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Variability of ocean heat uptake in a grand ensemble transient climate change experiment

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The rate of transient climate change is determined by the strength of atmospheric feedbacks and the effective rate of ocean heat uptake. Extensive studies have been performed exclusively on atmospheric feedbacks but relatively little has been done on the ocean. In this study a grand ensemble of perturbed coupled atmosphere-ocean GCM transient forcing climate change experiments from 1920 to 2080 have been conducted under the A1B future forcing scenario, as part of the climatePrediction.net experiment. Control experiments, corresponding to each transient ensemble member, have been run in parallel under constant forcing. In the analysis of the results, anomalies between transient runs and corresponding control runs are taken to remove climate drift. Ocean heat uptake properties across models are examined to measure the degree of penetration of heat into the deep ocean. It is found that different perturbations to the oceanic physics parameters did not significantly vary the heat uptake properties. On the other hand, they show a wide spread within runs with the same combinations of ocean perturbations. This suggests that either the ocean parameters had not been perturbed sufficiently or that the variability in the atmosphere has a larger effect on the ocean heat uptake. To investigate the role of the atmospheric variability on the ocean heat uptake the correlation with changes in surface air temperature and total precipitation rate have been examined. Global mean heat uptake properties are found to be correlated with the change in total precipitation rate, but not with surface air temperature.