Geoscience and Remote Sensing (2020) Vol. 3: 9-16
Clausius Scientific Press, Canada
DOI: 10.23977/geors.2020.030102
ISSN 2523-2592

Evaluation of soil erosion in hilly gully area of the Loess Plateau based on remote sensing survey and RUSLE model

Hui Kong[1, 2, 3, 4]

[1]*Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an 710075, China*

[2]*Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an 710021, China*

[3]*Key Laboratory of Degraded and Unused Land Consolidation Engineering, the Ministry of Land and Resources, Xi'an 710021, China*

[4]*Shaanxi Provincial Land Consolidation Engineering Technology Research Center, Xi'an 710021, China*

Keywords: Remote sensing, RUSLE, Hilly gully region, Soil erosion

Abstract: Based on the model to quantify the small watershed soil erosion condition, for the loess plateau watershed ecosystem management and regulation of service to provide the basis, with the help of ArcGIS and ENVI platform, using the DEM data to extract the sheepfold ditch basin boundary, and quantify the rainfall erosion force respectively R factor, soil resistance to erosion of K factor, terrain, S L factor, vegetation factor, soil and water conservation measures P factor C, etc., based on the revised universal soil loss equation A RUSLE model to calculate the amount of soil erosion, soil erosion of small watershed of the sheepfold quantitative grading and spatial distribution of the statistics, drawing thematic maps.The specific conclusions are as follows: (1) the soil erosion area of the whole study area accounts for 36.33% of the total area; (2) Pattern quantitative classification standard, the size of erosion distribution areas at all levels is mild & GT;Moderate & gt;Very strong & gt;Strong & gt;Severe; (3) According to the status of land use and vegetation cover, the strong erosion is mostly distributed in farmland cultivation areas, while the vegetation is sparse. The weak erosion is distributed in forests, grasslands and other areas with dense vegetation. (4) From the perspective of spatial distribution, the amount of erosion in the southwest of the basin is greater than that in the northeast, and there is still severe erosion in the southwest.

1. Introduction

As one of the biggest ecological environmental problems in the world, soil erosion not only causes land quality degradation and reduces agricultural productivity, but also causes many environmental problems such as sediment deposition in water system, eutrophication of water body and decline of regional biodiversity.As a large country of population and agriculture, China is also one of the countries with the most serious soil and water loss in the world, which is characterized by a wide range of soil and water loss, a large amount of soil loss and a very severe intensity of soil erosion.Traditional survey methods are not effective, especially in large area scale, it is difficult to determine the dynamic changes of soil erosion.With the development of computer technology, information technology, remote sensing and geographic information system technology, it is an inevitable trend to apply RS and GIS technology to soil erosion investigation, evaluation and monitoring.The rapid development of RS and GIS makes the quantitative evaluation and monitoring of regional soil erosion possible.Organic combination of RS and GIS and soil erosion, soil investigation, evaluation and monitoring, can not only deepen the development of the theory of soil erosion and improve the accuracy of investigation, evaluation and monitoring of soil erosion, more rapid, accurate, real-time acquisition and processing spatial information and simulate the geographical advantage of the process, makes the soil and water loss evaluation more efficient.The results and conclusions of the correlation study between topographic factors and regional soil erosion based on GIS and RS technologies will provide scientific data reference and thematic reference for the implementation of land engineering.For the land problems caused by natural factors, it can provide a better basis for restoration and remediation.

In this paper, soil erosion amount of A, rainfall erosion force of R, soil erosion resistance of K, topographic factors of LS (slope length, slope), vegetation cover factor of C and other factors related to soil erosion were extracted and calculated.This paper probes into the influence of vegetation cover change on soil erosion, discusses the application of soil erosion evaluation model and GIS in soil erosion evaluation, and provides reference for soil erosion related research in small watershed of hilly and gully region on loess Plateau.At the same time, the research results can directly provide a scientific basis for the Yellow River basin governance and further rational use of land resources, so it is also of practical significance.In the long run, the soil erosion on regional and global environmental benefits, the evaluation is objective, systematic, combined with the soil and water resources utilization, put forward targeted prevention and control of soil erosion of strategic plan and the technical way, build a benign ecological environment system, to achieve healthy development of the national ecological safety, economy, promote the discipline of soil and water conservation science and technology research and development of far-reaching significance.

2. Overview of the research area and technical route

2.1 Introduction to the research area

The Yangguanggou Watershed research area (109°31 '-109°71', 36°42 '-36°82') is located in the jurisdiction area of Liqu Town, Baota District, Yan 'an. It is located in the typical gully region of loess hills in northern Shaanxi, and belongs to the first-level tributary of Niangzhuanggou watershed. The second-level branch gully on the left bank of Yanhe river is a typical example of small watershed synthesis, as shown in Figure 1.

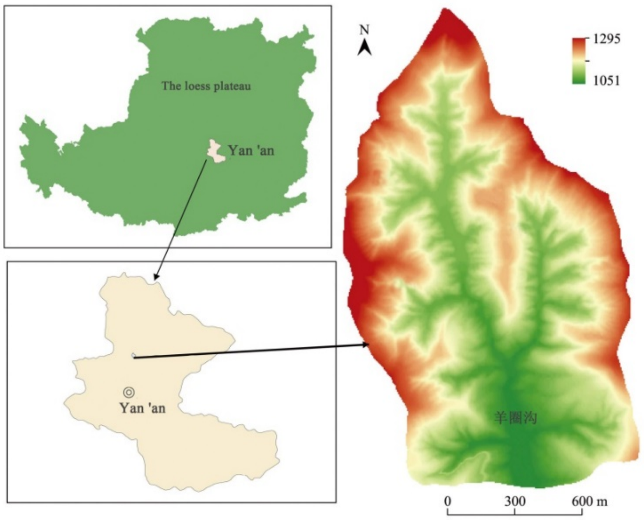


Figure. 1 Location map of Yangchanggou Watershed

2.2 Introduction to data source

Table 1 Introduction to data sources table

ID	Data	Precision	Use	Source
1	GDEM-DEM	30m	Determination of watershed boundary	Geospatial data clouds
2	STRM-DEM	90 m	Extract slope length factors L and S	Geospatial data clouds
3	NDVI	500 m	Calculate the vegetation cover factor C	MODIS image
4	Land use classification	30m/ vector	Determine soil and water conservation measures factor P	OLI and TIRS images
5	Meteorological station data	Annual and monthly rainfall	Calculate rainfall erosion factor R	China Meteorological Data Network
6	Soil texture distribution data	500 m	Calculate soil erodibility factor K	World Soil Database

2.3 Technical Roadmap

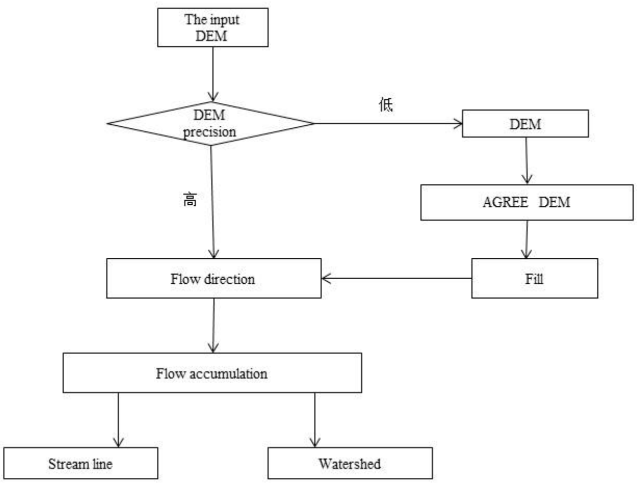
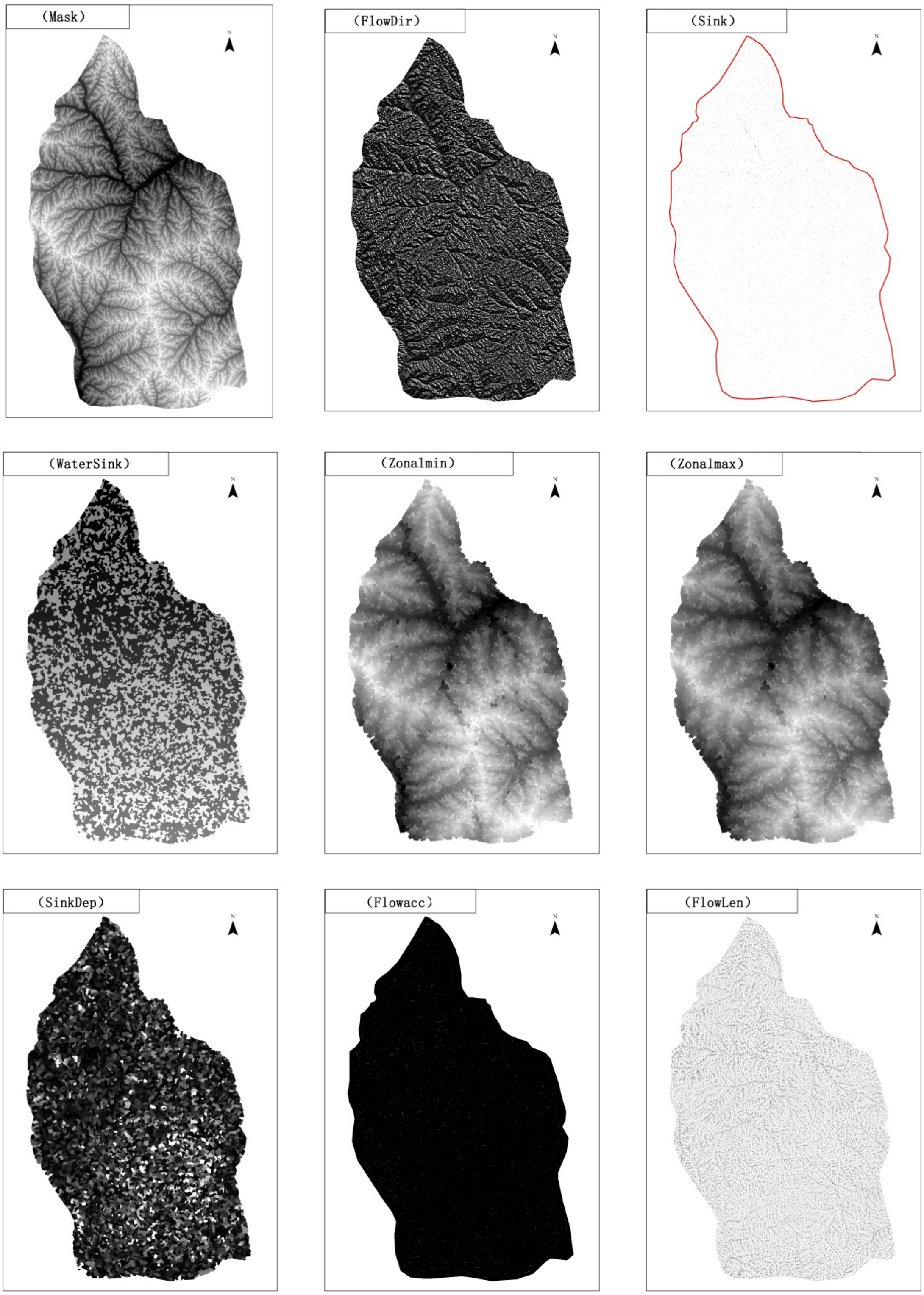


Figure. 2 Technical roadmap for watershed boundary determination

3. The experimental results

3.1 Extraction of the yangyanggou watershed boundary

Watershed and boundary determined according to calculations of Hydrology modules and DEM, as shown in Figure 3:



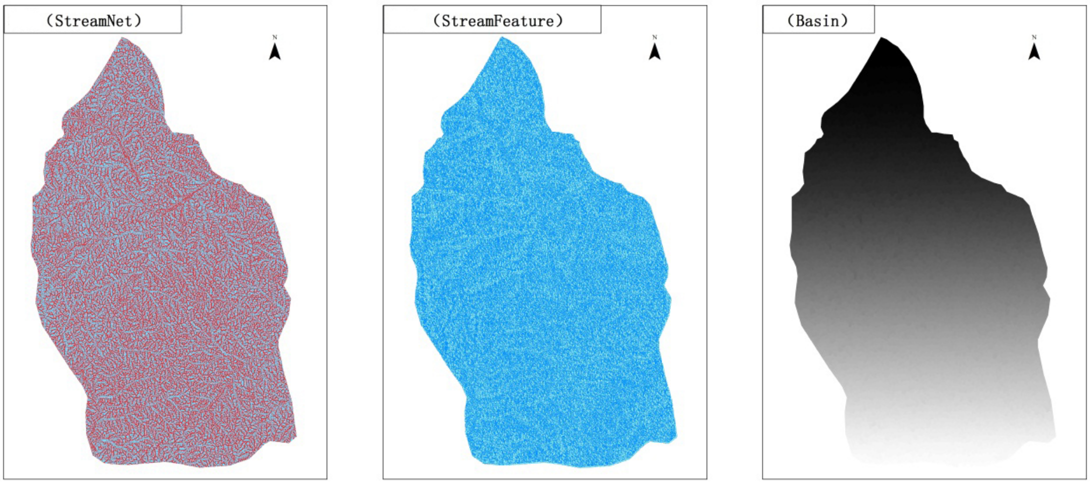


Figure. 3 Process and results of watershed boundary calculation

3.2 Interpretation of land use types and Soil and water conservation measures P factor

According to the quantified values of P factor in the above table, the land use classification status was interpreted by remote sensing image, and the classified data under different land use types were assigned by ArcGIS raster calculator to obtain the quantified results and spatial distribution characteristics of P factor, as shown in FIG. 4.

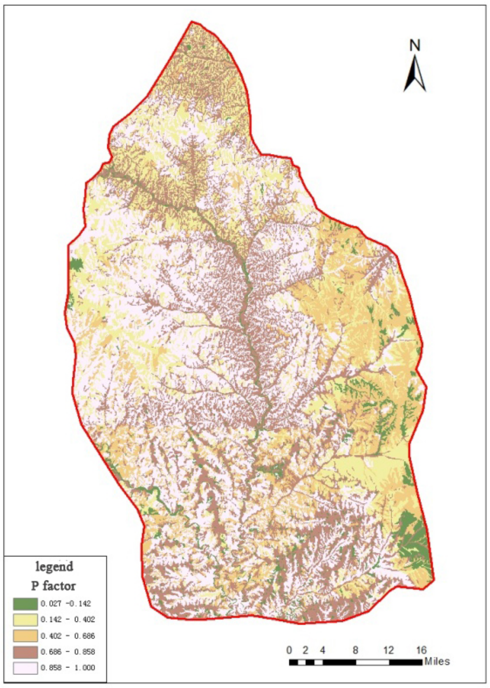


Figure. 4 Quantization diagram of P-factor under land use classification

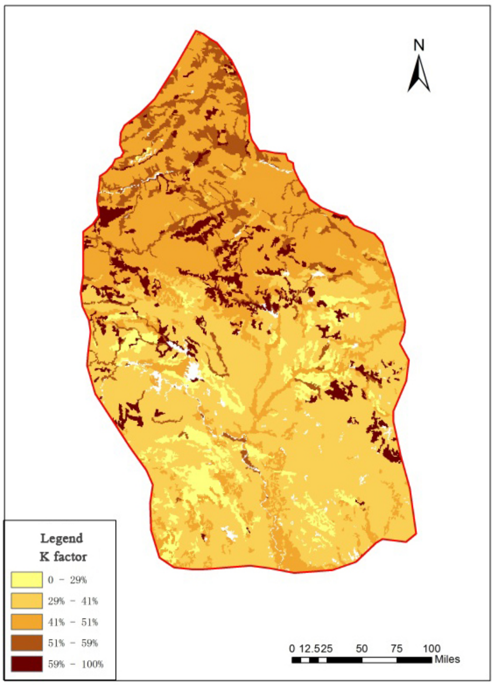


Figure. 5 Quantification diagram of soil erodibility K factor

3.3 Calculation of soil erodibility K factor

The value of soil erodibility K factor was calculated by grid computer according to the quantitative values of each particle composition and organic matter, as shown in FIG. 5.

3.4 Calculate the topographic slope S and slope length L factors

Finally, the slope data graph of raster is rendered according to the grading standard with layered colors, as shown in FIG. 6. The slope length is calculated according to Formula, as shown in FIG. 7:

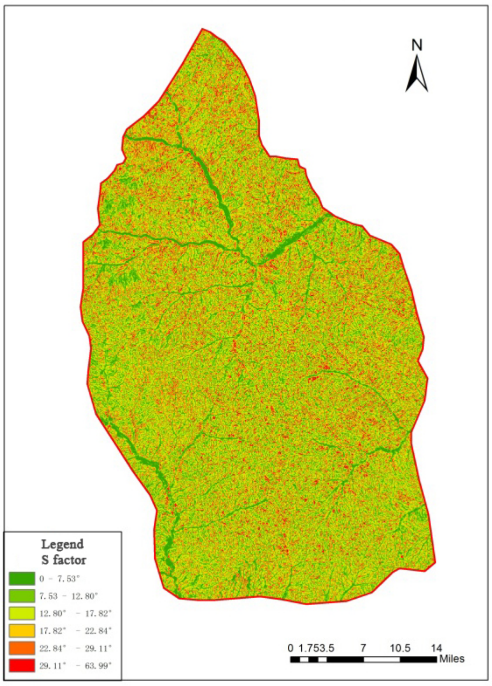


Figure. 6 Quantization diagram of Slope S factor

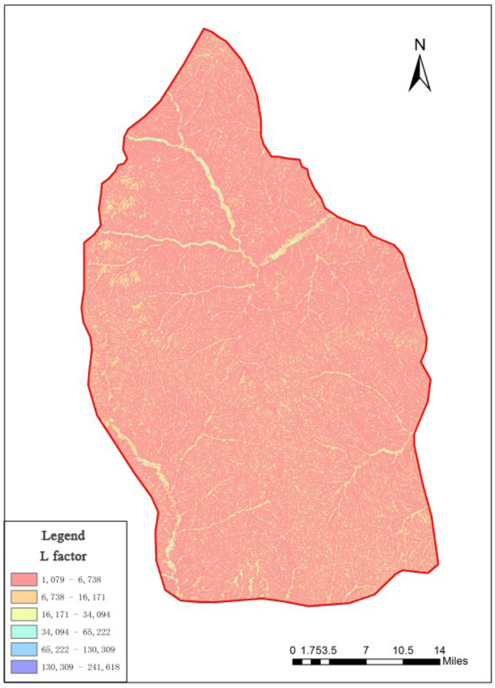
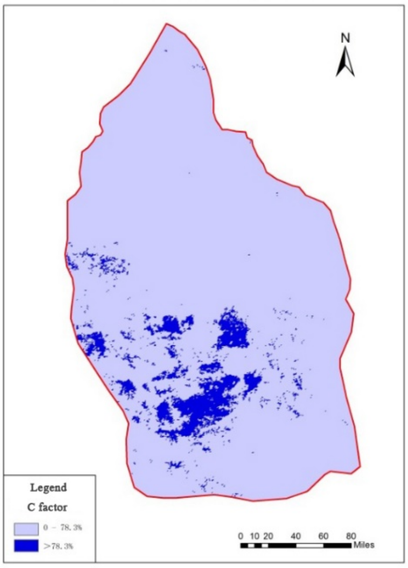


Figure. 7 Quantization diagram of slope length L factor

3.5 Calculate the C factor of vegetation cover

The quantized spatial distribution of C factor is shown in Figure 8:



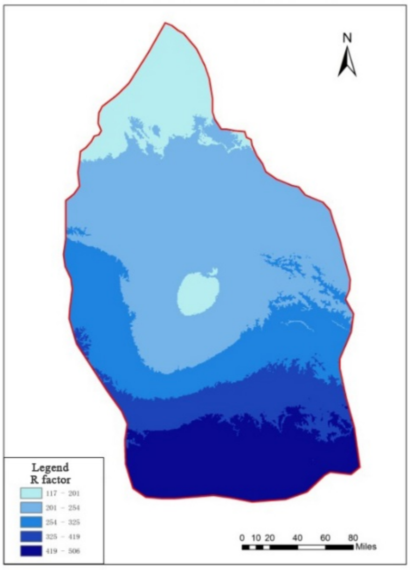


Figure. 8 Quantification diagram of Vegetation cover C factor

Figure. 9 Quantification diagram of precipitation erosion factor R

3.6 R factor of rainfall erosion

According to the spatial interpolation distribution of annual and monthly precipitation in Shaanxi Province, combined with formula, the daily rainfall model calculated the results, as shown in Figure 9:

3.7 Model RUSLE Model Calculated soil erosion A

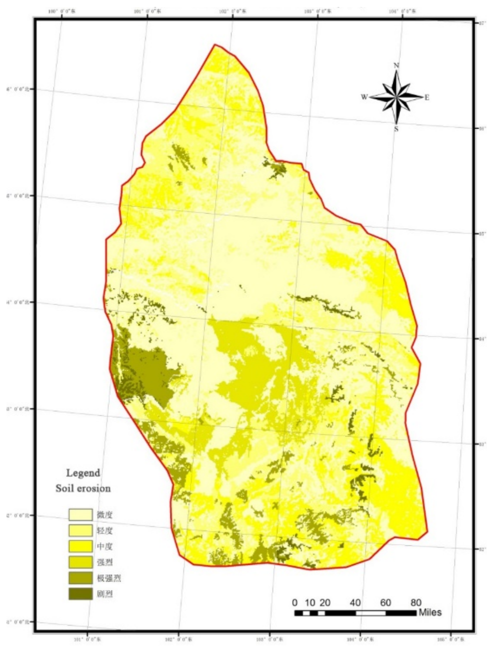


Figure. 10 Soil erosion distribution of Yangyanggou Watershed

4. Conclusion the analysis

(1) the core of this project is by using the revised universal soil loss equation (RUSLE) model parameters are calculated and the quantitative results of different factor, and the commonly used soil loss equation (UCLE) model than the C factor (vegetation cover) and P factors (land management and soil and water conservation measures), the P factor is usually hard to determine, by experience or half experience formula calculation, this for the accuracy of the model parameters to be fastidious, since in future research, the theory of how to determine the P factor formula under different erosion types and soil and water conservation measures and dimensionless value is an important direction;

(2) different model calculation factor based on different types of spatial data acquisition, the space in the same tense under the same image has a very good guarantee, but in fixed space distribution under the different image scale and lateral temporal compared to two aspects of the research is not enough in-depth, this also is the direction of the follow-up studies need to be further expanded.

(3) The research of this project is based on faster and broader acquisition of monitoring results by information means, but how to ensure the accuracy and reliability of the obtained results by various technical means needs further study and verification.

Acknowledgements

Thanks for Research on loess Landslide prediction and early warning based on GeoStudio model and vegetation characteristics (2019JQ-945) and Research on Quick Calculation of Earthwork in Land Consolidation Based on Digital Elevation Model Data (DJNY2019-29).

References

[1] Gong Shuyu. Scale soil erosion evaluation in the middle Reaches of the Yellow River basin [D]. Chang 'an University, 2016.

[2] Meusburger K, Konz N, Schaub M, et al. Soil erosion modelled with USLE and PESERA using QuickBird derived vegetation parameters in an alpine catchment [J]. International Journal of Applied Earth Observation and Geoinformation, 2010, 12 (3): 208-215.

[3] Qin Zhijia. Comparative Study of Soil erosion in Guizhou Province based on remote sensing Survey and RUSLE Model [D].Guizhou Normal University, 2017.

[4] Liu Zhihong, Mcvicar R, LingTao, et al.Spatial interpolation of meteorological elements in time series based on ANUSPLIN [J]. Journal of Northwest A&F University: Natural Science, 2008, 36 (10): 227-234.

[5] Wang Xiaofeng, Xiao Feiyan, Yin Lising, et al. Evaluation of soil erosion at different watershed scales in the middle Reaches of the Yellow River [J]. Journal of Anhui Agricultural University, 2017, 44 (6): 1070-1077.

[6] Zhang Xiwang, Zhou Yuemin, LI Xiaosong, YUAN Chao, Yan Nana, Wu Bingfang. (In Chinese)Research Progress of remote sensing for soil erosion Assessment [J]. Soil Bulletin, 2010, 04: 1010-1017.

[7] Wang chao.Research on soil erosion Evaluation in Weihe River Basin based on RS/GIS [D]. Northwest University, 2010.

[8] The data is from the International Scientific Data Mirror website (http://www.gscloud.cn) of The Computer Network Information Center of the Chinese Academy of Sciences.

[9] The data are from the Data Center for Resources and Environmental Sciences, Chinese Academy of Sciences (http://www.resdc.cn).

[10] Data from heihe planning data management center (http://westdc.westgis.ac.cn).