





### The national geographical infrastructure Référentiel à Grande Echelle (RGE) : 4 components

- Ortho image (aerial)**  
**BD ORTHO®**  

- Topography**  
**BD TOPO®**  

- Cadastral component**  
**BD PARCELLAIRE®**  

- Addresses**  
**BD ADRESSE®**  


Jean-Philippe CANTOU - IGN - 10 June 2008 Page 2/41

### National infrastructure (RGE)

- **BD Ortho®** : Pleiades to ease a demand for increased aerial survey revisit
  - required product : a homogeneous geometry and radiometry per « french département »
  - observing conditions shall be constrained to keep image content close to 50 cm standards
- **BD Topo®** : Pleiades to help improving data actuality & completeness
  - a new data source in the IGN early warning network (terrain + Spot/Formosat data),
    - speed up the collection process of changes
    - winter images might help detect changes in forest or inaccessible areas
  - a potential input for data plotting with < 1.5 m rms accuracy
  - an external source for checking operations before DB release

### Other geographical infrastructure and needs

- French **Defence mapping** programmes : IGN expertise & means as a support (2D & 3D)
- **European directives & programmes** (INSPIRE, GMES) : Pléiades to speed up harmonization and integration of national data infrastructure ?
- Partnership with **local authorities** : development & control of high quality 3D urban data bases
- **Export**

### National infrastructure (RGE)

- **BD Ortho®** : Pleiades to ease a demand for increased aerial survey revisit
  - required product : a homogeneous geometry and radiometry per « french département »
  - observing conditions shall be constrained to keep image content close to 50 cm standards
- **BD Topo®** : Pleiades to help improving data actuality & completeness
  - a new data source in the IGN early warning network (terrain + Spot/Formosat data),
    - speed up the collection process of changes
    - winter images might help detect changes in forest or inaccessible areas
  - a potential input for data plotting with < 1.5 m rms accuracy
  - an external source for checking operations before DB release

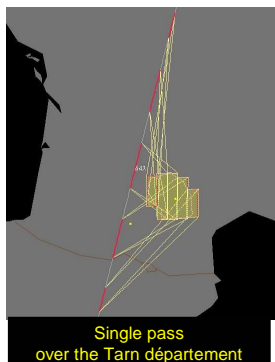
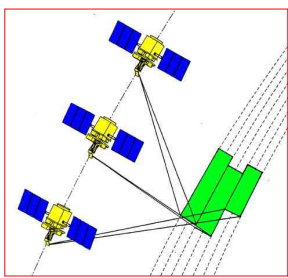
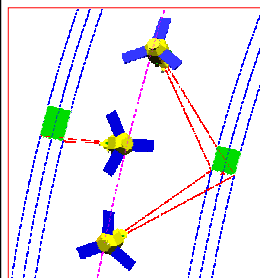
### Other geographical infrastructure

- French **Defence mapping** programmes : IGN expertise & means as a support (2D & 3D)
- **European directives & programmes** (INSPIRE, GMES) : Pléiades to speed up harmonization and integration of national data infrastructure ?
- Partnership with **local authorities** : development & control of high quality 3D urban DB
- **Export**

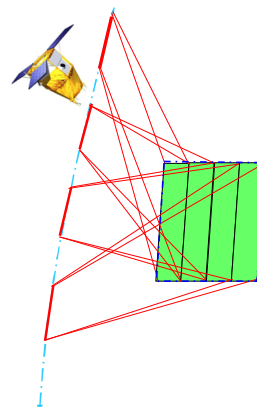
## The Pleiades system : high coverage capabilities



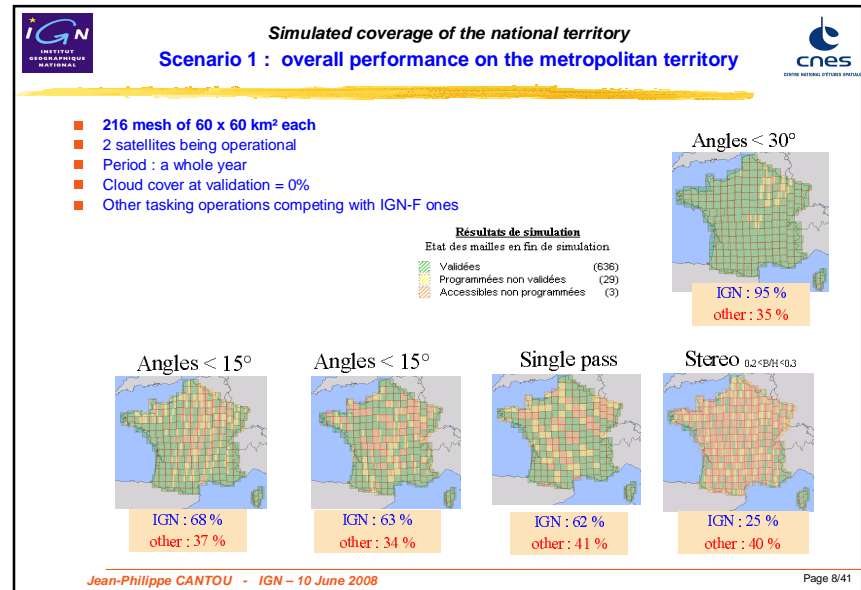
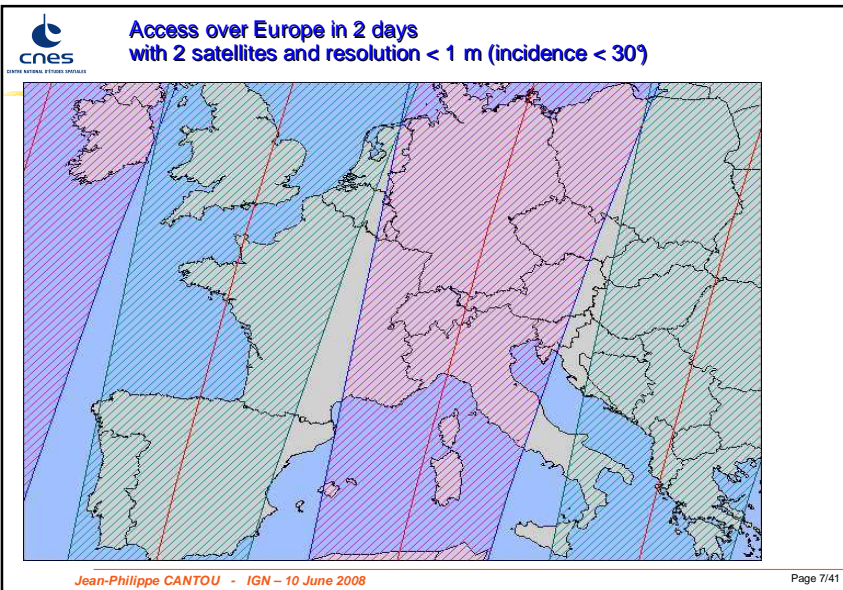
- 2 agile satellites
- 300 images / day / satellite
- Stereo pairs & mosaics

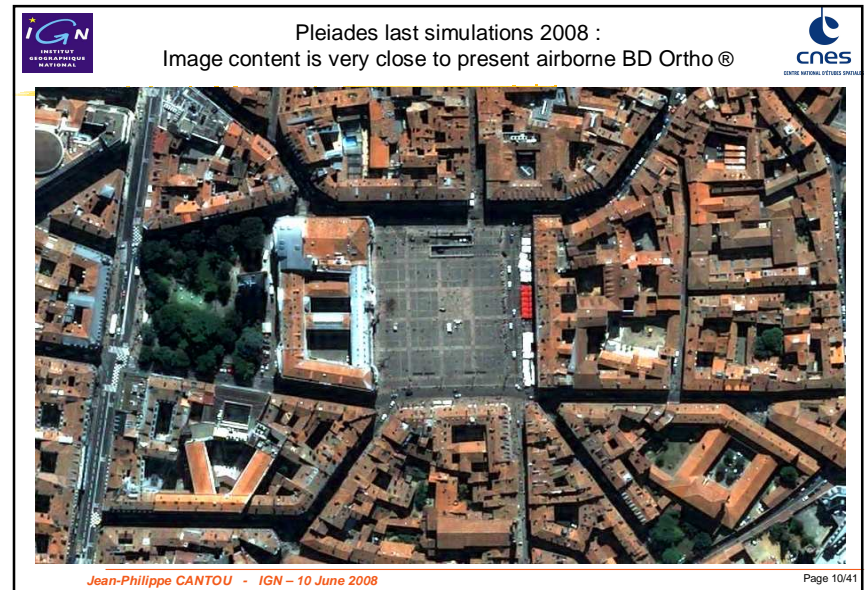
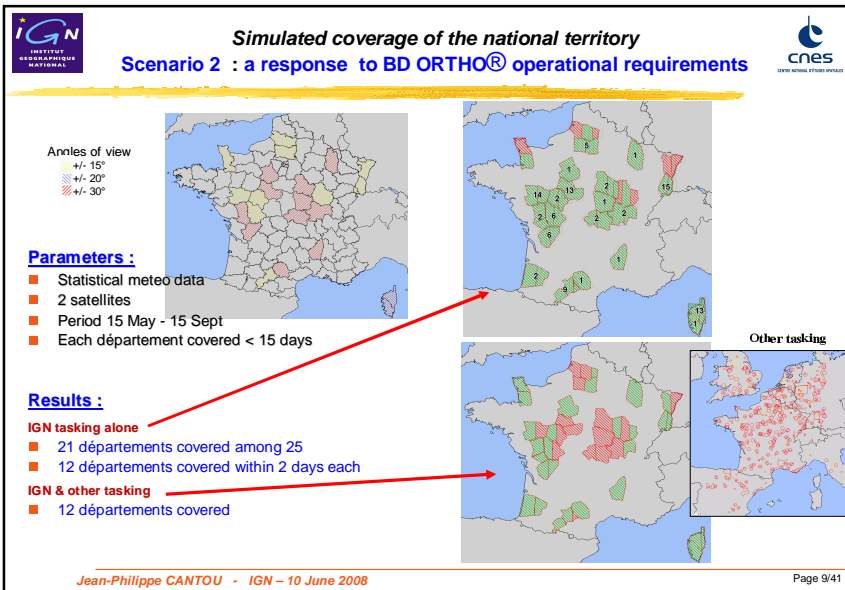


## Single pass coverage performance



Width of coverage	Maximum length
<b>20° viewing angle access authorised</b>	
60 km (3 strips)	185 km
<b>80 km (4 strips)</b>	<b>110 km</b>
100 km (5 strips)	70 km
120 km (6 strips)	45 km
<b>30° viewing angle access authorised</b>	
60 km (3 strips)	300 km
<b>80 km (4 strips)</b>	<b>205 km</b>
100 km (5 strips)	150 km
120 km (6 strips)	110 km
140 km (7 strips)	85 km





IGN  
INSTITUT  
GÉOGRAPHIQUE  
NATIONAL

cnes  
CENTRE NATIONAL D'ÉTUDES SPATIALES

Seam line automatic tracing should make the ortho processing represent a marginal cost in the overall orthoimage production line

Jea...

Page 11/41

IGN  
INSTITUT  
GÉOGRAPHIQUE  
NATIONAL

**Potential contributions of Pleiades imagery to IGN activities**

National infrastructure (RGE)

- **BD Ortho®** : Pleiades to ease a demand for increased aerial survey revisit
  - required product : a homogeneous geometry and radiometry per « french département »
  - observing conditions shall be constrained to keep image content close to 50 cm standards
- **BD Topo®** : Pleiades to help improving data actuality & completeness
  - a new data source in the IGN early warning network (terrain + Spot/Formosat data),
    - speed up the collection process of changes
    - winter images might help detect changes in forest or inaccessible areas
  - a potential input for data plotting with < 1.5 m rms accuracy
  - an external source for checking operations before DB release

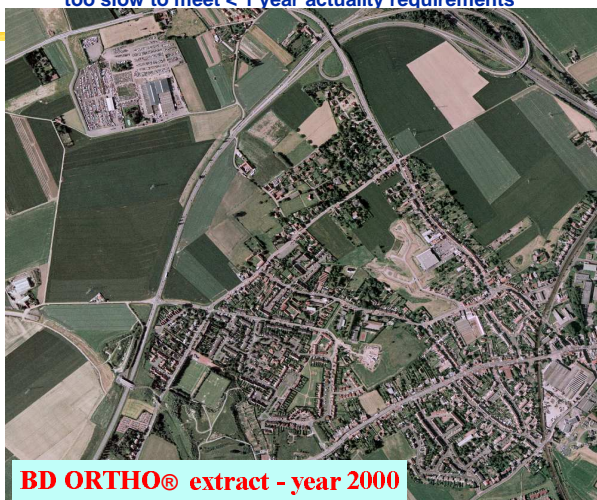
Other geographical infrastructure

- French Defence mapping programmes : IGN expertise & means as a support (2D & 3D)
- European directives & programmes (INSPIRE, GMES) : Pleiades to speed up harmonization and integration of national data infrastructure ?
- Partnership with local authorities : development & control of high quality 3D urban DB
- Export

Jean-Philippe CANTOU - IGN - 10 June 2008

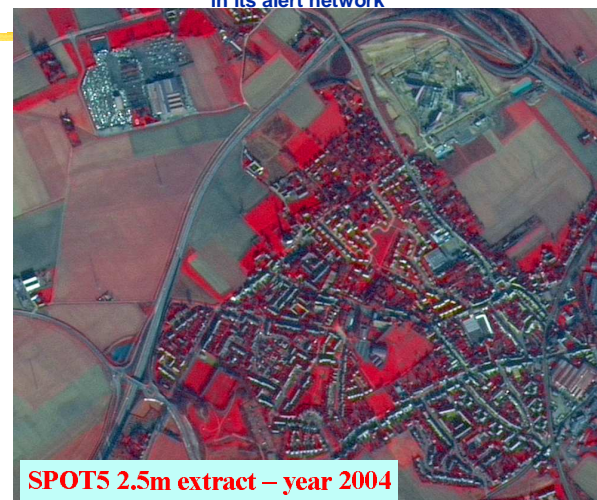
Page 12/41

In some evolving areas, the revisit cycle of aerial campaigns is too slow to meet < 1 year actuality requirements



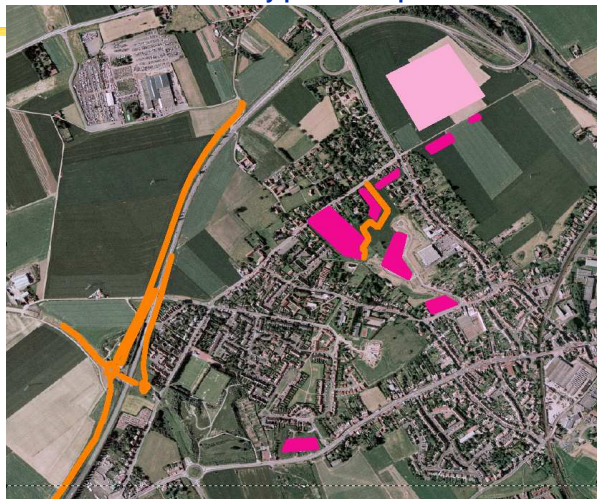
**BD ORTHO® extract - year 2000**

IGN has assessed Spot 5 / Formosat image potential in its alert network



**SPOT5 2.5m extract - year 2004**

Observed changes from Spot 5 images  
are identified by photo interpreters



The 3D topographic component is generated and updated  
by stereoplotting of 50 cm sampled aerial photographs



■ BD Topo ®

- 3D Vector Database
  - Metric accuracy
  - Topological data structure
- Landscape description
  - Networks
  - Woods / Forest
  - Built-up area
- Thematic information
  - Networks attributes
  - Admin boundaries
  - Footpaths
  - Place names





### 3D stereoplotting from Pleiades stereopairs ?

The legibility in evolving suburban areas shall be optimal

Pleiades last simulations 2008  
(zoom x 2)



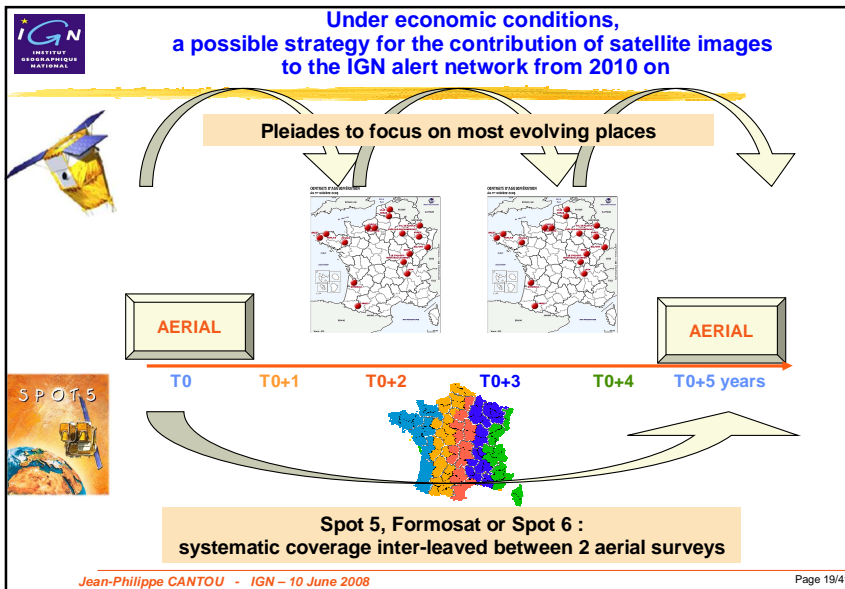
### Shall winter images help ?

... on going experimentation from Quickbird images over the Drôme département



28 Jan 2008  
Angle = 24°

Answer soon...



**IGN**  
INSTITUT GÉOGRAPHIQUE NATIONAL

**Potential contributions of Pleiades imagery to IGN activities**

National infrastructure (RGE)

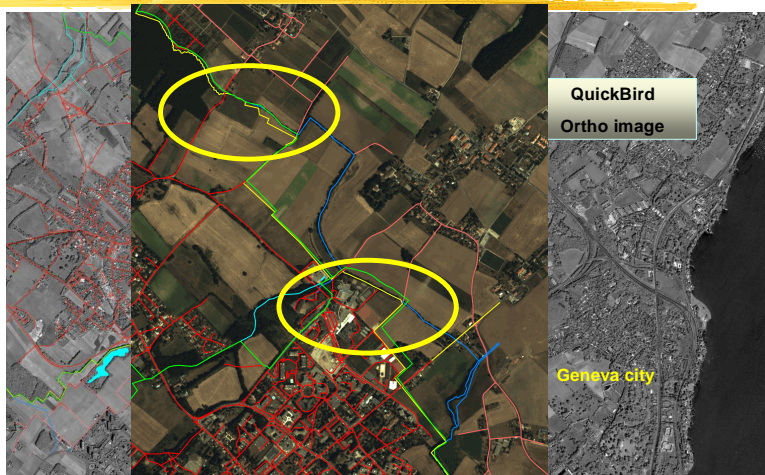
- **BD Ortho®** : Pleiades to ease a demand for increased aerial survey revisit
  - required product : a homogeneous geometry and radiometry per « french département »
  - observing conditions shall be constrained to keep image content close to 50 cm standards
- **BD Topo®** : Pleiades to help improving data actuality & completeness
  - a new data source in the IGN early warning network (terrain + Spot/Formosat data),
    - speed up the collection process of changes
    - winter images might help detect changes in forest or inaccessible areas
  - a potential input for data plotting with  $\leq 1.5$  m rms accuracy
  - an external source for checking operations before DB release

Other geographical infrastructure

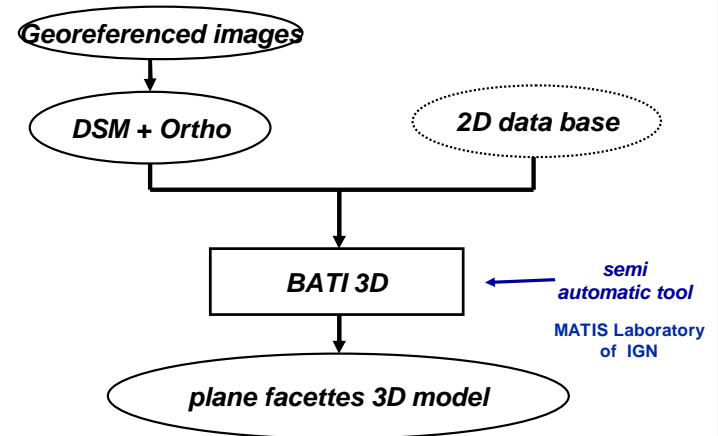
- French **Defence mapping** programmes : IGN expertise & means as a support (2D & 3D)
- **European directives & programmes** (INSPIRE, GMES) : Pleiades to speed up harmonization and integration of national data infrastructure ?
- Partnership with **local authorities** : development & control of high quality 3D urban DB
- **Export**

Jean-Philippe CANTOU - IGN - 10 June 2008 Page 20/41

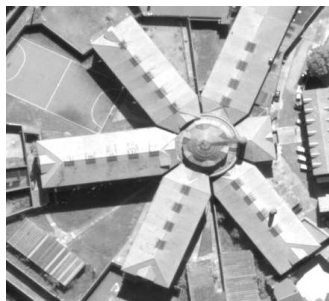
Pléiades orthoimages : a potential for checking 1m accuracy data base consistency in 2D along national borders



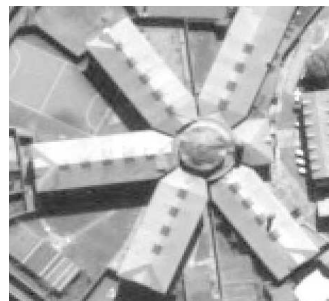
Methodology used to retrieve 3D shapes of buildings from Pleiades stereo pairs simulations



25 cm aerial images

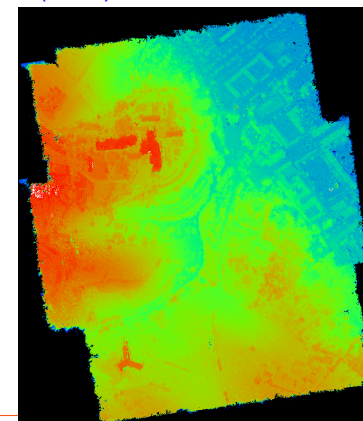
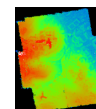
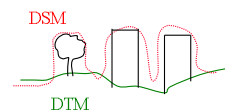


70 cm Pleiades simulations



■ Computation of a Digital Surface Model (DSM)

- Full automatic process with parameters
- Multi scale approach

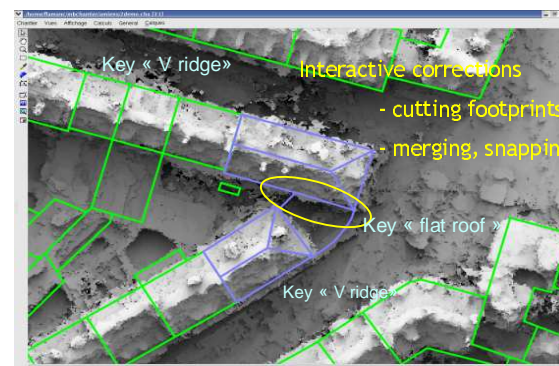


## First step : image matching

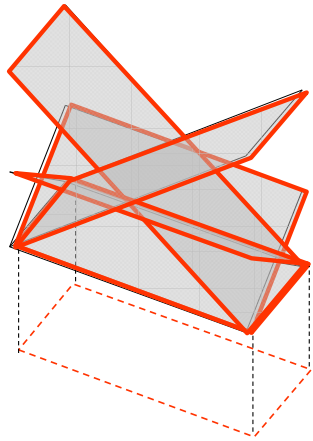
- Generation of a « true » ortho image



## User interface : 2D building footprints are drawn or modified from an existing cadastre



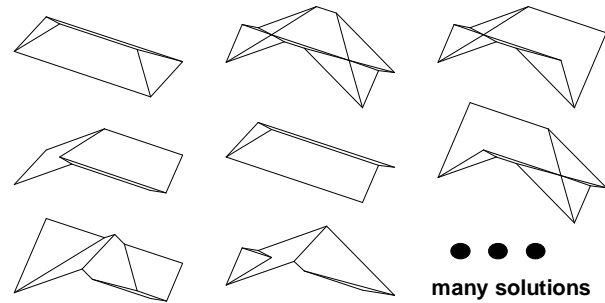
## Second step : search for probable planes



- Facades hypothesis
- Roof planes hypothesis
- Slope value

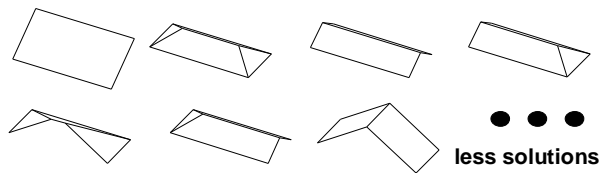
## Second step : probable roof solutions

- All planes are intersected into facettes



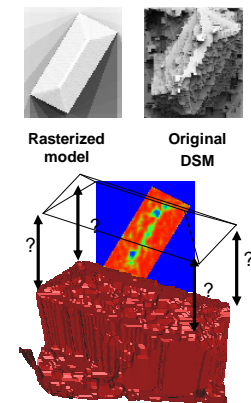
## Second step : probable roof solutions

- Filtering of solutions :
  - Surface of facettes > X m<sup>2</sup>
  - Angles > 10°
  - Each facette lays on a gutter segment



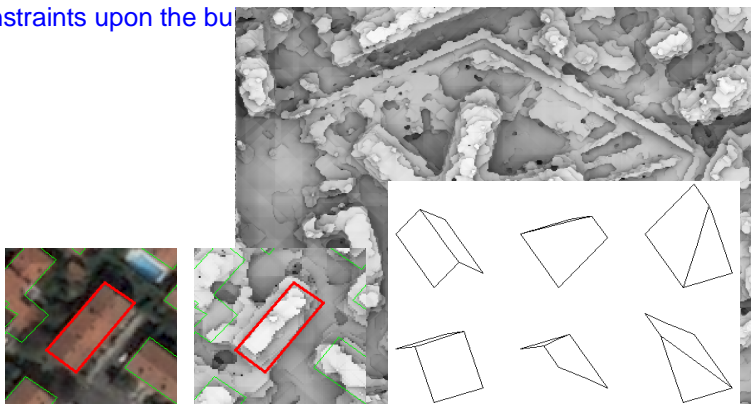
## Third step : search for the best roof model

- Each solution is compared to the original DSM by a matching process
- The chosen model is being assigned a computed gutter height and a roof slope.



Pleiades « low » image resolution requires to add up constraints to the algorithm

- « noisy » DEM
- constraints upon the bu



Combined view over Toulouse Hospital area :  
Pleiades orthoimage draped on DTM and 3D models





## Assessment – Toulouse Hospital area

- « Raster » assessment of height differences % reference
  - Mean : 0.2 m
  - Standard deviation : 1.3 m
- « Vector » assessment upon remarkable points

Toulouse Hosp area (pop : 1966 buildings)	X	Y	Z
Mean	-0,4	-0,1	0,5
Standard deviation	1,3	1,1	1,2

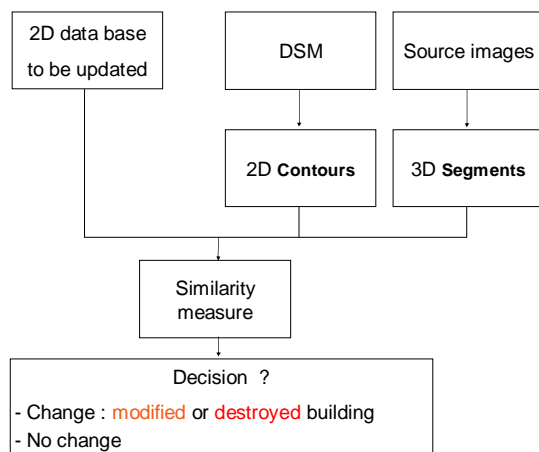
- Productivity : around 100 buildings / hour

## Automatic change detection from Pleiades stereo images : a new R&D axis started in 2007

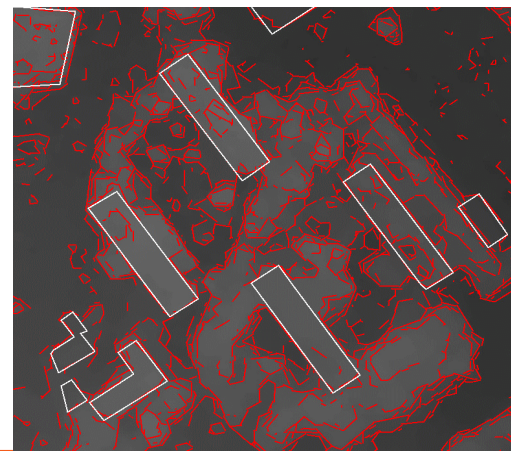
Simulation of a data base  
that shall be updated



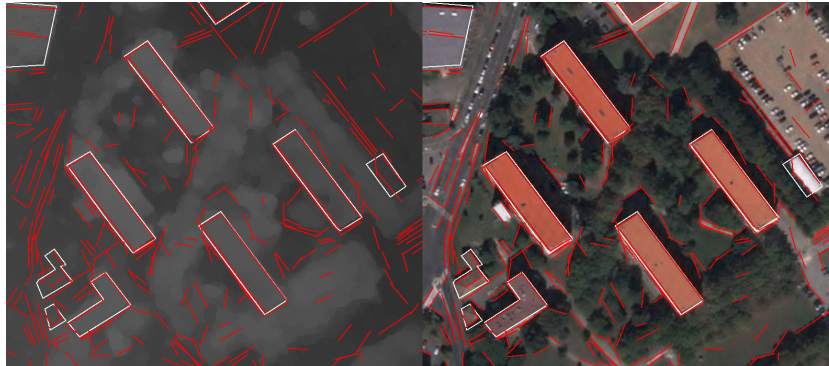
## Checking the old data base : a methodology oriented towards operational needs



## 2D contour retrieving

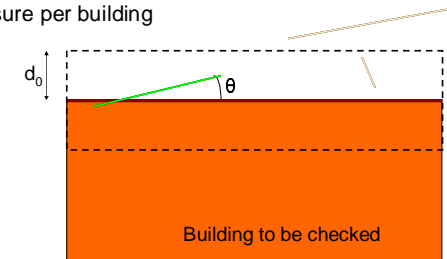


## 3D segments retrieving



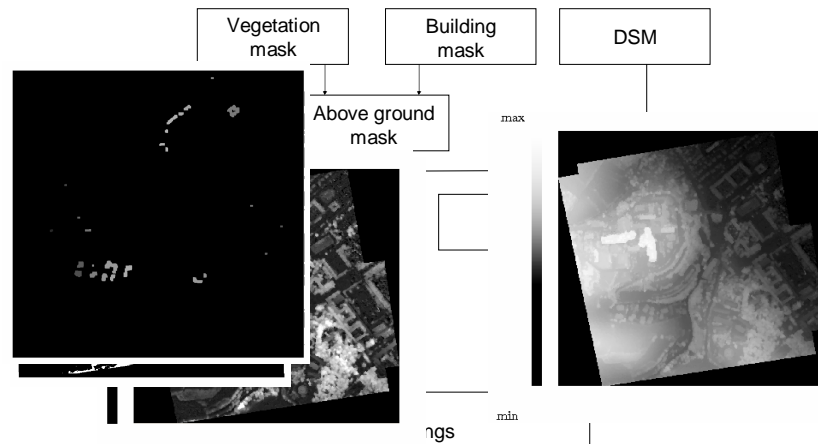
## Similarity measurement

- For each building edge, selection of 2D contours and 3D segments
- Calculation of a similarity measure per edge
- Calculation of a similarity measure per building



- Classification of each building according to the similarity threshold value
  - confirmed
  - modified
  - destroyed

## Detection of new buildings



## Automatic change detection from Pleiades : first conclusions

- The proposed method indeed allows change detection :
  - 97% of changes are detected (in green)
  - The percentage of the data base remaining to be checked is reduced (in yellow)



## Perspectives

- Thematic axis
  - Potential of winter acquired images
- Methodological axis
  - Automatic extraction of 2D footprints for further 3D reconstruction : R&D CNES-IGN 2007-08
- Economic axis
  - Discussion IGN – Spot Image – CNES for a guaranteed access to Pleiades resource over France
- Commissioning phase 2010 :
  - Many promises !