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Attributing Future Changes in Surface Temperature Variability to Thermal Advection

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Assessing the projected changes in variability of surface temperature is a key step towards assessing the future probability of extreme events such as cold spells and heat waves. Furthermore, understanding the driving mechanisms behind such changes in variability enables more confidence to be placed in model projections. A large fraction of present day temperature variance is associated with thermal advection, as anomalous winds blow across the land-sea temperature contrast for instance. This study investigates the extent to which this mechanism may also explain projected changes in temperature variability up to the end of the 21^{st} century.

Under greenhouse gas forcing there is expected to be an increase in land-sea temperature contrasts in summer and a decrease in winter. In winter, the northern hemisphere will also see decreased large scale meridional temperature gradients due to Arctic amplification of the warming signal. In this study, it is found that the associated changes in thermal advection are expected to lead to widespread changes in daily and monthly temperature variability by the end of the twenty-first century. The study uses a multiple regression analysis applied to ESSENCE, a 17 member ensemble of the ECHAM5/MPI-OM climate model, to separate the contributions from changing temperature gradients and changing circulation patterns. It will be shown that many changes can be explained using only the changes in seasonal mean temperature gradient.

A comparison with the CMIP5 suite of models will also be presented to highlight which changes in variability are robust across climate models, and to demonstrate the temporal evolution of the variability signal in model projections.