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Vegetation of a warmer world: Data-model comparison of global biome distributions for the Middle Pliocene and the 21st century

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The Middle Pliocene geological stage, ca. 3.6 to 2.6 million years ago, is the most recent interval of time in which Earth experienced greater global warmth with climate conditions similar to those predicted for the end of the 21st century. For a better understanding of the past and future impact of increased CO_2 on vegetation and climate, we compare a newly developed Middle Pliocene biome reconstruction with two new predictions of equilibrium vegetation conditions for the 21st Century ($\sim$ 400 and 560 ppmv CO_2 in the atmosphere). The Middle Pliocene biome reconstruction is based on an internally consistent dataset of 202 palaeobotanical sites and predictions from a state-of-the-art coupled climate-vegetation model (HadAM3-TRIFFID-BIOME4), the output of which is used to provide biome estimates for data sparse regions.

For the Middle Pliocene, both the vegetation reconstruction and model simulations indicate a generally warmer and moister climate than today. The Middle Pliocene biome distribution closely resembles predicted global vegetation under elevated atmospheric CO_2 in showing similar trends such as a northward shift of boreal forests and reduction in deserts. However, the Middle Pliocene world was still several degrees warmer than its predicted analogue as suggested by differences in the distribution of polar vegetation. This discrepancy may result from the reduced size of polar ice sheets and lower elevation of the Rocky Mountains during the Middle Pliocene.