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Two water worlds in temperate forests? Partitioning of water sources in two forested headwater catchments in Germany

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Recent ecohydrological studies using stable isotopes have suggested that water used by plants is largely separated from water that is returned to streams and groundwater. These observations have led to the postulation of a “two water worlds hypothesis” with distinct reservoirs of water in the subsurface that are not well mixed. This has major implications for our understanding of the water cycle and its conceptualization.
Most of the studies to date have been conducted in forested catchments located in regions with a pronounced seasonal distribution of precipitation. Here we present findings from a study of the ecological separation of water in two forested headwater catchments in Germany where precipitation is distributed rather evenly throughout the year. Over the course of 18 months we sampled plant water, soil water, groundwater and stream runoff monthly to analyze isotope ratios of 18O and 2H. Plant and soil water were cryogenically extracted, and isotope ratios in the water samples were analyzed using cavity ring-down spectroscopy and isotope-ratio mass spectrometry. The isotope ratios of the different water sources were used to test the hypothesis that separate water worlds also exist in climates that do not exhibit a seasonal distribution of precipitation. First findings indicate distinct differences in isotope ratios between tree species, suggesting complex processes at the biosphere-hydrosphere interface, but otherwise little evidence for the existence of separate water reservoirs.