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Modelling the climate and the terrestrial carbon cycle for the last millennia

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Climate-induced changes in the terrestrial biosphere and the ocean modulate the release and uptake of carbon dioxide and this, in turn, alters atmospheric composition and influences the climate. This is known as the climate-carbon cycle feedback. The Coupled Carbon Cycle Climate Model Intercomparison Project (C4MIP), using models of the ?terrestrial and ocean carbon cycles inside ocean-atmosphere general circulation models, has shown that the carbon cycle-climate feedback appears to be positive BUT there is great uncertainty about the magnitude. It is important to know the magnitude of this feedback because it affects the amount of carbon dioxide that can be emitted in the future in order to stabilize the concentration of CO2 at a given level. There are projects attempting to reduce these uncertainties through systematic evaluation of carbon cycle models against observations of the contemporary carbon cycle. An alternative approach is to use knowledge about past variations in climate and CO2 to provide additional constraints. Here we therefore work on the last millennium (LM) climate-carbon modeling and examine the factors that contribute to atmospheric CO2 change. Ice core is the only proxy that provides the CO2 content in detail for the last millennium and it shows up to 10ppm change around the Little Ice Age and during the LM. Several LM experiments by AOGCM are used to drive the terrestrial carbon cycle model LPJ. We investigate the role of external forcing of climate such as volcano and solar forcing as well as that of internal variability of climate in an unforced experiment of decadal to centennial time scale. We show that the CO2 changes in the same order of magnitude in the unforced experiment as in the forced experiment.