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Palaeoclimate reconstruction within the upper Eocene in central Germany using fossil plants

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The Eocene has been commonly called “The world‘s last greenhouse period” covering the Paleocene-Eocene Thermal Maximum (PETM) as well as the Eocene-Oligocene turnover. In the mid-latitudes of Europe this turnover was characterized by pronounced climatic changes from subtropical towards temperate conditions that were accompanied by significant vegetational changes on land. Fossil plants are regarded as excellent palaeoenvironmental proxies, because leaf physiognomy often reflects climate conditions. The study site, the Paleogene Weißelster basin in central Germany, including fluvial, estuarine and lacustrine deposits, provides several excellently preserved megafloras for reconstructions of terrestrial palaeoclimate. For our case study we used material from different stratigraphic horizons within the late Eocene Zeitz megafloral assemblage recovered from the open-cast mines of Profen and Schleenhain. These horizons cover a time interval of ca. 3 Ma. The Zeitz megafloral assemblage (“Florenkomplex”) was characterized by mainly evergreen, notophyllous vegetation, consisting of warm-temperate to subtropical elements. Tropical species are present but very rare. To infer the regional climatic conditions and putative climate changes from these fossil plants we compare proxy data obtained by the application of standard methods for quantitative reconstruction of palaeoclimate data: the coexistence approach (CA), leaf margin analysis (LMA) and Climate Leaf Analysis Multivariate Program (CLAMP).Before the CA was applied to the material the list of putative nearest living relative species (NLR) was carefully revisited and partly revised. In case of the LMA approach information of so-called “silent taxa” (fossil species preserved by diaspores, leaf margin state is inferred from NLR data) were partly included in the data set. The four floras from the Zeitz megafloral assemblage show slightly different floral compositions caused by various taphonomic processes. An aim of the investigations was to test whether these differences lead to differences in calculated mean annual temperatures (MAT) or not. The MAT, calculated by LMA for the four sites, remarkably differ in dependency on the incorporation of ”silent taxa” whenever present. MAT based on leaf remains only is often higher, because of the overrepresentation of laurophyllous entire-margined leaves in the respective taphocoenoses. Inclusion of “silent taxa” that often represents species with un-toothed leaves significantly decreases calculated MAT. It is expected that CLAMP and CA will render more reliable results, which will be part of the discussion. The contribution will also focus on problems in the use of leaf physiognomy as palaeoclimatic proxies and on the comparison of results obtained from a single plant taphocoenosis using different methods for quantitative reconstructions of MAT.