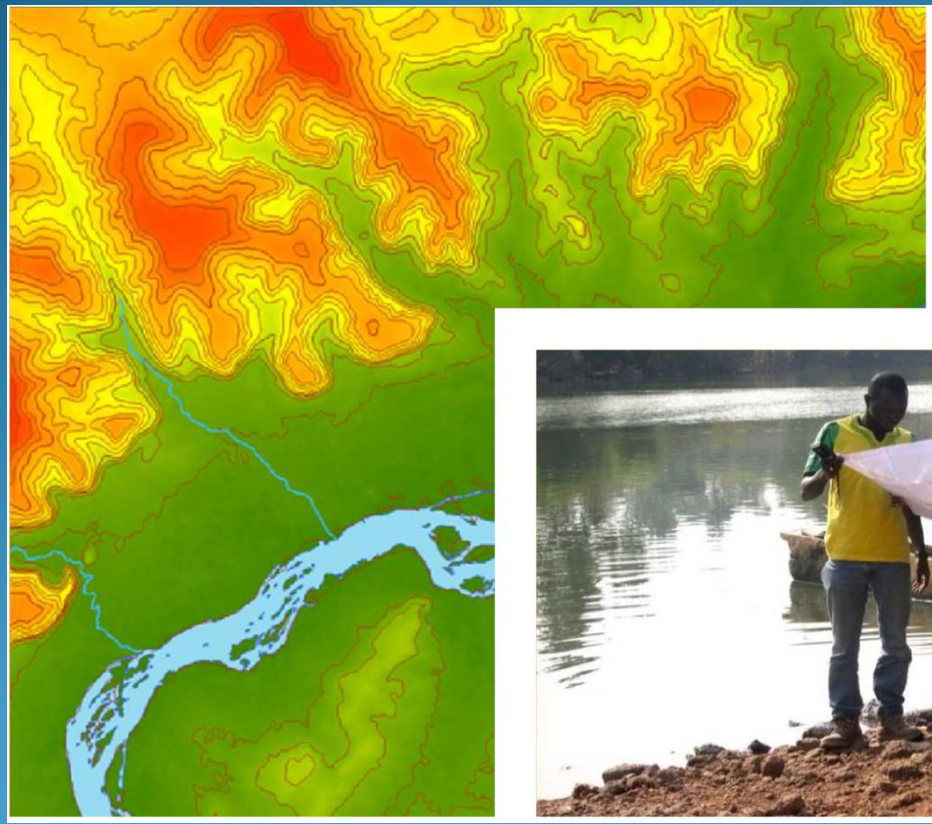
Aerial photography coverage and LiDAR in Haiti



National Center for Geospatial Information (C.N.I.G.S)

Outline of the presentation

I-) Background of aerial photography in Haiti

II-) Aerial photography in 2014-2015

II-1) lot 1: aerial photography acquisition and fieldwork
Aerial photography shooting
LiDAR acquisition

II-2-) lot 2: derived products
LiDAR filtering and digital elevation model (DEM)
Production of a national orthophoto
3D thermoformed model

III-) potential applications of this data
IV-) availability of data and products

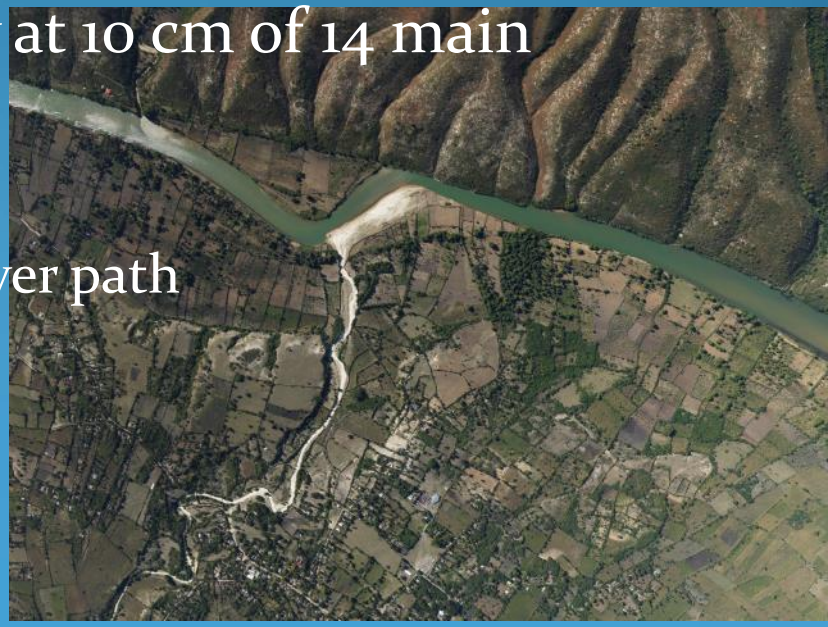
I-)Background of aerial photography in Haiti

- Before 1956 aerial photography was done in specifc areas and at different scales : 1957, 1944, 1954, 1955 over Port-au-Prince (PAP) and over the low lands of Cul de sac, Les Cayes, 1959, 1961, 1973 in the PAP metropolitan region, etc.
- 1956 over all of Haïti
- 1978 over all of Haïti
- 1991 Landsat over all of Haïti,
- 1998 SPOT over all of Haïti
- 2002 aerial photography over all of Haiti
- 2010 aerial photography over all of Haiti

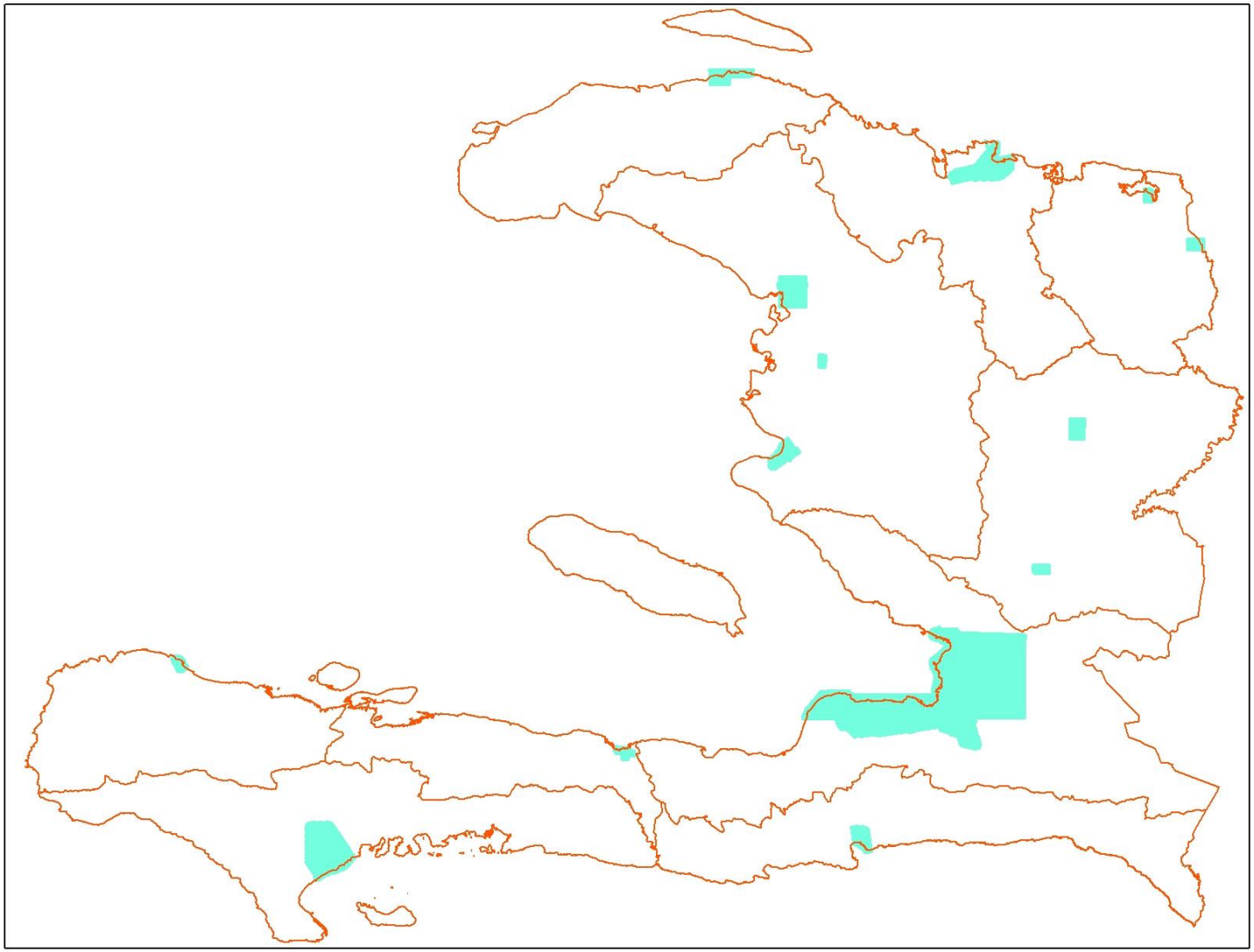
Aerial photography 2014 - 2015

- Numerical aerial photography at 25 cm over all of Haiti
  - About 57.000 photographies
  - 650 flight paths and 33.000 km over path

- Numerical aerial photography at 10 cm of 14 main cities
  - About 14.000 photographies
  - 220 flight paths and 3.300 km over path



Aerial photography of main cities



14 Cities

Orthophoto

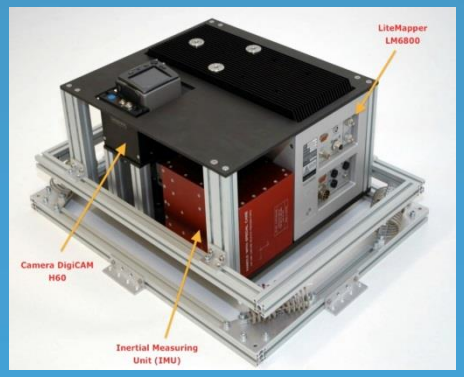
12 cm resolution

Aerial photography

twin engine plane PA34

Camera DIGIcam H60

Inertial system



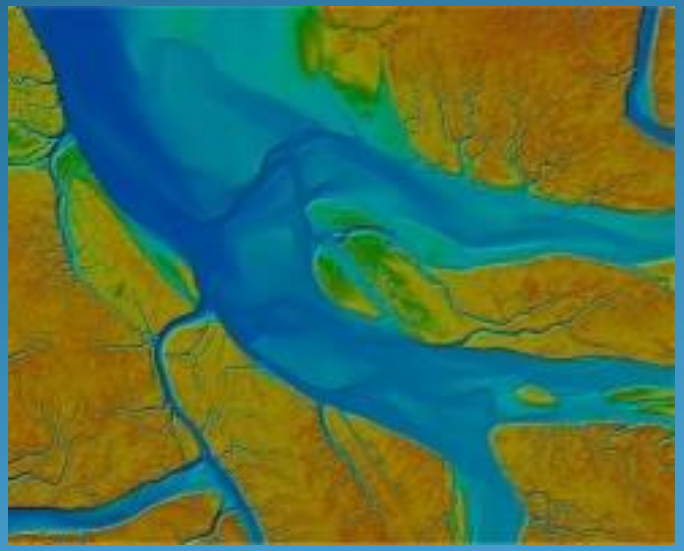
Acquisition of LiDAR

- Piper PA34 SENECA – LM6800 + H60

Acquisition of LiDAR

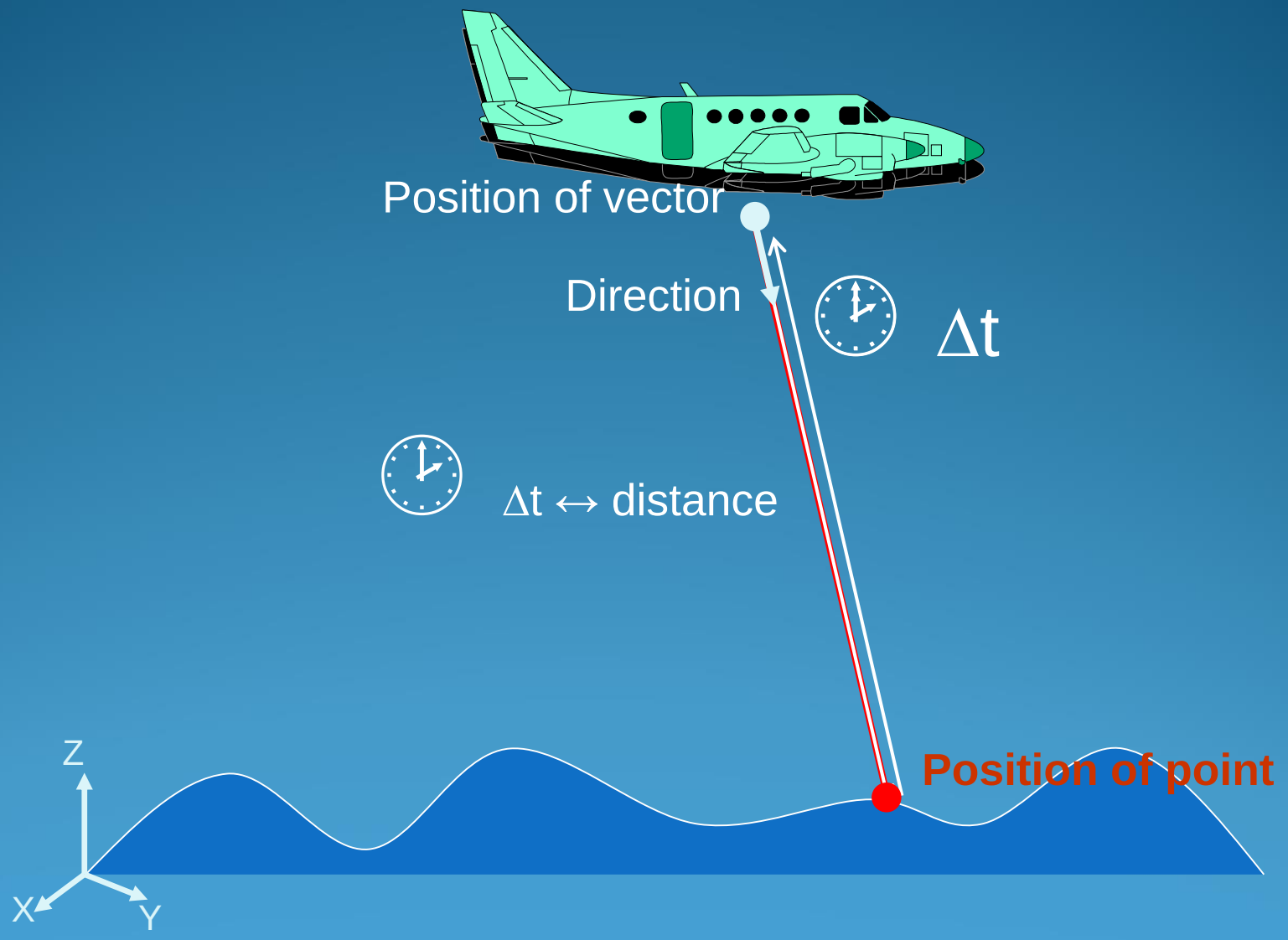
LIDAR = LIght Detection And Ranging

"Mesure of distance through ligh detection"

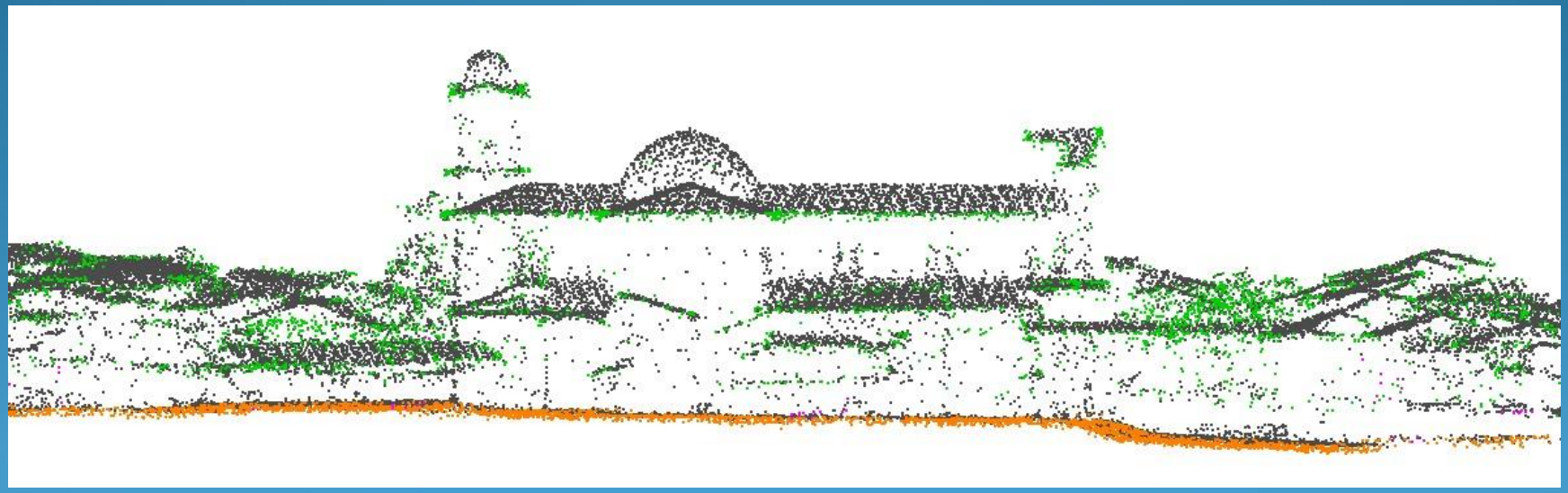


Acquistion of Digital Elevation models (DEM) with very high precision

Acquisition LiDAR



- *Acquisition of LiDAR*



Details of LiDAR acquisition

- Density of 0.5 pt/m² over all the territory
  - Flight at 1350 m (height from ground)
  - planimetric accuracy 20 cm, height accuracy 15 cm
- Density of 1 pt/m2 over 14 main cities
  - Flight at 600 m (heigh from ground)
  - planimetric accuracy 12 cm, height accuracy 10 cm

More than 16 billion points to describe the terrain of the country

Aerial photography acquisition and fieldwork

- *Stereopreparation*

- Measure of identified points on the photos which will serve to attach the photos on the geodesical reference system (GCP)
  - Measure of points
  - Calculation of coordinates
  - Identification form

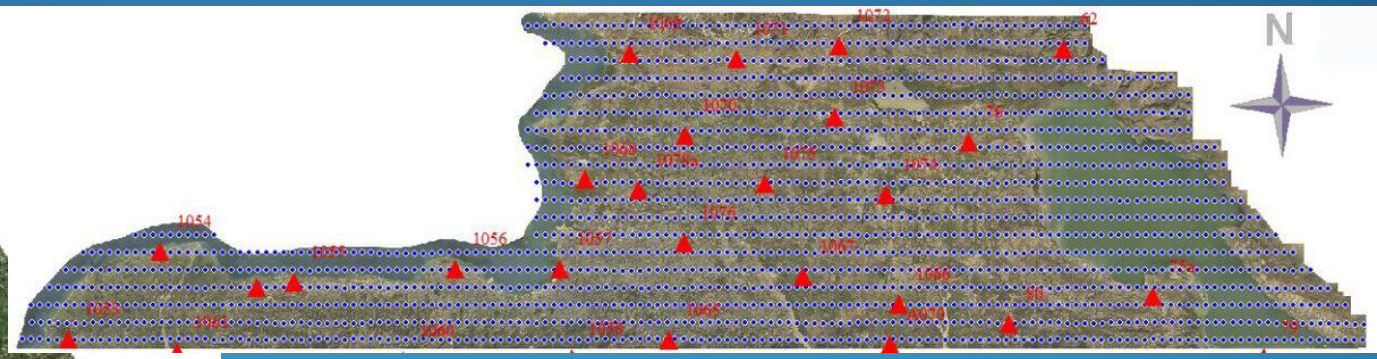
- About 225 stereopreparation points
- 150 GCP for the PVA at 25 cm
  - 75 GCP for the cities

Stereopreparation work

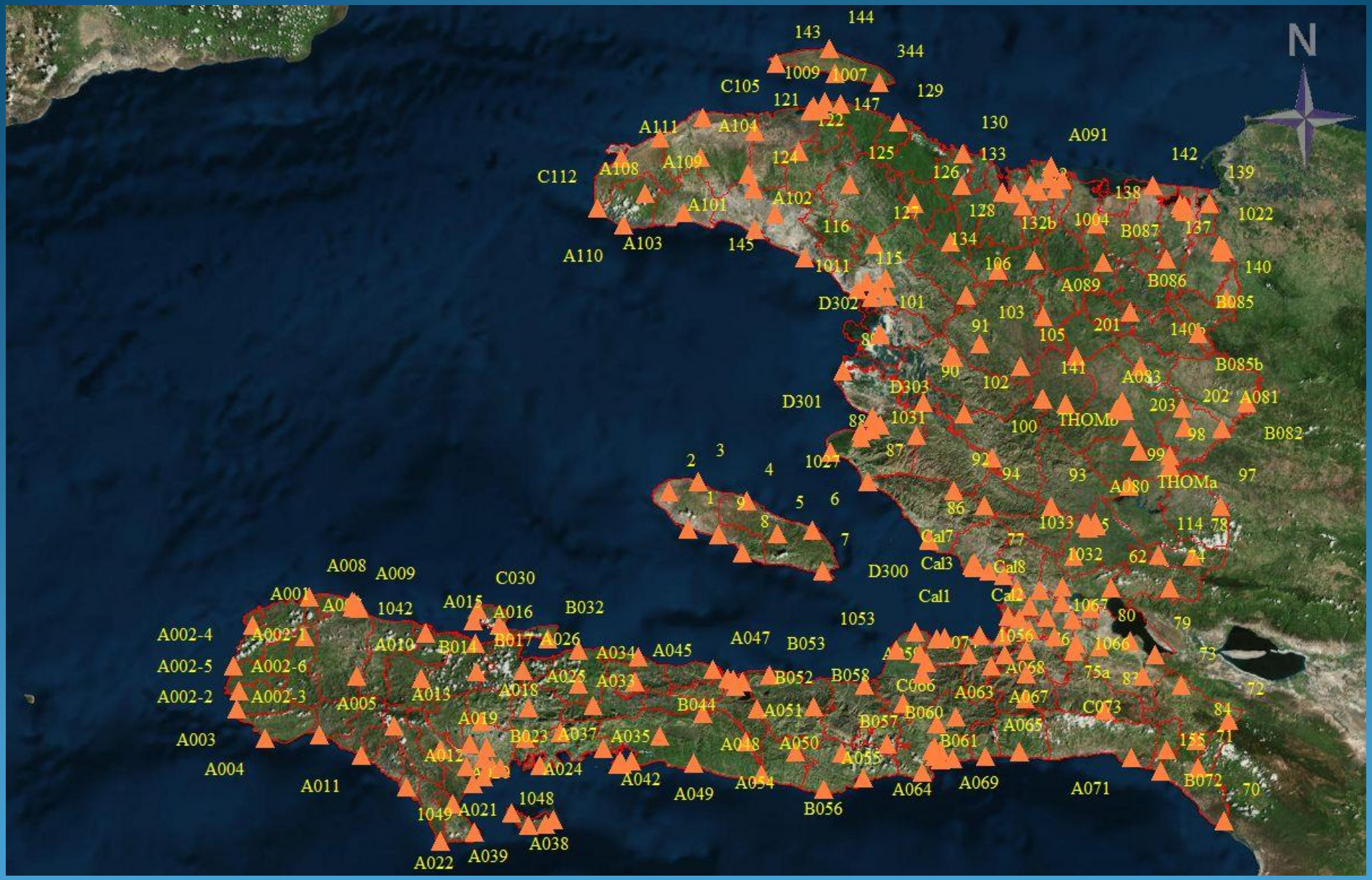
- Two field work campaigns:
  - March – April 2014
  - November – December 2015

Stereopreparation work

- 289 points measured, including:
  - 190 points for the coverage of the country at 25cm
  - 99 points for the coverage of the cities at 10cm

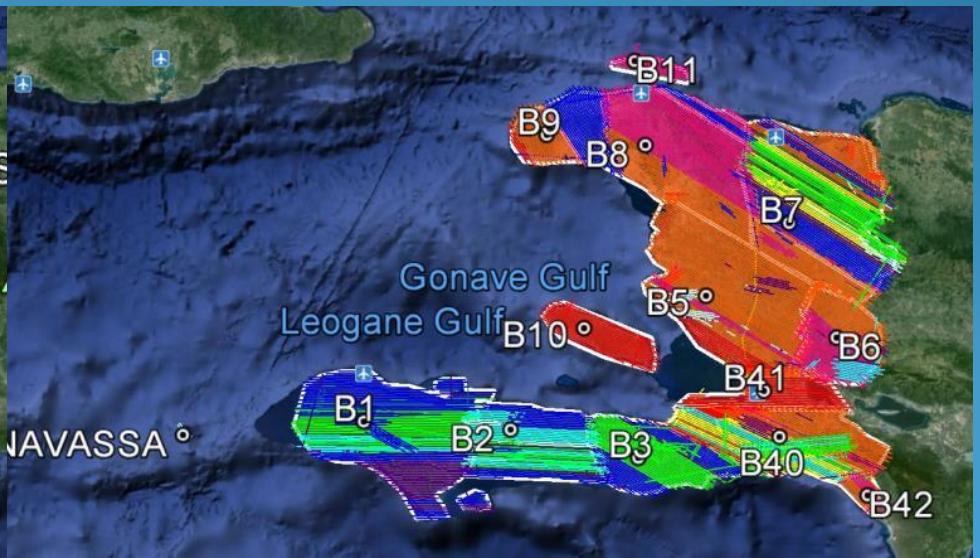


Stereopreparation work



Data acquisition

- First phase 2014 : 12/01/2014 - 1/04/2014
- Second phase, 2014-2015 : 5/12/2014 - 10/02/2015
- Third phase, 2015-2016 : 9/12/2015 - 21/01/2016

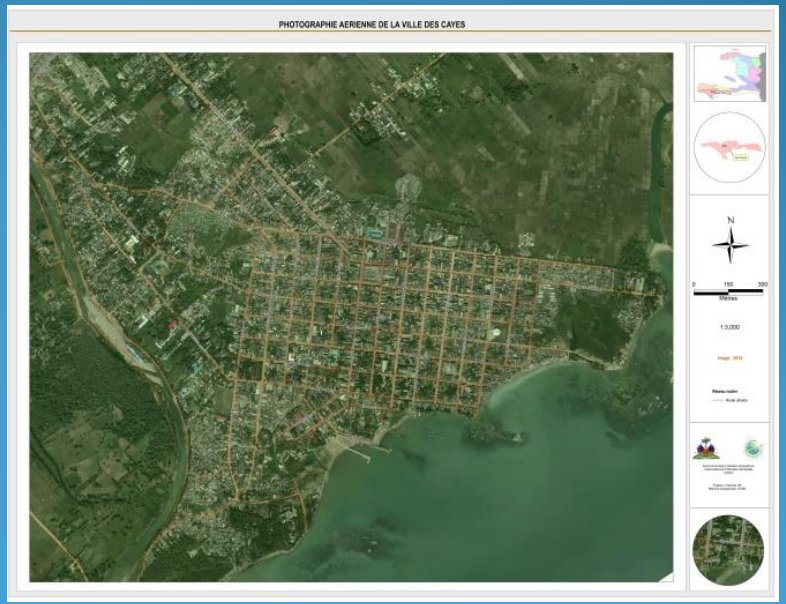


Lot 2 – Derived products

- Assembling images in blocs (Relative Orientation)
- Referencing images with géographical coordinates (Absolute orientation)

⇒Utilisation of stereopreparation points

- *Production of an orthophoto*



Production of an orthophoto

- Using DEM from the cloud of points from the LiDAR
  - Orthophoto at 25 cm over the whole country
  - Orthophotos à 10 over the cities

  - Ortho rectification of images
  - Harmonisation of radiometry
  - Creation of mosaics

Capitale d'État	PORT-AU-PRINCE
Chef-lieu de département	CAYES
Chef-lieu de commune	CHANTAL
Autre Ville	BEAUMONT
Lieu-dit, Quartier	Port à Piment
Lieu-dit autre	Magney
Autre désignation	Aubas
Relief	Morne
Hydrographie	Petite Rivière
Désignation côtière	Pointe Ouest
Limite d'État	
Limite de département	
Limite de commune	
Limite de section communale	
Route Nationale	RN1
Route Départementale	RD1
Piste carrossable ou voie urbaine	
Piste ordinaire	
Aéroport international, Aérodrome, Autre piste	
Patrimoine culturel, historique ou site remarquable	
Hôpital	H
Église ou Temple, Chapelle	
Antenne	
Équipement sportif et terrain de football	
Marché	
Ruine, vestige	
Grotte, Voûte, Fort	
Artisanat	
Cimetière	
Zone industrielle, usine	
Rivière, Ruisseau permanent	
Rivière, Ruisseau temporaire	
Château d'eau, Puits et forage	
Station de pompage, traitement des eaux	
Bassin, Source	
Chute d'eau	
Port, Port de plaisance	
Mouillage	
Phare	
Plage	
Point coté	• 1900
Courbe de niveau : 1. Standard 2. Maîtresse	1 2

Orthophotoplan réalisé par superposition de données issues de la base de données cartographique du CNIGS sur fond de photographies aériennes prises entre 2014 et 2016.

Données : CNIGS
Conception et réalisation :IGN France International.

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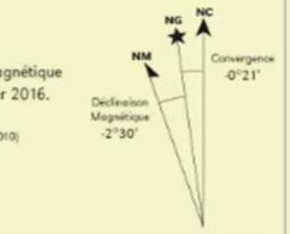
Projection UTM (Universal Transverse Mercator), fuseau 18 Nord, dans le système géodésique mondial WGS84 (World Geodetic System).

Les lignes et croisillons sur la carte ainsi que les chiffraisons dans le cadre, correspondent respectivement :

- en **rouge**, aux coordonnées géographiques (latitude, longitude) sur WGS84
- en **bleu** à la projection UTM fuseau 18 Nord sur WGS84 en mètres avec corrdonnées d'angles kilométriques en **bleu foncé**

Valeur moyenne de la déclinaison magnétique au centre de la feuille au 1er janvier 2016.
Variation annuelle : 6' Est.
(Source : NOAA, World Magnetic Model 2010)
NM = Nord Magnétique
NG = Nord Géographique
NC = Nord Cartographique

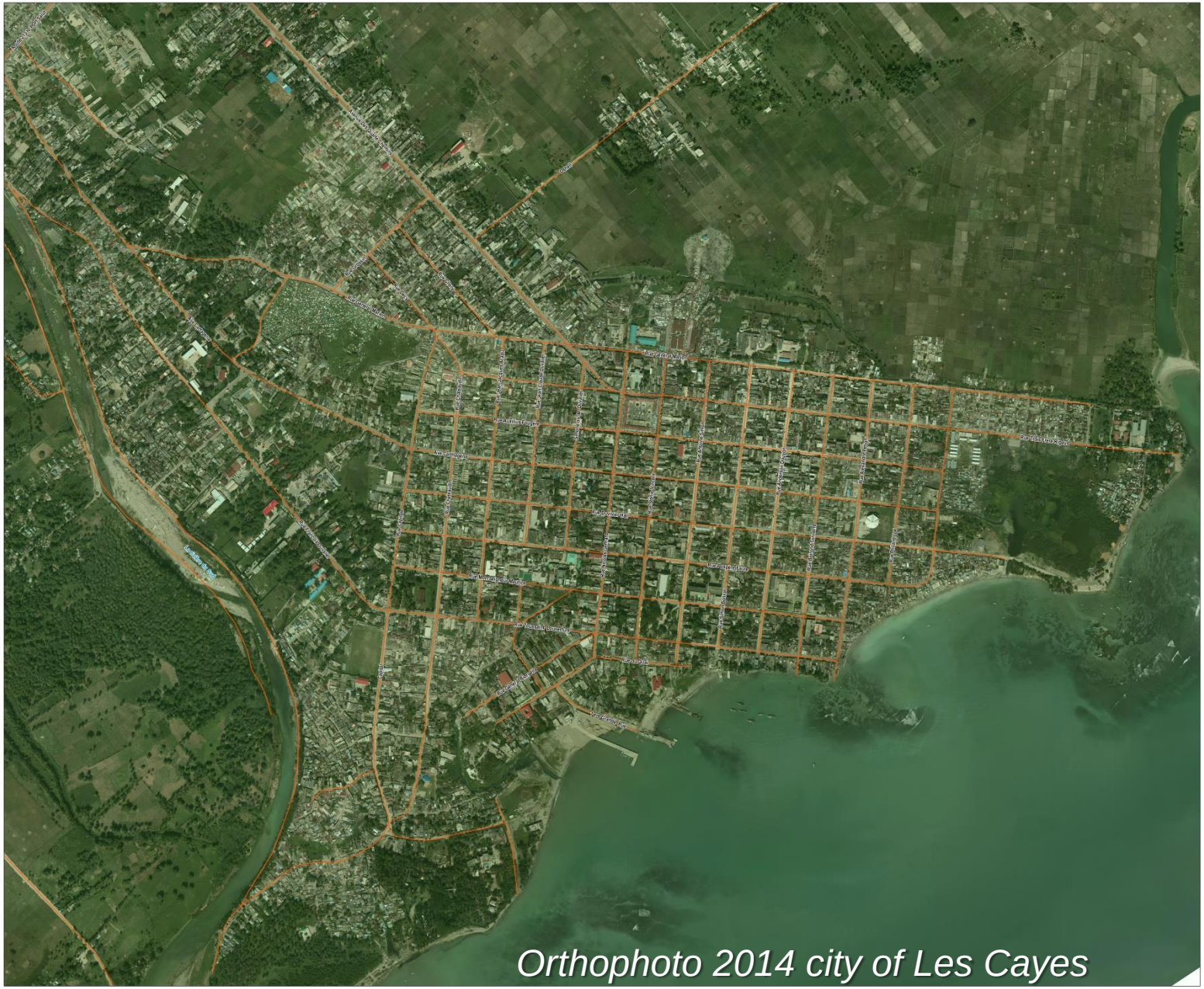


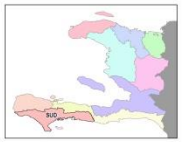
Echelle 1: 25 000 (1 cm = 250 m)

250 m 0 0,5 1 1,5 2 Km

Le tracé des frontières internationales et des limites administratives figurant sur cette carte n'a pas de valeur juridique et ne saurait engager la responsabilité du Centre National de l'Information Géo-Spatiale.

PHOTOGRAPHIE AERIENNE DE LA VILLE DES CAYES





N

0 150 300

Mètres

1:3,000

Image : 2014

Réseau routier

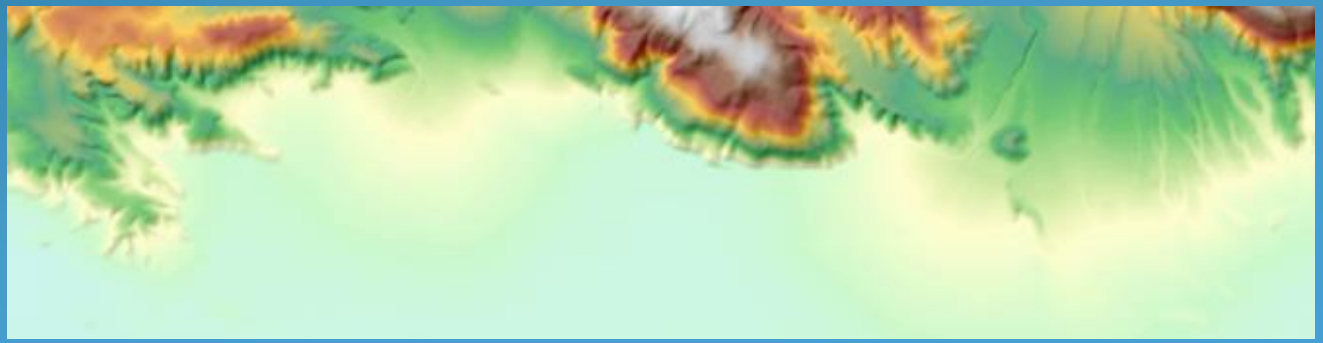
Route urbaine

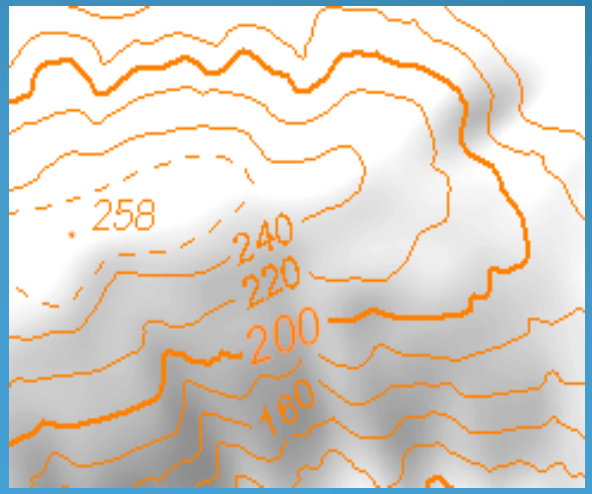
Source de données et réalisation catographique:
Centre National de l'Information Géo-Spatiale
(CNIGS)

Projection: UTM-Zone 18N
Référence cartographique: WGS84

Lot 2 – Derived products

- *Filtering of LiDAR and calculation of a national DEM – level curves*
- DEM web of 1.5 m, altimétry precision 20 cm
  - Extraction of level curves from the DEM
    - Equidistance 1 meter

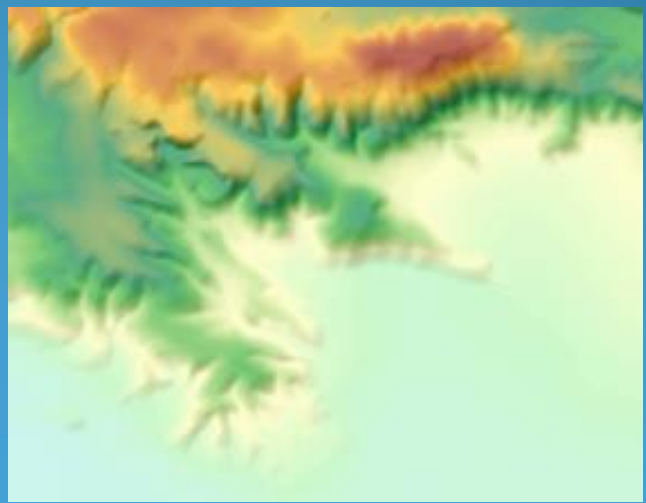




Filtering of LiDAR and calculation of a national DEM – level curves

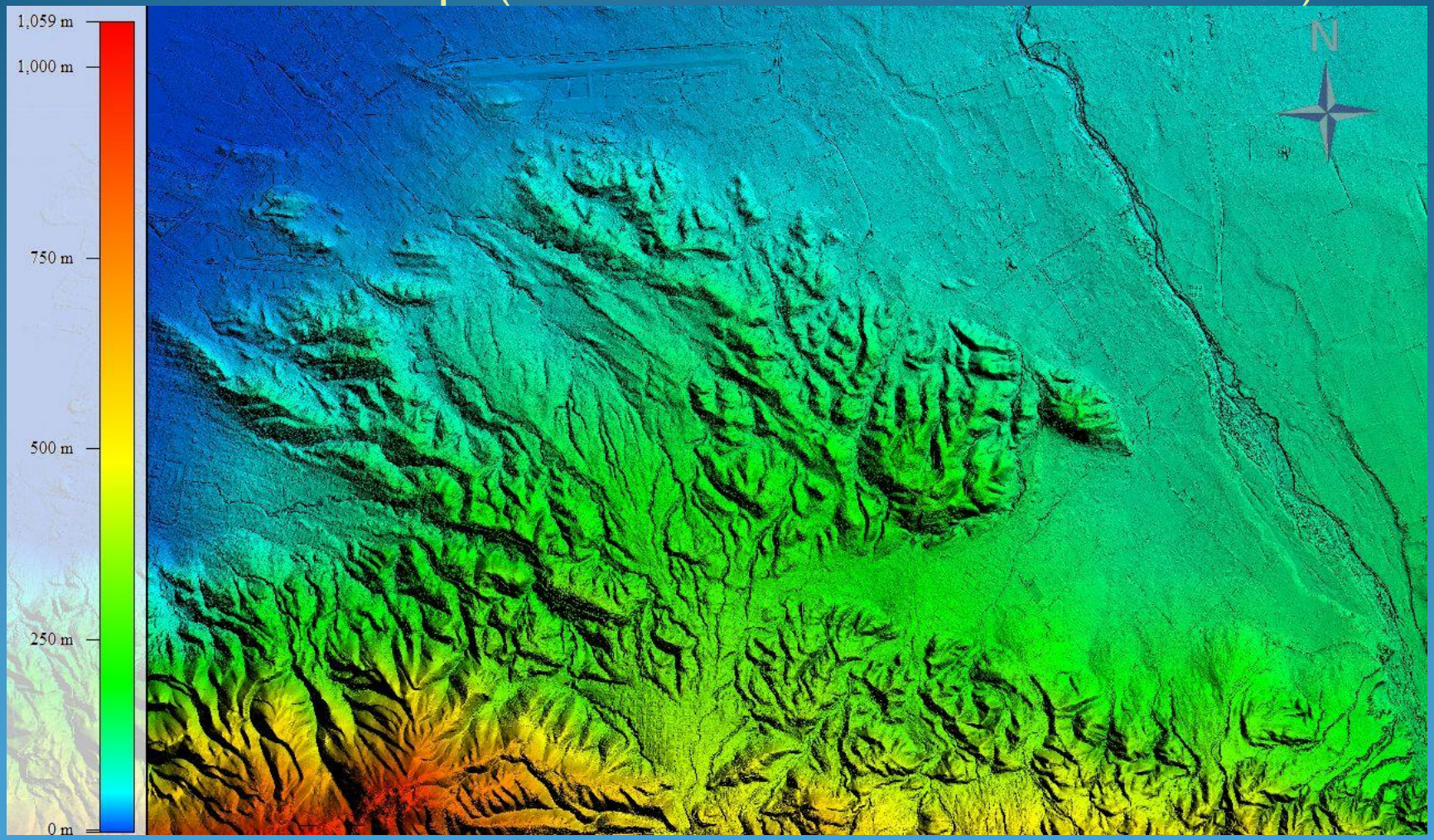
- Generation of DEM from the LiDAR points
  - Adjustements of bands
  - Classification
  - Cleaning of topcover (constructions and vegetation)

- Final Result: DEM 1.5 m, altimetry precision 20 cm



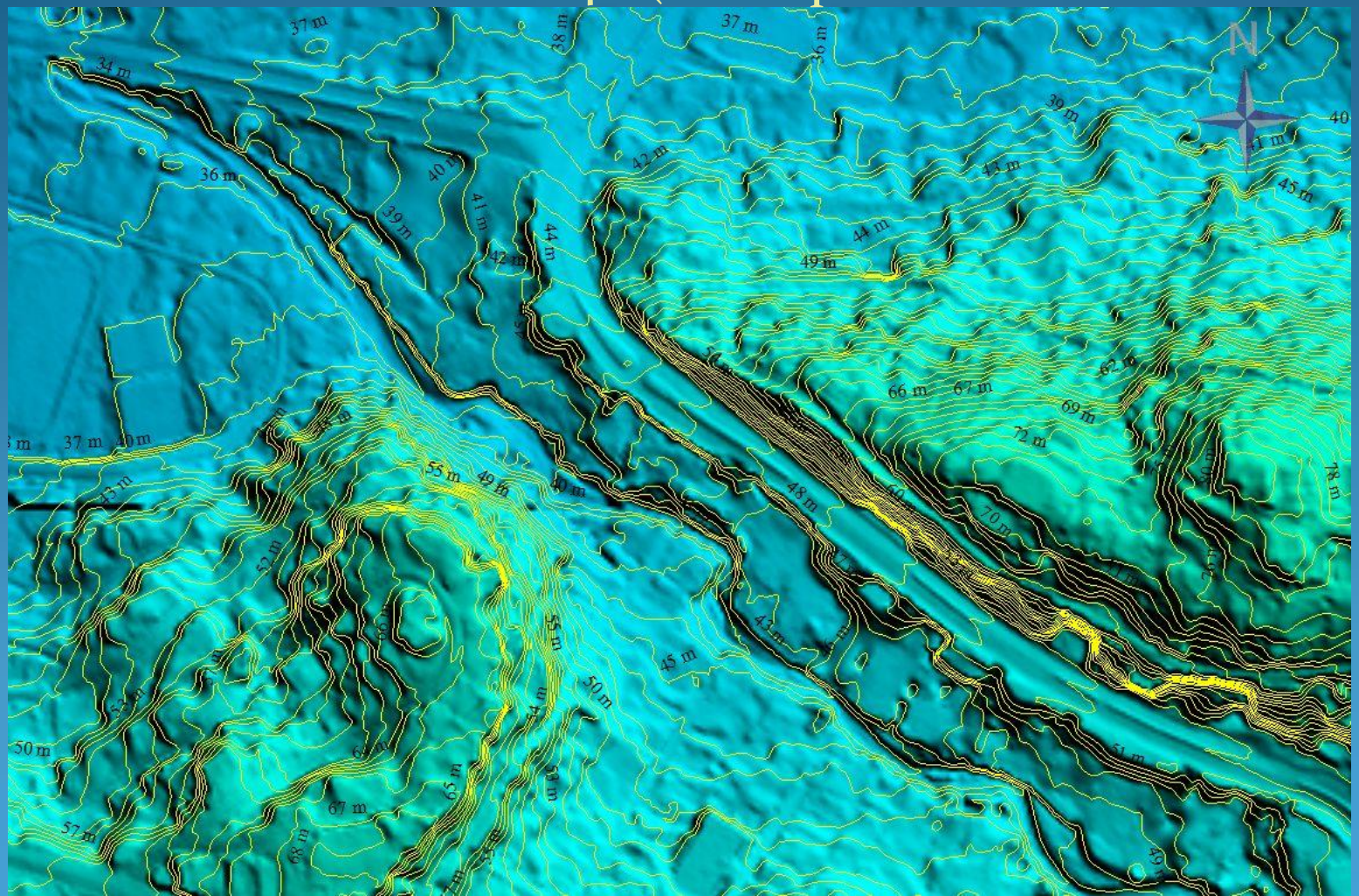
Filtering of LiDAR and calculation of a national DEM – level curves

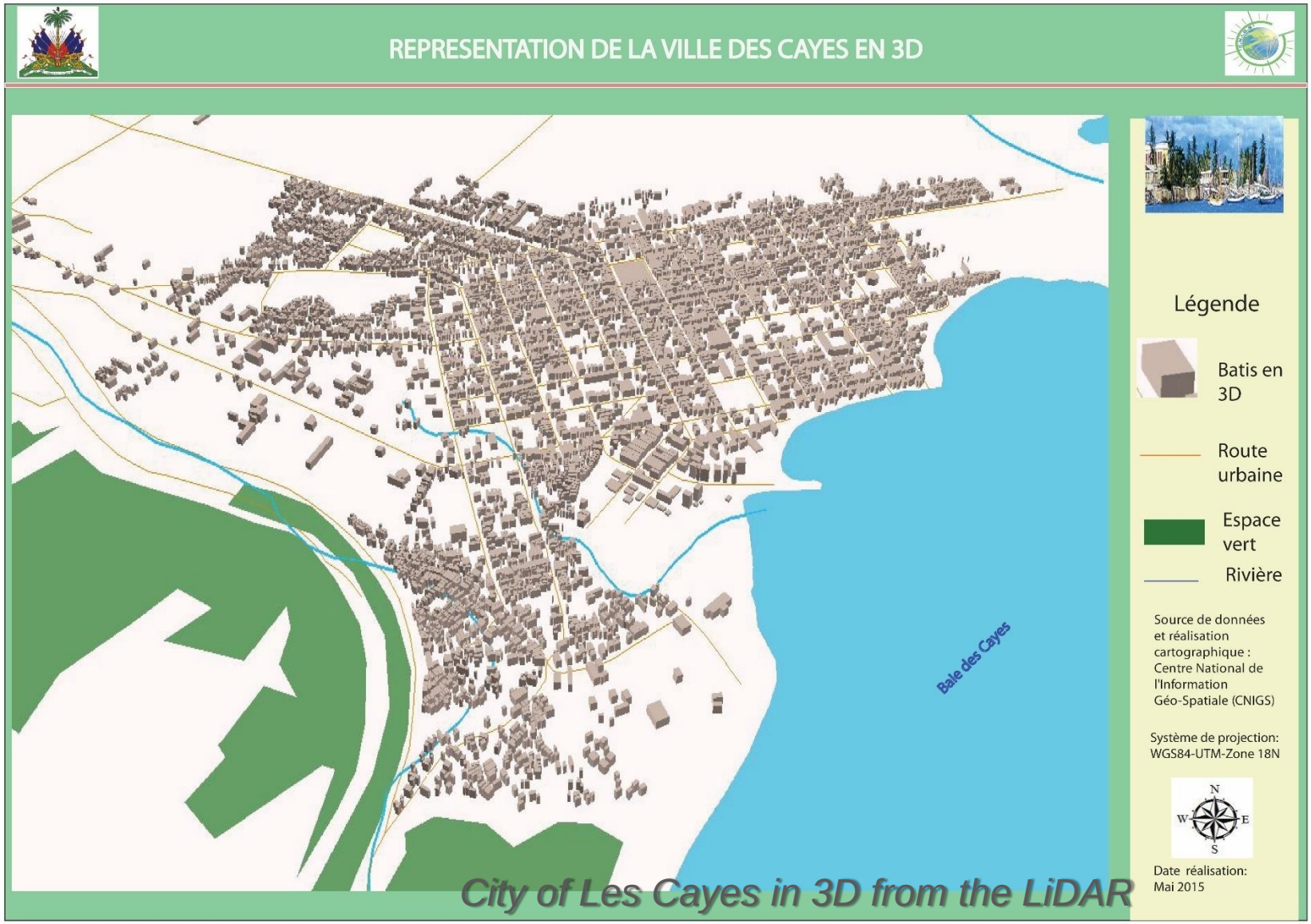
- DEM on B40 (block that includes Port au Prince)



Filtering of LiDAR and calculation of a national DEM – level curves

- Courbes sur MNT - B40 (bloc qui inclut Port au Prince)





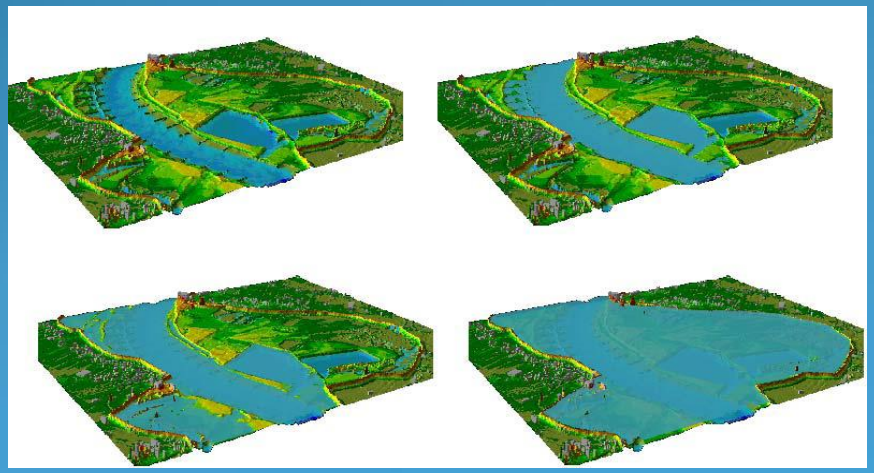
City of Les Cayes in 3D from the LiDAR

Perspectives

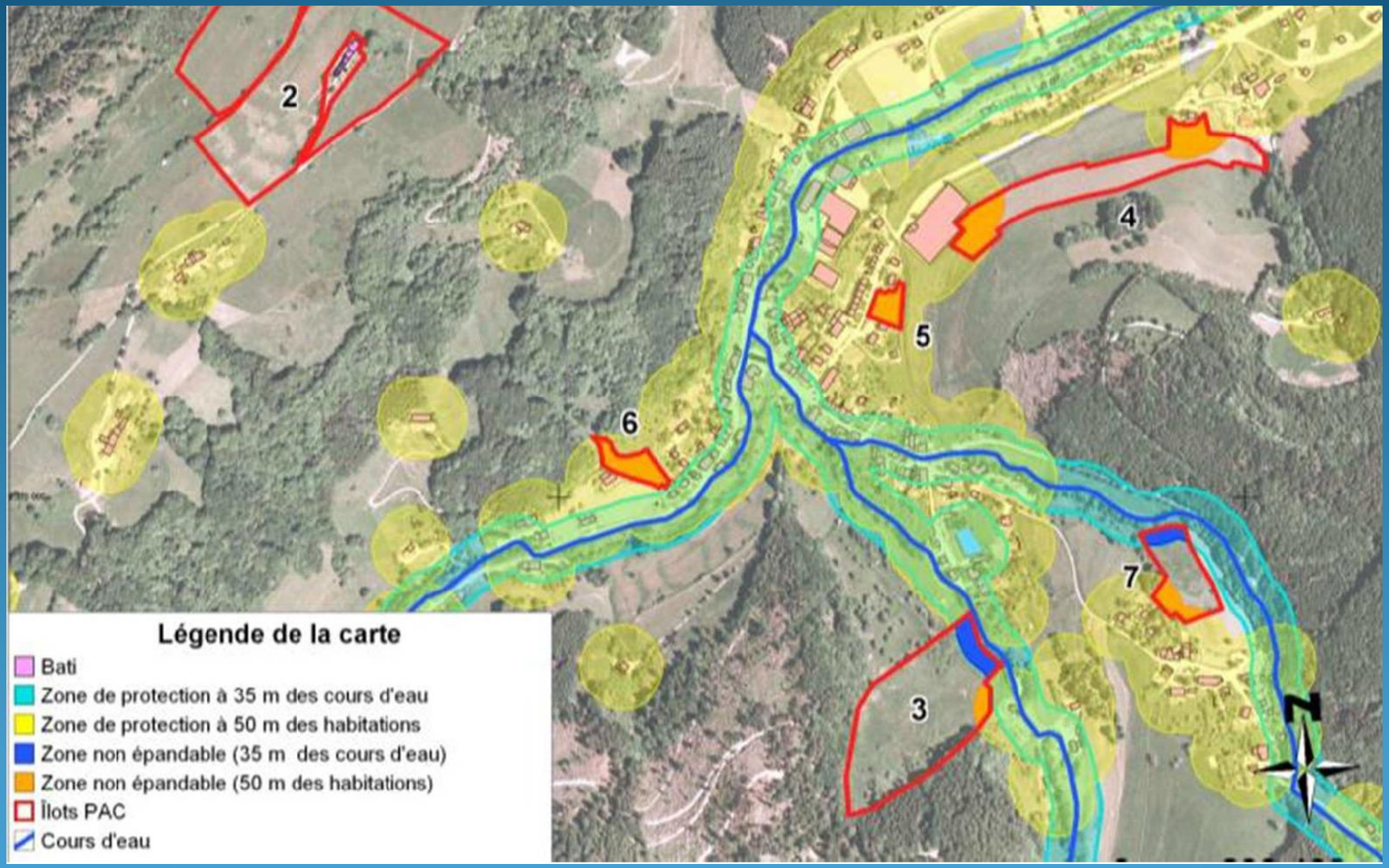
- Geographical data bases
  - Improvement of the national maps (1:25.000, 1:10.000)
  - Plans of cities at large scales
  - Urban database
  - Land use maps at large scale
  - Road database
  - Etc.

Perspectives

- Thematic applications
  - Cadaster
  - Disaster Risk Management (flooding, sea level rise, etc.)
  - Urban planning, 3D models
  - Street addressing
  - Management of buildings
  - Management of agricultural resources
  - Population census
  - Environement : protection of water ressources



Management of agricultural ressources



Civil protection : Flood risk

Représentation et information sur les risques et enjeux

Use of LiDAR to assess seismic risk

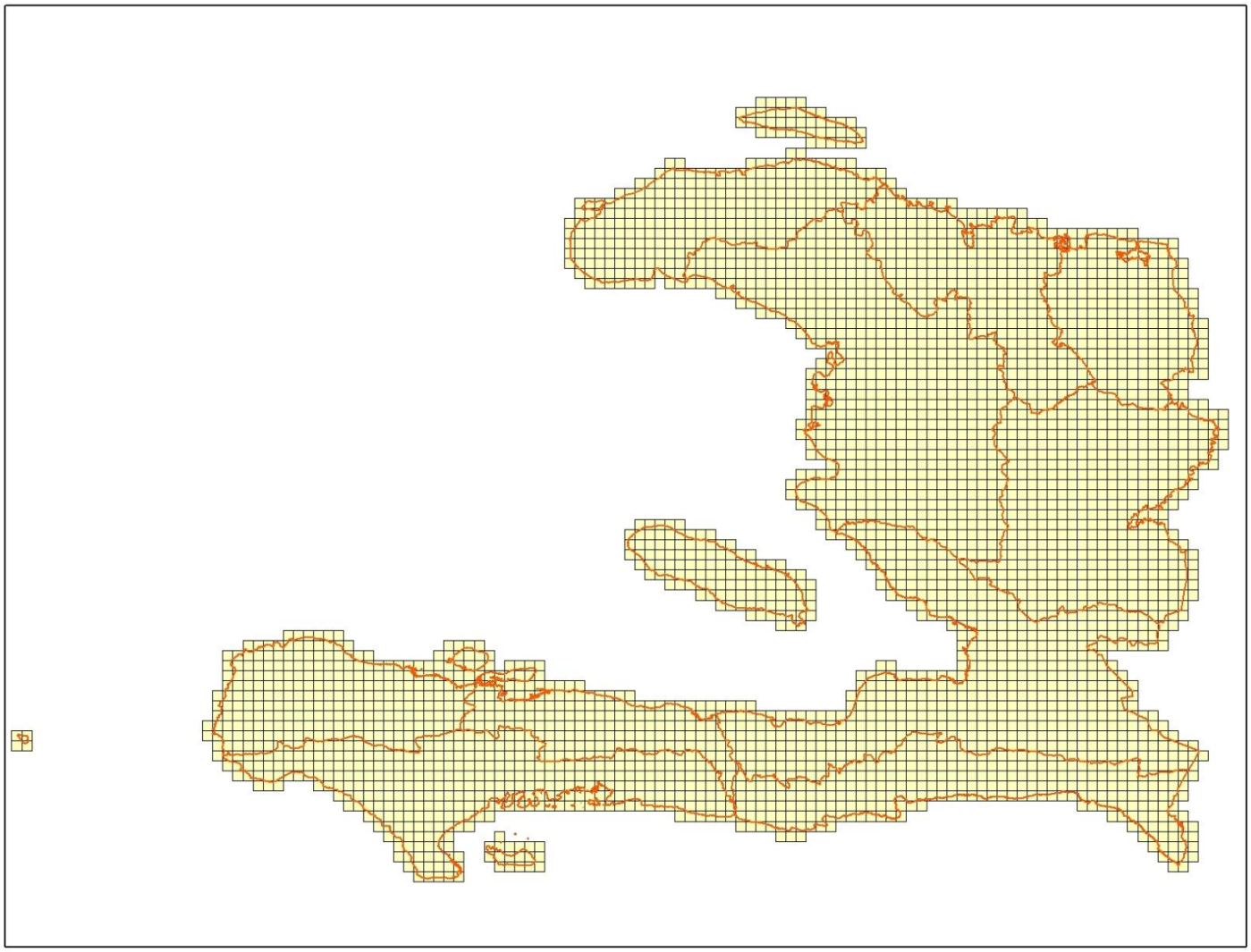
- Identification of seismic faults
- Indicators of seismic hazard, including regional level

Key goegraphical information to update

N0	Couche géographique
1	Limites administratives
2	Chef lieu de département et de commune
3	Base de données RéNOP
4	Courbes de niveau 20 m
5	Model numérique du terrain
6	Pente
7	Localisation de Marchés
8	Tache urbaine
9	Occupation du Sol 1998
10	Occupation du Sol 1978
11	Nouvelle Occupation du Sol
12	Potentialité du sol
13	Géologie
14	Géomorphologie
15	Carte de failles
16	Hydrogéologie
17	Réseau hydrographique
18	Réseau de drainage
19	Limites des Bassins Versants et Sous Bassins Versants
20	Infrastructures hydro agricoles
21	Limites des Aires Protégées
22	Localisation des stations agro-météo
23	Localisation des stations climatiques
24	Produits dérivés dès Images Satellitaires Baisse résolution
25	Données historiques des Stations Météorologiques
26	Agro météo Station automatiques/manuelles

N0	Couche géographique
27	Géodésie et Nivellement
28	Surfaces Emblavées
29	Statistiques de Rendement et Production Végétale
30	Données des anomalies WSI et rendement
31	Zones Vulnérables de Sécurité Alimentaire
32	Données de Modes de Vie
33	Données Socio-économiques
34	Réseau Routier
35	Bâtiments importants (Ecole, Eglise, Dispensaire, Hôpitaux, etc.)
36	Mines et Carrières
37	Ouvrage d'Art
38	Couverture ligneuse
39	Tenure foncière
40	Habitat dispersé
41	Zones agro-sylvo-écologique
42	Sites remarquables
43	Occupation des sols
44	Réseau hydraulique
45	Point d'eau (source, forage,…)
46	Couverture réseau électrique
47	Couverture réseau téléphonique

IV-) Availability of data and products



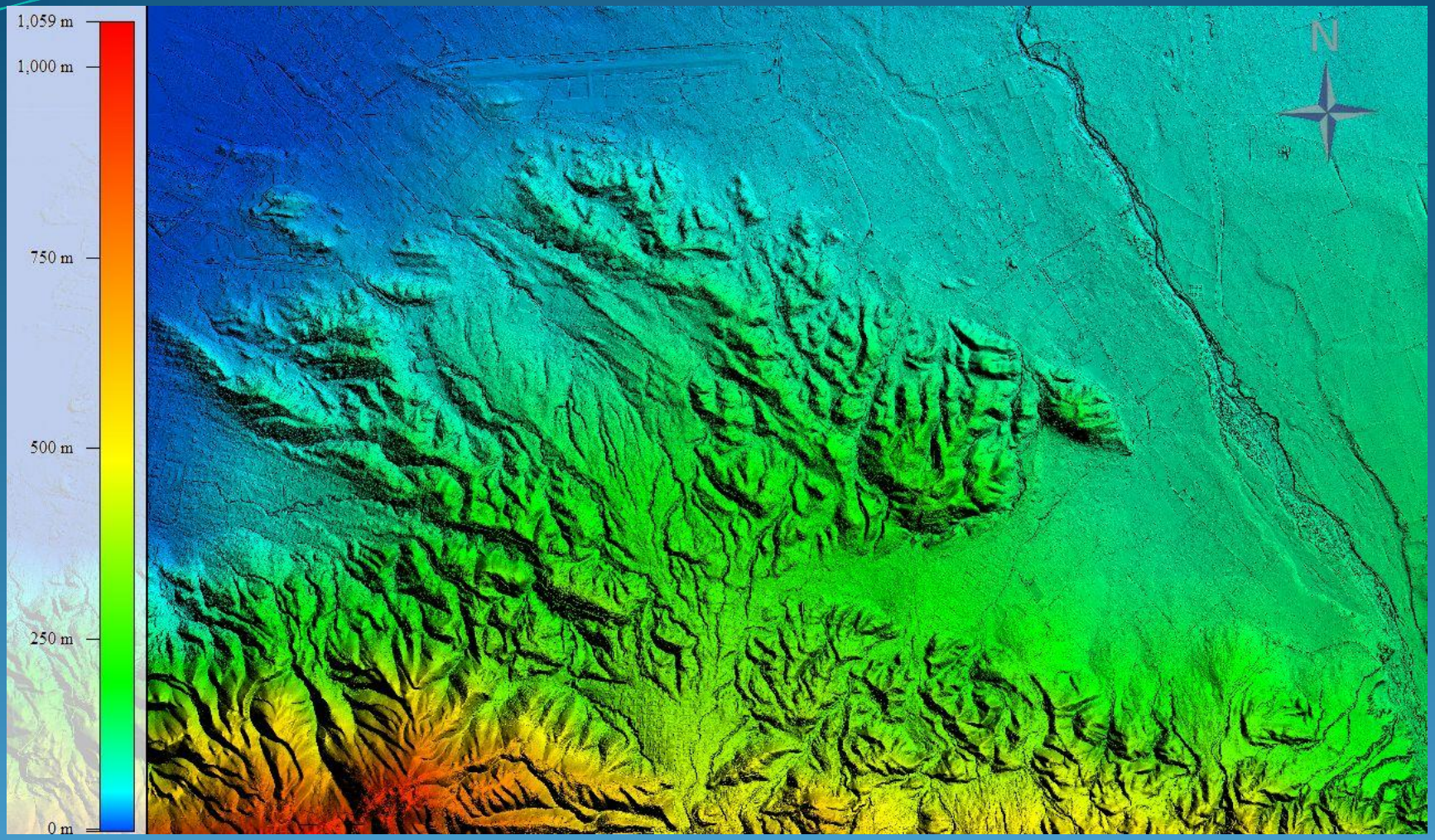
Photo

Orthophoto

Orthophoto treated

3,515 orthophotos at 25 cm resolution
450 Mb in format .Tiff - 50Mb in format .Ecw

IV-) Availability of data and products



3,750 files for the whole country in format ascii for about 100 GB on drive

IV-) Availability of data and products

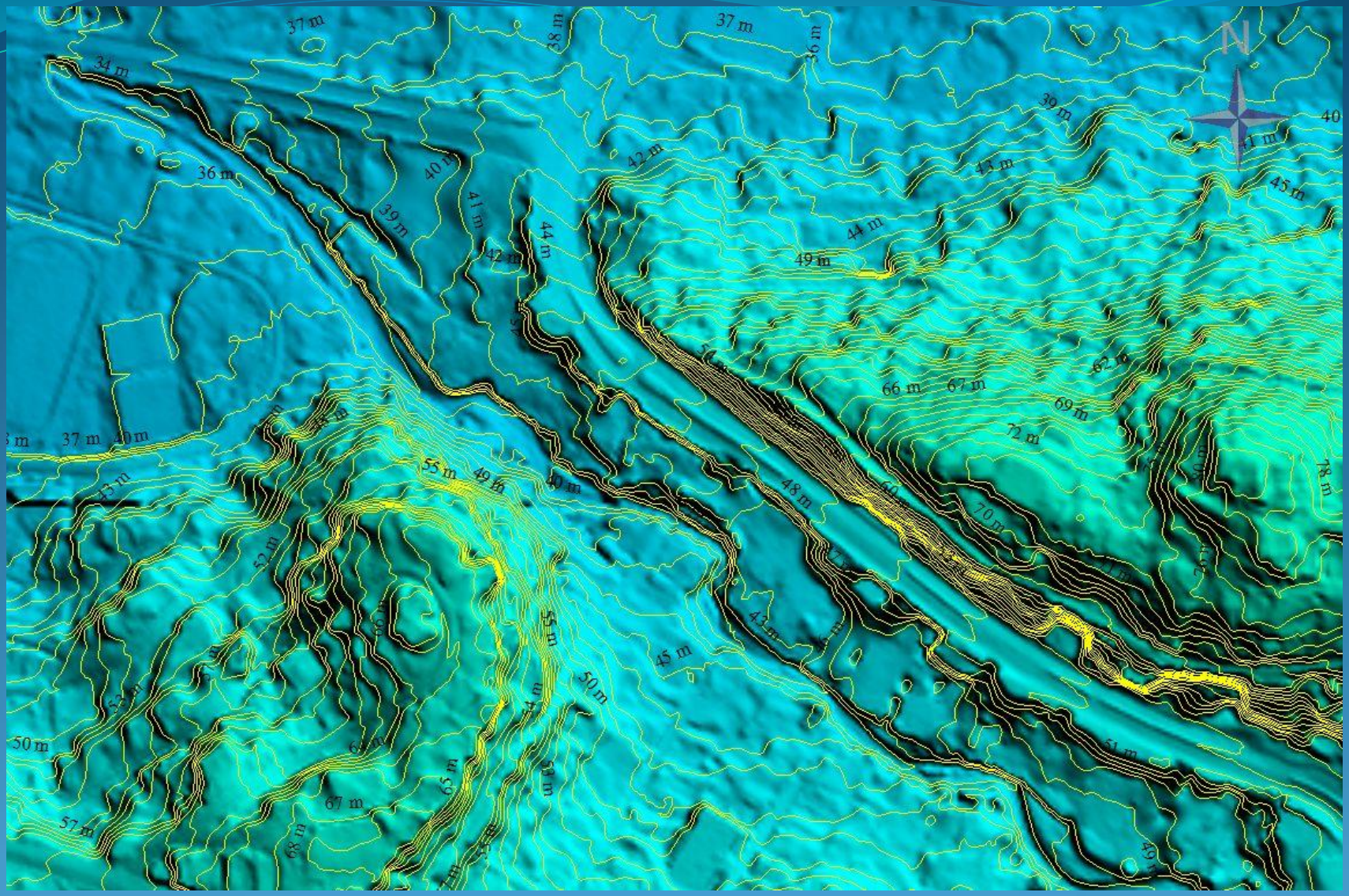
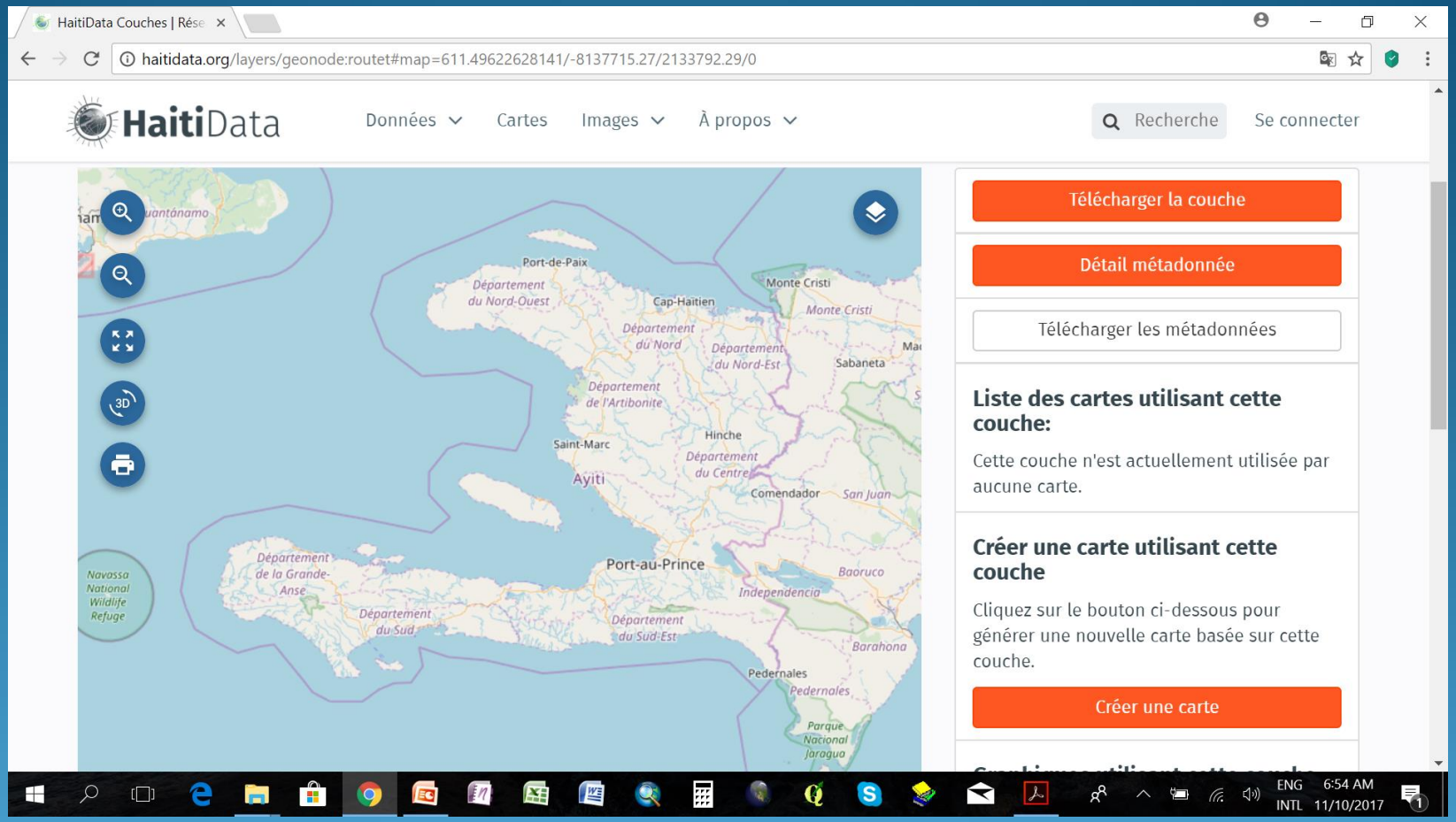


Photo at 1.5x1.5 km
Photo at 3x3 km

IV-) Availability of data and products

Haitidata.org



- GeoNode
  - Open source
  - Open Web Plateforme easy to use

Thank you !

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