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Uncertain analysis of carbon cycle and climate parameters using a simple climate model

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Aggregated Carbon Cycle, Atmospheric Chemistry & Climate Model (ACC^2) is essentially a globally aggregated climate model that also gives information on grid-by-grid climate change by applying an Empirical Orthogonal Function approach. ACC^2 was developed on the basis of ICLIPS Climate Model (Bruckner et al., 2003) and incorporated elaborated parameterization of atmospheric chemistry of a fairly comprehensive set of radiative forcing agents (CO_2, CH_4, N_2O, SF_6, 28 species of halocarbons, O_3, sulfate and carbonaceous aerosols, and stratospheric water vapor) as well as indirect radiative forcing agents (OH, NO_x, CO, and VOC). The overall model description is fully updated with the scientific findings reported in IPCC TAR (2001) and other recent literature (e.g. Joos et al., 2001). Two major uncertain parameters representing the CO_2 fertilization effect and the climate sensitivity were estimated during the spinup optimization scheme (from the year 1750 to 2000) by employing an inverse modeling approach and by using reconstruction data (Crowley, 2000; Etheridge et al., 1996; Houghton, 2003; Jones et al., 2001; Keeling et al., 2004; Mann and Jones, 2003; Marland et al., 2003). The optimization results point to a low estimate for the climate sensitivity relative to the range suggested by the CO_2 doubling experiments using major AOGCMs (2.6 – 4.0K) (IPCC WGI, 2004, p.5) and a high estimate for CO_2 fertilization effect relative to the range implied by terrestrial vegetation models. Relatively low climate sensitivity as well as high CO_2 fertilization effect leads to the projections of a less pronounced future climate change than the corresponding IPCC TAR projections.

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