

New tools on *Terra Antiqua 2.0* applied to reconstructing the paleogeography of the India-Asia collision

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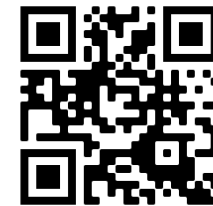
⁸ GeoRessource, Univ Lyon, France

⁹ ITPR CAS, Beijing, China

¹⁰ CUG, Wuhan, China

¹¹ Utrecht University, the Netherlands

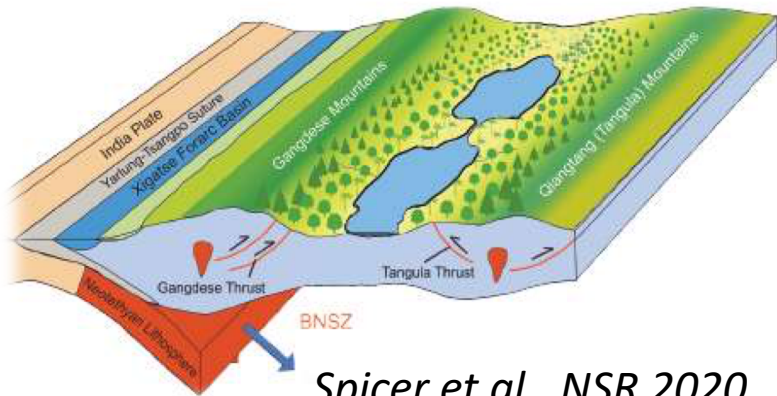
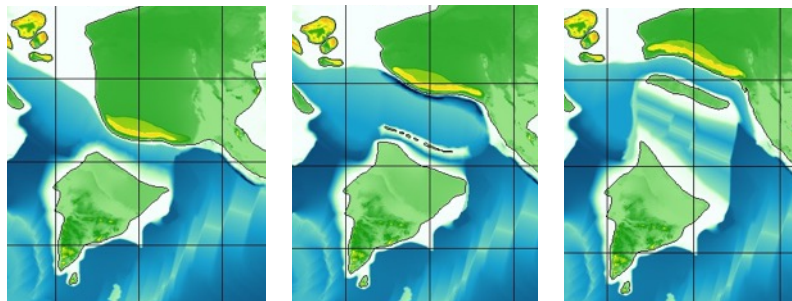
www.paleoenvironment.eu



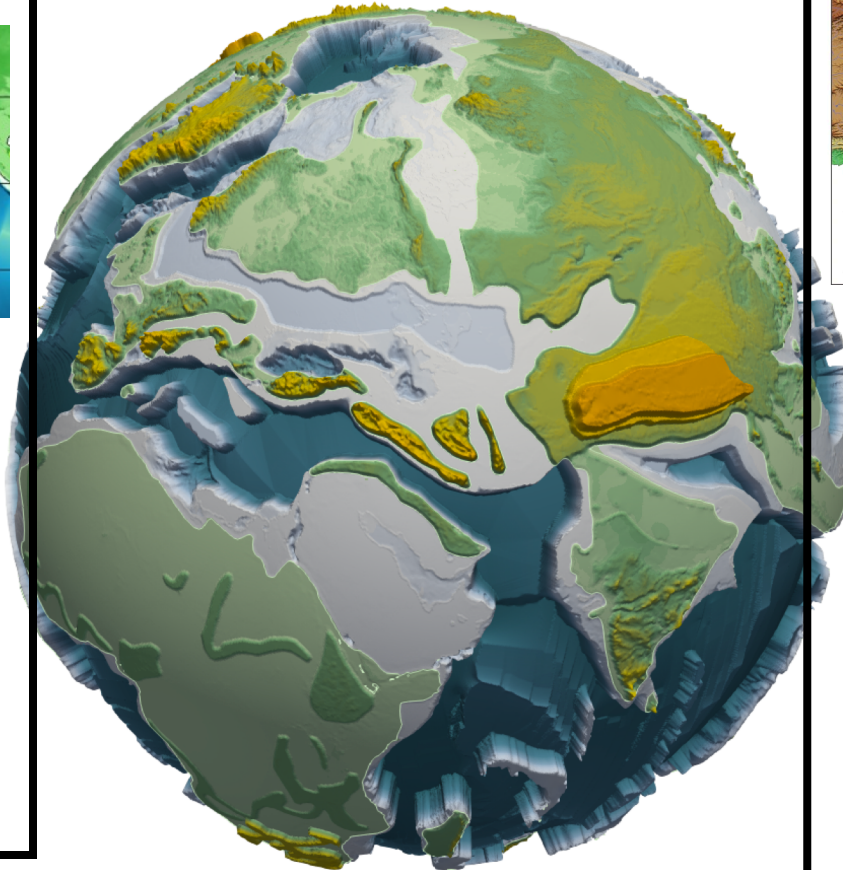
Paleogeographies are essential

Current need for regional high-resolution reconstructions.
India-Asia collision : an ideal site.

Databases



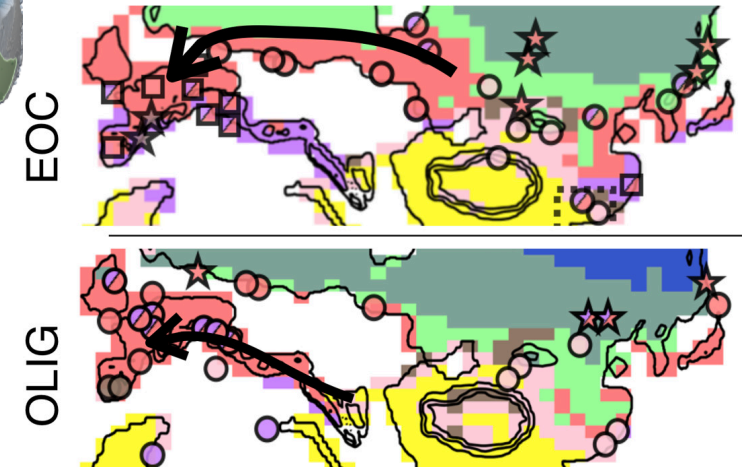
Spicer et al., NSR 2020



Numerical Modeling



Rey et al., 2022 Nature REE



Tardif et al., 2021 Sci. Adv.

Raging debates remain on:

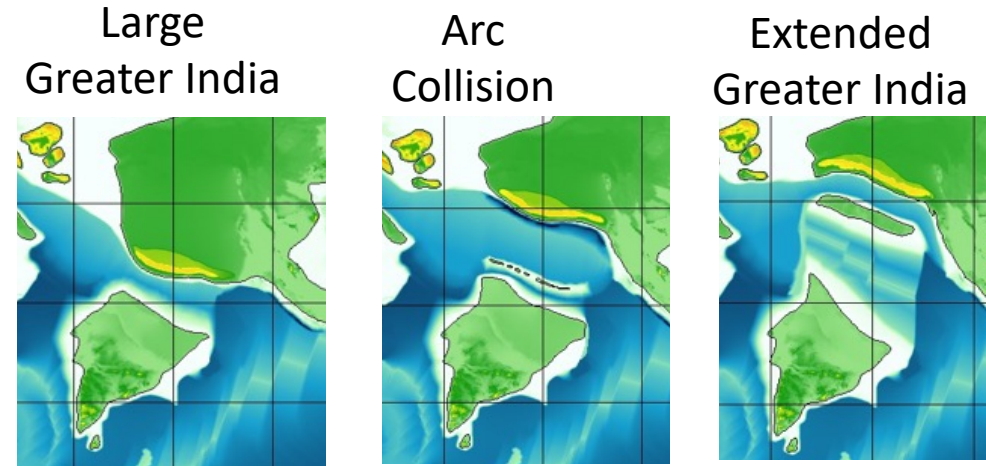
1. The India Asia collision

- Collisions with an arc or with Greater India?
- Age of the collision(s) ?

Meng et al., 2020 EPSL

Westerveel et al., 2019 Nature Geo

van Hinsbergen et al., 2019 Tectono.



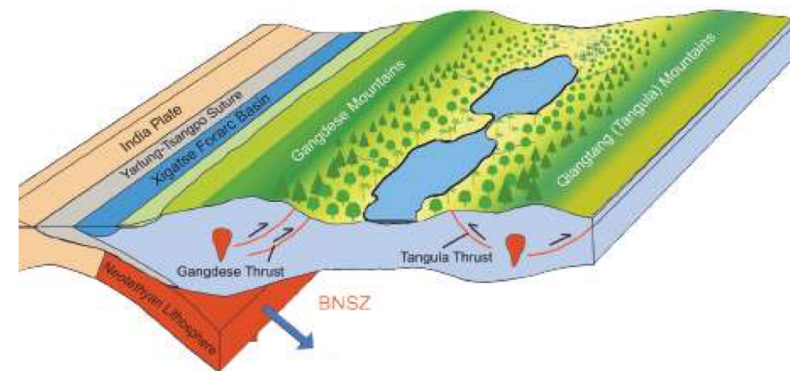
2. The growth of the Tibetan Plateau

- Age of the uplift?
- Wholesale or propagating uplift?

Spicer et al., 2020 NSR

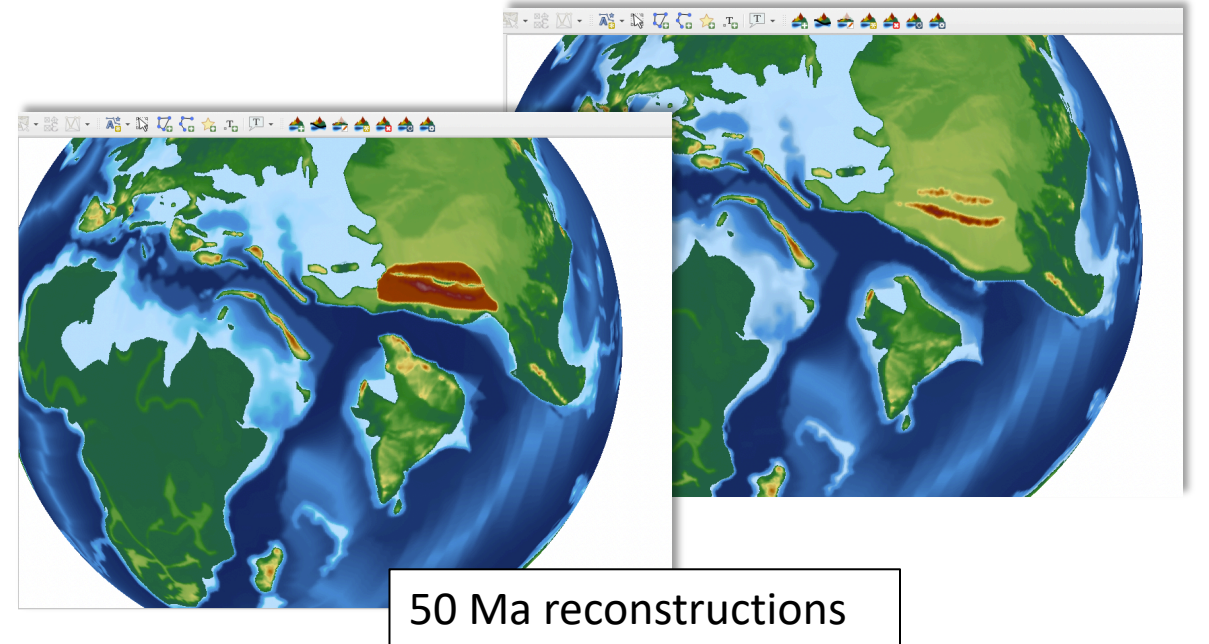
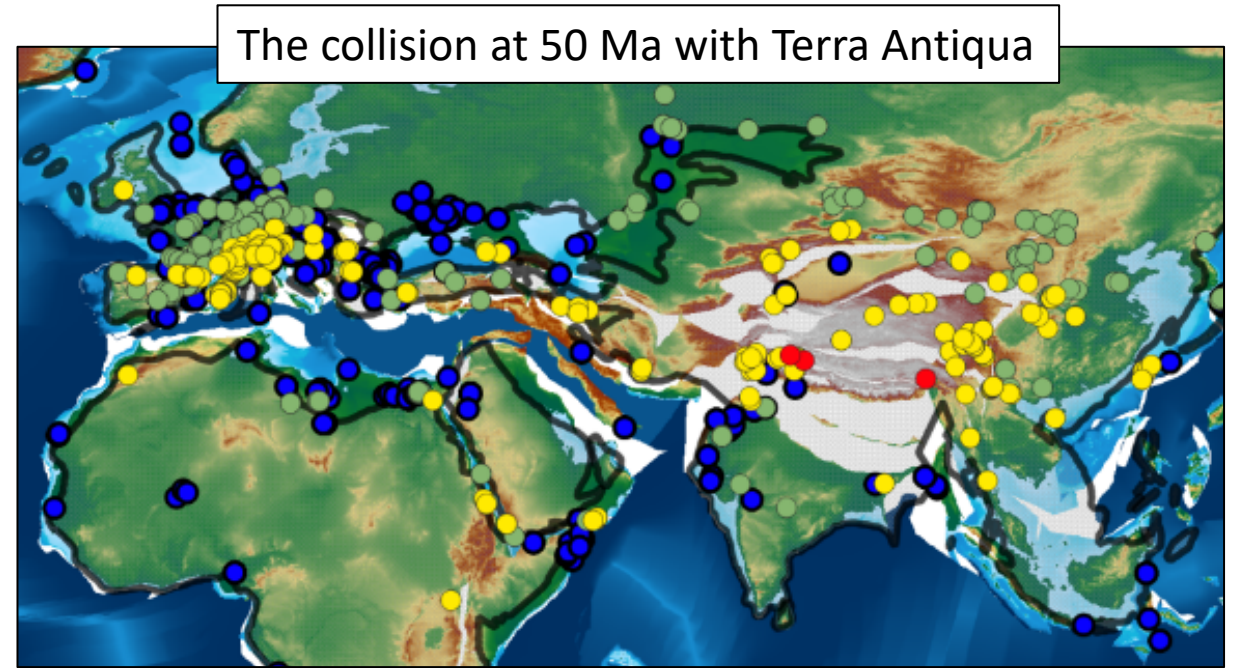
Fang et al., 2021 Sci. Advances

Yuang et al., 2023 EPSL



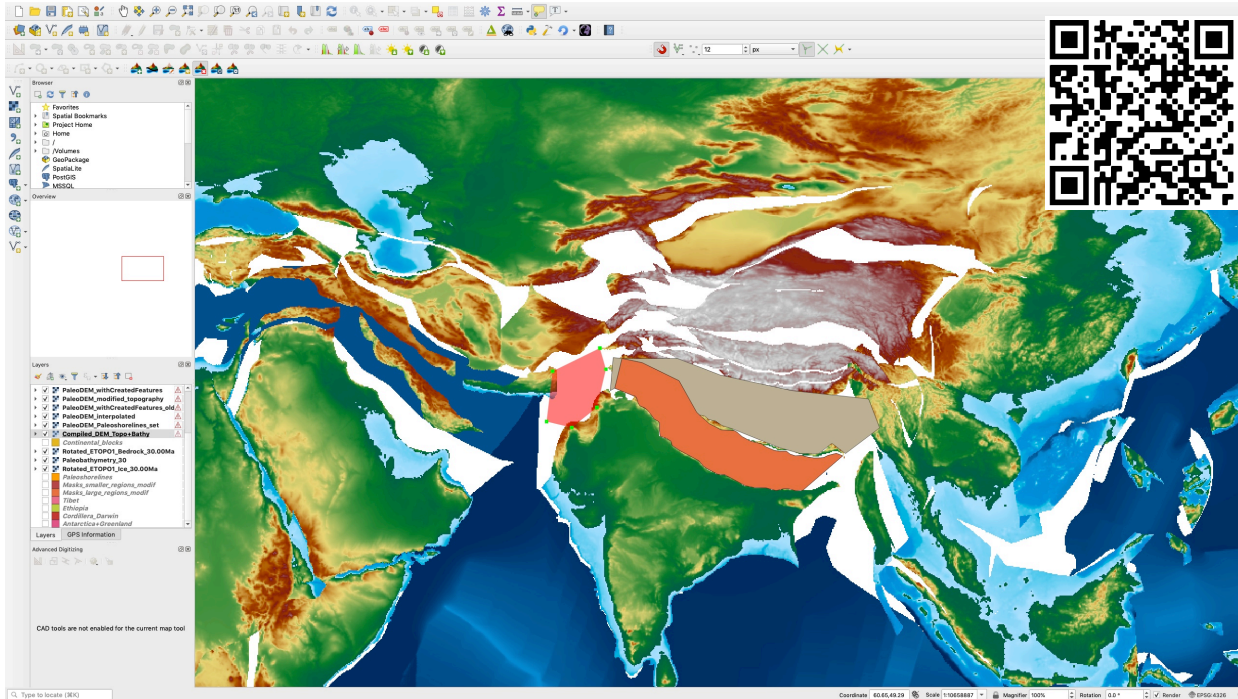
Objectives

- Build a set of reconstructions based on various collision, uplift scenarios and updated databases.
- Link collision scenarios with Tibetan uplift.
- Need a simple tool to generate and modify paleogeographic reconstructions: **Terra Antiqua**



Towards accessible and easy paleogeography with:

1. *Terra Antiqua* Reconstruction tool

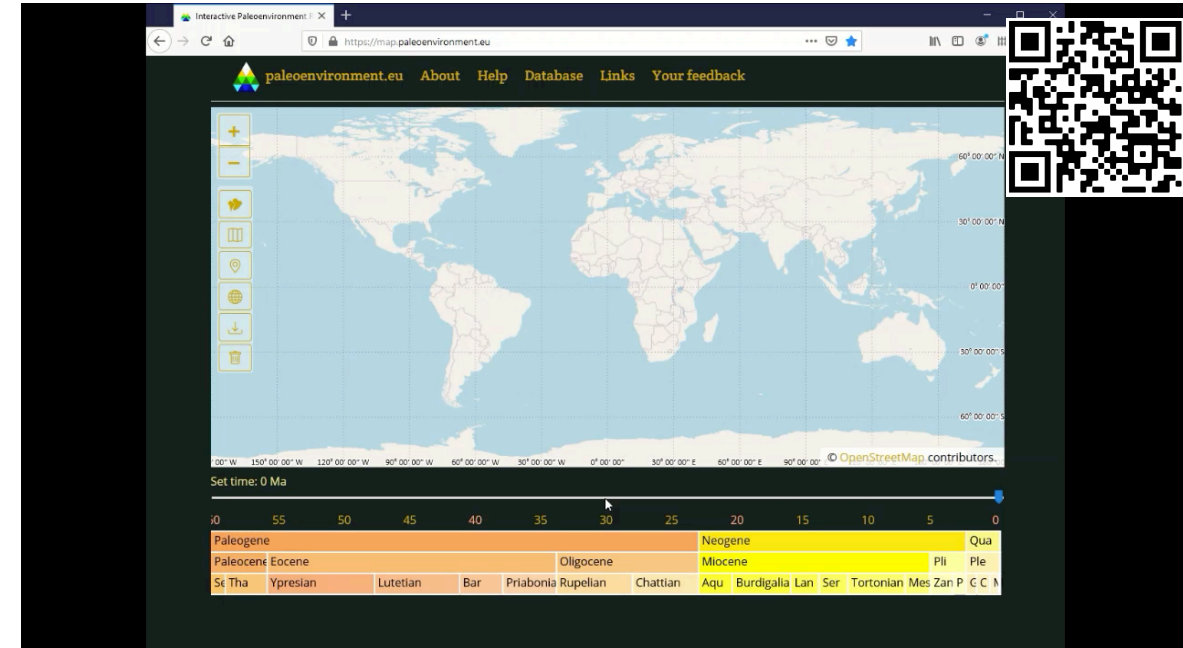


Aminov et al., Earth Science Reviews 2023

Jovid Aminov, Diego Ruiz, Boris Gailleton



2. Interactive maps and databases



Poblete et al., Earth Science Reviews 2021

Fernando Poblete, Thomas van der Linden,...



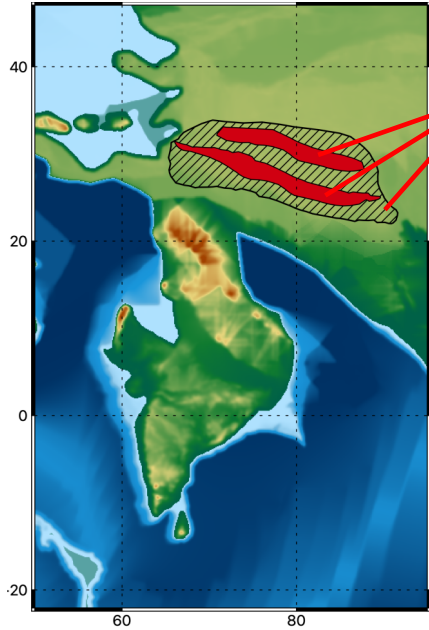


Create topography

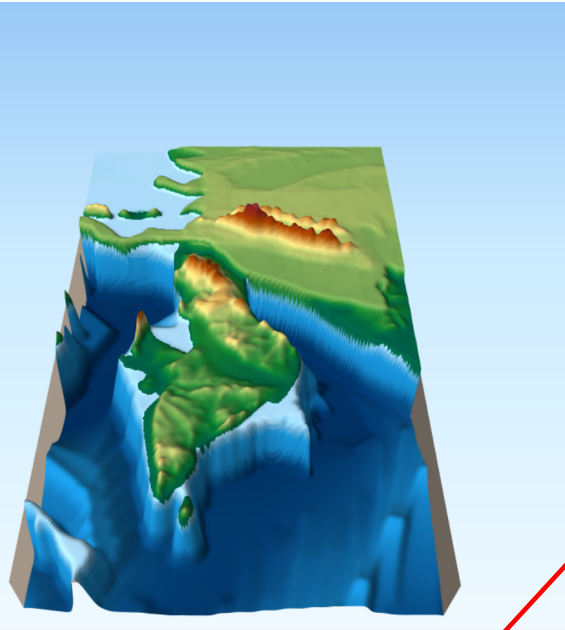
Terra Antiqua

User-friendly and open-source plug-in for **QGIS**

[Help manual](#)



Masks



Terra Antiqua - Create Topo/Bathymetry

Parameters Log

Raster to be modified: *
PaleoDEM_modified_topography

Layer with feature polygons: *
Tibet

Selected features only

Geographic feature type:
Mountain range

Maximum ridge elevation (in m)
5000

Minimum ridge elevation (in m)
3000

Ruggedness of the mountains (in %)
30

Width of mountain slope (in km)
5

Output file path:
.../8gkxwvs3xvg6p9pqrtn5n4w0000gn/T/PaleoDEM_withCreatedFeatures.tif

This tool creates a DEM in the area of interest. About the process, **Raster to be modified**: Select a raster layer containing the features. **Layer with feature polygons**: Select a vector layer where you want to create features. If only certain mask feature(s), these mask feature(s). **Geographic feature type**: Select the type of topography you want to create (sea level, mountain range, etc.). **Note**: All the numerical values (max depth, min depth, etc.) must be entered in the attribute table of the **polygons**. For this table, you must select the attribute table. **Maximum sea depth**: Enter here the maximum or maximum depth features must have. **Minimum sea depth**: Enter here the minimum or minimum depth.

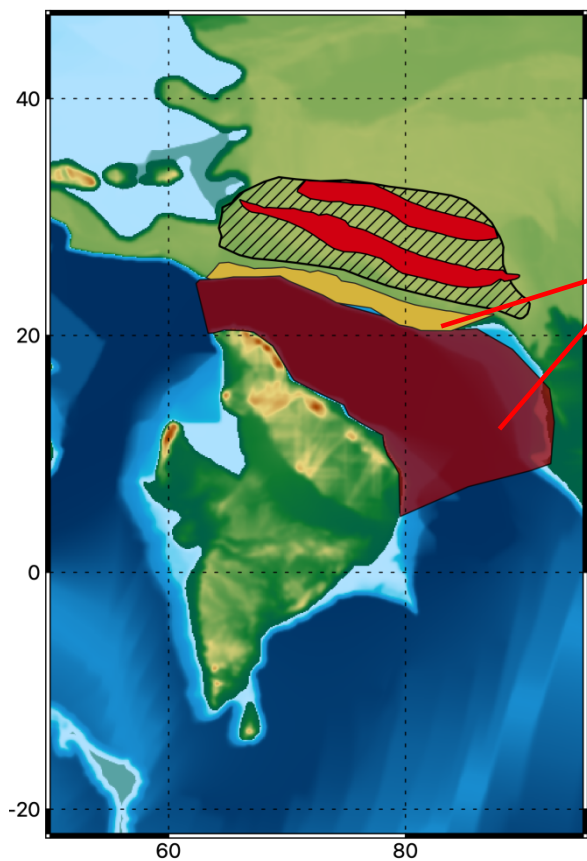
Max. and Min. ridge elevation

Ruggedness

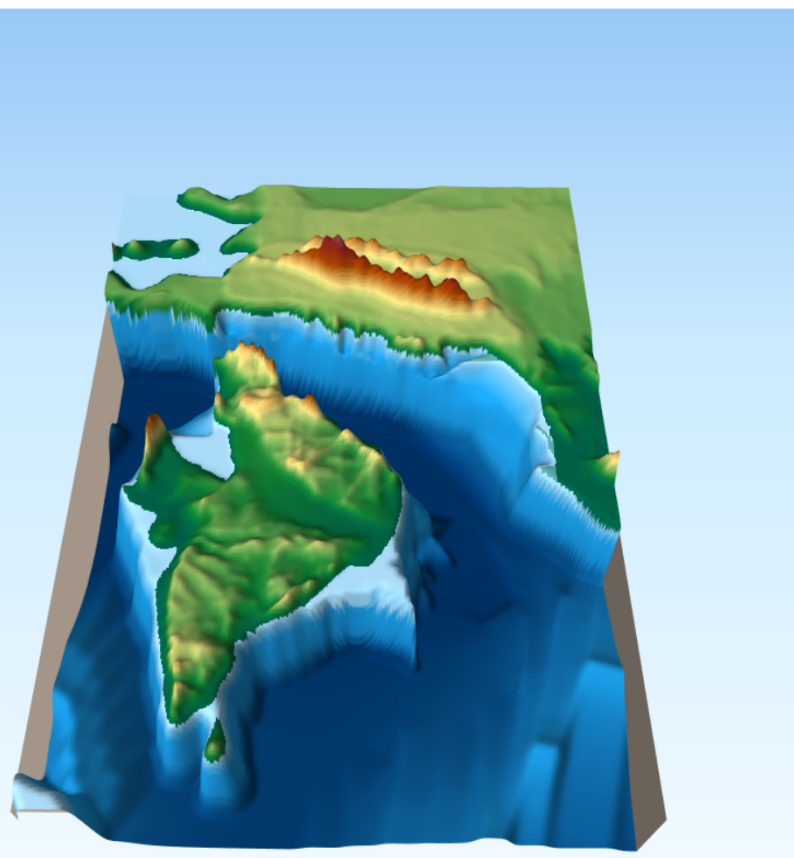
Width of mountain slope



Create bathymetry



Masks



Geographic feature type:

Sea

Maximum sea depth (in m):

-5750

Minimum sea depth (in m):

-4000

Maximum shelf depth (in m):

-200

Shelf width (in km):

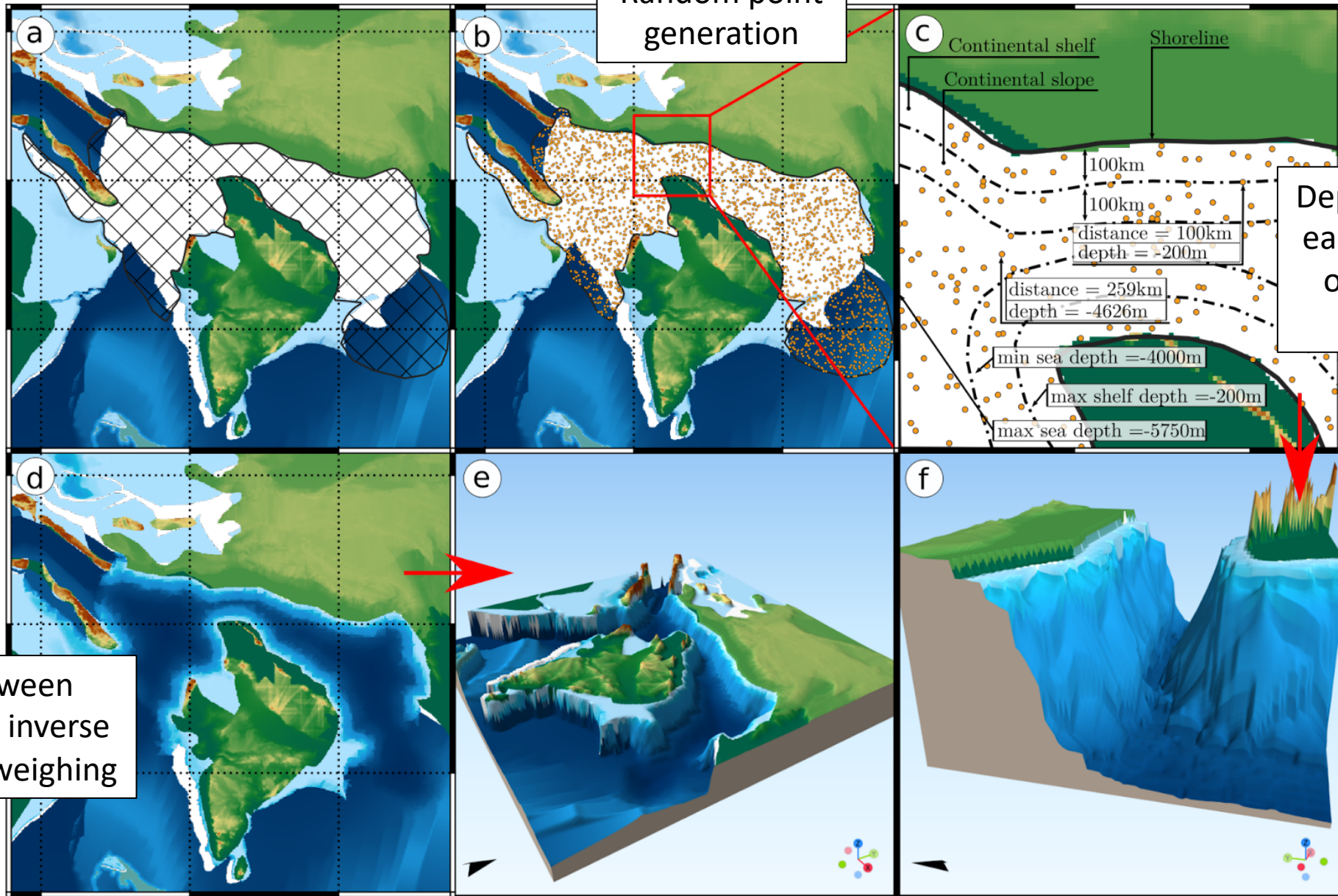
150

Width of continental slope (in km):

100



Create "random" topo / bathymetry



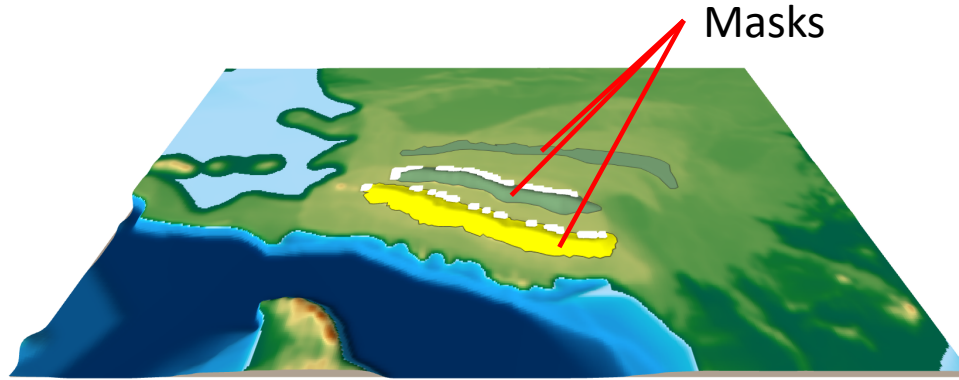
Random point generation

Depth assigned to each point based on distance to shoreline

fill between points by inverse distance weighing

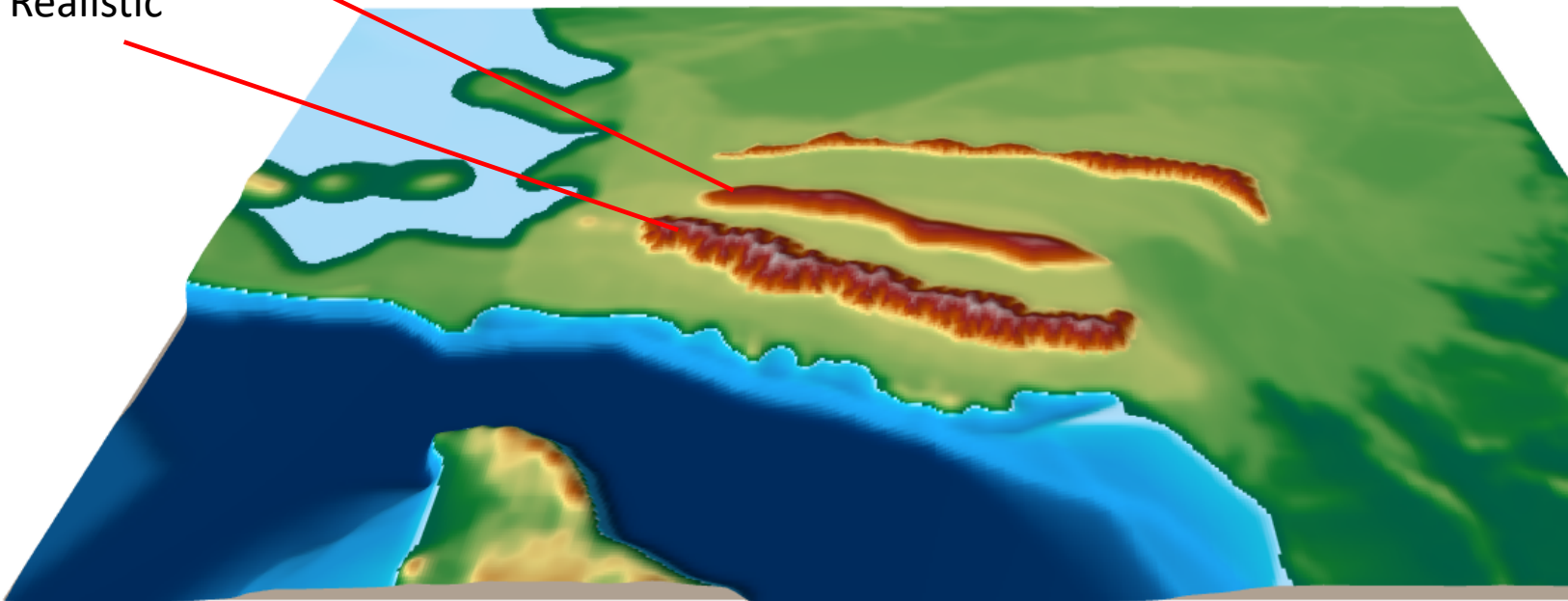


Create "realistic" topography



"Random"

"Realistic"



Geographic feature type:

Mountain range (fractal)

Maximum ridge elevation (in m):

5000

m exponent of the Stream power law:

0.45

n exponent of the Stream power law:

1.00

Rock erodability (K):

0.00002000000000

Upstream drainage area (A):

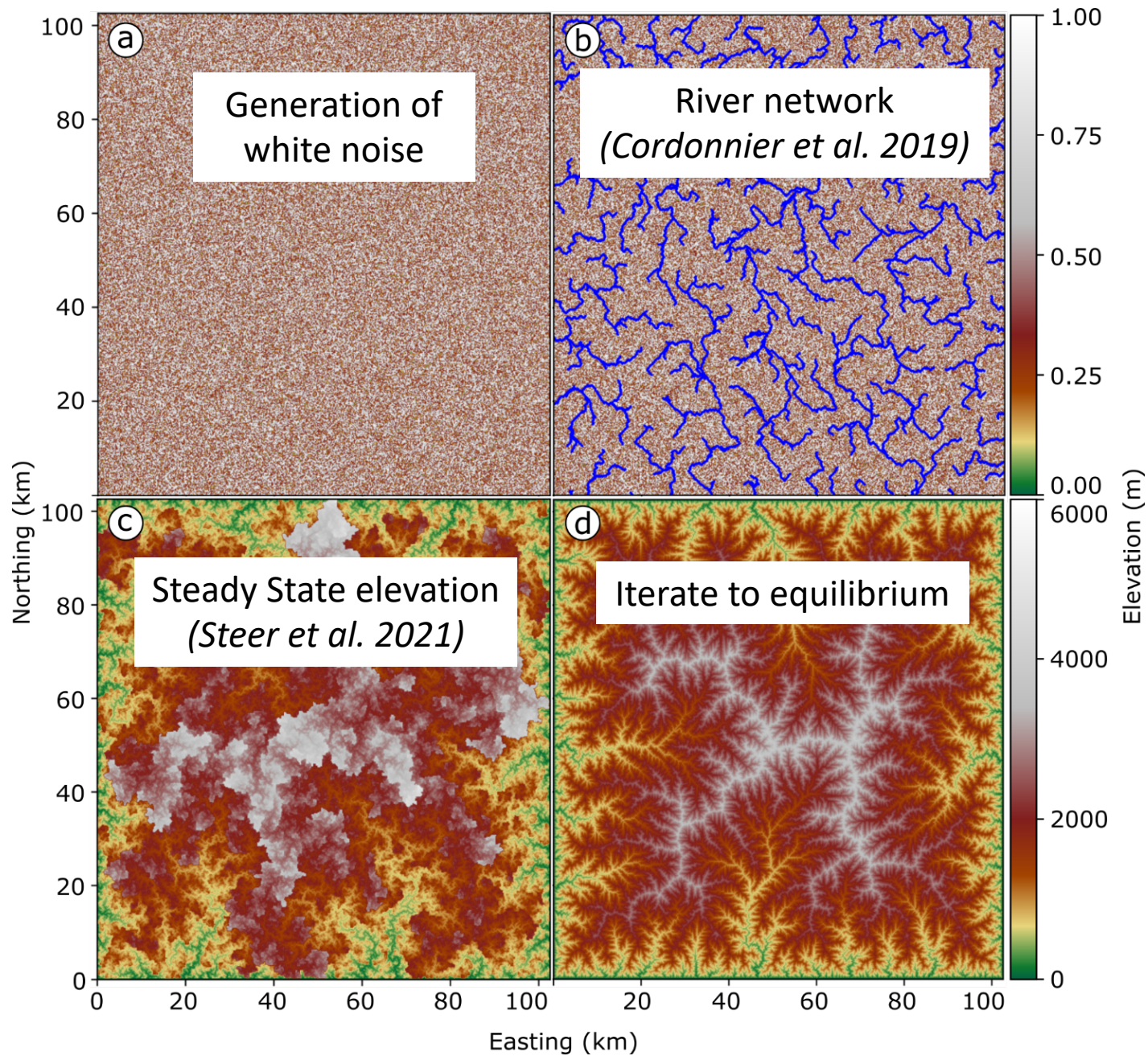
20000.00

Channel slope (S):

0.60



Create “realistic” topography



Preliminary conclusions and perspectives

Preliminary conclusions

- The database is coherent with high plateau and small Tibetan valleys.
- Later (30-20 Ma) regional uplift is coherent with extended Greater India and Arc collision.

Perspectives

- Time slices at 60, 50, 40, 30, 20 Ma.
- Test paleogeographies with numerical simulations (climate, earth surface, source to sink, biotic).
- Refine Terra Antiqua!

