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Using satellite imagery to improve emergency relief

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Mapping has always been indispensable to the progress of humankind. Ancient mapping consisted of drawing by hand the coastline of unknown lands as if observed from above. In 1583, the first Westerner admitted to the court of the Chinese emperor, Jesuit Mattia Ricci, used geographic information to convince the emperor to accept a cultural exchange with the Jesuits. He drew a world map (mappamondo) to show the emperor that, for all his power, his country was relatively small compared to the rest of the planet. Ricci's map, with information written in Chinese, told the empire of the existence of a developed culture in the West. Of course, since Ricci's time a lot has changed, but visual images and geographic information hold the same power. If a picture is worth a thousand words, a map can be worth even more.

From global monitoring to personal global positioning systems (GPS), satellites offer a growing range of applications. Remote sensing and other satellite applications are not sophisticated and over-expensive gadgets. Rather, they are becoming common in many professional and consumer domains, and represent an inexpensive instrument to remotely monitor and assess land use and risk reduction policies, to mention just one example. Global initiatives like GMES (Global Monitoring for Environment and Security) and GEOSS (Global Earth Observation System of Systems) testify to the significant progress space applications have made. Both have a global dimension, and aim to use satellites and applications to help reduce the planet's vulnerability to natural hazards and to support humanitarian relief.

Space-based technologies: an expanding role in humanitarian relief

There is clearly great potential for applying space-related systems to the assessment of damage and the evaluation of the situation on the ground in the aftermath of natural and technological disasters. After their extensive use in the Indian Ocean tsunami and the Kashmir earthquake, rapid mapping and high-resolution imaging have become important support tools in emergency relief operations. In parallel, awareness and understanding of the benefits of space applications for disaster management, beyond the well-known satellite systems devoted to weather forecasting, have grown significantly. Albeit with to varying extents, satellite maps and Geographic Information Systems (GIS) are regularly used in emergency response and humanitarian relief, including for logistics, staff security, distribution, transport and the setting up of telecommunication networks and refugee camps.

The UN is stepping up its space-related activities and studies. A number of initiatives are being carried out through inter-agency cooperation, in particular in the areas of environmental research, monitoring and assessment, the management of natural resources, weather and climate forecasting, disaster management, refugee protection and public health, as well as the enhancement of information and communications infrastructure. The Office for Outer Space Affairs (UNOOSA) coordinates a number of policy initiatives and links with the UN General Assembly, while UNOSAT (www.unosat.org) is active within the humanitarian community, with a special focus on capacity-building in an effort to help developing countries use and benefit from space-based technologies. In addition, NGOs are showing growing interest in space-based geographic information. During emergencies, this information is made widely available, at no cost, through mechanisms such as Humanitarian Information Centres (HICs), Reliefweb, AlertNet and the UNOSAT web portal. In major disasters, the UN can, through UNOOSA, invoke the International Charter on Space and Major Disasters, which prompts participating space agencies to release satellite data at no cost.

Space-based technology and the Indian Ocean tsunami response

The Indian Ocean tsunami hit such a large land area that it was at first thought that earth observation (EO) could not be used to support the response effort. In fact, since Hurricane Mitch in 1998 no emergency has involved such intensive production and use of EO applications as the response to the tsunami. It was also the first tsunami to be recorded from space just as the front wave was propagating through the sea. Some 650 images were produced, using data from 15 different sensors. During the first stages of the crisis, satellite maps were used at headquarters to assess the extent of the emergency. Later, these images were used in the field, distributed by the HIC and other sources, to support relief and coordination. Today, the wealth of information generated at the time of the crisis is at the disposal of different user agencies for the recovery and reconstruction effort.

The relatively wide availability of satellite-based products in the tsunami response was made possible by three main factors: the ability of the International Charter to react rapidly and efficiently; the existence of established cooperative links between the UN system via UNOSAT and the space industry; and the capacity to relay products to a wide range of key users, both at headquarters and in the field.

The chronology highlights how efficient the system has become. The earthquake and tsunami hit on 26 December 2004. During the night of 26–27 December, the UN Office for the Coordination of Humanitarian Affairs (OCHA) began to identify affected areas. On 27 December, the UN triggered the International Charter over three locations: Phuket in Thailand, Male in the Maldives and Aceh in

Indonesia. Image processing began on the same day. By 29 December, UNOSAT had put its first maps online, and by 14 January 2005 UNOSAT's online image bank was operational. At its peak, the image bank hosted some 650 maps by UNOSAT and a number of partners like Germany's DLR and the French SERTIT, and was accessed by 41 relief organisations. UNOSAT's website recorded 200,000 map downloads during the tsunami crisis – 60% of all downloads recorded in the previous year.

In emergencies such as the tsunami, satellite-based imagery is most useful for relief coordination and information gathering. Indeed, users report that the tsunami maps helped agencies involved in coordination, as well as in logistics and distribution. Data released under the International Charter was used to develop rush disaster impact assessment maps that were used by the UN Inter-Agency Standing Committee (IASC) Task Force on the Tsunami for coordination purposes. Geographic information can also be an important component in fundraising, and can help donors assess the amount of effort required. Here, the power of visual information, maps and geographically referenced analysis is unparalleled. However, the impact of satellite imagery is felt most strongly in operational areas, such as urban search and rescue, damage assessment and relief planning and coordination.

Emergencies on the tsunami's scale, entailing massive relief operations, often require diverse types of imagery, including high-resolution maps (although in this case moderate-resolution imagery was enough to reveal the tsunami's destructive force). High-resolution imagery can be particularly useful to operators on the ground: comparing these maps with satellite images taken before the disaster helps relief workers to locate villages that are no longer visible on the ground. This process of comparing pre- and post-disaster images is becoming common, in particular as a way of confirming initial estimates of impact and needs assessments. Cross-checking information derived from space maps with findings from assessment missions is probably the best means of doing this, and could be an important way of improving the efficacy of humanitarian relief.

Satellite imagery and the South Asian earthquake

The devastating earthquake in South Asia in October 2005 confronted the humanitarian community with a difficult challenge. A large part of the problem derived from the difficulty of locating and reaching affected villages. Satellite maps were provided to headquarters and the field to help agencies 'see' levels of destruction and check the condition of roads, thereby allowing them to identify obstacles to access and to prioritise their activities more efficiently. Providing relief was still problematic, but it would probably have been even more so without the support of geographic information. This information enabled an overview of the disaster impact long before information and data became available from the large number of assessment missions on the ground, saving precious time. At the time of writing, a new form of map was being produced by UNOSAT using snowfall prediction data to reveal how long was left before certain villages became inaccessible.

Conclusions

The tsunami and the South Asian earthquake are two examples of emergency relief operations in which geographic information derived from satellite data have made a tangible difference to the relief response. Across the entire disaster cycle, from response to prevention, satellite applications can be well worth the investment. Such investment is going to be necessary one way or the other, as satellites, GPS and GIS (Geographic Information Systems) increasingly become part of everyday life. The conscious, rational integration of these support tools could yield a better return on investment.

To achieve this, we should see geographic applications as analytical instruments rather than simply orientation tools. We should consider moving away from the occasional use of GIS applications towards the elaboration of models applicable to a wider range of crises, thus taking full advantage of the global trend towards integrated information management systems. Finally, we should not underestimate the value of geographic information systems and satellite imagery in helping to fill the gap between relief and development. Efforts in this direction have begun, albeit they are still at an embryonic stage. These efforts need support from across the humanitarian community.

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