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Agro-hydrological modeling of soil water retention measures to increase crop system resilience to extreme events

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An increase in the occurrence of drought events potentially aggravate conflicts between agricultural water use and other human and ecological demands for water resources. Increasing the natural soil water retention capacity can help to defuse these conflicts and at the same time strengthen climate mitigation, biodiversity, and food security. Although a variety of measures may be taken to increase soil water retention in agricultural systems, their effects in response to climate extremes are largely unknown. As part of the OPTAIN initiative (OPTimal strategies to retAIN and re-use water and nutrients in small agricultural catchments across different soil-climatic regions in Europe, www.optain.eu), this project aims to evaluate the soil water dynamics affected by these measures and their extent of influence on the cropping system, looking for possibilities to increase the resilience to drought stress under current and future climatic conditions. The steps include (1) utilizing information from a long-term lysimeter experiment to setup, calibrate and validate a detailed model of soil water dynamics (SWAP) for a typical Swiss cropping system, (2) specifying soil water retention measures through modifications of input parameters based on a literature review (and additional field measurements), and (3) apply the model to conduct a series of simulation experiments with varying combinations of soil water retention measures and future climate scenarios. Study findings will identify soil water retention measures with the largest potential to mitigate drought stress limitations to agricultural productivity, helping to make future arable production systems in Switzerland less dependent on supplement irrigation.