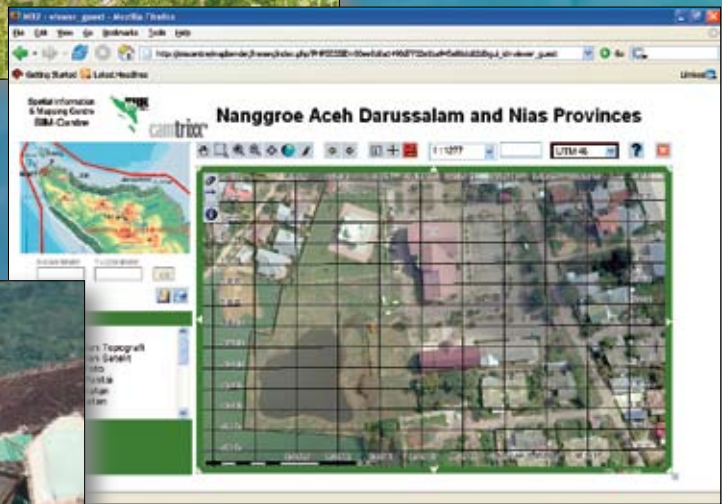


# GIS for Disaster Recovery



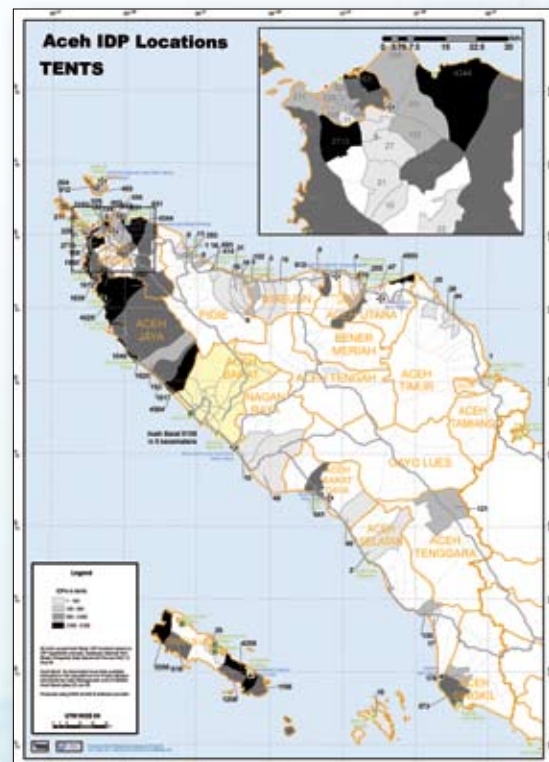


# GIS Use in Aceh Province and Nias Islands, Indonesia, after the 2004 Indian Ocean Tsunami

December 26, 2004, ushered in the largest natural disaster in recent history. A magnitude 9.1 earthquake and resulting tsunami brought incredible devastation to many countries in Southeast Asia. Countries including Sri Lanka and Thailand saw massive human casualties as well as the demolition of houses, roads, hospitals, and even entire villages.



*Epicenter of Magnitude 9.1 Indian Ocean Earthquake Occurring on December 26, 2004. Credit: WorldSat Int'l, Inc., and ESRI Data & Maps CD 2002*



Immediately after the tsunami, more than 300,000 people were missing or deceased. Maps displaying tents for those displaced were created quickly to assist agencies needing to get supplies to those who had nothing after the disaster.



No country was more affected than Indonesia. A wave purported to be 30 meters high hit the province of Nangroe Aceh Darussalam (Aceh) on the northern tip of Sumatra. The devastation affected 800 kilometers of coastline. In some villages, up to 90 percent of the residents lost their lives.

For a region already suffering from neglect and civil turmoil, even a small emergency would have been difficult to handle. Faced with such an insurmountable event as the tsunami and ensuing magnitude 8.6 earthquake a few months later, the world community came to the region's aid seemingly overnight and launched the largest relief effort ever undertaken.



*Images of Destruction from the Tsunami throughout Aceh. Credit: Joerg Meier, Aceh Besar*



# First Response

From the beginning, geographic information system (GIS) technology played an important role in guiding emergency responders to affected areas and mapping the impact to coordinate the relief effort.

This was no easy task, as large areas of land were no longer suitable for housing because of the impact of the tsunami and earthquake. The land that remained had to be cleared of tons of debris and silt before it could be used again. Landownership had to be established before houses could be rebuilt.

The destruction affected all levels of service including water, sewer, and electricity, all of which had to be reestablished in the communities. Even the transportation of supplies and labor force to affected areas was hampered since the single road along the west coast had been either severely damaged or completely washed away in large sections.

Another issue faced by first responders was finding current and accurate maps. The national mapping agency Badan Koordinasi Survei dan Pemetaan Nasional (Bakosurtanala) provided 1:50,000 scale maps with complete coverage in North American Datum (NAD), but many times, infrastructure for the province itself was not up to date.



*1:50,000 scale maps were available, but the tsunami rendered many of them out of date.*



*Satellite Imagery of the Changed Coastline*

“While it’s fine to assume that all countries have regular data collection programs, the reality is that most disasters occur in areas where there is little accurate information,” says Paul Harris, advisor to Spatial Information & Mapping Centre (SIM-Centre), Badan Rehabilitasi dan Rekonstruksi (BRR). “The importance of having a national mapping agency that has a regular program of data collection was really exemplified in the face of this emergency.”

Within days of the devastation, the United Nations (UN) set up a Humanitarian Information Center (HIC) in Sumatra. Based in tents in the heart of the catastrophe, HIC collected data from the Indonesian government, nongovernment organizations (NGOs), and international agencies. Using ArcGIS® software from GIS and mapping software manufacturer ESRI, UN HIC delivered this information, including GIS data and maps, to the responding humanitarian community, allowing it to deliver assistance more effectively immediately after the emergency.



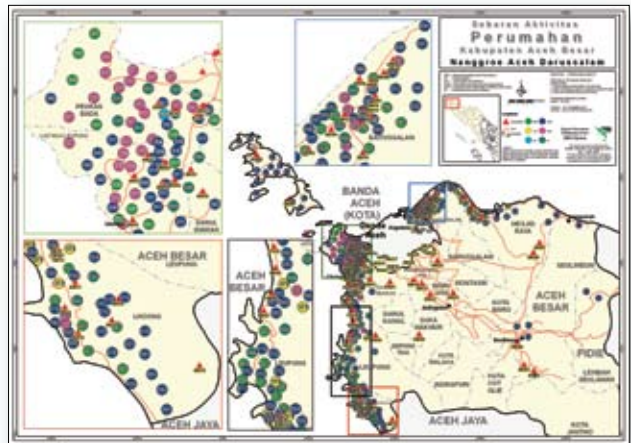
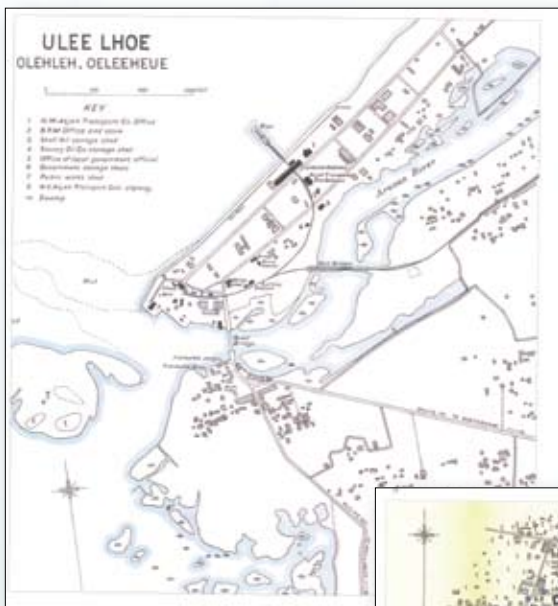
*UN HIC responded as quickly as possible to the emergency by providing an area for mappers and analysts in the field.*



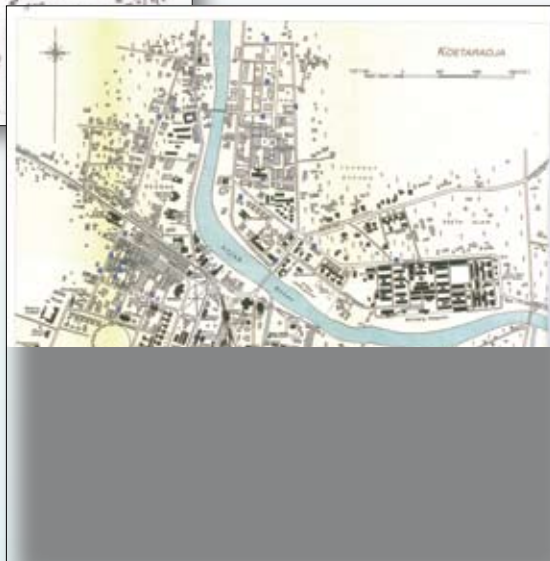
UN HIC tried to enhance existing vector data by acquiring high-resolution satellite imagery. Unfortunately, a complete image of the area was unobtainable because of heavy cloud cover. UN HIC supplemented sporadic satellite images by scanning decade-old topographic maps and using them as an initial base.

The organizations made extensive use of GIS in the production of maps for humanitarian work including maps of injured or displaced people and damage assessments.

Among the most valuable products produced by UN HIC was a map of where each organization was working, so information could be communicated quickly to relief workers scrambling to aid those affected by the devastation.



*Banda Aceh has a rich history of mapmaking as shown in these 19th century Dutch colonial maps.*





# GIS Aids Emergency Workers

Apart from providing informative topographic maps to coordinate relief efforts, GIS was used in specific sectors during the initial response to the disaster including the following:

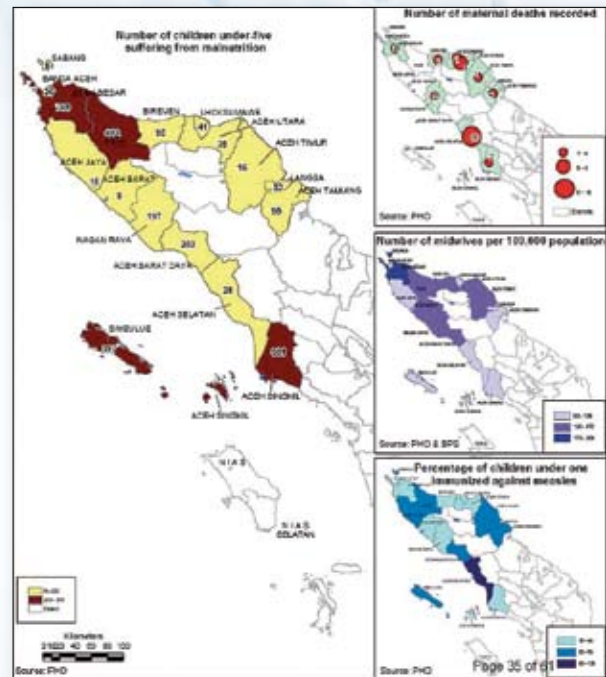
## Health

Directly after the tsunami, the most immediate concerns were containment of any outbreak of disease and prevention of further deaths as a result of starvation. Information on the location and number of survivors, as well as the extent of their injuries, was urgently needed in order to provide food, water, and medical supplies.

The UN HIC team, working with the UN World Health Organization (WHO), set about collating and evaluating data using GIS to create an accurate picture of the damage and prioritize need. Activities were coordinated and prioritized; field hospitals and mobile health clinics were set up in the places they were needed. No major outbreak of disease occurred, and there were few deaths from starvation, contrary to expectation after a disaster of this magnitude.



Mobile Health Clinics



UN HIC worked with WHO to collect and evaluate data using GIS to create an accurate picture of the damage and prioritize need.

## Mobile Resource Planning

Since the main west road and all seaports were not usable, transporting food, water, and medical supplies seemed nearly impossible. GIS was used to plan movement of trucks and prioritize shipments.



GIS was used to plan movement of trucks and prioritize shipments of goods throughout the region. Credit: Joerg Meier, Aceh Besar

## Infrastructure

After the tsunami, many groundwater reservoirs were polluted, sanitation at temporary shelters was an issue, and drinking water had to be trucked in to the city. GIS was used to identify risk areas and develop management plans to deal with this.



*GIS was an invaluable tool in analyzing infrastructure.*

## Education

Since 50 percent of the schools in the area were damaged or destroyed, GIS was used to discover where best to build, or not build, new schools based on population analysis and proximity to health facilities. An assessment of damaged facilities was also taken to identify which could be restored more quickly.



*GIS maps helped agencies rebuild and repair more than 100 educational facilities in the region, allowing children to return to school.*

## Housing

The simple act of providing shelter presented many challenges. More than 600,000 people were left homeless when 150,000 houses were destroyed. Some land had completely washed away and traditional land markers had vanished. Land that remained had to be cleared of millions of tons of debris and silt before it could be used again, and many areas were no longer suitable housing locations because of the impact of the earthquake.

The aid community responded to the problem by going to the field to map where houses once stood and determine who owned the properties. Pseudo titles were issued with the signatures of all neighbors and the village leader.

Building shelter continues to be a challenge, as initially there was no mandate to coordinate rebuilding among the various agencies. The government, through its reconstruction and rehabilitation agency BRR NAD-Nias, performs this coordinating role and continues to focus its resources on coordinating activities including spatial planning, village mapping, community planning, engineering design, and house building. GIS was seen as a crucial tool to assist this coordination among the various agencies as they scrambled to rebuild. Recovery programs are now focused on rebuilding houses and infrastructure and restoring livelihoods.



*Temporary Shelter  
Credit: HIC, Aceh Besar*



*Credit: WFP, Charlie Higgins*



## Meeting Changing Needs



*SIM-Centre staff from left to right: Aliman Selian, Augusta Mindry, Revico Fajarul, Yokab Isbadamy (Manager), Gemma Bailey, Akhyar Hassan, Seto Adi. Not pictured: Wanti P. Diani, Richard Kidd, Paul Harris*

As the relief efforts transitioned into recovery and development, the focus of UN HIC shifted as well. In September 2005, HIC was renamed the United Nations Information Management System (UNIMS), and its mission changed to reflect the need for better coordination with the Indonesian government as well as to continue to meet the high demand for GIS during the next rehabilitation and reconstruction phase.

Data collection, collation, and dissemination continued to be provided at no cost to the agencies that needed it. UNIMS provided ArcGIS software and a staff of 40 to keep up with demand.

To provide closer support to the Indonesian government, GIS software, data, and expertise were successfully transitioned from UNIMS to the Indonesian government in February 2006. The SIM-Centre was established.

Partially funded by a grant from the Norwegian government and United Nations, SIM-Centre is part of a temporary building and reconstruction arm of the Indonesian government in the province. BRR NAD-Nias continues to oversee the work of the humanitarian agencies and ensure that the needs of the local population are met. It will function until the middle of 2008, when its activities will be absorbed into the standard provincial departments of the Indonesian government.



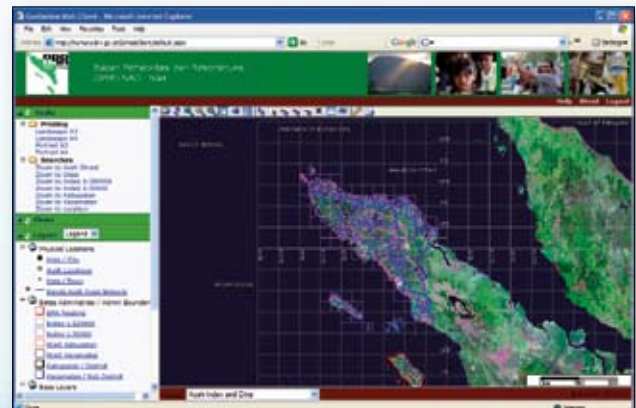




*A GIS user group has started meeting in the area every six weeks. All GIS users in Aceh Province are invited to attend.*

SIM-Centre has also created and continues to support a GIS user group and GIS consortium to advance the use of GIS in the area. A user group meeting is held every six weeks, and all GIS users in Aceh Province are invited to attend. The consortium is a voluntary group of passionate GIS professionals from more than 20 agencies who come together to discuss the current and future use of GIS in the province.

Currently, the GIS consortium is finalizing a customized training manual for ArcGIS. The manual is written in Bahasa Indonesian and based on Aceh Province datasets. The consortium, supported by GTZ-SLGSR, held the first training class in July 2006, successfully training 18 government staff from 12 agencies, and plans to host more in the near future.



*SIM-Centre not only provides online GIS and information but also fills hundreds of requests for specialized datasets and thousands of printed maps.*

To effectively manage the map work requested of it, SIM-Centre employs a full-time staff of eight. The province is divided into six regions with one staff member responsible for the gathering, QA/QC, and maintenance of data in each region. SIM-Centre maintains vector roads, aerial photographs, UN reports, and catalogs of available maps. It offers data and system coordination and integration, large-format printing for both standard and customized mapping, support on BRR projects, and GIS training.

To date, SIM-Centre has trained 192 people in the use of GIS and GPS. It has filled approximately 1,200 client requests for GIS data and printed more than 4,900 maps.



## The Road Ahead

It may well take decades for affected communities to fully recover from the devastation. As the acute humanitarian risks are mediated, the long-term challenges of sustainable development, repatriation, relocation, and sanitation will need to be addressed.

SIM-Centre continues to work closely with BRR and the local government to train staff, create an SDI, and maintain a comprehensive GIS database.

“The area will continue to develop well after the international aid community has left the area,” says Yakob Ishadamy, SIM-Centre manager. “GIS has a role to play by providing information to government officials and others to support their efforts. The reconstruction, economic, and social factors involved all have a time and space component. GIS provides an invaluable framework for building an information base and providing the best decision support, communication, and collaboration possible.”



*Thanks to the international aid community and the government of Indonesia, the future is bright for these Acehnese children.  
Credit: WFP, Rein Skullerd*



*The international community is now focusing on livelihoods and rebuilding. Credit: HIC, Aceh Besar*



*Credit: Rob Richardson, CRS*

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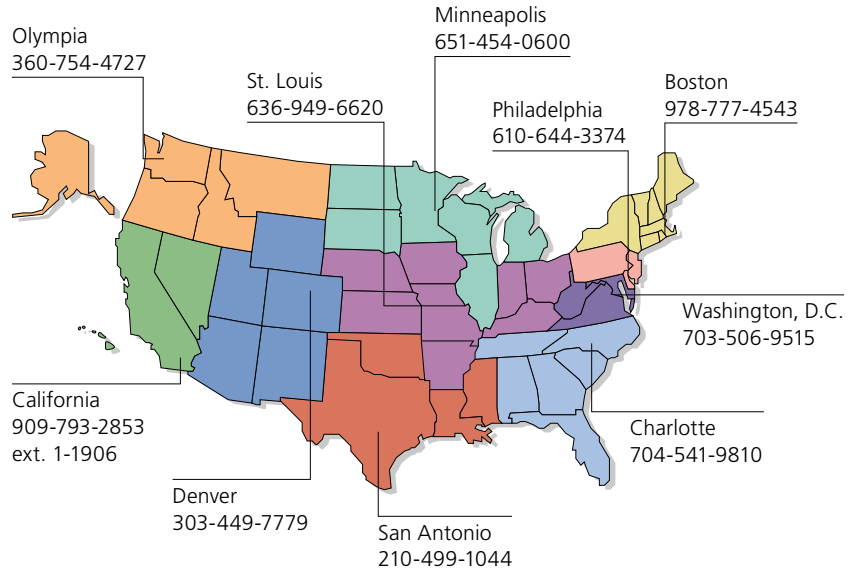
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