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Unravelling the complex interactions between root development and soil moisture profiles in the soil-root-system

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We study the coupled action of water uptake and root development of maize in Rhizotrons under greenhouse conditions. Questions we aim to answer are: What is the effect of a vertical soil moisture gradient on the root growth? How does the root structure in turn influence soil moisture? Do constant irrigation quantities and depths eventually lead to constant root distributions and soil moisture profiles?

We apply highly controlled subsurface irrigation schemes in potting soil-sand mixtures and measure the real-time response of the interdepending soil moisture fields and root structures.

Following a top-down approach, in which the overall behaviour of the coupled system is carefully investigated and described, we aim to unravel the complex soil-root-interaction system. Looking at the occurrence of steady states and continuities sheds light on the type of the underlying feedback loops, which in turn provides insight into the fundamental processes that underlie the typical behaviour. We are particularly interested in trade-offs between the development of rooting depth and rooting density (including its dependency on soil moisture profiles) and the coupled effect of roots and root structures on the infiltration capacity of the soil-root-system. Preliminary results suggest the possibility of an enhancing feedback loop between these processes.

The next step will be to develop a numerical model that incorporates the interactions that were identified experimentally. The model will allow us to study the behavior and sensitivities of the system in more detail.