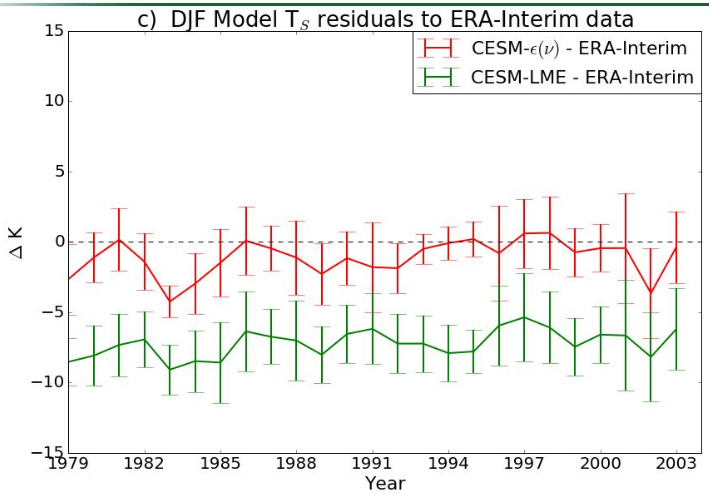
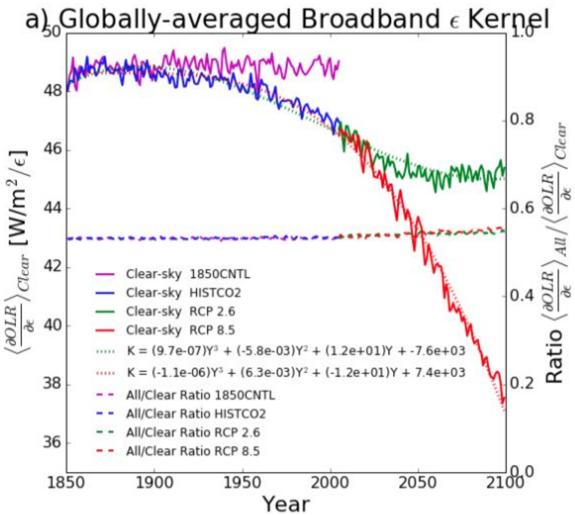
Earth System Model High-Latitude Temperature Biases can be Resolved by Incorporating Realistic Surface Longwave Emission





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Scientific Achievement

The goal was to investigate the importance of the representation of surface radiative transfer physics on the persistence bias that earth system models exhibit at high latitudes. This work also identifies and quantifies the ice-emissivity feedback in an Earth System Model (ESM).

Significance and Impact

This work found that incorporating physically realistic infrared surface emissivity across model components leads to a reduction in the bias that ESMs exhibit whereby their wintertime Arctic Ocean surface temperature predictions are too cold compared to observations.

Research Details

- Physically realistic surface emissivity was incorporated into the ocean, atmosphere, and land surface representation of an Earth System Model.
- The modified ESM (CESM-$\varepsilon(\nu)$) compared more favorably against high-latitude observations, as compared to the unmodified ESM (CESM-LME), particularly over the Arctic Ocean.
- Since the effect of surface emissivity depends on atmospheric water vapor and clouds, a novel time-dependent feedback analysis was performed, where it was found that accounting for temporal variability could provide feedback assessments which differ in sign from conventional feedback analysis frameworks.