Progress studies from Thematic Working Group TWG _ GT2 Risks and Humanitarian Aid

Herve YESOU
on the behalf of the GT2

Based on CNES presentations and report
from
Vinciane Lacroix, Hélène De Boissezon & Jean-Claude Favard

TWG 2: Risks and Humanitarian Aid

- **GT Coordinator: Pierre-Alain Ayral** Ecole des Mines d'Alès
- **Former GT Coordinator : Vinciane Lacroix**, ERM, Bruxelles.
- **Jérôme Bequignon,** Défense et Sécurité Civile Mission des relations internationales (DDSC/MRI) du Ministère de l'intérieur et membre du Secrétariat Exécutif de la Charte Internationale Espace et Catastrophes Majeures.
- **Jérôme Chemitte,** Mission Risque Naturel.
- **Daniel Fournier,** DDSC/MRI, en charge des interventions de la DDSC à l'étranger.
- **Jean Claude Poppi**, Service Départemental d'Incendie et de Secours du Var
- **Alain Retiere**, UNOPS/UNOSAT
- **Sophie Sauvagnargues-Lesage**, EMA, (**Former GT Coordinator)**.
- **Hervé Yesou**, SERTIT, ULP Strasbourg

CNES coordinators: JC Favard, H. de Boissezon, S. Cherchali

sertit

Overall expectation

For all crisis:

- Before: risks assessment, vulnerability study, stakes assessment
- during: geographical extend, event dynamic and accessibility
- After: crisis analysis and scenario production

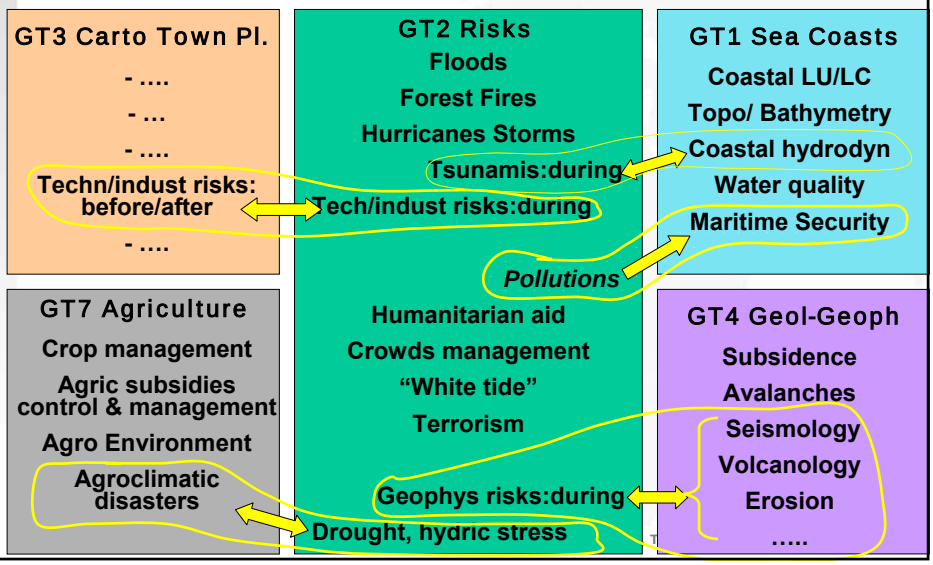
Understanding the on going phenomenon

cnes

sertit

ORFEO Preparatory Program progress

Links TWG2 Risks / other WG



sertit

Synthesis on datasheets from TWG2 «Risks and Humanitarian Aid »

Number and type repartition by hazards
47 datasheets : very good score !

		Nb fiches
Risques hydrométéo	Inondations (crues éclair, lente)	12
	Marée blanche	2
	Tempêtes / Cyclones	4
	Tsunamis	*0*
Risques origine naturelle ou anthropique	Feux forêts	5
	Risque technologique	2
	Stress hydrique	*0*
Risques géol-géoph.	Tremblements terre	3
	Eruptions volcaniques	1
	Glissements terrain	2
	Coulées de boue	1
Crises Humanitaires	Camps de réfugiés	3
	Déminage	2
Grands évènements		1
Marées noires		2
Cartographie 2D		4
MNT MNE		3
Total fiches		*47*

cnes

sertit

Expectation according to risk

- Humanitarian aid
  Risks assessment: need for archives and for monitoring sensitive zones (airports, harbours, etc.)
- Insurances
  Crisis analysis: precise damage location localisation: comparison before/after and both damage quantification and qualification
- Floods
  - Risks assessment: river cartography during the dry season, altimetry (riverbed, flood plain , soils moisture state, study of preceding floods dynamics, phenomena understanding
  - During the flood: logjam detection, highest water levels
  - After the flood: maximum flood height, intervention scenario

cnes

sertit

Expectation according to risk (cont.)

- Forest fire
  - Risks assessment: water stress, dominant winds, relief (3D navigation), fire evolution scenarios understanding phenomena
  - During the crisis: daily cartography of fire contours
  - For the interventions: knowledge about housing and cleared and non cleared areas
- Technological Risks

  Risks assessment: DTM/DEM, gas propagation model, dominant winds, etc. understanding phenomena
- Other:
  - Seism: Need for a large satellite swath
  - "White tide": geographical extent and accessibility
  - Terrorism: preparing response scenarios
  - Large gathering: intelligence

cnes

sertit

ORFEO Preparatory Program progress

Main categories of information required in TWG2 product sheets

" Status of the area "	2D cartography	at t at t+Δt	STATUS
	3D information	at t at t+Δt	DYNAMIC Info
"Quantification"	Water height Snow height Immersion duration		MEASUREMENT
" Input for models"	Flood propagation Landslide Volcano inflation Biomass, etc..		PREVISIONS INDICATORS

Synthesis (in terms of system)

- Risk assessment: need for recent archives **quickly** accessible
- During the crisis:
  - need for **very quick programming** facility and **very quick delivery** of images supply
  - All weather conditions (SAR)
- Crisis analysis: need for images time series

Synthesis (in terms of products)

- Optical/Radar (less knowledgeable): **ortho-images**
  - Visible: ***70 cm colors*** natural colors **P+XS**
  - Stereo (tri-stereo).
  - Scales 1:10.000 (sometimes 1 :5.000) au 1:50.000.
- **3D** (DTM, DEM precise) → **3D navigation**
- **Dynamics of observed phenomena** (images + models)
  - communication for managers and general public,
  - formation and prevention (ex best position of fire wall)
  - temporal information relative to the overall phenomenon à la dynamics. Ex: maximum floods.
  - 4D: evolution of DTM DEM in time
- **multi-scale:** zone 100 km*100km to 200km*200km
  - global: resolution 10-20m = scale 1/100.000-1/50.0000 ;
  - Local: 0,7-1m = scale de 1/10.000 -1/5.000 .

On going GT2 thematic studies

- **Floods**
  - **Flash flood : Gardon upper watershed (Pleiades HR)**
  - **Plain flood: Arles/Tarascon (Pleiades HR)**

    Plain flood, Alsace Luxembourg, China (Cosmo Skymed, ASI call, June 2008)

    Cartography of assets
    Cartography the impact extent
    Water paths
    Comparison/input for modelling
- **Earthquake Alger/Boumerdès**
  Damage mapping and reconstruction monitoring.
- **Protection of forest against fire St-Tropez**
  Suivi débroussaillage/ défense contre les feux de forêt
  Pointing out the areas sensitive to forest fires

(Large gathering, proposal under elaboration with GT8)

Pleiades potentialities

Cleared shrublands detection in operational fire management

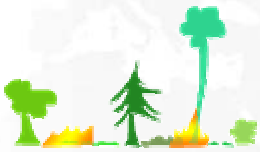
V. Therion, D. Marechal D., PA Ayral, MC Lyx C V Foitier., S. Sauvagnargues-Lesage & JC Poppi

sertit

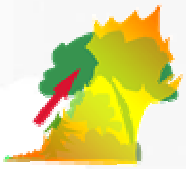
Forests fires and DFCI equipments

Défense des Forêts Contre les Incendies

- **Tank, water points,…**
- **Heli - surfaces,**
- **Barriers, tracks**
- **DFCI grids**



Good clearing



Bad clearing

Clearing :

Creation of horizontal and/or vertical discontinuity of fuel in DFCI tracks

TRABAUD, L. 1992. Les feux de forêts : mécanismes, comportement et environnement. France-Sélection, Aubervilliers, 278 p.

V. Therion et al., 2008

sertit

Typologies prospection

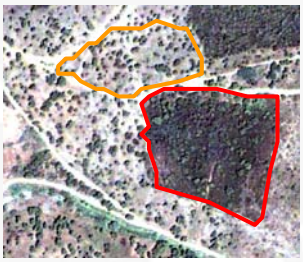
Operational typology	Ecological typology
Good clearing	• Bare soil • Opened cork oak forest with low herbaceous biomass
Intermediate clearing	• Mid-opened cork oak forest with brushwood layer presence • High biomass shrubs
Low clearing	• Mid-opened cork oak forest with high biomass brushwood layer
No clearing	• Closed cork oak

V. Therion et al., 2008

sertit

Pleiades-hr simulations

	Panchromatic	Multi-spectral
PELICAN	0.25 m	0.25 m
QUICKBIRD	0.6 m	2.4 m



Good clearing

Intermediate clearing

Low clearing

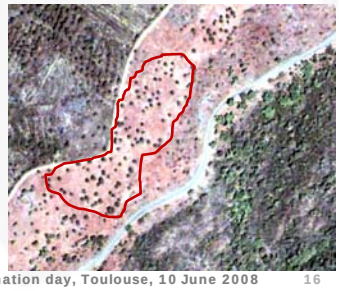
V. Therion et al., 2008

sertit

Ecological Typology : good clearing

Bare soil

pened cork oak with low herbaceous biomass



V. Therion et al., 2008

sertit

Problematic | Imagery | Remote sensing | S. A. | Results | Prospects

Ecological Typology : intermediate clearing

Mid-opened forest and brushwood layer

High biomass shrubs

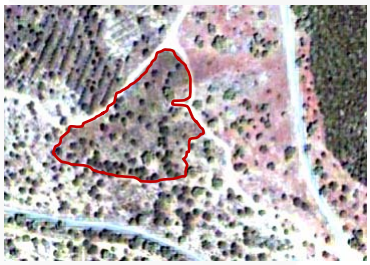
V. Therion et al., 2008

sertit

Problematic | Imagery | Remote sensing | S. A. | Results | Prospects

Ecological Typology : low and no clearing

Mid-opened forest biomass brushwood layer



Closed erophyllous egetation

V. Therion et al., 2008

sertit

Problematic | Imagery | Remote sensing | S. A. | Results | Prospects

Methodological confrontation

Are future Pleiades-hr products adapted for operational clearing management in DFCI zones ?

Trees / Ground 1st Approach	" Multi-stratum " 2nd Approach
✓ Pléiades like Panchromatic	✓ "Pixel" Method Pléiades like fusion
✓ PELICAN fusion	✓ "Objet" Method Pléiades like fusion

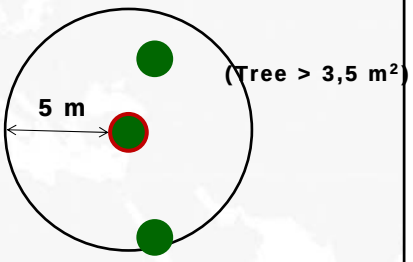
V. Therion et al., 2008

sertit

Problematic | Imagery | R. S. | Spatial Analysis | Results | Prospects

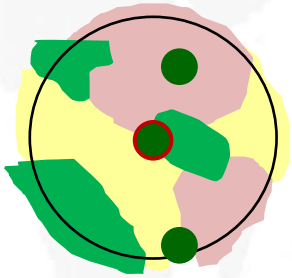
Step 1 : Tree neighbourhood

- One tree
- Two trees
- More than two trees



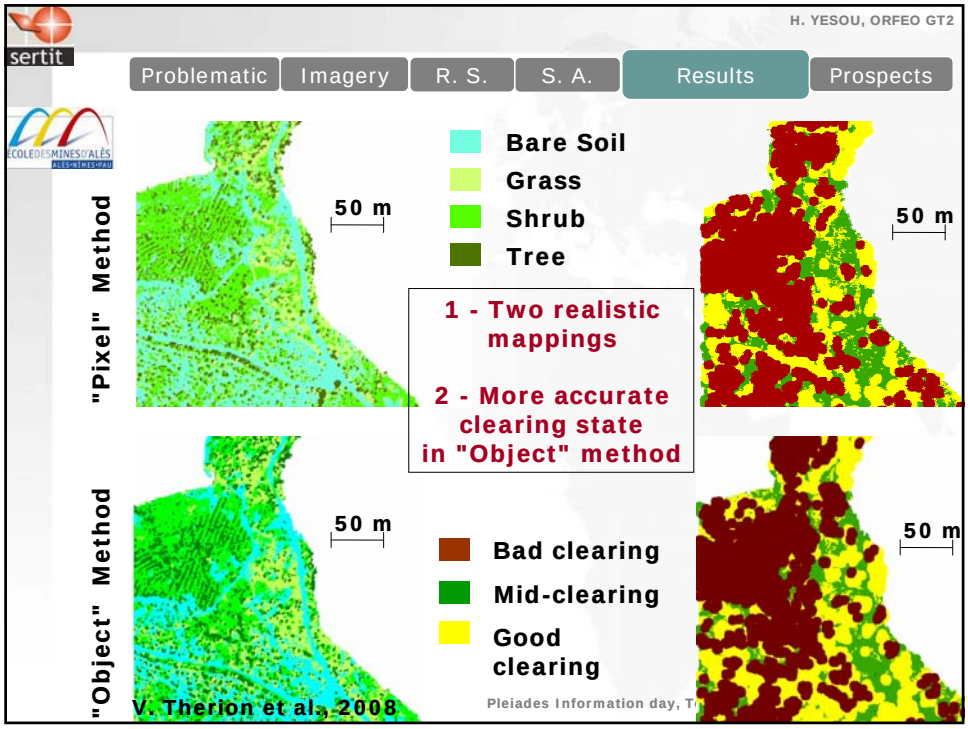
Step 2 : brushwood layer density

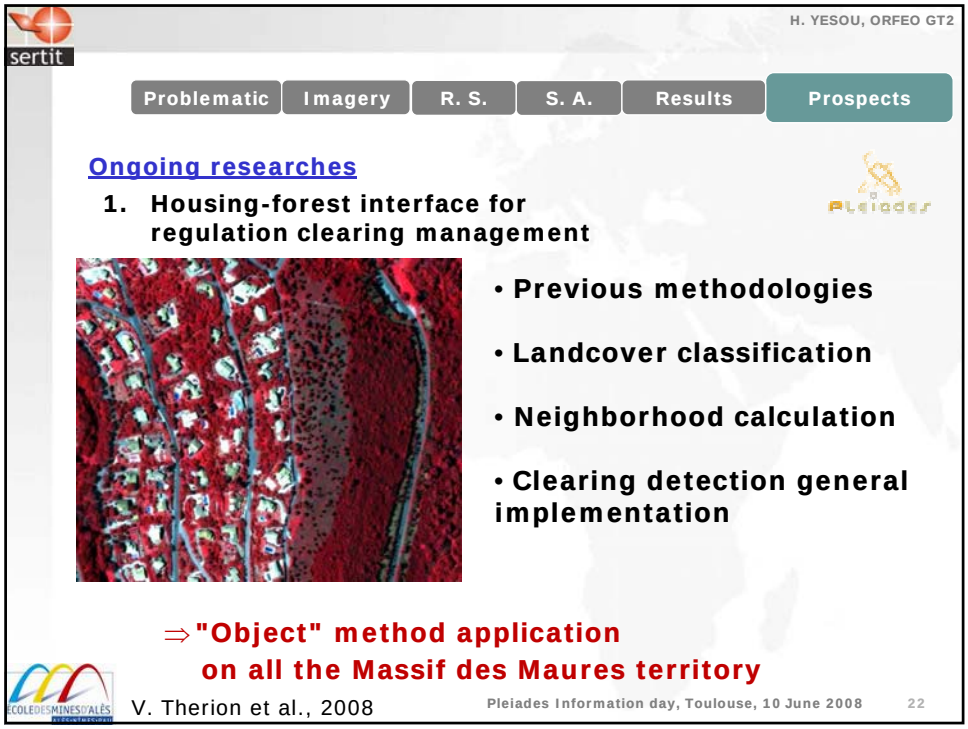
- 0 – 25 %
- 25 – 50 %
- > 50 %



Step 1 x Step 2 = 9 combinations = 3 clearing levels

V. Therion et al., 2008


H. YESOU, ORFEO GT2
sertit
Problematic
Imagery
R. S.
S. A.
Results
Prospects
"Pixel" Method
"Object" Method
50 m
50 m
50 m
50 m
Bare Soil
Grass
Shrub
Tree
1 - Two realistic mappings
2 - More accurate clearing state in "Object" method
Bad clearing
Mid-clearing
Good clearing
V. Therion et al., 2008
Pleiades Information day, T


H. YESOU, ORFEO GT2
sertit
Problematic
Imagery
R. S.
S. A.
Results
Prospects
Ongoing researches
1. Housing-forest interface for regulation clearing management
Pleiades
• Previous methodologies
• Landcover classification
• Neighborhood calculation
• Clearing detection general implementation
⇒"Object" method application on all the Massif des Maures territory
V. Therion et al., 2008
Pleiades Information day, Toulouse, 10 June 2008
22

sertit

Problematic | Imagery | R. S. | S. A. | Results | Prospects

Ongoing researches

Pleiades

2. Multi-temporal approach

- **Accuracy of clearing detection => vegetation cycle**
- **Improvement of monitoring of clearing evolution ?**

3. Integrated and operational methodology definition

- **An integrated remote sensing and GIS workflow**
- **Implementation of an operational tool (ORFEO ToolBox)**

⇒ **Operational-oriented research**

ECOLE DES MINES D'ALÈS

V. Therion et al., 2008

sertit

From potential to real drainage

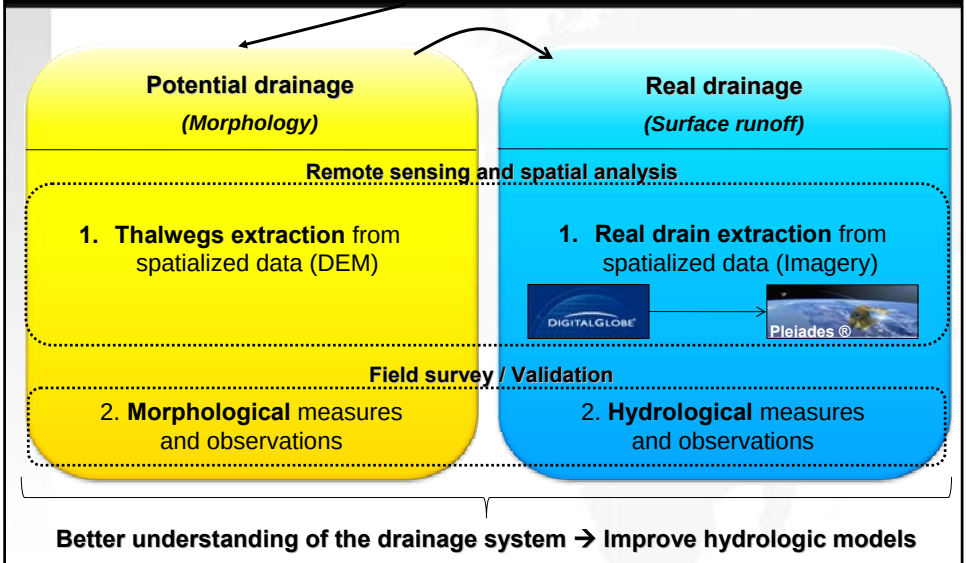
Using very high resolution satellite imagery for characterizing hydrographic network at different scales on small Mediterranean watersheds subjected to flash flood events

Pleiades

D. Marechal, C Puech, S. Sauvagnargues-Lesage , JS Bailly & PA Ayral

ECOLE DES MINES D'ALÈS | cnes | Cemagref

Objective : Caracterizing and spatializing hydrographic networks at a very fine scale …



Hypothesis

Hydrology

-The temporary gully network participate to the intense rise of waterflow in hydrographic networks of superior order

-The whole thalwegs of a bassin represent the maximum extent of the hydrographic network (real drainage)

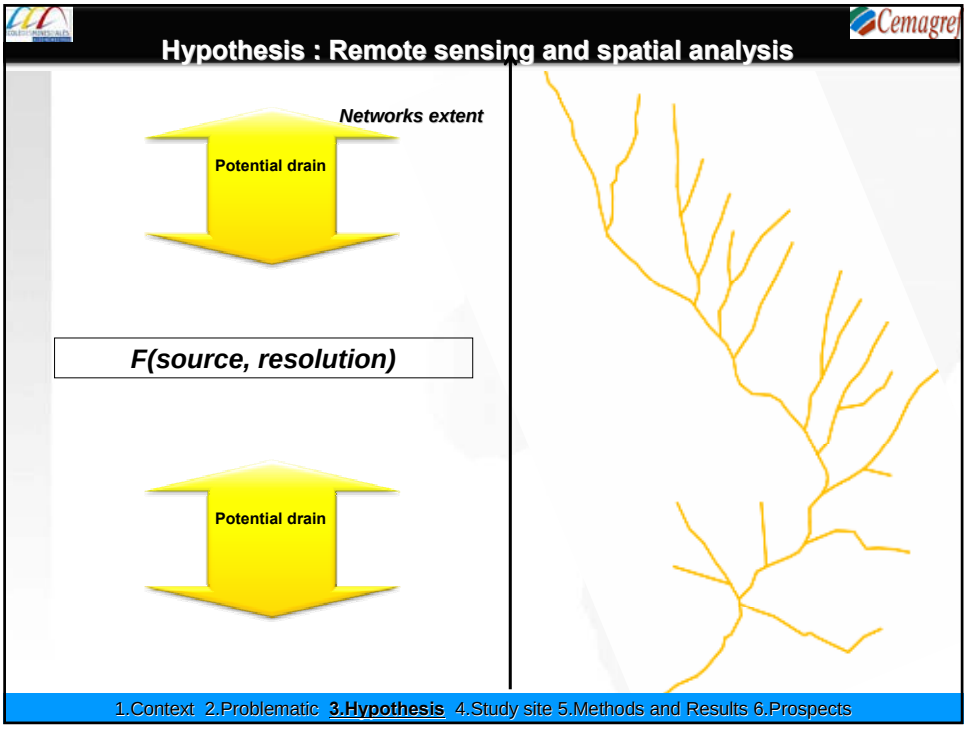
Remote Sensing

-The whole thalwegs are extractible through DEM only (vegetation cover)

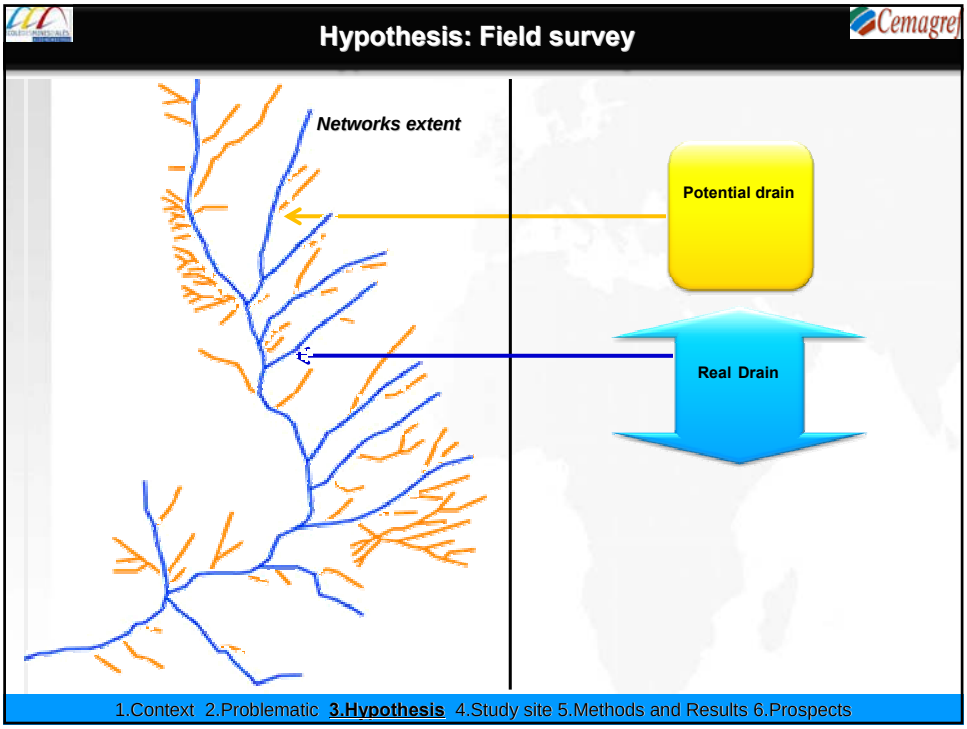
-Surface water is non visible on imagery (in our case)

-Real drainage can be indirectly extracted from imagery by analysis of vegetation, humidity, soil depth etc…

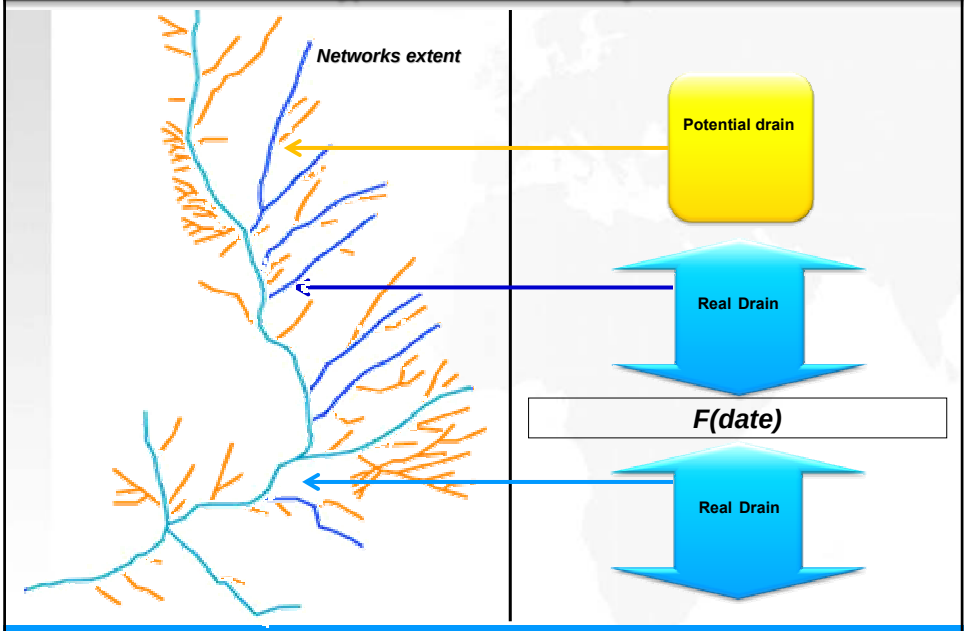
Hypothesis : Remote sensing and spatial analysis



Hypothesis: Field survey

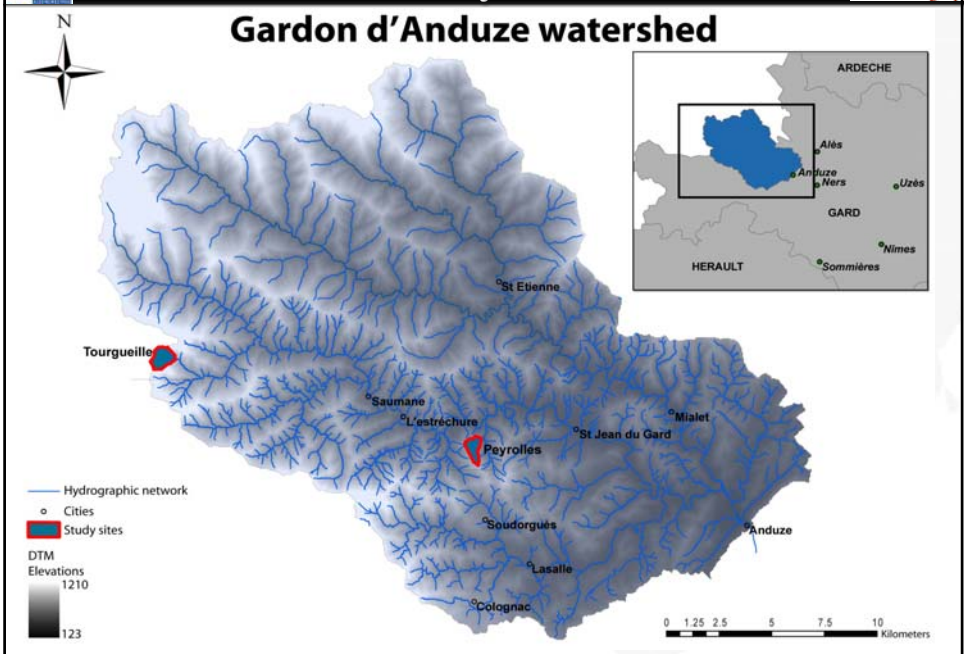


Hypothesis: Field survey



1.Context 2.Problematic **3.Hypothesis** 4.Study site 5.Methods and Results 6.Prospects

Study site



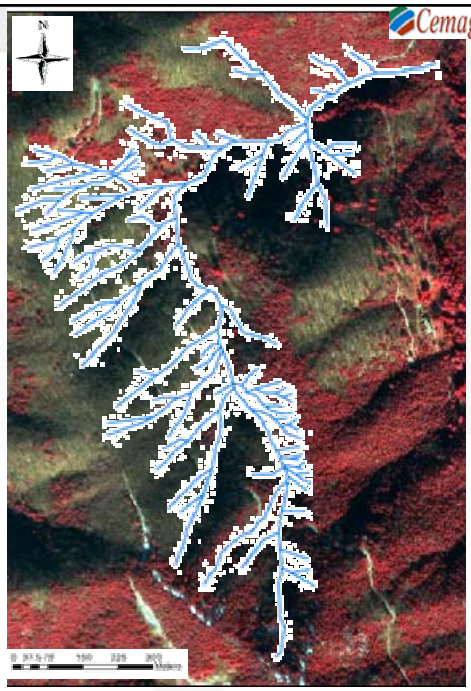
1.Context 2.Problematic 3.Hypothesis **4.Study site** 5.Methods and Results 6.Prospects

Extraction of hydrographic network by photointerpretation, using Pléiades like imagery (Gille, 2007)

- **Limited extraction**
- **Important variations between analysts**
- **Not an automatic method**

Quickbird imagery:

Peyrolles, February 2006,



Potential drainage

(Morphology)

Remote sensing and spatial analysis

→ Automatic morphologic network extraction using DEMs (raster and TIN)

→Complementary spatialized data

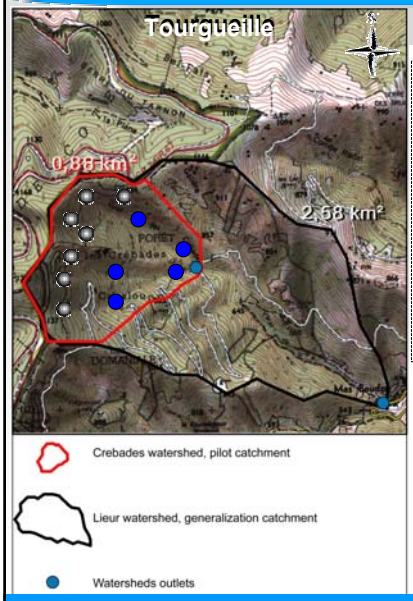
Field survey

→Observations and network analysis (morphologic indexes, confluences)

→Spatialization of cross-section measures

Real drainage – Field survey

(surface runoff)



Placing hydrologic sensors

-2 capacitive sensors are installed in Tourgueille, one in Valescure:

→ difficulties appeared

→ first results

- 2 stations installed in Tourgueille (Crébades and Lieure): pressure sensors and staff gauges

- First dilution gauging and currentmeter measures → rating curve

● Capacitive sensor

● Binary sensor

Conclusion…

- *1st works on imagery : photointerpretation (Gille, 2007):*

  → limited network extraction (trees, shadow, snow, differential lightings on valleys, complexity of our field...)

- *DEM seem very interesting for water paths but also limited (where does channels begin ?)*

→ Coupling VHR imagery and DEM seems very interesting to define real drain pathways

Needs

- DEM: waiting for LIDAR (CG30), realized on the whole Gard department
- Imagery and spatialized data:
  - More pictures (Spring and Fall, Winter without snow)
  - Band of MIR → humidity
  - Get More data: anthropogenic structures and soil depth

Characterisation of assets using simulated Pléiades HR images, and post crisis feedback following the December 2003 Arles flood event

H. Yésou, S. Heitz, S. Battiston, B. Allenbach
&
S. Cherchali and H. de Boissezon

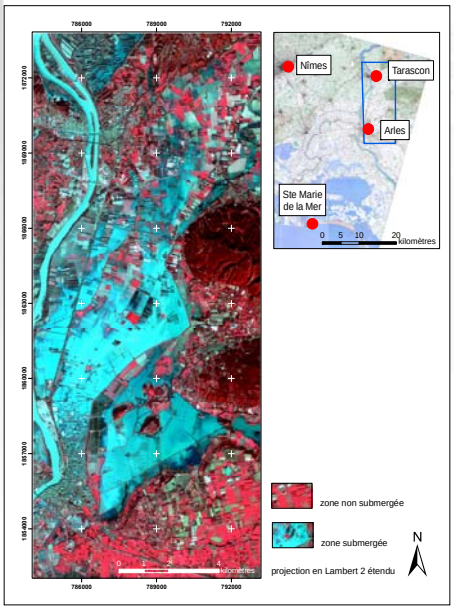
GT2 « Hazards- Humanitarian » requests and expects

On assets/ stakes

Fiche DSC n°4 « inondation »
Fiche SDS-83 « pendant »
Fiche EMA « inondation 1 »
Fiche EMR « carte de crise »
Fiches MNR « zones inondées »
Fiche Sertit « Inondation 3-impact

Characteriszation of the flood event

Fiche DSC n°4 « inondation »
Fiche Unosat « inondation »
Fiche ERM « carto de crise »
Fiche EMA « inondation 2 »
Fiche MNR « zones inondées »
Fiche SERTIT « inondation extension »



Study area: Arles

- Superficies: 198 km²
- Flooding in rural landscape : Tarascon plain
- Flooding in urban landscape : Arles and neighbourhood
- Intensive ran fall from the 1st to 3 of December 2003

- Sertit has been involved :
  - Charter action
  - MEDD study in 2005

Objectifs of Arles study

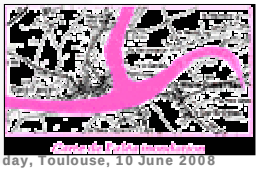
PLEIADES HR data and flooding

➡ Assessment of efficiency and fiability of Pleiades HR data

↪ Characterize the flood impact within urban and peri urban areas

- From the stakes point of view : dense and isolated artificial areas

- From the hazards point of view : highest water level, recognition of hydraulic elements



sertit

Pléiades HR and post crisis hydrological analysis

- Feed back after crisis

➡ Work at local scale :
- Location of breaks and over flow
- Draw off characterization

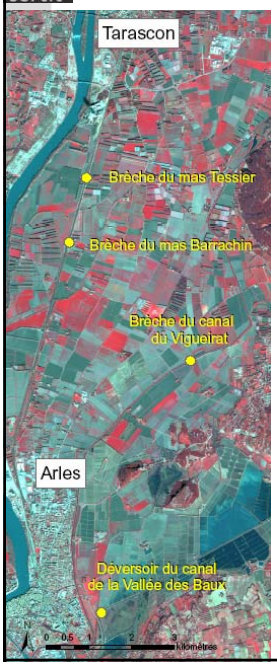
➡ Work at regional scale
- Highest water level recognition and location

➡ Search for elements useful for modelling (water paths water fluxes)

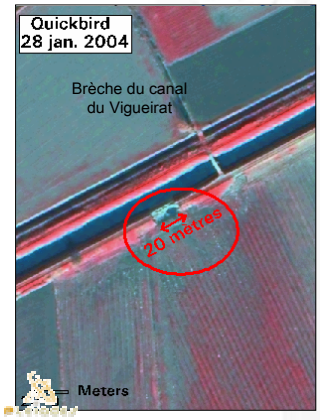
- Data acquired during the flood event : *Orthophoto (0.5m), Ikonos (1 et 4m) et SPOT 5 (2.5m)*
- Data acquired after the flood event : ***Quickbird*** *(0.7m) –* ***simulating Pléiades HR***

sertit

Pleiades HR for hydrological analysis



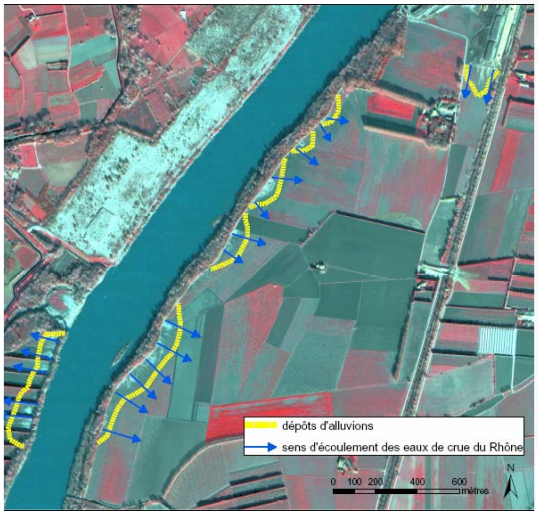
Recognition of breaks on levees and over flow



CNES ORFEO programme, 2007

Post crisis analysis

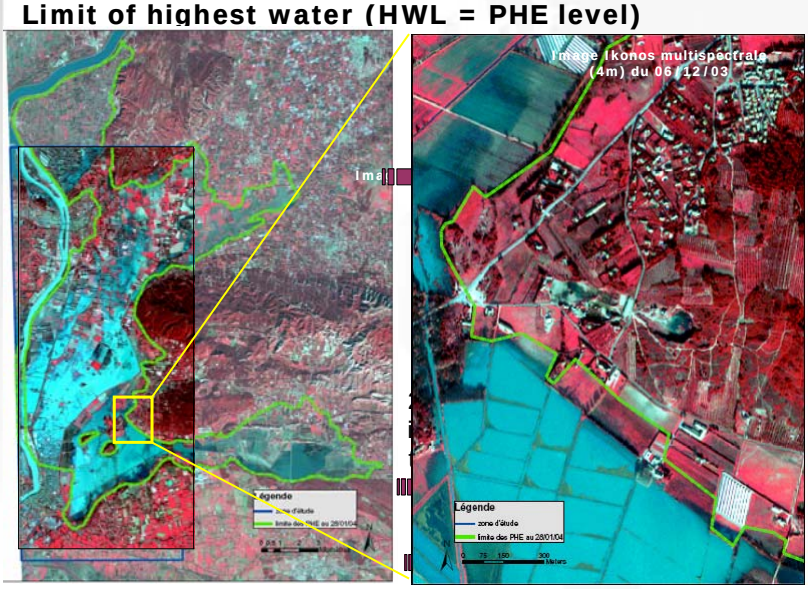
Rhône River over flowing in the South of Tarascon



- Affected area but not observed on crisis EO data
- Alluvial deposits along the Rhone reaches and in the South of the water cleaning station
- Possibility of drawing on the post crisis image the directions of the flow

Post crisis analysis

Limit of highest water (HWL = PHE level)



sis

Post crisis analysis

Simulated viewing of a flood event: SPOT 5 vs Pléiades HR

Residential area

Parking

Center of activities

Concluding remarks

- Asset analysis: brings and limits of VHR

→ Fine detail level , access to additional information for the characterization and identification of some sensitive targets

→ Difficulties to determine the function of building

→ SPOT 5 : 7 elements / 31 listed

Simulated Pléiades HR : 20 elements / 31 listed

→ Pléiades HR : a fine tool for up dating

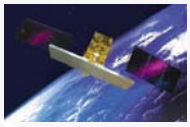
Concluding remarks

Hydrological post crisis analysis: Pléiades HR complementary source of information

- Local and global/regional aspects
  - Breaks recognition, indicators of over flow and draw off s
  - Limit of highest water
- Indicators of the flood event dynamic
  - Éléments pour la modélisation (occupation du sol, extension de l'inondation, éléments structurants)
- Strong interest for feed back
  - Indications for the zoning of risky areas
  - Information on soils states

Future trends and actions : SAR

Analyse the Potential of VHR SAR



- Cosmo Skymed
- Terra SAR
- Radarsat II

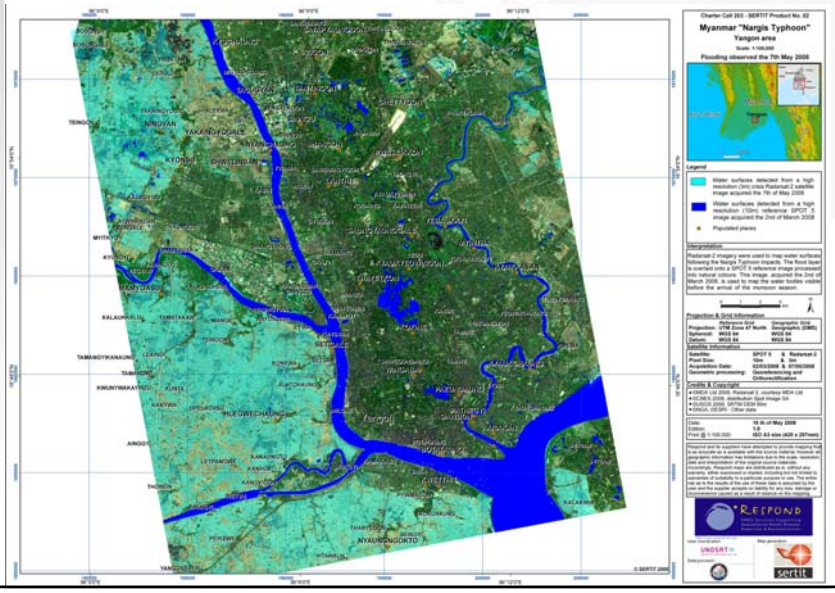
- High resolution,
- Polarisation

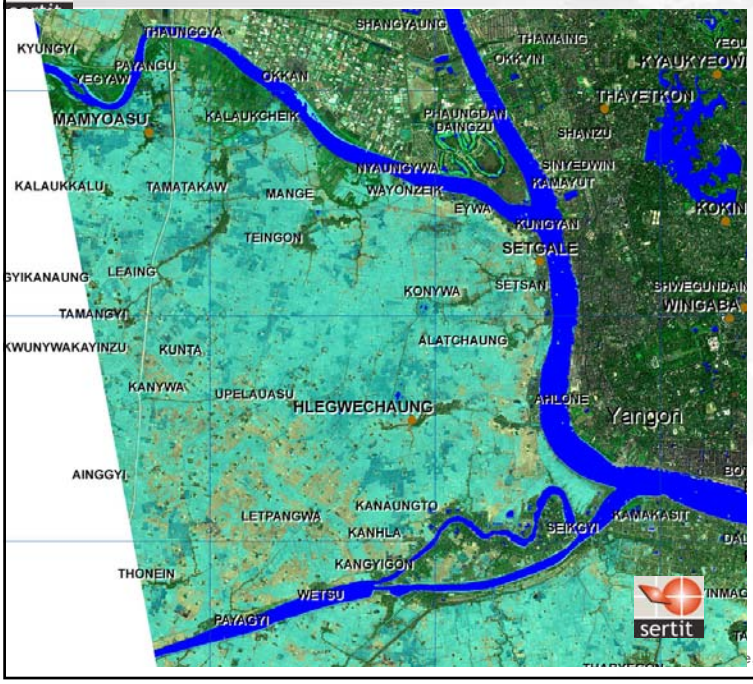
Example of Nargis typhoon floods over Maynmar

(question of the potential of acquisition and revisit over such areas (500 by 300 km)

Future Cosmo Project over Luxembourg, NE France and China

Exploitation of VHR SAR: Nargis typhoon Maynmar

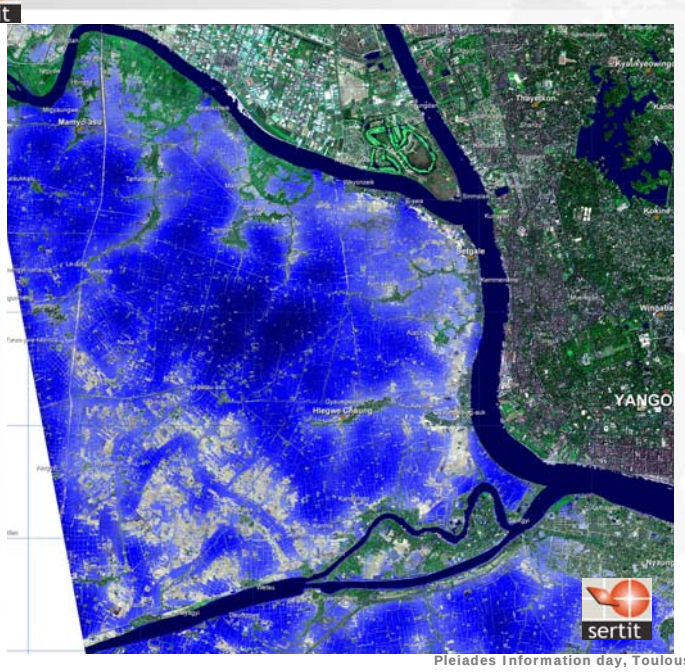




Radarsat Ultrafine mode : 3 m

Lot of details within rural areas

sertit



Fine resolution allowed to derived a very innovative information from a single crisis image

Relative water depth

sertit

Recognition of earthquake damage
&
Rapid mapping product elaboration

based on Pleiades HR data targeting decision makers:

2003 Boumerdes earthquake case study.

Pleiades

R. Andréoli, H. Yésou, F. Ledrappier, S. Clandillon
&
S. Cherchali and H. de Boissezon

sertit

cnes

sertit

Context Boumerdes

Charter rapid mapping action: May 2003

- **Request of DDSC (Sécurité Civile française)**
- **Rapid mapping products transmited to Algerian survey services by DDSC channel**

Test site :

- **Methological works for CNES**
- **Demonstator of Pleiades HR potential (DDSC-SERTI initiative) within the ORFEO programme**
  - **Asset mapping**
  - **Earthquake damage recognition and mapping**
  - **Temporary relief settlement monitoring**
  - **Reconstruction monitoring**

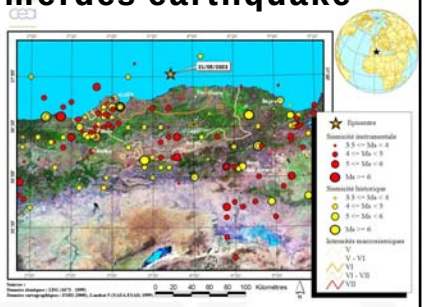
Exploitation of QB data set simulating Pleaides HR data

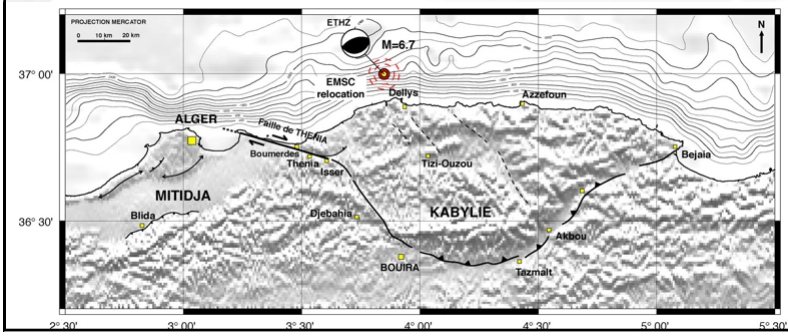
sertit

May 2003 Boumerdes earthquake

21 - 05 -2003

6.8 Mw
2300 casualties
12 000 injured,
146 000 homeless





sertit

Boumerdes

Urban area with high building density and important urban dynamic

See for example the “quartier du Plateau “

sertit

Starting point : crisis SPOT 5 THR

SPOT 5 THR, 2.5 m
Alger May 2003 Earthquake

cnes

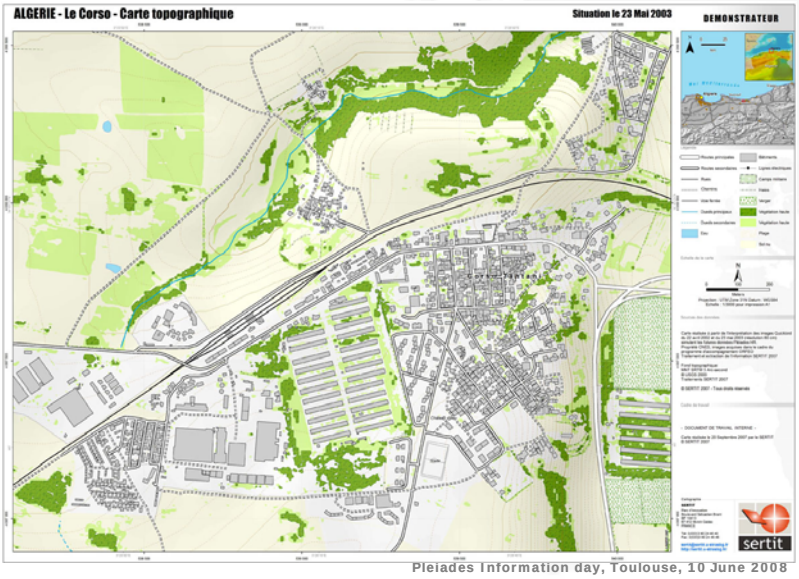
Optical VHR and damage recognition

Reference 2002/04/22

Crisis data 2003/05/23

Quick Bird- Pléiades HR like data

Land cover mapping
Extraction of building and road networks



sertit

Damage recognition : multi-criteria approach

Area of investigation Boumerdes, le Corso, Regbaia, Boudouaou Le Figuier, Cap Blanc, Zemouri, Thenia

- 11 310 referenced buildings (ph 1: 4377 in Boumerdes)
- Multicriteria approach for damage recognition (visible damages, geometry of damage, human activity, etc ..)

⇒18 classes damage description from VHR analysis

⇒Linkage between EMS 98 and the 18 damages classes

⇒Linkage between mercali and the 18 damages classes

sertit

Optical VHR and damage recognition

- Blocks of flats

Collapsed buildings

© Ayadi, CRAAG, 2003

© Davidovici 2003

sertit

Optical VHR and damage recognition

sertit

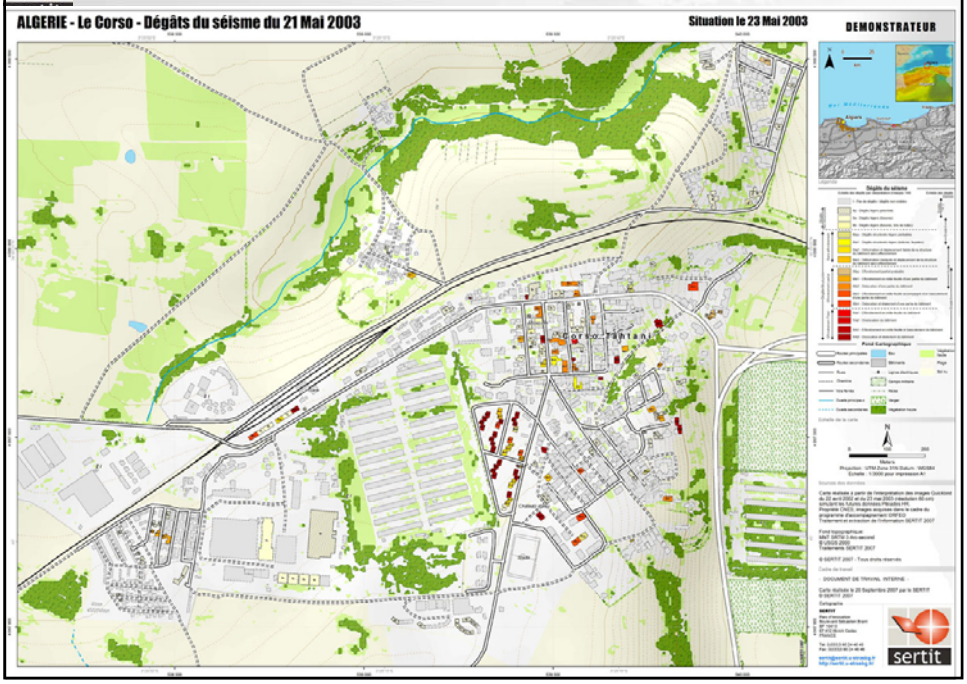
Optical VHR and damage recognition

Optical VHR and damage recognition

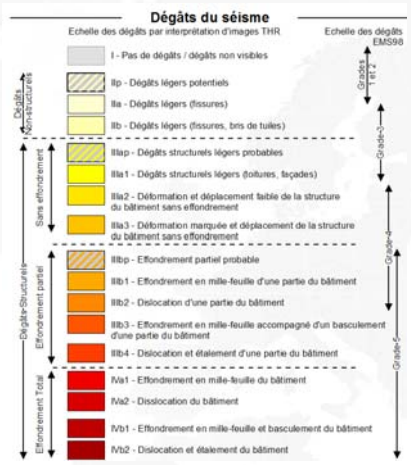
- Industrial buildings : grain silos

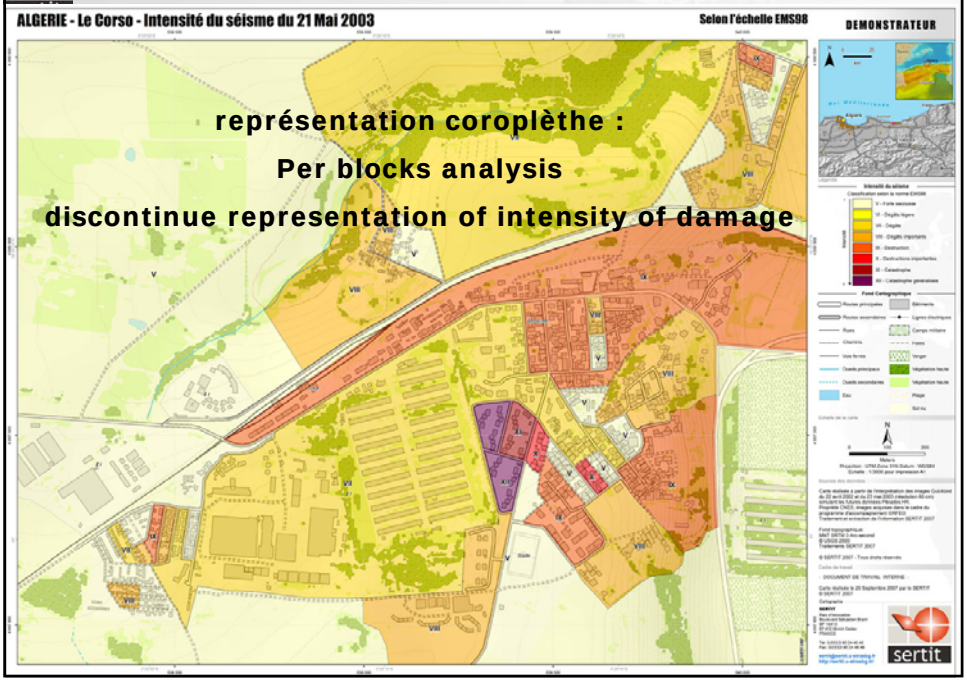
Sheared buildings with grain on the ground

© AYADI, GRAAG, 2003



Per building damage description

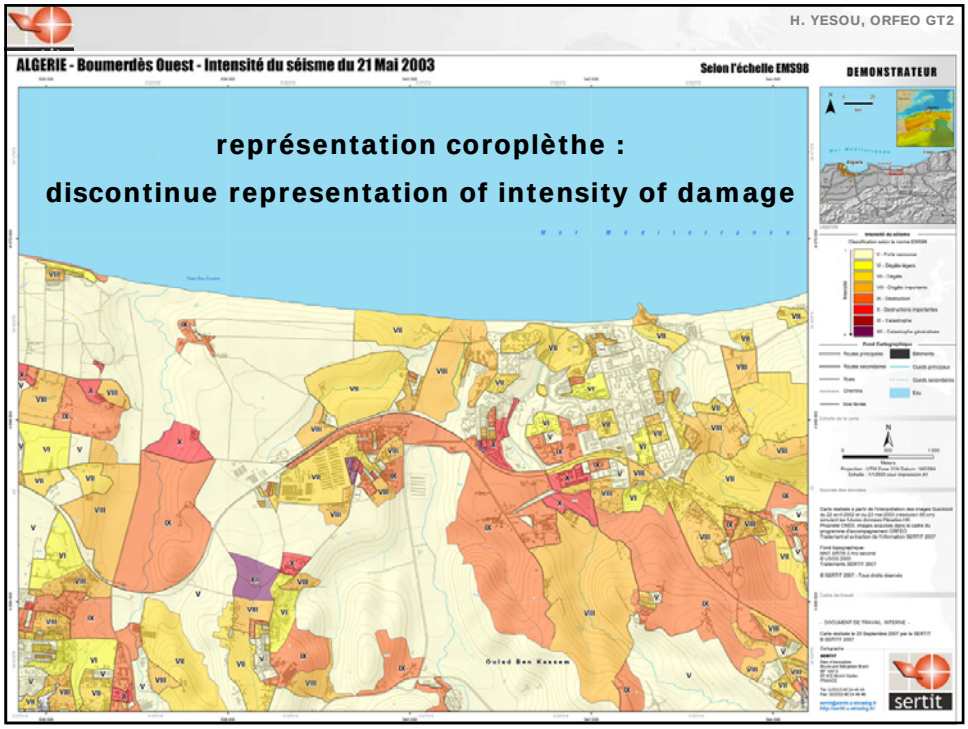


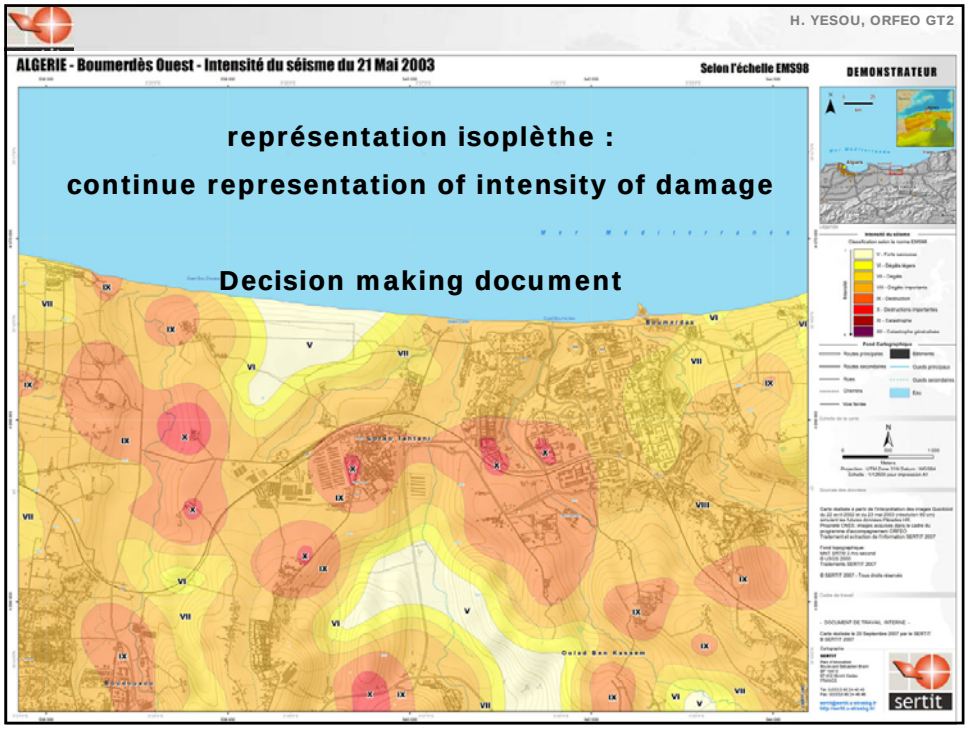


représentation coroplèthe :

Per blocks analysis

discontinue representation of intensity of damage


H. YESOU, ORFEO GT2
ALGERIE - Boumerdès Ouest - Intensité du séisme du 21 Mai 2003
Selon l'échelle EMS98
DEMONSTRATEUR
représentation coroplèthe :
discontinue representation of intensity of damage
sertit


H. YESOU, ORFEO GT2
ALGERIE - Boumerdès Ouest - Intensité du séisme du 21 Mai 2003
Selon l'échelle EMS98
DEMONSTRATEUR
représentation isoplèthe :
continue representation of intensity of damage
Decision making document
sertit

VHR optical and camps recognition

Short term monitoring

Two images acquired within 3 weeks, may and June 2003

Monitoring short and long term reconstruction

Exploiting the two crisis data and 2006 image

VHR optical and camps recognition

Possibility of recognition camps organization

@ Dr. K. Meguro

sertit

VHR optical and camps recognition

Within 3 weeks

⇒Increasing of amount of tents in a camp

⇒Increasing of the number of camps

⇒ Increasing of the camps size

Total observed amount of tents moving from a few hundreds of tents to more than 4000

sertit

Help to displaced people

Rescue tents and displaced people tents mapping…

… and their evolution during one month following the event

cnes

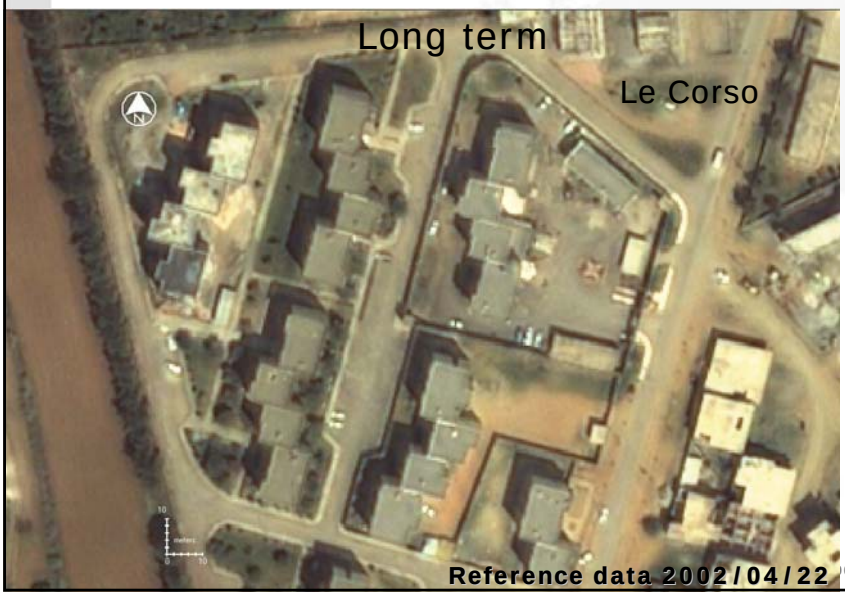
sertit

Reconstruction monitoring

- **Clearing activities: begun since May 2003**
- **Short term evolution: 23 May 2003 and 18th of June 2003**
- **Middle term evolution**
  - **March 2006, Pléiades like data 0,70 et 2.8 m**
  - **March 2008, Kompsat data, 1 m, 4m**

sertit

Clearing activities recognition and monitoring



Clearing activities recognition and monitoring

Clearing activities recognition and monitoring

sertit

Clearing activities recognition and monitoring

Rubish deposits

sertit

Long term displaced population monitoring: 2003 -2006

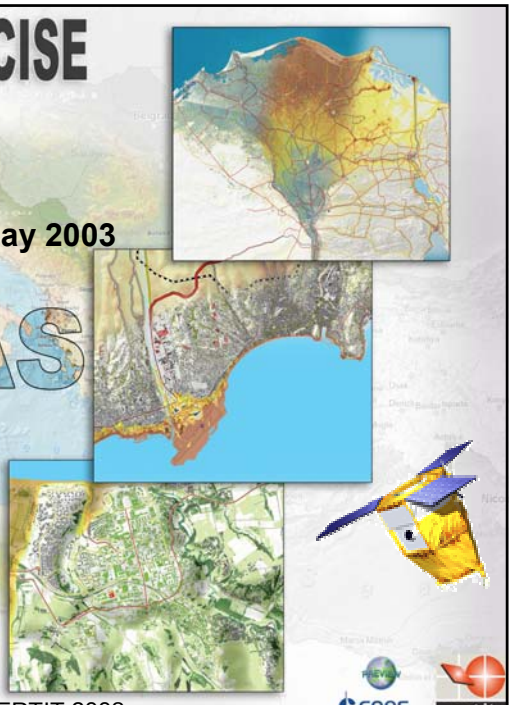
sertit

Long term displaced population monitoring: 2003 -2006

MED2007 - EXERCISE

Simulation case

Boumerdès earthquake of May 2003



© SERTIT 2008

sertit

SERTIT

Parc d'Innovation

Boulevard Sébastien Brant

BP 10413

67412 ILLKIRCH CEDEX.

France

Tél. : +33 (0)3 90 24 46 47

Fax : +33 (0)3 90 24 46 46

Mail : sertit@sertit.u-strasbg.fr

Web : http://sertit.u-strasbg.fr