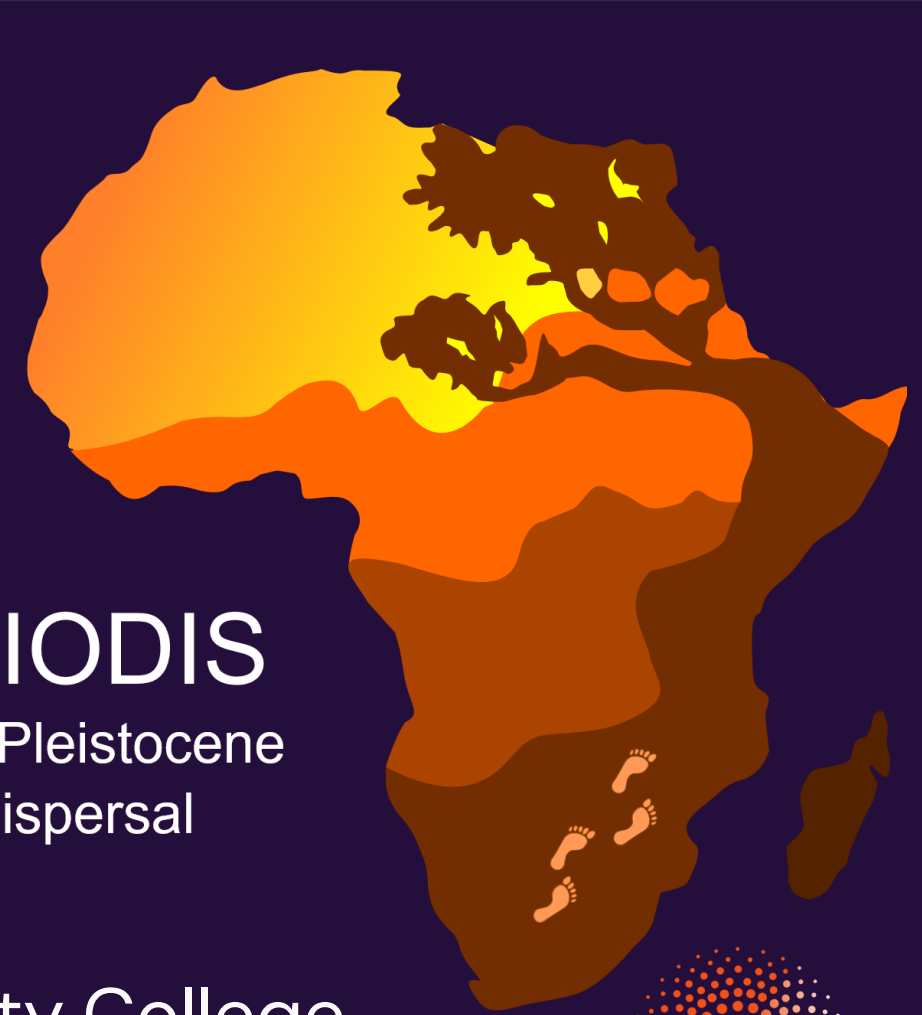


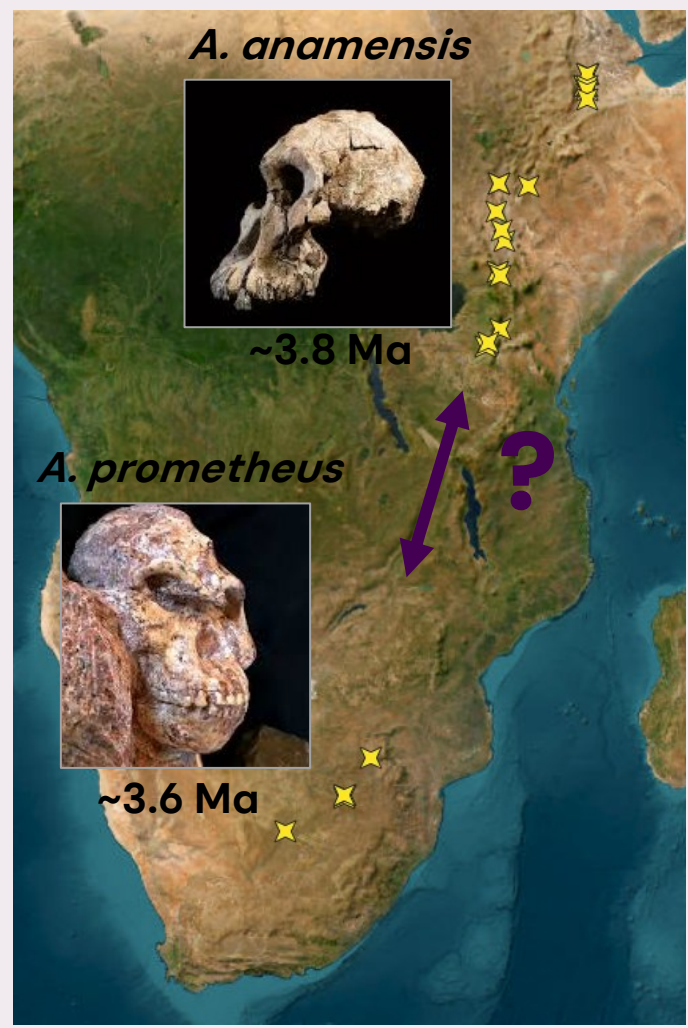


Guido Pastore^{1,2}, Matthew Fox¹, Pieter Vermeesch¹
and Gabriele A. Macho².

¹ Department of Earth Sciences, University College London, London, UK.

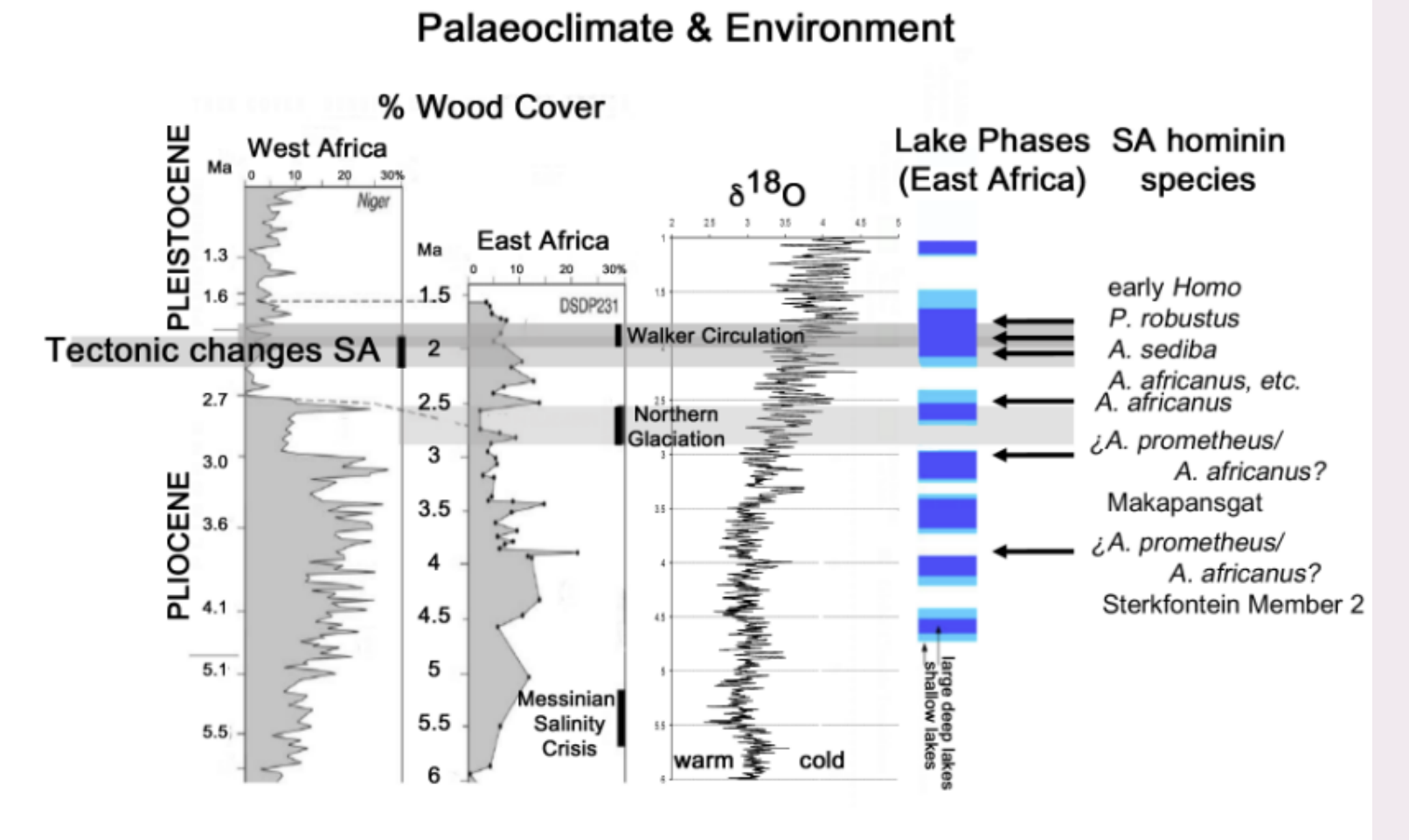
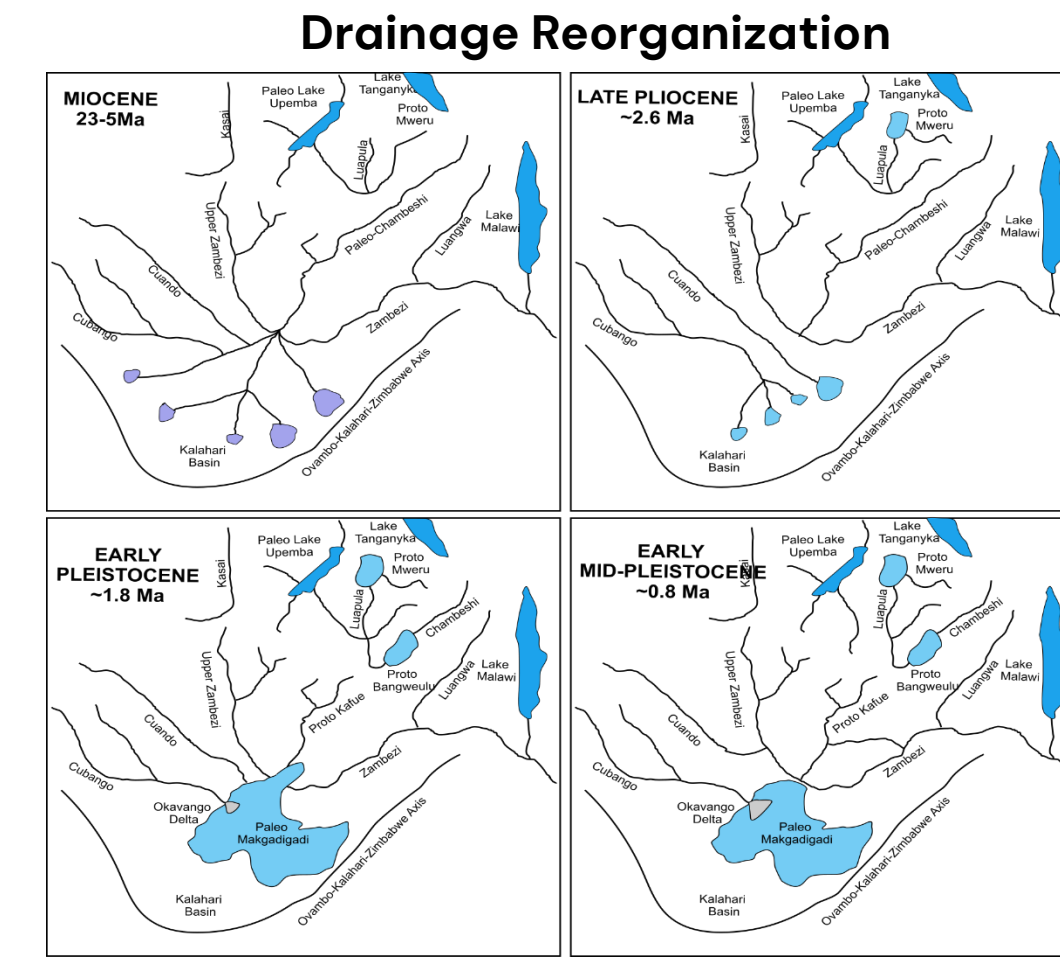
² AMGC–Archaeology, Environmental Changes & Geo–Chemistry, Universiteit Brussel, Brussel, Belgium

Pliocene Hominin Dispersal to southern Africa: Choice or Chance?



Early hominin sites are known from eastern and southern Africa, with vast intervening regions where no fossils have yet been found. Despite this apparent gap, hominins from eastern and southern Africa are believed to be closely related. This raises important questions: what was the pan-African distribution of early hominins? Were these regions connected in the past?

As part of the ERC-funded PLIODIS project, we investigate landscape changes during the Plio-Pleistocene and explore potential migration routes.



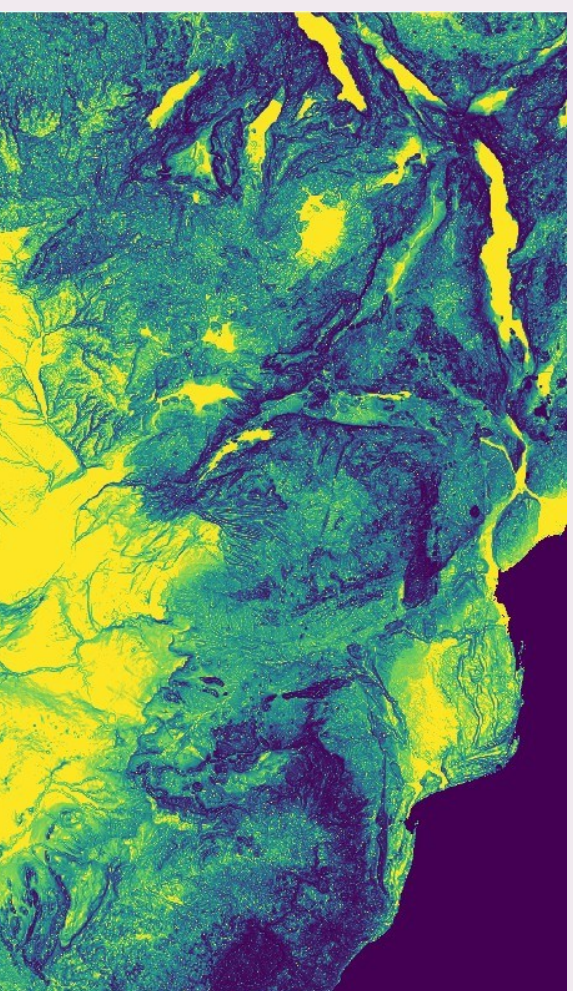
Modelling hominin dispersal

Least Cost Path analyses are based on the “Principle of Least Effort” (Zipf 1949), which assumes that humans tend to choose routes of least resistance when moving through a landscape. Various factors influence this choice, including surface ruggedness, climate, and the availability of food and water.

Topographical cost

Slope dependent

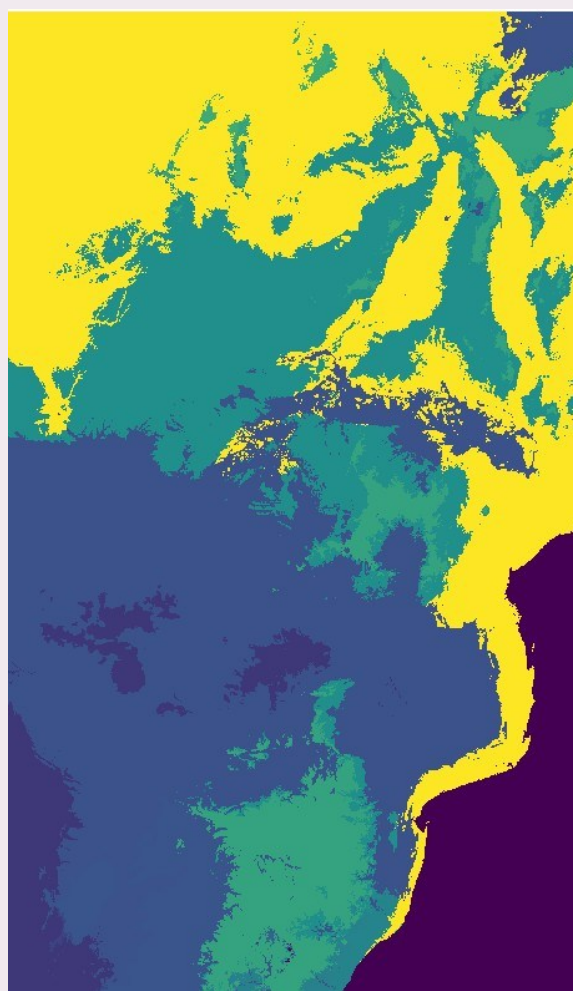
Cost of climbing uphill



Environmental cost

Köppen classification

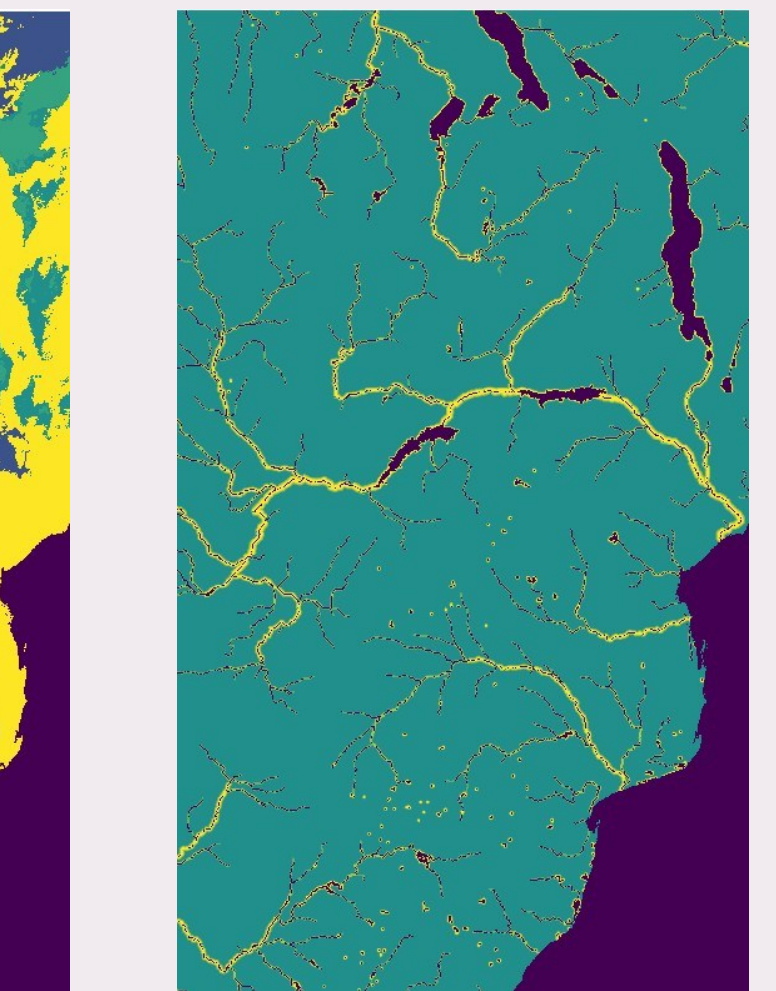
Cost of moving in harsh climate



River Network cost (& attractiveness)

Strahler Order

Cost of crossing large rivers

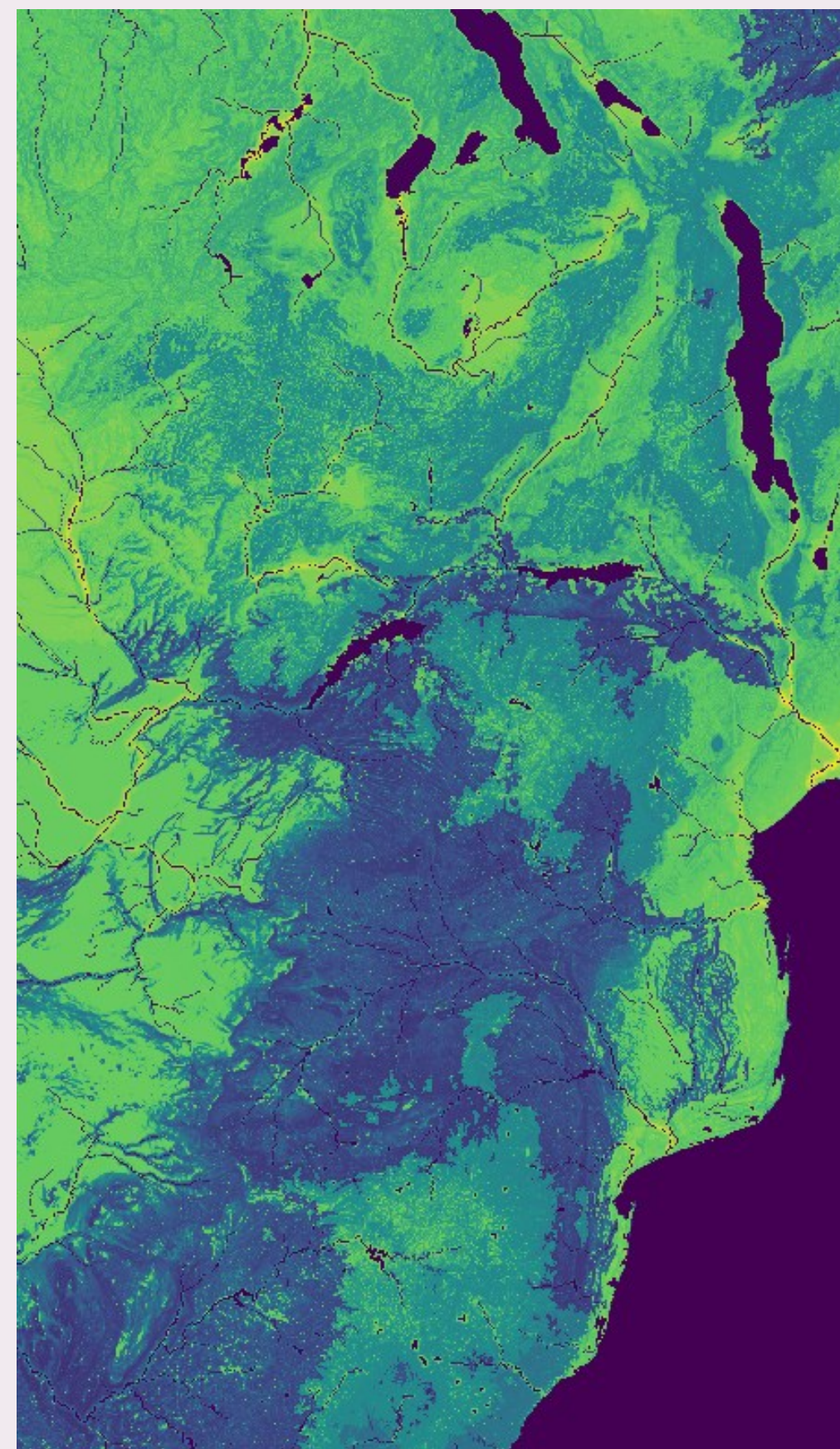


Each cost map is resampled and normalized

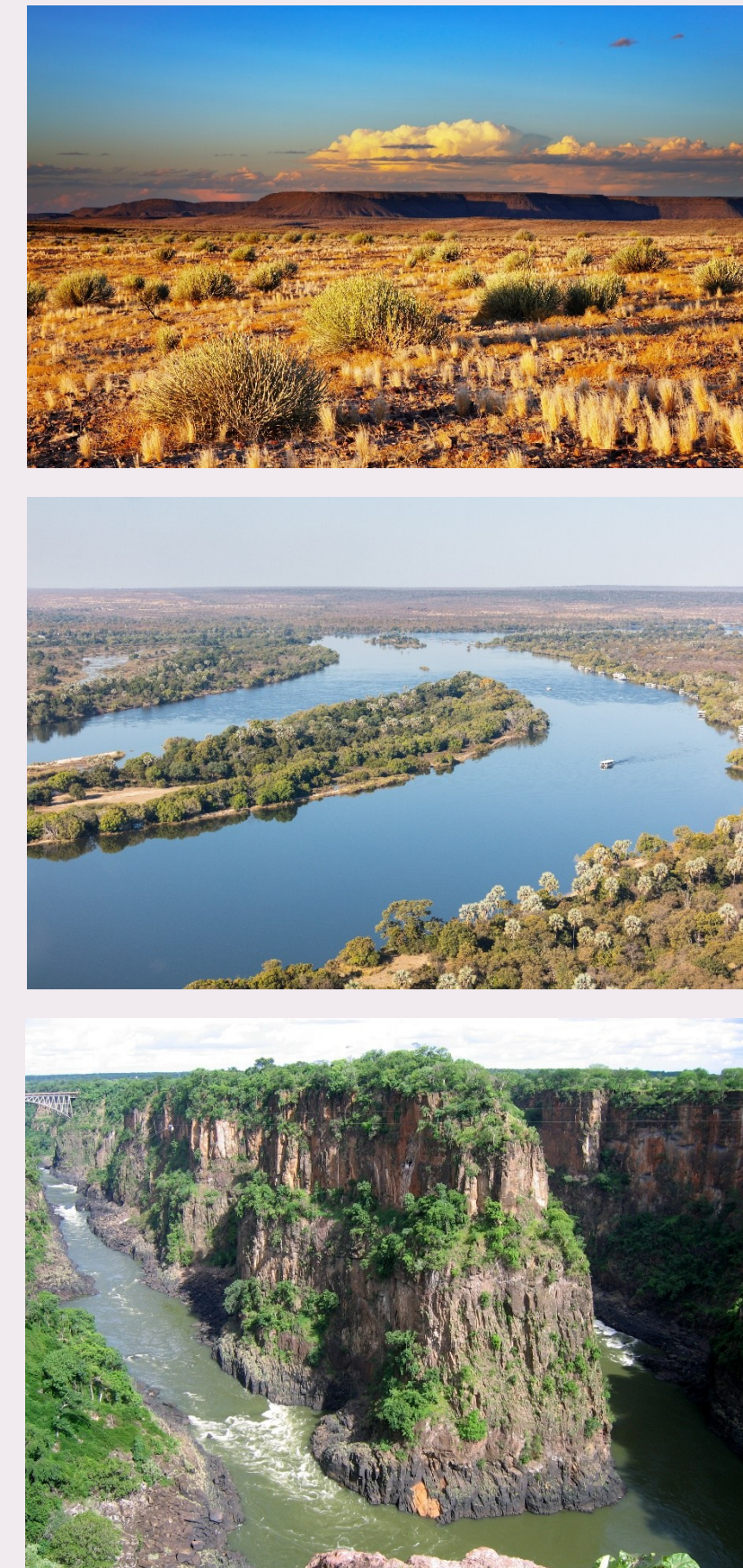
The total cost surface is computed as a weighted linear combination:

$$C_{\text{total}}(i) = w_{\text{topo}} \cdot C_{\text{topo}}(i) + w_{\text{river}} \cdot C_{\text{river}}(i) + w_{\text{env}} \cdot C_{\text{env}}(i)$$

Combined total cost



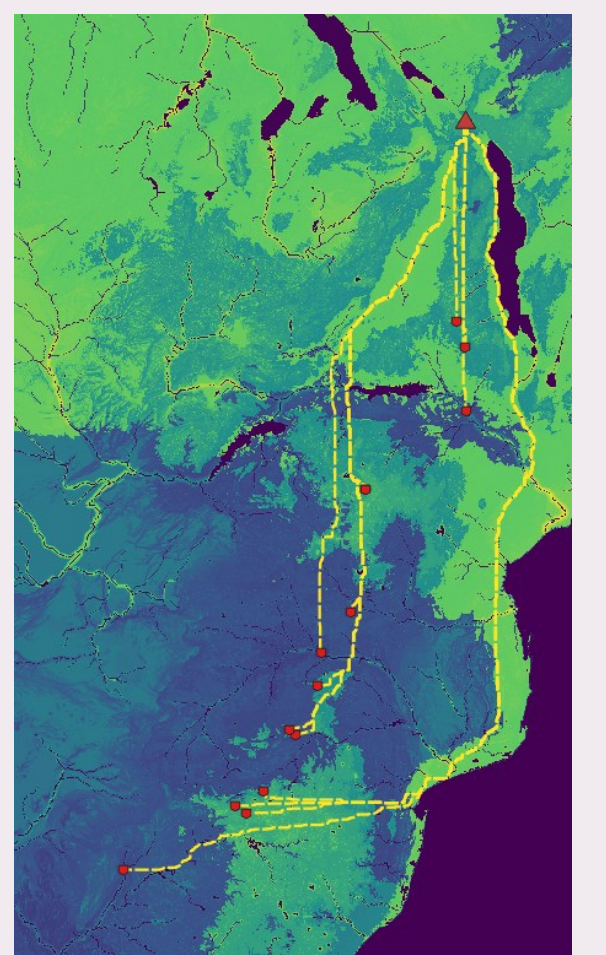
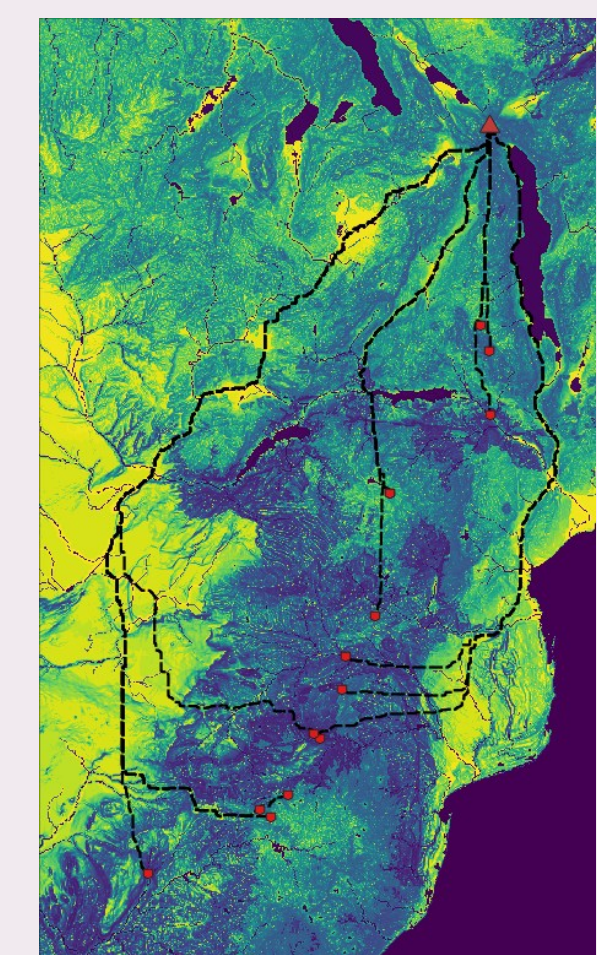
African landscapes



Least Cost Path requires an origin and a destination point. The origin is set between lake Malawi and lake Tanganyika, a probable passage point for southward dispersal. The destination is *Makapansgat*, a cave site with various fossil bones of australopithecus, connected by a series of intermediate points.

LCP are affected by climate?

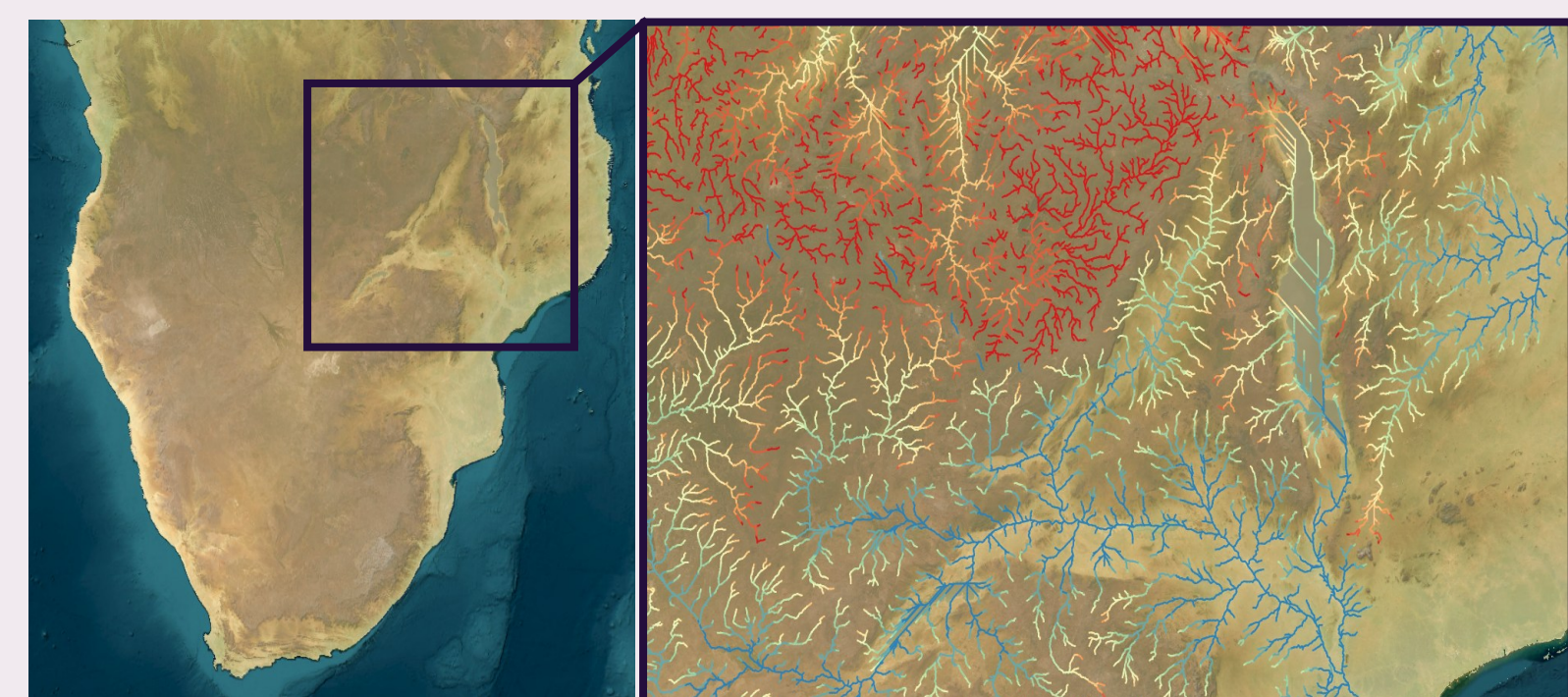
A skewed cost toward topography or environmental surfaces modifies potential paths. Arid conditions in the continental interior favour a coastal path.



A landscape evolution modelling approach for drainage capture

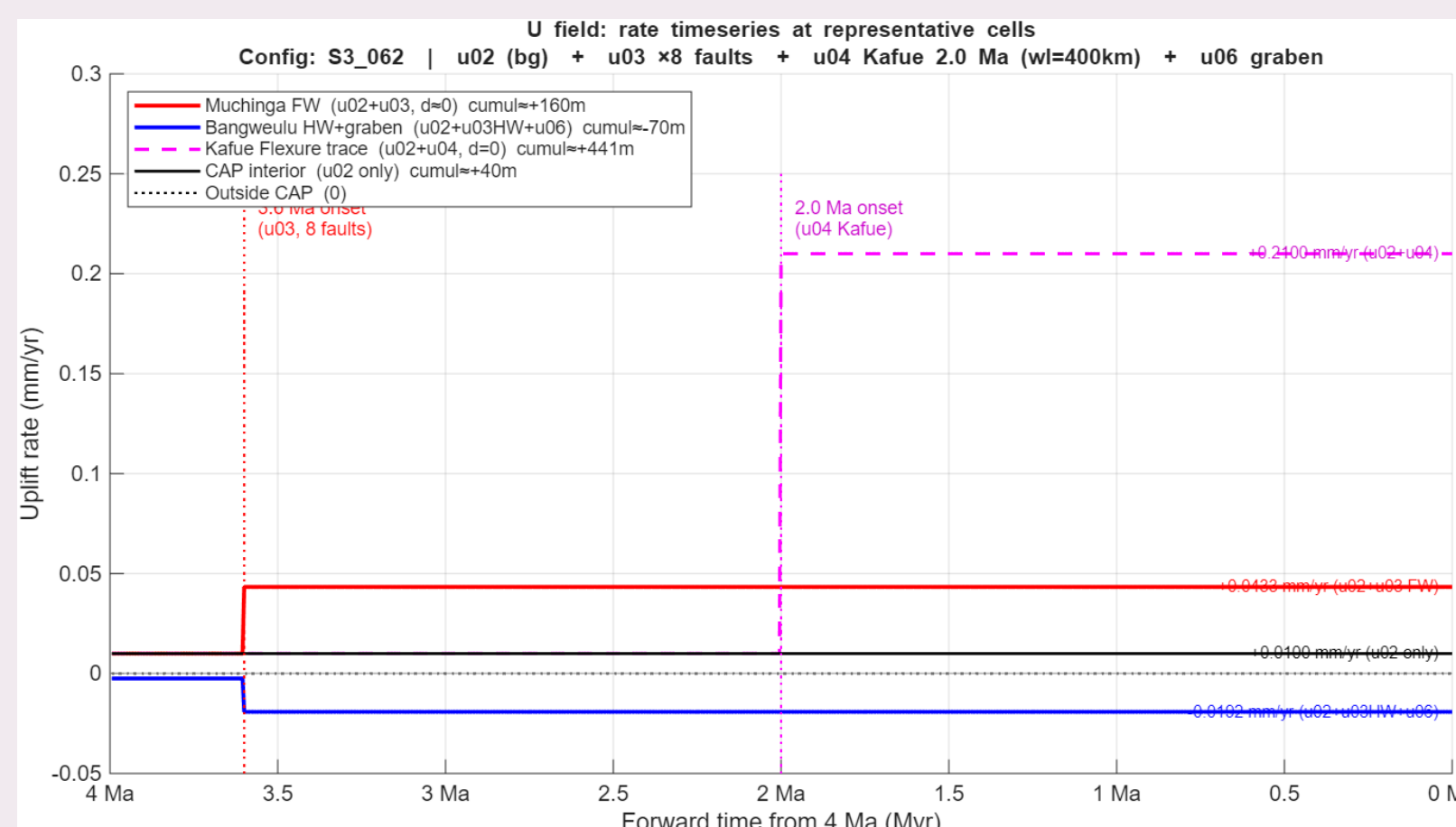
We use the TopoToolbox (Schwanghart et al., 2010) Landscape Evolution Model (TTLEM), which solves the stream-power incision law $E = K \cdot A^m \cdot S^n$ (E is erosion [m/yr], K is erodibility coefficient [m^{1-2m}/yr], A is upstream drainage area [m²], m is the area exponent and n is the slope exponent) on a fixed grid under prescribed, time-varying uplift.

Study Area: Central African Plateau (CAP)

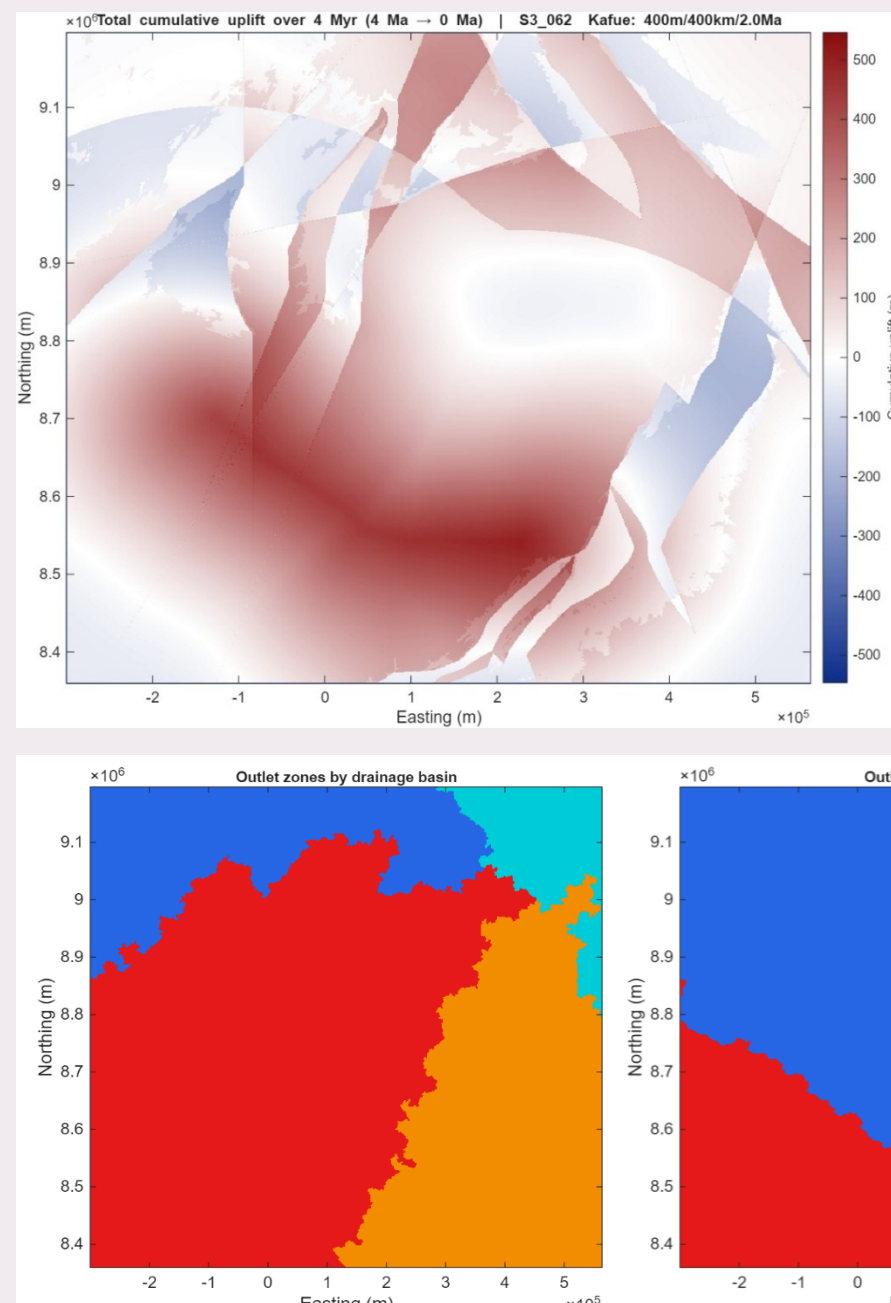


X-values suggest that CAP uplift may have reorganized the course of the Chambeshi – Kafue drainage during the Plio-Pleistocene.

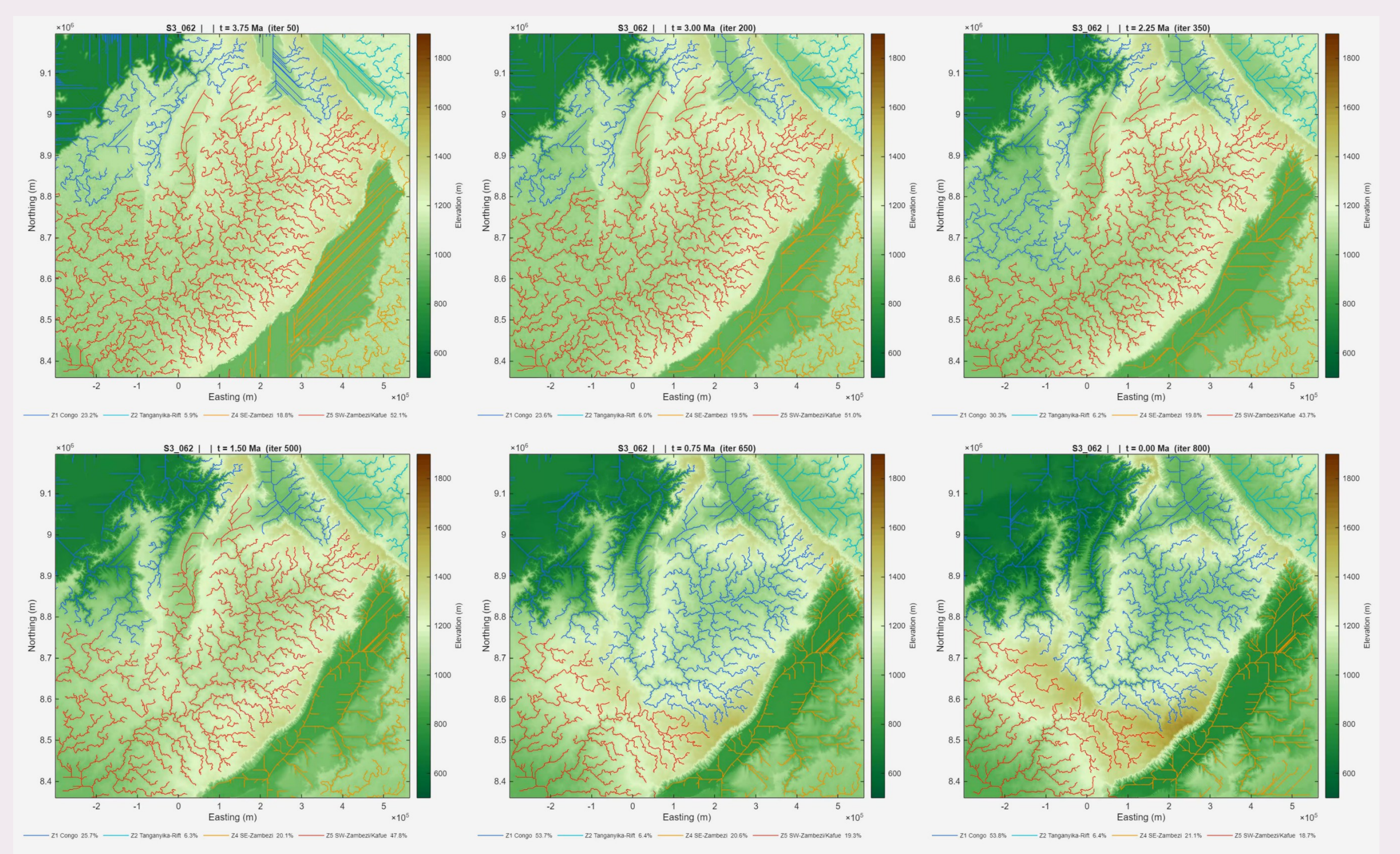
Partitioned uplift



Output

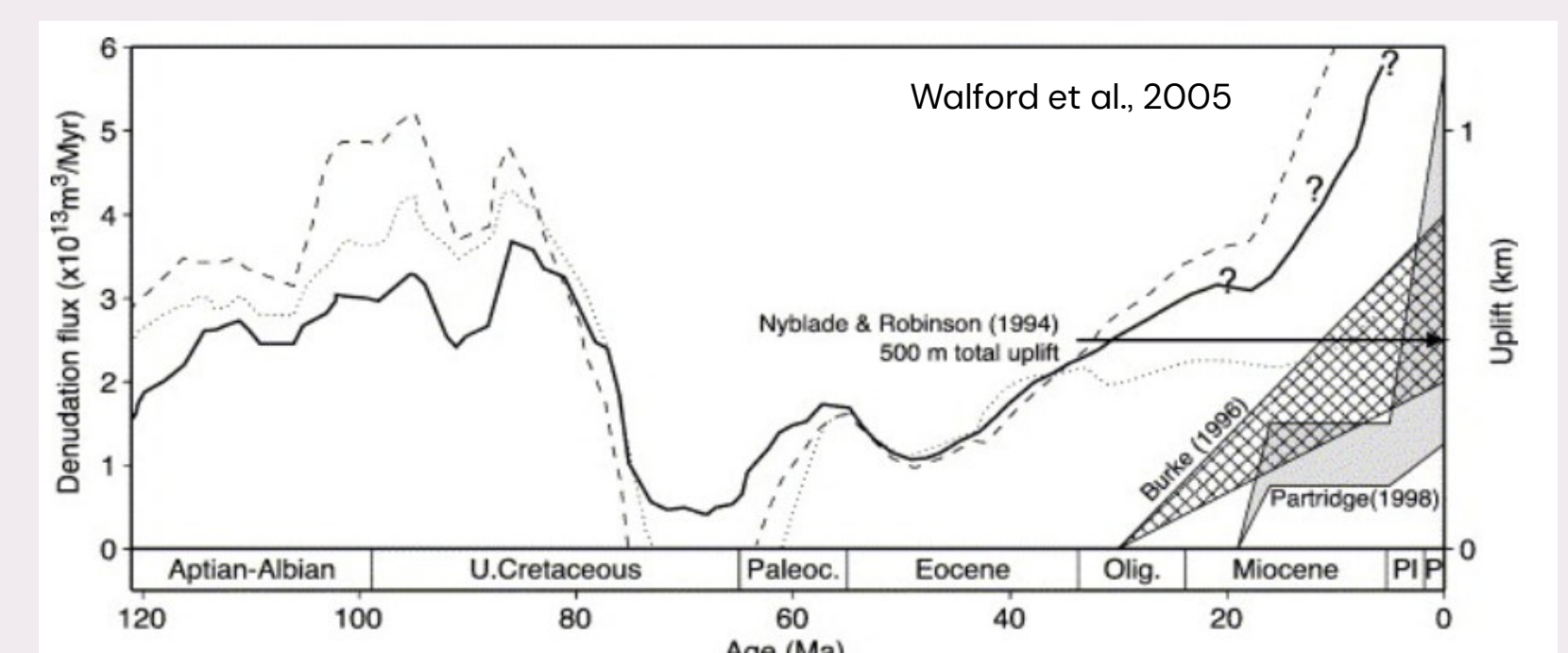


Preliminary results suggest that the Kafue–Chambeshi disruption can only be explained by a complex interplay of headward erosion, subsidence, and flexural slip.



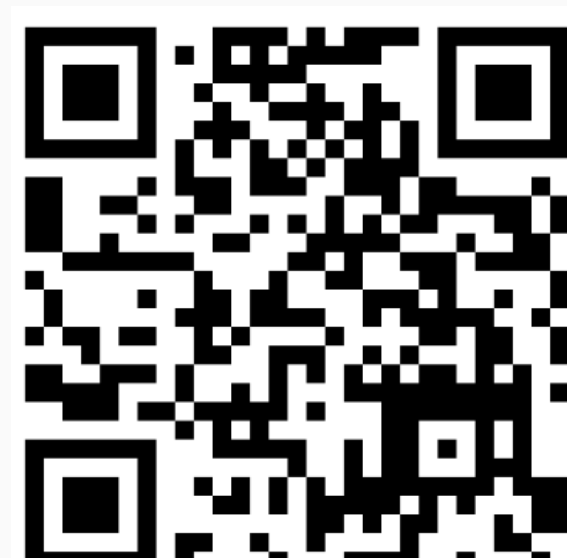
How to test the model?

To test the model, drainage reorganization can be reconstructed using provenance studies in river deltas, supported by thermochronological data and sediment flux estimation.



LCP suggests that the river network plays a dual role in hominin dispersal: creating corridors along the trunk while acting as a barrier when crossing is required. A connected Kafue–Chambeshi drainage up to ~1.5 Ma may have played a major role in directing hominins southward.

If you are interested in the project visit
PLIODIS website: pliodis.github.io



"Little Foot" (Stw 573)– Sterkfontein



"Not all who wander are lost"

Cited literature

- Zipf G.E. (1949), *Human behavior and the principle of least effort*, Addison–Wesley Press.
- Schwanghart, W., et al., (2010). TopoToolbox: A set of Matlab functions for topographic analysis. *Environmental Modelling & Software*, 25.
- Daly, M. Cet al., (2020). Tectonics and landscape of the Central African Plateau and their implications for a propagating Southwestern Rift in Africa. *Geochemistry, Geophysics, Geosystems*, 21.
- Walford, H. L., et al., (2005). Solid sediment load history of the Zambesi Delta. *Earth and Planetary Science Letters*. 238.