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Improved reliability and accuracy of CMIP5 global mean surface temperature projections

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Climate predictions are only meaningful if the associated uncertainty is specified. The range of likely conditions should be reliably estimated in order to use the predictions of any forecast. A standard practice for providing climate projections is to use an ensemble of projections (often generated by varying uncertain parameters, initial conditions, parameterization of unresolved processes, and global circulation models). The ensemble mean serves as the projection while the ensemble spread is used to estimate the associated uncertainty. The main drawback of this approach is the fact there is no guarantee that the ensemble projections adequately sample the possible future climate conditions. A secondary drawback is that the quantification of the ensemble spread relies on assumptions (regarding the probability density function of the projections) that are not always justified. The relation between the true uncertainties associated with projections and ensemble spreads is not fully understood. Here, we suggest using simulations and measurements of past conditions in order to study both the performance of the ensemble members and the relation between the ensemble spread and the uncertainties associated with their predictions, thereby providing improved projections of Global Mean Surface Temperature (GMST). Using an ensemble of CMIP5 long-term climate projections, that was weighted according to sequential learning algorithm and whose spread was linked to the range of past measurements, we found reduced uncertainty ranges for the projected GSMT for both RCPs 4.5 and 8.5 and for both time periods of 2046–2065 and 2080–2099. The results suggest that by employing advanced weighting schemes and using past information for linking the ensemble spread and the measurement range, it is possible to provide more reliable and accurate GMST projections.