Application Test and Analysis of 2m/8m optical satellite in coastal zone survey

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Abstract. The 2-meter/8meter optical satellite (GF-1 B, C, D) constellation was successfully launched on March 31, 2018. The constellation consists of three operational satellites with the same performance and status. The design life of the satellite is 6 years; the panchromatic spatial resolution is 2m and the multispectral resolution was better than 8 m; single star imaging width is greater than 60 km. The three satellites will have a global coverage of 15 days and a revisit capacity of two days. In this paper, GF-1C satellite was used to investigate the ecological and geological environmental problems in the silty coastal zone in northern Jiangsu province, and we contrast and analysis the ability of ecological and geological environmental investigations of GF1C satellite in the coastal water boundary line, coastal type, human engineering activities and so on[1] [3].

1. Introduction

2m/8m optical satellite (GF-1 B, C, D) constellation led the main user for the department of natural resources, other users, including Ministry of Emergency Management, Ministry of Ecology and Environment, Ministry of Housing and Urban-Rural Development, Ministry of Transport, Ministry of Agriculture and Rural Affairs, National Forestry and Grassland Administration. This satellite constellation is the first civil high resolution in China. In collaboration with GF-1, it can be implemented for 11 days global coverage, 1 day revisit, and represent the highest level of civil remote sensing satellite constellation in China, and it greatly improve the mountain, water, forest, farm, lake, grass and other natural resources total factor, full coverage, all-weather real-time monitoring survey ability. It has promoted the upgrading of the means of natural resources investigation and monitoring, protection and supervision, and it can be widely used in disaster prevention and reduction, environmental protection, urban and rural construction, transportation, agriculture, rural areas, emergency management and other fields[1]. In this paper, GF-1C satellite was selected as the data source to investigate the coastal zone and other ecological geological environments in Lianyungang Area, Jiangsu province, in order to analyze the application ability of GF-1C satellite in the ecological geological environment.

| Table 1. Satellite parameters |
|-----------------------------|
| parameter                  |
| Panchromatic/multispectral / (P/MS) |
| Panchromatic                |
| 0.45-0.9µm                  |
| 0.45-0.52µm                 |
| 0.52-0.59µm                 |
| 0.63-0.69µm                 |
| Spectral range              |
| multispectral               |
2. Research area overview

Lianyungang is located in the central coast of China, northeast of Jiangsu Province, between 33°59'-35°07'N 118°24'-119°48'E. It faces the yellow sea to the east, and faces North Korea, South Korea, and Japan across the sea, bordering Rizhao in Shandong in the north, Linyi in Shandong and Xuzhou in Jiangsu in the west, and Suqian, Huai'an and Yancheng in Jiangsu in the south. The maximum longitudinal distance between east and west is about 129 km, and the maximum longitudinal distance between north and south is about 132 km. The total land area is 7,499.9 square kilometers, the water area is 1,759.4 square kilometers, and the urban built-up area is 120 square kilometers. Lianyungang is located in the south of the warm temperate zone, with an average annual temperature of 14℃. Its water system basically belongs to the Yi Shusi water system of Huaihe River Basin. Lianyungang is located at the junction of the hills in the middle of Shandong and the Plain in the North of Huaihe. Terrain from northwest to southeast tilt, shape like a butterfly flying to the sea. The landforms are mainly distributed in the western Gangling area, central plain area, eastern coastal area and Yuntai mountain area. The western hills are 100 meters to 200 meters above sea level. The central plain is 3-5 meters above sea level. It is mainly composed of the piedmont inclined plain, flood alluvial plain and coastal plain, with a total area of 5,409 square kilometers. It has a cultivated area of 3,797.9 square kilometers. Along the eastern coast are about 700 square kilometers of salt pans and 480 square kilometers of tidal flats. Yuntai Mountain is the last part of Yimeng Mountain. There are 214 peaks of various sizes, among which The main peak of Yuntai Mountain, Yunu Peak, is 624.4 meters above sea level and is the highest peak in Jiangsu Province. Lianyungang yuntai Mountain, Jinping Mountain, Maring Mountain, Yu Mountain and other mountains. Lianyungang has a standard coastline of 162 kilometers and 21 islands, among which The east-west Island is the largest island in Jiangsu with an area of 7.57 square kilometers and the bedrock coast is unique to Jiangsu [2].

In this paper we choose GF1C, located in the northeast of Lianyungang.

GF1C data: The data view:GF1C_PMS_E119.5_N34.7_20180603_L2A0000006555.
The data compared: GF-1:GF1_PMS1_E119.6_N34.7_20160617_L1A000006555-MSS1.
3. **Data processing process:**
The original remote sensing image of the satellite is registered by multi-spectral image orthophoto and panchromatic image orthophoto. And then the two orthophoto images are registered. The two orthophoto images are then fused by PC. After the fusion, the image is interpreted visually. Both GF-1 and GF1C images were processed above, and then compared and analyzed.

3.1. **Band combination**
The multi-spectral images of GF1C satellite data were compared with panchromatic spectral images in the permutation and combination mode of band 3, band 2 and band 1. The images were shown as follows:

![Mul and pan images of GF1C](image)

**Figure 2 Mul and pan images of GF1C**

3.2. **Multispectral/panchromatic image orthography**
The original remote sensing image is affected by the internal state change of the sensor (optical system distortion, scanning system nonlinear, etc.), external state (such as attitude change) and surface condition (such as curvature of the earth, topographic relief). Image orthophoto is a process to correct the geometric distortion of the image. It will deal with the obvious geometric distortion caused by terrain, camera geometric characteristics and sensor related errors. The GF1C satellite images were orthophotomized by multi-spectral images and panchromatic images respectively.

3.3. **Image registration**
Image registration refers to the best matching process of two or more images obtained from different sensors at different times. During image registration, an image is usually specified as the reference image. The other image is to be registered. The purpose of registration is to make the coordinate of the image to be registered consistent with the reference image by some geometric transformation. The GF1C satellite image took panchromatic orthophoto as the reference image and multi-spectral orthophoto as the image to be registered.

3.4. **Image fusion**
GF1C images after being shot, after the registration of low-resolution multi-spectral image and high-resolution panchromatic image fusion, the fusion image after improved the data resolution, there was no obvious color distortion phenomenon such as distortion. By image fusion, it can improve the coastal zone water line at the same time, human engineering activity recognition, image display is as follows:
4. Interpretive effect

The fusion image of GF1C satellite was used for visual interpretation of the coastal zone. There are four types of coastline, including bedrock coastline, aquaculture coastline, silt coastline and artificial coastline. The four kinds of shore edges are clearly visible, which is conducive to visual interpretation and identification. Fusion images of GF1C and Gaofen-1 are compared. The images are shown as follows Figure 4-11.
GF-1 and GF1C have the same resolution and visual interpretation in the same area. Both images can clearly identify the separation boundary between land and sea, and can quickly identify the type of coastline. The images of the two satellites at different phases show that the coastal water boundary line is relatively stable with no obvious changes.

5. The conclusion
(1) At the same resolution, images combined with multi-band data of GF1C satellite have better recognition effect than grayscale images of single band, and colors of GF1C satellite are more vivid than those of Gaofen-1.

(2) GF1 satellite and GF1C satellite images have the same resolution, and visual interpretation in the same area. Both images can clearly identify the separation boundary between land and sea, and can distinguish the type of coastline.

(3) The recognition effect of GF1C satellite images on muddy water edges is slightly worse than that of Gaofen-1 satellite considering seasonal changes.

(4) We can clear the structure drawing shoreline types and human engineering activities in coastal zone, after the GF1C satellite data processing, remote sensing. And the test results show that the GF1C satellite multispectral satellite can meet 1:100000 ~ 1:200000 ecology geology environment investigation into figure, after fusion image can satisfy the ecology geology environment investigation of 1-50000.

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