

Updating a National Spatial Data Infrastructure : How satellite imagery contributes in France ?

Jean-Philippe Cantou
IGN Espace

IGN France : key figures 2015



1 622 employees

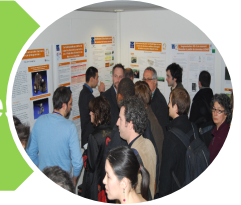


5 Inter-regional branch offices
(60 to 70 employees in each)



1 Aerial Survey Department

5 Research laboratories



1 Space Center
(IGN Espace, Toulouse, **80**
employees)



190 M€ budget
(2014)



IGN duties

Produce and update
the large scale reference NSDI

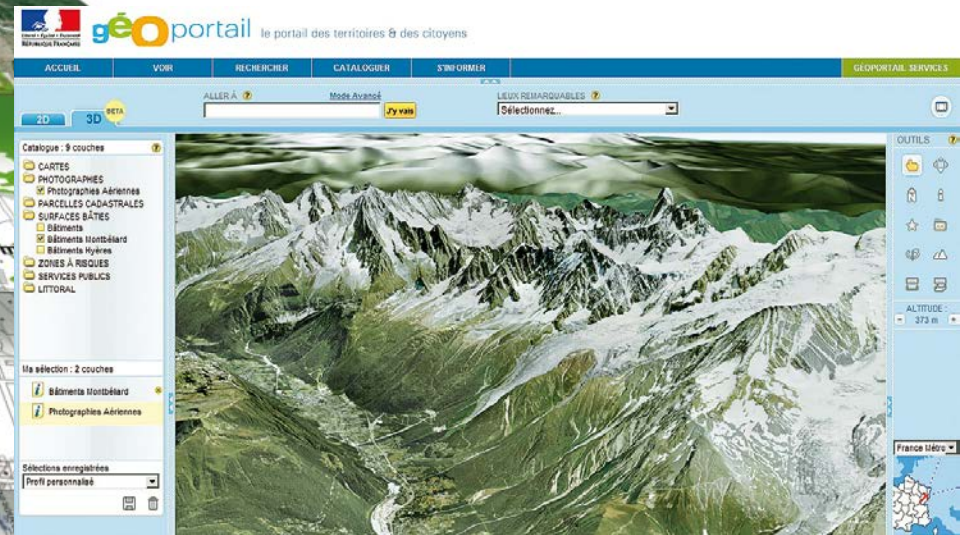
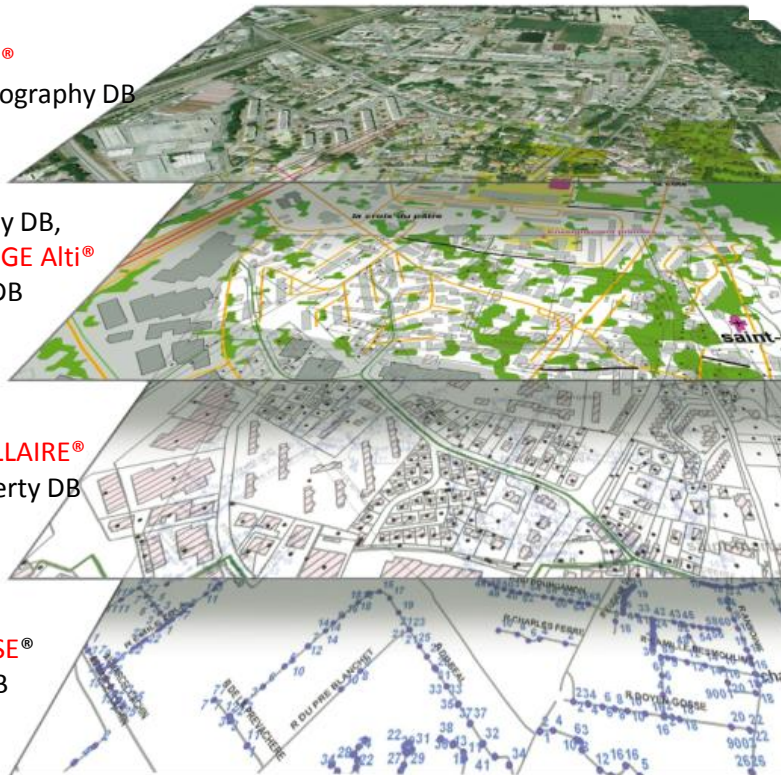
Manage the French Inspire portal

BD ORTHO®
Orthophotography DB

BD TOPO®
Topography DB,
including **RGE Alti®**
Altimetry DB

BD PARCELLAIRE®
Land property DB

BD ADRESSE®
Address DB



40 millions visits in 2014
<http://www.geoportail.fr>

CONTENT

Image demand : IGN is the national focal point for public bodies

Pléiades and SPOT image archive gathered since 2013

Product dissemination

Product experimentations / operational applications at IGN

SPOT 1.5 m images reveal rapid changes in infrastructure

LE PORTAIL IGN

< DETECTION DES CHANGEMENTS - BÊTA

Comparer SPOT 6 - 2014 Avec Photographies aériennes

34000 Montpellier

SPOT 2014

Aerial survey 2012



Attribution

Pléiades 50cm images reveal coastal changes due to hazards

Comparer Photographies aériennes Avec PLEIADES - 2014

**IGN systematic
aerial survey**
Summer 2012



*Atlantic
coast
north of
Bordeaux*

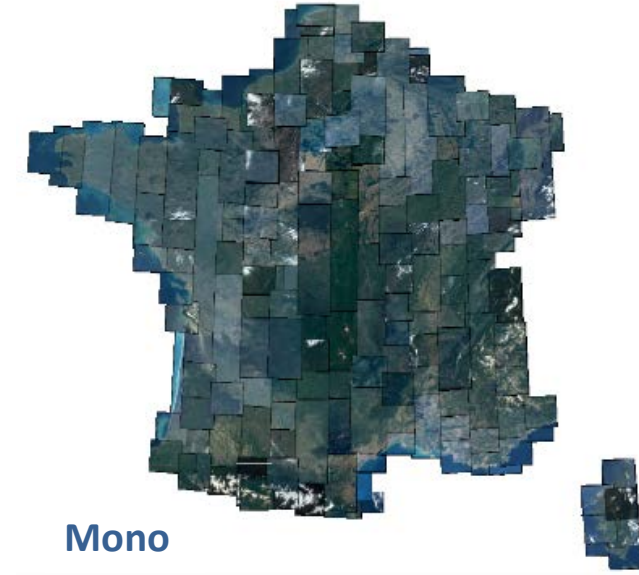
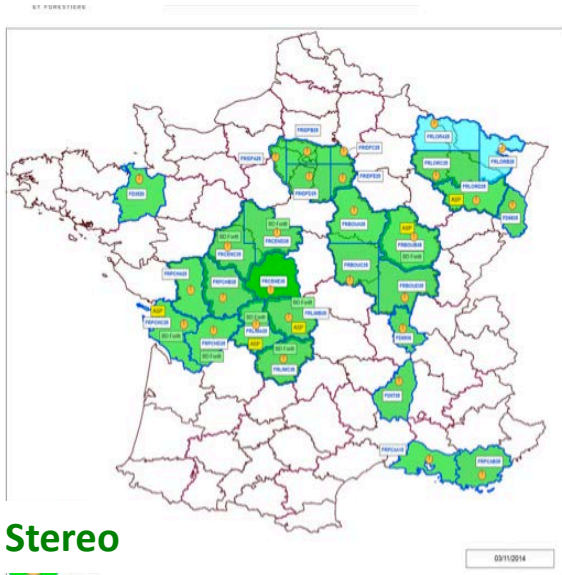
Pleiades
Spring 2014

2014 was the first hybrid acquisition plan

Aerial surveys

PLEIADES

SPOT 6-7



- **Aerial surveys**
 - Cover 30% of the national territory every year at 25 to 35 cm GSD → BD Ortho®
 - Update the national topographic data base → BD Topo®
- **SPOT 6-7**
 - Guaranty an annual coverage of the metropolitan territory to all public bodies / local authorities
 - Publish an entire seamless mosaic before the end of each year
- **PLEIADES**
 - Cover sensitive and urban areas every 1 or 2 years to speed up BD Topo® updating
 - Cover overseas regions every 3 years
 - Publish the georeferenced images as soon as processed

Pleiades targets covered in 2013 and 2014 and SPOT coverages of France since 2014 can be seen by all citizens and downloaded for free by public bodies

Suggestions 8 3

Saumur Y ALLER +

Résolution...

Remonter le temps 2D 3D

Rue

Pléiades 2014
50 cm

SPOT 2014
1.5 m

www.geoportail.gouv.fr

Echelle 1 : 3.385 0 100 m

Catalogue de données
Ma sélection de données

IGN
AIRBUS
cnes

CATALOGUE

SERVICES
PUBLICS

ENSEIGNEMENT
ET RECHERCHE

ENTREPRISES

SUPPORT
& CONTACTS

DOSSIERS
& ACTUALITÉS

TÉMOIGNAGES

RECHERCHE

ACCUEIL / CATALOGUE

CATALOGUE

IMPRIMER

ENVOYER

PARTAGER

Les cartes >>

■ Les ortho-images >>

BD ORTHO®

BD ORTHO® Historique

Ortho satellite

Les bases de données en
format vectoriel >>

Le parcellaire cadastral >>

Les modèles numériques
3D >>

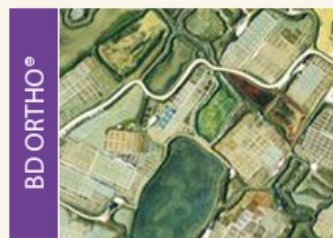
Les géoservices en ligne >>

L'offre de prestations >>

Mises à jour des données et
services >>

Les ortho-images

Des ortho-images riches dont le détail et la qualité géométrique en font un support de référence pour l'aménagement, la gestion et la valorisation du territoire.



BD ORTHO® >>

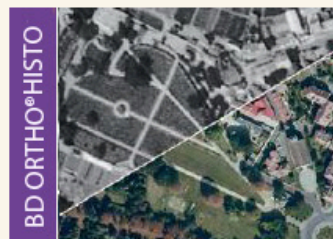
VOIR LE TERRITOIRE

L'image géographique du territoire national, la France vue du ciel.

→ ORTHO HR®

→ BD ORTHO® 50 cm → BD ORTHO® 2,5 m → BD ORTHO® 5 m

→ BD ORTHO® éd. anciennes → PVA

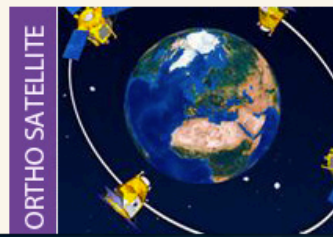


BD ORTHO® HISTORIQUE >>

IDENTIFIER LES ÉVOLUTIONS DU TERRITOIRE

La BD ORTHO® Historique permet de remonter le temps.

La France vue du ciel ... depuis 1945 !



ORTHO SATELLITE >>

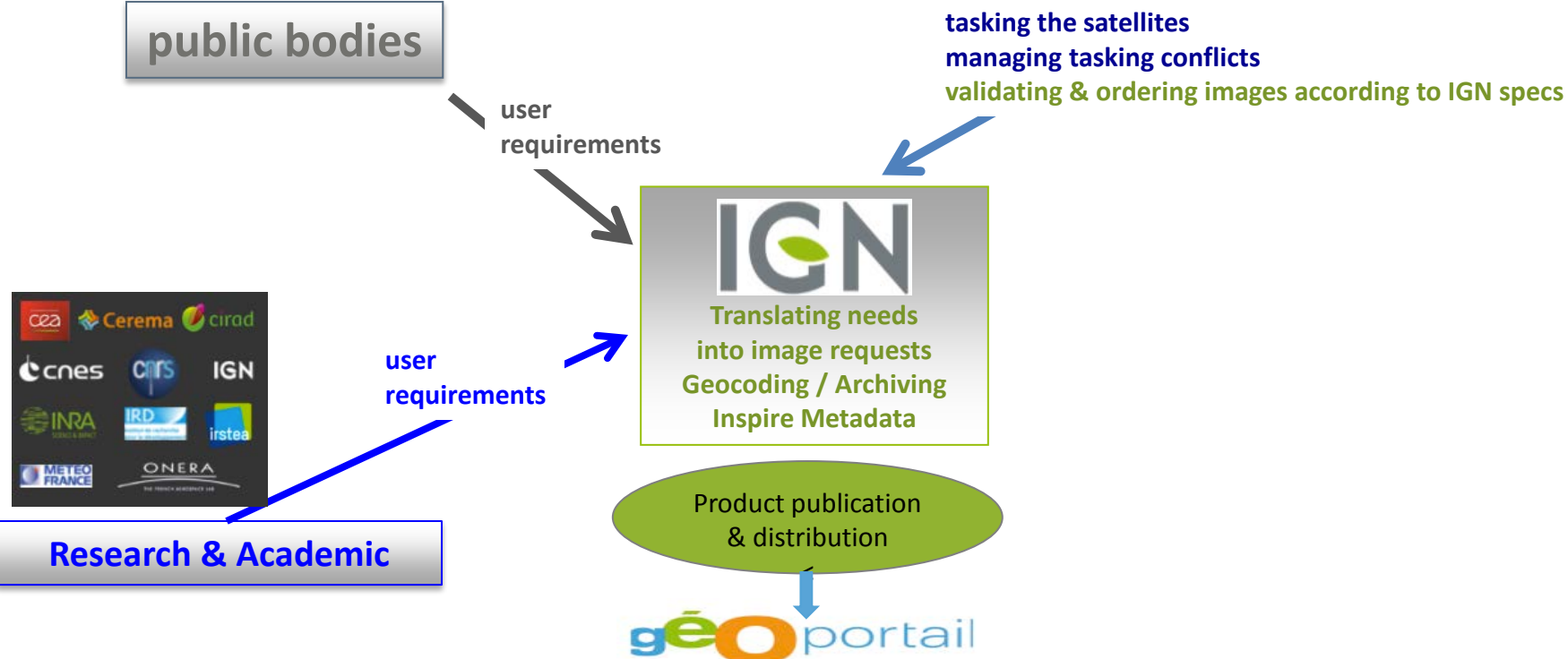
VOIR LE TERRITOIRE... PLUS SOUVENT !

Les ortho-images issues de prises de vues satellitaires sont complémentaires des données du RGE® et peuvent être mises à jour plus fréquemment.

Organization in France : optimize and share the satellite resource

images-satellites@ign.fr

IGN is the national contact point for Governmental and Local Authorities



Requests collection and processing

■ Process the requests

A unique contact point for public bodies : images-satellites@ign.fr

A unique contact point for researchers : <http://www.satelliteimageaccess.eu/>

■ Bring technical assistance

User requirements are refined

Suggestions : sensor , archive or tasking

■ Commitment to respect the license

Users shall :

- use the products within their public duties
- respect license conditions
- commit themselves to give feedback on the use



1 - ZONE D'INTERET GEOGRAPHIQUE	
NOM :	
SURFACE DE LA ZONE (en km²) : (fournir un shape)	
2 - UTILISATION	
ORGANISME DEMANDEUR	CONTACT
Nom :	Nom :
Adresse :	Tel :
.....	Mail :
APPLICATION VISÉE :	

4 – ENGAGEMENTS

En signant le présent acte d'engagement j'atteste que :

J'ai pris connaissance de la « **Licence d'Utilisation des Produits Pléiades aux Utilisateur Institutionnels Autorisés français** » - v1 jointe, et m'engage à en respecter les termes et conditions pour les produits décrits ci-dessus.

NB : la signature du présent document vaut signature de ladite licence

J'ai pris connaissance et accepte que la **responsabilité de l'IGN** ne saurait être engagée sur l'adéquation du (des) produit(s) livré(s) aux attentes de l'utilisateur ou sur l'aptitude à un usage spécifique. Par conséquent l'IGN ne saurait être tenu responsable d'aucun dommage direct ou indirect lié à l'utilisation ou la non-utilisation du (des) produit(s) livré(s).

Je m'engage à porter le logo IGN sur toute représentation graphique de ce produit géoréférencé.

Contracting & Financing

■ *Image acquisition*

○ Pleiades

- IGN signed a 2014-2016 supply contract with Airbus
- A budget amount was granted by the *Agence Nationale de la Recherche* to stimulate Pleiades use until 2017
- An IGN dedicated budget amount allows to meet requirements linked to NSDI updating



○ SPOT

- A consortium of 6 public bodies has committed itself to finance an annual coverage of the French territory for the coming years
- A specific SPOT receiving station has been set up in Montpellier

■ *From acquisition follow up to product dissemination*

- financed by IGN



Products

- **Ortho-image 16 bits 50cm**

- 4 spectral bands RGB NIR
- Applications: classification, interpretation, ...



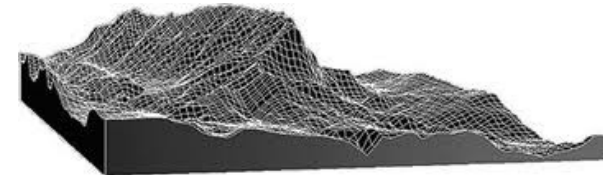
- **Ortho-image 8 bits 50cm**

- 3 spectral bands RGB (if needed : seamless mosaic)
- Applications: data capture, discovery



- **Image + geometric model fitted to NSDI**

- Standard format
- Applications: ortho from user's own DEM, image matching



- **Discovery service : National Geoportail** <http://geoportail.gouv.fr>
 - RGB Pléiades targets and SPOT seamless mosaics

- **Downloading service :** <http://professionnels.ign.fr/ortho-satellite>
 - Téléchargement des couvertures ortho RVB SPOT

- **Streaming service for use in GIS :** <http://professionnels.ign.fr/api-sig>

- **Specific portal for RS processing services :** <http://geosud.ign.fr>
 - Visualization of 4 spectral bands
 - Orthorectification
 - DEM generation

Access portal for discovery and RS processing services

GEOSUD

Se déplacer :

Recherche ▼
 Intervalle temporel :
 Du Au
 Zone de recherche :

 Satellite : Pléiades Spot

Résultats 15

Co-visualiser
 Masquer les emprises Masquer les couches

Position	Date	Actions
Niort	2013-09-22	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Niort	2013-09-22	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Dolus-d'Oleron	2013-07-06	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
LasTouches-de-Perigny	2013-06-16	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Aulnay	2013-07-31	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Cherac	2013-06-16	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Bernay-Saint-Martin	2013-07-31	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Chives	2013-07-31	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Aytre	2013-07-11	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
LaTremblade	2013-07-11	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Dolus-d'Oleron	2013-07-06	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Nere	2013-07-25	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Marans	2013-07-11	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Clerac	2013-07-18	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Benon	2013-06-04	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>

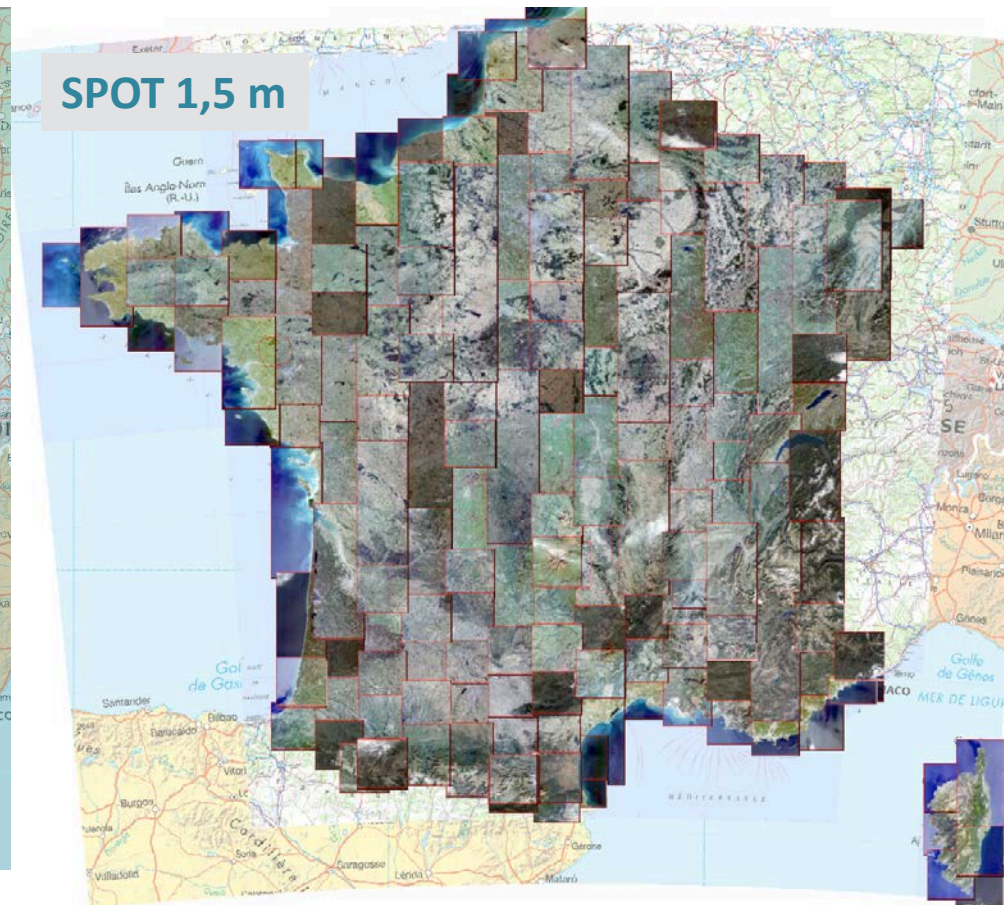
« 1 / 2 »

Conditions générales d'utilisation

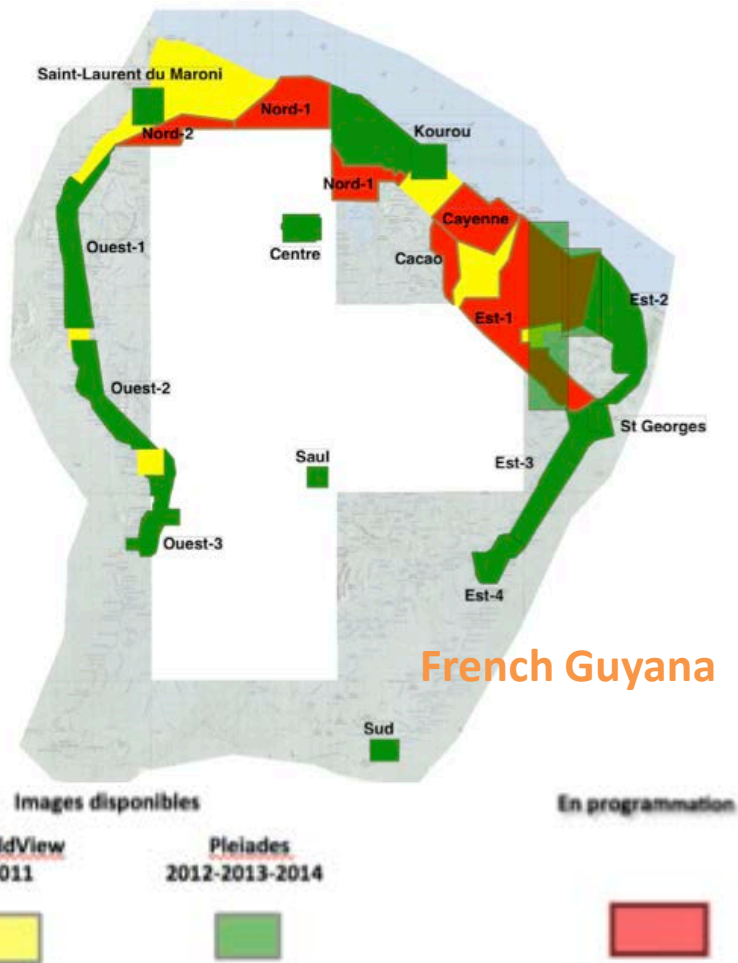
Satellite programme 2015 over metropolitan France

3D topographic data capture : 2 high speed train lines, 10 towns
Annual coverage of coasts subject to erosion

Metropolitan France annual coverage
A base for land monitoring projects



Overseas territories : covered by **Pleiades** in 2013-2014



Guadeloupe



Mayotte



Martinique



Réunion

French Guyana : IGN produces cloudfree seamless mosaics for local authorities

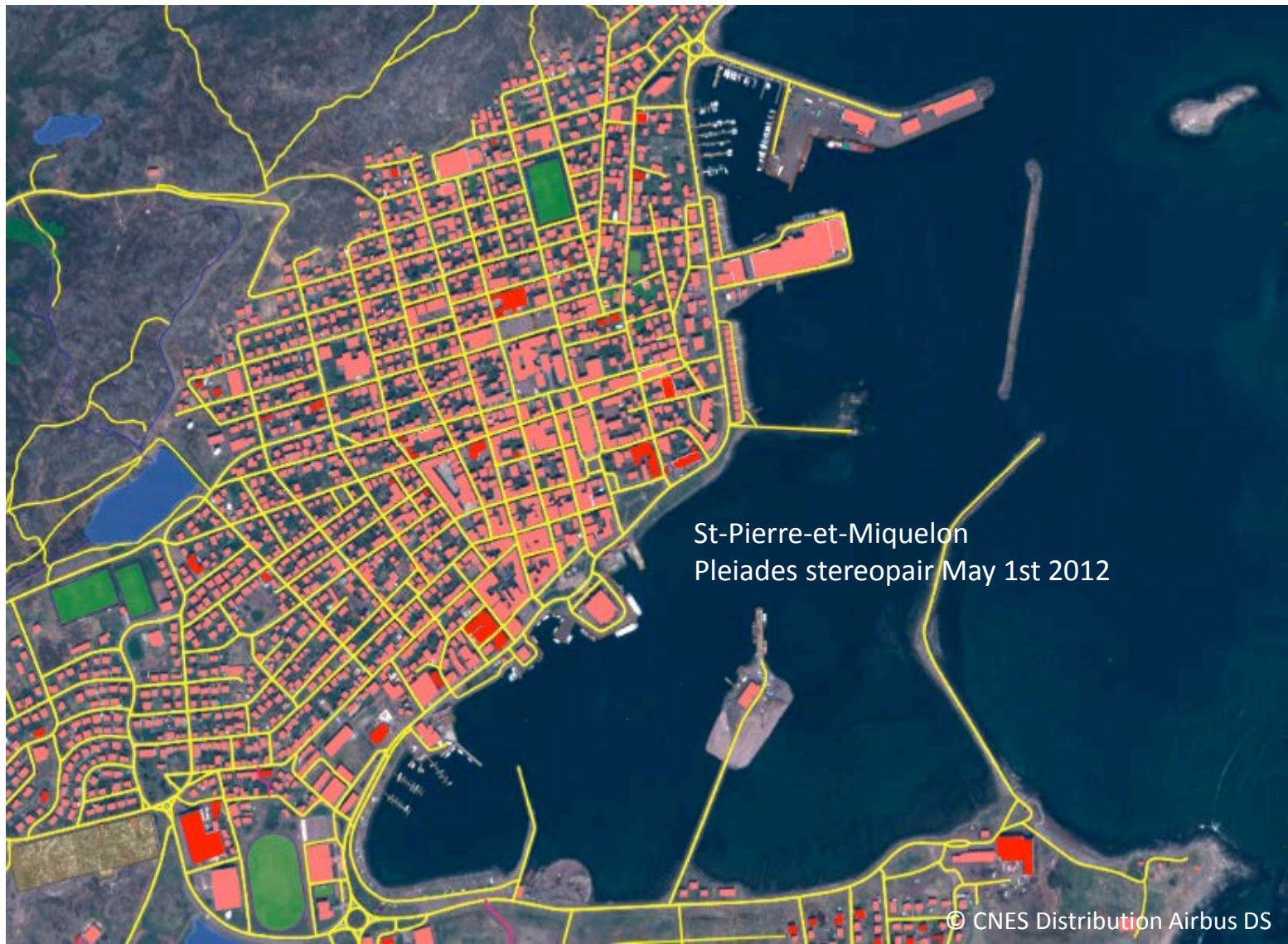


Best image among 3



Cloudfree patchwork

1. BD Topo® updating :
are retrieved 3D vector data from Pleiades stereo
compliant with data base specifications ?

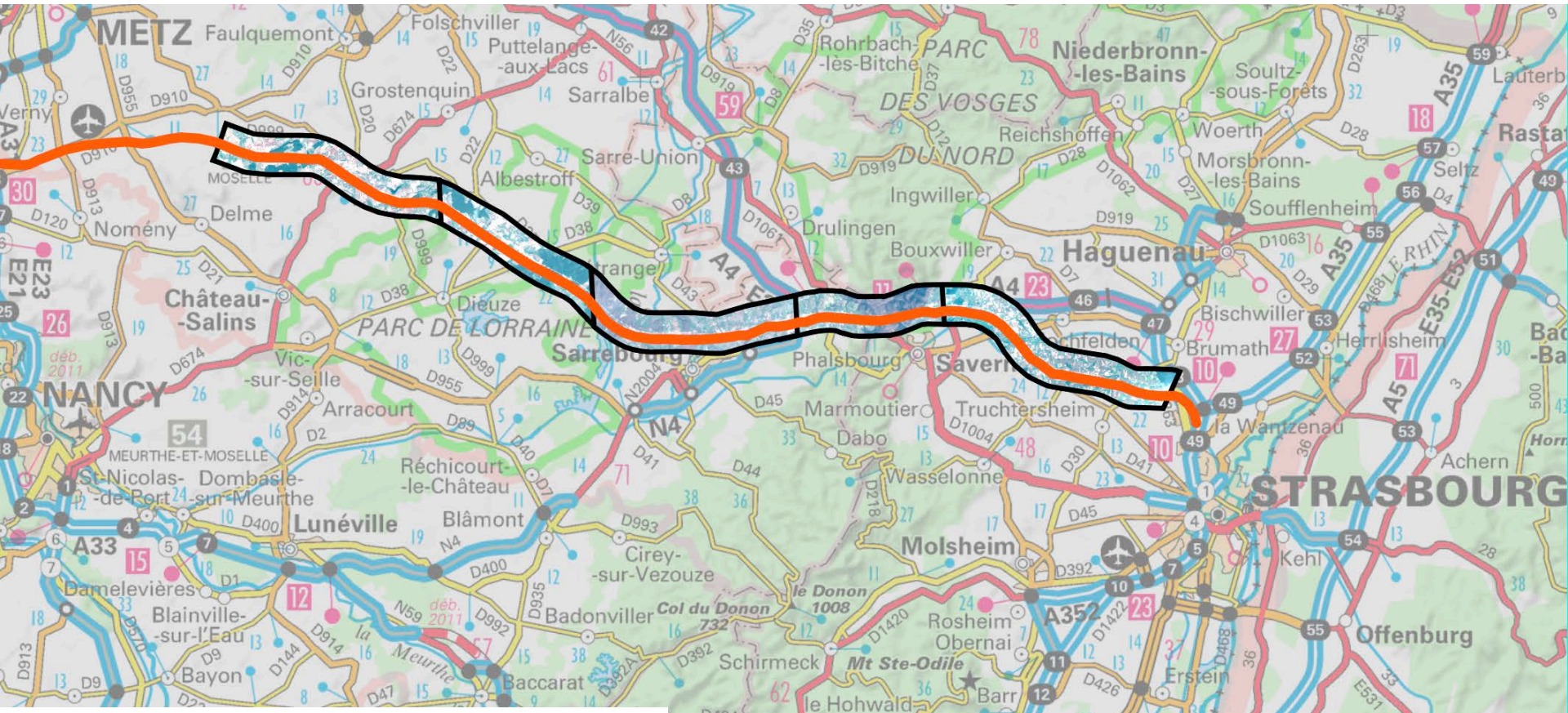


St-Pierre-et-Miquelon
Pleiades stereopair May 1st 2012

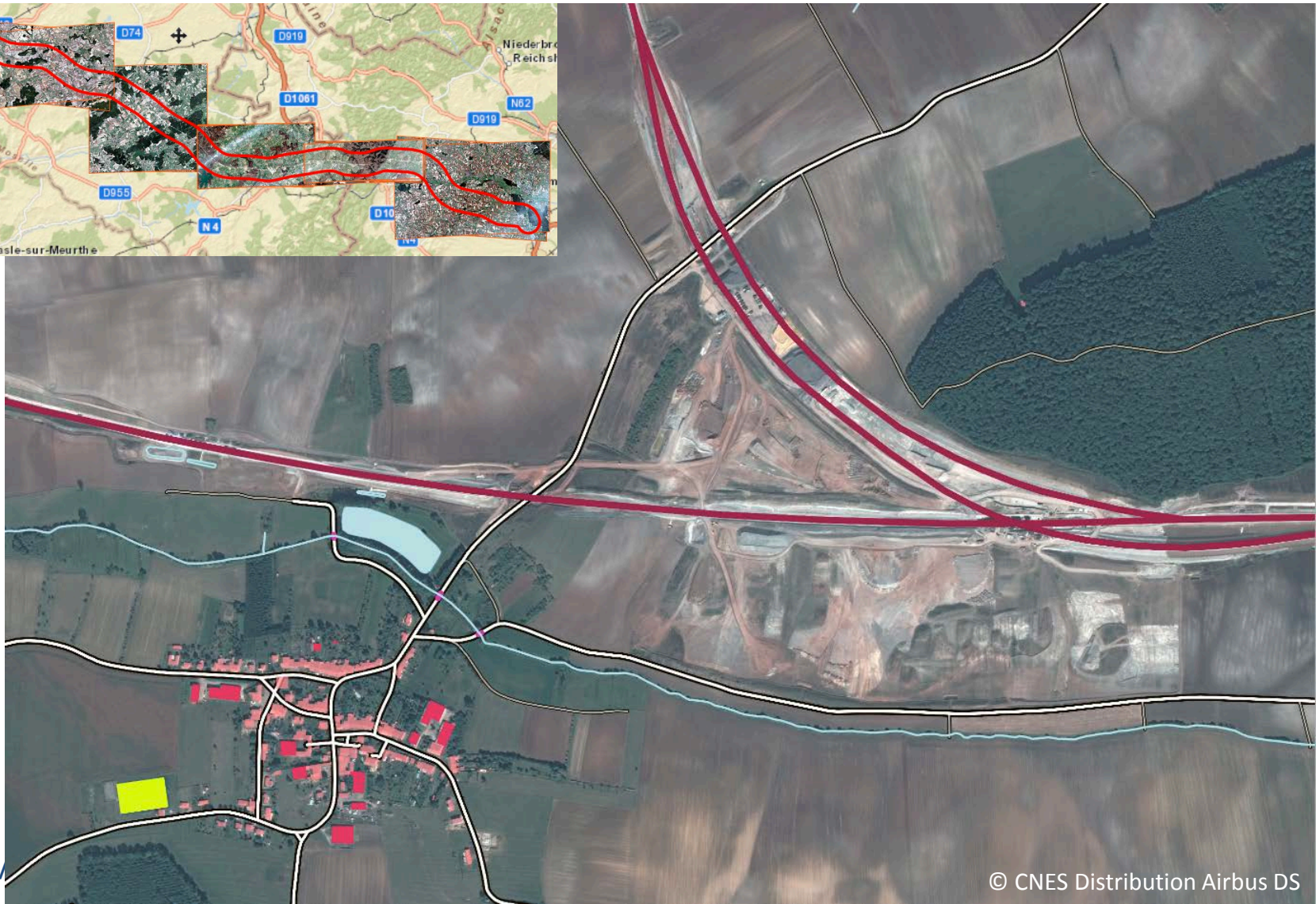
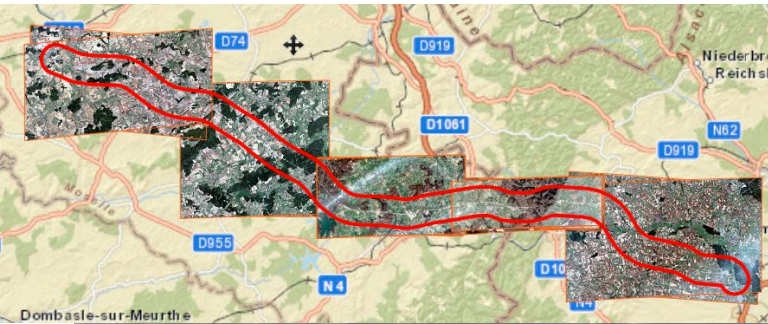
1. BD Topo® updating along a High Speed Railway under construction

■ Railway *Nancy-Strasbourg*

- "ribbon" of 100 km x 5 km to be covered by **Pleiades** in stereoscopic mode



1. BD Topo® updating along a High Speed Railway under construction



1. BD Topo® updating : results and recommendations

■ Processing and data capture

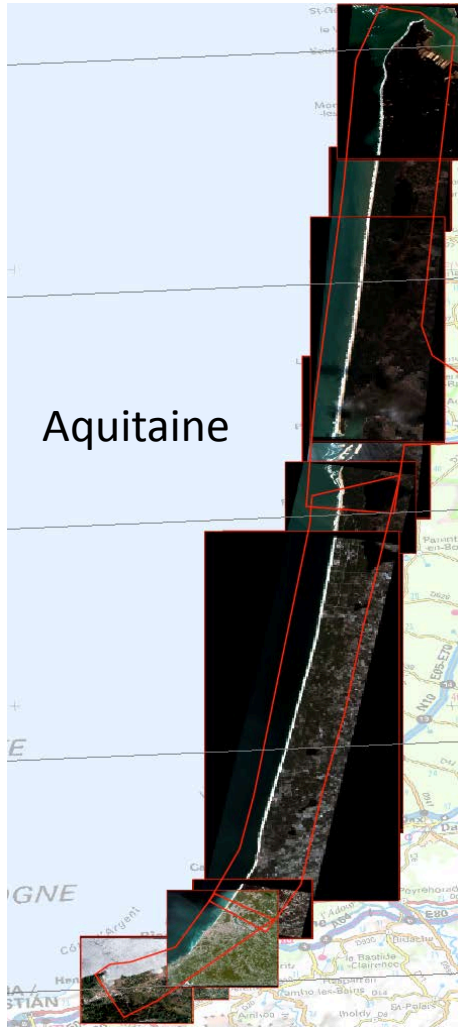


- Pleiades stereo pairs : B/H ratio recommended from 0.5 to 1
- Features retrieved in 3D : railway axis, secondary network, hydrography

■ Results

- Processing duration correct
- XYZ accuracy assessed against ground control and geodetic points : better than 1 m, matching BD Topo® specifications
- Visual comfort is suitable, with slight preference for colour to B&W
- Drawback : no possibility to see the objects from several angles of view
- Advantage : a large coverage (up to 20x21 km) which reduces switches between several photo pairs
- Vectors obtained have been integrated into the BD Topo® data base

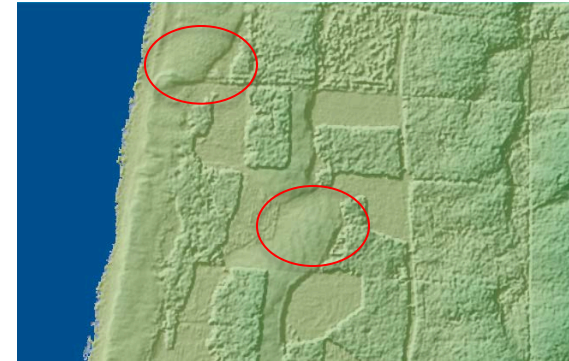
2. Coastal erosion : assessment of height accuracy in Pleiades derived DSM/DEM



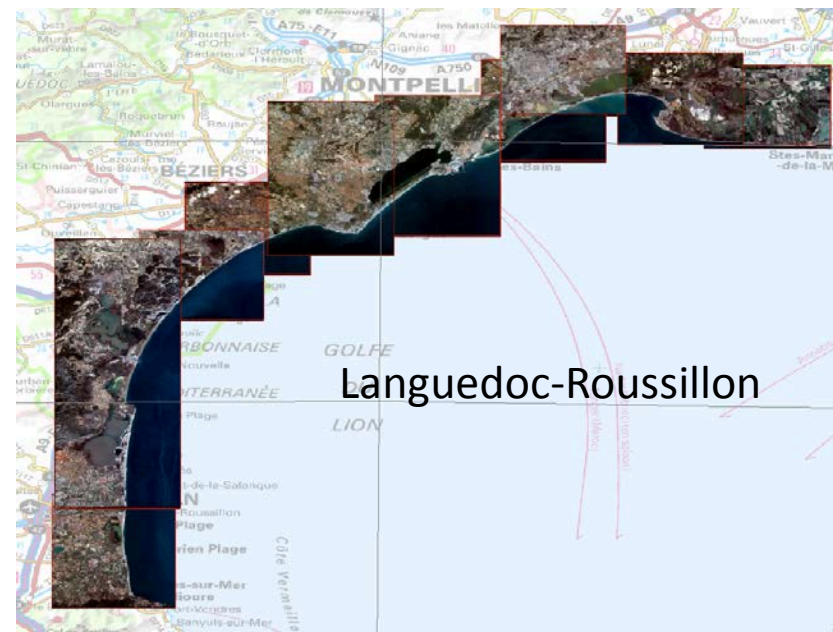
DSM Lidar 2011



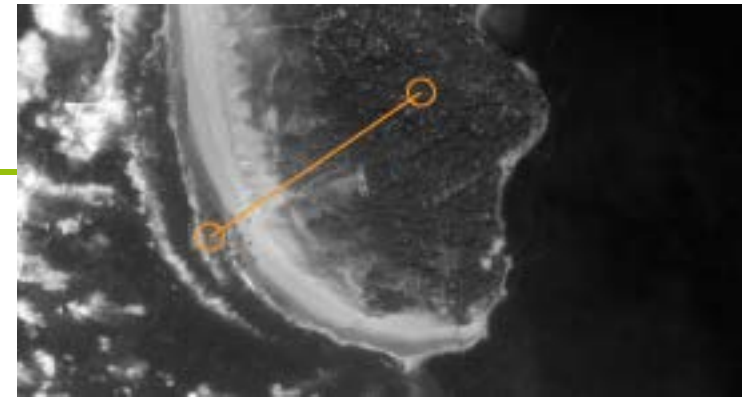
DSM Pleiades 2013



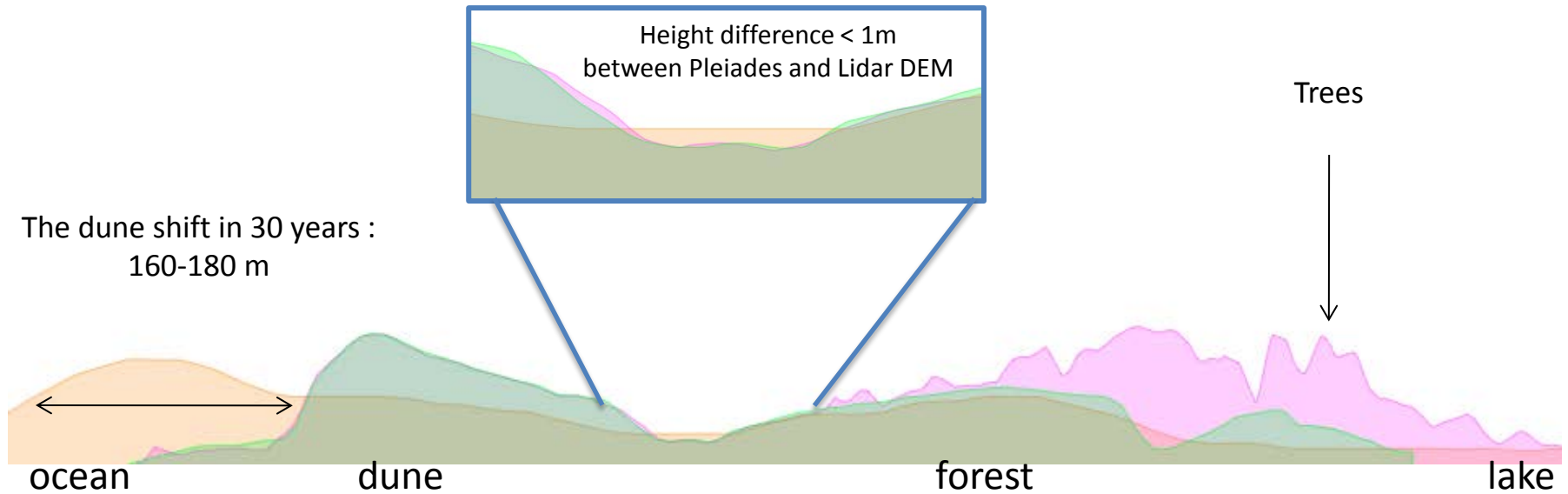
In areas with no vegetation, the 2 DSM look similar



Cap-Ferret (Atlantic) : Evolution of dune shape



Pleiades **march 2014**
aerial Lidar **october 2014**
BD Alti® **1980's**



3. DTM generation over high mountains

- **Purpose of the study**

- Generate DTM in mountainous areas where existing BD Alti® data base is less accurate
- Test area Corsica (Bavella) :
 - 3 pairs were acquired on the same area :
 - 2 with 20° roll angle but with 26 days interval
 - One with low roll angle later

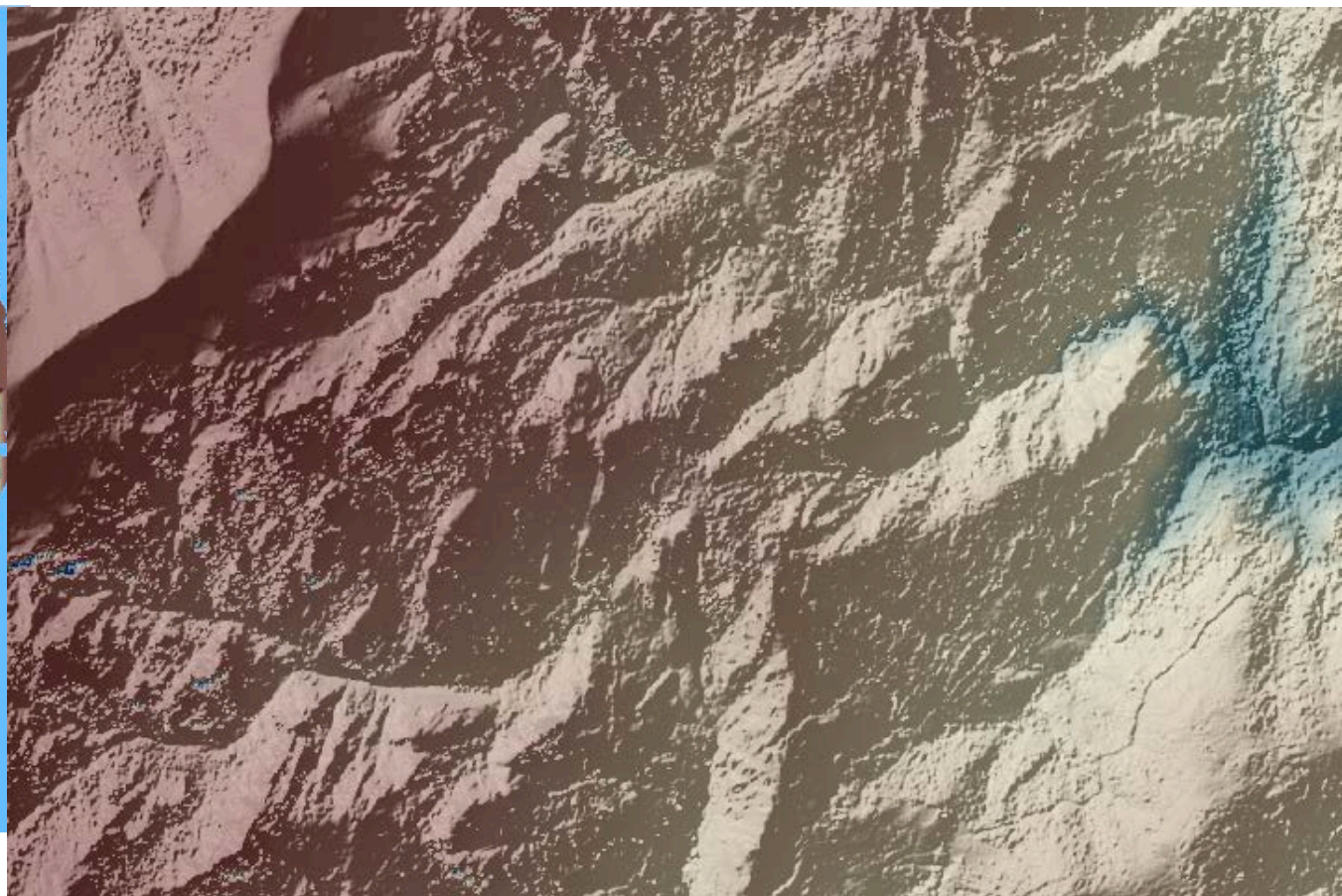


- **Methodology**

- Geometric modelling of images
- DSM production
- Transformation DSM => DTM (existing production line)
- Comparison with :
 - BD ALTI® accuracy > 6 m
 - INTERMAP (radar data) accuracy about 7 m
 - Qualified points xyz (geodetic, networks) submetric accuracy

Comparison of Pleiades and SPOT6 DSM over Corsica

SPOT6 DSM (6m)



4. Generation of an artificial land layer from SPOT 6/7





- **Context** : IGN is producing a large scale land use and cover map with a slow updating cycle
- **Between 2 versions** a simplified land use map is produced annually from SPOT 6/7 coverage
- **The objective** is to follow the degradation of agricultural land (determination of artificialization index)
- **2 products** are experimented :
 - a 6 classes map
 - a binary map



Spot 6 image, april 2013

A hybrid processing line

- Use of IGN and external databases as input
- Investigation focussed on the **fringe agri/urban**

-  Agricultural plots (PAC declarations by farmers)
-  Houses
-  Roads
-  Not investigated

- > Use of automatic segmentation tools










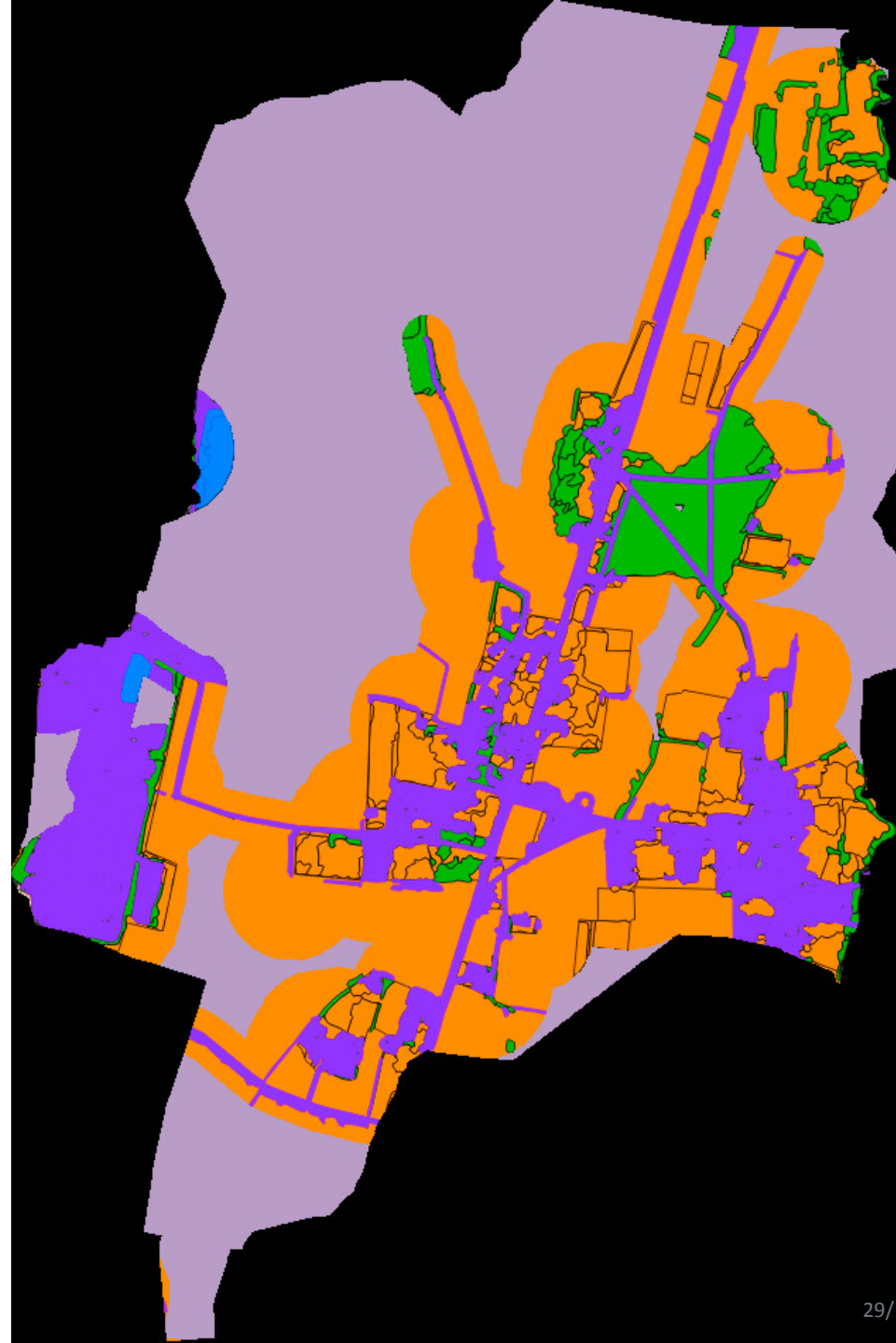
A hybrid processing line

> Computer assisted labelling of plots to be classified

> Simplified land use maps with 6 classes (merging of databases and labelling)

Nomenclature

	Artificialized land
	Natural environment
	Crops
	Forest / hedges
	Lakes / rivers
	Unknown but not artificialized
	Not processed



Conclusion : present uses of satellite imagery by IGN France



■ as a complementary source to aerial photography

- **Pleiades** (BD Ortho®) : speed up the frequency of observation (coasts, towns, overseas) *(operational)*
- **SPOT** (annual revisit) : point out changes in land cover / land use anywhere *(operational)*
- **Pleiades** (civil protection) : emergency response *(experimented)*
(floodings, forest fires and storm damages,...)

■ as a substitute to aerial photography

- **Pleiades** (BD Topo® updating) : 3D stereo plotting of urban and infrastructure features *(operational)*
- **Pleiades** height measurement (RGE Alti®) : DTM generation over high mountains *(to be implemented)*
- **SPOT** (annual revisit) : measuring the urban sprawl *(under development)*
- **Pleiades** (BD Forêt® updating) : 2D classification of forest species *(to be experimented)*

Challenge : How can European and National image coverage programmes cooperate ?

 *Optical VHR Pan Europe coverages* 

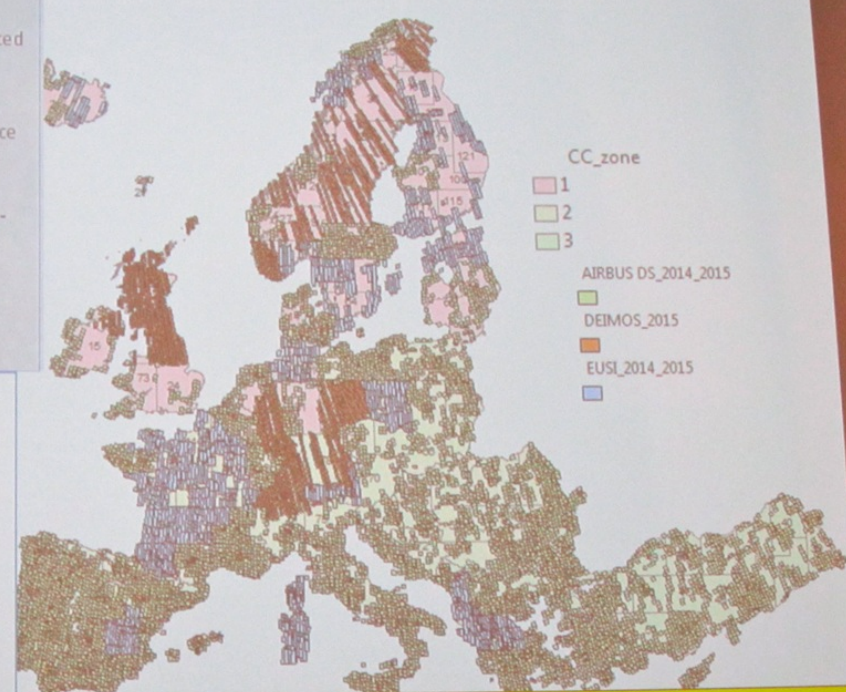
Optical Very High Resolution (VHR) multispectral and panchromatic coverage over Europe: One coverage of 39 European states and the French Overseas Departments. Such coverages are generated every 3 years (reference years 2012, 2015 and potentially 2018)

Acquisition windows only applicable as of reference year 2015, corresponding to the vegetation season as predefined by the National Reference Centres of each country https://www.eionet.europa.eu/ldap-roles/?role_id=eionet-nrc

Resolution: 1-4m

Dataset IDs: VHR_IMAGE_2015, DWH_MG2_CORE_03

- Europe in 137 large regions
- 3 data providers, 6 missions: Pléiades, Deimos-2, Dubaisat-2, WorldView-2, WorldView-3 and GeoEye-1
- **After 2 years, about 2/3 of Europe is covered cloud-free**
- Data delivery to CDS archive started; access will be open before end October 2015



2015: Selection required by EEA to start production!