Project Database of ICP Forests

PROJECT DESCRIPTION

PROJECT INFORMATION

Project title:	**The development of the Machine Learning Forest Growth Simulator (MLFS)**
Project ID:	241
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Forests are complex ecosystems governed by ontogenetic and external environmental factors, with different forest communities exhibiting different dynamics and interactions with environmental factors. Understanding such complex systems is difficult but important for determining the future state of global forests, including their role in mitigating climate change and meeting the needs of human society. Forest models are among the most sophisticated tools for understanding and predicting forest dynamics. To date, numerous forest models have been developed based on a variety of statistical approaches, ranging from relatively simple yield tables to state-space models to size-class models and the single or single-tree forest models most commonly used in recent decades. Single-tree models are increasingly becoming the gold standard for modelling forest dynamics. In recent decades, mixed forests are preferred almost everywhere on earth, which increases the need for developing single-tree forest models. Pretzsch et al. (2015) listed more than 50 existing forest growth models, some of the most commonly used models being TASS, SILVA, PROGNAUS (CALDIS), ORGANON, MOSES, MASIMO and BWIN-Pro. Some of the main limitations of these models are 1) the need for parameterization, 2) inability of applying the model in areas with different forest characteristics, and 3) fixed input requirements.

Therefore, we propose the development of a new forest development model based on the principle of machine learning - learning from data - which can overcome the need for parameterization. The machine learning forest development model (MLFS) will be an age-independent model and will require data from at least two inventory periods, which will then be used in the algorithms to train sub-models for simulating four important forest processes: 1) basal area increment (BAI), 2) height increment and crown recession, 3) mortality, and 4) ingrowth and regeneration. In addition, the MLFS will allow different harvesting scenarios where the user can specify the amount of biomass harvested per species and plot.

The aim of our project is therefore to develop the machine-learning forest growth simulator (MLFS), a completely new approach to modelling forest development based on the principle of learning from data and therefore overcoming the need for model parameterisation. We expect that the new model should be more accurate due to the use of machine learning algorithms, which are known to have high predictive power. To evaluate the performance of the large-scale model, we would like to use the ICP Forests data that meet all the requirements needed for the MLFS model. In addition to MLFS, we will also test the performance of the model at the local scale using the Slovenian national forest inventory data.