

Investigation of Mountain Trails with Regional Partnerships

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Abstract

Mountain trails, defined as one of the acquired feature items of the Digital Japan Basic Map, have been investigated locally where changes were pointed out by users such as climbers, because of the difficulty of extracting changes from aerial photographs. Since fiscal 2012, the Geospatial Information Authority of Japan (GSI) has started a new approach to investigate them with regional partnerships such as relevant local agencies and volunteers. This approach enables us to reflect the latest mountain trails on a wide area of the target mountains on the Digital Japan Basic Map. We report the details of the flow of investigations and the methods of surveying mountain trails with regional partnerships, as well as achievements in 2012 and 2013.

1. Introduction

GSI develops and updates the Digital Japan Basic Map, which shows the current status of geospatial features such as detailed terrain in conformance with unified standards. GSI Maps, GSI's webmap service, and the digital topographic map derived from the Digital Japan Basic Map are used not only for administrative purposes such as land management and disaster prevention, but also for climbing, hiking and other purposes.

Though the Digital Japan Basic Map is normally developed and updated using a photogrammetric method, it is difficult to read mountain trails from aerial photographs and update them on the map in many cases, because many parts of the trails are covered by trees, and they are narrow. Therefore, it has been difficult to extract the location to be updated and promptly update the map. In practice, the mountain trails to be updated are determined on the basis of information about the position and shape of the trails obtained from climbers and local governments. Though this makes it possible to update locally, it is difficult to investigate wider areas of mountains collectivity containing a trail network.

In order to solve these problems, GSI has started to investigate mountain trails with regional partnerships such as local government and mountain officials since 2012. This approach enables us to survey and update the trails of the entire area of the target mountain. The details of the

approach will be described in the following chapters.

2. Overview of investigation with regional partnership

The mountains whose trails have been investigated with regional partnerships in 2012 and 2013 are shown in Table 1. The trail investigation project with regional

Table 1 The list of mountain subject for investigation

Mountain (Prefectures)	Period (year)	Partner organizations
Mt. Daisen (Tottori Prefecture)	2012 ~	Daisen town, Chugoku Regional Development Bureau, Tottori Prefecture, Tottori Mountaineering Association, Tottori University
Mt. Minamidake (Gifu Prefecture)	2013	The Japanese Alpine Club
Mt. Aso (Kumamoto Prefecture)	2013 ~	Aso city, Aso nature environment office, Aso area Promotion Bureau, Kumamoto Mountain Climbers Association, Takamori town, Minami-Aso village
Mt. Yaotome (Toyama Prefecture)	2013	Toyama Mountain Climbers Association, Doshumichi-No-Kai, Nanto city
Mt. Horaiji (Aichi Prefecture)	2013	Shinshiro city
Mt. Hakone (Kanagawa Prefecture)	2013 ~	Kanagawa high school athletic federation, Hakone town

partnerships named “The trail map made and brought up by people on Mt. Daisen” was firstly established in October 2012, and continued up to 2014. Likewise, trail investigations were also conducted in Mt. Minamidake, Mt. Aso, Mt. Yaotome, Mt. Horaiji and Mt. Hakone areas in 2013, and investigation in Mt. Aso and Mt. Hakone areas were continued up to 2014. Although the partner organizations were different in each area, common investigative methods such as review meetings, field surveys and updating the Digital Japan Basic Map were employed. The details of the methods are shown in the next chapter.

3. Review meetings with partner organizations

For better understanding of the investigation among partner organizations, review meetings were held and the following agenda items were discussed.

- 1) Current situation of mountain trails that are displayed on the map
- 2) Mountain trails that should be reflected on the map
- 3) Selection of the survey point and description of survey method to the members
- 4) Adjustment of the survey schedule
- 5) Members who participate in the survey

Each detail is shown as follows.

- (1) Current situation of mountain trails route displayed on the map

The current situation of the mountain trails that was displayed on the Digital Japan Basic Map were checked on the basis of the information obtained from the members who know the current situation of the trails.

- (2) Mountain trails that should be reflected on the map

The members of the meeting discussed whether a mountain trail should be displayed or removed from the map from the point of view of safety and security for the climbers. The trails that used for distress rescue should be displayed on map. Criteria for removal were as follows.

- 1) Trails that cannot be used
- 2) Dangerous trails that contain high risk points such as rockfalls
- (3) Selection of the survey point and description of the field survey methods to the members

The survey points were determined on the basis of the result of (2), where the shape data of trails to be added to the map should be acquired by GPS logger and the current situation of trails to be removed on the map should be checked. In the case of Mt. Daisen, trails currently prohibited for use were selected as the target of the field survey, if it is possible that the trails will be available in the future. GSI showed its field survey method to the members of the meeting.

- (4) Adjustment of the survey schedule

It is difficult to conduct a field survey of mountain trails in the winter, because of snowfall. Therefore, field surveys should be done before the winter. In the meeting, survey schedule was adjusted for rapid implementation.

- (5) The members to participate in survey

The members such as general volunteers recruited by review meeting secretariat went to a field survey, instead of GSI staff. There were some cases that the members of review meeting as well as local government officials joined a field survey without recruited volunteers.

4. An example of urgent survey of mountain trails investigation

GSI had received information that old trails which were not being used were displayed on the map, and that new trails which were being used were not displayed on the map from map users on Mt. Minamidake. These trails were used for senior or intermediate climbers, and contained points with a high risk of getting into distress or slipping down. It was necessary to investigate urgently. The Japanese Alpine Club, with which GSI had signed an agreement, had conducted a survey quickly without holding a review meeting with local agencies.

5. Field survey

GSI rented hand-held GPS loggers (MobileMapper6 and MobileMapper10) and provided a simple operation manual to partner organizations so that investigators including non-expert volunteers could operate them easily. GSI staff taught the operation of the GPS logger to investigators at the first time of the field survey, and GSI staff accompanied investigators to field survey in some cases. The process of a field survey is as follows.

- 1) Acquiring coordinate and trajectory data of the trails by using GPS logger
- 2) Taking photographs at the intersection of trails

The specific and detailed method of field survey are as follows.

One survey route was basically surveyed by at least two investigators for accident prevention. When a route was surveyed by one investigator, he/she surveyed the trail route back and forth or acquired data using at least two GPS loggers at the same time. Because the GPS logger was small and could be tied to the backpack, the burden on the investigator was reduced and safety could be ensured.

When they started the field survey, it was necessary to initialize the GPS logger before starting logging data. It requires adjusting the time of the clock in the digital camera. The GPS logger has the ability to acquire data at 2-second intervals on standard settings, and acquire data continuously at 10,000 points (in real time of 5 and a half hours). The GPS logger used for the field survey acquired data continuously even in the shadow of the trees, and the data was good enough quality to get the shape of the trail trajectory. Investigators took photographs to record the situation as shown in Fig.1 at the start point and the end point of trails, if these were newly opened, changed in geometry or could not be used by climbers. The photographs were taken in all directions at the start point and end point of trails, in addition to writing down which directions were to be taken.

Under poor GPS receiving conditions where radio



Fig. 1 An example of the photographs taken at the start point.

waves were blocked by trees, the investigator wrote down the current position on the topographic map as shown in Fig 2, guessing from the surrounding terrain. The notes on the topographic maps were used as support documents for updating the Digital Japan Basic Map where GPS data did not have enough quality to get the shape of the trail trajectory.

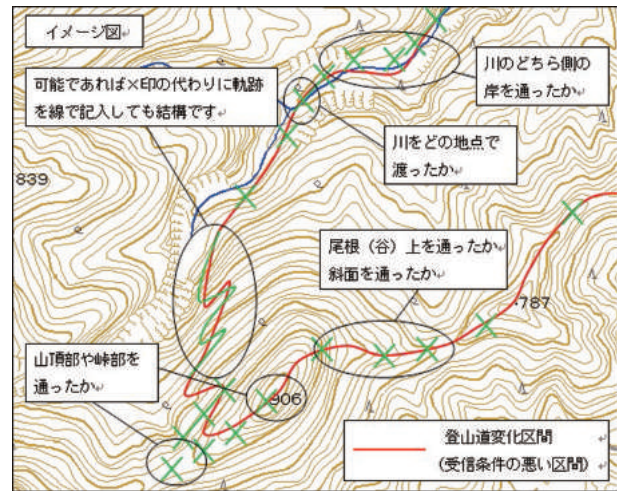


Fig. 2 The example of map noted current position by hand

6. Updating Digital Japan Basic Map

GSI updated the Digital Japan Basic Map data using GPS data acquired in the field survey, to add a new route, to modify geometry, and to delete a route. The data that GSI analyzed based on photographs taken with a digital camera was used to update the map. The mountain trails updated on the map have been made public through GSI Maps. The results of the investigation were published on the GSI website (http://www.gsi.go.jp/kihonjohochousa/kihonjohochous_a40023.html) (In Japanese)

The result of investigation on Mt. Daisen is shown in Fig. 3, which shows the target route to the survey, the route to be reflected on the map, the route to be deleted, the routes which were decided not to be displayed on the map in the review meeting, etc.

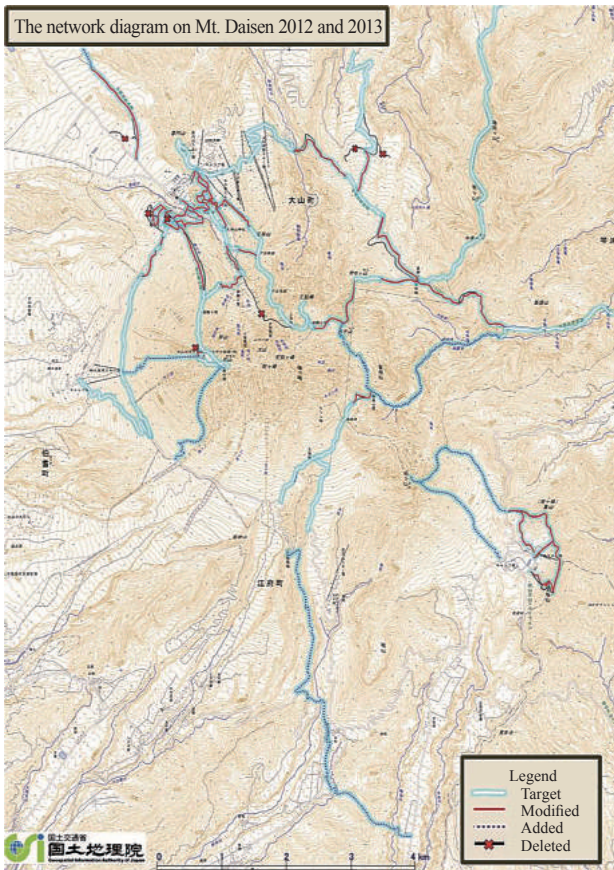


Fig. 3 The network diagram on Mt.Daisen

7. Conclusions

The authors report the details of mountain trails investigation with regional partnership. The model case of mountain trails investigation with regional partnership started in the Mt. Daisen area in 2012. Its efforts have expanded to Mt. Aso, Mt. Yaotome, Mt. Horaiji and Mt. Hakone in 2013. In addition, a survey on Mt. Minamidake was urgently conducted with the cooperation of the Japanese Alpine Club, with which GSI has signed an agreement. Although the scale of each target area for investigations may be different, a framework to investigate mountain trails in cooperation with relevant local agencies and volunteers is being established. The results of the investigations are used for updating the maps and tourist guide maps made by relevant local agencies. It is further expected that it will be widely utilized by relevant local agencies and climbers as the latest and most appropriate information about mountain trails. The authors hope that the investigation of mountain trails with the cooperation of relevant local agencies will be continued, assuming the reflection of latest information of mountain trails on the Digital Japan Basic Map.