Investigate research of Soil Erosion base on Ikonos and Landsat images in Jinning

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Abstract

By use of " the satellite data of IKONOS in 2007 in Jinning County in 2007 ,and to take the census of the soil erosion and make a contrastive analysis with the data of the beginning of 1996 and 2002 which was conducted at that period on soil erosion, objectively evaluate the results of soil erosion, in order to make the further study and exploration of the new "3s " technique in the field of soil and water conservation.

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1. Introduction

The soil erosion and its causes the land degradation is one which of substantial clauses the ecological environment worsens\cite{1}. The small basin is the most elemental area which the soil erosion occurs and develops, to the small basin soil erosion quantity's quota forecast that the appraisal is works out the conservation of water and soil plan, the determination government plan, the method and the measure foundation\cite{2,3}. The local economy obtains the rapidly expand along with western big development each measure's gradual realization, the land utilization presents the dynamic change process, carries on the land utilization and the land cover investigation using the remote sensing technique has, fast, the present

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objectively strong and so on characteristics, compares with the traditional investigation method has the expense to be low, the speed is quick, the precision is high, cycle short and so on superiority[4]. GIS and the remote sensing unify the distributional method as a result of using the raster data analysis function, may calculate each grid the soil erosion quantity, is advantageous for the superintendent to discover the more serious soil erosion area, thus proposes the best management measure target-oriented; Can carry on the effective management and the synthesis computation using GIS to soil erosion each factor.

In 1998 the State Council will authorize the Yangtze River upstream to list as the nation conservation of water and soil key prevention area, and started “Changzhi” in 1989 the project, Jinning and so on 29 counties is listed as successively “Changzhi” the project key government area, symbolizes the county-wide formalization government soil erosion work start.

2. Technical route

2.1. Radiation adjustment

This research uses the Landsat satellite phantom was on December 16, 1996, multi-spectrum resolution 30m; The IKONOS satellite phantom receive date respectively was on December 14, 2002, on December 18, 2007, the image became by the panchromatic 1 m resolution and the colored 4 m resolution's image fusion.

Whether does the remote sensing data obtain the widespread effective application not only to be decided by the satellite sensor's design and the performance, is also decided by its observation data quantitative level, namely by primary data product inversion geophysics parameter level, because explains the remote sensing data to need correctly, in the satellite load obtains the observation quantity and between the real observation's Earth physical quantity establishes the corresponding relationships[5].

What the radiation adjustment refers to is establishes the satellite load the value of exports and corresponding known, between the incident ray radiation which expressed with international system of unit system (SI) quota relations a series of operations. Carries on the goal which the radiation adjusts is establishes a sensor each survey Yuan output the digital signal and between this detector input radiation luminance value stoichiometric relation.

Radiation adjustment model use:

\[
\alpha_x \exp(-\alpha_x(t - 1984.2)) + \alpha_z + \alpha_z(t - 1984.2)
\]

(1)

2.2. Image space coordinate and WGS-84 coordinates system's transformation

The Ikonos image's coordinate datum is WGS 184, it provides the rational polynomial transformation is[6]:

\[
F_x = x = \frac{\sum_{i=1}^{20} \text{LINE} - \text{NUM} - \text{COEF}, \cdot \rho, (B, L, H)}{\sum_{i=1}^{20} \text{LINE} - \text{DEN} - \text{COEF}, \cdot \rho, (B, L, H)}
\]

\[
F_y = y = \frac{\sum_{i=1}^{20} \text{SAMP} - \text{NUM} - \text{COEF}, \cdot \rho, (B, L, H)}{\sum_{i=1}^{20} \text{SAMP} - \text{DEN} - \text{COEF}, \cdot \rho, (B, L, H)}
\]

Because the formula (2) is the
nonlinear function, to solve \((B, L, H)\), the formula (2) to \(B, L, H\) takes the parital differential separately:

\[
\begin{align*}
  x' &= \frac{\partial x}{\partial B} \Delta B + \frac{\partial x}{\partial L} \Delta L + \frac{\partial x}{\partial H} \Delta H + x_o \\
  y' &= \frac{\partial y}{\partial B} \Delta B + \frac{\partial y}{\partial L} \Delta L + \frac{\partial y}{\partial H} \Delta H + y_o
\end{align*}
\]

(3)

The formula (3) might write:

\[
V = BX - L, \quad P = I
\]

(4)

The formula (4) composition normal equation, the iterative solution correction counts \(AB, DL, DH\), until is smaller than a small quantity. Solves \((B, L, H)\) needs to gauge two scenery Ikonos satellite imagery at least the image point coordinate of the same name.

2.3. WGS-84 coordinates system and place coordinates system's transformation

The satellite survey's datum is WGS 184, but the different country and the area usually use own geodetic survey datum. In China, 1954 Beijing coordinate systems use the carat Suofusi base ellipsoid, 1980 national coordinate systems used in 1975 the international geodetic survey the ellipsoid which recommended with the geophysics federation. In order to satisfy the practical request, the WGS 184 coordinates must transform to the area coordinates system.

Transformation between coordinates system's uses cloth sha the formula to carry on the conversion:

\[
\begin{bmatrix}
dL \\
 dB \\
 dH
\end{bmatrix} = A \begin{bmatrix}
X_o \\
 Y_o \\
 Z_o
\end{bmatrix} + B \begin{bmatrix}
\epsilon_x \\
\epsilon_y \\
\epsilon_z
\end{bmatrix} + CK + D \begin{bmatrix}
da \\
d \alpha
\end{bmatrix}
\]

(5)

In transforms after the corresponding coordinates system, may according to certain projection, like Gauss a gram Lu standard projection, transform to the place coordinates. In the altitude area, to satisfy the engineering design and the construction need, but must further transform to measured that the area redeems on the project surface.

2.4. Technical route

According to "Nation Soil erosion Remote sensing Investigation Technical schedule", strictly according to "Work Program" the request, chooses ETM and the IKONOS phantom takes the remote sensing information source, the union land utilization present situation chart, the topographic diagram, and refers to other with the soil erosion related material and the graphic document, the analysis soil erosion type, the ground line gradient, the vegetation degree of coverage, the surface composition material condition, using the software, adopts the man-machine interaction the interpret method, outlines the soil erosion chart spot directly on the microcomputer screen, passes through the generalized analysis determination soil erosion intensity.
2.5. The interpretation symbolized

Before carrying on the remote sensing phantom interpretation, first according to reflection soil erosion information video information characteristic - tone, texture, graph. Phantoms and so on landform spot, relevance carry on the analysis, with soil erosion related various factors which and the phantom comparison grasps compares, in the different tone, the texture and the pattern region decides certain spots respectively, takes down its coordinate. Based on this, by the notebook, GPS, the digital camera and the compass takes the tool, locates with GPS, the digital camera photograph, the scene determination land utilization present situation and the soil erosion intensity rank, carries out the field operation. If selects the spot is unable in the field operation process the objective cause to arrive on the spot, compares the phantom nearby again point sort in the notebook, establishes the remote sensing investigation interpretation symbol.

3. Survey result

3.1. Soil erosion survey result

County-wide soil erosion total area 494.00km, accounts for the total acreage 40.18%. Mainly distributes in Kunyang Town (48.86km²), Jincheng Town (84.69km²), valuable peak town (62.56km²), Erjie towns (65.34km²), setting sun town (65.72km²), Shuanghe Town (61.59km²), on garlic township (52.19km²), six Jie Town (40.87km²) and new Jie Town (12.17km²).

3.2. Soil erosion dynamic change characteristic and reason analysis

(1) the soil erosion total area and the mild corroded area reduces. since 1999, our province Water conservancy department positive development “Changzhi” the project, “the bead has governed” the project, the national debt conservation of water and soil project, the country ecological environment construction priority project, the provincial level conservation of water and soil key government project, the forestry department to develop “the day to guarantee” in the project as well as the province the regional spontaneous development government work progresses smoothly, achieves remarkable success, in addition each government project in line with the principle development government which starts with the easy and then does the difficult, governs the region mainly to concentrate in the mild corrosion area, therefore this
investigation's achievement displays the county-wide soil erosion total area and the mild corroded area reduces.

(2) the deep erosion area increases. Jinning County is a mineral resource, the hydro energy fruitful in resources the county, simultaneously is also an infrastructure relatively quite backward county, to promote the provincial economy development, in recent years Jinning County developed local vigorously the mineral resource and the hydro-energy resources, simultaneously infrastructural facilities and so on transportation, urban construction also vigorously developed, although all levels of surveillance Law-enforcing departments strengthened the surveillance law enforcement dynamics vigorously, but these development items of basic construction will inevitably form the massive high strength soil erosion region in the construction process.

4. Conclusion

Using IKONOS and the Landsat satellite phantom data, carries on the present situation investigation to the soil erosion. Not only has made up the artificial statistical data insufficiency, moreover the speed is quick, the efficiency is high. . Looking from the technical angle, uses IKONOS and the Landsat satellite phantom data can respond objectively the small basin the soil erosion situation, may for the small basin conservation of water and soil comprehensive program of public order achievement investigation and the small basin comprehensive program of public order plan, the design and the approval provides the more scientific technical support.

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References

[1] Zhihua Shi, Chongfa Cai, Shuwen Ding, and so on, studies based on GIS and the RUSLE small basin farmland conservation of water and soil plan[J], the agricultural engineering journal, 2002,18(4), p.172-175

[2] Tianshu Xu, Shikui Peng, Cai Yue, Study on small basin soil erosion evaluation based on GIS[J], Nanjing Forestry University journal (natural sciences version), 2002, 26(4), p.43—46

[3] Jinghu Pan, Xiaofeng Dong, evaluation of phantom small basin soil erosion quantitative based on GIS and QuickBird[J], Ecology and rural environment journal, 2006.2,p.1—5

[4] Jiaqi Chen, Feng Zhang, IKONOS satellite phantom in small basin conservation of water and soil achievement investigation application[J],Conservation of water and soil notification, 2004.10,p.64-66

[5] Jun Chen,Wen Wang, Ziyang Li,An Li, LANDSAT 5 TM data radiation adjustment and geometry pointing accuracy[J], Chinese image graph journal, 2008.6,p.1094-1100

[6] Chujiang Chen,Deren Li,Qing Zhu, Research on Ikonos-2 space orientation and precision in Tibet's[J], Wuhan University journal. Information science version, 2005.9,p.782-786