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Quantifying how plants with different species-specific water-use strategies cope with the same drought-prone hydro-ecological conditions

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Plant transpiration and root water uptake are dependent on multiple traits that interact with site soil characteristics and environmental factors such as radiation, atmospheric temperature, relative humidity, and soil-moisture content. Models of root architecture and functions are increasingly employed to simulate root-soil interactions. Root water uptake is thereby affected by the root hydraulic architecture, soil moisture conditions, soil hydraulic properties, and the transpiration demand as controlled by atmospheric conditions. Stomatal conductance plays a vital role in regulating transpiration in plants. We performed simulations of plant water uptake for plants having different mechanisms to control transpiration, spanned by isohydric/anisohydric spectrum. Isohydric plants follow the strategy to close their stomata in order to maintain the leaf water potential at a constant level, while anisohydric plants leave their stomata open when leaf water potentials fall due to drought stress. Modelling the stomatal regulation effectively will result in a more reliable model that will regulate the excessive loss of water. We implemented hydraulic and chemical stomatal control

of root water uptake following the current approach where stomatal control is regulated by simulated water potential and/or chemical signal concentration. In order to maintain water uptake from dry soil, low plant water potentials are required, which may lead to reversible or permanent cavitation. We parameterise our model with field data, including climate data and soil hydraulic properties under different tillage conditions. This helps us to understand the behaviour of different crops under drought conditions and predict at which growing stage the stress hits the plant. We conducted the simulations for different scenarios to study the effect of hydraulic and chemical regulation on root system performance under drought stress.