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Exploring the climatic impact of the continental vegetation on the Mezosoic atmospheric CO_2 and climate history

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Abstract. In this contribution, we continue our exploration of the factors defining the Mesozoic climatic history. We improve the Earth system model GEOCLIM designed for long term climate and geochemical reconstructions by adding the explicit calculation of the biome dynamics using the LPJ model. The coupled GEOCLIM-LPJ model thus allows the simultaneous calculation of the climate with a 2-D spatial resolution, the coeval atmospheric CO_2, and the continental biome distribution. We found that accounting for the climatic role of the continental vegetation dynamics (albedo change, water cycle and surface roughness modulations) strongly affects the reconstructed geological climate. Indeed the calculated partial pressure of atmospheric CO_2 over the Mesozoic is twice the value calculated when assuming a uniform constant vegetation. This increase in CO_2 is triggered by a global cooling of the continents, itself triggered by a general increase in continental albedo owing to the development of desertic surfaces. This cooling reduces the CO_2 consumption through silicate weathering, and hence results in a compensating increase in the atmospheric CO_2 pressure. This study demonstrates that the impact of land plants on climate and hence on atmospheric CO_2 is as important as their geochemical effect through the enhancement of chemical weathering of the continental surface. Our GEOCLIM-LPJ simulations also define a climatic baseline for the Mesozoic, around which exceptionally cool and warm events can be identified.

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