Grabels watershed — Pléiades © Airbus DS / CNES · Cerema · TerraNIS

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Pléiades4UrbanFlood

Mapping urban flood hazard from very-high-resolution satellite imagery

A Cerema-led Space for Climate Observatory project · 2023–2025 · Grabels, Southern France

Context: flash floods in a changing climate

1 Climate change + urban growth

Intense rainfall over increasingly sealed soils turns rain into fast surface runoff.

2 Flash floods, little warning

In small Mediterranean watersheds, floods build in minutes — hard to anticipate.

3 Conventional models, costly data

2D flood models rely on terrestrial land-cover databases that are expensive and rarely updated.

4 The P4UF question

Can very-high-resolution satellite imagery provide that input — and track how risk evolves?

Grabels · the 2014 reference event

~280 mm

of rain in 12 hours (6–7 Oct 2014)

574

households affected

> €1 M

in public / road damage

~155 ha

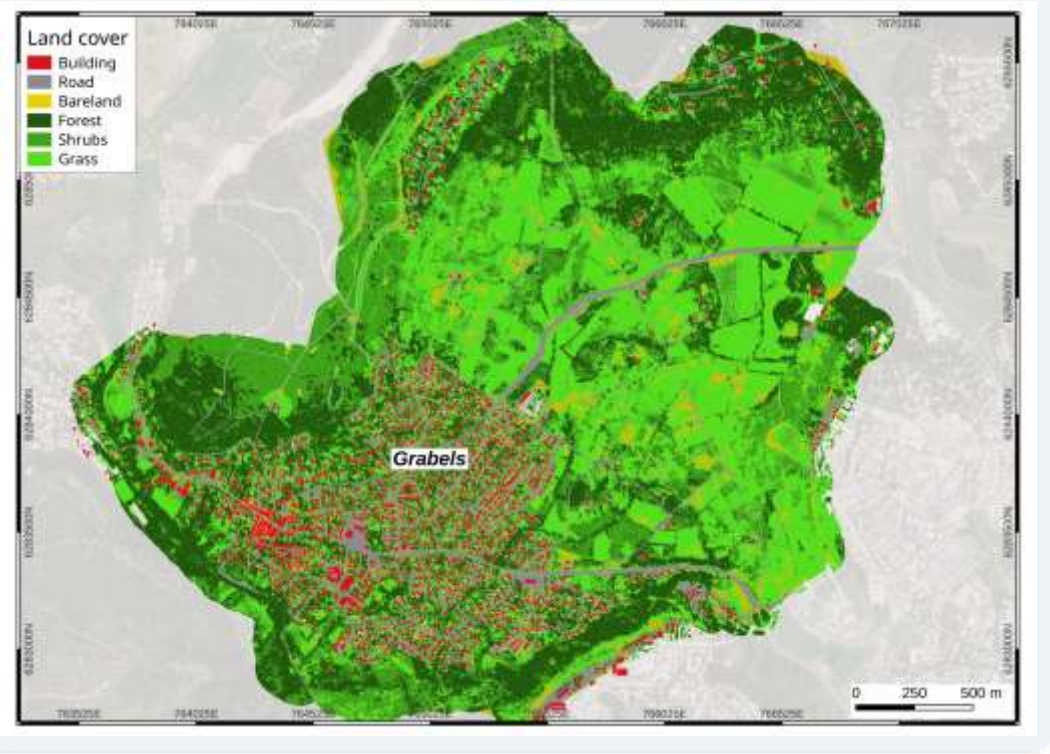
burned in the 2017 wildfire

Study area & spatial data

Grabels (~6 km²), near Montpellier — in the Rieumassel watershed of the Mosson river. A Mediterranean climate: dry summers, sudden autumn floods.

- 8 monoscopic VHR images, 2012–2024
- Pléiades (50 cm) + Pléiades Neo (30 cm)
- Capturing the 2014 flood, the 2017 drought & wildfire,
- and the town's urban growth (+13 % population, 2015–21)

Each image → a detailed land-cover map: buildings + three vegetation strata, produced by machine learning, with no 3-D / height data.



Aggregated land-cover map from Pléiades — © Cerema / Agenium / TerraNIS

From imagery to flood hazard

1. **VHR satellite imagery**

   Pléiades / Pléiades Neo monoscopic images of Grabels.

2. **Land-cover mapping**

   Buildings + three vegetation strata, by machine learning — no height data.

3. **Metamodelling**

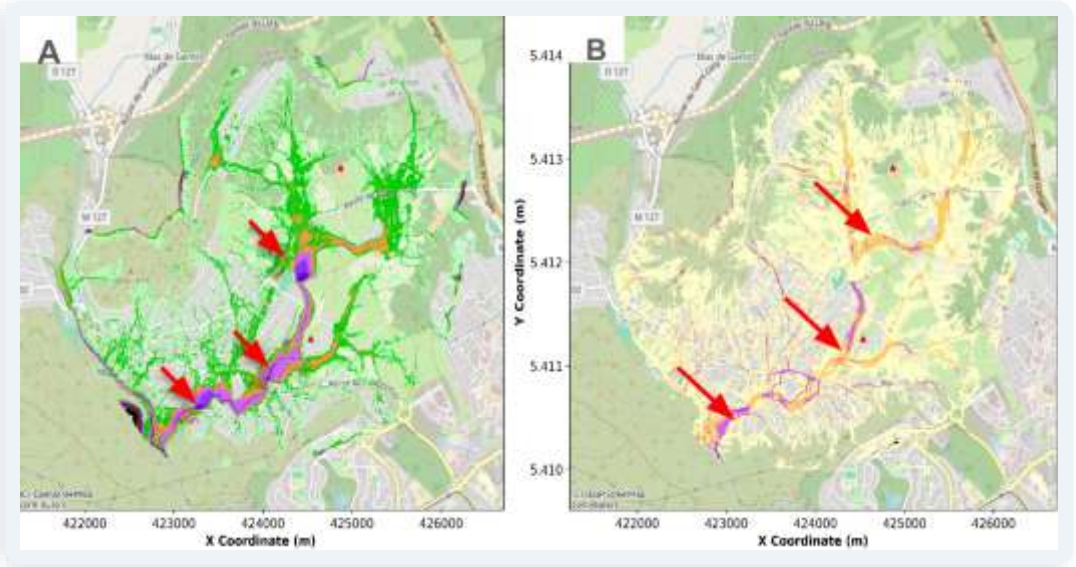
   Each class → hydraulic parameters: friction (Strickler Ks) + runoff (Curve Number).

4. **Hydrodynamic model**

   TELEMAC-2D in the CARTINO2D chain, with a terrain model (RGE Alti®) + rainfall.

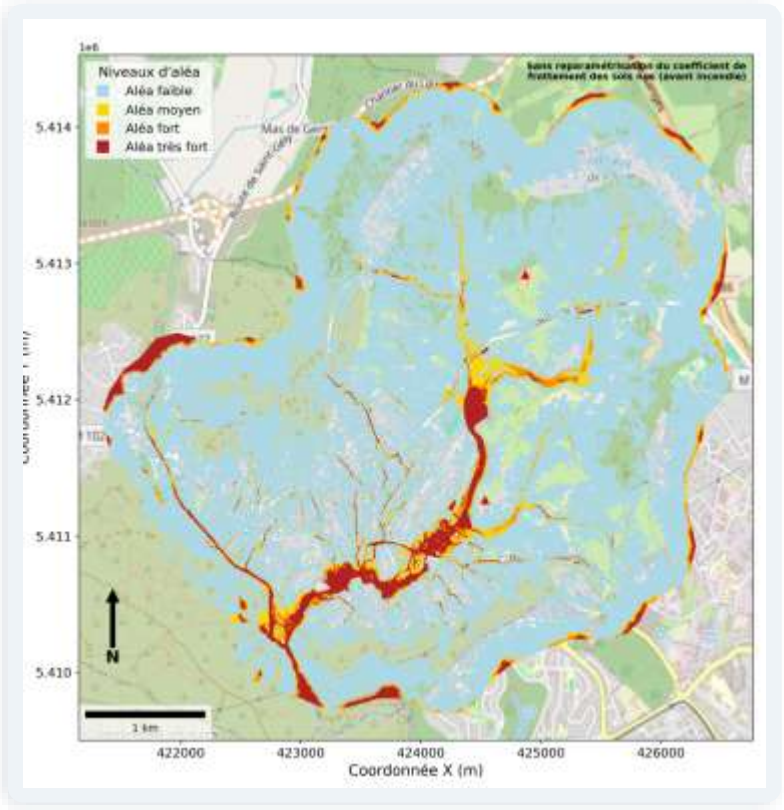
5. **Flood-hazard outputs**

   Max water depth (h) and flow velocity (V) → crossed flood hazard.



Model output — max water depth (left) and flow velocity (right), 2014 event

Results: satellite land cover works



Crossed flood hazard (h × V), 2014 event — © Cerema

0.03 m

RMSE · water depth (R^2=0.99)

0.13 m/s

RMSE · velocity

56 cm

at 33 flood marks = reference

Validated against reality

Satellite-derived land cover reproduces the 2014 flood as accurately as the BD TOPO® reference and the observed high-water marks — same extent and timing.

Land-cover monitoring

After the 2017 drought & wildfire, bare soil rose sharply and vegetation fell; built-up sealing increased +12 % (2012→2020).

Hazard evolution

A physically-based re-calibration of soil friction reveals a structural rise, shifting zones to “high” / “very-high”.

Hazard maps are research outputs — not for regulatory use.

Conclusions & perspectives

1 Validated & transferable

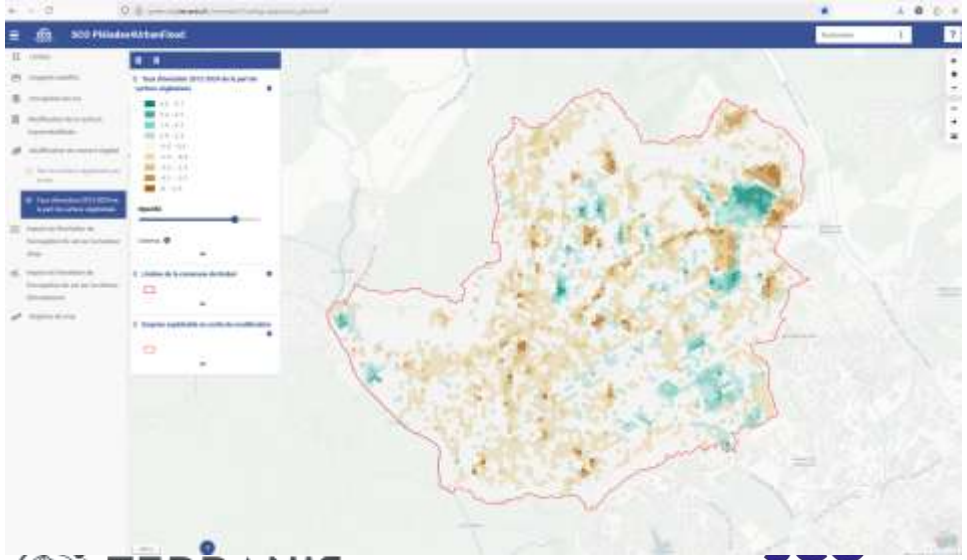
VHR Pléiades / Pléiades Neo land cover is a reliable input for peri-urban flood-hazard mapping — as accurate as terrestrial data, with a unique time depth.

2 Two requirements

A terrain model (≤ 10 m) that keeps vertical obstacles (buildings), and a physically-based calibration of the hydraulic parameters (Ks, CN).

3 Value for public authorities

An open web viewer to explore data & results — useful for climate-adaptation planning and for territories that lack high-resolution databases.



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Next — full-satellite pipeline

Replace terrestrial terrain data with the CO3D 3-D model (CNES / Airbus, 2025), plus automatic detection of events (fire, deforestation) for rapidly revised hazard maps.

The consortium & project team

Cerema — coordinator
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Hydraulic modelling & EO
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Airbus Defence and Space

VHR imagery & buildings
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Agenium IT & Systems

Building detection & data
V. Denaux · V. Gambino

TerraNIS

Vegetation land cover & web viewer
C. Ciron · N. Lagarrigue

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Thank you for your attention

Project web viewer & SCO page

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