

AN OVERVIEW OF APPLICATION AND DEVELOPMENT OF REMOTE SENSING IN COUNTRY-SCALE ECONOMIC DEVELOPMENT: CASE OF LANGFANG, HEBEI PROVINCE, CHINA

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KEY WORDS: GF series satellites, agriculture, forestry, industrialization model.

ABSTRACT: In pace of the launch of the Chinese “GF series satellites”, China is able to receive superb high-resolution remotely sensed images with high spatial, temporal, and spectral resolution. The GF series satellites data have been playing an important role in various fields related to regional economic development, such as agriculture, forestry, environmental monitoring, Urban/Rural Planning and so on. However, the applications of remote sensing at the country’s scale are still at the early-stage and difficult to popularize, due to some reasons involved data resources, technical matters, and the user’s cognition to remote sensing. In order to better serve the local economy and society using remote sensing technology, Collaborative Innovation Center of Aerospace Remote Sensing Information Processing and Application of Hebei Province (hereinafter referred to as the Center) has pioneered in applying space remote sensing technology to county-scale economic development in Langfang city, Hebei province, China since 2014. In the recent years, the Center has initially established a country-scale remote sensing service framework, developed a number of remote sensing thematic products providing information service for the Country Level Government, and applied the scientific researches to 11 countries. Next, the Center will further strengthen the cooperation with governments and enterprises, strive to form a fairly mature industrialization model to widely promote the application of remote sensing.

1. INTRODUCTION

Satellite remote sensing technology has become more and more important in key areas such as agriculture, forestry, environmental protection, land survey, disaster prevention and mitigation, urban and traffic fine management, etc. for its fastness, continuity, wide coverage and large information. Ground observation satellites have gradually become national basic and strategic resources. In recent years, with the steady implementation of the major national high-resolution projects, spatial resolution, temporal resolution, spectral resolution and high radiation resolution of satellite data has been greatly improved (Jin, 2013). Thus high-quality data are guaranteed for the country in the land, agriculture, forestry, environmental protection and other fields and there are unprecedented development opportunities for satellite remote sensing applications.

With the ongoing economic and social development of Hebei Province, the demand of all regions, corporate and the public for remote sensing image data is growing and the total annual order value of high-resolution remote sensing data reaches over 100 million yuan (Li, 2014). For a long time, satellite resources are mainly allocated to major national projects and key scientific research projects but are rarely accessible to all regions, corporate and the public,

especially the counties for economic development. To meet the increasingly urgent demand of all regions, corporate and the public for remote sensing data, Hebei Provincial Government established the Hebei Province Aerospace Remote Sensing Information Processing and Application Collaborative Innovation Center (Cheng, 2014). The Center focuses on the "1000-County Plan" and "Internet + space-based information application" (Lu, 2015) forwarded by Academician Sun Jiadong. Oriented towards regional development, it focuses on the application of satellite remote sensing technology for remote sensing applications in counties, and promotes the application of high-resolution ground observation data and industrial development by starting with the areas of agriculture, forestry, environmental protection and land resources.

2. HEBEI HIGH-RESOLUTION SATELLITE APPLICATION NEEDS AND STATUS QUO

Hebei Province covers an area of 184,700 square meters and has a population of 67.44 million people. Now it has 11 prefecture-level cities, 36 municipal districts, 22 country-scale cities, 108 counties and 6 autonomous counties. It has mountains, hills and plateaus in the northwest and vast plains in the center and southeast. Hebei borders Bohai Sea on the east, with a coastline of 487km long. It is the sole province with seashores, plains, lakes, hills and plateaus and it has rich tourism resources. The farmland of the province covers an area of 65,200 square kilometers, accounting for 34.7% of the total surface areas. It is an important grain and cotton base, with many agricultural counties; it has the forest area of 36,700 square kilometers, with the forest coverage rate reaching 17%. The heavy industry is well developed in Hebei and the air and water pollution becomes increasingly prominent in recent years with the rapid industrial development. It can be seen that Hebei Province has a huge demand for remote sensing technology in agricultural monitoring, forestry monitoring, coastal area remote sensing monitoring, land resources survey, environmental remote sensing monitoring and many other fields.

The demand of the county administrative districts for the application of remote sensing technology differs due to different industrial structure, urban development and resource distribution. It can be said that the application of remote sensing technology in Hebei Province has been gradually shifted to supporting the development of county economy, environmental management, disaster prevention and mitigation, industrial development, smart tourism resources development, government fine management, and other high-end customized services from the more popular services such as basic surveying and mapping, resource investigation and urban planning management. Therefore, to boost the development of Hebei, it is important to build the high-resolution satellite applications and service platform and develop the county remote sensing application industry, providing the government, enterprises and the public with all-weather and all-day ground observation information of high spatial, high temporal and high spectral resolution.

In June 2013, Hebei data and application center for high-resolution ground observation system was opened officially, with the piloting starting in Hebei Province to carry out the work of remote sensing applications. In December 2013, Collaborative Innovation Center of Aerospace Remote Sensing Information Processing and Application of Hebei Province was set up, and worked with the Institute of Remote Sensing and Digital Earth Chinese Academy of Sciences, China Centre For Resources Satellite Data and Application, Space Star Technology CO., LTD. and other organizations to carry out multiple satellite remote sensing applications projects (as shown in Table 1). In addition to the national and provincial projects, county remote sensing application projects are implemented regarding the agricultural monitoring, forestry monitoring, water monitoring, soil heavy metal pollution monitoring and so on to satisfy different demands of counties. These projects mainly use remote sensing, navigation and communication satellite integrated applications to enable the Beijing-Tianjin-Hebei county development. Human-computer interactive information extraction, computer automatic classification and extraction, physical mathematical model and other information extraction methods are combined to quickly tap useful information for different industries and make data analysis

and model inversion. Thus diversified and standardized remote sensing information products are provided for the county's economic developments, to meet the customization needs of all counties, while making the remote sensing technology accessible to both rural and urban areas.

Table 1 Hebei high-resolution satellite remote sensing application implementation projects

No.	Project name	Project source
1	Research on Regional Monitoring Technology of Beijing - Tianjin - Hebei Integration Based on High-resolution Data	National Defense Science and Technology Bureau
2	Application and Demonstration of Remote Sensing in Beijing - Tianjin - Hebei Counties	National Defense Science and Technology Bureau
3	Hebei Province Aerospace Remote Sensing Collaborative Innovation Center Platform	Hebei Provincial Bureau of National Defense
4	Research on Key Technology of Country-scale Information Integration Service Platform Based on High-resolution Remote Sensing Data	Hebei Science and Technology Department
5	Research on Key Technology of Distribution Inversion and Protection of Ancient Tombs Based on Remote Sensing Image	Hebei Science and Technology Department
6	Research on Multi-source Remote Sensing Data Based on Three-dimensional Spectral Exponential Feature Space for Cooperative Retrieval of Heavy Metal Pollution in Farmland in Hebei Province	Hebei Provincial Department of Education
7	Remote Sensing Monitoring and Analysis System of Agriculture and Forestry in Langfang City	Langfang City Government
8	Verification and Analysis of Remote Sensing Data of New Afforestation in Anci District	Anfang District, Langfang
9	Verification and Analysis of Remote Sensing Data of New Afforestation in Xianghe County	Xianghe County, Langfang City
10	Remote Sensing Monitoring and Demonstration Platform in Julu County	Julu County, Xingtai City
11	Remote Sensing Dynamic Monitoring System of Water in Gu'an County	Gu'an County, Langfang City

3. HIGH-RESOLUTION REMOTE SENSING APPLICATIONS IN LANGFANG, HEBEI PROVINCE

3.1 Country-scale remote sensing products

The country-scale remote sensing information products use domestic high-resolution remote sensing satellites and unmanned remote sensing images as the data source (spatial resolution up to 5cm). The remote sensing information can be extracted for dynamic monitoring and data analysis of agriculture, forestry, atmosphere, water, land and other

resources in counties, greatly enhancing scientific decision-making capacity, fine management level and efficiency of local governments, enterprises and institutions, and achieving good economic and social benefits. Now these products have been successfully applied in agriculture, forestry, land and resources survey, environmental monitoring and other fields.

In Figure 1 we can find the agricultural and forestry information products, showing the monitoring results of maize, arable land, greenhouse vegetables and forest resources. The main information includes the area and spatial distribution of crops. These special products can realize rapid investigation and dynamic monitoring of agricultural and forestry resources to help relevant departments to make timely management decisions and execute precise agriculture and forestry management.

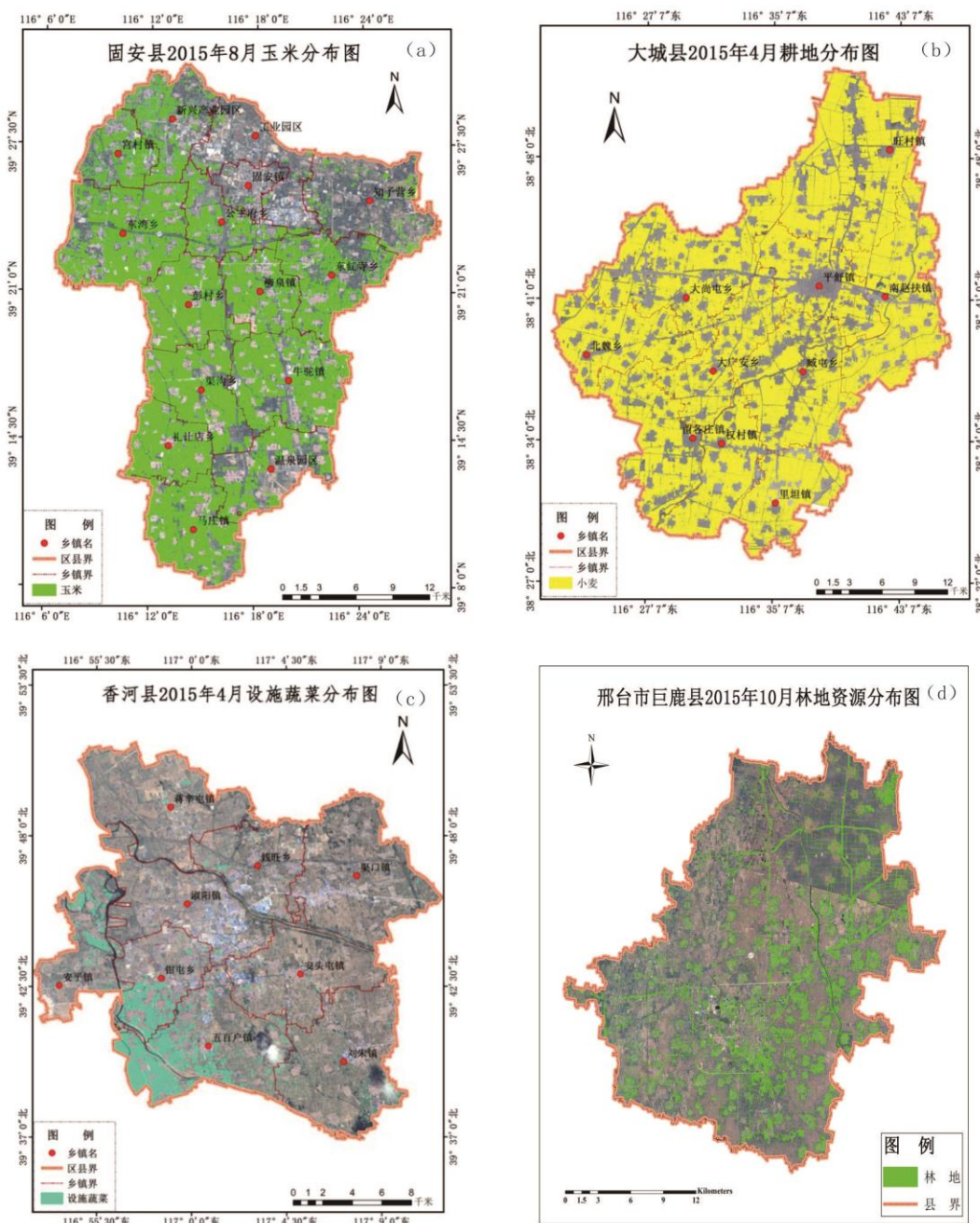


Figure 1 Remote sensing products, (a) distribution of corn in Gu'an country, (b) distribution of farmland in Dacheng country, (c) distribution of vegetable in Xianghe country, and (d) distribution of forestry in Julu country

3.2 Remote sensing monitoring and analysis platform

The platform relies on high-resolution remote sensing satellite image data and its thematic product data to provide more comprehensive county resource monitoring services, develop and deploy the agriculture and forestry remote sensing monitoring and analysis platform for agriculture and forestry resources, achieve multi-scale spatial visualization, information query statistics, chart analysis and change monitoring of monitoring results in routine monitoring of agriculture and forestry resources, fully tap the application value of remote sensing data and guarantee the real-time sharing of information for the government management and decision analysis. The main functions and interface are shown in Figure 2 - Figure 4.

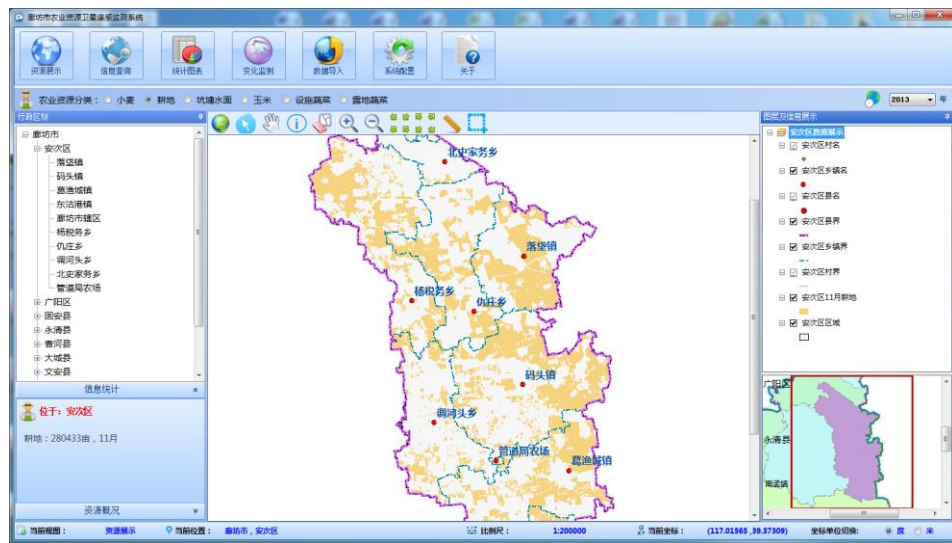


Figure 2 Remote sensing resource display interface

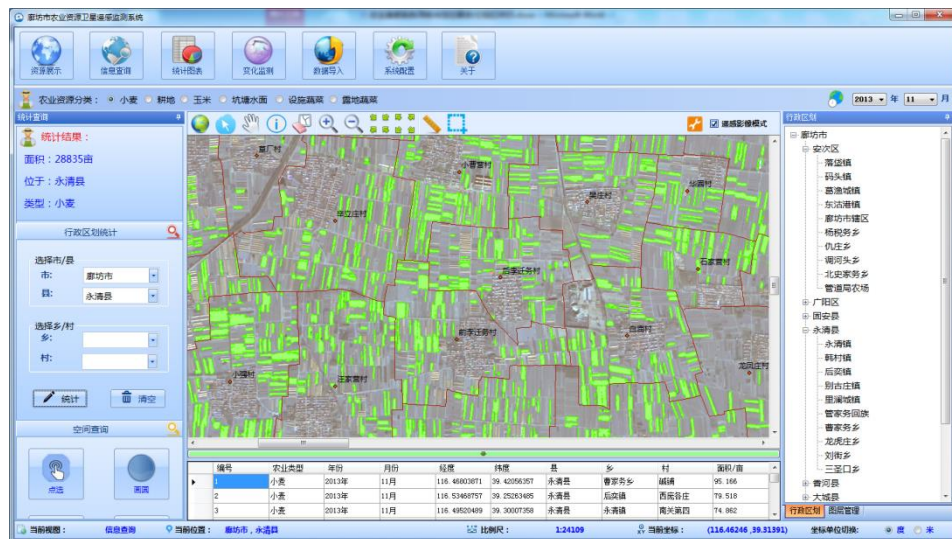


Figure 3 Remote sensing resource distribution and query interface



Figure 4 Remote sensing data chart analysis interface

3.3 Mobile inspection platform

In view of the characteristics and requirements of remote sensing field verification, Hebei Province Aerospace Remote Sensing Information Processing and Application Collaborative Innovation Center has developed a remote sensing mobile inspection platform suitable for filed verification and management. The platform includes the remote sensing map service release system, mobile terminal acquisition equipment and web management. The main functions include: (1) the Web-based remote sensing mobile inspection business management system, mainly used for the inspection business management, including new inspection tasks, inspection task management, inspector position real-time monitoring and historical file query; (2) the mobile inspection terminal, to achieve precise positioning and measurement (positioning accuracy of less than 7m), to take and upload HD pictures, have real-time access to released maps, remote sensing images and checkpoints and have illegal operation and error route alarm etc. Figure 5 shows the system interface of the system interface.

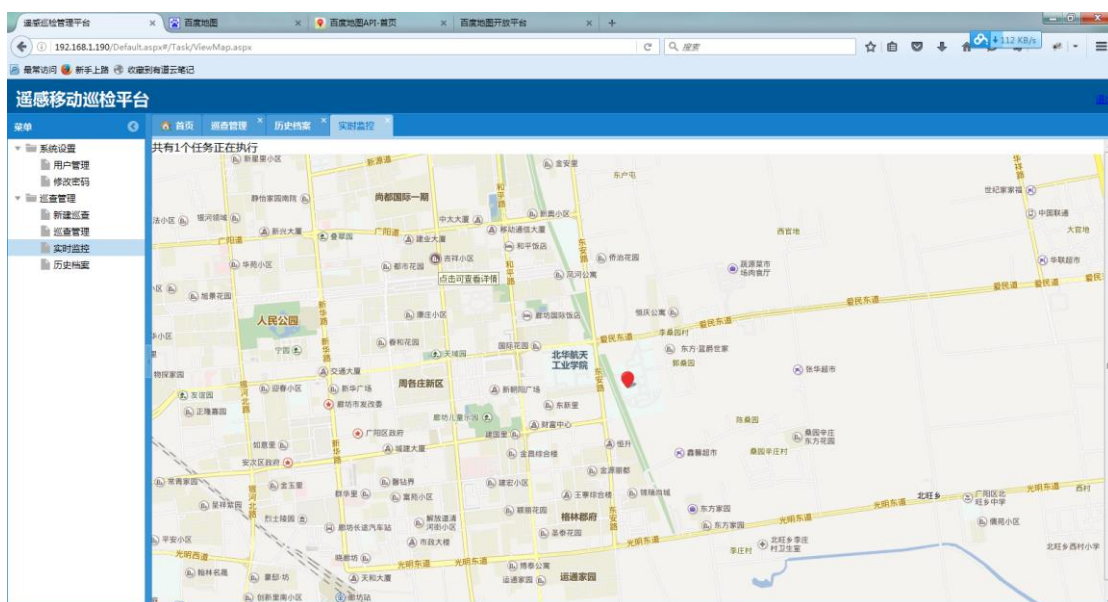


Figure 5 Remote sensing field verification inspection platform

3.4 Country-scale remote sensing integrated application service framework

A more mature service framework system has formed for high-level county remote sensing integrated application services. As shown in Figure 7, according to actual needs of the provincial, county government departments and the business sector, remote sensing monitoring of target areas is executed, customized products are made and real-time information sharing, product push and comprehensive analysis report delivery are realized by building a county high-resolution satellite integrated cloud platform. The construction of a standardized service framework speeds up the promotion of remote sensing technology and in the past 2 years, the county remote sensing application has been successfully unfolding in Langfan, Xingtai and a number of other counties (cities and districts).

4. PROSPECTS

4.1 Further enrich the domestic high-profile remote sensing data source

With the steady implementation of the major national high-resolution projects, great progress has been made in remote sensing technology. But we need to see that in the application of various industries, foreign high-resolution satellite applications are still dominant and timely domestic high-resolution data acquisition is difficult due to weather and other reasons. Difficult and low frequent remote sensing data acquisition makes it impossible to use the computer system to achieve nationwide, in-depth and long-term dynamic monitoring of urban and rural areas. Domestic remote sensing data has greatly improved in terms of spatial resolution, but there is still a gap with foreign data in terms of quality. Domestic remote sensing data resolution (sub-meter level) is generally low, making it difficult to accurately extract management objectives from the remote sensing data in the urban planning, construction and management process. Manual work is dominant but not able to help business personnel to improve the efficiency of daily work and urban management level and meanwhile the relevant technical means can't be enabled. So in the future, we need to further enrich the domestic high-resolution remote sensing data sources.

4.2 To enhance independent satellite integration applications

High-resolution remote sensing data processing is heavily dependent on foreign software. Now the vast majority of data processing software is either foreign or redeveloped. We are still lacking in the system software used for the county management services based on domestic high-resolution ground observation data processing platform and also in efficient algorithms and application models doing batch high-resolution remote sensing data processing. The existing technology and models are under-developed for business-oriented applications and the accuracy is not able to meet the business requirements. We are in dire need to transform the stable domestic high-resolution data sources to render them more professional and more business-oriented.

4.3 To enhance the industrialization of remote sensing applications

Country-scale remote sensing applications have broad market and development potentials. It is difficult to meet the growing demand for remote sensing applications if relying solely on scientific research institutions and scientific research platform to provide technical services. We should speed up the industrialization process, give full play to the role of capital market in allocation of resource, encourage competition and private capital into the satellite application industry, adopt new technologies to enhance the management level, open terminal applications, fully tap the mass consumer market and promote industrial development of the county remote sensing applications. At the same time, it is also important to enhance the degree of automation of product production and distribution, reduce the manual

intervention of information extraction and improve the automation and standardization of remote sensing products.

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