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# Changes in sensible heat are an important contributor to global precipitation changes

Gunnar Myhre and the PDRMIP team
CICERO, Norway (gunnar.myhre@cicero.uio.no)

Precipitation changes under global warming are strongly linked to the underlying changes in the atmospheric component of the Earth's energy budget. Globally, latent heating associated with a change in precipitation is balanced by changes to atmospheric radiative cooling and sensible heat fluxes. Both components can be altered both by climate forcing mechanisms and through climate feedbacks, but the impacts of climate forcing and feedbacks on sensible heat fluxes have received much less attention. Here we show, using a range of climate modelling results from Coupled Model Intercomparison Project Phase 5 (CMIP5) and Precipitation Driver and Response Model Intercomparison Project (PDRMIP), that changes in sensible heat are the dominant contributor to the present global-mean precipitation change since pre-industrial time, because the radiative impact of forcings and feedbacks approximately compensate. However, future changes will be dominated by enhanced atmospheric radiative cooling, as the radiative feedbacks become the largest term. This transition explains why historical precipitation changes have been modest relative to expected future precipitation changes. We further attribute the present large spread in projected precipitation change among climate models to differences in calculated atmospheric radiative cooling. The model results show a dissimilar influence on sensible heat and precipitation from various drivers of climate change. Due to its strong atmospheric absorption, black carbon is found to influence the sensible heat very differently to other aerosols and greenhouse gases. Our results indicate that this is likely caused by differences in the impact on the lower tropospheric stability.