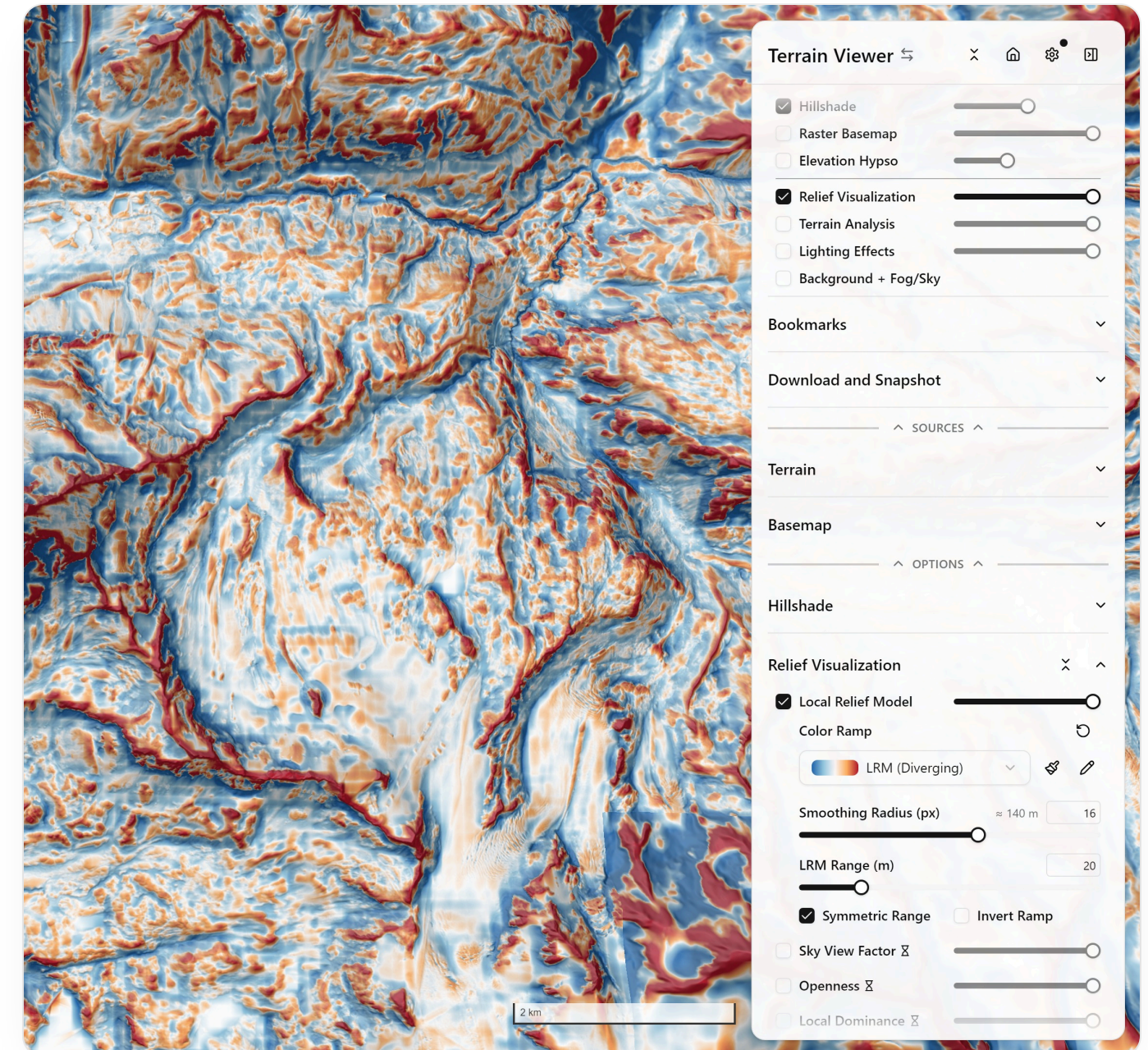


Reading the ground

Landscape archaeology and earth surface processes with elevation data and a time axis, in a browser tab.



Four things turn heights into evidence

■ Relief visualization

Hillshade, sky-view factor, openness, local relief: centimetre-to-metre features legible whatever their orientation.

■ Terrain derivatives

Slope, curvature, TPI, ruggedness: numbers on form, so landforms can be classified and mapped.

■ Differences of surveys

Uplift of an earthquake, thickness of a lava flow, ice a glacier lost, rock an avalanche removed.

■ Historical imagery

The time axis for the surface itself: looting pits, a site under a new town, a coastline retreating.

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■ The data changed

Airborne LiDAR through canopy at 0.5 m, published openly by England, the Netherlands, France, Switzerland, the USA. Elsewhere Copernicus GLO-30 gives every place a 30 m surface.

■ 130+ references

Every one checked against its DOI, each linked to its study area in the app with the modes the paper used.

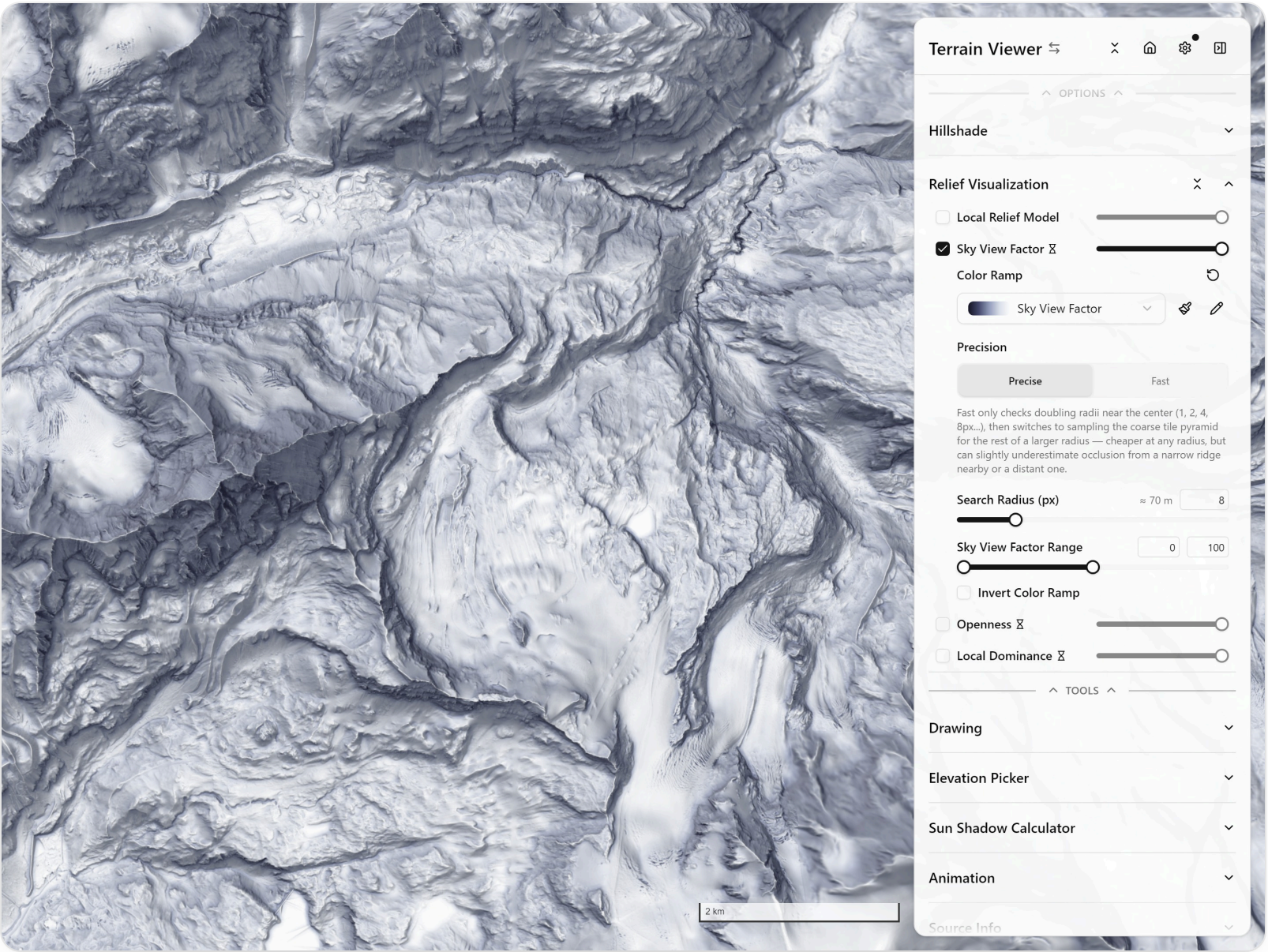
The RVT toolbox, in the browser

2010	Hesse LiDAR-derived Local Relief Models · Archaeological Prospection 17
2011	Zakšek, Oštir, Kokalj Sky-view factor as a relief visualization technique · Remote Sensing 3
2011	Kokalj, Zakšek, Oštir Sky-view factor for historic landscape features in LiDAR · Antiquity 85
2013	Doneus Openness for interpretative mapping of LiDAR DTMs · Remote Sensing 5
2017	Kokalj, Hesse ALS raster data visualization: a guide to good practice · ZRC SAZU
2016	Hesse Local dominance · Remote Sensing 8

LRM elevation minus a low-pass trend: the small bumps, whatever the slope.

SVF fraction of sky seen: pits dark, ridges bright, no light direction.

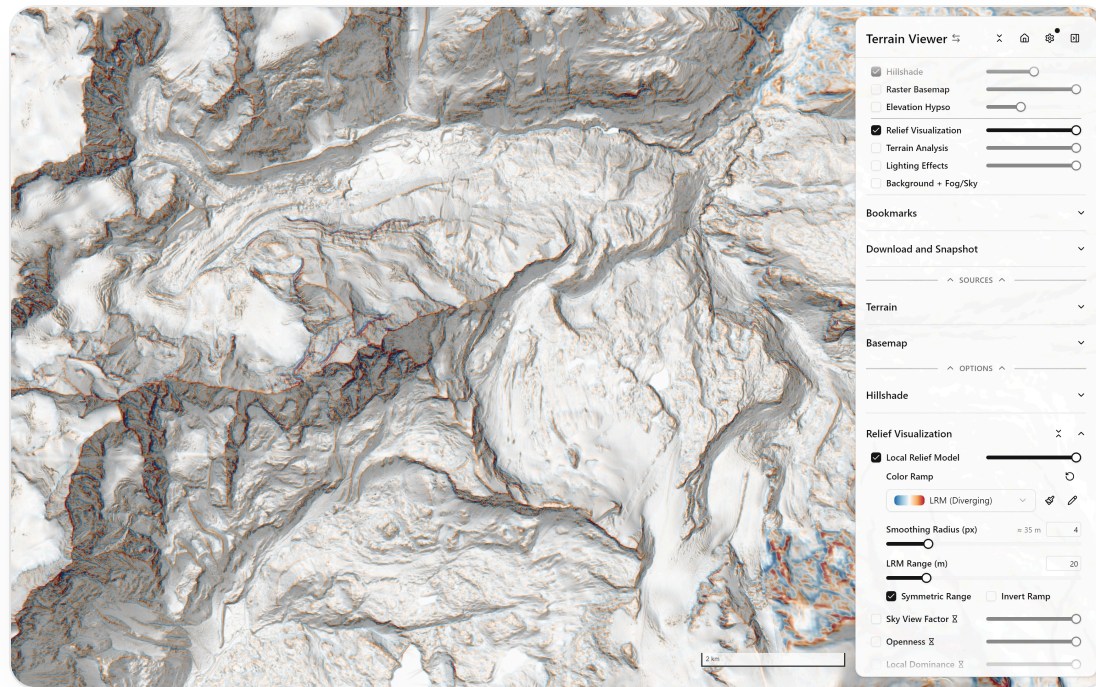
Openness + for crests and banks, – for ditches and channels.



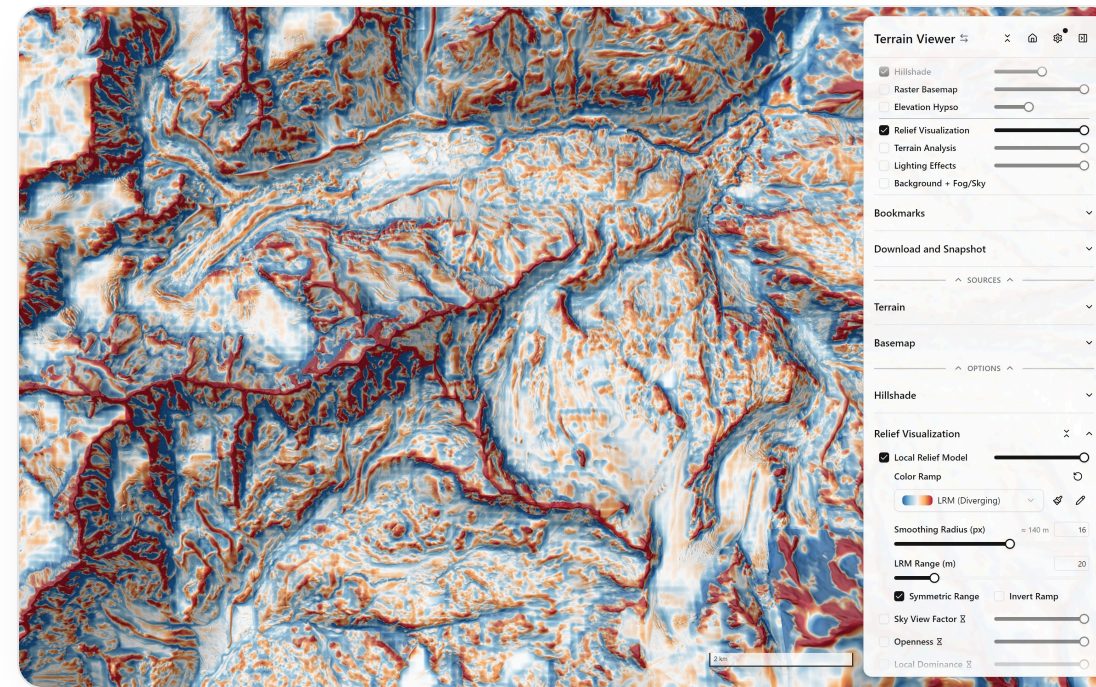
Sky-view factor over hillshade, Matterhorn

Zakšek et al. (2011), Sky-view factor as a relief visualization technique, doi:10.3390/rs3020398
Hesse (2010), LiDAR-derived local relief models, doi:10.1002/arp.374

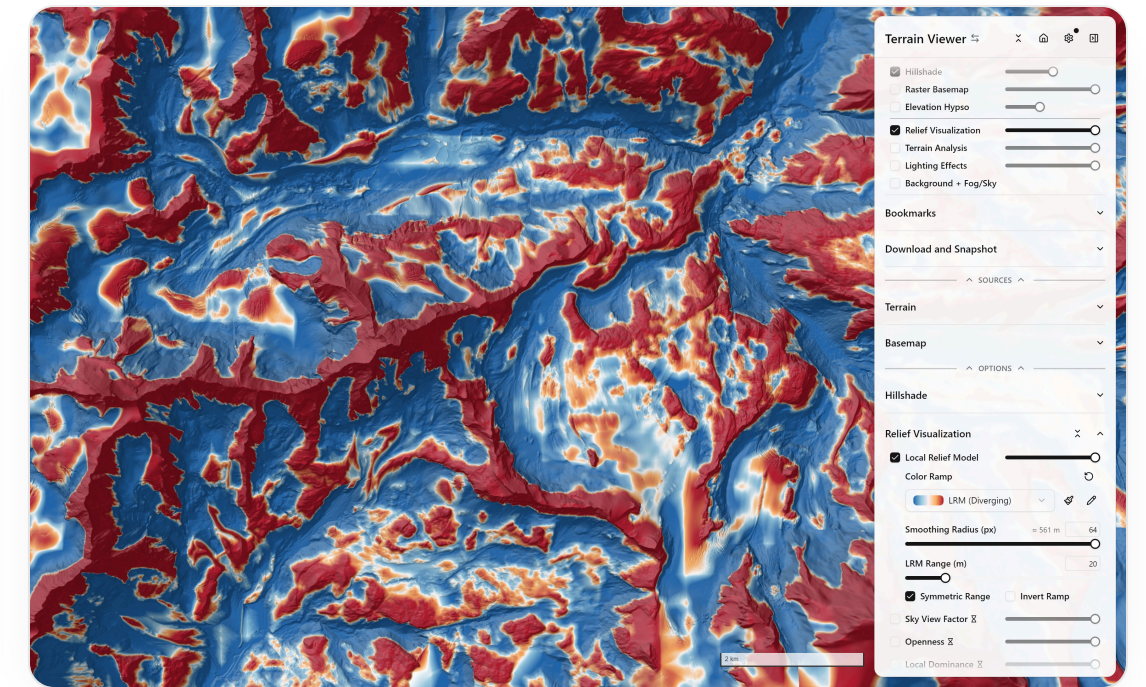
One slider, three questions



Radius 4 px: barely more than a 3×3 blur



Radius 16 px, the default



Radius 64 px: a broad regional trend

■ In metres

radius × ground resolution at this zoom, shown live beside the slider.

■ Free low-pass

the ancestor tile k levels up is already the blur: no kernel to run.

■ Pick the scale

a barrow wants 4–8 px at z16; a field system 16; a terrace 64.

Detect candidates, then look at every one

Tells detector (beta) Difference-of-Gaussians of the LRM, non-maximum suppression at the tell size, three vetoes: blobness, plan curvature, det-Hessian.

Resolution is the limit Bronze and Iron Age mounds run 50-300 m across, 3-20 m tall; a 30 m DEM misses the small end. LiDAR finds it.

Iterate import an inventory, step through sites with → and N, delete with D.

Aguada Fénix a platform invisible from the ground, unmistakable in a hillshade: the LiDAR dataset itself is in the library.

2020

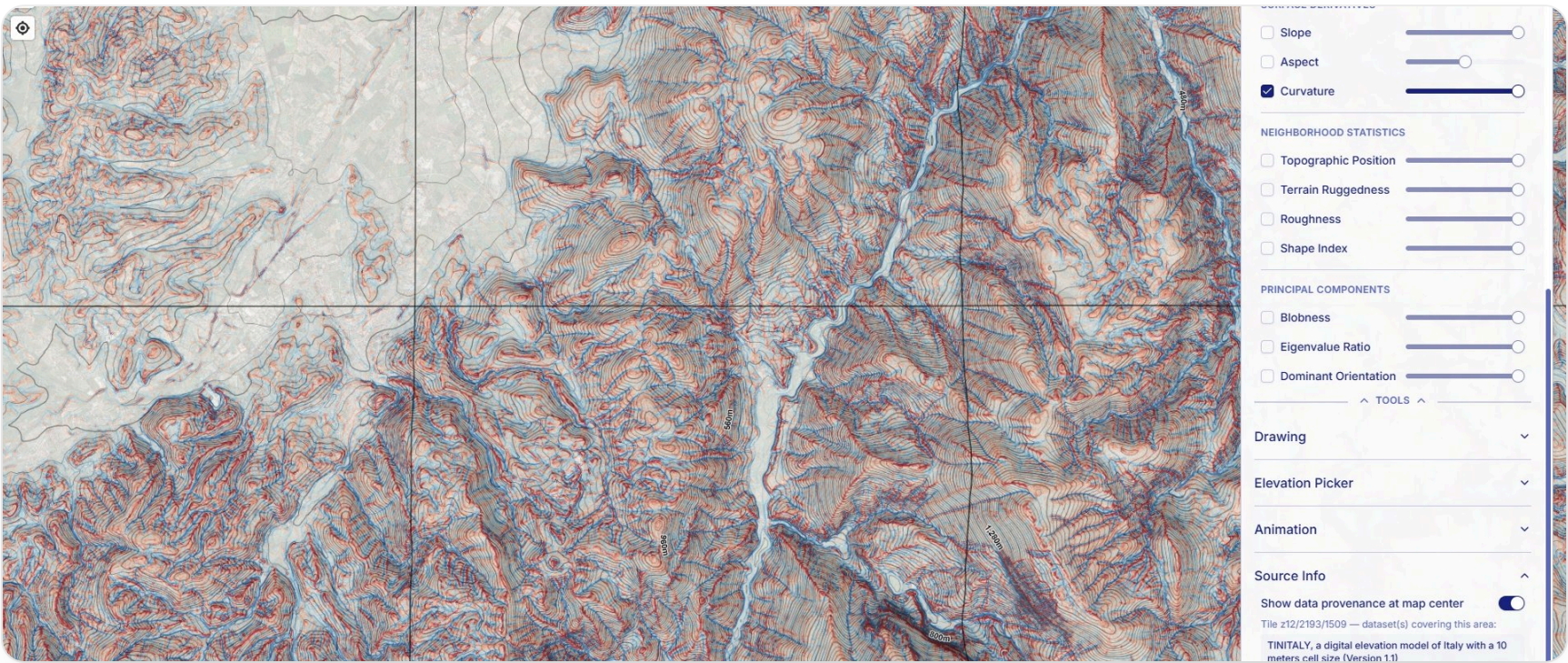
Inomata et al. Monumental architecture at Aguada Fénix · Nature 582

2018

Canuto et al. Lowland Maya complexity from airborne laser scanning · Science 361

2019

Verschoof-van der Vaart, Lambers R-CNN detection of barrows and Celtic fields on AHN · J. Computer Applications in Archaeology



Terrain analysis submodes, with per-tile provenance

■ Heritage Quest

Citizen science on AHN LiDAR for barrows and Celtic fields (Zooniverse). The viewer with AHN and the mound detector is the same question put to a browser.

Menze & Ur (2012), Long-term settlement in Northern Mesopotamia at a large scale, doi:10.1073/pnas.1115472109
Orengo et al. (2020), Automated detection of archaeological mounds, doi:10.1073/pnas.2005583117

DEM of difference: what moved between two surveys

Bhotekoshi 2026 post-event 0.5 m DSM minus GLO-30; geo-pera's corrected 2 m dh raster beside it.

Columbia Glacier 2012-2021 two ArcticDEM strips subtracted: tens of metres of ice lost at the front.

Ridgecrest 2019 coseismic change, a diverging ramp around zero.

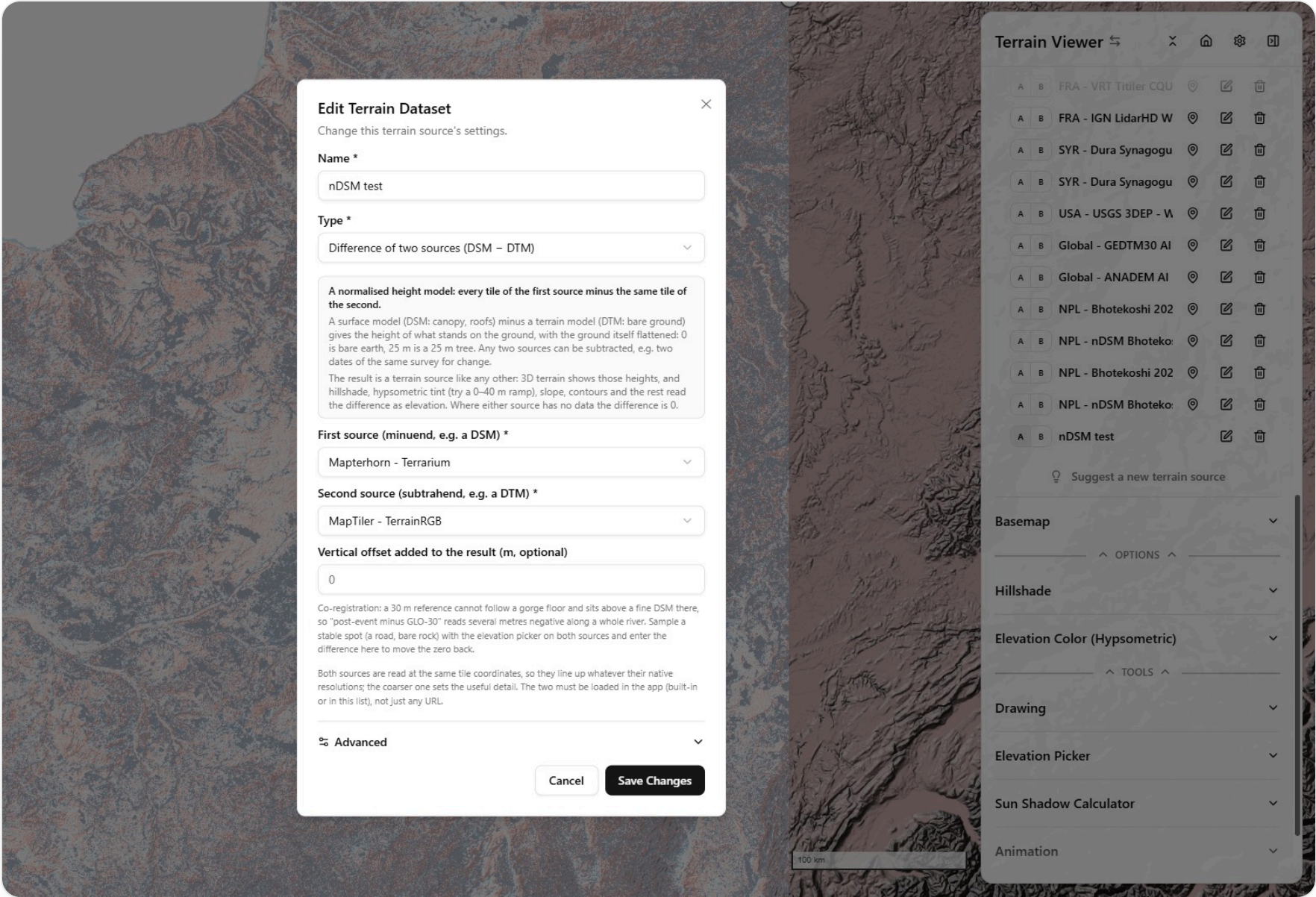
Three traps vertical datum (ellipsoid vs geoid), reference resolution, co-registration.

- 2021

Shugar et al. The 2021 Chamoli rock and ice avalanche · Science
- 2022

Mannerfelt et al. Halving of Swiss glacier volume since 1931 · The Cryosphere
- 2015

Iverson et al. Landslide mobility: the 2014 Oso disaster · EPSL



A difference source over a symmetric hypsometric ramp

Relative elevation: metres above the river

$REM = DEM - WSE(\text{interpolated along the centreline})$

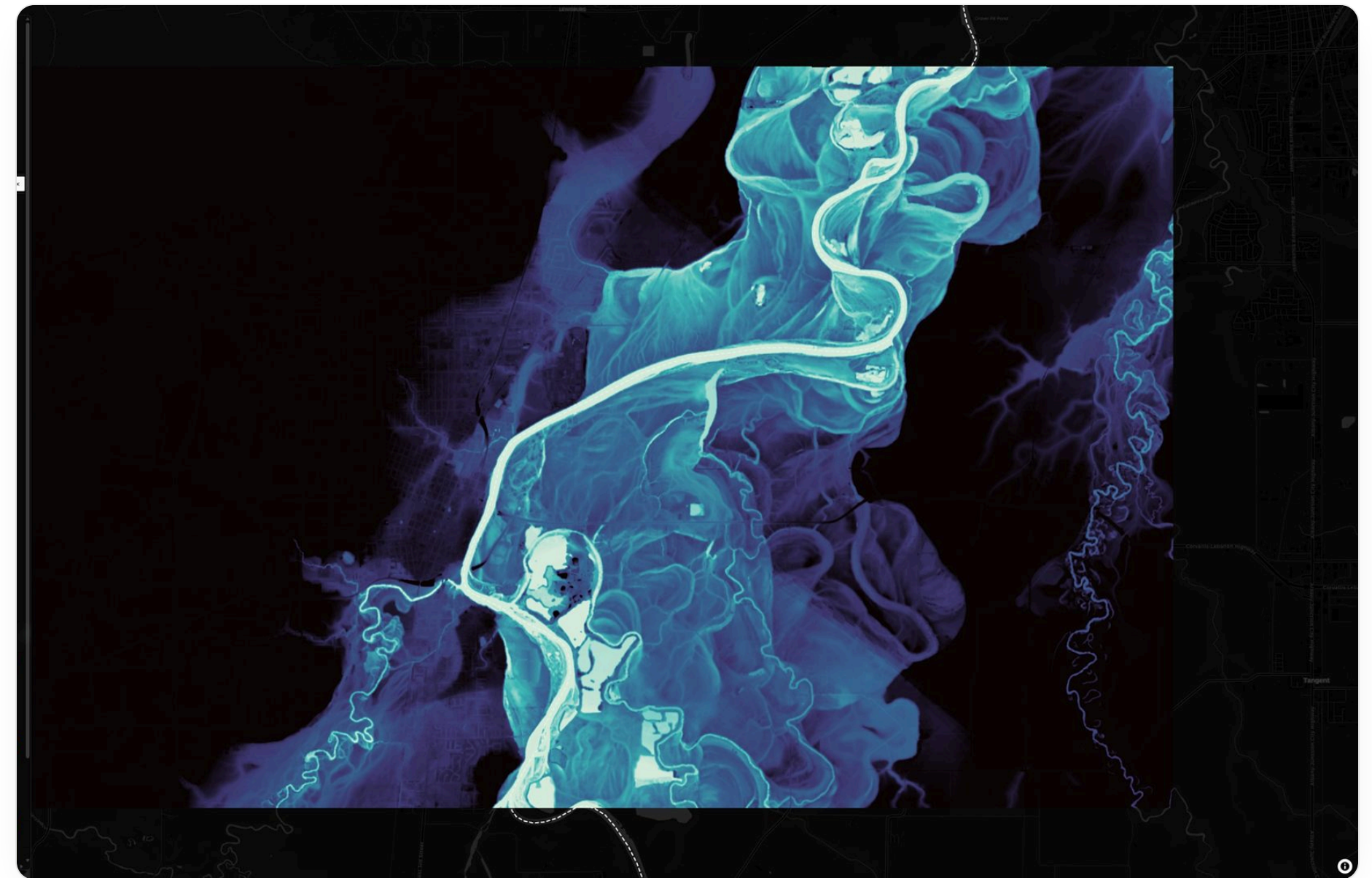
Why meander scrolls, terraces and palaeochannels are metre-scale relief on a flat floodplain; a hypsometric ramp hides them.

River-REM Iconem's companion app: OSM centreline, WSE sampled from Mapterhorn, detrended live in a `rem://` protocol.

Interpolation IDW (classic, bull's-eyes), nearest-polyline (clean bands), Euclidean distance transform ($O(\text{cells})$).

Open In hands the current viewport to River-REM.

2018 Strick et al. Morphology and spacing of river meander scrolls · Geomorphology



River-REM: a detrended floodplain, meander scrolls visible

Strick et al. (2018), Morphology and spacing of river meander scrolls, doi:10.1016/j.geomorph.2018.03.005

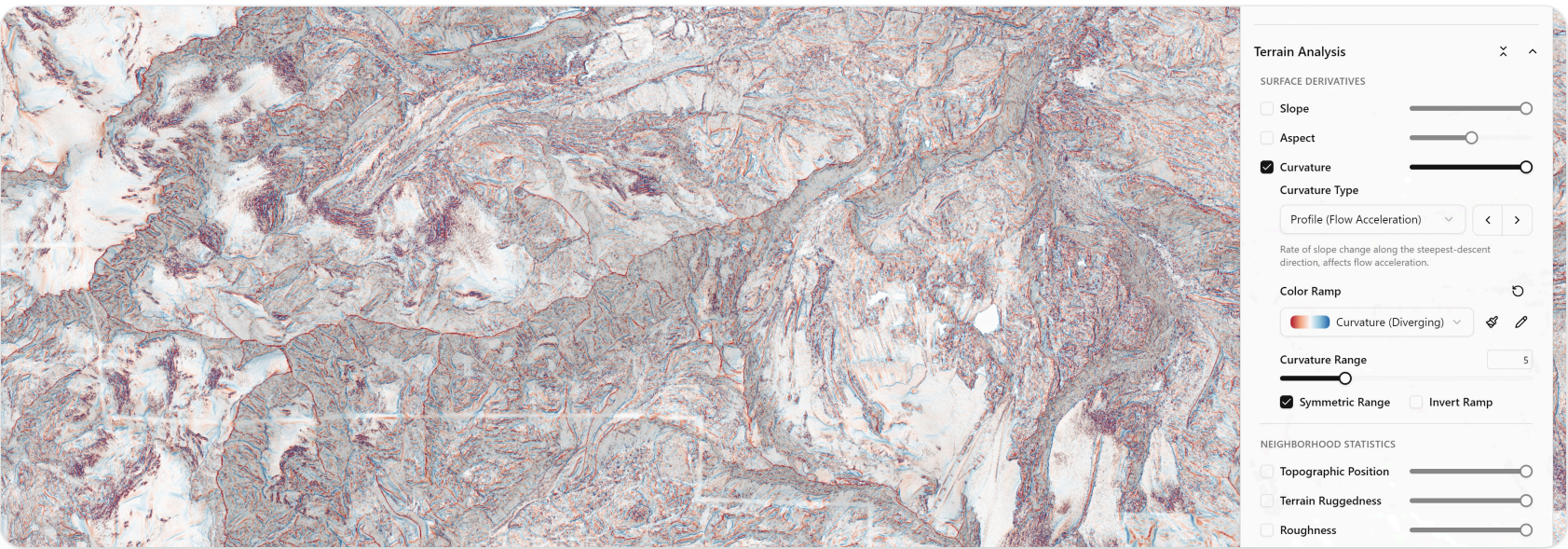
Singh et al. (2017), Himalayan river morphodynamics and Indus urban settlements, doi:10.1038/s41467-017-01643-9

Slope, curvature, TPI: numbers on landforms

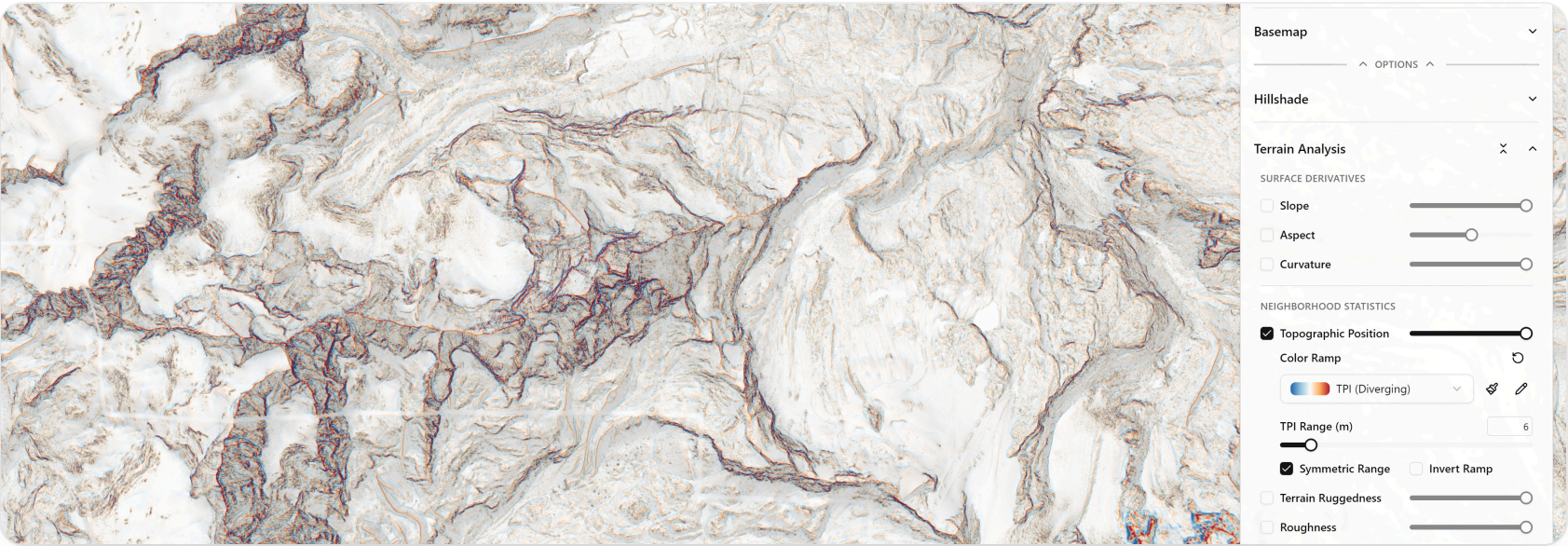
1981	Horn Hill shading and the reflectance map: the 3×3 gradient · Proc. IEEE
1987	Zevenbergen, Thorne Quantitative analysis of land surface topography · ESPL
2001	Weiss Topographic position and landforms analysis · ESRI UC
1999	Riley, DeGloria, Elliot Terrain ruggedness index · Intermountain J. Sci.
2012	Van Den Eeckhaut et al. Forested landslides from LiDAR derivatives · Geomorphology
2019	Verbovšek, Popit, Kokalj VAT for mass-movement features · Remote Sensing
2015	Yu, Eyles, Sookhan Drumlin shape and volume from LiDAR · Geomorphology

Landslides head scarps and hummocks in SVF and openness; inventories by derivative.

Glacial landforms drumlins, moraines, eskers: TPI and curvature with LiDAR.



Profile curvature



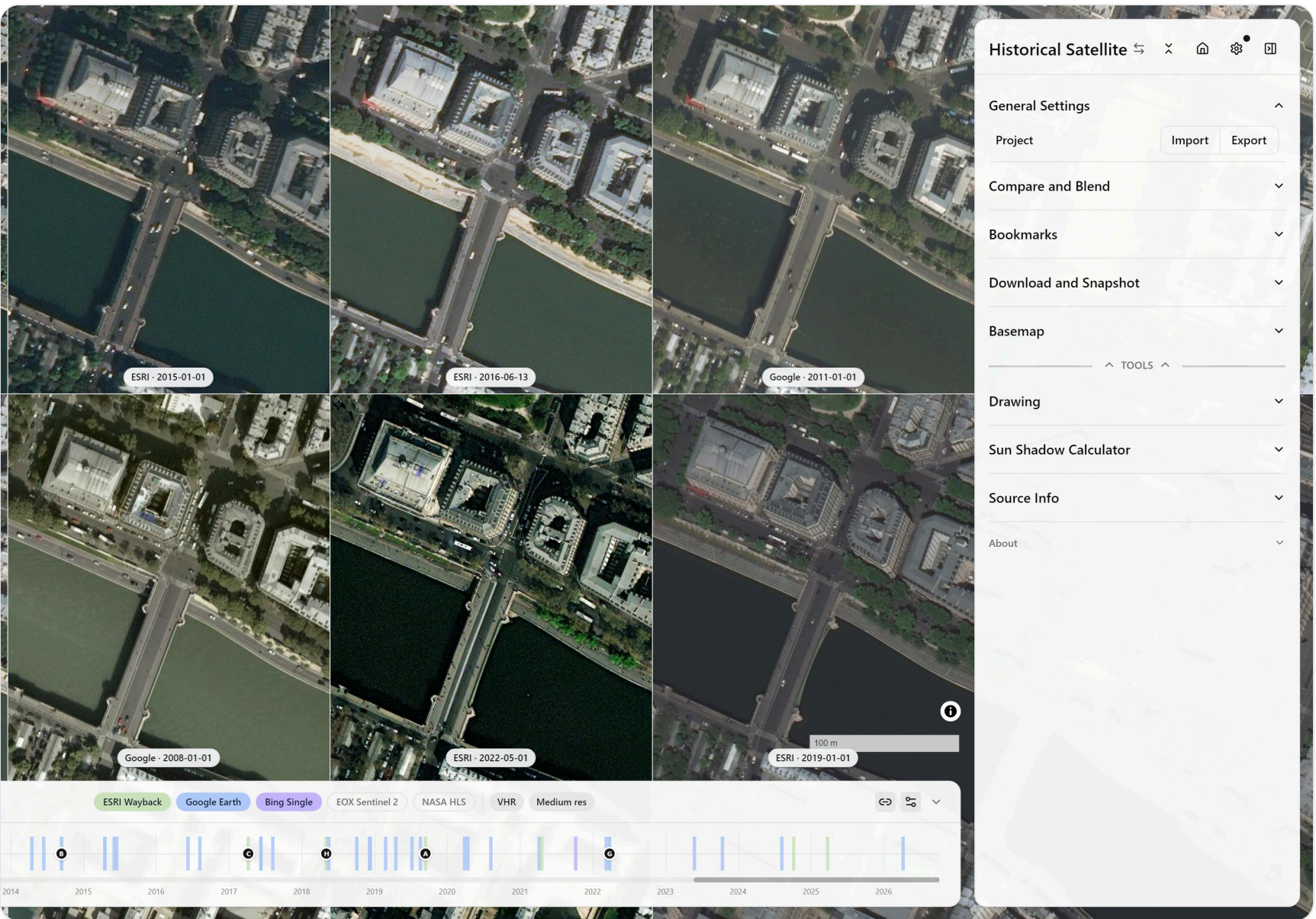
Topographic position index

The time axis: looting, damage, change

2016	Parcak et al. Satellite evidence of looting in Egypt, 2002-2013 · Antiquity
2017	Casana, Laugier Monitoring site damage in the Syrian civil war · PLOS ONE
2003	Ur CORONA photography and ancient road networks · Antiquity
2012	Casana, Cothren, Kalayci Archaeological applications of CORONA · Internet Archaeology
2023	Westley et al. Coastal erosion and the archaeology of Cyrenaica · PLOS ONE
2018	Haritashya et al. Large glacial lakes in the Nepal Himalaya · Remote Sensing

In the app Wayback since 2014, Google Earth often to the early 2000s, CORONA KH-4 1963-72, national archives to the 1920s.

Compare Difference blend between two dates; eight dates in a grid.



Eight dates over Île de la Cité

■ What can be done

A survey, start to finish, without installing anything

■ 1 · Find data

Coverage overlays: is there LiDAR here? Load it from the library, or search STAC.

■ 2 · Look

Stack SVF + LRM + openness at the right radius; tilt in 3D; drive the light from a date.

■ 3 · Measure

Profiles, a plane slicer, an iso-line at one height, a difference of two surveys.

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■ 4 · Review

Import the inventory, iterate feature by feature, draw what you see.

■ 5 · Export

Float32 GeoTIFFs of raw values, contours as GeoJSON, on one EPSG:3857 grid, into QGIS.

■ 6 · Share

The link reproduces the view; bookmarks by URL; an iframe in the paper's blog post.

Honest about the limits

Resolution a 30 m global DEM is a 30 m DEM; the viewer cannot sharpen it.

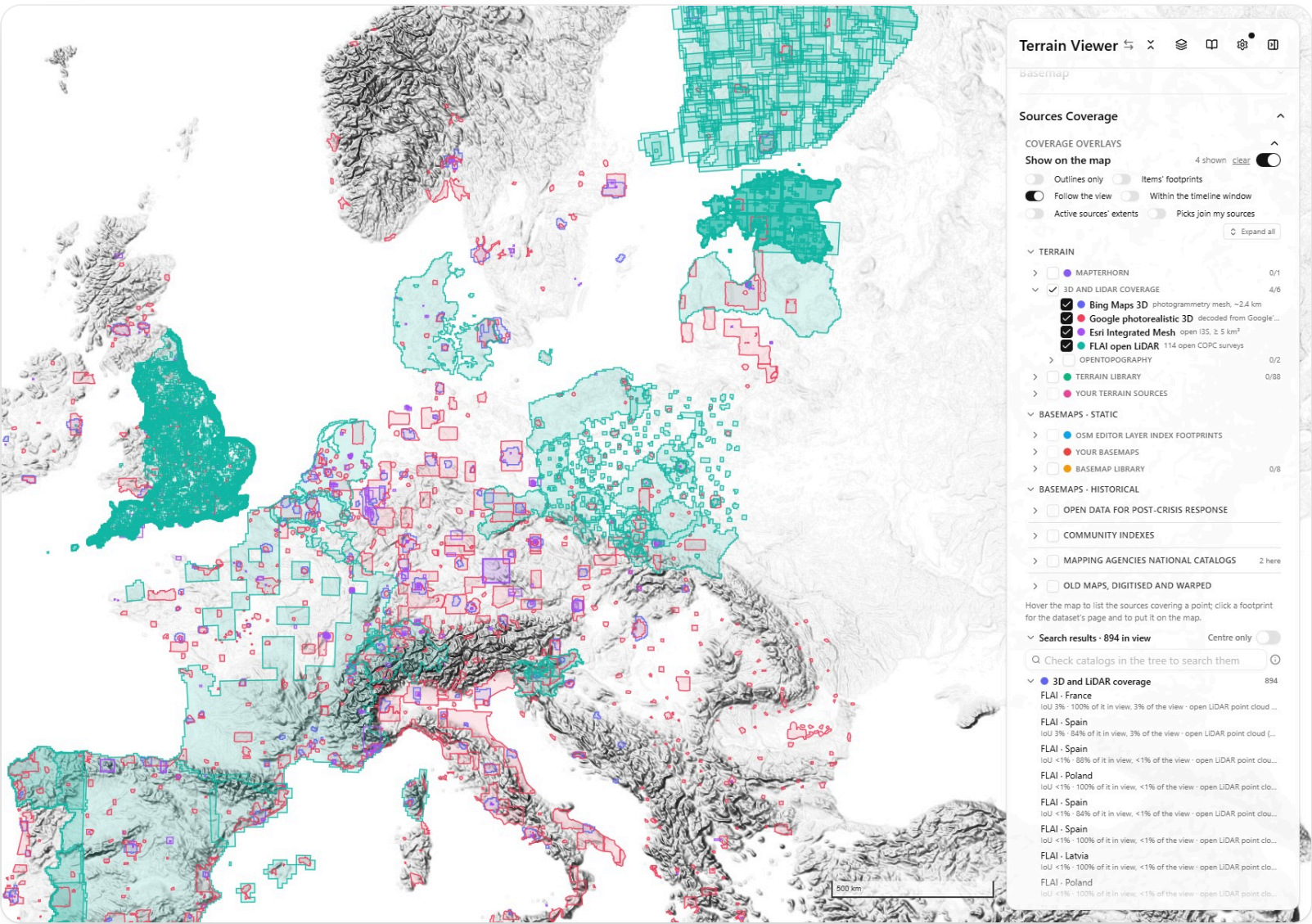
Datums no vertical transformation; differences need matching references.

CPU derivatives run per tile in JavaScript; SVF over a wide radius takes a moment.

Not an ephemeris solar position is closed-form, local solar time, no refraction.

Browser memory a 96 MB result cache; huge exports go through gdal_translate scripts.

Access what an agency puts behind a login stays there.



Where fine data exists: 3D mesh and LiDAR footprints over Europe