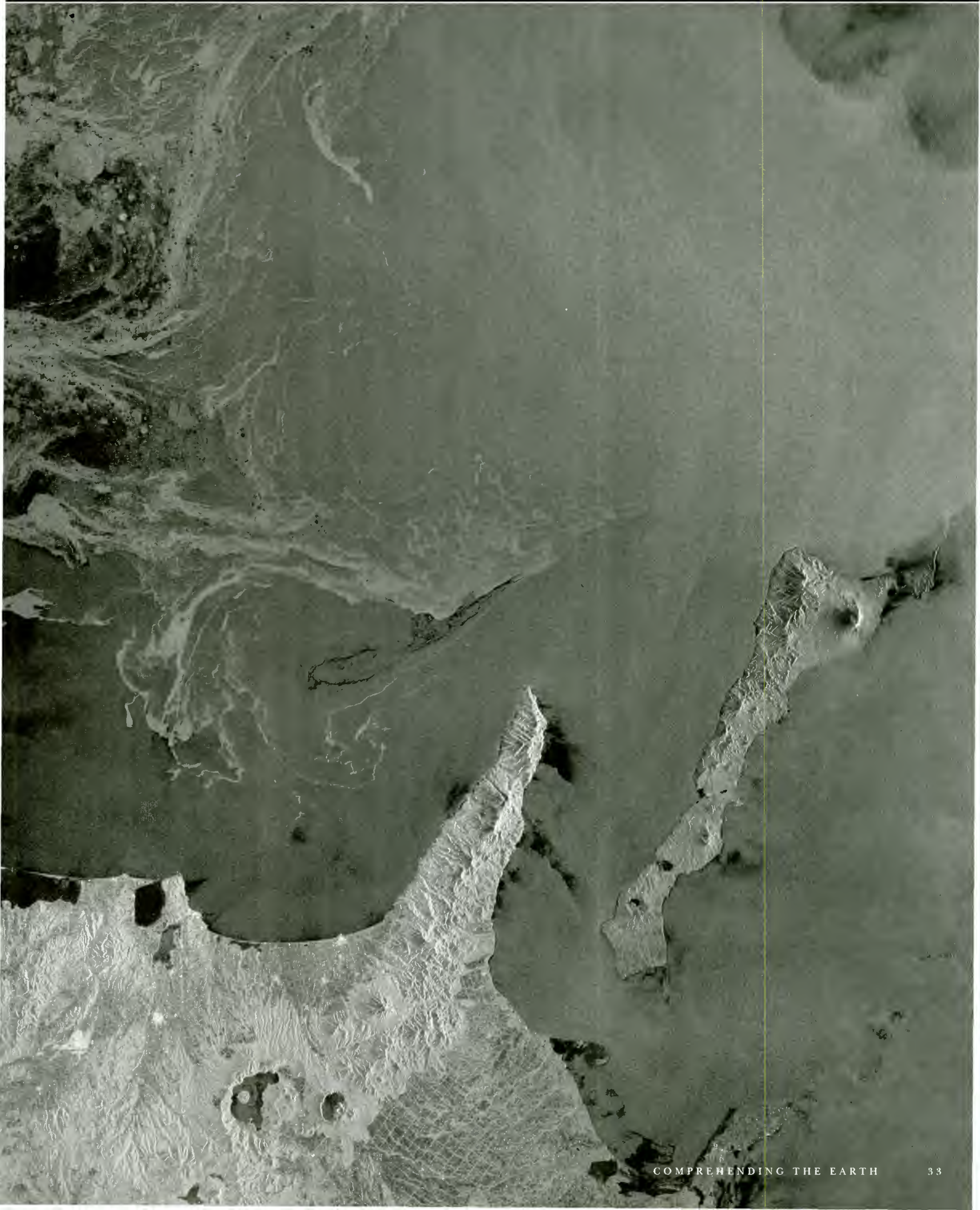
To prevent such sea disasters, the 1st Regional Coast Guard Headquarters launched a project together with JAXA to utilize satellite images from ALOS for ice floe information. "ALOS can take measurements during bad weather and at night," said Shinobu Inazumi, Hydrographic and Oceanographic Division Chief of the Headquarters, speaking about the project's goals, "And it can provide the latest information about ice floes".

Images from ALOS are combined with other data at the 1st Regional Coast Guard Headquarters of the Japan Coast Guard to create sea ice condition charts (above).

SEIICHI MEGURO

Ice floe observation image taken by ALOS. The whitish areas are ice floes. The 1st Regional Coast Guard Headquarters of the Maritime Safety Agency creates sea ice condition charts based on images like this from ALOS.

METI, JAXA

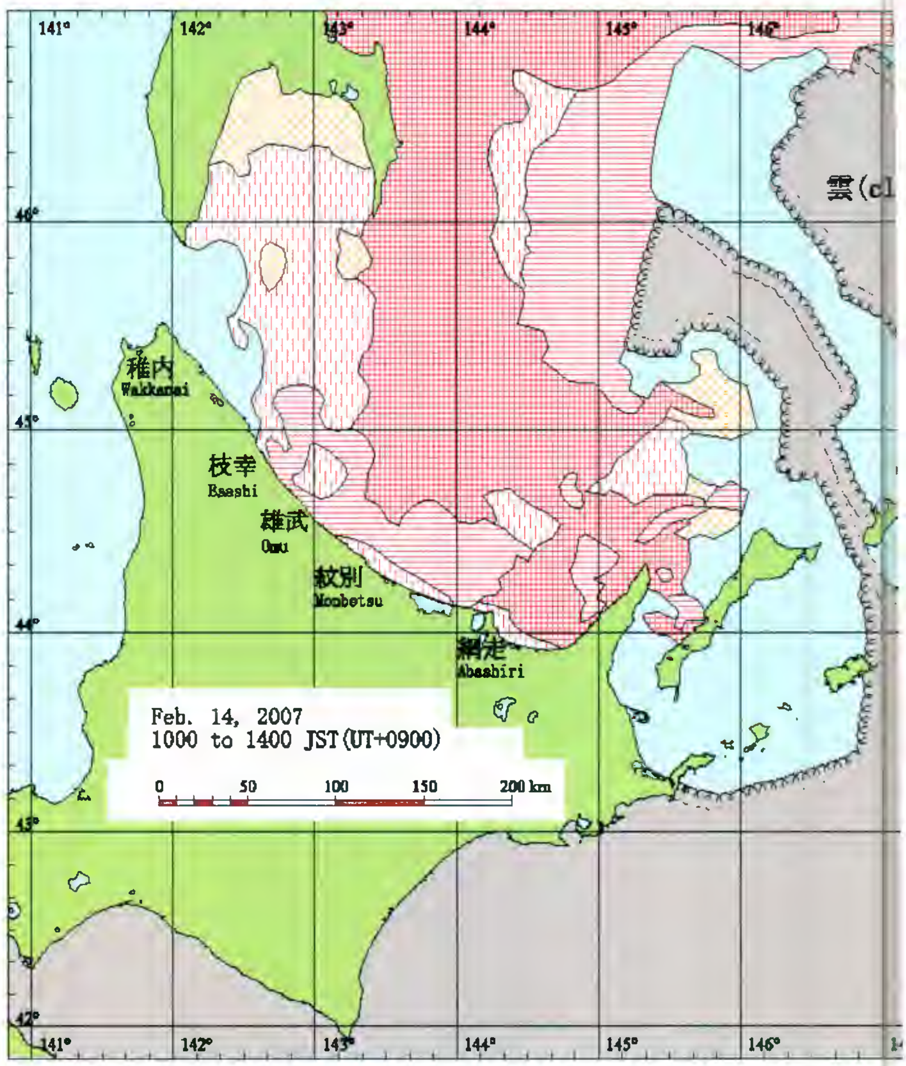


CONCENTRATION 1-3

4-6

7-8

9-10

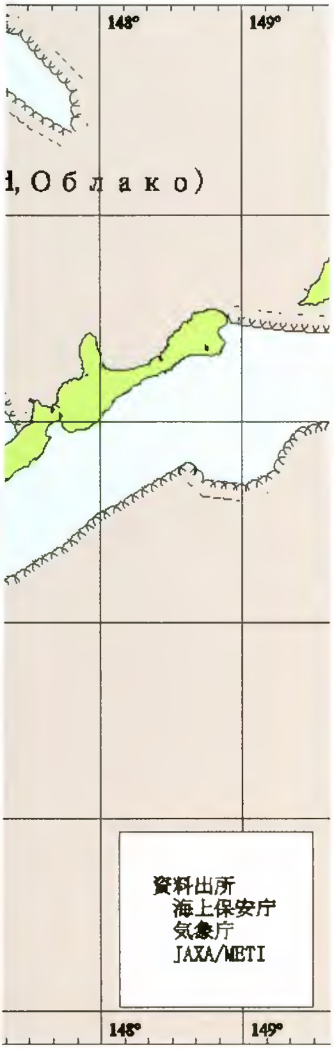


Ice flow density reports use a standard World Meteorological Organization measure called concentration (expressed as a fraction of 10). Concentration is given in 4 levels on the map, which are shown in the photos above. Higher levels pose greater risks, but even loose ice can move dangerously fast.

METI, JAXA (TOP RIGHT), JAXA/TSIC TRIC (CENTER RIGHT), OTHER PHOTOS PROVIDED BY 1ST REGIONAL COAST GUARD HEADQUARTERS

The Headquarters sets up an ice information center at Otaru every year, from December through the following May, to provide ice floe information to fishing fleets and other shipping. This center was established in response to a disaster that occurred in March, 1970, involving a fleet of fishing boats at Hitokappu Bay on Etorofu Island.

A fleet of 19 ocean-going trawlers was operating in the sea to the south of Etorofu Island. To avoid a low pressure system that had developed, they anchored overnight in Hitokappu Bay. At the same time, a group of ice floes was moving southward in the Pacific




PALSAR image from ALOS


MODIS image


Photograph from aircraft

SEA ICE CONDITION CHART CREATION PROCESS BASED ON ALOS DATA

Around 10:30

ALOS OBSERVES THE TARGET SEA REGION

The PALSAR sensor on ALOS observes the target area from an altitude of 700 km, and this data is sent to the receiving antenna at the JAXA Earth Observation Center. Data is then transmitted to the Tsukuba Space Center, where it is processed into a format for easier interpretation, and then sent on to the Japan Coast Guard and the 1st Regional Coast Guard Headquarters.

14:00

ICE FLOE MAP PRODUCED FROM PALSAR IMAGERY

The Survey Manager bases the 1st Regional Coast Guard Headquarters' ice flow distribution map on the PALSAR images from ALOS, and also refers to MODIS images, photos from aircraft, and Himawari images to create the sea ice condition chart. Human experience is also incorporated when creating the chart.

17:00

SEA ICE CONDITION CHART IS ISSUED

About seven hours after ALOS provides the data, the chart that classifies ocean regions according to ice density is complete (left page). The sea ice condition chart is issued by fax and Internet. In addition to being used for safe ocean travel, it is also a source of tourist information .

at an unusual speed, a rare occurrence for that time of year, and the ice was driven into the bay by an east south-east wind. Seven ships that were unable to escape the ice pack under their own power overturned and sank, with a loss of more than 30 lives. Due to this terrible accident, improving ice floe monitoring and notification systems became an urgent issue, and the center was established.

The center was just a simple operation at first, relying on visual ice observations from cruisers and other ships. After that, observations from radar installations on the coast of the Sea of Okhotsk and from aircraft carrying synthetic aperture radars (SARs) were added, but there were still problems. The SAR-equipped aircraft, for example, were not able to work full-time on ice floe monitoring. More recently, images from satellites have been used, but because these satellites use optical sensors, they cannot supply images at night or in bad weather.

These difficulties led the 1st Regional Coast Guard Headquarters to launch an ice floe monitoring research project together with JAXA, utilizing image data from ALOS. Bad weather is not a concern, because the PALSAR sensor on ALOS uses microwaves

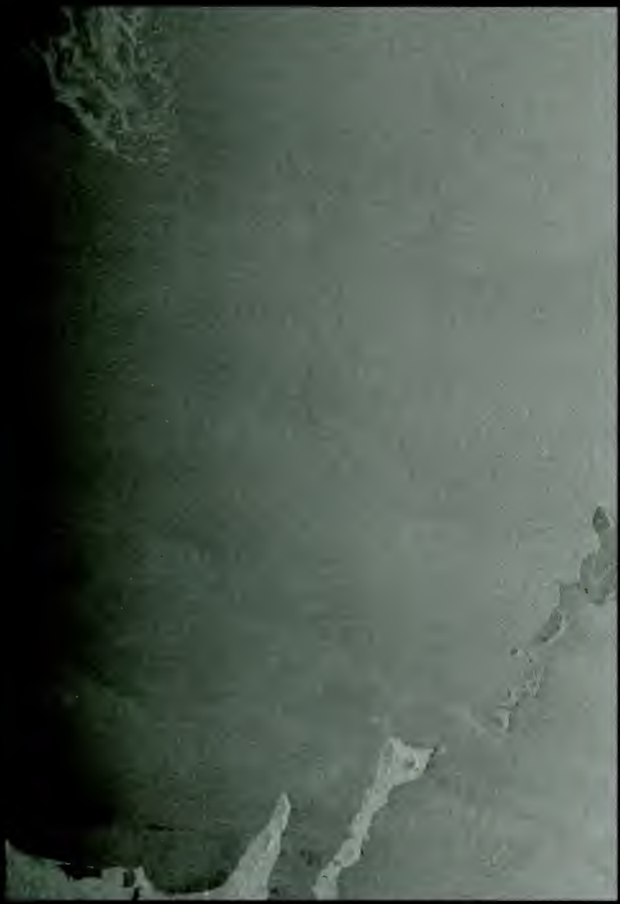
DISTRIBUTION OF EVER-CHANGING ICE FLOES

The speed and direction of ice floes is largely determined by the wind speed, ice shape, concentration and so on.
This image shows the trends in ice floe distribution from images taken by PALSAR from December 2006 to February 2007.

METI, JAXA (ALL 4 PHOTOS)

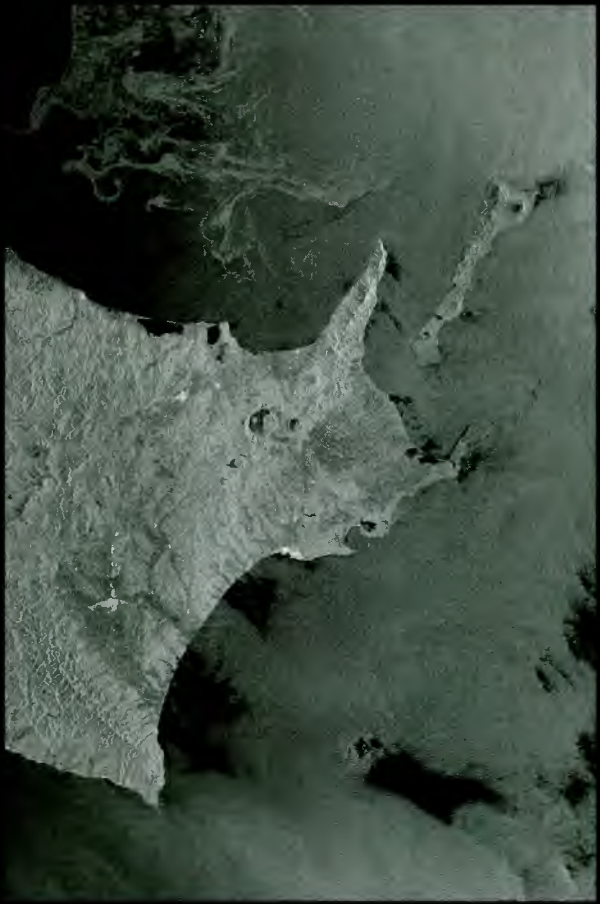
December 20, 2006

Sea ice appears in the Sea of Okhotsk, far north of Hokkaido, and begins to show signs of moving southward.



January 23, 2007

Sea ice has moved far southward, and is approaching Hokkaido. Concentration is still not very high.



MITI, JAXA (ALL 4 PHOTOS)

for its observations, and so it can spot ice floes even during bad weather or at night. The weather is often cloudy when ice floes move southward, so this function of PALSAR is extremely useful for creating ice floe reports.

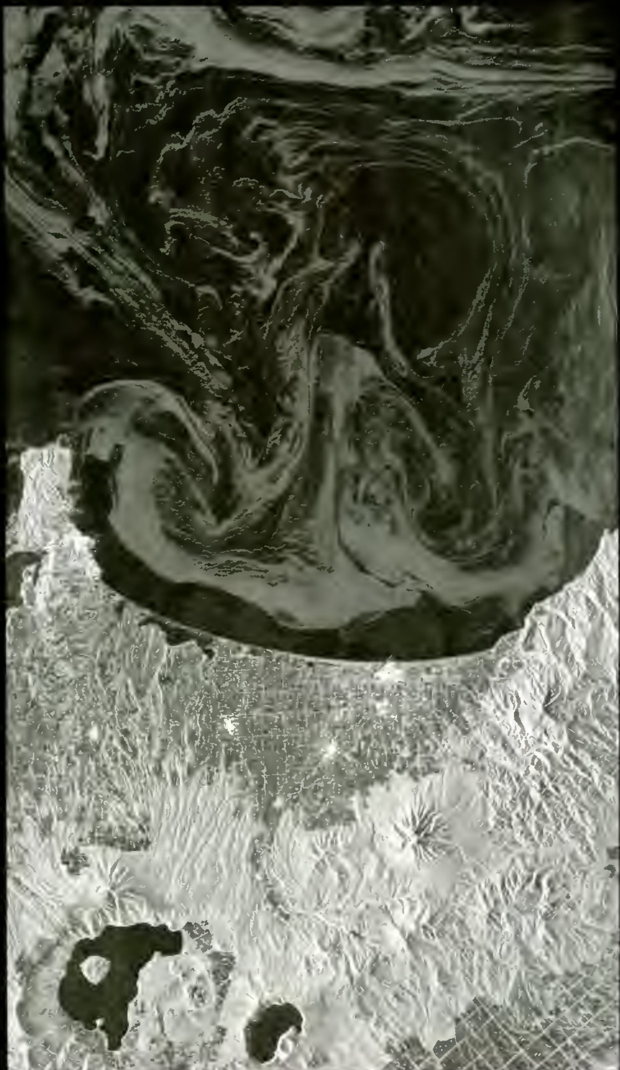
The ice information center began to receive ALOS images in December 2006, and it started to issue this practical information in its sea ice condition charts.

At approximately 10:30 a.m., ALOS passes over the target area and makes observations. When this observation data is delivered to the Earth Observation Center in Saitama. Data is then transmitted to the Tsukuba Space Center, where it is reformatted for easier interpretation and then to the Japan Coast Guard. The delivery time is approximately 2:00 p.m.

At the 1st Regional Coast Guard Headquarters, the survey officer interprets and analyzes the satellite data, and converts it into a sea ice condition chart.

February 10, 2007

The sea ice penetrates Japanese territorial waters, and the concentration has increased.



February 14, 2007

Ice floe concentration has increased even more, and the sea from Sakhalin Island to the coast of Hokkaido has become covered in ice.

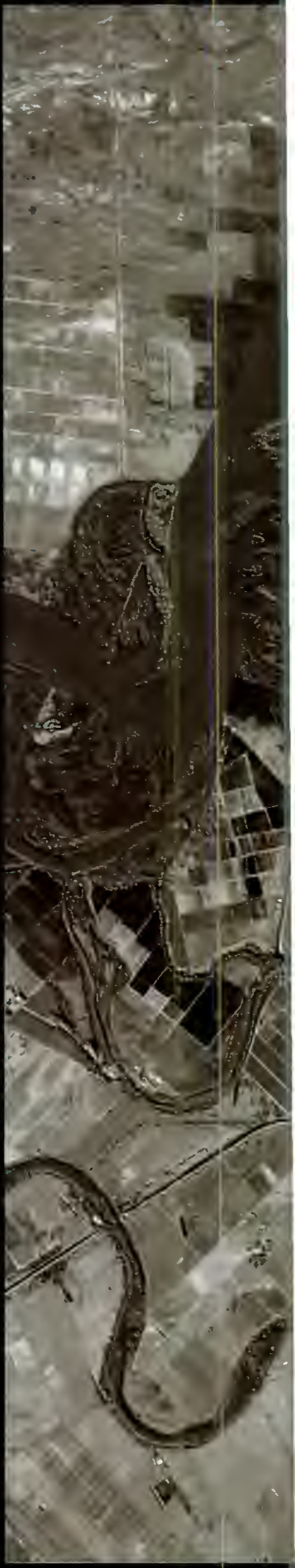
The actual process involves combining the PALSAR images with images from the Himawari weather satellite, images from the optical sensor MODIS on the Earth Observing Satellite Terra (operated by NASA), and information from aircraft and ships. The combined image is then manually tweaked to complete the sea ice condition chart. By approximately 5:00 p.m., the sea ice condition chart is completed, and it is issued by fax and on the Internet.

In the report, ocean regions are classified according to sea ice density, so dangerous regions can be identified at a glance. "PALSAR images are used for locations that cannot be visually observed from aircraft," explains Jun Ogata, Hydrographic Surveys officer. "To further improve the information, we also refer to photos taken by MODIS, Himawari, and from aircraft."

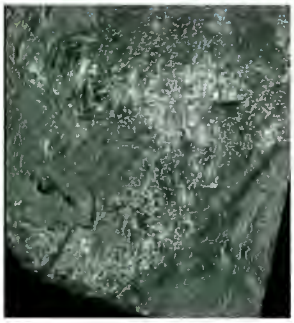
The images observed by ALOS truly come into their own during times of natural disaster such as severe earthquakes, tsunamis, floods, landslides and so on. This is because it is often extremely difficult to get a good picture from ground level of what has happened immediately after a disaster. PALSAR, which can observe even at night or in difficult weather conditions, is particularly useful at such times. ALOS is starting to be utilized throughout Asia and the world to observe disaster areas.

Flooding of the rivers Limay and Negro, which threatened the southern Argentine cities of Neukuen and Cipolletti, as observed by PRISM. Flooding of fields and the central area of the crescent lake is evident in a comparison of images taken before the flood (above) and after (right).

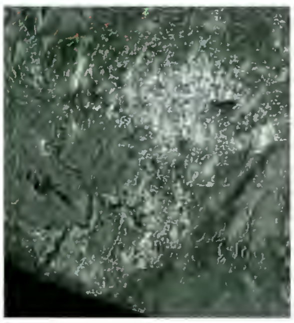
(BOTH) JAXA



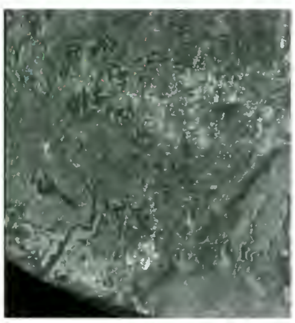
From flooding in Argentina (shown below) to environmental conservation and disaster prevention efforts around the world, ALOS contributes to a safer, richer society. This is an important part of "JAXA Vision – JAXA 2025 –", the long-range plan for Japan's space development work.



April 29, 2006



May 16, 2006



May 28, 2006

(3 IMAGES ABOVE METI, JAXA
(RIGHT) METI/JAXA, PROCESSED BY NIED

THE CENTRAL JAVA EARTHQUAKE, INDONESIA

PALSAR images taken before (left, top two images) and after (left, below) the Central Java Earthquake, which occurred on May 27, 2006. The surface of the Earth can be seen to have significantly changed. The chart to the right shows assumed damage based on this data, with red indicating the most severe damage.

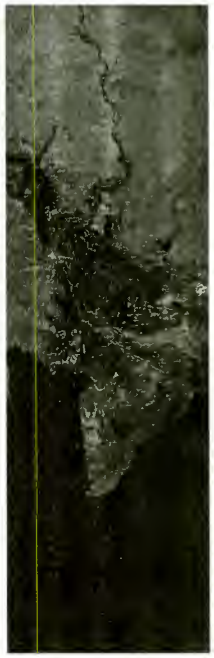
One of ALOS's most important functions is the early observation of damage after a natural disaster. Being able to make a swift and accurate assessment of the situation means that efficient rescue and recovery measures can be put into place.

The use of satellites to prevent disasters was listed as one of JAXA's most important tasks in the long-range vision statement issued in 2005, "JAXA Vision – JAXA 2025 –." "JAXA Vision describes an ideal for the place Japan's space development work should have reached in the 20 years to 2025," comments executive officer Hideshi Kozawa, who is in charge of satellite utilization at JAXA. "We intend to have manned space flight and lunar / planetary probes, but alongside this, we want to ensure that our space technology contributes to a safer, more affluent society. It is a hugely ambitious idea. As part of that vision, we proposed that for the first 10 years our priorities should be the development of space technologies that contribute to environmental conservation and disaster prevention. The use of ALOS in disaster prevention is part of this strategy. We believe that ALOS can be useful in this way not only in Japan but throughout Asia, and that's how the Sentinel Asia project came about."

At the 12th Asia-Pacific Regional Space Agency Forum (APRSAF-12), held in October 2005, JAXA pro-

September 15, 2006

October 2, 2006



October 15, 2006

FLOODING IN THE MEKONG DELTA

A sequence of images of the Mekong Delta (x3, above), taken during the rainy season (between September and October), using PALSAR's wide-swath mode (with swath width 250 – 350 km and spatial resolution 100 m). Flooded areas appear black. (Left) A composite image made of the three images above. Adjusting the observational angle allows changes in the flooded areas over time to be displayed as differences in color. PALSAR's continuous observations mean that changes in the flooded areas can be observed over time.

(4 IMAGES) METI, JAXA

posed the creation of a disaster prevention satellite system for the Asia-Pacific region. Sentinel Asia is the first step in this process: it is a system for distributing observational images from various countries' land observation satellites to disaster prevention agencies throughout the region. Depending on the specific needs of each country and region, this observation data could be used to create hazard maps in the future.

The system at the heart of Sentinel Asia is known as Digital Asia, which was developed by Professor Hiromichi Fukui, of Keio University's Faculty of Policy Management. This is an Internet-based geographical information system (Web-GIS), which supplies not only mapping but also social and economic data.

"The goal of the Sentinel Asia system proposed by JAXA is the joint creation of an Asia-wide disaster prevention system," comments Professor Fukui. "I hope we will be able to contribute something to this with Web-GIS."

The International Charter on Space and Major Disasters is a collaborative framework between space agencies, which was launched in June 2000. As of March 2007, nine space agencies including JAXA are involved in the Charter. The objective is to share observational data free of charge between the agencies

JAXA

involved during a major disaster, in order to reduce the danger arising from the disaster.

Using images from PALSAR to assess the damage after the Central Java Earthquake

Since ALOS began operating, it has carried out observational activities in response to requests from Sentinel Asia and the International Charter on Space and Major Disasters several times. These observations included the landslides in Leyte, the Philippines, on February 24, 2006, the flooding in northern Thailand on May 25, 2006, and the flooding in central Java on February 5, 2007.

Together with his staff, Masashi Matsuoka, team leader at the Earthquake Disaster Mitigation Research Center (EDM), part of the National Research Institute for Earth Science and Disaster Prevention (NIED), tested the use of image data from ALOS in assessing the damage caused by the earthquake on May 27, 2006 in central Java, Indonesia. In their assessment, they used observation data collected by PALSAR both before and after the earthquake.

Team leader Matsuoka is hopeful that ALOS will provide a valuable service. "In general," he said, "The reflected waves from PALSAR come back strongly from urban areas, so if we detect that the reflected strength over a disaster area has weakened, we can as-

Tanker oil spill, the Philippines

PALSAR image of an oil spill off Negros Island, the Philippines (opposite), after a tanker sank on August 11, 2006. The red circle shows where the tanker sank, and the yellow line indicates the oil spill.

Mt. Merapi Volcano, Indonesia

Image of Mt. Merapi, Indonesia, observed by AVNIR-2 on April 29, 2006, which clearly shows smoke issuing from the volcano's crater.

METI, JAXA

sume that buildings and such have been destroyed. When we compared our analysis with the information that had been collected on the ground, we realized that the system had painted an accurate picture. I think this system will be useful in the future in providing a rapid assessment of situations."

In the Central Java earthquake, several other satellites provided observation data alongside ALOS, but PALSAR's data was particularly appreciated because it covered a wide area – 70 square kilometers – and was unaffected by clouds.

When a large-scale disaster occurs in a developing nation, it is often difficult to get a speedy assessment of the overall situation. There is a tendency for rescue operations and relief supplies to be concentrated in certain areas, and as a result the damage in other locations can actually spread. PALSAR, which can operate in difficult weather conditions and cover a wide area, is particularly useful in such cases.

"I hope that we can use the Japanese disaster response experience to create a swift flow of disaster observation, data collection and analysis," said JAXA's satellite utilization executive officer Kozawa, speaking about his plans for the future. "I also hope that this will enable us to build a system that makes it easier to issue warnings to individuals where needed."

THE ENVIRONMENT

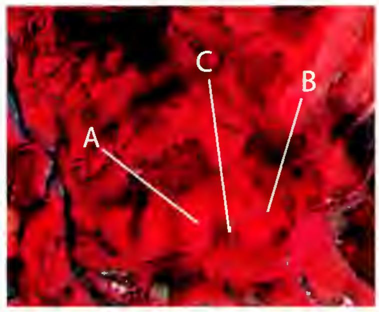
KEEPING AN EYE ON GLOBAL WARMING AND THE FORESTS FROM SPACE

Accurate observation and recording of the Earth, and communication of these facts to the next generation, are also important components of ALOS's mission. Using ALOS images, research into the progress of global warming has begun, and vegetation in different regions is being monitored.

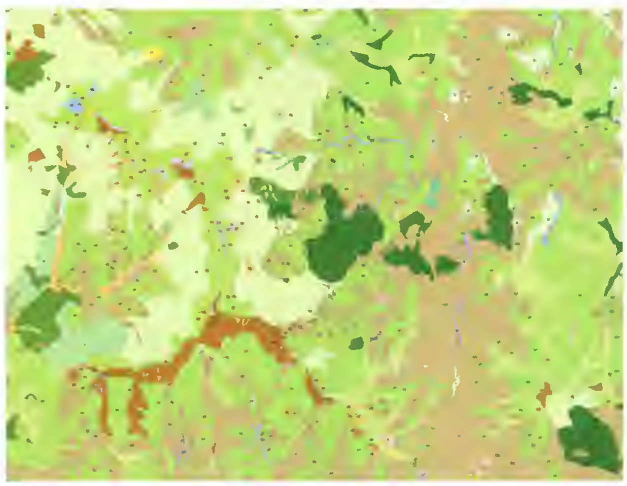
Pansharpen image created from data captured by ALOS's sensors AVNIR-2 and PRISM, showing the Hadano / Oyama region of Kanagawa prefecture (April 30, 2006). Various types of vegetation are shown in colors from bright red to darker red.

JAXA

KEEPING AN EYE ON GLOBAL WARMING AND THE FORESTS FROM SPACE



Pansharpen image created from PRISM and AVNIR-2 visible wavelengths (right, top), and (right, below) pansharpen image created from near-infrared wavelengths. Points marked A, B & C are equivalent to A, B & C on the locally captured photograph. A and B are broad-leaved deciduous woodlands, while C is an area of managed cedar forest.



Local survey being carried out to confirm the actual plant species growing in the areas observed by ALOS.

(TOP RIGHT, 2 PHOTOS) JAXA, (TOP AND BOTTOM LEFT) ASIA AIR SURVEY, CO., LTD., (BOTTOM RIGHT) BIODIVERSITY CENTER, DEPARTMENT OF THE NATURAL ENVIRONMENT, MINISTRY OF THE ENVIRONMENT

Alongside creating maps and surveying disasters, another of ALOS's important missions is to observe the global environment. As we become more aware of environmental problems, typified by global warming, the importance of this task is growing. ALOS is needed for a variety of monitoring tasks, from observing the state of glaciers and ice at the North and South Poles, through to keeping an eye on the shrinking rainforest cover in the Amazon basin, which is having such an impact on global warming.

There are many tasks for ALOS in Japan, too, from monitoring the extent of red tide outbreaks to observing marshlands. In particular, ALOS is expected to play a significant role in surveying forest distribution.

The Biodiversity Center in Fujiyoshida City, Yamanashi prefecture, run by the Ministry of the Environ-

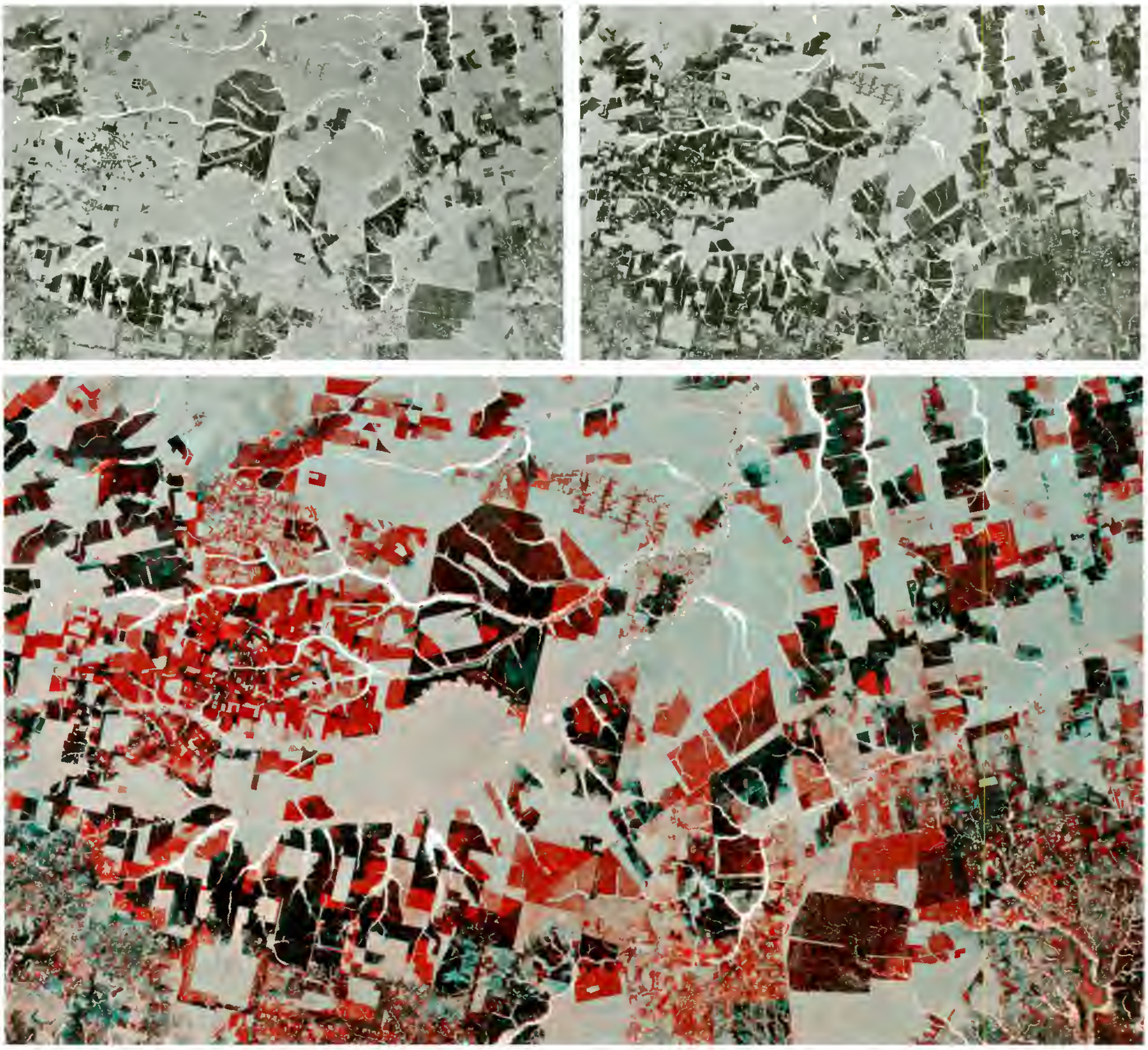


Image identifying a deforested area in the Amazon rainforest. The image to the left above was taken by JERS-I in June 1996, while the one to the right above was taken by PALSAR in June 2006. Comparison shows the area deforested during the decade, as outlined in red (below).

MITI, JAXA (ALL 3 IMAGES)

ment's Department of the Natural Environment, is utilizing images supplied by ALOS in its creation of vegetation maps. "We are hopeful that the use of satellite imaging will help us implement efficient vegetation surveys," says Naoko Nakajima of the Biodiversity Center of Japan.

JAXA entered discussions with the Biodiversity Center before ALOS was launched, and cooperated on the development of practical technologies. At present, they are still at the stage of verifying the system, but staff involved in the creation of vegetation maps say the value of using ALOS is likely to be high.

In comparison with conventional methods, exactly what benefits does the use of satellite images bring to vegetation surveys?


The Fedchenko Glacier in the Parmir Mountains (taken by AVNIR-2 on August 26, 2006). This glacier seems to be undergoing regression, causing concern to observers (left). The Oze wetland (right) is listed under the Ramsar Convention (taken by AVNIR-2 on November 9, 2006). Monitoring of glaciers and wetlands is an extremely important task for ALOS.

(BOTH IMAGES) JAXA

ALOS's images include features not found in aerial photography

Vegetation maps show the spread of vegetation in a particular area on a geographical map, and are used in environmental strategies such as conservation, assessments and land use planning. Vegetation assessments have been under way since 1973, with the purpose of creating nationwide vegetation maps.

Currently, vegetation surveys are carried out using a two-pronged approach, combining aerial photography interpretation and local surveying. There are several unresolved issues with this approach, however.

The photographs used to interpret vegetation are invariably supplied by the Geographical Survey Institute (GSI), and were originally taken in order to correct geographical maps. This means that photographs are not necessarily taken to uniform standards nationwide. Compared to swiftly-changing urban areas, there is a significant difference in how often photographs are taken of relatively static mountainous regions. If comparative photographs are taken in winter and summer, it is possible to distinguish deciduous woods from evergreens, but aerial photographs are not scheduled with regard to the seasons. As one aerial photograph only covers an area of 6.9 square kilometers, around 12 photographs must be joined together to make a single vegetation map.

There is a strong possibility that these problems can be solved by using images from ALOS. The images are not as high-resolution as aerial photographs, but the satellite can cover a huge area in a single capture: 70 square kilometers, which is equivalent to around 50 veg-

An image of Kagoshima Bay captured by AVNIR-2 on April 7, 2006. The blue line to the south of Sakurajima is a red tide caused by the plankton *noctiluca scintillans*.

JAXA

etation maps. Since the images are captured at a height of around 700 km, distortion of the surrounding area is also considered slight. ALOS has an orbit cycle of only 46 days, so it can observe vegetation during a range of seasons.

Local surveys prove the effectiveness of ALOS's images

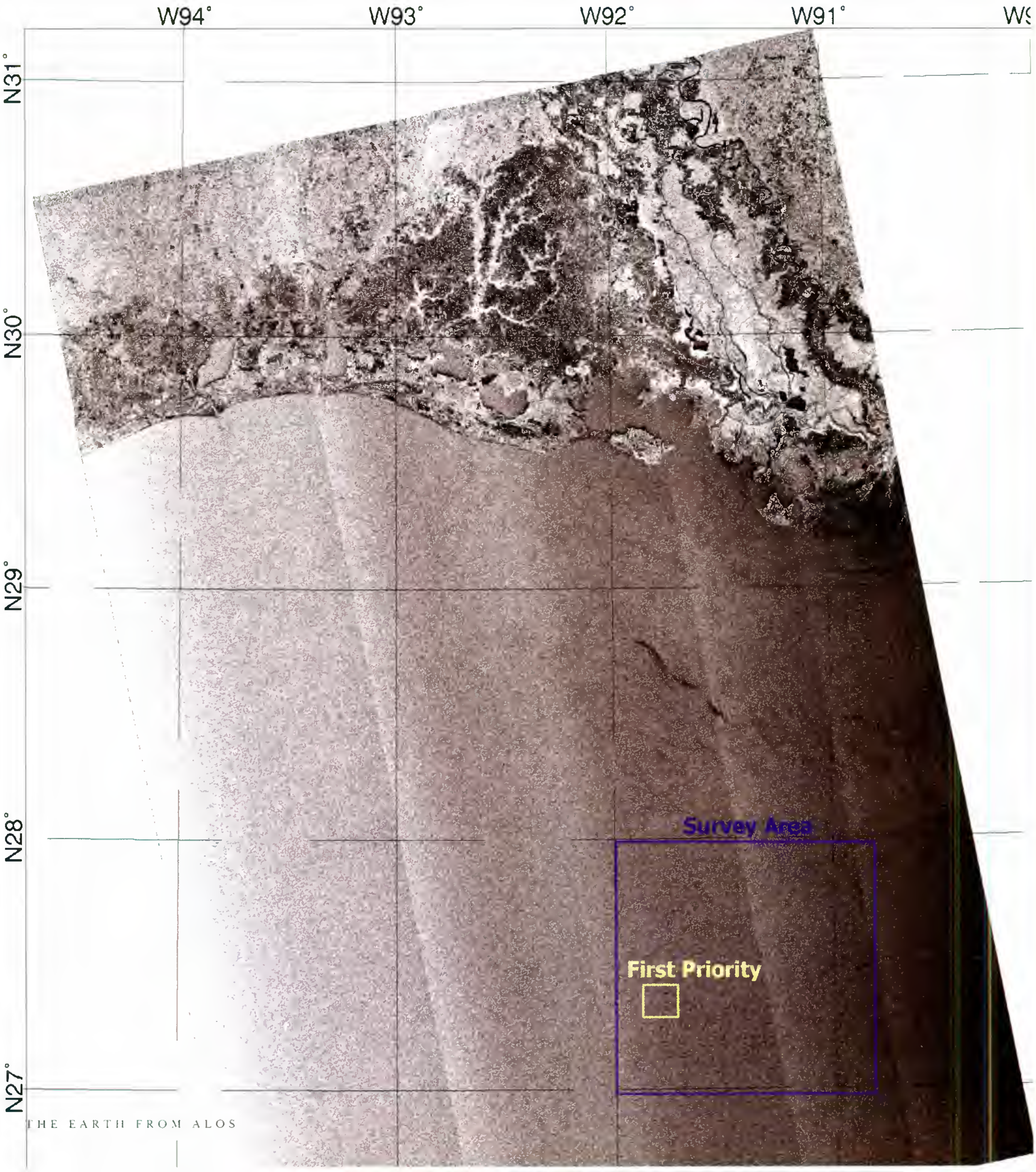
In autumn 2006, a local survey was carried out in order to confirm how differences in ALOS's image tone corresponded to the actual vegetation.

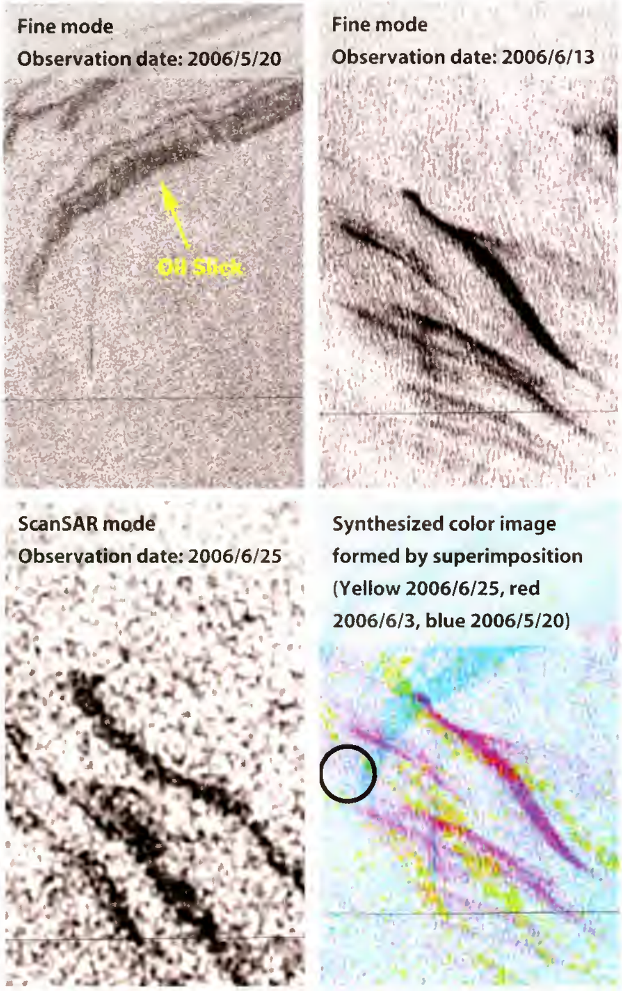
ALOS's AVNIR-2 produces images in both the visible and near-infrared spectrums. In some areas where it was almost impossible to distinguish types of vegetation in visible light, near-infrared images showed clear changes in tone. A local survey confirmed that the tones reflected differences between areas of cedar and Japanese cypress trees. Using near-infrared wavelengths, it becomes possible to see things that are invisible to the naked eye, as red tones become brighter, making interpretation easier.

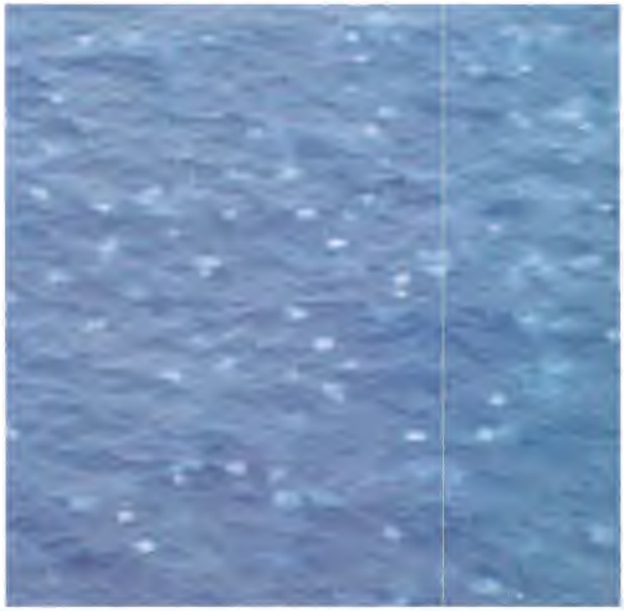
Speaking of the future, the Biodiversity Center's Nakajima says that, based on this, "We are going to compile data and results for a year, and hope to start practical utilization of the images during fiscal 2008".

As the problems faced by the global environment continue to grow, surveying the natural environment to find solutions will become more and more important. Helping create an accurate record of the environment as it is today, and handing that on to the next generation, are surely vital tasks for ALOS.

Searching out oil slicks on the surface to discover oilfields hiding at the bottom of the sea: ERSDAC is researching how PALSAR imagery from ALOS can accomplish this.







Photograph of the same region from a helicopter. The whitish reflections are from the oil slick, which extended for about 10 kilometers.

These four images (left) show the Gulf of Mexico, within the area shown the yellow frame opposite. Oil slicks stretch into a variety of directions as flowing bands, depending on currents, winds and other factors, so the point of original seepage can be identified by stacking images taken at different times. The estimated origin is indicated by the circle in the multitemporal color image.

METI AND JAXA DISTRIBUTED BY ERSDAC (ALL SIX IMAGES)

There are many oil and gas fields in ocean region slike continental shelves, but it is not easy to discover them. The Earth Remote Sensing Data Analysis Center (ERSDAC) is engaged in R&D into identifying these offshore oil and gas fields using ALOS imagery.

In particular, ERSDAC is evaluating the effectiveness of ocean oil slicks leaked from offshore oil fields. The surface of the ocean has considerably less microwave backscattering when covered with an oil slick than it does otherwise, because the surface tension of the slick suppresses wavelets.

PALSAR images of ALOS generated from the microwaves reflected from the water surface show oil slicks as dark patches. It is thought this data can be used to discover new offshore oil and gas fields.

In May 2006, ERSDAC performed a study in the northern Gulf of Mexico, offshore Louisiana, America, to verify the effectiveness PALSAR's three observation modes. This region is known to have many oil fields, and oil slicks are commonly observable.

Images made in the fine and polarimetric modes captured oil slicks clearly, and it was possible to identify large-scale oil slicks in the ScanSAR mode images as well.

Since the ScanSAR mode can observe a wide swath up to 350 kilometers in width, it is useful for a reconnaissance oil slick mapping of the interest region. Fine mode imagery is then used for detailed analysis. ERSDAC believes this approach can be a useful tool to discover new oil fields in the ocean.

EDUCATION

SMILING CHILDREN IN AFGHANISTAN

The National Federation of UNESCO Associations in Japan (NFUAJ) is partnering with JAXA and other organizations to donate images captured by ALOS to children in Asia.

The donor organizations hope that seeing images of their own regions will encourage the children to learn more about Asia and the rest of the world.

(far left)
The images from ALOS donated to Senjit Dara in Afghanistan, showing the village and surrounding areas. The white circle highlights the Terakoya built by NFUAJ.

JAXA

Girls studying in a tent classroom at the Senjit Dara Terakoya (above), listening carefully to what the teacher has to say. These boys (below) are seeing a map of their village area for the first time. They soon tried to find their village on the map.

(BOTH) THE NATIONAL FEDERATION OF UNESCO ASSOCIATIONS IN JAPAN

The images observed by ALOS are also making a contribution to the World Terakoya Movement in regions recommended by NFUAJ, and are already in use as educational materials in selected developing countries.

Because of war or poverty, there are still around 100 million children around the world who cannot attain a basic level of school education. It is estimated that there are a further 800 million adults who have never learned to read or write, because they grew up without ever going to school.

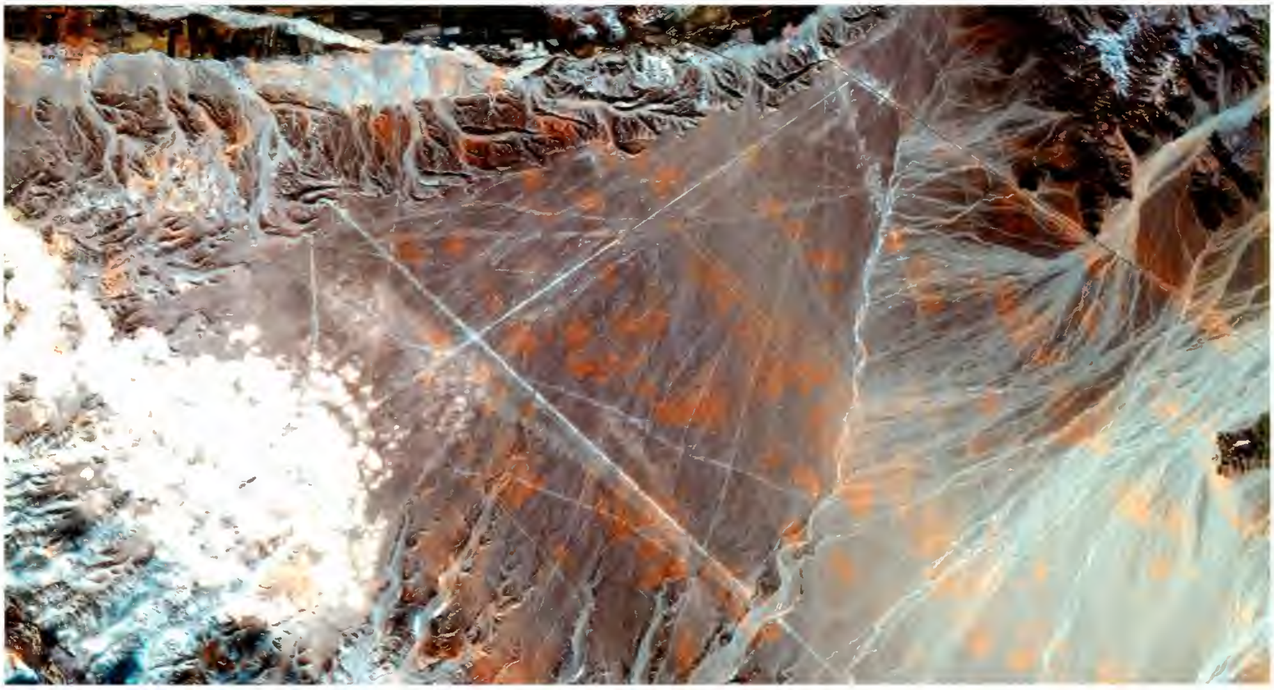
NFUAJ has begun to supply ALOS's images to these children to allow them to learn about their own countries, Asia and the world at large. In the first stage of this project, they supplied local area images to a Terakoya (a local learning center) built in Senjit Dara, Afghanistan, by NFUAJ (facing page).

The people of Senjit Dara, both adults and children, were fascinated by the pictures from ALOS, and spent a long time studying them. Most people had never seen a map of their own village, even if they had seen one of the world or of Afghanistan. Comments from people who saw the image ranged from, "It's beautiful and I'd like to display it at home," and, "It's fascinating because it looks just like the real thing," through to, "We could use this to revitalize Senjit Dara," and, "You get a feel for the whole village, so people will be encouraged to work harder." This indicates that many people are thinking hard about the future of the area.

There is no shortage of places where people do not yet have a map of their own region. This means that there will be many more opportunities to use ALOS's images as educational materials.

HELPING PRESERVE THE NAZCA LINES

The Nazca pampa in southern Peru is famous for the enormous figures etched on the ground there. Designated a World Heritage Site, it is still unknown who created them, or why. Yamagata University is utilizing satellite imagery to create maps of these geoglyphs to assist in preserving them for the future.



The Yamagata University research team on a hill overlooking the Nazca River valley (top). Nazca lines photographed by ALOS. The five bright, thick straight lines are roads, but all other linear forms are geoglyphs, as confirmed from a light aircraft and on-site observation.

(TOP IMAGE) FACULTY OF LITERATURE AND SOCIAL SCIENCES, YAMAGATA UNIVERSITY (BOTTOM IMAGE) JAXA

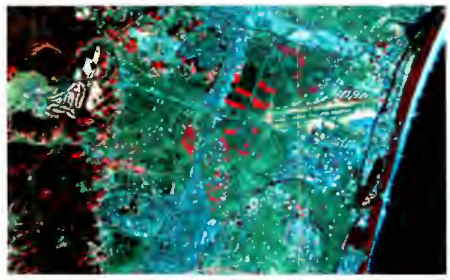
The Nazca lines, gigantic linear shapes and pictures, are dated to between 100 BC and AD 600. They were made by removing rocks from selected areas of the pampa, exposing the whitish sand and gravel below. A research team from Yamagata University is using satellite imagery in distribution diagrams of the Nazca lines. "Except for a few special regions," explains Professor Isao Akojima, "There is very little detailed location data for the geoglyphs. Sometimes they are unwittingly destroyed. We make maps to help preserve them." The research team first used satellite imagery from the American commercial satellite QuickBird to identify geoglyphs, and verified the data from a light aircraft. They found more than a hundred new geoglyphs: mostly linear shapes but some may represent living things.

QuickBird images are high resolution (0.6 meters), but they are also expensive. In contrast, ALOS PRISM images are lower resolution (2.5 meters), but provide in-depth information. "They are ideal for making distribution maps so we can determine the relative locations of all the geoglyphs," explains Associate Professor Masato Sakai. "The wide [35 km] observation area is very attractive. And the images cost a fraction of what QuickBird charges." They plan to use more ALOS images to speed their work.

AGRICULTURE

THE THREE SENSORS MONITOR AGRICULTURAL LAND AND CROPS

By monitoring crop maturation, checking the state of agricultural land prior to seeding and measuring crop damage from natural disasters such as typhoons and floods, ALOS is playing an increasingly important role in agriculture.



AVNIR-2 images of agricultural land on two separate days. The upper image, made on March 25, 2006, shows cropland planted with wheat in red. The lower image, made on May 4, 2006, was taken in the middle of the rice planting season. The red regions in the center are where rice planting has been completed.

REMOTE SENSING PROMOTION COMMITTEE, GENYA SAITO, FIELD SCIENCE CENTER, GRADUATE SCHOOL OF AGRICULTURE SCIENCE, TOHOKU UNIVERSITY (BOTH IMAGES)

ALOS's three sensors are invaluable in agriculture as well. For example, AVNIR-2 imagery, capable of observing in both the visible and near-infrared spectra, shows the degree maturation of crops through delicate shadings of color. These images are highly useful in determining crop status in rice paddies, wheat fields and other plots.

The reflectivity of the microwaves emitted by PALSAR also indicates minute differences in the moisture content of the land. This information can be used to check the condition of rice paddies before and after planting, providing precise information on planting state, and would also be invaluable in determining the degree of cropland damage caused by a flood. PRISM imagery has a high resolution (2.5 meters), making it possible to accurately determine cropland divisions. Using elevation data, the same information can be made available for complex topography, such as terraced paddies.

ALOS is also being used to periodically observe land in countries other than Japan, to monitor such things as the state of salt spray damage, which is uncommon in Japan. If the data gained through these observations can be used to promptly react to problems, it could help to avoid a global food crisis.

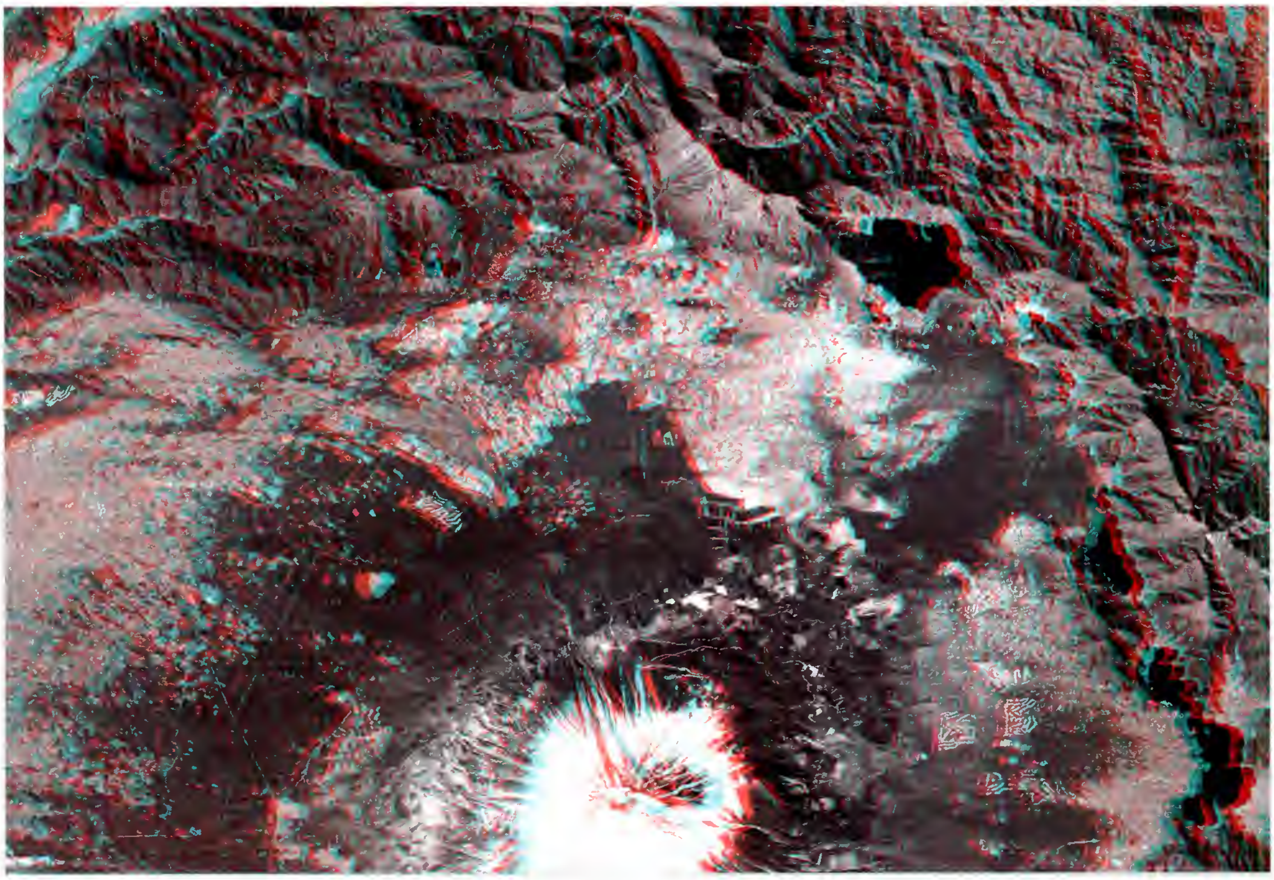
THREE-DIMENSIONAL SATELLITE PHOTOS

SATELLITE PHOTOS IN 3D: ENJOYING THE WORLD'S BUMPS AND RIDGES IN THREE DIMENSIONS

Look at these mountains and valleys using the attached special 3D glasses with lenses of red and green film. You'll see the land suddenly gain a depth dimension.

The PRISM sensor, one of several sensors on ALOS, has a camera directed at a forward angle, another pointing straight down, and a third at a reverse angle. The three images are superimposed here, and when you look at them through the 3D glasses, each eye sees a different image. This makes it look like a three-dimensional picture.

DETACH THE 3D GLASSES from the book, and put them on for a look at Mt. Fuji.

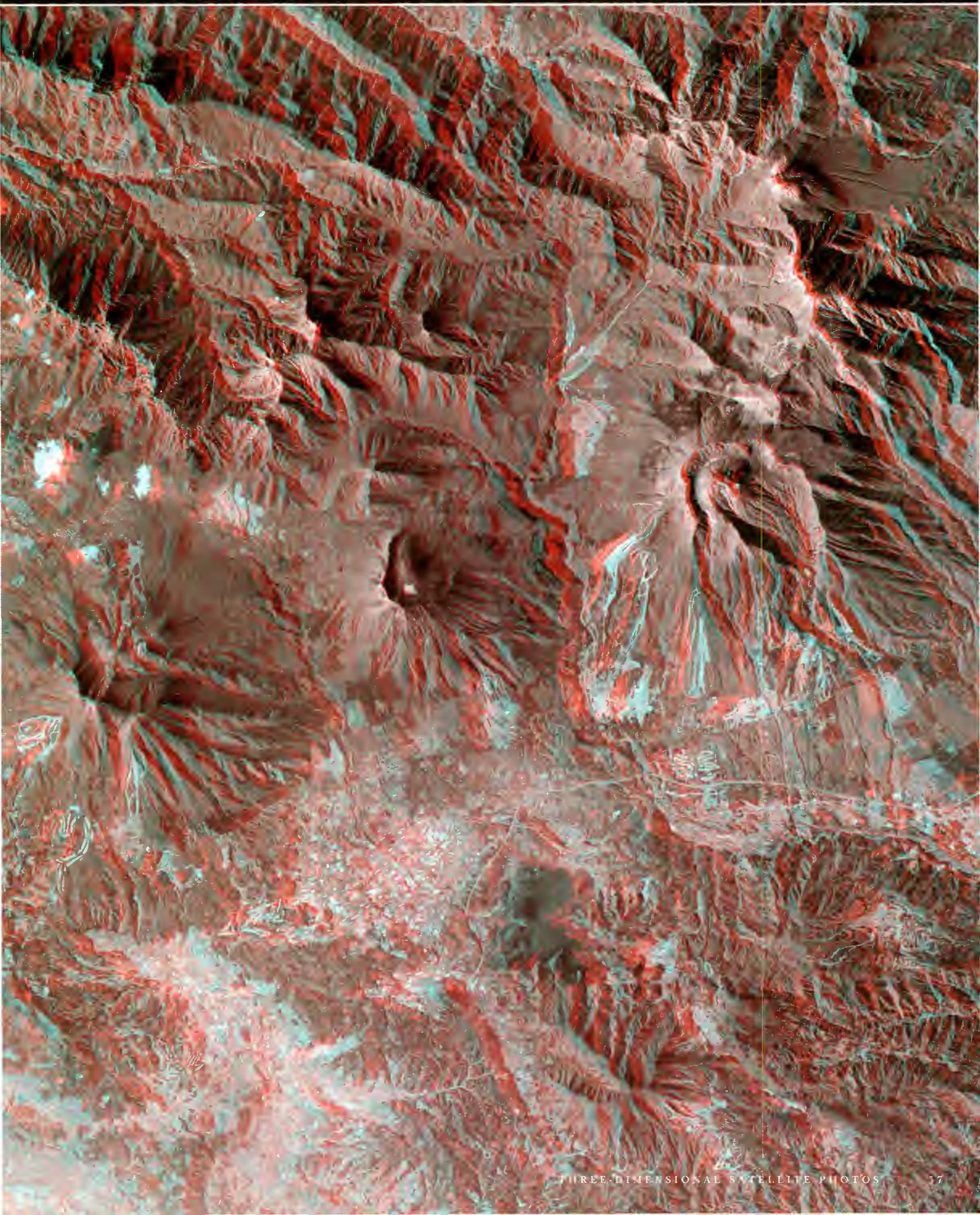


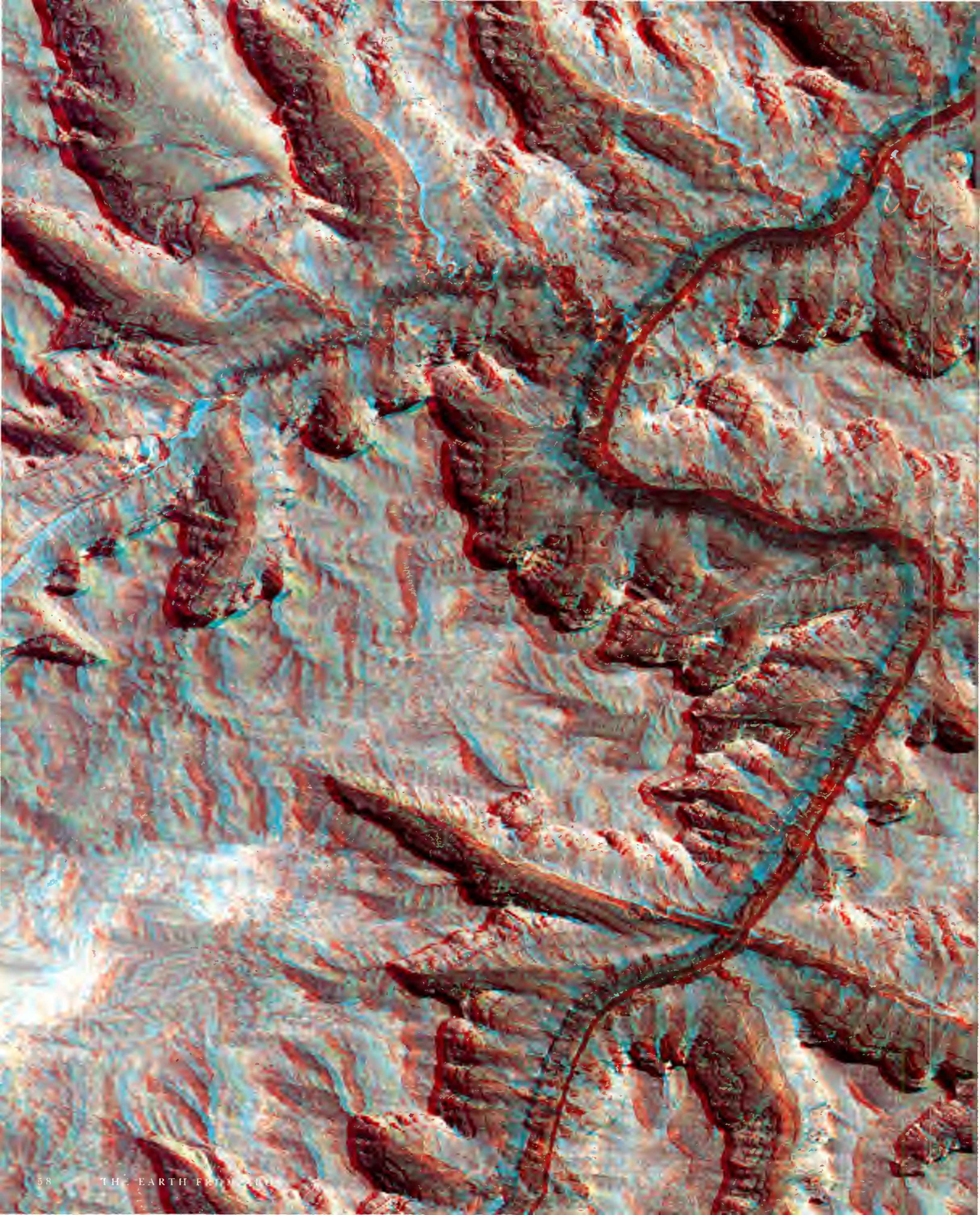
Carefully detach the 3D glasses along the perforated line, and put them on with the blue film in front of your right eye, and the red to the left. Hold the image of Mt. Fuji about 30 to 40 cm away: it will jump out at you when you find the right distance. If you put the glasses on with blue on the left, or hold the book upside down, the image will look strange. Using these 3D glasses does put a strain on your eyes, and prolonged use may cause fatigue, or you may even begin to feel bad.

ALL IMAGES COURTESY JAXA

Shinshu Gogaku – The Five Peaks of Shinshu

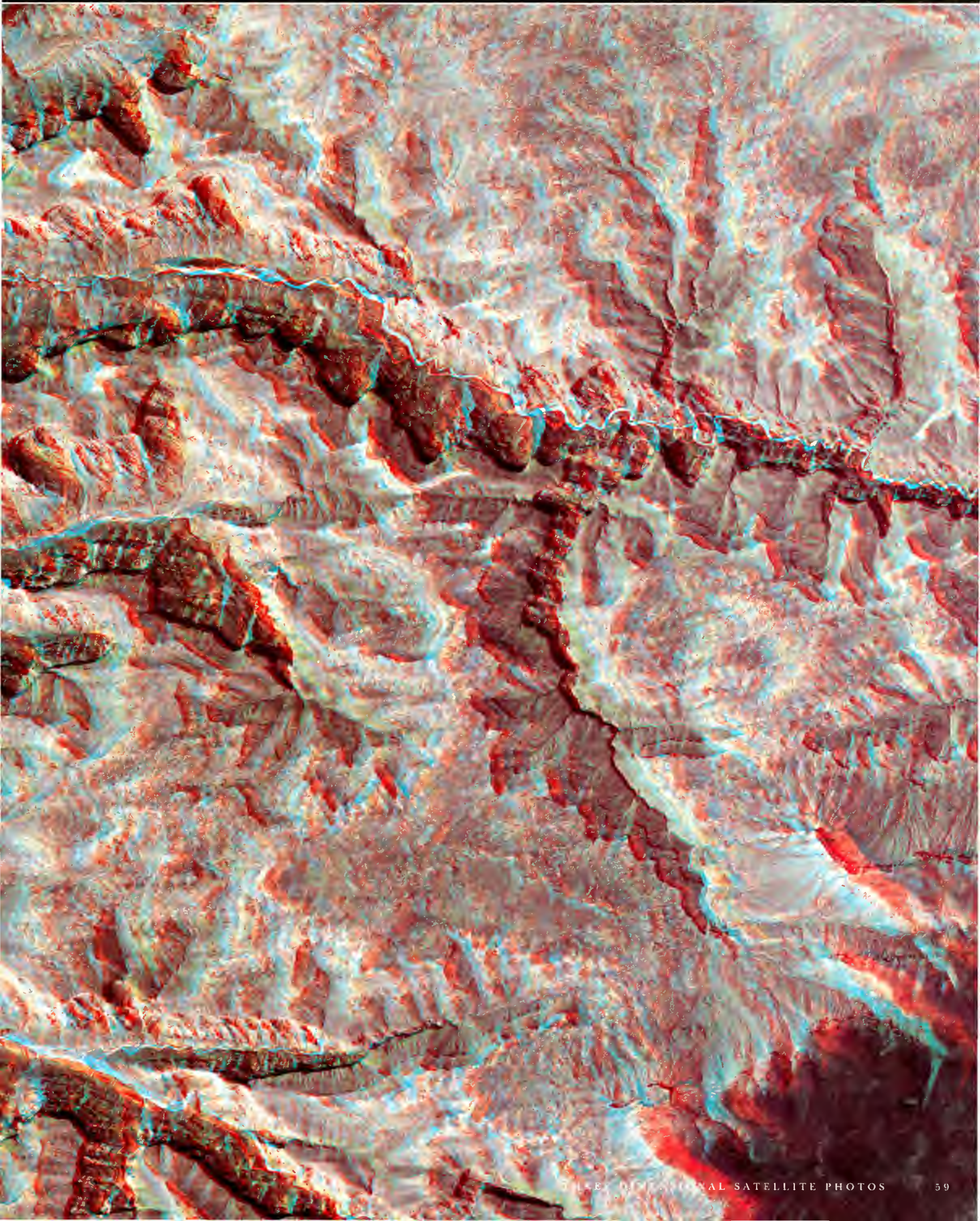
The five mountains encircling Nojiri Lake in Nagano Prefecture, Japan – Mt. Myoko, Mt. Kurohime, Mt. Togakushi, Mt. Iizuna and Mt. Madarao – are called the Five Peaks of Shinshu.

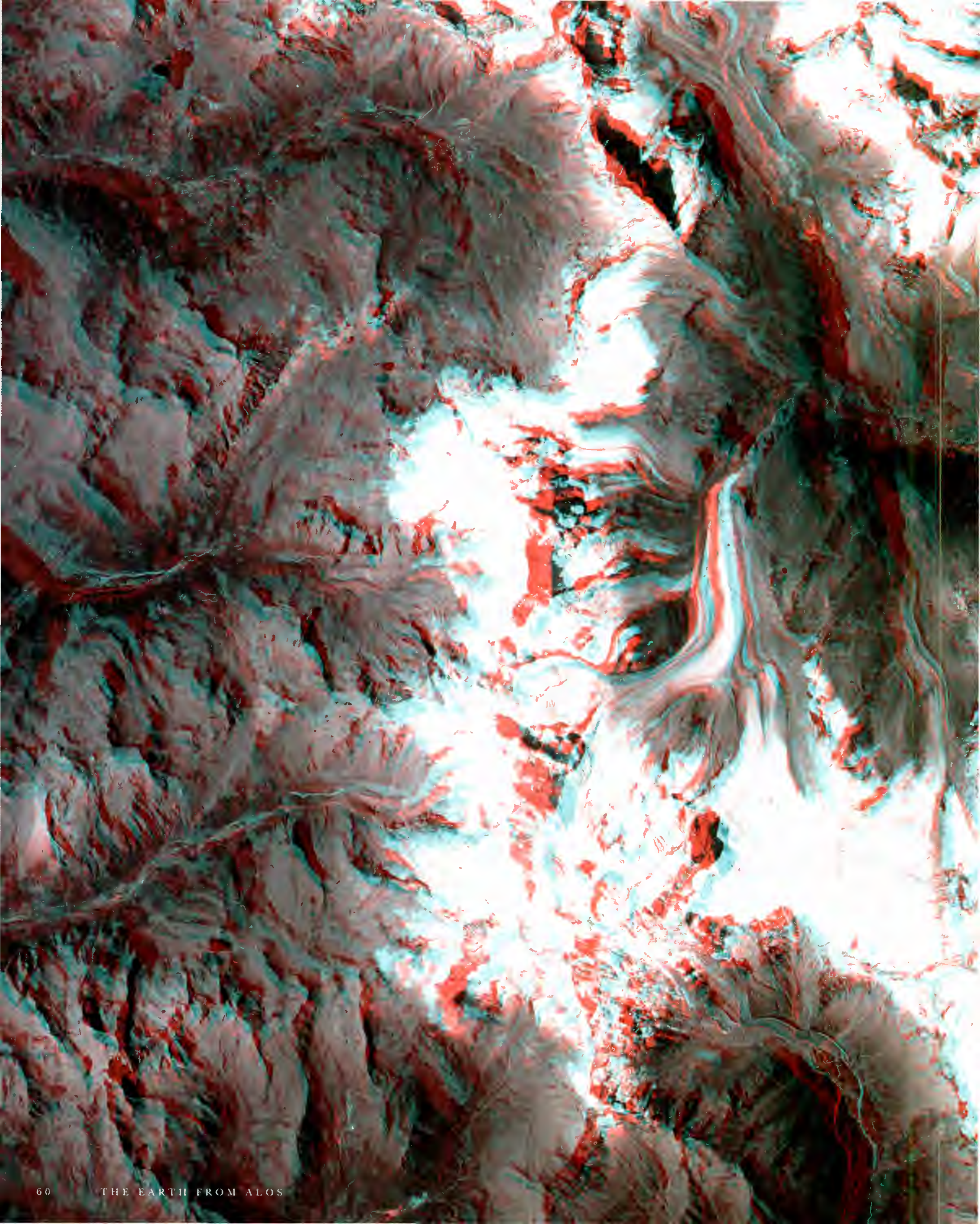




Grand Canyon

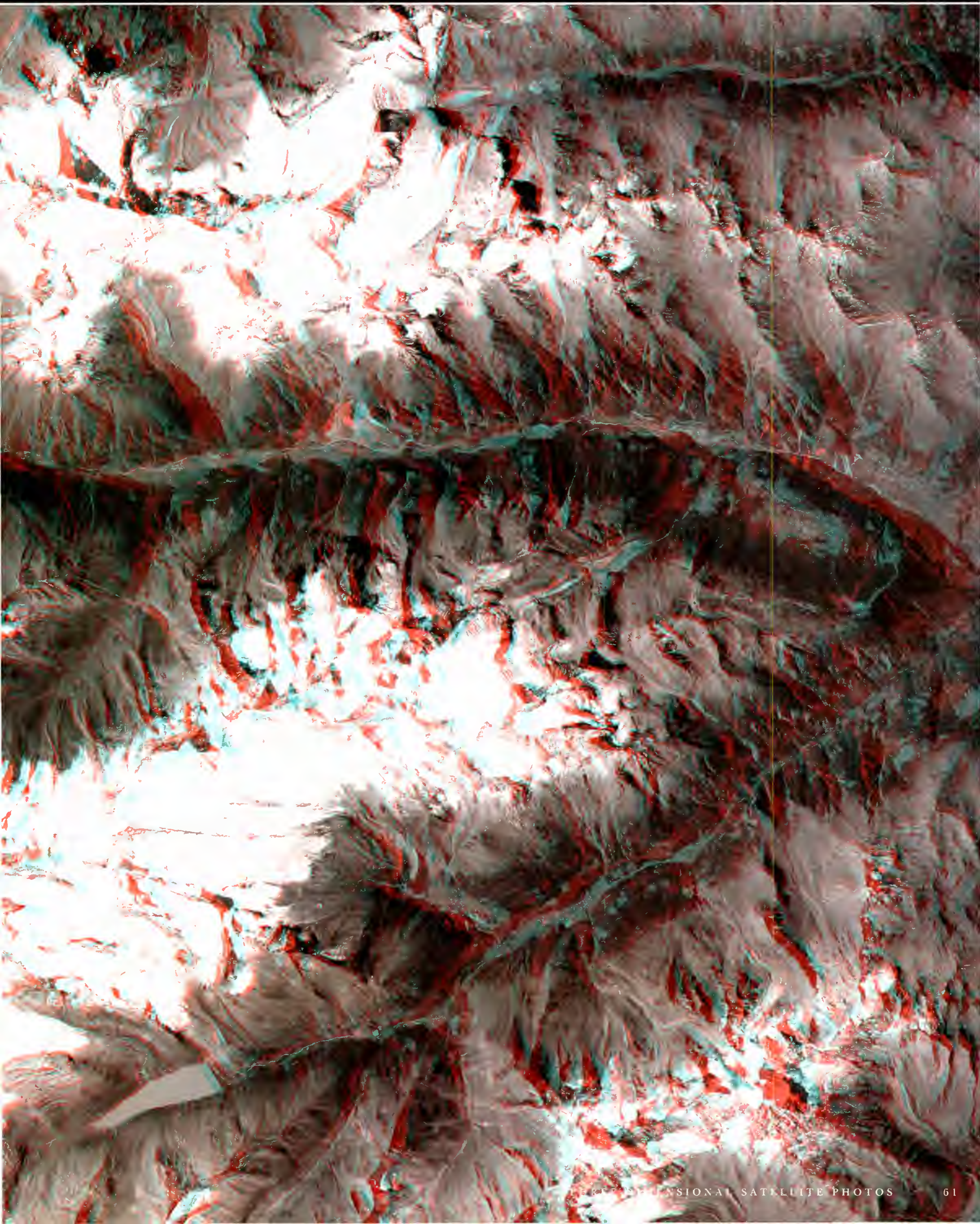
This enormous canyon was eroded by the Colorado River into the terrain of northern Arizona, in the United States of America. The average depth is 1200 meters.

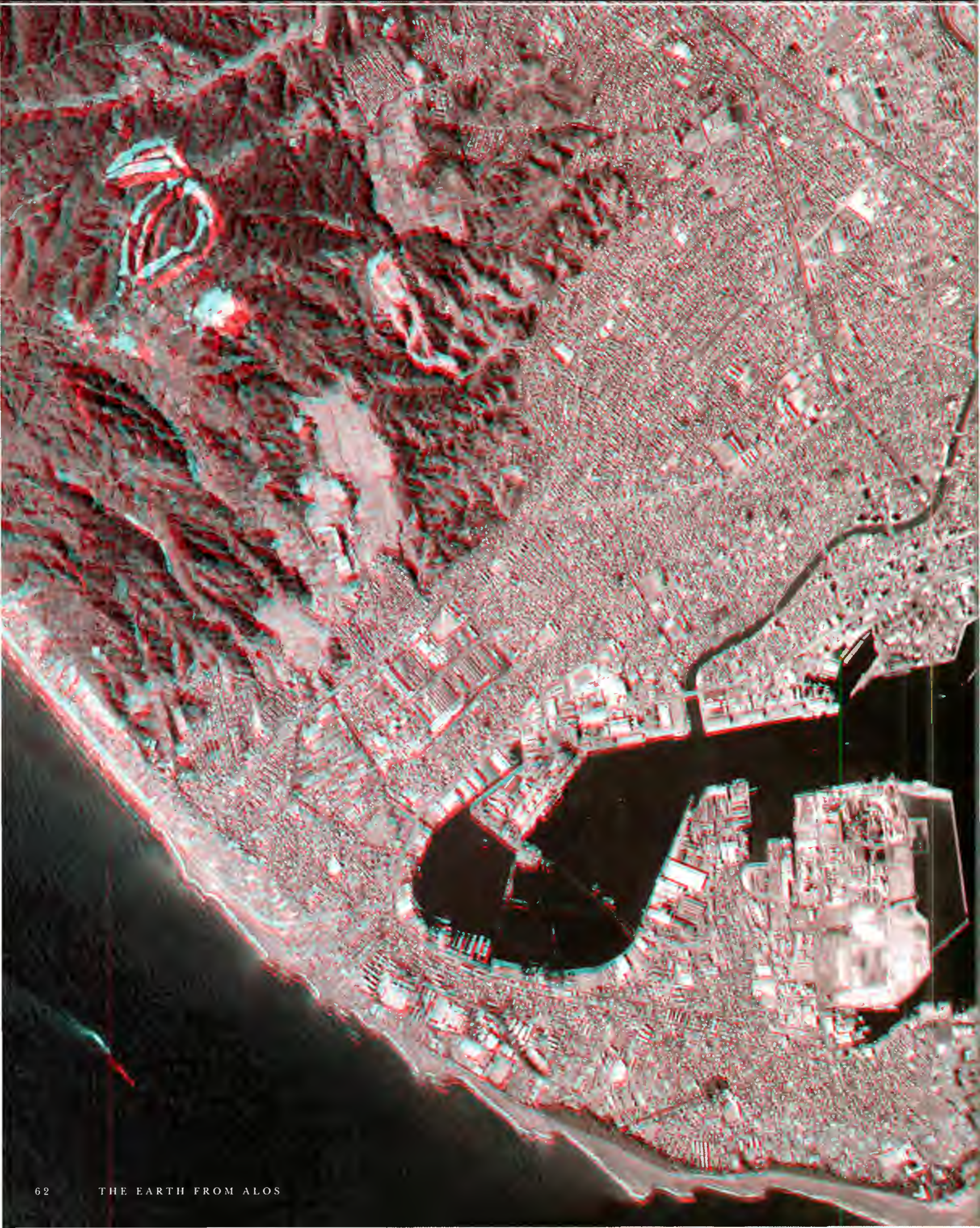


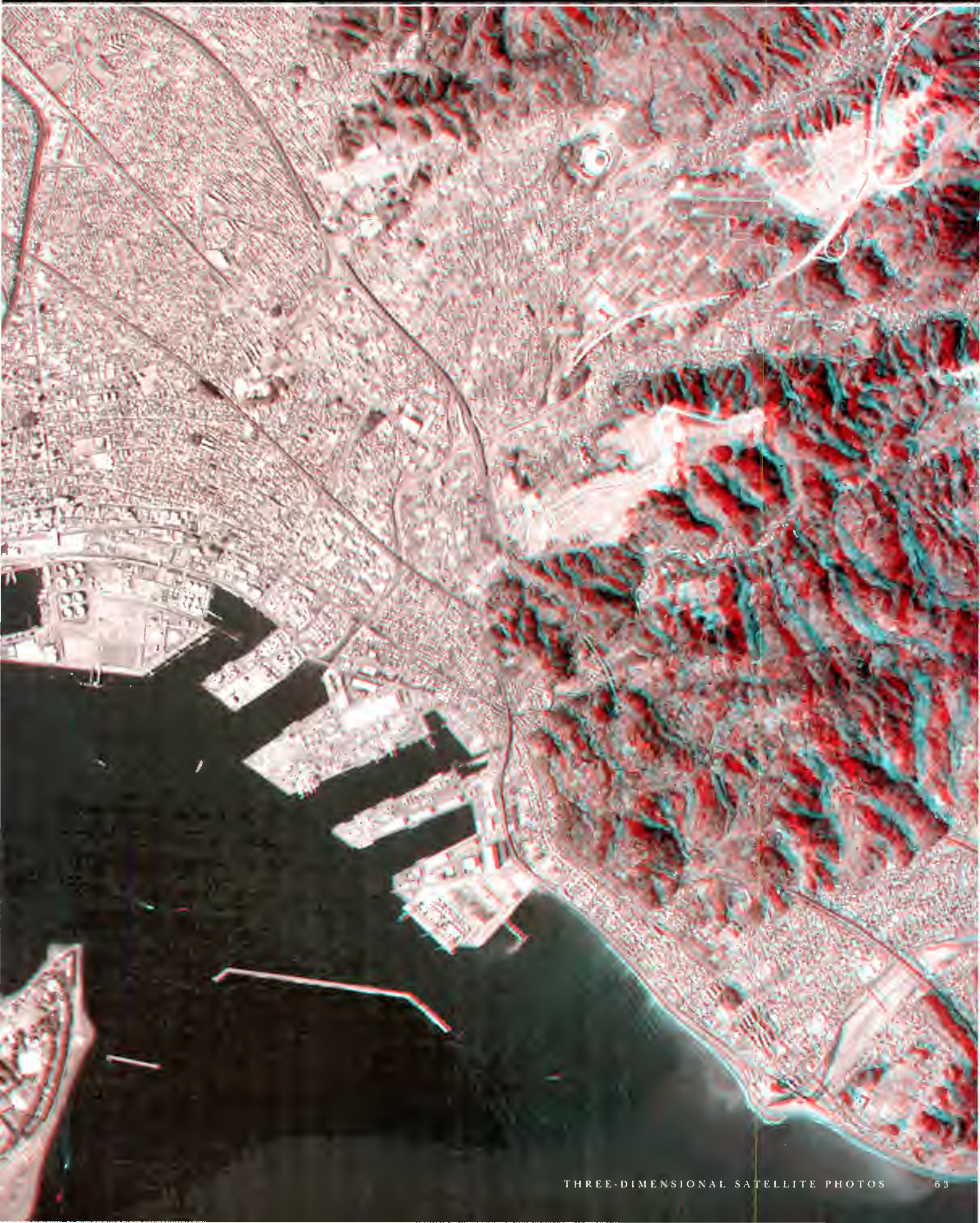


The Matterhorn

Famous for having one of the toughest north faces in the European Alps, the Matterhorn rises to an elevation of 4478 meters, and is located on the border between Switzerland and Italy.







Shimizu

The Shimizu district of Shizuoka City, Japan. Nihon Daira, site of the Kunozan Toshogu Shrine, stretches out to the left. The Miho Peninsula, where Matsubara is located, is in the foreground.

WALKS THROUGH OLD PARIS

A JOURNEY THROUGH THE HISTORY OF PARIS, AS REVEALED IN IMAGES FROM ALOS

"In the mid-19th century, Paris, modeled on the human body, was completely reconstructed to be a utopian city by Napoleon III, the last emperor of France. At his command, prefect Georges Eugène Haussmann of Seine Province managed the work, re-creating the city in the image of the human body."

– Shigeru Kashima, professor, Kyoritsu Women's University

Just north and across the Seine from the Île de la Cité is Angelina, the café I often frequent, which faces onto the rue de Rivoli. Every time I visit Paris I walk its streets from this café, idling in familiar second-hand bookstores, or strolling through the old shopping arcades...

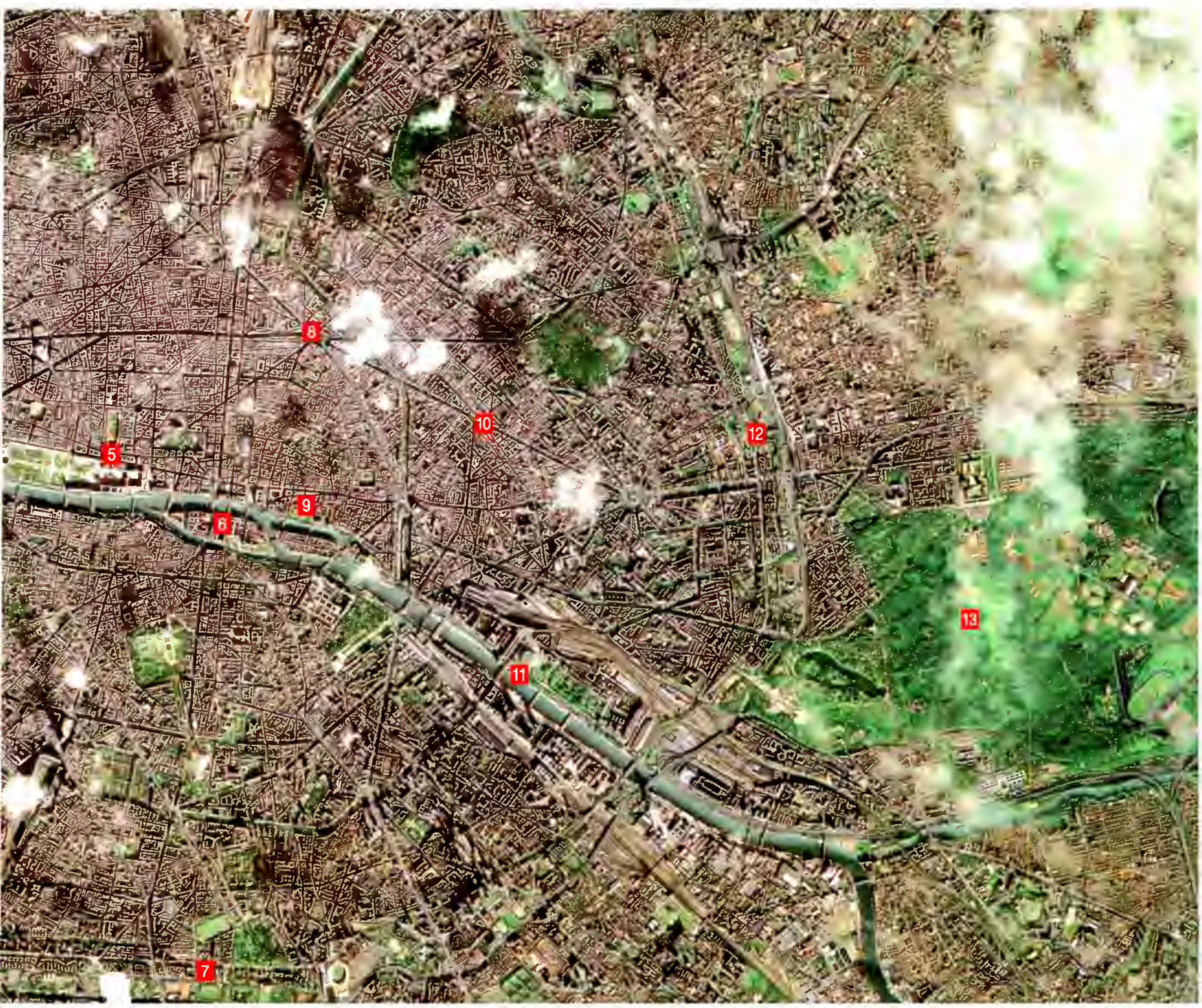
Instead of this chapter merely serving as a guidebook to the face of Paris in the 21st century as revealed through these photos from space, I would like to invite you on a journey through the history of my beloved Paris.

ALL IMAGES JAXA

Napoleon III rebuilt the city in the 19th century

The streets of Paris are based on the redesign of the city carried out by Napoleon III in the 19th century. After becoming president of France in 1848, Louis Napoleon was determined to rebuild the city. He summoned Jean Jacques Berger, the prefect of Seine Province, and handed him the plans for a new city, showing the roadways to be opened. He refused, however, and after Louis Napoleon was crowned Emperor following his coup d'état in 1851, Berger was fired from his post and replaced by Baron Haussmann, who implemented the Emperor's grand vision for a modern Paris.

The design was meant to correspond to the human body. The Place du Chateau and the Place de l'Étoile (today, Place Charles-de-Gaulle) were the "heart" of the city, pumping fresh blood throughout via the "arteries" radiating out from it: the Place Vendôme (boulevard Voltaire), the boulevard du Nord (boulevard Magenta) and other spacious roads. The Bois de Boulogne, Bois de Vincennes and Parc des Buttes Chau-



Arc de Triomphe and Eiffel Tower

The Arc de Triomphe (A) was constructed by Napoleon III in 1836. This giant arch stands 50 meters tall and 45 meters wide. Twelve boulevards radiate from the Arc de Triomphe, in a star-shaped design that was named "Place de l'Étoile" (Star Plaza). The Eiffel Tower (B) was built for the International Exhibition of Paris in 1889, and takes its name from the contractor who built it: Gustave Eiffel. It stands 324 meters tall, with three sightseeing decks. It was originally scheduled to be taken down after the Exhibition, but it was retained as a military radio transmitting tower.

Bois de Boulogne

In 1315, King Philip IV visited Boulogne Sur Mer on the shores of the Strait of Dover, and named this forest Bois de Boulogne (Forest of Boulogne) after a chapel he saw there. The 8,460 square kilometer Bois de Boulogne includes an extensive English garden constructed by Napoleon III in 1852, the Hippodrome de Longchamp (C) which hosts the Prix de l'Arc de Triomphe (the pinnacle of horseracing in Europe), and more. To the south is Boulogne-Billancourt (D), with the vacant lot where the Renault plant once stood (E).

mont, among other places, served as the "lungs," supplying Paris with fresh air. Paris had been a humid and malodorous place before the project, and Napoleon III was determined to make it an airy and bright city.

Before the grand rebuilding the city was a bit smaller, and its boundary was demarcated by a stone wall called the "Wall of the Farmers-General." The wall had 54 gates, and was intended to enforce the payment of a toll on goods entering Paris. Instead of paying a tax in cash, suppliers of goods to the city paid indirectly, in the form of a tax on their foodstuffs. It was a method of privatizing indirect tax collection. It caused a sharp increase in the price of goods in Paris, however, which fed dissatisfaction among city residents and became yet another factor leading to the French Revolution.

The wall was constructed between 1784 and 1787, upon a proposal by Antoine-Laurent de Lavoisier, one of the farmers-general and the "Father of Chemistry." On both sides of the gates grandiose tax barriers were built to the design of Claude Nicolas Ledoux, but most of them were removed later as impediments to the construction of the Boulevard Périphérique. Only four portions of the wall still exist: the rotunda of the barrier of La Villette, the barrière du Trône, the barrière d'Enfer, and the rotunda of the Parc Monceau. Of these, the latter is a two-story round structure like a pagoda, possibly reflecting the Orientalism of the late 18th century, and today it is used as a public pay toilet... today, as when it was first built, it still collects money.

The modern city, which expanded in Napoleon III's great project, was almost entirely enclosed within

Cité Internationale Universitaire de Paris

The Cité Internationale Universitaire de Paris (F) was constructed in 1925 by André Honnorat, Minister for Public Education. It was designed to provide housing for the foreign students and French citizens attending the University of Paris and other high-level educational institutions and research facilities, promoting cultural and academic exchange. The Maison du Japon, standing seven stories tall with one basement, was completed in 1929, and is provided with a spacious Japanese garden.

a military defense called the Thiers Wall, constructed from 1841 to 1845 in preparation for war with Prussia. For military reasons, no structures were permitted within 250 meters from the outside of the wall, earning the area the name "zone militaire." In contemporary Paris the beltway winds through the greenery encircling the city.

A large number of barracks were built throughout this zone, and these evolved into slums where waste collectors lived. A rumor that the piles of waste they collected had yielded a Stradivarius violin, a Rembrandt and other treasures triggered a rush of antique collectors to the area, creating quite a hullabaloo. Antique dealers hoping to turn up more treasures set up street stalls, laying the foundations of today's flea market there. During the Paris Olympics in 1924 a number of stadiums and tracks were built in the zone militaire, and most still remain.

In the western reaches of Paris, outside the zone militaire, is the vast Bois de Boulogne. The city of Boulogne-Billancourt is just across the city limits to the south, and I lived there with my family in 1984 and '85. A large Renault plant was located there at the time, and many plant workers lived in the area. The plant was later closed, and the former site is clearly visible from space. I used to visit the Hippodrome de Longchamp in the Bois de Boulogne, to enjoy a meal and watch the horse races, spending a day of leisure under the distant silhouette of the Eiffel Tower.

When viewed from the distance of space, the streets of Paris reveal so many scenes. I have no doubt that Napoleon III would have wanted to see these images, too.

DOCUMENTING ALOS

SATELLITE'S EXCESS WEIGHT FORCED ADJUSTMENTS TO ITS DESIGN

It took ten years to bring the development of the Earth observation satellite known as ALOS to the point of launching and operation. For JAXA (the Japan Aerospace Exploration Agency), this was an unusually large project. Here we follow the trials and tribulations of the project team.

2003 was a terrible year for JAXA. In October, the environmental observation satellite Midori-II ceased to function only 10 months after its launch. In November, the H-IIA rocket failed to launch properly after solid rocket boosters did not separate from the main rocket. Later, in December, the team behind the Martian exploration probe Nozomi had to abandon attempts to put the craft into orbit around Mars.

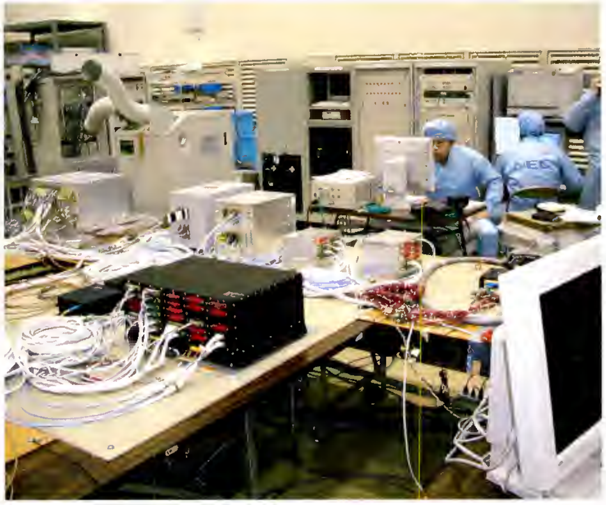
These failures left the newly formed JAXA open to all sorts of criticism. Japan's space development activities were already being called into question, but these incidents magnified the Agency's problems. In particular, Kenji Tomioka, project manager of the team behind ALOS, felt a strong sense of impending crisis. The ALOS project was reaching its final stages, and it was clear that the Agency could not tolerate any further failure. Tomioka, along with the rest of his team, was always aware of this fact.

Tomioka had been aware of the scale of the project ever since he joined the ALOS team in 1996. "The satellite's weight, the level of investment, and the impact it would have on society," he recalls. "All of these were far bigger than any satellite development project I had been involved in before." Furthermore, ALOS was developed using methods with which JAXA had little experience. Conventional satellite development begins with the technology, but ALOS came about initially with the definition of its mission.

That mission was fourfold: to create maps; to observe regions of the Earth; to aquire an overview of disasters; and to survey natural resources. The team was charged with developing technologies to allow this mission to be accomplished smoothly. "The satellite's functions and capabilities were defined by the end users," said Tomioka. "It was no more and no less than that." In order to successfully fulfill the four aspects of its mission, the team gradually came to the conclusion that they would need to equip ALOS with three different sensors: PRISM, AVNIR-2 and PALSAR.

Bringing it under the required weight limits

The development of a satellite goes through various stages – conceptual design, preparatory design,



Left: Assembling ALOS
Above: Testing the EM (Engineering Model) in April 2001
Below: PALSAR BBM (Bread Board Model)

basic design and detailed design -- before reaching the maintenance design stage. At each stage, various models are produced, and these must pass JAXA's internal reviews before work is permitted to proceed further. ALOS made it as far as the preparatory design stage with few delays, but when it entered the basic design stage, in 1998, it became clear that the satellite was going to be too heavy.

Based on the capacity of the rocket to be used to lift it into orbit, ALOS had to be constructed with a weight of 3.8 tons. The PALSAR sensor, however, which was originally planned at 480 kg, was found to have increased to 750 kg due to developments in the

January 5, 2006

The satellite is fitted to the fairing of its launch rocket at Tanegashima Space Center

January 10, 2006

The satellite, fitted to the fairing, is transported to the rocket launch complex.

Directly Before the Launch

All settings completed, the H-IIA rocket no. 8 waits to be launched from Tanegashima Space Center

January 24, 2006 (Launch Day)

Staff watch the launch of the H-IIA rocket from the Tanegashima Space Center. Excitement and fear combine in a single moment.

structure of its antenna and the addition of some extra new functions. This put the satellite over its weight limit. Norimasa Ito, lead engineer of PALSAR, met many times to negotiate with staff from JAROS (the Japan Resources Observation System Organization), who were jointly responsible for the development of the sensor. "We weren't able to come to a conclusion, even though the basic design review was coming closer and closer," remembers Ito. "It was terrible." In the end, the team agreed to reduce PALSAR's panel width from its original design of 3.5 m to 3.1 m. They were just in time to make the basic design review. "Even though we'd spent two years working on the equipment we were going to install on the satellite," explains Tomioka, "If we'd not been able to solve the weight problem we would have been set back another year." Despite their best efforts, however, the completed satellite still weighed 4 tons – outside the initial target of 3.8 tons. The team decided to add boosters to the rocket in order to solve the problem.

After successfuly passing the basic design review at the end of 1999, the team stepped up a gear. Almost every day, Tomioka visited the partner companies manufacturing the satellite.

Around the time JAXA experienced a run of failures with its satellites and rockets. Everyone was asking whether it was possible for ALOS to succeed.

Tomioka recognized that such criticism, coming from both within and outside JAXA, was unavoidable, so he decided to review the entire project and ensure

The Earth from ALOS
New Perspectives from Space

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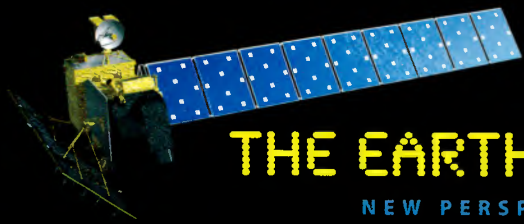

THE EARTH FROM ALOS

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