

MTT033-P01

Room:Convention Hall

Time:May 25 16:15-18:45

Effects of the third rotation angle concerning the oblique aspect of a map projection

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1. Parameters that defines oblique aspect of a map projection

Oblique aspect is sometimes used in map projections, for example, aiming at reducing distortions at desired locations represented on a specific map. Functions of latitude and longitude that transform to the plane coordinates are used in a map projection, where simple functions can be derived in normal aspect because in this aspect poles and/or equator are used as the reference. When necessary, coordinate transformation on the sphere are applied to obtain transverse aspect formulas or oblique aspect formulas.

Many of existing literatures on map projection often explain that oblique aspect formulas are obtained by coordinate transformation that treats an arbitrary point on the sphere as if it is the new pole(*). This implies that the number of parameters specifying the transformation is two, namely latitude and longitude of the point. But rotation in three dimensional space is specified by three parameters, such as Euler angles. The first two rotation angles of the Euler angles correspond to the latitude and longitude parameters. Therefore the third rotation angle that rotates around the new z axis is left behind.

This means the third rotation is necessary if one wants to make complete oblique aspect transformation. Without the third rotation, north or south poles are always located on the central meridian on the map and this constrains free representation of a map. For example the so-called Atlantis projection that is a kind of oblique Mollweide projection requires the third rotation.

2. Examination on the effect of the third rotation angle

We now examine the effect of this third rotation on the map representation according to the categories of map projections.

The third rotation merely rotates the map around the center of the projection (standard point) in case of azimuthal projections where oblique aspects are often used. This does not change the shape and size of the figures drawn on the map. It rotates around center of the fan in case of conic projection and moves laterally in case of cylindrical projections and does not change the shape of figures on the map, too. The third rotation does not change the shape of figures on the map for these projections with high symmetry.

However, it actually changes the shape of figures in other map projections such as pseudo-cylindricals.

3. The meaning to consider the third rotation in oblique aspect

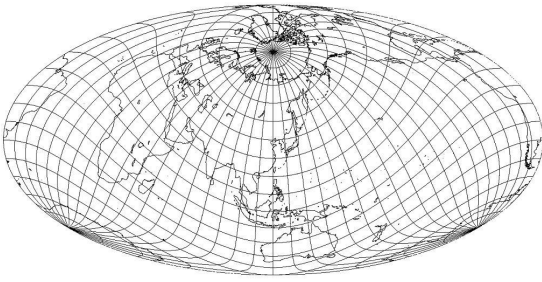
By comparing the cases using three rotations and two rotations, we consider the meaning and effect of the third rotation as follows.

(1) Some arrangement of land distribution on a map requires the third rotation in oblique map projection. Therefore this rotation is necessary.

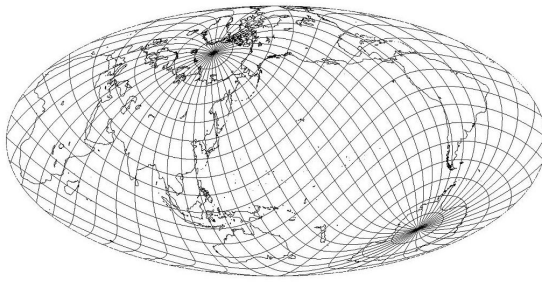
(2) Using three rotation angles for oblique aspect is theoretically consistent because spatial rotation is expressed by three rotation angles.

(3) Graticules of oblique Mollweide projection, for example, become complex curves and unfamiliar continent shapes are shown. But this is also a map representation that keeps the characteristics (eg. equal-area) of the projection. These representations may help to understand distortions of familiar map projections.

(*) Snyder (1987) properly writes with mathematical formulas that three rotation angles are required for oblique transformation.



Oblique Mollweide projection where 60W, 50N is represented as a pole
Antarctica is divided into two.



Oblique Mollweide projection where 60W, 50N is represented as a pole and 55 degrees rotated around it.
No continents are divided by the edge of the map.

Keywords: map representation, map projection, oblique aspect, Euler angles, spatial rotation

MTT033-P02

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Designing method of map projections balancing area and angular distortion

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1. Introduction

There is no map projection without distortion. Therefore, many map projections have been proposed. Map projections are designed and evaluated by accuracy or appropriateness of area, angle, length, azimuth, etc. However if we focus on infinite area and difference from congruence, area and angle are enough elements to evaluate map projections. Seeking global map projections which balancing area distortion and angular distortion, this presentation propose designing method of such map projections, where. The earth is assumed a sphere.

Less attention has been directed on distortions of poles; many map projections have expressed a pole as line. This fact means that we have less interest to express poles, where human activities are very low, accurately. However many explorers are launched and many maps of extra-earth planets are produced recently. Because there are no human activities on the planets everywhere, disregard of distortions of poles are not appropriate. Therefore this study intends to balance area and angular distortion on the globe including poles.

2. Definition of area distortion and angular distortion

Angular distortion is defined as S'/S , and area distortion is defined as $A'-A$ in cartography, where S and S' are area before and after the map projection, and A' and A are angle before and after the map projection. Area distortion by this definition shall not be an object to be minimized. Angular distortion by this definition is also not appropriate object to be minimized, because transformation on 1 degree to 2 degrees and 100 degrees to 101 degrees are equally evaluated.

If some quantity X changed to X' , distortion is usually defined as $(X'-X)/X$. Therefore area and angular distortions are evaluated based on $E_{S0}=(S'-S)/S$, $E_{A0}=(A'-A)/A$ in this study. If Tissot's indicatrix is available, $E_{S0}=m_1m_2-1$, where m_1 and m_2 are major axis and minor axis of Tissot's indicatrix. The maximum of $|E_{A0}|$ on a point is $E_A=m_1/m_2-1$, which is for infinite small angle at the minor axis.

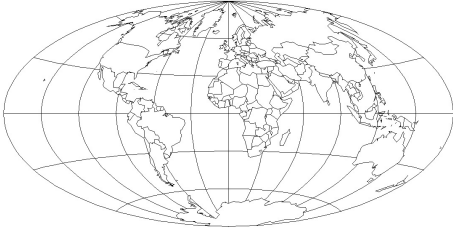
3. Evaluation criterion

Values of $|E_{S0}|$ are different between k times expansion and $1/k$ times reduction. Therefore $E_S=\max(S'/S, S/S')-1=\max(m_1m_2, 1/m_1m_2)-1$ is introduced to evaluate k times expansion and $1/k$ times reduction equally. This presentation propose weighted sum of square of E_S and E_A for evaluation of distortion, and minimize $L =$ spherical mean of $(w_S E_S^2 + w_A E_A^2)$ over the globe, where w_S and w_A are weight for area and angular distortion and $w_S + w_A = 1$. If $w_S = w_A$, then 2 times conformal expansion, 1/2 times conformal reduction, and a equal-area transformation of 2-times-expansion in height and 1/2-times-reduction in width are evaluated equally, which correspond to $L=4.5$. Suitability of weighted square sum shall be subject of further study.

4. Example

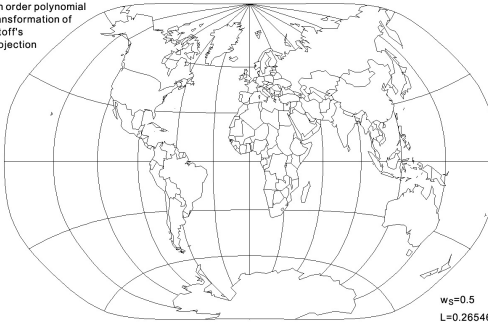
The figure is a result of the preliminary study, which minimizes L among 9th order polynomial transformation of the Aitoff's projection; step of numerical integration is 5 degree.

Aitoff's projection



$L=0.960981$
 $(w_0=0.5)$

9th order polynomial transformation of Aitoff's projection



$w_0=0.5$
 $L=0.265465$

Keywords: map projection, design, area distortion, angular distortion, balance

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The development of space-time information certification system using VLBI correlation technique

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Abstract

We have the plan to develop techniques for validating the position and time information of users who have a high demand on accuracy of these parameters. NICT has already developed the advanced precise positioning service (APPS) and has set up position validation test servers which provide mm accuracy for advanced users. The main target of this research is to generalize this system for the user who does not need high accuracy. In addition, the system will be able to validate not only position information but also time, i.e. 4-D validation. The user terminal which is equipped with a GPS receiver and a digital TV tuner should send GPS position information as well as sampled digital TV carrier signals to a certification center. In the certification center, digital TV carrier signals will be sampled and recorded independently for the purpose to be correlated with the user's data. If a fringe can be detected with the a-priori position information provided by the user, the user's position is correct. In this case, a certification message will be issued to the user. The focus of this research project is set to the development of an eVLBI technique based on digital TV carrier signals.

1. Concept

VLBI can determine the distance and direction of two radio telescopes with mm level accuracy by correlation processing of radio waves from quasars which are received at each telescope. A-priori delay time has to be calculated using the initial position of each telescope before VLBI correlation. The correlation fringe will not be detectable if the initial position is wrong or has larger error exceeding the size of the search window.

In this research project, we are going to apply a similar technology and confirm whether the initial position of user is right or not. Both, the certification center and the user receive radio waves which are emitted from a common transmitter at the same time. The user sends his received data to the center together with the position information that is obtained by other means. If the user's position is correct, an interference fringe will be detectable by correlation processing, which relies on a-priori delay information calculated from the information sent to the certification center. By this process, it is possible to confirm the user's position and issue a certificate for it. This certification system is expected to support a large number of users who have different requirements on the position accuracy certification level. Thereby, accuracy will range from the meter level, which is based on a single fringe detection, to millimeter accuracy, which relies on correlation of many different signals such as those emitted from GPS satellites.

2. The procedure of certification

2-1. Reservation

The user who wants to get a certification must inform the center in advance in order to be prepared to record of the same radio signals at the certification center.

2-2. Recording at the certification center

The center starts the recording of the radio signals based on the user's request.

2-3. Recording on the user's terminal and obtaining the position

The user also starts recording of the same radio signals and measures his position. The user's terminal must be synchronized with the standard time in advance.

2-4. Sending of the data and position information to the center

After recording, the user can send the data to the center. The data size is expected not to exceed a few Mbytes since signals are much stronger than those obtained from quasars and thus require less integration time to achieve high signal to noise ratios.

2-5. Correlation process at the center

The center correlates the signals provided by the user with those received at the center using the user reported position as a-priori value.

2-6. Certification of the user's position and time

If the fringe is detected, the center issues a certification to the user.

Acknowledgment

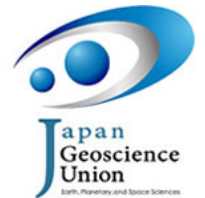
This work is supported by a Grant-in-Aid for Scientific Research (A) "KAKENHI" (21241043).

Keywords: position certification, space-time information, VLBI, cross-correlation, space geodesy, time certification

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Color Design of the land condition maps of Japan

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Geospatial Information Authority of Japan (GSI) prepares the land condition maps since 1963, for the purpose of providing basic information on the natural condition of land, which is required to disaster prevention measures such as compiling hazard maps and to making plans for land use, land preservation and regional development. Also GSI started to revise the maps in the urban areas from 2010. Meanwhile, revised versions of the landform classification maps for flood control, whose purpose is grasping the information about the land condition of the lowland areas controlled by the government, are prepared by GSI since 2009.

Although these maps have different aims, object areas and acquisition standards, their classification methods are based on form, origin and characteristics of landform in common. But, there are some problems for users, because each map has each color design. When the landform classification maps for flood control are revised, GSI intended to standardize color design of both maps.

We will describe on this report about the outline of the result that we examined about the standardization of the color design and the visibility of the maps for users.

Keywords: Color design, landform classification, land condition maps

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Landscape ecological map using LIDAR data

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¹GSI of Japan, ²Rakuno Gakuen Univ., ³Univ.of Tsukuba, ⁴Tottori Univ.

The authors try to produce of landscape ecological maps for the evaluation of biodiversity supported by the fund of Environment Research Project (D-0805). In this research, we produce the landscape ecological map consists of three dimensional vegetation structure and micro topography under the forest using LIDAR. Two study areas were selected. One is the Shiretoko Peninsula (Mt. Rausu and Shiretoko Corp) as primary forest area. Another is the Chugoku Mountains (north foots of Mt. Dougo) which are many historic iron sand mining sites (Kanna-Nagashi sites) as secondary forest area.

The legend of landscape ecological map is composited the combination of vegetation classification and landform classification. Vegetation is divided into deciduous forest and evergreen forest based on the difference of random points LIDAR data on two seasons, and is classified as three dimensional structures depending on vegetation height. Landform is classified automatically depend on slope degree and convexity of detailed DEM on winter season. Grid size of landscape ecological maps is 4m, because the grid size is corresponding on tree crown size. At first, we produced 1m grid vegetation maps and automated landform classification maps, and then we resampled 4m grid data from 1m grid data. In poster presentation, these maps would be introduced as example of LIDAR application for ecological field.

Keywords: landscape ecological map, LIDAR, biodiversity, Shiretoko Peninsula, Chugoku Mountains

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Easy tool for digital surface modeling

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¹JACIC

Infrastructures in Japan are always exposed to threats of natural hazards. When structures are damaged, it is necessary to estimate cost of restoration and request budget to take necessary measure. To assist this procedure, JACIC Foundation developed a software tool for cost estimation of restoration of damaged sites. The tool is a combination of close range photogrammetry and CAD. For photogrammetry, compact home-use digital cameras are available. The tool runs on a personal computer and is easy to use and cost effective. Recently, we added a function to show digital surface model as wire frame model. Users can use this tool not only for restoration of damaged sites but also for making DSM for various objects. Use of Digital cameras with GPS and digital magnetic compass adds some more interesting applications.

Keywords: Close range photogrammetry, CAD, Natural hazard, Digital surface model

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MTT033-P07

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Outline of Digital Japan Web system

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Digital Japan Web system served by Geospatial Information Authority (GSI) of Japan takes a browsing role on survey results, and anyone can superimpose geospatial information on the background map data. Furthermore, the map data are scrollable and scalable. Now GSI promotes usage of the system for national and local government offices and facilitates usage and distribution of geospatial information, base on the principles of Basic Act on the Advancement of Utilizing Geospatial Information.

On the day, we will explain outline of the system as focusing on the background map data delivered by it.

Keywords: Digital Japan, geospatial information

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MTT033-P08

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Utilization of Global Map for addressing global issues

Takayuki Nakamura¹, Hidehisa Takahashi¹, Takeshi Iimura¹, Noriko Kishimoto¹, Miho Takagi¹, Shuhei Kojima¹, Masaki Suga^{1*}

¹GSI of Japan

Global Map is the data in 1km resolution with consistent specifications, covering eight thematic layers: boundaries, drainage, transportation, population centers, elevation, land use, land cover and vegetation. The data development is being made in cooperation of National Mapping Organizations in the world. Land Cover and Percent Tree Cover data of the whole globe were released in 2008 as Global Map Version 1. Global Map data are utilized in various fields: climate change, disaster, biodiversity, etc. as a basic material which objectively represents the status of global environment.

This poster introduces the examples of the data utilization.

Keywords: Global Map, Utilization

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MTT033-P09

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Visualization of geoscience information by using Augmented Reality

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Augmented reality (AR) is a technology to add some information made by computer to real-world environment, and an augmented environment made by the above technology. There are many invisible research objects in geoscience, for example electric and magnetic field. For geoscientist, it is one of the important work to know those spatial distributions and structures. By using AR, we can visualize and overlap these invisible objects on real-world. These help us to understand these objects simply and accelerate our research. In addition, Sekai Camera, which is based on Global Positioning System and AR, shows one of the good example and future potential to collaborate between geoscience information and AR. In this presentation, we will introduce the case example of the visualization of geoscience information by using Augmented Reality.

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MTT033-P10

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Development of the Virtual Theodolite for Geomagnetic observation

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To understand geomagnetic observation is important for the researcher who analyze the geomagnetic data. Then practical training helps understanding the geomagnetic observation. In the university, learner have opportunity to experience with the observation. However, learner have to do it in the group because of the limitation of the number of equipments. Under such a situation, the gap can be done in the understanding level between active learner and non-active learner. The benefit of our VTG is that each learner can simulate the geomagnetic observation on their own virtual geomagnetic observation environment. The VTG is the web application, 1.to display stars by using Google Earth, 2.to display geographic information by using Google Earth, 3.to simulate the magnetic field by using IGRF model, 4. to simulate the geomagnetic observation by using 1-3 and the program which is written by JavaScript and WebGL. In this presentation, we describe our VTG.

Keywords: Geomagnetic Observation, Simulator, Fieldwork, Google Earth, Web Application, WebGL

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3D visual representation of geophysical fluid simulations on Google Earth and its transmission: the EXTRAWING project

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We introduce the EXTRAWING, an R/D project for novel and attractive representations of geophysical and environmental fluid simulations and effective transmissions of those results to the public. In this project, we have developed a technique to make the three-dimensional visualization results of those simulation datasets be represented on Google Earth. We have also developed a web application program based on the Ajax framework to observe those results on an internet browser. The name EXTRAWING is a coined acronym consisting of the initial letters of the words; EXploring and TRAVeling the World INSide Geoscientific data. The outline of the project is described below.

Most of graphical contents for geo-scientific data displayed on Google Earth are represented by following forms; point (zero-dimensional form) as information attached on each place, line (one-dimensional) as tracking results of tagged pelagic fishes and surface (two-dimensional) as a satellite image. What we should visualize is a volume dataset (three-dimensional form) obtained by a geophysical fluid simulation. It is needed to develop a novel way to represent three-dimensional feature of the dataset on Google Earth. Graphical contents data for Google Earth should be given as a geometric dataset, a set of polygons. Therefore, a volume rendering based on ray-casting is unavailable. Furthermore, the number of the polygons should be minimized to ensure fluid operability of Google Earth. It might be said that iso-surface representation, which needs a large number of polygons in order to extract three-dimensionally complicated distribution of fields, is not an appropriate way to display on Google Earth. We tried another volume rendering approach by piling color contouring images made from each slice of a volume dataset and mapped suitable opacity on each pixel of them. This approach has a great advantage in minimizing the number of polygons because this method needs only polygons same as the number of sliced surfaces.

Next, we consider how to transmit it to the public. Information transmission utilizing the internet is nowadays common practice. The simplest way to transmit our volume rendering contents for Google Earth is to install a web server for downloading those contents on the internet. However, this way imposes burdensome tasks on the user of those contents, such as installing Google Earth, downloading the content data and reference material, operating Google Earth functions and extracting features from the data. Such tasks are difficult for the people who are unfamiliar with Google Earth. Therefore, it is important to construct a system that everyone can easily access those datasets and comprehend the meaning of our simulation results without such difficulties. Under this consideration, we developed a web application program based on an Ajax framework with the Google Earth API library provided by Google Inc. The layout of this web application is shown in the figure. In designing the program, we concerned about user's computer environment (monitor size, browser type and version) and prepared several text documents (Google Earth, operating instructions, FAQ, etc.).

As the first release of EXTRAWING, we prepared two kinds of contents by simulation results; (1) temperature distribution in central Tokyo (shown in the figure) and (2) Typhoon No.4 of 2007. The MSSG model developed in the Earth Simulator Center is used in each of the simulations. In the case (1), the growth and collapse streaky structure in the temperature distribution are found in the graphical region of the figure. In the case (2), three-dimensional structures of the Baiu front lying on the Japanese archipelago and the typhoon located at southwest of Kyushu is visible.

This web program is available on wherever there is Internet-connected environment. The development of useful tools and visualization techniques, improvements, and the expansion of contents are future works of this project.



Keywords: EXTRAWING, Google Earth, visualization, volume rendering, web application, transmission of information

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Visualization of vegetation landscape of the past by geocoding the Herbarium Specimens information

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The necessity to grasp and record the long-term change in the environment and the living thing came to be recognized along with the recent changes in global environment and ecosystem. In the field of botany, specimens as a basic material for the plant research have been collected with Herbarium over many years. Though a lot of useful information is contained in these specimens, only partial information has been published and organized. On the other hand, the recent progress of the technology of GIS (Geographical Information System) enabled us to process a large amount of geospatial information and to represent it visually.

The author tried to put the information on the specimen data base of the Makino Herbarium in Tokyo Metropolitan University into GIS by giving geographic coordinates with reconstruction of a present name of the place where the specimens were collected. Analysis of the geocoded specimen data with GIS clarified the geographical distribution and spatial relationships of many specimens. In addition, the vegetation landscape since the Meiji era and its changes can be visualized with detailed plant species name using the Google Earth.

Keywords: Herbarium, specimen, GIS, vegetation history, vegetation landscape, Google Earth

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Visualization of spatial structure of Sotobori moat

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The urban area of central Tokyo that took over the structure by the Edo period was developed to high density urban spatial after world war two. In the 21st century, it claims on importance to observe of a point of view of ecological environment and urban environment. The layers of ecological environment and urban infrastructure and historical place has layered complicate on the around the Sotobori moat.

In this research, we built 3D model of spatial structure about the Sotobori moat. This paper reports to examine about the following three items. (1)representation of digital terrain model of the high precision,(2) spatial representation of the Sotobori moat by depth sounding,(3)representation of underground spatial for boring log.

Keywords: Sotobori moat, spatial structure, visualization, spatial representation

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Estimation of population density based on topography

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To calculate population density, usually total area on administrative units is used. But in perspective of "Livability", we may feel the narrowness in the mountains even if low population density region.

So, we sometimes use "Habitable area" that subtracted forest and lake area from the administrative area, but it doesn't necessarily match reality because this value contains habitable area by reclamation.

In this study, focused on the terrain inclination, we extract habitable area from relationship slope and building location, and estimate "Buildable area" from this value minus lake area.

We will compare population density on this value with generally density on administrative units, and verify that the value bases on actual situation.

Keywords: population density, topography, Habitable area, Buildable area, Livability

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Geovisualization of Endemic Malaria in Sakishima Islands in the First Half of the 20th Century:A Case of Iriomote Island

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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.

This research restored the geographical environment of endemic malaria in Sakishima island in the first half of the 20th century combining high resolution DEM, an old edition topographic map, and historical records, and performed consideration from a viewpoint of land use or a settlement form. We studied Iriomote Island where the whole area was almost an existence disease place of the island as an example.

Keywords: Sakishima islands, Endemic Malaria, Geographical Environment, Geovisualization

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Mapping the recent development of condominiums and demographic change in Nihonbashi district of central Tokyo

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Since the 1990's, back-to-the-city movement has progressed and a large number of condominiums that receive the immigrants to downtown has been developed in Tokyo Metropolitan Area. While previous studies in geography and urban planning clarified various aspects of this trend, its overall picture has not yet been given. The aim of this study is to map the state of condominium development and demographic change in Nihonbashi district of Chuo ward, where remarkable conversion from office functions occurred owing to the population growth since the late 1990's, to capture the process of recent transformation of the central business district synthetically. Data used in this study were obtained from population census, establishment and enterprise census, "Market trend of condominiums", and urban planning information of Tokyo Metropolitan Government. By putting these data into GIS, we made maps of change in population, locations of condominiums, and land use since the 1990's. The result enabled us to understand the relationship between population/land-use change and condominium development visually. Specifically, we revealed that these changes vary with the location within Nihonbashi district according to the previous conditions of land use and type of business functions.

Keywords: Geographic Information Systems, central Tokyo, demographic change, condominium, maps

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Children's map skill building through the eco-map making activities

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The environmental map made from two or more joint work is called "eco-map". It is a map where a familiar environment and energy, etc. are made a theme. Three meanings are put in the word eco-map. "e" of eco means environment and energy. "co" of eco means collaboration. The map exhibitions of eco-map have been held several times. The environmental map was made by various themes. In some maps, geographic information system (GIS) was skillfully used. In these maps, various research procedures and the techniques are used. For instance, there is a work that clarifies that the transformation of the region is related to the change in the number of utility poles. The distribution of the utility pole was expressed on the transparence sheet clarified the regional change. It is an unique technique of map expression. There is a work that examines the regional change through the distribution pattern of the nest of swallow. There was a swallow's nest in the area that person lived, but the population decreased area where the number of vacant houses increased lost of the swallow's nest. It indicate the importance of the map that was expressed the data with adequate way of map expression. With what cartography skill is such a map-making connected? First of all, the skill that clarifies the investigated purpose can be acquired. Moreover, they understand that the adequate data is necessary for the purpose that they want to clarify. They will take the skill that selects and creates the map expression according to their purpose. Recently, GIS comes into wide use, and a variety of map expressions are packaged, and there are few chances to consider the expression technique deeply. The map should be drawn according to the research purposes. It might be important to offer the experience for children to draw a map with my purpose.

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