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Interannual variations of atmospheric CO2 and their implication to climate - carbon cycle interactions

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It has been recognized through modeling efforts that climate - carbon cycle interactions may form a positive feedback loop for the global warming. Actual extent of the feedback is, however, strongly model dependent. This situation necessitates a measure for estimating how accurately a model mimics nature concerning climate - carbon cycle interactions. A possibility for such a measure that one would first come up with is reproducibility of the relation between ENSO events and CO2 concentration anomalies, as it is known from observations that ENSO events are often followed by positive CO2 concentration anomalies with a time lag of about 1 year. Here we examine results from our coupled GCM with terrestrial and oceanic carbon cycle processes embedded, using which we conducted experiments to project future CO2 concentrations with and without interactions between climate and carbon cycle. Using SRES A2 scenario, the experiment with the interactions projects at 2100 a global mean CO2 concentration 130 ppm higher than that in the experiment without them; this means that our model exhibits a strong feedback effect as compared to other models of a similar kind. We examined the relation between the simulated ENSO events and CO2 concentration anomalies, and found that a positive CO2 concentration anomaly often follows an ENSO event, which is in agreements with observations. The simulated time lag between them (2 years) is, however, longer than observed and cause for this discrepancy is being investigated. We also found that there is a structural difference between the global warming - carbon cycle interactions and the ENSO event - carbon cycle interactions; the former is dominated by the CO2 release from high-latitudes while the latter from low-latitudes, posing a limitation in using ENSO events as a measure of carbon cycle model performance.