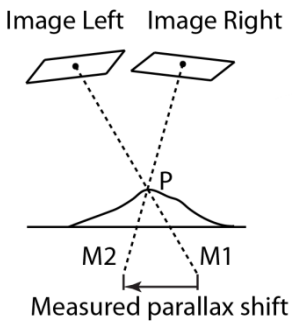
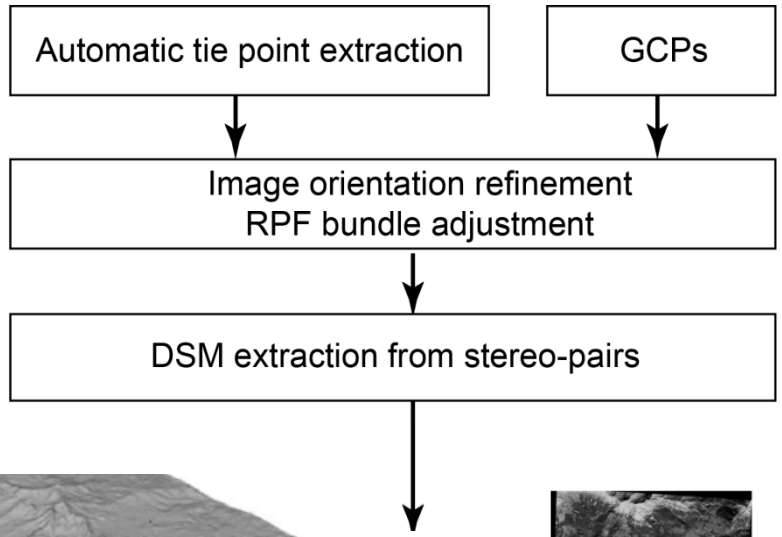
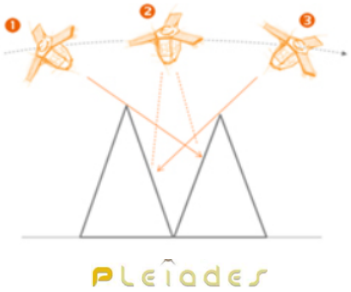
Towards on-line services for DSM creation?

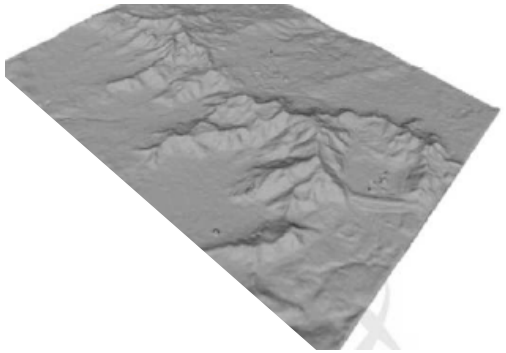
Jean-Philippe Malet (CNRS-EOST / A2S)

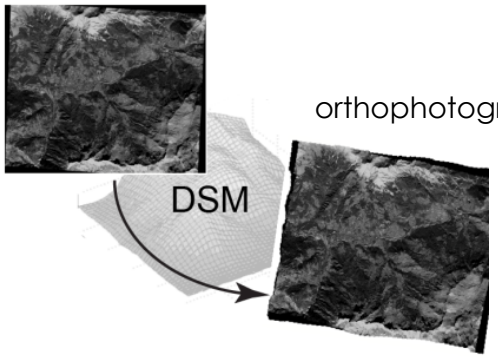
Stereo images to create Digital Surface Models











orthophotographs

Commercial softwares

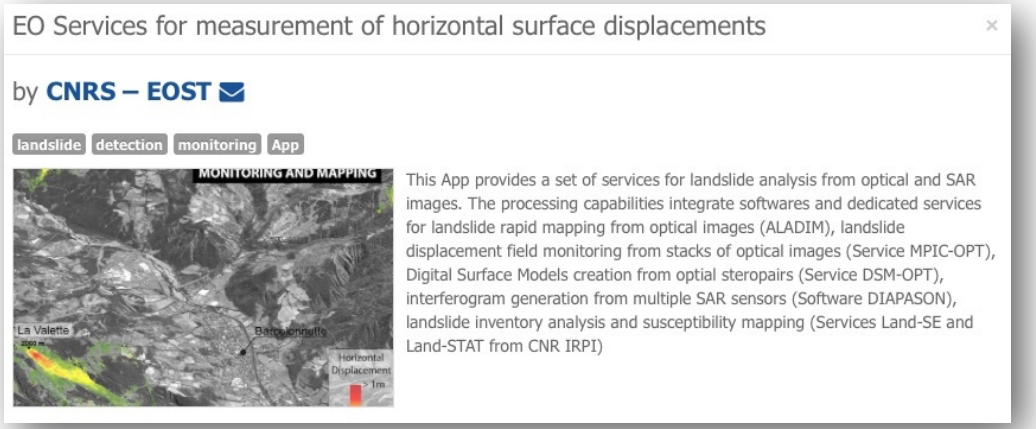
- Erdas Imagine
- PCI Geomatica
- Pixel Factory
- Agisoft Photoscan
- Smart3DCapture

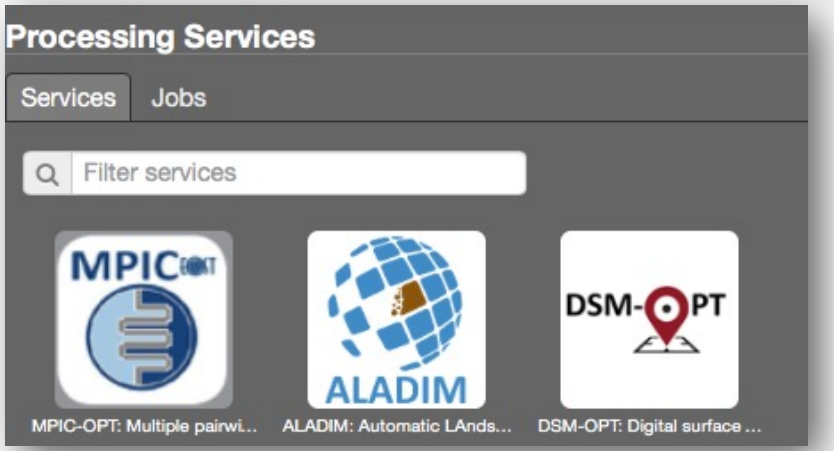
Open-source softwares

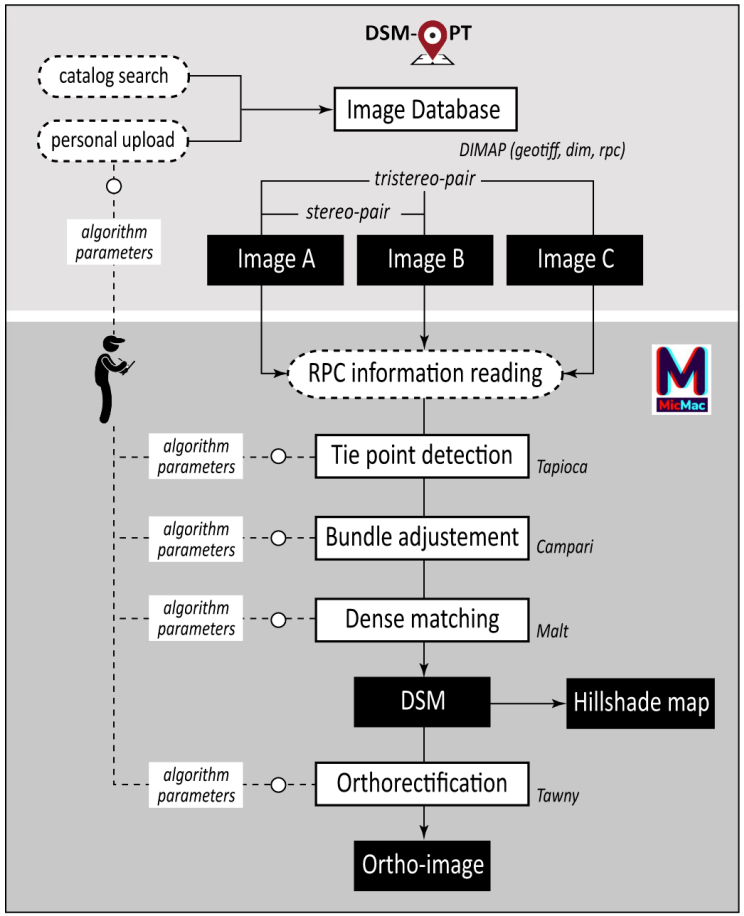
- Mic-Mac
- AMES/ASP
- S2p /Sat Stereo Pipeline
- SURE
- PMVS2
- RSG

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

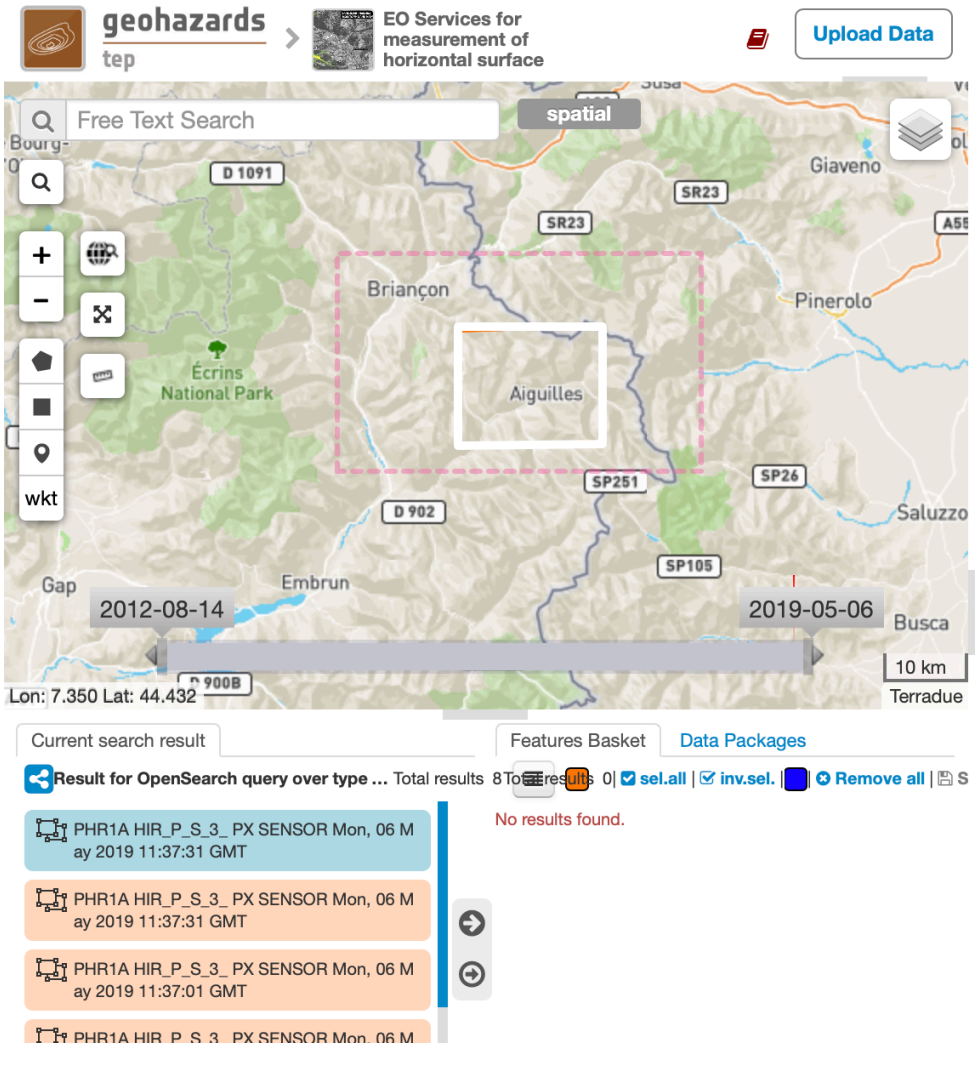
- Based on the MicMac open-source library (*Deseilligny et al., Rupnik et al., and many others – IGN/IPGP*)
- Fully optimized (chained modules, node calculation) on clusters (*Unistra/A2S, ESA GEP*)

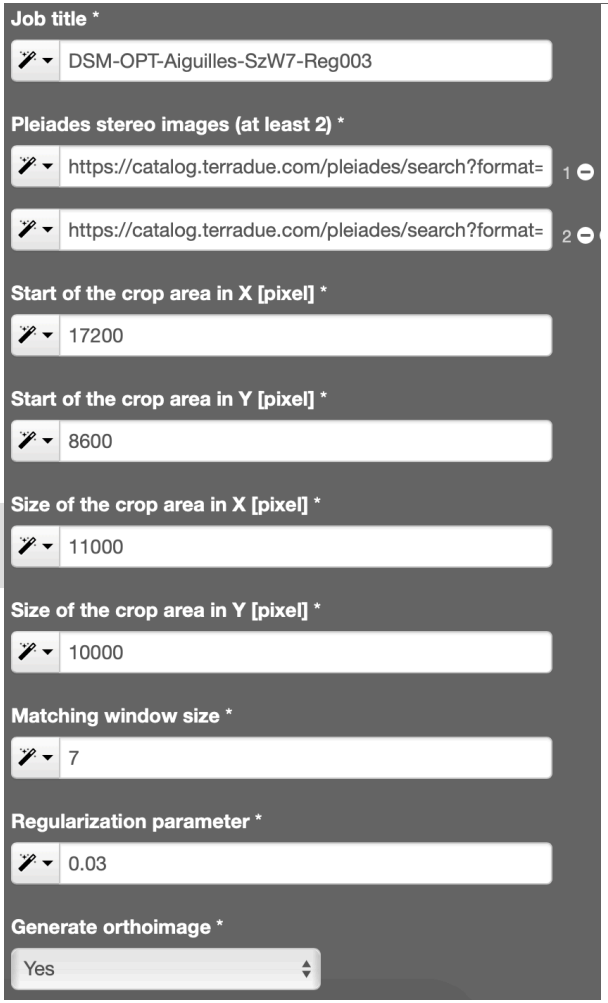






DSM-OPT: application for the Alps – Guil Valley





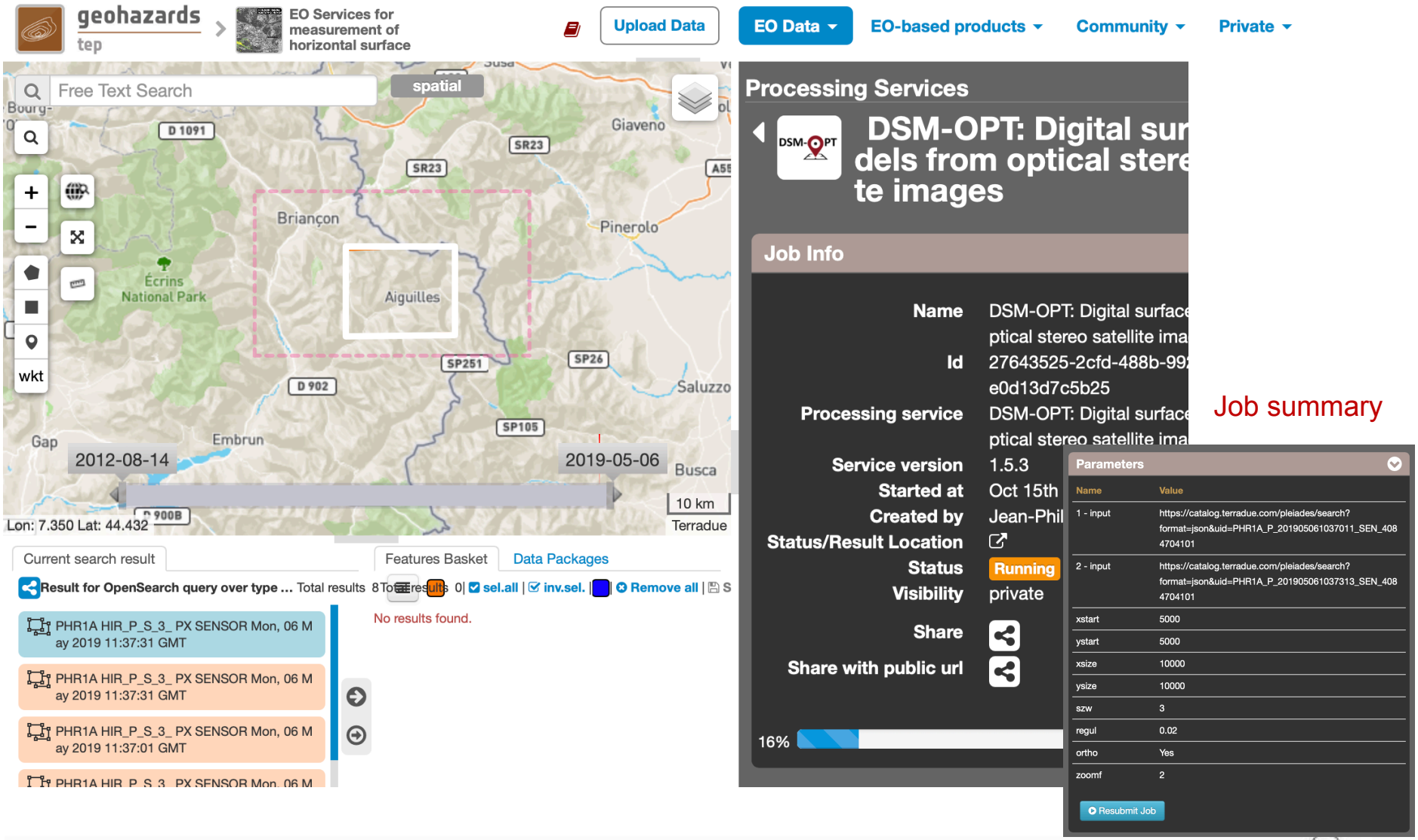
Input data

RoI

Parameterization

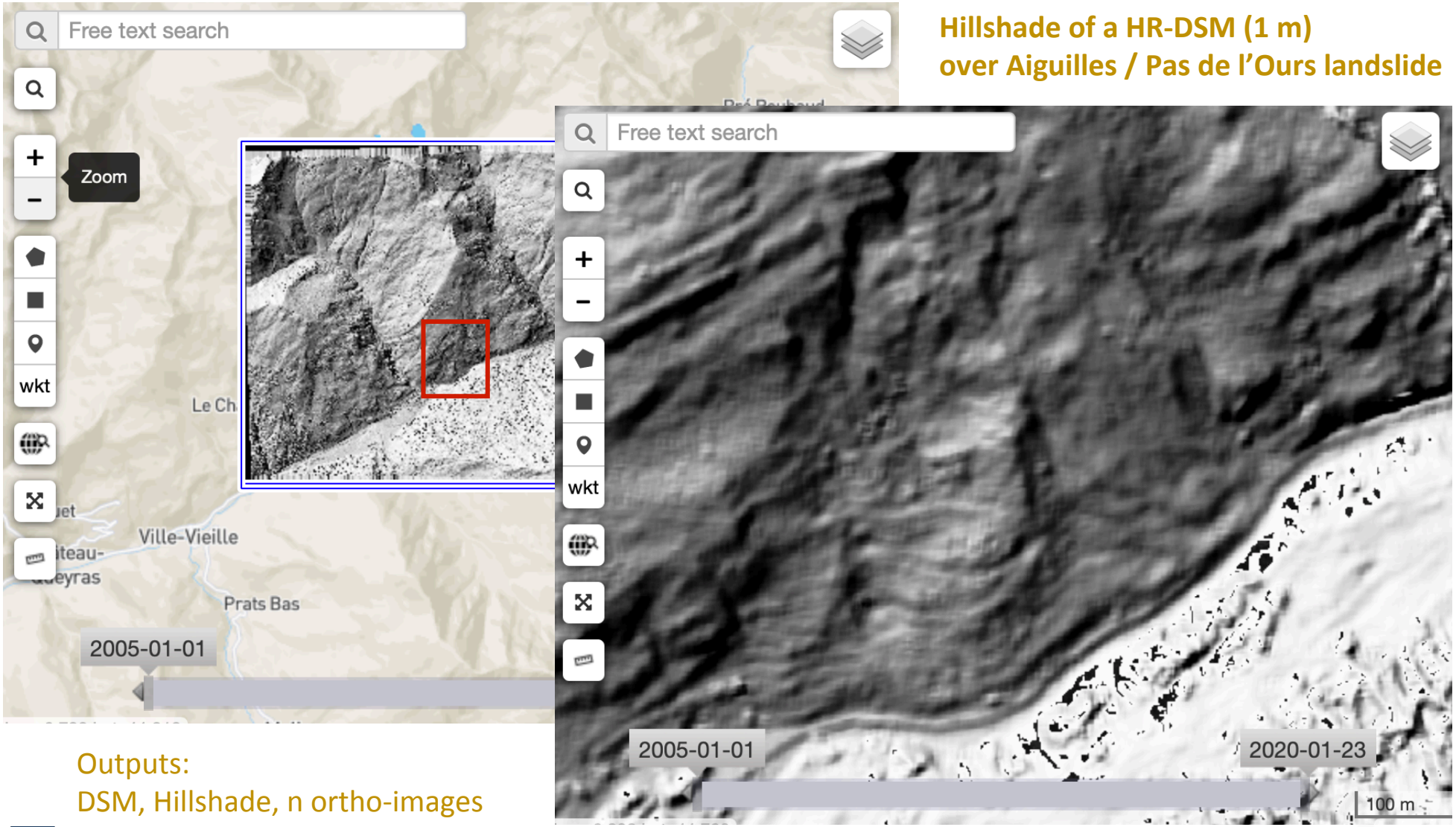
Pre-defined set of parameters
Hilly / Mountain / Plain / Urban landscapes

DSM-OPT: application for the Alps – Guil Valley



Job summary

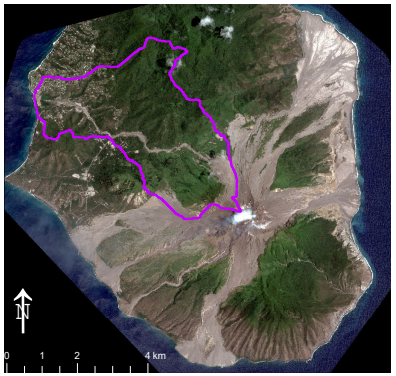
DSM-OPT: application for the Alps – Guil Valley

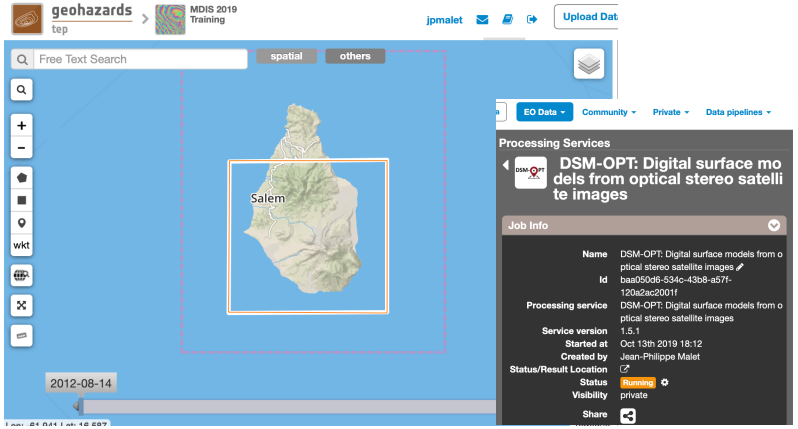


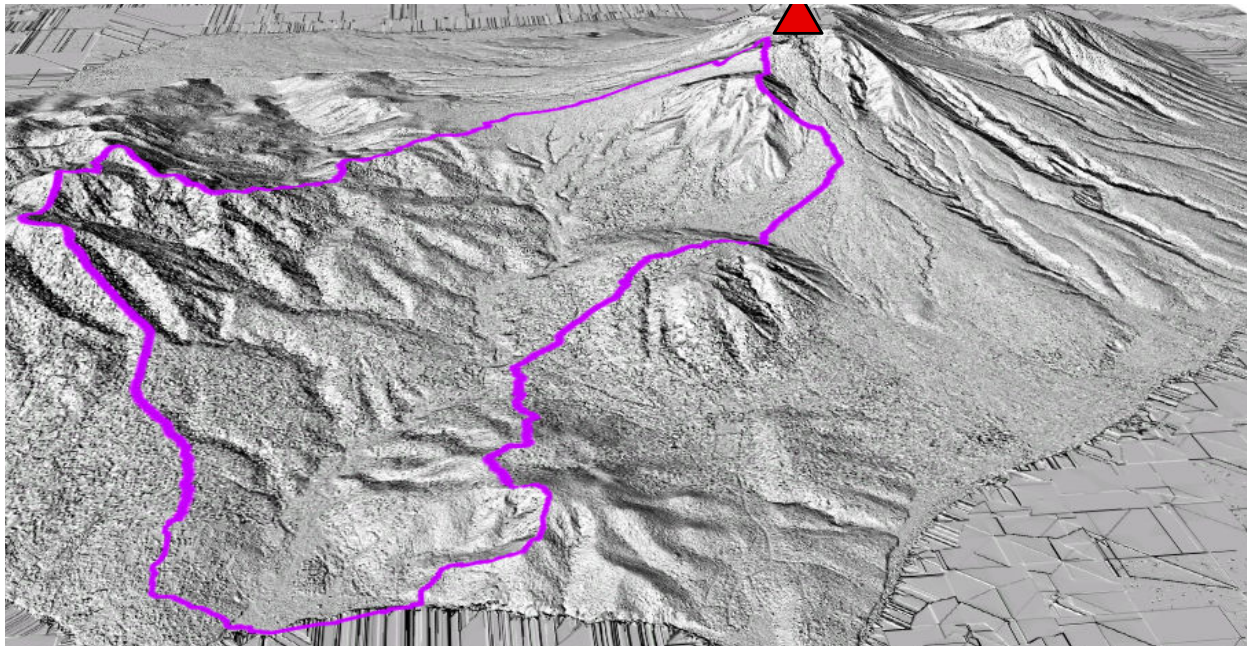
Hillshade of a HR-DSM (1 m)
over Aiguilles / Pas de l'Ours landslide

Outputs:
DSM, Hillshade, n ortho-images

DSM-OPT: application on volcanoes

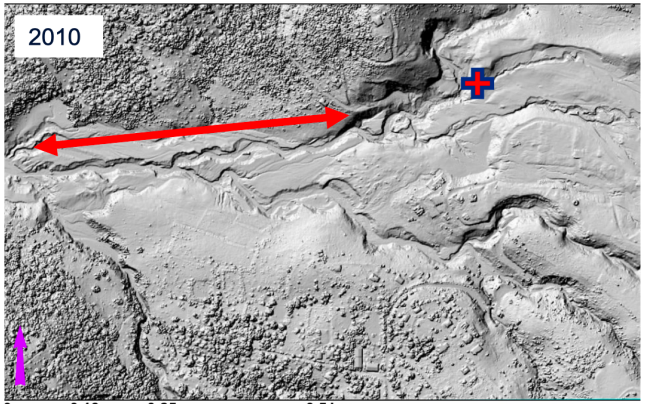


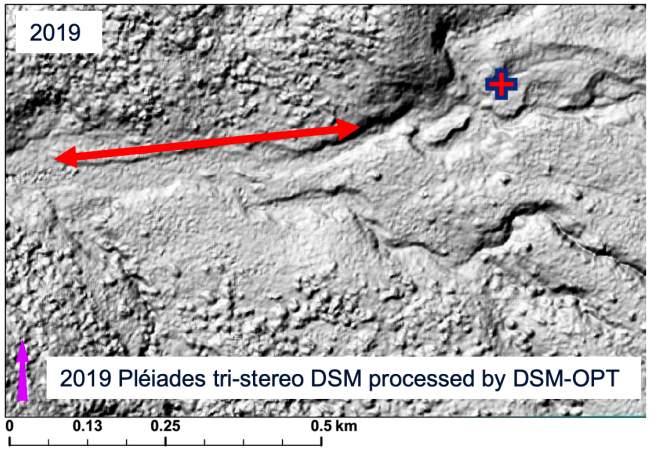




Hillshade of a HR-DSM (1 m) over Soufriere Hills / Montserrat

2010 1m LiDAR DSM (*Montserrat Volcano Observatory*)





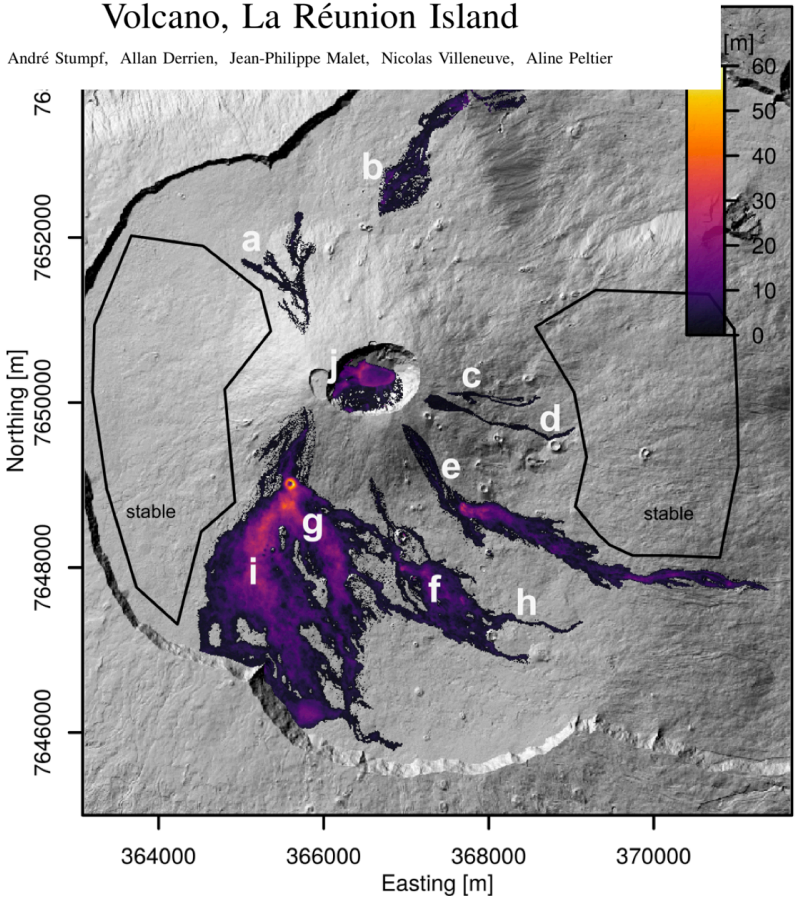
James Christie &
Georgina Bennett
(Univ. East Anglia)

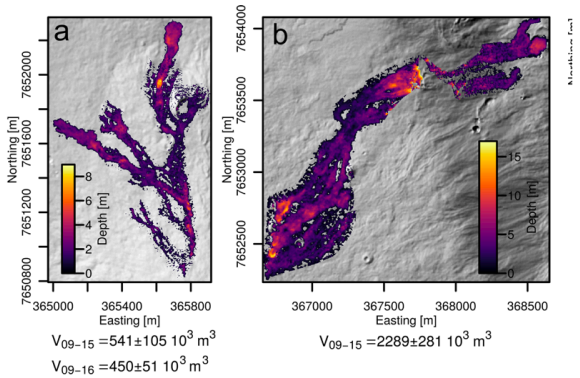
DSM-OPT: application on volcanoes

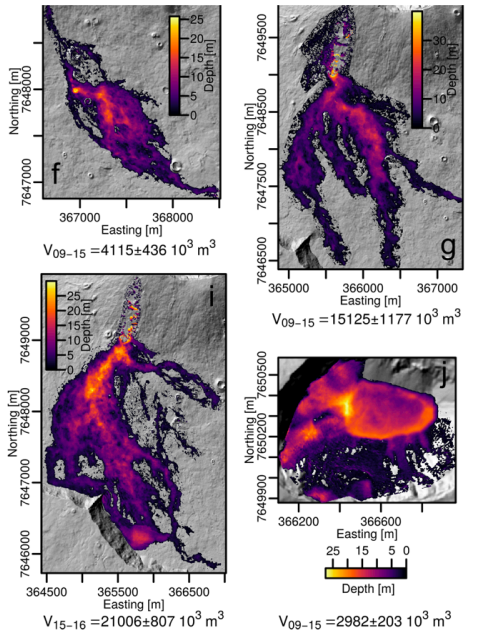
Hillshade of a HR-DSM (1 m) over Piton de la Fournaise / La Réunion

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

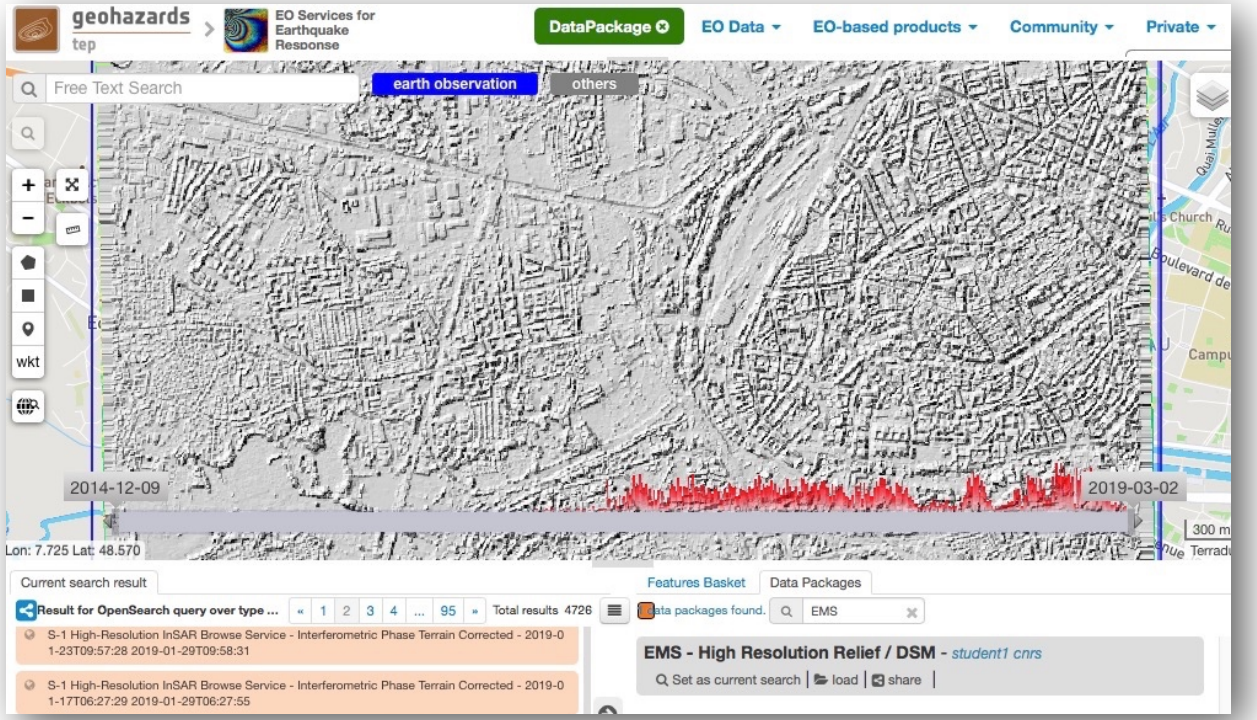


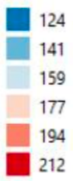


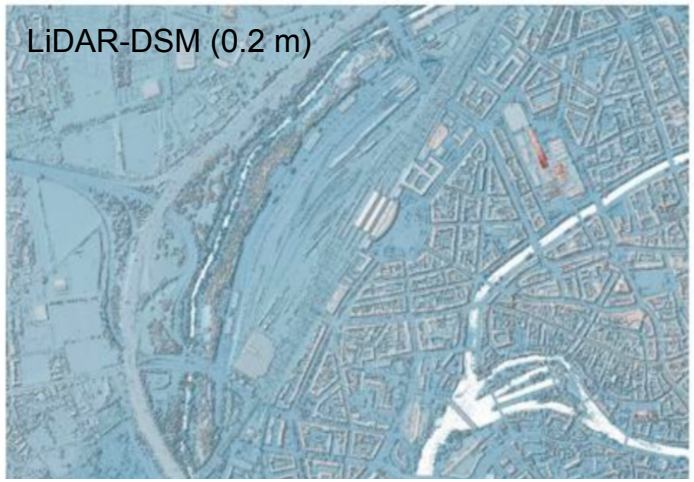


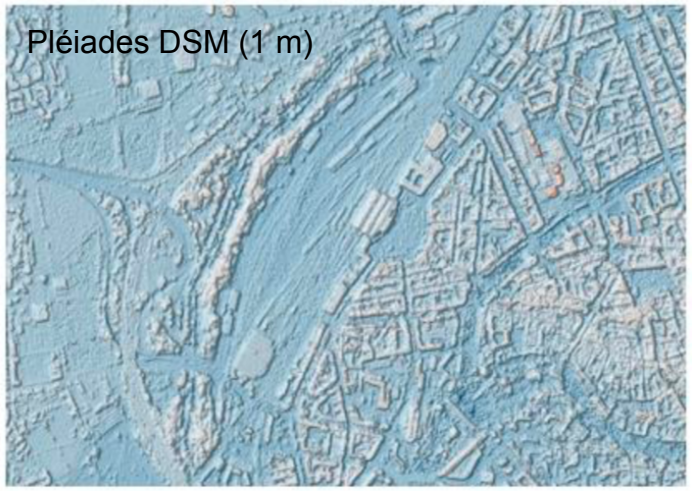
DSM-OPT: application for urban studies

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



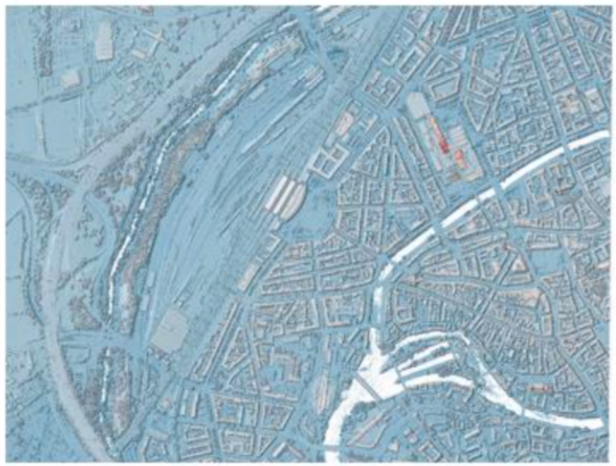






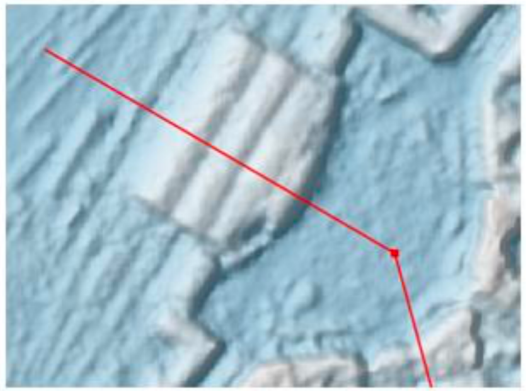
DSM-OPT: parameterization and scenario modelling window size and regularization

LiDAR-DSM (0.2 m)

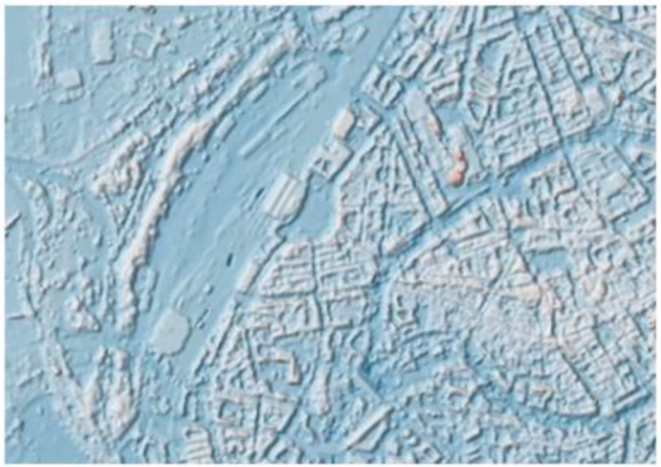


Pléiades-Scenario 1

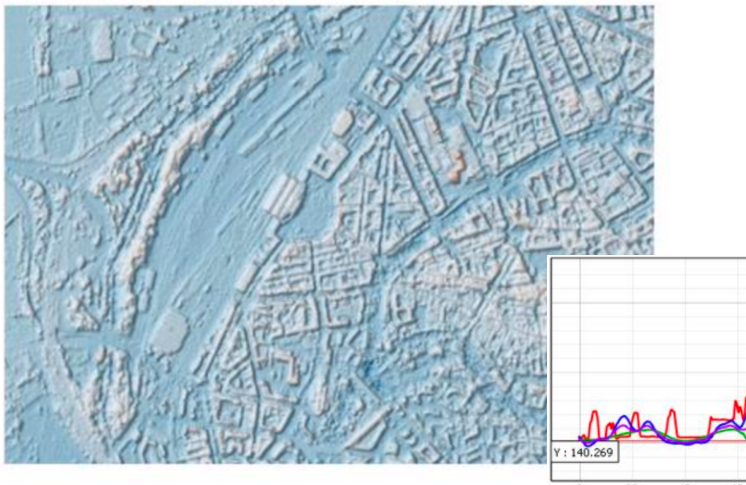
Strasbourg train station

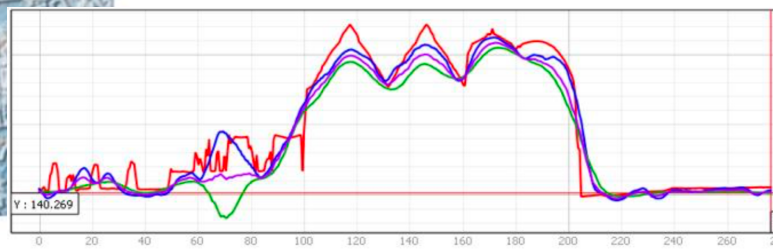


Pléiades-Scenario 2



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 (Worldwiew, 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
- Μετηοδσ:
  - αυτοματεδ χηανγε δετεχτιον μετηοδσ (ε.γ. ιμΧΛΑΣΣ) το δετεχτ ανδ μαπ τηε λανδσλιδεσ (πολψγονσ) → *Υσε: χηανγεσ ιν λανδσλιδε συρφαχεσ → ηαζαρδ μαπ υπδατεσ*
  - ιμαγε χορρελατιον μετηοδσ το εστιματε λανδσλιδε 2Δ/3Δ ϖελοχιτψ → [illegible]
- [illegible] + [illegible]3[illegible] [illegible]
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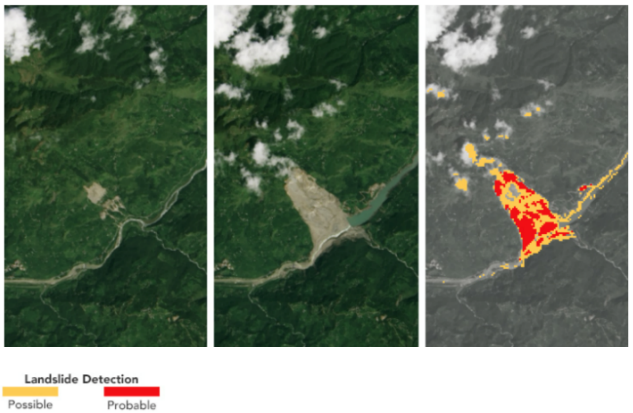
Direct observation of new landslides using change detection method



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 -

CO3D derived information for landslide applications

Application 2: Towards operational landslide warning service from rainfall data

- Δατα ρεθυεστ: ↔ ραπιδ ≈ ΧΟ3Δ χοωεραγε αφτερ ηεαωψ ραιν εωεντ περιοδσ (ον-δεμανδ)
- Μετηοδσ:
  - αυτοματεδ χηανγε δετεχτιον μετηοδσ (ε.γ. ιμΧΛΑΣΣ) το μαπ τηε λανδσλιδε εξτεντσ
  - αναλψσισ οφ ασσοχιατεδ αινφαλλ παττερνσ φρομ ιν-σιτυ μετεορολογιχαλ ραδαρσ
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- ⌲♋❒♦■♏❒⬩♒♓◘: ☜⚐♦❄ + ♦✌☝☜ (⬩□❒&⬩ ♋●❒♏♋♎♲ □■-♑□♓■♑)
- ⌲♋❒♦■♏❒⬩/♏■♎-◆⬩♏❒⬩: 👍👎, 👎👎❄, ⚐☠☞-☼❄💣
- ❄♋❒♑♏♦: 1 ◆⬩♏ ♍♋⬩♏ ♓■ ☞❒♋■♍♏ ♓■ 2020 (✞♋● ♎✌❒●♲ ?) ; 1 ◆⬩♏ ♍♋⬩♏ ♓■ ♦♓♏❒❒♋ ☹♏□■♏ ♓■ 2021 (◘□⬩⬩♓♌●♏ ●♓■&; ♦□ ✟✍/☜♦✌ ◘❒□ℯ♏♍♦)

CO3D derived information for landslide applications

Application 2: Towards operational landslide warning service from rainfall data

- Δατα ρεθυεστ: ↔ ραπιδ ≈ ΧΟ3Δ χοωεραγε αφτερ ηεαωψ ραιν εωεντ περιοδσ (ον-δεμανδ)
- Μετηοδσ:
  - αυτοματεδ χηανγε δετεχτιον μετηοδσ (ε.γ. ιμΧΛΑΣΣ) το μαπ τηε λανδσλιδε εξτεντσ
  - αναλψσισ οφ ασσοχιατεδ αινφαλλ παττερνσ φρομ ιν-σιτυ μετεορολογιχαλ ραδαρσ
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- [illegible]

CO3D derived information for landslide applications

Application 3: Changing landslide exposure in high altitude slopes with permafrost melting

- Δατα ρεθυεστ: ↔ ραπιδ ≈ ΧΟ3Δ χοϖεραγε αφτερ ηεαϖψ ραιν εϖεντ περιοδσ (ον-δεμανδ)
- Μετηοδσ:
  - αυτοματεδ χηανγε δετεχτιον μετηοδσ (ε.γ. ιμΧΛΑΣΣ) το μαπ τηε λανδσλιδε εξτεντσ
  - αναλψσισ οφ ασσοχιατεδ αινφαλλ παττερνσ φρομ ιν-σιτυ μετεορολογιχαλ ραδαρσ
  - 👎♏♐♓■♓⧫♓□■ □♐ ⧫♒❒♏⬧♒□●♎⬧ ♋■♎ ⬧♍♋●♓■♑ ●♋⬥⬧ / ◻❒□♌♋♌♓●♓⬧⧫♓♍ ❍□♎♏●⬧ -> ❒♋♓■♐♋●● ◻♋⧫⧫♏❒■ ❖⬧. ●♋■♎⬧●♓♎♏ ◻♋⧫⧫♏❒■
- ✌♎♎♓⧫♓□■♋● ⬧□◆❒♍♏ □♐ ♓■♐□❒❍♋⧫♓□■: ❒♋♓■♐♋●● ♎♋⧫♋ (❒♋♎♋❒ ♏⬧⧫♓❍♋⧫♏ + ❒♋♓■ ♑♋◆♑♏⬧)
- 🏱❒□♎◆♍⧫: ◻❒□⧫□⧫⍓◻♏ ⬧♏❒❖♓♍♏ ♐□❒ ◻❒♏♎♓♍⧫♓■♑ ●♋■♎⬧●♓♎♏ ♋♐♐♏♍⧫♏♎ ♋❒♏♋ ♐❒□❍ ❒♋♓■♐♋●● ♐□❒♏♍♋⬧⧫
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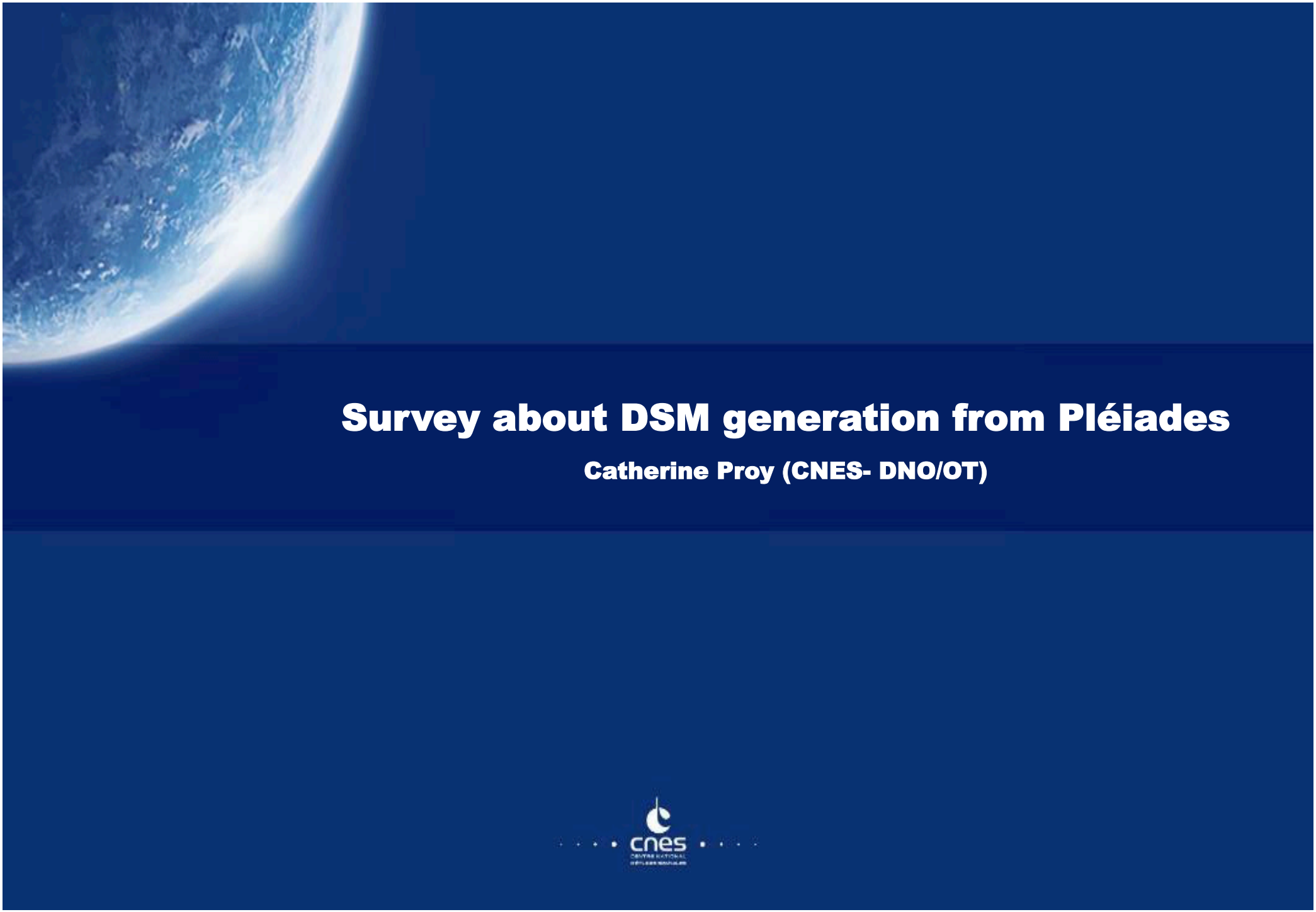
- 🏱♋❒⧫■♏❒⬧♒♓◻: ☜🏳💧❄ + 💧✌☝☜ (⬥□❒🙵⬧ ♋●❒♏♋♎⍓ □■-♑□♓■♑)
- 🏱♋❒⧫■♏❒⬧/♏■♎-◆⬧♏❒⬧: 👍👎, 👎👎❄, 🏳☠☞-☼❄💣
- ❄♋❒♑♏⧫: ⬧🙵♓ ❒♏⬧⬧□❒⧫ ⬧⧫♋⧫♓□■ (♐□❒ ♓■⬧⧫♋■♍♏: ☹♏⬧ ✌❒♍⬧, ☹'✌●◻♏ ♎'☟◆♏⌘)



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

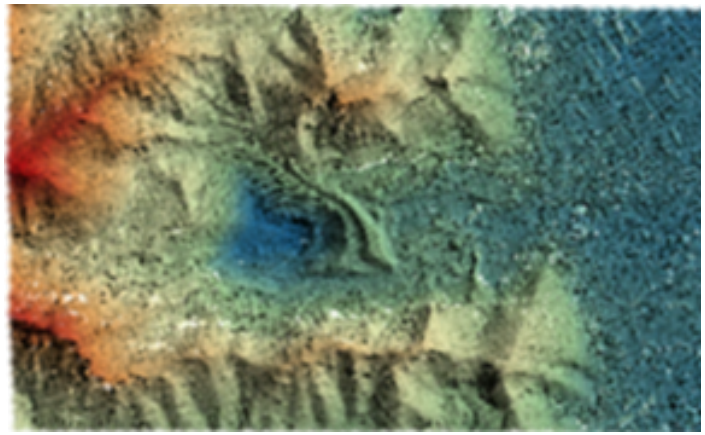
Scientific french community and public entities have no easy-to-use tool or service to generate elevation information from Pléiades

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



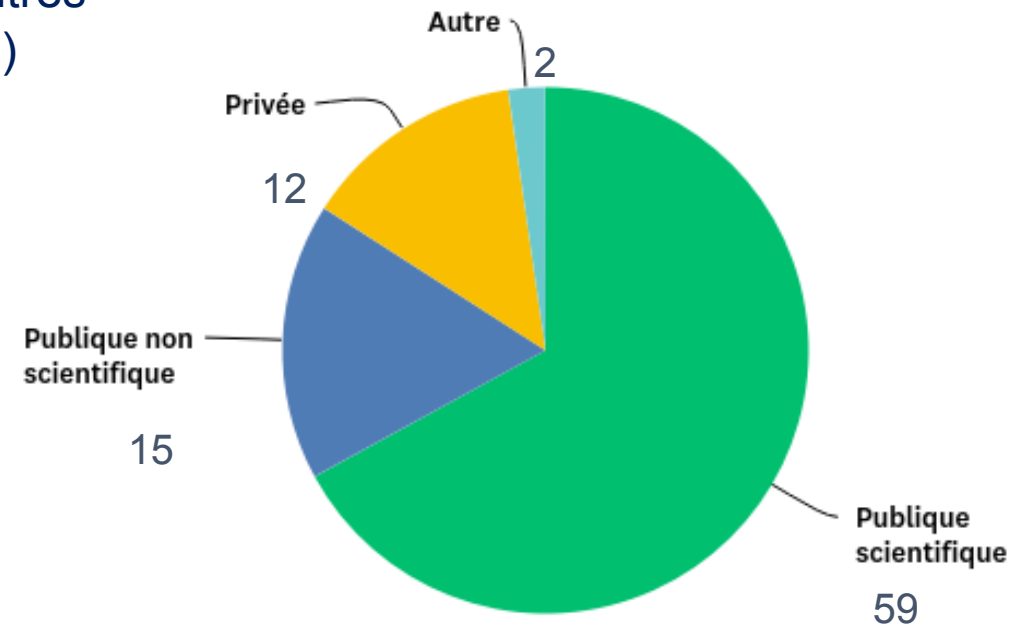
Post-processing

- 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

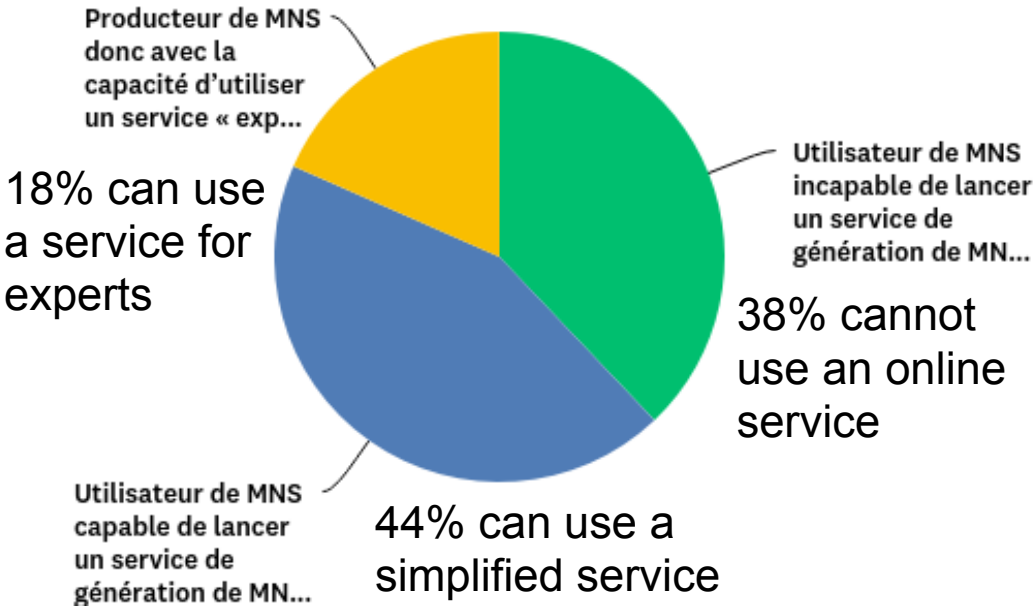
- 2 non interested

Level of service requested

38% cannot use an online service

44% would use a simplified service

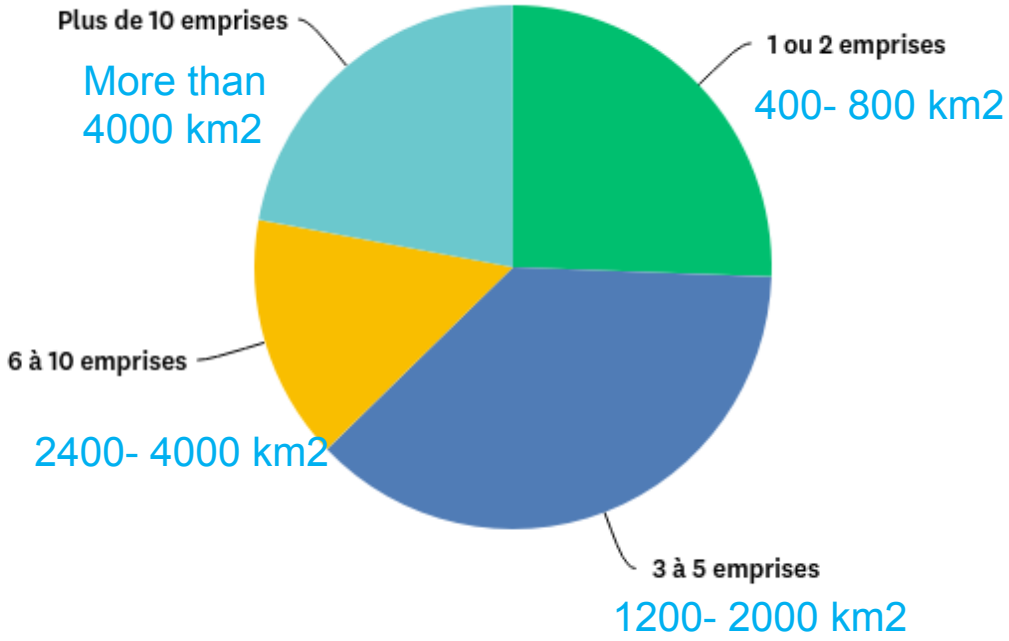
18% would use an expert service



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

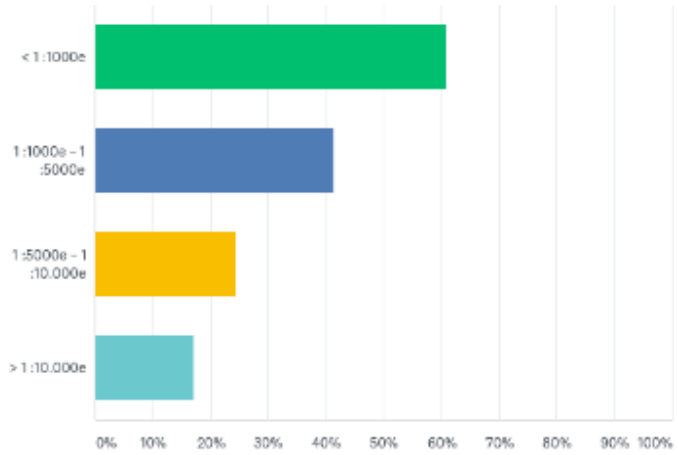
Annual needs

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 positionning 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

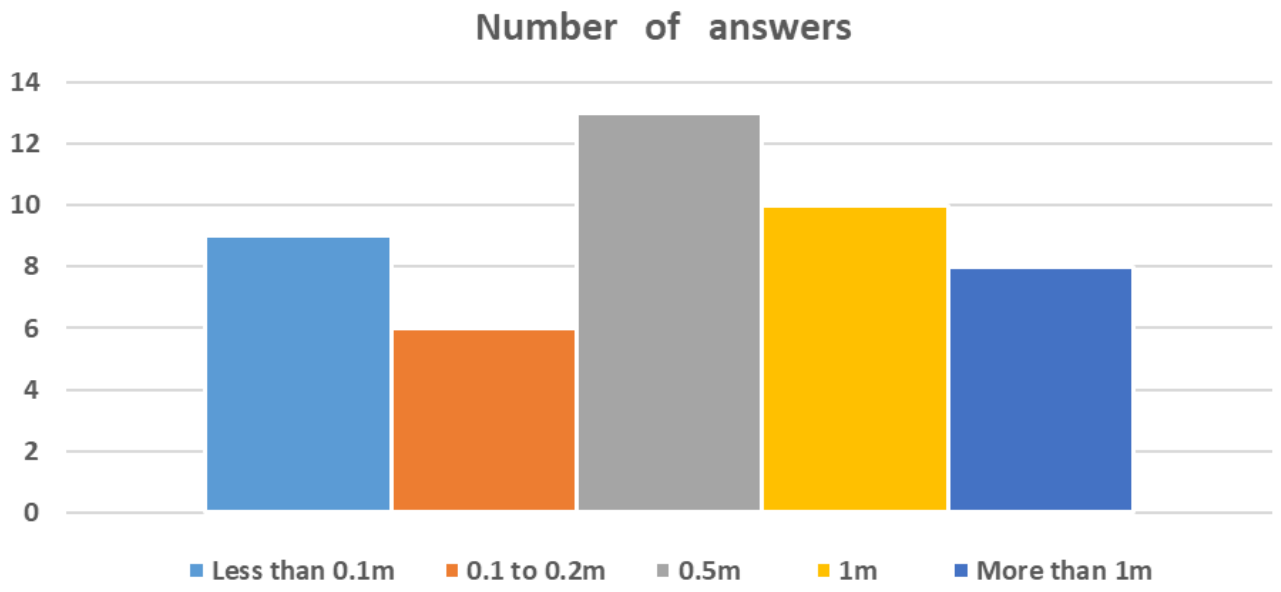
55 / 88 users have additional needs:

- **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**