THE SPATIAL TECHNOLOGY APPLICATION RESEARCH ON THE TRACING SOUCE PROJECT OF CHINESE CIVILIZATION

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Foundation Item: 1025 national science and technology support projects “Tracing Source Project of Chinese Civilization and Related Technology Research about the Protection of Cultural Relics” （2010BAK67B07）

KEY WORDS: Remote Sensing, Tracing Source Project, Spatial Distribution, Land Surface Temperature

Abstract: The Chinese civilization is the crystallization of the Chinese nation wisdom during her formation and development. The research introduced the comprehensive application which combined RS and GIS in the spatial distribution analysis of Taihu Basin, Linfen Basin and Luoyang Basin. It is found that the archaeological sites were mainly distributed in the secondary tributaries of main rivers, most in the second terrace where the slope is less than 5°.A predictive model was built based on these results. This model of significance in guiding the development of the urban planning and protection of ancient sites. The article also analyzed the fusion of multi-source remote sensing data, and the optimal data and method were selected to detect the paleochannel and ancient city wall from comprehensive information. Moreover, the research aims to extract the weak information from the images and enhance the contrast to recognize the ancient site ruins. Then the research employed the multi-source thermal infrared data to retrieve the LST which had close ties to the ancient wall. It can be seen that there may be some ancient walls showing abnormality of temperature. The research demonstrated the effectiveness of remote sensing and GIS on the Tracing Source Project of Chinese Civilization, not only for the detection and recognition, but also for the spatial distribution and prediction of sites ,as well as explanation of site development and disappearance combined with the geographic changes.

1. INTRODUCTION

The Chinese civilization is the crystallization of the Chinese nation wisdom during her formation and development. The starting time of Chinese civilization is near 3500BC. The Yellow River basin, Middle-Lower Yangtze Plain and Liaohe basin are the core areas of Chinese civilization. Environmental factors have had a significant influence on the formation of Chinese civilization, and the central China offers a significant environmental advantage due to its landform diversification which contribute to the sustainable development of Chinese civilization. Then it became the center of the pluralistic integration of Chinese civilization.

The tacing source project of Chinese civilization is the multi-disciplinary comprehensive research on formation and development of Chinese civilization in order to fully reveal her richness and brilliant success. Compared with other ancient civilization, we can summarize the characteristics of the early Chinese civilization and its position in the history.

Remote sensing archaeology is a new technology which can quickly and comprehensively explore the sites on ground and underground in large scale and the spatial analysis function can reflect the evolution of environment and culture. With the development of spatial technology, many data sources including the multi-angle, multi-spectral, multi-resolution and multi-scale data, even the muti-band, multi-polarization and multi-mode imaging radar data are available. These data source can offer data for the environmental archaeology, cultural landscape archaeology and palaeogeographic reconstruction and GIS can offer basic remote sensing image database for the ancient cultural resources management and monitor the temporal and spatial variation of cultural heritage.

Because the research object survived thousands of years, these sites cannot be detected by the usual remote sensing method. It's necessary to employ the environmental analysis method, weak information extraction, multi-source data fusion and DEM analysis method using multi-temporal and multi-sensors data in order to get the optimal efficiency. Liangzhu, Erlitou and Taosi sites are of great values in the research of Chinese civilization (Han Jianye,2010). It's essential to take more targeted approaches to different sites.

2. THE SPATIAL ANALYSIS OF SITES AND PREDICTING MODEL

Because the productivity of ancients is limited, human life are influenced by the natural environment to a great extent, which can be seen from the Figure 1.
From paleolithic age to Qin and Han dynasties, the settlements migrated gradually from the high terrace to the low terrace even to the flood plain. This is consistent with the law of social development which transmitted from hunting in the paleolithic age to the productive economy period. With the improvement of productive level, the ability to dominate the nature was enhanced and ancients moved from the mountains to the plain.

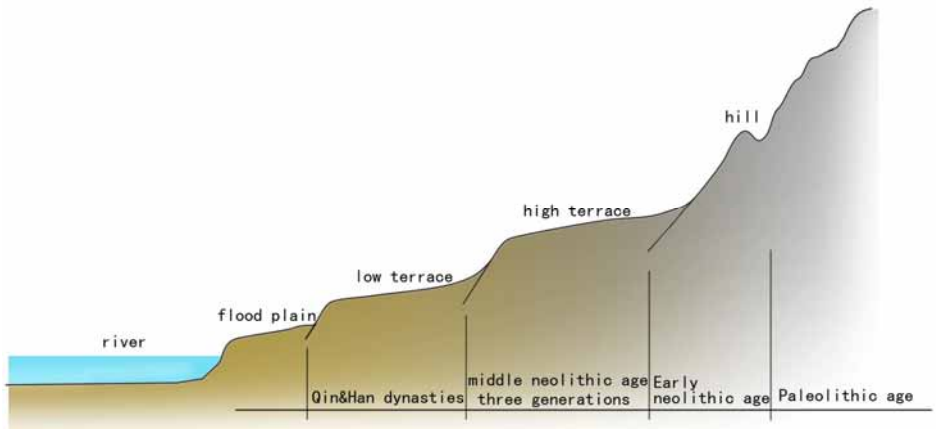

Figure 1: Regularity of general distribution of ancient sites

2.1 THE SPATIAL DISTRIBUTION CHARACTRISTIC OF SITES

Taihu Lake Basin is an important cultural center of middle and lower reaches of the Yangtze River basin with continuous development and intensive sites. Liangzhu located in the Yuhang and Deqing of Zhejiang province, which is the late Neolithic culture BC4000-5300. Liangzhu site was excavated off and on since its discovery. The Liangzhu sites spread over the Taihu basin centering in the Mojiaoshan sites. The village, graveyard and altar were found around sites group of which are the most advanced jade industry and the emergence of the settlement center (Liu Shuren,1996). These discoveries reflected the five thousand years of China.

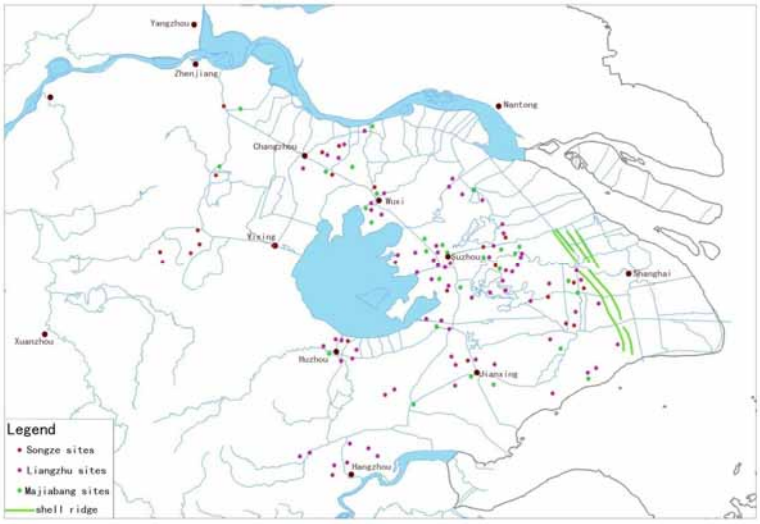

Figure 2: Neolithic culture sites map in Taihu basin

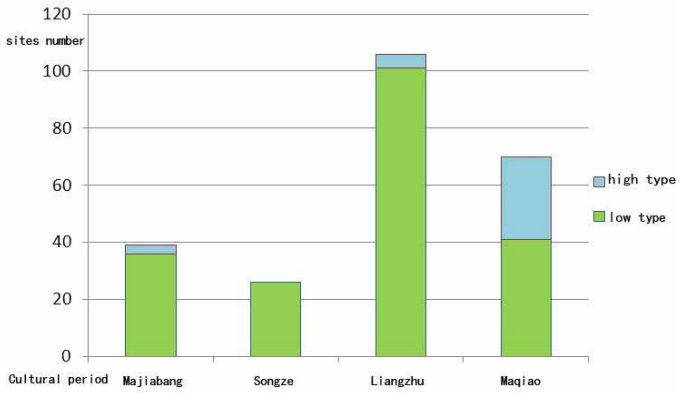

Figure 3: The geomorphology of Neolithic cultural sites in Taihu basin

As shown in Figure 2 and Figure 3, there is a close relationship between the sites and environment. The sites centered the Taihu lake, and are distributed mainly over the eastern Ningzhen mountain. The spatial distribution of ancient sites has a certain trend and potential regularity, which widely distributed along streams and most in the level-2 terrace. The terrain, slope and aspect had great influence on ancients, limiting the range of settlements choices. These conclusions matched Chinese traditional Feng-Shui theories. The same works with the Luoyang basin and Tarim basin.

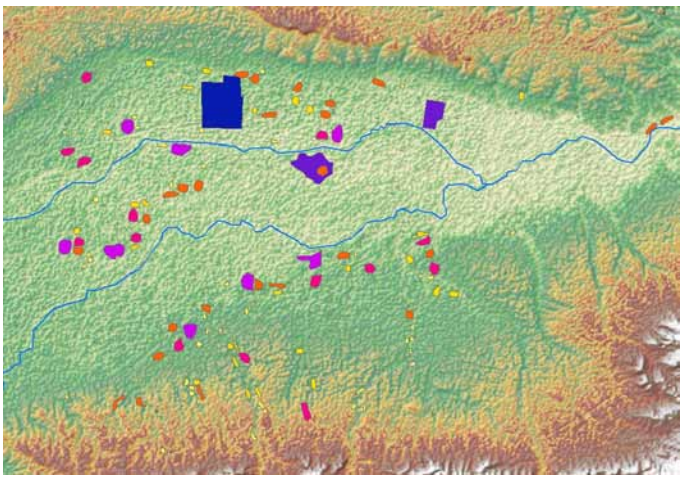

Figure 4: The map of site in different periods in Luoyang Basin

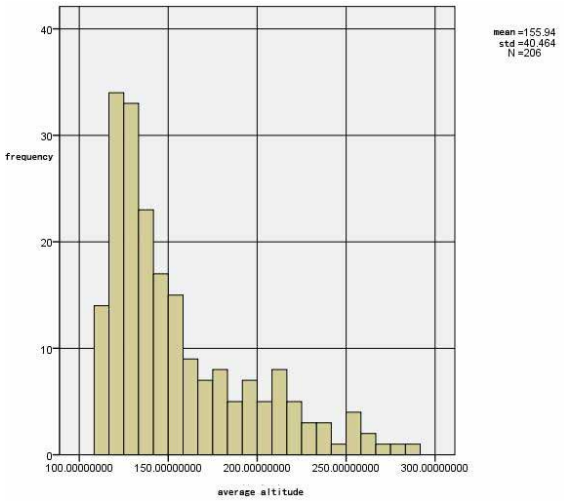

Figure 5: The histogram of sites' average altitude in Luoyang basin

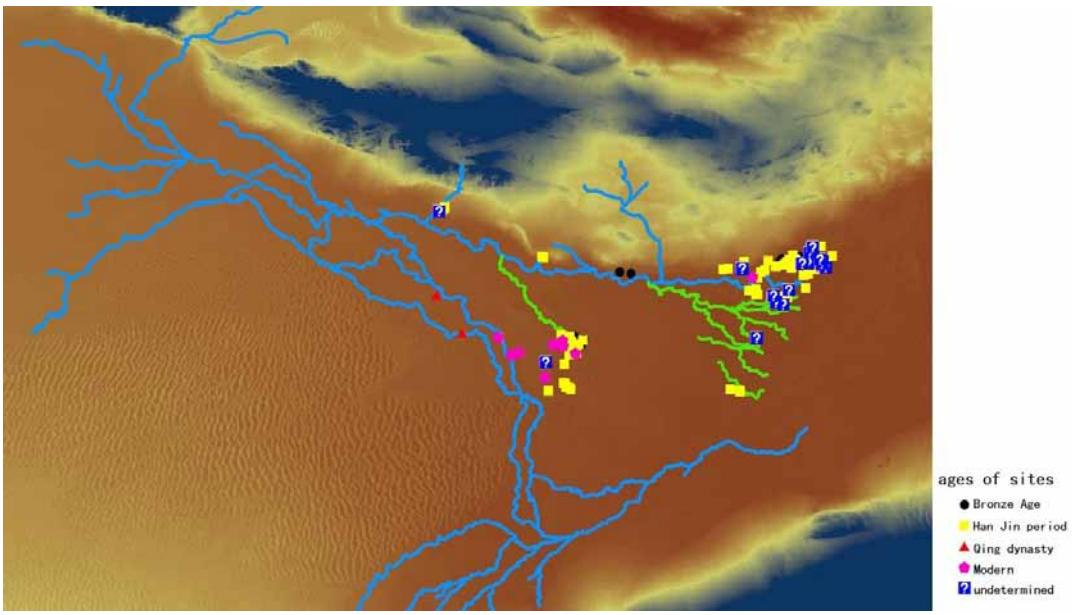

Figure 6: The interpretive charts of water networks in Tarim basin

The study found that the sites followed river tributaries. The less the basin, the less settlements are. The basin with bigger areas can accumulate the rainfall and suit the development of settlements. So, there always are many great large and medium-sized settlements in the downstream of big basin.

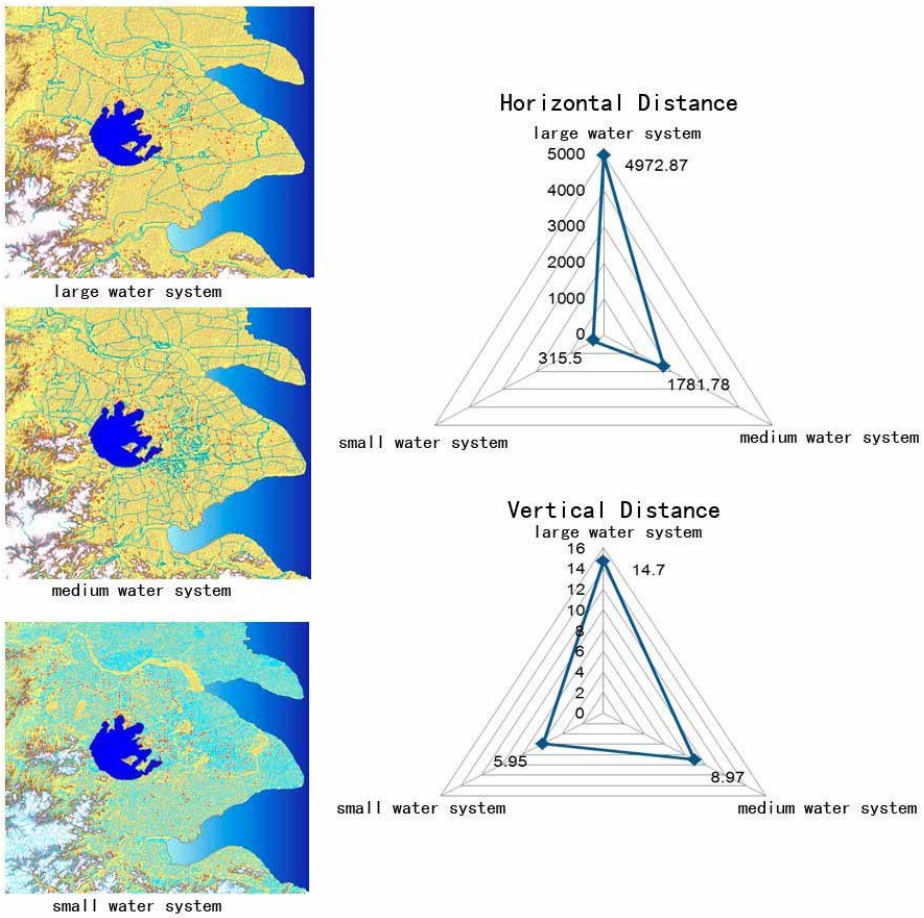

Figure 7 River restriction to the historical sites

2.2 PREDICTIVE MODEL

It is vital to know the special nature and humanity environment, which played different roles in different sites (Yan Wenming,1997;Tang Zhuowei,2004). According to these features analyzed above, the predictive model was build according to the logistic regression analysis.

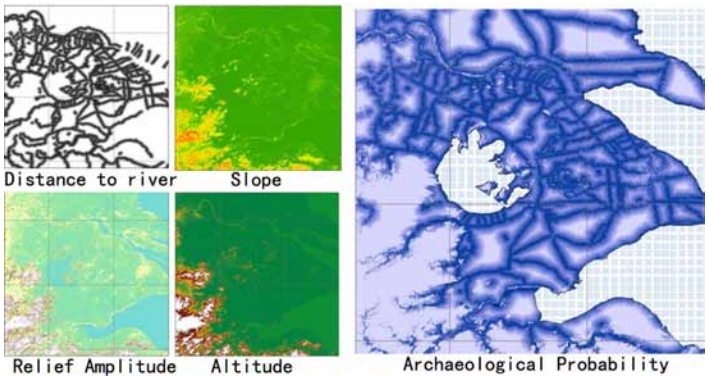

Figure 8: The predictive model

3. WEAK INFORMATION EXTRACTION

The sites were collectively impacted by nature, human activity and environment. Different burial objects can lead to different vegetation and soil, which can be reflected in the spectral data and can be detected in the remote sensing images. In general， the shadow, soil, vegetation, flood, frost and snow marks can be used to interpret images. They can reflect the range of human activity and provide clues about the production activities and daily actions. Different methods should be employed in different sites information extraction.

3.1 DATA FUSION

With the development of remote sensing technology, it is important to make good use of the available multi-source data. Data fusion can take advantage of the multi-source data and provide a basis for the recognition, extraction and monitor. The paper selected the old aerial photographs, ETM+, SPOT5 and WORLDVIEW2 to do the data fusion experiments. The multi-spectral and panchromatic image fusion is discussed in Taosi sites using the PCA, Brovey, HIS, HPF and Wavelet analysis methods. According to the visual effect and statistical evaluation, the HIS and Wavelet methods are effective with relatively high precision.

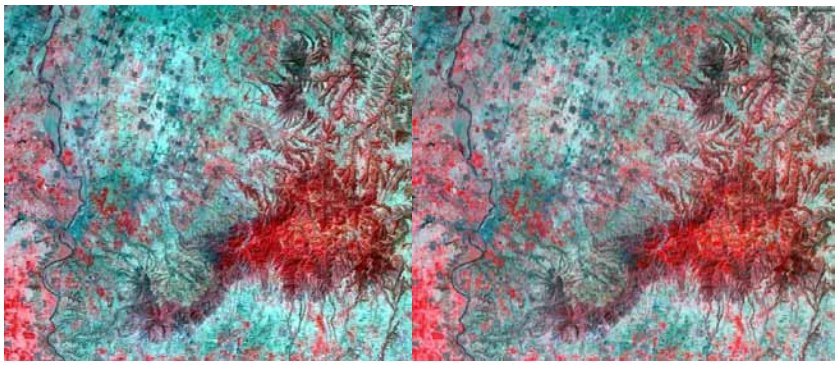

Figure 9: HIS and WAVELET Analysis (ETM+ multi-spectral and panchromatic image)

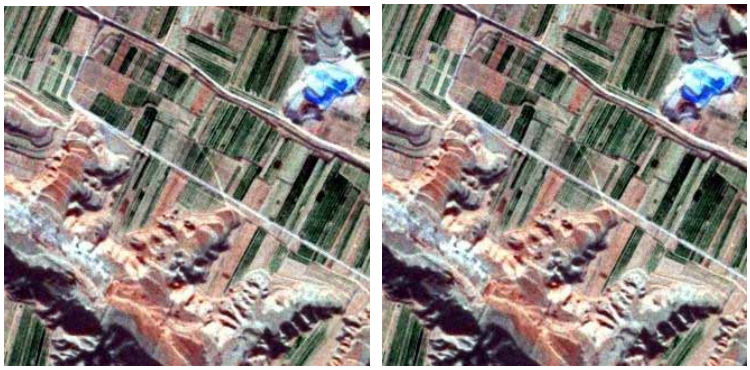

Figure 10: Pansharp and Gram-Schmidt (old aerial photography and Worldview2)

3.2 ANOMALY DETECTION OF THERMAL INFRARED RADIATION

Because of the fact that the sites cannot be found on the ground and the moist and compact soil environment in Erlitou, the thermal infrared image can play the full role in the detection of ancient wall (China's State Administration of Cultural Heritage, 1991; Li Jiuchang, 2007). The paper analyzed the soil distribution and physical feature in Luoyang basin, used the mono window algorithm and split window algorithm to invert land surface temperature with ETM+, HJ, Aster and MODIS. LST and NDVI were integrated to reflect the soil water content effectively.

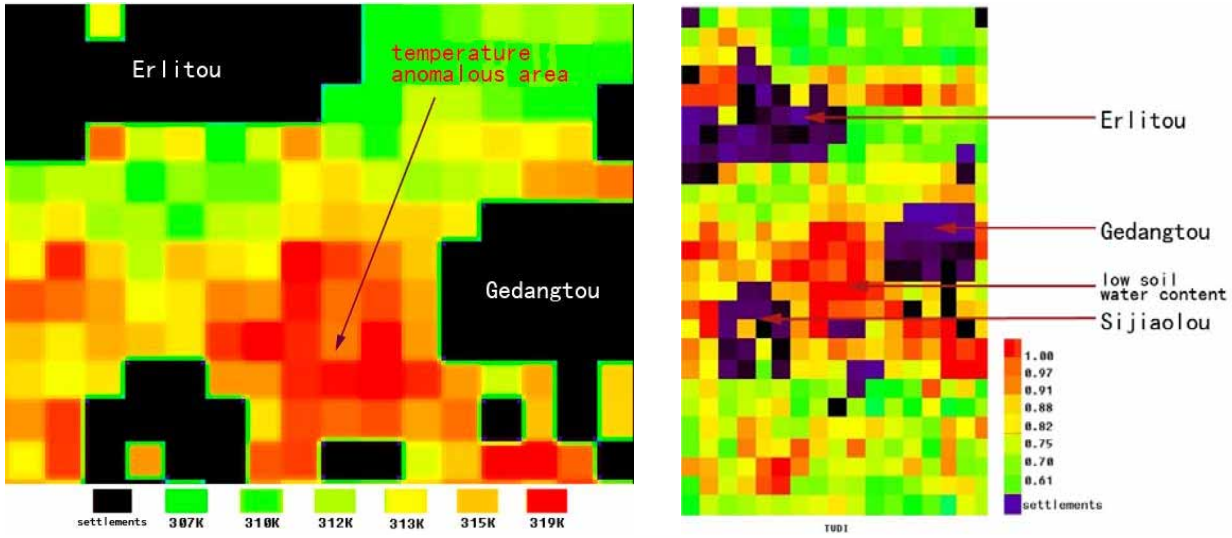

Figure 11: LST map processed by Gaussian low-pass filter; TVDI map of Erlitou sites

It can be seen from the left graph of Figure 11 that TVDI around the Erlitou, Gedangtou and Sijiaolou is bigger, meaning the lower soil water content and that place is just the exact area of great palace of Erlitou. The LST and NDVI method were proven to work.

4. CONCLUSIONS

Aiming at the requirement of tracing source project, the paper demonstrates that the application of spatial technology is useful from the aspect of detection of sites and spatial pattern. The researches on geometrical features, information fusion and detection of spatial information were carried out systematically and comprehensively; a spatial information database of remote sensing archaeology was established laying a solid foundation for ancient environment recovery; the thermal infrared research provided new ways of detecting the sites and archaeological research.

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