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Large-scale controls on convective extreme precipitation

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The influence of large-scale conditions on extreme precipitation is not yet understood well enough. We will present the results of Loriaux et al. (2017), in which we investigate the role of large-scale dynamics and environmental conditions on precipitation and on the precipitation response to climate change.

To this end, we have set up a composite LES case for convective precipitation using strong large-scale forcing based on idealized profiles for the highest 10 percentiles of peak intensities over the Netherlands, as described by Loriaux et al. (2016). In this setting, we have performed sensitivity analyses for atmospheric stability, large-scale moisture convergence, and relative humidity, and compared present-day climate to a warmer future climate.

The results suggest that amplification of the moisture convergence and destabilization of the atmosphere both lead to an increase in precipitation, but due to different effects; Atmospheric stability mainly influences the precipitation intensity, while the moisture convergence mainly controls the precipitation area fraction. Extreme precipitation intensities show qualitatively similar sensitivities to atmospheric stability and moisture convergence. Precipitation increases with RH due to an increase in area fraction, despite a decrease in intensity.

The precipitation response to the climate perturbation shows a stronger response for the precipitation intensity than the overall precipitation, with no clear dependency of changes in atmospheric stability, moisture convergence and relative humidity. The difference in response between the precipitation intensity and overall precipitation is caused by a decrease in the precipitation area fraction from present-day to future climate. In other words, our climate perturbation indicates that with warming, it will rain more intensely but in less places.

Loriaux, J.M., G. Lenderink, and A.P. Siebesma, 2016, doi: 10.1002/2015JD024274
Loriaux, J.M., G. Lenderink, and A.P. Siebesma, 2017, doi: 10.1175/JCLI-D-16-0381.1.