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Observational constrains reduce the increases of summertime temperature variance in CMIP5 projections

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Europe has experienced extreme summer temperatures over the past few decades (e.g. Alexander et al.2006; Tebaldi et al 2006; Moberg et al.2006; Della-Marta et al.2007). Though there has been a debate on which effect, the growing mean (Rhine and Huybers, 2013) or the increasing variance (Hansen et al, 2012), dominates the observed increase of temperature extremes, it is important to quantify both of them in future climate projections.

Global climate models are vital to making predictions about future climate, but have many uncertainties associated with them needed to be quantified/understood/reduced. Model biases can be connected across multiple timescales, which leads to the suggestion that such biases in the current climate would grow and further bias the projected changes (Christensen et al 2008, Christensen and Boberg 2012, Bellprat, 2013). This, however, allows the possibility to constrain future projection with model biases in the current climate, which can be estimated against the observations.

In this study, we examine the biases in summertime surface temperature variance simulated by 30 of the CMIP5 models for the historical period (1986-2015); in many regions, the models have too much temperature variance compared to observations.We then show that in many regions, the projected change in the variance of temperature at end of the 21st century (RCP 8.5) scales as the amplitude of the bias in temperature variance in the current climate. Finally, we use the scaling relationships and the biases in historical simulations to correct the model projections. In many regions, the larger the bias in summertime temperature variance in the historical period, the greater the projected increase in the variance the model will project in the future scenario. This is especially true in Western Europe, where this relationship is shown to be significant across large regions. In the original multi-model projection (RCP 8.5), much of Europe and parts North America and Canada are expected to experience a significant increase in summertime surface temperature variance as much as 1° C^2. However, when the multi-model bias and the cross-model scaling relationship are considered, the new projections reduce the increase of temperature variance in these regions by up to 0.3° C^2. This highlights the importance of taking into account model performance in the current climate when analyzing any simulations predicting the future climate.