

## Long term observation of winter lake surface changes in Izunuma, in northeast Japan

Tatsuru Sato<sup>1</sup> and Ken-ichi Kobayashi<sup>1</sup>

<sup>1</sup>*National Institute of Technology, Ichinoseki Collage*

Izunuma is an important wetland that receives about 100,000 migratory birds each year and is listed under the International Convention for the Protection of Wetlands. The surface of the lake is almost completely covered by lotus in the summer, and the overgrowth of lotus has been found to contribute to the deterioration of water quality and shallow bottoming. The COD value of Izu-numa has the highest observed value among the lakes in Japan. Restoration of the lake environment and research for this purpose are being attempted. Equipment for lotus harvesting is being developed and operated, and other aquatic plants are being planted. Migratory birds come to Izunuma in winter. The birds that visit the Izunuma area dive from the lake surface to feed on plants. These birds avoid areas where the lake is completely frozen, but even in the surrounding lakes and marshes such as Izu-numa, the surface of the lake is partially frozen and their movements are restricted in winter.

In order to understand the environment around the lakes and its seasonal changes, we proposed a method of monitoring observation of Izu-numa using IoT data and a multispectral camera that is installed in a UAV. These data were analyzed using machine learning, statistics and image processing methods. The remote camera at the Izunuma-Uchinuma Sanctuary Center has recorded a large number of images from 2002 to the present, and the Ministry of the Environment, which manages the images, provided us with the image data. When the lake was frozen, it was segmented along the ice edge. Using these image features, a time-lapse movie was created to examine the changes in the number of days the lake was frozen. The static results showed that the number of days of freezing in the winter season (October-December) decreased from more than 40 days in the early 2010s to about 20 days in the late 2010s. The lake surface during the winter period can be divided into three periods. The lake often remained frozen for more than a few days after freezing in the past, but in recent years, the lake may have thawed on the same day or the next day after freezing.