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On the possibility of constraining the climate sensitivity: A view from LGM multimodel simulations

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Charney climate sensitivity (CCS) is defined as the equilibrium surface temperature change under the doubling of atmospheric CO_2 concentration specifically without vegetation, ice sheet, and carbon cycle feedbacks. CCS is one of the most important metrics in climate projections of coming centuries, and past climate has been used to constrain its uncertainty. The use of paleoclimate as a guide for the future needs to be demonstrated based not only on statistical relation between the past and future climate changes but also on sound physical understanding of mechanisms behind the changes. Much attention has been paid to the last glacial maximum of about 21 thousand years ago, and this presentation overviews previous and current effort on estimating CCS based on LGM climate. The emphasis is placed on the activity with general circulation models and the analysis of the latest PMIP3/CMIP5 multimodels. While perturbed physics ensembles of single models (sensitivity to model parametric uncertainty) suggest a relatively high correlation between LGM and $2xCO_2$ global climate feedbacks, multimodel analysis (sensitivity to model structural uncertainty) suggest little correlation between them. This implies that globally averaged LGM climate change does not likely provide a strong constraint on the CCS spread in current models. The radiative feedback analysis indicates that the reason may be cloud feedback induced by the ice sheet forcing unique to the LGM. On the other hand, it was and is proposed that regional change, particularly in the tropics, may be of more use than global mean change. In order to more effectively impose the regional constraint and to increase our confidence, however, uncertainties in proxy data and the forcing estimate need to be reduced and the number of models need to be increased.

Keywords: climate sensitivity, last glacial maximum