# IRS data analysis in Longmenshan Mountain Range, China after the earthquake of May 2008

Last year, a 7.9 magnitude earthquake occurred (31.021°N, 103.367°E) around 80 km WNW of Chengdu, Sichuan, China and the focus of the earthquake was at 10 km depth (shallow focus; source: USGS)[1]. The epicentre of the quake was in the southern part of the Longmenshan, the range of mountains directly bounding the Sichuan Basin. The Sichuan Basin is surrounded by the Himalayas to the west, the Qinling range to the north, and mountainous areas of Yunnan to the south. The Yangtze River flows through the basin. The place has earlier records of several prehistoric earthquakes[2]. The northwestern margin of the Sichuan Basin has previously experienced destructive earthquakes. The earthquake of 25 August 1933 killed more than 9300 people. The present earthquake with a magnitude of 7.9 has affected ten million people and may have killed as many as 50,000, according to a death toll estimate released by the Chinese Government. The shallowness of the epicentre – only 10 km underground – contributed most to the destructive power (source: USGS).

The main objective of the present study was to understand the terrain changes after the earthquake, especially landslides and their relationship to major tectonic elements.

The study area was confined to the western part of the Sichuan Basin and occurs in the Longmanshan mountain range of the Himalayas. This area is a tectonically active zone and a thrust fault runs along the base of this mountain range. This fault called the Longmanshan fault. Motion on this fault is responsible for the uplift of the mountains relative to the lowlands of the Sichuan Basin to the east. The strike of the fault plane is approximately NE. The Longmanshan fault was the causative factor for this earthquake (source: USGS)

IRS-P5 Cartosat-1 data (spatial resolution 2.5 m) were analysed for the terrain elements just before the earthquake. IRS P6 LISS-IV Mono data (5.8 m spatial resolution) were used for the post-earthquake damage analysis due to the unavailability of Cartosat-1 data just after the earthquake.

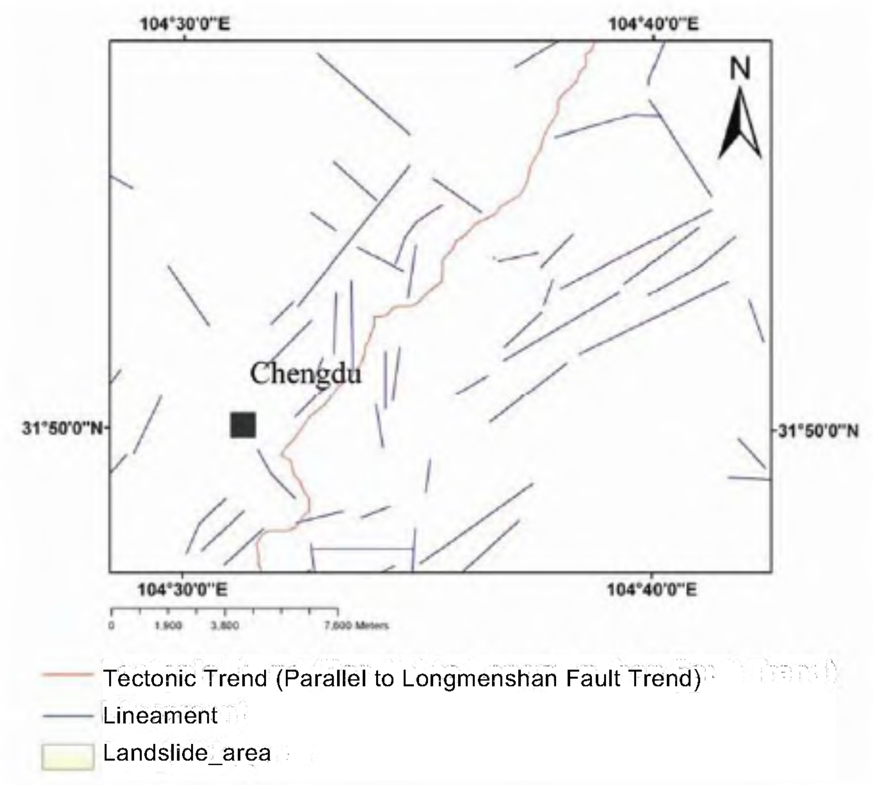


**Figure 1.** Spatial relation between tectonic fabric and landslide zone.

Earthquakes trigger many natural hazards[2], and landslides are an important natural disaster after any major earthquake. Therefore the aim of the present study was to delineate the fresh landslide which had occurred after this earthquake, and also to evaluate the relationship between tectonic elements and the recent landslides. High-resolution Cartosat-1 satellite data were used to delineate the major terrain and structural elements in the area, especially to understand the terrain condition before the earthquake. IRS P6 LISS-IV Mono data with 5.8 m resolution were used to delineate the major terrain changes, specially landslides after the earthquake. These data are suitable in delineating landslides of medium to large dimension (size greater than 20 m because the sensor has 5.8 spatial resolutions). Freshly occurring landslides in the area appear as a brighter tone in the grey scale image because freshly mobilized earth residuum/gravel/rock fragments have higher reflectance compared to other features in the terrain. Analysis was also carried out to find the relationship between lineaments/major tectonic trend and the freshly occurred landslide. A map was prepared by delineating all the landslides that occurred after the earthquake (Figure 1). It was seen that the major tectonic zone represented by Longmanshan fault had spatial proximity to the landslide zone and it aligned along the strike of the Longmanshan fault. It was also found that concentration of some of the landslides was more along the lower-order geological lineaments delineated from Cartosat-1 data. These landslides had affected roads, settlements rivers, etc. Some of the major changes like the landslide affecting the rivers (Figure 2 *b*) and settlements (Figure 3 *b*) can also be seen by comparing the pre- (Figure 2 *a* and Figure 3 *a*) and post-earthquake data.

The results demonstrate how a major earthquake can trigger landslides and the

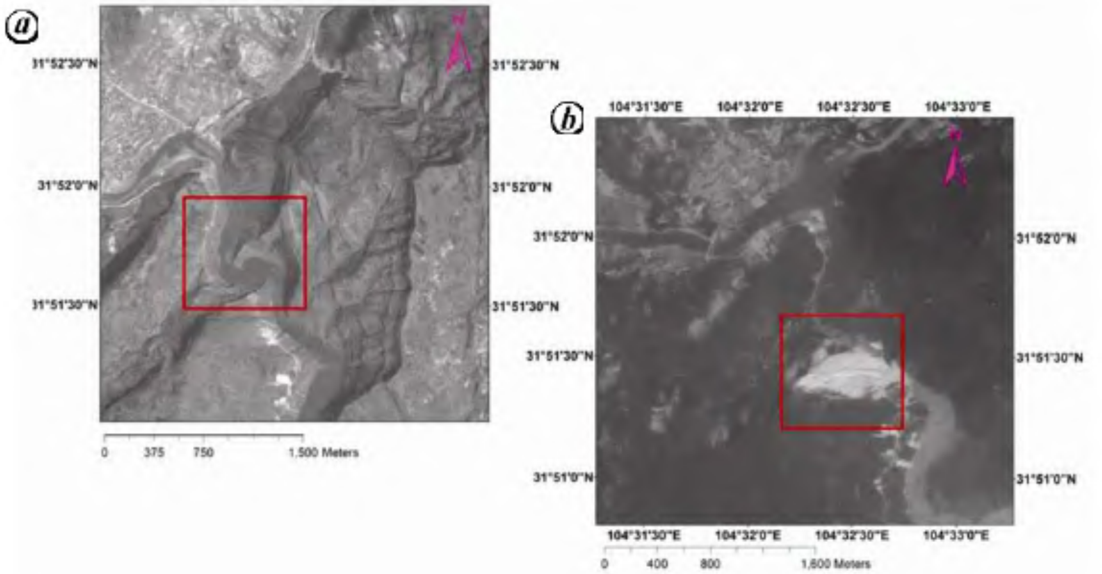


**Figure 2.** ***a***, Unaffected river course prior to earthquake in Cartosat-1 data (dated 19 April 2007). ***b***, Fresh landslide blocks the active drainage channel as shown within a rectangular block in the post earthquake IRS P6 LISS-IV Mono data (dated 18 May 2008).

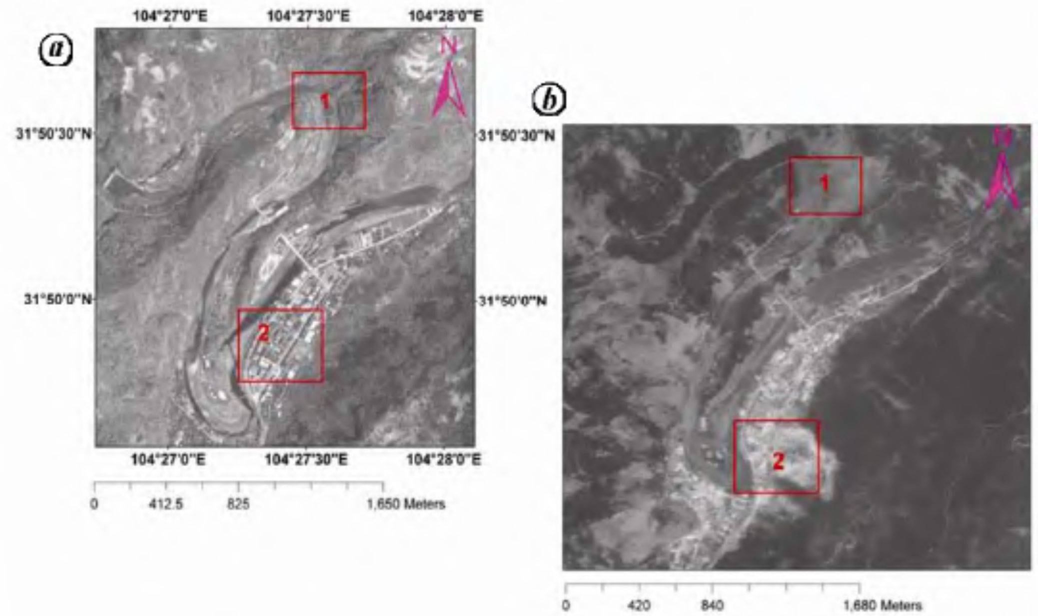


**Figure 3.** ***a***, Settlements and drainage were unaffected by landslide prior to earthquake. ***b***, Fresh landslide blocks the active drainage channel (marked as 1) and settlement area (marked as 2) (IRS P6 LISS IV P6 data of 18 May 2008). (IRS P5 Cartosat-1 data collected on 19 April 2007).

fault system can play a major role in their spatial distribution.

1. Ma-Zongzin *et al.*, *Earth Prediction, Nine Major Earthquakes in China*, Springer-Verlag, Berlin, 1990, pp. 46–55.
2. Bruce, A., *Earthquake*, W.H. Freeman & Company, 2003, 5th edn, pp. 246–247.

ACKNOWLEDGEMENTS. We thank the Director, NRSC, Hyderabad for support and encouragement. We also thank the NRSC Data Centre for supply of satellite images.

Received 30 June 2008; revised accepted 20 February 2009

K. VINOD KUMAR*
ARINDAM GUHA
P. S. ROY

*National Remote Sensing Centre,*
*Indian Space Research Organization,*
*Balanagar,*
*Hyderabad 500 625, India*
**For correspondence.*
*e-mail: vinodkumar_k@nrsa.gov.in*