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The role of non-CO2 radiative forcing in determining of the amplitude of climate-carbon feedback

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The atmospheric CO2 concentration is one of the most important factors in determining the 21st century climate when simulating future climate. The majority of climate Ocean Atmosphere General Circulation Models (OAGCMs) use prescribed CO2 concentration scenarios. In these models the CO2 concentration is not sensitive to climate change. However, both the atmosphere-land and atmosphere-ocean fluxes of CO2 are known to be sensitive to climate. Indeed, offline carbon cycle simulations of the 21st century have confirmed a large sensitivity. Consequently, climate and CO2 form a feedback loop, such that an increase in CO2 results in climate change and vice versa. Following these studies, numerous coupled climate-carbon cycle simulations were performed under a common protocol (C4MIP). This protocol imposes forcing by fossil fuel and deforestation emissions. C4MIP underlined a large uncertainty in the responses of such models. For example, Friedlingstein et al. (2006) highlight that the climate-carbon cycle feedback results in an additional increase in atmospheric CO2 of anywhere between 20 and 200 ppm by 2100. To study the interactions between the atmosphere and carbon-cycles of both the continental biosphere and the ocean we have developed a new climate carbon coupled model (IPSL_CM4_LOOP). With IPSL_CM4_LOOP we obtain a carbon-climate feedback of 31 ppm in 2100. This places IPSL_CM4_LOOP in the lower range of the C4MIP models despite having one of the highest climate sensitivity. In the C4MIP protocol, the concentration of other greenhouse gases (GHG) and aerosols are constant and set to pre-industrial values. Although, the modelled carbon cycle is not directly sensitive to the concentrations of non-CO2 GHG and aerosols, it reacts to the climate change induced by this additional radiative forcing, and hence, affects the atmospheric CO2 concentration. In order to evaluate this contribution, we have performed a series of simulations where the evolu-

tion of non-CO_2 GHG and aerosols is taken into account. We found a carbon-climate feedback of 60 ppm in 2100. In summary, the amplitude of the CO_2 feedback strongly depends on the radiative forcing due to non-CO_2 GHG and aerosols. In our model the amplitude of the carbon-climate feedback is two-fold greater when the radiative forcing due to all GHG and aerosols is taken into account.