Supplemental Figures for:

On the Linearity of Local and Regional Temperature Changes from 1.5°C to 2°C of Global Warming

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We only consider departures from scaling for

Sensitivity tests

The analysis was also performed separately for 1.5°C and 2°C worlds composed only of model years using each of the RCP4.5 and RCP8.5 projections to assess whether departures from scaling are sensitive to the choice of projection, and how “transient” the climate is as it passes through the 1.5°C and 2°C global warming targets (Figure S1). The RCP4.5 and RCP8.5 scenarios were chosen as they represent slower and faster rates of warming, respectively, and these scenarios include more model simulations than RCP2.6 and RCP6.0 (Table 1). If we decompose this analysis based on the RCP4.5 and RCP8.5 projections separately, we find broadly similar patterns in departures from scaling between the two warming scenarios (Figure S1). Pattern correlations (Spearman’s rank) of these scaling departures are 0.44 for boreal summer and 0.51 for boreal winter. For most regions of the world, how strong a predictor the local warming to 1.5°C of global warming is for local warming up to the 2°C warming level, is relatively insensitive to the pace at which the globe passes through these warming levels.
temperature, but we also investigate how other variables are projected to change from 1.5°C to 2°C from global warming as these changes may help to explain the departures from temperature scaling projected for some regions of the world.

An RCP2.6 analysis was also conducted as it is closest to equilibrium (Figure S4). It is worth noting that while comparing the RCP scenarios is informative, neither scenario is in equilibrium and there are likely to be slightly different warming patterns than those in simulated equilibrium climates at these warming levels.

An additional analysis based on only individual runs of each model and scenario was also performed. This was to test the sensitivity of the results to the number of simulations per model as this varies greatly (Table 1). The model-median deviation from scaling, as a percentage departure, is very similar when only single simulations from each model are used (Figure S2) when compared to the entire ensemble. Note that the models are still weighted differently as the numbers of model years in the 1.5°C and 2°C ensembles is dependent upon the rate at which individual simulations pass through these global warming levels as well as the number of runs per model.

A test was conducted to identify if internal climate variability could be altering the results as for some models there are relatively few simulations (Table 1) and associated 1.5°C and 2°C years available for calculations to be made. The CanESM2 and CSIRO-Mk3.6.0 models have more simulations available so departures from scaling were calculated for those models and individual run numbers (combining each RCP for r1i1p1, r2i1p1, etc.) separately. Similarity between scaling departures from individual runs was quantified based on pattern correlations of the percentage departures from scaling (Figure S3). Intra-model differences in spatial patterns of scaling departures provide an estimate of the influence of internal variability.

When the analysis is repeated for subsets of model 1.5°C and 2°C years in the CanESM2 and CSIRO-Mk3-6-0 models, we find generally strong agreement between runs of the same
model with respect to the pattern of scaling departures (Figure S3). This is more true for CSIRO-Mk3-6-0 than CanESM2, although there are more model years in the sub-ensembles for CSIRO-Mk3-6-0. Internal variability affects some of the local-scale differences in scaling departures but does not have a strong influence in the overall patterns found here despite these ensembles being 1-2% of the size of the full 1.5°C and 2°C ensembles.

Figure S1: As Figure 6(b),(d) but calculated using only (a),(b) RCP4.5 and (c),(d) RCP8.5.
Figure S2: As Figure 6 but based on 1.5°C and 2°C ensembles composed of only individual runs per available model and emissions scenario.

Figure S3: Pattern correlation matrices for (a) JJA and (b) DJF showing the level of spatial agreement in scaling departures calculated from model years derived from individual model runs (e.g. CSIRO-Mk3-6-0 r1) and the individual models as a whole (e.g. CSIRO-Mk3-6-0).
Figure S4: (a),(b) Maps of scaling departures as Figure 6(b),(d) but for RCP2.6 only. (c),(d) Maps of precipitation changes as Figure 8(b),(d) but for RCP2.6 only.