Improvement of accuracy of DEM generated using UAV -a case study of the central crater of Izu-Oshima volcano, Japan-

*mori takaaki[1], Shunsuke Miura[1], Takumi Mochizuki[1], Shino Naruke[1], Hideki Nonaka[1], Hisashi Sasaki[1], Kenichi Arai[1], Koji Fujita[1], Toshihiro Urayama[1], Tatsuro Chiba[1]

1. ASIA AIR SURVEY CO.,LTD.

1. Introduction

Typhoon No. 19, which occurred on October 6, 2019, landed on the Izu Peninsula with large and strong power and passed through the Kanto region. We prepared a topographic model of the Miharasan central crater using UAV in 2017 in preparation for the next eruption of Izu Oshima. However, the terrain around the central crater of Miharayama may have changed due to the effect of Typhoon No.19, so the latest terrain model around the crater was recreated using UAV. The terrain model was created using SfM / MVS from images taken by UAV. The software used was Metashape.
In this study, in order to evaluate the accuracy of the terrain model, a reference point (GCP: Ground Control Point) was set around the crater, and the position accuracy of the terrain model with and without the reference point was verified. In addition, the volume of the crater was calculated and the state of collapse was confirmed from the created terrain model around the crater.

2.Izu Oshima, Miharayama central crater photography

A demonstration experiment was conducted at Izu Oshima from November 7 to November 8, 2019. The UAV used is Matrice210 (manufactured by DJI) and the camera mounted is ZENMUSE X4S (visible light). The UAV was automatically navigated with the camera oriented vertically to cover the area around the crater. The number of shot images is about 500.

3. Ground Control Point (GCP)

Until now, the position information obtained from the GPS mounted on the UAV was used, but there was a problem with the position accuracy, especially in the height direction, when compared with existing aerial laser surveying. Therefore, in this flight, a reference point was set and the position accuracy of the terrain model was verified. 18 reference points were set along the crater outer ring promenade so as to be uniform over the UAV measurement range. Network-based RTK-GPS positioning (VRS method) was performed on the installed reference points to obtain highly accurate position information.
Comparing the position accuracy (elevation value) of the terrain model with and without the reference point, the terrain model was created with "with reference point (RMS: 0.10 m)" compared to "without reference point (RMS: 24.96 m)" As a result, the result that the error was significantly reduced was obtained. In particular, the accuracy in the height direction was reduced. It is important for the difference analysis of the terrain model that the error of the position accuracy is small, and it is considered important to acquire and accumulate the reference point coordinates of the measurement candidate site before the eruption.

4.Difference analysis

For the image taken last time in 2017, the model was recreated by applying the reference point of 2019, and difference analysis was performed. It was confirmed that a part of the vertical cliff west of the central crater collapsed and accumulated at the bottom of the crater. According to the data of the volcanic eruption prediction series, it was clear that the collapse occurred between September 26 and October 9, which seems to have occurred during the typhoon 19.

5. Summary

A reference point was set around the central crater of Miharayama, and a terrain model with higher positional accuracy than before could be created. The volume of the crater was clarified, so that it was possible to calculate the amount of lava accumulated in the crater from images taken obliquely, even if the crater could not fly over the crater after the eruption. In addition, from the difference analysis of the topographic models of 2017 and 2019, it was confirmed that the landslide had collapsed on the western slope of Miharayama central crater.

Although the reference point was found to be important for the accuracy of the terrain model in the creation of the terrain model, it is practically difficult to enter the vicinity of the crater during the eruption, and it is difficult to set the reference point. The latest UAV has an RTK-GNSS-equipped type, and there is a possibility that the same high-precision terrain model can be created without setting a reference point. Utilizing such technology, we would like to study so that a more accurate terrain model can be created in a short time.

Keywords: UAV, Active Volcano, SfM/MVS