Remote Sensing and Humanitarian Aid

- A life-saving combination

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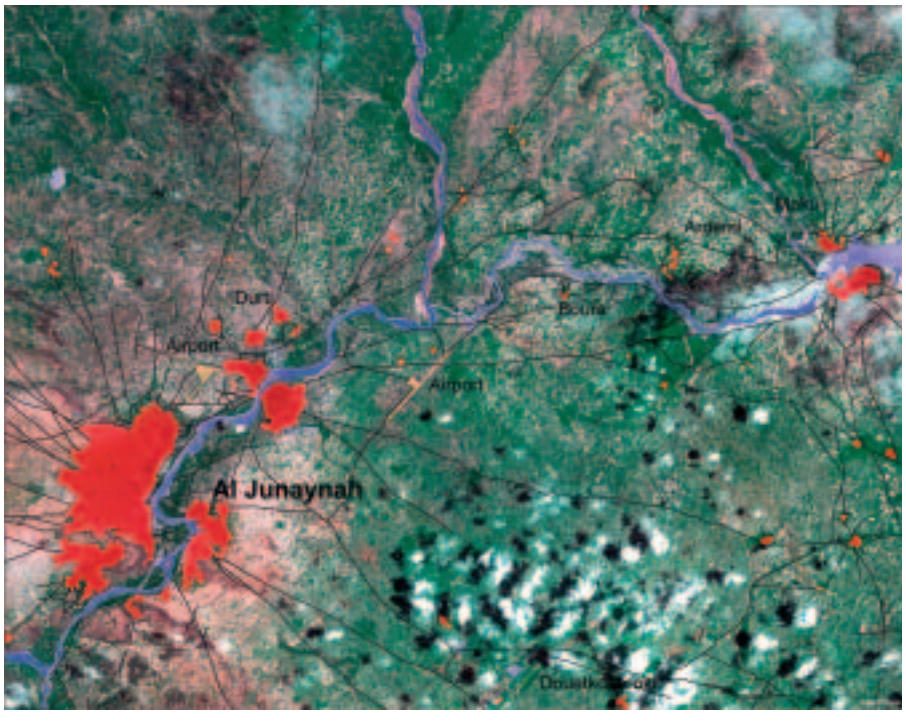
The earthquake and the tsunami which struck the coastline of the Indian Ocean on 26 December 2004, along with the cataclysmic images of the disaster that followed, will form part of our collective memory for ever more. However, this should not cause us to forget all the other emergency situations that arise: virtually every week, the mass media publish images of some other disaster or conflict. According to the World Disasters Report published by the International Federation of Red Cross and Red Crescent Societies (IFRC), in 2004 up to 300 million people were affected by natural disasters, conflicts or a combination of both (referred to as complex emergencies).

Since the foundation of the Red Cross in 1863 in Geneva and of the IFRC in Paris in 1919, Europe has earned World recognition for its competencies in emergency management and humanitarian assistance. The overall annual budget for humanitarian aid amounts to some six billion Euros, of which 1.2 billion are used in response to natural disasters. Summing the contributions from its member states and from the European Commission, Europe is the biggest donor in the World.

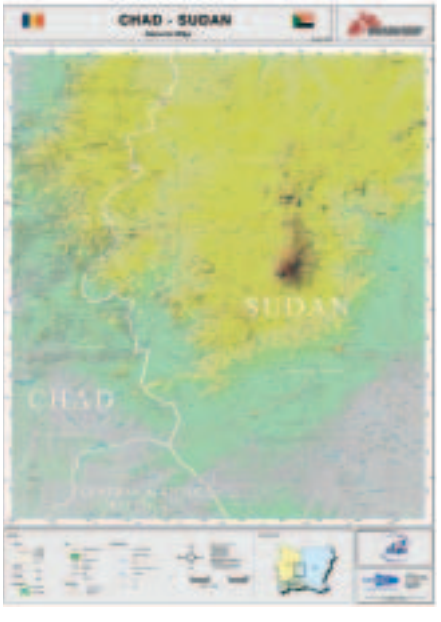
Europe is channeling its humanitarian assistance through a wide range of actors in the broad humanitarian-aid community, which comprises the United Nations with its specialised organisations, such as the Office for Coordination of Humanitarian Affairs and the Office of the High



Space-derived map by GMES RESPOND of the Al Junaynah region in Sudan generated in rush production mode using Charter data (SPOT-5, Envisat and Radarsat images acquired on 19, 20 and 21 August) and delivered to German Red Cross and UN OCHA on 24 August 2004
(Credits: SERTIT, Charter. SPOT data - copyright CNES, distributed by Spot Image; Radarsat data – copyright CSA, distributed by RSI; Envisat data - copyright ESA)

Commissioner for Refugees, the Red Cross and Red Crescent movements, government agencies such as Germany's Techniches Hilfswerk, the French Sécurité Civile, or the Räddningsverket in Sweden. In addition, there are a wide range of non-governmental organisations (NGOs), including such famous ones as Médecins Sans Frontières, Action Contre la Faim, Care and Oxfam, but also myriads of others that are less well-known to the public but still play a key role in the field under sometimes extremely difficult conditions, often through long-lasting missions in countries regularly affected by conflicts and natural disasters.

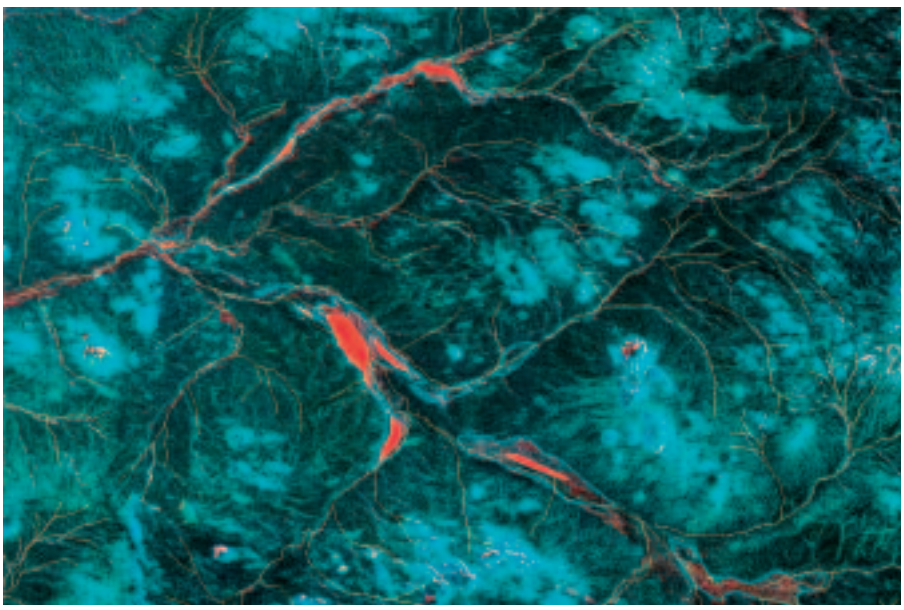
Emergency and humanitarian practitioners want to stay focused on their job at all times, not on technology. They all need better tools to support their tasks at all levels of decision-making and in the field, but they often have different cultures, languages and working practices. In this context, ESA, in supporting the action of the European Commission and its member states, is well placed to set up a European capacity based on value-adding companies and the service industry, involved in international co-operation, with the aim of providing user-driven services to the humanitarian-aid community. Over the years, a working relationship with key humanitarian organisations has been established, from the DUP HUMAN and the EOMD UNOSAT projects and maturing into RESPOND, the consortium of European value-adding companies (led by Infoterra UK) and public agencies involved with geo-information resources to support humanitarian aid. RESPOND is a project of the GMES (Global Monitoring for Environment and Security) initiative.



The key issues that humanitarian-aid organisations have to face are numerous and complex, including water, sanitation, habitat, health, nutrition, crisis relief – either conflict or natural disaster – and post-crisis recovery and reconstruction. Their major objectives are to prevent or relieve human suffering and, linking to longer-term issues, to help prepare for risks or prevent disasters and help reduce poverty and vulnerability both at community and national level. A careful understanding of the activities that humanitarian staff carry out is needed to assess the relevance of geographic information – and Earth Observation as one component. These are primarily planning and management: planning humanitarian response actions, post-crisis reconstruction projects, planning within disaster management, of which disaster prevention is a crucial component, and within international development programmes all over the World. In addition to the activities they conduct, it is crucial for aid organisations to have the means to monitor the effectiveness and efficiency of their actions. This is all the more critical when aid programmes are dependent upon donors, and objective information is needed to derive the so-called 'needs assessment'.

When a humanitarian crisis develops, be it in the form of a slow-onset scenario as in Darfur in 2003-2004, or a sudden disaster such as that in Asia on 26 December 2004, a first task for the European Community Humanitarian Office (ECHO) is to evaluate its impact and determine what the needs are, in order to size the necessary

Example of an emergency mapping product for the Chad-Sudan border generated by Keyobs less than 48 hours after the request from Médecins Sans Frontières
(Credit: Keyobs)



SAR-based image map of Eastern Chad used for hydro-geological interpretation in a water-resource development project of the UN High Commissioner for Refugees
(Credits: UNOSAT and Radar Technologies France. ERS data - copyright ESA; JERS data - copyright JAXA)

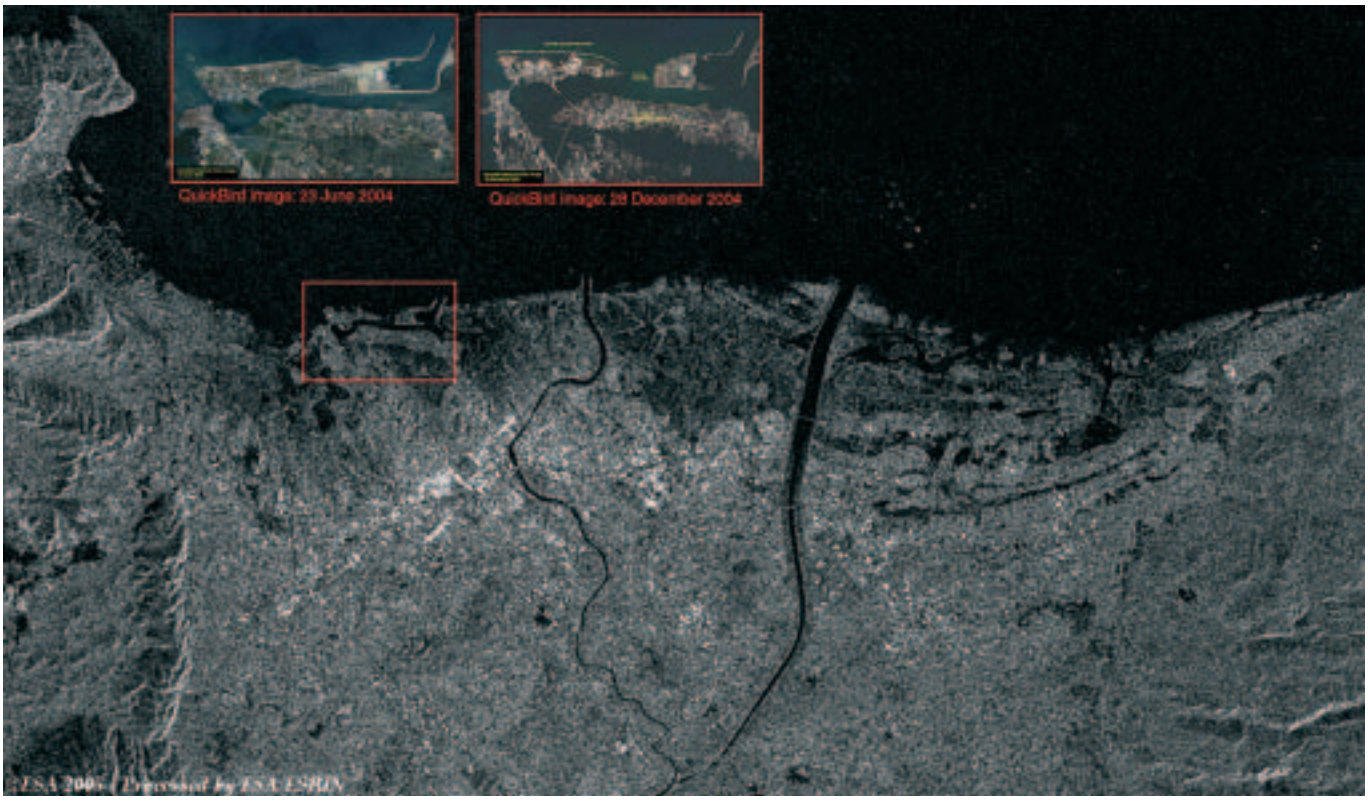
response appropriately. Satellite imagery can help to achieve this, as it has no frontiers and can be used to derive the hard facts when other information sources are impossible to access directly. In the case of the Asian tsunami, Earth-observation satellites have demonstrated a unique ability to provide donors with a synoptic view of extended remote areas in a relatively quick and cost-effective manner.

Although geographic information is only one of the many tools that humanitarian organisations are using, it represents an important element of the jigsaw puzzle, and more and more of them use geographic information systems and satellite imagery in their headquarters, in their crisis rooms and in their intelligence reports for decision makers in New York, Geneva or Brussels. The humanitarian emergencies in Northern Afghanistan and in Angola at the end of 2001 showed the need to establish an anticipative database including satellite images, vector data, elevation data, global land-cover maps and a refugee-camp positioning spatial analysis tool in order for an organisation such as the International Committee of the Red Cross to be operative as soon as any new request comes in. In addition, with the increased levels of utilisation of geographic information in the field, organisations such as the UN Office for Coordination of Humanitarian Affairs and the UN Department of Peace-Keeping Operations have set up networks of specialised local units such as the humanitarian information centres.

One of the generic requirements of humanitarian aid workers is for objective, accurate and up-to-date topographic maps of the theatre of operation. In many places in the World, accurate maps are still not available, or are treated as classified military information. This is why Médecins Sans Frontières and other NGOs regularly require base maps that service suppliers like the UK-based MapAction and Keyobs derive from old topographic maps or from recently archived satellite imagery, which they combine with information concerning the road network where distances are measured in hours rather than in kilometres, to account for traffic conditions. Quite importantly, these maps are delivered to the field as robust, large-format plasticised sheets. The German Red Cross and the relief agency Techniches Hilfswerk report that such maps had not only been useful to assist their work in Darfur, but they further explain that, after having had reports of bombardment some 15 km from their position in Al Fashir, these were the only maps that were not taken from them at Sudanese customs, and which they could use to verify their staff evacuation plans – saving expensive helicopter time and allowing them to keep on working.

As a matter of fact, Darfur is one of those regions of the globe, like Africa's Great Lakes region, affected by endemic, very long conflicts or civil wars coupled with disasters, known as 'complex emergencies'. These represent the primary cause of population displacement, which led the UN High Commissioner for Refugees and the NGOs to set and manage camps in Darfur and across Sudan's border in Chad. It is hard to overstate the scale of the humanitarian emergency unfolding in this region: by current estimates, 1.45 million people have been displaced from their homes across an area the size of France. Earth-observation data not only help in finding appropriate locations fulfilling camp-setting criteria: because they help in the identification of each and every individual tent or building, very-high-resolution images are used to manage camps and urban clinics around Al Fashir, the capital of north Darfur State and a crucial distribution point for food and supplies. The service is based on the census, a kind of 'zip code' and address for each inhabitant and family, and allows the management of the evolution of the camp and its population.

In parallel, caring for more than 180 000 Sudanese refugees gathered in eastern Chad, the UN High Commissioner for Refugees has used satellite data to identify hidden water resources and to site new camps. Conventional methods of extracting water are based on coarse geological analysis, and drilling has a success rate of typically 50%. To address the problem, UNOSAT teamed up with the consulting firm Radar Technologies France (RTF) and provided services combining Landsat optical data with ESA ERS C-band and Japanese JERS-1 L-band radar satellite data and expert knowledge of local geology and geophysical exploration. Using techniques previously employed for oil and gas and mineral



Post-tsunami image map of the Banda Aceh area (Sumatra) produced by ESA using Envisat ASAR data from 3 January 2005. The two small inserts are QuickBird optical images before and after the disaster, showing damage to the island facing the shoreline, similarly visible in ASAR imagery. Because of its all-weather capability and extended swath, ASAR has the capacity to detect damage over the complete area
(Credits: Envisat data - copyright ESA; QuickBird data - copyright DigitalGlobe)

exploration, the Earth-observation-based water target maps covering 22 500 square kilometres were used by aid workers to drill water boreholes and wells, and confirmed their ability to more accurately assess the water-supply potential. Using multispectral imagery from the Disaster Monitoring Constellation (DMC) provided by Surrey Space Technologies, RESPOND has been providing information on regional vegetation change over time. The United Nations Joint Logistic Centre team in Khartoum have explained that the processed vegetation imagery was essential to estimate where wood was available, in order to assign cooking-fuel priorities to settlements and camps.

Relief operators need not only an initial estimation of the disaster's impact, but also an accurate picture of the extent and degree of damage at the level of individual buildings, roads and other features of interest. The primary mechanism for providing imagery worldwide following the occurrence of a natural or technological disaster has become the International Charter on Space and Major Disasters. Operational since 2000, this European initiative has earned international recognition and has been extended to include specialised UN agencies, in addition to national emergency authorities. It has already been activated more than 80 times for 65 different disasters. Currently, space agencies in Europe, France, Canada, India, the United States, Argentina, and most recently Japan, offer resources from a constellation of a dozen satellites.

In Darfur, imagery from ten different sensors and nine separate spacecraft were delivered and used in near-real time. Roads in the region were inundated, as wadies – normally dry desert riverbeds – were flooded, crippling communication links in remote areas. Some agencies reported that it could take as long as ten days to travel 120 km by road. Rain conditions were such that the Charter was activated in mid-August, and on this basis SERTIT and DLR provided additional flood-map products, which were delivered to humanitarian workers and relief crews active in the area.

Immediately following the tsunami on 26 December 2004, the Indian, French and German authorities and the United Nations invoked the Charter. Thousands of images from SPOT, Envisat, ERS, IRS, Radarsat, Landsat and US commercial satellites were acquired. Partners of the RESPOND consortium, a rich network of organisations and agencies such as the European Commission Joint Research Centre, UNOSAT, the German space agency, Alertnet from the Reuters Foundation, as well as a range of service suppliers including Infoterra, Keyobs, Sertit, Metria, Kayser-Threde and Scisys,

The GEOSS Reference Document and Implementation Plan

prepared nearly 300 maps on scales ranging from 1:400 000 to 1:10 000 over Sri Lanka, the Indian coast, the Andaman islands, Africa, the Maldives, Myanmar, Thailand and Indonesia, together with the French space agency and other international actors.

Through the GMES RESPOND consortium, the Agency is not only providing support in the aftermath of the Asian disaster, but is also preparing to contribute to post-disaster recovery and reconstruction. In the context of international collaboration for reconstruction programmes that involve the United Nations and the European Commission in particular, aid organisations and the World Bank are defining the needs, while agencies and service providers are preparing geo-information services to support a variety of actions. As described by the World Bank in their assessment report concerning Indonesia, these needs are as diverse as getting people back to work, getting children back to school, supporting community-driven reconstruction, rebuilding houses, roads, bridges, ports and airports, and reconnecting people: electricity and telephones, reviving the economy, rebuilding irrigation systems, bringing clean water and sanitation, rebuilding health services, restoring damaged ecosystems and protecting the environment, restoring local and provincial governments, managing reconstruction transparently, and developing a disaster-mitigation strategy.

This implements the continuum from relief to rehabilitation and development: *"emergency assistance must be provided in ways that will be supportive of recovery and long-term development"*, as laid down in United Nations Resolution 46/182. It implies that development activities should be involved in the early stages of the aid, and that satellite imagery acquired at this time can, and should be used to support reconstruction and sustainable development.

As another example, the European and the French space agencies provided data from their ERS and SPOT satellites covering Nicaragua, San Salvador and Honduras in the aftermath of Hurricane Mitch in October 1998. This was used locally via the mapping agencies such as INETER in Managua as well as NGOs and local municipalities in Central America. Similarly, the whole SPOT data set acquired over San Salvador after the 2001 earthquakes was donated to the national geographic survey, which used it to issue a brand new set of topographic reference maps.

The first summit of nations and organisations involved in Earth Observation, held in Washington DC in July 2003, was a first step in putting in place a global system of systems for improved coordination of observations of the Earth, whether from satellites or ground-based oceanographic and atmospheric in-situ sensors. Summit participants launched the intergovernmental ad-hoc Group on Earth Observations (GEO) to set up a Ten-Year Implementation Plan for the development of such a system of systems. Following the second Earth Observation Summit hosted in April 2004 in Tokyo, the third Summit, hosted by the European Commission (EC) in Brussels, adopted the plan and authorised its implementation. The parties of the International Charter have offered it as a practical mechanism of the Global Earth Observation System of Systems (GEOSS) for responding to disasters at the local, national, regional and global level. The primary European contribution to GEOSS is the Global Monitoring for Environment and Security (GMES) initiative. Jointly led by the European Commission and ESA, this initiative is bringing together the capacities in Europe to collect and manage data and information on the environment and civil security, for the benefit of the European citizen. The recent tragic events in Asia and the long-term crisis that is affecting Darfur have shown the important benefits that can be derived from the successful implementation of the GEO plan.

Conclusion

The above examples of large-scale services provided by European networks of value-adding companies and the service industry illustrate that a long and patient process is underway with key stakeholders and user organisations to fulfil the ambitious challenge of GMES in the domain of humanitarian aid and disaster reduction.

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