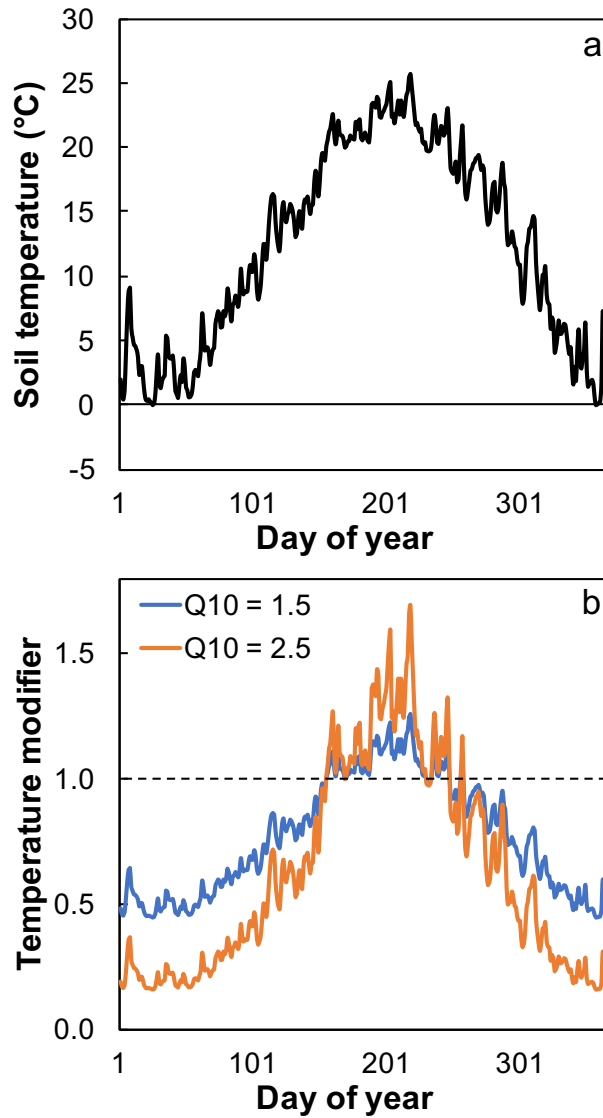
2 **Figure S1. Residual (modeled – observed) of soil respiration (SR) from 2005 to 2013.** The

3 respective negative and positive residuals indicate that the E3SM underestimated SR during peak

4 growing seasons and overestimated SR during other seasons.

5

6   **Figure S2. An example showing the effect of Q_{10} on the seasonality of soil heterotrophic**

7   **respiration. a,** soil temperature; **b,** temperature modifier on soil heterotrophic respiration with

8   Q_{10} of 1.5 (blue) and 2.5 (orange).

9

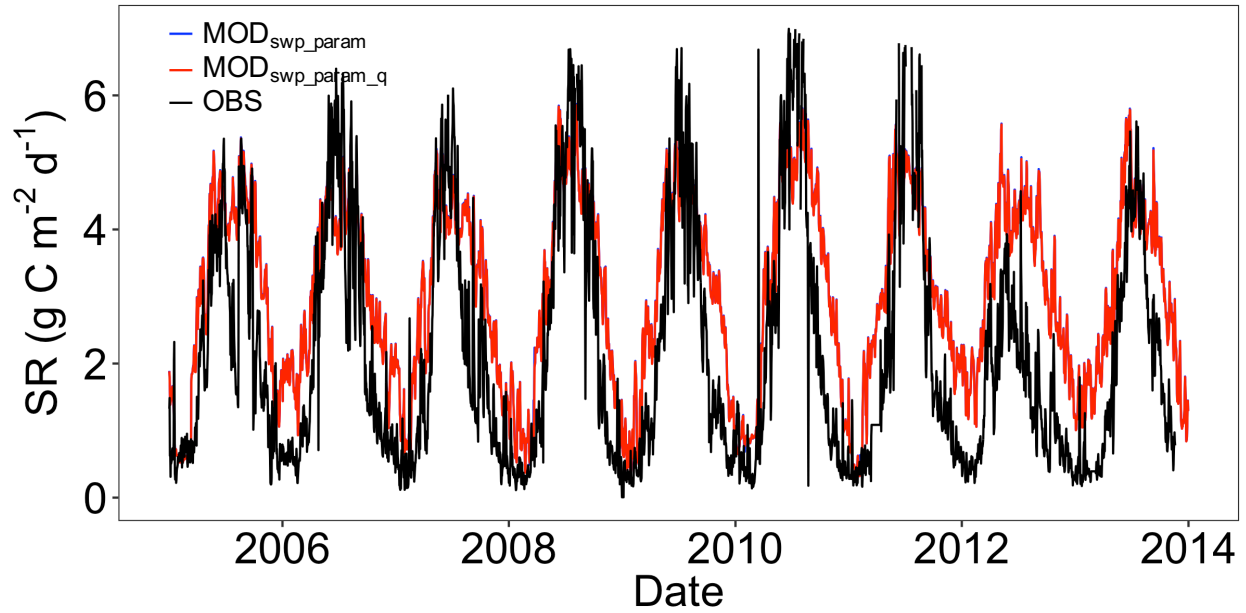



Figure S3. Effect of Q_{10} modification on soil respiration (SR). OBS: observation;

MOD_{swp_param}: model output after soil water potential improvement and parameter modification

but with the default Q_{10} value (i.e., 1.5); $MOD_{swp\_param\_q}$: model output after soil water potential

improvement and parameter modification with modified Q_{10} (i.e., 2.5). The blue and red lines are

almost overlap with each other, indicating that changing Q_{10} resulted in little change in SR.