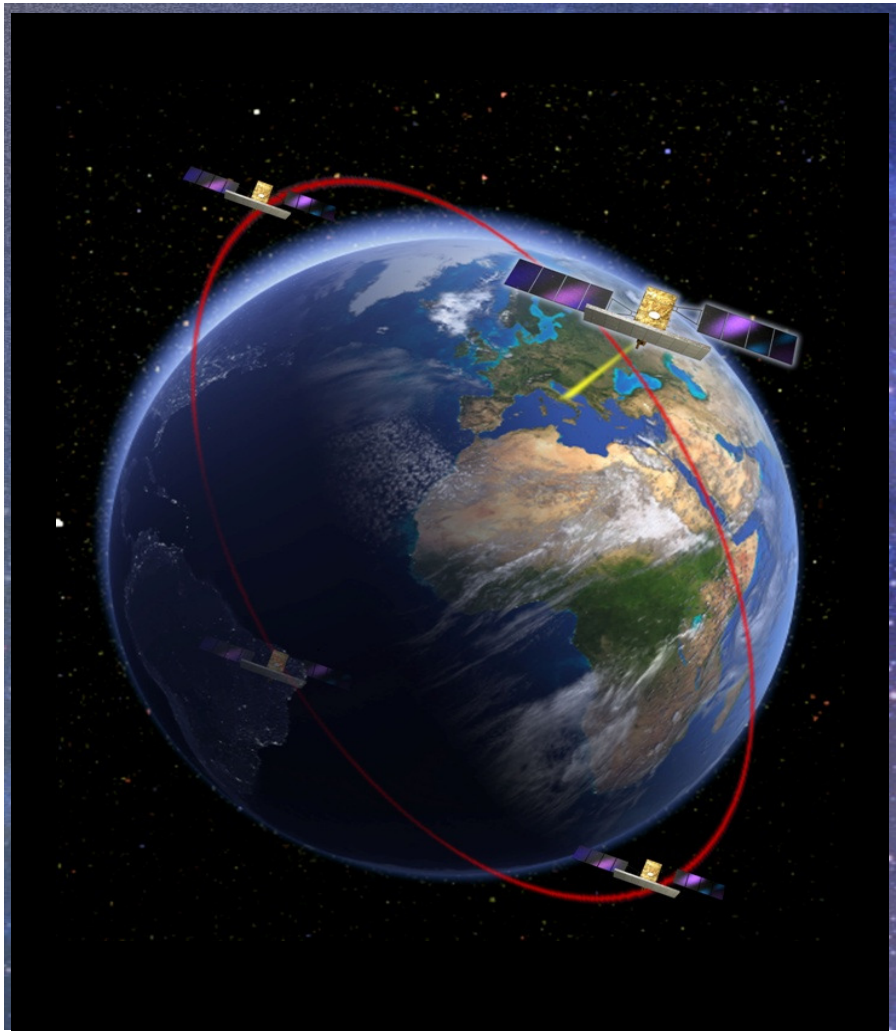
Disaster and emergency management: the contribution of the Italian Space System COSMO-SkyMed

F. Covello

Agenzia Spaziale Italiana (ASI)

COSMO-SkyMed System Features

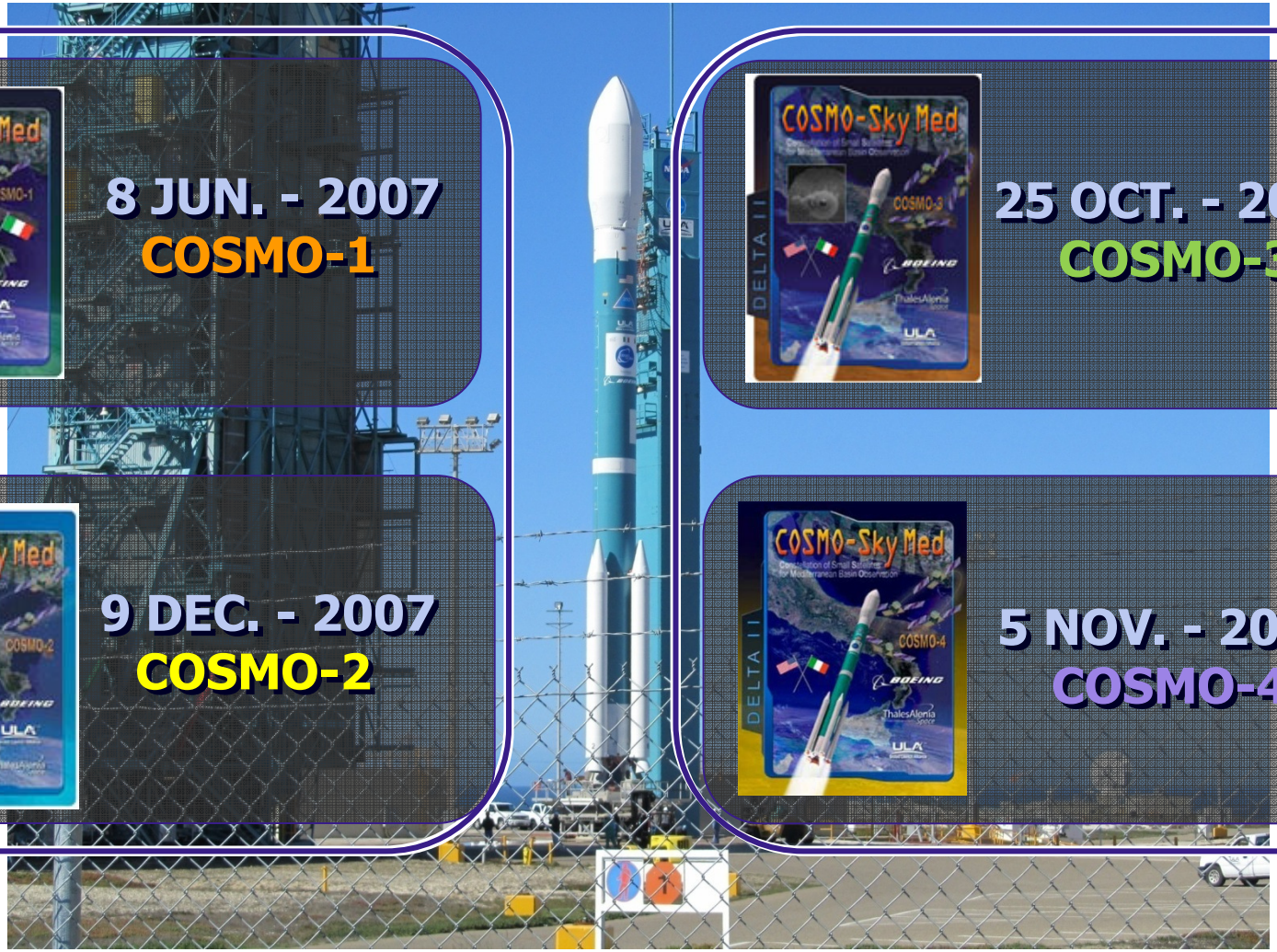


DUAL USE SYSTEM

- 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

CONSTELLATION SATELLITES LAUNCH DATES

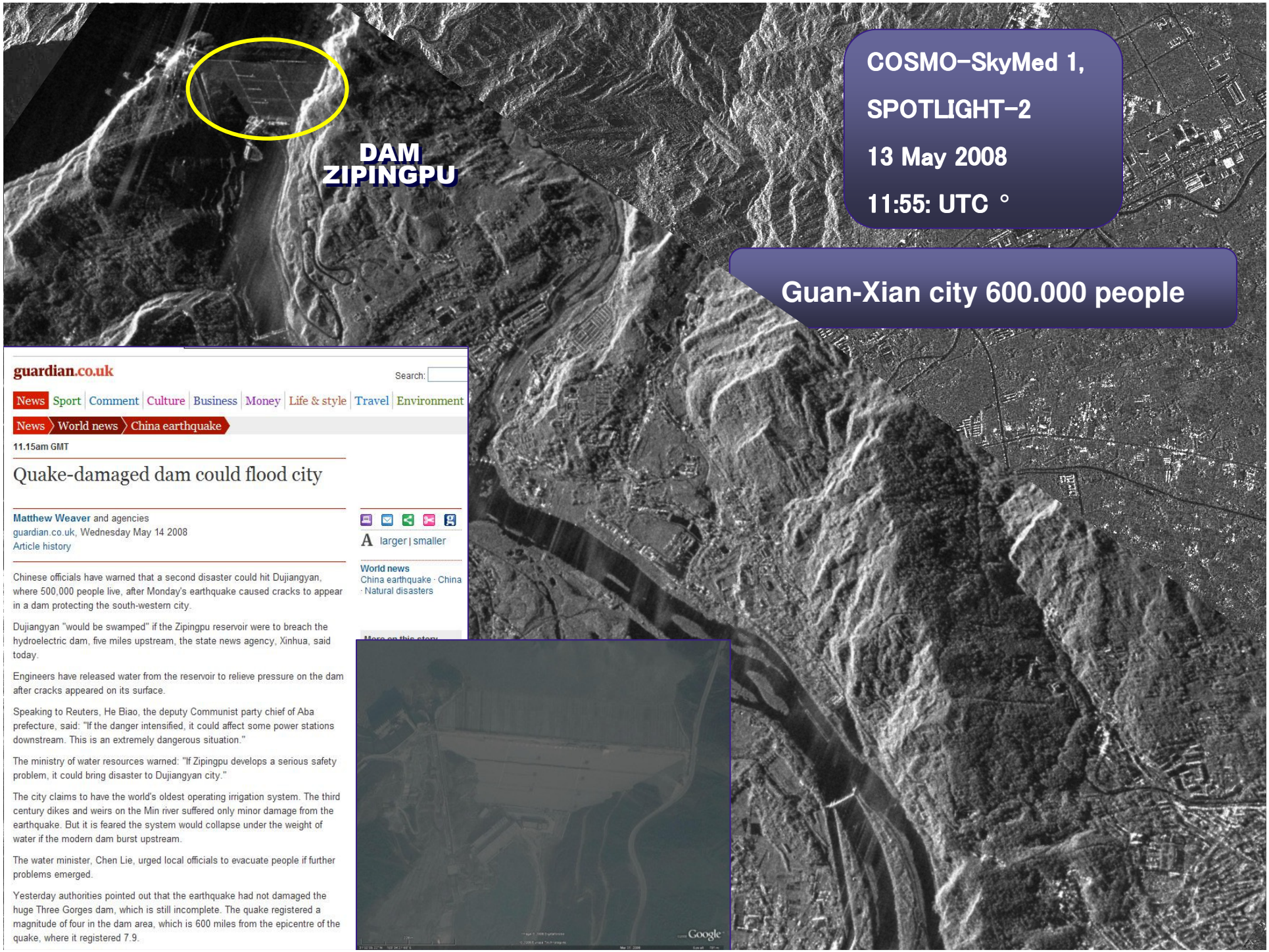


8 JUN. - 2007
COSMO-1

25 OCT. - 2008
COSMO-3

9 DEC. - 2007
COSMO-2

5 NOV. - 2010
COSMO-4



guardian.co.uk

Search:

News | Sport | Comment | Culture | Business | Money | Life & style | Travel | Environment

News › World news › China earthquake

11.15am GMT

Quake-damaged dam could flood city

Matthew Weaver and agencies
guardian.co.uk, Wednesday May 14 2008
Article history

A larger | smaller

World news
China earthquake · China · Natural disasters

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 intensified, it could affect some power stations downstream. This is an extremely dangerous situation."

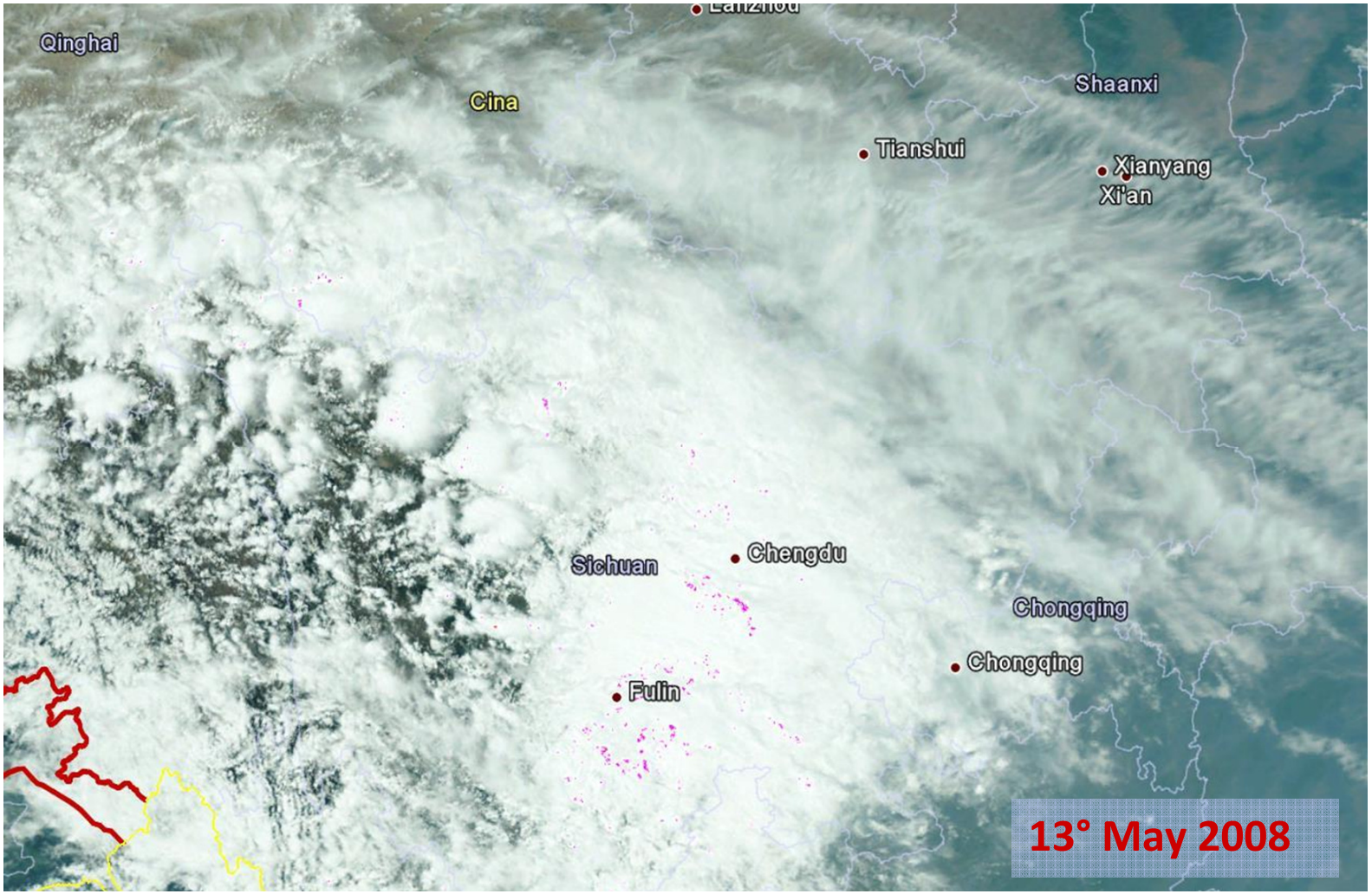
The ministry of water resources warned: "If Zipingpu develops a serious safety problem, it could bring disaster to Dujiangyan city."

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 it is feared the system would collapse under the weight of water if the modern dam burst upstream.

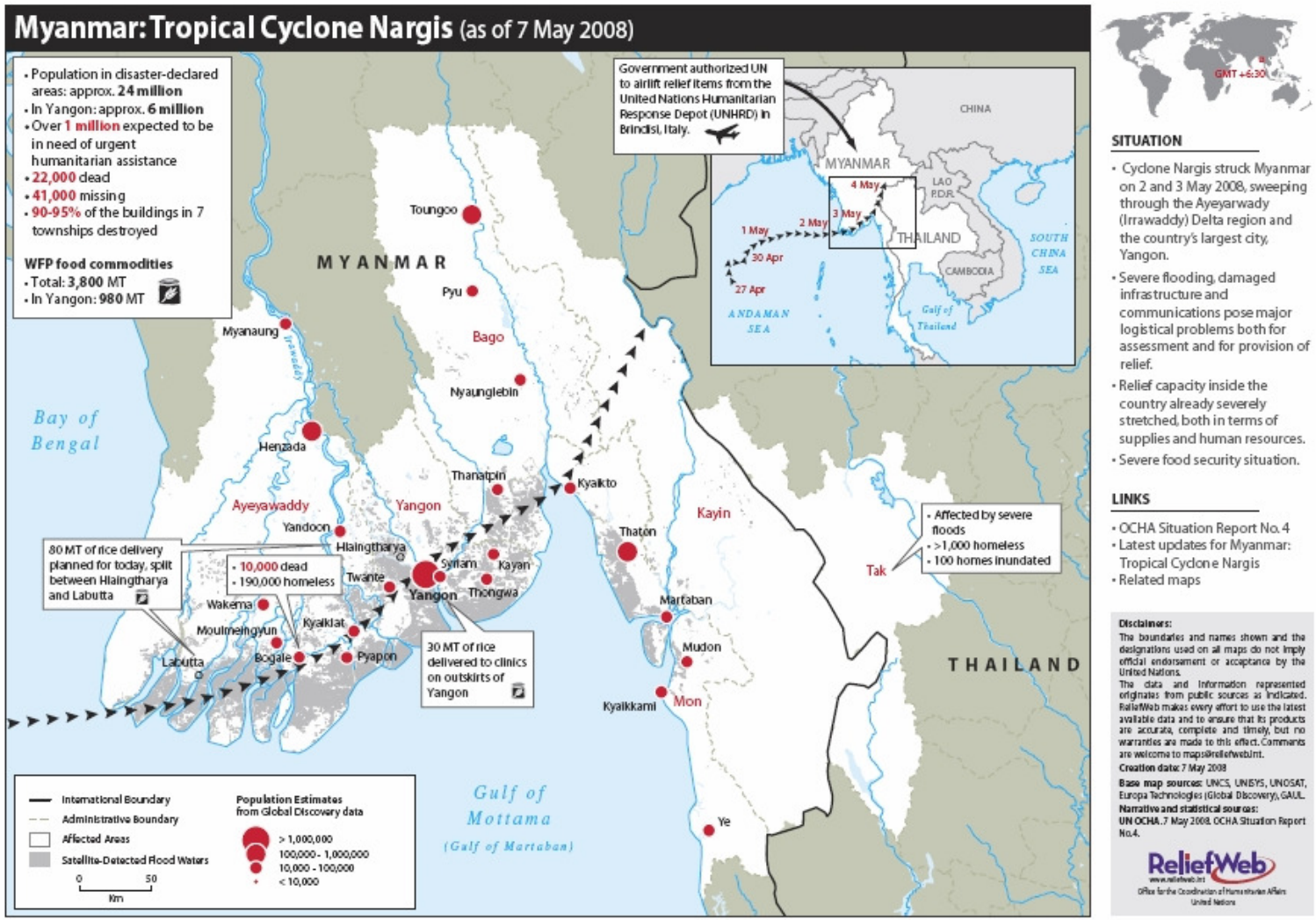
The water minister, Chen Lie, urged local officials to evacuate people if further problems emerged.

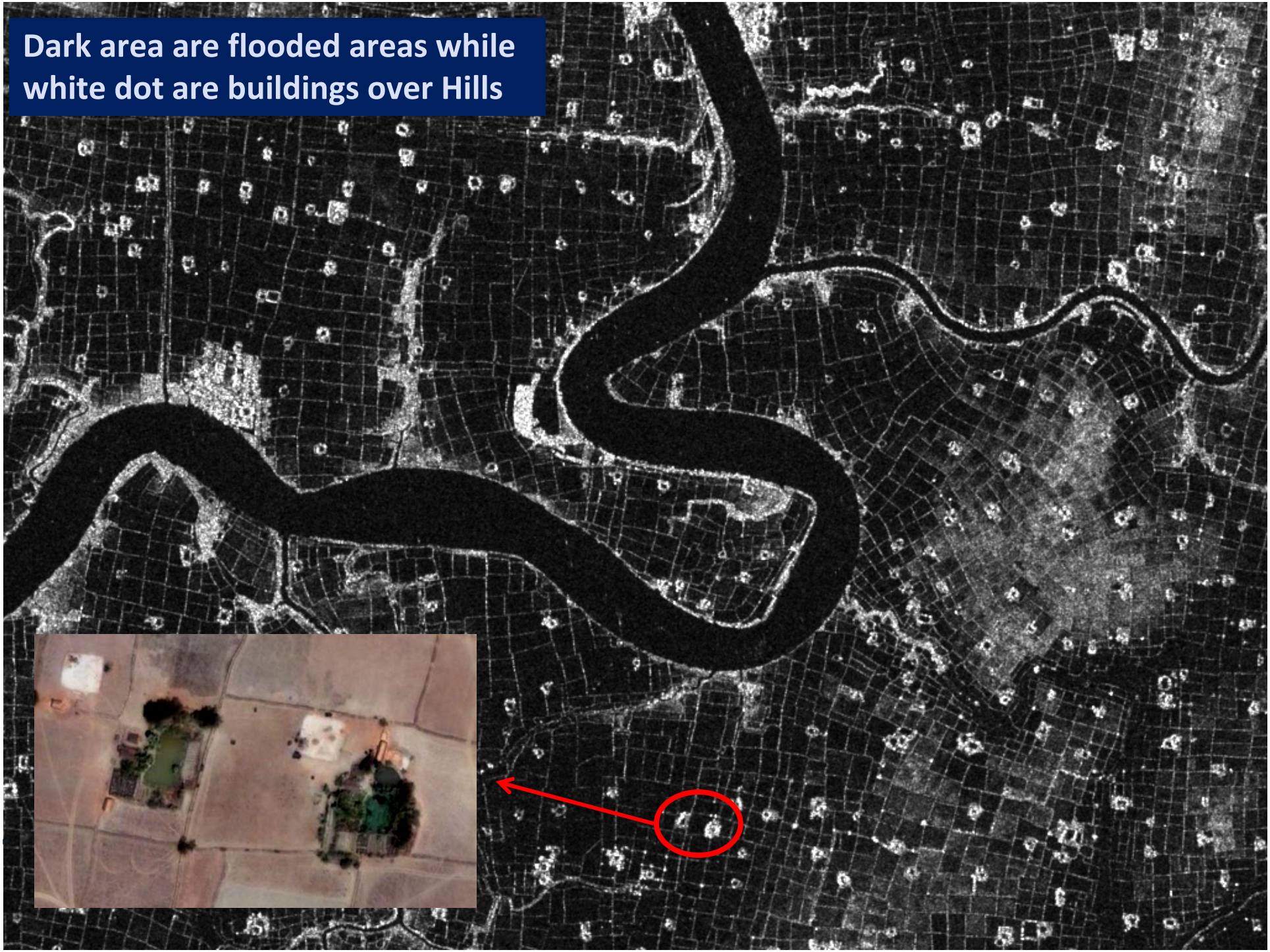
Yesterday authorities pointed out that the earthquake had not damaged the huge Three Gorges dam, which is still incomplete. The quake registered a magnitude of four in the dam area, which is 600 miles from the epicentre of the quake, where it registered 7.9.

Meteo Conditions over Sichuan



Myanmar: Cyclone Nargis




Dark area are flooded areas while white dot are buildings over Hills

Myanmar: Cyclone Nargis

The comparison between two subsequent acquisitions shows the evolution of wet and dry areas

Myanmar: Cyclone Nargis

Thank you for ASI assistance and your personal support - Messaggio (Testo normale)

File Modifica Visualizza Inserisci Formato Strumenti Azioni ?

Rispondi | Rispondi a tutti | Inoltra

Messaggio inoltrato in data 12/05/2008 15.45.
Interruzioni di riga in eccesso rimosse dal messaggio.

Da: Carlos Veloso [Carlos.Veloso@wfp.org] Inviato: lunedì 12/05/2008 10.04

A:

Cc:

Oggetto: Thank you for ASI assistance and your personal support

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 god maps based on satellite imagery and data offered by ASI.

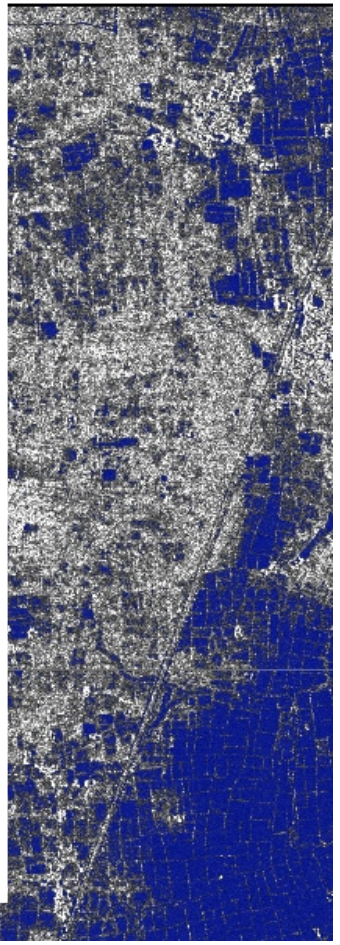
As you can imagine this type of information is crucial in defining priorities and types of equipment that is needed to assist the victims.
saving time we are saving lives.

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

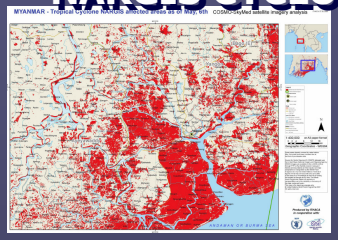
atellite imagery analysis



COSMO-SkyMed EMERGENCY EXAMPLES

MYANMAR

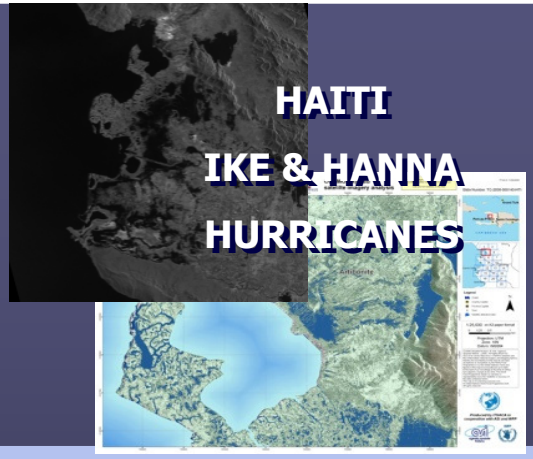
NARGIS CYCLONE



HAITI

IKE & HANNA

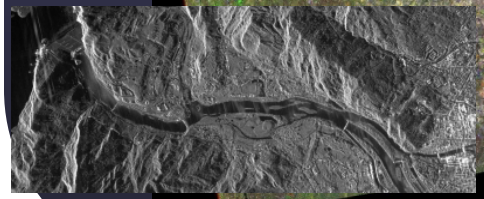
HURRICANES



MAY 08 | **SEPT. 08** | **APR. 09**

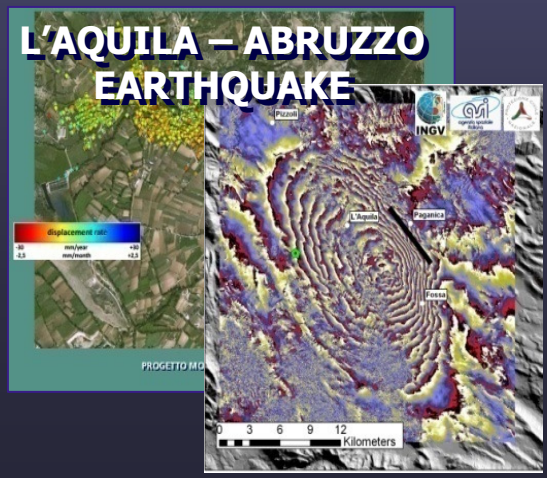
SICHUAN

EARTHQUAKE



L'AQUILA – ABRUZZO

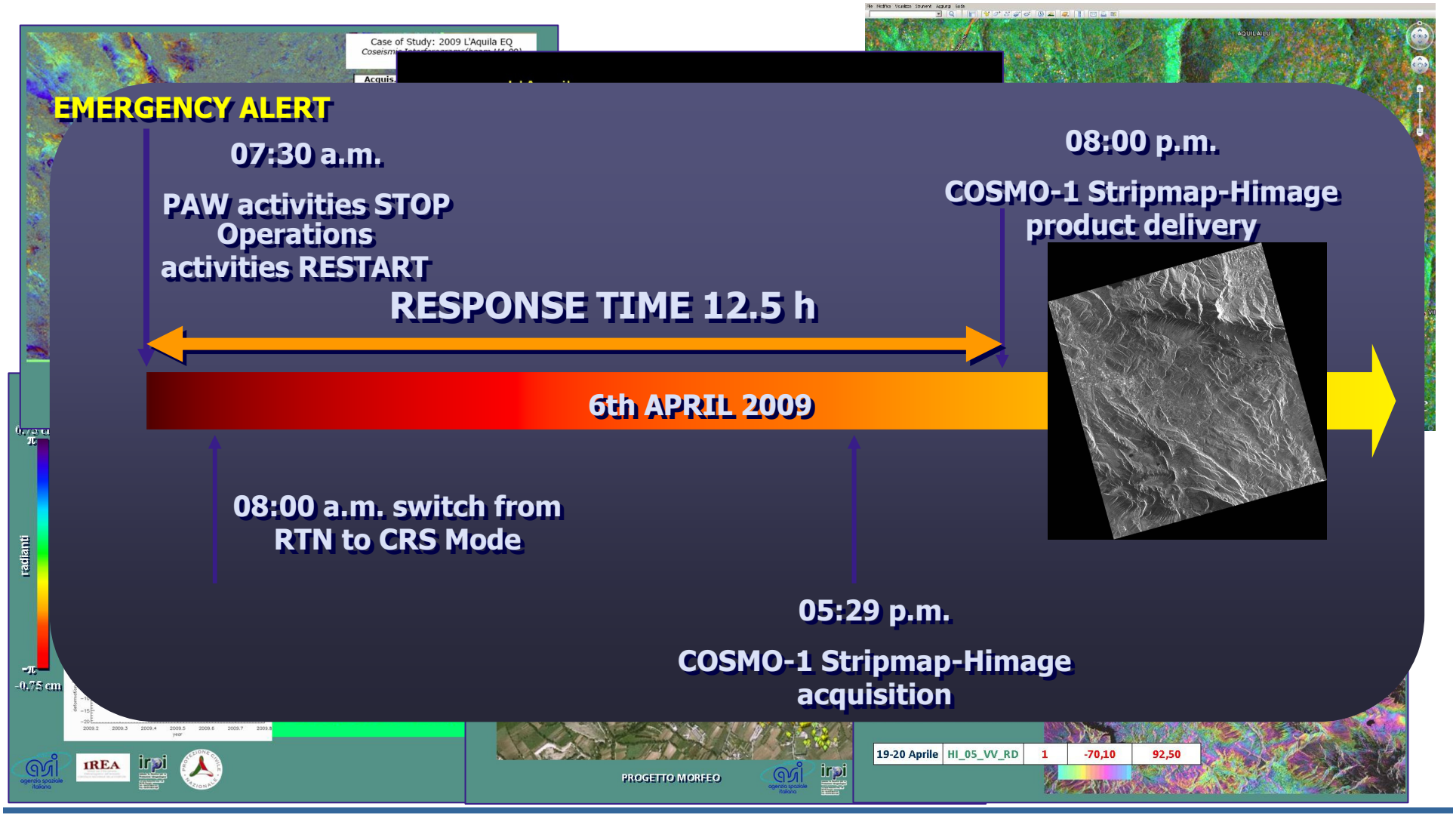
EARTHQUAKE



UNITED NATIONS
Office for Outer Space Affairs

TITLE: Disaster and emergency management: the contribution of the Italian Space System COSMO-SkyMed
AUTHOR: F. Covello
EVENT: COPUOS - SCIENTIFIC AND TECHNICAL SUBCOMMITTEE 15th SESSION - 20 FEBRUARY 2013, Wien

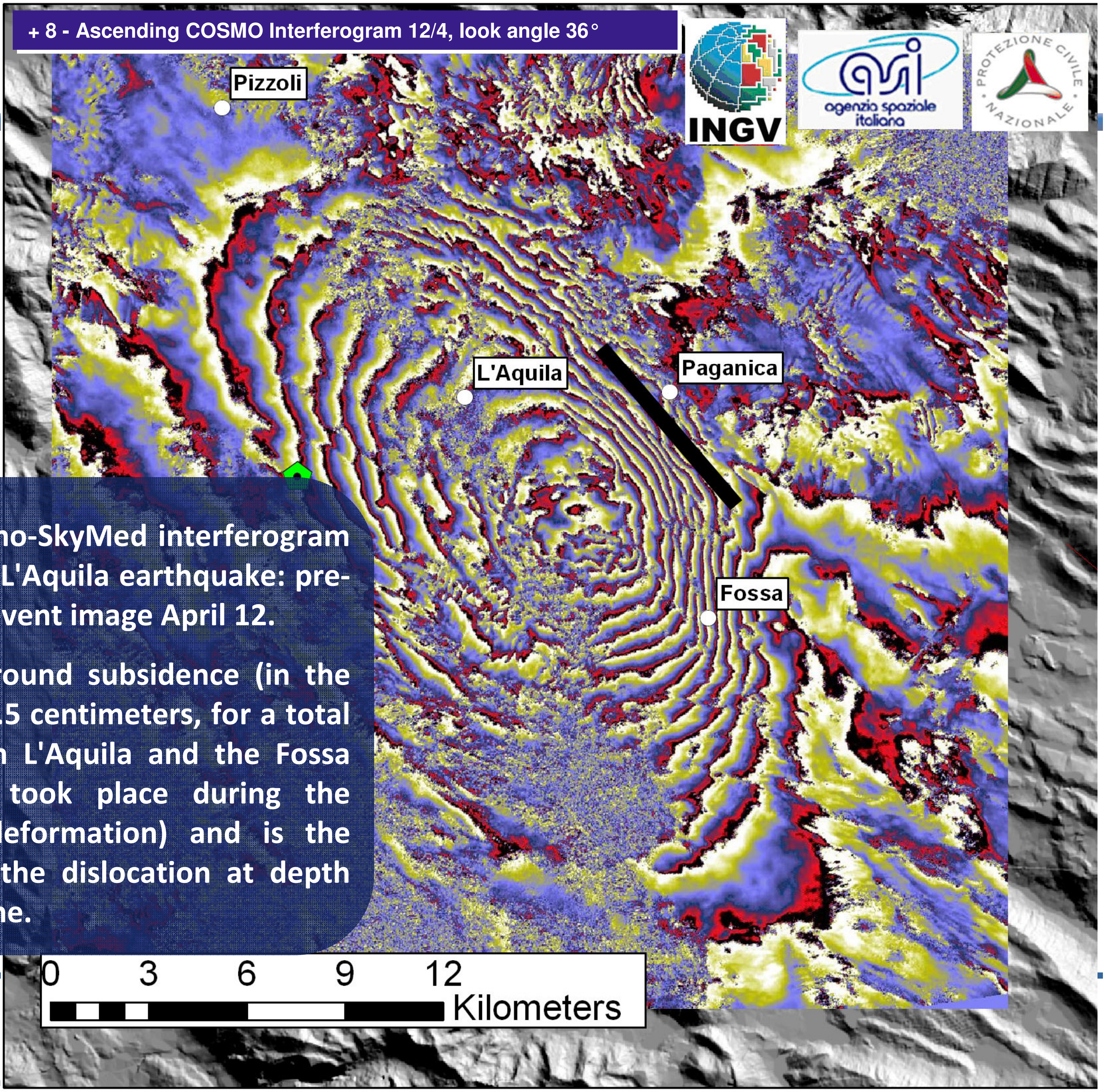
COSMO-SkyMed - L'Aquila ABRUZZO – Earthquake 06th April 2009



agenzia spaziale italiana

The deep location of the earthquake fault is identified from the analysis of the COSMO-SkyMed SAR Interferograms

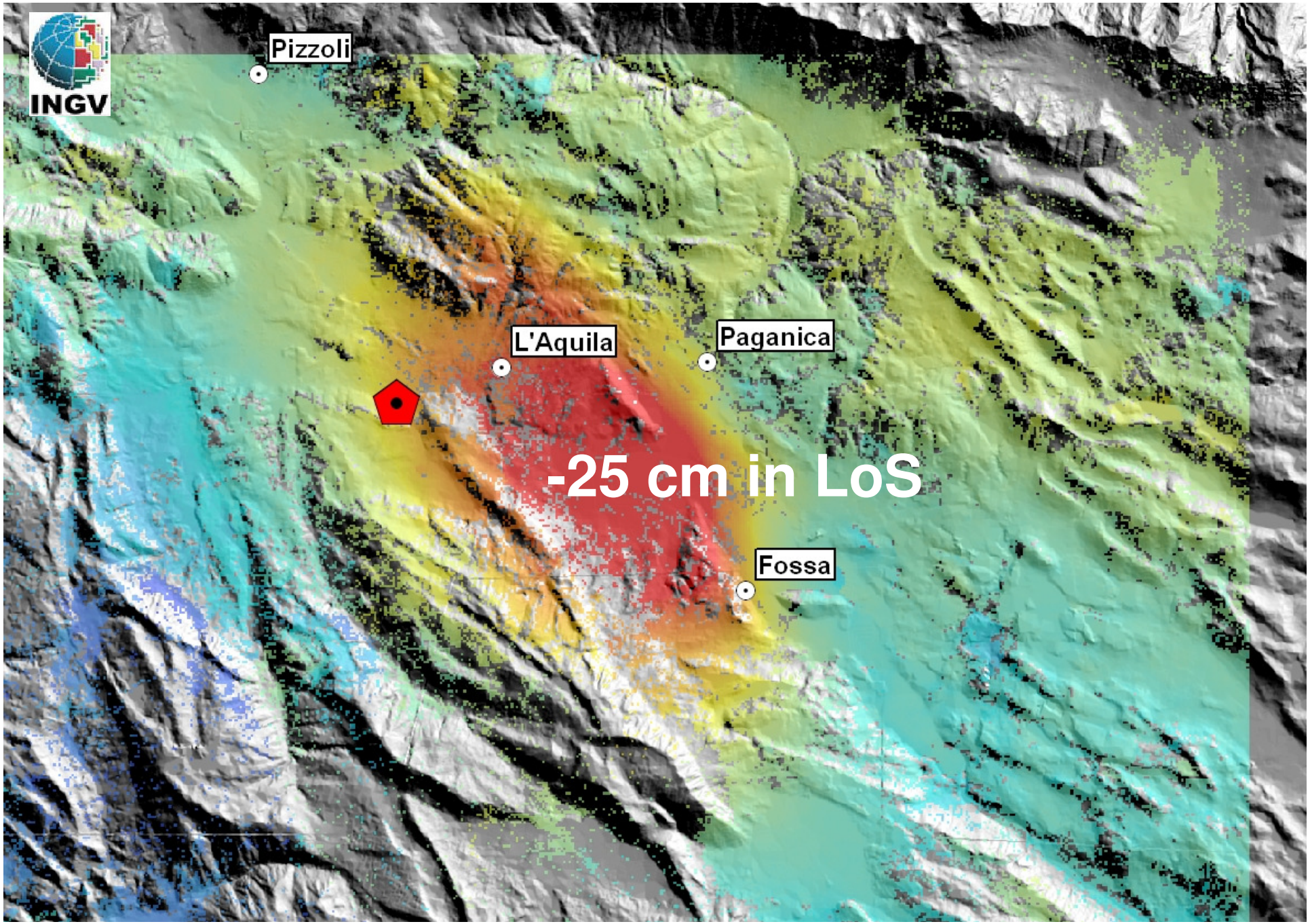
The Black Line in the Figure shows the partial outcrop of the fault itself

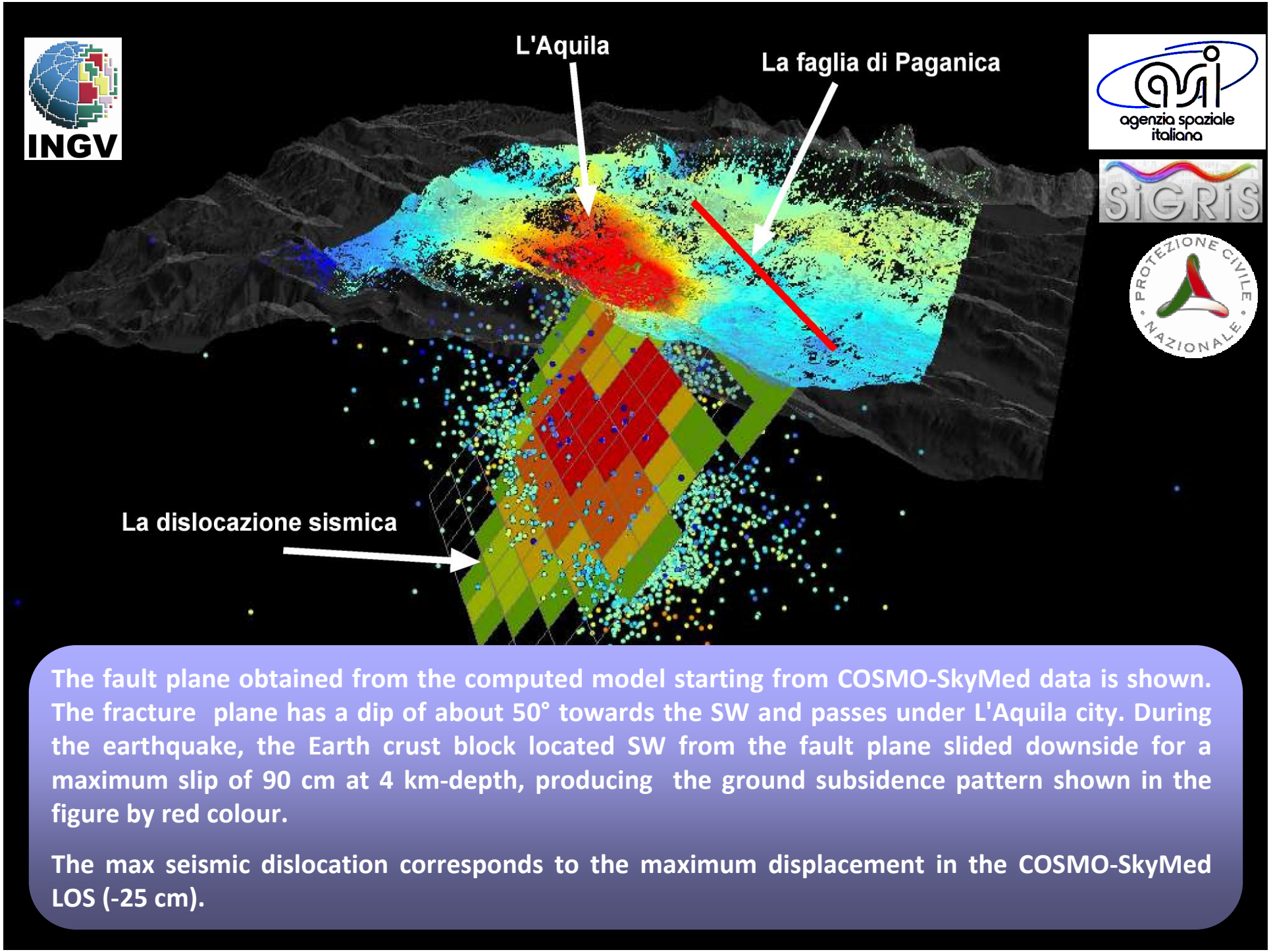


Co-seismic ascending Cosmo-SkyMed interferogram covering the April 6, 2009 L'Aquila earthquake: pre-event image April 4, post-event image April 12.

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

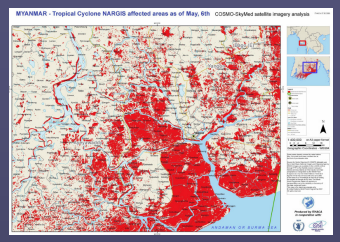




The fault plane obtained from the computed model starting from COSMO-SkyMed data is shown. The fracture plane has a dip of about 50° towards the SW and passes under L'Aquila city. During the earthquake, the Earth crust block located SW from the fault plane slided downside for a maximum slip of 90 cm 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

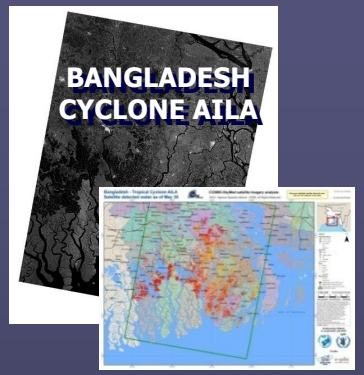


MYANMAR
CYCLONE NARGIS

MAY 08

HAITI
HURRICANES
IKE & HANNA

SEPT. 08



BANGLADESH
CYCLONE AILA

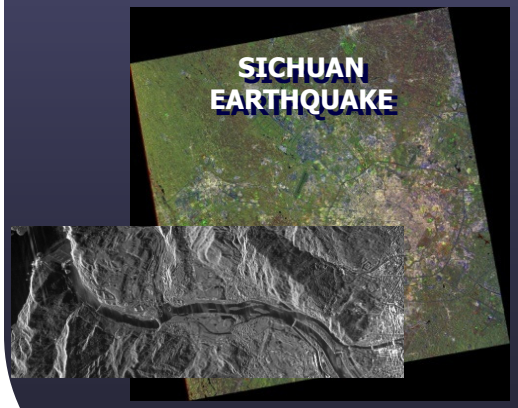
APR. 09

GULF OF MEXICO – LOUISIANA
OIL SPILL

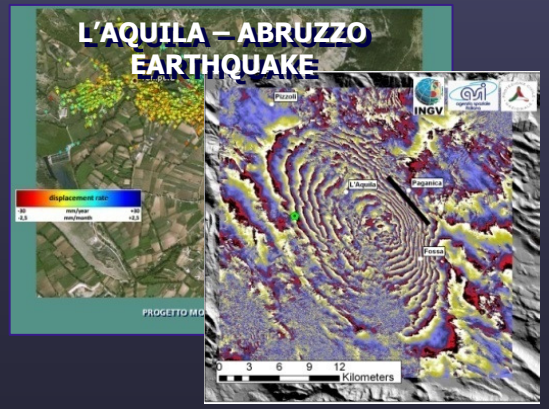
MAY 09

JAN. 10

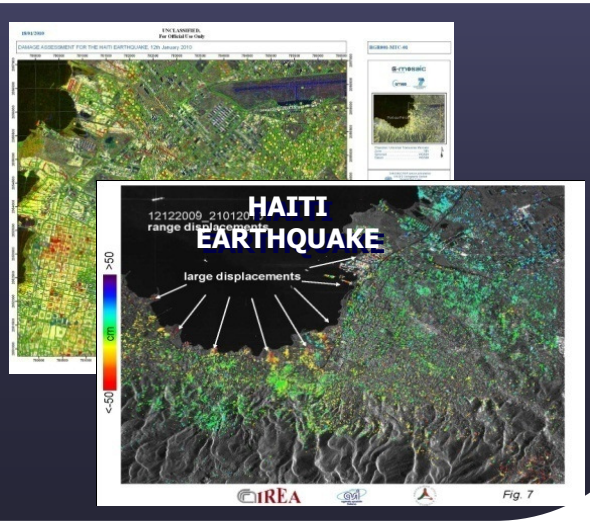
APR. 10



SICHUAN
EARTHQUAKE



L'AQUILA – ABRUZZO
EARTHQUAKE

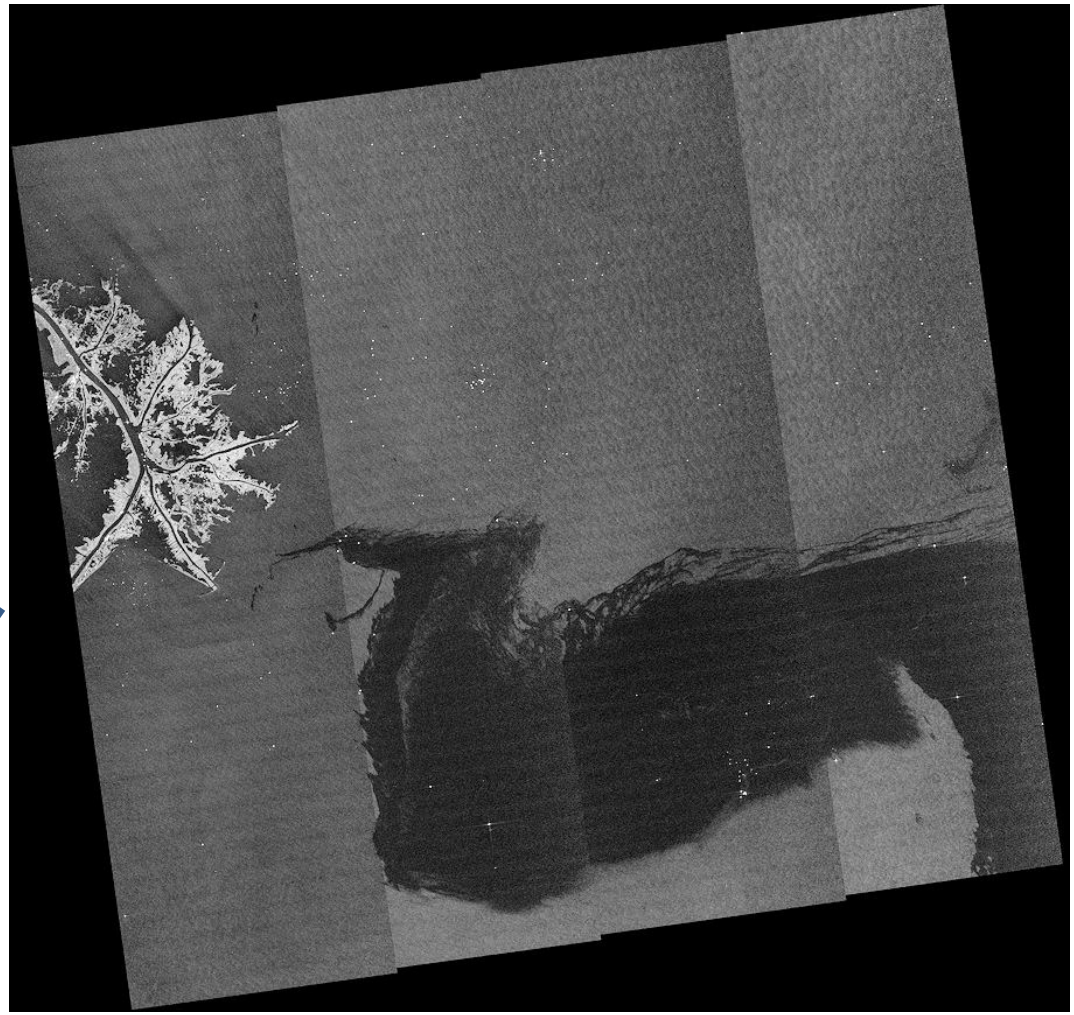


HAITI
EARTHQUAKE

JAN. 10

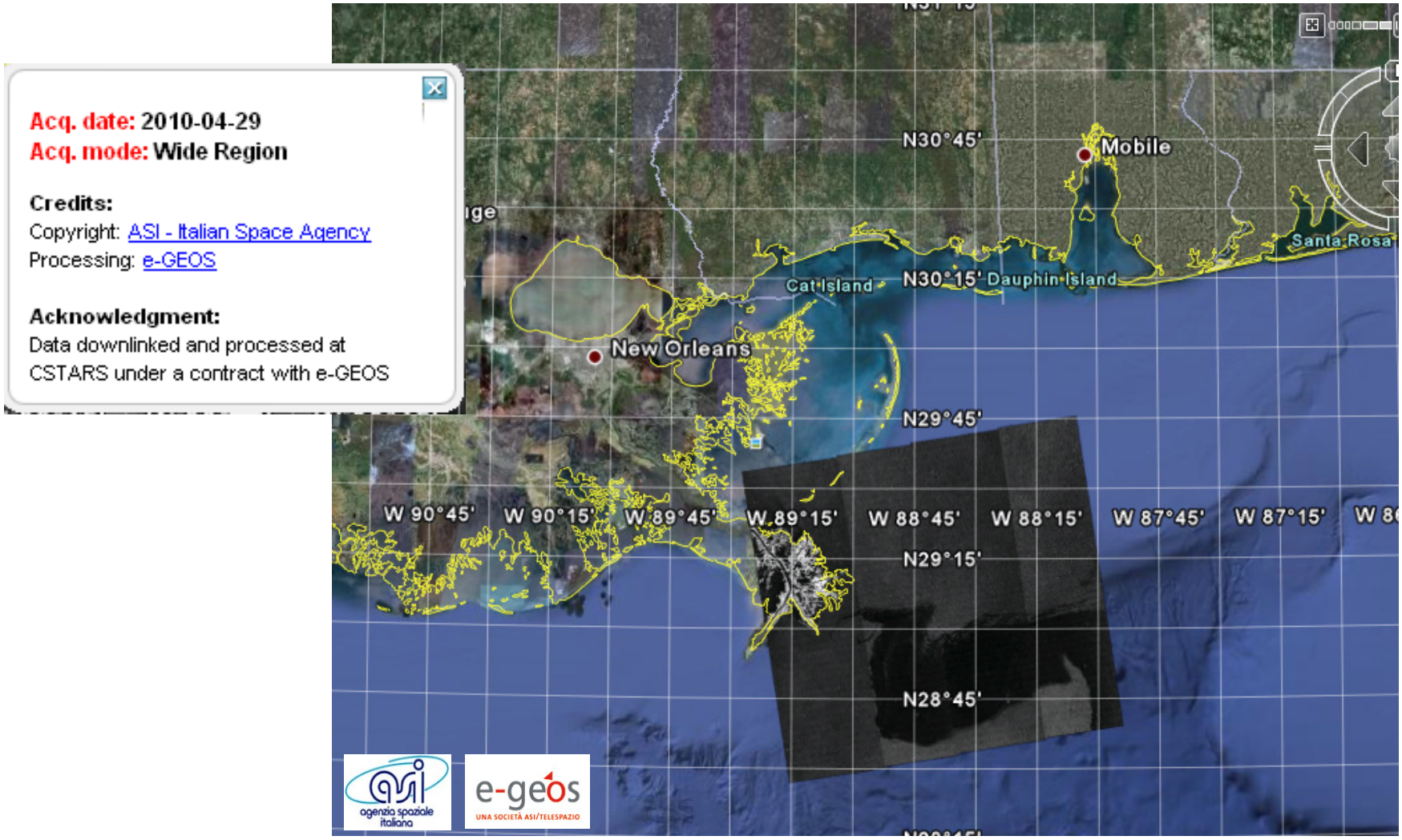
APR. 10

OIL SPILL IN MEXICO GULF

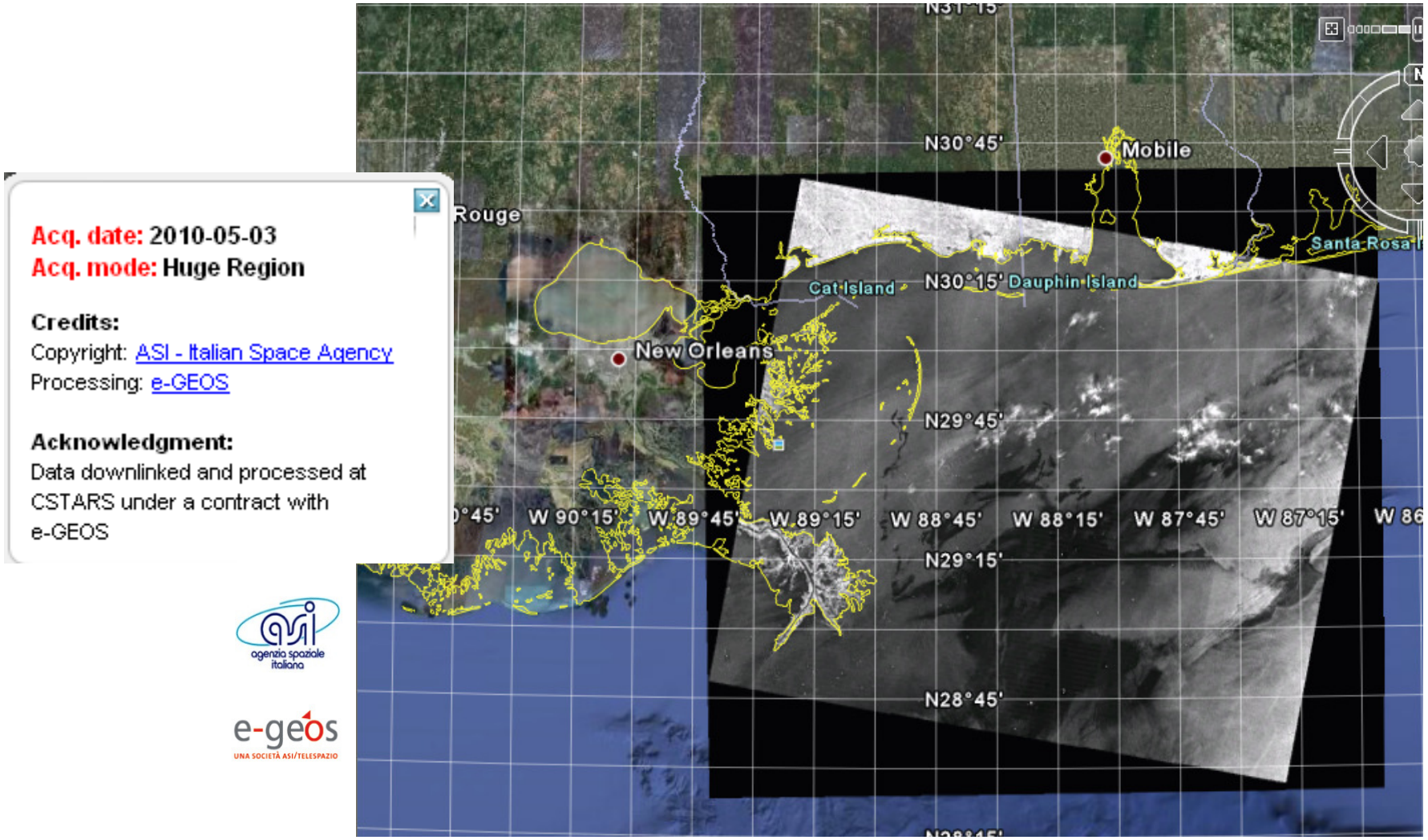


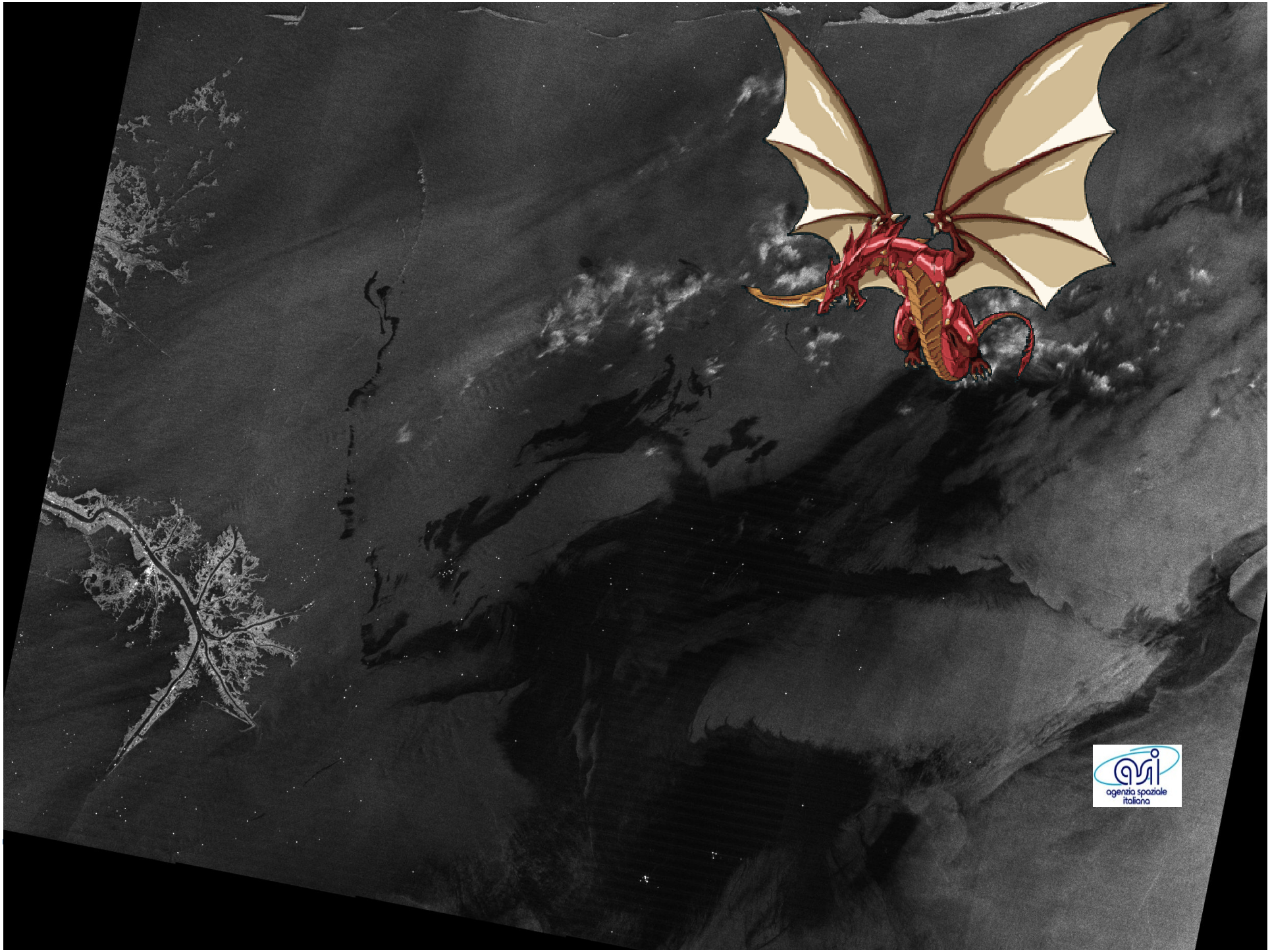
Cosmo-SkyMed 1
ScanSAR Wide
Incidence angle 54°
Ascending orbit
Right looking
Polarization: VV
Acquistion time:
April 29, 2010 12:09 UTC

OIL SPILL IN MEXICO GULF

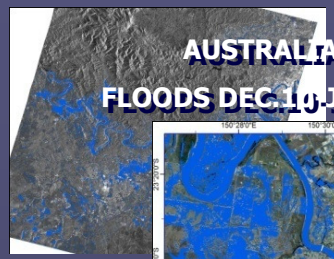


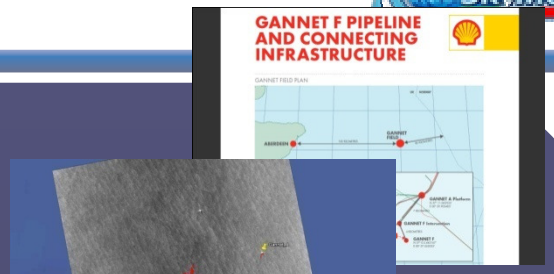
OIL SPILL IN MEXICO GULF

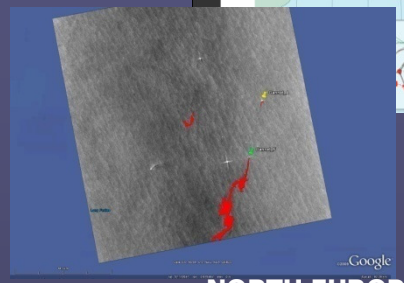



agenzia spaziale
italiana

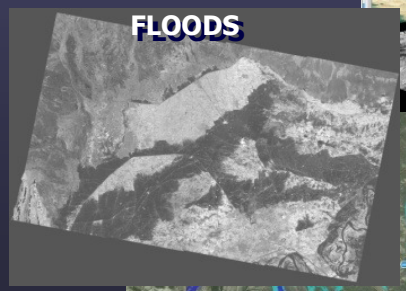
COSMO-Skymed emergency timeline

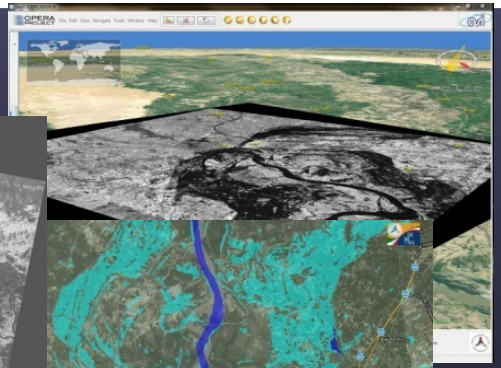


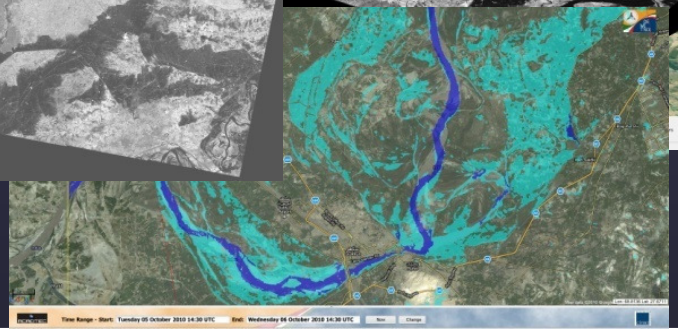


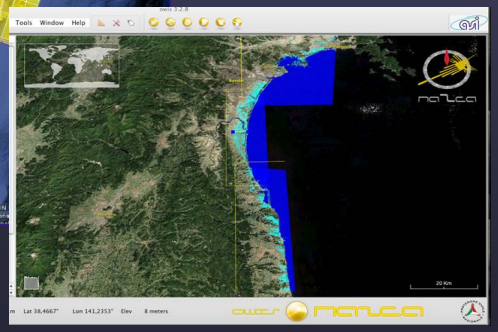


AUG. 10 **DEC. 10** **MAR. 11** **AUG. 11**



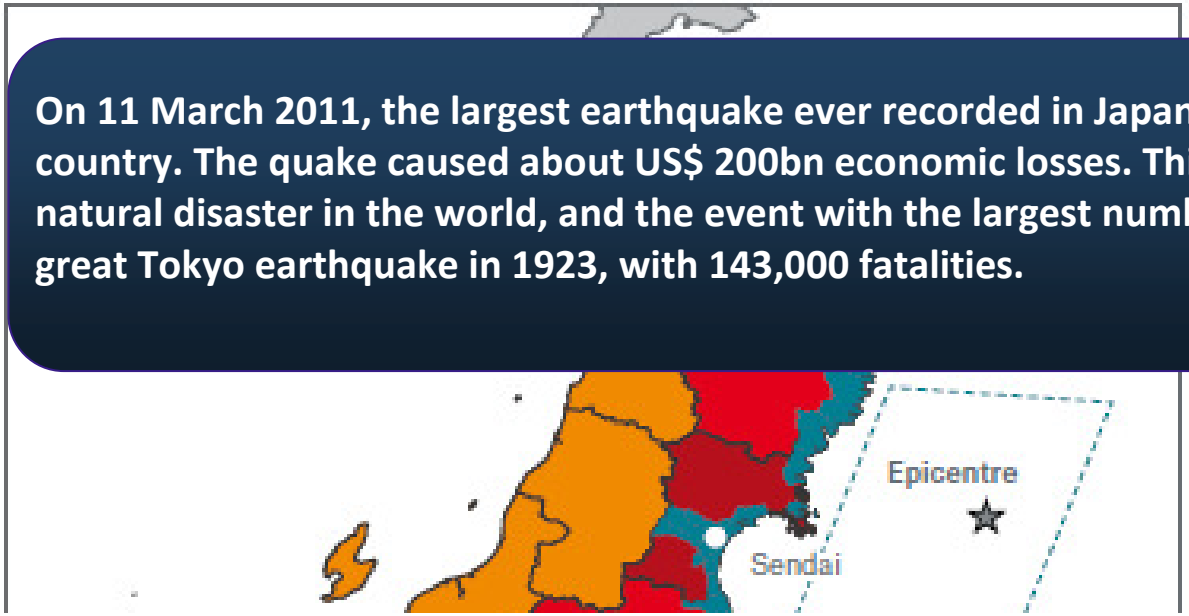






Japan Earthquake 2011

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.



Earthquakes with a magnitude of 9.0 or more since 1900

Month/ Year	Event	Magnitude M_w	Country	Overall losses US$ m (in original values)	Insured losses US$ m (in original values)	Fatalities
5/1960	Earthquake, tsunami	9.5	Chile	550		1,500
3/1964	Earthquake, tsunami	9.2	USA	540	45	131
11/1952	Earthquake, tsunami	9.0	USSR (Asia)			1,300
12/2004	Earthquake, tsunami	9.0	South and Southeast Asia	10,000	1,000	220,000
3/2011	Earthquake, tsunami	9.0	Japan	210,000	35–40,000	15,840

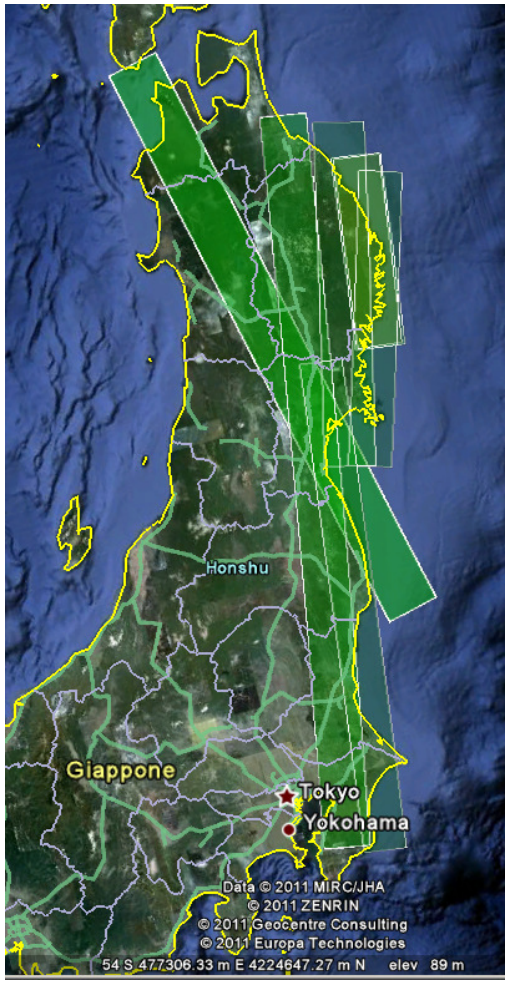
Japan Earthquake 2011

Starting from alert COSMO-SkyMed constellation has been acquiring:

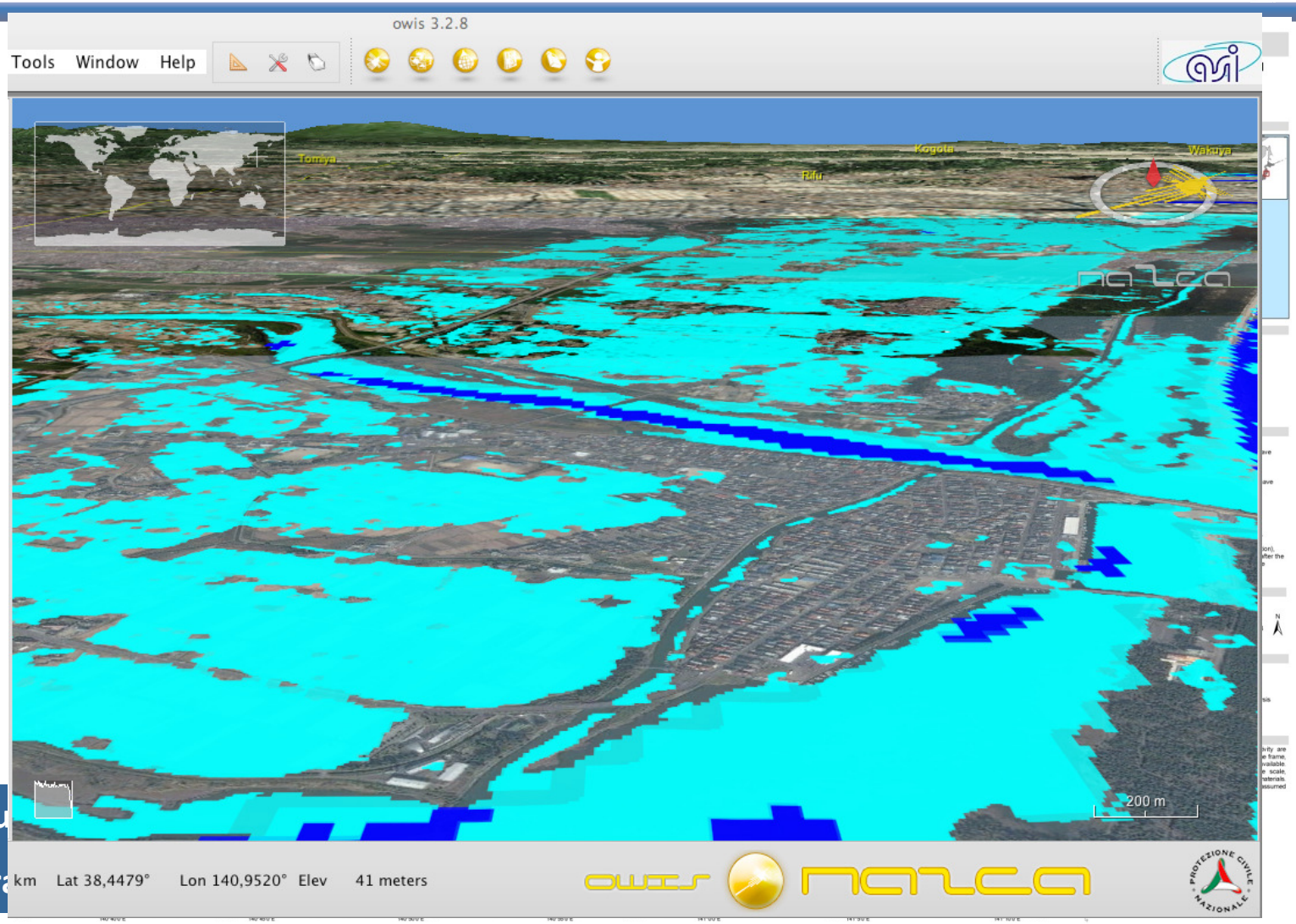
- 10 Spotlight-2 images over three "hot" nuclear power plants:
  - Fukushima 1
  - Fukushima 2
  - Oganawa

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



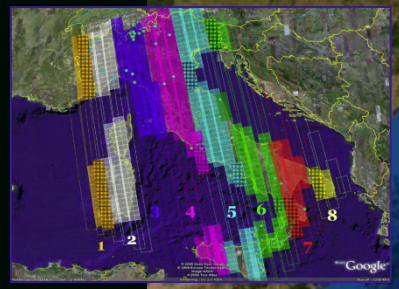
DARK blu

Carthogra

Wide range of applications

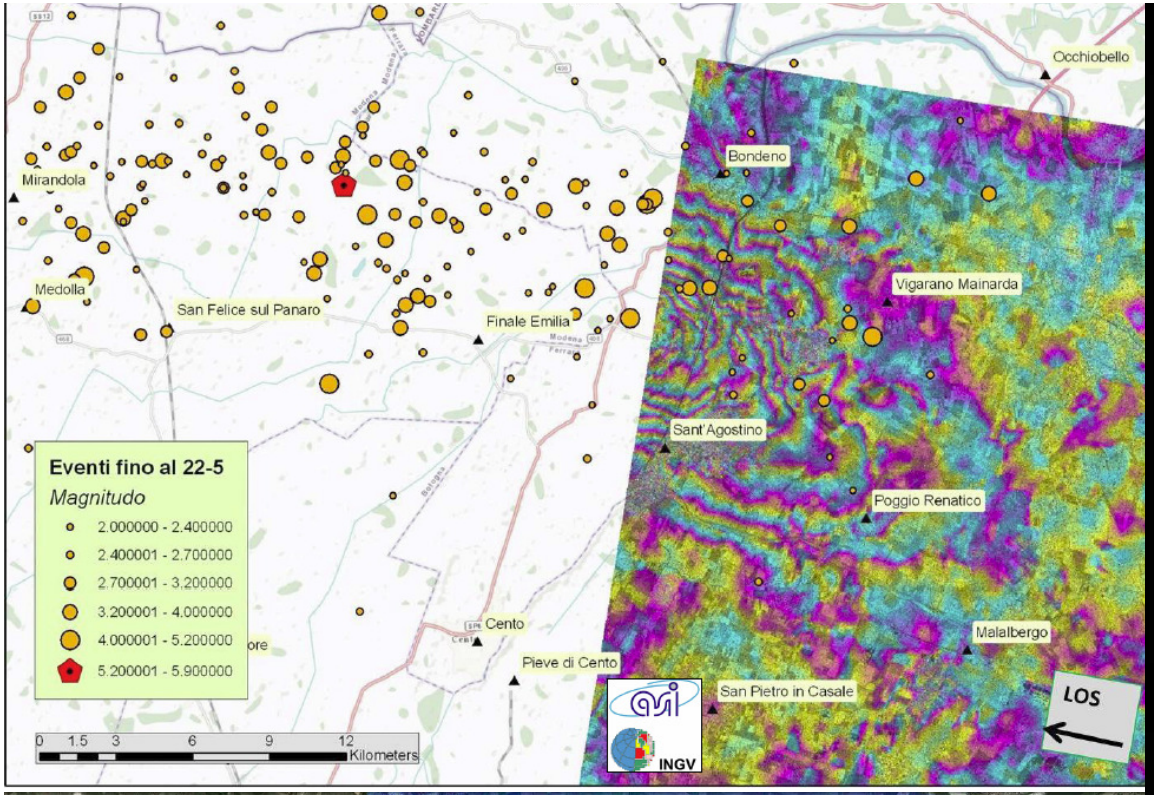
- RISK MONITORING AND MANAGEMENT OF EMERGENCIES
- OCEAN AND ICE MONITORING
- MONITORING AND MANAGEMENT OF COASTALIINES AND INLAND WATERS
- MONITORING AND MANAGEMENT OF FORESTRY AND AGRICULTURAL RESOURCES
- TECHNICAL CARTOGRAPHY – URBAN PLANNING
- SCIENTIFIC APPLICATIONS
- SECURITY APPLICATIONS

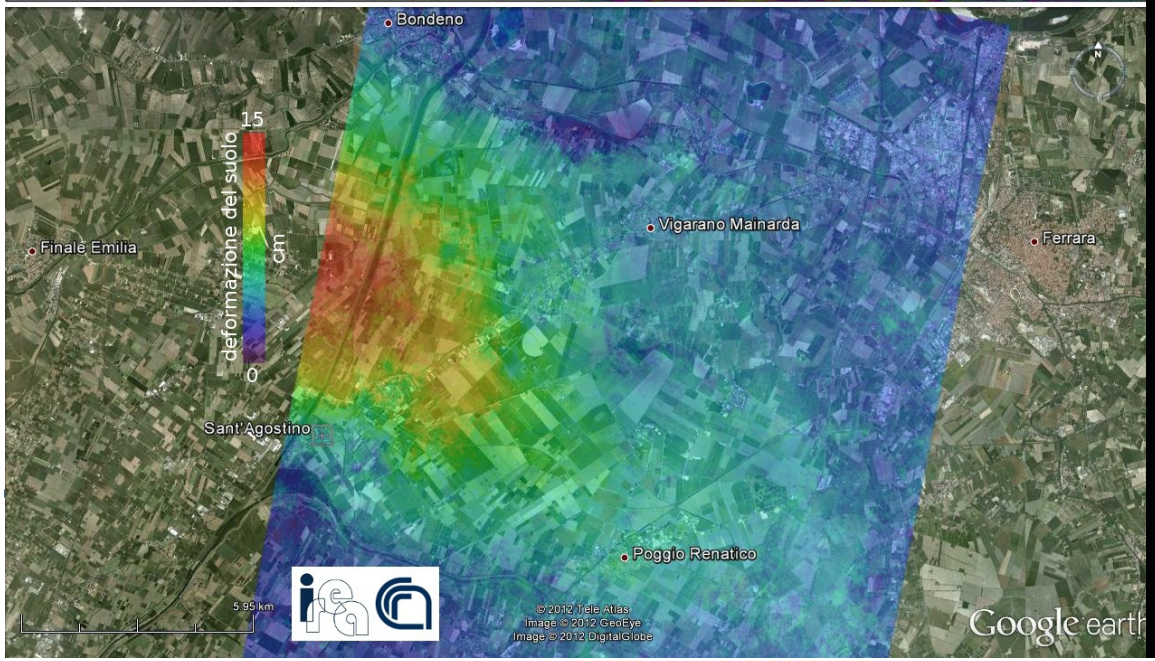
MAPPING: ITALY STRIPMAP MOSAIC

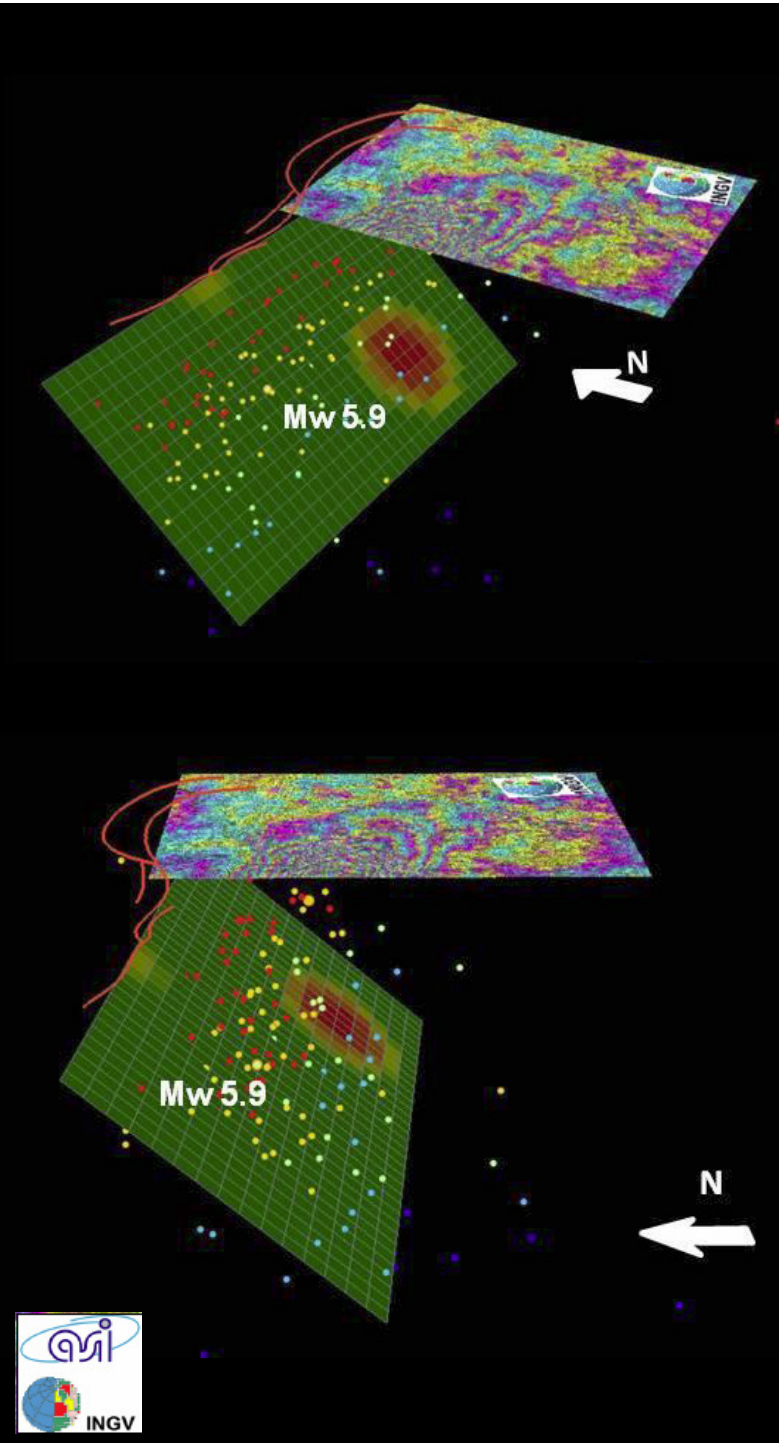


- USE OF 4 SATELLITES
- 16 DAYS PASSAGES (INTERFEROMETRIC ACQUIS.)
- ASC./DESC. PASSAGES

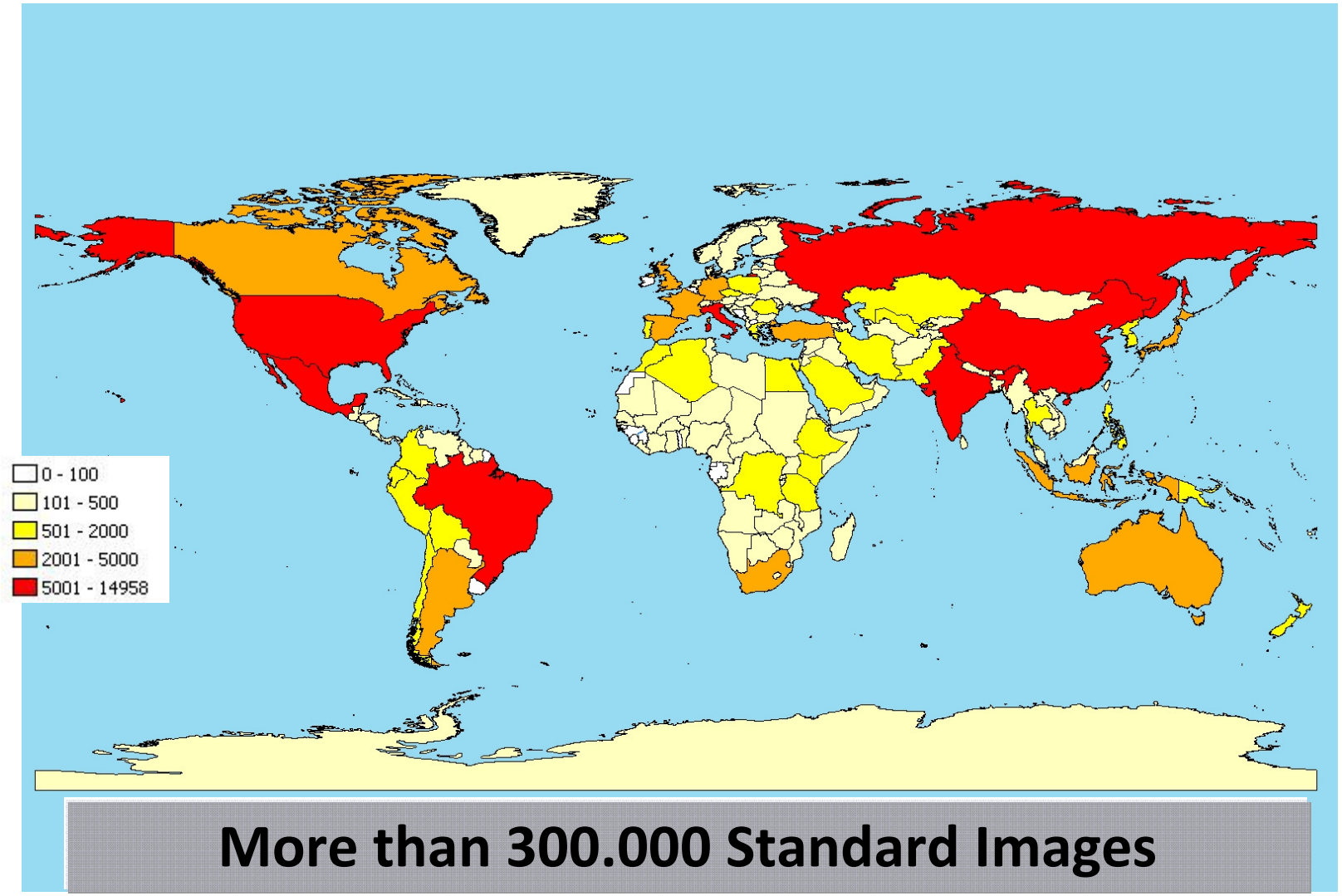
Emilia Romagna (Italy)
Earthquake(s) May-June 2012


Occhiobello
Bondeno
Mirandola
Medolla
San Felice sul Panaro
Finale Emilia
Vigarano Mainarda
Sant'Agostino
Poggio Renatico
Cento
Malalbergo
Pieve di Cento
San Pietro in Casale
Eventi fino al 22-5
Magnitudo
2.000000 - 2.400000
2.400001 - 2.700000
2.700001 - 3.200000
3.200001 - 4.000000
4.000001 - 5.200000
5.200001 - 5.900000
0 1.5 3 6 9 12
Kilometers
INGV
LOS


Bondeno
Vigarano Mainarda
Finale Emilia
Ferrara
Sant'Agostino
Poggio Renatico
deformazione del suolo
15
cm
0
5.95 km
© 2012 Tele Atlas
Image © 2012 GeoEye
Image © 2012 DigitalGlobe
Google earth


Mw 5.9
N
Mw 5.9
N
INGV

COSMO-SkyMed Catalogue Dec. 2012



More than 300.000 Standard Images

Accessing the System - Users

INSTITUTIONAL USERS

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

TWO MACRO-CLASSES

COMMERCIAL USERS

'ALL THE OTHERS'

- IMAGE BUYERS
- PORTABLE USER TERMINAL CUSTOMERS

Requesting data

INSTITUTIONAL 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 I

GENERAL CONDITIONS FOR THE PROVISION OF COSMO-SkyMed PRODUCTS

Definitions

Agreement — The ag… SkyMe…

Contractors and Consultants	Natura… intends… as spe…
Original PRODUCT	Herein… or High… the ter…
Ancillary Data	Techni… PROD…
Derived Product	Produc… which i… that th… whole …
Protected Product	Produc… charac… of the … are Pr…
Purposes of Use	PROD… agreen… of the … frame… been a…
User	The na… terms … (attach…
Affiliated User	The na… a Join… author…
Use	The te… proces… compu…
Joint Project	Specif… Affiliat…

ANNEX II

LICENCE to USE

1. Parties to the Licence

On the one part, the Agenzia Spaziale Italiana ("ASI" – Italian… located in Viale Liegi 26, 00198 Roma, and on the other part, the… also referred to as the User,

2. Object of the Licence

The definitions contained in the General Conditions for the prov… be deemed as entirely reproduced, used and applicable to the pr… This Licence to Use confers to the User a non-exclusive right to… in the Project Form (Annex III) under the terms and conditions sp… The User shall guarantee and notify ASI the written acceptance… to avail itself of, concerning the respect of the PRODUCTS lim… Contractors and consultants shall not be authorised to keep cop… Products once performed their contractual or consultancy activiti… After the PRODUCT delivery, ASI hereby reserves the right to… PRODUCT utilization, ensuring confidentiality of the information… The User shall not disclose, reproduce, transfer or make in… information or any ancillary data supplied by ASI together with a…

The transfer in whole or in part of this Licence to Use or any o… sub-licences or similar assignments to third parties is explicitly p… ASI.
Such prohibition shall apply to any provisions of this Licence to… any reason whatsoever.

3. Intellectual Property Rights

The COSMO–SkyMed System PRODUCTS, object of this Licen… the Italian Republic. Under Article no. 2 of the Interdepartment… ASI is the owner of the intellectual property rights pertaining t… satellites

The PRODUCTS are protected by the Italian and international … by the satellites or anyway present in the archives are protect… protection under Directive EU 96/9 dated 11th March 1996, a… Legislative Decree no. 169 dated 6th May 1999.
The User hereby acknowledges that *COSMO-SkyMed®* and *CS…* itself to reproduce the trademark as follows: *COSMO-SkyMed®*…

The User hereby acknowledges ASI copyright over the PROD… copyright notice irrespective of the supporting device of the PRODUCT, as follows:
"COSMO-SkyMed Product - ©ASI - Agenzia Spaziale Italiana - (year of acquisition). All Rights Reserved"

Within the limits of its own business, the User hereby guarantees the respect of the ASI's intellectual property rights over the PRODUCTS and commits itself to promptly notify in writing to ASI of any unlawful use, including that of third parties, of the supplied PRODUCTS or of the Protected Products processed under the terms of this Licence to Use.

ANNEX 3

PROJECT FORM

INTRODUCTION

The main goal of the Project Form is to provide an explicit and detailed description of the needs of the User who signed the specific Agreement with ASI and is proposing the present project.
The User's needs must be made explicit in terms both of activity purposes requiring the use of COSMO-SkyMed data takes acquisition and typology/volume of required products (tasking from new programming/production from archived data) to allow the necessary feasibility analysis be performed by the System operational chain.

The following fields are included in the Project form:

- PROJECT TITLE
- PRIMARY APPLICATION DOMAIN / UTILIZATION SCOPES
- EXECUTIVE SUMMARY (PROJECT DESCRIPTION)
- END USER INFORMATION (PROJECT RESPONSIBLE)
- PROJECT TEAM:
  - USERS
  - AFFILIATED USERS
  - CONTRACTORS/CONSULTANTS
- PLANNING OF THE ACTIVITIES (Optional)
- PROJECT REQUESTS DETAILS (See nested excel file)
- ANNEXES (If considered necessary by the User himself)

Should you have any problem in filling/submitting the Project Form, please don't hesitate to contact us:

1) at the following address:

ASI
Viale Liegi, 26
00198 Roma - Italy
e-mail csk.help@asi.it

2) or directly contacting the COSMO-SkyMed Mission Manager
Alessandro Coletta
e-mail: alessandro.coletta@asi.it

ONAL
loitation

tation

e-geos.it

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 Genarazione" will provide operational continuity at least until 2023

ASI is open to new international partnerships

THANK YOU