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New coupled vegetation-carbon model used inversely for reconstructing historical terrestrial carbon storage from pollen data

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A long-standing issue exists between data concerning the discrepancy of paleocarbon storage reconstructions since the Last Glacial Maximum by means of pollen, carbon isotope, and general circulation model (GCM) analysis. In this study, a new estimate of past biospheric carbon stocks is reported using a new paleocarbon model (PCM), which is defined as a physiological process vegetation model (BIOME4) coupled to a process-based biospheric carbon model (DEMETER). The PCM was constrained to fit pollen data to obtain realistic estimates. It was estimated that the probability distribution of climatic parameters, as simulated by BIOME4, was compatible with pollen data while DEMETER successfully simulated the carbon storage values with the corresponding outputs of BIOME4. The carbon model was validated with observable global vegetation biomass and soil carbon, and the inversion scheme was tested against 1491 surface pollen spectra sample sites procured in Africa and Eurasia. Results showed that this method can successfully simulate most biomes at selected pollen sites, and that the coefficient of determination (R2) calculated between the observed and reconstructed modern climates vary from 0.70 to 0.96. Comparisons between the simulated biome-average terrestrial carbon variables with the available observations also indicated a consensus: R2 variability of 0.92 for vegetation carbon density and

0.81 for soil carbon density. Results demonstrate the reliability and feasibility of this paleoclimate reconstruction method and its efficiency in reconstructing historical terrestrial carbon storage.