

Intermodel spread of radiative feedback patterns traced to regional surface warming using NASA GISS ModelE3 Green's Function

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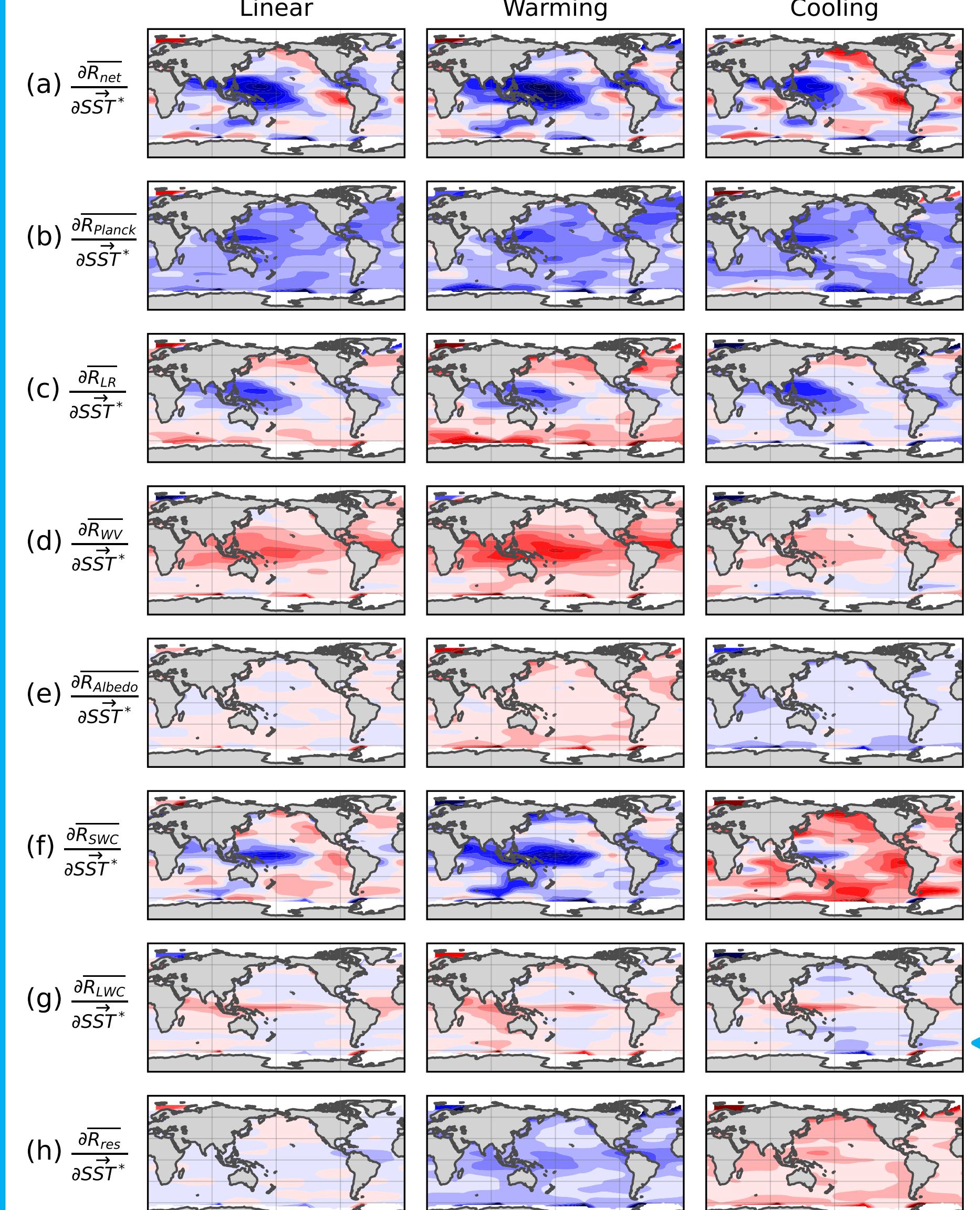
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Abstract

The strength of the radiative feedback to global warming is known to vary with the sea surface temperature pattern. This “pattern effect” has been widely used to understand how and why the feedback varies with time and to resolve discrepancies between different lines of evidence. However, there has been ongoing debate on the limitations of the pattern effect, especially in describing the intermodel spread of radiative feedbacks. Here we present a new set of Green’s Functions in the NASA GISS ModelE3 and apply it to the reconstruction of radiative feedback in CMIP6 models. We find that the tropical SST pattern is more important in reconstructing model-simulated patterns of each feedback process, while extratropical SST patterns are a major source of noise. Furthermore, while the Western Pacific SST plays a strong role in modifying the global-mean radiation budget, we suggest that the Eastern Pacific SST can better capture the feedback patterns in most CMIP6 models. The research highlights the significant role of the Eastern Pacific SST in accurately capturing radiative feedback patterns and their spread across models.

GISS ModelE3 Green's Function



Results

- Convolving only tropical SST with the Green's Function (GF) yields a better skill in reproducing the key features of λ (comparing the 1st and 3rd columns in Fig. 2) than using global SST.**
- Within the tropics, the Eastern Pacific SST has a dominant role in reproducing λ patterns (the 6th column in Fig. 2).
- The noises of GF-reconstructed λ (using global SST) arise mostly from extratropical SSTs (comparing the 2nd and 4th columns in Fig. 2).
- For net, shortwave cloud, and longwave cloud feedback, **the GF-reconstructed feedbacks with Eastern Pacific SST have a larger pattern correlation** with the feedbacks estimated from models. For lapse-rate feedback, the Western Pacific SST reconstruction instead leads to a larger pattern correlation (Fig. 3).

