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Detection of spatially aggregated changes in temperature and precipitation extremes

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Observed trends in the intensity of hot and cold extremes as well as in dry spell length and heavy precipitation intensity are often not significant at local scales. However, using a spatially aggregated perspective, we demonstrate that the probability distribution of observed local trends across the globe for the period 1960-2010 is clearly different to what would be expected from internal variability. We detect a distinct intensification of heavy precipitation events and hot extremes. We show that CMIP5 models generally capture the observed shift in the trend distribution but tend to underestimate the intensification of heavy precipitation and cold extremes and overestimate the intensification in hot extremes. Using an initial condition experiment sampling internal variability, we demonstrate that much of the local to regional differences in trends of extremes can be explained by internal variability, which can regionally mask or amplify the forced long term trends for many decades.