Climate sensitivity estimates – sensitivity to radiative forcing time series and observational data

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A key question in climate science is how the global mean surface temperature (GMST) responds to changes in greenhouse gases or other forcings. The climate sensitivity is determined by complex feedbacks that operate on very different timescales and may depend on the transient climate state. Here we use a method combining radiative forcing (RF) time series and several series of observed ocean heat content (OHC) and near-surface temperature change in a Bayesian-framework using a simple energy balance model and a stochastic model. The model is updated using forcing estimates from IPCC, including OHC data for the upper (0-700m) and deep ocean separately, and extending the time series to 2015.

The mean value for the Inferred Effective Climate Sensitivity (ECSinf) is estimated to $2.0\,°C$, with a $90\,\%$ credible interval of 1.2–$3.1\,°C$. Estimate using this methodology has recently been shown to be consistent with the higher values for the equilibrium climate sensitivity estimated by climate models. Previous estimates using historical forcing data, observed temperatures and OHC to infer the climate sensitivity have shown considerable spread in the results. We show through a series of sensitivity experiments a strong sensitivity of the estimated ECSinf to the choice of a priori RF time series, excluding pre-1950 data and the treatment of OHC data. Sensitivity analysis performed by merging the upper (0–700 m) and the deep ocean OHC or using only one OHC data set (instead of four in the main analysis), both give an enhancement the mean ECSinf by about $50\,\%$ from our best estimate.