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Land biosphere dynamics during the present and the last interglacials

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During the last eight glacial-interglacial cycles, the atmospheric CO_2 concentration has fluctuated between glacial levels of about 180 ppm and interglacial levels of up to about 300 ppm. These CO_2 concentra¬tion changes appear to be closely linked to Antarctic surface temperature as inferred from ice cores (e.g. Luethi et al. 2008). Several physical and biogeochemical mechanisms responsible for this strong coupling between the Antarctic surface temperature and the CO_2 concentration have been identified (e.g. changes in sea surface temperatures and deep water formation, marine productivity, $CaCO_3$ accumulation, terrestrial productivity and weathering), and quantification of their relative roles is under active investigation (e.g. Brovkin et al. 2012). Recently, focus in the paleo-carbon research community has shifted towards the link between surface temperature and CO_2 concentration during warm periods, including Quaternary interglacial periods.

To date it is unclear what mechanisms drive the atmospheric CO_2 concentration trends during interglacial periods. While the majority of climate-carbon cycle model simulations (e.g. Elsig et al. 2009; Joos et al. 2004; Kleinen et al. 2010; Menviel and Joos 2012; Ridgwell et al. 2003) agree that the ocean was the main source of carbon to the atmo¬sphere, the impact of land carbon changes on atmospheric CO_2 concentration is less clear. To understand the role of the land biosphere on atmospheric CO_2 concentration changes during the present and the last interglacials, we have used a new climate-carbon cycle model CLIMBER-JSBACH, which is the asynchronously coupled EMIC (Earth System Model of Intermediate Complexity) CLIMBER-2 (Ganopolski et al. 2001) and the land component JSBACH of the Max-Planck Earth System Model (MPI-ESM) described by Raddatz et al. (2007).

We will present a model study focusing on vegetation dynamics and carbon storage on land during warm climates (primarily Holocene) and their variability. Using a factor separation method, an ensemble of transient simulations including / excluding (i) different land use changes, (ii) orbit forcing, and (iii) peat accumulation will be analyzed to disentangle the overall change in the land carbon by including all drivers. The new developed model gives a reasonable timeframe for the ensemble of these 8000yrs spanning transient experiments.