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Simulated Climate Sensitivity Uncertainty: Control Climate Bias vs. Perturbed Physics

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In this study the relationship between climate model biases in the control climate and the simulated climate sensitivity are discussed on the basis of perturbed physics ensemble simulations with a globally resolved energy balance (GREB) model. It is illustrated that the uncertainties in the simulated climate sensitivity can be conceptually split into two parts: a direct effect of the perturbed physics on the climate sensitivity independent of the control mean climate and an indirect effect of the perturbed physics by changing the control mean climate, which in turn changes the climate sensitivity, as the climate sensitivity itself is depending on the control climate. It is shown that the two effects are opposing each other. Biases in the control climate are negatively correlated with the climate sensitivity (colder climates have larger sensitivities) and perturbed physics are in average positively correlated with the climate sensitivity (perturbed parameters that lead to warmer control climates lead to larger climate sensitivities). In the GREB model the biases in the control climate are more the important effect for the regional climate sensitivity uncertainties, but on the global mean climate sensitivity both, the biases in the control climate and the perturbed physics, are equally important.