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Constraining Climate Projections using Decadal Predictions

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There is an increasing demand for robust, reliable and actionable climate information for the near-term future (1-40 years). Seamless information on these time-scales can only be derived from uninitialized climate projections, which however are not aligned with the observed, internal state of the climate system. Another source of information are Initialized predictions for which the observed state is taken into account, but these are only available for the upcoming decade.

In this study, we test in how far decadal predictions can be used to constrain uninitialized projections to obtain skillful predictions on time-scales beyond decades. This is done by selecting a sub-ensemble of uninitialized projections, which are chosen by their proximity to the decadal predictions ensemble mean. This framework is applied to surface air temperatures from CMIP5 simulations over the North Atlantic Gyre region, as decadal predictions show largest added value over projections for this region. Skill is measured using anomalous correlation coefficient (ACC) and root-mean-square-error (RMSE). Results show that ACC values for forecast years 10-15 for the constrained sub-ensemble are similar to those derived for the non-constrained uninitialized ensemble. However, RMSEs are significantly decreased for the constrained sub-ensemble, not only for the first 10 forecast years but also beyond. This is mainly due to the fact that the constrained sub-ensemble has a much higher ability to capture the observed warming trend during the end of the 20th century compared to the uninitialized ensemble mean. Further to these results, the limitations of this framework are discussed, including an assessment of the potential upper limit of added value and it's dependency on the skill of the decadal forecast system.

This easy-to-apply framework can be used to provide crucial climate information for mitigation and adaptation strategies by filling the gap between initialized decadal predictions and uninitialized projections.