SPATIAL DISTRIBUTION FOR THE ANCIENT MOUNTED TOMBS USING UAV AND DIGITAL MAPS IN FUKUOKA

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ABSTRACT: In 2018, a large keyhole-shaped tomb mound was discovered in Tagawa, Japan. This mound was estimated as the remain of Yamatai country. Yamatai was a country in Japan in the 3rd century and written in the Sanguozhi, Chinese three country history. However, the detailed location has not been determined yet. In Tagawa, there are about 20 remains that are related with Yamatai country. In this study, three-dimensional survey of the ancient tombs was conducted with UAV and digital maps of Geospatial Information Authority of Japan. Based on the results, dating estimation was carried out with the shape analysist. Finally, the distribution of the remains location was plotted, and the center of the locations was obtained to estimate the scales of Yamatai country.

1. INTRODUCTION

In the 3rd century in Japan, 30 countries were recognized by China. Yamatai country was a representative of them. However, the location of this country and Himiko's tomb was still uncertain. On the other hand, In 2018, a posterior circle was found in Akamura, Tagawa-gun, Fukuoka. As shown in Fig. 1, there are many terrains that are expected to be the ruins of Komadai country around Tagawa. In this study, we surveyed old tombs around the Tanabe area around Tagawa based on 3D survey of UAV and contour map of Geographical Survey Institute.

2. METHODS

2.1 3D images

UAV was Phantom 4 Professional with a 4K camera. The shooting was done with drone's automatic navigation and manual navigaton. Smaller size terrain was taken with manual navigation, and Larger size terrain was taken with automatic navigation. Figure 2 shows the automatic navigation route map of UAV. Three-dimensional model was constructed from aerial images taken with PhotoScan. An altitude map and an inclination direction drawing were created by a DEM image obtained from UAV. Then, vertical and horizontal profiles, a diameter, a square side and the total length were measured with Geospatial Information Authority of Japan.

2.2 Ratio of length

For keyhole tomb, there are divided some types by those shape like as Figure 12. These were classified by the diameter, and two length on the square. The boundary of these two lines on the square is top of the square. Currently, keyhole tomb were classified four types form the ratio of 3 length. In this study, 3 keyhole tomb were surveyed except Akamra tomb. The authors calculated the ratio for each keyhole tomb.

3. RESULTS

3.1 3D images

Figure 3 shows a three-dimensional model created from the aerial images. The total length: 443 m, the diameter of the circular: 152 m, and the bottom side: 230 m. The east side of the circular part was paved in the residential area, but the west side has a circular shape and it looks like a artificial structure. Figure 4 was a circle type tomb in Mitate. For this mounted tomb, the height: 15 m, and the diameter: 200 m. This mounted tomb is located just west side from Akamura mounted tomb and there are same latitude. The authors think that this location is intentional. Figure 5 shows Ayaduka which is a elipse type mounted tomb. The longer diameter: 200 m, shorter diameter: 100 m, and the height: 10 m. In this mounted tomb, the grave of Iyo who is younger sister of Himiko includes. Figure 6 shows Onduka. This is a circle type mounted tomb. This is a circle type mounted tomb. This terrain is located most northwest side in the other mounted tomb of Tagawa. The diameter: 300 m. The height: 40 m. The size is most large in all circle type mounted tomb which is surveyed in this study. Figure 7 shows Miyabaru tomb. The total length: 222 m, the diameter of circle: 148 m, and the bottom side: 111 m. This terrain is keyhole type. At present, the outline of the mounted tomb remains, the mountain has been cut into farmland. Figure 9 shows syoyaduka tomb. This is a keyhole tomb. The diameter is 30 m.

The width is 46 m, and The total length is 70 m. Figure 10 shows Sosya tomb. This is a keyhole tomb. The diameter: 40 m, width: 45 m, and total length: 120 m.
Also, Figure 10 shows DSM of some tombs.

3.2 Ratio of length

For keyhole tombs (Miyabaru, Shoyaduka, Sosya), the ratio of length were examined like as Figure 12. Although, the mountain of Miyabaru tomb were pioneered as farmland, and the height of square part of Sosya tomb was constant. Therefore, the ratio of length for these two tombs were not calculated. On the other hand, the length ratio of Syoyaduka tomb was calculated. The ratio was 6:4.4:3.4.

4. DISCUSSION

4..1 Comparison of tombs in Uchida and Nintokuryo

Figure 11 shows comparison with the Nintokuryo mounded-tomb which is the largest ancient tomb in Japan. Where L is the total length, D is a diameter, H is a height, and W is a square side. If Uchida's mounded-tomb-typed terrain is an actual tomb, it becomes the second largest in Japan.

4.2 Ratio length of Syoyaduka

Like as Figure 12. Keyhole tomb are classified four types based on the ratio of length. The ratio of Syoyaduka was 6:4.4:3.4. This number was close to that of Akamura (O type) and Nintoku (B type).

4.3.Center of tomb

The center of gravity was calculated from the latitude and longitude of all the tombs around Tagawa. The result shows Figure 13. From Figure 13. The center of tomb was located in Tagawaita.

5. CONCLUSIONS

Following shows conclusions for this study.

(1). A keyhole tomb which was suspected Himiko’s tomb was discovered in Akamura, Tagawa-gun, Fukuoka. About 20 tombs are exist in Tagawa, Fukuoka, and some tombs are examined archaeological survey.

(2). The shape of about 10 tombs were found from 3D survey of UAV and contour map of Geographical Survey Institute.

(3). The center of gravity was calculated from the location information of each tomb. As

a result, the center of tomb was located in Tagawaita.

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Figure 1. Location of Uchida, Tagawa, Fukuoka.

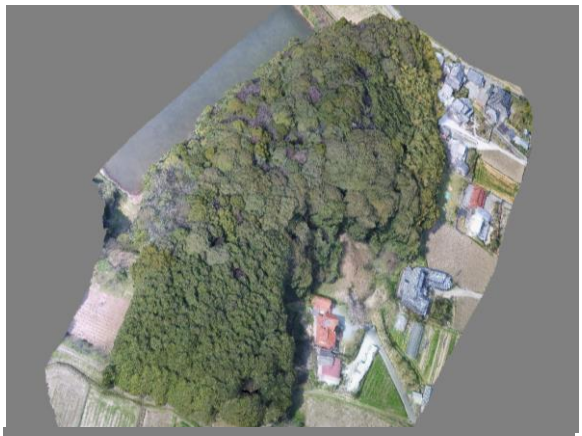
Figure 2. UAV route map for mounded tomb in Uchida.

Figure 3. 3D model of Akamura.

Figure 6. 3D model of Onduka.

Figure 4. 3D model of Mitate.

Figure 7. 3D model of Miyabaru.



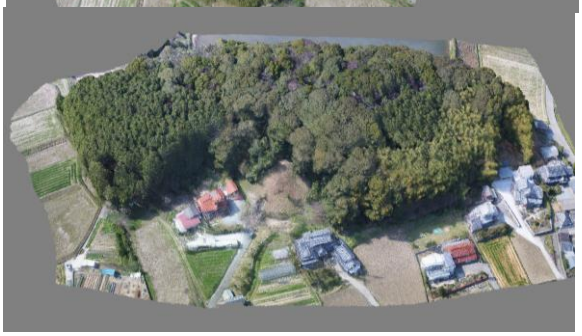


Figure 5. 3D model of Ayaduka.

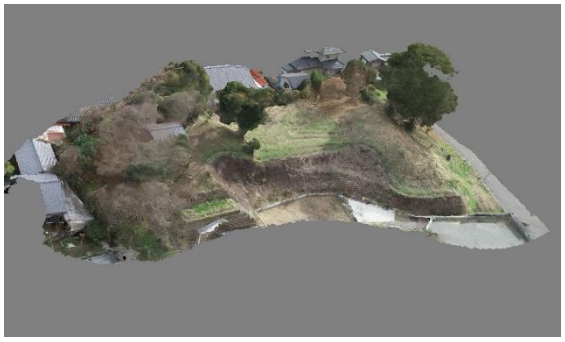


Figure 8. 3D model of Syoyaduka.

Figure 9. 3D model of Sosya

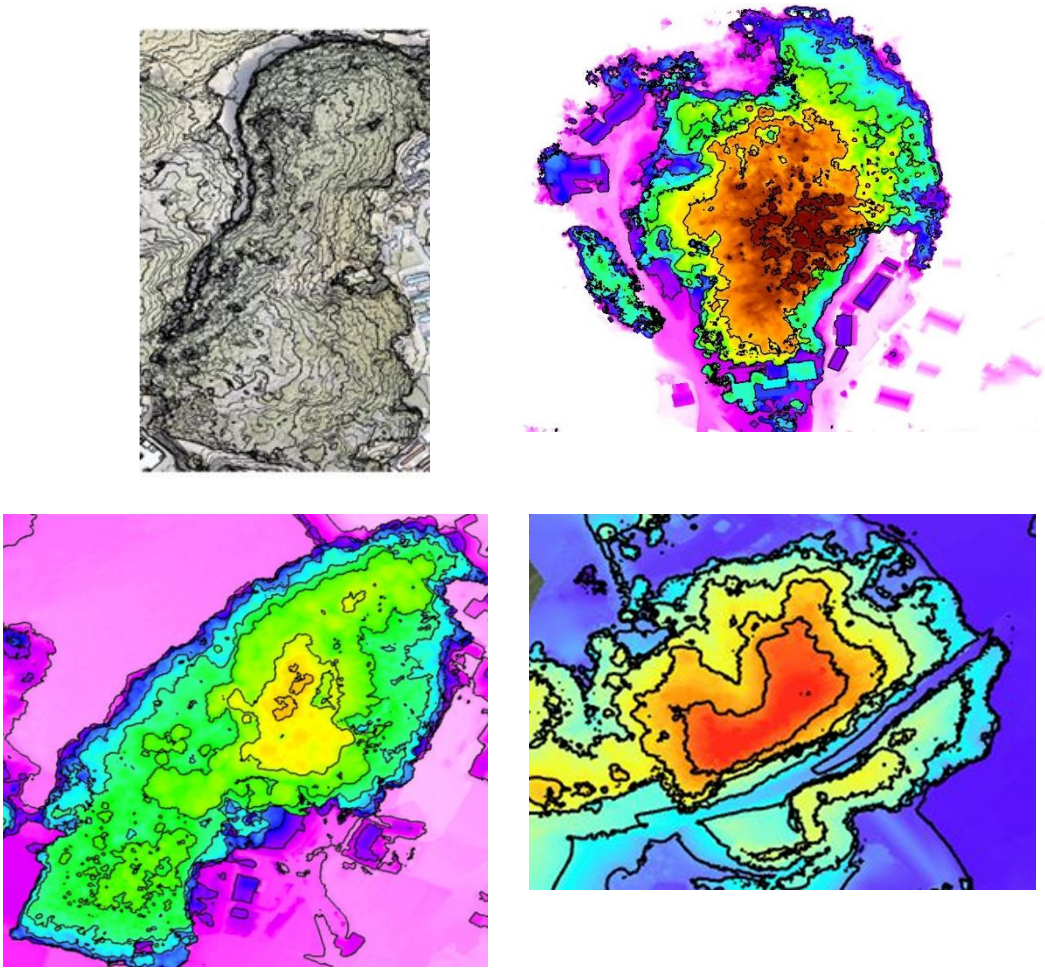


Figure 10. DSM of some tombs

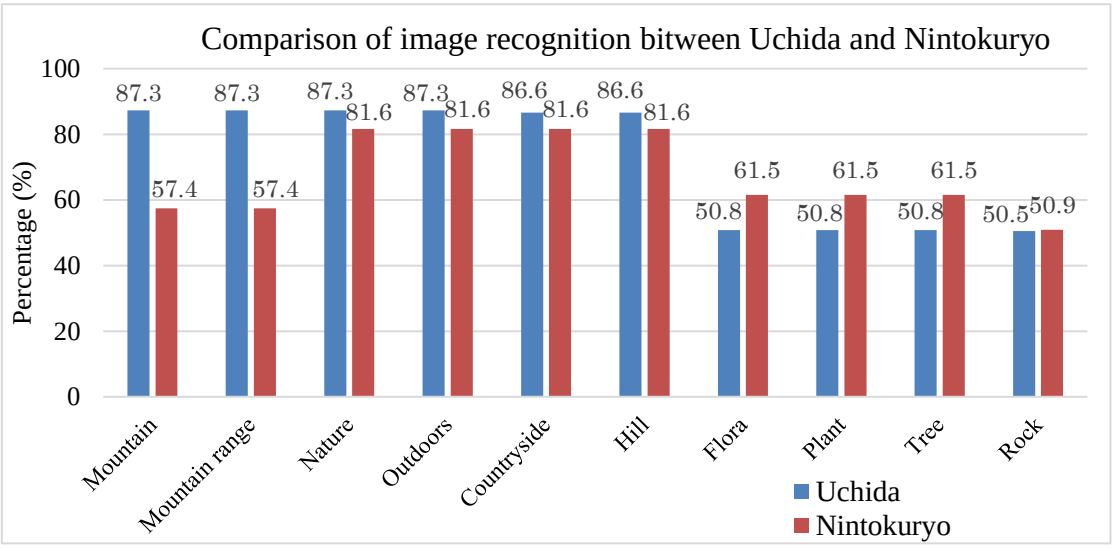


Figure 11. Comparison of tombs in Uchida and Nintokuryo

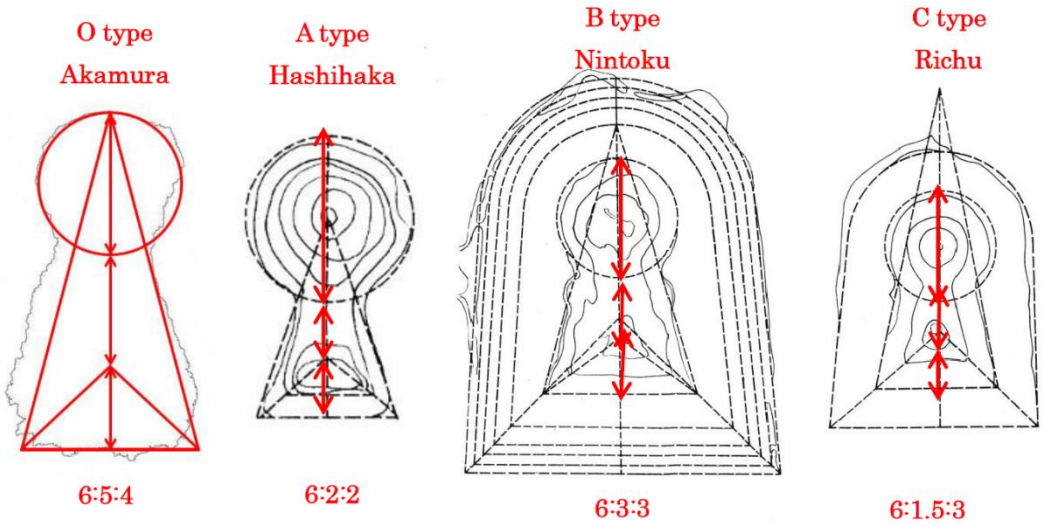


Figure 12. Four types of mounded tombs by Ueda classification(1969)

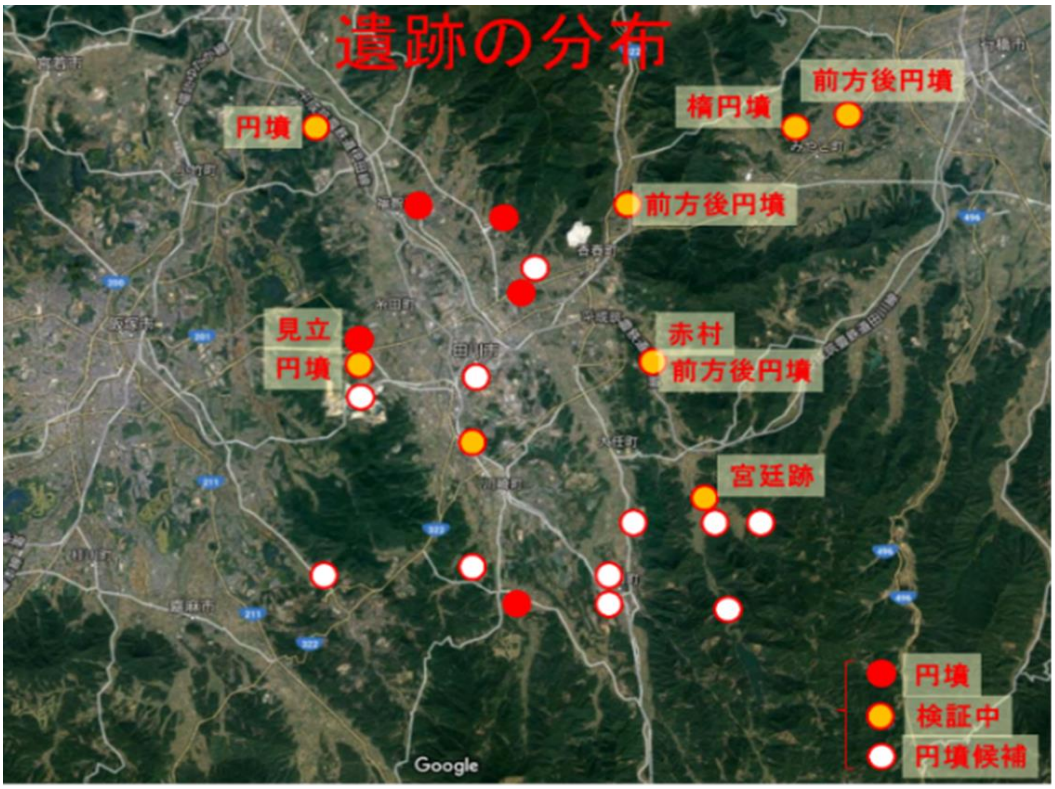


Figure 13. The center of gravity for tombs distribution.