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A revised picture of the atmospheric moisture residence time

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The atmospheric branch of the hydrological cycle is a key component of variability in the global water and energy budget. We study the transport of moisture by weather systems using a refined Lagrangian moisture source diagnostics on a global air mass transport climatology calculated with the FLEXPART model for the period 1979-2013. The diagnostics determine source-sink relationships for all precipitation events in the ERA-Interim data set, which provides a new estimate of the atmospheric moisture residence time (defined as the time moisture spends in the atmosphere between evaporation and precipitation). The global mean residence time of 4 to 5 days obtained from our diagnostics is about half the value assumed so far. This is mainly because previous estimates neglect moisture transport, and assume that depletion time constants can be considered as a proxy for the time moisture spends in the atmosphere. We show from different arguments that these assumptions are generally not fulfilled. The revised spatial and temporal picture of the atmospheric moisture residence time reveals patterns that are consistent with the footprints of precipitation producing weather systems in different regions of the earth. This will be exemplified with examples from tropical and extratropical regions.