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Water at Night: Relevance from Observations and Models

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The possibility of nocturnal water loss from the surface into the atmosphere has been historically overlooked by the climate community due to the absence of solar radiation to drive evapotranspiration (ET) and the technical difficulty to measure ET during the night. However, there is a growing number of studies that estimate nocturnal ET—and particularly transpiration—to represent 20% or more of daytime values. Most of these estimates come from physiological studies measuring sap flow in plants and/or water losses at the leaf scale. As it is the case with nocturnal ET, there is still very limited knowledge about the contribution of non-precipitation water inputs (D) to the surface such as dew. Here we analyze the observed characteristics of both nocturnal ET and D, as well as how they are simulated in climate models. The observations correspond to direct measurements of nocturnal ET and D obtained from a network of lysimeters with sub-hourly temporal resolution installed across Swiss grasslands. Furthermore, at one site the lysimeter record spans 18 years providing information about the year-to-year variability. These lysimeter data are complemented with a literature review and latent heat flux estimates from the FLUXNET 2015 dataset to extend the analysis to other regions and land-cover types. We also analyze the nocturnal water fluxes from climate models of the fifth phase of the Coupled Model Inter-comparison Project (CMIP5) with 3-hourly output. Overall, this study highlights the relevance of water exchange at the surface during the night and explores its influence on the hydrology and climate under present and future conditions.