ABSTRACT

"Computational Morphodynamics models of the shoot apical meristem"

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The shoot apical meristem (SAM) is a stem cell niche acting as a main regulator of above-ground plant development. The maintenance of stem cells in the SAM, and the initiation of organs at the periphery are dependent on genetic regulation, hormone signaling, and mechanical anisotropies resulting in a complex dynamical system regulating organized differentiation and growth. Mathematical modeling has proven to be a useful tool to understand SAM development at a systems level, and the use of live microscopy has increased our knowledge of details in the protein dynamics associated with SAM development. The emerging field of Computational Morphodynamics aims at increasing the understanding of developmental systems by combining computational models whith microscopy data that provides four dimensional experimental templates for optimizing the models, and then predictions of the models are to be verified in experiments, in an iterative loop between experiments and computation.

In this talk I will discuss models for stem cell regulation and primordia formation in the SAM. I will give examples of models where hormone signaling and transport are combined with mechanical models for generating phyllotactic patterns as well as models for stem cell regulation focusing on the CLAVATA WUSCHEL feedback. I will further discuss how we use model optimization to fit the models to templates where expression regions are marked in spatial regions relating to confocal images, and how this is used to make model predictions for the molecular networks.