EGU26-7017, updated on 18 Nov 2026
https://doi.org/10.5194/egusphere-egu26-7017
EGU General Assembly 2026
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African paleogeography since 30Ma : setting boundary conditions for climatic, physiographic and biodiversity models.

Raphaël Tournier[1], Laurent Husson[1], Sandrine Prat[2], Jean-Renaud Boisserie[3,4], Doris Barboni[5], Nicolas Bellahsen[6], Cécile Doubre[7], Raphaël Pik[8], Tristan Salles[9], Pierre Sepulchre[10], and Christel Tiberi[11]

[1]ISTerre / CNRS, Université Grenoble-Alpes, Grenoble, France (raphael.tournier1@univ-grenoble-alpes.fr)
[2]HNHP / CNRS, MNHN, Paris, France
[3]CFEE, CNRS & Ambassade de France, Addis Abeba, Ethiopia
[4] PALEVOPRIM, CNRS & Université de Poitiers, Poitiers, France
[5]INSU UMR 7330, CEREGE; Aix-en-Provence, France
[6]ISTEP / Université Paris-Sorbonne, CNRS, Paris, France
[7]EOST / Université Strasbourg, CNRS, Strasbourg, France
[8]CRPG / CNRS, Université de Lorraine, Nancy, France
[9]School of Geosciences, The University of Sydney, Sydney, Australia
[10]LSCE / CNRS, Université Paris Saclay, Paris Saclay, France
[11]Geosciences Montpellier / CNRS, Université de Montpellier, Montpellier, France

The African continent has undergone major Cenozoic transformations, including the formation of the East African Rift System and the opening of the Red Sea and the Gulf of Aden. The impact of these transformations on the various components of the Earth system over time—climate, hydrographic networks, and the dispersal and evolution of biological species—raises multiple questions.

In this context, we aim to reconstruct the paleogeographic evolution of continental Africa over the past 30 million years using a multi-layered modelling approach. First, the integration of several geodynamic components (including mantle-driven dynamic topography, the history of crustal tectonics, plate tectonic motions, and volcanic eruptive dynamics) allows us to produce an elevation model for Africa since 30 Ma that is continuous in space and time. This elevation model is then used as a boundary condition for climate simulations, followed by physiographic simulations, generating a more comprehensive and coherent representation of past environments.

The simulation outputs reveal the sensitivity of climate reconstructions to topographic boundary conditions, as well as temporal variations in hydrographic networks. These new topographic, climatic, and physiographic constraints provide improved calibration for future eco-evolutionary studies (e.g., geographic barriers, water availability, resource distribution, and environmental stability) on the African continent.

We then evaluate the spatial and temporal accuracy of these reconstructions by confronting them with field-based evidence. This assessment identifies the scales at which the models are most robust, informing which interrogation can be explored with confidence. It also highlights where the reconstructions are consistent with geological, paleoenvironmental, and paleontological data, and where their precision may require further refinement.

Looking ahead, the objective is to continuously update these maps and simulations, which will also be used to investigate the dispersal and evolutionary changes of Cenozoic faunal communities in Africa, notably early hominids. This whole study offers a coherent spatio-temporal context for evaluating links between the different components of the Earthsystem.