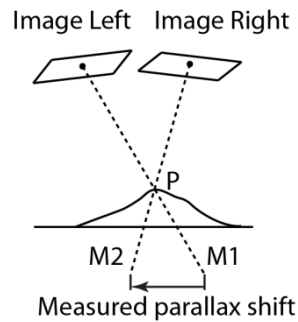




Towards on-line services for DSM creation?

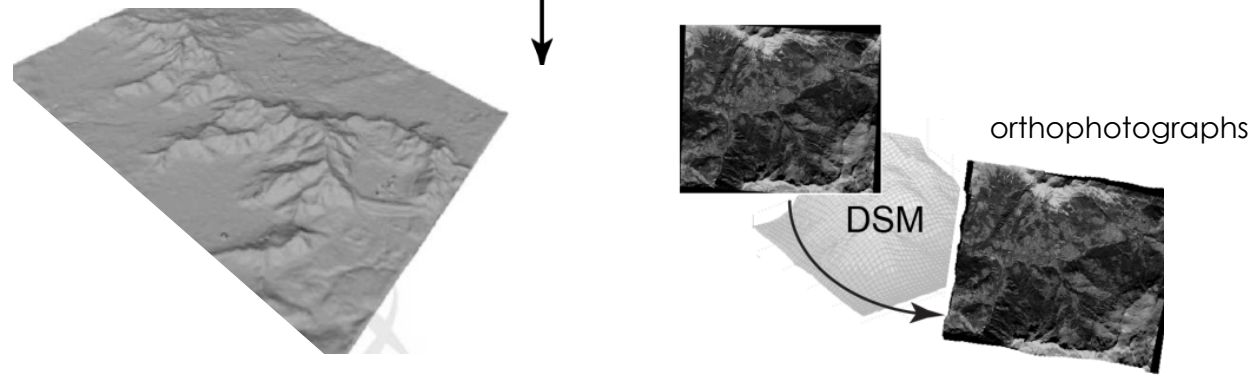
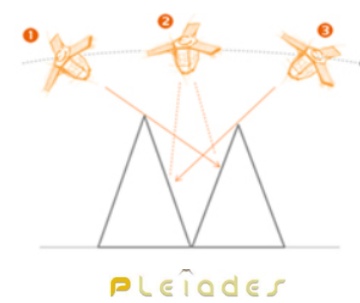
Jean-Philippe Malet (CNRS-EOST / A2S)

Stereo images to create Digital Surface Models



```

    graph TD
      A[Automatic tie point extraction] --> B[Image orientation refinement  
RPF bundle adjustment]
      C[GCPs] --> B
      B --> D[DSM extraction from stereo-pairs]
  
```



Commercial softwares

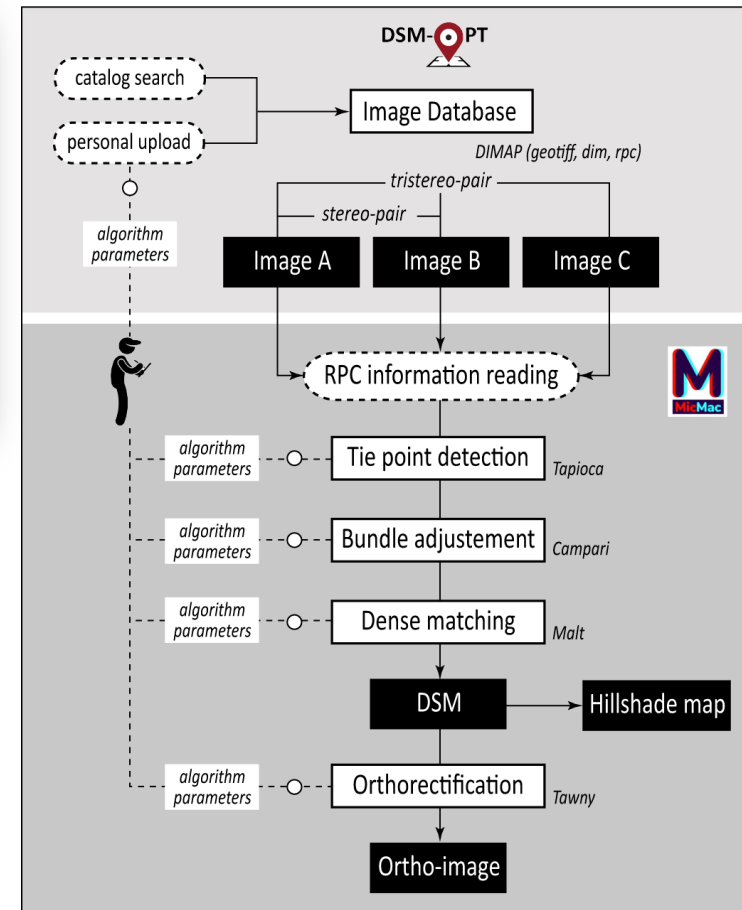
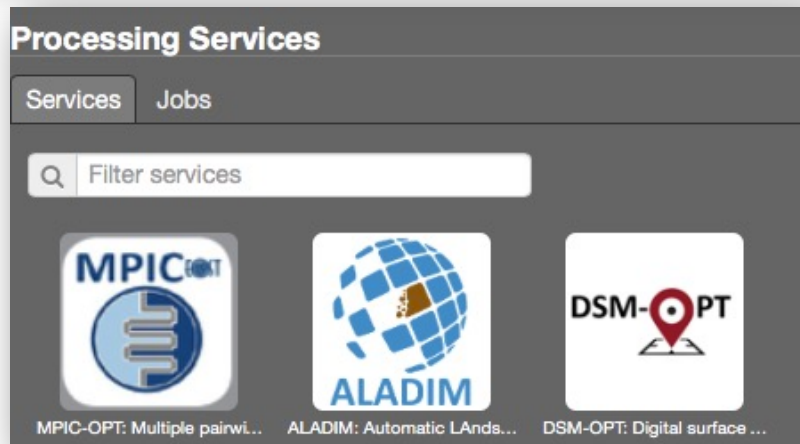
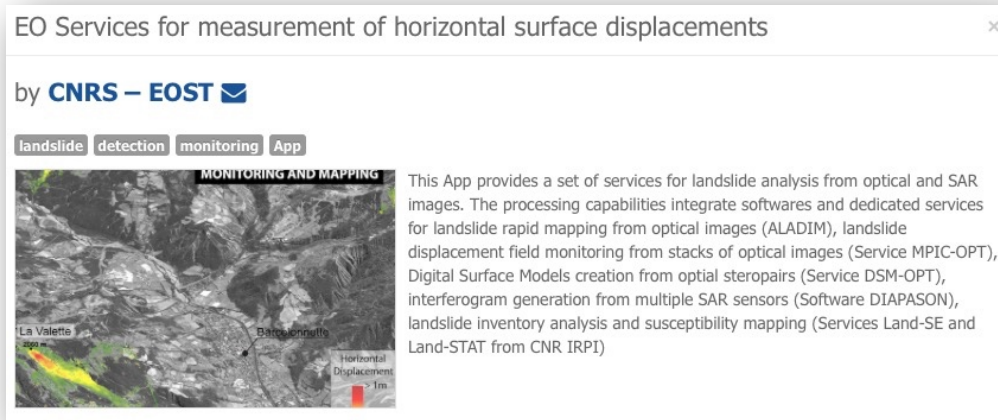
- Erdas Imagine
- PCI Geomatica
- Pixel Factory
- Agisoft Photoscan
- Smart3DCapture

Open-source softwares

- Mic-Mac
- AMES/ASP
- S2p /Sat Stereo Pipeline
- SURE
- PMVS2
- RSG
- openMVG
- JOANNEUM RESEARCH

DSM-OPT: an on-line service for DSMs and ortho-images

- Based on the MicMac open-source library (*Deseilligny et al., Rupnik et al., and many others – IGN/IPGP*)
- Fully optimized (chained modules, node calculation) on clusters (*Unistra/A2S, ESA GEP*)



DSM-OPT: application for the Alps – Guil Valley

The screenshot displays the 'geohazards' web application interface. On the left, a map shows the Guil Valley region in the Alps, with a red dashed box indicating the area of interest around Aiguilles. The map includes a search bar, navigation controls, and a timeline from 2012-08-14 to 2019-05-06. Below the map, there are tabs for 'Current search result', 'Features Basket', and 'Data Packages'. The 'Features Basket' shows a list of search results for 'PHR1A HIR_P_S_3_PX SENSOR' with various timestamps. On the right, a configuration panel for 'DSM-OPT-Aiguilles-SzW7-Reg003' is visible, with fields for 'Pleiades stereo images', 'Start of the crop area in X [pixel]', 'Start of the crop area in Y [pixel]', 'Size of the crop area in X [pixel]', 'Size of the crop area in Y [pixel]', 'Matching window size', 'Regularization parameter', and 'Generate orthoimage'. The panel is labeled with 'Input data', 'Rol', and 'Parameterization' in red text.

Input data

Rol

Parameterization

Pre-defined set of parameters
Hilly / Mountain /
Plain / Urban
landscapes

DSM-OPT: application for the Alps – Guil Valley

geohazards
tep

EO Services for measurement of horizontal surface

Upload Data

EO Data ▾

EO-based products ▾

Community ▾

Private ▾

Free Text Search

Processing Services

DSM-OPT: Digital surface models from optical stereo satellite images

Job Info

Name	DSM-OPT: Digital surface models from optical stereo satellite images
Id	27643525-2cfd-488b-990e0d13d7c5b25
Processing service	DSM-OPT: Digital surface models from optical stereo satellite images
Service version	1.5.3
Started at	Oct 15th
Created by	Jean-Philippe
Status/Result Location	📄
Status	Running
Visibility	private
Share	
Share with public url	

16%

Parameters

Name	Value
1 - input	https://catalog.terradue.com/pleiades/search?format=json&uid=PHR1A_P_201905061037011_SEN_4084704101
2 - input	https://catalog.terradue.com/pleiades/search?format=json&uid=PHR1A_P_201905061037313_SEN_4084704101
xstart	5000
ystart	5000
xsize	10000
ysize	10000
szw	3
regul	0.02
ortho	Yes
zoomf	2

Resubmit Job

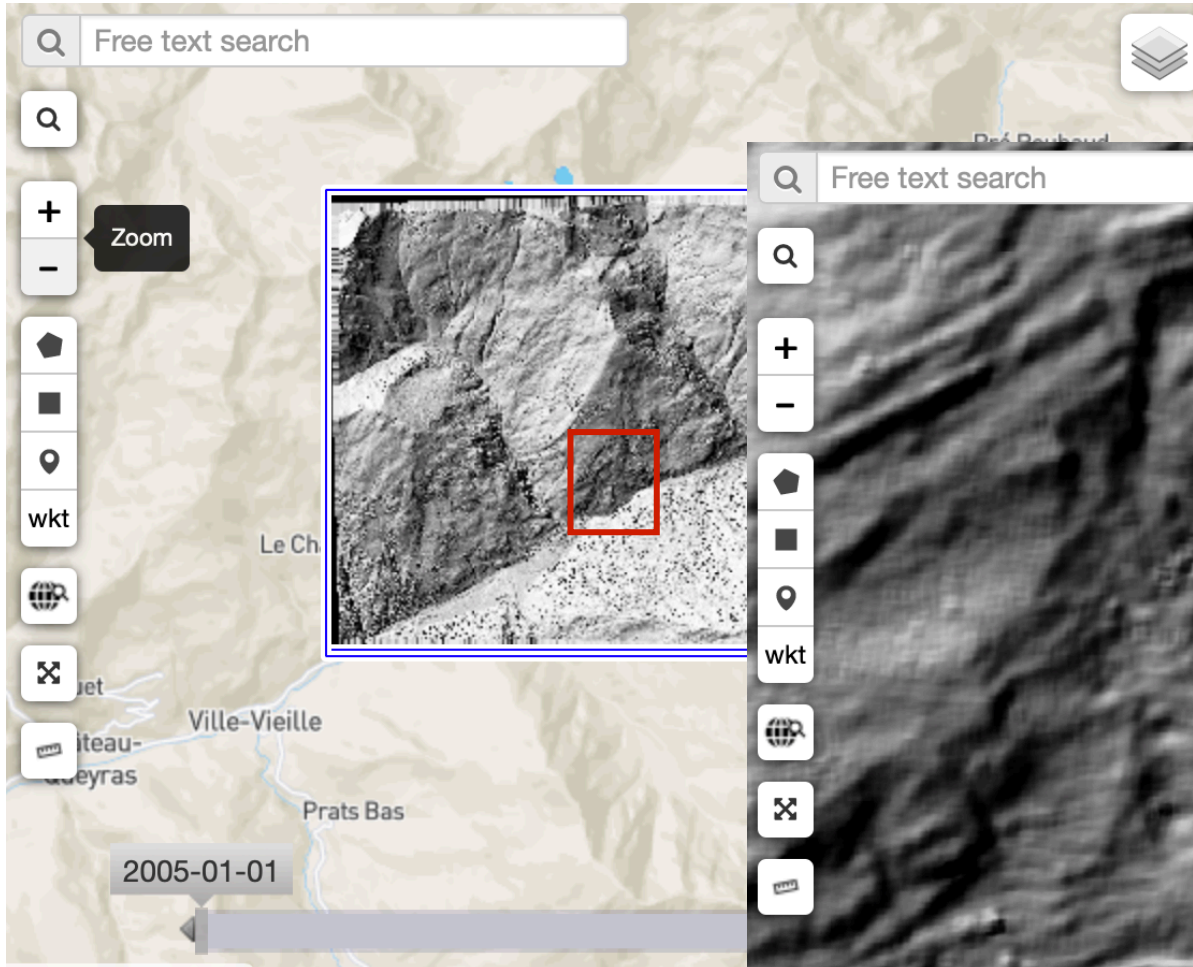
Current search result

Result for OpenSearch query over type ... Total results 8 To No results found.

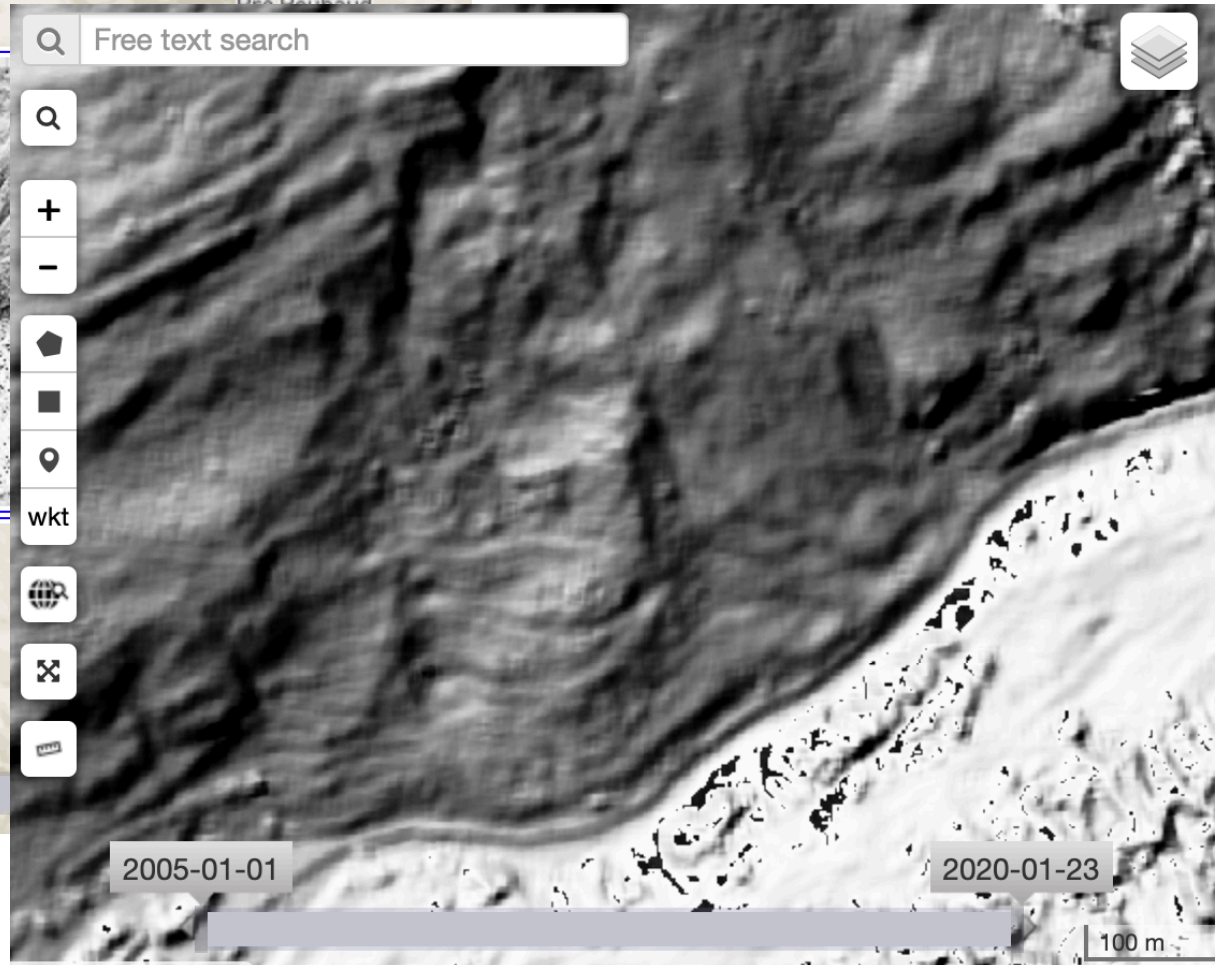
- PHR1A HIR_P_S_3_PX SENSOR Mon, 06 May 2019 11:37:31 GMT
- PHR1A HIR_P_S_3_PX SENSOR Mon, 06 May 2019 11:37:31 GMT
- PHR1A HIR_P_S_3_PX SENSOR Mon, 06 May 2019 11:37:01 GMT
- PHR1A HIR_P_S_3_PX SENSOR Mon, 06 May 2019 11:37:01 GMT

Job summary

DSM-OPT: application for the Alps – Guil Valley

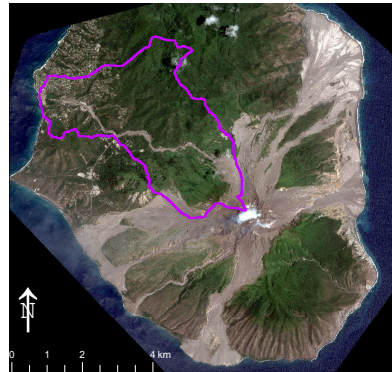


Hillshade of a HR-DSM (1 m)
over Aiguilles / Pas de l'Ours landslide



Outputs:
DSM, Hillshade, n ortho-images

DSM-OPT: application on volcanoes



geohazards tap MDIS 2019 Training jmalet Upload Data

Free Text Search spatial others

EO Data Community Private Data pipelines

Processing Services

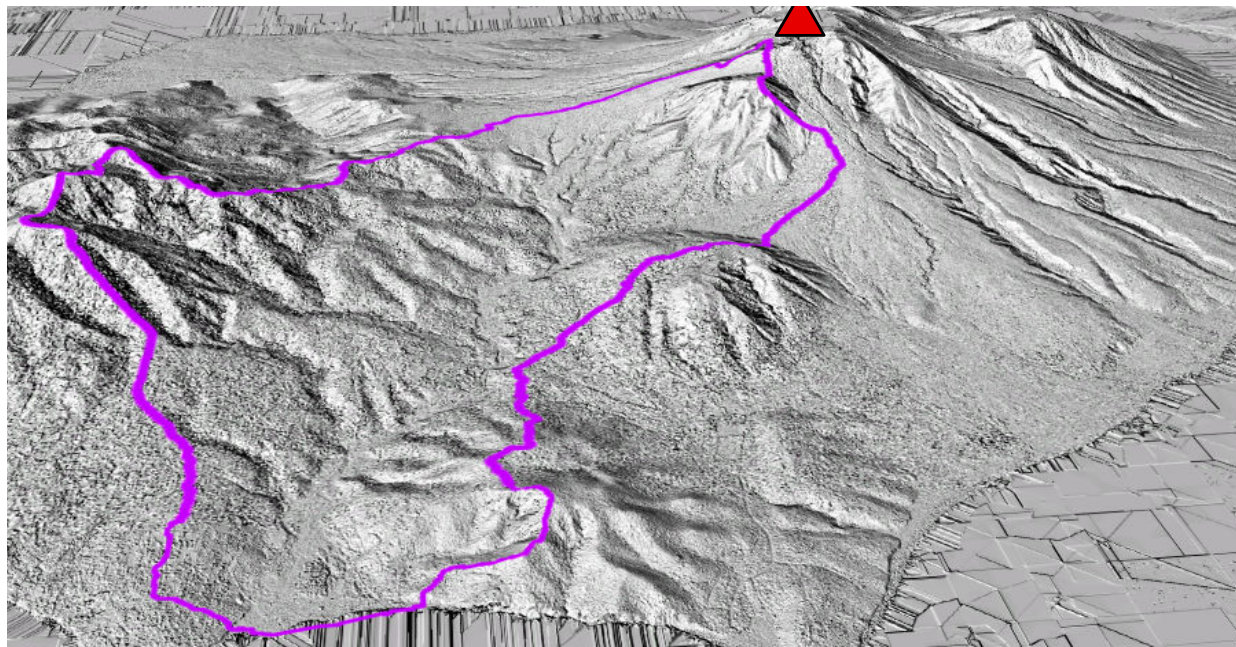
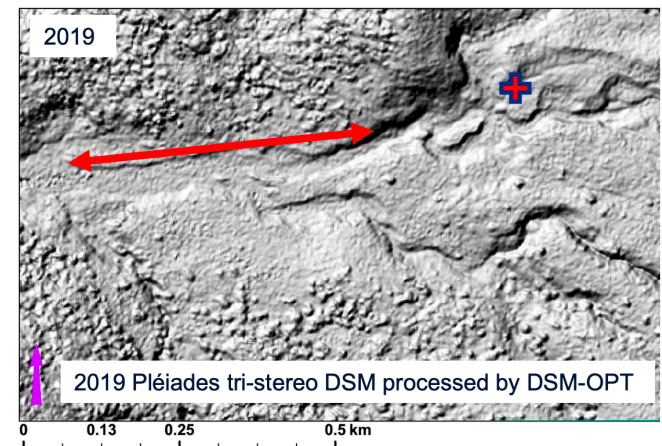
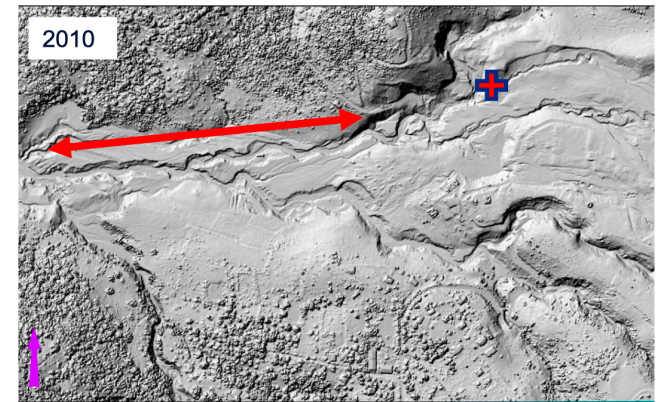
DSM-OPT: Digital surface models from optical stereo satellite images

Job Info

Name	DSM-OPT: Digital surface models from optical stereo satellite images
Id	baaf5595-634c-4308-a37f-120a2ac2001f
Processing service	DSM-OPT: Digital surface models from optical stereo satellite images
Service version	1.0.1
Started at	Oct 13th 2019 18:12
Created by	Jean-Philippe Malet
Status/Result Location	
Status	Running
Visibility	private
Share	

Hillshade of a HR-DSM (1 m) over Soufriere Hills / Montserrat

2010 1m LiDAR DSM (Montserrat Volcano Observatory)



James Christie & Georgina Bennett (Univ. East Anglia)

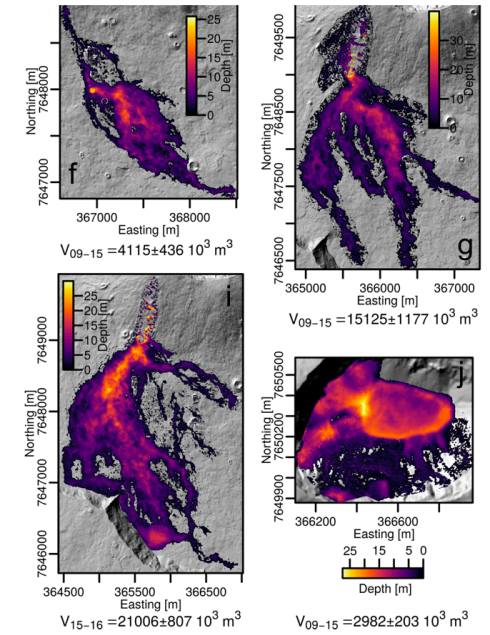
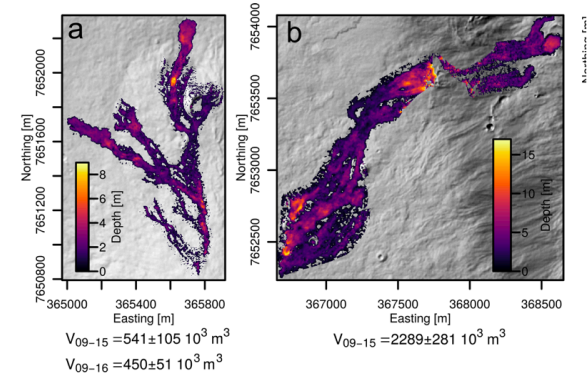
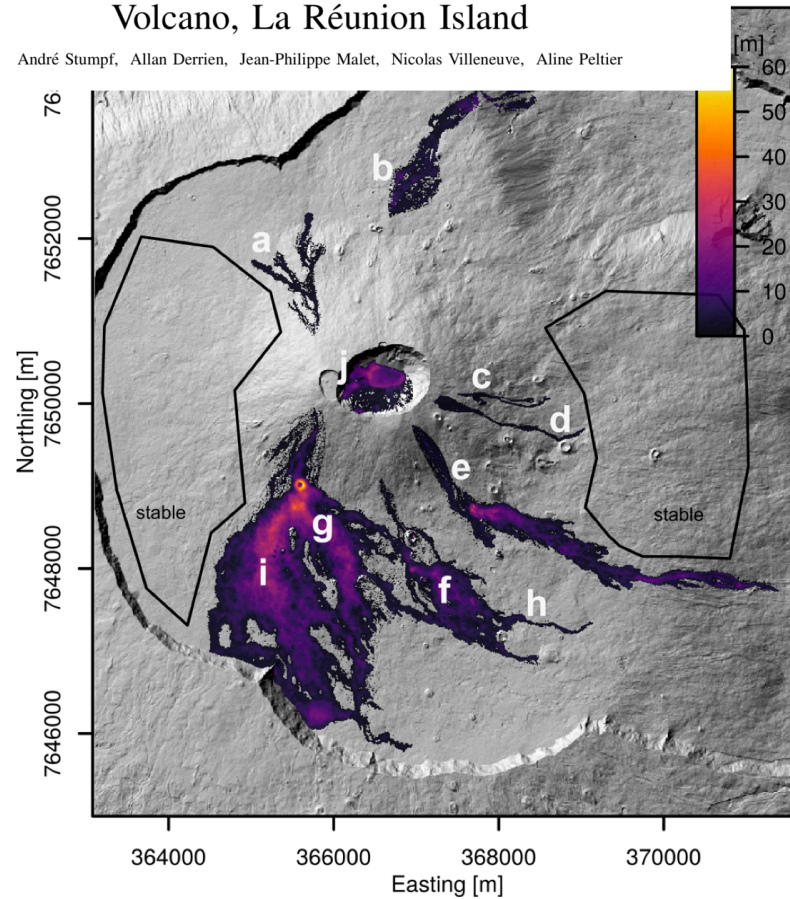
DSM-OPT: application on volcanoes

Hillshade of a HR-DSM (1 m) over Piton de la Fournaise / La Réunion

IEEE GEOSCIENCE AND REMOTE SENSING LETTERS

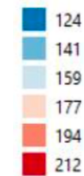
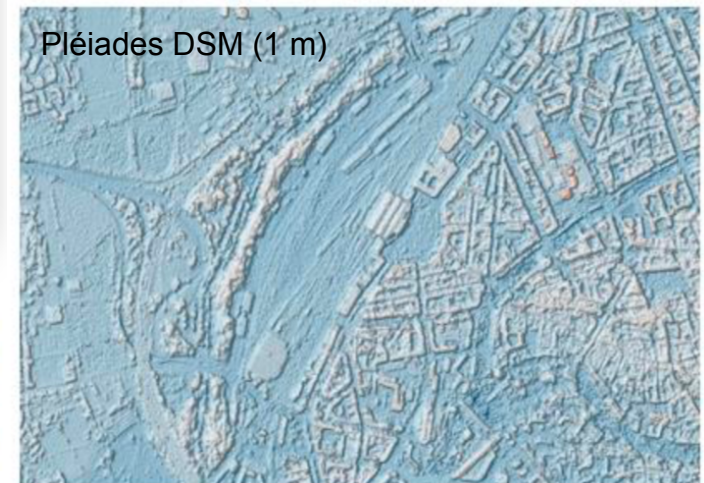
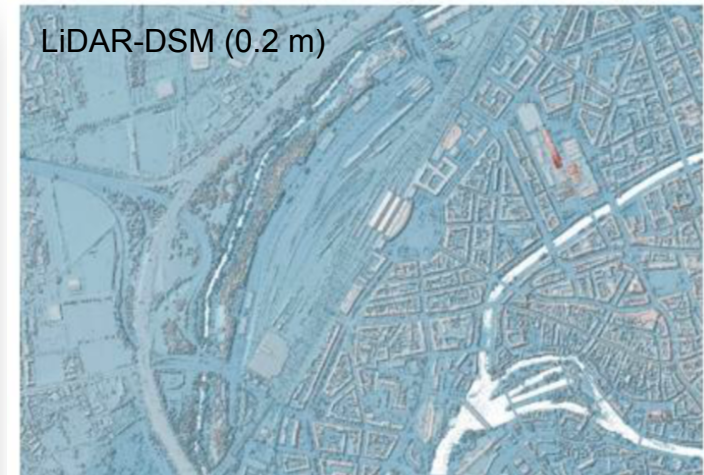
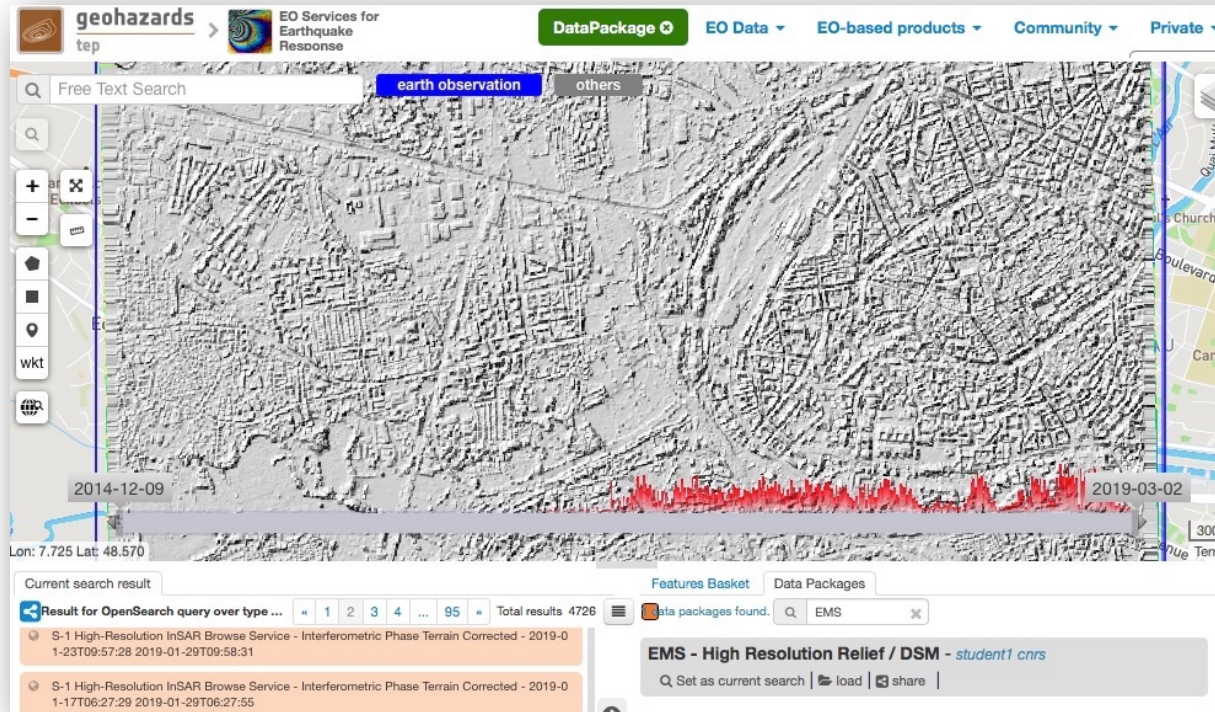
High Resolution Satellite Photogrammetry for Lava Flow Volume Estimation at Piton de la Fournaise Volcano, La Réunion Island

André Stumpf, Allan Derrien, Jean-Philippe Malet, Nicolas Villeneuve, Aline Peltier



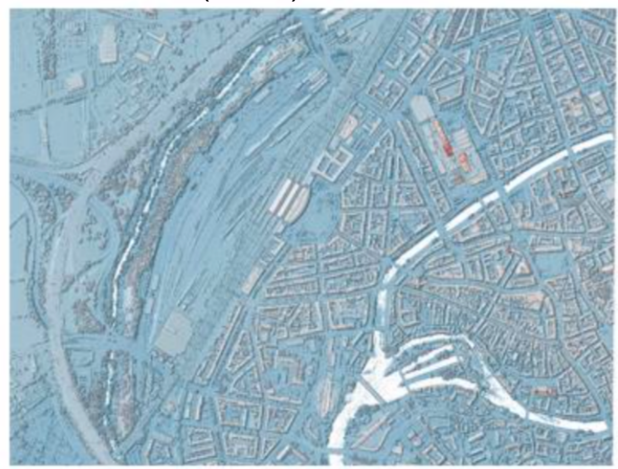
DSM-OPT: application for urban studies

Hillshade of a HR-DSM (1 m) over the city of Strasbourg / Pléiades stereo of Sept. 2016

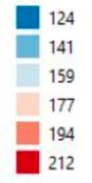


DSM-OPT: parameterization and scenario modelling window size and regularization

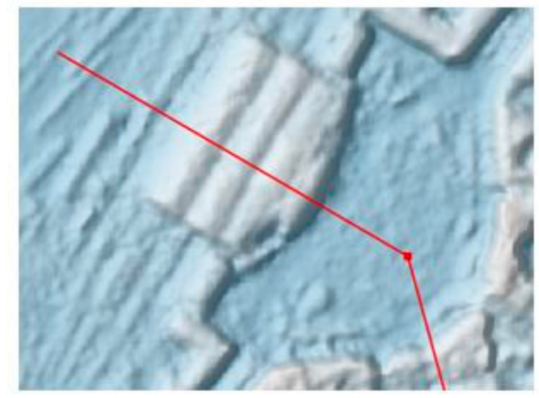
LiDAR-DSM (0.2 m)



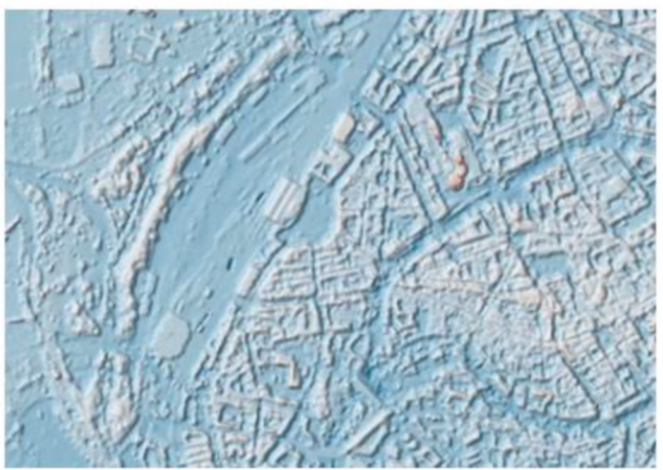
Pléiades-Scenario 1



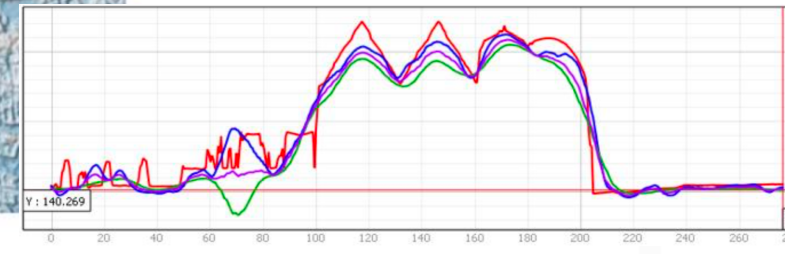
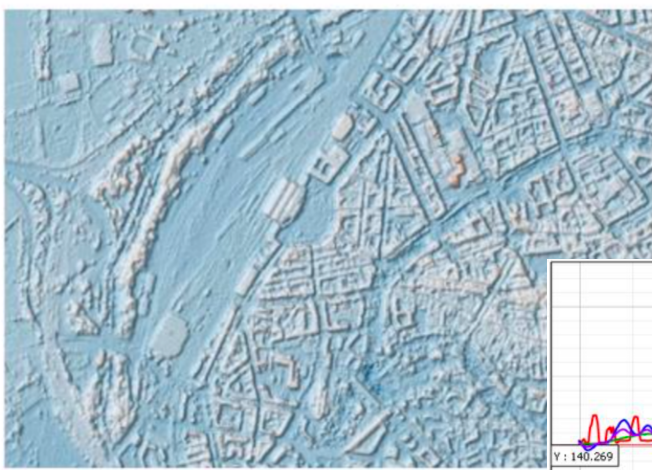
Strasbourg train station



Pléiades-Scenario 2



Pléiades-Scenario 3



On-line automated service? Which strategy?

Service features:

non-expert (pre-defined set of parameters) and expert use

use of HPC clusters – the target is a run in < 15 minutes

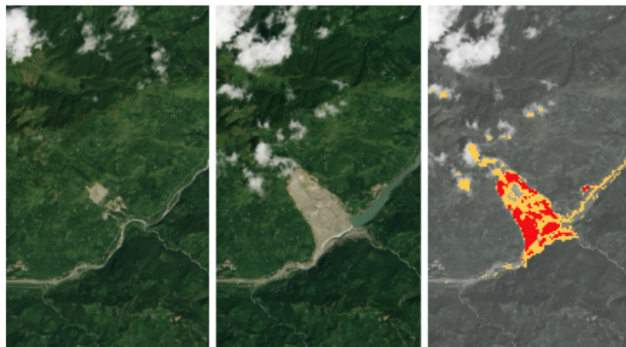
scenario modelling -> stacking of several models

not only for Pléiades – currently working on other sensors (Worldview, CartoSat, etc)

CO3D derived information for landslide applications

Application 1: Documenting landslide surfaces (e.g. inventory) over traffic corridors

- Δατα ρεθυεστ: φρεθυεντ (ατ λεαστ 3) ΧΟ3Δ χοπεραγεσ οφ τηε χορριδορσ
- Μετηοδοσ:
 - αυτοματεδ χηανγε δετεχτιον μετηοδοσ (ε.γ. ιμΧΛΑΣΣ) το δετεχτ ανδ μαπ τηε λανδσλιδεσ (πολυγωνοσ) → Υσε: χηανγεσ ιν λανδσλιδε συρφαχεσ → ηαζαρδ μαπ υπαδαεσ
 - ιμαγε χορρελατιον μετηοδοσ το εστιματε λανδσλιδε 2Δ/3Δ πελοχιτυ → $\frac{d}{D} = \frac{L}{L_0} \cdot \frac{H}{H_0}$
- Direct observation of new landslides using change-detection method



Landslide Detection
Possible Probable

L'accès à l'Andorre depuis la France devrait rester fermé pendant quatre semaines

Mercredi 1 mai 2019 à 16:18 - Par Sébastien Berriot, France Bleu Roussillon, France Bleu Occitanie

La route d'accès à l'Andorre par la France est toujours fermée à la circulation en raison d'un glissement de terrain. La réouverture ne devrait pas intervenir avant quatre semaines. L'information a été donnée par le préfet de la région Occitanie au chef du gouvernement andorran.

Les travaux en cours sur la nationale 22 - Jean Ribot

La ligne SNCF entre la France et l'Italie via Modane est inutilisable pendant "plusieurs semaines", en raison d'une coulée de boue sur la voie ferrée au niveau du tunnel d'Orelle, coulée provoquée par l'orage de mardi soir. Ce mercredi, place au diagnostic plus précis.

Coulée de boue sur la ligne SNCF à Orelle (Maurienne) © Radio France -



Survey about DSM generation from Pléiades

Catherine Proy (CNES- DNO/OT)

Context

Pléiades data more and more useful for several application fields

Lots of applications require the use of relief information

Methods to generate Digital Surface Models are now mature

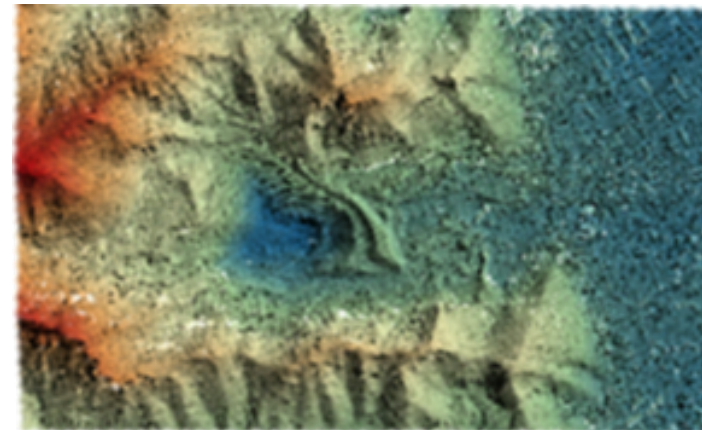
Scientific french community and public entities have no easy-to-use tool or service to generate elevation information from Pléiades

The thematic data centers ForM@Ter (Solid Earth) and Theia-Land (Continental Surfaces) are willing to offer this support

DSM proposed from Pléiades

Characteristics

- Z precision around 1.5 m for a stereo pair and slopes less than 20%
- Planimetric precision around 9 meters (absolute) – 1 meter (relative)
- Spatial resolution between 0.5 and 10 m



Post-processing

- Filtering of outliers
- Interpolation on a regular grid - GeoTIFF grid with elevation (Z)
- Some areas cannot be measured and are set to « no data value »
- A radiometric image is delivered (P or P+XS)

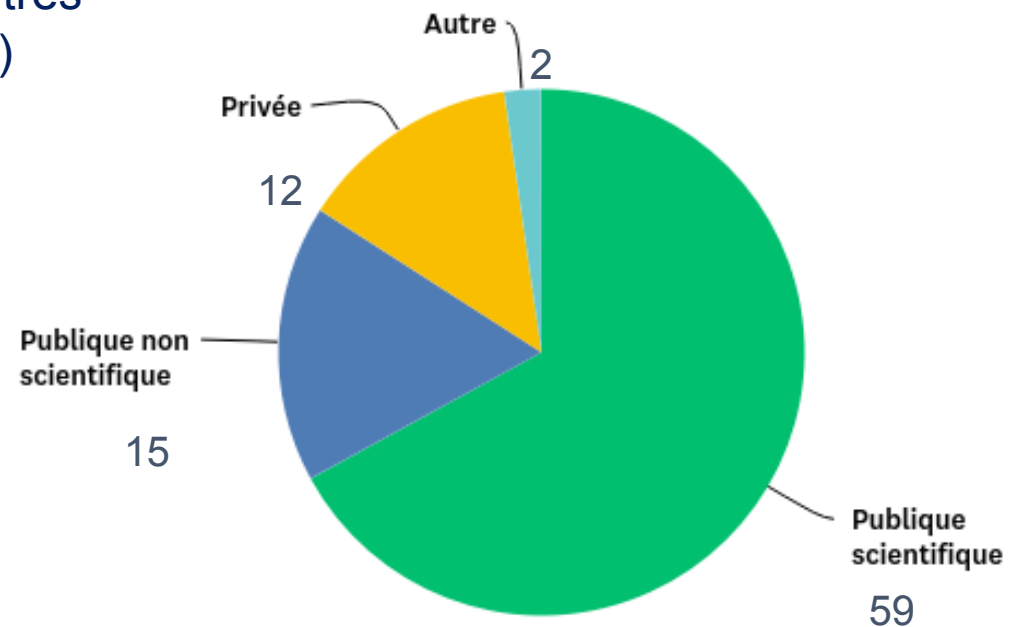
Survey for the French users

A survey was launched in July 2019 through

- THEIA and ForM@Ter thematic centres
- Geomatic community (Decryptageo)
- CNES partners for applications

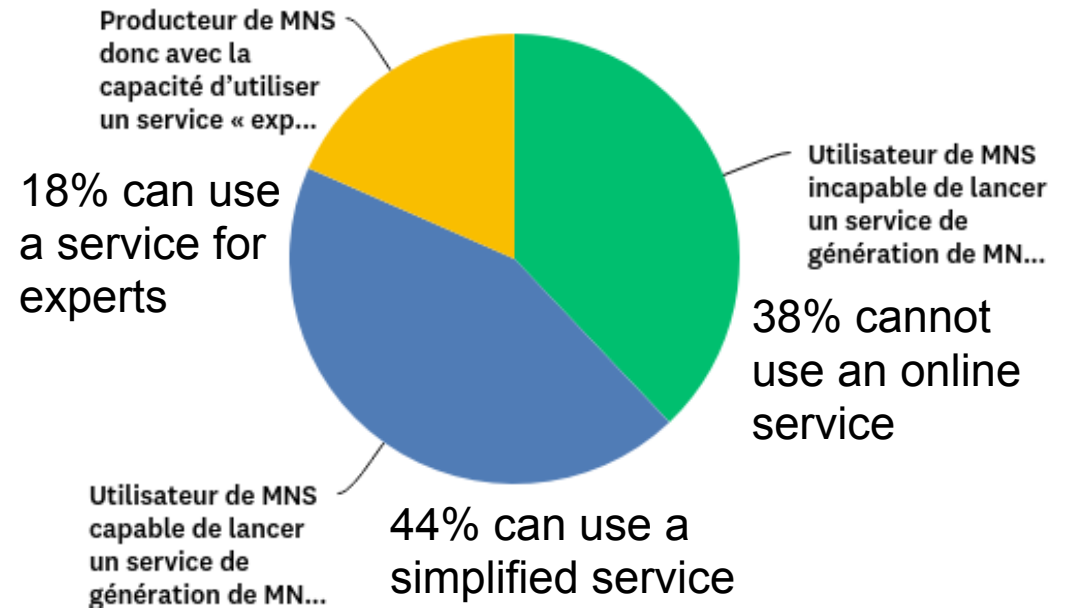
Results: 88 Answers

- 79 interested
- 7 able to produce by themselves
- 2 non interested



Level of service requested

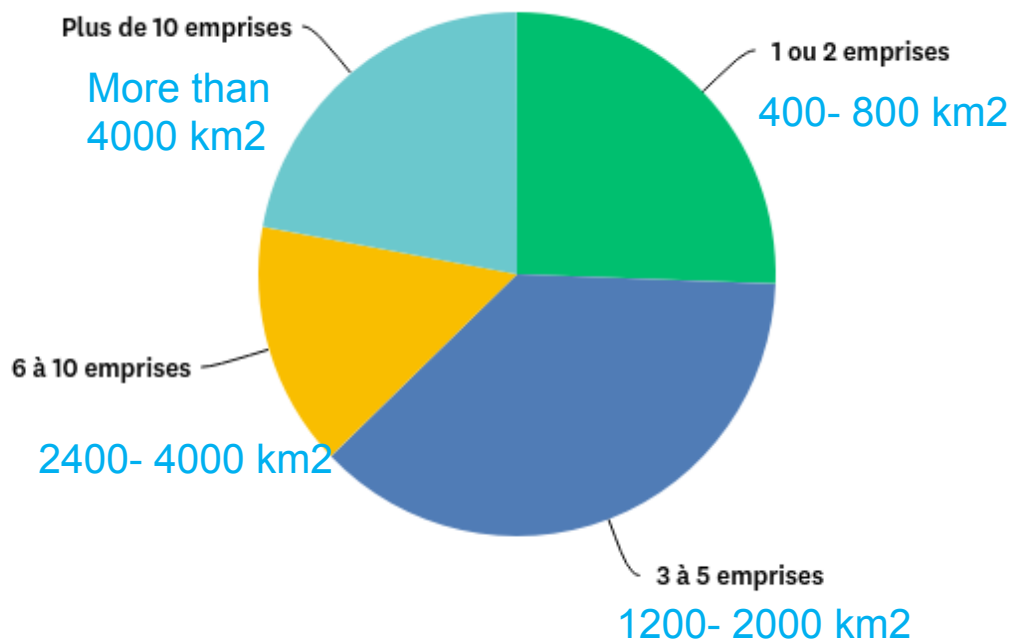
38% cannot use an online service
 44% would use a simplified service
 18% would use an expert service



CAPABILITY for TASKING: 44% need support to specify stereo tasking

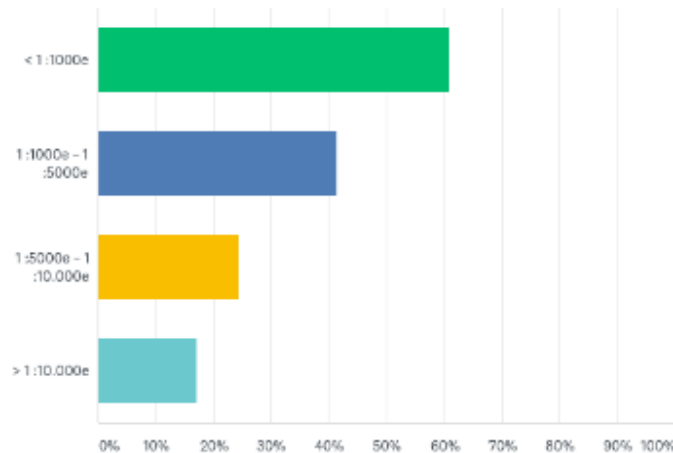
Annual needs

More than 500 Pléiades (20kmx20km) footprints each year for these 86 users: 200 000 km²



Precision requested

Several feedbacks mostly related to the precision of positioning in planimetry that needs to be improved (mainly for urban applications)



50% need a very precise scale 1/1000 for their applications

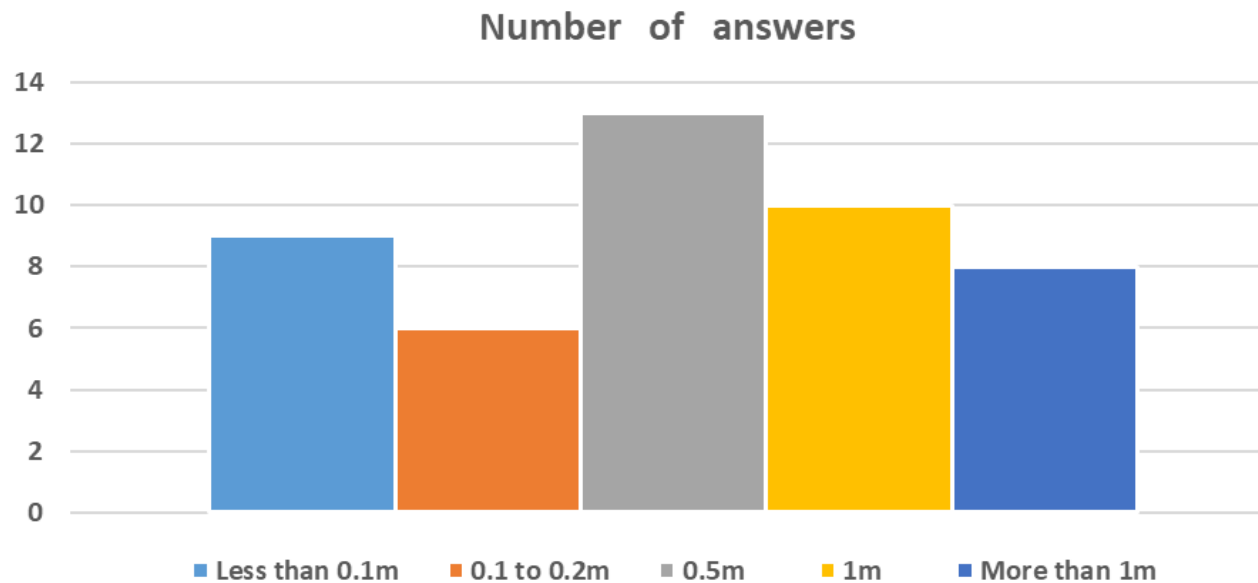
Needs for products derived from DSMs

55 / 88 users have additional needs:

- Buildings and/or Vegetation height (30 answers)
- Whole Digital Elevation model (5 answers)
- Digital Terrain model (10)
- Other needs (8)
 - Interpolation, precision, water mask, slopes computation
 - Fusion with other Z information
 - Height of dams or ancient walls

Need for Z change detection

- 64 /88 users are interested in change detection
- Precision in Z variation requested by users difficult to obtain with Pléiades



Lessons learnt

- Various types of entities - representative of people familiar to EO
- More than 1/3 need support for stereo-tasking and end-to-end service (not only on-line processing)
- Most users also need
 - Elevation or 3D classification
 - Change detection
- Precision remains a challenge for some applications

