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Moisture recycling: concepts, definitions, metrics and applications

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Evaporation that becomes precipitation again - over the same area or over land in general - is water that recycles in the atmosphere. Hence, this process is often called moisture recycling. But, exactly how important is land evaporation for land precipitation? For some reason this has always been a rather controversial field of study. Different methods, but especially different definitions of moisture recycling are probably at the base of this problem.

Here, I would like to present an overview of about eight years of my own research (including contributions from many co-authors), in which I describe the moisture recycling process from different angles. This presentation will guide you to several new concepts and metrics developed to describe and understand the local to global scale moisture recycling process. Topics that will be discussed include: evaporation vs. precipitation recycling, continental moisture recycling, length scales of moisture recycling vs. regional moisture recycling ratios, oceanic and terrestrial sources, the precipitationshed and the evaporationshed concept, the age of atmospheric water, time scales and residence times, the role of interception and transpiration in moisture recycling.

These concepts are appealing and useful to a wide range of applications, for example: estimating consequences of land-use change, understanding of past climates, calculating net water footprints, understanding of extremes (rainfall and droughts), climate model evaluation, and management and governance of the role of ecosystems in the water cycle. However, the concepts and metrics developed in moisture recycling studies can only be useful when correctly applied and carefully interpreted. For example, they do not always necessarily describe causal relations. I hope the work presented here serves as a reference for anyone wanting to make use of moisture recycling concepts in their research.