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New palaeoclimate record from ancient river channels in the eastern Sahara: Implications for climate impact on human dispersals during the late Quaternary

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Throughout the last 65,000 years, there have been several brief periods of increased temperatures and precipitation over the eastern Sahara. These periods have been constrained by numerous proxies including: palaeodischarge and sediment-load estimates of the Nile River, cave speleothems, dust fluxes, fossil groundwater, marine sediments, and reconstructed palaeolake level fluctuations. These climate disturbances are widely considered to have affected both the migration patterns of anatomically modern humans and Holocene human settlements.

However, these proxies can not be directly translated into precipitation intensity which would have had a profound impact on human activities, as intense precipitation events would make settlements next to rivers hazardous places to live. Here we reconstruct the paleoenvironmental conditions of six palaeoriver channel systems preserved over a ca 40’000 km^2 area in southern Egypt using geochronological, palaeohydrological and sedimentological techniques. These palaeorivers deposits are currently topographically inverted due to wind deflation. Despite previous attempts at dating these river channels using Acheulean artifacts and pottery shards collected from within the channel bodies, their age remains contentious between the middle Pleistocene to Holocene. Here we provide refined age constraints using Optically Stimulated Luminescence (OSL) coupled with Carbon-14 dating. Our results show that these rivers record at least 8 episodes of fluvial deposition distributed between 53 ± 7 ka and 1 ± 0.25 ka ago.

In addition, we estimate, using channel geometry (width and height) and median grain size (D_{50}), the palaeoslope, palaeovelocity, and palaeodischarge of these ancient inverted channels.

Combining these parameters with estimates of palaeodrainage areas (based on digital elevation models (derived from ALOS PALSAR data) and Hack's law) allows us to assess palaeoprecipitation rates in the range of 50 ± 10 mm/h during the incision of these palaeorivers. These rates indicate relatively intense periods of precipitation and important sediment transport periods during the early to mid-Holocene pluvial period in the Sahara compared with previous pluvial periods. Our results show that during these warmer and wetter periods the precipitation occurred in intense periods, which we suggest created hazardous environments close to the rivers and thus causing forcing human migration away from the rivers into the West and North. This, therefore, gives a plausible mechanism for the dispersal of human settlements from the South of Egyptian Sahara to the North-West 8,500 to 5,300 years ago.