QUALITY CONTROL OF POSITIONAL ACCURACY OF 1:10000 ORTHOPHOTO PRODUCTS IN THE THIRD NATIONAL LAND SURVEY

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KEY WORDS: The third national land survey, Orthophoto products, Quality control, Plane Position Accuracy, Image Edge Accuracy, Quality Assessment

ABSTRACT:

The third national land survey is based on the orthophotos products. Only by providing 1:10000 orthophoto products that meet the quality requirements can the third national land survey be carried out smoothly, and the third national land survey products can be guaranteed to be accurate and reliable. Positional accuracy as an important quality element of 1:10000 orthophoto products is a key factor affecting the quality of 1:10000 orthophoto products, and directly affects the quality of the third national land survey products.

This paper introduces the content of the positional accuracy quality inspection in the 1:10000 orthophoto products of the third national land survey.The mean square error in plane position and the image edge match are two important test entries in the quality control of positional accuracy . The paper specifically elaborates on the quality control of the above two important test entries. The quality control indexes of mean square error in plane position and the image edge match are introduced in detail, and the quality inspection method and quality evaluation method of position accuracy are proposed. And, the main quality problems found in the positional accuracy checking are illustrated by way of case analysis. At the same time, the cause analysis was carried out for these specific quality problems, and corresponding improvement suggestions were also proposed.This paper provides technical support and reference for the quality inspection of 1:10000 orthophoto products, and also has some positive effects on quality improvement.

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1. INTRODUCTION

The Third National Land Survey (hereinafter referred to as "Third-survey") is a major national strength survey based on the results of the second national land survey. By comprehensively refining and improving the national land use basic data, the state directly grasps the current national land use status and changes in land and resources, improves land survey, monitoring and statistical systems, and realizes information management and sharing of results. The implementation of the third national survey is of great significance for the implementation of stricter farmland protection systems and land-saving systems, improving the level of land and resources management, and supporting and promoting sustainable economic and social development.

The main source of data for the third national survey is orthophoto, which is an important part of the "third-survey" data. Only orthophotos that meet the quality requirements can meet the production needs. For orthophoto results, accuracy and image quality are the main issues considered in this national survey. Therefore, the positional precision quality control of orthophoto results is extremely critical.

This paper focuses on the method of plane position accuracy inspection and quality assessment in the process of orthophoto quality inspection in Third-survey.

2. POSITION ACCURACY CONTROL INDEX

The positional accuracy of 1:10000 Orthophoto Image of third-survey is mainly controlled from two aspects: plane position medium error error and image edge.

2.1 Medium Error Control Index in Plane Position

The plane geometric accuracy of Orthophoto Image generally reaches 1:10000 scale mapping requirement.The median error of the orthophoto point relative to the nearby field control point shall not exceed the value of the index specified in Table 1.

Topographic Categories	1:10000 Coverage area	Non-1:10000 Coverage Area
Flat land , Hilly land	5.0 meters	7.5 meters
Mountain, Alpine	7.5 meters	10.0 meters

Table 1. Plane Accuracy of 1:10000 Orthophoto Image

2.2 Image Edge Accuracy

After image correction, the boundary difference between different resolution, different mosaic blocks and between adjacent counties, different production units, provinces and provinces shall not exceed the value of the index specified in Table 2.

Topographic Categories	Between the county inlays	Between counties and provinces
Flat land , Hilly land	2 pixels	5.0 meters
Mountain, Alpine	4 pixels	5.0 meters

Table 2 . Edge accuracy of 1:10000 orthophoto image

3. METHOD AND QUALITY ASSESSMENT OF POSITION ACCURACY INSPECTION

The third-survey image position accuracy check mainly uses the control point results completed by the provinces and regions, the large-scale map results, the 1:10000 basic survey results, and the geographical results. Plane position accuracy detection is carried out by using a combination of data comparison and pile point method. When the control points are insufficient or there are no basic surveying and mapping results that have been checked and accepted, supplementary inspection should be carried out with the help of the field acquisition checkpoints.

3.1 Error Checking Method and Quality Assessment of Plane Position

For areas covered by 1:500, 1:1000, 1:2000, 1:5000 and other

large-scale mapping results, no less than 30 obvious geophysical points with distribution can be selected for high-precision data comparison and inspection.

Calculating the error m of plane position according to formula 1, the error value within 2 times of the allowable error (including 2 times) should participate in the mathematical accuracy statistics, and the error over 2 times of the allowable error should be regarded as gross error.

$$m = \pm\sqrt{\frac{\sum_{i=}^{n} \Delta_i}{n}} \quad \text{……Formula 1}$$

Where m—Plane position error;
n—Total number of detection points;
Δi—Difference value

Within the area covered by 1:10000 results, for those large-scale surveying and mapping results without the above, a basic surveying and mapping result can be selected, and no less than 30 distinct topographic points with uniform distribution can be selected for comparison and inspection of data with the same accuracy.

Calculating the error m of plane position according to formula 2, the error value within $2\sqrt{2}$ times of the allowable error (including $2\sqrt{2}$ times) should participate in mathematical accuracy statistics, and the error exceeding the allowable error times should be regarded as gross error.

$$m = \pm\sqrt{\frac{\sum_{i=1}^{n} \Delta_i^2}{2n}} \quad \text{……Formula 2}$$

Where m—Plane position error;
n—Total number of detection points;
Δi—Difference value

For non-1:10000 coverage area, field measurement is adopted to carry out high-precision data accuracy statistics. The error m of plane position is calculated according to formula 1. The error value within 2 times of the allowable error (including 2 times) should participate in mathematical accuracy statistics. Errors exceeding 2 times of the allowable error are regarded as gross errors.

When the proportion of gross errors is not more than 5%, the plane position quality is evaluated according to formula 3.

$$s = \begin{cases} 60 + \frac{40}{0.7 \times m_0}(m_0 - m) & : m > 0.3m_0 \\ 100 & : m \le 0.3m_0 \end{cases} \quad \text{Formula 3}$$

Where s—Score
m—Medium error in plane position
m_0—Medium error limit

3.2 Image Edge Accuracy Checking Method and Quality Assessment

（1）For the indirect edges of different resolution or different mosaic blocks in the county, manual comparison is mainly used.If there is an object dislocation, the measurement dislocation distance is beyond the required range of the indicators in Table 2.

（2）The inspection methods of manual comparison are mainly used in the adjacent counties, different production units, provinces and provinces. If there is an object dislocation, the measurement dislocation distance is beyond the requirements of Table 2.

For different resolution, indirect edges of different mosaic blocks and adjacent counties, different production units, provincial and provincial borders, manual comparison is mainly used.

Choose the boundary with longer edge, select about 20 points with obvious same name at the edge, and calculate the mean value m of the difference of edge. When the proportion of gross errors is not more than 5%, the image edge accuracy is counted according to formula 3.

3.3 Quality Assessment of Position Accuracy of Image Achievements

Compare the error of plane position and the quality score of image edge.The minimum value is taken as the final score of position accuracy.

4. MAIN PROBLEMS AND REASONS OF ACCURACY INSPECTION

4.1 Plane Position Accuracy

During the inspection, it was found that the location accuracy of individual districts and counties was low. The reasons for analysis are as follows:

(1) The original image is of poor precision;

(2) Large changes in local topography;

(3) There are fewer control points in the high mountainous areas and western desert areas;

(4) The DEM involved in the correction has a large interval and a low elevation accuracy.

4.2 Image Edge Accuracy

(1) In the edge inspection between different resolutions and different mosaic blocks, it is found that due to the resolution or the mosaic block, the image boundary of the same name is out of tolerance.

The over-limit of the boundary is mainly found in artificial objects such as roads, bridges and buildings. Due to the poor accuracy of the original image or the excessive margin caused by local topographical changes, the inlaid line can be solved by bypassing the artificial object.

(2) Due to the different production units, the edge inspection between the county and the county, the province and the province has an over-limit of the boundary of the image with the same name.

The reason for the boundary error is that the accuracy of the orthophoto image on both sides of the joint does not meet the technical requirements. On the other hand, there is no correction of the image edge difference, which results in the inadequate accuracy of the edge joint.

5. CONCLUDING REMARKS

This paper discusses the technical methods of location accuracy checking and quality evaluation in the third national land survey, analyses the causes of the problems existing in the accuracy checking of Orthophoto Image results, and puts forward suggestions for improvement, which can provide technical reference for the follow-up evaluation of position accuracy quality of 0.2m resolution Orthophoto Image results.

REFERENCES

Erxin Y , Liguo W , Aigong X , et al. Exploratory on the orthography production for the 3th national land survey——Take Jingtai County as an example[J]. Mine Surveying, 2018.

Li-Xia Z , Yan-Li C , Shuang Z . Simple Discussion the Checking of Standard Time Approval of the Geographic Conditions Census Project Digital Ortho Image[J]. Geomatics & Spatial Information Technology, 2015.

Qiu-Ying J , Ke-Xue Z , Rong Z . Method and Technique of Adjusting Color for Digital Orthophoto Map[J]. Coal Technology, 2007.

Yousong Z , Li Z , Wenjuan M , et al. Application of pile point method in production quality inspection for surveying and mapping of island[J]. Science of Surveying & Mapping, 2016.