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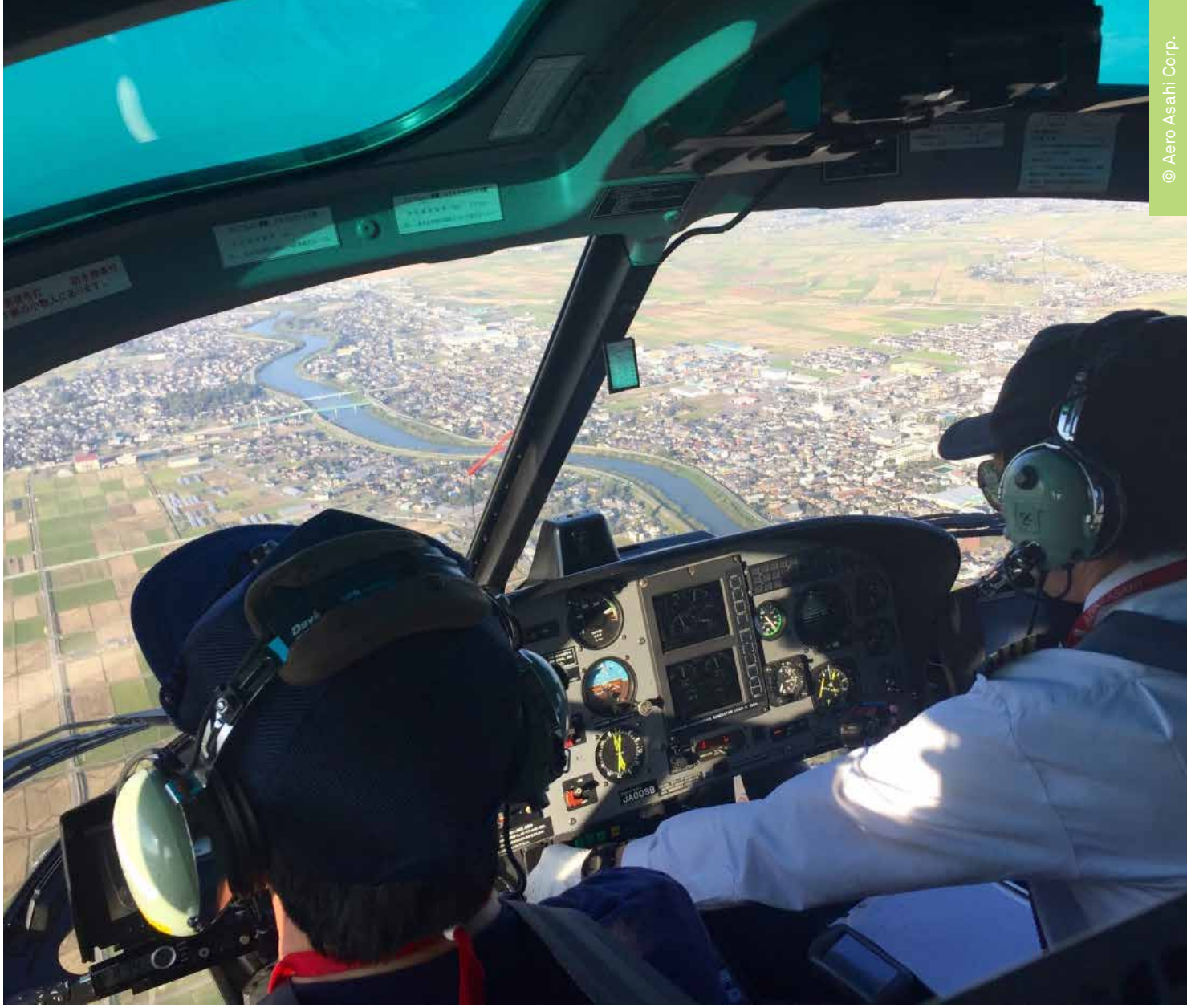
PROTECTING PEOPLE AND PROPERTY WITH BATHYMETRIC LIDAR

Renata Barradas Gutiérrez

Case Study

Creating accurate and precise models of riverbeds in Japan to support disaster risk management



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Japan is a large archipelago situated along an active convergent zone next to deep trenches on the Pacific side and many faults and canyons in the Japan sea. Due to its geography and complex topography, Japan is one of the most exposed countries on Earth to natural hazards, such as sea-level rise, flooding, earthquakes and tsunamis. Population growth, climate change and economic development, furthermore, are threatening people, infrastructure and the ecosystems located at the plains of several rivers and coasts.

Despite its great exposure to hazards, ranked by the 2016 World Risk Report as the 17th most prone disaster risk country, Japan has lowered its vulnerability by adapting long-term preparedness strategies and taking actions to understand its topography and environment.

Aero Asahi Corp's (AAC) mission is to protect life and property from any disaster or incident by using the latest hardware and software technologies. This aviation and spatial information services company is aware that data is required to mitigate the risks in the event of future disasters. To support disaster management and prevention, maintain infrastructure and map properties, AAC uses mobile mapping, aerial photo surveys, and LiDAR topographic and bathymetric surveys.

ON A MISSION

Rivers in Japan, directly managed by the government, have a total length of approximately 8,800 kilometres and are characterised by a deep V-shaped rinsing from steep forests. The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) manages and monitors the rivers of the Nippon country. To monitor the river bed deformation every 200-metre pitch, MLIT used in the past an echo sounder performing cross-sectional terrain surveys every five years on the major rivers. To prevent disasters and speed up

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any recovery efforts, AAC now provides bathymetric and topographic data and maps to MLIT's river management bureau.

AAC collects data precisely and safely using the Leica Chiroptera II bathymetric and topographic LiDAR sensor mounted in a helicopter, covering large areas in just minutes. The Chiroptera II's near-infrared (NIR) wavelength for topographic and a green wavelength for bathymetric data collection allows the team to map and measure depth in shallow coastal zones and inland freshwater bodies, such as rivers and lakes and surrounding flood-plains.

"We collect and analyse all the precise data to provide information ready to use, such as deformation, sediment, cross sections, erosions, and bank height for management authorities. Since the Chiroptera II combines a topographic and bathymetric LiDAR, we can seamlessly measure from water to land – this is particularly useful when rivers are running shallow," said Hiroshi Isobe, deputy chief of airborne operations at AAC.

AAC improved the approach used in the past by complementing the data captured with Chiroptera II with an in-house solution – an echo sounder "Underwater Inspector." The team tested this approach on the government-controlled rivers in Japan. This combined survey helped the team to create a seamless dense point cloud regardless of the water depth, turbidity, colour, temperature and PH of the river.

THE PERKS OF ATTACHING A LIDAR SENSOR TO A HELICOPTER

Mountains cover 73 per cent of the land of the rising sun. When performing aerial surveys in mountainous terrain, AAC attaches the Chiroptera II to the back of an AS350-B3 helicopter with a GNSS antenna on the top of the vertical stabiliser to obtain a georeferenced point cloud with higher density. AAC is convinced that the variable airspeed, the flexible base location, the shorter turning time and the very low-altitude that can be flown with a helicopter is preferable than the quieter flight with long range and extended flight time that a fixed wing plane provides.

"Point clouds obtained in slower airspeed are denser. Flying with a helicopter allows us to collect water depth where a swath boat with an echo sounder cannot enter and control the altitude along the Japanese steep terrains," said Isobe.

MULTIPLE APPLICATIONS

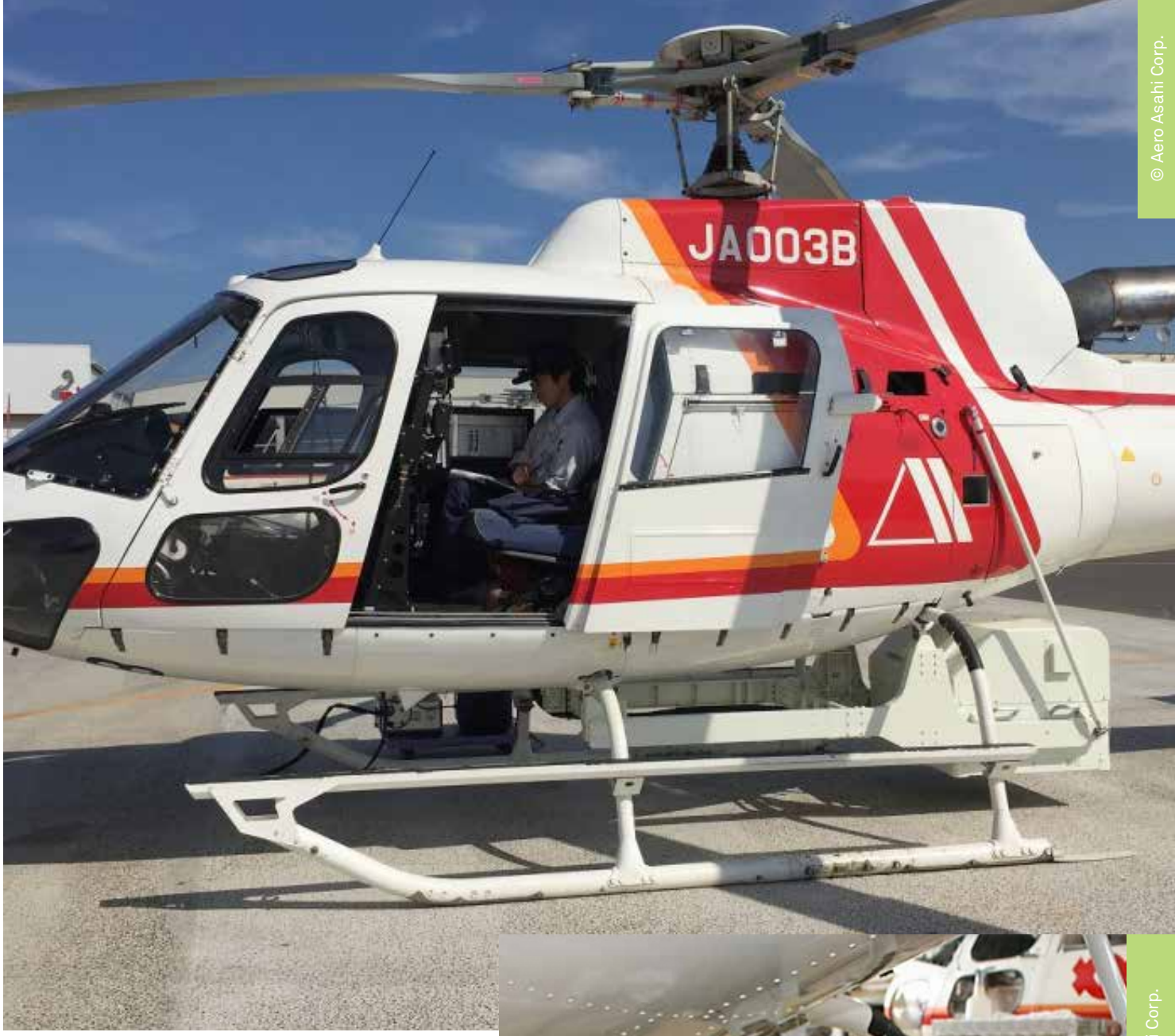
A wide range of deliverables like digital surface and terrain models, classified point clouds, orthophotos, and GIS layers can be created using Chiroptera II's collected data to develop hydrological models to analyse the water flows, drainage management, flood control and support land planning activities. The team of experts uses Leica LiDAR Survey Studio (LSS) to understand the river's topography and create accurate risks analysis.

The periodical cross-sectional survey AAC provides can be used for a wide variety of applications including:

- Flood mapping
- Environmental modelling and monitoring
- Visualise the riverbed deformation ground and underwater
- Deriving flow capacity
- Accuracy controls for water level applications.

PREDICTING THE UNPREDICTABLE

To protect populations living near water bodies authorities need to study the topography of a river and its surrounding area to monitor changes and predict the behaviour of a water body under



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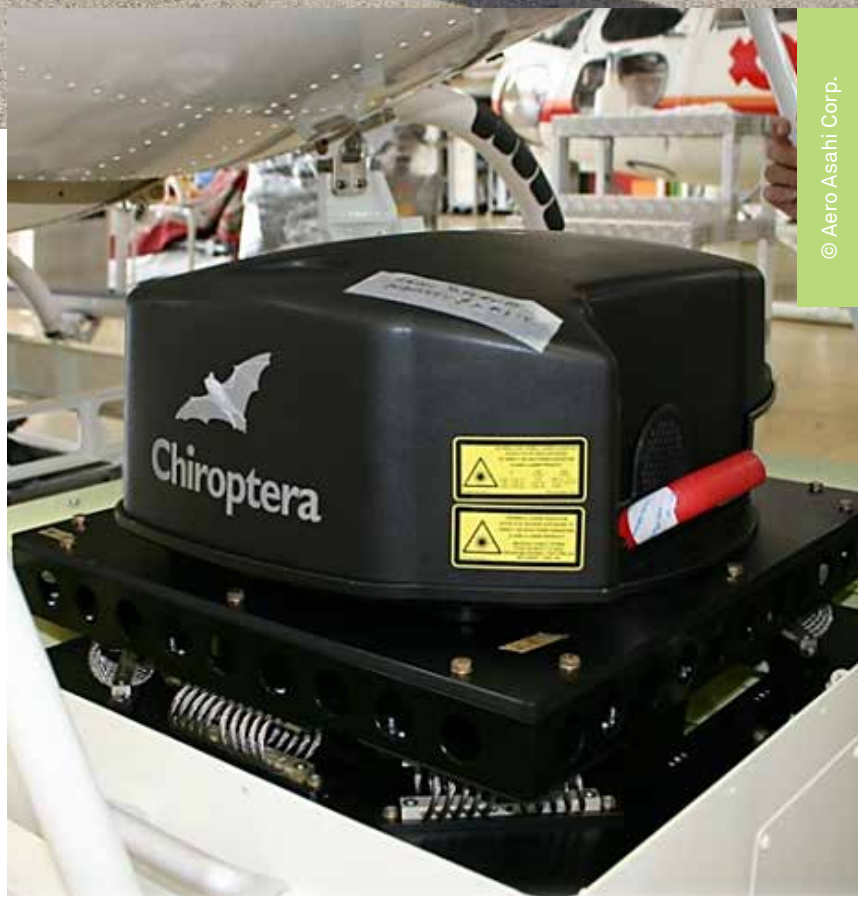

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different conditions. Airborne LiDAR bathymetry is an effective method to survey even in hazardous areas and turbid waters, creating accurate and precise models of coastal and inland water bodies.

"*The detailed topographic data obtained from aerial laser surveys is used to simulate flooding and make hourly predictions of how floods spread. The simulation results and infrastructure information maps are analysed to provide optimum data for crisis management, such as evacuation routes, evacuation shelters and affected population. In addition, stereo matching of aerial photos during flooding is used to analyse surface flow rate and flow direction,*" concluded Isobe.