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Rhizosphere spatiotemporal organisation – a key to rhizosphere functions

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In the past, reductionist approaches have dominated in rhizosphere research, i.e. the study of individual components (soil, roots, microorganisms, chemicals) in isolation or simplified model approaches. For the study of a complex system like the rhizosphere this is not appropriate as novel information generated by interactions is not captured. The Priority Programme 2089 Rhizosphere spatiotemporal organisation – a key to rhizosphere functions (PP 2089) is motivated by the necessity to bring together the different aspects, processes and scales of rhizosphere research under a common framework in order to utilize this knowledge for improving our understanding of resilience in agricultural systems.
The last decade showed a boost in rhizosphere research related to the availability of new techniques, well demonstrated by recent reviews. Each of these articles is a plea for more interdisciplinary approaches. The main knowledge-gaps in rhizosphere research are related to the difficulty in mechanistically linking the physical, chemical and biological processes, taking place at different scales (nm to cm) in the rhizosphere and then upscaling them to the scale of the root system and the soil profile. The key for overcoming these knowledge gaps is to link the spatial arrangement of the different interconnected components of the rhizosphere and their temporal dynamics. We suggest that this can be fulfilled best by moving to a system approach applying the tools and principles of self-organisation.
It is the objective of the PP to identify spatiotemporal patterns in the rhizosphere arising from a cascade of feedback loops between root, microbiome and soil. Such patterns have only recently become accessible at the relevant scales. Rhizosphere 2D and 3D parameter patterns will be measured over time by combining the most recent developments in soil physics and chemistry with those in microbiome research and plant genomics/physiology. For superposition of data, pattern recognition and deciphering mechanistic understanding the PP will take advantage from developments in other disciplines and extend the existing modelling approaches ranging from single root to root system scale. Hypotheses will be tested by investigating the response of the system to a number of drivers, which relate directly to basic system components (texture, plant genotype), but also to anticipated risks for agricultural systems (drought, pathogens).
PP 2089, funded by DFG, will start in June 2018 and its central platform experiments will serve as a starting point for collaborations on the national and international level.