



The fate of anthropogenic CO₂ emissions in the Earth System

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The atmospheric CO₂ concentration has reached almost 400 ppm and emissions of anthropogenic CO₂ continue to increase. At present, about a half of emitted CO₂ is taken by land and ocean, and the rest remains in the atmosphere. With accelerated global warming, the airborne fraction of CO₂ emissions is expected to increase. Removal of anthropogenic CO₂ by natural mechanisms such as photosynthesis, carbonate dissolution, and silicate weathering will take many millennia. Consequently, anthropogenic global warming could persist for very long time. On this time scale, slow physical components of the Earth System (such as permafrost and ice sheets) and biogeochemical compartments (e.g. organic carbon stored in peatlands and permafrost soils) will start to respond and interact with each other. Accounting for cycling of macro-nutrients, such as nitrogen and phosphorus, complicates projections of atmospheric CO₂ changes. Challenges in the analysis of interactions between biogeochemical and physical components of the Earth System under CO₂ forcing will be discussed.