Disaster and emergency management: the contribution of the Italian Space System COSMO-SkyMed

F. Covello
Agenzia Spaziale Italiana (ASI)
COSMO-SkyMed System Features

- DUAL USE SYSTEM
  - WORLDWIDE GLOBAL COVERAGE
  - ALL WEATHER NIGHT / DAY ACQUISITIONS
  - 4 SAR SATELLITES CONSTELLATION
  - X-BAND SAR (9.6 GHz) SENSOR
  - 400 MHz BANDWIDTH
  - 619.6 Km HEIGHT
  - SSO ORBIT
  - 97.8° INCLINATION
  - ~97 min ORBITAL PERIOD
CONSTITUTION SATELLITES LAUNCH DATES

8 JUN. - 2007
COSMO-1

9 DEC. - 2007
COSMO-2

25 OCT. - 2008
COSMO-3

5 NOV. - 2010
COSMO-4
Quake-damaged dam could flood city

Matthew Whittaker and agencies

Chinese officials have warned that a second disaster could hit Dujiangyan, where 500,000 people live, after Monday's earthquake caused cracks to appear in a dam protecting the south-western city.

Dujiangyan "would be swamped" if the Zipingpu reservoir were to breach the hydroelectric dam, five miles upstream, the state news agency, Xinhua, said today.

Engineers have released water from the reservoir to relieve pressure on the dam after cracks appeared on its surface.

Speaking to Reuters, He Biao, the deputy Communist party chief of Aba prefecture, said: "If the danger intensifies, it could affect some power stations downstream. This is an extremely dangerous situation."

The ministry of water resources warned: "If Zipingpu develops a serious safety problem, it could bring disaster to Dujiangyan city."

The city claims to have the world's oldest operating irrigation system. The third century dikes and weirs on the Min river suffered only minor damage from the earthquake. But if it failed the system would collapse under the weight of water if the modern dam burst upstream.

The water minister, Chen Lie, urged local officials to evacuate people if further problems emerged.

Yesterday authorities pointed out that the earthquake had not damaged the huge Three Gorges dam, which is still incomplete. The quake registered a magnitude of four in the dam area, which is 600 miles from the epicentre of the quake, where it registered 7.9.
Meteo Conditions over Sichuan

13° May 2008
Myanmar: Cyclone Nargis

Myanmar: Tropical Cyclone Nargis (as of 7 May 2008)

- Population in disaster-affected areas: approx. 2.4 million
- In Yangon: approx. 600,000
- Over 1 million expected to be in need of urgent humanitarian assistance
- Over 12,000 dead
- Over 41,000 missing
- Over 360,000 homes lost
- Over 400,000 buildings in Yangon severely damaged

WFP food commodities
- Total: 3,400 MT
- In Yangon: 960 MT

Government authorities: UN Humanitarian Response Unit (UNHRR) in Bangkok, Thailand.

SITUATION
- Cyclone Nargis struck Myanmar on 8 and 3 May 2008, sweeping through the Ayeyawady (Inle Bay) Delta region and the country's largest city, Yangon.
- Severe flooding damaged infrastructure and communications, posing major logistical problems both for assessment and for provision of relief.
- Relief capacity inside the country already severely stretched, both in terms of supplies and human resources.
- Severe food security situation.

LINKS
- OCHA Situation Report No. 4
- Latest updates for Myanmar: Tropical Cyclone Nargis
- Related maps

ReliefWeb:
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Dark area are flooded areas while white dot are buildings over Hills
The comparison between two subsequent acquisitions shows the evolution of wet and dry areas.
We would like to thank ASI for the support to WFP and ITHACA during the recent emergency in Myanmar. The prompt offer of ASI has allow us to supply to the humanitarian community in general and to our colleagues in the field with good maps based on satellite imagery and data offered by ASI.

As you can imagine this type of information is crucial in defining priorities and types of equipment that is needed to assist the victims.

I hope that the openness and the important support given by ASI, is a first step of a relation that can be consolidated and formalized in the coming weeks.

Grazie mille

Carlos Veloso
Head
Emergency Preparedness Branch
WFP
Rome
COSMO-SkyMed EMERGENCY EXAMPLES

MYANMAR
NARGIS CYCLONE
MAY 08

HAITI
IKE & HANNA HURRICANES
SEPT. 08

SICHUAN EARTHQUAKE

L’AQUILA – ABRUZZO EARTHQUAKE
APR. 09

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COSMO-SkyMed - L’Aquila ABRUZZO – Earthquake
06th April 2009

EMERGENCY ALERT
07:30 a.m.
PAW activities STOP
Operations activities RESTART
RESPONSE TIME 12.5 h
6th APRIL 2009

08:00 a.m. switch from RTN to CRS Mode

05:29 p.m.
COSMO-1 Stripmap-Himage acquisition

08:00 p.m.
COSMO-1 Stripmap-Himage product delivery

RESPONSE TIME 12.5 h
EMERGENCY ALERT
Operations activities RESTART
The deep location of the earthquake fault is identified from the analysis of COSMO-SkyMed SAR Interferograms. Co-seismic ascending Cosmo-SkyMed interferogram covering the April 6, 2009 L'Aquila earthquake: pre-event image April 4, post-event image April 12.

Each fringe indicates a ground subsidence (in the satellite Line of Sight) of 1.5 centimeters, for a total of about -20 cm between L'Aquila and the Fossa village. This subsidence took place during the earthquake (co-seismic deformation) and is the surface response due to the dislocation at depth along the seismic fault plane.
Ground displacement Up to 12/4, COSMO data

-25 cm in LoS
The fault plane obtained from the computed model starting from COSMO-SkyMed data is shown. The fracture plane has a dip of about 50° towards the SW and passes under L'Aquila city. During the earthquake, the Earth crust block located SW from the fault plane slid down side for a maximum slip of 90 cm at 4 km-depth, producing the ground subsidence pattern shown in the figure by red colour.

The max seismic dislocation corresponds to the maximum displacement in the COSMO-SkyMed LOS (-25 cm).
COSMO-Skymed emergency timeline

- MYANMAR CYCLONE NARGIS
- HAITI HURRICANES IKE & HANNA
- BANGLADESH CYCLONE AILA
- GULF OF MEXICO – LOUISIANA OIL SPILL

- MAY 08
- SEPT. 08
- APR. 09
- MAY 09
- JAN. 10
- APR. 10

- SICHUAN EARTHQUAKE
- L’AQUILA – ABRUZZO EARTHQUAKE
- HAITI EARTHQUAKE

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**OIL SPILL IN MEXICO GULF**

**Cosmo-SkyMed 1**
ScanSAR Wide
Incidence angle 54°
Ascending orbit
Right looking
Polarization: VV
**Acquisition time:**
April 29, 2010 12:09 UTC
OIL SPILL IN MEXICO GULF

Acq. date: 2010-04-29
Acq. mode: Wide Region

Credits:
Copyright: ASI - Italian Space Agency
Processing: e-GEOS

Acknowledgment:
Data downlinked and processed at CSTARS under a contract with e-GEOS

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OIL SPILL IN MEXICO GULF

Acq. date: 2010-05-03
Acq. mode: Huge Region

Credits:
Copyright: ASI - Italian Space Agency
Processing: e-GEOS

Acknowledgment:
Data downlinked and processed at CSTARS under a contract with e-GEOS
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COSMO-Skymed emergency timeline

- AUSTRALIA FLOODS DEC. 10-JAN. 11
- NORTH EUROPE OIL SPILL AUG. 11
- PAKISTAN FLOODS AUG. 10
- JAPAN TSUNAMI MAR. 11
On 11 March 2011, the largest earthquake ever recorded in Japan shook the northeast of the country. The quake caused about US$ 200bn economic losses. This makes it the most expensive natural disaster in the world, and the event with the largest number of fatalities in Japan since the great Tokyo earthquake in 1923, with 143,000 fatalities.
Starting from alert COSMO-SkyMed constellation has been acquiring:

- 10 Spotlight-2 images over three “hot” nuclear power plants:
  - Fukushima 1
  - Fukushima 2
  - Oganawa

More than 3000 linear km in Stripmap mode along the Japanese Eastern coast from Achinohe down to Tokyo

c.ca 200 images delivered to JAXA
Tsunami flooded area map
Wide range of applications

<table>
<thead>
<tr>
<th>Category</th>
<th>Images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Monitoring and Management of Emergencies</td>
<td></td>
</tr>
<tr>
<td>Ocean and Ice Monitoring</td>
<td></td>
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<tr>
<td>Monitoring and Management of Coastallines and Inland Waters</td>
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<tr>
<td>Monitoring and Management of Forestry and Agricultural Resources</td>
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<tr>
<td>Technical Cartography – Urban Planning</td>
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<tr>
<td>Scientific Applications</td>
<td></td>
</tr>
<tr>
<td>Security Applications</td>
<td></td>
</tr>
</tbody>
</table>
MAPPPING: ITALY STRIPMAP MOSAIC

- USE OF 4 SATELLITES
- 16 DAYS PASSAGES (INTERFEROMETRIC ACQUIS.)
- ASC./DESC. PASSAGES
Emilia Romagna (Italy)
Earthquake(s) May-June 2012
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Accessing the System - Users

TWO MACRO-CLASSES

INSTITUTIONAL USERS

- NATIONAL & INTERNATIONAL AGREEMENTS
- ANNOUNCEMENT OF OPPORTUNITY
- ASI THEMATIC PROJECTS (PILOT PROJECTS)
- INTERFEROMETRIC MISSION
- BACKGROUND MISSION
- INSTITUTIONAL REQUEST “ON DEMAND”

COMMERCIAL USERS

- ‘ALL THE OTHERS’
  - IMAGE BUYERS
  - PORTABLE USER TERMINAL CUSTOMERS

INSTITUTIONAL USERS

INSTITUTIONAL USERS

COMMERCIAL USERS

COMMERCIAL USERS
ASI supports the INSTITUTIONAL (incl. SCIENTIFIC) data exploitation

www.cosmo-skymed.it

COMMERCIAL USERS

e-GEOS supports the COMMERCIAL data exploitation

www.e-geos.it

Requesting data
ANNEX II

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Conclusions

Fast Response ( >= 4 collection opportunities per day) with right/left looking access

Large (or Long) fast area coverage

Interferometric revisit down to 1 day

Few minutes between two subsequent collections for motion detection

Invaluable amount of data

“COSMO-Skymed Seconda Generazione” will provide operational continuity at least until 2023

ASI is open to new international partnerships
THANK YOU