

3D modeling around Aso crater with SfM of UAV

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1. Introduction

For volcanic disaster prevention, surveying situation near the crater just after eruption is very important. However, there is a risk of on-site investigation into the site and flight over the crater by a manned aircraft. For this reason, oblique photographing from a place away from the crater and laser measurement at high altitude have been performed. However, it was insufficient to capture detailed information near the crater. Although high resolution satellite photographs can be taken from directly above, there was a drawback that it is susceptible to the influence of clouds. To solve these problems, it is considered effective to take photographs from low altitude and create 3D models using unmanned aerial vehicles (UAV).

2. Mt. Aso volcano and UAV shooting

Mt. Aso erupted early on October 8, 2016. The erupted volcanic ash reached 11000 m above the ground and spread to the Shikoku area. From the image from the helicopter after the eruption, the volcanic bullets and ash fall were confirmed at the crater edge and its vicinity, the situation had changed completely. A big hole was found on the roof of the ropeway station building.

Therefore, in order to grasp the situation of 2 km square around the crater urgently, we took pictures using UAV. To create 3D models and grasp the damage situation, 5 or more images with ground resolution of about 1 cm are required per point. It was a single lens reflex with a full size CCD equipped with a 24 mm lens and it was necessary to keep the ground altitude below 350 m. Considering the payload of UAV and the duration of the battery, the flight time is 15 minutes / times, and it is necessary to take off from a safe place as close as possible to the crater. Therefore, we selected the parking lot in front of the station building under the ropeway as a takeoff point from the crater. The warning level became 3 after the eruption immediately, and that point was in a no-entry area. Then after discussing with the Aso Volcano Disaster Prevention Council, the Kyoto University Volcano Research Center, and the Meteorological Agency, we got a special permission for entry, and took pictures on December 8, two months after the eruption

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3. Data processing and interpretation

A 3D model was constructed by SfM processing from 1,000 or more photographs taken. Furthermore, 20 cm DSM data and orthophotos were prepared, and topographical interpretation was carried out together with the red color map. At the valley near the crater, we were able to confirm the micro topography such as pyroclastic flow or mud flow, which seems to be a flow deposit.

Volcanic bullets and craters formed at the time of falling were also confirmed. On the other hand, due to gully erosion and secondary migration of descending volcanic ashes formed during the two months after the eruption, it was also confirmed that some of the craters were buried. Mt. Aso had erupted in 2015, and the calculation of the amount of blowout by comparison with the last topography is currently under construction because it requires the creation of a new model.

4. Future tasks

It took two months from the recognition of the eruption to the actual shooting. This is a major reason why it took time to consult with relevant organizations for access and to apply flight application and permission etc. In advance, the development of the aircraft, such as setting rules for emergency photography at the time of eruption or capable of autonomous flying over long distances and long hours

from outside the danger area is an issue. This work is part of MEXT project ,Integrated Program for Next Generation Volcano Research and Human Resource Development.

Keywords: UAV, SfM, Aso volcano

