Overview EU-scale models and existing efforts

Report from Break-out group 4

TG4 in FORMASAM: Forest management at the European scale

- **Objective 7 (O7):** To foster exchange and discussion among modellers how different management practices are implemented in European-scale forest models.

- **Objective 8 (O8):** To translate the overall management scenarios developed in TG1 into concrete management settings for European-scale models.
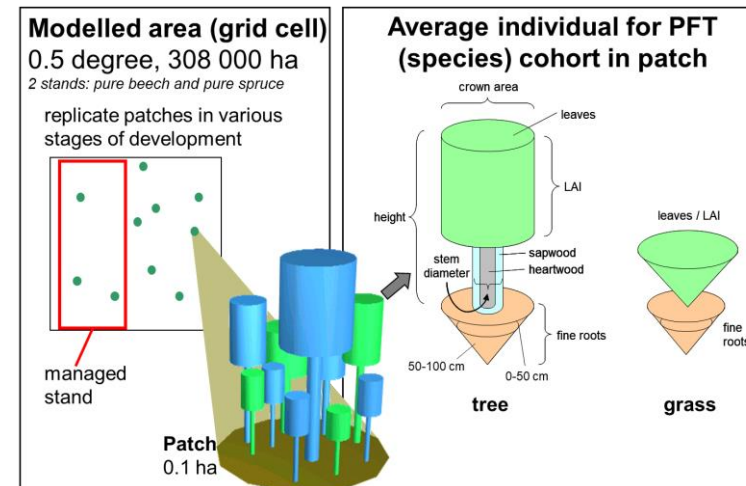
Models

- ORCHIDEE-CN-CAN
- LPJ-GUESS
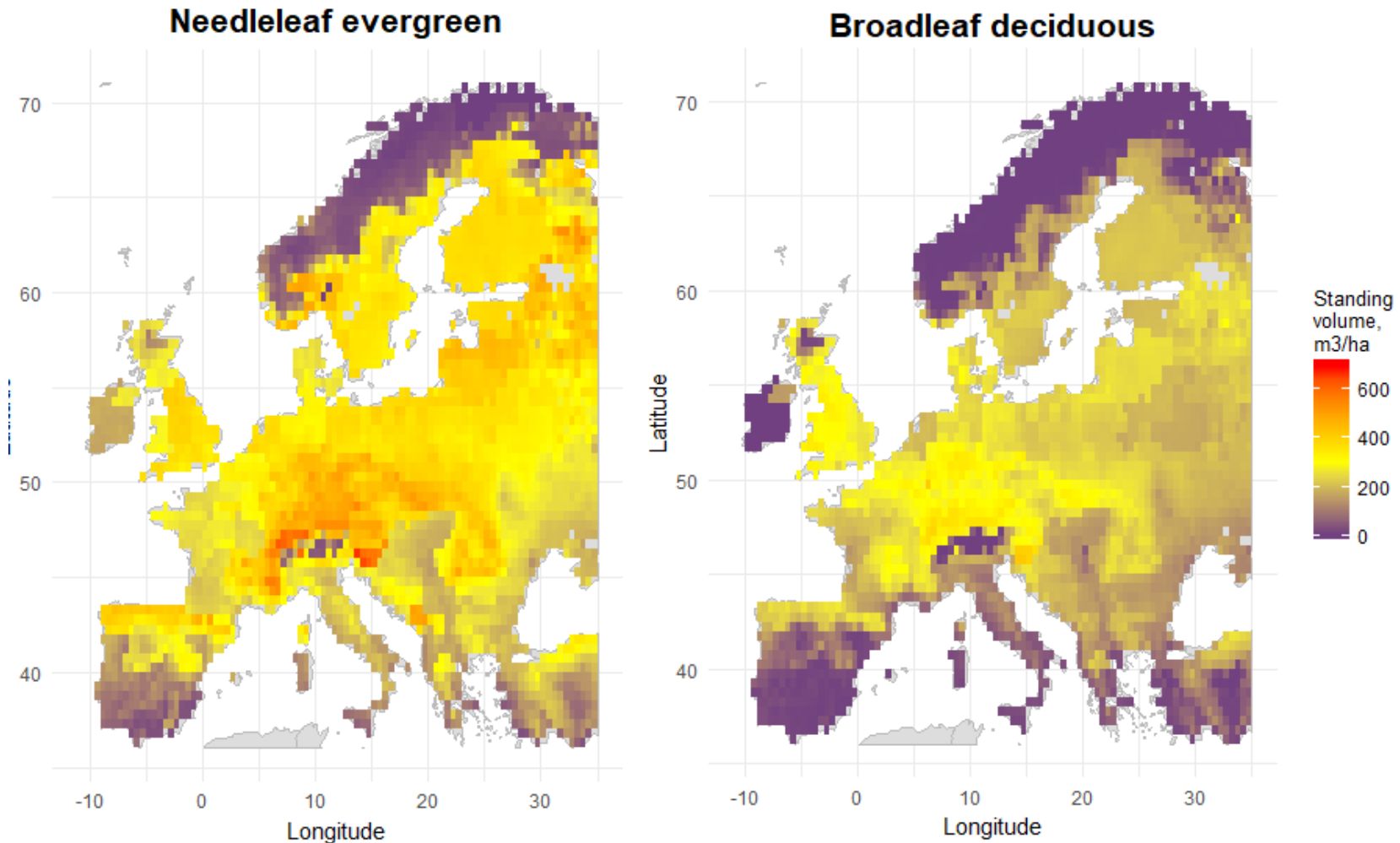- EFISCEN
- EFISCEN-space

LPJ-GUESS Dynamic Global Vegetation Model
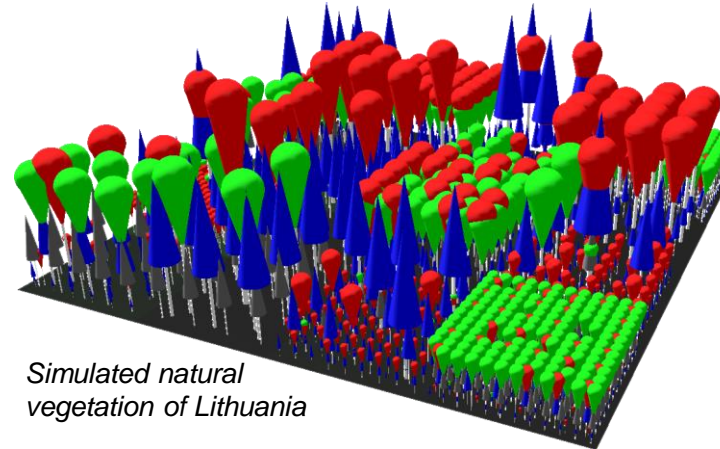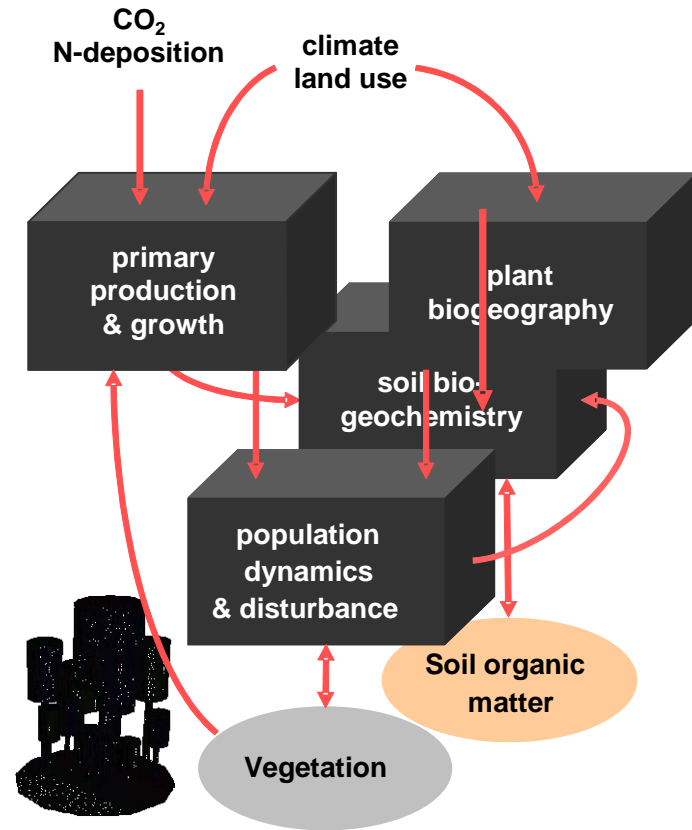
Simulated natural vegetation of Lithuania

Standing volume across Europe for managed forests
simulated by LPJ-GUESS for 2010 based on observed age structure

Needleleaf evergreen · Broadleaf deciduous · Standing volume, m3/ha

ORCHIDEE-CN-CAN

- Land surface component of the IPSL earth system model
- Fully coupled nitrogen cycle
- Dynamic canopy structure
  - Multi-layer canopy
  - Age classes introduced for each PFT, and diameter classes introduced for each Age class
  - The distribution of trees follows a Poison distribution, allowing for calculations of light penetration within the canopy
  - At each canopy layer the model can simulate: dynamic LAI, albedo, photosynthesis, water stress (using hydraulic architecture) and energy budget (including leaf temperature)

EFISCEN

- Large-scale forest resource model (area, growing stock and increment, structured by tree species and age-class)

- Empirical model, based on inventory data

- European-wide applicable (currently 38 countries)

- Particularly suitable for even-aged forests

- Provides scenario projections up to 50-60 (100) years

- EFISCEN logics
  - The state of the forest at a certain time is depicted by matrices as a distribution of area over age- and volume classes
  - Processes (increment, mortality, thinning, final felling, regeneration) are simulated by transitions between matrix cells)

EFISCEN-space

- Spatially explicit
- As much as possible empirically based, more detailed than EFISCEN
- Initialised using NFI plots
- Includes also mixed forests, uneven-aged, unmanaged, at the European scale
- State of the forest modelled using distributions of 20 species (groups) over diameter classes

Questions to the modellers

1. How is management and harvesting simulated?
2. What types of management does your model simulate?
3. Does your model simulate PFTs or species? Which ones?
4. What are simulated adaptation strategies? Do you simulate increased species mixture? Do you simulate exotic/southern species?
5. How is regeneration simulated in your model? Are the same species growing back?
6. Most important: How ready is your model? What are the issues?

1) How is management and harvesting simulated?

- ORCHIDEE-CN-CAN: Trees are not explicitly simulated instead there is a pool of carbon from photosynthesis, the number of trees and diameter of each diameter class are prescribed, carbon is distributed to these trees; Management based on Rdi (relative density index) and increment; set target Rdi to which is thinned;

- LPJ-GUESS: cmass of specific cohorts is reduced by a certain percentage depending on age of the cohort and PFT/species

- EFISCEN: harvesting: only thinning and final fellings are possible; "theoretical" management regimes determine the maximum amount of wood that can be harvested, management: includes also regeneration/species changes

- EFISCEN-space: removal of trees from diameter classes, currently based on observed probabilities, in future depending on using decision rules (thinning from above, below targeting certain species)

2) What types of management does your model simulate?

- ORCHIDEE-CN-CAN: frequent thinning, cutting, coppicing, fast coppice rotation; goal to implement: continuous forest cover, adaptive forest management, mixed forest

- LPJ-GUESS: harvesting options are clear cut or thinning, selective cuttings; rotation time is fixed with clear cut at the end or continuous cover;

- EFISCEN: thinning and final fellings, coppice

- EFISCEN-space: removal of trees

3) Does your model simulate PFTs or species? Which ones?

- ORCHIDEE-CN-CAN: both, PFTs and species (8 PFTs & 55 forest entities from 9 species, 2 biomes, 4 age classes + residual species)

- LPJ-GUESS: both, PFTs and species (still working on species parameterization)

- EFISCEN: particularly suitable for even-aged forests, amount of tree species simulated depends on what is available from NFI data

- EFISCEN-space: mixed forests, depends on what is available from data

→ All four models can represent typical species and their distribution across Europe.

4) What are simulated adaptation strategies? Do you simulate increased species mixture? Do you simulate exotic/southern species?

- ORCHIDEE-CN-CAN: following a clear-cut or a natural disturbance, species and management can be changed; no mixed forest, but plan to introduce multi-stratified forest; as a global model, ORCHIDEE can simulate exotic/southern species

- LPJ-GUESS: after management scheme PNV can reestablish

- EFISCEN: no mixed forests

- EFISCEN-space: species mixing only if it exists in the country

5) How is regeneration simulated? Are the same species growing back?

- ORCHIDEE-CN-CAN: canopy openness is used to calculate seed survival; otherwise trees are replanted.

- LPJ-GUESS: regeneration from bare ground/clearcut can either be planted or naturally; species in natural regeneration are determined based on climatic limits.

- EFISCEN: after final felling, forest area is entering the same matrix or another matrix, this is user-defined. Species depend on what is available from data.

- EFISCEN-space: still to be implemented, adding trees to the lowest diameter class

6) How ready is your model? What are the issues?

- ORCHIDEE-CN-CAN: no mixed forests, no continuous cover forestry and coppice with standards, no abrupt mortality from insects (but will be implemented from LandClim; fire, storm, drought is there); resilience based optimum scenario

- LPJ-GUESS: management options in place, setup for European management runs still ongoing, implementation of disturbances under development

- EFISCEN: running

- EFISCEN-space: under development, more possibilities for different simulations and to be applied to different questions

What information do we need from scenarios?

Step 1: Simulate silvicultural systems across Europe. Use table from FORMIT that Annikki presented with different parameters to set up our models. This is what happens currently = baseline.

Step 2: We need to know what could change in the future? How will these silvicultural systems change? What are the objectives? Very clear storyline description.