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Robust joint projections for humidity and temperature extremes

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Impacts of climate change such as the effects on human discomfort, morbidity and mortality often depend on multiple climate variables. Thus, a comprehensive impact assessment is challenging and uncertainties in all contributing variables need to be taken into account. Here we show that uncertainties in some impact-relevant metrics such as extremes of health indicators are substantially smaller than generally anticipated. Models that project greater warming also show stronger reduction in relative humidity. This joint behavior of uncertainties is particularly pronounced in mid-continental land regions of the subtropics and mid-latitudes where the greatest changes in heat extremes are expected. The uncertainties in health-related metrics combining temperature and humidity are much smaller than if uncertainties in the two variables were independent. Such relationships also exists under present-day conditions where the effect of model biases in temperature and relative humidity largely cancel for combined quantities. Our results are consistent with thermodynamic first principles. More generally the findings reveal a large potential for joint assessment of projection uncertainties in different variables used in impact studies.