



The Max Planck Institute Grand Ensemble (MPI-GE) - Enabling the Exploration of Climate System Variability

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The Max Planck Institute Grand Ensemble (MPI-GE) is the largest ensemble of a single comprehensive climate model currently available, with 100 members for the historical simulations and each of four future forcing scenarios. It is currently the only large ensemble available that includes scenario RCP2.6, which has become vital for projections given the targets set by the Paris agreement. The ensemble also has the advantage that it is initialized by sampling the control state both for the ocean and atmosphere, which means that, except for long-timescale deep-ocean variables, the ensemble can be directly investigated from the beginning of the model runs. Given this initialization, deep ocean drift can also be efficiently removed using the parallel control simulation. These advantages make MPI-GE the most powerful large ensemble available today.

We present an overview of MPI-GE and its components. A novel approach for comparing model internal variability with observed variability is demonstrated, with six interesting regions highlighted. The power of MPI-GE to accurately estimate both the forced signal and internal variability is also shown, with the Atlantic Meridional Overturning Circulation (AMOC) used as an example. In this example, we quantify the forced signal as the ensemble mean and the internal variability as the standard deviation across the ensemble dimension. Finally, MPI-GE can be used to determine the ensemble size needed to investigate a specific application. Here, we find that 30-40 members are sufficient to quantify the projected sea level pressure trend and its variability in RCP4.5 over the period 2007-2099. We suggest that MPI-GE can be used to estimate the ensemble size needed for many future studies.