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Exploring the limits of the terrestrial fresh water cycle

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Precipitation is the ultimate source of life on this planet: it makes our crops grow, provides drinking water, feeds rivers and replenishes groundwater aquifers. Climate modelling studies estimate changes in precipitation due to increased greenhouse gas emissions and climate impact studies use those estimates as input to their (hydrological) models to predict future water availability and societal impact. However, humans also significantly alter the land surface by, for example, deforestation and irrigation, which is not frequently taken into account in our climate studies.

Here, we present an overview of several papers in the field of moisture recycling, published by our group, that show the extent to which terrestrial evaporation influences terrestrial precipitation. It is found that 38% of the terrestrial precipitation originates from terrestrial evaporation and that 58% of all terrestrial evaporation recycles, and return again as terrestrial precipitation. Knowing this, it is clear that evaporation is not necessary a loss to the hydrological cycle. We show that in some cases even transpiration during the dry season can act as a moisture source for a distant region. To assess the vulnerability of a region to local and remote land use changes we propose the concept of the precipitationshed, which maps out a region's precipitation sources. Our results are useful in mapping out possible land use change threats, but also opportunities to safeguard our water resources in the Anthropocene.