

NAKANIHON AIR



Pioneering Airborne Mapping in East Asia!

50 years of expertise, and now adding the top line RIEGL VQ-1560 II LiDAR sensor, with options for pairing with infrared and thermal imaging.

July 2021

Introduction

Leading Japanese aviation services company, 'NAKANIHON AIR, has been providing airborne survey and research since 1971, when they began building an impressive airborne mapping toolbox. 'NAKANIHON AIR is now commissioning one of RIEGL's latest generation LiDAR scanners, the powerful and versatile VQ-1560 II. This new sensor ensures that 'NAKANIHON AIR meets the increased point cloud density requirements of their clients, and adds efficiency by allowing them to scan wider swaths from higher elevations, with incredible precision!

As missions require, 'NAKANIHON AIR will have the option to pair the VQ-1650 II with their existing hyper-spectral and thermal sensors, and/or their UltraCam Eagle Mark 3 camera. Their fleet of aircraft will soon include a custom-modified Cessna with all the bells and whistles. This rare combination of scanners, sensors, large format camera, and modern aircraft is a dream package for the experienced surveyors and scientists who work there.

In the following pages we review NAKANIHON AIR impressive history of projects throughout Japan, and the evolution of the tools they have used. Long-timers in the industry might enjoy seeing pictures of the old tools of the trade.



NAKANIHON AIR is commissioning one of the latest in airborne LiDAR scanners, the RIEGL VQ-1560 II, to provide their clients with the most sophisticated 3D technology available in this part of the world.

The Evolution of NAKANIHON AIR Research and Survey Division

[CLICK HERE to view a short video of an impressive urban dataset of LiDAR base-map with thermal imaging overlay, showing precise locations of escaping heat.](#)



Merging LiDAR with other datasets can produce astounding results. This one minute video shows data collected by NAKANIHON AIR at night over Sakae, Japan. Thermal imaging from their iTRES TABI sensor was overlaid on the digital surface model which was acquired with the RIEGL LMS-Q780. Thanks to the high point density and precise geometry, thermal properties of buildings and facilities can be clearly grasped and corrective measures can be suggested to reduce energy consumption.

The NAKANIHON AIR Research and Survey Division began providing airborne research and survey in 1971 with a new Fairchild K-22 camera they imported from the US and mounted on their own aircrafts. Seeing the value for terrain mapping and other projects, they soon expanded their photogrammetric capability by adding a RC-10 by Wild from Switzerland.

After experiencing successes in photogrammetry, NAKANIHON AIR leadership began researching other types of sensors and was the first airborne research and survey company in Japan to add thermal airborne scanning to their list of services. Their teams began innovating with thermal technology on projects such as monitoring the temperature of drainage from thermal power plants, something that is very important even today as it affects the local ecosystem.

In the late 1990s through early 2000s, NAKANIHON AIR expanded beyond photogrammetry and thermal imaging, and began to invest in equipment for spectral imaging and moved into precision 3D mapping using LiDAR.

It was in 2007 that their geospatial data took a huge leap forward and into 3D, with the purchase of their first RIEGL scanner, the LMS-Q560, now retired.

Soon after, they began experimenting to see what could be accomplished with the pairing of LiDAR with photogrammetric images, and thermal and hyper-spectral data. They found many innovative uses for the combination.

Most of NAKANIHON AIR bread and butter work is terrain mapping for large infrastructure projects like roads and rail, power transmission lines or urban mapping. But they also frequently get involved in a wide variety of more specialty projects such as:

- mangrove forest modeling for environmental studies,
- 3D mapping that is key to landslide prevention plans,
- monitoring the many volcanos in the area, and
- providing smart-city models that help cities with things like thermal heat loss studies, traffic planning, urban development and drainage.



Japan has about 110 active volcanoes. Forty-seven of those are monitored closely because of recent seismic activity, ground deformation or emission of large amounts of smoke. Airborne LiDAR is an excellent way to collect frequent data and perform change detection analysis from a distance. Photo printed with permission by ltl.cat.

NAKANIHON AIR will ultimately operate the VQ-1560 II on a new, specially modified C208, and has put great thought into creating the perfect platform that will include its other sensors. The modifications feature proper camera hatches for the ITRES CASI and ITRES TABI sensors, the UltraCam Eagle Mark 3, and an opening with a SOMAG GSM4000 Gyro Mount stabilization platform for the RIEGL LiDAR scanner. This mount will drastically reduce the vibrations that would otherwise affect the sensor. The modifications also include an exhaust deflector that mitigates noise in the thermal and camera images.

All of this meticulous attention to detail ensures that NAKANIHON AIR will be able to produce the highest quality data of its kind.



NAKANIHON AIR has dedicated three AS350 helicopters and three C208 fixed wing aircraft for airborne survey and research, from within its total fleet of seven various fixed wing aircraft and 60 helicopters.

Pairing LiDAR and Hyperspectral Sensors

Pairing LiDAR with hyper-spectral and thermal imaging at NAKANIHON AIR takes the form of many types of projects in Japan, and they are able to provide these same services in other parts of the region:

- Water Quality
- Coastal Mapping
- Snow Accumulation and Depth Analysis
- Environmental - Vegetation, Wildlife, Contamination, Wetlands Mapping
- Wildfire and Hotspot Mapping
- Geology, Mining, Oil and Gas Exploration
- Emergency Response
- Search and Rescue
- Thermal Anomalies or Identifying Areas of Heat Loss
- Defense and Target Detection
- Agriculture and Forestry

TIMELINE of AIRBORNE SCANNING INNOVATION

1953 Established NAKANIHON AIR

1950's to 1960's Starts businesses of transportation, news gathering, agricultural spraying, goods transportation, etc. using Bell 47G-2, De Haviland 104-5A, Sikorsky S62A, Grumman G-21A Goose, Douglas DC-3 and other misc. airborne equipment



1971 - This 50 year old Fairchild K-22 Camera Image is Public Domain

1971 Fairchild K-22 Camera (this model camera is now on display at the National Air and Space Museum in Chantilly, VA, USA)

1971 NAKANIHON AIR puts into service Japan's first thermal airborne scanner, the JIRCO, J-SCAN-AT-1, initially used to monitor temperatures of warm drainage from thermal power plants

1972 NAKANIHON AIR adds Wild RC10 photogrammetric camera from Switzerland - in some cases mounted on a helicopter and used on archeological excavation sites

1976 NAKANIHON AIR begins providing aeromagnetic survey using a domestic airliner NAMC YS-11

1984 Company begins providing helicopter emergency medical service

1989 NAKANIHON AIR adds the Wild RC20 photogrammetric camera

1989 Engaged in Japanese Antarctic Expedition with AS350B and flight crew



1995 - [CLICK HERE to read the 1969 ASPRS article on the Wild RC10 film camera](#)

1995 Adds Wild RC30 photogrammetric camera

1996 Purchased Japan's first helicopter-based laser measurement system called NTOMS. The scanner was made in Japan. (NEC, TOMS-1)



1989 - Japanese Antarctic Expedition Photo by NAKANIHON AIR

2003 Operates discrete LiDAR Optech ALTM2050 system

2004 Operates ITRES hyper spectral imager CASI-3 and also domestic multi spectral scanner J-SCAN-AT-ZM (also known as AZM) which covers visible to thermal infrared

2005 Operates discrete LiDAR Optech ALTM3100 system

2005 Optech ALTM3100 and ITRES CASI-3 are integrated in the same platform C208. The system called Hyper Mapper and used in vegetation mapping projects and monitoring projects. (See Bamboo paper)

2006 Operates Vexcel UltraCam D, a large format digital aerial camera



[CLICK HERE to view paper](#)



2007 - NAKANIHON AIR first RIEGL LiDAR scanner, the LMS-Q560

2007 NAKANIHON AIR purchases first RIEGL scanner, the LMS-Q560 - Named SAKURA1, mounted on helicopter (now retired)

2007 The first project by SAKURA1 : "HD Laser profiling for the Koishiwara-Dam construction" The deliverable won multiple kinds of awards from Japan water agency, Kyushu Regional Development Bureau (Ministry of Land, Infrastructure, Transport and Tourism(MLIT)), A technical society which managed by MLIT, and Japan society of Dam Engineers.



2007 - Koishiwara-Dam Construction

2007 Pioneered soil and water conservation projects of LiDAR

2008 NAKANIHON AIR RIEGL LMS-Q560 was integrated - Named SAKURA 2, mounted on helicopter (scanner retired)

2008 Mangrove Modeling in Amami Oshima Island at southern tip of Japan, as part of the research project by Tohoku Gakuin University

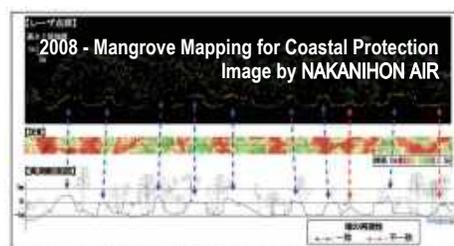


図4 予実測データと現場測定データとの比較結果 (断面図)
Fig. 4 Comparison between LiDAR data and field-measured data for Thalassia astrovata (断面図)

Mangrove mapping for coastal protection of the southern region of Japan - [CLICK HERE to read the final study paper](#)

2008 Landscape simulation project for Shugakuin Imperial Villa in Kyoto



2008 - Shugakuin Imperial Villa in Kyoto
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2009 River management and levee maintenance projects using airborne LiDAR by SAKURA 2. This method superseded one of the ground based survey projects for levee height measurements in the land subsidence area.

2009 Projects for soil erosion conservation planning. The beginning of 1 meter point spacing in large area soil conservation projects. The standard point density requirements used to be 2 meters point spacing.

2009 Construction progress tracking project using LiDAR in Osawa-kuzure erosional valley at Mt. Fuji.

2009 Change detection analysis in a river management and levee maintenance project. Using past year measurements with the latest LiDAR profiling, levee subsidence and cracks on the bank were successfully identified and accurately located.



2009 - Erosion Correction
Image courtesy of Mt. Fuji Sabo Office



2010 - The RIEGL LMS-Q680i was put in service

2010 Upgraded large format digital aerial camera to the Vexel UltraCam Xp-wa

2010 NAKANIHON AIR first RIEGL LMS-Q680i was integrated with multi (three) angle digital camera system - Named SAKURA 3

2010 Road disaster management projects. High point density data was essential to comprehend the slopes existing around road side.

2010 Cultural properties and archaeological survey projects. Captured and profiled old castle and ruins.

2010 LiDAR data acquisition around active volcano Mt. Yake for the snow run off simulation in the eruption using change detection analysis.

2011 Great East Japan earthquake. Unevenness measurement on highway, damage evaluation in Tsunami disaster area and also liquefaction area.

2011 Heavy Rain by Typhoon TALAS Kii Peninsula. Emergency response under the land route disruption situation. Contributed to initial recovery by immediate localization of landslide location in mountainous region over wide area. The acquired LiDAR data were provided to wide range of groups such as government, prefectural office, university, and other organizations.

2011 City modeling project of the main commercial districts Sakae in Nagoya City.

2011 Modeling project of Nagoya Castle as part of landscape plannings.

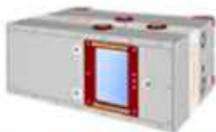
2012 NAKANIHON AIR second LMS-Q680i was integrated with five angle digital camera system - Named SAKURA 4

2012 As part of disaster recovery after Great East Japan earthquake, terrain mapping projects for residence relocation plannings.

2012 Constantly involved in large area soil conservation projects.

2012 Detailed terrain profiling and data analysis for the forest monitoring project over the source of bottled natural water.

2012 Accurate high-resolution LiDAR measurement of 25cm point spacing in many of river management projects



2013 - RIEGL LMS-Q780 came on board

2013 NAKANIHON AIR purchases RIEGL Q780, mounted on a fixed wing platform - Named SAKURA-F. A large format photogrammetric camera Ultracam-Xp was adopted in the same platform as the LMS-Q780.

2013 Fixed wing based high-resolution LiDAR measurement by LMS-Q780 dramatically increases operational efficiency in large area soil conservation projects.

2014 NAKANIHON AIR purchases VUX-1 and launched UAV based LiDAR system named "TOKI".



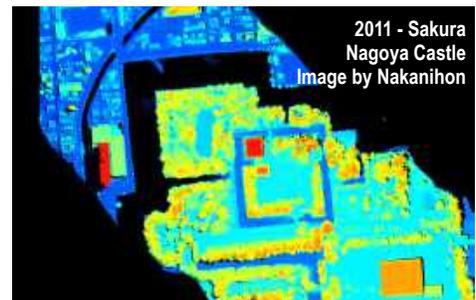
2010 - Snow runoff simulation, Mt. Yake



2011 - Example of roadway/bridge damage following 2011 earthquake



2014 - Emergency response re landslide caused by Typhoon TALAS



2011 - Sakura Nagoya Castle
Image by Nakanihon

2014 Cultural properties and archaeological survey projects.



2014 - ITRES CASI and TABI were added

2014 Terrain mapping projects for dam and reservoir management. Data fusion with water bed profiling by Narrow Multi-Beam echo sounder system.

2014 Rockfall detection surveys using high density LiDAR data as part of road counter disaster measurements.

2014 NAKANIHON AIR ITRES CASI-1500h and ITRES TABI-1800. These were integrated with the *RIEGL* LMS-Q780 on a fixed wing aircraft to form a four-sensor fusion: LiDAR, medium format RGB camera, hyper-spectral imager and thermal imager.

2014 Projects for urban heat island studies, localization of seaweed forests, vegetation activity surveys of rice paddies, wild deer detection, volcano activity surveys and so on.



2017 - Addition of the *RIEGL* VQ-880-GH that combines bathymetric and topographic capabilities

2016 Counter disaster projects in 2016 Kumamoto earthquakes. LiDAR fleet used to locate collapsed sites and cracks. Also utilized for studies on active faults.

2016 Many of terrain modeling projects for the Mega-Solar power plant construction plannings.

2017 NAKANIHON AIR purchases *RIEGL* VQ-880-GH Named SAKURA-GH, mounted on a helicopter

2017 Groundbreaking surveys by ALB (Airborne LiDAR Bathymetry) in the river excavations.

2017 River management projects using ALB for monitoring, and various plannings and studies.

2018 After 2018 Japan floods, change detection project of the lava dome on Mt. Unzen as part of a volcanic soil conservation study. Hundreds of points per square meter could be derived by overlapping measurement flight paths by a helicopter.

2018 High density measurement by SAKURA over the location where UAV operation is challenging.



RIEGL VQ-1560 II came online in 2021

2018 SAKURA-GH engaged in the pilot project by MLIT (Ministry of Land Infrastructure, Transport and Tourism) for river profiling by ALB.

2019 ALB began to supersede man-powered river profiling in several river management projects.

2020 ALB becomes more widely used on river management projects.

2021 NAKANIHON AIR *RIEGL* VQ-1560 II and Modified Cessna (C208). Platform will include the Vexcel Ultra-cam Eagle MarkIII with GSM4000 Gyro Stabilized Mount, and ITRES CASI and ITRES TABI sensors to give highest quality datasets available worldwide.



[CLICK HERE to view rockfall detection paper \(in Japanese\)](#)

With the knowledge gained over the past seven decades, the addition of this new *RIEGL* sensor NAKANIHON AIR ensures that they continue to lead the country of Japan in providing highly sophisticated 3D geospatial data, aerial photography, cartography, GIS, remote sensing and aerial surveys.

It's nice to look back and appreciate the equipment our industry has built upon. We've evolved from using functional but somewhat clunky 2D photogrammetry workhorses, to extremely sophisticated and elegant equipment for modern 3D LiDAR airborne survey.

- Kohei Wakamatsu, NAKANIHON AIR, Group Leader of airborne sensor operation



The Fairchild K-22 camera became commercially available in the late 1960s. This one is on display at the Smithsonian Institution, National Air and Space Museum. Image is Public Domain



[CLICK HERE to read the 1969 ASPRS article on the Wild RC10 Film Camera.](#)



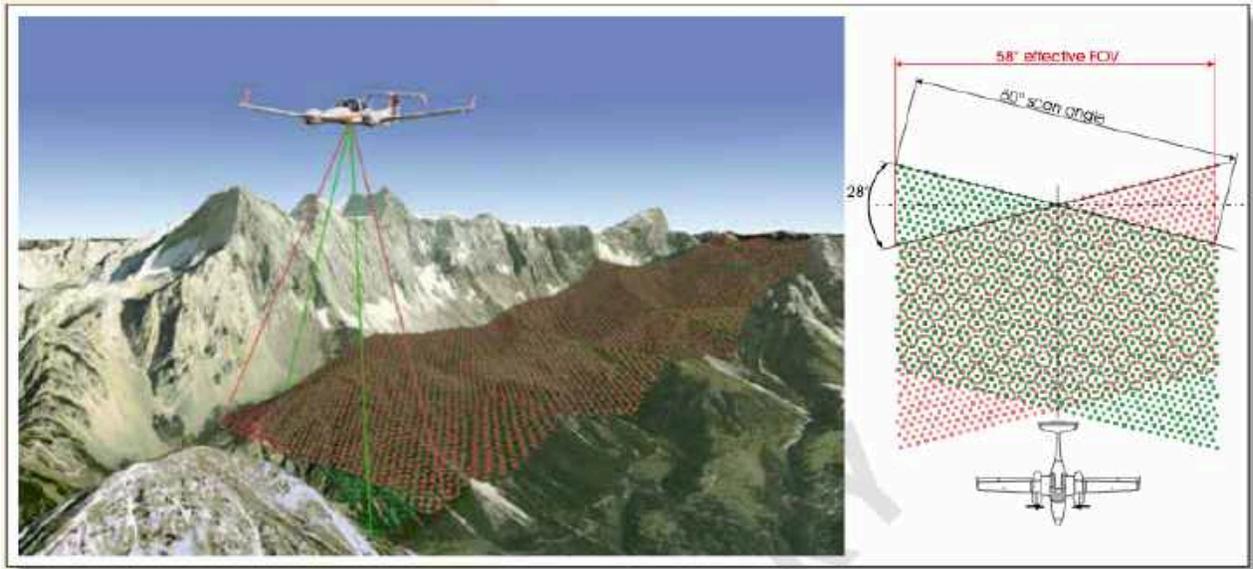
A half century later, the *RIEGL* VQ-1560 II has taken the airborne survey technology to an infinitely higher, more sophisticated level.

How NAKANIHON AIR Will Make the Most of their New *RIEGL* VQ-1560 II

The Dual LiDAR Waveform Processing Airborne Scanning System VQ-1560 II provides further increased performance and highest productivity based on a laser pulse repetition rate of up to 4 MHz, resulting in more than 2.66 million measurements per second on the ground.

The VQ-1560 II Crossfire Scan Pattern Captures Wider Swaths Per Path

The VQ-1560 II unique "cross-fire" scan pattern and its wide operational range make the instrument the most versatile airborne laser scanner on the market today. It can gather data at higher altitudes and capture a wider swath of data in each pass. The ability to fly higher is a wonderful attribute in mountainous geographies like in Japan, where elevations can change quickly. Further, because a wide swath of territory can be collected with each pass, it is possible to gather data from multiple systems that are adjacent such as multiple power-lines, roadways or railway track.



The VQ-1560 II is perfectly suited for a wide range of applications – from ultra-dense corridor mapping from low altitudes; high resolution city mapping with minimum shadowing effects in narrow street canyons; and large-scale wide area mapping at utmost efficiency of up to 1130km² per hour at a density of 4 points per square meter, the density now required by many agencies in Japan.

Full Waveform Technology Allows NAKANIHON AIR to Scan Through Vegetation - Down to Bare Earth

Last but not least, the *RIEGL* full waveform technology allows NAKANIHON AIR to easily see bare earth. In the comfort of the office the LiDAR specialist will be able to remove unwanted layers to show only what they are most interested in seeing. Once the point cloud has been created the different views will be easy to display and give their clients a wealth of information.

Main Features of the VQ-1560 II

- *High laser pulse repetition rate up to 4 MHz*
- *Up to 2.66 million measurements per second on the ground*
- *Offers highly efficient data acquisition at a wide range of point densities*
- *Two waveform processing LiDAR channels offering excellent multiple target detection capability*
- *Enables Multiple-Time-Around (MTA) processing of up to 35 pulses simultaneously in the air*
- *Excellent suppression of atmospheric clutter*
- *Online waveform processing as well as smart and full waveform recording*
- *Integrated inertial measurement unit and GNSS receiver*
- *Integrated, easily accessible medium format camera*
- *Prepared for integration of a secondary camera*
- *High-speed fiber data interface to RIEGL data recorder*
- *Housing shape and mounting flange optimized for interfacing with typical hatches and stabilized platforms*
- *Detachable handgrips for facilitated handling*
-



[CLICK HERE to go to the RIEGL VQ-1560 II Data Sheet](#)

The VQ-1560 II was specifically designed to accomplish the following:

- | | |
|--|--|
| • <i>Ultra-Wide Area / High Altitude Mapping</i> | • <i>City Modeling</i> |
| • <i>Ultra-High Point Density Mapping</i> | • <i>Mapping of Lakesides & Riverbanks</i> |
| • <i>Mapping of Complex Urban Environments</i> | • <i>Agriculture & Forestry</i> |
| • <i>Glacier & Snowfield Mapping</i> | • <i>Corridor Mapping</i> |



“From the first steps into the world of airborne laser scanning back in 2007, NAKANIHON AIR has grown to become a worldwide reference in the capture of high altitude LiDAR data, coupled with other remote sensing technologies,” said Marcos Garcia, Business Development Manager, RIEGL Asia Pacific.

Summary

NAKANIHON AIR's experienced teams have the equipment and expertise to utilize the right combinations of sensors and aircraft to meet the requirements of each mission.

NAKANIHON AIR provides its services throughout Japan, and is open to collaborating on projects in other areas of the world. NAKANIHON AIR, Director of Research & Survey Department Naoaki Murate aid, our research and survey team members have a somewhat unique and rare skillset that has been developed over many years. We are excited to put our people and equipment to work on projects that benefit society and the environment.

Later this year RIEGL will release a follow-up article that will show actual NAKANIHON AIR data sets obtained on various flights including LiDAR, thermal and spectral sensors.

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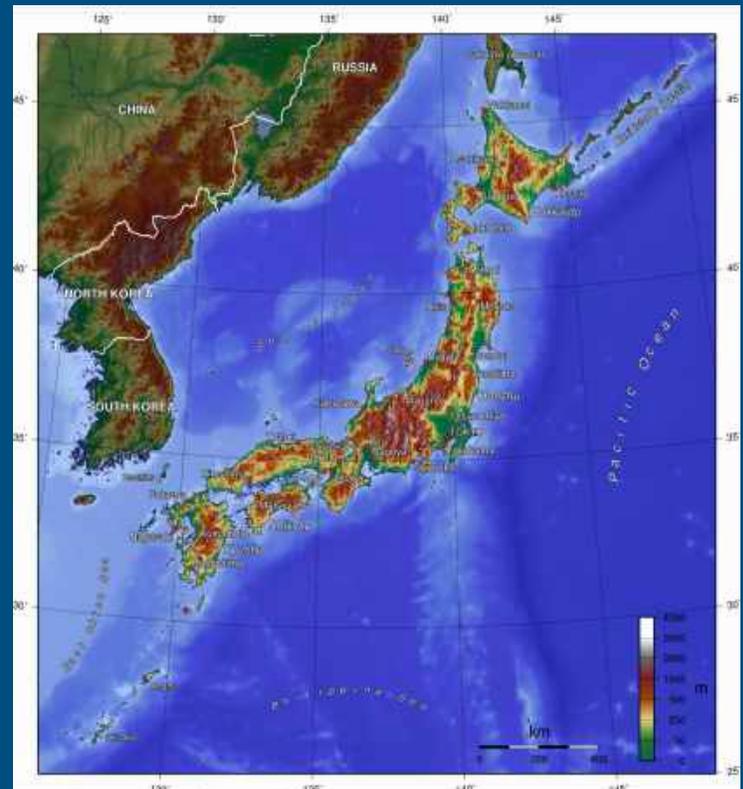
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CLOSING NOTES FOR FUN



FOR THE EARS: Click to hear this and access other country anthems performed by the US Navy Band. Kimi ga Yo, the Japanese Anthem performed by the United States Navy Band in 2007. Public domain. <https://www.navyband.navy.mil/music/anthems/japan.mp3>

Japan (Japanese: 日本, *Nippon* [ɲippo̞˨˩ ɲ̚], or *Nihon* [ɲiho̞˨˩ ɲ̚]) is an island country in East Asia, located in the NW Pacific Ocean. It is bordered on the west by the Sea of Japan, and extends from the Sea of Okhotsk in the north toward the East China Sea and Taiwan in the south. Part of the Ring of Fire, Japan spans an archipelago of 6852 islands covering 377,975 sq km (145,937 sq mi); the five main islands are Hokkaido, Honshu, Shikoku, Kyushu, and Okinawa. most populous metropolitan area in the world, with more than 37.4 million residents.



Because of its mountainous terrain, approximately 67% of Japan's land is uninhabitable. Most of its 125.62 million residents live on narrow coastal plains in highly urbanized areas. This sharable image file is licensed under the [Creative Commons Attribution-Share Alike 3.0 Unported](https://creativecommons.org/licenses/by-sa/3.0/) license.

SAKURA

NAKANIHON
AIR named its
first RIEGL
LiDAR
scanners
SAKURA 1, 2,
3, 4, F, and
GH.



The national flower of Japan, the cherry blossom – or Sakura, represents a time of renewal and optimism.