Supporting Information

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SI Text

Although the exceeding probabilities given in this article have been derived for the long-term (year-2500) temperature response, they also apply, with some approximation, to the instantaneous temperature response. To demonstrate this result, we have conducted two additional simulations with the UVic ESCM, whereby the total emissions compatible with the 2 °C target (674 PgC, which are the allowable cumulative emissions in 2250, i.e., at the time of temperature stabilization; see Fig. 1 in the main article) are emitted (*i*) as a pulse and (*ii*) according to a scenario with estimated emissions until 2006 and with emissions evolving according to the fastest rate of all SRES marker scenarios (0.35 PgC/yr^2) until the cumulative emissions limit is reached (at about 2045; see Fig. S1). We find that for the 674-PgC pulse the simulated surface air temperature (SAT) anomaly exceeds the 2 °C target by a maximum of 0.02 °C. For the "fast SRES" scenario, the SAT anomaly exceeds the target by maximally 0.01 °C (see Fig. S1).

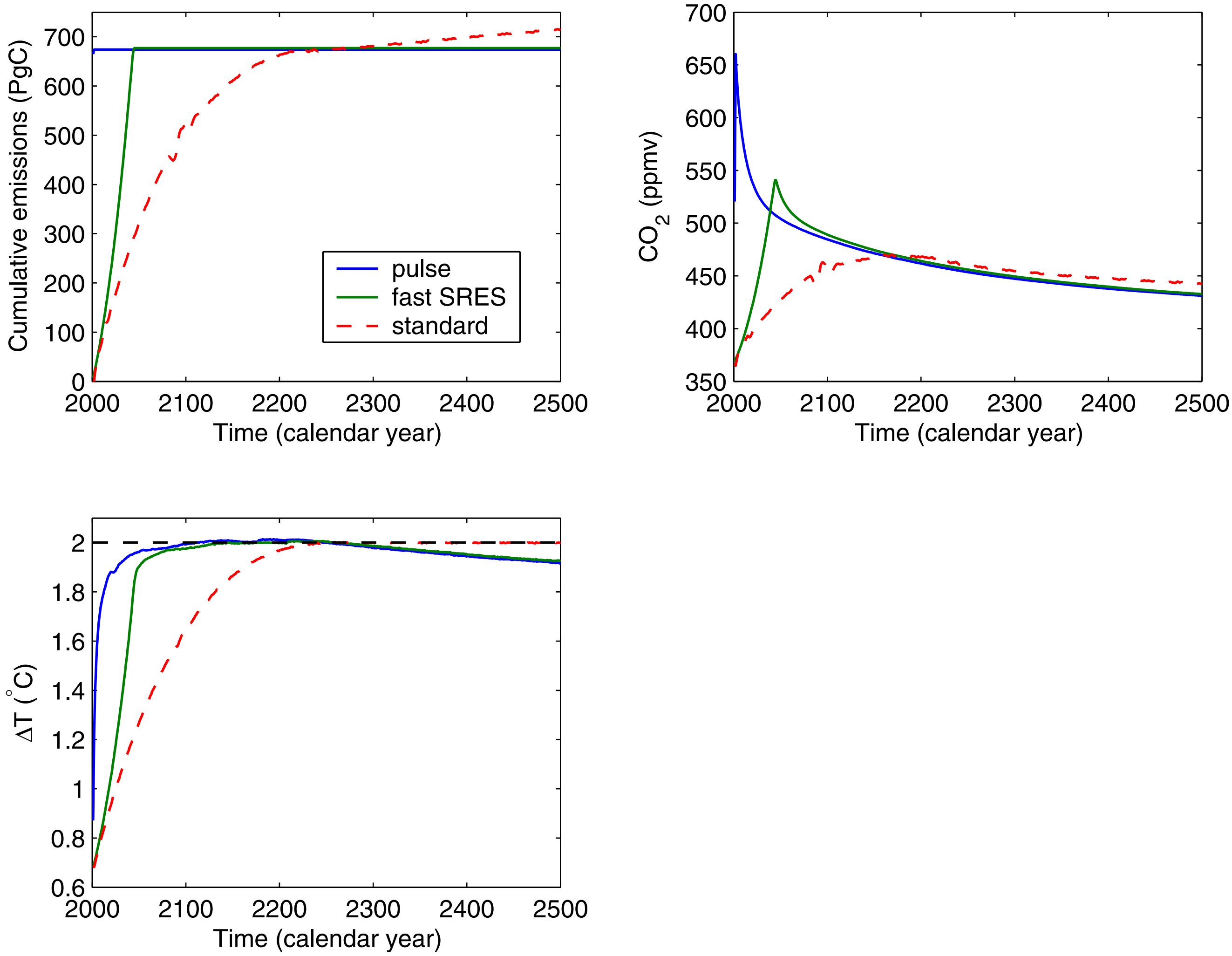

Fig. S1. Cumulative CO_2 emissions (*Upper Left*), CO_2 concentrations (*Upper Right*), and surface air temperature anomaly (*Lower*) for two emissions scenarios with total emissions of 674 PgC (''pulse'' and ''fast SRES'' scenarios; see *SI Text* for details) and the standard scenario stabilizing at 2 °C used in the article. The standard climate sensitivity of the UVic ESCM (3.6 °C) is assumed.

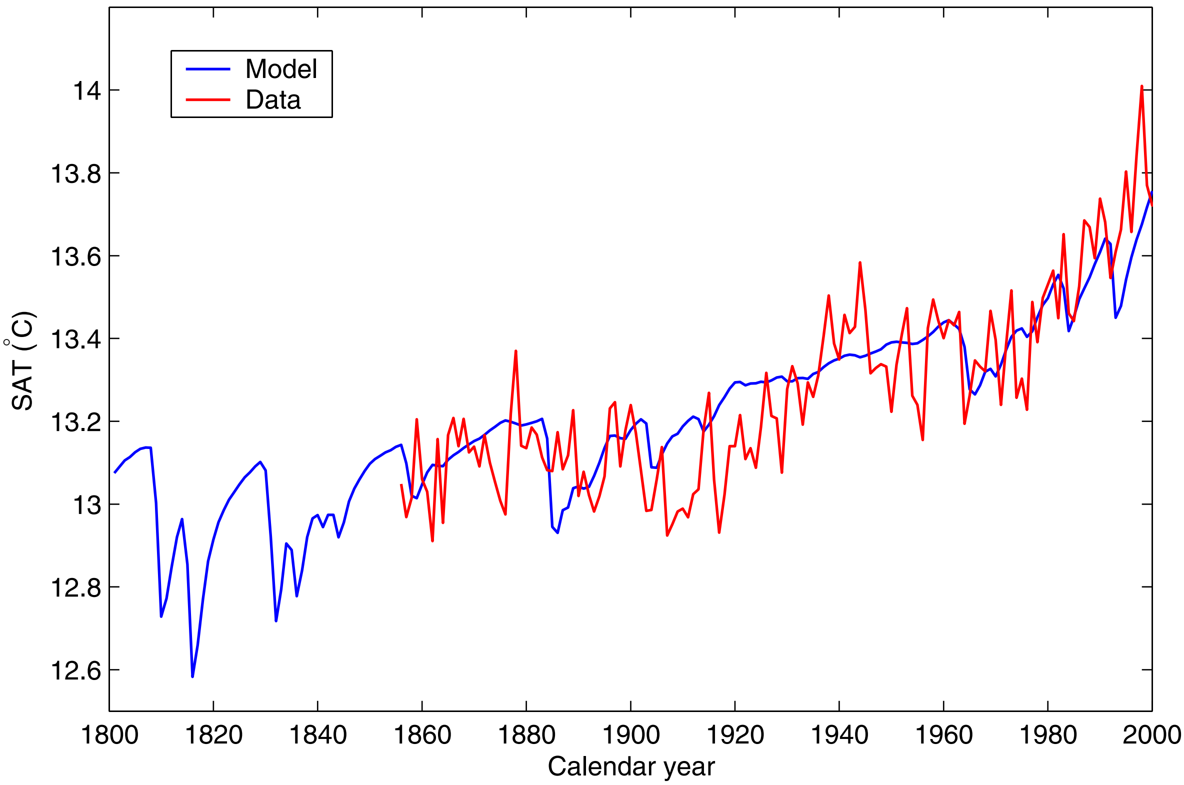

Fig. S2. Historical surface air temperature (SAT) evolution simulated by the UVic ESCM as compared with observations (1). The model simulation includes known natural and anthropogenic forcings (from greenhouse gases such as CO_2, CH_4, NO_2, and halocarbons, sulfate aerosols, land-use change, solar irradiance, volcanoes, and orbital changes).

1. Jones PD, Parker DE, Osborn TJ, Briffa KR (2006) Global and hemispheric temperature anomalies–land and marine instrumental records. In *Trends: A Compendium of Data on Global Change* (Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, TN).

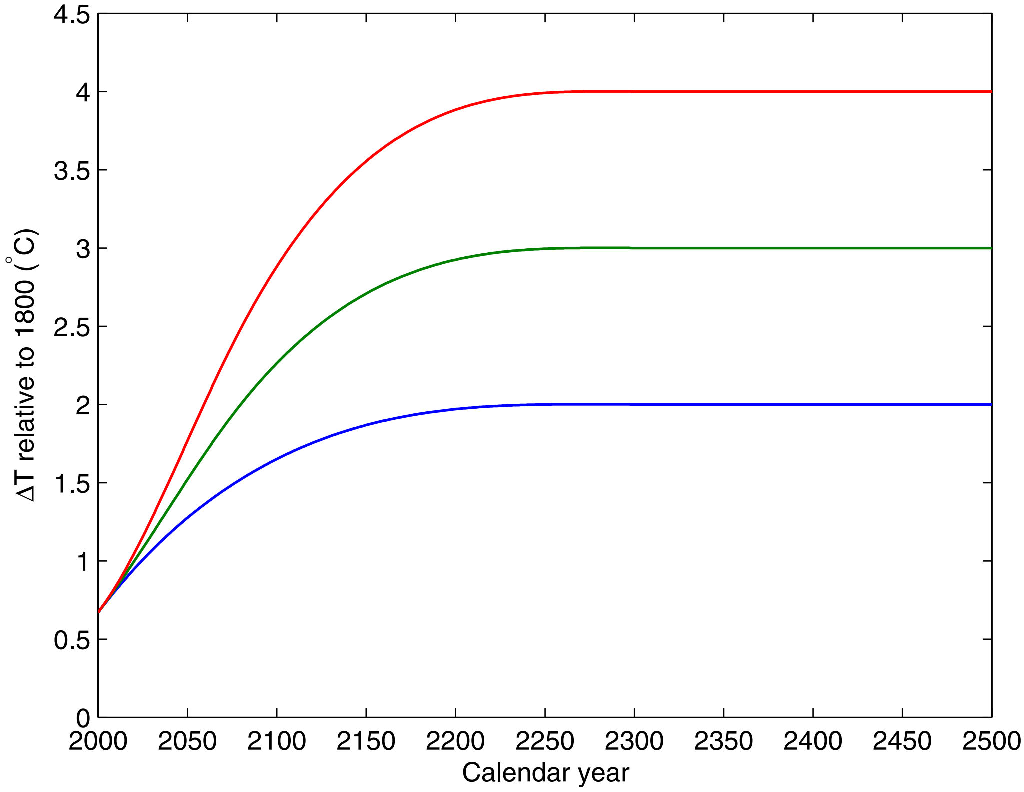

Fig. S3. Standard trajectories stabilizing global mean temperature change at 2 °C, 3 °C, and 4 °C (relative to preindustrial) used in this study.

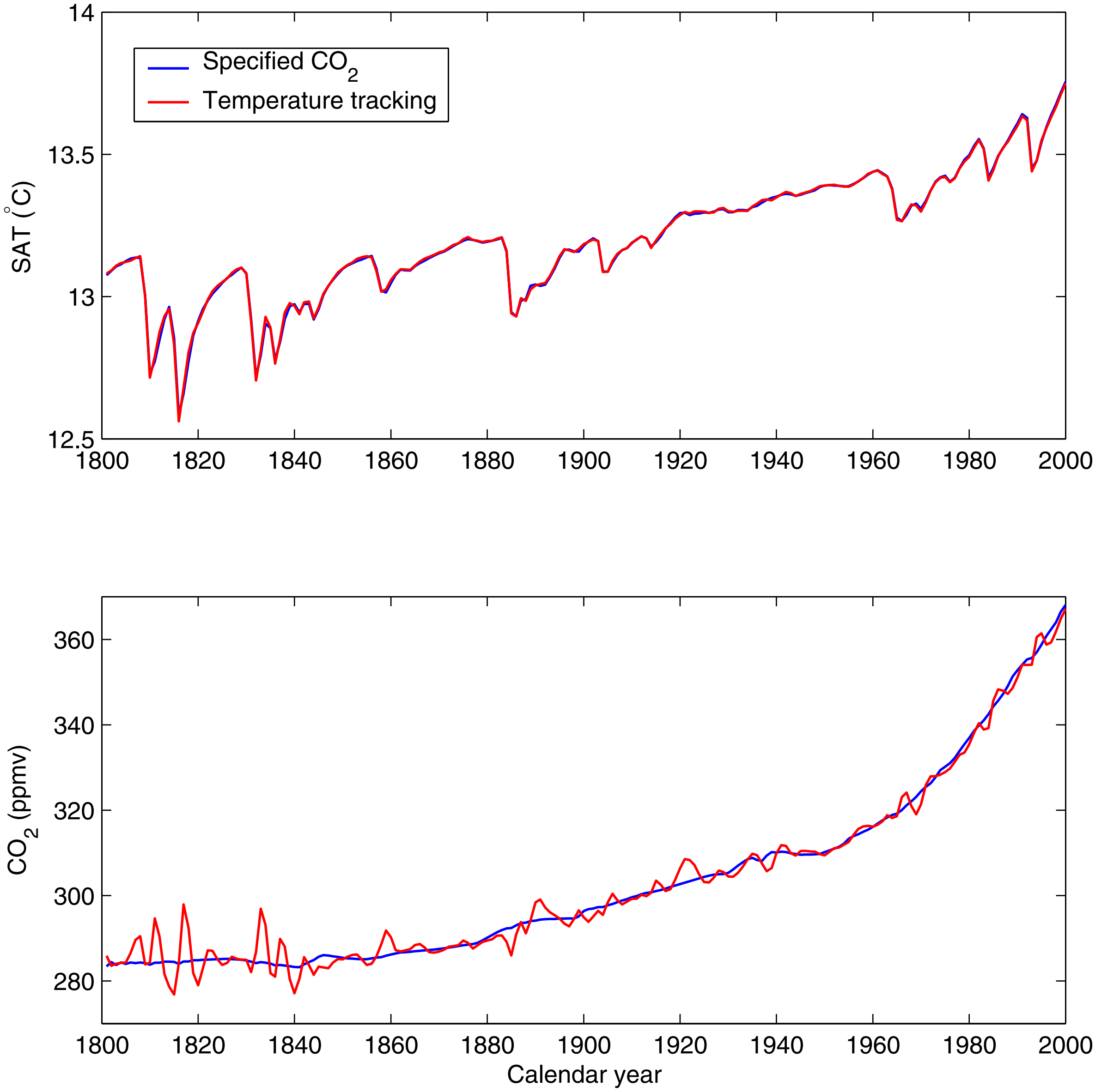

Fig. S4. Simulated surface air temperature (SAT) (*Upper*) and atmospheric CO_2 (*Lower*) over the historical period (1800–2000). The blue and red curves refer to experiments with specified CO_2 and specified temperature, respectively. Note that the two temperature curves are almost indistinguishable. In terms of atmospheric CO_2, the temperature tracking simulation exhibits a larger variability at times of rapid temperature change. The reason is that the model compensates for an overshooting or undershooting of the prescribed temperature trajectory by regulating CO_2 emissions.

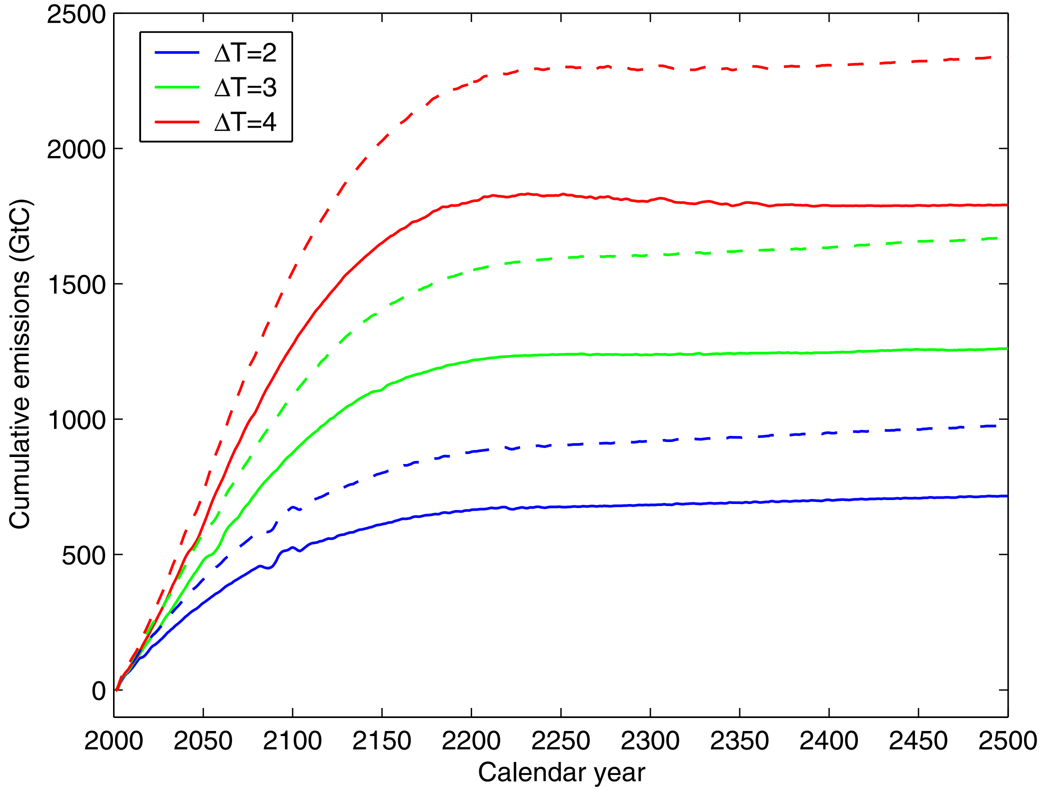

Fig. S5. Cumulative CO_2 emissions compatible with temperature stabilization targets of 2 °C, 3 °C, and 4 °C under inclusion (solid lines) and exclusion (dashed lines) of climate-carbon cycle feedbacks. The standard climate sensitivity of the UVic ESCM (3.6 °C) is assumed.