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Characteristics of gravity fields in the Jinggu *M*6.6 earthquake

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Abstract: Based on the study of high-precision gravity data obtained from recent studies and the regional gravity network for Yunnan province, a variation in the regional gravity field was identified before the occurrence of the Yunnan Jinggu *M*6.6 earthquake.

Key words: Jinggu earthquake; gravity field; evolution characteristics

1 Introduction

On October 7,2014, an earthquake of magnitude 6.6 occurred in Jinggu county, Pu'er City, Yunnan province (23.4°N,100.5°E). The earthquake had a focal depth of 5 km with an epicenter located at the northwestward extension of the western Wuliangshan fault. The epicenter was also close to the Lancangjiang and Jinggu faults on the northwest side and parallel to the middle segment of Wuliangshan and Babianjiang faults on the east side. It was surrounded by several deep faults, including the southwestward Heihe fault, northwestward Nandinghe fault, and northeastward Honghe fault. The structural features of the seismogenic fault in this region are difficult to observe, and few small-to-moderate earthquakes had occurred there. Consequently, little information was available for predicting the Jinggu earthquake. Despite these constraints, the earthquake was successfully predicted on the basis of the relative gravity data and well documented in the report on seismic tendencies submitted by the First Crust Monitoring and Application Center at the end of 2013.[1] Therefore, in this study, we analyzed recent gravity data obtained from gravity monitoring networks in a seismic area and determined the evolutionary pattern of the regional gravity field before the Jinggu earthquake.

2 Survey grid and data sketch

The gravity networks in the area of the Jinggu earthquake comprised of regional gravity networks in Yunnan province and the gravity network for major national projects. These projects primarily consisted of the Crustal Movement Observation Network of China and the Integrated Geophysical Observation of China (The eastern Tibetan Plateau project) (Fig. 1). The Crustal Movement Observation Network of China mainly aimed to establish a gravity monitoring network covering the mainland of China and monitor dynamic changes in the gravity field. This could provide fundamental information for studying the dynamic background of strong earthquakes and continental dynamics. The Integrated Geophysical Observation of China aimed to optimize and modify the mobile gravity earthquake-monitoring network in the North-South Seismic Belt. This study could improve the monitoring of earthquakes of magnitude larger than *M*6.0, obtain and process the space-time images of variations in the North-South seismic Belt's gravity field, and apply the results in the prediction

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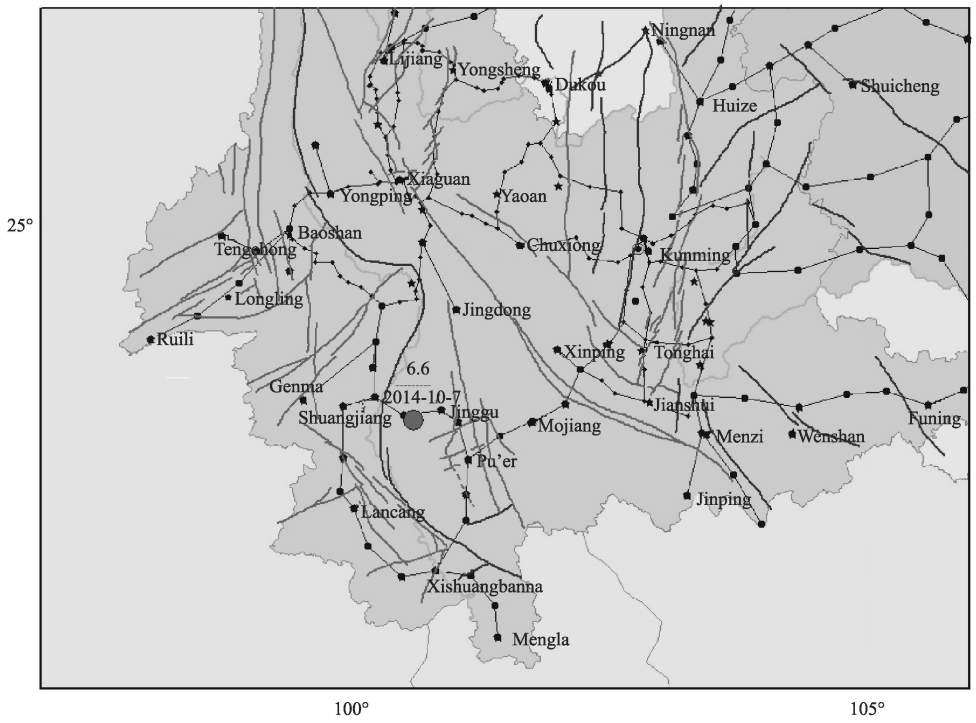

Figure 1 Gravity network and structure in Yunnan region

of earthquakes.

The gravity network (Fig.1) was completed in 2010. Data from the network is made available once or twice a year, with six sets of data provided so far. All measurements were based on quasi-synchronous observations conducted by combining absolute and relative gravity measurements. The FG5 absolute gravimeter, LCR-G gravimeter, and CG-5 relative gravimeter were used in the observations. The inherent quality of the survey data was sufficient to obtain information on nontidal gravity caused by tectonic movement. The accuracy of the absolute and relative gravity measurements exceeded 5×10^{-8} ms^{-2} and 20×10^{-8} ms^{-2}, respectively.

In light of the gravity data obtained from monitoring networks in the area of the Jinggu earthquake, it was crucial to select a reasonable space-time datum for studying the temporal variations in regional gravity anomalies[2]. This study developed a time variation map of the regional gravity field, while the first observation of the network in 2010 was established as the space-time datum. Given that anomalies in earthquakes in the range of *M*7.0 in the Yunnan region last for about three years, we selected data for the same period in each year since 2010 and attempted to document the annual activity of the regional gravity field before the Jinggu earthquake.

3 Characteristics of variations in the gravity field of the epicentral region

In southwestern Yunnan, there have been seven earthquakes of magnitudes above 5.0. Of these, six were in the Yingjiang-Tengchong area, and one was in Jinggu. The earthquakes were more concentrated in 2011 and 2014. The relative parameters of the seven earthquakes are listed in table 1.

The evolution of the regional gravity field in recent years (Fig.2) should correlate with the occurrence of earthquakes in the Yingjiang, Tengchong, and Jinggu areas. The variation map for October 2011 revealed that the gravity field in most of southwestern Yunnan coincides with the strike in the northwest-southeast direction. The largest increase occurred in the Yingjiang-Tengchong area. The variation map for October 2012 showed that the area of increase had narrowed, and the rate had decreased as the center moved toward the Jinggu area. In October 2013, the regional gravity field in southwestern Yunnan remained the same as that of October 2012. However, regional gravity field in the Jinggu area increased dramatically in 2013. By October 2014, when the Jinggu earthquake occurred, the area had expanded from Jinggu to most of the southwestern Yunnan.

Table 1 Earthquakes above *M*5.0 in southwestern Yunnan since 2010

Occurrence time (YY-MM-DD T HH:MM:SS)	Latitude (°)	Longitude (°)	Focal depth (km)	Magnitude (m)	Location
2011-03-10 T 12:58:12.0	24.7	97.9	10	5.8	Yingjiang Country, Dehong Dai and Jingpo Autonomous Prefecture
2011-06-20 T 18:16:49.0	25.1	98.7	10	5.2	Tengchong Country, Baoshan City
2011-08-09 T 19:50:16.3	25.0	98.7	11	5.2	Border region of Tengchong Country and Longyang District, Baoshan City
2014-05-24 T 04:49:21.2	25.0	97.8	12.4	5.6	Yingjiang Country, Dehong Dai and Jingpo Autonomous Prefecture
2014-05-30 T 09:20:12.9	25.0	97.8	12	6.1	Yingjiang Country, Dehong Dai and Jingpo Autonomous Prefecture
2014-05-30 T 09:20:50.3	25.1	97.8	14	5.1	Yingjiang Country, Dehong Dai and Jingpo Autonomous Prefecture
2014-10-07 T 21:49:39.5	23.4	100.5	5	6.6	Jinggu Dai and Yi Autonomous Country, Jinggu City

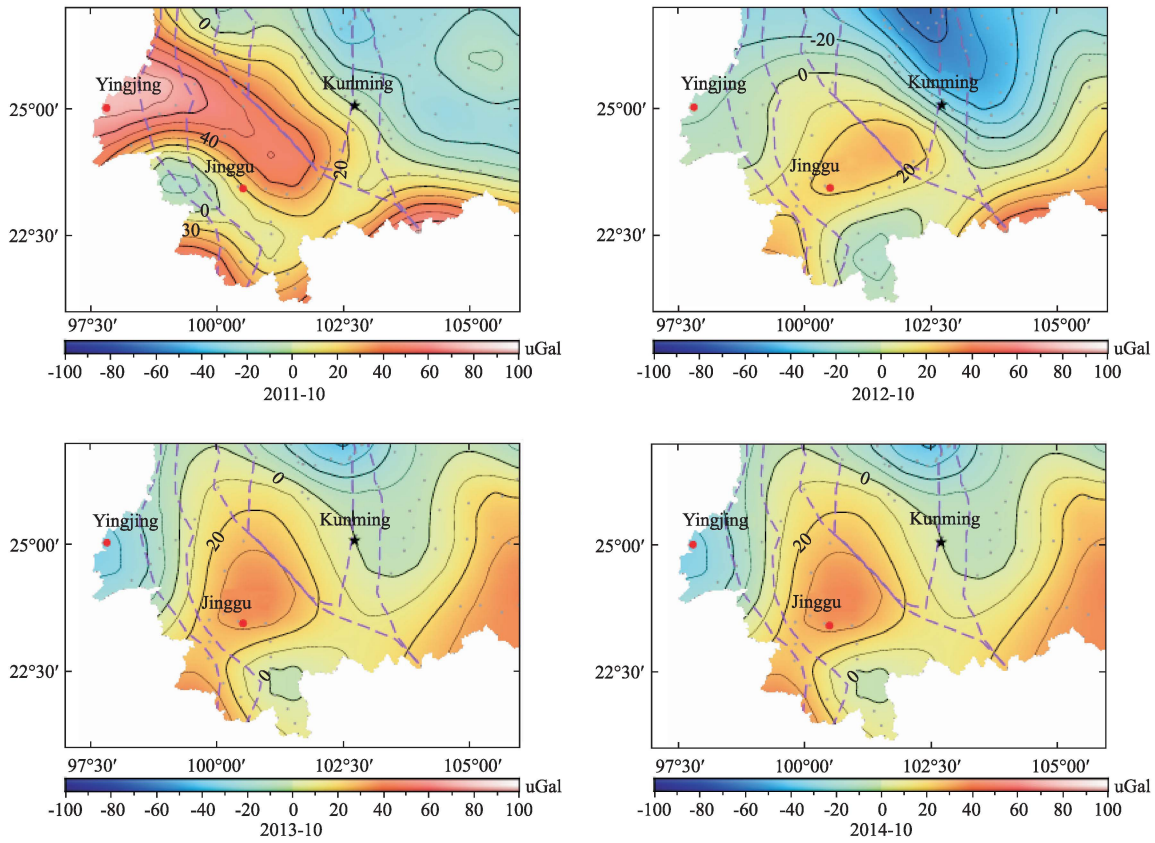

Figure 2 Sequence of regional gravity fields in the epicentral area

4 Conclusions

The high-quality data obtained from the gravity network in recent years clearly shows the variation in the regional gravity field before Yunnan Jinggu *M*6.6 earthquake.

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