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Emission scenario dependencies in climate change assessments of the hydrological cycle

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Anthropogenic global warming will lead to changes in the global hydrological cycle. The uncertainty in precipitation sensitivity per 1K of global warming across coupled atmosphere-ocean general circulation models (AOGCMs) has been actively examined. On the other hand, the uncertainty in precipitation sensitivity in different emission scenarios of greenhouse gases (GHGs) and aerosols has received little attention. Here we show a robust emission-scenario dependency (ESD); smaller global precipitation sensitivities occur in higher GHG and aerosol emission scenarios. Although previous studies have applied this ESD to the multi-AOGCM mean, our surprising finding is that current AOGCMs all have the common ESD in the same direction. Different aerosol emissions lead to this ESD. The implications of the ESD of precipitation sensitivity extend far beyond climate analyses. As we show, the ESD potentially propagates into considerable biases in impact assessments of the hydrological cycle via a widely used technique, so-called pattern scaling. Since pattern scaling is essential to conducting parallel analyses across climate, impact, adaptation and mitigation scenarios in the next report from the Intergovernmental Panel on Climate Change, more attention should be paid to the ESD of precipitation sensitivity.