Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

MTT41-P01 Room:Poster Time:April 28 18:15-19:30

Publication of redesigned multicolor 1:25,000 topographic maps

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With rapid development of the information and communication technology, the national basic map accomplishes a big change. As for the 1:25,000 topographic map produced by the Geospatial Information Authority of Japan (”GSI”), which underpins the geo-science studies, publication of newly designed multicolored 1:25,000 topographic map was started from November 2013, with different production process and more detailed contents which the topography was easy to understand.

New 1:25,000 topographic map is based on ”digital Japan basic map (DJBM)”, and the production process was greatly changed. A Plotting work using aerial photo, which was the biggest characteristic of the past topographical map making, is not included in the process, and a part of the vector data in the digital Japan basic map is directly clipped and printed.

It is enactment of ”the Basic Act on the Advancement of Utilizing Geospatial Information (NSDI act of Japan)” of 2007 that became the starting point of such a change. By this law, it was prescribed in particular that the government shall prepare and use ”the fundamental geospatial data (FGD)” as a standard of the positions on the digital map. The GSI executed the production of FGD utilizing 1:2,500 city planning base map and 1:25,000 topographic map to mostly complete for the whole country by the end of 2011, and produced DJBM using FGD as a frame.

New 1:25,000 topographic map is based on DJBM, which means that the contents became more detailed than the conventional one. Furthermore, introduction of process printing enabled multicolor production, and some expression methods were realized for the first time.

Contents becoming more detailed means that the information becomes the precision of 1:2,500 level in city planning area. This comes from that DJBM is maintained at 1:2,500 level in the city planning area, where in the area except it at 1:25,000 level. All the buildings are displayed without being generalized even in the crowded city areas. In addition, the indication density of the road rises because all the roads are displayed without thinning.

Introduction of process printing allowed to add green shadows to grasp the topography intuitively. Orange colored buildings can avoid the congestion with roads or the place names. In addition, expressions using various colors improved the readability of the topographic map, e.g., expressways, national highways and public roads are colored in green, red and yellow respectively, and national highway numbers are displayed in inverse triangle type of the blue.

Besides, GSI started to present ”digital topographic map 25,000” to provide image data clipped from DJBM online using internet from 2012. Users can choose the central position, size and the direction of the map image depending on the purpose of use, and can choose colored/monochromatic map and with/without the shadows. It makes it easier to use it as the background map of geo-science study.

As for 1:25,000 multicolored topographical map, around ten sheets a month are published newly for the time being, and conventional topographic maps are going to be replaced several years later.

Keywords: 1:25,000 topographic map, NSDI Act of Japan, Digital Japan Basic Map, process printing

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Design of the PNG Elevation Tile and Rapid Response of Disaster Prevention-related Web Site

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In order to achieve the advancement of elevation data use, we designed the PNG Elevation Tile. We create PNG elevation tiles based on the elevation tile of CSV currently published from the Geospatial Information Authority of Japan, and tested using test applications. In such applications, the redraw which took several minutes until now can be performed in several seconds, and a high-speed response can be realized using the PNG Elevation tile.

Keywords: PNG Elevation Tile, tile, disaster prevention, energy cone, Seamless Geological Map, 3D

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The monitoring of the NIED Hi-net by using the mobile application

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For the geophysical research and the disaster prevention, monitoring the seismic activity is important. By monitoring of the seismicity, for example, we can detect the unusual event and know the fault plane. Monitoring of the real time wave filed is also important for the early warning. In order to correctly monitor the seismic activity, we have to monitor the seismic stations. The trouble of the station causes the decrease of the accuracy and the wrong interpretation. NIED runs the Hi-net seismic network which has more than 80 seismic stations with the average separation of 20 km all over Japan. NIED provides the waveform data and automatically detected earthquake information through the internet. All stations are always watched and the trouble information is reported. Usually, this watching is done by checking the individual waveform. The map information, however, is easier to understand the station condition than the waveform. In this study, we propose a method to monitor the seismic network by using the mobile device and develop the mobile application. Also we develop the applications to check the automatic hypocenter determination system.

First, we develop the application which shows the seismicity on the map. We plot earthquakes listed on the catalog determined by the Hi-net automatic system on the embedded map application. We also plot the cross section of the seismicity. We can enlarge, reduce and rotate the map. Corresponding to these gestures, the cross section is also changed. Therefore, we can see the subducting slab and the fault plane from arbitrary directions. By plotting the past seismicity on the background, we can check that the recent earthquake is usual or unusual.

Second, we develop the application which shows the wave traces of selected stations and the earthquake information on the same image in order to know whether the automatic hypocenter determination system works properly. On the Hi-net web site, we can see the 100-trace image of selected Hi-net stations. By looking this image, we can roughly know the location, the origin time and the magnitude of the earthquake. We can see some earthquakes are correctly determined but some earthquake is not determined by the automatic system by plotting the earthquake information on the trace image.

Finally, we develop the application for the manager of the Hi-net network, which shows the real time Hi-net records on the map. We get the real time data from the data server of the Hi-net and make the map image of the RMS (1s) velocity amplitude. We stock this image every second and download it from the mobile device. On the device, we can see the real time record of all stations of Hi-net every second. Hence, we can visually find abnormal behaviors of stations. By changing to the map application and showing the detail station information, we can check which station has some troubles. We also plot the information of the rapid source parameter determination system, named AQUA, on the real time map. We can see the wavefield and the source location at the same time. By comparing this information, we can check both AQUA system and station condition.

By using first two and third applications, we check the Hi-net automatically hypocenter determination system and stations, respectively. We can watch the Hi-net in terms of the wavefield, the waveform and the hypocenter by integrating three applications.

Keywords: Hi-net, mobile, real time

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Red Relief Image Map of the terrain representation method of the moon

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Summary

Although detailed terrain data of the lunar surface is obtained, terrain representation technique has become an issue. So called Red Relief Image Map (RRIM), which has been developed specifically for volcanic terrain analysis by LiDAR was applied to the topographic representation of the moon that seems to be similar to the volcanic terrain on the earth. The resulted RRIM of the moon showed effectiveness for visual interpretation of the lunar terrain.

Terrain of the Moon

The moon terrain may be characterized by high land and mariner of basaltic plane. There are several commonly used terrain representation methods. Contouring is very effective method for representing high relief topography, but not quite suitable for enhancing low relief terrain such as lunar surface. Many small scale maps and map atlas employ shaded-relief and/or gradation representation method. Even for the small scale topographic representation of the lunar surface, the shaded-relief and gradient method was used to be employed most of the cases. However, these traditional methods have issues to be solved since there are many craters lie one upon another on the lunar surface. These dipped terrains sometimes erroneously expressed by shaded-relief method depending on the direction of illumination light. Development of more effective terrain representation method is expected to solve these issues.

The RRIM

The RRIM is a method for enhancing terrain relief and is based on concept of slope map. In the RRIM, the slope is expressed by red graduation, and ridge-valley is expressed by intensity of light. Namely, the steeper the slope, the more ridge area, the lighter, and the valley and more dipped terrain, the darker on the RRIM. This image, although it is single ortho-image, provides 3D perspective.

The RRIM of the Moon

The RRIM was applied for making map of the moon. Digital terrain data (DEM) used for making the RRIM was acquired by ”Kaguya” lunar mission by JAXA. The DEM has 1/20 degree mesh interval. Presently, The RRIM of the moon can publicly be viewed at home page of Geospatial Information Authority of Japan , MILIT. It is also possible to 3D high speed viewing using Secium and Three.js.

Acknowledgement

Authors acknowledge JAXA and NAOJ for providing the lunar terrain data from ”KAGUYA” mission. .

Keywords: moon, DEM, terrain representation, red relief image map, crater, selene

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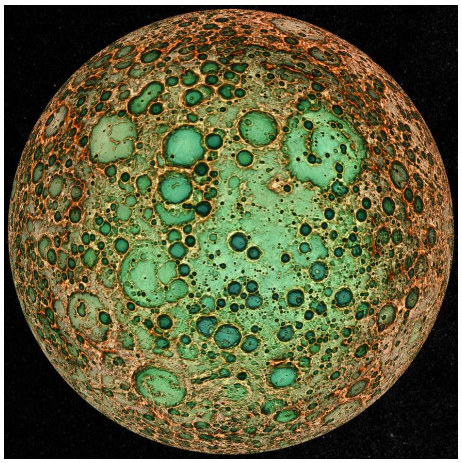

Japan Geoscience Union Meeting 2014
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Development of the CS (Curvature and Slope) topographical map

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For the topographical interpretation, we developed CS (Curvature and Slope) topographical map to visualize micro-relief that affect landslide susceptibility in mountain area. The CS topographical map represents valleys by blue color and ridges by red color, simultaneously steep slopes are assigned to dark color. We produced CS topographical map for the entire area of Nagano Prefecture from airborne LiDAR DEM and conducted many micro landslide such as linear depressions in landslide blocks, valley head hollows were recognized, and they were confirmed by subsequent field survey. The CS topographical map provides us with many information about distribution of micro-relief in mountain area, and it may be a prominent tool for evaluating landslide susceptibility.

Keywords: CS topographical map, topographical interpretation, curvature, slope

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The map of a geopark

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The authors reviewed about the deployment of geopark activity and the practical use of maps of geopark in Japan, and reported the actual condition of the map in the geoparks of all Japan. In this work, the authors collected many pamphlets of geopark with map information, reviewed all pamphlets in the points of view for expression of geographical feature.

There are many maps like tourist resort maps. But, some maps for Geopark had tried geographical feature expression in base map. For example, some maps express the landform using color for each elevation simply, and some maps were carried out 3D expression of the shade figure using DEM. These type maps were considered to be easy to understand the outline of geographical feature, compared with a contour drawing map.

Keywords: geopark, map, expression of geographical feature

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Landslide Geomorphological Map of the Northern Hida Mountains, Japan

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The northern Hida Mountains located in central Japan consist of high-relief mountain ranges. A previous study has reported the distribution of the glacial topography and explained the landform development caused by glaciers in this region. In 2008, we published the *Landslide Geomorphological Map of the Northern Hida Mountains*. This map revealed the landslide distributions and glaciated topographies. Our poster shows this map and explains the methods and criteria for geomorphological mapping, as well as the development and characteristics of landslide distribution.

Keywords: Geomorphological map, Landslide topography, Glacial topography, Geomorphological development, The Northern Hida Mountains

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Geographic Environment Reconstruction and Geo-visualization using High Resolution DEM and Old Printed Map

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[1]Rissho University

This study combines high resolution DEM (5m or 10m) with topographical maps published in the early 20th century and make 2D and 3D maps. By such a work, I try the then geographical environmental reconstruction and geo-visualization.

The main study area is Sakishima Islands of the early 20th century.In Sakishima islands in the first half of the 20th century, 1000 to 2000 malarial patients were reported in every year. According to the old research findings, there was much endemic malaria in Sakishima islands in the island of continentality or volcanic island, and it was distributed over the area where there is a vertical interval of land and the basin system network progressed.

Keywords: High Resolution DEM, Printed Map, Geographical Environment, Geo-visualization

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Visualization of tsunami and circumstances during initial evacuation and its effectiveness for disaster education

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Public interests in forthcoming large-scale tsunami have been increasing since the notification of the large-scale projected tsunami scenario along Nankai Trough. It is important for people to keep their high consciousness of tsunami hazards by means of continuous and effective tsunami-disaster prevention education. With regard to safe evacuation from tsunamis, people must evacuate as early as possible, and they should prepare an appropriate plan and method for evacuation, which is corroborated by understandings on tsunami behavior and situations of the initial stage of tsunami evacuation. In this study, we will present visualizations of tsunami behavior and circumstances during initial evacuation activity. We will further investigate effectiveness of the visualization for disaster prevention education.

Coastal areas of the Pacific coast of Tohoku have been photographed before and after the Great East Japan Earthquake. These photographs have been taken as both orthographical and diagonal (oblique) aerial imageries. The diagonal photographs are useful for people to figure out the elevations of features, such as buildings and topography three-dimensional and clearly. The oblique photographs and inundation map computed from the numerical simulation of 2011 Tohoku-oki tsunami are synthesized, to derive a realistic visualization of the tsunami flooding. This visualization will be useful for people to understand tsunami behavior, which is influenced by land use and local topography.

Visualization of circumstances during initial evacuation activity will be useful information for people to understand imminency and available time for tsunami evacuation. Airborne orthographical photographs and satellite imageries are superimposed by concentric circles centered by selected representative points that is familiar with local people, as well as main roads and evacuation facilities, because they are crucial for evacuation plan. It is unlikely that people may stay in their own houses and offices at the time of the earthquake and tsunami. The visualization proposed by this study will lead people to understand plausible circumstances and will provide useful information for various alternative measures for initial evacuation activity, as well as existences of insusceptible areas for evacuation.

Keywords: tsunami behavior, tsunami evacuation, visualization, disaster prevention education

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A Web-based Volcano Hazard Map with Information on Evacuation Shelters, Hospitals and Facilities for Vulnerable People

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National Institute of Public Health is a governmental agency that belongs to Ministry of Health, Labour and Welfare. It provides with training courses related to public health, environmental hygiene and social welfare as well as conducts research on the fields. It revises the countermeasures to protect lives and health of citizens during large-scale disasters on the lessons learned from the experience during the Tohoku Earthquake and Tsunami Disaster. As a part of the revision, I am now developing an information-sharing system to facilitate support teams to effectively and efficiently distribute a limited number of staff and resources during large-scale disasters. The mapping of relevant facilities, such as evacuation shelters and hospitals, is the key function of the information-sharing system because the understanding of geographical relationships is the first step to visit and work in an unfamiliar area during disasters. I adapted the information-sharing system to volcanic eruptions to display potentially hazardous areas. I will show an example of the application by using the hazard map of Mt. Fuji, which has been published by Mt. Fuji Volcanic Disaster Prevention Conference in 2002.

Keywords: Hazard Map, GIS, Volcanic Eruption, Mt. Fuji, Disaster Medicine, Public Health

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Mapping the supply-demand gap in childcare services with GIS: A case study in Tokyo

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[1]Tokyo Metropolitan University, [2]Oita University, [3]Hiroshima University

The aim of this study is to visualize the spatial pattern of the gap between childcare supply and demand on a map. Study area is Tokyo where the number of children awaiting enrollment in licensed childcare centers is extremely large. To map the supply-demand gap with geographic information systems, we calculated difference between supply and demand densities after converting the vector data concerning childcare supply from the public sector and pre-school children into raster data using kernel density estimation. The result of the analysis showed a spatial imbalance between childcare supply and demand. The map that added the distribution of unlicensed childcare centers proved that the shortage of the childcare supply by the public sector is spatially complemented by the services by the private sector.

Keywords: childcare services, supply-demand gap, kernel density estimation, raster calculation, Tokyo

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Geo-interactive Guidebook Services: Design and Development of LBS Applications Featuring Geo-enabled Illustrations

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The current location-based mobile applications for tourists usually use Web maps as base maps with attached objects like POIs (points of interest) to provide relevant guide information. Their services rely on accuracy of positioning functions on the handsets and accessibility of the Web maps. However, their diversity of maps and geo-information representation methods are insufficient, and are regardless of the differences in cultures as well as target users. Meanwhile, such services provide information mainly based on points, but storytelling and plots are less concerned. On the other hand, conventional paper-based guidebooks and magazines are still popular because they are good at dealing with subdivided topics, content arrangement, illustrations and stories to provide tentative travel plans with attractiveness and readability. However, they lack the capability of interactions with readers' actions and locations.

In considering of combining the advantages of positioning-enabled devices and well-designed guidebooks, we researched on a framework to create geo-enabled pages for designing applications and services providing better user experience when traveling in the real world. By analyzing the graphic components of the pages of a guidebook from the viewpoint of geo-information representation, a structured description of both graphic and geographic information of the components is established. Different geo-reference methods for geocoding the components are discussed. Especially, the methods of positioning using illustrated-maps and lines on pages are focused. Possible location-based events in the procedures of interactions with users and their locations are summarized. The design principles of user interfaces for both content creators and final users are discussed.

Finally, prototypes named "Manpo" including a content editor and a content browser are developed based on Apple Inc.'s iOS platform. Contents created by the prototype editor from existing guidebooks were used with Manpo by experimenters, to show the usability of the framework and the potential to be a commercial product.

Keywords: guidebooks, illustrated maps, geo-reference, mobile applications

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Development of a Learning Environment based on Spatio-temporal Historical Story Mapping Animation

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The purpose of leaning history is to have the capability of imaging the future by using the knowledge in historical facts. In history learning, it is important for users to understand effectively causal relationships of events. However, paper textbooks have a limitation of dynamically representing historical stories, because articles of paper textbooks consist of pieces of texts and pictures such as photos, maps, diagrams, and chorological tables. These kinds of articles are fragmental and static descriptions from the viewpoint of visual presentations. A learning environment that the user can easily understand causal relationships of events for a historical story is desired.

For resolving the limitation of paper textbooks, we propose a new framework for visualization of historical stories with relationships of events. A historical story can be defined what to combine causal relationships of events along the axis of time. We classified and defined simple data models for visualization according as time series and locations of events. We have implemented an application software system that has an interactive user interface by displaying sequences of graphics with our data models. Visual representation of our user interface is realized by three basic methods for depicting historical stories as follows:

(1)Visualization of causal relationships with arrow icons on chorological tables and maps
(2)Visualization of hierarchies of events with chorological tables and maps
(3)Visualization of the focal position in storytelling

We are creating animation content telling the story about the government's actions for the aftermath of the 2011 Tohoku earthquake and tsunami by using our prototype system as a model case. The purpose of our study is to realize a learning environment for users to easily understand causal relationships of events, in brief, and to prove effectiveness of historical learning through the model case.

Keywords: History Learning, Visualization, Ubiquitous Mapping

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Integrating Maps in Photos with Relative Spatial References

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1. Introduction

Signboard maps are widely distributed in public places, such as parks, subway stations, universities, and so on. Signboard maps are usually designed specially for the local area. POIs are usually highlighted in the maps. Many signboard maps are also drawn in an artistic way, and the mapping styles are various in different signboard maps. Except for the content, the locations of the signboard maps also provide rich information. The locations of the signboard maps are usually important places, such as the entrance of the facility and the place people easily miss the way. However, one of the disadvantage of the signboard maps is that they are not accessible anytime anywhere if users are far from them. To solve the problem, we propose a method to integrate the signboard maps in photos with digital maps to provide location based services with the signboard maps on smart phones.

2. Mapping Signboard Maps onto Digital Topographical Maps

An example of a signboard map we are going to integrate is a map of Kashiwa Campus at the University of Tokyo. We took the high resolution photos of the signboard maps in the campus. And we use a digital topographical map provided by The Geospatial Information Authority of Japan as the base maps.

We use the road intersection points as the control points of the photos. All the road intersection points are picked and are given the same coordinates as the corresponding points on the base maps. With the control points, we can map a user's location coordinates onto the photos including the signboard maps. However, factors such as the generalization, exaggeration, and the different of map projection used in the signboard maps make errors of the mapped user's location on the photo. And the errors of relative spatial relations, like locating the user on the wrong side of roads intersection, will easily mislead the users.

To ensure the relative spatial relationship of user's location with roads, we depict the roads on the photos, record their coordinates, and find the corresponding roads on the base maps. Instead of mapping the user's location directly onto the photos, we first map it onto the base map. Then we find the nearest road in the base map from the user's location. Then we map the location from the base map to the photo, so that the relative distance from user's location to the road keeps same and the foot point cuts the road with same proportion. As shown in the figure, AB and A'B' are corresponding roads in base map and in the photo, U and U' are the user's locations, V and V' are the nearest point on the road from user's location. Then, AV/VB=A'V'/V'B', UV/AB=U'V'/A'B'.

3. Integrating Multiple Various Signboard Maps

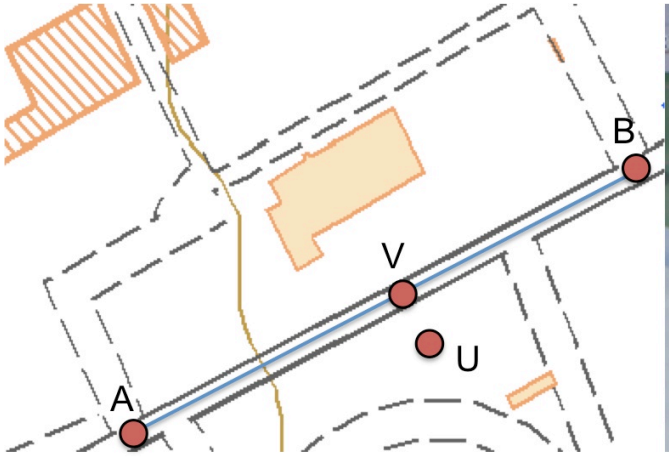
As we have mentioned, the locations of signboard maps themselves are usually important places. We annotate in each signboard map the locations of other signboard maps. By doing so, we do not only tell the users the locations of other signboards, but also composed different signboard maps, each may refer to a relatively small local area, to form a larger map. While the user is moving out of the current map, we zoom out of the current map and zoom into another map in which the user's location falls.

4. Conclusion

The signboard maps are generally more artistic, more stylish and more thematic than commonly used digital navigation maps. And the locations of the signboard maps are also important. We proposed the method to integrate the signboard maps in photos with digital base map to provide location based service with signboard maps on smart phones.

In this paper, we just made the experiment with the signboard maps of Kashiwa Campus at the University of Tokyo. In the future, we are going to cooperate with local governments and communities to collect and integrate more signboard maps on our proposed framework.

Keywords: Signboard Maps, Photos, Location-based Services, Relative Spatial References



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Portrayal and Symbology of Global Map

ANDO, Akifumi[1] ; UBUKAWA, Taro[1] ; SAITO, Toshinobu[1*] ; YAMADA, Akiko[1] ; UEDA, Maya[1] ; SUGA, Masaki[1] ; YAMAZAKI, Satoko[1]

[1]Environmental Geography Division, Geocartographic Department

Global Map is fundamental geospatial information datasets composed of
eight kinds (Population Centre, Drainage, Transportation, Boundaries,
Land Use, Land Cover, Vegetation, Elevation) of thematic information
based on consistent specifications. It is developed under international cooperation of respective National Geospatial Infomation Authority (NGIA) around the world. Global Map version 2 (Global Version, Land Cover and Vegetation) was published in July, 2013. Analyzing Global Map with other geospatial information gives good understanding of the relationship between human activities and environmental conditions including forest distribution and land cover conditions. This poster shows our recent achievements in developing new portrayal for Global Map and tiles for WTMS.

Keywords: Global Map, Map Symbology

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Estimation of the Horizontal Positional Accuracy of Geospatial Data

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[1]GSI of Japan, [2]GSI of Japan

Expectations for positioning accuracy enhancement vitalize efforts for the advancement of positioning services. For example, various driving assist service with the use of 'Authority map' (which is a large scale map that anyone can use) is being studied in the field of ITS service. It is expected that further disclosure of information about the horizontal positional accuracy of map (which should be combined with positioning information) will be required.

As for the horizontal positional accuracy of map, the threshold (upper limit value) called 'standard deviation' is prescribed in the General Standard of Operation Specifications for Public Surveys for digital topography: 1.75m in the case of the scale 1:2500 (2.50m in the case of editing pre-existing data). However, this 'standard deviation' gives no specific information about probability density functions which are inevitable for the definition of the positional accuracy. Moreover, it is pointed out that above threshold is too large in relation to actual values of public survey works and thresholds of several rules in other countries.

We therefore give the definition of the index 'standard deviation' expressing the horizontal positional accuracy of map with the use of the past research of GreenWalt-Shultz (1968), which had a crucial impact in the FGDC accuracy standards (1998). Let X, Y be random variables which have horizontal residual component values x, y as realized values which are obtained from sample points in the map. Here, 'residual value' means the difference of the observed value and the value considered to be true concerning the same point. If a set { (x,y) } contains no bias and outlier, residual value (x,y) is considered to represent positional accuracy of the point. We assume that realized values of X (Y) are normally distributed with density function fx (fy) of mean 0 and variance sxˆ2 (syˆ2). Let P(R) the probability which a sample point falls in the closed disc with radius R. P(R) is represented by the density function f which has fx and fy as a marginal density function on XxY with the use of conversion from (x,y) to polar coordinates. If sx=sy then we can easily show that P(sx)=P(sy)=0.3935, othewise P(s)=0.3935 leads an approximate expression s=0.5(sx+sy), which is shown by converting the polar coordinates expression of P(R) into the form of integral transformation of certain modified Bessel function (of the first kind) and using numerical calculation methods. If sx=sy then sx=sy=s. Therefore, we define the index 'standard deviation' by s, and call s 'Circular Standard Error' or 'CSE' for short. Estimated value of s should be calculated by { (x,y) }.

Based on this redefinition, we investigated the horizontal positional accuracy of public survey works for digital topography with the scale 1:2500. We regarded (independently) observed coordinate value of GNSS positioning as true value at the sample point, and removed the effect of bias and outlier as much as possible in advance. As a result, we obtained a rough estimate on the CSE: Estimated average value of CSE is 0.3˜0.4m, and estimated threshold (upper limit value) is 0.8m. This estimation indicates the necessity of tightning the threshold for the positional accuracy in the General Standard of Operation Specifications for Public Surveys.

Keywords: positional accuracy

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Effectiveness of the consecutive cross sections expression for the relief representation

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A map that shows the relief topography is having a lot of kinds. For example altitude tints map, and a color shaded relief map, etc. In late years, by a detailed digital altitude model, we can come to express an irregularity of the slight topography. In this way, we can recognize the topography intuitively.

However, like a contour line, it is important that we grasp ups and downs of the topography quantitatively. Therefore we stack a contour line on topography irregularity map and are effective in visualizing the ups and downs between specific two spots by beginning to talk about any section. Furthermore, we may express the topography as a map of the subject by handling shadow in the continuation section that cut and brought down a parallel section to equal distance continually. In addition, it may show former city space structure by grasping ups and downs of such slight topography.

This study made the topography irregularity map around the rich moat of topography ups and downs. Furthermore, I visualize the city space structure that watched ”Ichigaya Hachiman” from a geographic characteristic as an example by consecutive cross section expression. And I reevaluate an effect of the consecutive section expression in the topography irregularity map.

As a result, I showed city space structure and ups and downs of the slight topography by an irregularity map clearly as well as superficial contour line and color shaded relief. And the consecutive cross section expression expressed detailed topography incline to supplement an irregularity map.

Keywords: topographic map, consecutive cross sections, urban space structure, moat of a Edo castle, hilly sections of Tokyo, shrine