



Remote sensing in the aftermath of large water related disasters:

from Relief to Development

*Examples from the Indian Ocean Tsunami
and the hurricane Mitch*

Alain RETIERE

UNOSAT

United Nations / Austria / European Space Agency Symposium

**SPACE SYSTEMS: PROTECTING AND RESTORING WATER RESOURCES
13-16 September 2005, Graz, Austria**

Background

- The Brahimi report on improving UN Peacekeeping Operations identified the use of satellite imagery and Geographic Information Systems (GIS) as a key tool to better cope with civil unrest and restoring peace in war-torn societies.
- The report also identified a need for a single entity (one-stop-shop) within the UN to take on such a service.
- UNOSAT was created to respond to these needs and to assist the UN and its implementing partners in general with geographic information services.

What is UNOSAT ?

- A project born in 2001, and now a UNITAR (United Nations Institute for Training and Research) operational programme executed by UNOPS (United Nations Office for Project Services)
- Implemented by a UN-private consortium with support from the European Space Agency (ESA), the European Organization for High Energy Physics (CERN) and the French Space Agency (CNES)
- Government support from Norway and France



UNOSAT - created to respond to needs of UN, NGOs, local authorities



Difficult access to reliable geo-information for territorial management in the context of natural and man-made disasters in disadvantaged countries

GIS technologies: growing interest in humanitarian and development communities

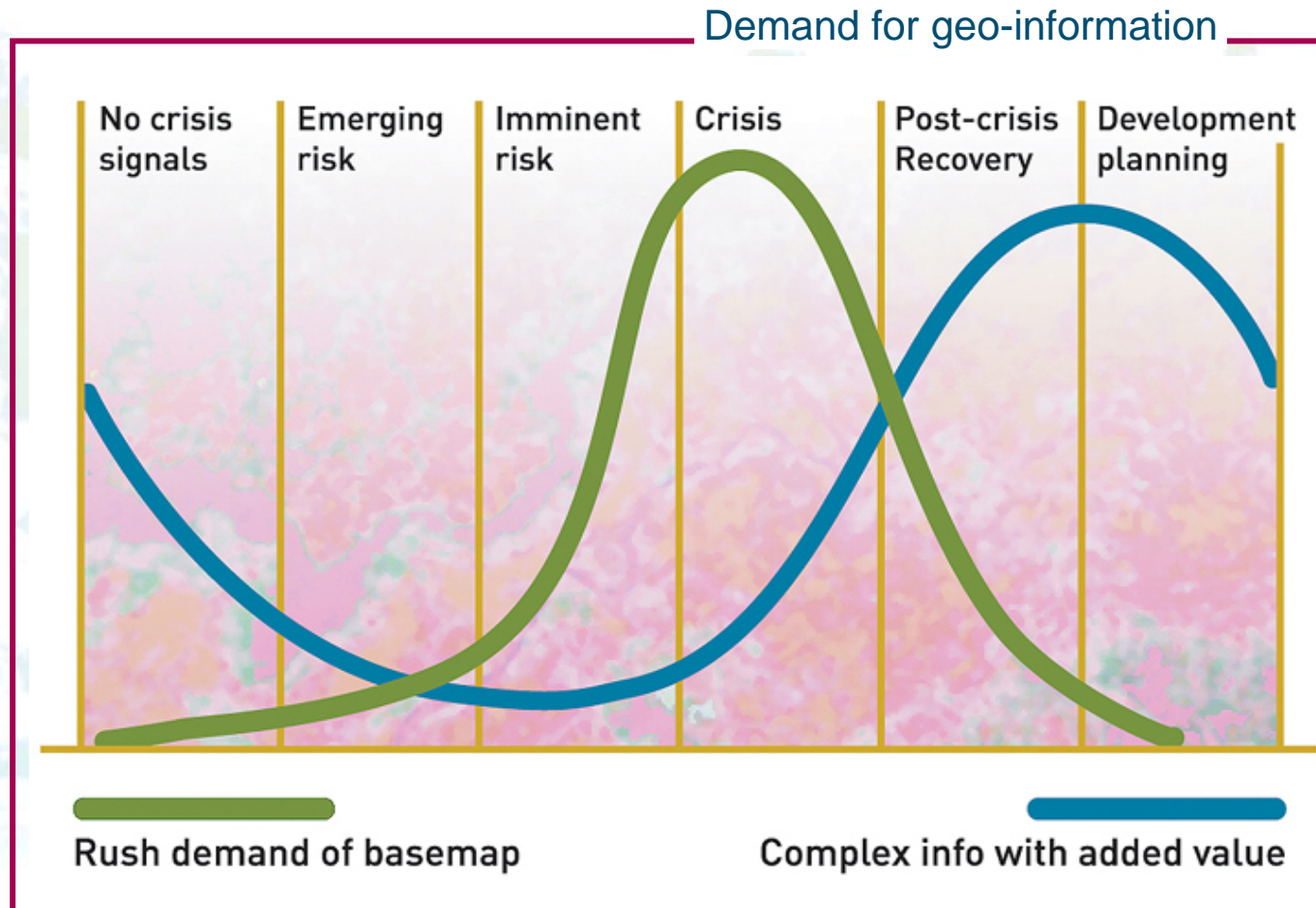
Satellite imagery: still expensive and complex to handle and process but source of reliable geo-information especially during crises

WEB access: digital divide adds a comparative disadvantage for developing, transition and crisis countries, so contributing to bridge it is a key priority

UNOSAT's wide and integrated services

- Methodological guidance and project formulation
- Selection and procurement of satellite imagery
- Cartographic products (space map, digital elevation models, ...)
- Thematic products (land cover, change detection, natural risk assessments etc.)
- Rapid mapping service (natural disasters and crises)
- Turnkey solutions (projects)
- Database hosting and customized web interface development
- E-training and on-site capacity building
- On-line, desk and on-site technical assistance

UNOSAT works in all operations phases - with varying demands for geographic information



International Charter "Space and Major Disasters"



www.disasterscharter.org

- to strengthen the bridge between space and risk communities
- space agencies contribute to free satellite imagery during natural disasters
- images need to be converted into information and maps (which has a cost)
- open to International Humanitarian Community since July 2003



United Nations
Office for Outer Space Affairs

UNOSAT 
satellite imagery for all
www.unosat.org

Charter Call 79

Indian Ocean Tsunami

(1)

Emergency starts at 26/12/04 11:00AM GMT

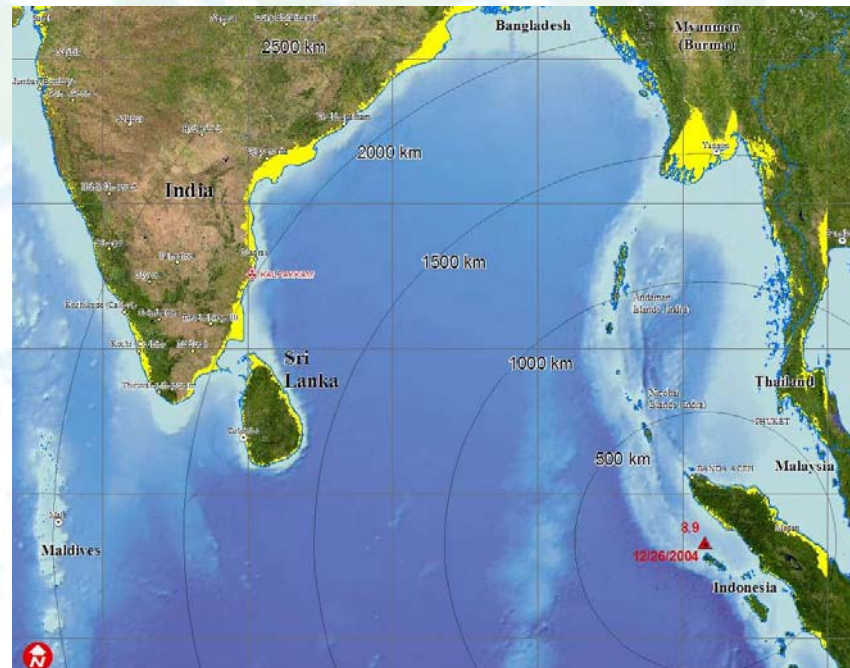
- Internal consultation
- Call and coordinate with OCHA (Virtual OSOCC)
- Calls from UN, NGO, Media, Space agencies, GO
- Request OOSA to trigger the Charter on 27/12/04 4:00 PM GMT for Sumatra, Thailand and Maldives (Sri Lanka and India done already by ISRO and CNES)
- Nomination as PM (ordering data from 13 satellites from CNES, ESA, CSA, ISRO, CONAE)

Data processing starts on 27/10/04

- Archive space-maps
- Population density maps
- Topographic maps
- Crisis space maps
- Change detection and pre-post crisis maps
- Damage assessment maps

Crisis Management to Development at the local level

Indian Ocean Tsunami example



Charter Call 79

Indian Ocean Tsunami

(2)

Data dissemination starts on 28/12/04

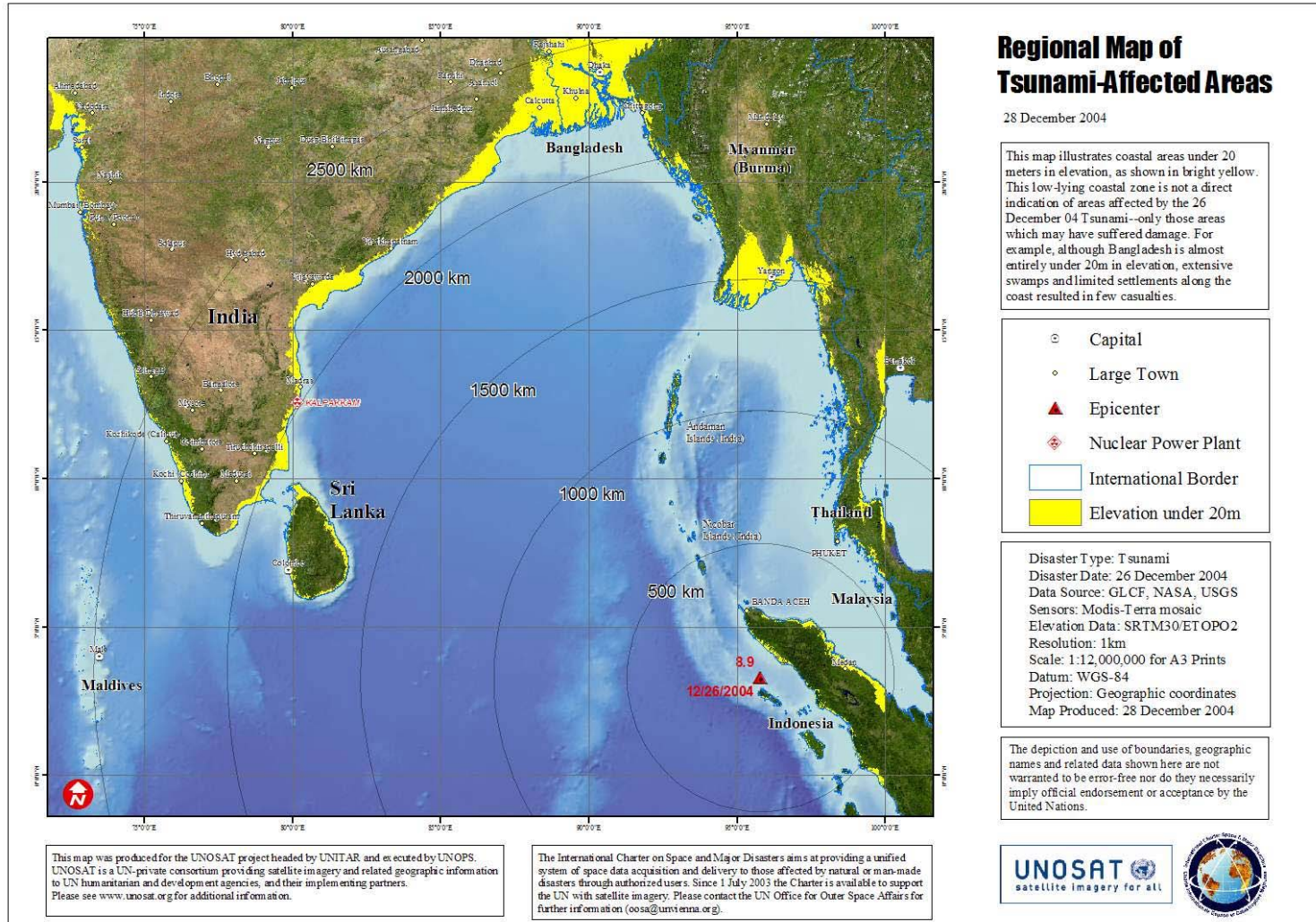
- Publishing of maps at www.unosat.org (updated every 6 hours, 40,000 downloads in 10 days)
- Active coordination and cooperation with UNEP Grid Geneva, JRC, SERTIT, CNES, ESA, CSA, ISRO, DLR.
- Letter sent to the Secretary General and to all PR of the member states
- Dissemination on partner portals (Charter, ReliefWeb, IFRC-EIS, AlertNet)
- Pushing information availability through SMS virtual OSOCC system

Integration of user feedback starts on 31/1/05

- With humanitarian organizations
- With UN colleagues: OCHA, UNDP, UNEP, UNJLC, WFP, FAO, WHO, etc...
- With national civil defense and disaster management institutions
- With affected local communities (training request 2nd week)
- With donors (WB office in Djakarta, ECHO, UNDP, etc...)

Products delivered

Satellite imagery to support to emergency response and reconstruction



Regional Map of Tsunami-Affected Areas

28 December 2004

This map illustrates coastal areas under 20 meters in elevation, as shown in bright yellow. This low-lying coastal zone is not a direct indication of areas affected by the 26 December 04 Tsunami—only those areas which may have suffered damage. For example, although Bangladesh is almost entirely under 20m in elevation, extensive swamps and limited settlements along the coast resulted in few casualties.

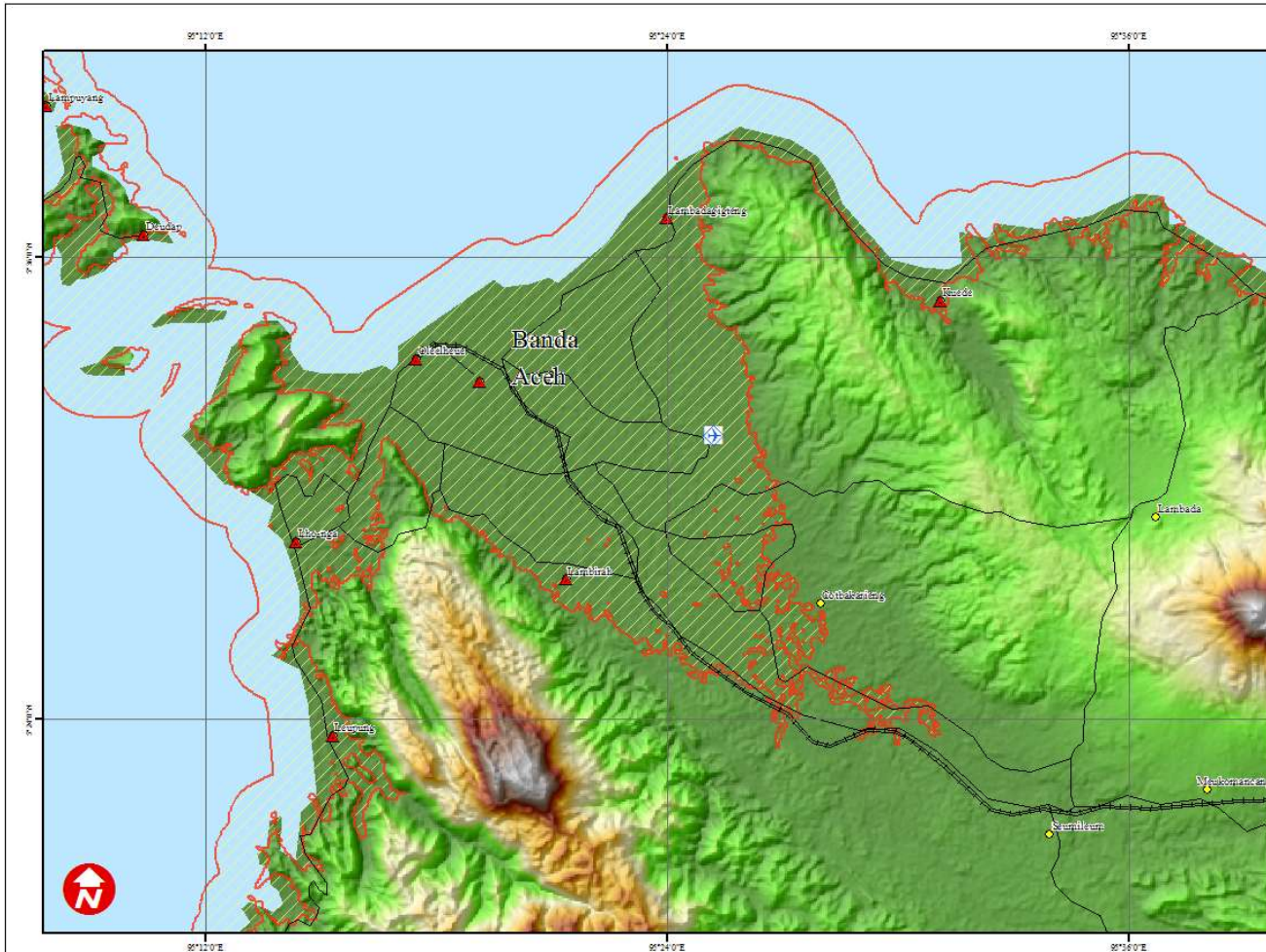
- ⊙ Capital
- ◊ Large Town
- ▲ Epicenter
- ⊛ Nuclear Power Plant
- ▭ International Border
- Elevation under 20m

Disaster Type: Tsunami
 Disaster Date: 26 December 2004
 Data Source: GLCF, NASA, USGS
 Sensors: Modis-Terra mosaic
 Elevation Data: SRTM30 ETOP02
 Resolution: 1km
 Scale: 1:12,000,000 for A3 Prints
 Datum: WGS-84
 Projection: Geographic coordinates
 Map Produced: 28 December 2004

The depiction and use of boundaries, geographic names and related data shown here are not warranted to be error-free nor do they necessarily imply official endorsement or acceptance by the United Nations.

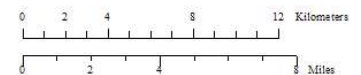
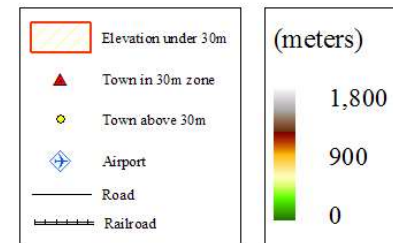
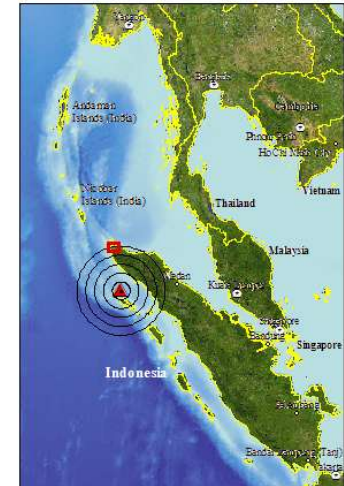
This map was produced for the UNOSAT project headed by UNITAR and executed by UNOPS. UNOSAT is a UN-private consortium providing satellite imagery and related geographic information to UN humanitarian and development agencies, and their implementing partners. Please see www.unosat.org for additional information.

The International Charter on Space and Major Disasters aims at providing a unified system of space data acquisition and delivery to those affected by natural or man-made disasters through authorized users. Since 1 July 2003 the Charter is available to support the UN with satellite imagery. Please contact the UN Office for Outer Space Affairs for further information at ooesa@unviena.org.



Elevation Map of Banda Aceh Region

28 December 2004



The International Charter on Space and Major Disasters aims at providing a unified system of space data acquisition and delivery to those affected by natural or man-made disasters through authorized users. Since 1 July 2003 the Charter is available to support the UN with satellite imagery. Please contact the UN Office for Outer Space Affairs for further information (ooasa@unvienna.org).

Disaster Type: Tsunami
Disaster Date: 26 December 2004
Data Source: GLCF, JPL, USGS, Global insight
Elevation Data: SRTM (3 arc second)
Resolution: 90m horizontal 16m vertical
Scale: 1:200,000 for A3 Prints
Datum: WGS-84
Projection: Geographic Coordinates
Map Produced: 28 December 2004

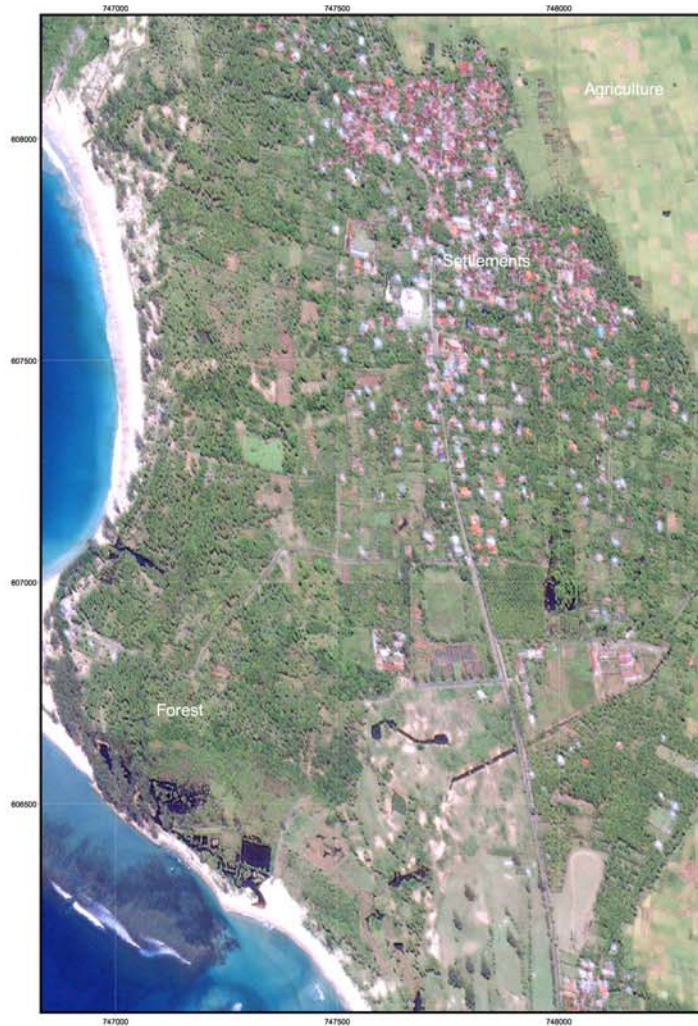
This map illustrates coastal areas under 30 meters in elevation, as well as towns which fall within this zone. The 30m value was selected to account for the margin of vertical error with the SRTM dataset (~15 meters). The 30m coastal zone is not a direct indication of areas affected by the 26 December 04 Tsunami—only those areas which may have suffered damage.

This map was produced for the UNOSAT project headed by UNITAR, and executed by UNOPS. UNOSAT is a UN-private consortium providing satellite imagery and related geographic information to UN humanitarian and development agencies, and their implementing partners. Please see www.unosat.org for additional information.

The depiction and use of boundaries, geographic names and related data shown here are not warranted to be error-free nor do they necessarily imply official endorsement or acceptance by the United Nations.

Indonesia - Banda Aceh Subset 3


IKONOS - January 10, 2003 - PRE-DISASTER IMAGE







1 : 5000

IKONOS - December 29, 2004 - POST-DISASTER IMAGE



 **Center for Satellite based Crisis Information**
- Emergency Mapping & Disaster Monitoring -

German Remote Sensing Data Center 
German Aerospace Center






Interpretation

The map shows an area north of the village of Lho-ga on the northwestern coast of Sumatra (Indonesia) before and after the devastating Tsunami food wave, which struck many countries in the Indian Ocean on December 26, 2004. The IKONOS images were taken on January 10, 2003 and December 29, 2004, respectively.

The region of Banda Aceh is one of most severely damaged areas. The Tsunami swashed up to two kilometers inland and destroyed major parts of the coastal plains, including settlements, forests and farmland.

Scale




1 : 5000

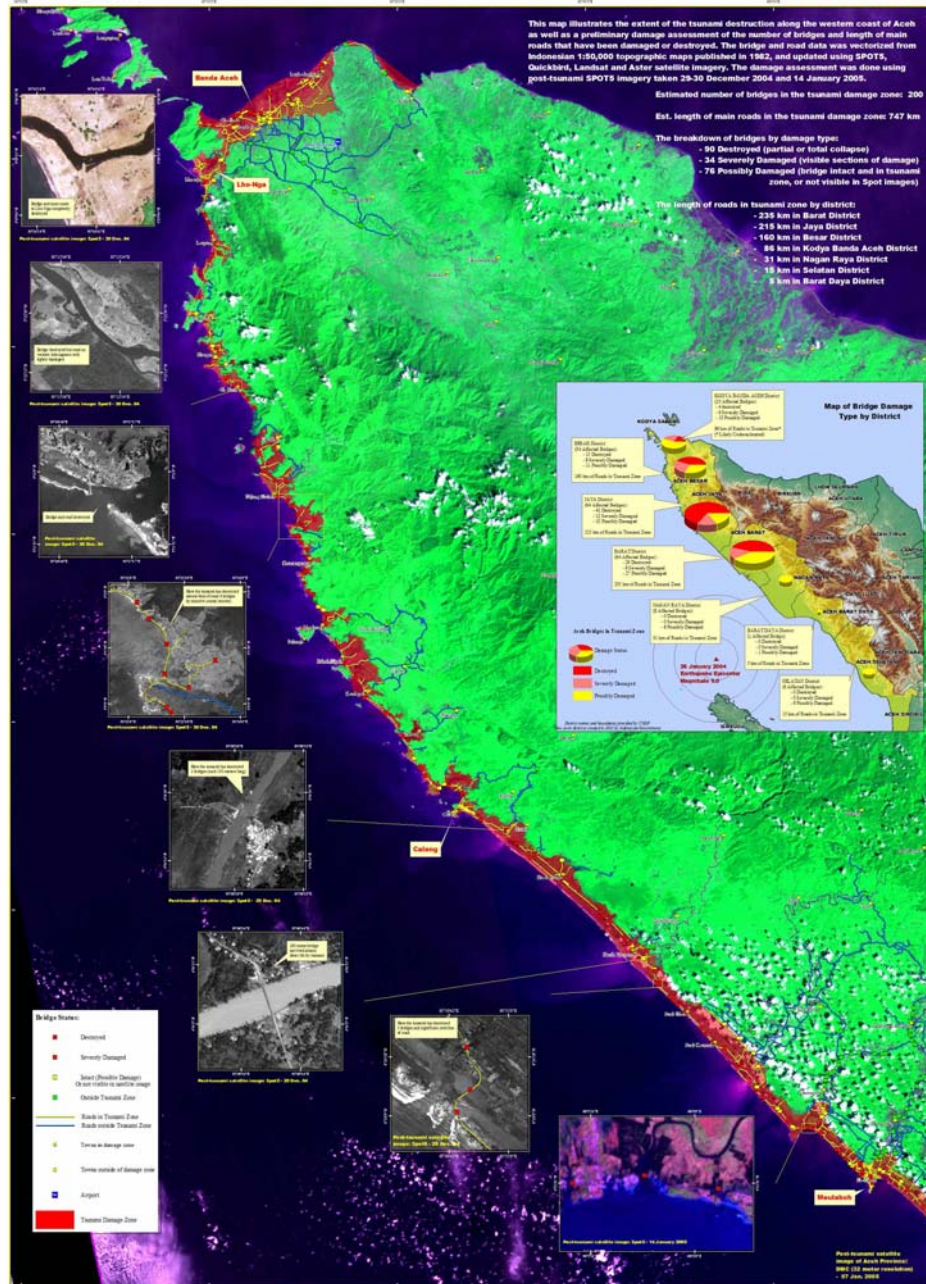
Projection: UTM Zone 46 N
Spheroid: WGS84
Datum: WGS 84

Data Source

IKONOS imagery provided through
Centre for Remote Imaging,
Sensing and Processing (CRISP)

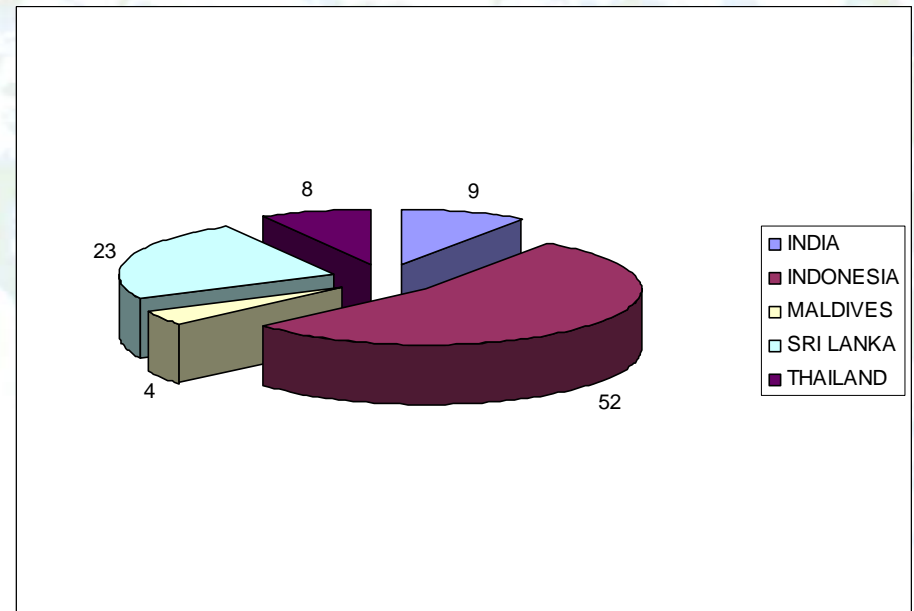

Visual Information, Visual Results

Map created December 30, 2004 by ZIG@DLR.DE



Sensors used & Products delivered

Sensors	Amount of Images
QUICK BIRD	377
IKONOS	95
SPOT5	43
ENVISAT	36
LANDSAT7	31
RADARSAT	23
DMC	18
IRS-6P	16
MERIS	12
ORBVIEW	4



Maps produced per area

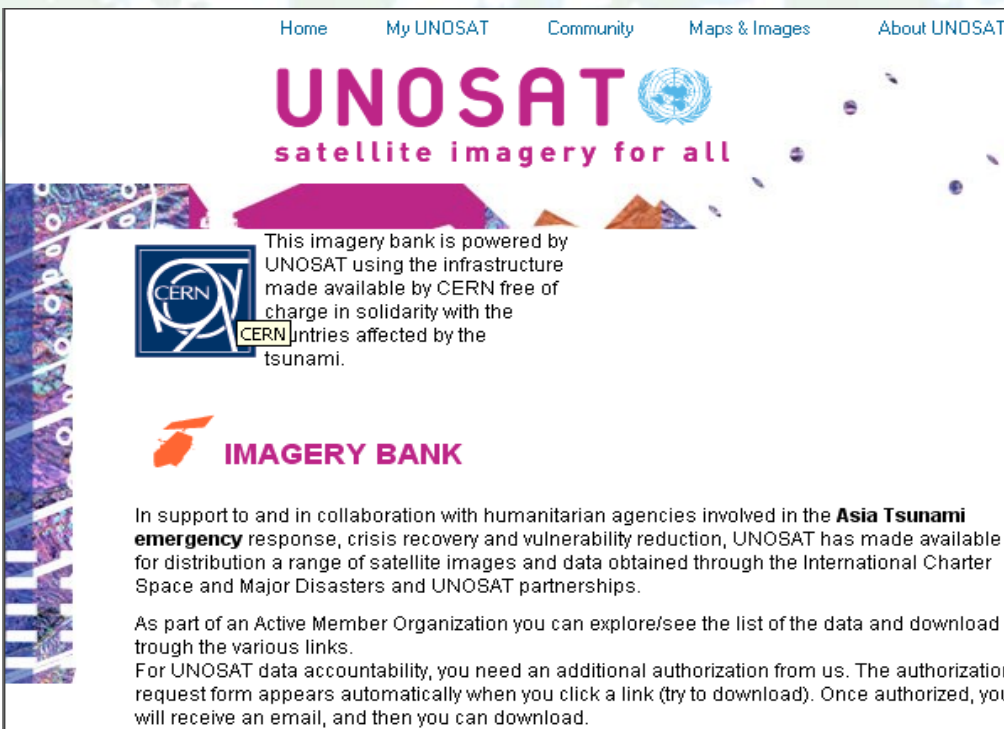
Total	655
--------------	------------

Satellite images in Imagery Bank

UNOSAT Imagery Bank

UNOSAT has developed **IMAGERY** Bank for the benefits of all the humanitarian community:

- secured database, developed in less than one week,
- more than 650 images hosted (500 Go),
- available for any Humanitarian organization,
- maintained by UNOSAT.

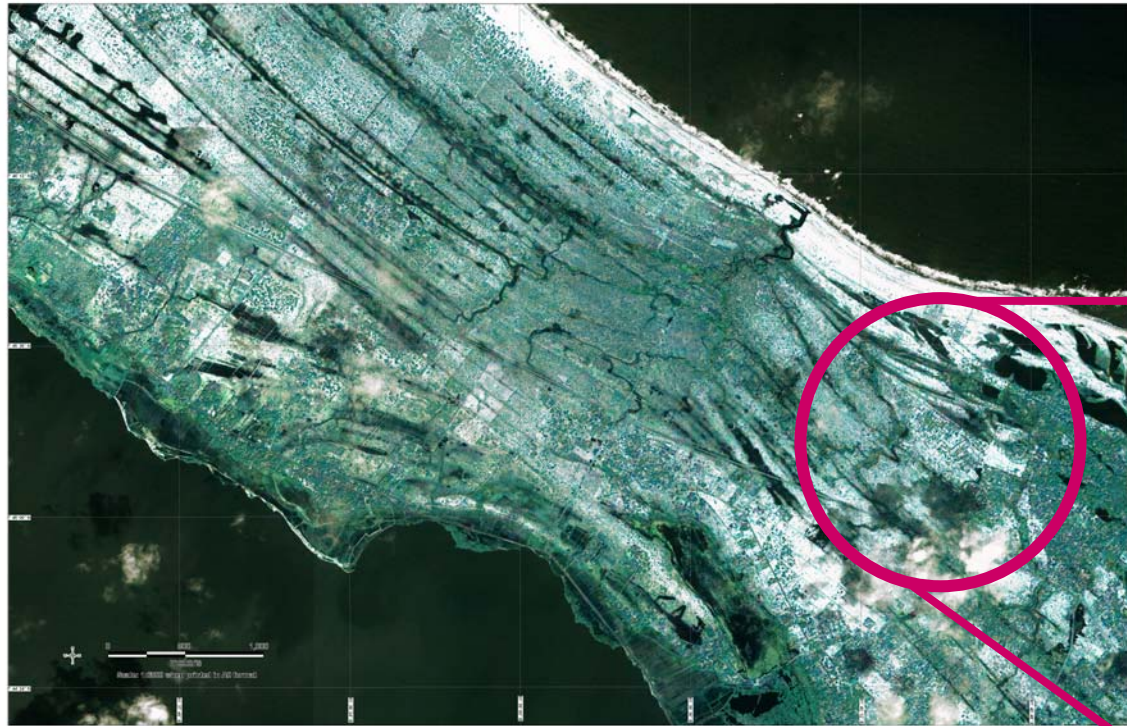


The screenshot shows the UNOSAT website interface. At the top, there is a navigation menu with links: Home, My UNOSAT, Community, Maps & Images, and About UNOSAT. Below the menu is the UNOSAT logo and tagline 'satellite imagery for all'. A central text block states: 'This imagery bank is powered by UNOSAT using the infrastructure made available by CERN free of charge in solidarity with the CERN countries affected by the tsunami.' To the left of this text is the CERN logo. Below the text is a red and orange graphic with the words 'IMAGERY BANK'. At the bottom, there is a paragraph of text: 'In support to and in collaboration with humanitarian agencies involved in the Asia Tsunami emergency response, crisis recovery and vulnerability reduction, UNOSAT has made available for distribution a range of satellite images and data obtained through the International Charter Space and Major Disasters and UNOSAT partnerships. As part of an Active Member Organization you can explore/see the list of the data and download through the various links. For UNOSAT data accountability, you need an additional authorization from us. The authorization request form appears automatically when you click a link (try to download). Once authorized, you will receive an email, and then you can download.'

From 10 January 2005 to 5 April 2005, 1923 images have been downloaded by the following users:

- 1 Ministry: Ministry of Marine Affairs and Fisheries of Indonesia
- 4 Institutes: DLR, JRC, EUSC, Indian Institute of Remote Sensing
- 6 UN organizations: WFP, WHO, UNEP, UNODC, UN Habitat, UNJLC
- 5 Value Added Companies: SERTIT, NPA, KEYOBS, GRAS, THW
- 4 Universities: Berne, San Diego, Chulalongkom, Bogor

Recovery Planning: Emergency Architects



Batticaloa, Sri Lanka



Satellite image: QuickBird
Sensor resolution: 2.5 m
Image acquisition date: 21 November 2004
Image processing: UNOSAT
Image georeferencing: UNOSAT
Image rectification and map projection: UNOSAT

Reference coordinate system:
Projection: UTM zone 48 South
Datum: WGS84
Geographic coordinate system:
Projection: Geographic Coordinate System
Datum: WGS84

The location and use of trademarks, logos and other marks used on this website are the property of their respective owners. All rights reserved. © 2004 UNOSAT



UNOSAT
satellite imagery for all
www.unosat.org

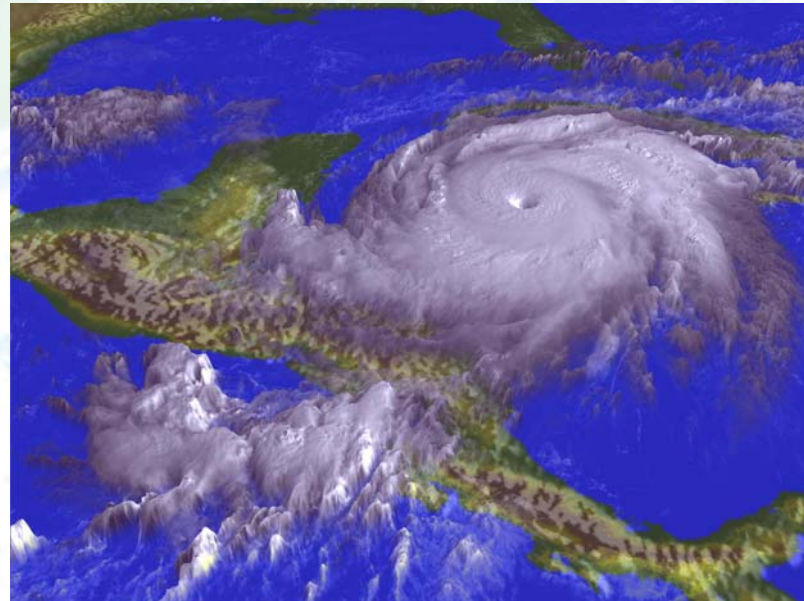
In the district of Tricomalee, Sri Lanka, Emergency Architects is in charge of:

- 1 commercial complex in course of rehabilitation
- Reconstruction of 40 wadies (to sale fishes)
- Reconstruction of 20 houses



Risk assessment to Development at the local level

Matagalpa example



Risk identification at the local level - Matagalpa example



Collaboration with local authorities
in the aftermath of Hurricane
Mitch, 1998;

❑ Destructive phenomena: flash
floods, debris flows, landslides

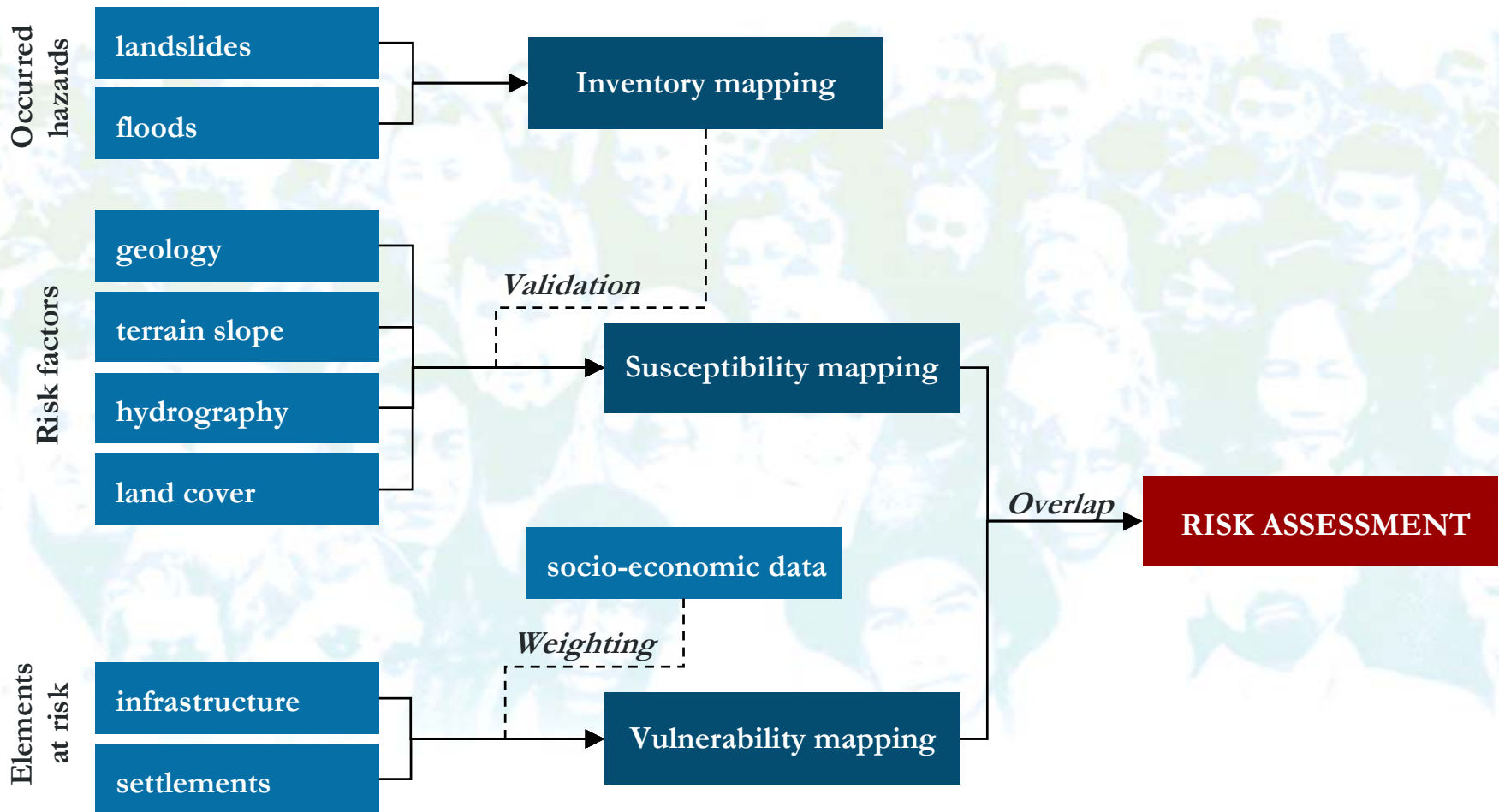
❑ Immediate assistance to victims
and their settlements based on
poorly informed decisions

Implementation of a GIS resource center - CIGMAT



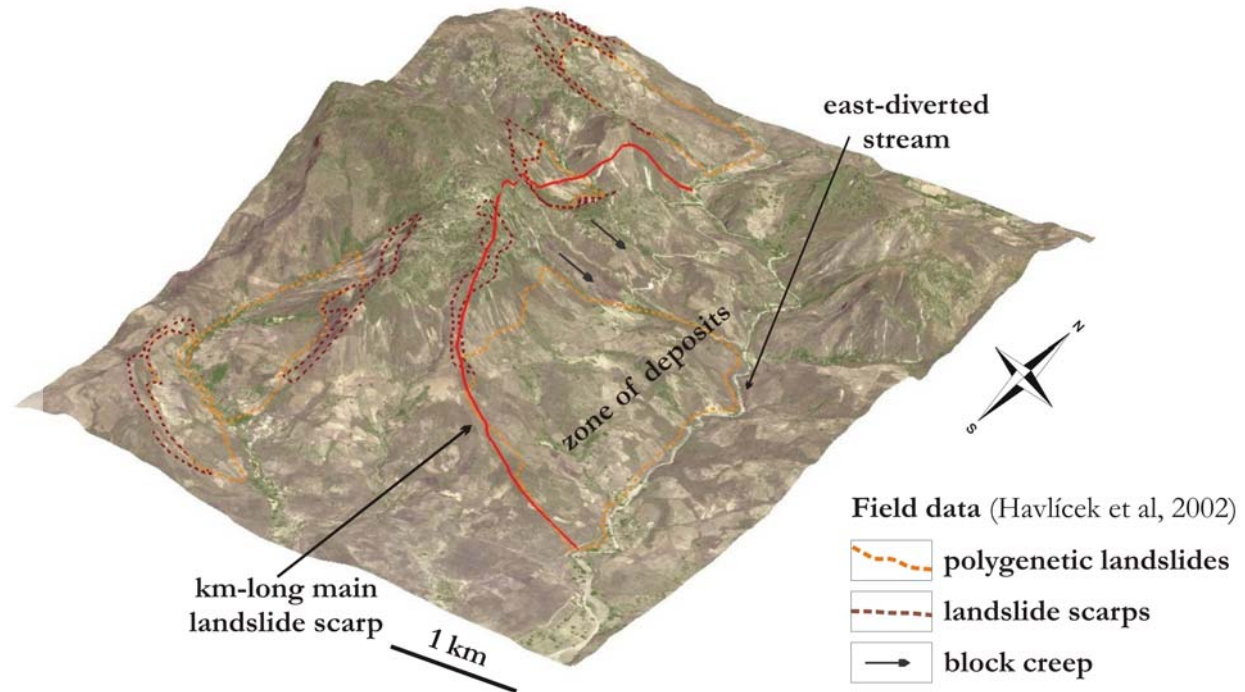
- ❑ Establishment of GIS office for improved risk assessment and urban planning
- ❑ Local authorities focus on safety and territorial management
- ❑ Know-how transfer to facilitate geographic data management (staff trained by UNOSAT)
- ❑ CIGMAT is currently generating its own projects and has its first clients

Matagalpa: From hazard mapping to risk assessment

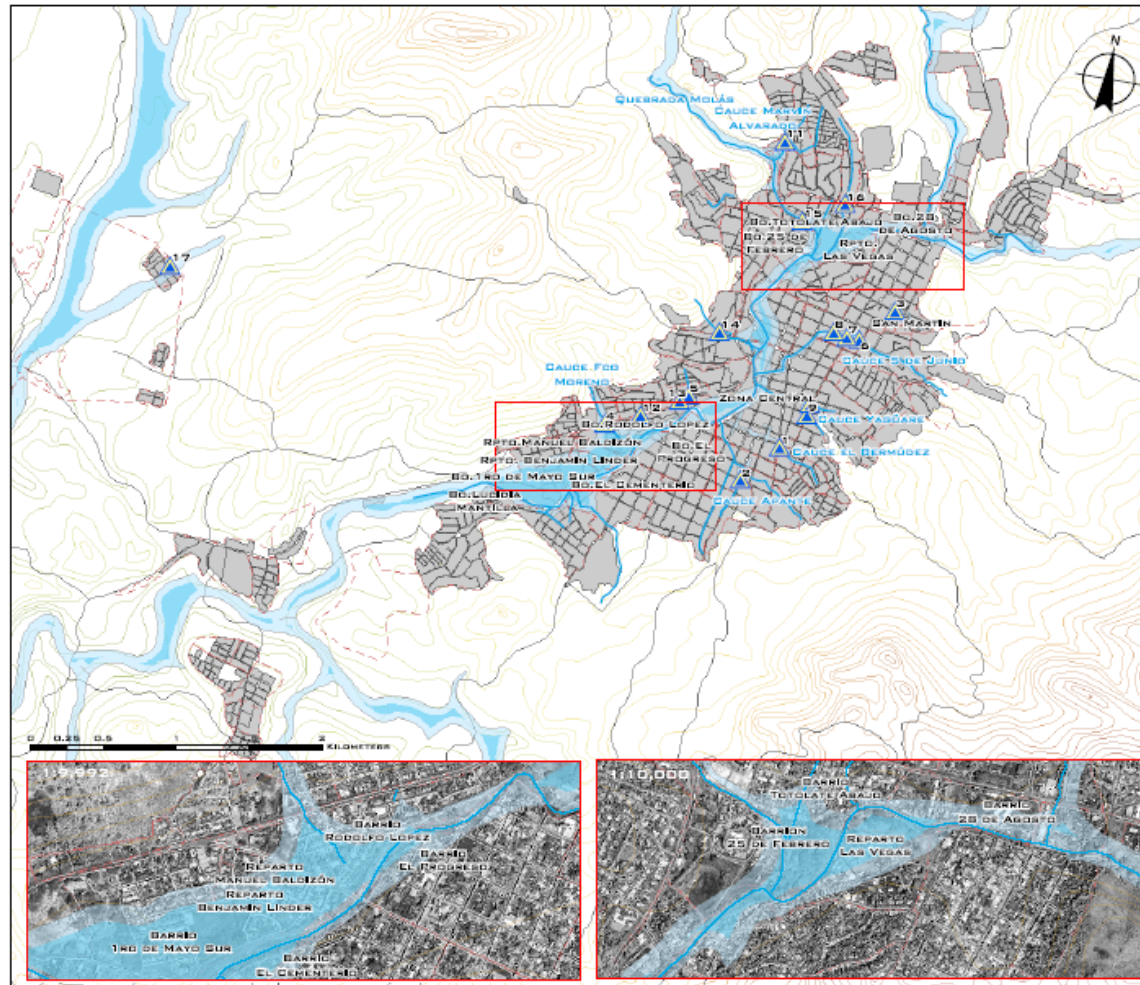


Risk identification at local level: Matagalpa landslide risk assessments using 3D analysis tool

- ❑ Tailored for detection of landslides and recent debris and mud flows at scales up to 1:25'000 (master plan)
- ❑ Satellite image detected hazard phenomena are consistent with field observations
- ❑ Qualitative monitoring of landslide activity through vegetation disturbance
- ❑ Senior geologist interpreter required



Risk identification at local level : Matagalpa flood preparedness



PLAN DE DESARROLLO URBANO

A L M A T
ALCALDIA MUNICIPAL DE MATAGALPA

DPT OFICINA DE
PLANIFICACION TERRITORIAL

AMENAZA DE INUNDACION

Simbología:

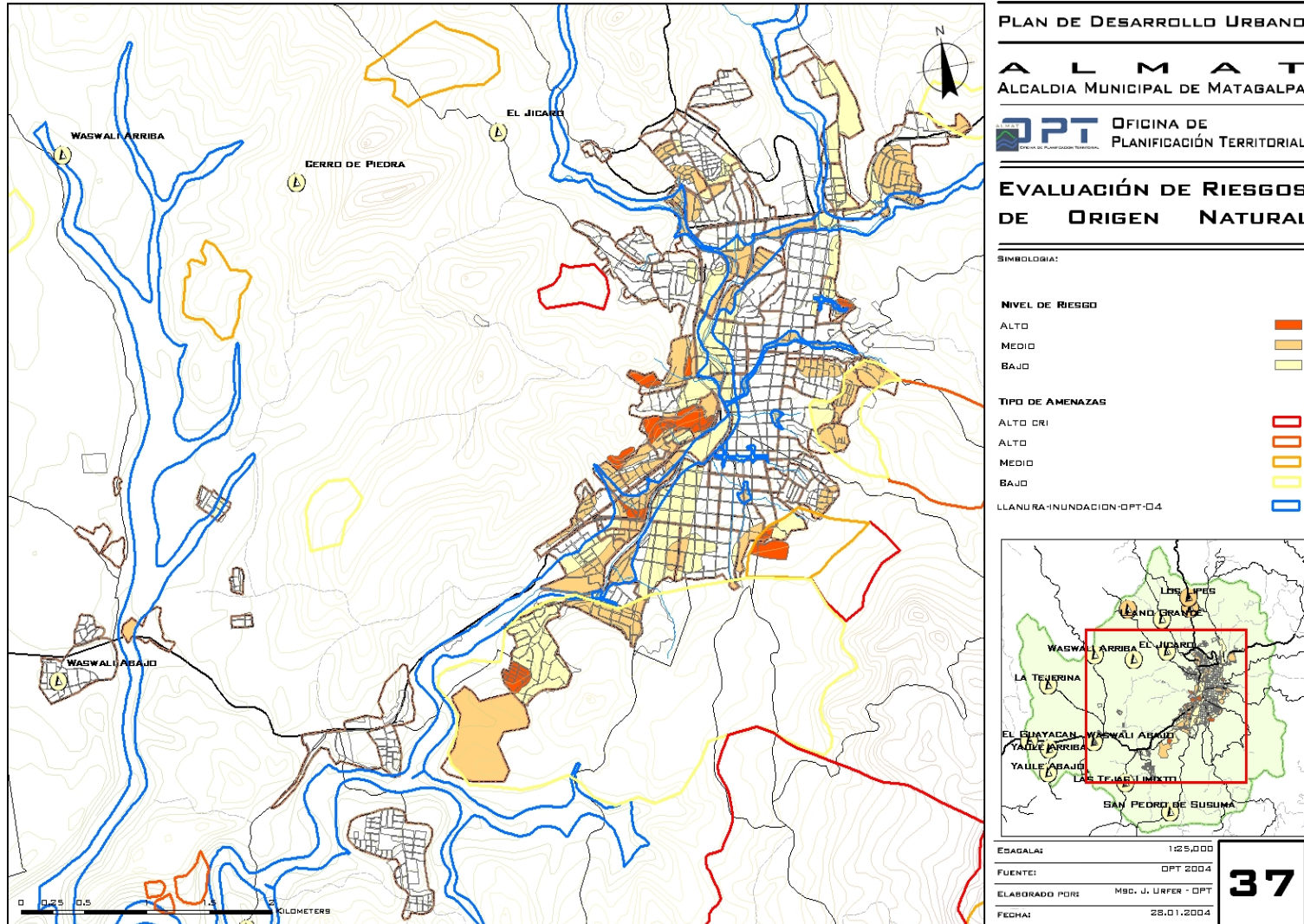
- LLANURA DE INUNDACION / AMENAZA BAJA ■
- LLANURA DE INUNDACION / AMENAZA MEDIA ■
- PUNTOS CRITICOS / AMENAZA ALTA ▲

N°	NOMBRE	DESCRIPCION
1	HOTEL	CAJAL QUE SE DESARRAMA DE MANERA
	RODOLFO	INCOMPLETADA EN EL BARRIO C. POBRESA
2	APARTE	TRABAJA CON REJA QUE SE TAPA FACILMENTE
	MORENO 2	CON DRENAJE CERRADO POR EL CORRIENTE
3	SAN MARTIN	MANUAL SUBDRENAMIENTO
4	FRANCISSCO	SISTEMA DE DRENAJE MAL DISEÑADO
	MORENO 3	
5	EL TAMBO	SISTEMA DE DRENAJE INCOMPLETO: FALTA UNOS
	BO. LUCIA	30 METROS HACIA EL RIO
6	BO. DE JUNIO	CAJAL QUE ATRAVIERA EL CENTRO DE LA CIUDAD
7	BO. DE JUNIO	CON UN CAJAL QUE SOBREPASA SU CAPACIDAD
8	BO. DE JUNIO	DE CARGA, ADEMÁS ESTÁ OBTURADO POR
	RECAMENTOS Y RAJAS	
9	YAGUARE	CANALIZACION BAJO LA CALLE QUE SIGUE LA
	BO. LUCIA	CAPACIDAD DE CARGA
10	LA PERFECTA	CANALIZACION BAJO LA CALLE QUE SIGUE LA
	BO. LUCIA	CAPACIDAD DE CARGA
11	MARVEN	CAJAL QUE SOBREPASA LA CAPACIDAD DE
	ALVARADO	CARGA DE LA TRAMITA
12	RODOLFO	SISTEMA DE DRENAJE PLUVIAL QUE SE
	LOPEZ	DESARRAMA EN UNA ZONA SIN DRENAJE
13	FRANCISSCO	RECALZAMIENTO SIN CONTROL DE AGUA DE
	MORENO 2	DESARRAMA EN EL CALLOS (RODOLFO LOPEZ)
14	FRANCISSCO	ATERRAMIENTO DE REJA DE PUENTE VADO
	MORENO 1	CAJAL SIN MANTENIMIENTO
15	QUEBRADA	ESTRUCTURA DEL PUENTE QUE REDUCE LA
	MOLAS	CAPACIDAD DE CARGA Y AUMENTAN LA
	PERDIDA DEL AGUA	
16	TOTOLATE	CAJAL BELLADO QUE SE DESARRAMA FACILMENTE
	ABAJO	
17	HABITAT	CAJAL QUE SE DESARRAMA EN EL CONJUNTO
	HABITACIONAL HABITAT SIN REE SEVERIDAD	

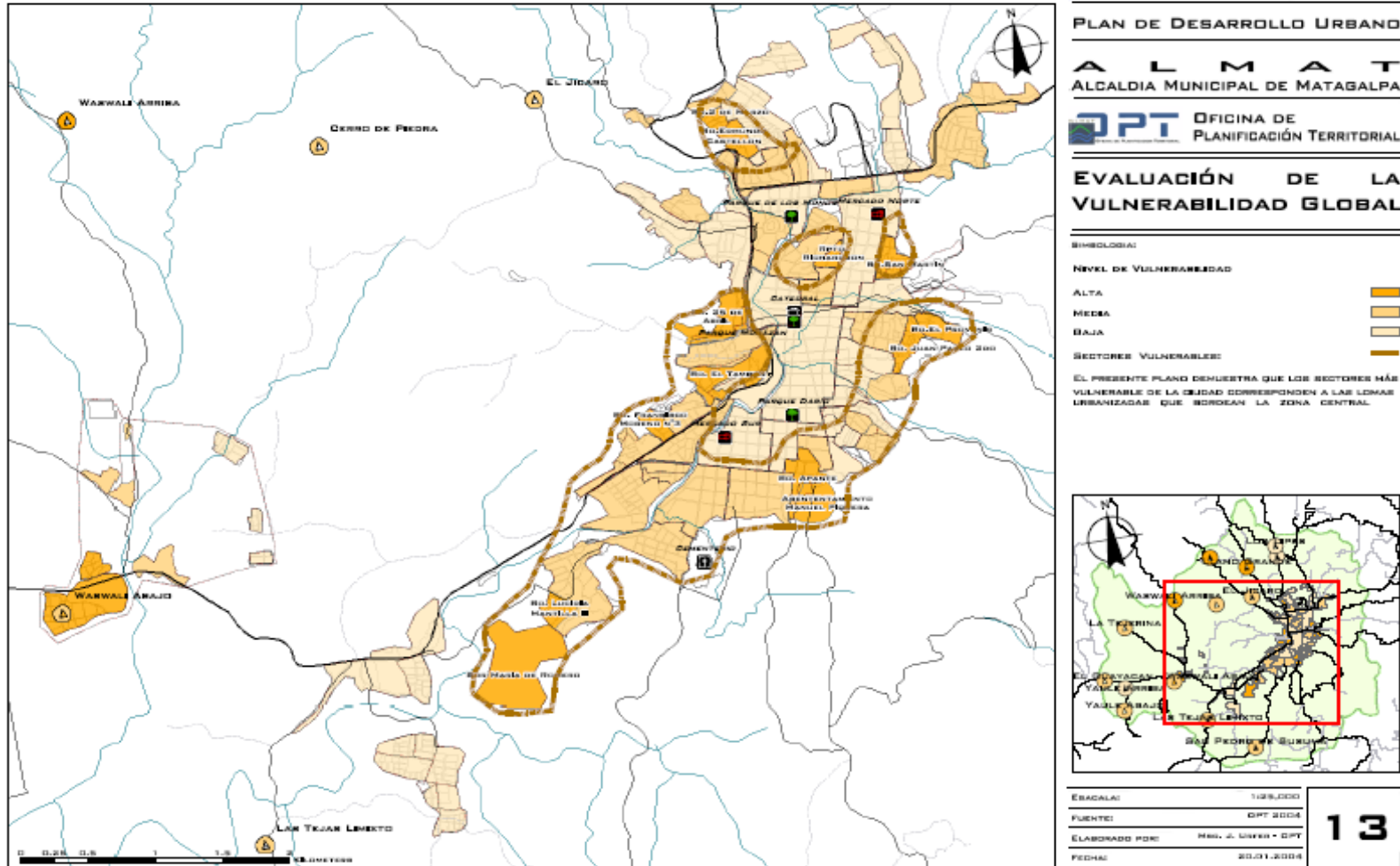
ESCALA: 1:25,000
FUENTE: OMB 1999, SOMAH Y DPT 2002
ELABORADO POR: MDC, J. UFFER - DPT
FECHA: 12.01.2004

10

Risk identification at local level: Matagalpa risk assessment



Risk identification at local level : Matagalpa vulnerability assessment



Matagalpa results

- ❑ Do not be afraid of introducing state of the art tools and techniques at the local level
- ❑ Absolutely crucial to have long term commitment and work in partnership to fully understand the local needs
- ❑ Make local entities sustainable by setting up reliable services

Remote sensing benefits

- Flexibility of scale. Wide range of sensor types to choose from, suitable to any size of project, from regional through to site specific studies.
- Regular repeat cycles. Sensors have a revisit time in the order of a few weeks. Ideal for monitoring environmental changes.
- Spectral detail. Multiple spectral channels allow to distinguishing between material properties, such as different land uses or geological materials.
- Rapid data acquisition. Remote sensing is an effective way to collect digital data from scenes covering thousands of square kilometres.
- Stereo capability. Accurate 3D spatial measurements and generation of DEMs.
- No political or physical barriers. Ideal for use in remote, physically severe or politically sensitive areas.

Recommendations

- Do not be afraid of introducing state of the art tools and techniques at the local level
- Absolutely crucial to have long term commitment and work in partnership to fully understand the local needs
- Make local entities sustainable by setting up reliable services
- Satellite imagery is an objective source of information and provides up to date and relevant information for the international humanitarian community

Contacts



The screenshot shows the UNOSAT website homepage. At the top left, there is a 'MEMBER SERVICES' section with links for 'Imagery Viewer' and 'Download images'. The main header features the UNOSAT logo and the tagline 'satellite imagery for all'. Below this, there are several content blocks: a left sidebar with navigation links for 'About UNOSAT', 'Product & services', 'Community', and 'Learn more'; a central banner with the text 'early warning, crisis response, sustainable recovery, vulnerability reduction, local capacity building' and images of people in a field; a 'Latest news' section on the right with recent updates from ReliefWeb and AlertNet; and a 'Latest maps' section at the bottom with a link to 'Zimbabwe 2 item(s) 9 Aug, 2005'. A 'UNOSAT Tour' section is also visible in the bottom right of the main content area.

For any information about UNOSAT
www.unosat.org

For any question/comment about
this presentation
alain.retiere@unosat.org