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Understanding the past to predict the future – How vegetation has responded to past climate change in Central Africa.

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Climate changes continuously over geological time, impacting vegetation and hence the distribution of plant species and their genetic variation. The Belspo-funded project AFRIFORD investigated signatures of past climate change in Central Africa over a range of timescales, combining paleovegetation proxies, wood biology, genetic variation and vegetation modelling, from the perspective of forest trees. Understanding vegetation dynamics under climate forcing helps predict the impact of anthropogenic climate changes. Our main findings are: - Most forest tree species display genetic signatures of past population fragmentation, recolonization and demographic changes dating from 104 to 106 years, highlighting long-term impacts of past environmental changes on species genetic variation. - Genetic research also revealed unsuspected hidden diversity: many taxonomic species comprise several distinct species, potentially doubling the species richness of African trees. - Time-correlated palynological signatures in lake sediments from the highlands east and west of the Congo basin over the last 105 years highlight the influence of glacial-interglacial climate cycles on vegetation but also the effects of climatic fluctuations occurring at a multi-decadal to century scales, while human impacts seem comparatively weak or concentrated in the last few centuries. - Pollen data from lacustrine sediments, d13C of soil organic matter, wood charcoal in soils, tree-ring and growth-rate analyses reveal large landscape disturbances in the Congo basin (e.g., rainforest fragmentation and wide development of savannahs in central Cameroon at the end of the Holocene) locally favoured by slash-and-burn agriculture practice from c. 2300 to 1300 BP and from 600 BP to colonial time. Current forest trees are on average c. 230 years old, conditioning the age and turnover of carbon stock. - Simulations by a dynamic vegetation model (DVM) allowed reconstructing the glacial refugia of a set of rainforest treespecies. However, accounting for seed dispersal, the model predicts range shifts by only a few km per 103 years, strongly limiting the potential of tree species to follow their optimal climate niche during the rapid climate changes that accompanied the deglaciation. - DVM simulations for the future show significant soil water reduction in Central Africa that substantially impact the distribution and net primary productivity of the studied tree species.