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New quantitative relationships between phytolith assemblages, vegetation and climate parameters. Application to a 50,000 yr crater lake core in Tanzania

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Dynamic Global Vegetation Models provide a way to translate the outputs from climate models into maps of potential vegetation distribution for present, past and future. Validation of these models goes through the comparison between model outputs and vegetation proxies for modern and well constrained past climatic periods. The diversity of the grass-dominated biomes – most widespread on the world - cannot be mirrored by common proxies such as pollen, charcoal or δ^{13}C of bulk organic matter but is well recorded by phytoliths. Phytoliths are amorphous silica that precipitate in and/or between living plant cells. Although commonly used for tracing grasslands, calibration between modern phytolith assemblages and vegetation are scarce. We present new quantitative relationships between phytolith assemblages, vegetation and climate parameters that can be used to reconstruct grass-dominated biomes and for model/data comparisons. Phytoliths and pollen are also applied to a 50,000 yr multi-proxies sedimentary sequence from a crater lake (Masoko, Tanzania : 9˚S; 33˚E, 780m a.s.l.). The data are confronted to simulations of the LPJ-GUESS dynamic vegetation model. Pollen and phytoliths show that the Last Glacial Maximum (LGM: 18-22 cal. ky BP) was expressed at Masoko lake by an increase of the tree cover density, associated with an increase of C_3 grasses, up to 13 cal. ky BP, also estimated by the model. Such an increase of C3 grasses during the LGM is also evidenced in South Africa by Scott (2002), while several studies of lake sediments of higher tropical sites, based on δ^{13}C analyses of bulk organic matter, evidenced an increase of C4 plants. These results suggest spatial diversity in C3/C4 development during the LGM and points out the need of better constraining local environmental parameters responsible of C_3/C_4 grasses distribution.