GEO Elevation : Produit 3D et utilisation

La force d'Airbus Group

AIRBUS GROUP

Employés*: ~ 140,000
CA*: ~ € 56 milliards

CASSIDIAN AN EADS COMPANY
AIRBUS MILITARY
ASTRIUM AN EADS COMPANY

Intégration & Rebranding 2014

AIRBUS

Employés*: ~ 73,500
CA*: ~ € 39 milliards

AIRBUS HELICOPTERS

Employés*: ~ 22,400
CA*: ~ € 6.3 milliards

AIRBUS DEFENCE & SPACE

Employés**: ~ 40,000
CA**: ~ € 14 milliards

* en 2012
** estimation pour 2014

Space Systems I Military Aircraft I Communication, Intelligence & Security I Electronics

- Geo-Intelligence
- SatComms
- Integrated Systems
- Secure Land Communications

AIRBUS DEFENCE & SPACE

L'expertise en héritage

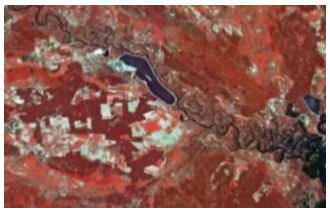
1982 — Le CNES fonde Spot Image

2001 — Création d'Infoterra

2010 — Intégration de Spot Image et Infoterra complète dans Astrium Services

2014 — Rebranding Airbus Defence and Space

1986



SPOT 1

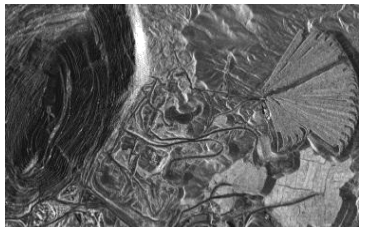
Lancement de SPOT 1

2002

SPOT 5

Lancement de SPOT 5

2007



TerraSAR-X & TanDEM-X

2007: Lancement de TerraSAR-X
2010: Lancement de TanDEM-X, pour WorldDEM™

2011

Pléiades 1A & 1B

2011 & 2012: Lancement des satellites Pléiades THR

2012

SPOT 6 & 7

2012 & 2014: Lancement de SPOT 6 et SPOT 7

Gamme de produits MNS et MNT

WorldDEM™

DEM or DTM - 12m posting – monde entier– 4m LE90

Elevation30

DEM – 80m km²– 6 to 10m LE90

Elevation8

DEM or DTM - SPOT 6 or SPOT 7 Stereo or Tristereo – 3m LE90*

Elevation10

DEM or DTM – radar– 5m LE90

Elevation1

DEM or DTM - Pléiades Stereo or Tristereo – 1,5m LE90*

Elevation4

DEM or DTM - Pléiades Stereo or Tristereo – 1,5m LE90*

*with GCPs

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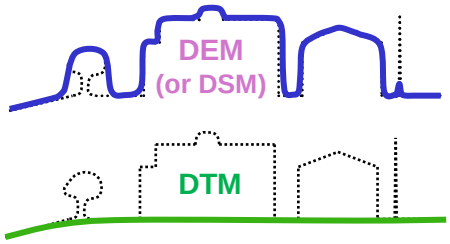
La filière optique

- Le **DEM** (Digital Elevation Model), ou DSM, est un modèle 3D du sol incluant **les éléments du sursol** (bâtiments, végétation,…).
- DEM calculé par stéréoscopie, corrélation automatique de couples stéréo ou tri-stéréo Pléiades ou SPOT 6/7 dans la Pixel Factory.



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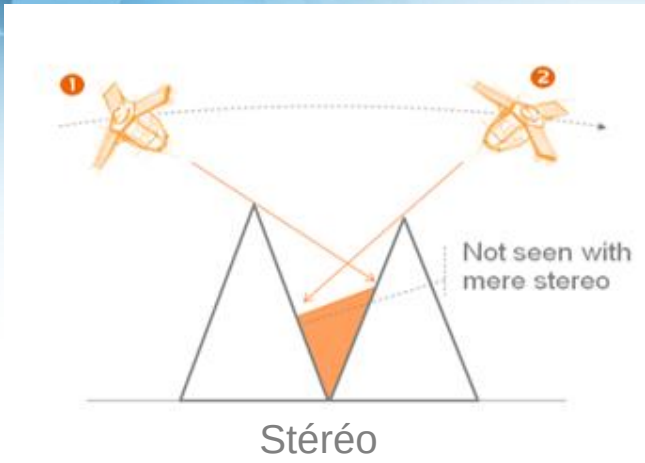
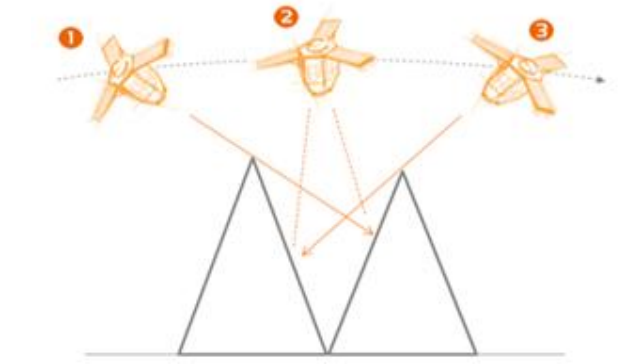
Stéréo ou Tristéréo ?



Stéréo



Tristéréo

La tristéréo réduit le risque de

Objets cachés

Dans les zones difficiles (relief, urbain dense, bâtiments de grande hauteur).

	Stéréo	Tristéréo
Elevation4	Tous types de terrain (paysage naturel ou urbain).	Paysage avec relief et urbain dense (bâtiments de grande hauteur).
Elevation1	Hors urbain, peu de relief, faibles pentes.	Paysage naturel avec relief possible. Zones urbaines possibles mais Elevation4 à privilégier

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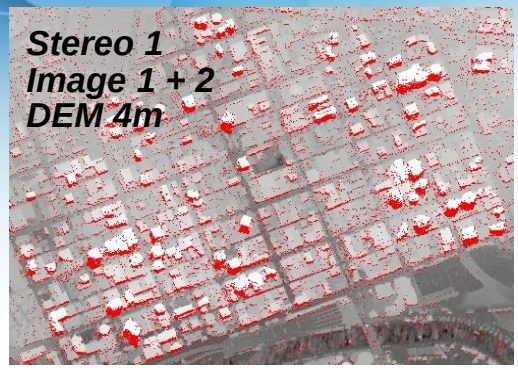
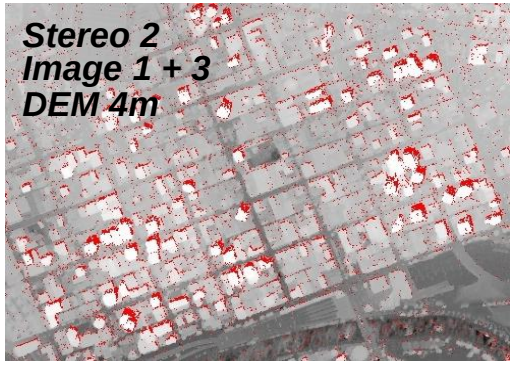
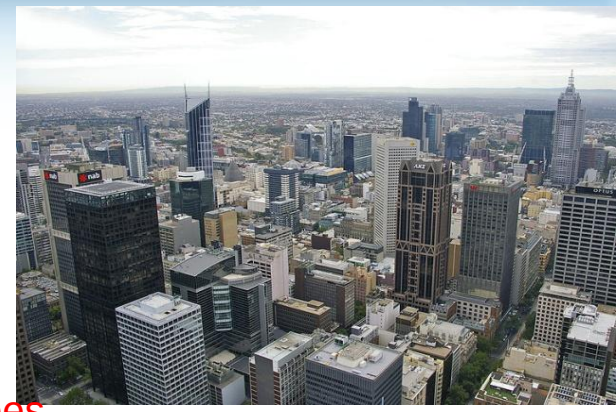
Stéréo or Tristéréo?





Assemblage de 3 DEMs stéréo

Illustration de l'apport de la tristéréo sur la ville de Melbourne. Zone urbaine difficile avec gratte-ciel



En rouge : faces cachées

AIRBUS DEFENCE & SPACE

Des outils de production automatiques

Pixel Factory™

Notre solution pour la production industrielle de données géographiques

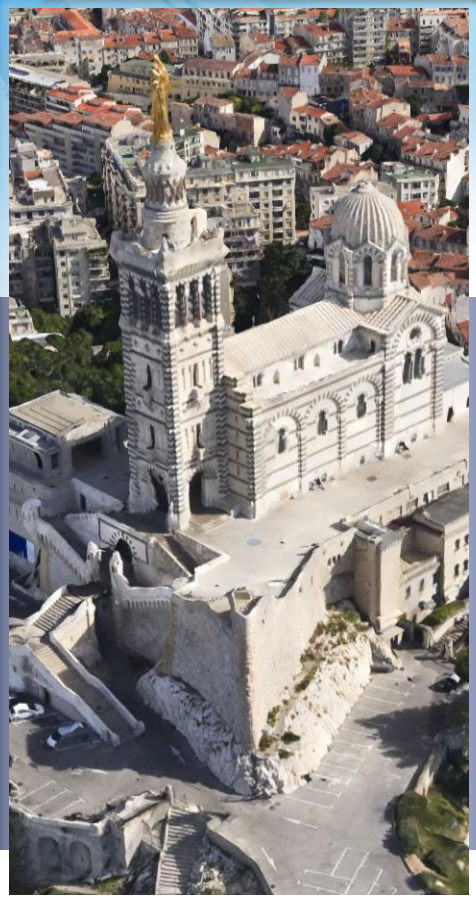
- **Traitement automatique de grands volumes de données aériennes, UAV et satellites**
- **Une gamme étendue de produits cartographiques avancés 2D et 3D**
- **Interfaçage transparent avec des outils et logiciels tiers**

Street Factory™

Notre solution nouvelle génération pour la production industrielle de données géographiques adaptée à la modélisation urbaine

AIRBUS DEFENCE & SPACE

Street Factory : Ex. de production 3D urbain



Marseille (France)

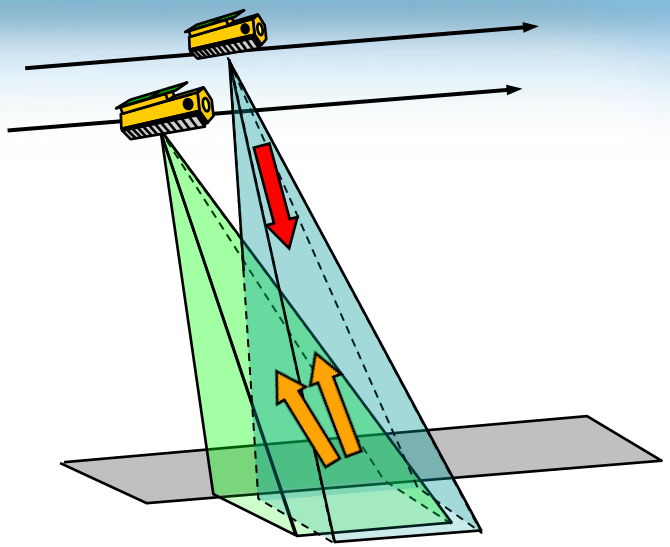
Up to 6600 images for 28km²

GSD 10cm / 15cm

TrackAir Midas system

AIRBUS DEFENCE & SPACE

La filière Radar



- Les 2 satellites filent sur des orbites très voisines, distants de qq centaines de mètres (**la base interférométrique**)
- L'un ou l'autre des satellites émet un signal radar
- L'écho radar (**backscatter**) est reçu par les 2 satellites
- Les échos reçus par les 2 satellites sont très similaires, mais pas identiques. Leur différence dépend de la **base** et de l'altitude du terrain qui l'a renvoyé.

⇒ Technique d'interférométrie radar

3 années d'acquisition avec des modifications de Base (100m et 600m environ)

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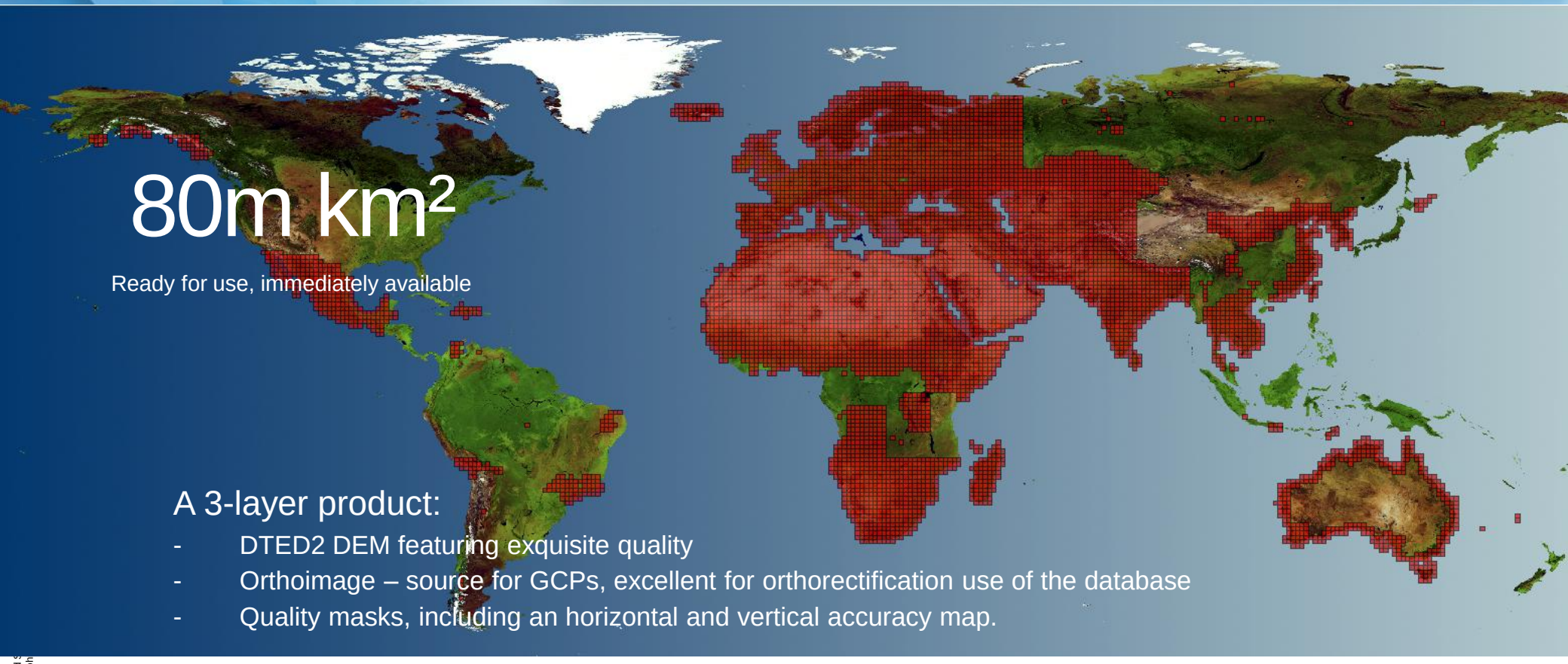
Elevation Product Line from now on

	Medium	High	Very High
Products	**Elevation30**	**WorldDEM** **Elevation10** **Elevation8**	**Elevation4** **Elevation1**
USPs	• Available off-the-shelf • External crediting of quality • QL masks & ortho image	• **WorldDEM**: guaranteed availability worldwide, low price • **Elevation10**: Guaranteed acquisition and delivery date • **Elevation8**: Fast delivery, low price	• External crediting • Fast delivery
Abs. Vertical Accuracy	**10m - w/o GCPs**	• **WorldDEM: 4m - w/o GCPs** • **Elevation10: 5m - w/o GCPs** • **Elevation8: 3m - GCPs**	• **Elevation4: 2m - GCPs** • **Elevation1: 1.5m - GCPs** (6 to 10m w/o GCPs)
Pixel spacing	**30m**	**12m, 10m, 8m**	**4m, 1m**
Minimum order size	**500** km²	• **WorldDEM: 500** km² (min width: **10** km) • **Elevation10: 500** km² (min width: **20** km) • **Elevation8: 1000** km² (min width: **20** km)	• **Elevation4: 100** km² (min width: **10** km) • **Elevation1: 100** km² (min width: **10** km)
Key Applications	**Global mapping** **Orthorectification** **Defence systems (now)**	**Global mapping and large area updates** **Orthorectification** **Defence systems (future)**	**Infrastructure planning (O&G: pipelines), Cities, target identification**

Elevation30 – Off-the-Shelf Coverage



80m km²

Ready for use, immediately available

A 3-layer product:

- DTED2 DEM featuring exquisite quality
- Orthoimage – source for GCPs, excellent for orthorectification use of the database
- Quality masks, including an horizontal and vertical accuracy map.

They tested our performances…

DEM Performances:

- FOMI (Hungary): **5.4m LE90** vs. 10m LE90 spec.

Orthorectification Performances:

- Orthoimage production in Australia: **0 to 6m CE90** vs. 6 to 10m CE90 spec.

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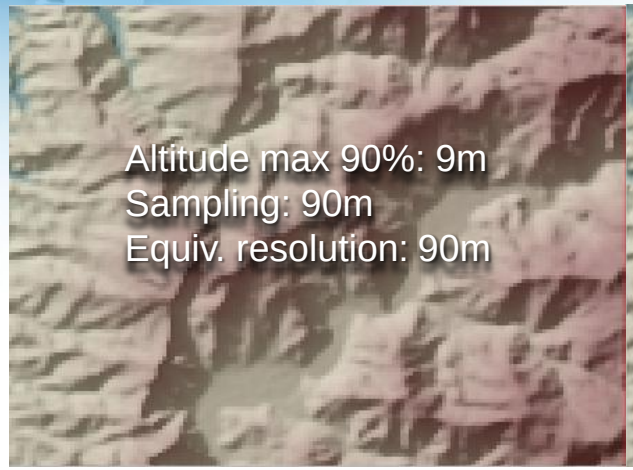
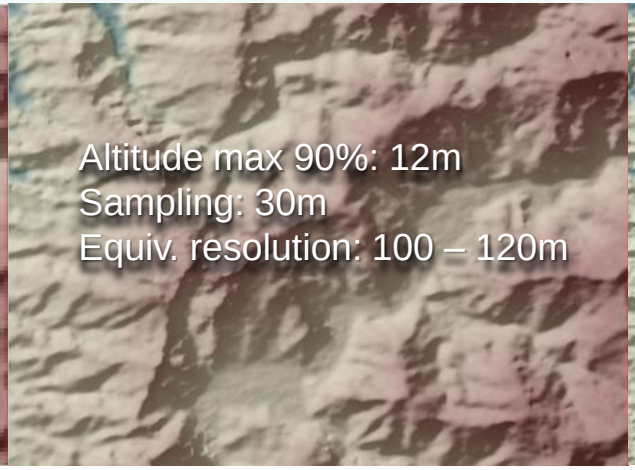
Latest Global DEM Evaluation Performed by IGN / DEM Samples Landforms

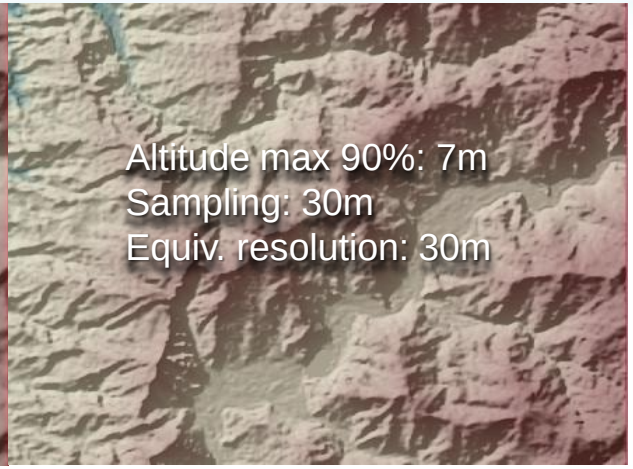
STRM



GDEM V2

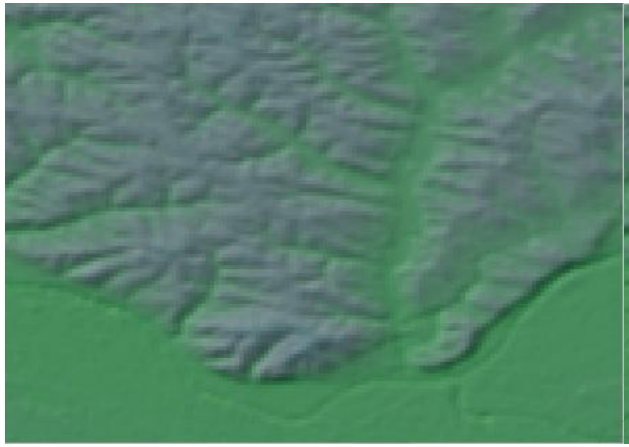


Elevation30

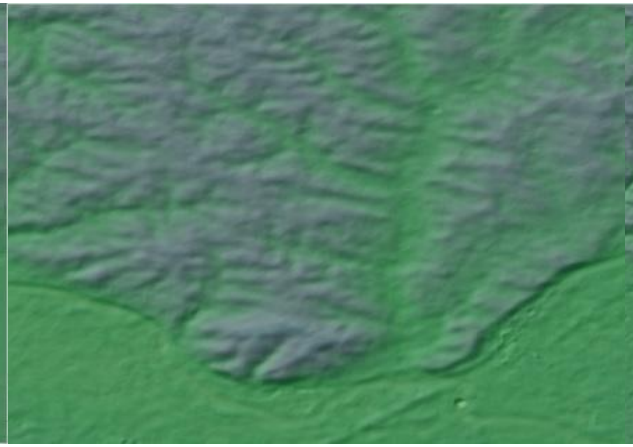


Mountains

STRM



GDEM V2

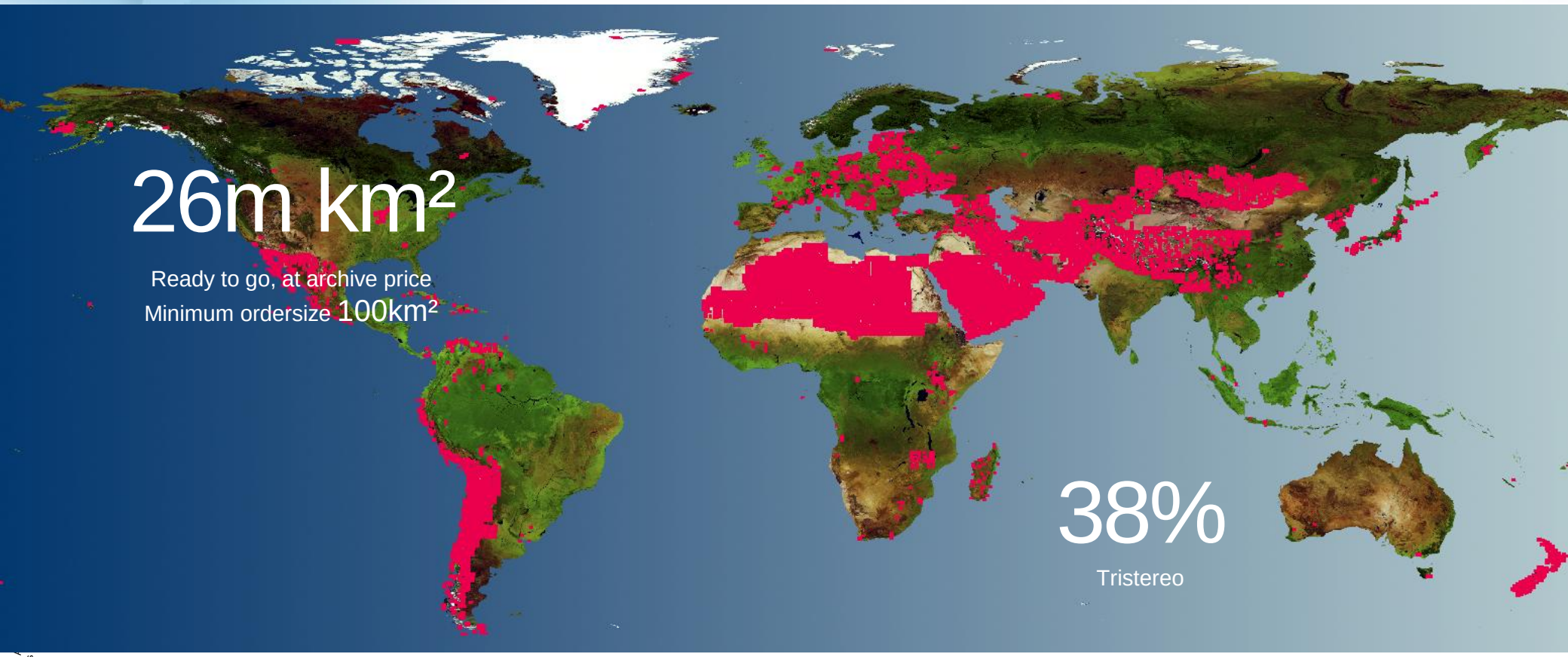


Elevation30

Rolling Hills

DEFENCE & SPACE

Elevation8 – Stereo Coverage



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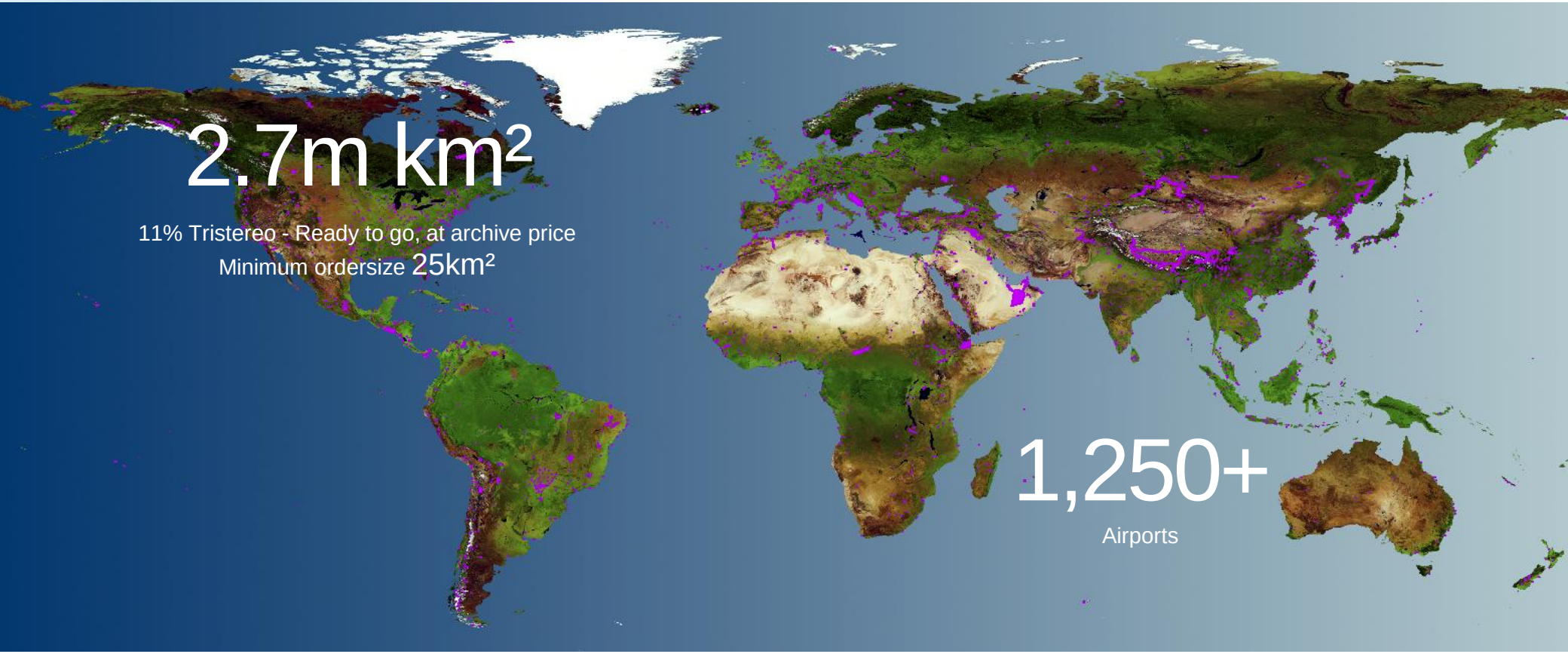
Elevation4/1 – Stereo Coverage



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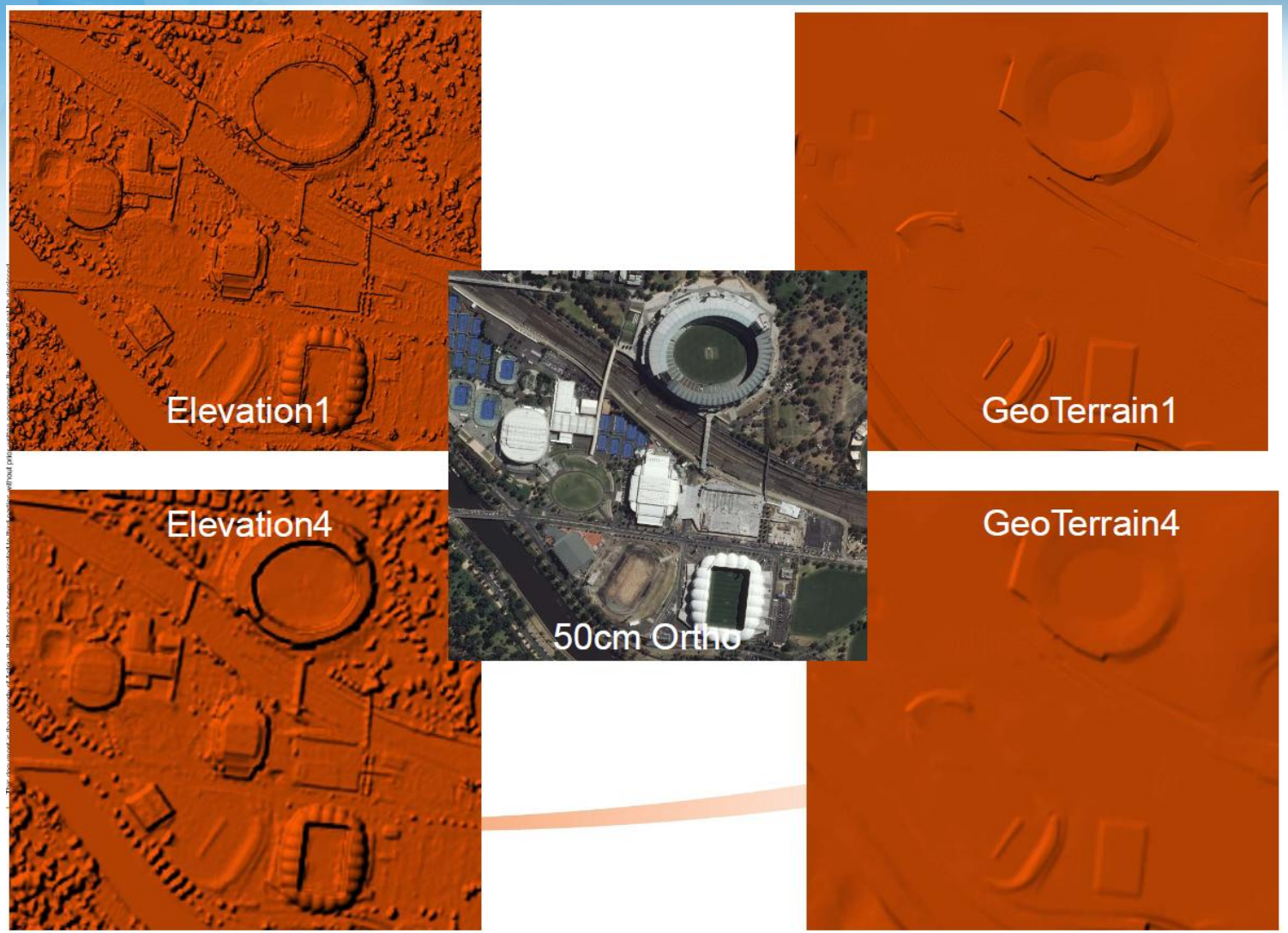
Elevation 1 & 4 – DTM and DEM Products



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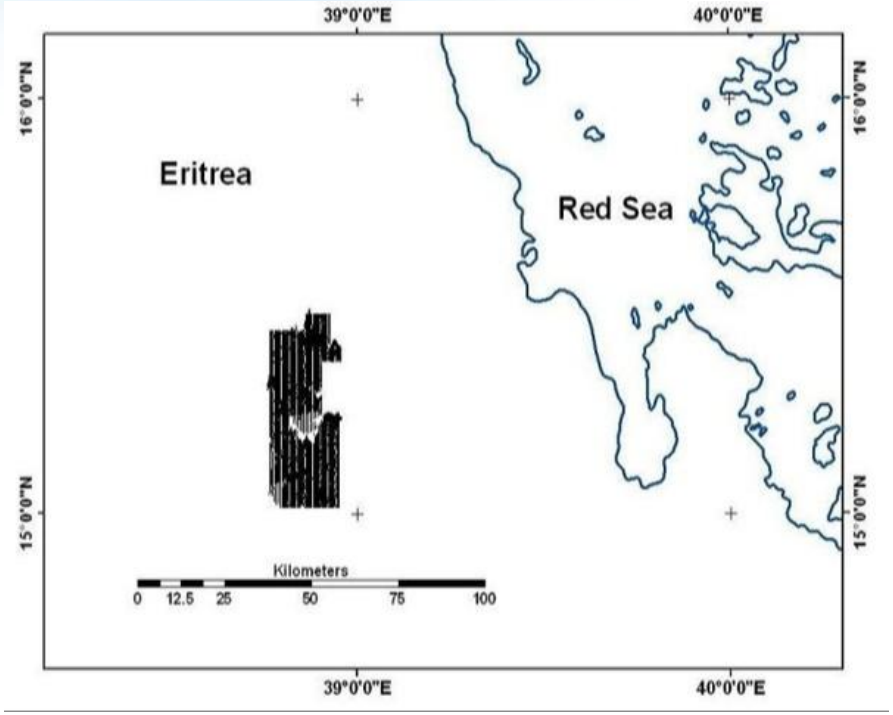
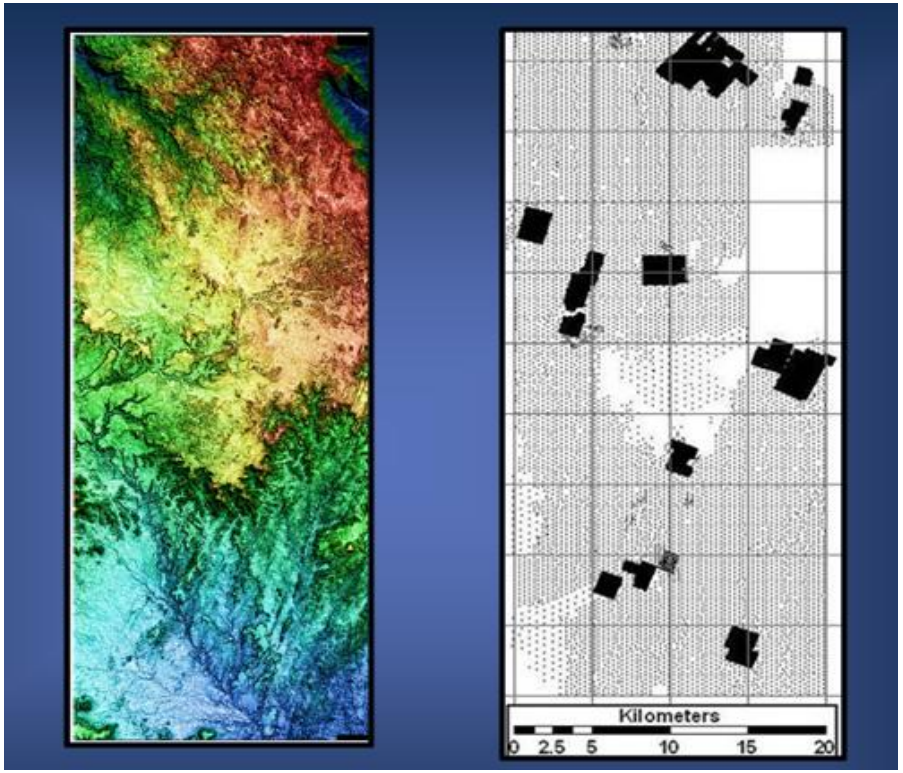
Stereo Pléiades Accuracy Study performed by PhotoSat
45,000 ground survey points, Asmara Eritrea



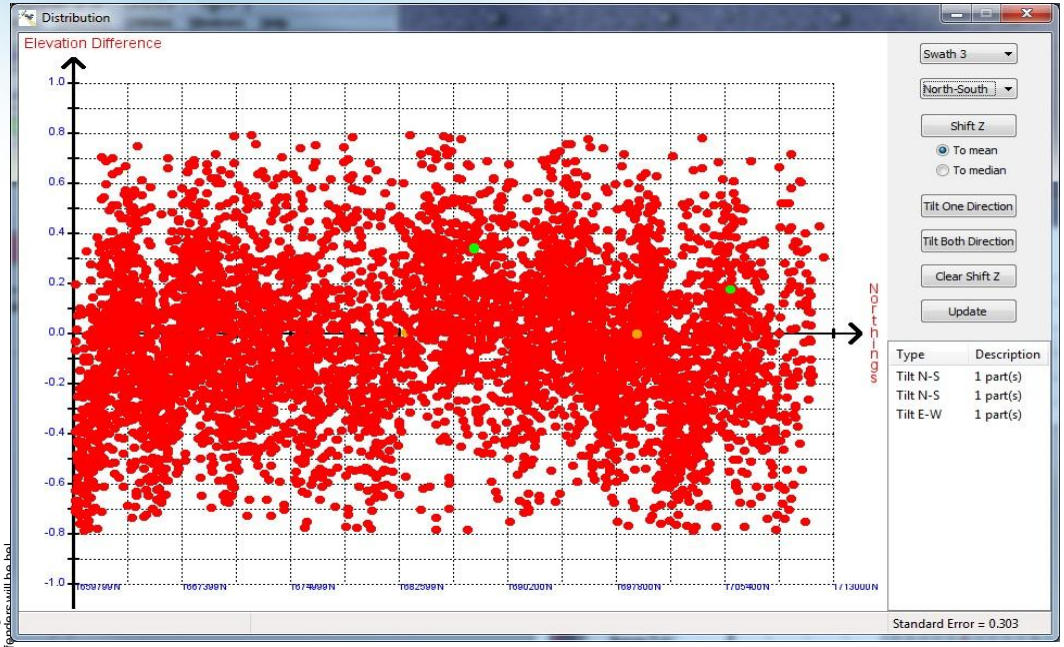


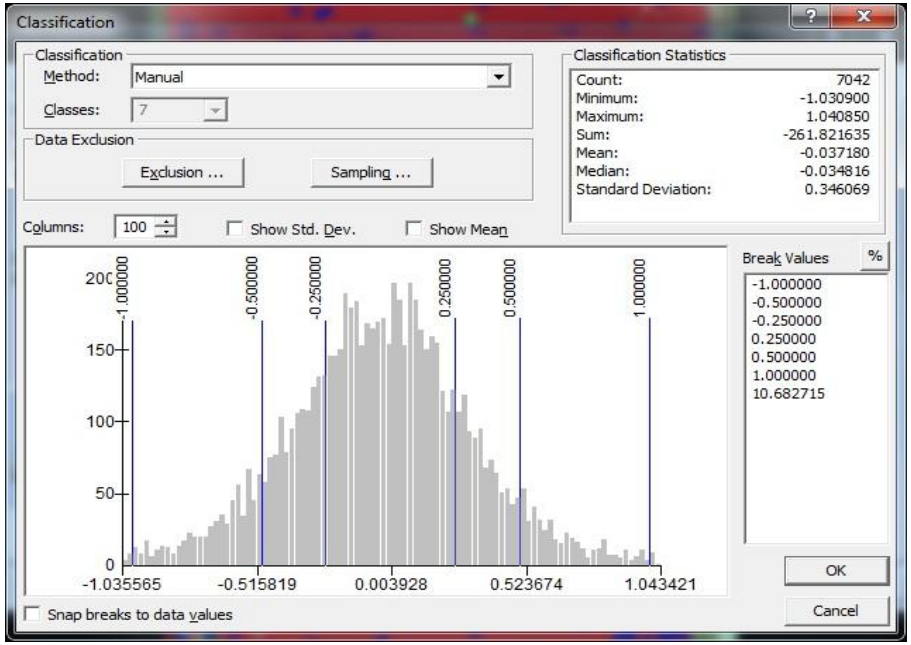
Elevation1

Ground Survey points

AIRBUS DEFENCE & SPACE

Stereo Pléiades Accuracy Study performed by PhotoSat 45,000 ground survey points, Asmara Eritrea





Producing E1 with one point, the reached accuracy is **0,34m rms** or **0,60m LE90**

Comparision made to **45 000 GCPs** (2cmLE90)

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Ortho Premium, DEM and DTM: Chicago

AIRBUS
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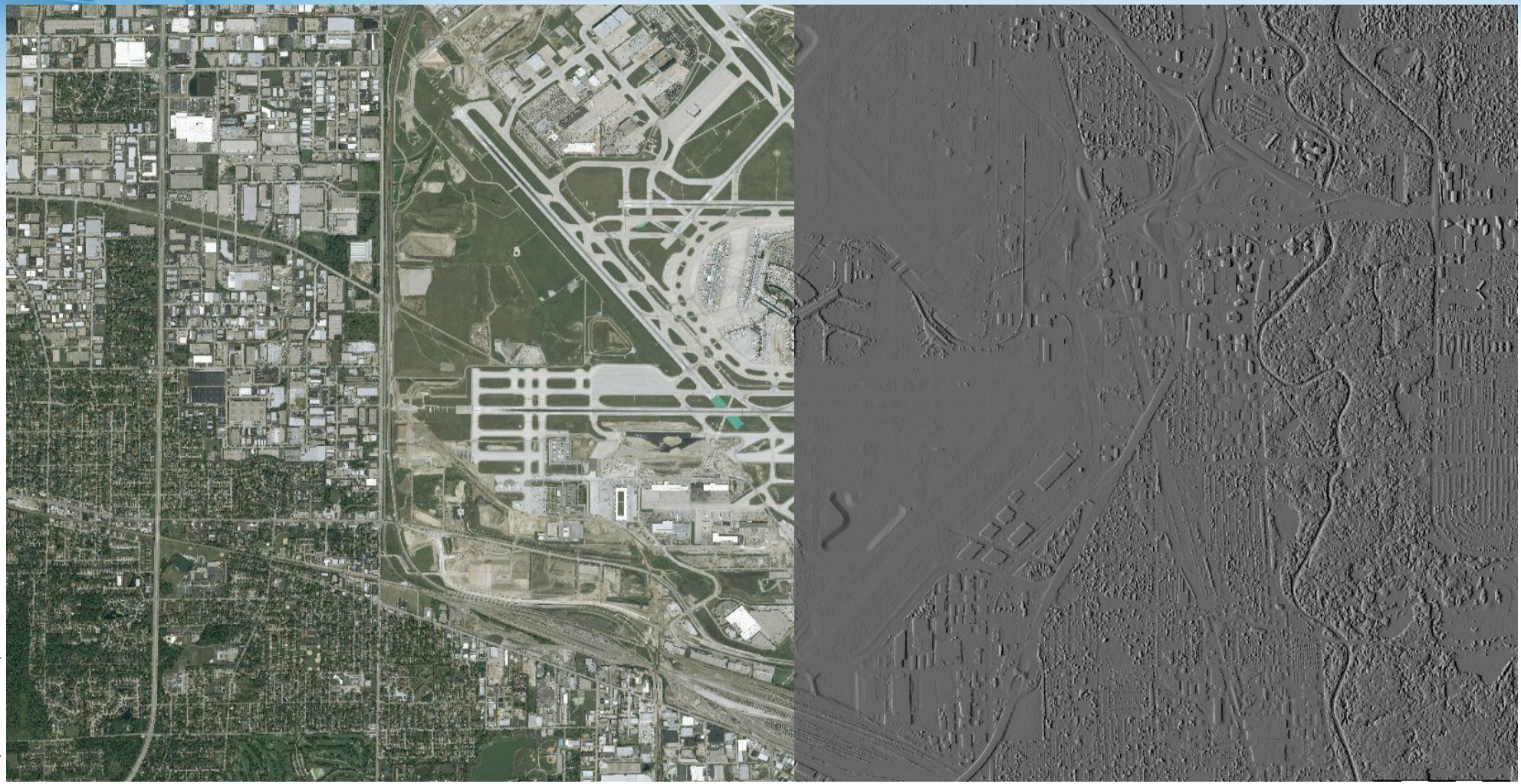
Ortho Premium, DEM and DTM: Chicago



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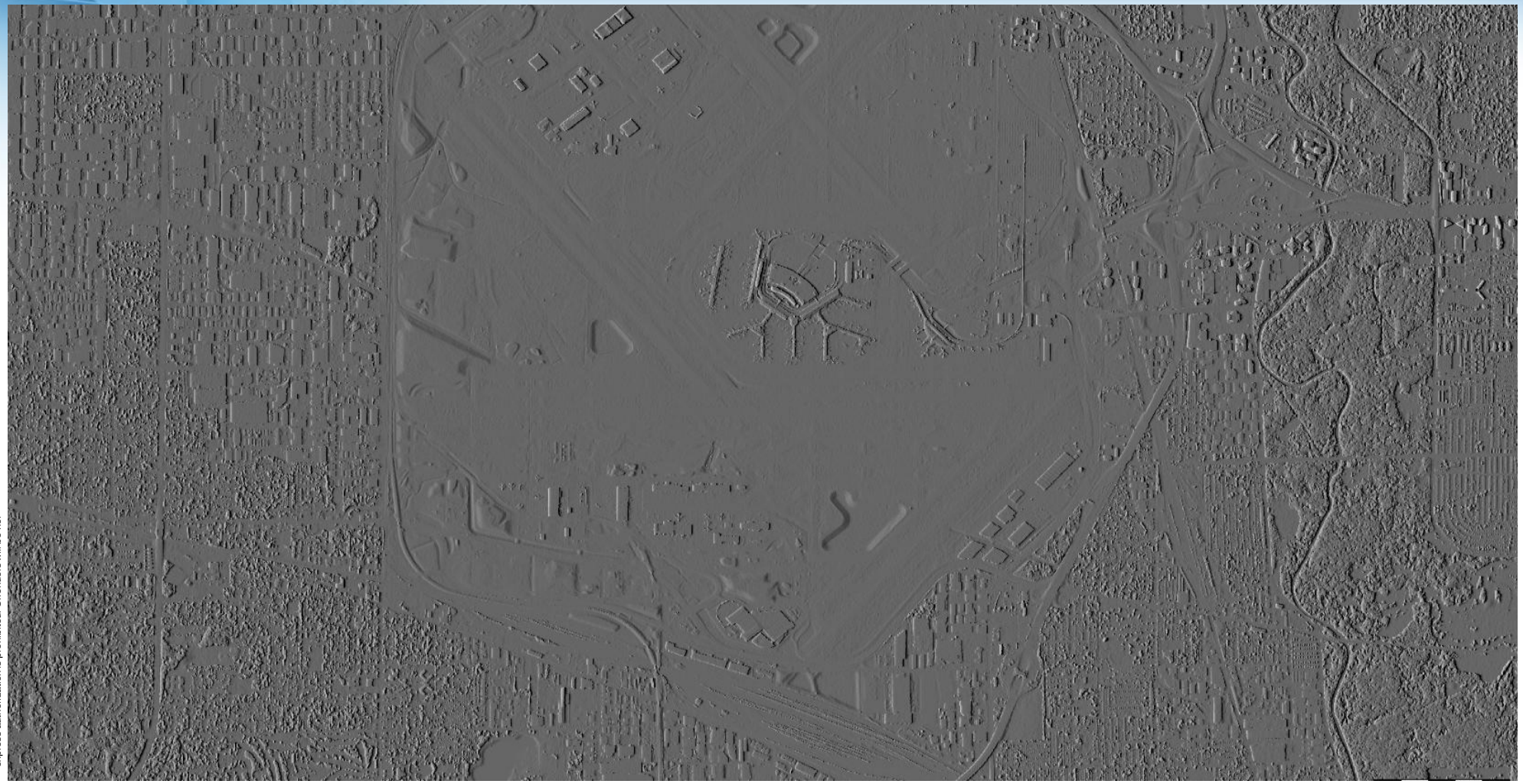
Ortho Premium, DEM and DTM: Chicago



AIRBUS
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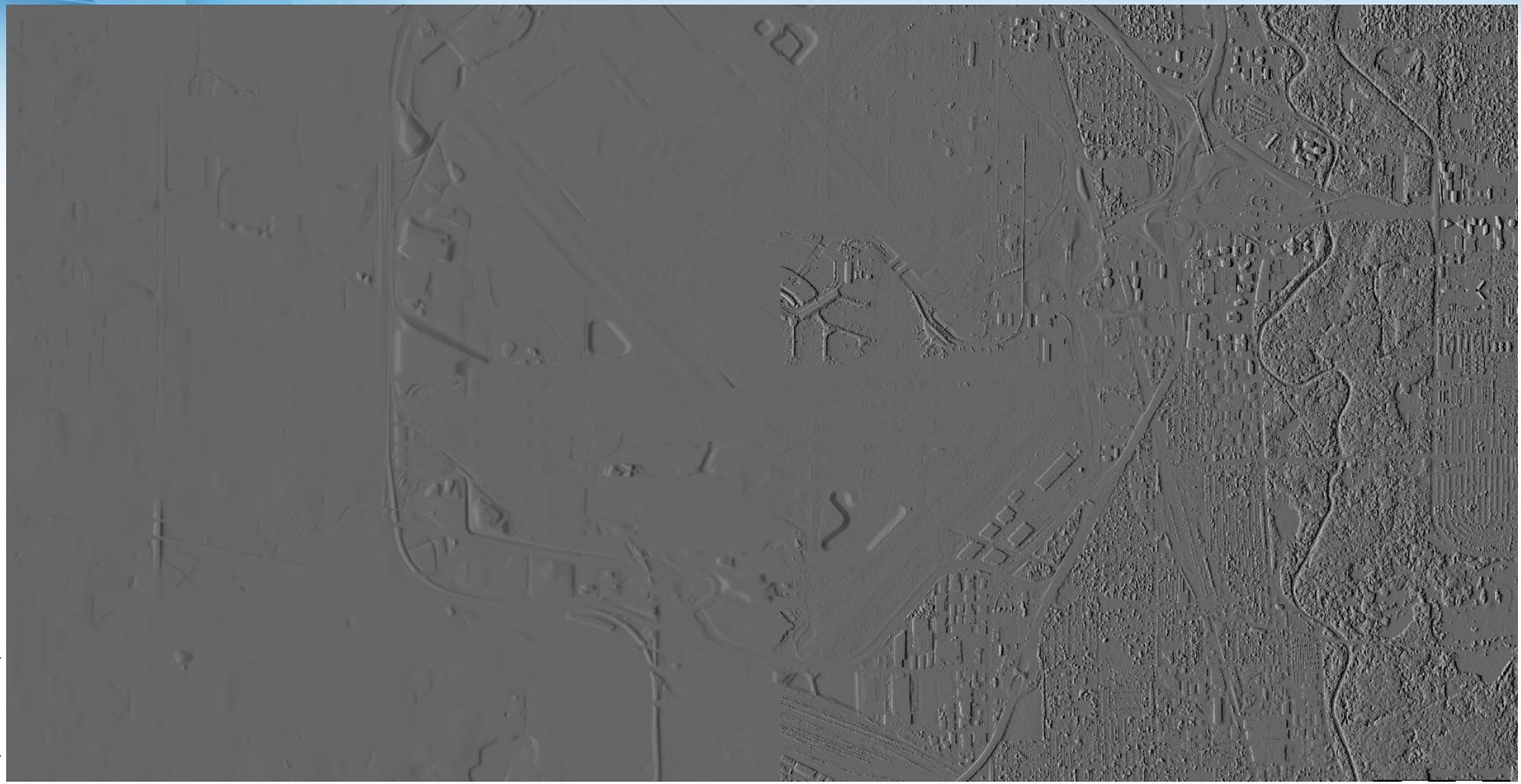
Ortho Premium, DEM and DTM: Chicago



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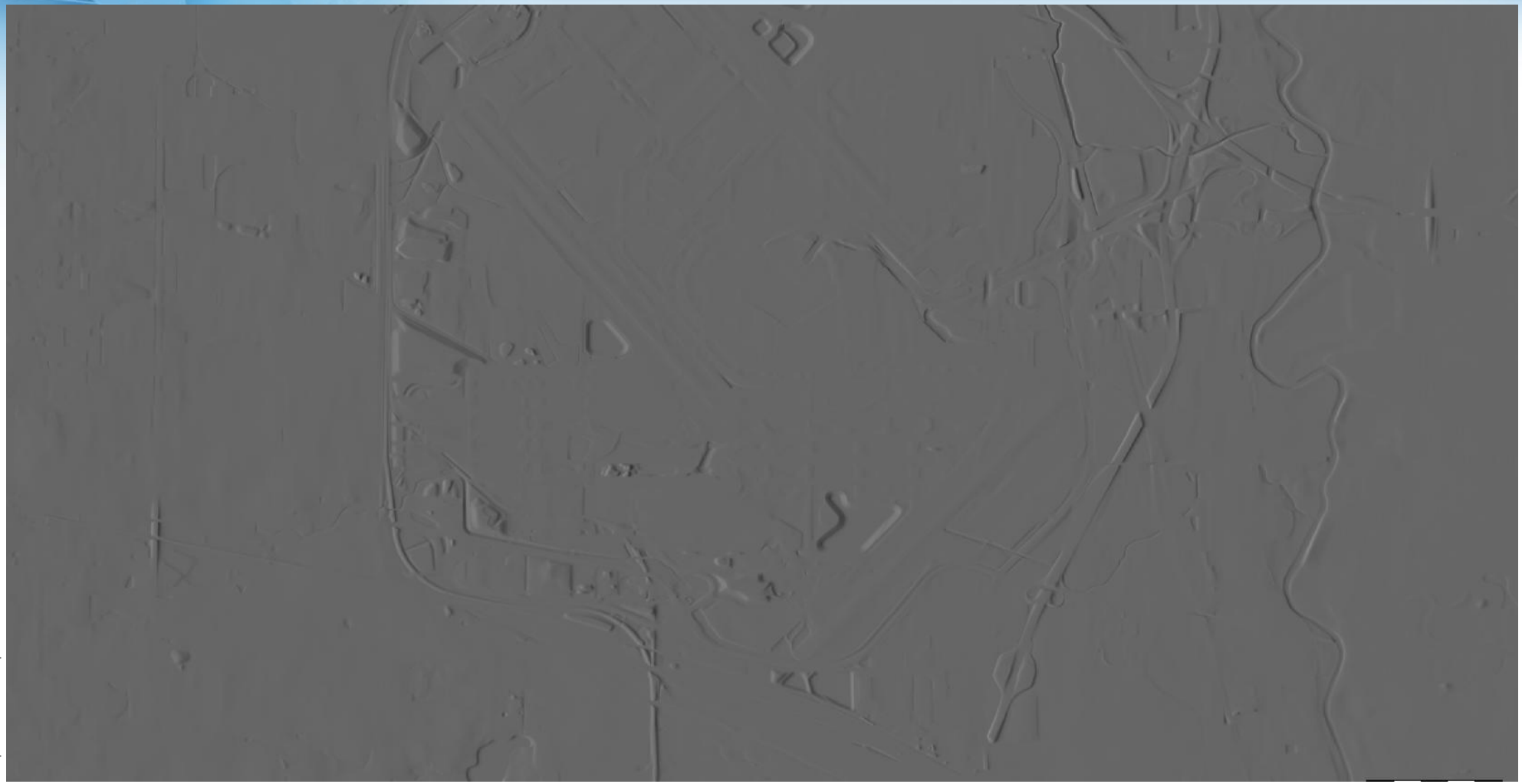
Ortho Premium, DEM and DTM: Chicago



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Elevation 1 DEM – Example

… Mashhad (Ortho)

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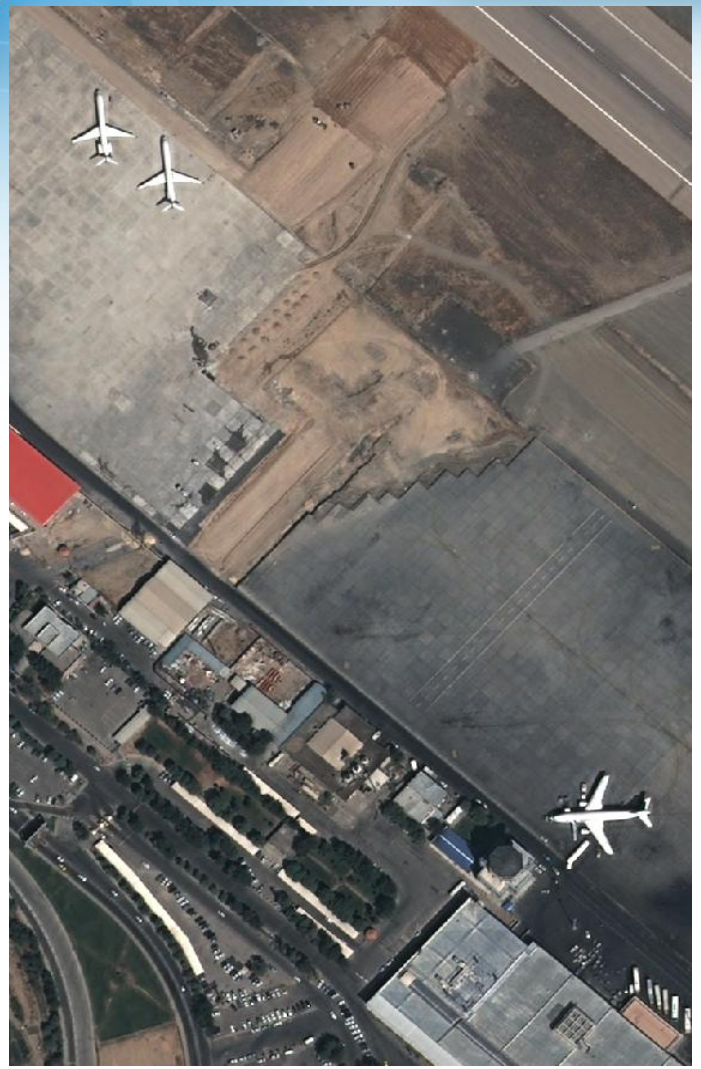
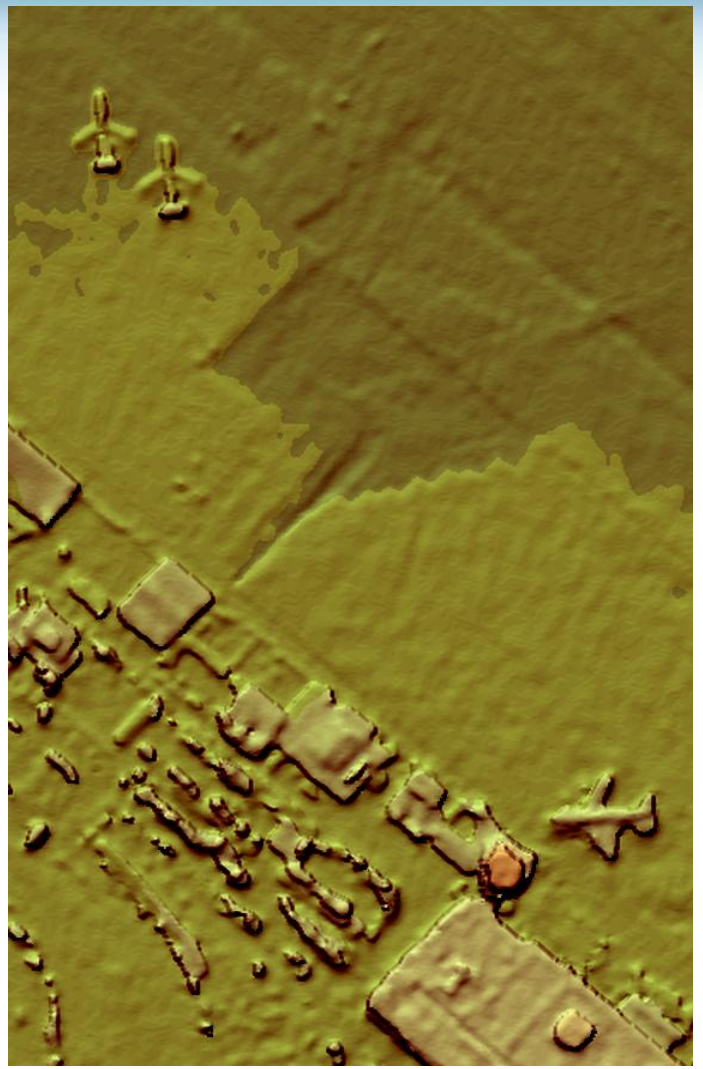
Elevation1 – Sample Mashhad



Ortho Image



Elevation1

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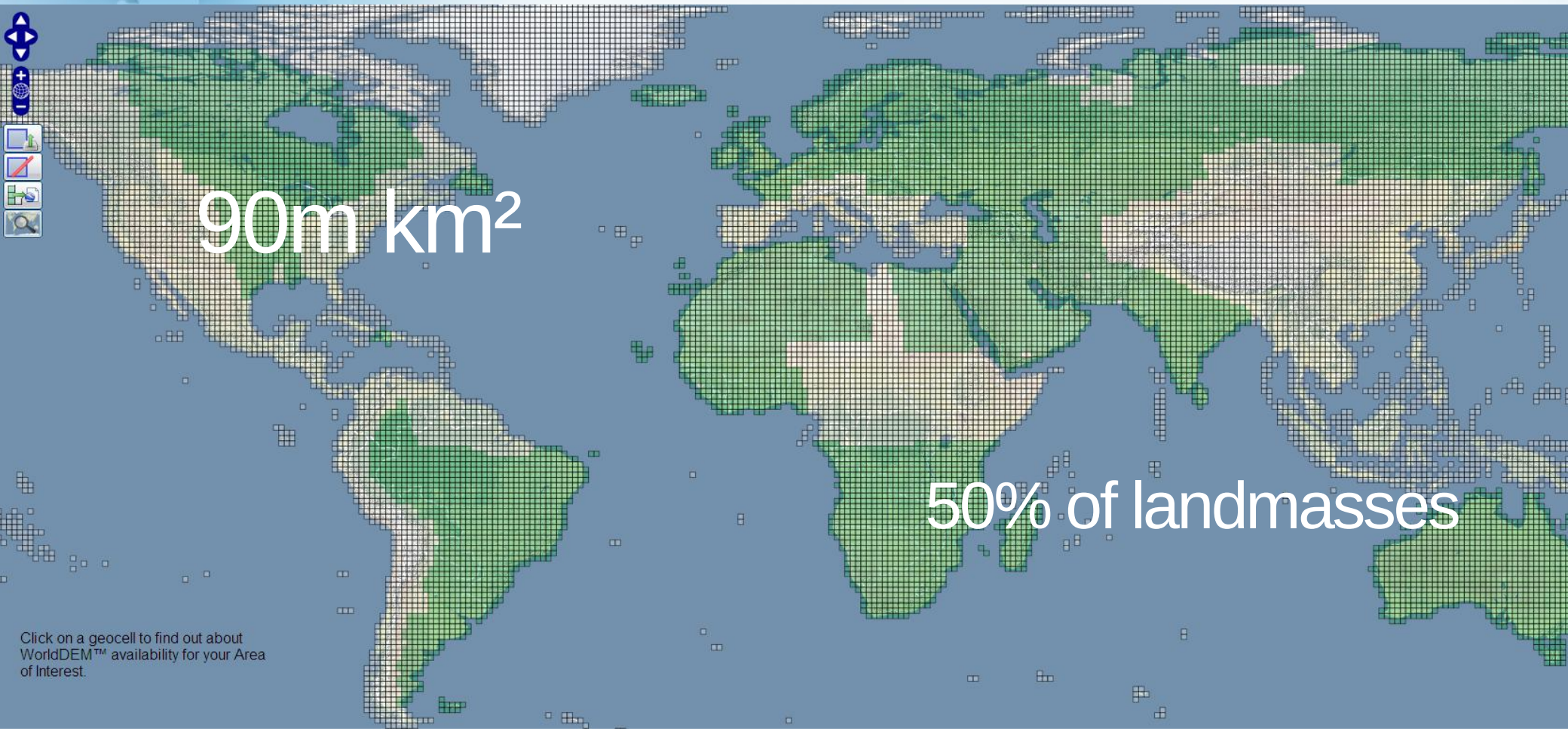
WorldDEM: Availability



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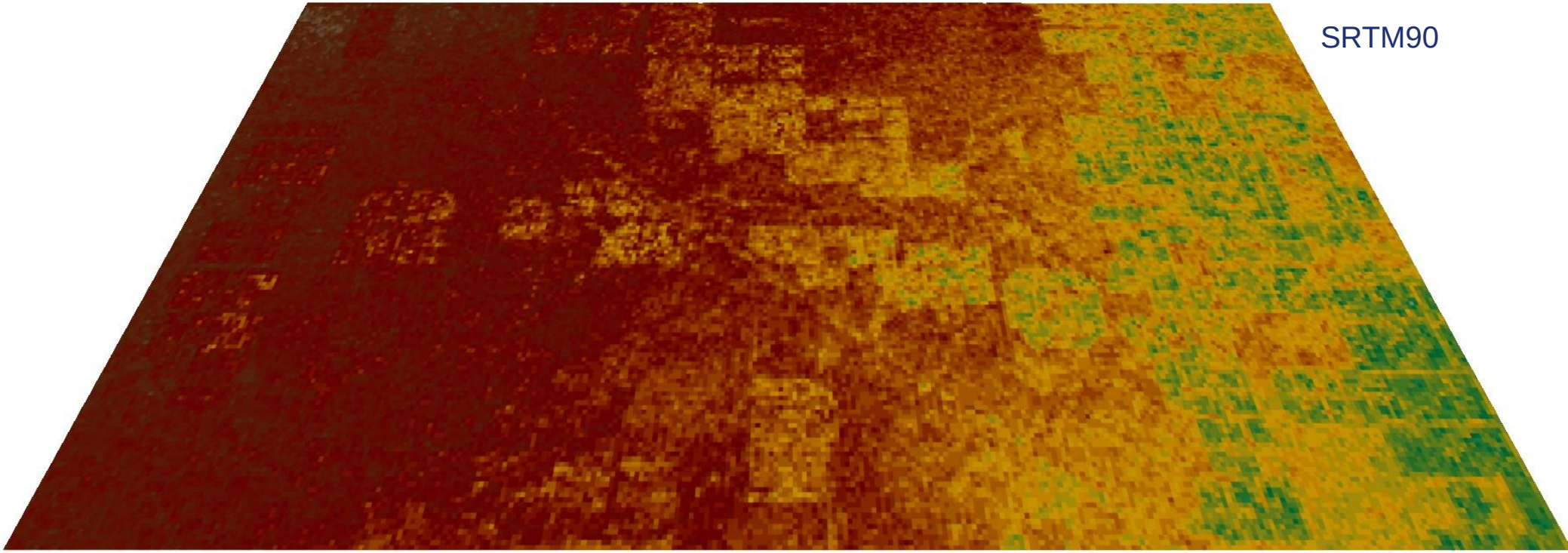
Update on WorldDEM: Quality

Level of Detail

Paraguay, NW of Filadelfia



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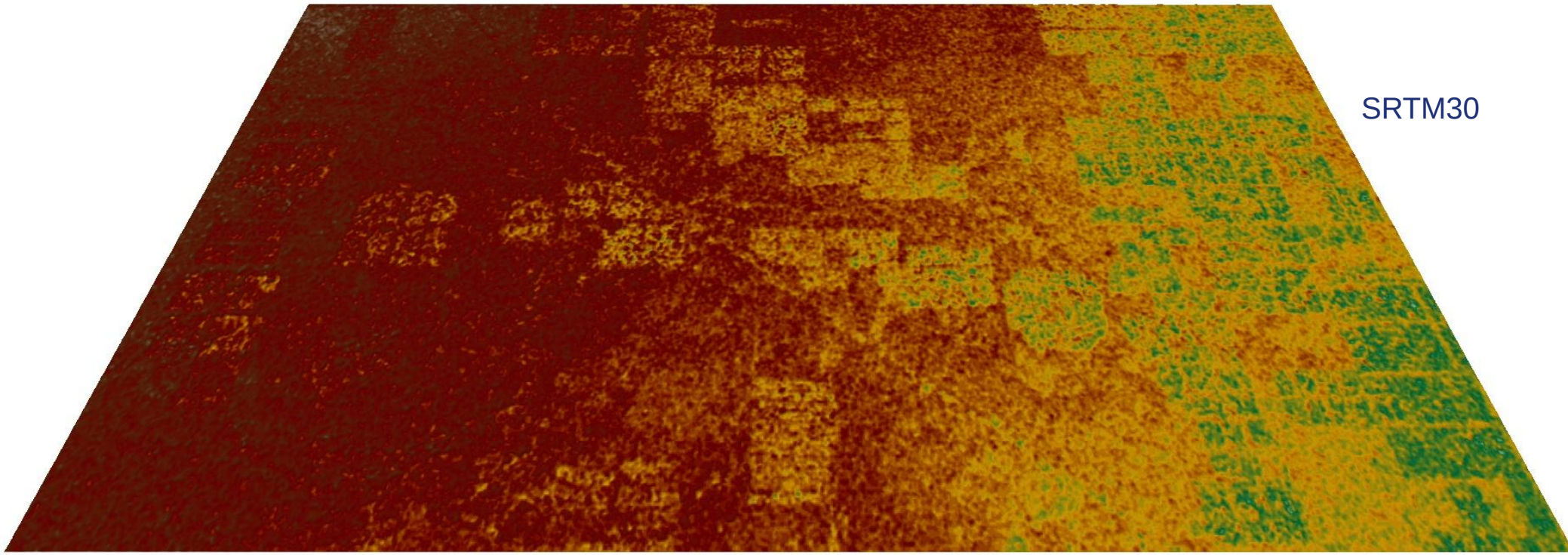
Update on WorldDEM: Quality

Level of Detail

Paraguay, NW of Filadelfia



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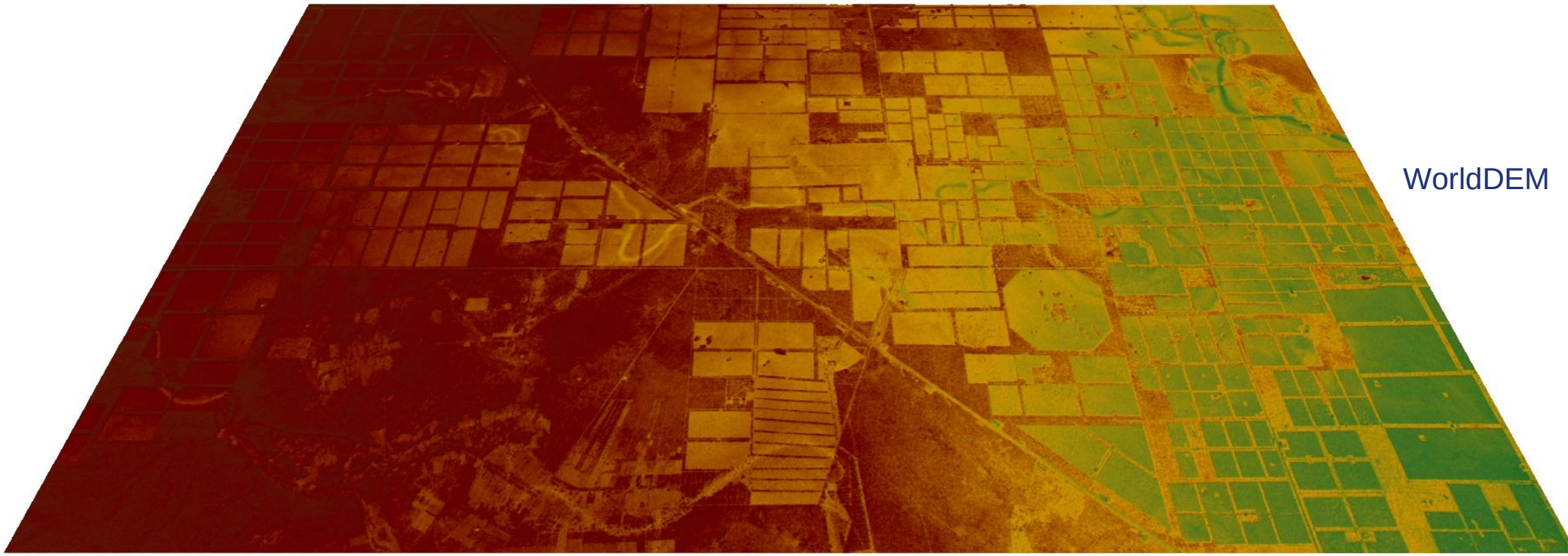
Update on WorldDEM: Quality

Level of Detail

Paraguay, NW of Filadelfia



WorldDEM

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Utilisation des MNE-MNT en agriculture / environnement

AIRBUS
DEFENCE & SPACE

Intégration dans les chaines de calcul biophysique

Acquisition

Image brute en luminance

Correction atmosphérique

Image en réflectance

Inversion biophysique

Modèle de transfert radiatif

Images de paramètres **biophysiques**

Segmentation

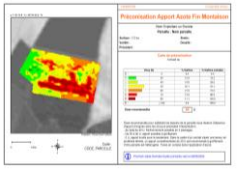
Contours des parcelles

Modélisation

Images de paramètres **agronomiques**

Expertise

Mise en forme



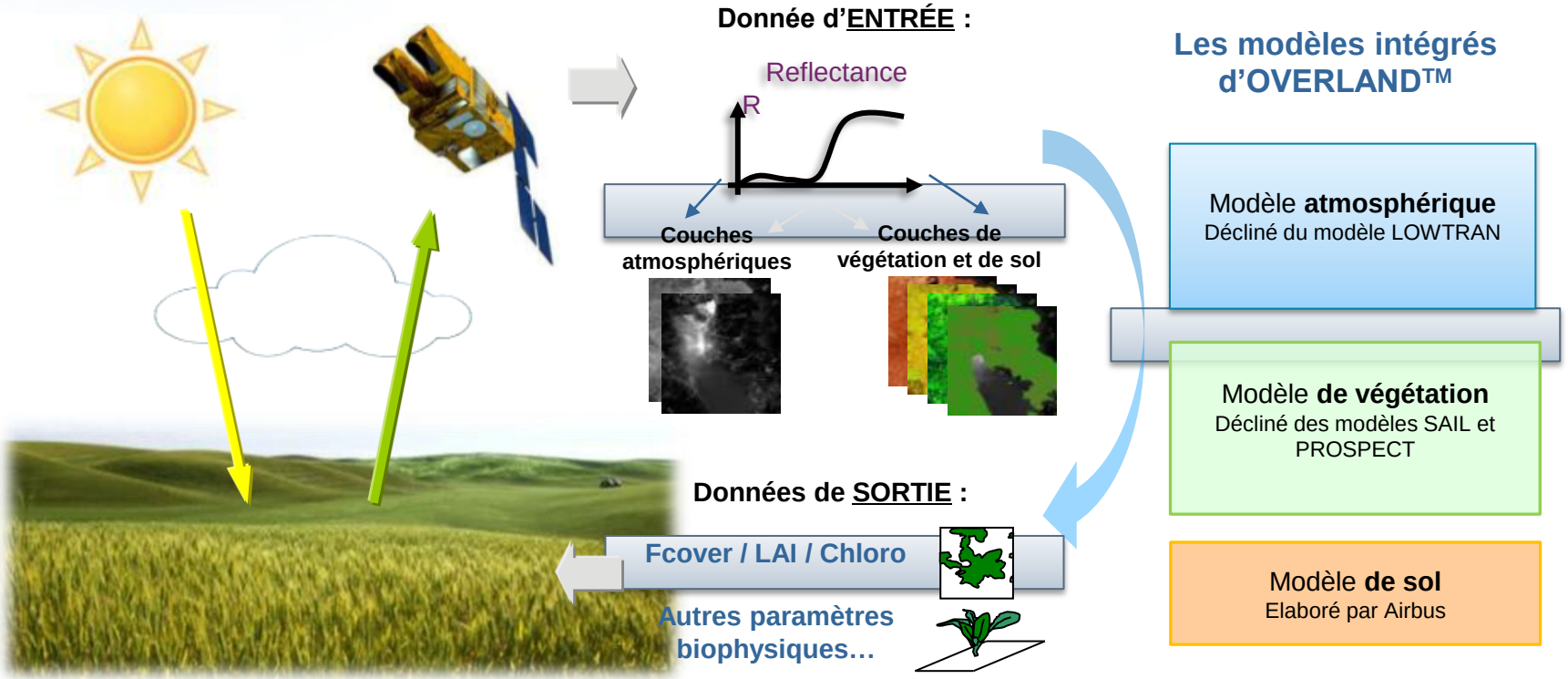
Conseil à la parcelle

AIRBUS DEFENCE & SPACE

Traitement des images par la chaîne automatisée Overland ™

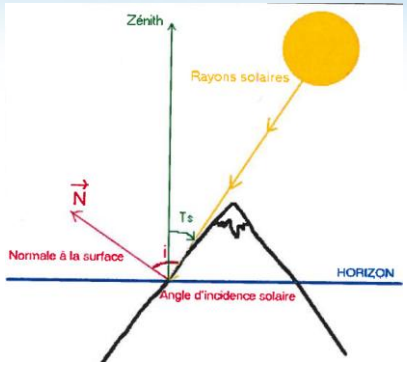
Overland est un ensemble de modèles, basé sur la comparaison de l'imagerie avec la mesure terrain. Ces modèles sont dérivés de méthodes existantes utilisées par la communauté scientifique, et adaptés par Airbus Defence & Space pour des applications opérationnelles.

Après des années de mise au point à l'aide de mesures terrain réalisées simultanément à l'acquisition d'images satellites, une inversion de modèle permet aujourd'hui de générer les paramètres biophysiques d'une culture à partir de la réflectance optique mesurée par satellite.



AIRBUS DEFENCE & SPACE

La correction topographique et inversion biophysique



- cas d'intérêt de la correction topographique
  - zone montagneuse ou collines avec forte variation de la pente au soleil
  - faibles variations de pente mais soleil bas (cas Farmstar en hiver)
- variables affectées
  - pour les cultures : LAI via la variation de brillance apparente du couvert
  - pour la forêt / le Land Cover : facteur d'ombrage du couvert
- 2 options disponibles dans le menu
  - pré-correction topographique sur la réflectance calculée initialement ('Top-of-Cloud') de type Minnaert classique : suffisant dans de très nombreux cas
  - pour cas complexes avec pentes et nuages: correction intégrée dans la modélisation biophysique

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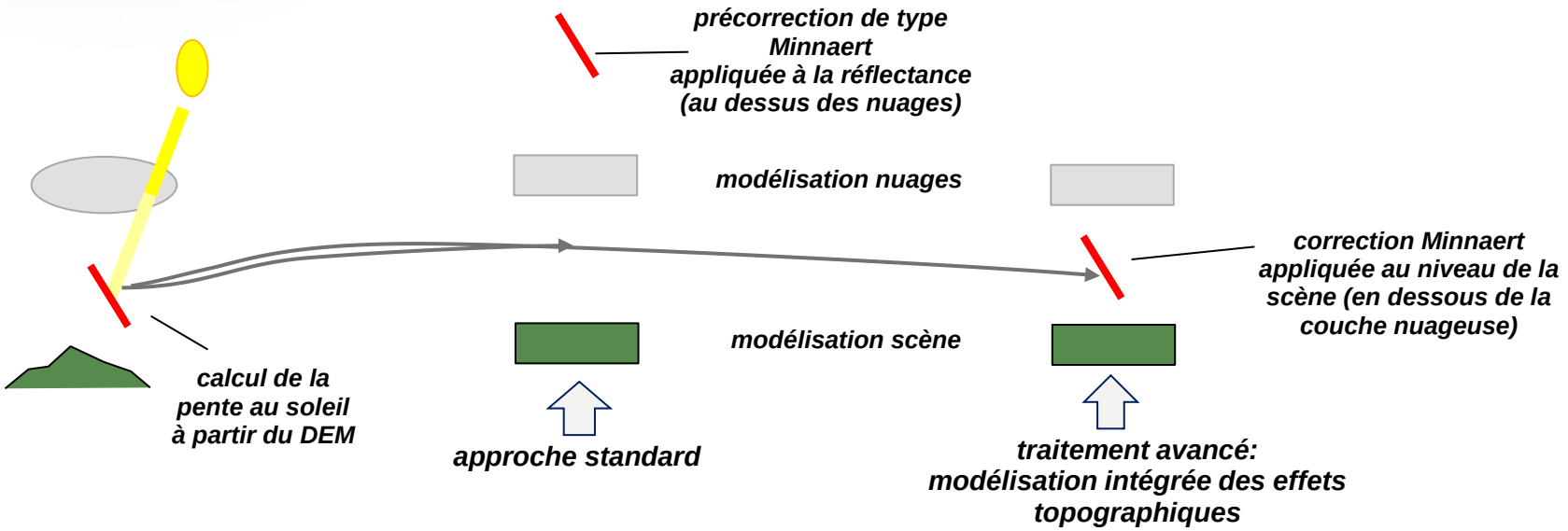
Correction topographique avancée

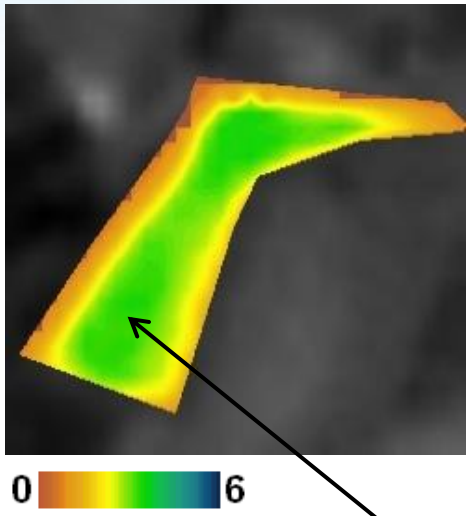
Ceci est possible en cartographiant l'information *'slope to sun'* (ou *'relative sun illumination'*) et en l'utilisant comme couche d'information supplémentaire en entrée du traitement biophysique



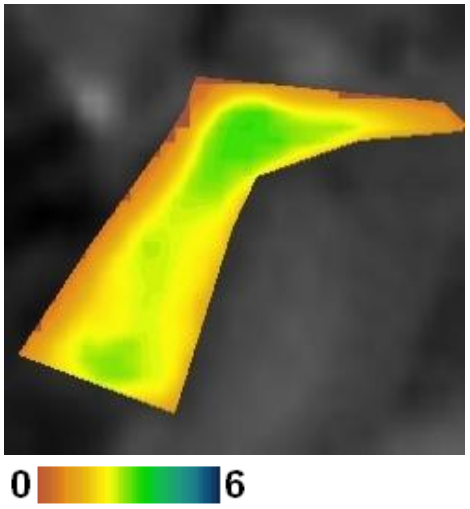
AIRBUS DEFENCE & SPACE

Exemple de l’impact sur une parcelle agricole

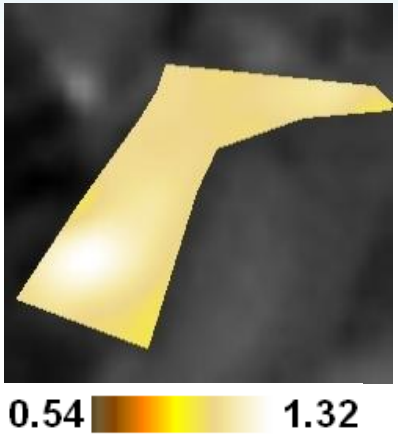
LAI – Sans SRTM
PARC : E-552609-4



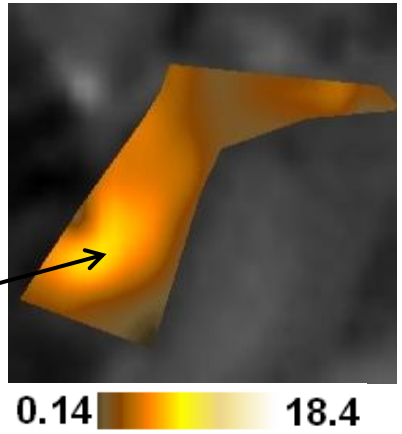
LAI – Avec SRTM
PARC : E-552609-4



Illumination relative



Pente calculée



Sans traitement avec SRTM, le LAI est plus important là où il y a de la pente : effet d’illumination

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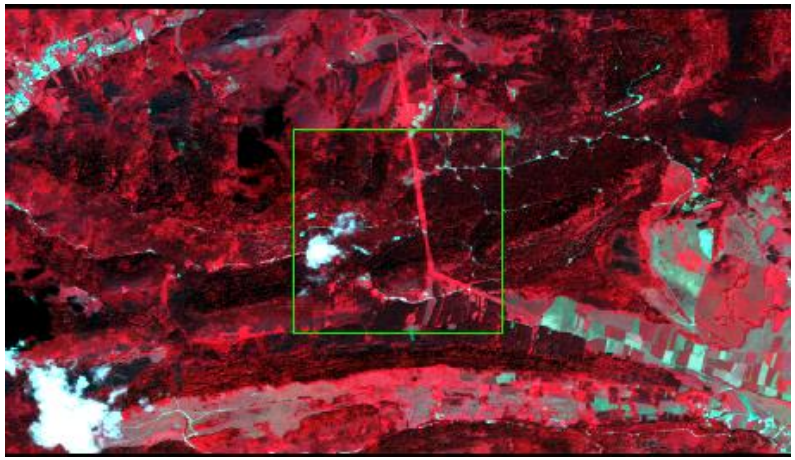
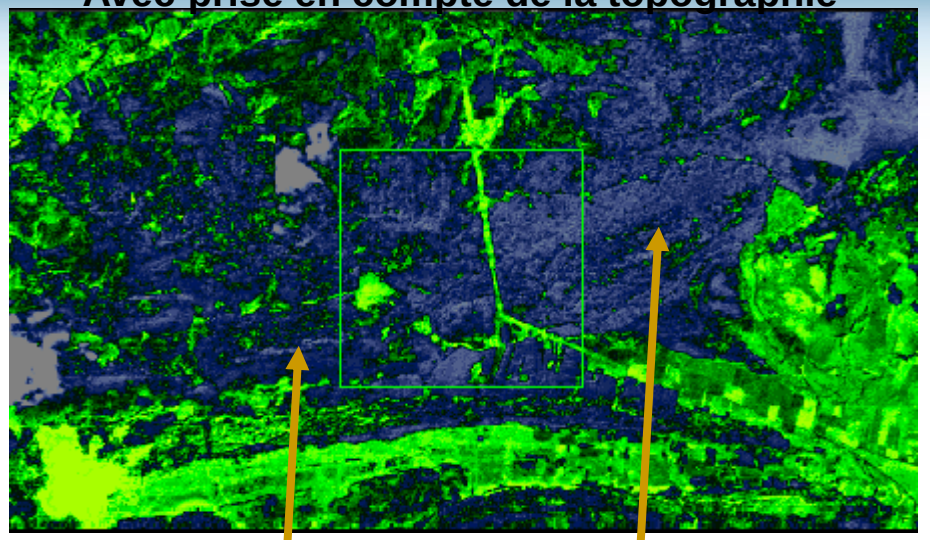
Exemple de l'impact sur un couvert forestier en zone accidentée

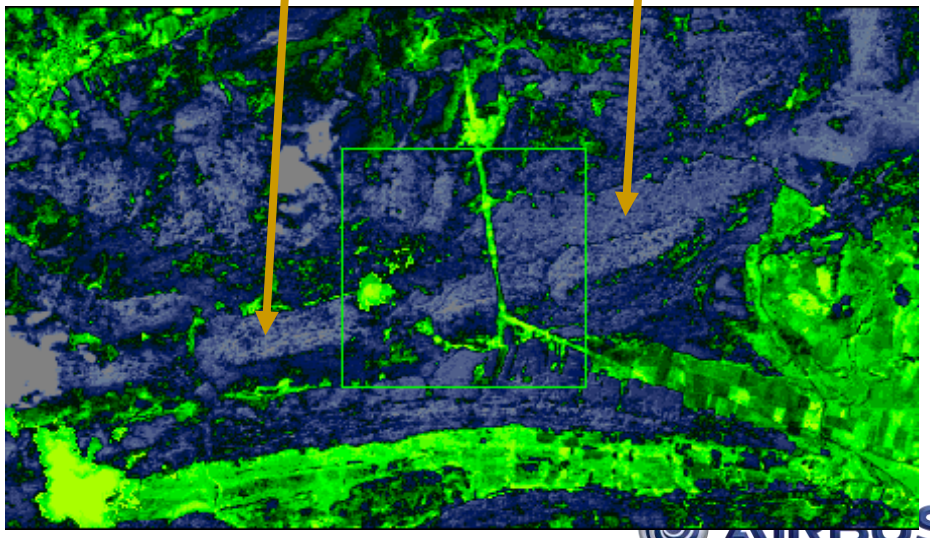
- **Intégration de la topographie dans la génération des plans biophysiques :**
  - **On peut ainsi dissocier les zones de feuillus qui étaient sur le versant à l'ombre dans la zone d'étude**



Avec prise en compte de la topographie



Sans



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Exemple d’une simulation de scénario environnemental

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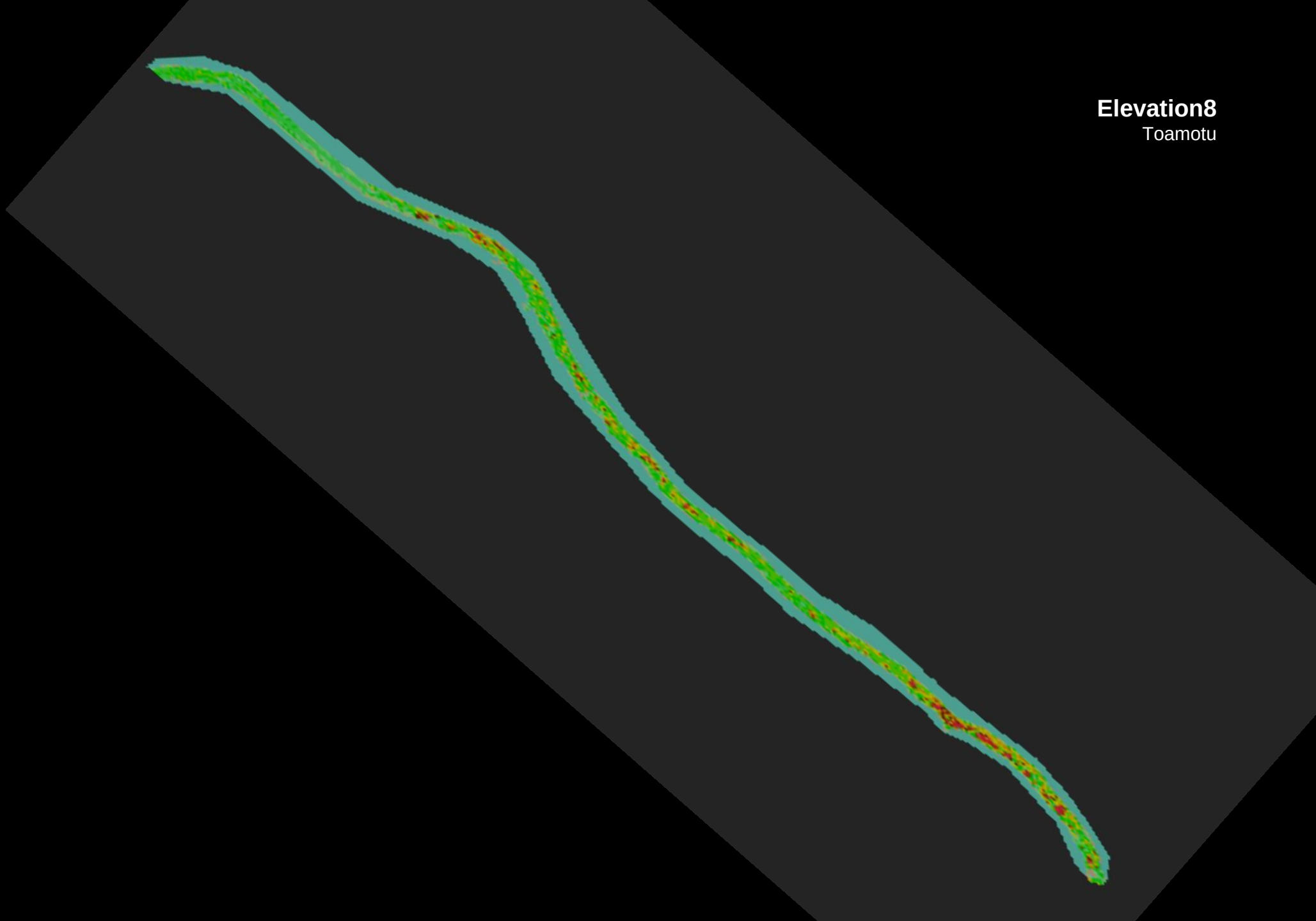
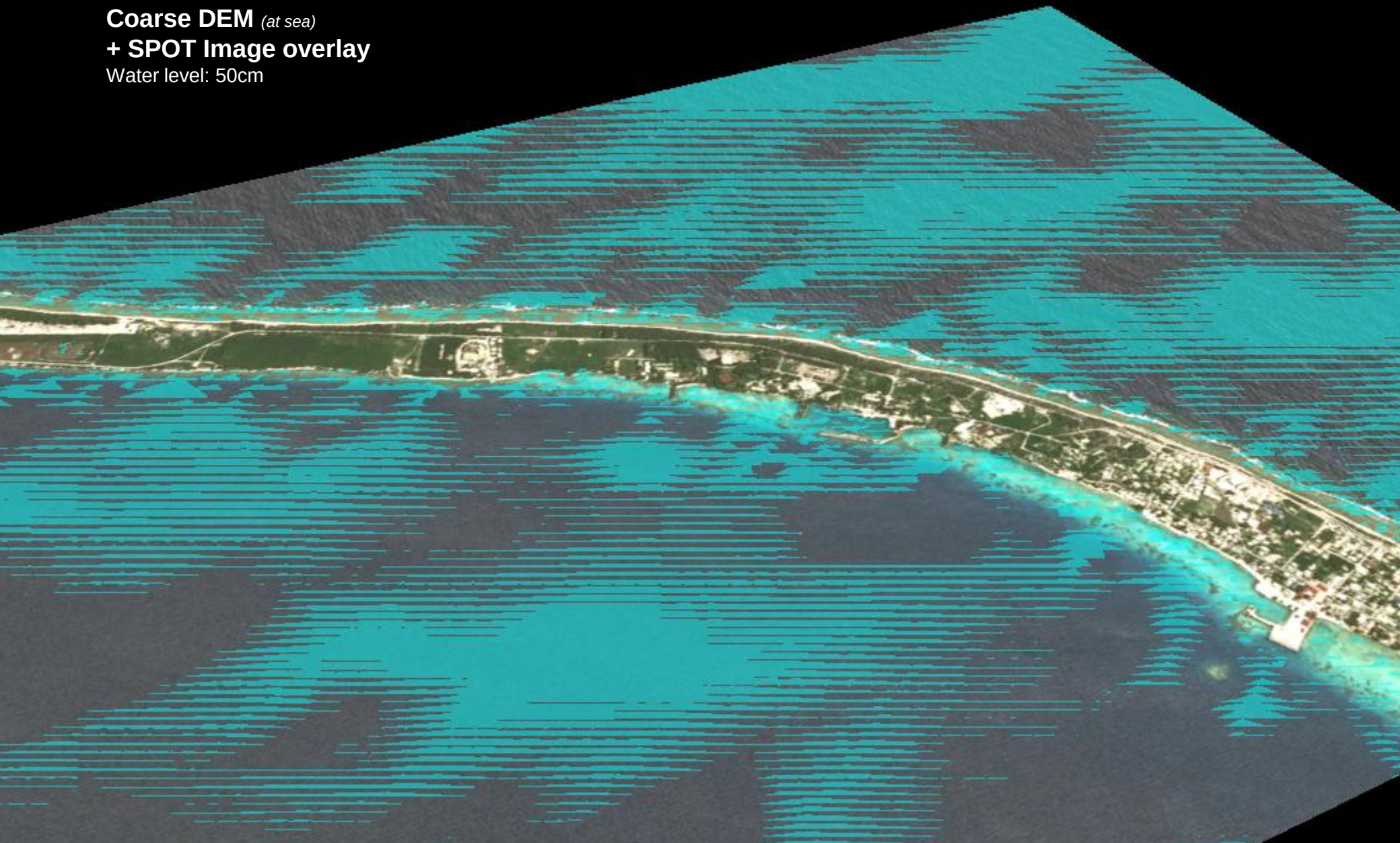
SPOT Stereo
Toamotu

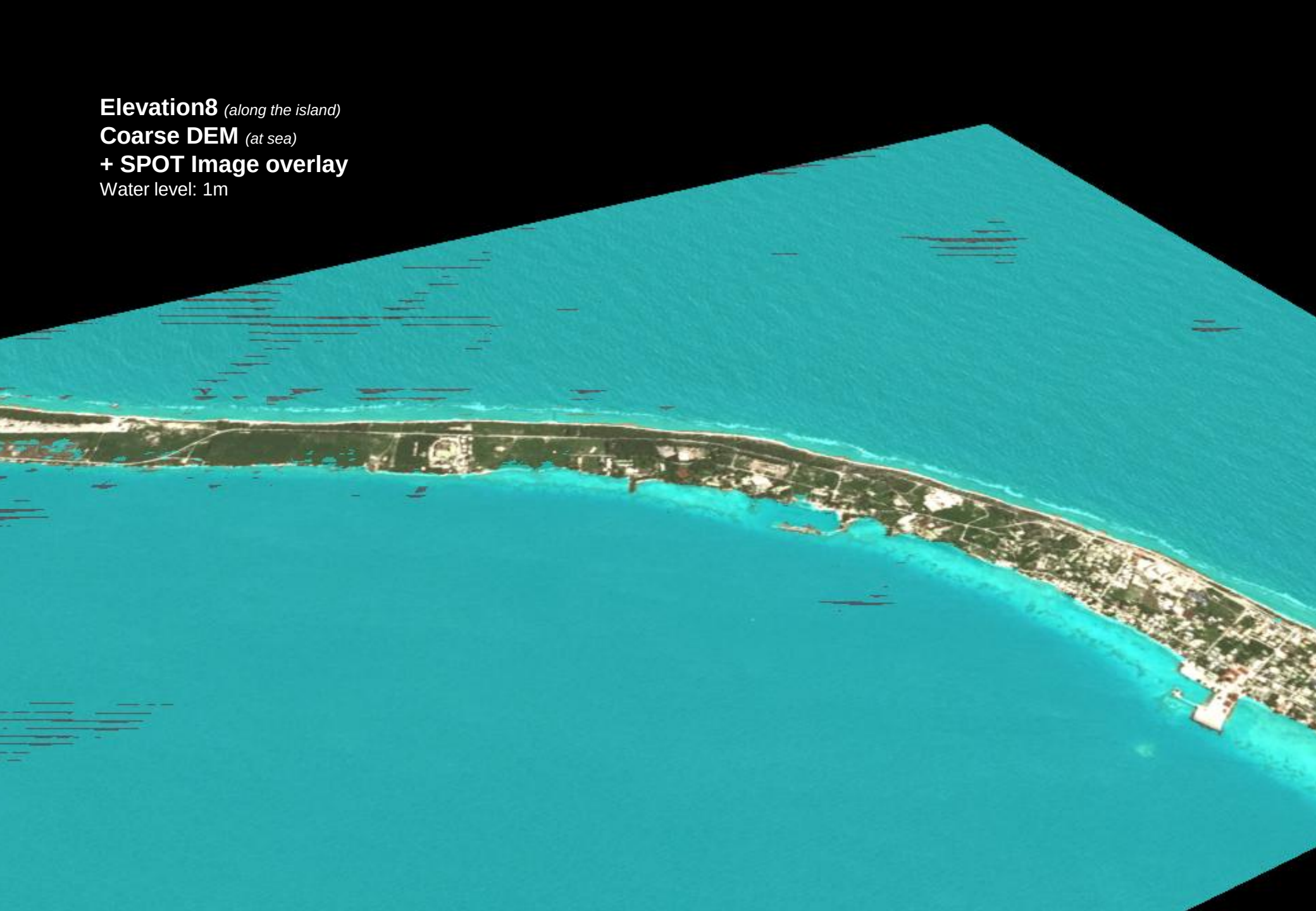

Elevation8
Toamotu

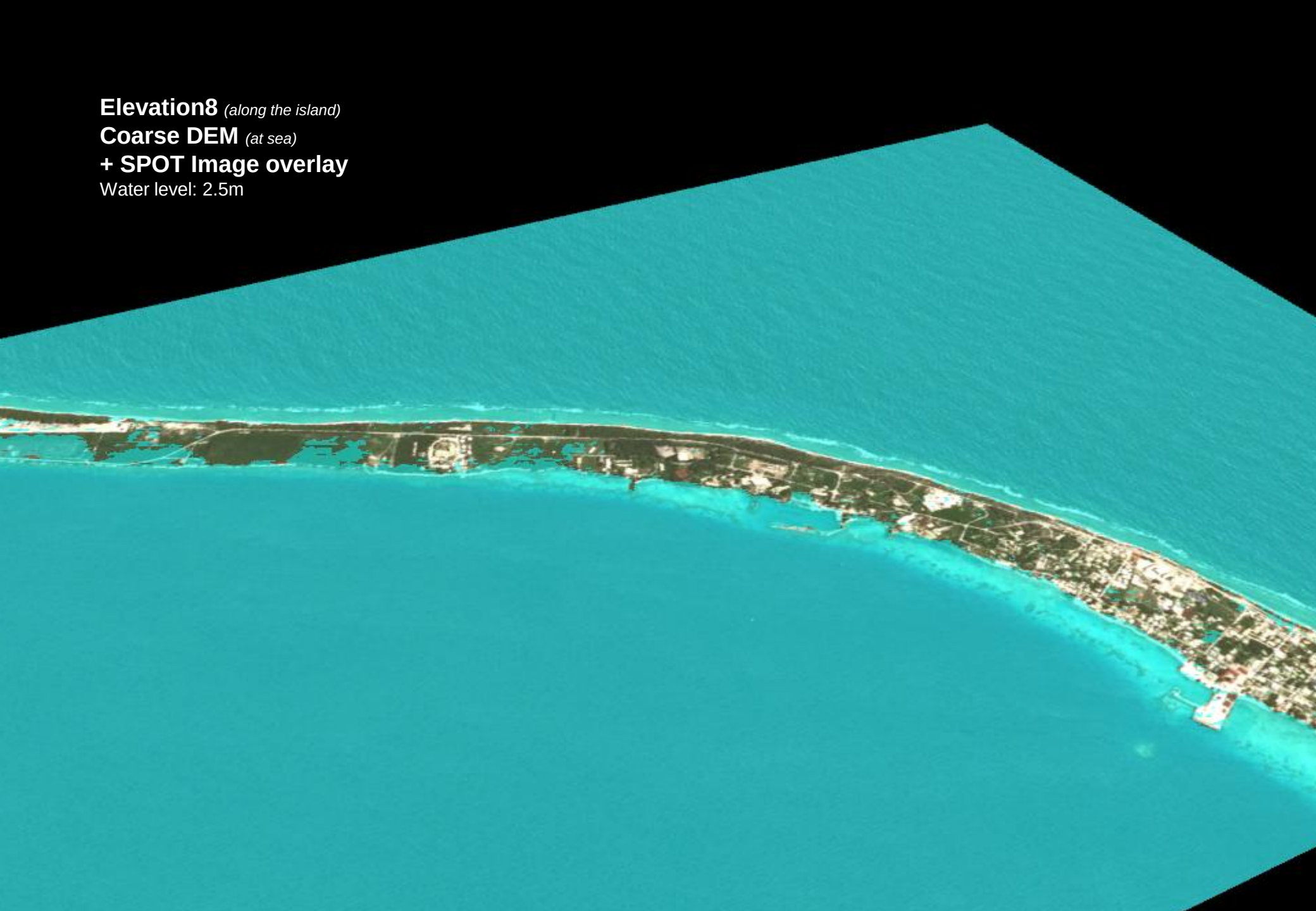

SPOT
Toamotu

Elevation8 *(along the island)*
Coarse DEM *(at sea)*
+ SPOT Image overlay
Toamotu

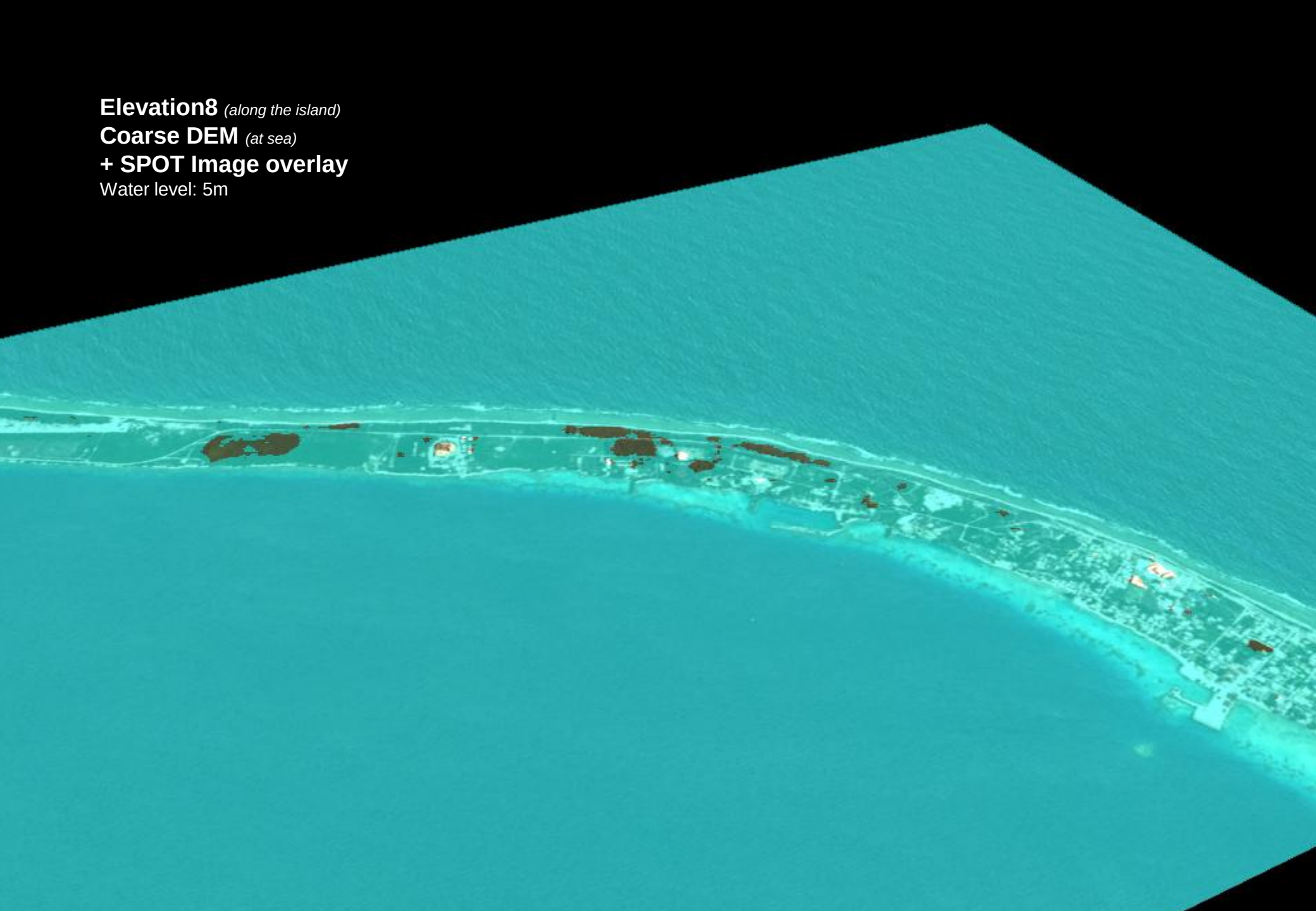
Elevation8 *(along the island)*
Coarse DEM *(at sea)*
+ SPOT Image overlay
Water level: 50cm




Elevation8 *(along the island)*
Coarse DEM *(at sea)*
+ SPOT Image overlay
Water level: 1m


Elevation8 *(along the island)*
Coarse DEM *(at sea)*
+ SPOT Image overlay
Water level: 2.5m

Elevation8 *(along the island)*
Coarse DEM *(at sea)*
+ SPOT Image overlay
Water level: 5m



Merci de votre attention

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The right DEM for Your Need

You Need…	You Pick…
Rapid delivery	**Elevation30** - 80 km² off-the-shelf **WorldDEM** in the future
Up-to-date information *- After a disaster, where cities/landscape change fast…*	**Elevation10, Elevation8**, **Elevation4**, **Elevation1** *Acquisition and production on demand*
No location constraint *Tropical belt, cloudy areas…*	**Elevation30**, **Elevation10**, **WorldDEM** *Weather independence of Radar (E30 filled-in of radar-based data)*
Detailed and high accurate information of elevation *- City models, engineering and infrastructure projects*	**Elevation4**, **Elevation1** *Based on VHR data (Pléiades)*
Terrain Model (bare Earth)	**WorldDEM**, **Elevation8**, **Elevation4**, **Elevation1** *Removal of buildings, trees and man-made objects*
Accuracy levels - DTED2, HRTE3, HRE40, HRE10	**Elevation30**, **WorldDEM**, **Elevation10**, **Elevation4**, **Elevation1**
Manage limited budget	**Elevation30**

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Elevation Product Line – Basic Specifications

		Elevation30	WorldDEM™		Elevation10		Elevation8		Elevation4		Elevation1	
Product		DEM	DEM	DTM	DEM	DTM	DEM	DTM	DEM	DTM	DEM	DTM
Sensor		SPOT5 HRS	TerraSAR-X & TanDEM-X		TerraSAR-X		SPOT6 / 7		Pléiades 1A & 1B		Pléiades 1A & 1B	
Spec. Level		DTED-2	HREGP (HRTE3)		HREGP (HRTE3)		HRE80		HRE40		HRE10	
Grid Spacing		1 arc second (~ 30m)	12m		10m		8m		4m		1m	
Vertical Accuracy (LE90)	Abs.	10m	<4m		5-10m	10m	≥3m*		≥2m*	2m*	≥1.5m*	1.5m*
	Rel.	8m	<2m (slope ≤20%) <4m (slope >20%)		<5m	8m	3m		2m	1.5m	1m	1.5m
Horizontal Accuracy (CE90)	Abs.	6m - 10m	<6m		5-10m	10m	≥2.5m*		≥1.5m*	≥1.5m*	≥1.5m*	1.5m*
	Rel.	5m	n.a.		<5m	5m	2m		1.5m	n.a.	1.5m	n.a
Coverage		>80M km² available off the shelf	Pole to pole coverage Global production on progress		On demand		On demand		On demand		On demand	

*Elevation 8, 4 & 1 accuracy dependent on ground control points (GCPs); valid for slopes ≤20%

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