Measurement of crater topography of Motoshirane 2018 eruption by SfM

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1.Intoroduction
It is important to measure the geomorphological changes in detail around the crater and crater caused by volcanic eruption. By the repeated topographical measurements, the transition of the eruption rate can be clarified, and it will contribute to predict volcanic eruption. Since approaching the vicinity of the crater immediately after the eruption is difficult, remote sensing and close-up shooting by UAV have been considered. In the eruption of Mt. Honkane on 23rd January 2018, due to snow and strong wind, close-up shooting by UAV was not easy. In order to secure safety, aircraft could fly limit of 3,000m above the ground, shooting from aircraft was also affected by snow.

2.Diagonal photography by manned helicopter
On January 28, 2018 Maeno, in cooperation with the Yomiuri Shimbun, helicopters flew over Honkonishama crater and flew swirling at an oblique distance of 1000 m to 2000 m, and oblique photographs were taken. Interpretation of oblique pictures were done promptly, and it was reported to the volcanic eruption prediction consortium.

3.3D model creation
Using about 500 photos taken from wide angle telephoto lens from the helicopter, 3D model was made by SfM method
Used software was ContextCapture, 1 km north and south and 500 m east and west range was relatively accurate. 10 cm resolution mesh could be created near the crater. However, due to changes in terrain and the effects of snow, GCP could not be
taken well for modeling,. The inclination of the model was large, and the amount of topographic variation could not be calculated without change. Therefore, referring to the 1 m mesh DEM obtained by the Ministry of Land, Infrastructure, Transport and Tourism(MLIT) by laser measurement in H27, the rotation vector and the movement amount were calculated using the point
group comparison method. Adjusting XYZ coordinates, the difference from the topography before eruption was getting smaller.
This work was carried out while referring to the photograph, considering the influence of the ejecta, snow thickness, and trees. It was impossible to match the whole with one set of parameters, and divided into three parts as follows.

4.Terrain change
1) North crater north crater row of column
Fig. 1 shows the geomorphological variation map, the topographical section, and the topographical change map after the correction. The northern side crater row of the Minohike Pond consists of isolated crater 1 to 3, connected crater 4 to 8 and crack crater 9. The total length is about 250 m. Except for the crater 9, it is aligned almost linearly in the N 78 W direction. The topography change (height difference) shows the maximum at -16 m at the crater 6, but since the ejecta are stacked on the north side, the depth from the crater edge is -18 m. The change amount (volume) of the crater row part is. It was -6800 m 3 at crater 6 - 7, -3800 m^3 at crater 4 - 5, -330 m^3 at crater 1 - 3.On the other hand, in the vicinity of the north

side and the south side of the crater row, there is a plus part of the amount of topography change, which seems to be an ejecta from the crater. Its volume is +4900 m^3 on the north side of the crater 4 - 7 part, +1700 m^3 on the south side of the crater 6 - 7. The crater 8 also seems to have a gentle slope at the northern side with a gentle slope, extending about 70 m in a grooved shape in the northern northeast direction. The lower part of the original topography is -700 m^3. These topographical change amounts outside the crater are considered to have many gaps, so apparent density correction was performed. As a result, the amount of topographic change within the measurement range was minus approximately 10,000 m^3. This value is about 1/5 to 1/3 of the amount estimated from tephra.

2) West crater

The west side crater is located on the slope of 60 m west of the ski course. The major diameter was 20 m, the short-term was 5 m, and the depth was about 10 m.

3) kagamiike

I read the orthophotograph of the kagamiike and the topography after the eruption. There is a rectangular cave hole on the south side, and a split is formed on the southeast extension of it. An avalanche in the central part descends from the northwest to the southeast direction on the snowy field, but it also seems to be continued to the sinkhole hole when tracing upstream.

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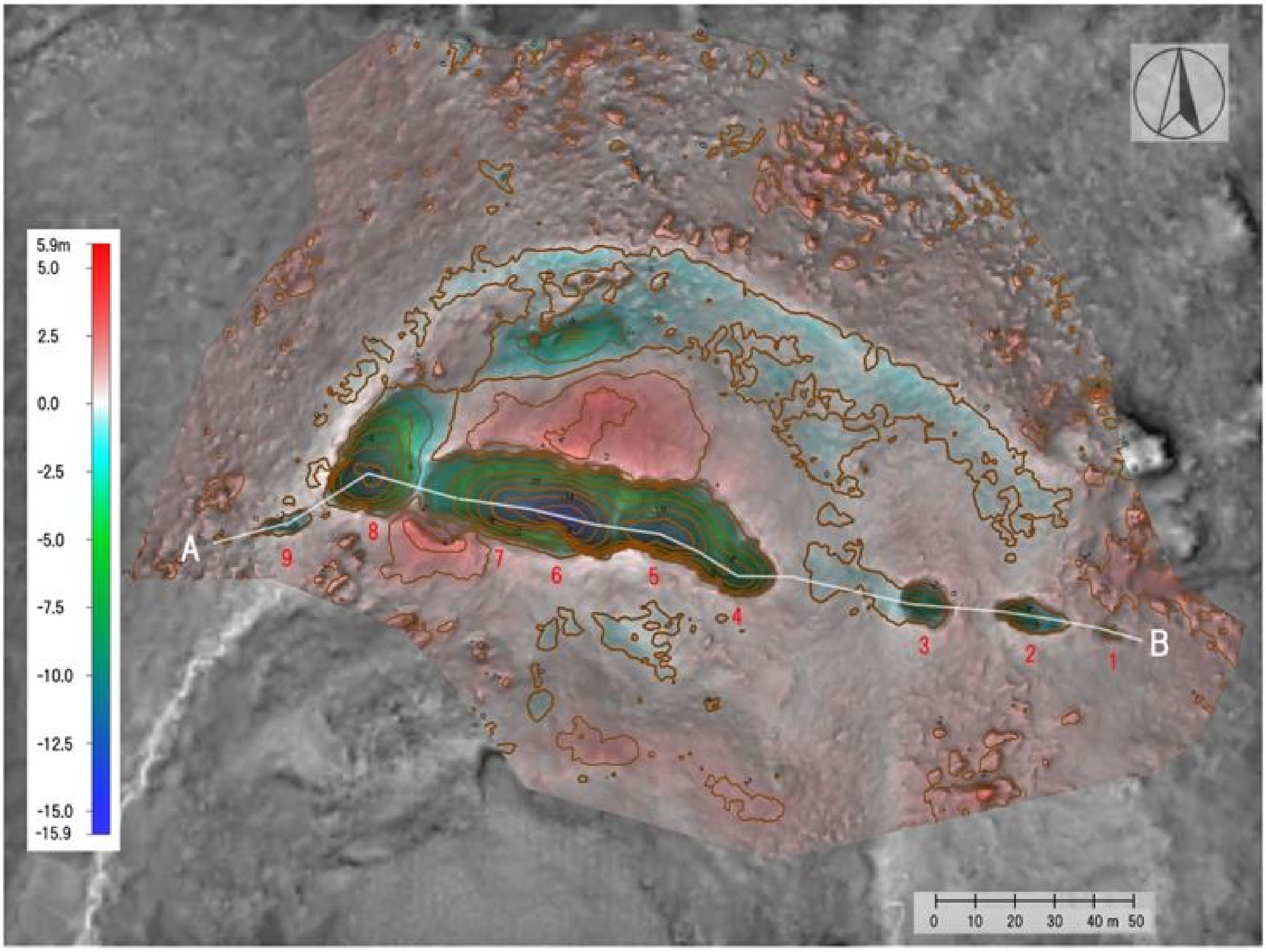
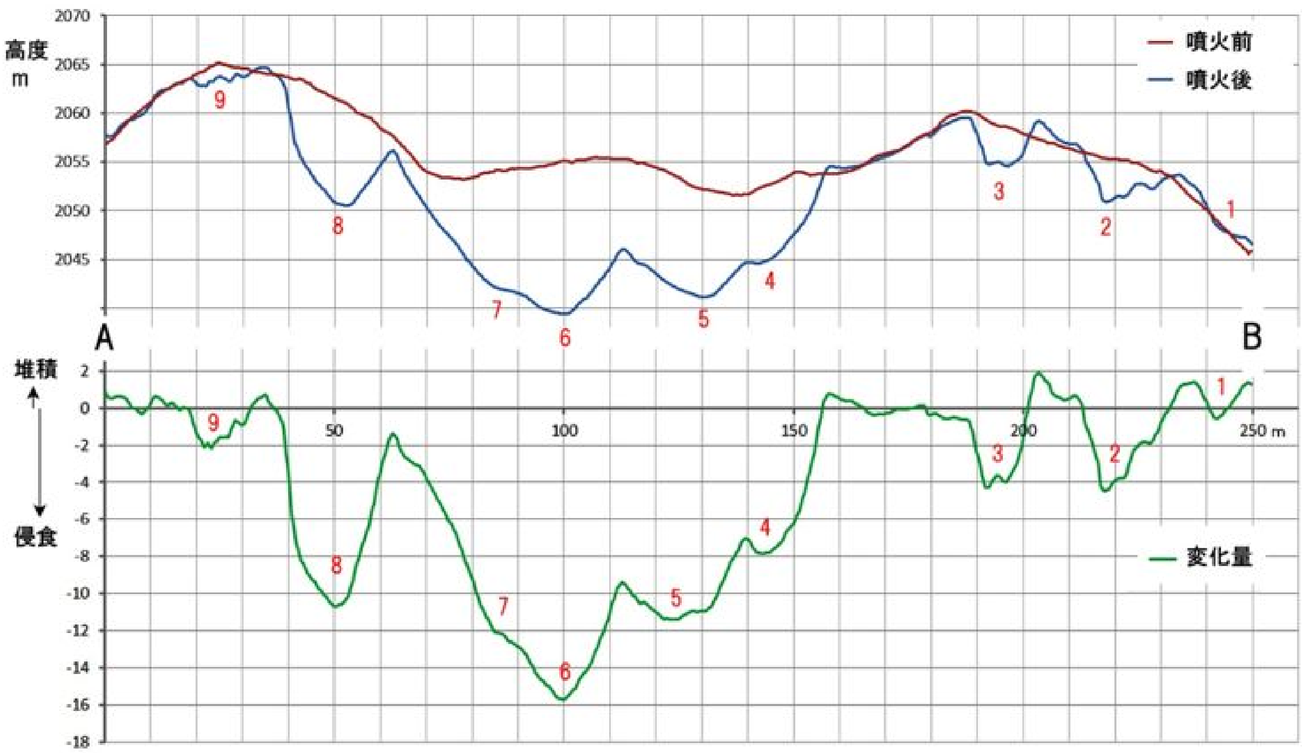
Keywords: SfM, crater, volumetry


5.9m
5.0
2.5
0.0
-2.5
-5.0
-7.5
-10.0
-12.5
-15.0
-15.9
A
B
9
8
7
6
5
4
3
2
1
0 10 20 30 40 m 50


高度
m
噴火前
噴火後
2070
2065
2060
2055
2050
2045
A
B
堆積
侵食
変化量
50
100
150
200
250 m
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18