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Preindustrial anthropogenic land use limits the future carbon sequestration potential of Europe

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Coupled climate-carbon cycle models that are used to assess the role of global biogeochemistry in the climate of the are typically initialized to equilibrium conditions at the "preindustrial" period, loosely defined as some point between AD 1700 and 1900 (e.g., Friedlingstein et al., 2006). In Europe, the cool temperatures of the Little Ice Age and the long history of intensive anthropogenic land cover and land use change may have disturbed European ecosystems to a point where the terrestrial carbon cycle was far from equilibrium when the Industrial Revolution began. These continental-scale climate and land use changes affected not only the total amount of carbon sequestered in the terrestrial biosphere at the present day, but also the long-term trajectory of ecosystems, which has implications for the capacity of the terrestrial biosphere to absorb atmospheric CO_2 in future centuries. Using novel reconstructions of changes in climate (Luterbacher et al., 2004) and anthropogenic land use (Kaplan et al., 2009) in Europe over the past 500 years to drive a dynamic vegetation model, we show that simulations that discount preindustrial climate change and human activities substantially overestimate both recent trends in carbon storage and the capacity of European ecosystems to absorb more carbon in the future.