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Responses of soil water storage and crop water use efficiency to climate change

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Future food production is expected to be affected by climate change, because it will alter the crop water balance components, such as water storage, evapotranspiration and drainage. Variations in weather conditions could explain more than 50% of the variability of wheat yield. Higher temperatures and lower rainfall amounts mainly limit the actual evapotranspiration and reduce soil water storage, which in turn affect crop yield and water use efficiency. To study these effects, soil monoliths were moved to sites with contrasting climatic conditions (space for time concept) and monitored.
In this contribution, yield, evapotranspiration, and changes in soil water storage from lysimeters soils for a period from 2011 until 2017 were analyzed. Data were obtained from a German wide monitoring network of lysimeter stations (TERENO-SOILCan), which was established across a rainfall and temperature transect, and lysimeters were transferred between the stations to subject them to different climate regimes. A uniform crop management (crop type, fertilizer, growth regulator, tillage, and use of pesticides) and crop rotation allows investigating the response of soil water storage and cropping water use efficiency for different soil types to a change in climate conditions.
Main results showed a characteristic decrease of water availability of soils with a finer texture and smaller pores under drier and warmer climate conditions. The drier and warmer climate significantly increase crop yield and reduce at the same time evapotranspiration. This result confirms a more efficient use of water by plants under less optimal water availability in the root zone.