Sharing spatial information for humanitarian response and disaster management.

Ivan Baehr, previous Web-GIS specialist at UNOSAT

Abstract

Timely and reliable information is essential in emergencies and disaster management. When disaster strikes - may it be natural disasters, technical disaster or conflicts – it is critical to know where, when and what happens – how many people are affected, extent of affected area, damage extent and location of available resources. Sharing geographical information through web solutions may speed up communication and facilitate coordination in a complex environment often with many different players involved and in rapid changing settings. Based on 25 years of practical experience, this article gives an overview of the development of spatial information for humanitarian response over this period.

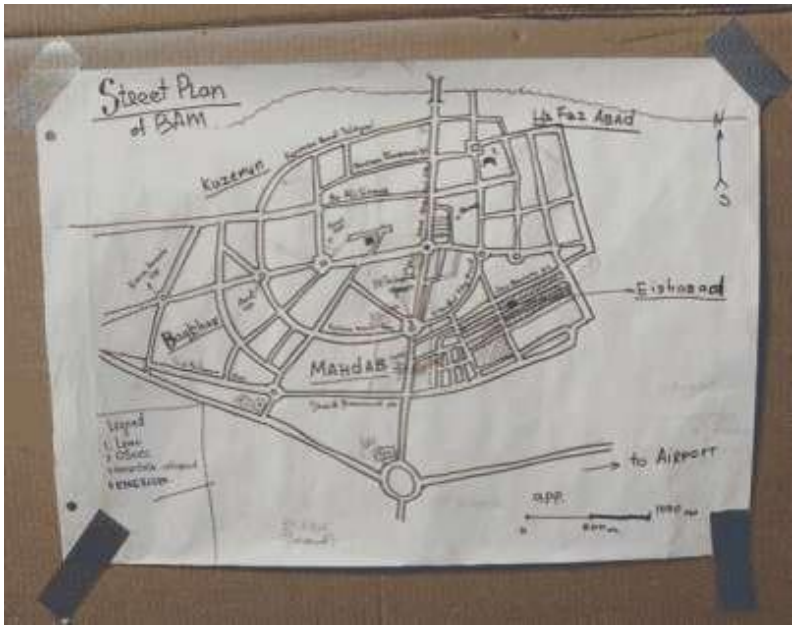
Keywords: Spatial information, Humanitarian response, Disaster management, Damage assessment, UNOSAT, UN-ASIGN, MapAction, OSOCC, UNOCHA, ESRI

1. Once upon a time

When I in the early 90s started working as a Red Cross delegate in civil war thorn Mozambique, messages from the remote provinces to HQ in Maputo were transmitted by poor HF radio communication. Radio communication was only possible at certain periods of the day due to atmospheric conditions. To make the message understandable to the receiver, the operator had to spell each word using the radio communication alphabet. Otherwise, a letter would be hand carried by a trustworthy passenger found in the provincial aerodrome before departure to the capital twice a week. The only topographic maps available was outdated maps drawn by the Portuguese colonial power for administrative purposes, and only available with approved signature from a ministry. In my work, planning humanitarian relief intervention, I often felt the lack of geographical overview and updated spatial information.

A decade later, after the earthquake in Bam, Iran 2003, causing severe damage to the town and causing the death of between 30.000 and 40.000 people with approximately 20.000 injured, the only map available to the first international responders was a hand drawn sketch map drawn from Lonely Planet Travelers Guide by Jesper Holmer Lund from UNOCHA.

Figure 1: Bam earthquake 2003, first responders sketch map drawn by Jesper Holmer Lund (UNOCHA) from Lonely Planet Travelers Guide (Source: UNOCHA).

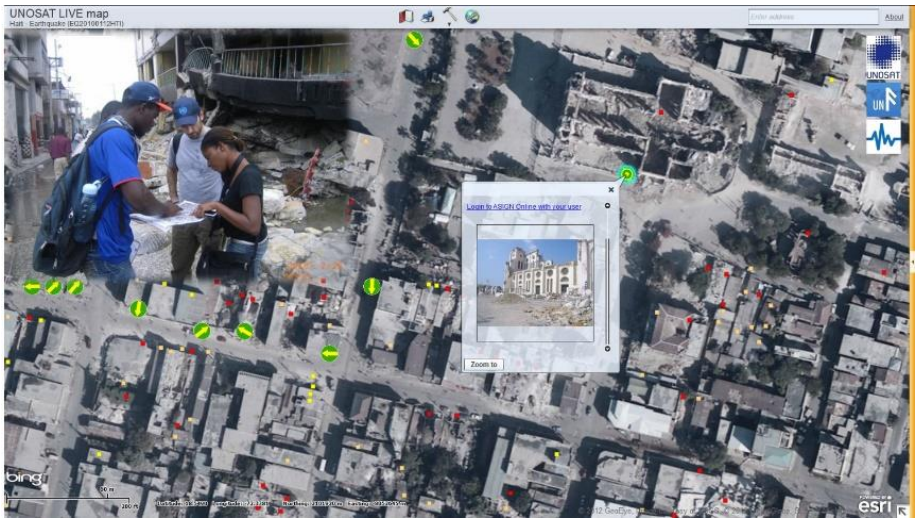


2. GIS and mobile technology

Today, fast growing space and information technologies make it possible to monitor emergencies from remote sensing, analyze and evaluate damage extent from satellite imagery and share results via web-GIS solutions. Mobile communication (smartphones, tablets and satellite communication) further enables sharing real-time spatial information with response personal in the field.

Since year 2000, UNOSAT (UNITAR's Operational Satellite Application Programme) has delivered satellite-derived analysis to support disaster management and humanitarian response. UNOSAT (a UN-programme hosted at CERN (The European Organization for Nuclear Research) in Geneva) is collaborating with a number of space agencies, research institutions and humanitarian organizations. UNOSAT is acting as a user intermediary to the International Charter on Space and Major Disaster for requests emanating from UN-agencies responding to natural disasters. The International Charter is a system of space data acquisition and delivery activated by participating space agencies in case of major natural or man-made disasters. The Space Charter provides free satellite imagery and data for UNOSAT Rapid Mapping Service to generate information and to publish maps for the use of the UN Disaster Assessment Coordination (UNDAC) teams and other operative field teams.

Fig. 2: Haiti earthquake 2010, Remote Sensing damage analysis. Source: UNOSAT



UNOSAT Rapid Mapping unit conducts analysis comparing pre- and post-event satellite imagery detecting extent of inaugurated areas, mudslides, physical damage to infrastructures or presence of dislocated population and converting the analysis into vector data for presentation in GIS. According to the dynamic of the situation, the analysis is frequently repeated to provide the most recent status of the situation. In order to constantly improve and refine the analysis, UNOSAT performs on ground verification of the results either with own staff or through partners. Thus, the analysis become more representative of the real world.

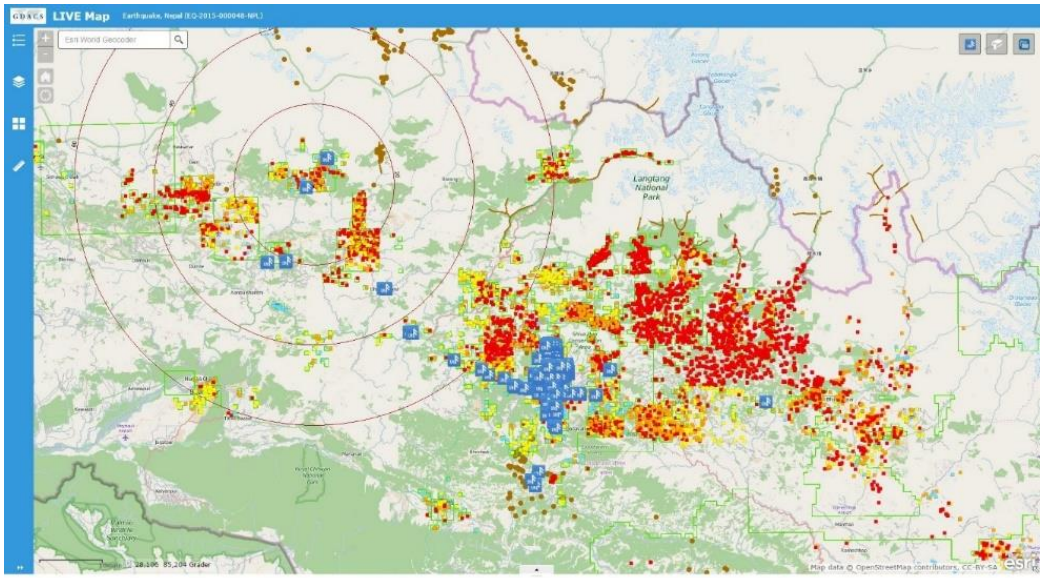
Figure 3: UNOSAT Rapid Mapping unit at CERN (source: UNOSAT).

Figure 4: Namibia floods 2008 - ground verification of flood analysis (source: UNOSAT).

In view of the apocalyptic situation after the Tsunami December 26, 2004, I got in contact with Informi-GIS. Assisted by Jan Juul Jensen from Informi-GIS, we set up a model for an online Common Operational Picture, which later became the outset for development of UNOSAT Live Map offering online scalable sharing of spatial information compiling information from various

sources and partners to one Common Operational Picture. This approach enables mash-up presentation of crowd-sourced data together with expert analysis. UNOSAT Live Map ensures that all communicating parties operates on the same map, minimizing misunderstanding and facilitating efficient and effective decision-making. Furthermore, improved overview optimizes coordination and allocation of scarce resources.

Figure 5: Nepal earthquake 2015 - UNOSAT LIVE Map compiling damage analysis and services from various organizations and agencies to one Common Operational Picture (Source: UNOSAT).



3. UN-ASIGN mobile app

Through another project, the GEO-PICTURES project, UNOSAT has in collaboration with research institutions, humanitarian organizations and private enterprises contributed to the development of a mobile solution for near-real-time sharing of spatial information between disaster management, assessment teams and response personal in the field. The mobile app, called ASIGN, for professional disaster responders developed by AnsuR Technologies enables transfer of messages and visual information direct from the field unit to the LIVE map.

In addition to ASIGN, AnsuR Technologies in partnership with UNOSAT launched the UN-ASIGN app for crowd sourcing of photos in disaster-affected areas. The UN-ASIGN app works on Android phones, iPhone and Windows phone. The crowd source photos help managers and analysts getting an overview from isolated areas, which - due to logistics and collapse of infrastructure - may not immediately be reached by the professional response personnel, may it be smaller islands (the case of Philippines typhoon) or mountain villages (the cases of Nepal and Pakistan earthquakes). A limitation to the mobile app is breakdown of mobile network in

the disaster-affected area. However, the app may also function offline for later upload via WIFI connection.

Figure 6: Nepal earthquake 2015 - UN-ASIGN crowd sourcing images from Katmandu area.

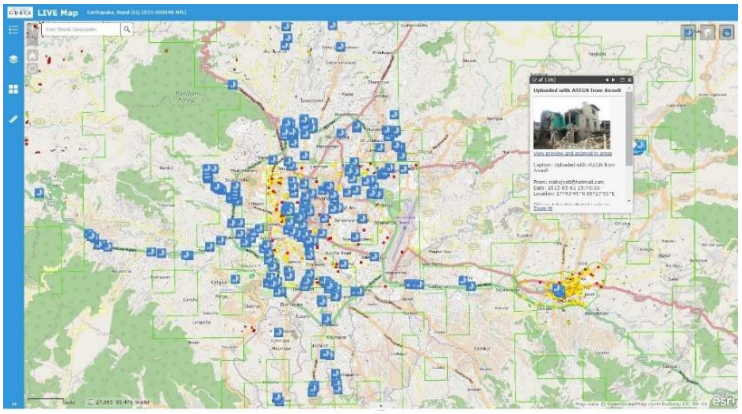


Figure 7: QR code for UN-ASIGN.

ASIGN mobile app together with UNOSAT LIVE map was in use for iterative testing at training sessions by EUCP Assessment Mission Courses at Cyprus and deployed in active operation at the humanitarian response to the typhoon Hayian at the Philippines in 2013 and the Nepal earthquake April 2015. Full-scale implementation of the GIS solutions requires an organization culture open-minded to technology and willing to invest in adequate equipment as well as training. To obtain full benefit, adequate resources must be available and new technological tools must be an integrated part of standing operative procedures.

4. UAV in humanitarian operation

In addition to applied analysis of satellite images, UNOSAT has deployed UAV (drone) technology for humanitarian response. In certain situations, there might be a request for higher resolution images for a limited area, than available remote sensing products offers. In such cases UAV (drone) technology may be the solution. In Haiti, UNOSAT provided UAV mapping with high-resolution georeferenced images and digital elevation model for an environmental project in the area of Cite Soleil. However, in addition to cost considerations, deployment of UAV technology requires thorough reflection on security, sensitivity and popular experience with flying objects. Flying UAV over a refugee settlement may be upsetting to traumatized people.

Figure 8: Haiti environmental project Cite Soleil 2011 - UAV Sense-fly mapping (source: UNOSAT)

5. GIS in the field

In the field, MapAction is the major implementing partner bringing spatial information in operative action. MapAction is a volunteer organization providing spatial information support to disaster managers in the OSOCC (On-Site Operations Coordination Centre) operated by UNOCHA (UN Office for the Coordination of Humanitarian Affairs). The OSOCC provides support and coordination to all participating partners in a humanitarian response operation aiming at efficient and effective use of all joint efforts and resources. MapAction produces ad hoc spatial information products according to immediate needs such as maps, analysis and reports to support the operative management and decision makers. In the field, MapAction may have an intermediate role in interpretation and presentation of spatial information from agencies like UNOSAT. During the international cross-border exercise TRIPLEX 2013 on the border between Denmark and Germany, I represented UNOSAT in the field in collaboration with MapAction and AnsuR Technologies presenting UNOSAT LIVE map and ASIGN mobile app.

Figure 9: TRIPLEX 2013 – UNOSAT GIS/mapping section at OSOCC (On-Site Operations Coordination Centre) (source: UNOSAT)

Recent development of ArcGIS Online makes the LIVE map and ASIGN app in combination with ArcGIS Collector App a powerful tool for the sharing of spatial information and recording information in the field.

Challenges

GIS and Web GIS solutions are powerful tools in humanitarian emergency response and disaster management. However, full and efficient implementation of new technology also represents new challenges to the humanitarian environment of both technical and organizational nature. Data foundation may be the major technical challenge ensuring data quality and reliable data capturing in highly dynamic settings. Recent refugee movements through Europe, where movements changed rapidly and refugees sought new routes due to the closing of borders, is an illustrative example of rapid changing environment in emergencies.

Another challenge is transfer of large data amounts through narrow communication channels. Mostly, normal communication system will be broken down in disaster prawn areas. There is a need for solutions enhancing fast information update outside the digital highways and offline solutions for continued work in disconnected scenarios. Likewise, it is essential to use standard equipment not requiring technical experts and import of special equipment. Bringing in expensive special equipment to an emergency area may cause costly delays for custom clearance.

In regard of organizational challenges, basic understanding of GIS and geographical information and staff training on various levels are crusial. Normally, response and management personnel in humanitarian operations are not technicians. It is crucial, that the end user consider GIS and spatial information as a helpful tool facilitating the response activities and not just another obstacle in an already difficult and stressful environment. Integration of training for basic understanding of GIS and spatial information into standard preparation of response personnel is crucial to ensure response personnel are familiar with the technology before deployment to the field.

Finally yet importantly, support by decision makers is crucial to efficient and effective implementation of GIS solutions as part of standing procedures in humanitarian response. As stated by Roger Tomlinson (2007) in his *Thinking about GIS*, management support to resource allocation, costs and staff training is vital to efficient implementation of GIS in any organizational settings.

6. References

***Books**:*

Tomlinson, Roger (2007). *Thinking about GIS: Geographic Information System Planning for Managers*, Redlands, California: ESRI Press.

***Web-based articles**:*

UNOSAT/UNITAR (2015). *Putting it All Together – How UNOSAT Makes Sure Earthquake Relief and Early Recovery in Nepal can Count on Integrated Geo-Spatial Information*, UNOSAT/UNITAR, at https://www.unitar.org/putting-it-all-together-how-unosat-makes-sure-earthquake-relief-and-early-recovery-nepal-can-count-integrated-geo-spatial-information, [accessed 12 October 2015].

UNOSAT/UNITAR (2015). *UNOSAT Analysis Reveals Nepal Earthquake Damage*, UNOSAT/UNITAR, at https://www.unitar.org/unosat-analysis-reveals-nepal-earthquake-damage, [accessed 12 October 2015].

UNOSAT/UNITAR (2015). *UN and European Union test UNOSAT live maps in civil protection exercise*, UNOSAT/UNITAR, at http://www.unitar.org/un-and-european-union-test-unosat-live-maps-civil-protection-exercise, [accessed 12 October 2015].

UNOSAT/UNITAR (2015). *UNESCO and UNITAR-UNOSAT Team Up to Protect Cultural Heritage with the Latest Geo-Spatial Technologies*, UNOSAT/UNITAR, at https://www.unitar.org/unesco-and-unitar-unosat-team-protect-cultural-heritage-latest-geo-spatial-technologies, [accessed 12 October 2015].