

Mapping Lake Ice Thickness Distribution Using UAV in the Saroma-ko Lagoon

Kohei Sato¹, Kazutaka Tateyama² and Tasuya Watanabe²

¹ Graduate School of Engineering, Kitami Institute of Technology

² School of Earth, and Environmental Engineering Kitami Institute of Technology

We attempted to develop a new observation technique for measuring sea ice thickness aimed at lower cost, higher efficiency and wider coverage under the low temperature condition precisely. We suggest that using the Unmanned Aerial Vehicle (UAV) with Structure-from-Motion Multi-View Stereo Photogrammetry (SfM) by aerial photography. This technique can understand sea ice thickness in two dimensions and does not need a special skill or experience. In this study, we surveyed lake ice by UAV and aim to Mean Absolute Percentage Error (MAPE) of less than 10 % of the estimated ice thickness.

The survey site Saroma-ko Lagoon in Hokkaido, Japan. Surveying all area is 640 m × 210 m, and divided it into 4 areas (A, B, C, D) of 1 area (160 m × 210 m). UAV used “Phantom4-pro” made from DJI company and SfM software is used the “Metashape”. In addition, the UAV is installed Global Navigation Satellite System (GNSS) receiver to get position of aerial photography. We estimated ice thickness by 3 processes.

- (1) Making Digital Surface Model (DSM) by SfM
- (2) Transforming DSM's height data into freeboard
- (3) Calculating ice thickness from freeboard by relation between actual measured ice thickness and freeboard

Figure 1 shows the result that compared ice thickness of an estimate with actual measurement and it's showing linearity.

Figure 2 shows distribution map of lake ice observed by UAV.

It seems that we could estimate lake ice thickness by this technique. However, MAPE became 15.9 % and it was unable to achieve 10 %. This error is considered to be caused by DSM error, freeboard or ice thickness calculation process and impact on tide in Saroma-ko Lagoon.

In this presentation, we discuss the above topic and propose the improvement method of the error.

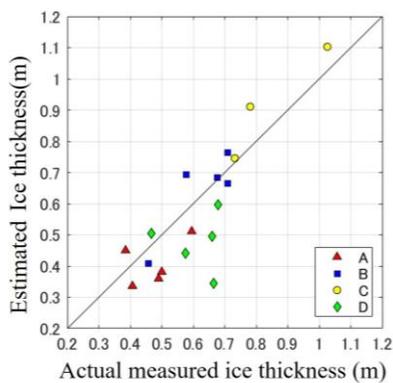


Figure 1 Result of estimated

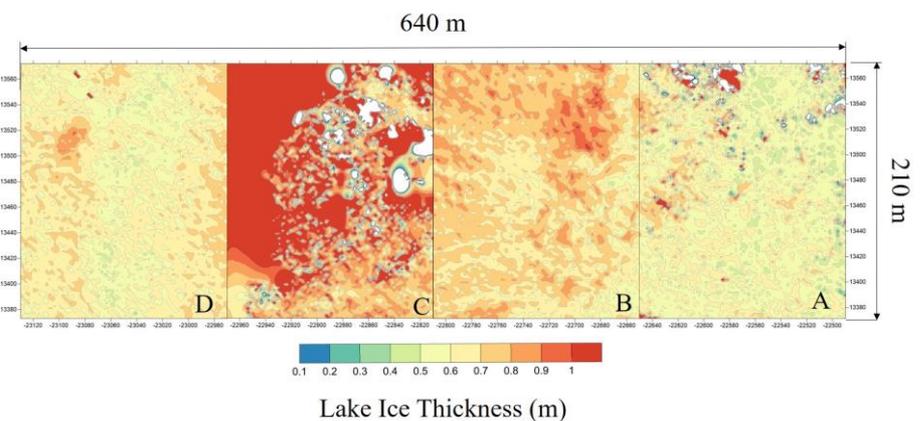


Figure 2 Lake Ice Thickness Map