



Feedback and sensitivity analysis in ACCESS-ESM1: Effects of rising temperature and CO₂ on the land carbon cycle

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Earth System models (ESMs) can be used to study the carbon cycle response to future climate and CO₂ changes by performing idealized simulations where atmospheric CO₂ levels are increased at a prescribed rate of 1%/yr. Due to interactions of the many components in ESMs, it is not possible to perform this feedback analysis based on a single model simulation only. It is therefore necessary to set up a number of artificially decoupled simulations, where the responses can be isolated.

Here we use the ESM version of the Australian Community Climate and Earth System Simulator (ACCESS), ACCESS-ESM1, to study climate-carbon and concentration-carbon responses. ACCESS-ESM1 is based on ACCESS-1.4, with the addition of land and ocean carbon cycle components. It uses the Community Atmosphere Biosphere Land Exchange (CABLE) model as its land surface model. The biogeochemistry component of CABLE includes the coupling of carbon, nitrogen and phosphorus cycles.

In this study we analyze three climate sensitivity runs with ACCESS-ESM1: (1) a fully coupled simulation, where the 1%/yr increase in CO₂ is input to the radiation and carbon cycle scheme, (2) a biogeochemically coupled simulation, where the 1%/yr increase in CO₂ is only input to the carbon cycle scheme and (3) a radiatively coupled simulation, where the 1%/yr increase in CO₂ is only input to the radiation scheme. Results will also be compared against CMIP5 ESMs.