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Coupling of a field-scale crop model and a 3D architectural root model

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Especially under unfavorable environmental conditions such as dry conditions or nutrient limitation, the accurate prediction of the root growth and related resource uptake efficiency is crucial to accurately simulate crop growth and development. With the aim to improve the prediction of crop growth, we coupled a 1D field-scale crop-soil water model (running in the modeling framework Simplace) with the 3D architectural root model CRootBox on a daily time step. Hereby, CRootBox obtains the maximal daily root elongation from Simplace, and Simplace receives the root length density (computed from the 3D explicit root architecture) from CRootBox. Due to the coupling, the root biomass provided by Simplace determines the maximal root elongation (feedback loop). When the potential root elongation is higher than maximal, CRootBox reduces the root growth equally for each root tip. A decreased root length density may result in decreased soil water and nutrient uptake and an increased water-/nutrient stress in Simplace which may reduce the total biomass production. The coupling of the models and simulation tests showing differences of spring wheat root growth and yield under no stress and drought stress conditions will be presented.