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# The influence of global sea surface temperature variability on the large-scale land surface temperature

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In global warming scenarios, global land surface temperatures ($T_{land}$) warm with greater amplitude than sea surface temperatures (SSTs), leading to a land/sea warming contrast even in equilibrium. Similarly, the interannual variability of $T_{land}$ is larger than the covariant interannual SST variability, leading to a land/sea contrast in natural variability. This work investigates the land/sea contrast in natural variability based on global observations, coupled general circulation model simulations and idealised atmospheric general circulation model simulations with different SST forcings.

The land/sea temperature contrast in interannual variability is found to exist in observations and models to a varying extent in global, tropical and extra-tropical bands. There is agreement between models and observations in the tropics but not the extra-tropics. Causality in the land-sea relationship is explored with modelling experiments forced with prescribed SSTs, where an amplification of the imposed SST variability is seen over land. The amplification of $T_{land}$ to tropical SST anomalies is due to the enhanced upper level atmospheric warming that corresponds with tropical moist convection over oceans leading to upper level temperature variations that are larger in amplitude than the source SST anomalies. This mechanism is similar to that proposed for explaining the equilibrium global warming land/sea warming contrast.

The link of the $T_{land}$ to the dominant mode of tropical and global interannual climate variability, the El Niño Southern Oscillation (ENSO), is found to be an indirect and delayed connection. ENSO SST variability affects the oceans outside the tropical Pacific, which in turn leads to a further, amplified and delayed response of $T_{land}$.