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# Relative roles of the climate sensitivity and the rate of forcing increase in defining model response on different time scales.

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Relative roles of the climate sensitivity and the rate of forcing increase in defining model response on different time scales has been studied by means of numerical simulations with the MIT coupled atmosphere-ocean model of intermediate complexity. In these simulations model atmospheric CO2 was increasing for 100 years and was kept fixed after that. A large number of simulations with the rate of CO2 increase changing from 0.2 to 1.5% per year and model sensitivity form 0.5 to 6oC have been carried out. Results of these simulations show that, while an “equilibrium” response is almost uniquely defined by the product of the rate of increase (r) and the sensitivity (S), the transient climate change strongly depends on the particular values of both r and S. The slowing down of the thermohaline circulation of the ocean as well as THE increase of surface air temperature during the first 100 years are primarily defined by the rate of CO2 increase and show very little dependence on climate sensitivity. On the other hand the fraction of the equilibrium warming realized during the initial part of a simulation is practically independent of the rate of forcing increase. Our simulations show that overturning in the Atlantic Ocean collapses in all simulations with r*S exceeding a critical value. However, in simulations with r*S close to this critical value the behavior of the overturning after CO2 stabilization strongly depends on the particular values if r and S. In simulations with high rates and low sensitivities the overturning continues to slow down after CO2 stabilization at the same pace as during the first 100 years. In the simulations with low rates and high sensitivities the overturning at first shows a partial recovery and then resumes degreasing only after a few hundred years. Such a behavior is explained by the fact that for high climate sensitivity a significant time is required for atmospheric feedback to start working at full strength.