High resolution satellite imagery
a shared and collective data source

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IGN France
IGN duties

Produce and update the large scale reference NSDI

- **BD ORTHO®**
  Orthophotography DB

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

- **BD PARCELLAIRE®**
  Land property DB

- **BD ADRESSE®**
  Address DB

Manage the French geoportal

- 50 millions visits in 2017
  - [http://www.geoportail.fr](http://www.geoportail.fr)
IGN Espace is the IGN expertise and production centre dedicated to the geometric processing of image satellites to the benefit of the institutional and economic sectors in France.

Keep such technical capabilities update requires to:

- **Lead a technology watch** on satellite missions / sensors suited to topographic mapping in 2D/3D and at various scales

- **Be able to qualify external topographic data sources** or produce them when required (i.e. Digital Elevation Models)

- **Benchmark and implement innovative processing methods**, in particular to deal with the increasing amount of data volume
1. Satellite images, what for?
   Basically Defence, Agriculture and Environment (Copernicus) are presently the main consuming sectors

2. Access to High Resolution images by French users
   A national data infrastructure has been designed to ease product understanding and use in GIS

3. Some applications using High Resolution images, including for statistical purposes
**Sentinel 2 sensors (ESA - Copernicus)**

Swath: 290 km  
Resolution: 10 - 60 m
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Swath: 290 km
Resolution: 10 - 60 m

Marseilles city
**SPOT 6/7** sensors (Airbus Defence and Space)

Swath: 60 km  
Resolution: 2 – 8 m
PLEIADES sensors (Airbus Defence and Space)

Swath: 20 km
Resolution: 0.5 - 2m
The technical choice of a sensor will depend on the map scale, with some thresholds linked to the information details to be retrieved from the images.

- **Aerial survey multiple views**
- **3D models**
  - 1:5 – 1:1,000
- **City map**
  - 1:12,5 – 1:5,000
- **Topo map**
  - 1:50 – 1:25,000
- **Middle scale map**
  - 1:250 – 1:100,000

- **Aerial 30-50 cm**
  - Worldview 2-3-4
  - Geoeye1
- **Pléiades**
  - SPOT 6/7
- **SPOT 5**
  - RapidEye
- **Sentinel 2**

Pixel (m)

- 0.30
- 0.60
- 3.00
- 10.00
1 : 200 000 topomaps of SENEGAL were updated using SPOT 5 images.
Copernicus is a long term EU programme designed to monitor slow and rapid environmental changes, in the range of small to medium scale mapping. Access to images and core services is free and open.

- **Sentinel 1** – radar imaging
  All weather, day/night applications

- **Sentinel 2** – Optical imaging
  Land applications: urban, forest, agriculture,..

- **Sentinel 3+6** – Ocean and global land monitoring, high precision ocean altimetry

- **Sentinel 4+5** – Atmosphere composition monitoring, from a geostationary (-4) and a polar orbit (-5)

13 spectral bands
Resolutions from 10 m to 60 m
Location accuracy 12 m
Revisit 5 days (2 satellites)

**EEA**
Land monitoring – pan European & local In-situ coordination

**ECMWF**
Atmosphere monitoring
Climate change

**Mercator Ocean**
Marine Environment monitoring

**FRONTEX**
Security – Border Surveillance

**EMSA**
Security – Maritime Surveillance

**SatCen**
Security – Support to External Actions

**Sentinel 2A (2015)**
**Sentinel 2B (2016)**
# Use of satellite imagery in agriculture

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Revisit</th>
<th>Application</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 m – 1 km</td>
<td>Daily</td>
<td>Global crop production trends</td>
<td>Not crop specific, difficult to separate area and phenology</td>
</tr>
<tr>
<td>10-30 m</td>
<td>Weekly</td>
<td>Crop area, crop type, phenology, crop diversity/rotation</td>
<td>Requires massive data processing, globally consistent methodology</td>
</tr>
<tr>
<td>Free &amp; Open</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5-5 m</td>
<td>On demand</td>
<td>Area measurement, detailed measures, precision farming</td>
<td>Costly, on sample basis only</td>
</tr>
<tr>
<td>Commercial, but plenty choice</td>
<td></td>
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</table>
COPERNICUS and Agriculture: a win–win context

The MARS programme (Monitoring Agriculture by Remote Sensing) maintains since 1990 an efficient network of key players.

LPIS (Land parcel information system) are updated in the 28 Member States.

The FEOGA programme uses VHR imagery to control the eligibility of subsidies requested by farmers.

The research programmes of the EU (FP7 and H2020) support innovation and help integration of Remote Sensing as a tool for implementing and checking the measures taken by the Common Agriculture Policy.

Apart from the Sentinel missions, ESA purchases commercial images from a various panel of satellite operators in order to better feed the Copernicus services.
The Copernicus Contributing Missions are divided into five Mission Groups, based upon the mission type (SAR/Optical /Atmospheric) and, for the Optical missions, per resolution class. The table below defines the groups and provides access to more information on each mission:

<table>
<thead>
<tr>
<th>Mission Group 1 - SAR VHR1-1R1</th>
<th>Mission Group 2b - Optical VHR1/2</th>
<th>Mission Group 2 - Optical HR1/2</th>
<th>Mission Group 3 - Optical MR1/2</th>
<th>Mission Group 4/5 - Atmospheric missions</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALOS-PALSAR</td>
<td>AURIGA</td>
<td>ALOS/AVNIR-2*</td>
<td>Proba-V</td>
<td>ERS*</td>
<td>Cryosat*</td>
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<tr>
<td>COSMO-SkyMed</td>
<td>BLACKSKY Constellation</td>
<td>DEIMOS-1</td>
<td>ResourceSat-1/</td>
<td>ResourceSat-2</td>
<td></td>
</tr>
<tr>
<td>Envisat*</td>
<td>DEIMOS-2</td>
<td>INGENIO</td>
<td>OceanSat-2*</td>
<td></td>
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</tr>
<tr>
<td>ERS*</td>
<td>Dubtanet-2</td>
<td>LandSat-7/LandSat-6</td>
<td>PERSEUS</td>
<td></td>
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<tr>
<td>Kompsat-5</td>
<td>GeoEye-1</td>
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<td>PAZ</td>
<td>INGENIO</td>
<td>Proba</td>
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<td>RADARSAT-2</td>
<td>IRS-P3/Cartosat</td>
<td>RapidEye Constellation</td>
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<td>RISAT-1</td>
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<td>ResourceSat-1/</td>
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<td>TerraSAR-X, TanDEM-X</td>
<td>KHALIFASAT</td>
<td>SPOT-4, SPOT-5, SPOT-6/7</td>
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<tr>
<td>Kompsat-2</td>
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<td>Pleides-1A/1B</td>
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<td>QuickBird-2</td>
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<tr>
<td>SPOT-5, SPOT-6/7</td>
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<tr>
<td>SkySat</td>
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*Supplied by ESA

VHR 2015 : ESA purchased a EU39 coverage at 50cm resolution
In France, a space data infrastructure was set up in 2011 by several public bodies in order to supply and disseminate HR and VHR commercial images to land planners.

RapidEye 5m

SPOT 5 2.5m

SPOT 6-7 1.5m

geometric and radiometric processing
IGN is the national contact point for collecting requests from Governmental and Local Authorities

Institutional partnership help share the satellite resource, bear license costs and disseminate data ready for use in GIS

Public bodies
images-satellites@ign.fr

Tasking the satellites
managing tasking conflicts
validating & ordering images according to IGN specs

Research & Academic
http://www.satelliteimageaccess.eu/

Translating needs
into image requests
Geocoding / Archiving
Inspire Metadata

Product publication & distribution
Since 2014, IGN has been acquiring and processing **PLEIADES** and **SPOT** data over metropolitan France in order to speed up the revisit of the areas subject to change.
IGN uses **PLEIADES** image stereo pairs as a complementary source to aerial surveys in order to update the national BD Topo® data base.
Some 3D applications require an operator-handled capture of buildings according to a detailed modelization of roofs
2D applications may take advantage from a **Digital Surface Model (DSM)**, a product that can be automatically retrieved from simultaneous observations.
Image and DSM layers are used as inputs in a classification process, so as to retrieve information about the height of buildings.
Built layer extraction with height

South East
Bordeaux Métropolis

Haight (m)
Housing floor surfaces indicator

South East
Bordeaux Métropolis

Floor surfaces (m²)

0 - 2500
2500 - 6500
6500 - 13000
13000 - 24500
24500 - 48000
48000 - 92500
92500 - 692000

Geometry: Urban Atlas
Several proofs of concepts show that VHR satellite images can help in the assessment and definition of urban planning policies.
Thank you for your attention

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