Spatial Database of the Northern Area of Yellow River for Research of Sediment Discharge

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Abstract: Nowadays, the absolute shortage of the water is happening at 31 nations of Asia and etc. This points that how water resources should be controlled. Global water problems are very important to adjust the natural resources in the twenty-first century. In this study, the one of the vast river in the world, yellow river in china was focused on the spatial database field, but only northern part of whole river region. In this paper, we used the topographical map, GTOPO30, SRTM, digital map and satellite data for special database. This database was used for getting some useful information of watershed-based sampling data like a river shape, surface character and etc.. In this paper, the results of extraction GIS database from non-digitalized data for this research between calculated and referenced data are compared. Contour diagrams, river channel network figure and watershed information were extracted from the spatial database. This paper shows that the special database is very useful for watershed-based sampling design.

Keywords: GIS, database, yellow river, watershed-based

1. Introduction

Using the computer modeling will concentrate on high accuracy estimation for hydraulic studies, it was felt that determination of the input parameters in a computer model which are related to surface parameter would be of critical importance for calibrating the model and using it to make accurate predictions of hydraulic model quantity and quality. A study which used geostatistical methods to describe spatial variations in infiltration (Loague and Gander, 1990) found that spatial correlation of infiltration measurements over a small, relatively uniform catchment was small (less then 10 m). Loague and Gander determined that the data requirements needed to accurately describe spatial variability of infiltration using geostatistical methods can be great, and concluded that it may not be the best tool for such a study.

Previous studies in the eastern Sierra Nevada Mountains (Hussain et al., 1969; Meeuwing, 1971; Guerrant et al., 1991; Burcar et al., 1994; Naslas et al., 1994) indicate that the surface attributes which influence variations in infiltration-runoff are soil type, vegetation cover, and slope. Existing information (e.g. Soil Survey report compiled by the Soil Conservation Service) relate to site-specific properties which might influence infiltration are usually general.

To help better quantify and delineate spatial variations in infiltration rates and estimate values for input parameters related to infiltration in computer models, data taken from field infiltration tests using a disk permeameter, an existing Geographical Information System (GIS) database, and field observations of surficial attributes were combined to develop a map of the watershed which quantifies and delineates spatial variations in infiltration rate. This map can then be used in

the development of different computer modeling scenarios of water quantity and quality runoff following rainstorm events. Digitalized database based on GIS could fulfill the function of this map.

2. Objectives of the study

The Objective of this research was to determine which data collection and analysis methods might be best suited for delineating spatial variations in the yellow river. Information management systems to support watershed-based sampling designs should include databases of watershed boundaries to define sample areas, databases of relevant watershed characteristics to support watershed classification, consistent coding strategies to facilitate information sharing, and distribution systems to facilitate applications at a wide scale. Database describing watershed areas and watershed characteristics are needed to construct sampling frameworks for designs using watersheds as the sample unit. The U.S. Geological Survey (USGS) was developed two worldwide databases which would support watershed-based sampling designs, and which would be made available as part of the world wide GIS database system.

In this research, the global GIS database was made by above data. And a case study of its practical use were carried out in applied area Yellow lever. First step, the data of DEM named GTOPO30 prepared by the U.S. Geological Survey, topographical map by Russia and digital chart of the world server by Penn State University Libraries of China around Yellow River were stored in the database. As a result, the work of the watershed-based GIS database is finished.

As a data extracting work for watershed characteristics, the modified data of GTOPO30 as a contour line was extracted from DEM (GTOPO30) data. And second step, the other practical use data for watershed based reserch which is length, width and distance from river entrance of research watershed was extracted from topographical map database.

For the GIS database, ArcGIS (Version.9.0) software of ESRI Co. Ltd. was used. Calculated and Estimated Coverages data from the original database of the surface attributes which can influence variations in infiltration rates – runoff, i.e. soil type, vegetation, and slope, are available in hydrology research. It was felt that this information data could easily be integrated with the field data, which could be grouped into various combinations of these attributes, and statistical tests could then be performed to determine which combination of attributes influence variation in infiltration. These coverages could then be overlain to produce a map which displays the spatial relationships of different infiltration rates based on similar attributes which can then be applied to future use in computer modeling of rainfall events or sediment discharge.

3. GIS Database Concept

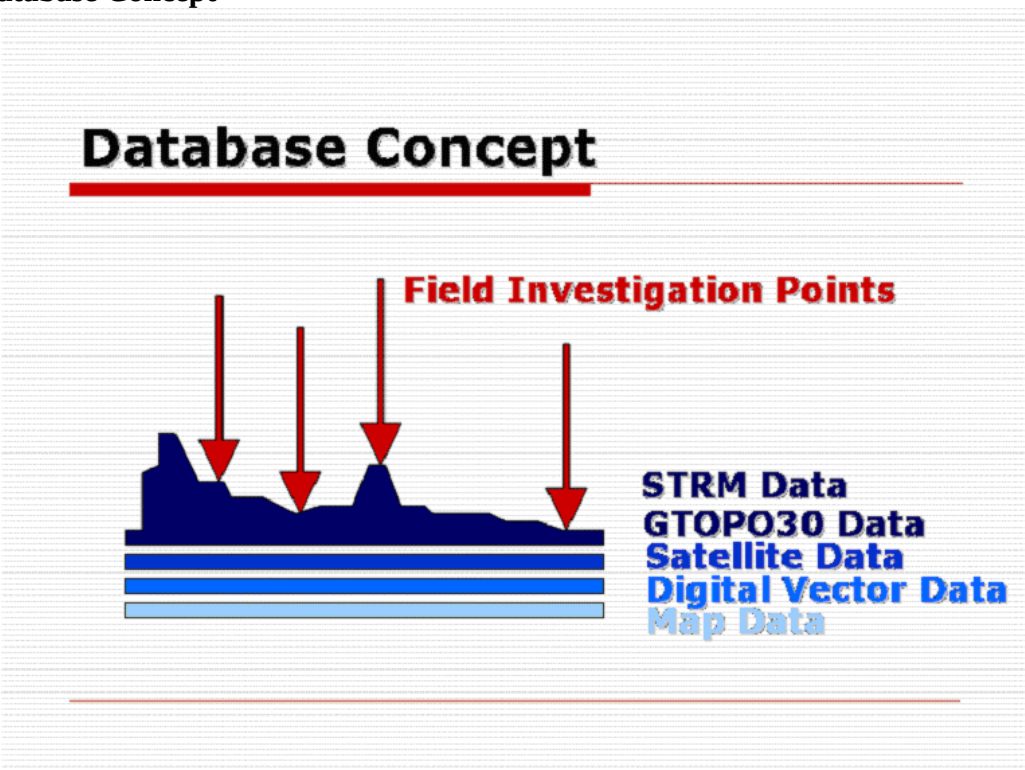


Fig.1 Concept map of watershed-based GIS database on this research

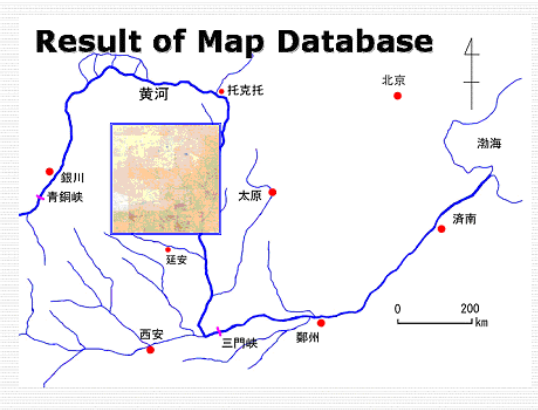
In this study, the Yellow River basin was selected as a database area using the GIS technology. Now, the water quantity of yellow river decreases now seriously[7]. It is because the rain did not fall very much recently. However the similar phenomenon occurs in all over the world. In a sense way the database for Yellow River can be used for helpful data to study global water problem.

1) Map Database

As we can see, the map is the best tool in other to catalog and show the arrangement on the Earth's surface. The map has a various kinds like a road map, political map, land use maps and etc.. One of the most widely used maps is the topographic map. This topographic has very useful information of the three-dimensional data expressed as Contour. Nowadays the topographic maps are used for engineering, energy exploration, natural resource conservation, environmental management, public works design, commercial and residential planning[8].

In this study, we used topographic map to extract the some information of river network and watershed outline etc.. This paragraph was explained only that the topographic map used for overlapping work as a one layer GIS database (7 X 10 sheets, total 70 sheets) of Kuye river as a small tributary of Wuding river and Dali basin as one research site each other.

There are two steps for overlapping work. First one is the data change and cutting work using by Photoshop software. And second one is the work of database procedure using by ArcGIS software. We can get the final results as like figure 2 and figure 3.



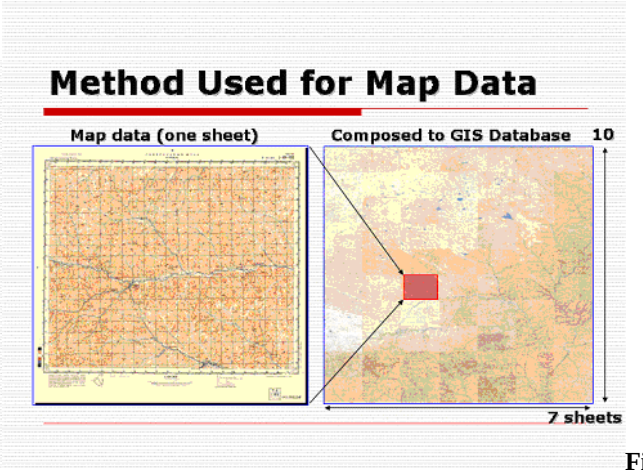
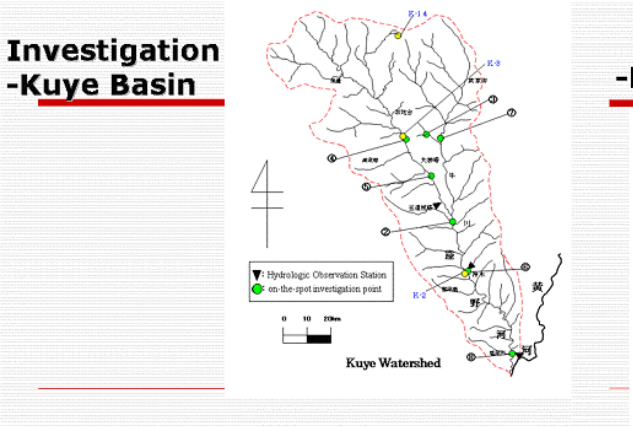


Fig.2

Used method of map database

Fig.3 Result of map database



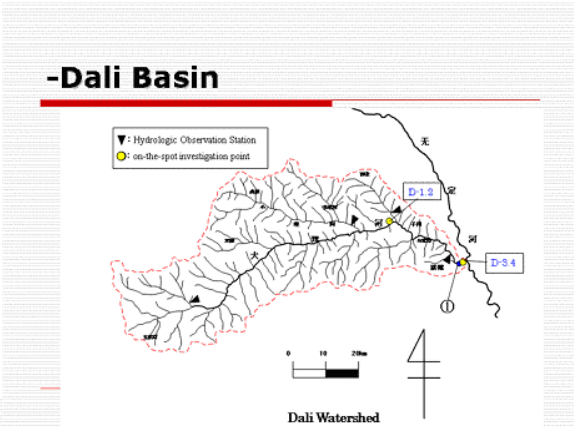
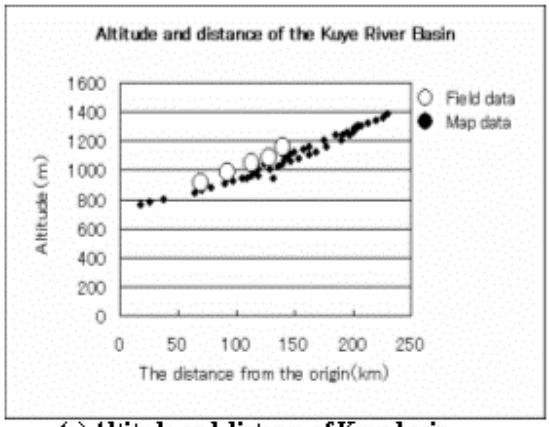
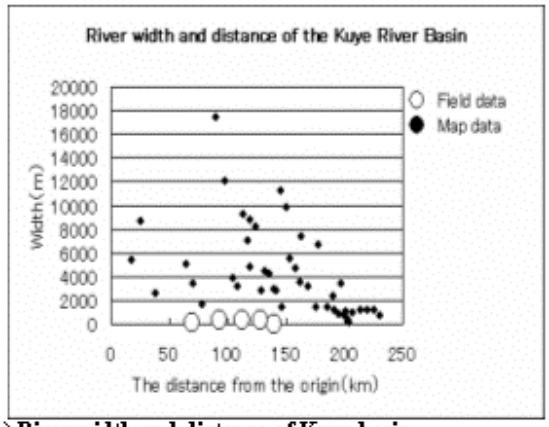


Fig.4 Extracted watershed(Kuye) from the database

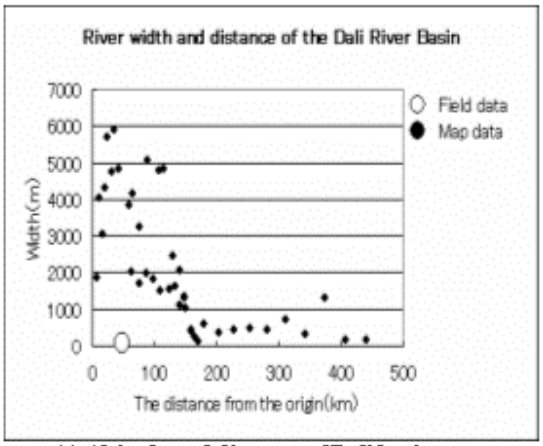
Fig.5 Extracted watershed(Dali) from the database



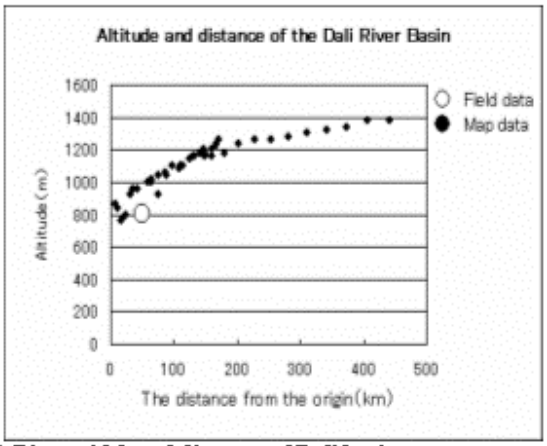
(a) Altitude and distance of Kuye basin



(b) River width and distance of Kuye basin



(c) Altitude and distance of Dali basin



(d) River width and distance of Dali basin

Fig.6 Extracted watershed characteristics from the GIS map database

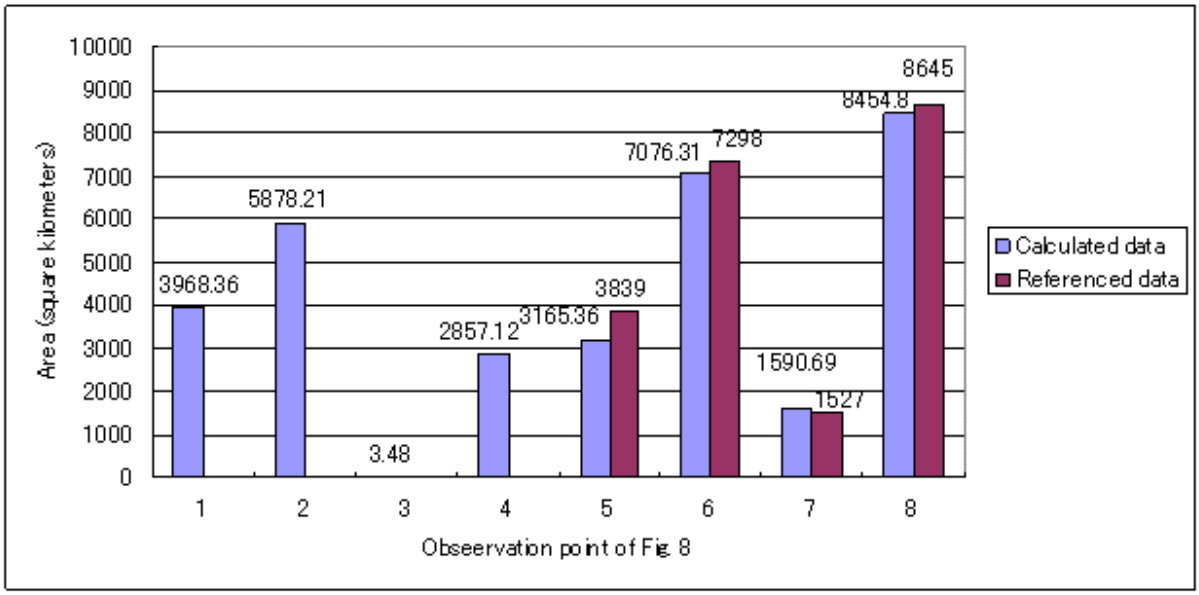


Fig.7 Result of verification data on the watershed based database

In this research, we are tried to apply for the practical use by the GIS database created through previous procedure. There are three parts. First one is the mapping of watershed information for the research area which is Kuye and Dali river basin. Second one is the extraction of some information (river width, each tributary volume, altitude of river point, distance from the start point of river branch line etc.

The figure 4 and figure 5 are the results for the first part extracted watershed information from the GIS map database. Some information of each river (Kuye and Dali) was extracted using by the GIS map database through ArcGIS software. The kinds of some information are river width and altitude, river width and distance from the start point of river branch line. Figure 6 shows some extracted information by using GIS technique. And figure 7 shows area comparison data for the observation points between calculated and referenced data.

2) DEM Database using GTOPO30

The GTOPO30[9)] is a global digital elevation model (DEM) with a horizontal grid spacing of 30 arc seconds (approximately 1 kilometer). This GTOPO30, completed in late 1996, was developed over a three year period through a collaborative effort led by staff at the U.S. Geological Survey's EROS Data Center (EDC). The GTOPO30 Data was derived from several raster and vector sources of topographic information. For easier distribution, This GTOPO30 has been divided into tiles which can be selected from the world map. Bellow Figure is the one sample of the data processing using by ArcGIS software. The final result is as like figure 8.

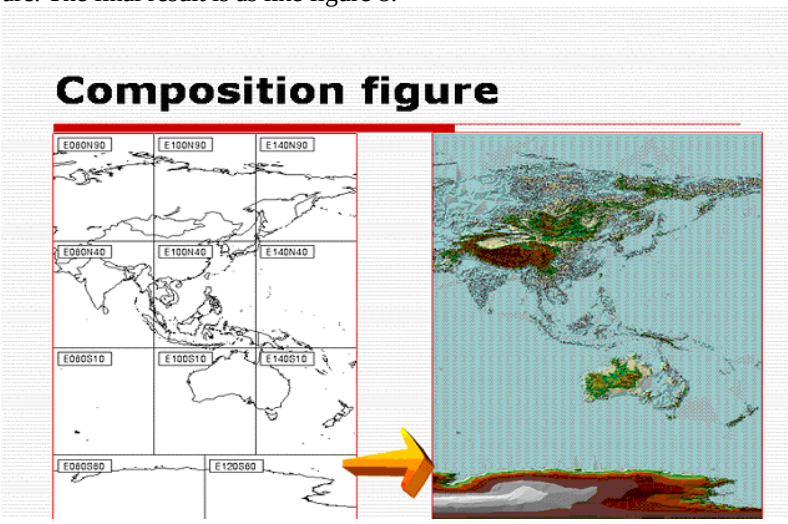
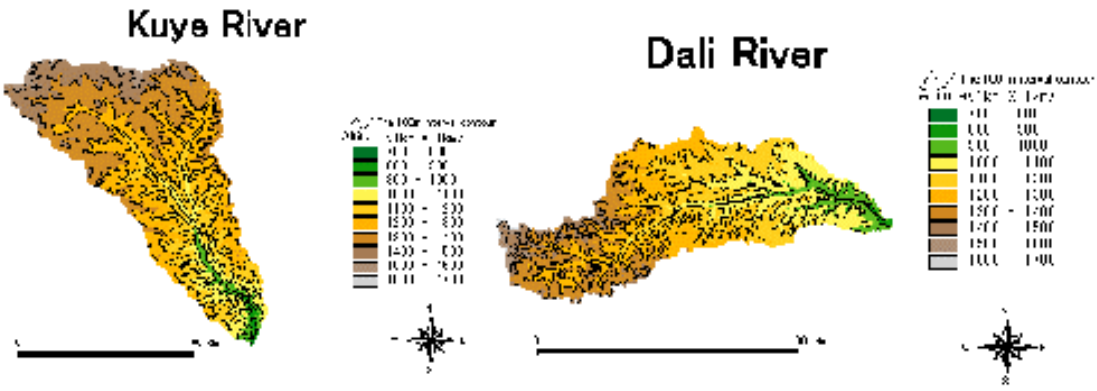


Fig.8 Result of verification data on the watershed based database



(a) contour line of Kuye river basin **(b) contour line of Dali river basin**

Fig.9 Extracted contour line from the GTOPO30 GIS database

The third part of watershed information is about contour line. This extracting work was used the DEM GIS database edited by GTOPO30. The used software also was ArcGIS of ESRI. The figure 9 is the result of extracting work.

3) Satellite Database

Using same method of database, satellite database for the research area like bellow Figure 10 finished. This satellite database is used for extracting watershed information and other data like figure 10. These samples are constructed by ArcGIS software also. The final result is as like figure 11 (database) and figure 12 (analysis data).

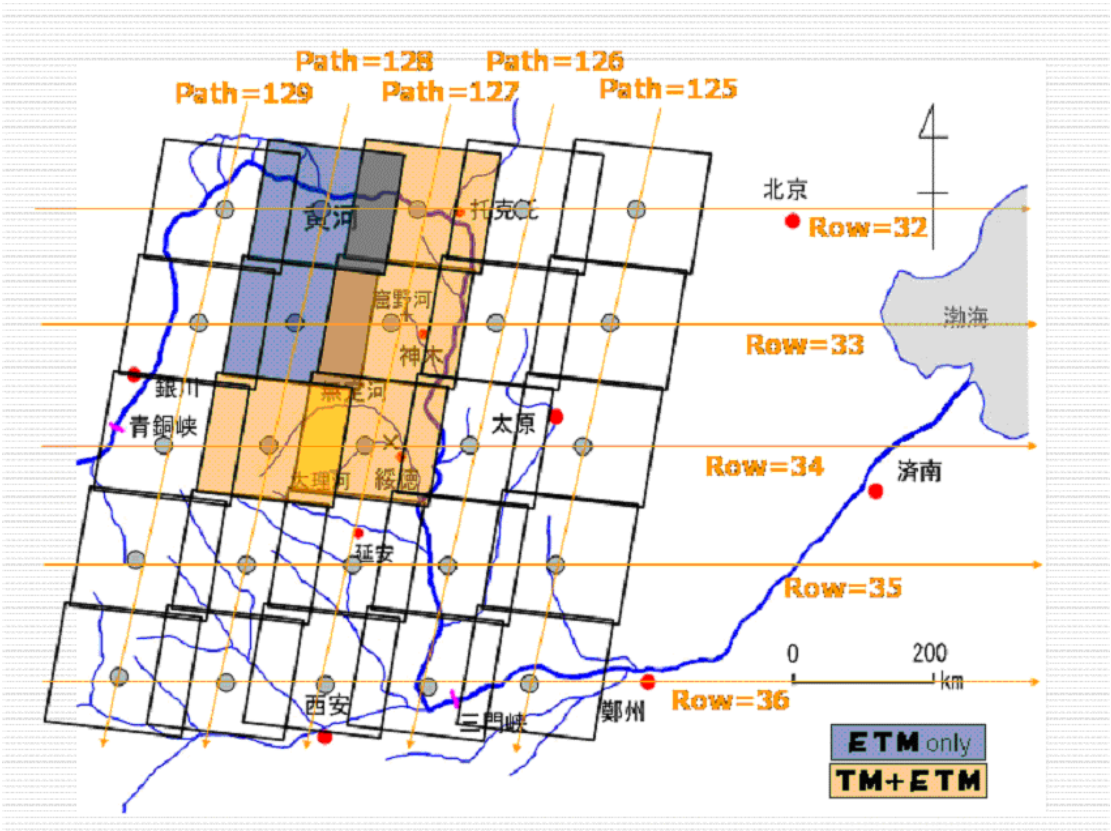
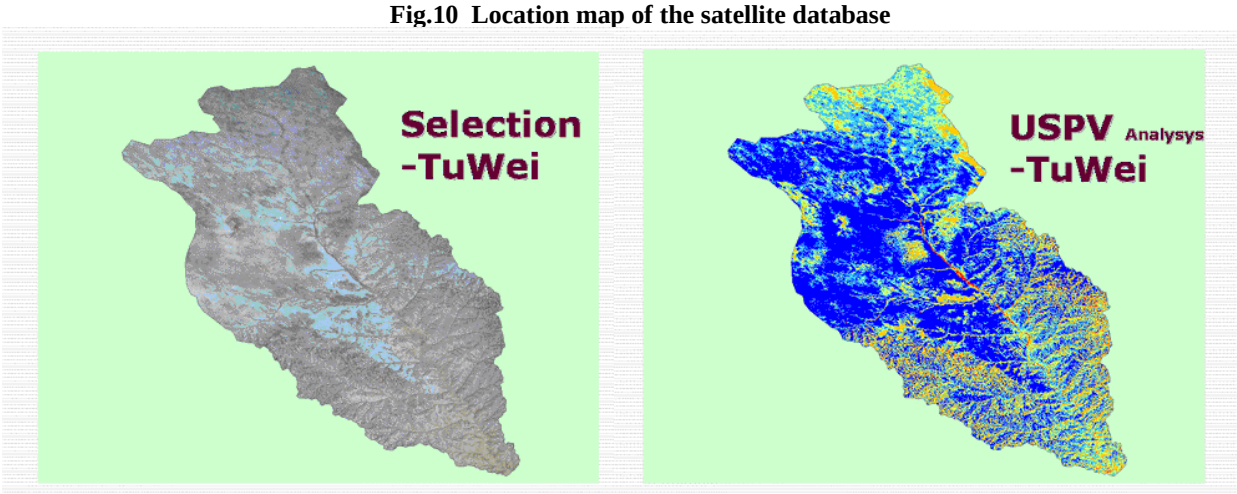


Fig.10 Location map of the satellite database



(a) extracted watershed of TuWei basin **(b) image processing data of TuWei basin**

Fig.11 Extracted and image processing data used by satellite database

4) SRTM Database

On February 11, 2000, the Shuttle Radar Topography Mission (SRTM) payload onboard Space Shuttle Endeavour launched into space. With its radars sweeping most of the Earth's surfaces, SRTM acquired enough data during its ten days of operation to obtain the most complete near-global high-resolution database of the Earth's topography. To acquire topographic (elevation) data, the SRTM payload was outfitted with two radar antennas. One antenna was located in the shuttle's payload bay, the other on the end of a 60-meter (200-foot) mast that extended from the payload pay once the Shuttle was in space. We used this data for watershed based GIS database. The figure 12 shows the database image by GIS software of ArcGIS. And figure 13 is the results of the watershed characteristics.

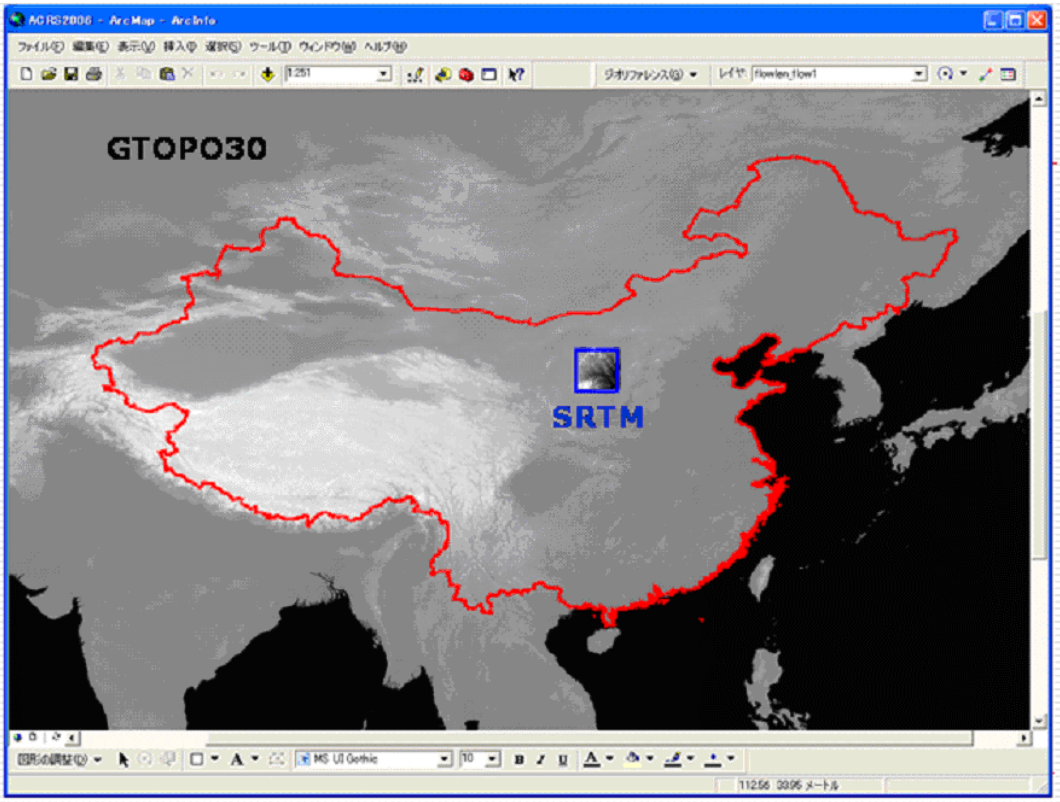


Fig.12 SRTM database in our research region

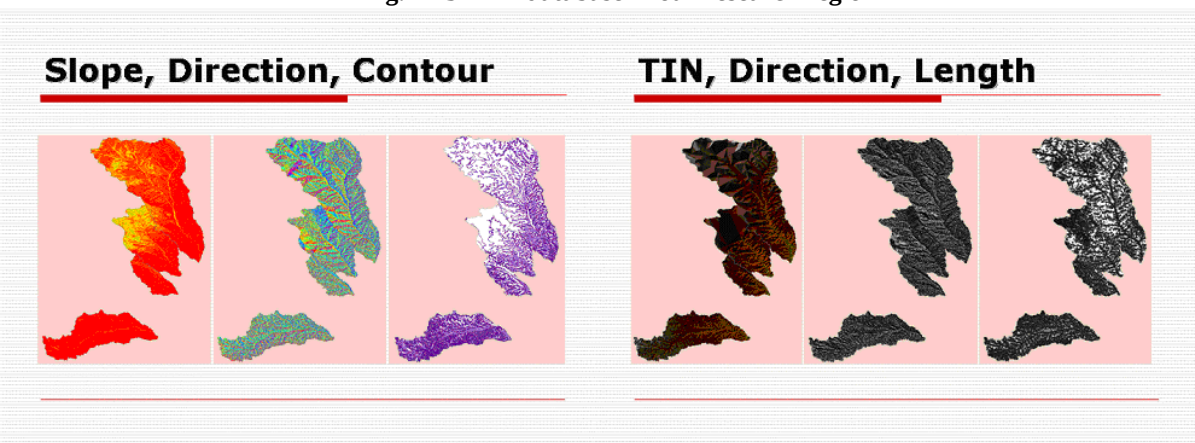


Fig.13 Result of the watershed characteristics by using STRM database

4. Discussion

In this study, the watershed based database using the GIS technology was made. Watershed characteristics of contour diagrams, river channel network figure and features of the watershed area were extracted from the constructed database of this research. We are looking forward to the secondary product of this database. These applied data showed that the watershed based GIS database was very useful for the practical use of civil work.

Acknowledgement

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[9] **URL: G**TOPO30 Information of U.S. Geological Survey: http://edcdaac.usgs.gov/gtopo30/gtopo30.html

[10] **URL: SRTM** Information of JPL of NASA: http://www2.jpl.nasa.gov/srtm/index.html