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A generalized radar scattering model for multispecies forests with multilayer subsurface soil

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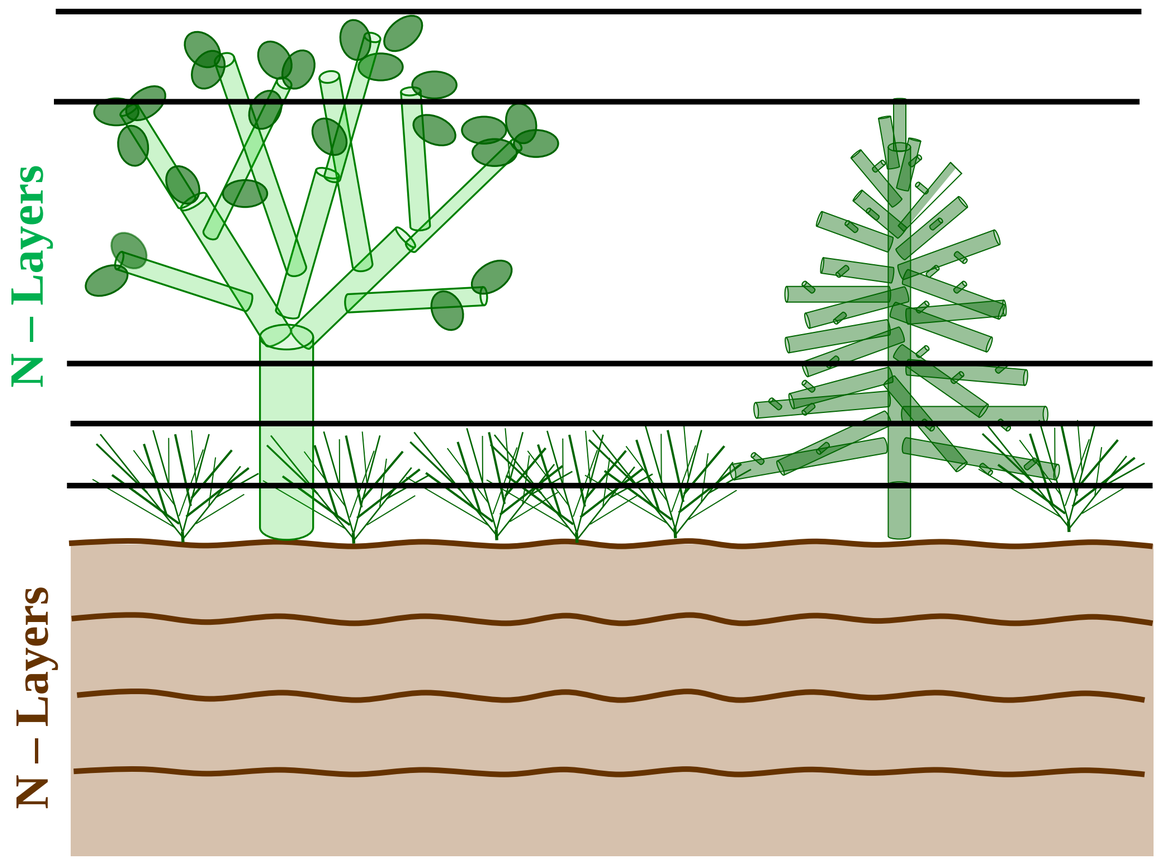
Objectives

Understand the relationship between radar measurement and properties for vegetation and soil to allow the estimation of both vegetation and soil information from radar data:

- Implement a multispecies vegetation model capable of accurately capturing different tree species and growth stages.
- Implement a multilayered soil scattering model to account for direct ground scattering from realistic soils with multiple layers of various textures, depths and moisture contents.
- Include the coherent interaction between the vegetation and layered ground.



Generalized radar backscattering model for forests

Develop uniform-ground multispecies vegetation model as an improvement over the uniform-ground single-species model by Durden et al. [Burgin et al., 2011]

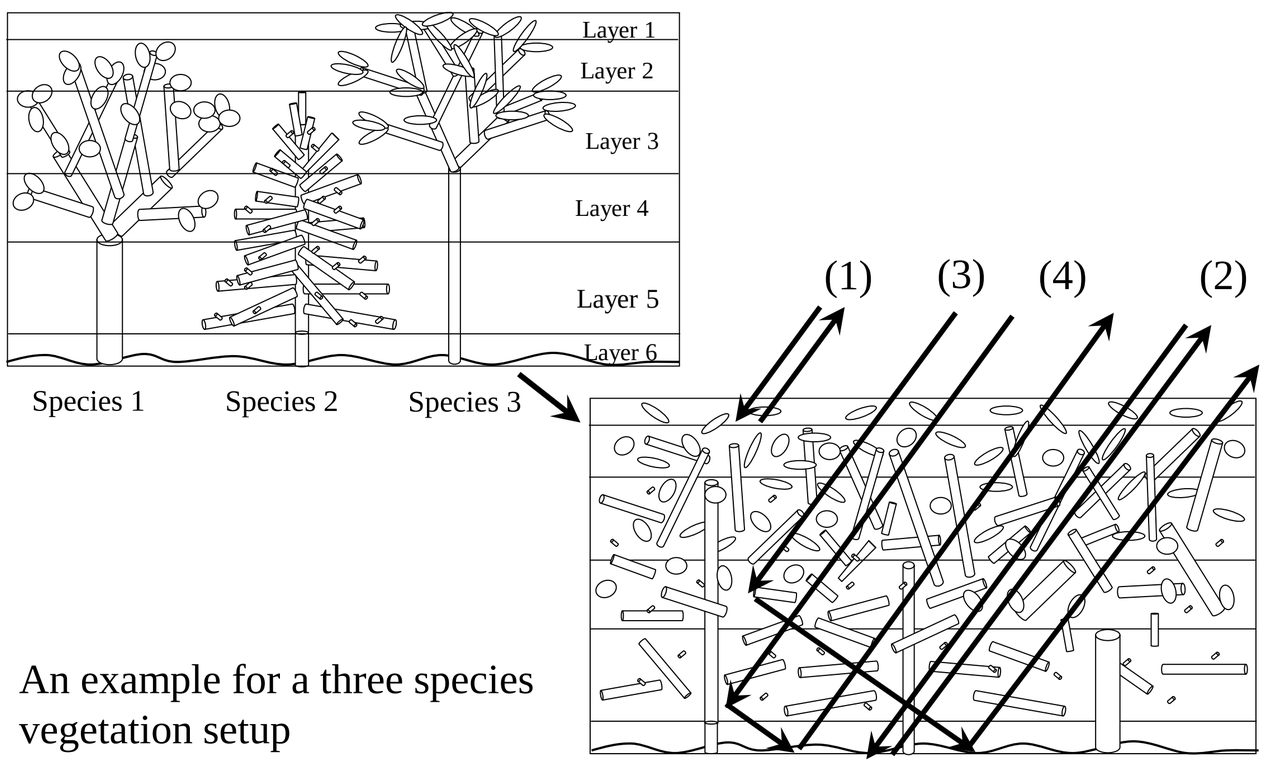
- Compute polarimetric backscattering coefficients of an arbitrary multiple species forest based on geometry and dielectric properties. Model
  - trunk layers as a distribution of tall cylinders
  - crown layers as a distribution of randomly oriented cylinders representing branches
  - leaves or needles as thin disks or cylinders
- Four scattering mechanisms are incorporated:
  - Direct backscattering from each of the crown layers (1)
  - Direct backscattering from the ground (2)
  - Specular crown scattering with ground reflection (3)
  - Specular trunk scattering with ground reflection (4)

Generalized radar scattering model with multilayer soil

Each soil layer can be uniquely defined by a specific soil type, layer depth, and soil moisture allowing a realistic soil moisture profile.

• Using the small perturbation method, implement direct ground scattering from a three-dimensional layered dielectric structure with slightly rough interfaces. [Tabatabaeenejad et al., 2006]

• Using Kirchhoff approximation, implement the coherent interactions between trunk-ground and canopy-ground by deriving a new reflection coefficient for a two-layer rough surface structure with small slopes. [Tabatabaeenejad et al., in review]



An example for a three species vegetation setup

Discussion & Future Work

A generalized model for multispecies forest on top of a multilayered soil is developed

- Modularity allows flexibly incorporating specific combinations of forest species and soil layers
- Model can simulate backscattering coefficients based on geometric & dielectric input variables of forest canopies and soil layers
- Future work includes adapting the generalized model to include topography

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