1 **Supplementary Material for:**
2 Observation-based Blended Projections from Ensembles
3 of Regional Climate Models

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8 This document presents supplementary materials to the submitted paper.
9 It contains: (i) Details about prior specification; (ii) Computational details;
10 (iii) Predictions results; and (iv) Additional results.

11 **1 Prior specification**

12 The following priors were used when running the models:
13 \( \eta \sim N((8, -6, 0, 0)^T, diag(4, 10, 100, 100)) \) (for winter) and
14 \( \eta \sim N((25, -6, 0, 0)^T, diag(4, 10, 100, 100)) \) (for summer);
15 \( \xi \sim N(0.005, 0.001) \);
16 \( \tau, \tau_j \sim IG(2, 0.01) \);
17 \( \sigma^2, \sigma_j^2 \sim IG(2, 0.01) \) (for \( j = 1, 2, 3 \));
18 \( \varphi \sim Ntr(-1.1)(0.5, 0.01^2) \);
19 \( \alpha_0 \sim N(0, I_M) \).
20 For the Matérn correlation function \( \phi_1 \sim IG(2, h) \) where \( h = \max(\text{dist})/(-2 \log(0.05)) \)
21 and \( \phi_2 = 1 \).

22 **2 Computational details**

23 The posterior results are based on keeping one sample for every five of a total of
24 50,000 iterations of the MCMC algorithm, after a burn-in of 10,000 iterations.
25 We ran two parallel chains starting from different initial values. With these
26 results, the convergence was checked via the Gelman and Rubin diagnostic.
3 Temperature predictions

Predictions at any spatial scale are calculated from the posterior samples. Specifically, the predictive temperature at any spatial location $s$ and time $t$ is given by $x^T(s)\eta + \xi t + \omega(s)$. This value is stored during the MCMC sampling scheme to simulate the true temperature value from its posterior distribution. Consequently, the mean of those stored values represents the predictive mean temperature at time $s$ and time $t$. Figures 5 and 6 (small subregions) in the manuscript, as well as Figures 1 and 2 (statewide) presented in this Supplementary Material show results considering the predictive mean summer/winter temperature averaged across selected spatial locations. Specifically, the values plotted in those figures (dashed blue lines) are calculated by averaging the posterior mean estimates across the spatial locations inside the small subregions or for each state.

4 Additional results

The proposed approach can provide blended predictions, with comprehensively-derived uncertainties, for a state, a watershed, an ecoregion, or, more generally, for any spatial domain of interest. To illustrate this feature of the modeling approach, we show additional results for statewide predictions (Figure 1, Figure 2).

The statewide summer predictions (Figure 1) show a clear increasing trend, with an increase between 2 and 4 °C in the 1971–2070 period. In all cases the predictions from an individual ensemble member underestimate future temperatures, when compared to blended predictions. This is not surprising, as underestimation occurs during the period under current conditions. It is important to notice, though, that the probability bands associated with the predictions are very large, showing ranges of up to 8 °C. Interestingly, even with such wide bands, some ensemble members are not fully contained within the prediction intervals and their sole use might lead to misleading conclusions. Average winter temperature predictions per state are shown in Figure 2. We observe that the increasing trend is not as pronounced as the one estimated for summer temperatures. Similarly to the summer results, we observe very wide prediction intervals and strong corrections to the RCM simulations.

References
Fig. 1 Times series of predictive mean summer temperature averaged by states (Nevada, Utah, California and Arizona). The gray shadows correspond to 95% credible intervals.

Fig. 2 Times series of predictive mean winter temperature averaged by states (Nevada, Utah, California and Arizona). The gray shadows correspond to 95% credible intervals.