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New deep-learning based approaches for forest modeling beyond landscape scale

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In times of rapid global change, the ability to faithfully predict the development of vegetation on larger scales is of key relevance to society. However, ecosystem models that incorporate enough process understanding for being applicable under future and non-analog conditions are often restricted to finer spatial scales due to data and computational constraints. Recent breakthroughs in machine learning, particularly in the field of deep learning, allow bridging this scale mismatch by providing new means for analyzing data, e.g., in remote sensing, but also new modelling approaches. We here present a novel approach for Scaling Vegetation Dynamics (SVD) which uses a deep neural network for predicting large-scale vegetation development. In a first step, the network learns its representation of vegetation dynamics as a function of current vegetation state and environmental drivers from process-based models and empirical data. The trained model is then used within of a dynamic simulation on large spatial scales. In this contribution we introduce the conceptual approach of SVD and show results for example applications in Europe and the US. More broadly we discuss aspects of applying deep learning in the context of ecological modeling.