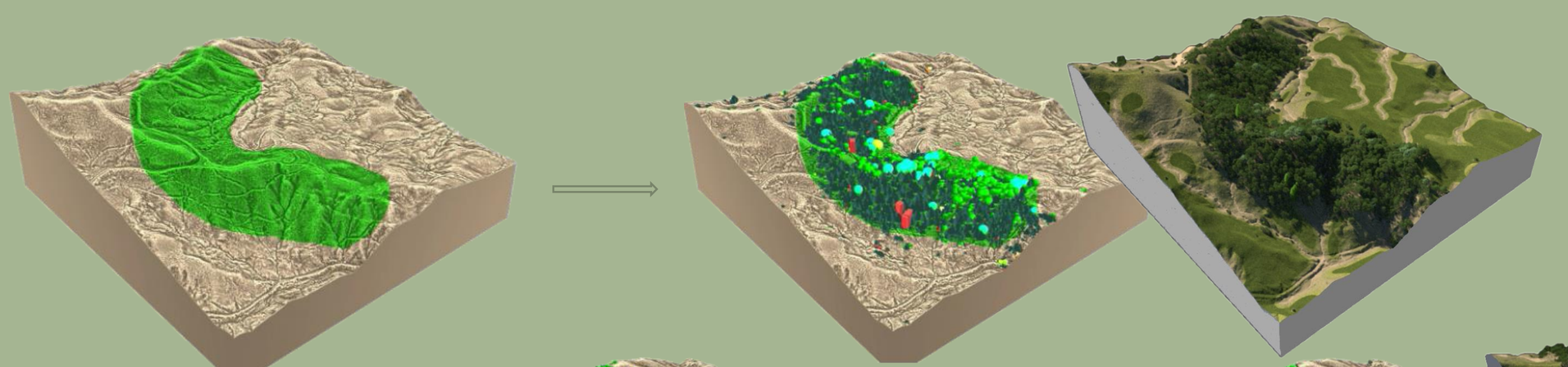
DATA-DRIVEN AUTHORING OF LARGE-SCALE ECOSYSTEMS

Problem Statement

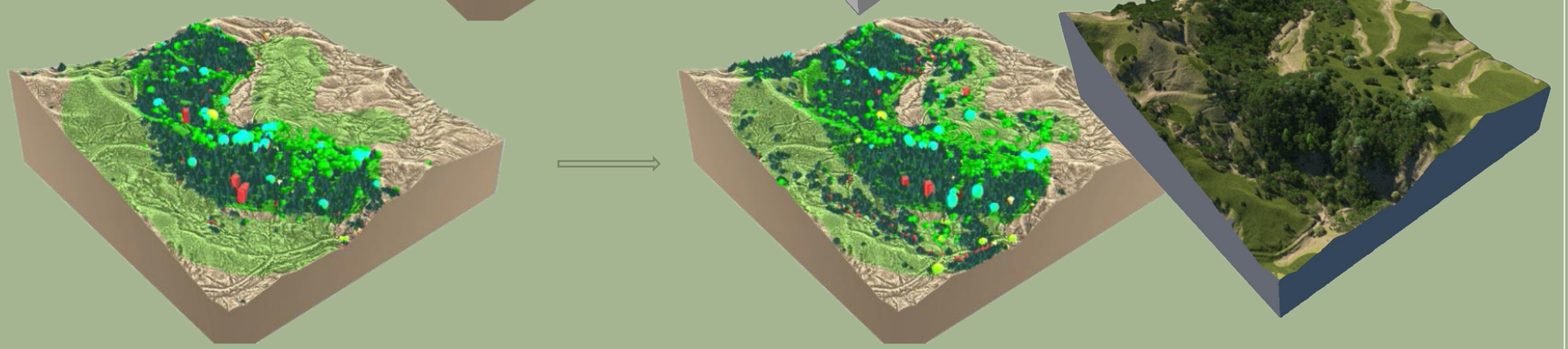
Current automated approaches for placing vegetation on virtual landscapes do not use real-world data on vegetation growth. Instead, they either rely on approximations of how vegetation grows, or purely on a user's specification, or on a combination of the two. In either case, the distribution of vegetation may diverge substantially from what is observed in nature, without a designer's knowledge.

Our Approach

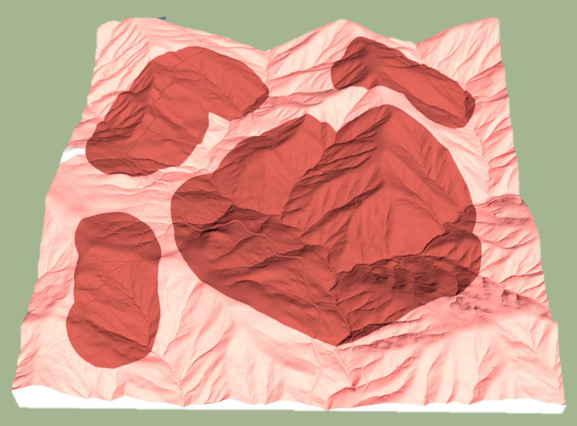
We use 2D raster data of tree stand canopies, known as canopy height models (CHMs), to learn distributions of how trees are spaced in nature. These distributions may then be used to synthesize tree locations on any given virtual landscape. The approach can be divided into two phases: a learning phase and a synthesis and user interaction phase. In the learning phase, a large amount of data is learnt by statistical and deep learning models. In the synthesis and user interaction phase, models from the learning phase, in conjunction with a sketch indicating regions where vegetation must occur on a landscape in the form of a digital elevation model (DEM), are used to determine exact tree positions on that landscape.

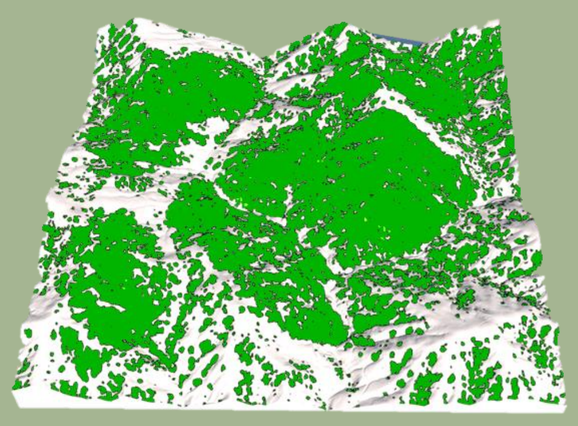


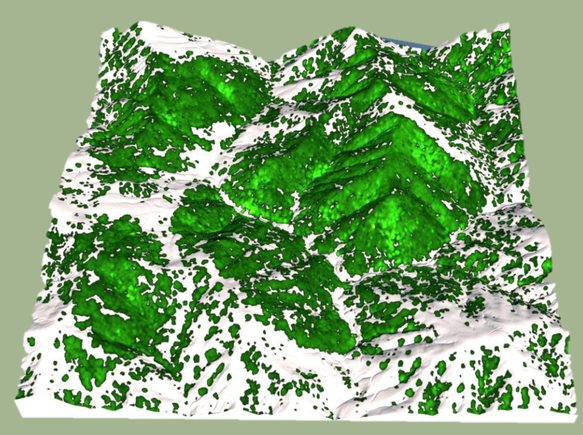
Designers can indicate with a sketch where dense or sparse tree growth should occur. The system automatically synthesizes plausible tree stands based on real-world data, corresponding to the sketch.



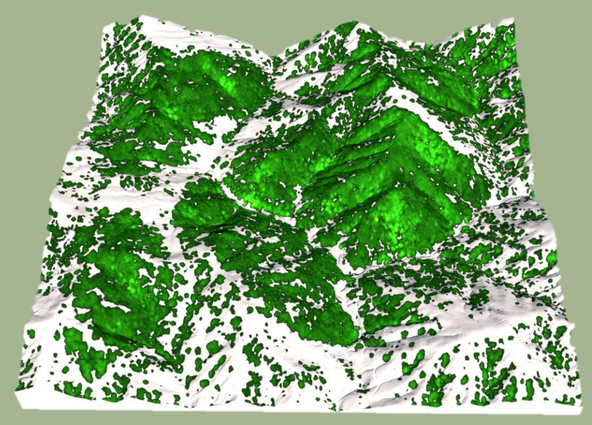
Our system supports iterative authoring, helped by very fast feedback times.

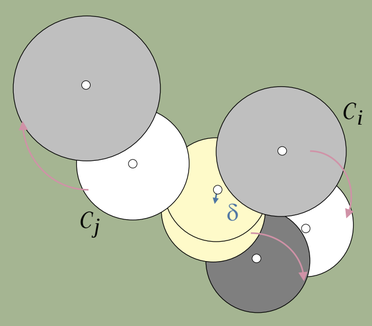


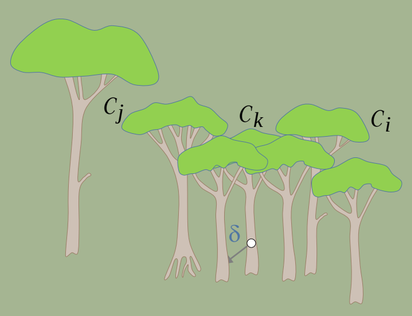




Two stacked conditional Generative Adversarial Networks (cGAN) learn from sketches and paired CFPs and CHMs. The cGANs effectively produce a CHM from a sketch. A CFP is simply a binary map indicating where vegetation occurs (middle image).







A CHM does not give us exact tree locations, but only possible tree heights. Using a tree spacing algorithm, based on trees' competition for light, we try to find feasible tree locations from the CHM.

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