



# A method for generating leaf-covers for tree structure models

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# Background

- A tree present in terrestrial laser scanning data (TLS) can be reconstructed as quantitative structure models (QSMs)
- Needles and especially broad-leaves are considered as nuisance for reconstruction
- One possibility is to scan leaf-off and generate a similar leaf-cover afterwards





# The method: QSM-FaNNI

- *Foliage and Needles Naïve Insertion* -algorithm
- MATLAB package that operates on a QSM
- User selects leaf basis shape, property distributions and total leaf area
- Candidate leaves are generated (intersecting)
- Intersections are prevented by altering candidate properties
  - Leaf candidates can be discarded
- The result is a collection of accepted leaf parameters

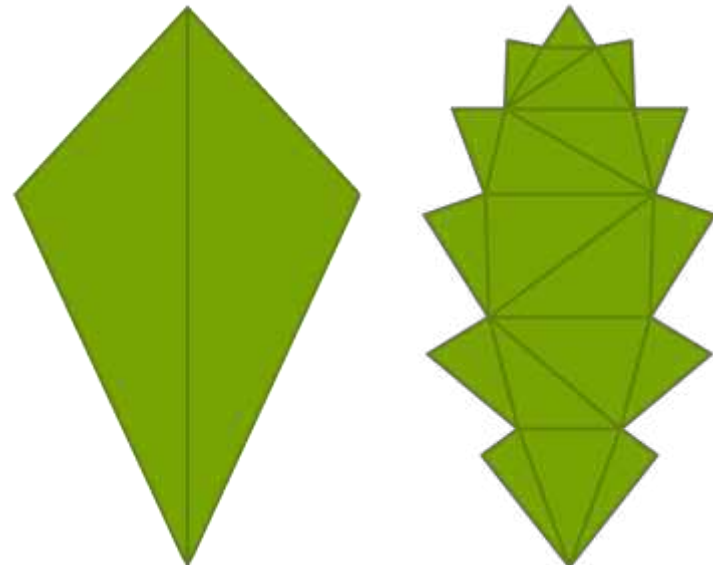




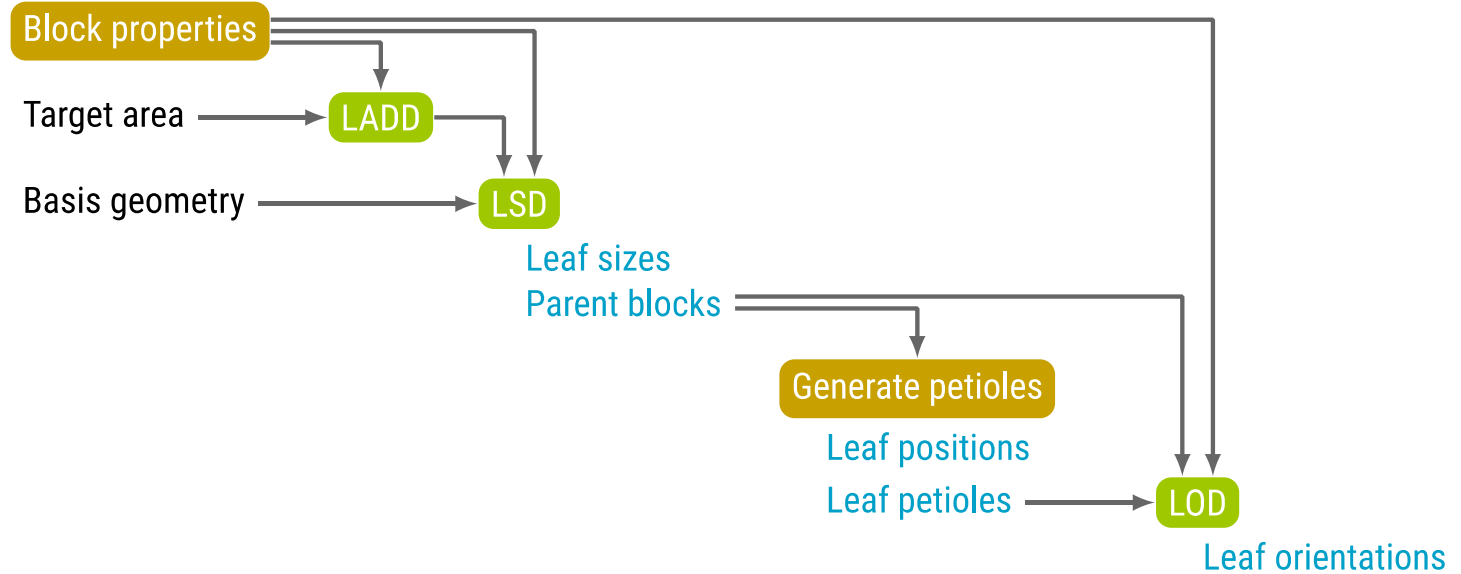
# Process overview

User-definable:

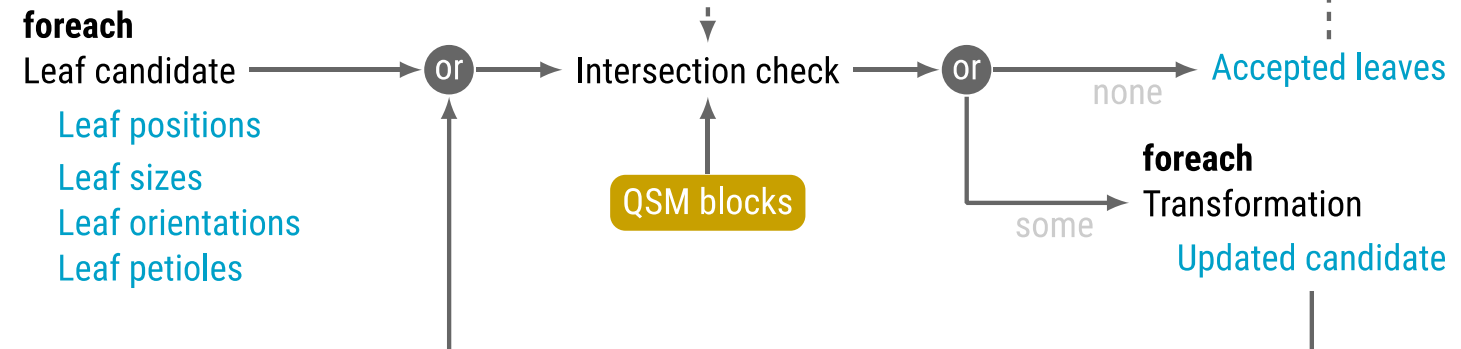
- Leaf shape
- Leaf size
- Leaf orientation
- Leaf position
- Petiole size and orientation



## I. CANDIDATE GENERATION

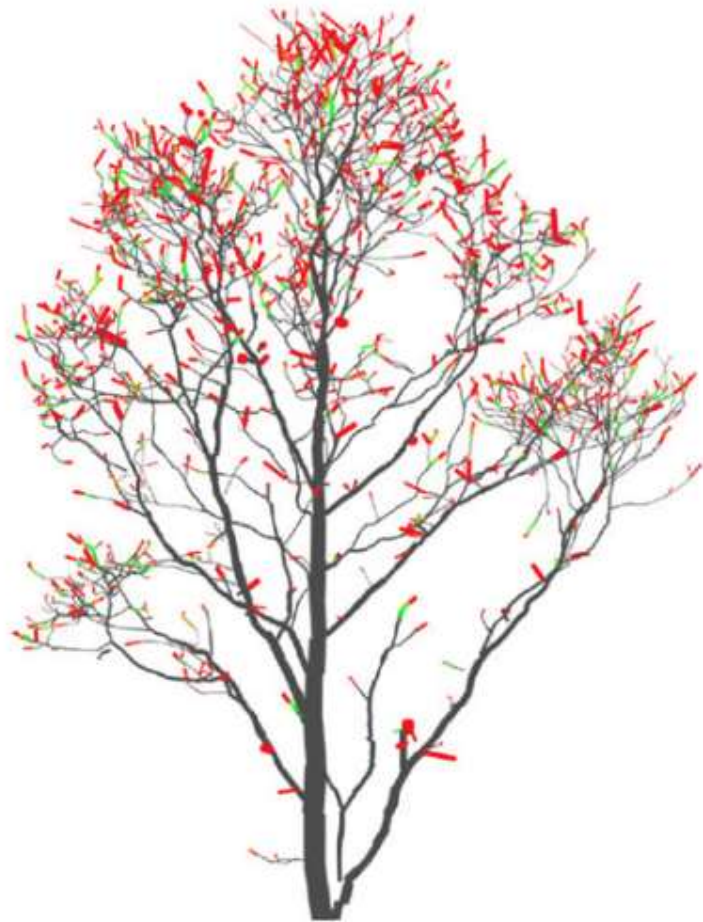


## II. ACCEPTING CANDIDATES

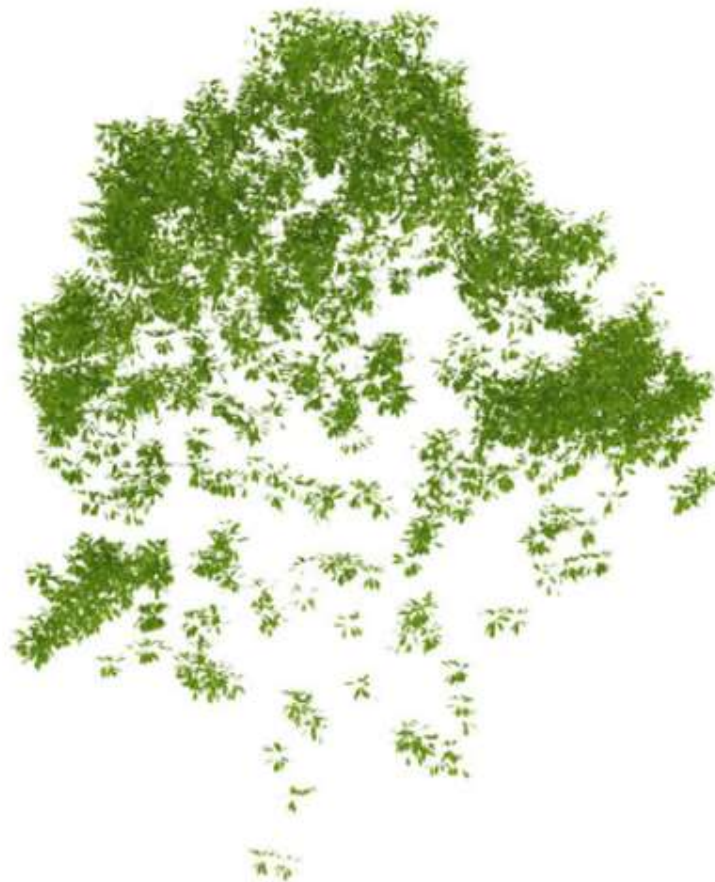




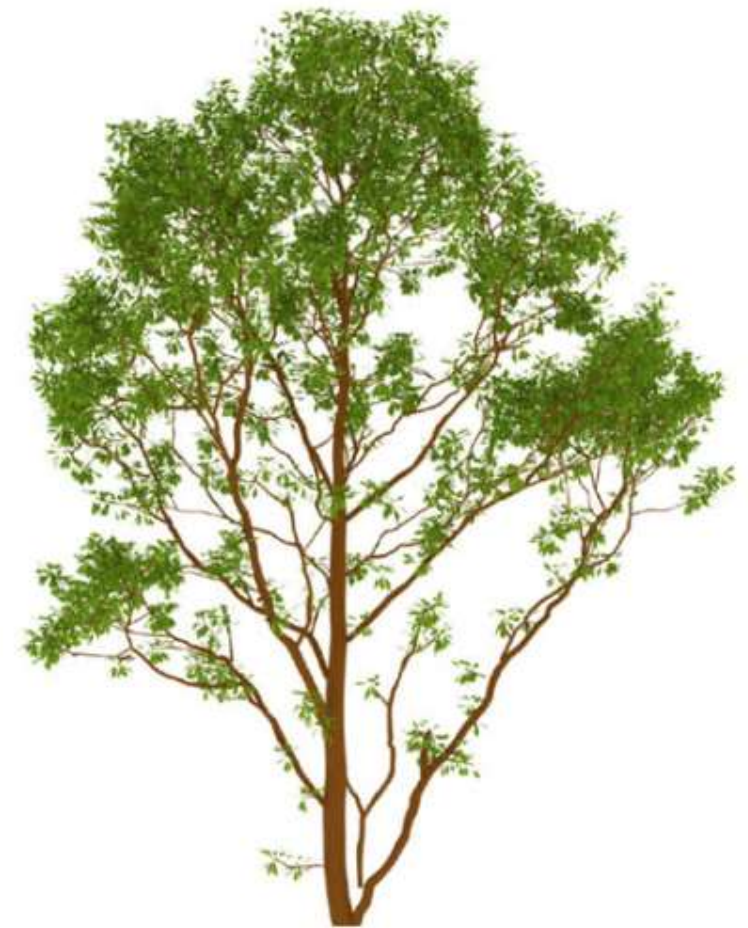
# Results



Distribution



Leaves



QSM + Leaves



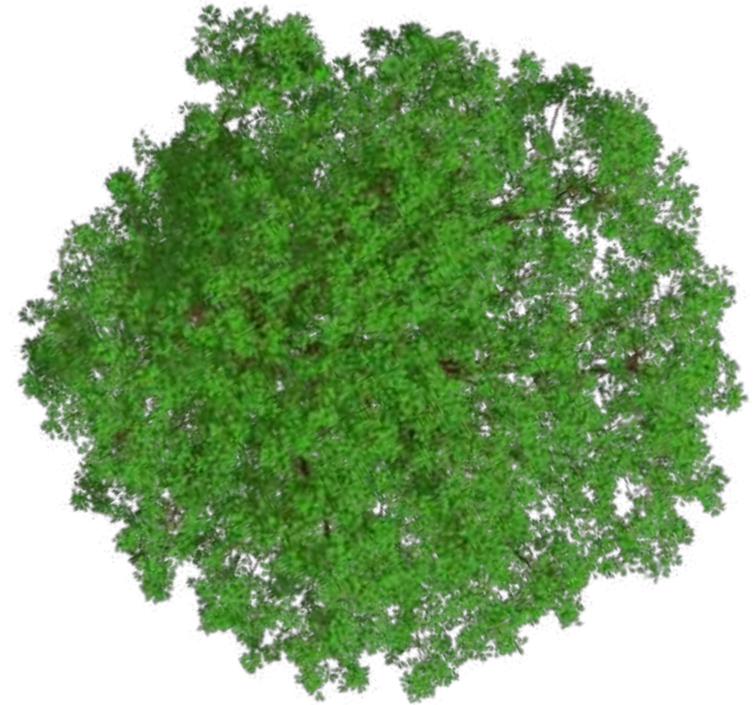


# Results

- Allows simulations involving **real** trees with leaves
  - Step towards growth and interaction prediction
- First paper to use the method:

Realistic Forest Stand Reconstruction from Terrestrial LiDAR for Radiative Transfer Modelling. 2018. Calders, K., Origo, N., Burt, A., Disney, M., Nightingale, J., Raunonen, P., Åkerblom, M., Malhi, Y. & Lewis, P. *In Remote Sensing*, 10(933).

- Second paper has been submitted





# Open-source

- TreeQSM

- Tree reconstruction from TLS data
- MATLAB package
- `github.com/InverseTampere/TreeQSM`

- QSM-FaNNI

- Leaf-cover generation for QSMs
- MATLAB package
- `https://github.com/InverseTampere/qsm-fanni-matlab`

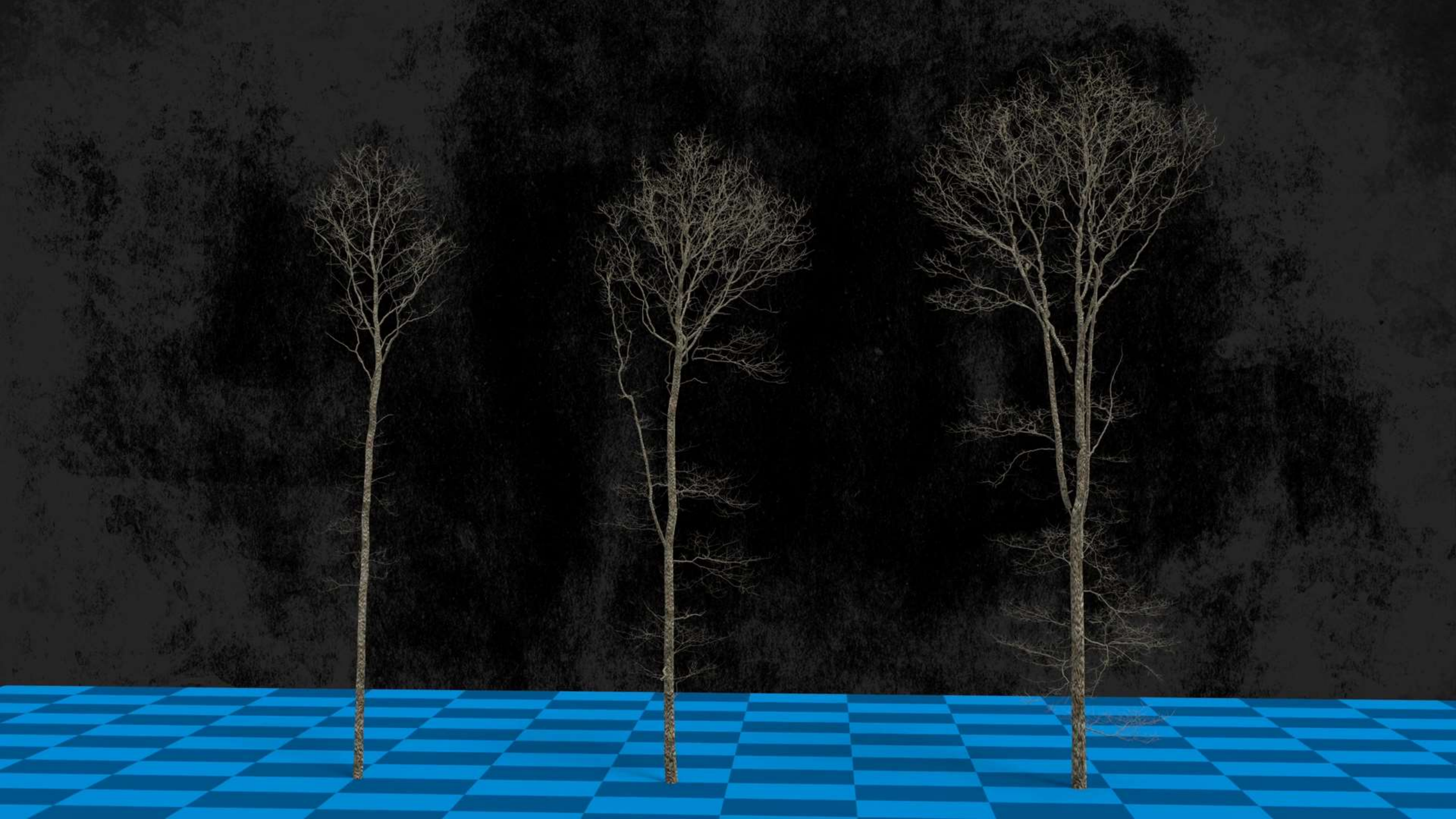




# Conclusion

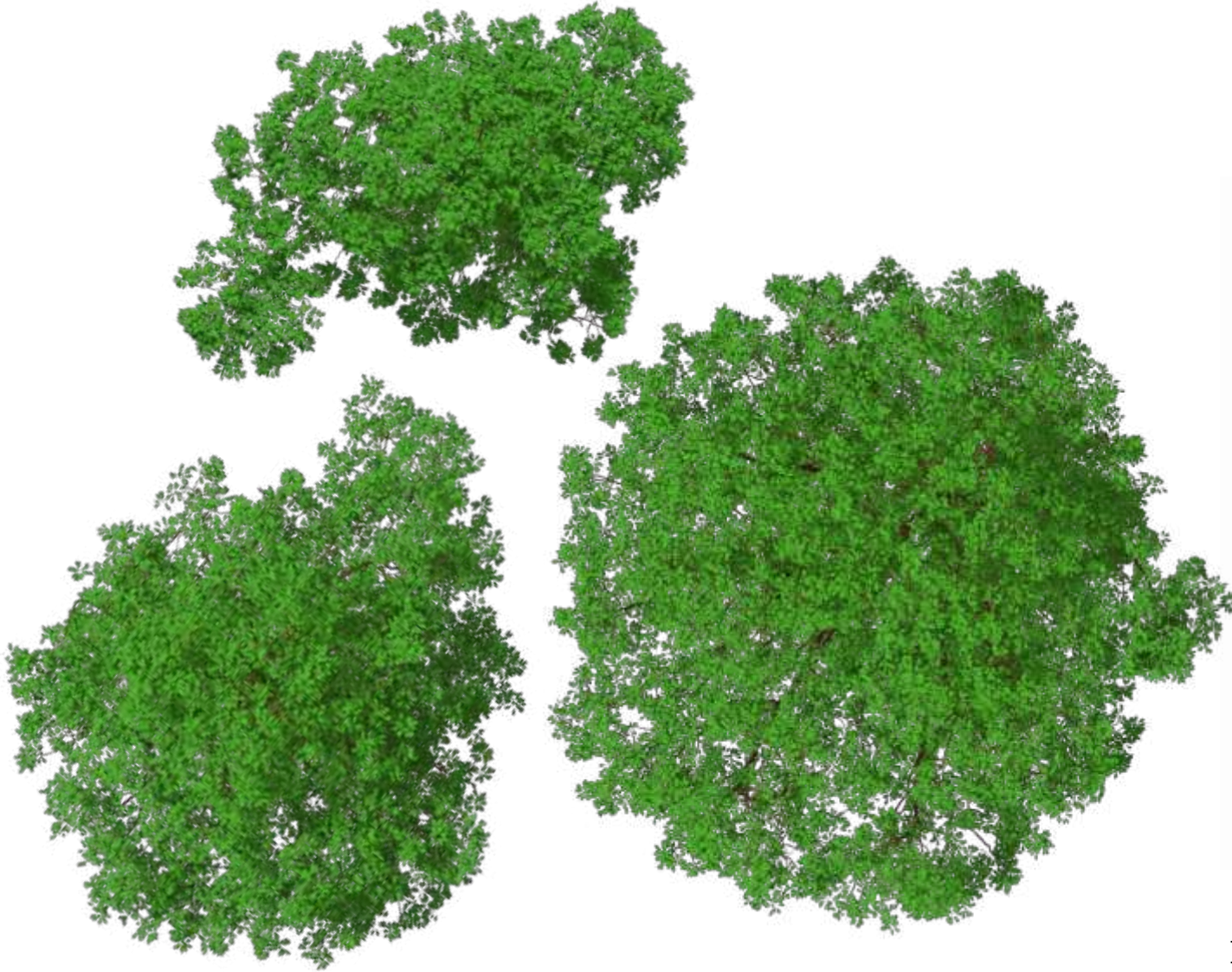
- What is the focus of your research and why is it important for climate, bioeconomy or people?
  - We develop tools for forest measurements and simulations. The presented leaf generation method is designed to enable more accurate tree and forest simulation studies.
- Did your research identify key challenges (threats or risks) to maintain the critical values of boreal and mountain ecosystems?
  - Better understanding of trees can improve our understanding of natural carbon cycle in forests. Possibility to include realistic leaf or needle cover in real reconstructed tree models is an important development step in tree and forest simulations.
- What would be your suggestion to address these challenges?
  - Reconstructed tree models with generated leaves are first steps towards comprehensive tree simulations. Next steps will be to include functional models and growth, but the process has to start with including leaves.







# Thank you



Watch a video of the method:  
[youtube.com/watch?v=urPDwcEf02A](https://youtube.com/watch?v=urPDwcEf02A)

