Pléiades HR
for cartography of Risks in Real Time

Mapping and feed back analysis

Flood
Forest fire
Large gathering
Earthquake Damage
Reconstruction monitoring

H. Yésou – SERTIT

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Expectation according to risk

- 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

- 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

Expectation according to risk (cont.)

- Others:
  - Seism: Need for a large satellite swath
  - "White tide": geographical extent and accessibility
  - Terrorism: preparing response scenarios
  - Large gathering: intelligence

- Humanitarian aid

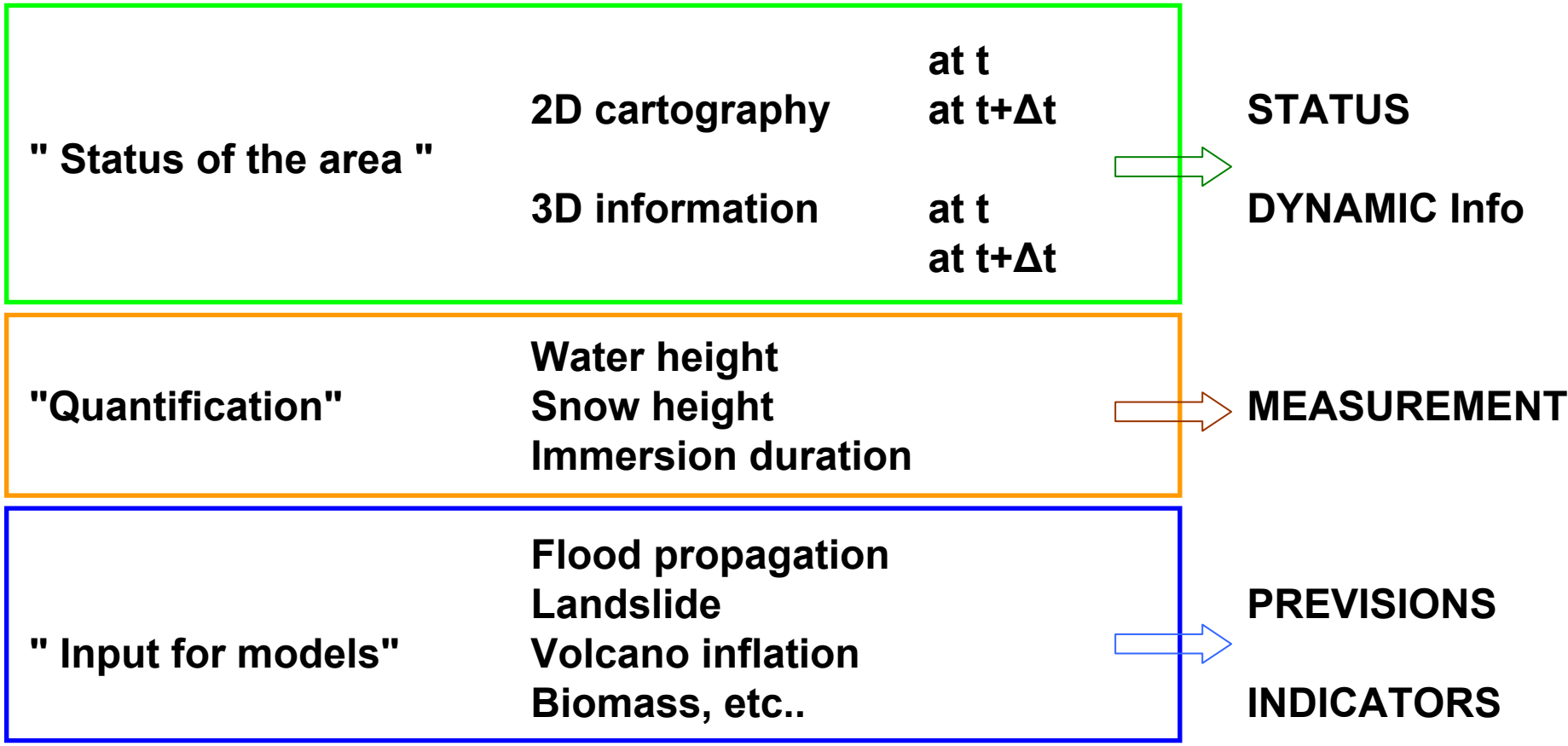
  Risks assessment: need for archives and for monitoring sensitive zones (airports, harbours, etc.)

- Insurances

  Crisis analysis: precise damage location localisation: comparison before/after and both damage quantification and qualification

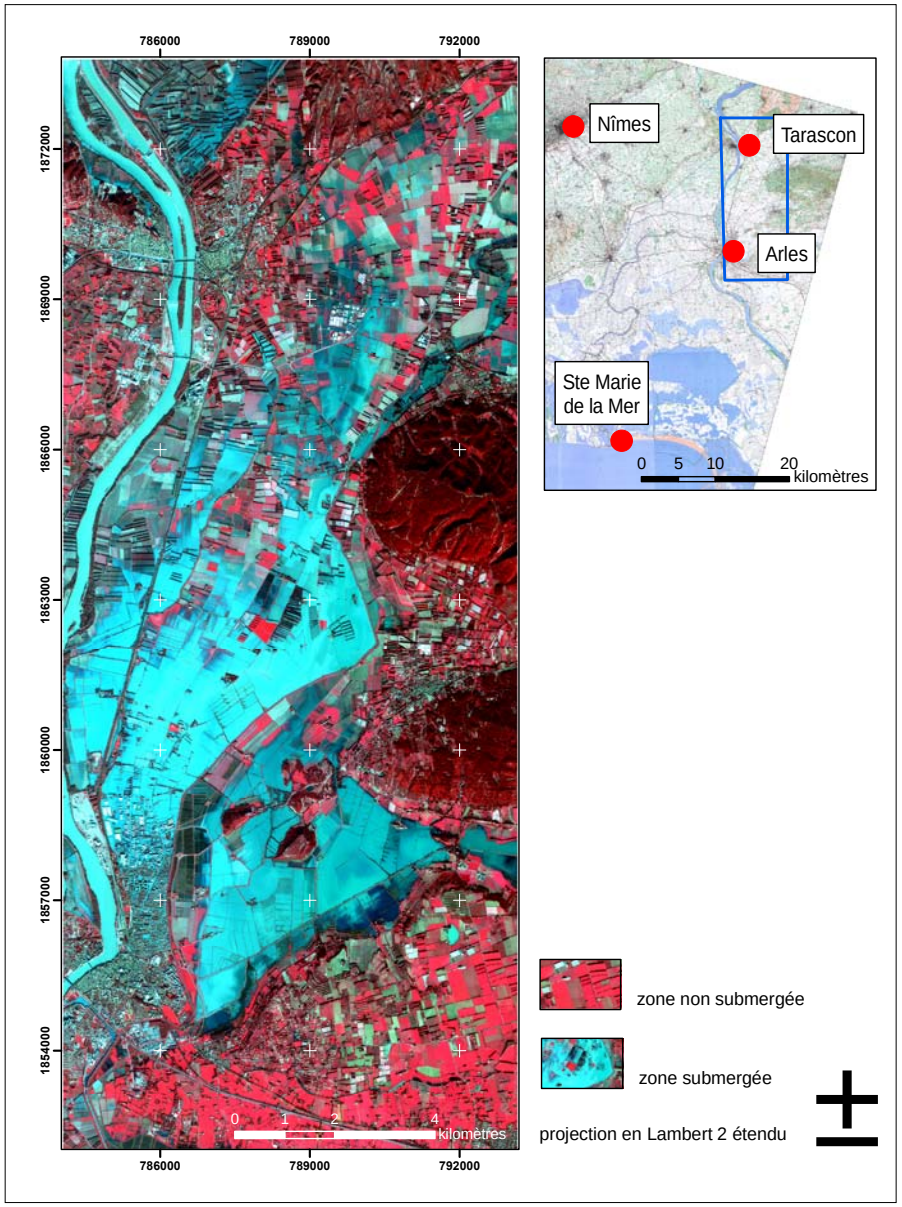
ORFEO Preparatory Program progress

Main categories of information required in TWG2 product sheets



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



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 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

Pléiades HR : post crisis hydrological analysis

- Feed back after crisis

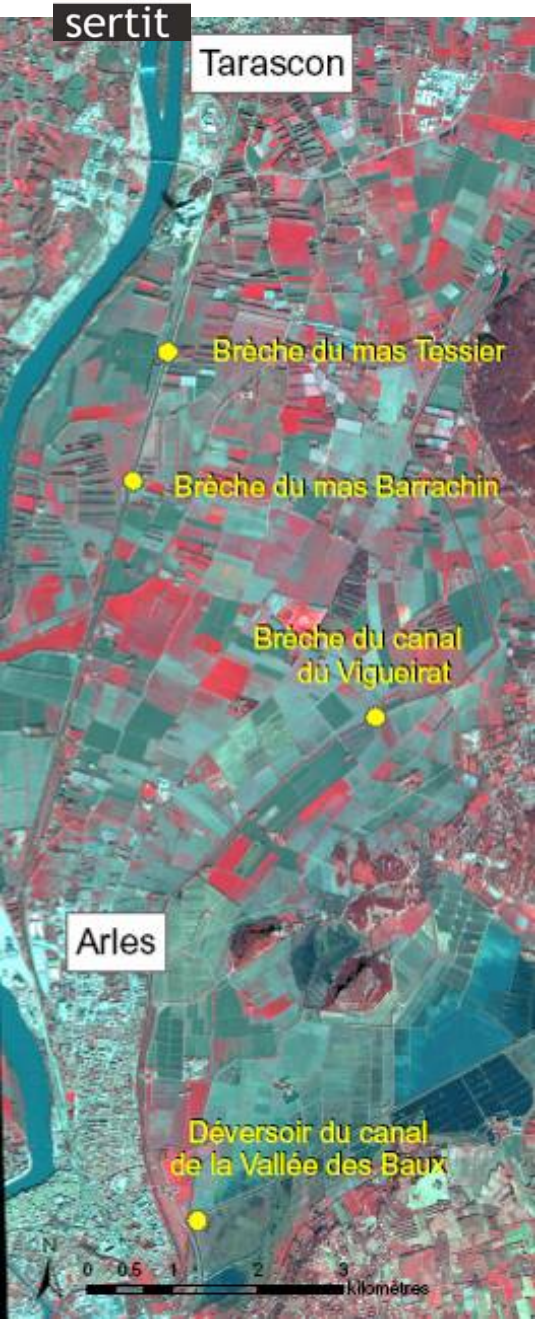
⇒ Work at local scale :
  - Location of breaks and over flow
  - Draw off characterization

⇒ 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***

Pleiades HR for hydrological analysis

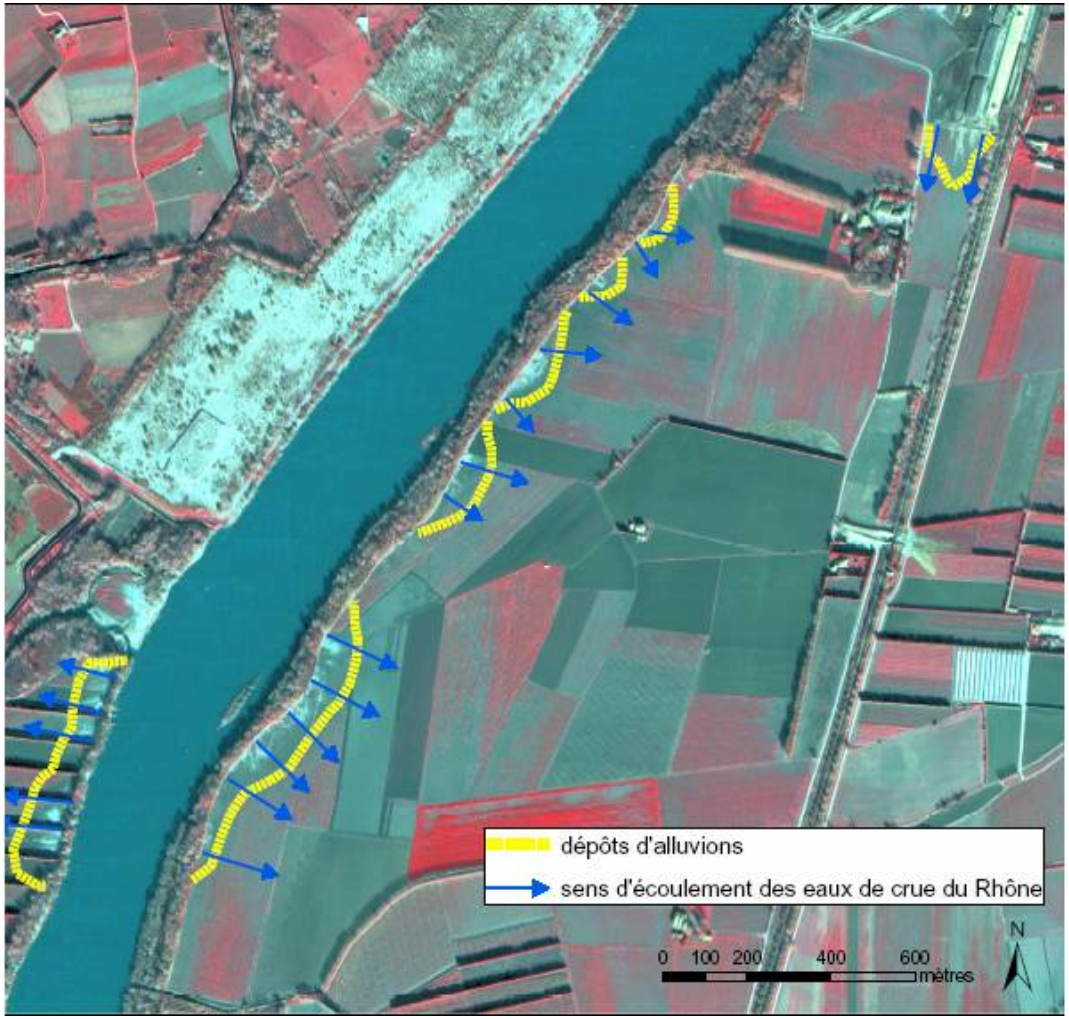


Recognition of breaks on levees and of over flow

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

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

Residential area

Parking

Center of activities

Forest fire extent and characterisation of assets using VHR images

The Marseille 22 July 2009 fire case

H. Yésou, S. Battiston, B. Allenbach, C. Uribe

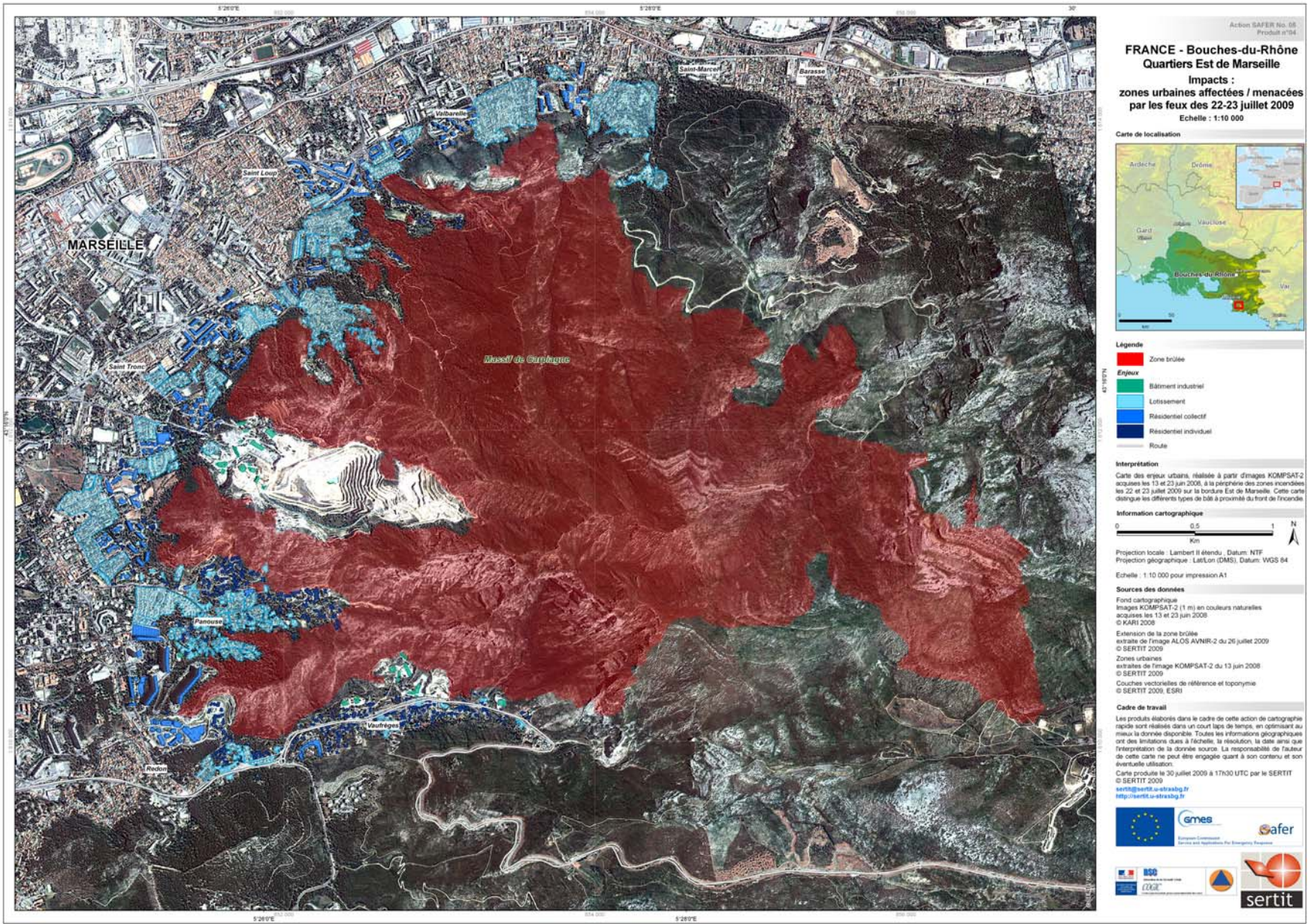



Safer framework

- **Framework: GMES Safer project**
- **Rapid mapping by SERTIT**
- **22 July 2009, forest fire affecting 1300 ha in Marseille vicinity**
- **22 afternoon arriving on the South and East sunburn**




VHR , fire and asset mapping

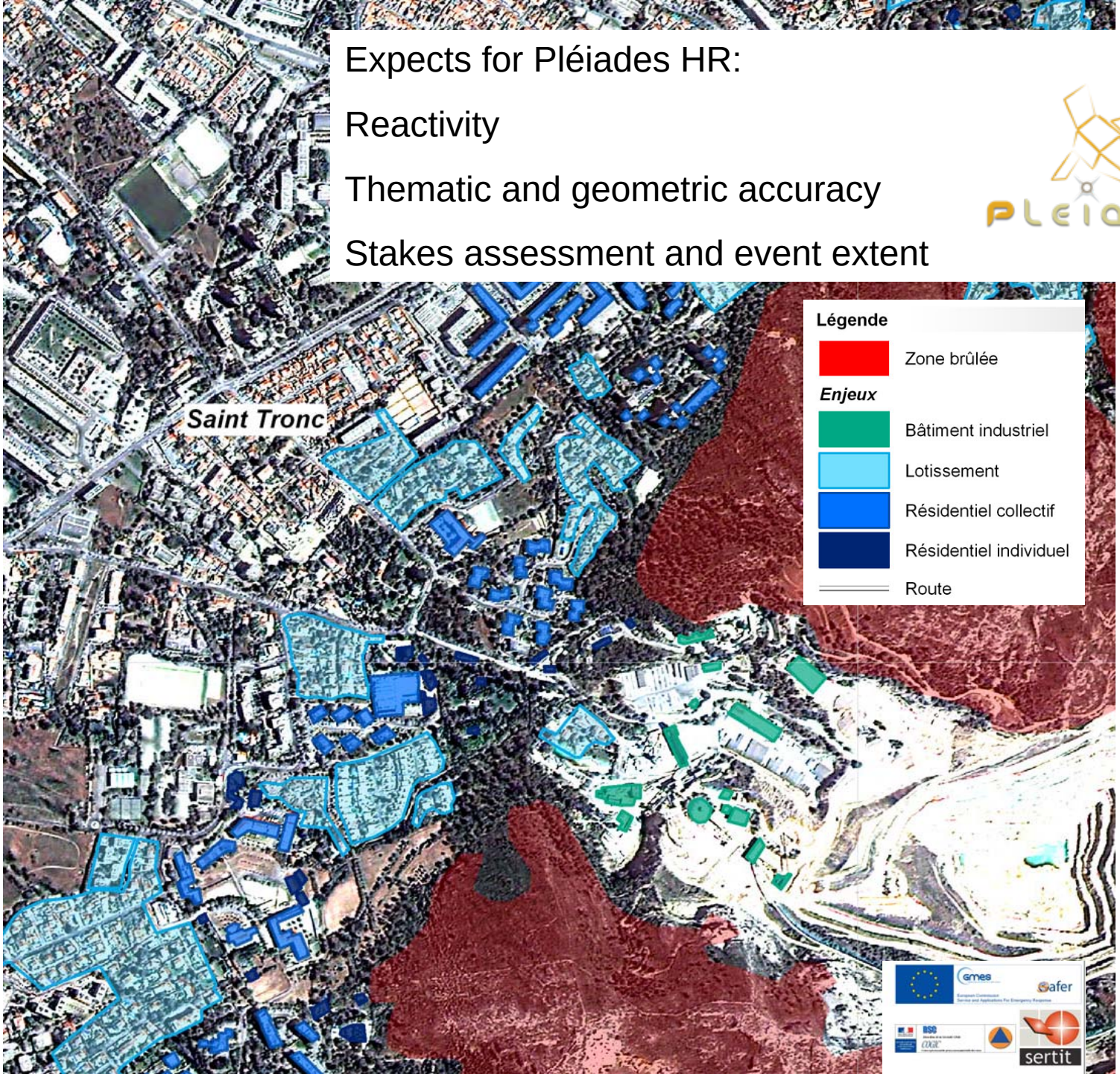


Expects for Pléiades HR:

Reactivity

Thematic and geometric accuracy

Stakes assessment and event extent



Large gathering

NATO Strasbourg Khel 04-2009

Population fleeing N'Djaména – 02- 2008

GT8 -GT2 request





Context and objectives

Remote sensing data and large gathering is a subject rarely covered

New original thematic threaded thanks to ORFEO program

Lot of expect from the users' communities:
- Security, (Police, Civil Defense, etc .)
- Humanitarian (UHCR, NGO's)
- Administrations (DG RELEX)

Objectives: assessment of the potential of Pleiades HR data

Large gathering

Civil population fleeing N'Djaména

February 2008

H. Yésou, M. Montbabord, S. Battiston, C. Uribe, S. Clandillon





Gathering: a new thematic for RS community

- Dynamic event
- Population fleeing:

Chad case of February 2008 : :

To escape fights between rebels and regular army units 30 000 people fleeing N'Djamena: 20 000 went to Cameroon. Between 7000 - 10 000 would camp somewhere

Gathering: a new thematic for RS community

- **Others cases: RDC October 2008**

« 20 000 personnes déplacées fuient les combats en RDC »

« Des milliers de Congolais se réfugient vers Goma.

45 000 personnes ont fuies dans la panique le camp de déplacés de Kibati »

(Le monde des 27 10 2008 et 29 10 2008)

Large gathering Chad: data & processing

Pleiades HR like data:

- **Quick Bird 8 January 2008**
- **World View, 4 and 8 February 2008**

Processing , information extraction chain

Geometric correction, merging XS-PAN

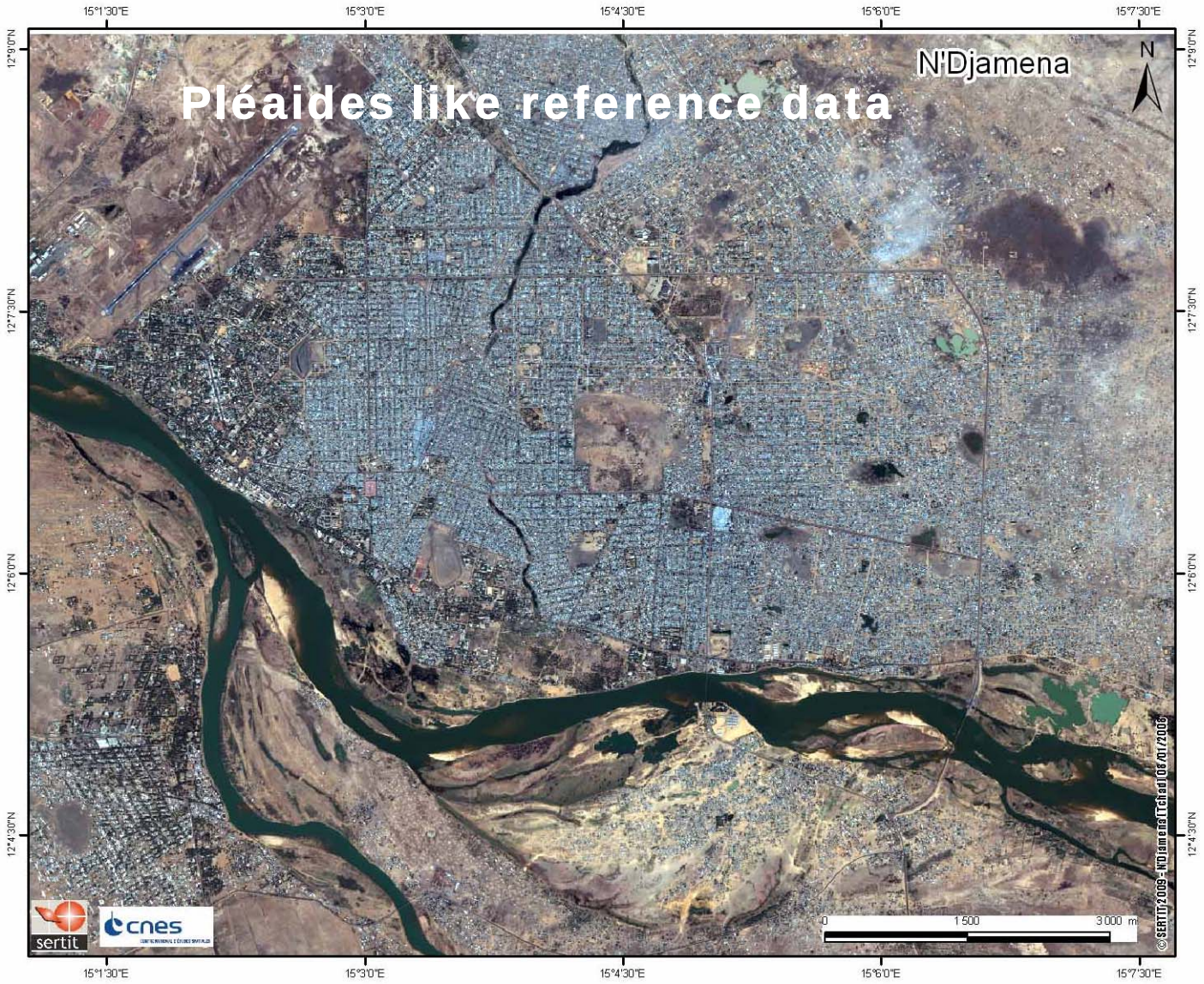
- **First step: Classical land use / cover product generation**

=> Object oriented Segmentation / SVM classification

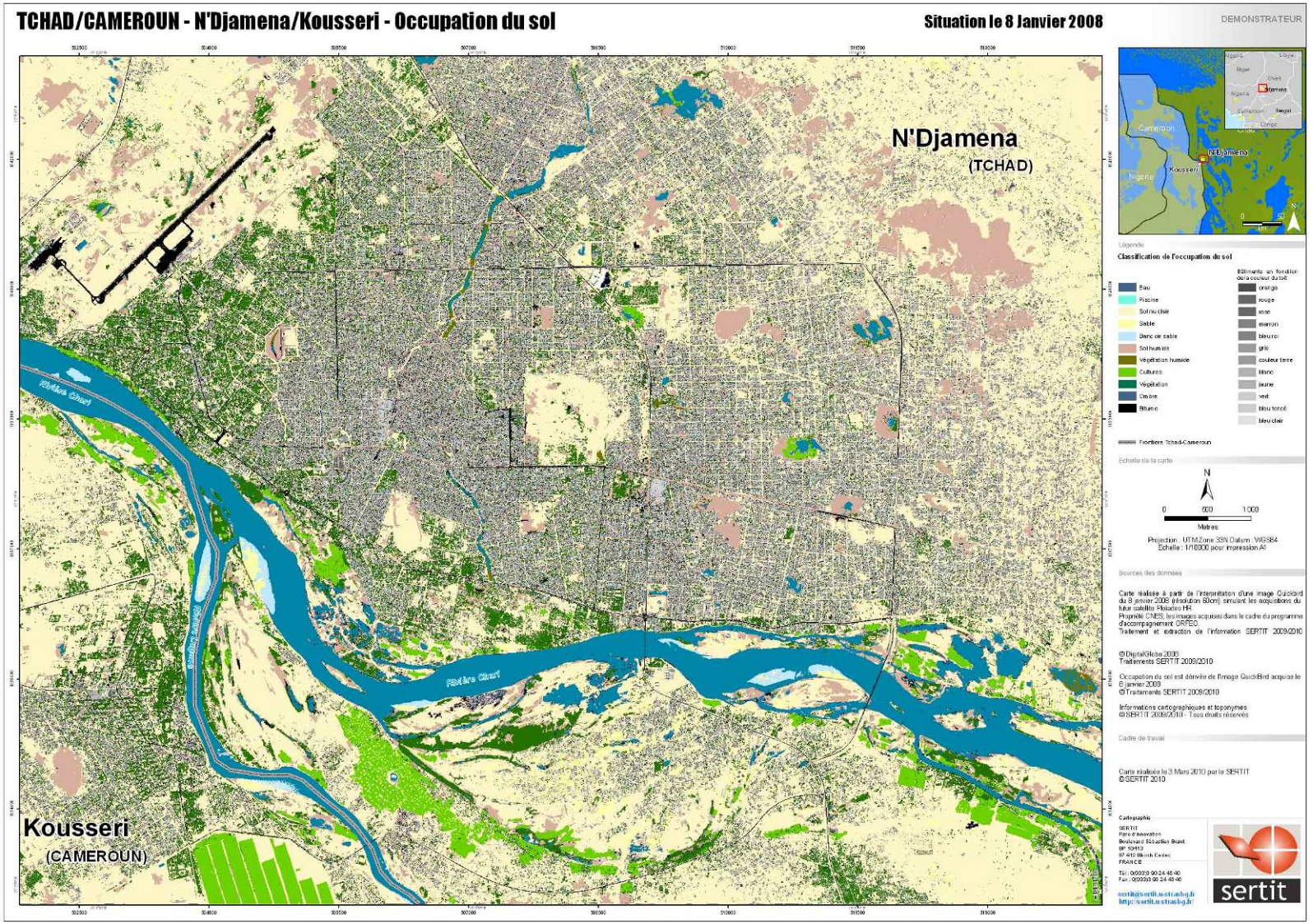
=> Net work extraction (road and hydrographical network)

- **Second step: Dedicated products generation**
  - **People movement on the 4 (flow)**
  - **People movement on the 8 of February**
  - **Potential sites for IDP camps**
  - **Potential sites for logistic**

Large gathering Chad



Land cover


TCHAD/CAMEROUN - N'Djamena/Kousseri - Occupation du sol
Situation le 8 Janvier 2008
DEMONSTRATEUR
N'Djamena
(TCHAD)
Kousseri
(CAMEROUN)
Rivière Chari
Rivière Logone
Classification de l'occupation du sol
Eau
Piscine
Sol nu clair
Sable
Banc de sable
Sol humide
Végétation humide
Cultures
Végétation
Ombre
Bitume
Bâtiments en fonction de la couleur du toit
orange
rouge
rose
marron
bleu roi
gris
couleur terre
blanc
jaune
vert
bleu foncé
bleu clair
Frontière Tchad-Cameroun
Echelle de la carte
N
0
500
1000
Mètres
Projection : UTM Zone 33N Datum : WGS84
Echelle : 1/16000 pour impression A4
Sources des données
Carte réalisée à partir de l'interprétation d'une image QuickBird du 8 janvier 2008 (résolution 60cm) simulant les acquisitions du futur satellite Pléiades HR
Propriété CNES, les images acquises dans le cadre du programme d'accompagnement ORFEO
Traitement et extraction de l'information SERTIT 2009/2010
©DigitalGlobe 2008
Traitements SERTIT 2009/2010
Occupation du sol est dérivée de l'image QuickBird acquise le 6 janvier 2008
©Traitements SERTIT 2009/2010
Informations cartographiques et toponymes
©SERTIT 2008/2010 - Tous droits réservés
Cadre de travail
Carte réalisée le 3 Mars 2010 par le SERTIT
©SERTIT 2010
Cartographie
SERTIT
Pôle d'innovation
Boulevard Sébastien Brant
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Tél.: 00(0)3 90 24 45 45
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sertit@sertit.u-strasbg.fr
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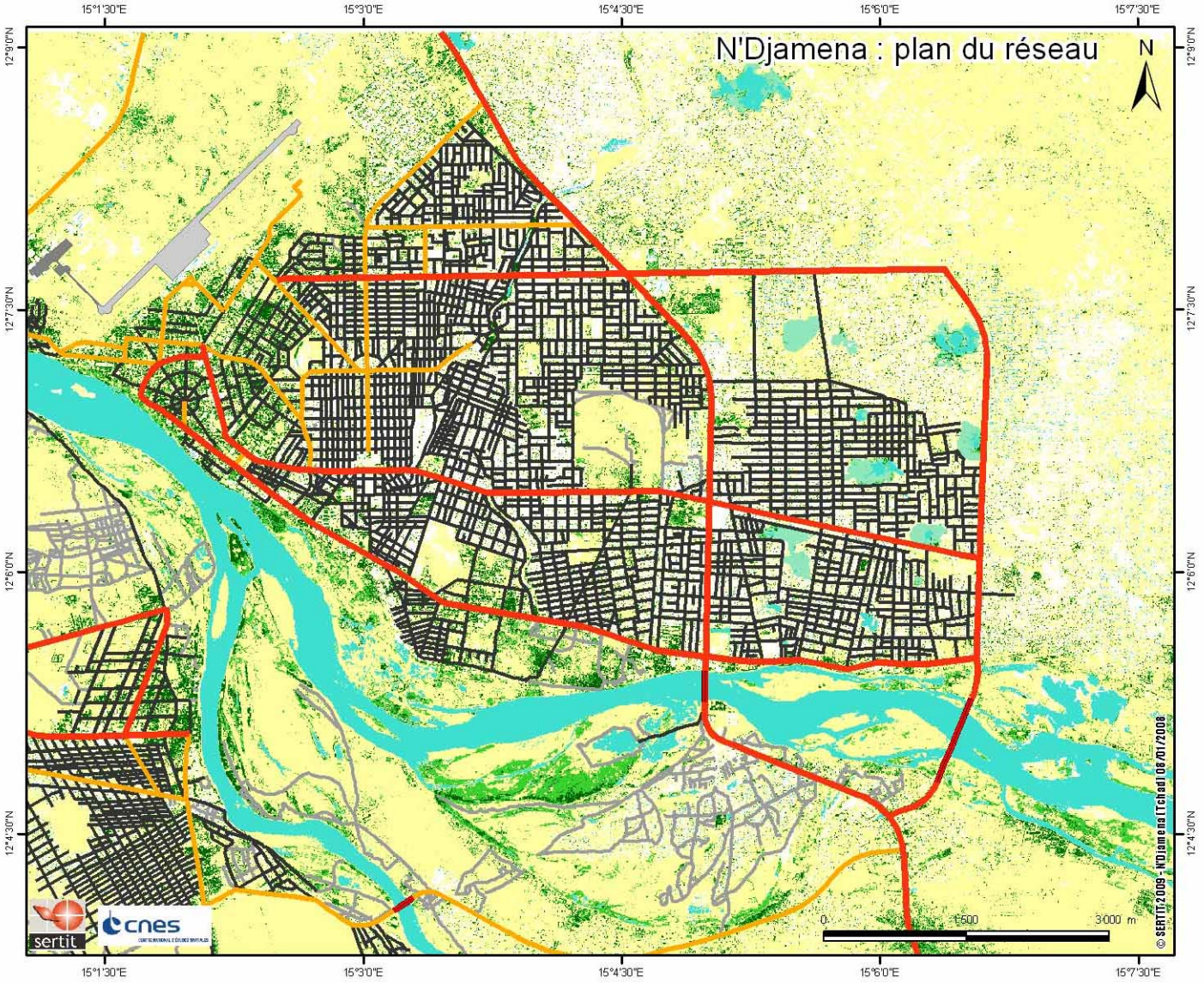
sertit

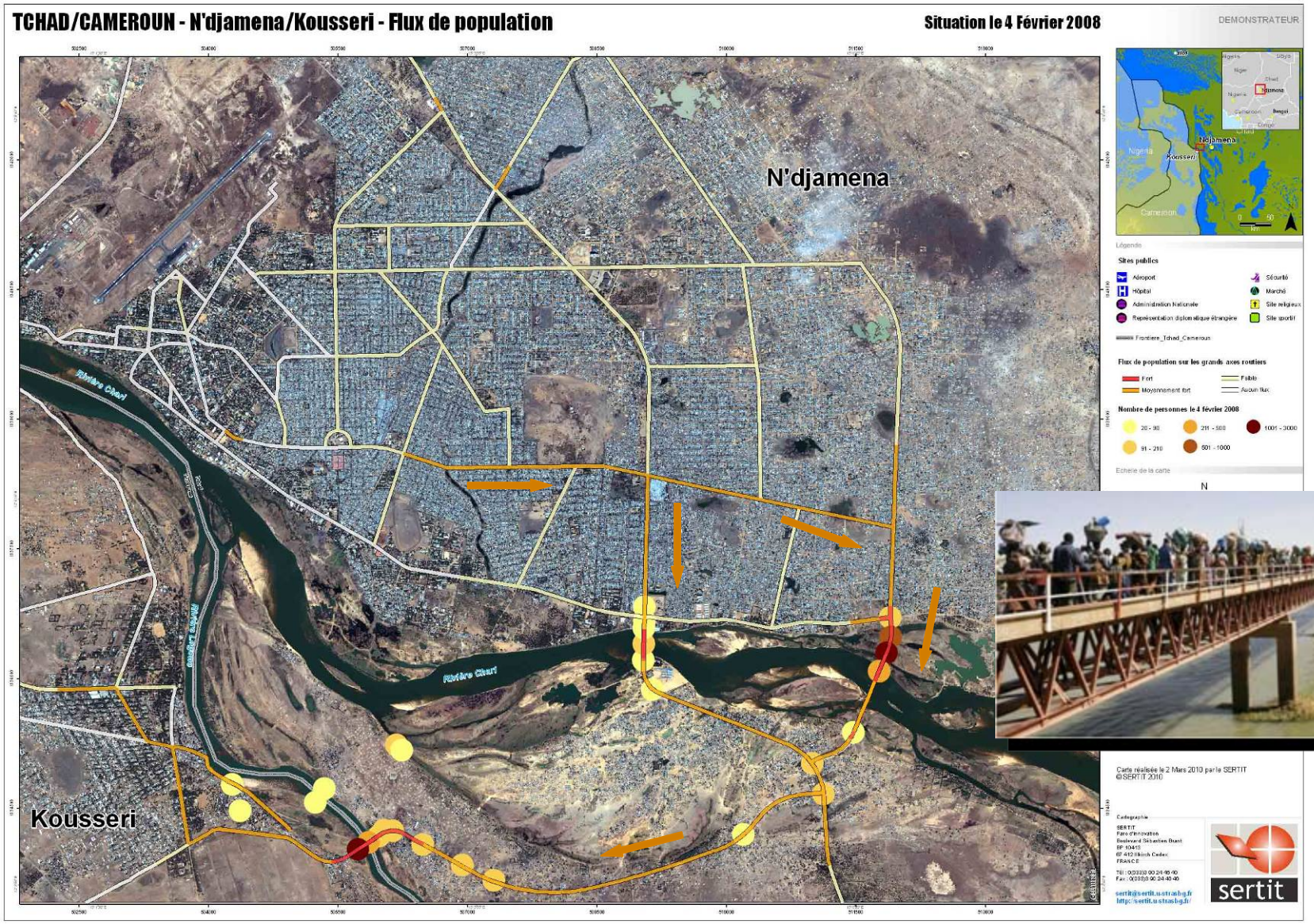
Network extraction



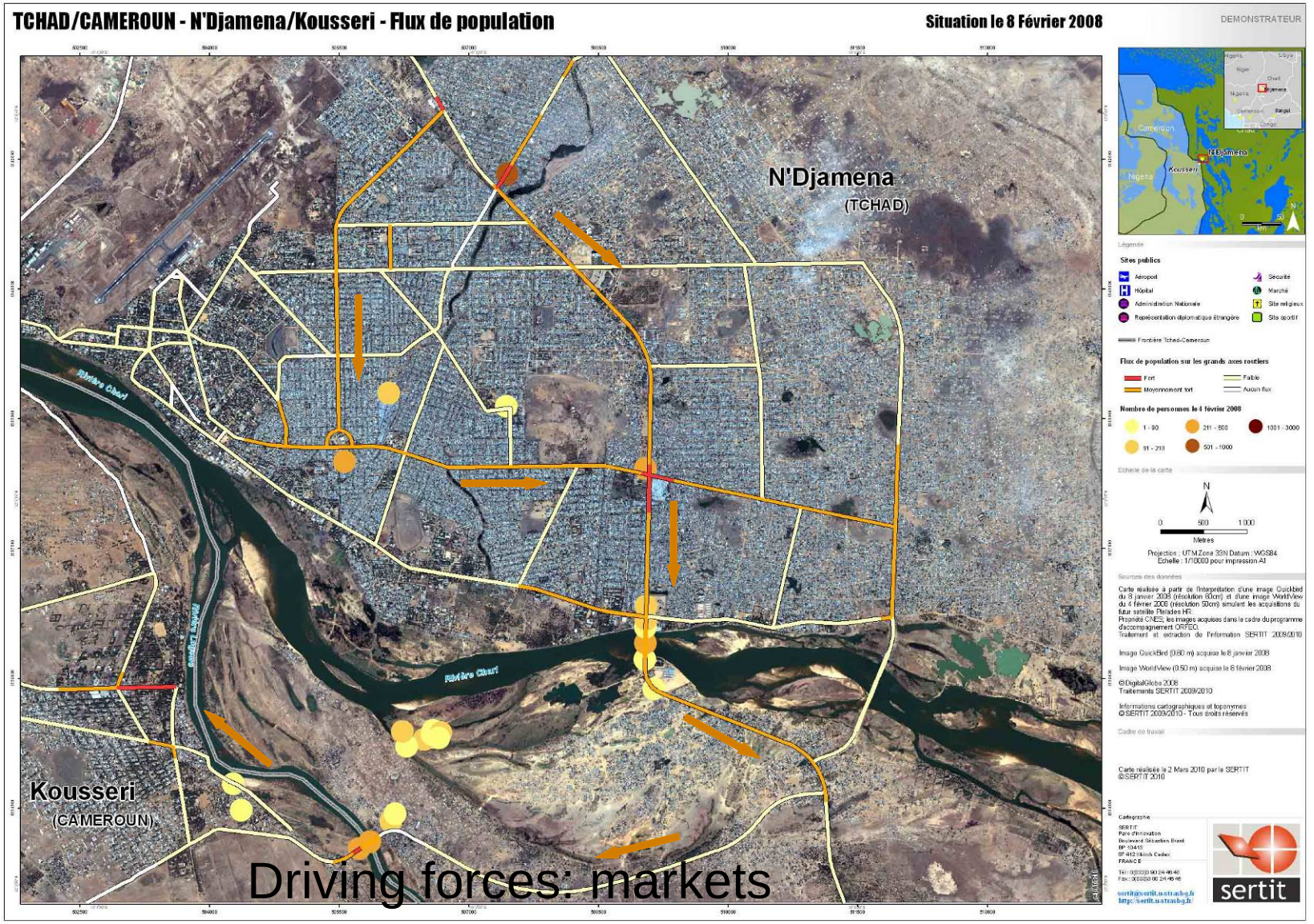
People fleeing

People temporarily blocked at bridge

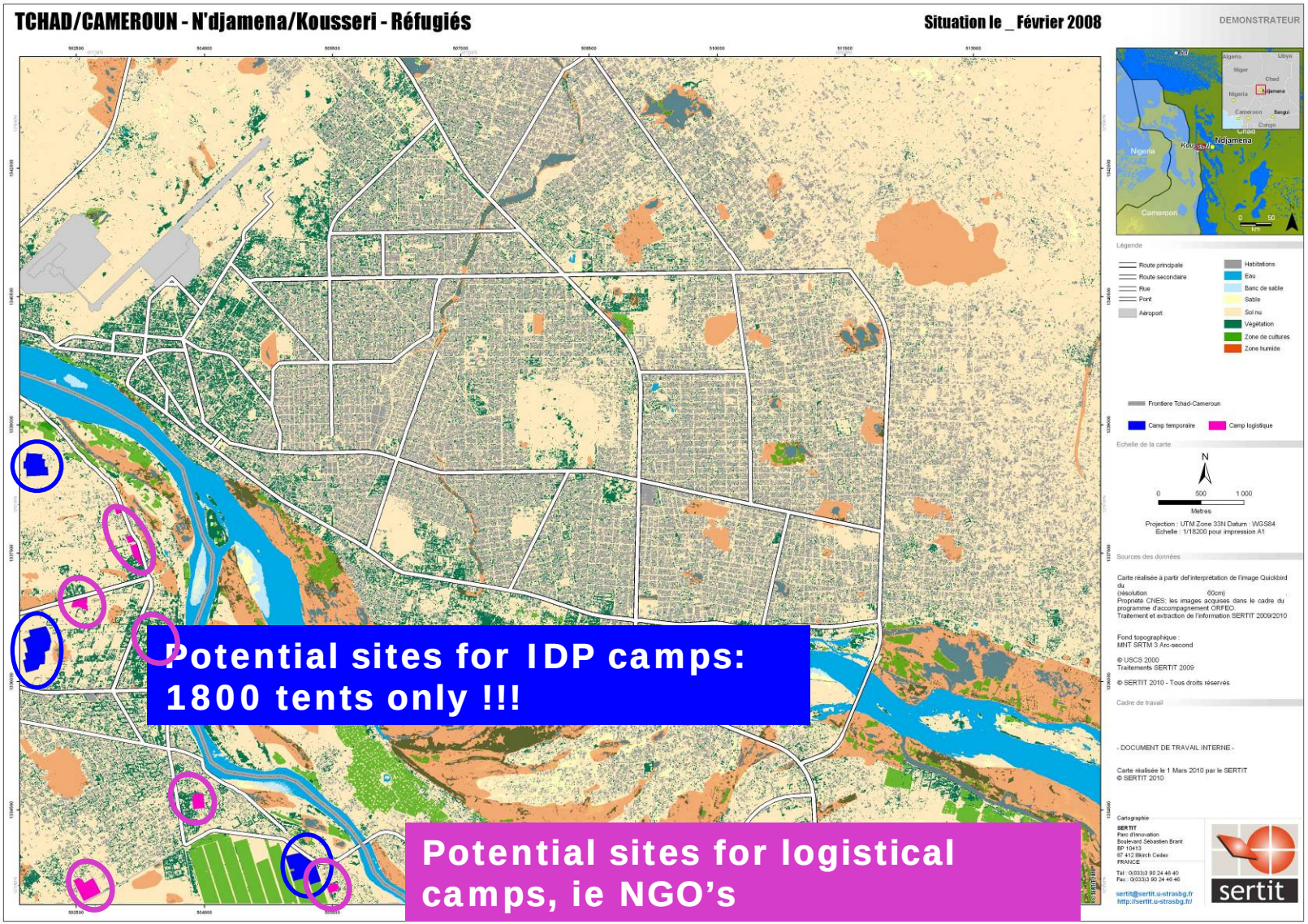
People fleeing estimation : 4 of February



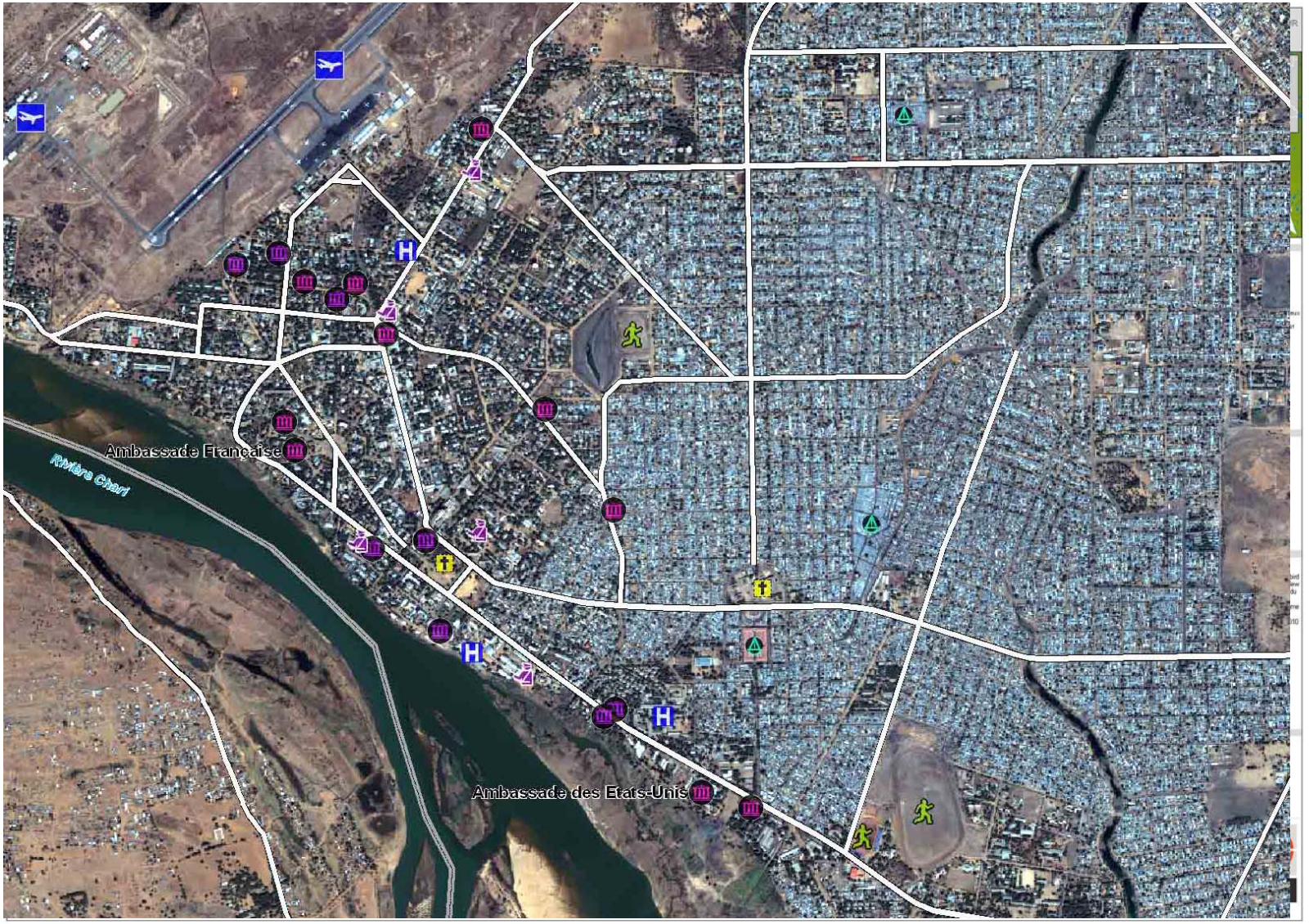
People fleeing estimation : 8 of February



Dedicated land cover map for IDP camp location



Dedicated logistic map



Recognition of earthquake damage
&
Rapid mapping product elaboration

based on Pleiades HR like data

targeting decision makers:

2003 Boumerdes earthquake case study.

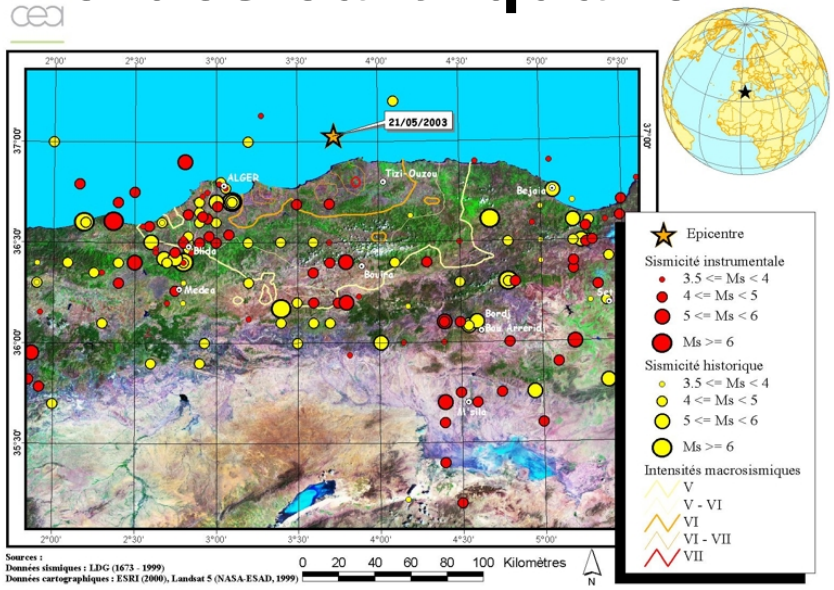
H. Yésou, R. Andréoli, M. Montabord,
F. Ledrappier, S. Clandillon

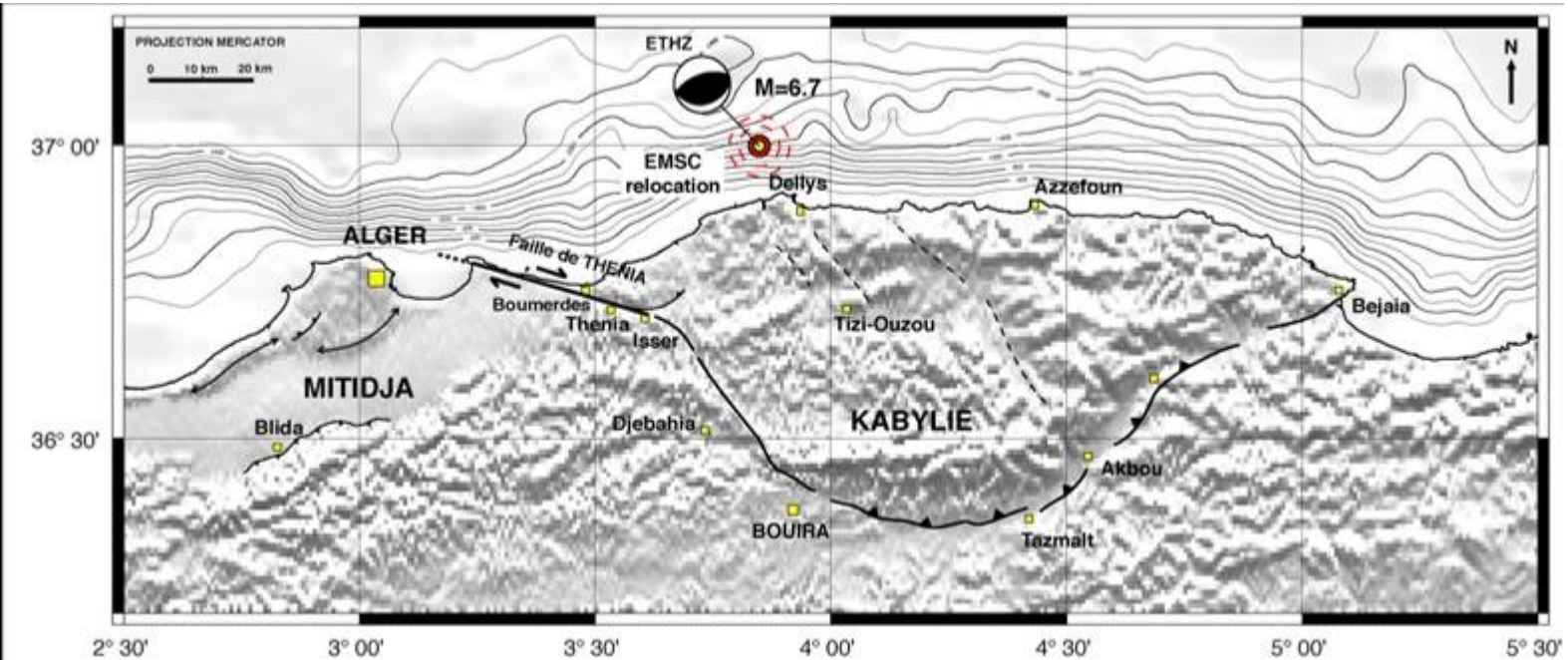
May 2003 Boumerdes earthquake

21 - 05 - 2003

6.8 Mw

2300 casualties
12 000 injured,
146 000 homeless





Context Boumerdes

Charter rapid mapping action: May 2003

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

Test site :

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

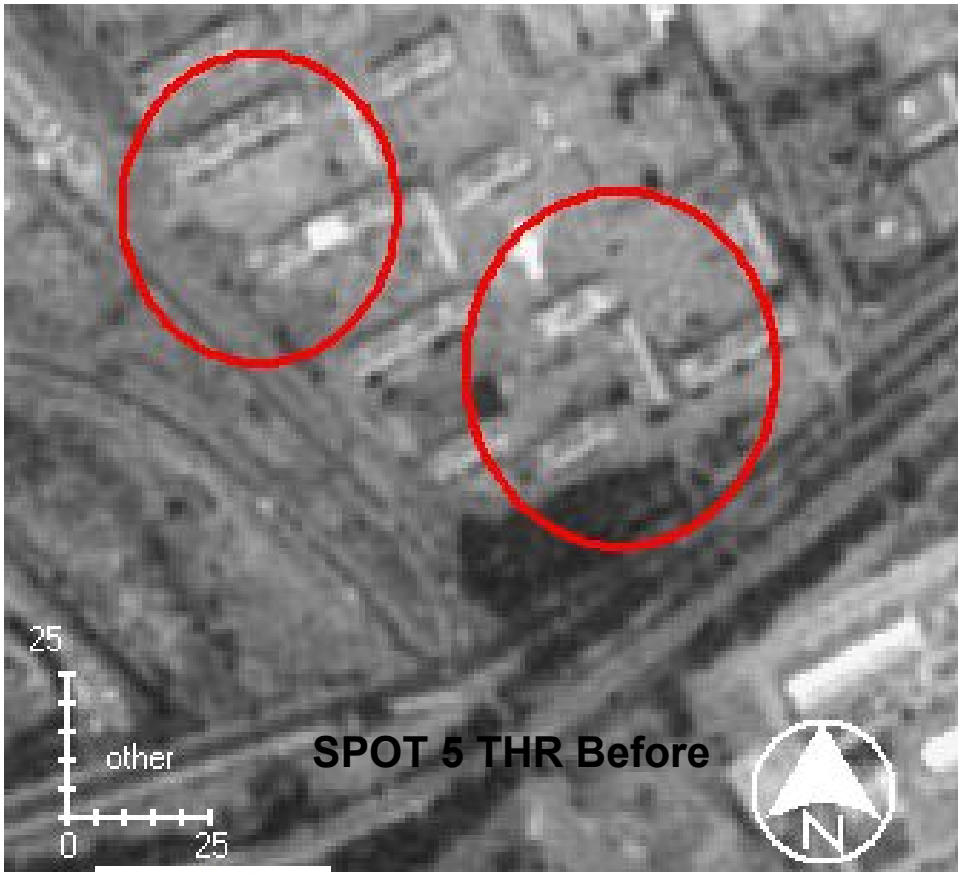
Exploitation of QB data set simulating Pleaides HR data

Boumerdes Area

Urban area with high building density and important urban dynamic

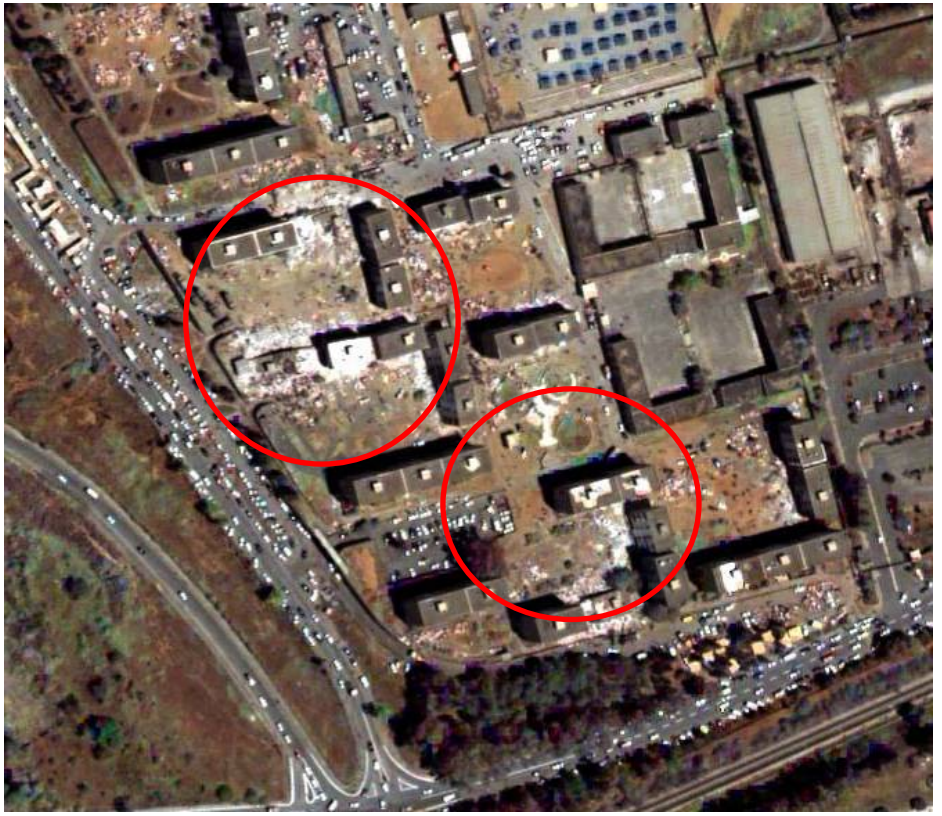
See for example the “quartier du Plateau “

Starting point : crisis SPOT 5 THR



SPOT 5 THR, 2.5 m
Alger May 2003 Earthquake

Optical VHR and damage recognition



Reference 2002/04/22

Crisis data 2003/05/23

Quick Bird- Pleiades HR like data

Optical VHR and damage recognition

- Blocks of flats

Collapsed buildings

Optical VHR and damage recognition

- Residential areas

Building under construction collapsed

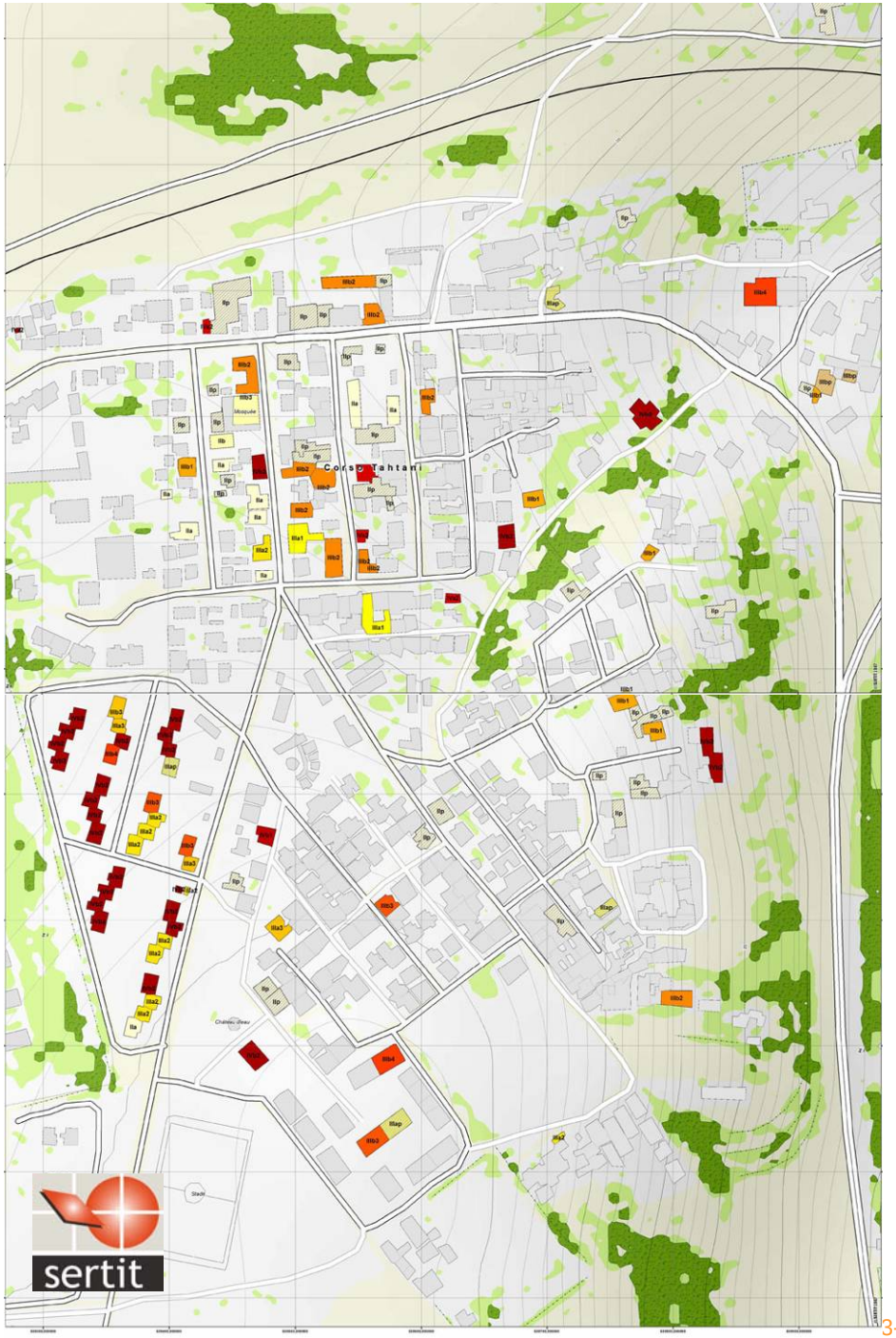
Optical VHR and damage recognition

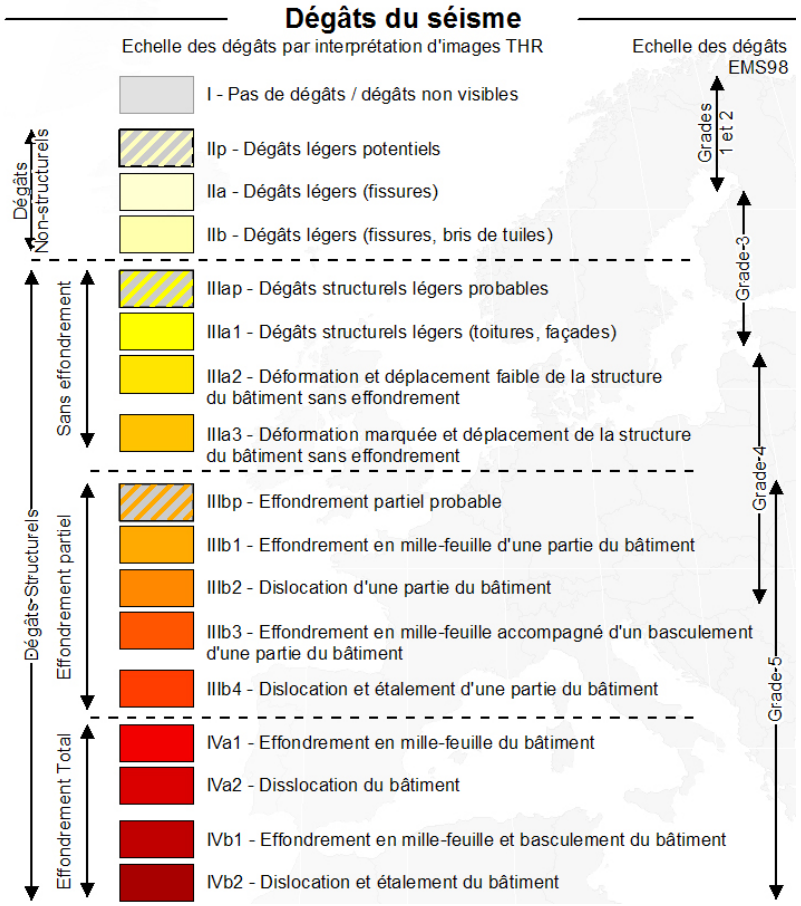
- Industrial buildings : grain silos

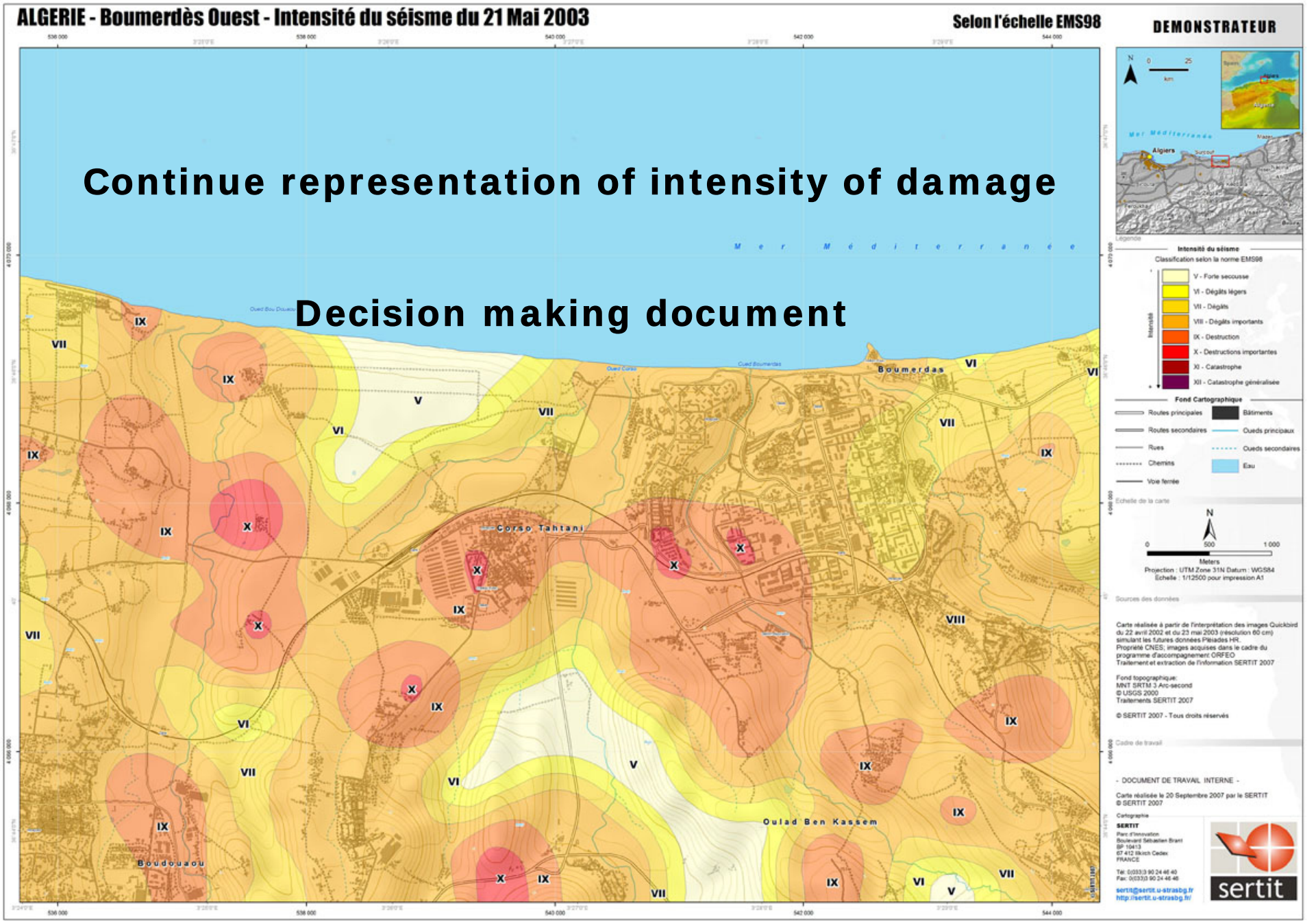
Sheared buildings with grain on the ground

© AYADI, GRAAG, 2003

Per building damage description






ALGERIE - Boumerdès Ouest - Intensité du séisme du 21 Mai 2003
Selon l'échelle EMS98
DEMONSTRATEUR
Continue representation of intensity of damage
Decision making document
Mer Méditerranée
Boumerdas
Corso Tahtani
Oulad Ben Kassem
Boudouaou
Intensité du séisme
Classification selon la norme EMS98
V - Forte secousse
VI - Dégâts légers
VII - Dégâts
VIII - Dégâts importants
IX - Destruction
X - Destructions importantes
XI - Catastrophe
XII - Catastrophe généralisée
Fond Cartographique
Routes principales
Routes secondaires
Rues
Chemins
Voie ferrée
Bâtiments
Oueds principaux
Oueds secondaires
Eau
Projection : UTM Zone 31N Datum : WGS84
Echelle : 1/12500 pour impression A1
- DOCUMENT DE TRAVAIL INTERNE -
Carte réalisée le 20 Septembre 2007 par le SERTIT
© SERTIT 2007
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 as well for long term 2006 and 2008 VHR images

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

Reconstruction monitoring

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

19 076 building and 1049 km of road network

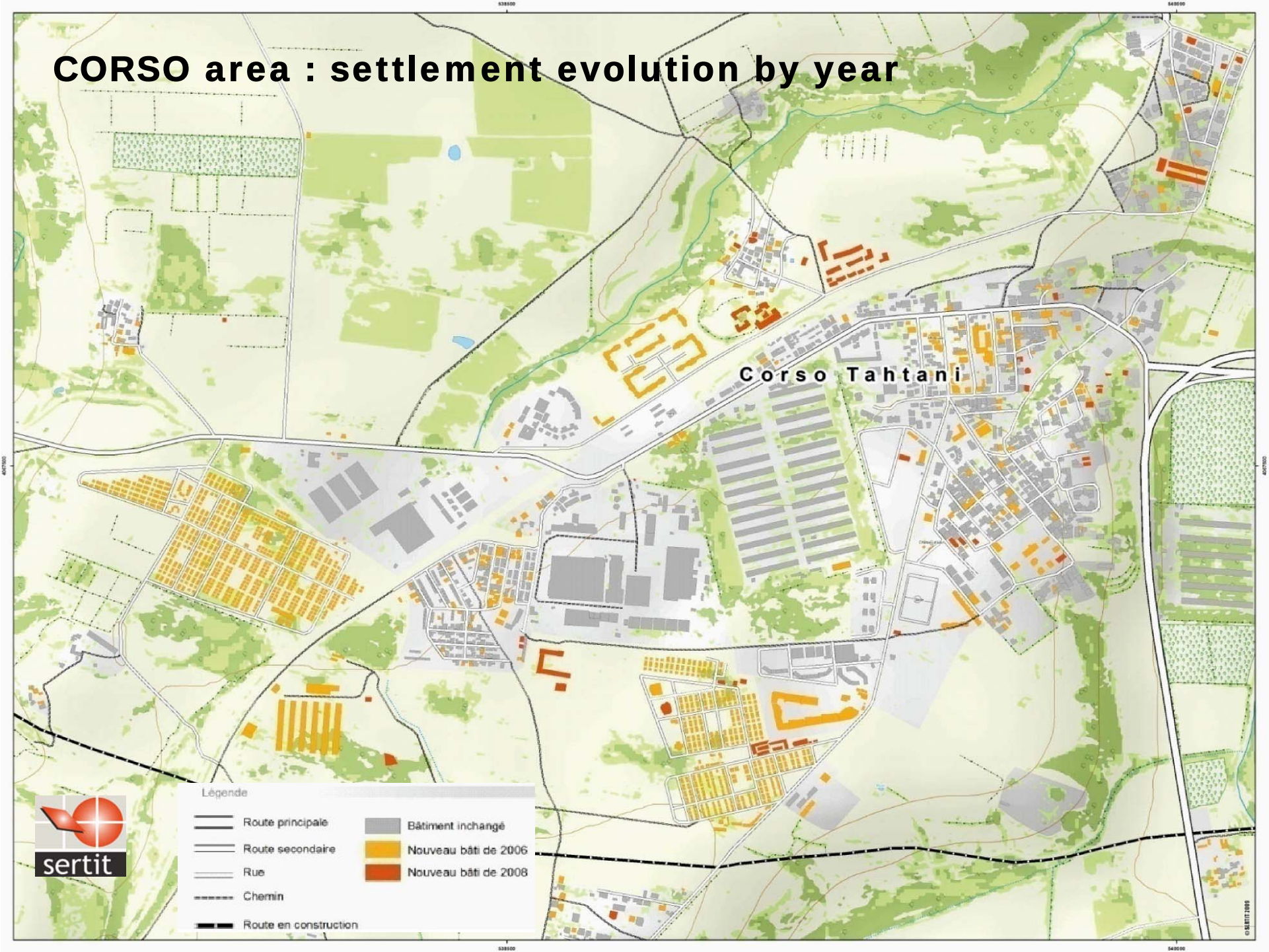
Clearing activities recognition and monitoring

Clearing activities recognition and monitoring

Long term displaced population monitoring: 2003 -2006

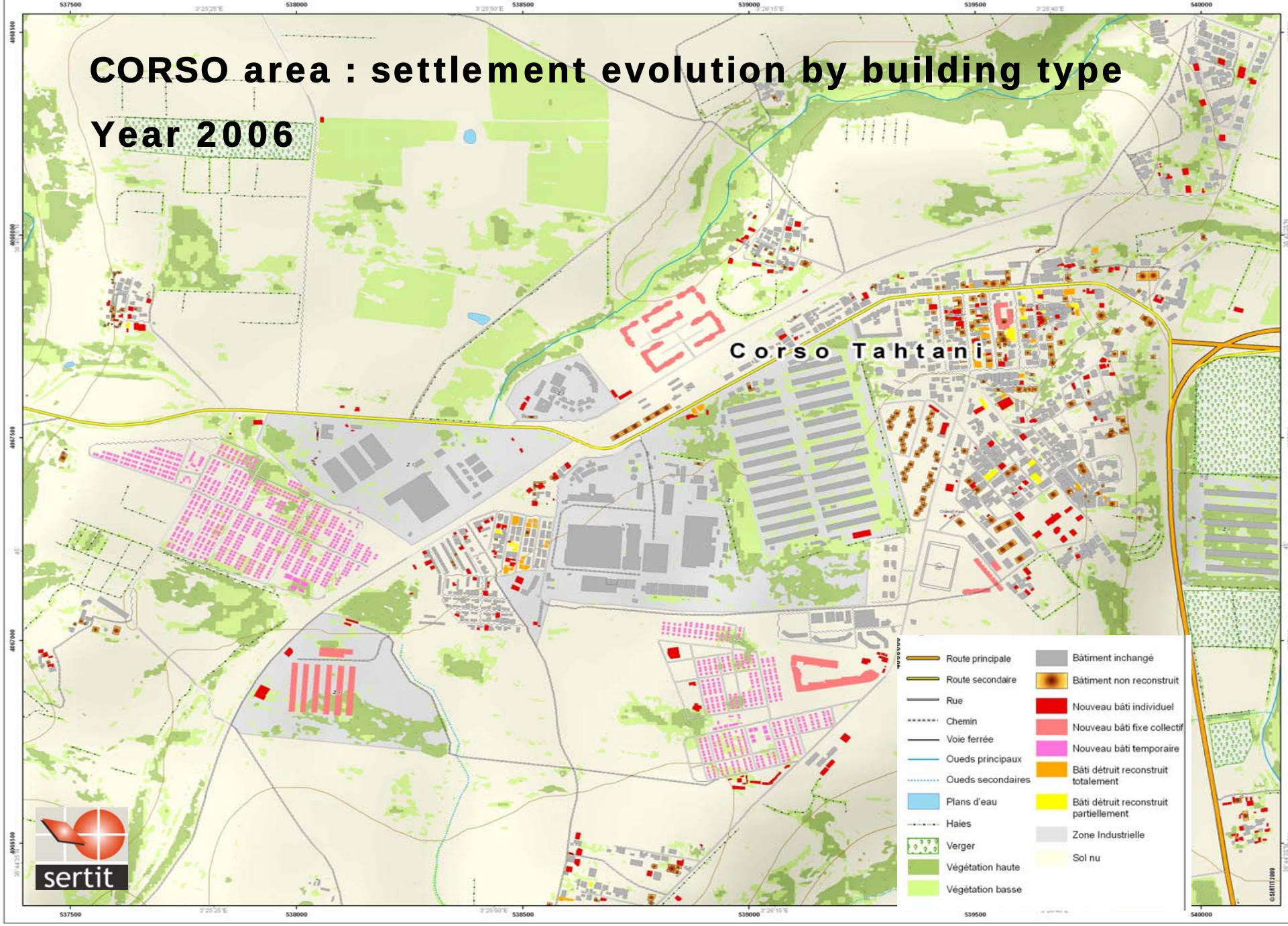
Long term displaced population monitoring: 2003 -2006

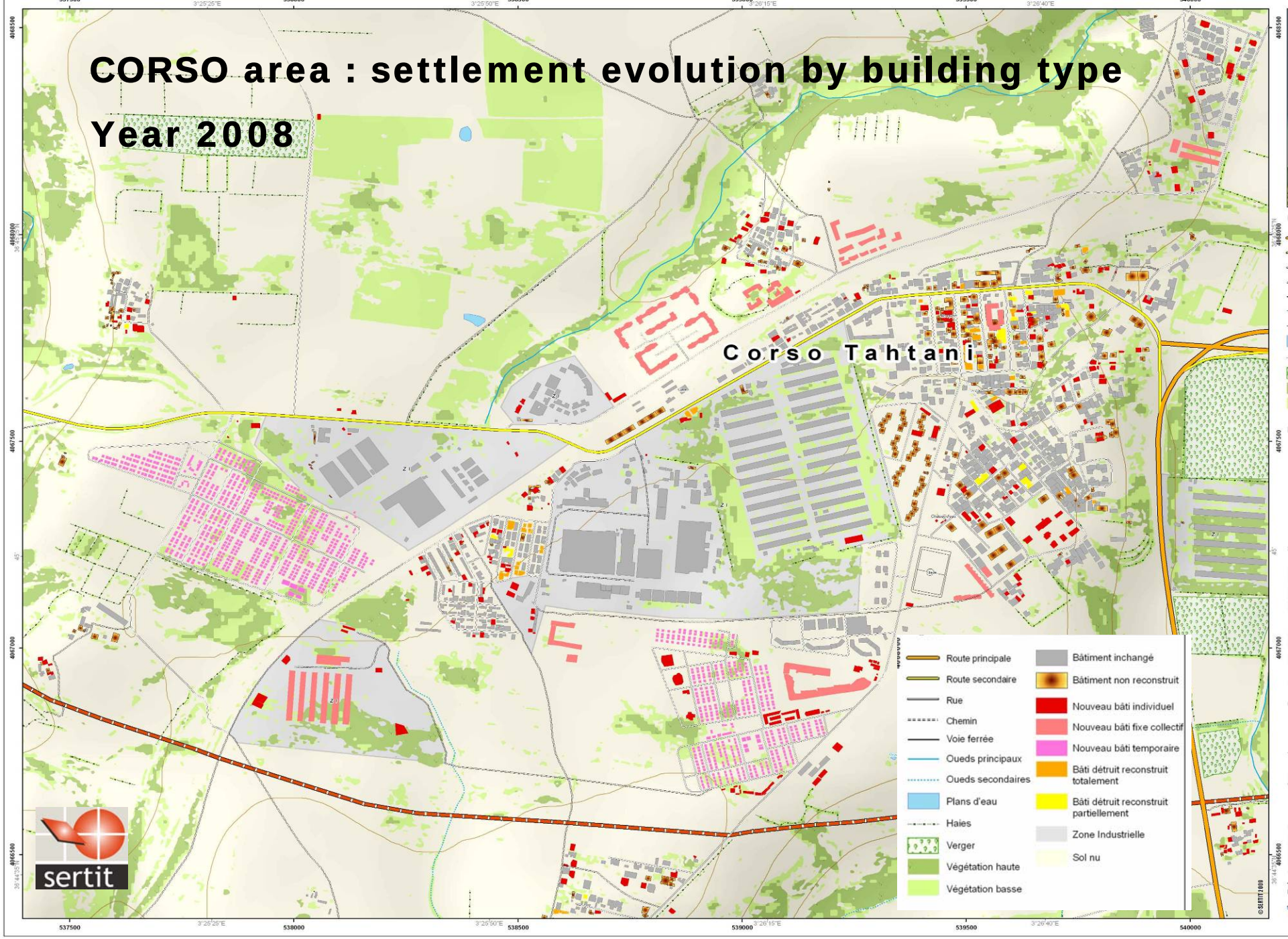
CORSO area : settlement evolution by year



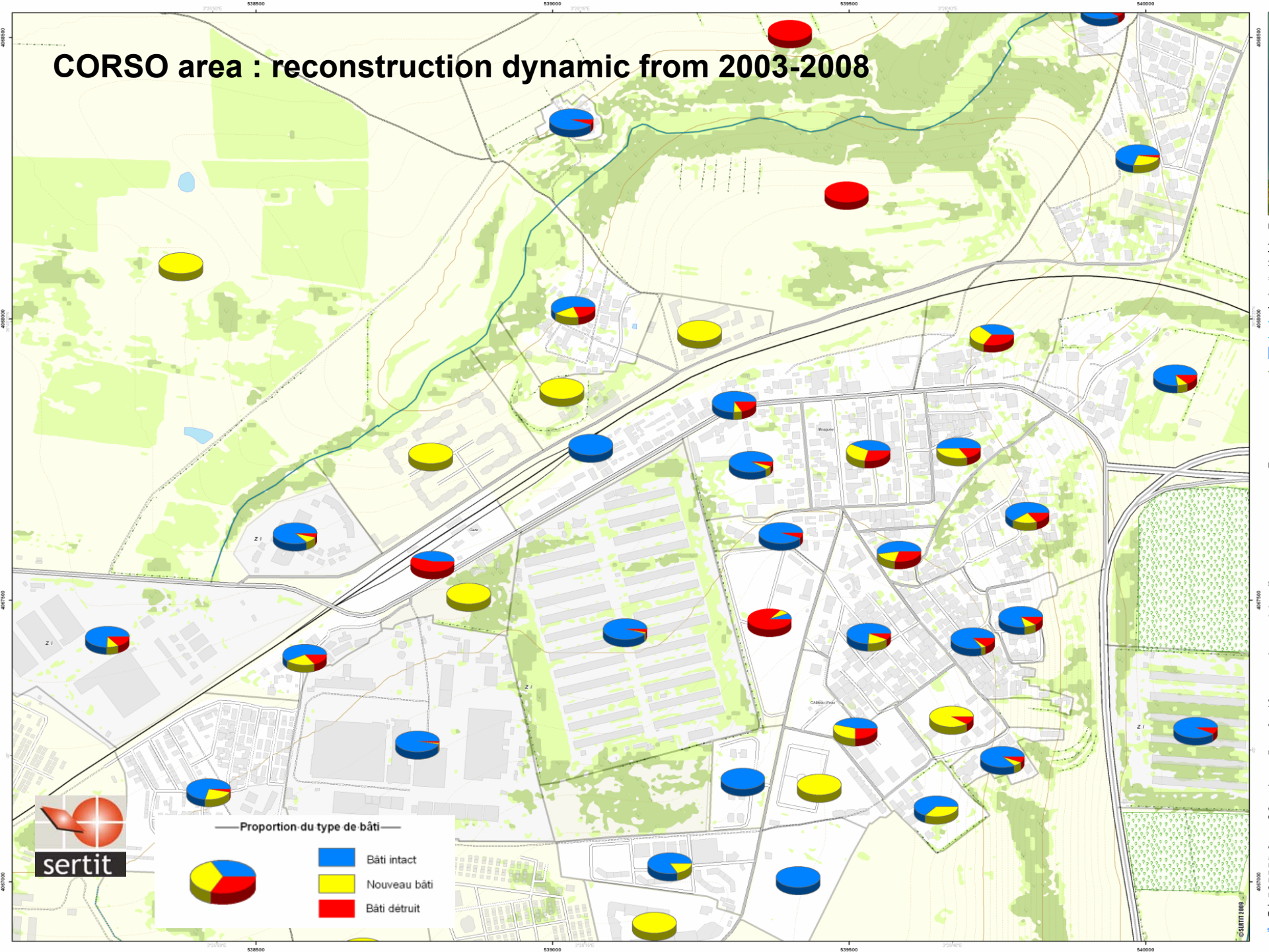
CORSO area : settlement evolution by building type

Year 2006

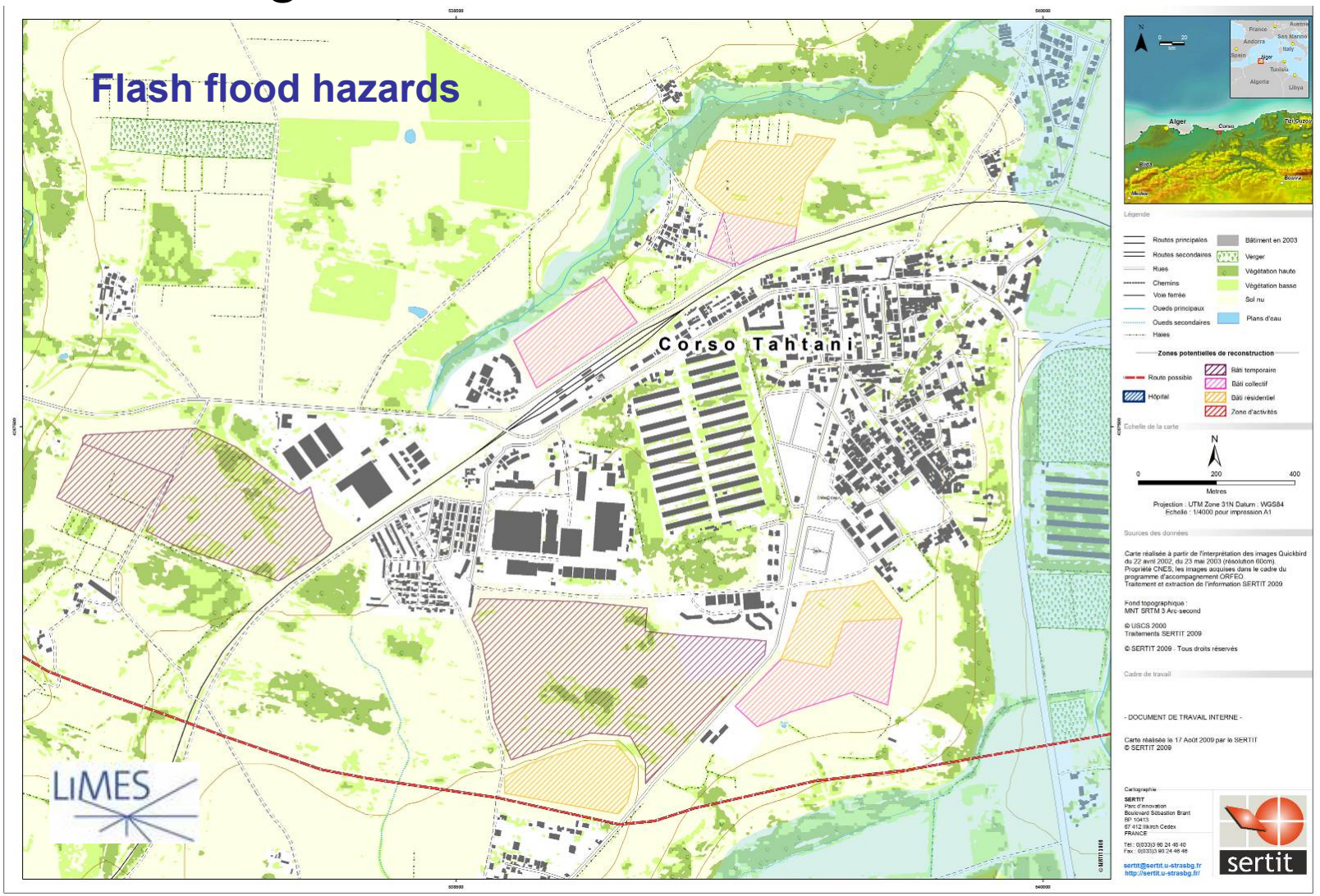



CORSO area : settlement evolution by building type
Year 2008
Corso Tahtani
Route principale
Route secondaire
Rue
Chemin
Voie ferrée
Oueds principaux
Oueds secondaires
Plans d'eau
Haies
Verger
Végétation haute
Végétation basse
Bâtiment inchangé
Bâtiment non reconstruit
Nouveau bâti individuel
Nouveau bâti fixe collectif
Nouveau bâti temporaire
Bâti détruit reconstruit totalement
Bâti détruit reconstruit partiellement
Zone Industrielle
Sol nu
sertit
537500
538000
538500
539000
539500
540000
4066500
4067000
4067500
4068000

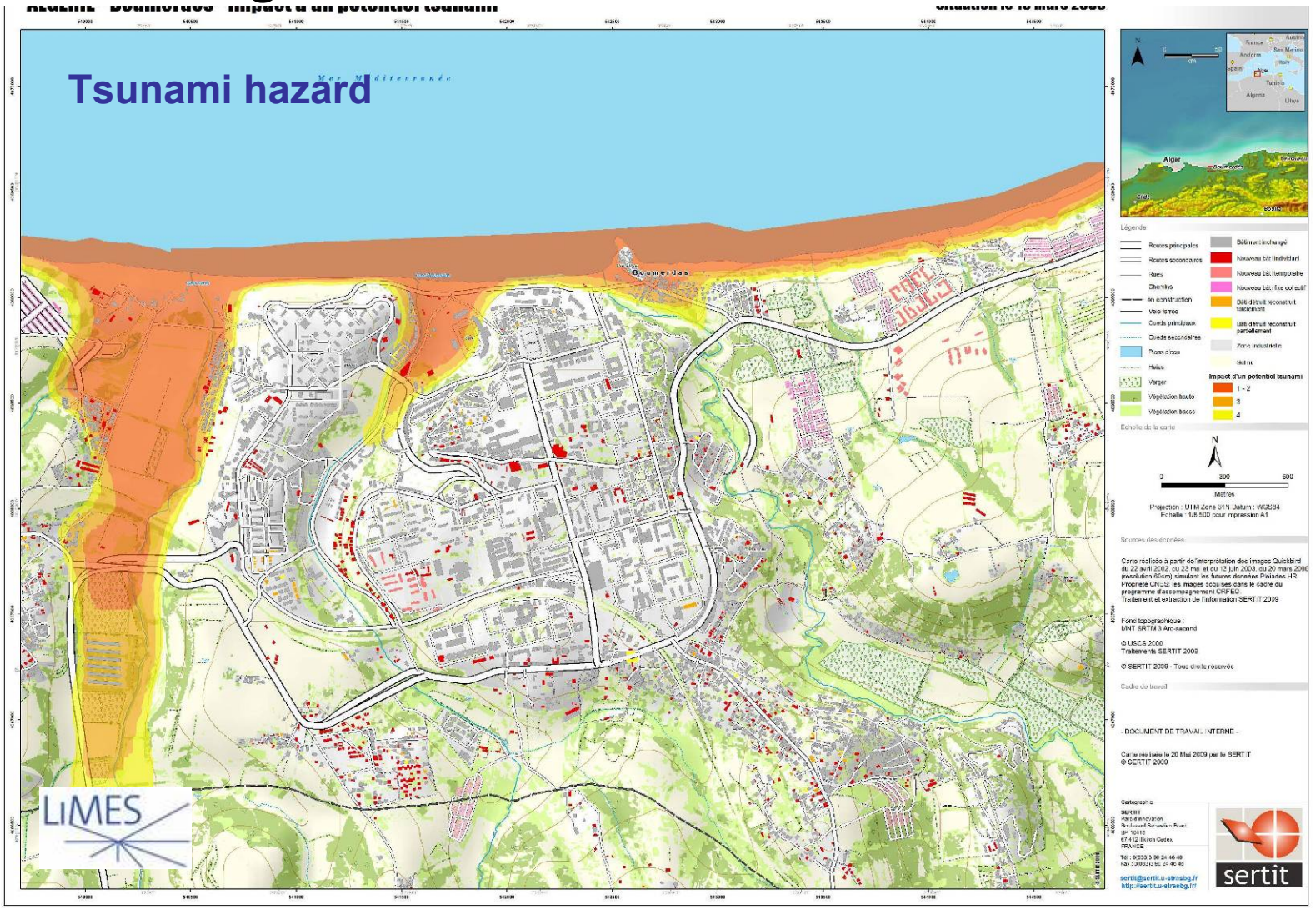
CORSO area : reconstruction dynamic from 2003-2008



EO and Geo spatial information for identification of potential reconstruction site taking in account natural hazards;



EO and Geo spatial information for identification of potential reconstruction site taking in account natural hazards;



Boumerdes : settlement evolution , Year 2006

Boumerdes : settlement evolution , Year 2008

Appraisal of ORFEO program for Charter and SAFER passed and future actions

Proof of Pleiades HR potential at different stages of a crisis

Emergency phase : People relief' phase (ie Charter domain of competencies)

And to the following ones:

- **Health**
- **Populations help and care ,**
- **Reconstruction / rehabilitation**
- **Prevention; through the comprehension of the devastating phenomenon (inputs for geophysical / hydrological modeling phase)**

Future trends for Pleiades HR commissioning Phase (2010-2011)

Three trends in the hazards/humanitarian domains

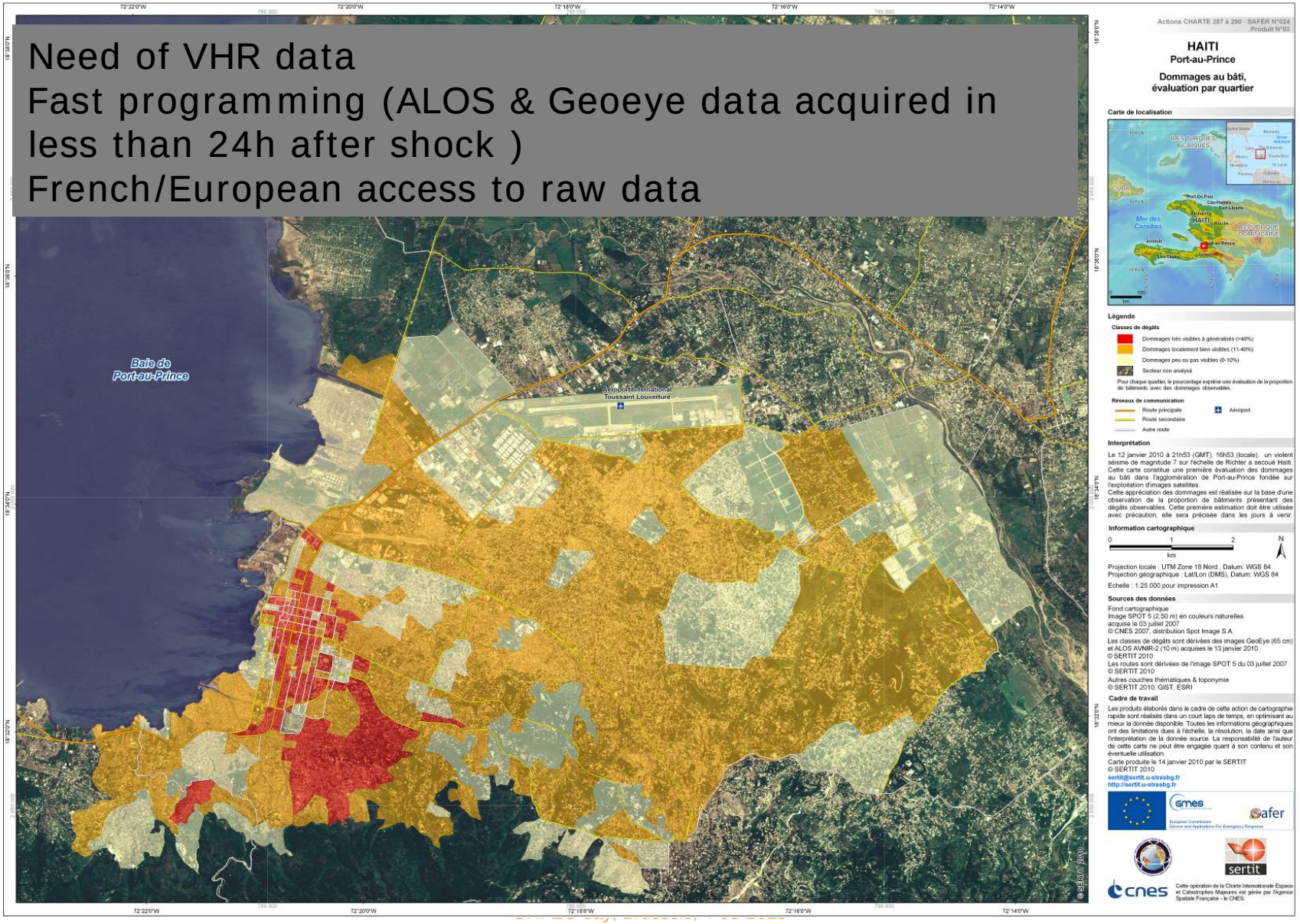
- **Boumerdes: reconstruction state in 2011 => unique case of reconstruction monitoring over more than 8 years after a seism**

- **Haïti: same reconstruction monitoring appraoch would/could/have to be proposed**

- **Rapid mapping actions: at the first regional /lajor event occurring at any place in the world acquired in rush Pleiades HR data:**
  - **Flood**
  - **Forest fire**
  - **Pollution**
  - **Etc ..**

Expects of the Hazards Humanitarian community in Pléiades HR constelation

Need of VHR data
Fast programming (ALOS & Geoeye data acquired in less than 24h after shock)
French/European access to raw data



Expects of the Hazards Humanitarian community in Pléiades HR constelation

Conclusion

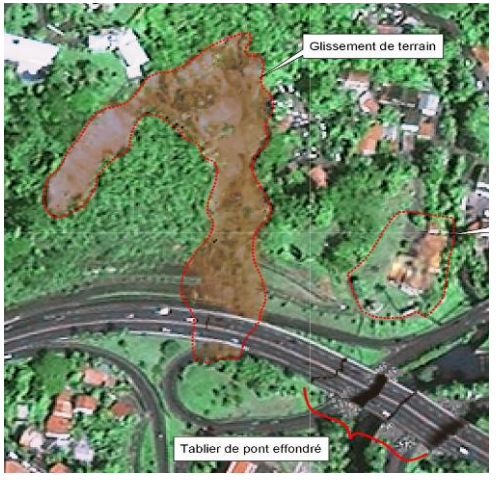
CNES ORFEO support was very primary, dense, and appreciated by users and operators/ actors of the hazards community

ORFEO projects: formative, innovative et testing aspects

- Exploitation of Pleiades Like data for demonstration purpose (Richter Martinique, Lourdes and Mulhouse exercises + SAR units of Vitrolles UIISC 7)

- Important profit for on going rapid mapping actions

Many thanks to ORFEO team



Pléiades HR for cartography of Risks in Real Time

Mapping and feed back analysis

Flood
Forest fire
Large gathering
Earthquake Damage
Reconstruction monitoring

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