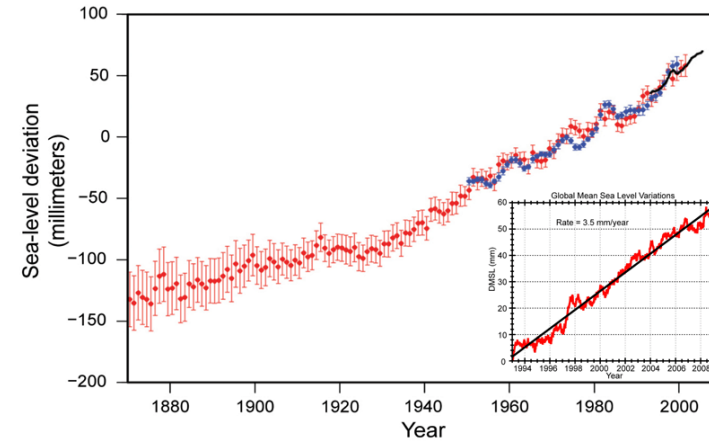
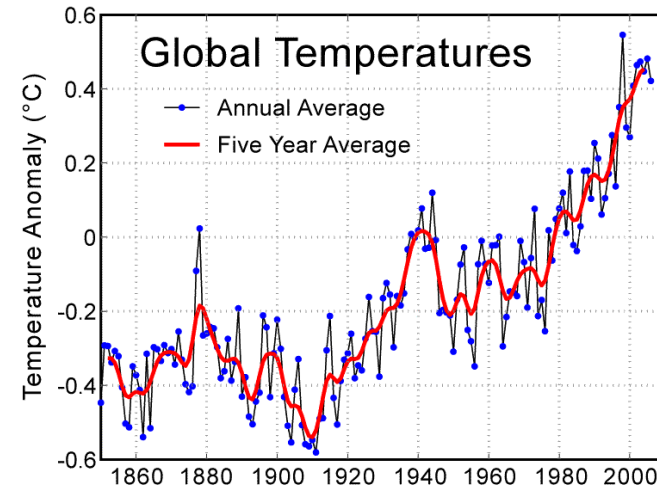
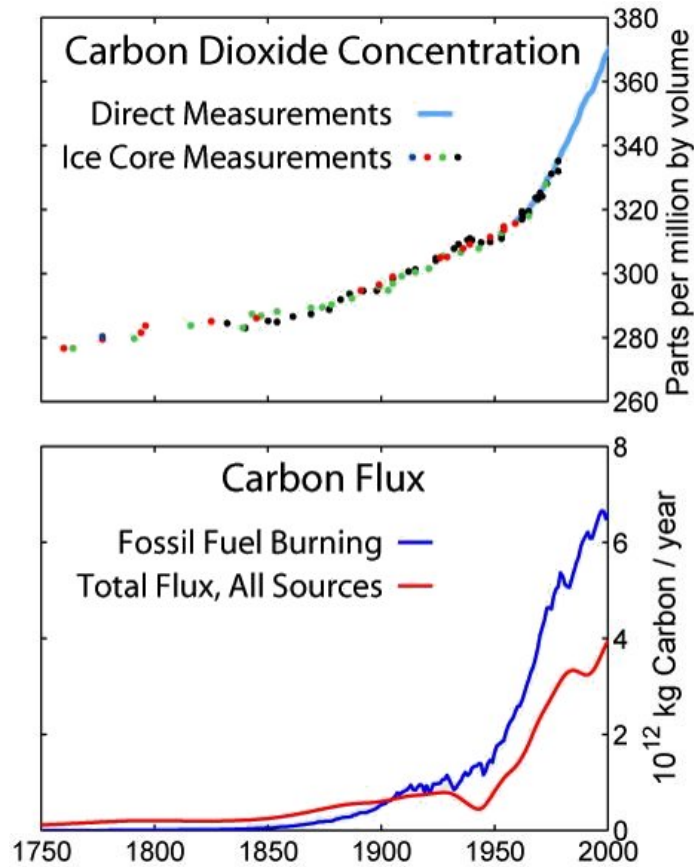


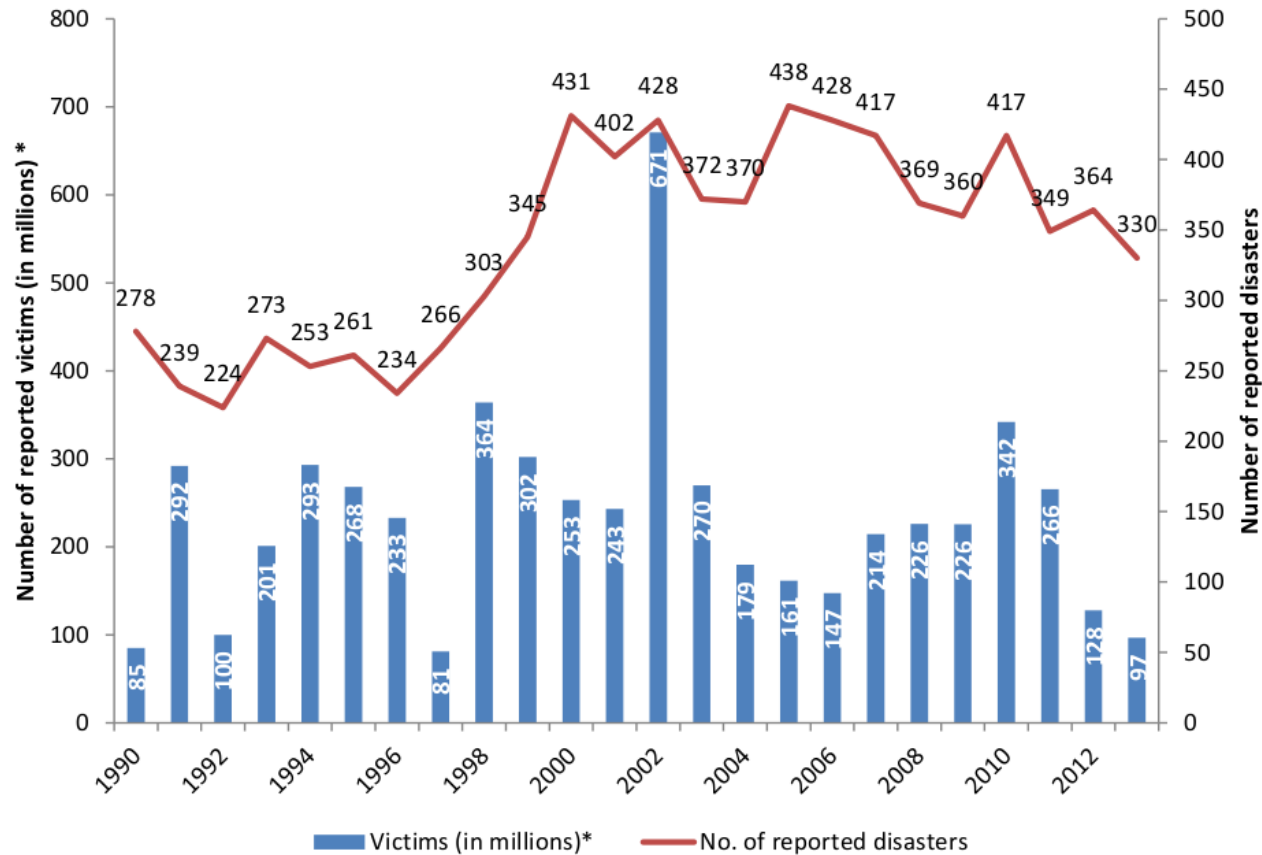
International Charter 'Space and major disasters' and rapid mapping products

Stéphane MAY
CNES DCT/SI, Toulouse
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Multitemp 2015 - Annecy

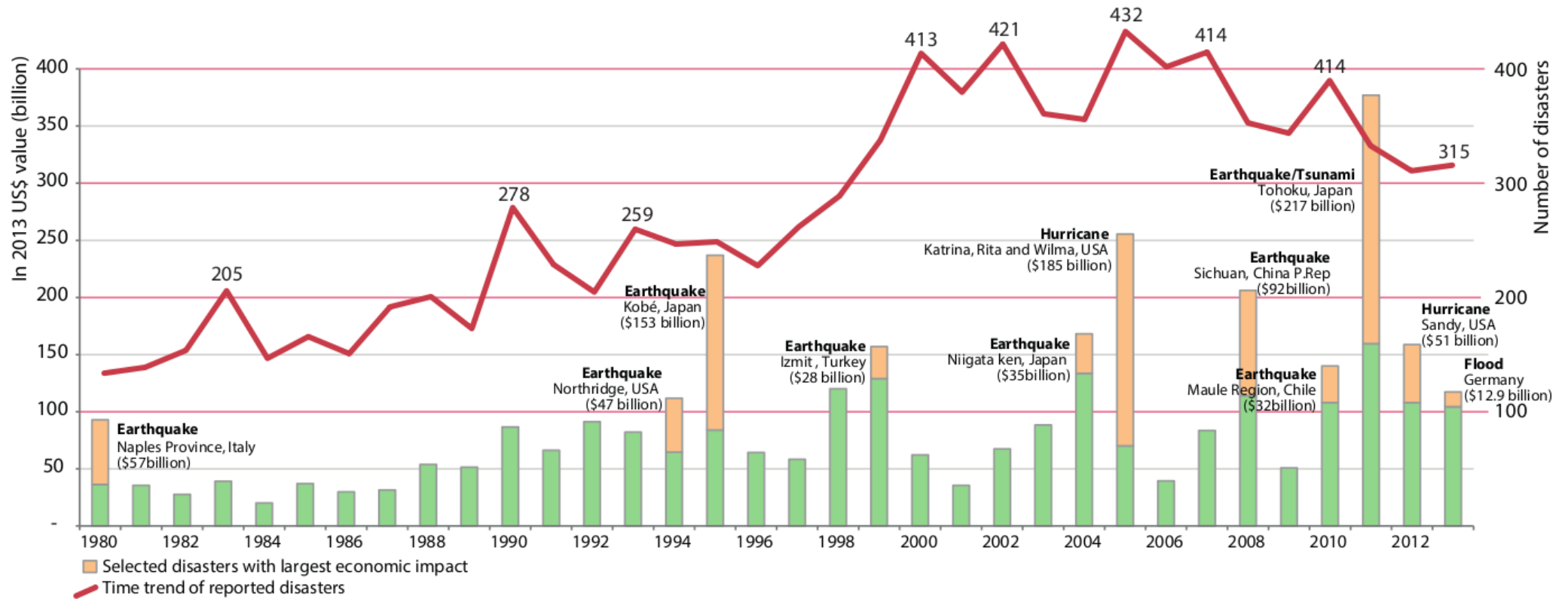


Sources : Carbon Dioxide Information Analysis Center (CDIAC), NOAA



**Victims = sum of deaths and total affected*

Sources : NOAA and CRED (Annual Disaster Statistical Review 2013)



Source : CRED (2013 - Disasters in Numbers)



Source : US Navy via Getty Images



Source : Reuters / Eduardo Munoz



Source : Kyodo news

- ① The International Charter 'Space and major disasters'
- ② Examples of floods activations
- ③ Examples of hurricane activations
- ④ Example of earthquake activation
- ⑤ Conclusion

- ① The International Charter 'Space and major disasters'
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What is the International Charter?

- The Charter is a worldwide collaboration between 15 space agencies, aimed at offering an integrated system of acquisition and provision of satellite data in the event of major disaster
- The Centre National d'Études Spatiales (CNES) and the European Space Agency (ESA) initiated the International Charter in 1999
- The Canadian Space Agency CSA signed the Charter on October 20, 2000
- Charter declared operational as of November 1, 2000
- Now composed of 15 member agencies from 12 countries + Europe

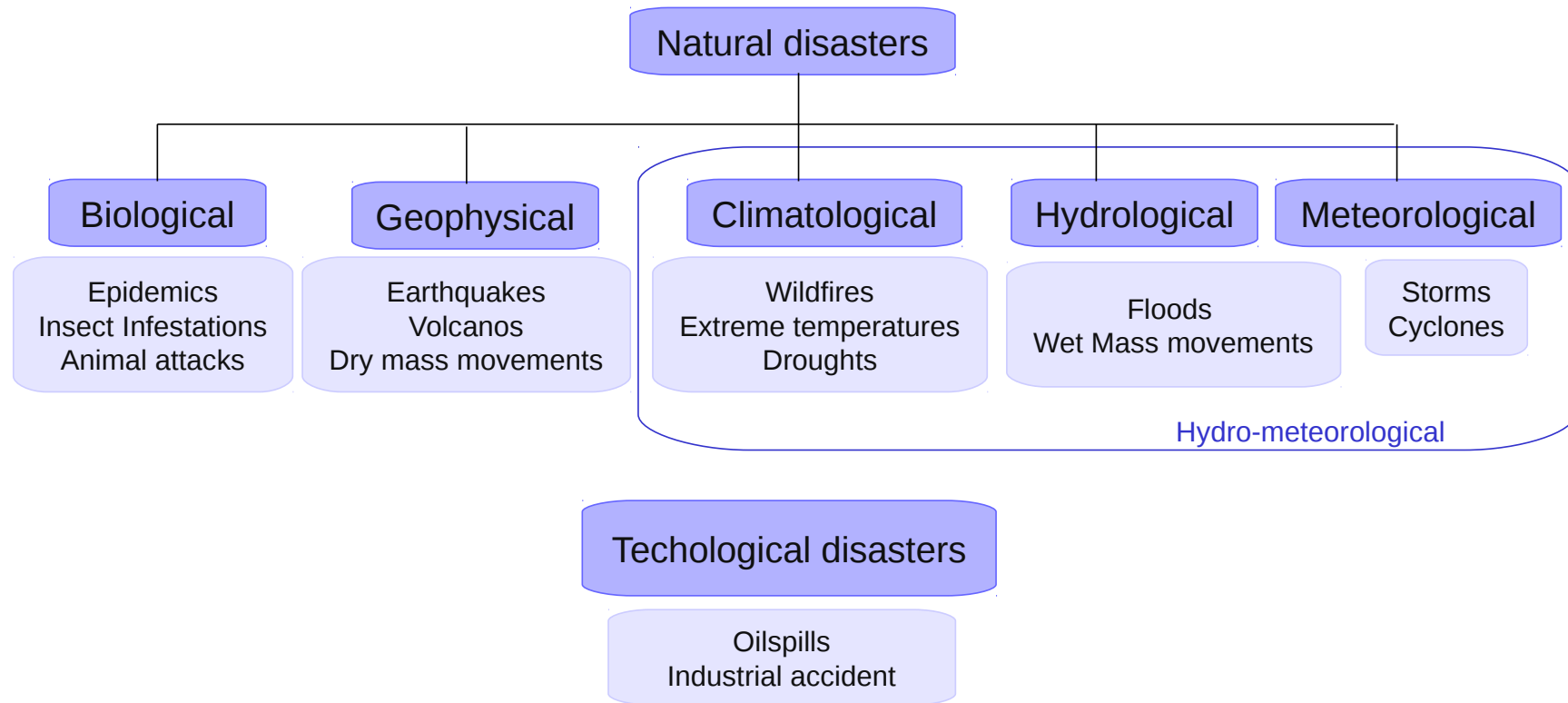




The International Charter 'Space and major disasters'

The virtual constellation of the Charter in 2014





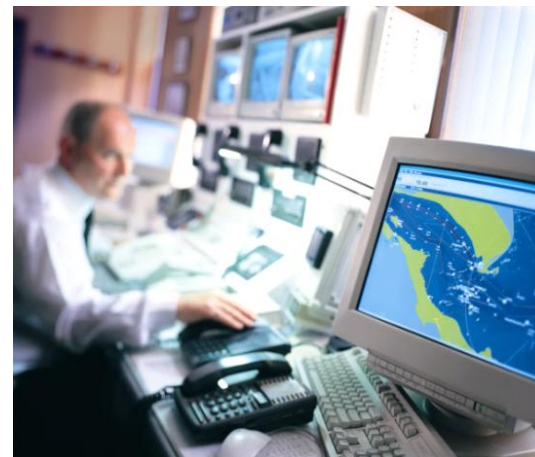
Universal Access

- Any national disaster management agency may submit a request to the Charter
- The entity must have the capacity to download and use maps
- The entity must be able to submit and pursue its activation request in English



Mandate of the Charter

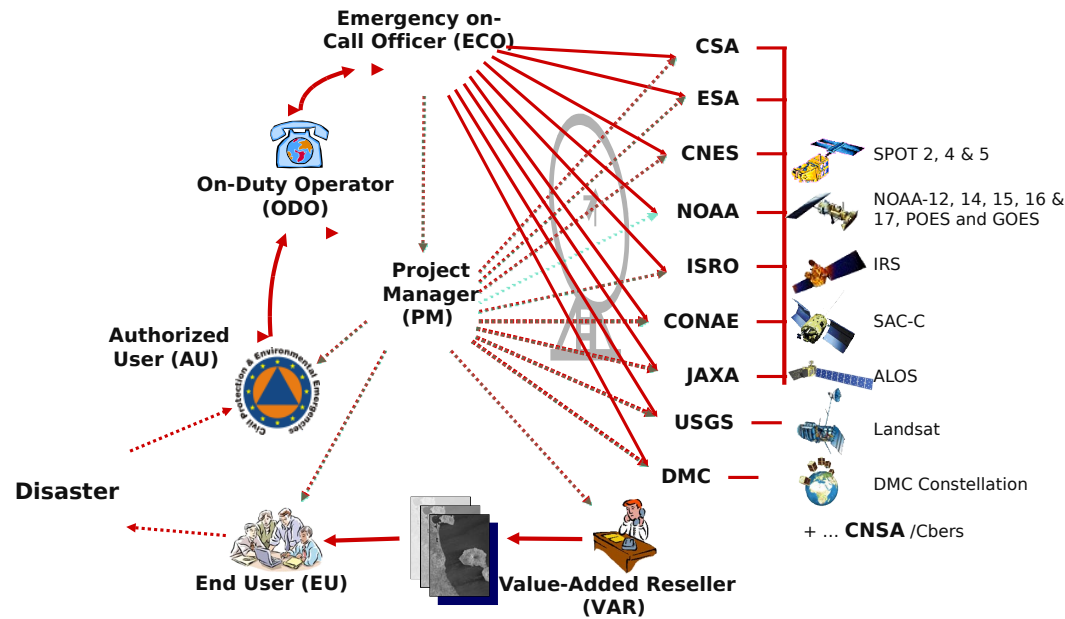
- Charter provides images, free of charge and as quickly as possible
- Charter provides crisis and damage assessment maps generated from these satellite images
- Charter offers a service 24/7
 - 24 hours a day, seven days a week





The International Charter 'Space and major disasters'

Operational organisation of the International Charter

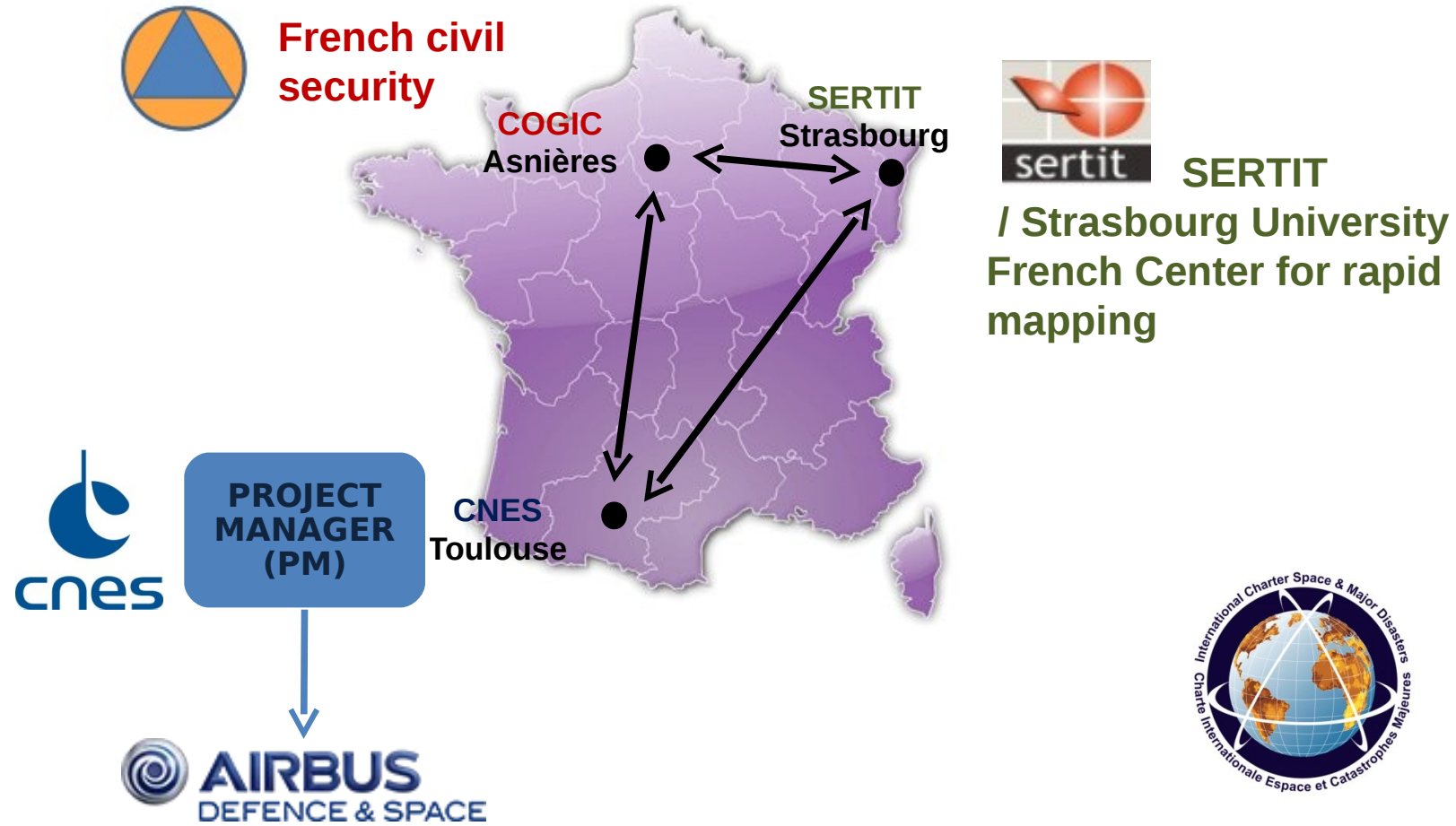


For each activation, a Project Manager is appointed by the member of the Charter to

- coordinate the acquisition of images
- coordinate the production of derived information
- communicate with the user to ensure effective and useful assistance

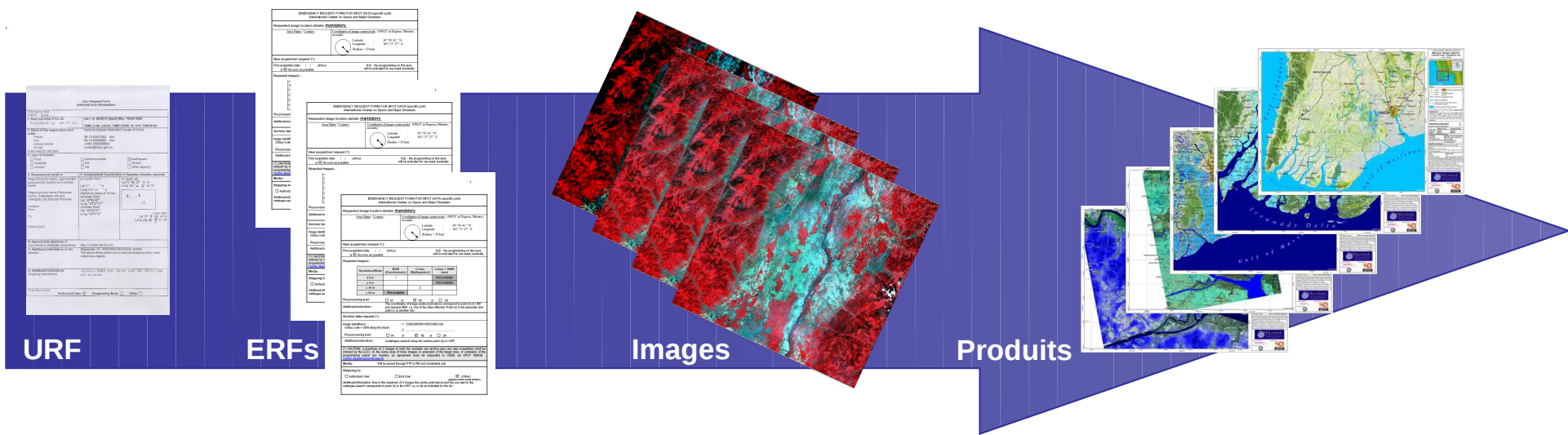
The International Charter 'Space and major disasters'

Operational organisation during activation the by French COGIC



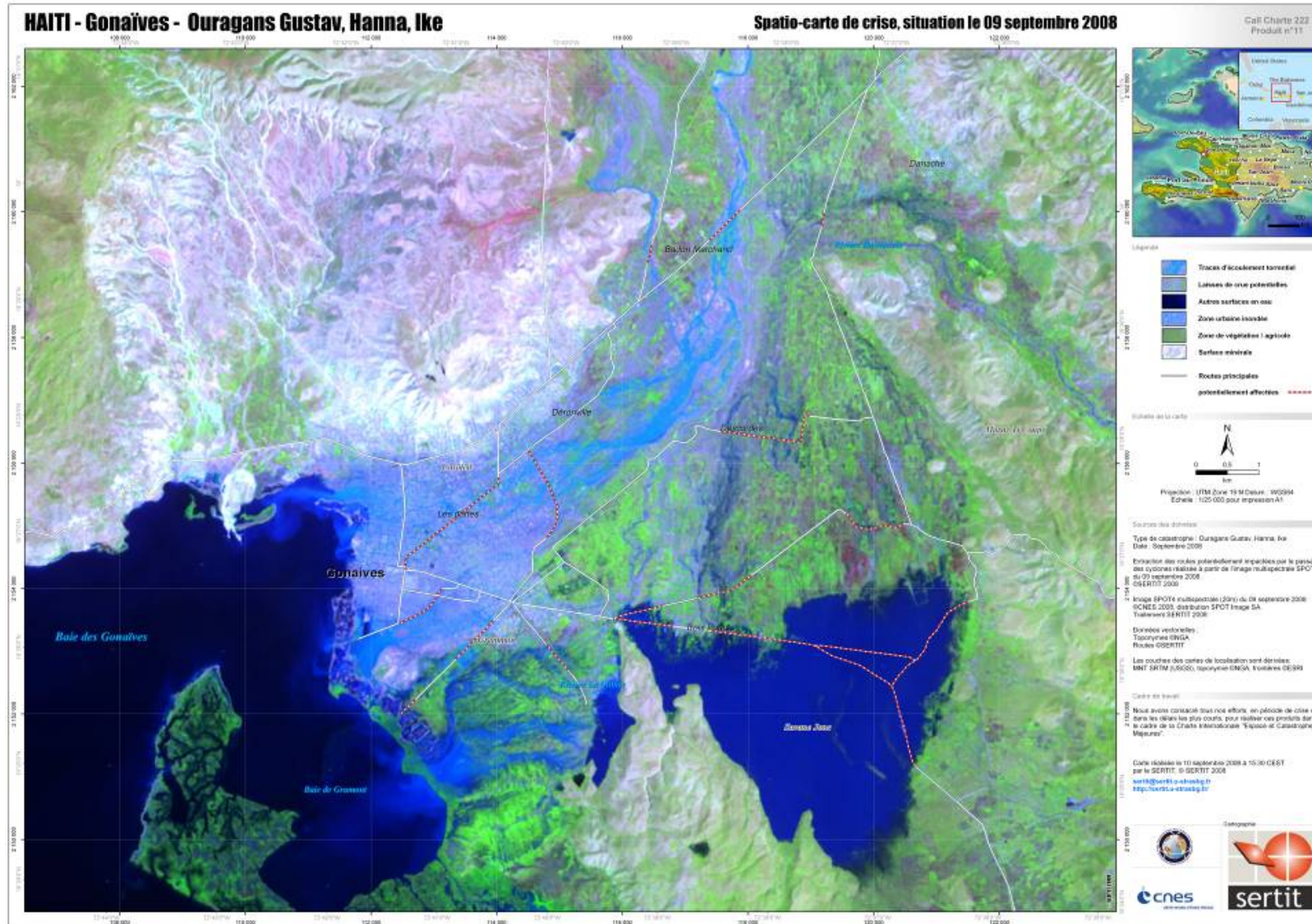
The International Charter 'Space and major disasters'

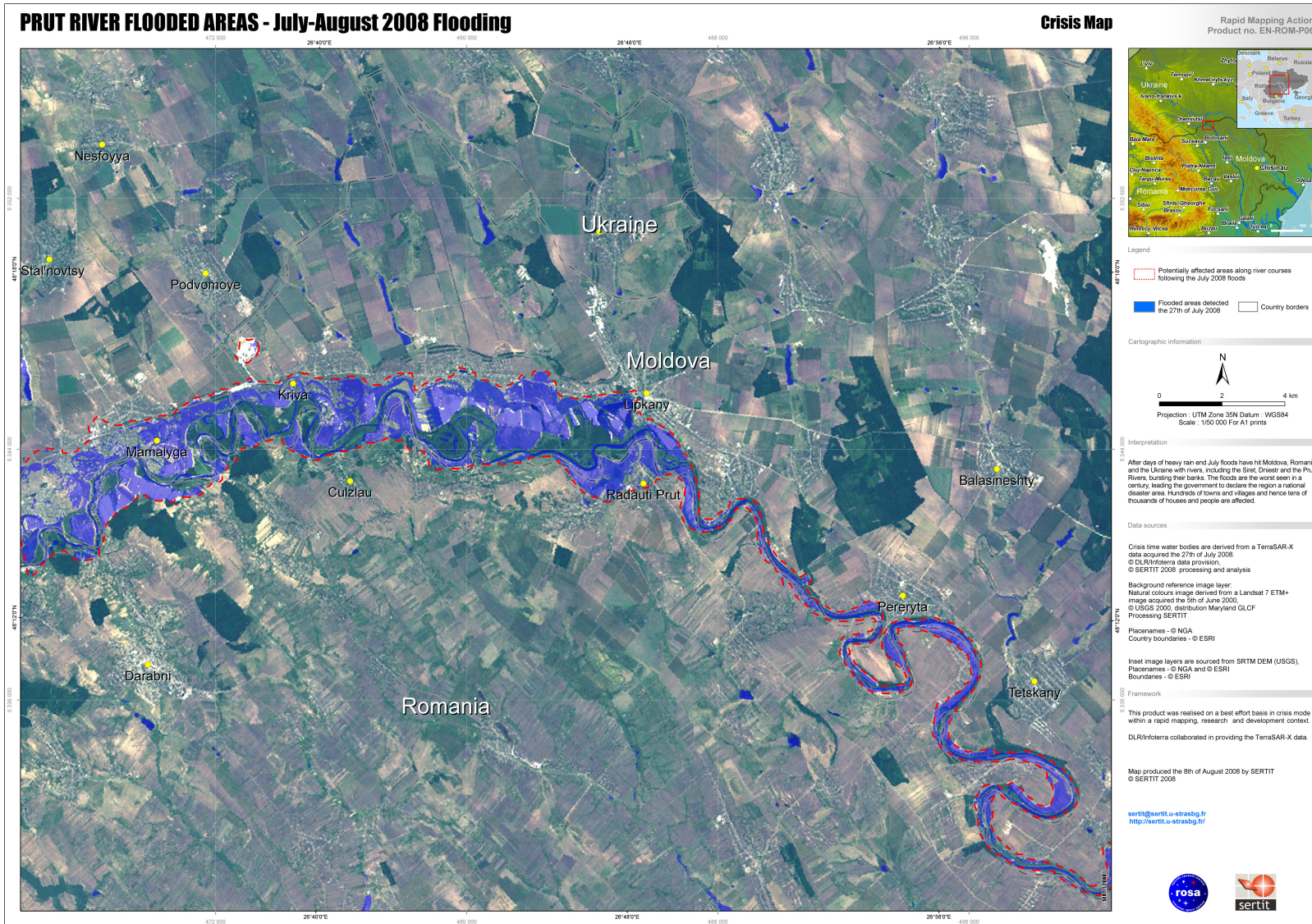
From images to products



The International Charter 'Space and major disasters'

Example of products done by SERTIT – Haiti 2008





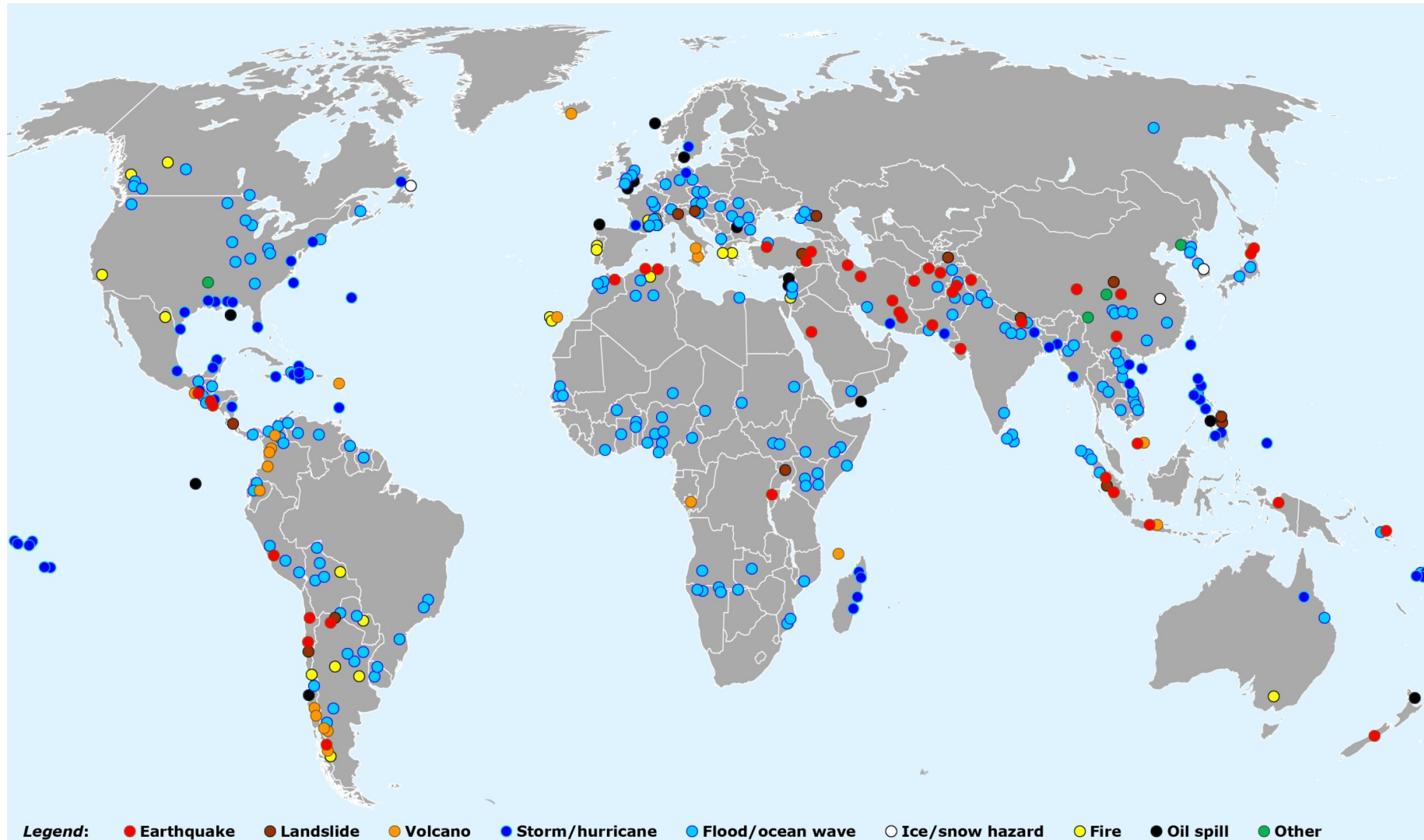
The International Charter 'Space and major disasters'

Examples of Charter activations (Oct 2008 - Apr 2009)

Activation ID	Call ID	Activation	Disaster	Country / Region	AU	ECO	PM
194	228*	22/10/08	Flood	Algeria		CNES	
194	229	28/10/08	Flood	Honduras	UNOSAT	USGS	ESA
195	230	28/10/08	Flood	Yemen	UNOOSA	USGS	DLR
196	231	03/11/08	Earthquake	Pakistan	USGS	CNSA	CSA
197	232	05/11/08	Flood	Vietnam	UNOSAT	CNSA	ESA
198	233	15/11/08	Flood	Kenya	UNOOSA	CONAE	USGS
199	234	27/11/08	Floods	Sri Lanka	UNOSAT(OCHA)	DMCII	ESA
200	235	27/11/08	Floods	Brazil	CONAE	DMCII	CONAE(INPE)
201	236	11/12/08	Floods	Colombia	UNOOSA (OCHA)	ESA	CONAE
202	237	8/1/09	Earthquake- Landslide	Costa Rica	SIFEM	CNSA	CONAE (Univ. Costa Rica)
203	238	9/1/09	Floods	US Washington	USGS (FEMA)	CNSA	USGS
204	239*	22/1/09	Floods	Fidji	UNOOSA(OCHA)	CSA	
204	240-241	24/1/09	Storm	France (SW)	COGIC/DSC	CSA	CNES
205	242	9/2/09	Floods	Morocco	UNOOSA(ECA)	ESA	ESA
206	243	10/2/09	Landslide	Argentina	SIFEM	ESA	CONAE (SEGEMAR)
207	244-45	12/2/09	Fires	Australia	USGS (FENSA)	ESA	USGS
208	246	24/2/09	Volcanic Eruption	Chile	SIFEM	JAXA	CONAE (INA)
209	247	27/2/09	Floods	Namibia	UNOOSA(UNDP)	JAXA	DLR
210	248	11/3/09	Floods	US Indiana	USGS	CNSA	USGS(Gov. Indiana)
211	249	20/3/09	Floods	Namibia	UNOOSA	CONAE	UNOSAT
212	250	25/3/09	Floods	US North Dakota	USGS	CSA	USGS (univ. Of N. Dakota)
213	251	26/3/09	Floods - Landslide	Peru	SIFEM (INDECI)	CSA	CONIDA
214	252	7/4/09	Volcanic Eruption	Chile	SIFEM (ONEMI)	ISRO	CONAE

* Activation was denied by ES

465 calls (07/2015) over >110 countries



① The International Charter 'Space and major disasters'

② Examples of floods activations

Lourdes - France - Floods in June 2013

Krimsk - Russia - Floods in July 2012

Niamey - Niger - Floods in August 2012

③ Examples of hurricane activations

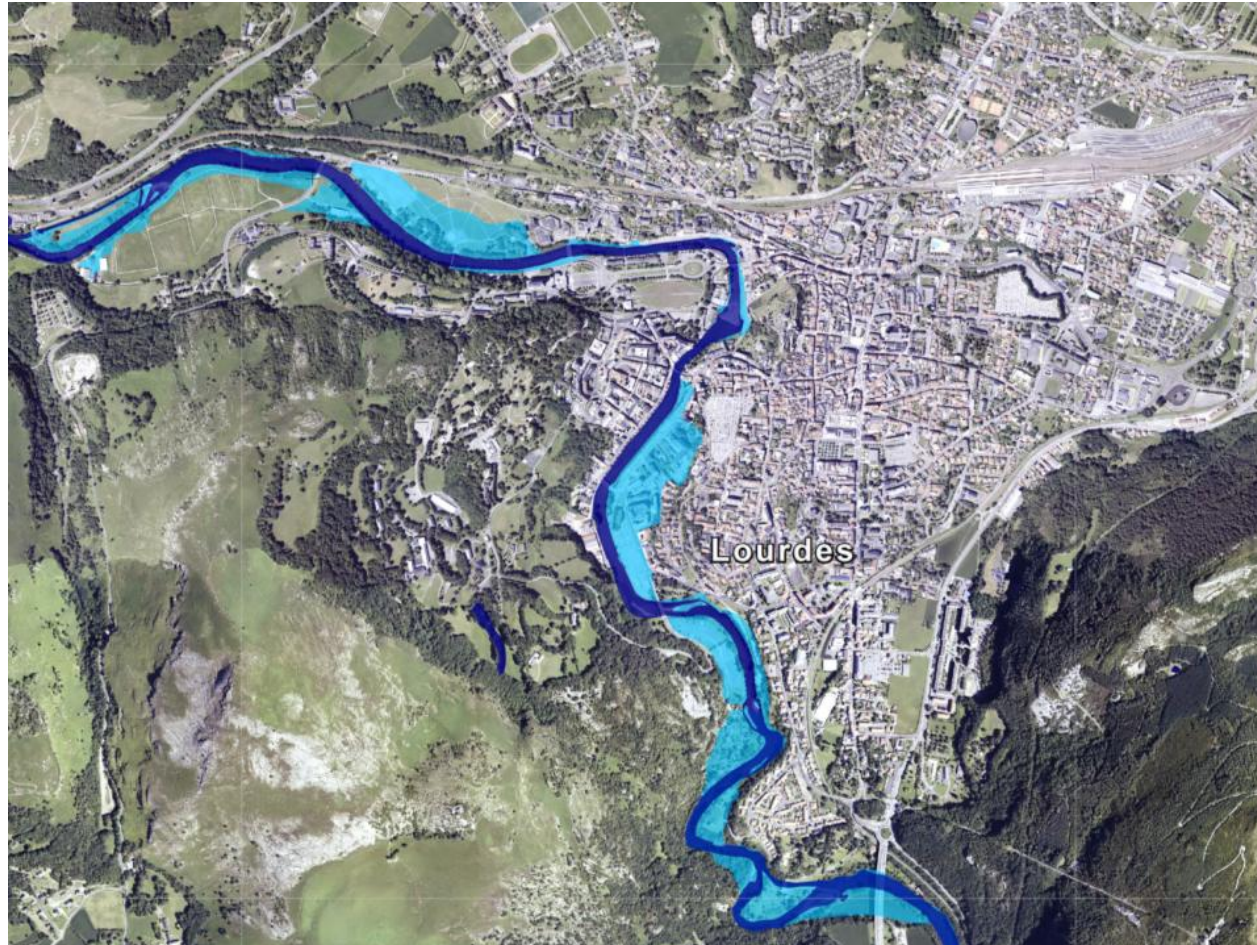
④ Example of earthquake activation

⑤ Conclusion

Lourdes - France - Floods in june 2013

VHR archive image / VHR Crisis image (Pleiades)



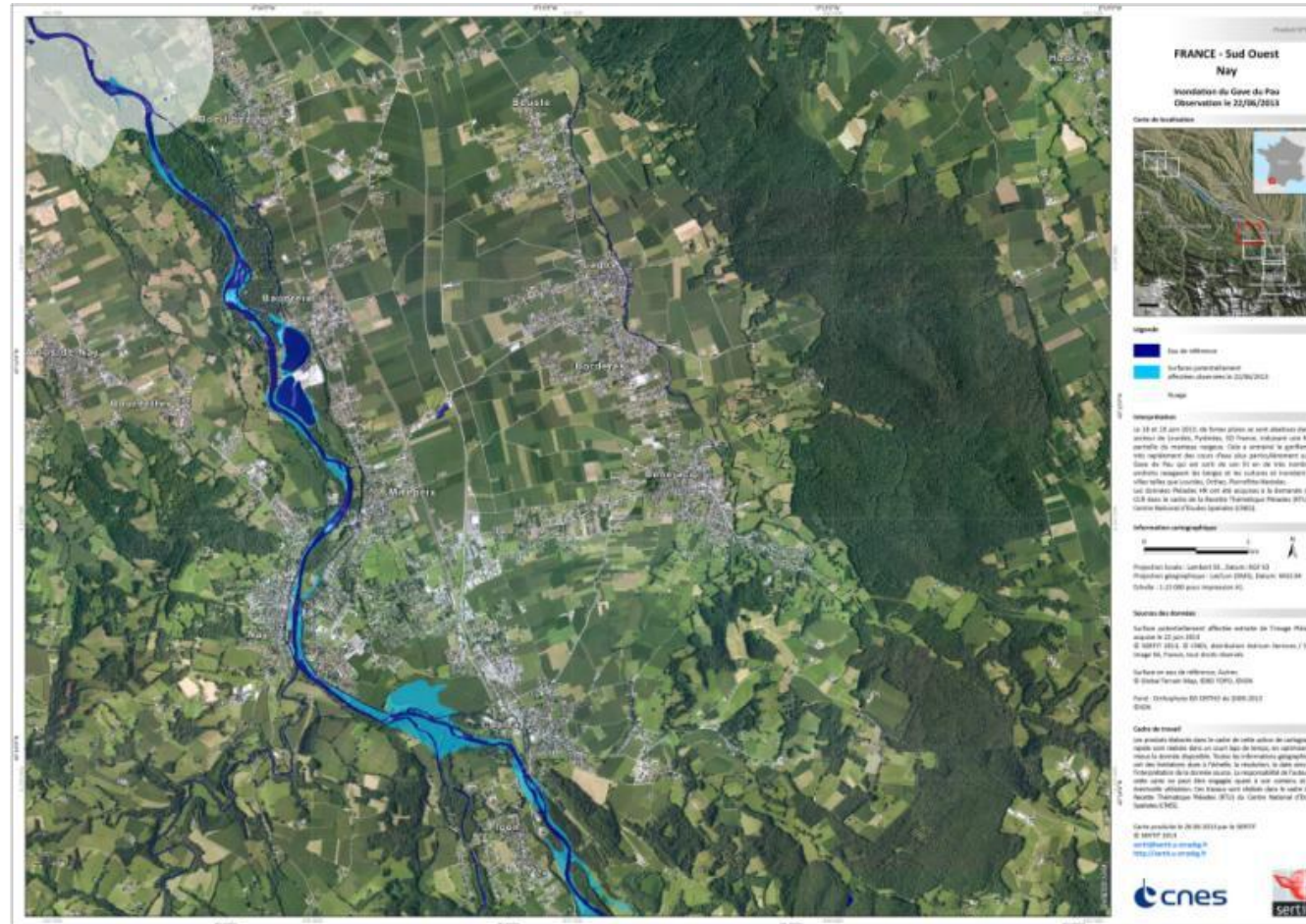




Lourdes - France - Floods in june 2013

Lourdes - Area near Nay (Hautes-Pyrénées)





- 7th of July 2012: floods near the Black Sea. 170 deaths, 13000 affected
- 10th of July 2012: activation of the Charter by USGS





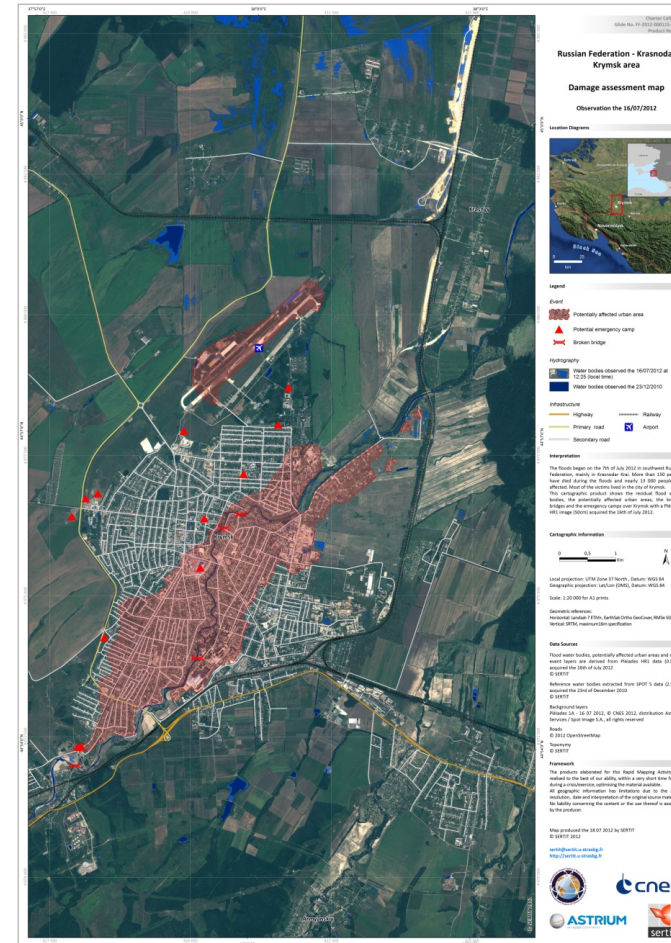
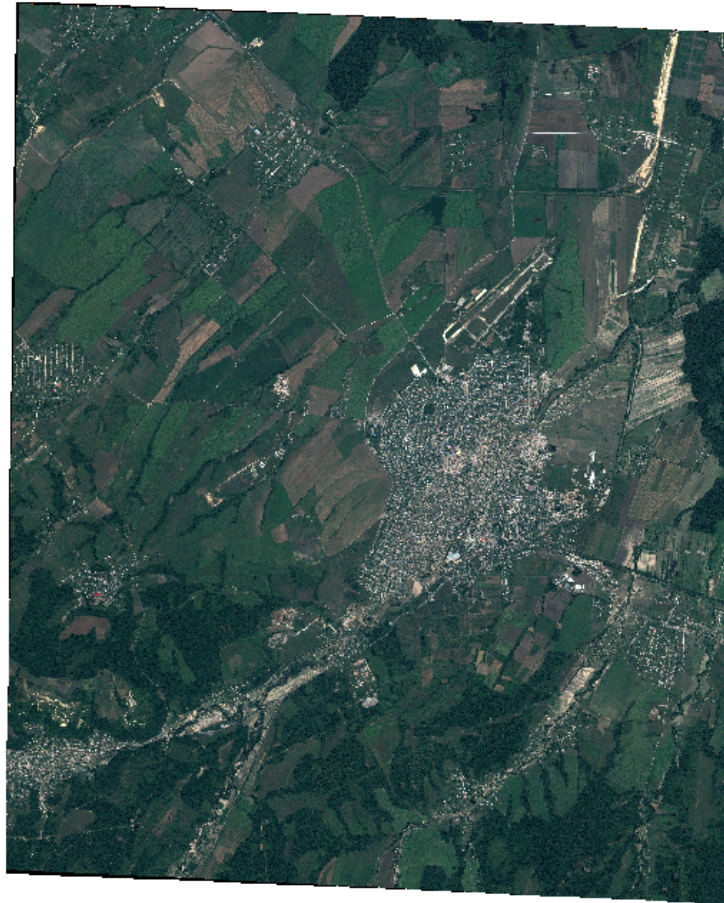
- Pre-crisis image: Google
- Crisis image: Pleiades, 70cm
- Detection of floods: stagnant water, mud areas



- Pre-crisis image: Google
- Crisis image: Pleiades, 70cm
- Detection of destroyed infrastructures

Krimsk - Russia - Floods in July 2012

From the Pleiades image to the rapid mapping product...



- Information related to source images
- Legend + Explanations on the product



Problems during this call

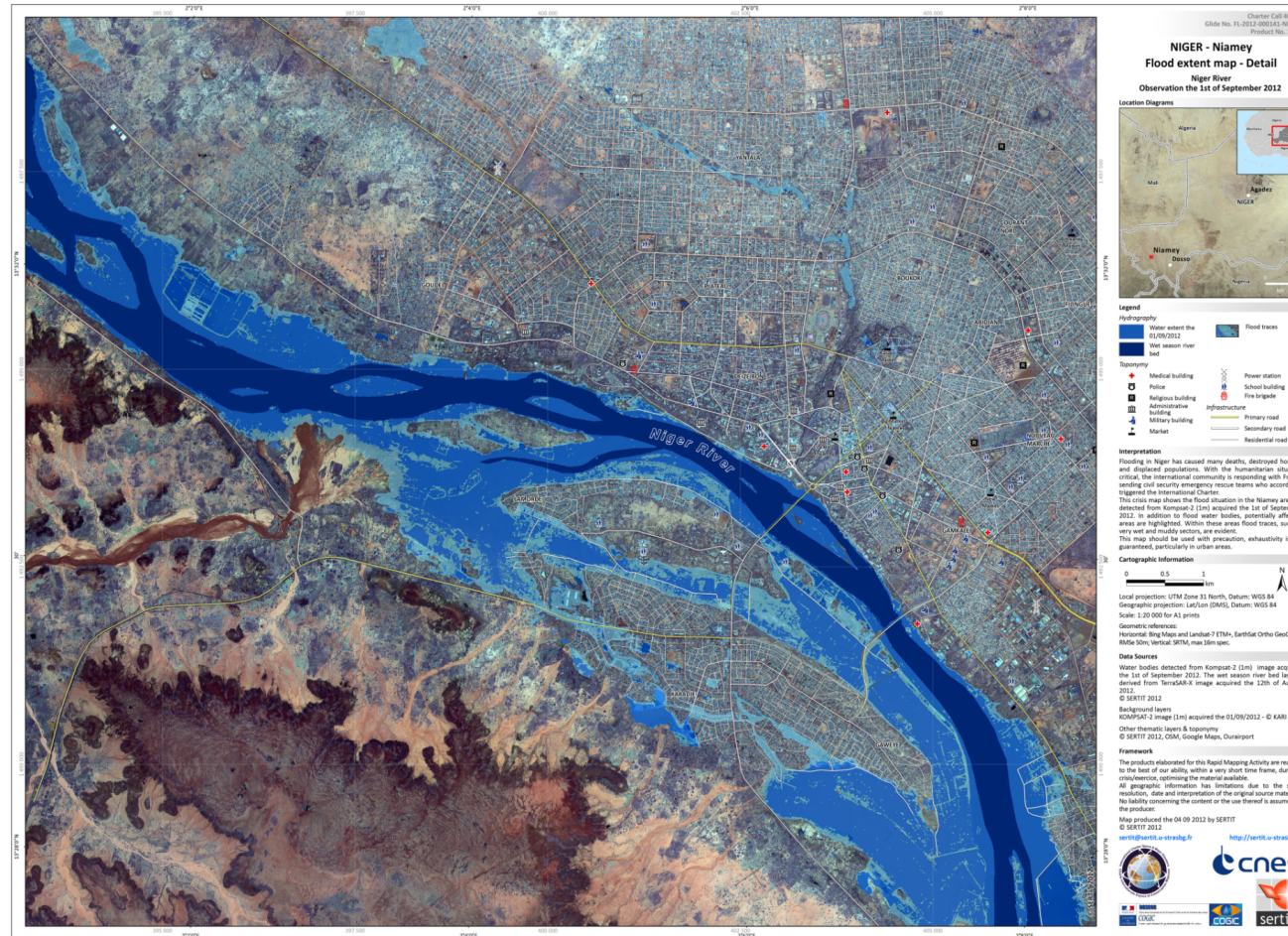
- VHR image available few days after the event
- Flooded area detected with mud
- No VHR archive image



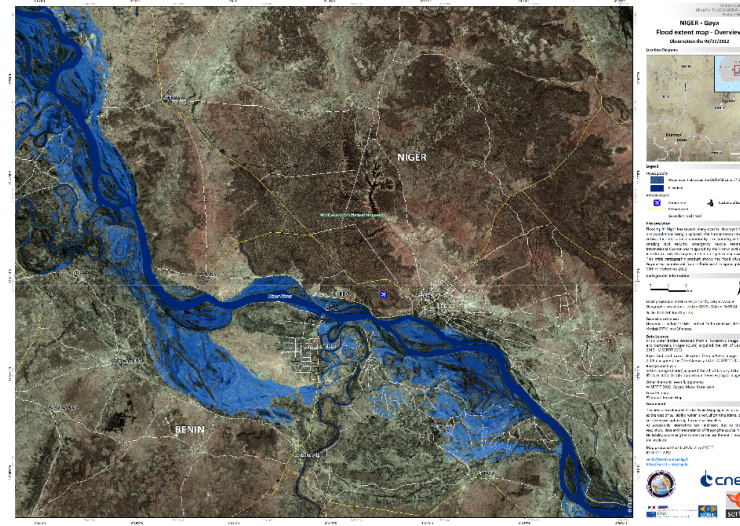
- Floods of the Century of the Niger river. 88 deaths, 72396 homes affected, 500000 persons affected
- 28th of August 2012: the Charter is triggered by the French Civil Protection in relation with Niger authorities



Crisis product over Niamey with Kompsat image



Crisis image over Gaya: Kompsat



Problems / challenges

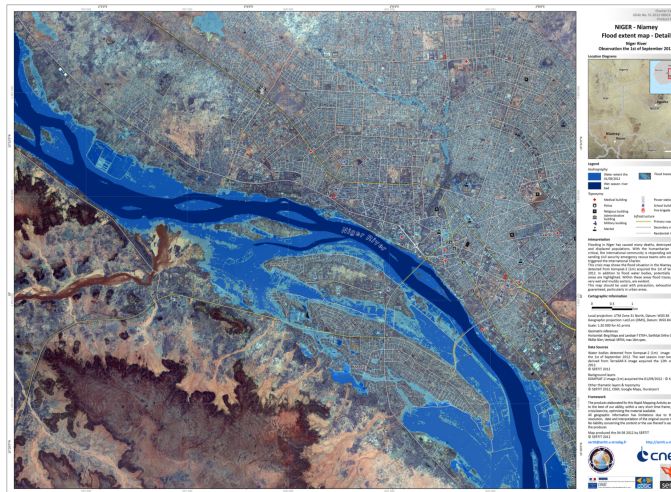
- Difficulties to pre-define the most impacted areas
- **Several** impacted areas: Niamey, Agades, Dosso and then Tillaberi, Gaya
- 2 cloudy Pleiades acquisitions
- Delay with radar VHR acquisitions (orbital constraints)
- No radar archive image for Radarsat 2 over interest areas
- Niger river level variations (flood, fall, flood)

Results

- 3 crisis products delivered 2.5 days after beginning of the charter call despite bad weather conditions

Return of experience

- Rapid mapping products : 6/8 hours delay maximum
- Radar is useful at the beginning of the call (no sensitivity to weather conditions)
- When radar and VHR optical data are available, optical images are used in priority
- Users like getting products with optical HR / VHR image to end the call

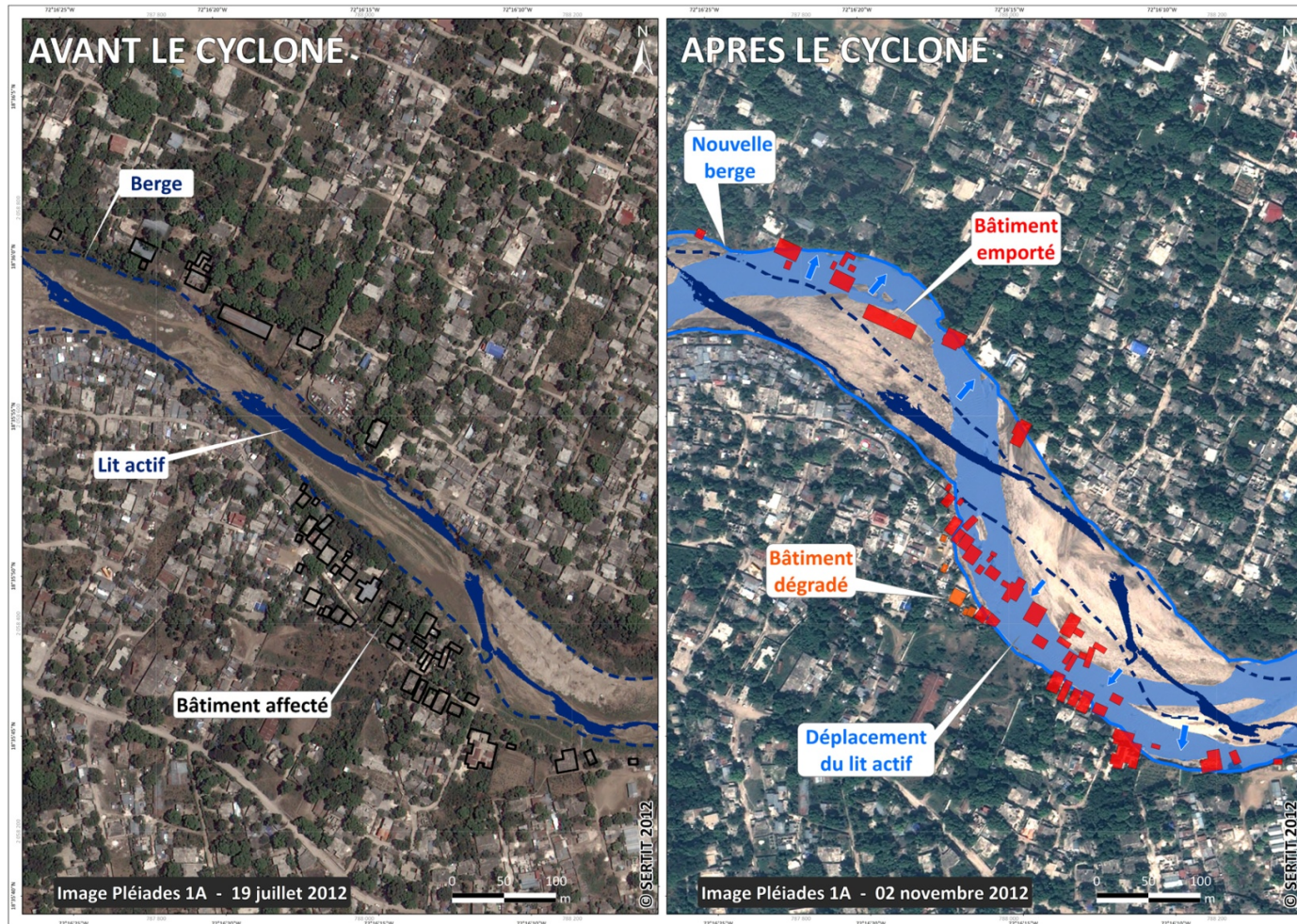


- ① The International Charter 'Space and major disasters'
- ② Examples of floods activations
- ③ Examples of hurricane activations
 - Haiti - Hurricane Sandy in October 2012
 - Phillippines - Category 5 Super Typhoon Bopha in december 2012
- ④ Example of earthquake activation
- ⑤ Conclusion

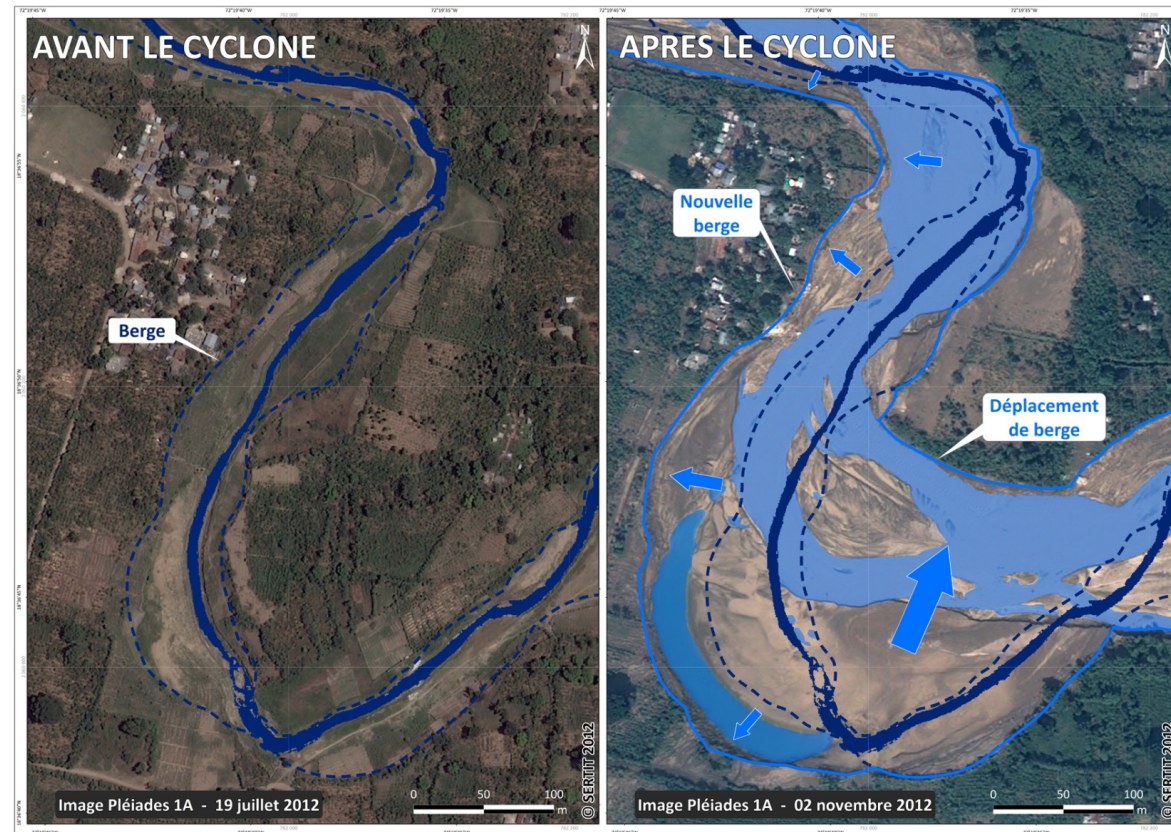
- Hurricane Sandy bore down on Haiti on the night 23 to 24 October 2012
 - Heavy rains, strong winds
 - Major floods and landslides
- Haiti that was devastated by earthquake in January 2012 is the most affected area
- 50 deaths, and 200000 people left homeless
- Entire crops in hurricane path are destroyed
- Charter activated on 29 October



Before / after image along the Grise river (Pleiades images)



Before / after image along the Grise river (Pleiades images)



- Overflow of the Grise river
- Displacement of the bed of the river and banks
- Damages on several buildings
- The map, generated by Sertit is sent to users working on the ground

Return of experience

- Charter activated five days after the passage of Sandy over Haiti
- Satellite images acquired late after the hurricane
- At times, substantial clouds does not facilitate detection of damages
 - But many archive images available on Haiti (previous activations...)

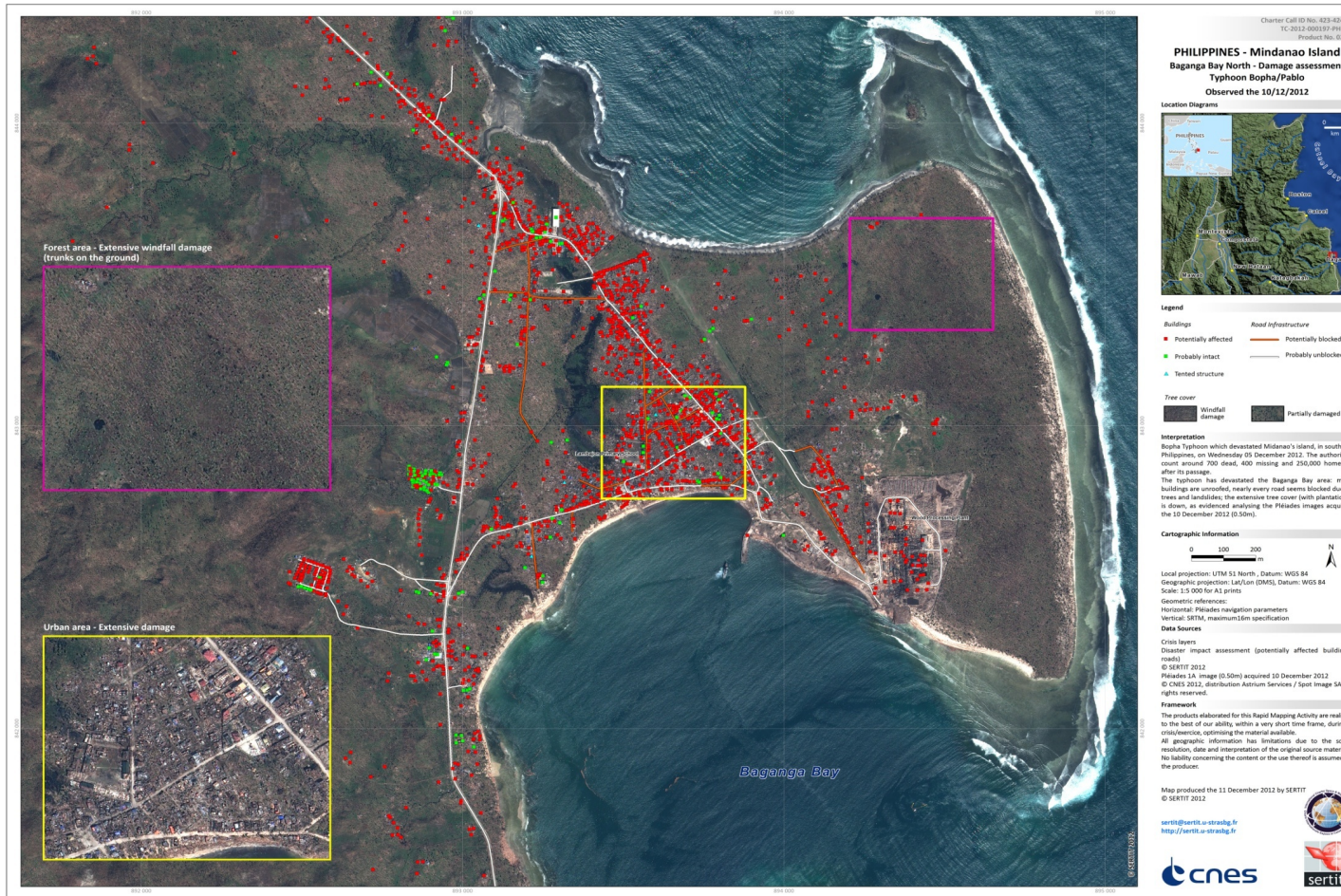
- The strongest tropical cyclone to ever hit the island of Mindanao (winds 260 km/h)
- Flattening coastal villages
- Wiping out banana plantations
- Causing mudslides and flooding



- Destruction of the banana plantations



Example of product



Problems

- Very large impacted area
- Destroyed houses only visible on VHR images (<0.7m resolution)
- Everything is destroyed...



- ① The International Charter 'Space and major disasters'
- ② Examples of floods activations
- ③ Examples of hurricane activations
- ④ Example of earthquake activation
Nepal - Earthquake in april 2015
- ⑤ Conclusion

- On 25 April 2015 at 11:56 local time, Nepal struck by an earthquake with a magnitude of 7.8 on the Richter scale and with the epicentre located 78 kilometres to the north-west of the capital city Kathmandu
- > 3700 victims
- Several locations of historical importance in the city with severe damage
- Most powerful earthquake to hit Nepal in over 80 years



Before / after image in Katmandu



Before / after image in Katmandu (Pleiades)

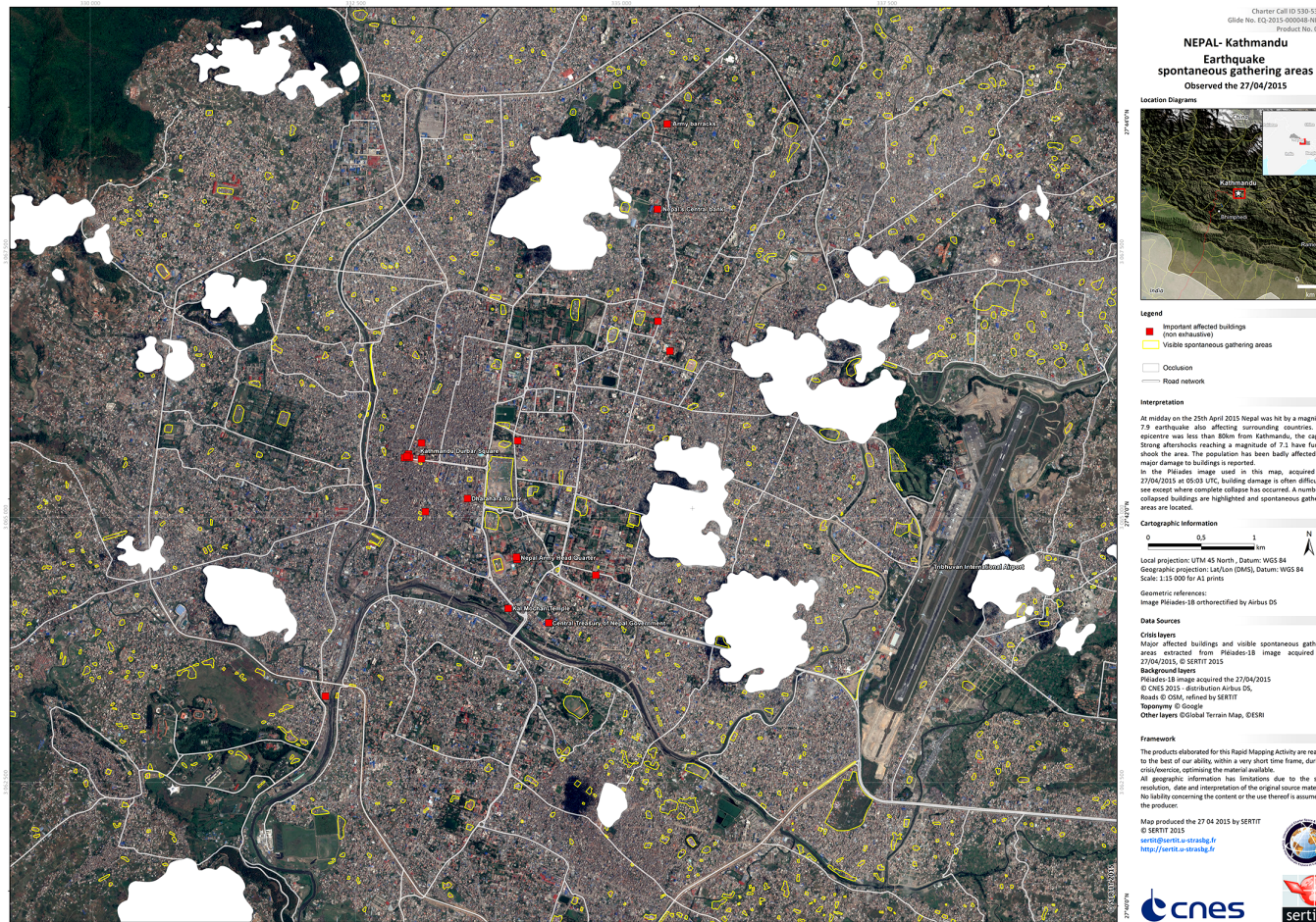


- Image acquired by the French Pleiades satellite (70cm) on 26th April
- Residents are afraid of the aftershocks and so sleep outside

Dharahara Tower



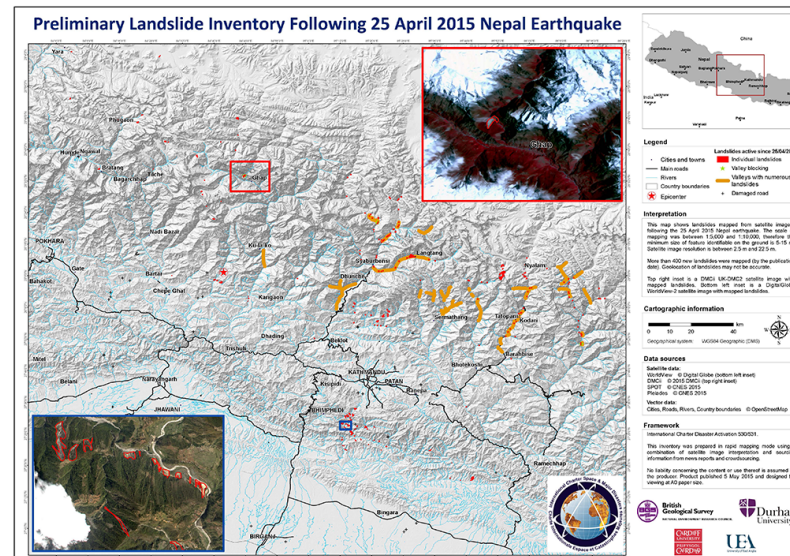
Example of products in Katmandu (Pleiades)



- First map of the situation in Kathmandu made by SERTIT on 27 April
- Identification of emergency camps set up by rescue teams and NGOs

Problems / Challenges

- Very large impacted areas
- Buildings damages mostly visible on VHR satellite image (<1m)
- Different users requirements:
 - Identify impacted buildings, houses, roads
 - Identify emergency camps
 - Identify point where water is available
 - Etc
- Analysis of an optical image: context of a building is used to identify if the building is damaged (shadows, cars, alignment with other buildings, etc)



- ① The International Charter 'Space and major disasters'
- ② Examples of floods activations
- ③ Examples of hurricane activations
- ④ Example of earthquake activation
- ⑤ Conclusion

Thanks to the Charter (ECO, PM, VA, end user):

- Ability to build synthesis of the disaster: evaluation of the damages, where they are, build a damage map
- Support to users working on the ground, decision-maker in the affected country, and also international aid
- In-depth knowledge of the whole information process, from user request to damage maps delivery

Image processing perspectives

- Diversity of use cases, often the case degraded
- Still lots of work for automatic algorithms
- Also build tool to ease work of photointerprets (man in the loop)

Thank you for your attention !

Useful links

- The Charter Web site : <http://www.disasterscharter.org>
- SERTIT products: <http://sertit.u-strasbg.fr/>
- DLR – ZKI products: <http://www.zki.dlr.de>