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Considering spatial dependence in areal interpolation method based on eigenvector spatial filtering

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Spatial data are often aggregated into spatial units. Because there exist many types of spatial units such as census units and grids, the difference in the spatial units among the spatial data often complicates the analyses. Transferring spatial data from one zonal system to another is useful for solving this problem. This process is called areal interpolation (e.g., Sadahiro 1999). We assume that areal interpolation is the conversion of spatial data from source units into target units.

Spatial dependence is a general property of spatial data, and it implies that data at nearby locations are similar whereas those separated widely are less similar. Thus, for accurate areal interpolation, it is quite natural to consider spatial dependence. However, there are no significant studies that have considered spatial dependence with respect to areal interpolation, except for Kyriakidis (2007), Gotway and Young (2007), and Mugglin et al. (1999). In addition, from the viewpoint of practical use, the methods proposed by these researchers are inferior to the conventional methods mentioned above. First, they are complex and difficult to implement. Second, their computational burden is large.

In this study, we propose a new areal interpolation method that is an extension of the regression-based method suggested by Flowerdew and Green (1992) in order to consider spatial dependence. A distinct advantage of our method is that it can be implemented by using ordinary least squares (OLS), which is most frequently used as a parameter estimation technique for the regression model, and can be easily handled with light computational burden. However, it is well known that OLS by itself is not suitable when the residuals of the regression model are spatially dependent. Therefore, we employ the eigenvector spatial filtering technique (Tiefelsdorf and Griffith, 2007). More precisely, we incorporate the technique into the areal interpolation method by adding the eigenvector of the geographic connectivity matrix as an explanatory variable to the basic model of regression-based areal interpolation. Because the constructed model itself is essentially identical to the traditional linear regression model, no specific procedures are required to obtain OLS estimators. Thus, as compared to other areal interpolation methods that consider spatial dependence, the proposed method has the advantages that it can be easily implemented and is computationally efficient.

Finally, in order to examine the effectiveness of the proposed model, we apply it to the aging ratio data of 2007 North Kanto area, Japan. In this study, the conventional regression-based method and the proposed method are compared, where the former does not consider spatial dependence but the latter does. The methods are applied to the areal interpolation of the aging ratio whose source units are the municipalities in 2007, and the target units are the municipalities in 1995. The predictive error of the proposed method is 7.63 percentage points less than those of the regression-based method in terms of the average differential between the observed and predicted values. This indicates that it is important to consider spatial dependence in areal interpolation.

Keywords: areal interpolation, spatial dependence, eigenvector spatial filtering

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# Visualizing income disparity in Japan with spatial statistic method

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With the collapse of the bubble economy in the early 1990s, economic disparities have arisen both among the people and among the different regions in Japan. Well known tools for analyzing income disparity are the coefficient of variation and the Gini coefficient, which are widely used such as in the reports of the government or standard economic textbooks, but they can only grasp the overall degree of income disparity. Advancements in spatial analysis have led to the development of strong tools to explicitly consider spatial dependence and heterogeneity; however, no significant research has been carried out using such tools for analyzing the economic disparity at the municipal level in Japan. The objective of this study is to visualize the dynamic change of the regional income disparities in Japan during the period known as the "lost decade." The data used in the study are annual data collected at the municipality level during 1998-2007. Exploratory spatial data analysis (ESDA) and local indicators of spatial association (LISA) have been used to classify municipalities into categories and to identify local spatial clustering and spatial outliers composing the income disparity in Japan, respectively.

We first classify each municipality into four clusters according to the Moran scatterplot: high per capita income municipalities with high per capita income neighbors (hot spot), high per capita income municipalities with low per capita income neighbors, low per capita income municipalities with high per capita income neighbors, and low per capita income municipalities with low per capita income neighbors (cool spot). The hot spots are concentrated along the center of Japan, also known as the Pacific Belt Zone, and the cool spots are located in the north and south west of Japan. The regional distribution of the clusters seems to be stable during the decade; however, unstableness of the clusters in Hokkaido prefecture are indicated. We also calculated the Euclidean distances between the Moran scatterplot for each region to extract municipalities with peculiar movement in the Moran scatterplot through the decade, and succeeded in detecting not only regions with dramatic cluster transition but also regions with peculiar behavior staying in the same cluster.

To identify influential observations and spatial outliers, analysis based on LISA has been carried out. Local Moran's I is efficient for identifying regions with similar and dissimilar values, thus it is a good indicator to spot strong spatial clusters, and local Geary's c is efficient for the quantification of income inequality between each region, thus can be used to indicate the degree of (dis)similarity. During the decade, the distribution of the municipalities' local Moran' I value had become simple except the regions in Tokyo, Nagoya and Osaka still have high values. This means that the strong spatial clusters only exist in the main metropolitan areas. A similar result is confirmed in the distribution of local Geary's c values, meaning that almost all municipalities do not differ compared to their neighbors, and the regions in Tokyo are identified to be strongly dissimilar to neighborhood regions.
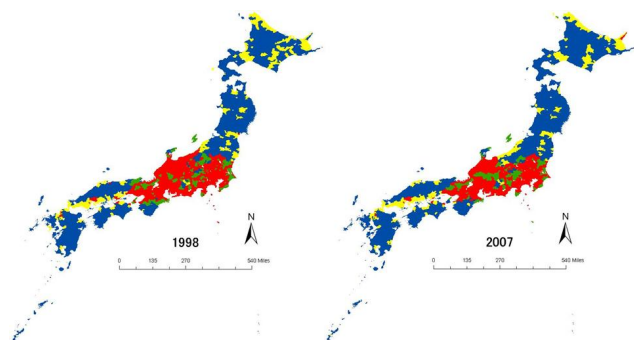
Distributions of the clusters

Keywords: income disparity, Moran scatterplot, local Moran statistic, local Geary statistic

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Evaluation of pan-sharpened image for human settlements mapping: A Case of South East Asia Cities

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Mapping the human settlements is essential for urban planning, disaster management and emergency preparedness and other humanitarian assistances. Effective disaster preparedness requires quantitative spatial distribution patterns of population in order to position emergency response centers and prepare food and shelter in the event of disaster. Mapping the human settlements from remote sensing data is cost effective and timely manners which is suitable for disaster management. This study reports the evaluation of human settlements mapping result using pan-sharpened image in order to improve the spatial and spectral properties of original low resolution remote sensing data.

Keywords: Pan-sharpened image, human settlements, South East Asia cities

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Sustainability of Agriculture Land Use in Eastern Bhutan

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Abstract

In Bhutan about 70% of the population live in rural areas based on agriculture farming and related activities. The eastern region occupies a major agriculture share. However, in recent years, the sector has been facing challenges in the form of land degradation, instability in productivity, crop damage, and issues of fallow land, leading to decline in agricultural land use. These challenges were implicated as a result of climate variability, especially fluctuations in temperature and erratic precipitation patterns although no detailed study exists. Against this backdrop this research measures the influence of climate variability on agricultural land use by analyzing- land use change (LUC) in eastern Bhutan from 1994 to 2005 in relation to biophysical and socio-economic factors [LUC = f (biophysical and socio-economic factors)], using GIS and the SPSS programs.

Given the importance of agricultural sectors, the sustainable utilization of limited arable land will play a critical role in sustaining rural livelihood and food security. The sustainability of agriculture is viewed mainly in terms of the capacity of an agricultural system to adapt and deal with stresses and to carry itself on. This study gives insights into the importance of addressing agricultural sustainability issues in a holistic manner, and finally provides some inputs towards developing strategies to deal environmental impact and changes.

Keywords: Agriculture land use, Climate variability, Eastern Bhutan, GIS, Sustainability

DEM-based morphomoetric analysis of drainage basins in Mt. Danxia, Guangdong Province, China

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Mt. Danxia is where the special term "Danxia landform" was coined. The landform is characterized by red-colored sandstones and steep cliffs, often providing a beautiful scenery. In recent years, the landform has been receiving international attention, and some of them were designated as the UNESCO World Natural Heritage. However, morphometric studies of Danxia landforms have been limited. Geomorphological characteristics of drainage basins in the Mt. Danxia area provide a key to understand the evolution of the unique landscape. Morphometric properties related to basin geometry (area, relief, relief ratio, slope, and hypsometry) of subwatersheds in the study area were quantitatively examined using the ASTER GDEM. We found high spatial variations in their morphometric properties throughout the whole basin. Some possible effects of tectonics and lithology on the basin geometry are inferred. Basin geometry of the subwatersheds can also be related to their relative position within the whole basin, i.e., upstream or downstream along the main stream, perhaps reflecting the geomorphological evolution of the whole basin. The hypsometric curves of the subwatersheds with concave and convex shapes may indicate the differing stages of the subwatersheds, some of which seem to have already reached the equilibrium (mature) stage.

Keywords: Danxia landforms, Morphomety, Hypsometry, DEM

Geospatial analysis on topography and archaeological sites in Kayseri, Turkey: A preliminary result

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Landform is a fundamental factor that affects cultural activities of human beings, and such effects on the artificial remains such as road position and settlement distribution can more strongly be reflected in ancient periods than in the modern periods. Here we investigate the spatial relationships between archaeological settlements (B.C. 3000-1000) and landforms in Kayseri region in central Anatolia Highland, Turkey. The data of landforms were acquired by both the field measurement and remote sensing techniques: The field topographic measurement comprise the use of LRF (Laser Range Finder) and DGPS (Differential Global Positioning System), which enables on-site quick (10^1-10^2 minutes for a 10^4-10^6 m^2 area) acquisition of detailed topographic data with a submeter-order accuracy. Some of these detailed topographic data suggest the existence of buried buildings and walls, which had never been identifiable by existing low-resolution topographic datasets. Satellite imagery data are also used to obtain the broad-scale topographic data in the area. A DEM produced from ALOS PRISM imagery data is used to identify characteristic landforms around the archaeological sites. Using these materials we discuss the historical, temporal changes in the archaeological site locations in relation to the landforms.

Keywords: LRF, DGPS, DEM, ALOS PRISM, geoarchaeology

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Establishment of interoperability Web-GIS in water environments by Mobile-phone-based Database for Water Quality

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1. Background and study objective

Long Term Ecological Research Network (LTER) [1] is widely watched as a view of environmental monitoring in global scale. In particular, LTER is able to capture a slow change in environmental issues as a precondition to make continued monitoring in Long term. On the other hand, they need to be huge costs so that we try to observe, analysis and transmission of information in many observation site. The key point of continued monitoring in Long term is how to assume including cost between citizens, ministry, industrials and academy. It is desirable that citizens investigates familiar water environments, organize results obtained, sort out the problems involved and makes it to practice activity. [2]One of the trials is Nationwide simultaneous survey of familiar water environments. [3]Citizen 's group has problems which are cumbersome management of the data, their activity can be closed and ill-attended in young person.One of the solution against these problems is Web-GIS(WG) facilitating citizen 's activity. There are varied databases for water environments in internet. Bur derelict sites are not negligible except in the case of sites managed by ministry. Another problem are difficult operation and less well-known. We address the challenge to develop by Water-Voice (WV) [4] which is the application can be registration and reference investigation results on investigate site.It 'll cost huge to develop functions as WV each WG for water environments.The purpose of research is validating the availability by development of interoperability of holding contents between WV to WG in existence within OGC interoperability technology. [5]

2. Methods

We adopted Open cafe system [6] which is FOSS4G package and can use XML in data passing in internet.Target WG are WV covers Tama-river basin and Yamanashi-water-net(YAN) [7] covers all area in Yamanashi prefecture.We adopted iPhone-OS and web browser which are Internet Explorer, Fire Fox and Google chrome for client applications.
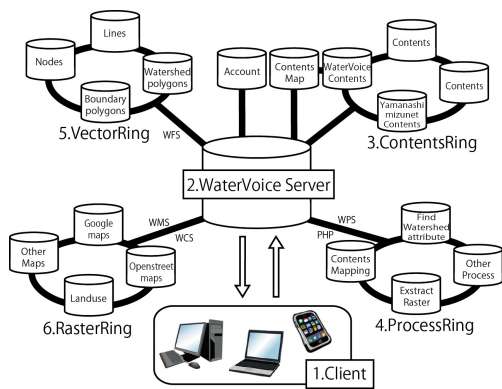
3. Results and discussion

The system architecture can be developing interoperability in different WG in the figure.All user have to do is access WV server by client application with location information and to be automatically selected registration destination and reference destination, we call Contents and to be confirmed current basin by polygon data of basin.This system can be interoperate between WV to YAN can define the attribute for the consistency different WG 's items of data by preparation Contents map table in WV server and equip the PHP function which are can be permitted registration to database and reference database from outside server request in YAN server. Using Web Process Service, it can be used for various analyses by make data which are Web Coverage Service distribution in Raster Ring, aggregate input data which are based on interpretation of Contents Map in Contents Ring and define region by polygon data which are Web Feature Service distribution in Vector Ring.

Our conclusions are following.

1. It can be shared new function to be equipped in different WG and cut cost down.
2. It can be used for various analyses from shared databases.
3. It can be registration and reference data under field survey not required expert knowledge to user.

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