The Sichuan Earthquake (1)

When in May 2008 an earthquake and associated landslides struck the Chinese province of Sichuan, geo-information service providers were able to support emergency response efforts by providing and analysing radar and optical satellite imagery, and continuous follow-on monitoring. The authors provide anoverview of the disaster and its effects, demonstratingthe suitability of satellite images for emergency rapid response.<P>

This is the first in a series of three articles jointly prepared by Infoterra and LIESMARS/Wuhan University. The next will describe how satellite imagery was processed and interpreted, while the final article will highlight the complementary benefits of optical and radar imagery.
On 12th May 2008 an earthquake measuring approximately 8.0Ms (source: Chinese Earthquake Administration) shook the steep eastern margin of the Tibetan plateau in Sichuan Province, China.The epicentre lay 19km below the surface, 80km west-northwest of Chengdu, capital of the province. The earthquake caused damage over 270km along a north-northeast-striking, west-dipping, steep fault beneath and parallel to the northeast-striking Longmen Shan thrust belt (Figure 1). The greatest destruction occurred along this fault, almost parallel to the mountain front, killing 70,000 people, injuring 375,000 and rendering 18,500 still missing. Seven million people lost their homes.

Rapid Response
The severity was immediately recognised. Ninety minutes after the earthquake, China's Premier Wen Jiabao flew to the area and the National Disaster Relief Commission immediately announced a 'Level I' emergency plan. This swift and efficient help saved thousands of lives, yet the scale of the disaster and the inaccessibility of the area complicated rapid response. Heavy rainfall further hindered the work of rescue teams in the first few days, and increased the incidence of aftershock landslide. Satellite images became indispensable in this time-critical situation, and Infoterra and Spot Image immediately tasked their satellites. Over subsequent days images were acquired by the German high-resolution radar satellite TerraSAR-X, the French optical SPOT satellite family, and Taiwan's FORMOSAT-2. Interpretation, map compilation and rapid analysis of urban areas, infrastructure and landscape were carried out in co-operation with Chinese government agencies and rescue organisations. These included the National Disaster Reduction Centre, the State Bureau of Surveying and Mapping (CASM), the Ministry of Land and Resource, the State Earthquake Administration and State Council of China satellite imagery.

Satellite Imagery
The heavy rainfall made radar data particularly useful, as radar works independent of weather. Seven hours after receipt, the first TerraSAR-X imagery was processed and delivered, made possible through an extensive network of global receiving stations and '24/7' availability of teams providing near-real-time data processing and data delivery in case of time-critical requests. At the same time, rapid-mapping experts in Europe and Beijing began scrutinising the images, first map sheets, then annotated maps that became available within hours of reception at the ground station. Detailed infrastructure and image analyses arrived the following day. The information extracted enabled rapid reporting to Chinese authorities of extent of the damage, later completed by onsite observations. Further, all results were immediately put online, ensuring accessibility for (inter)national and (non-)governmental organisations worldwide.

Landslides
Post-event imagery was not the only to be used; archived SPOT and FORMOSAT-2 optical images (of the more than 10 million archived datasets) and recent TerraSAR-X imagery added valuable information on, for example, normal water level of rivers and lakes, and pre-event infrastructure. The imagery and maps generated following the disaster were mainly used for recognition and assessment of damage in populated areas and to infrastructure, identification of focus areas, and action co-ordination. However, images acquired over days following the disaster helped identify and mitigate additional threats: landslides and 'quake lakes'. The earthquake, its frequent strong aftershocks, and the continuous heavy rainfall caused many landslides that compounded damage, deaths and injuries. After the earthquake had damaged it, a huge landslide slammed into Buryin, the old town area of the City of Beichuan, killing over 1,600 people. Landslides also formed over thirty natural dams, blocking rivers and creating 'quake lakes' that posed a permanent threat to survivors and rescue teams downstream. Potential overflow or dam breaking would cause flooding and flow of debris. The Tangjiashan dam alone endangered 1.3 million people, leading to the evacuation of more than 250,000 from Mianyang City. The various satellite images enabled continuous survey and monitoring of dams and water level of quake lakes, and threat assessment, so that authorities could conduct efficient, targeted rescue and evacuation efforts. A specialised team slowly drained the Tangjiashan lake without serious impact on people and environment, by building a small spillway channel. Other quake lakes have been similarly emptied since; yet others are still being monitored to assess their stability.

Concluding Remarks
Long-term follow-up will support detailed monitoring of progress, change and possible further effects, offering continual support for medium-term emergency activities. Updating preparedness plans with newly identified disaster zones, the implementation of enhanced emergency response plans, and improvements to disaster prediction and simulation models based on new experience and findings will all benefit from these follow-on acquisitions and evaluations.

Continued: The Sichuan Earthquake (2)

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Further Reading
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