FORest MAnagement Scenarios for Adaptation and Mitigation: Managing at the landscape scale

TG 3 – landscape models

University of Natural Resources and Life Sciences, Vienna
Department of Forest and Soil Sciences

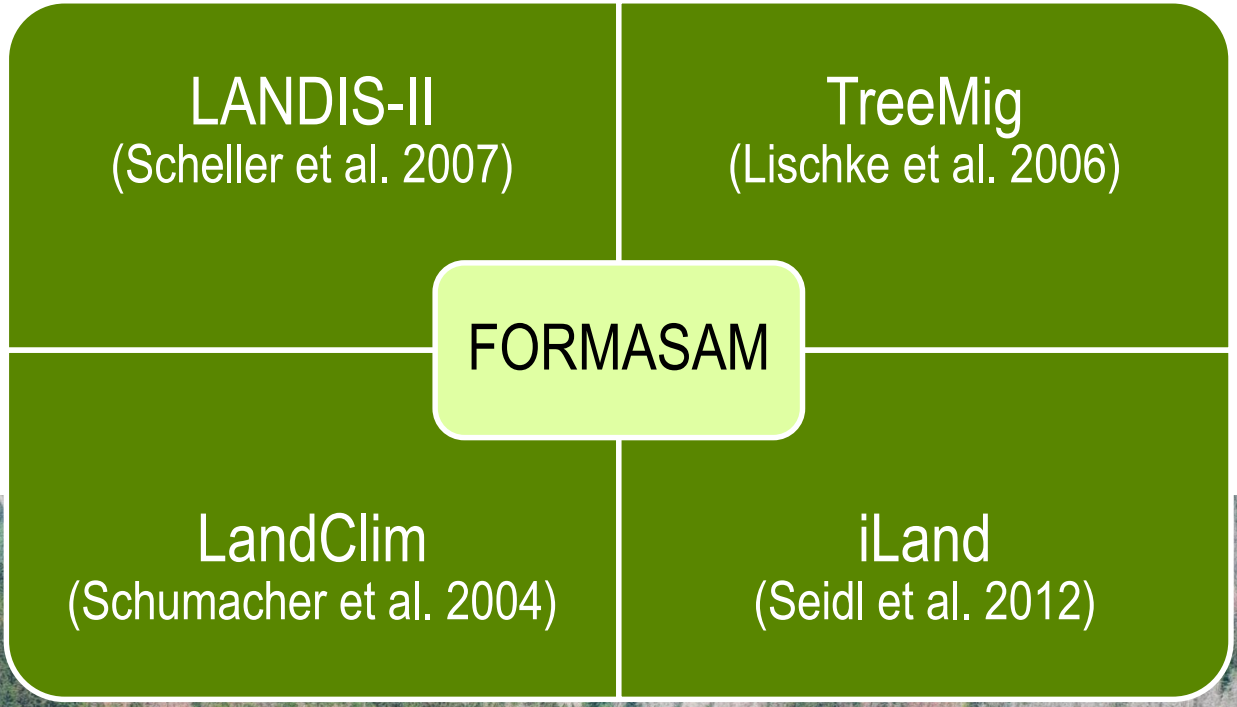
What the FORMASAM grant agreement says

“Many issues of crucial importance for climate change mitigation and adaptation pertain to spatial scales beyond the stand scale. […]

Considerations of disturbance and scale are the core domain of landscape modeling. […]

The ability of these landscape models to capture the complexity of current and future management in Europe’s forest landscapes has not been consistently assessed to date. […]”

The FORMASAM landscape models



Focus within FORMASAM TG3

Focus within TG3: Species diversity

New Phytologist

Review

Tansley review

Diversity and forest productivity in a changing climate

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Focus within TG3: Species diversity

SCIENTIFIC REPORTS

OPEN

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Diversity and carbon storage across the tropical forest biome

Martin J. P. Sullivan[1,*], Joey Talbot[1,*], Simon L. Lewis[1,2,*], Oliver L. Phillips[1,*], Lan Qie[1], Serge K. Begne[1,3], Jerôme Chave[4], Aida Cuni-Sanchez[2], Wannes Hubau[1], Gabriela Lopez-Gonzalez[1], Lera Miles[5], Abel Monteagudo-Mendoza[6,7], Bonaventure Sonké[3], Terry Sunderland[8,9], Hans ter Steege[10,11], Lee J. T. White[12,13,14], Kofi Affum-Baffoe[15], Shin-ichiro Aiba[16], Everton Cristo de. Almeida[17], Edmar Almeida de Oliveira[18], Patricia Alvarez-Loayza[19], Esteban Álvarez Dávila[20], Ana Andrade[21], Luiz E. O. C. Aragão[22], Peter Ashton[23], Gerardo A. Aymard C.[24], Timothy R. Baker[1], Michael Balinga[25], Lindsay F. Banin[26], Christopher Baraloto[27], Jean-Francois Bastin[28,29], Nicholas Berry[30], Jan Bogaert[31], Damien Bonal[32], Frans Bongers[33], Roel Brienen[1], José Luís C. Camargo[34], Carlos Cerón[35],

Focus within TG3: Species diversity

Oecologia (2015) 177:619–630
DOI 10.1007/s00442-014-3150-0

HIGHLIGHTED STUDENT RESEARCH

Tree species diversity mitigates disturbance impacts on the forest carbon cycle

Mariana Silva Pedro · Werner Rammer · Rupert Seidl

Idea

- Increasing tree species diversity is an important strategy to:
  - decrease climate change impacts
  - increase resilience of forest ecosystems

- Most analyses to date focus on stand-level diversity (alpha diversity)
- An alternative option: increase diversity at the landscape-level, i.e. the diversity in tree species between stands (beta diversity)
- Here we compare the effects of alpha and beta diversity under different scenarios of climate change

What we achieved so far

Study design (I)

- Two landscapes with ~ 1000 ha
  - Dischma (CH)
  - Rosalia (AT)

- Four forest landscape models
  - LandClim
  - iLand
  - LANDIS II
  - TreeMig

Study design (II)

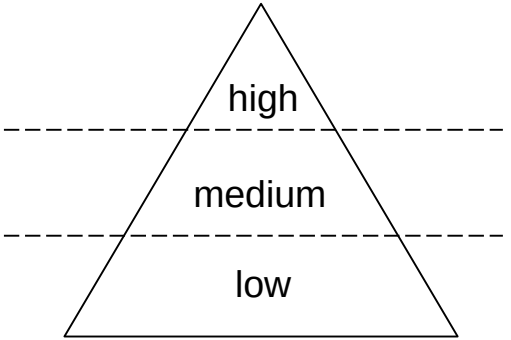
- Three management strategies
  - maximize alpha diversity on the stand level
  - maximize beta diversity on the landscape level
  - provide the most productive tree species all over the landscape
- Three climate conditions
  - historic climate
  - climate change RCP45
  - climate change RCP85
- Three disturbance scenarios
  - no disturbances
  - historic frequency and size
  - future frequency and size

Implementation

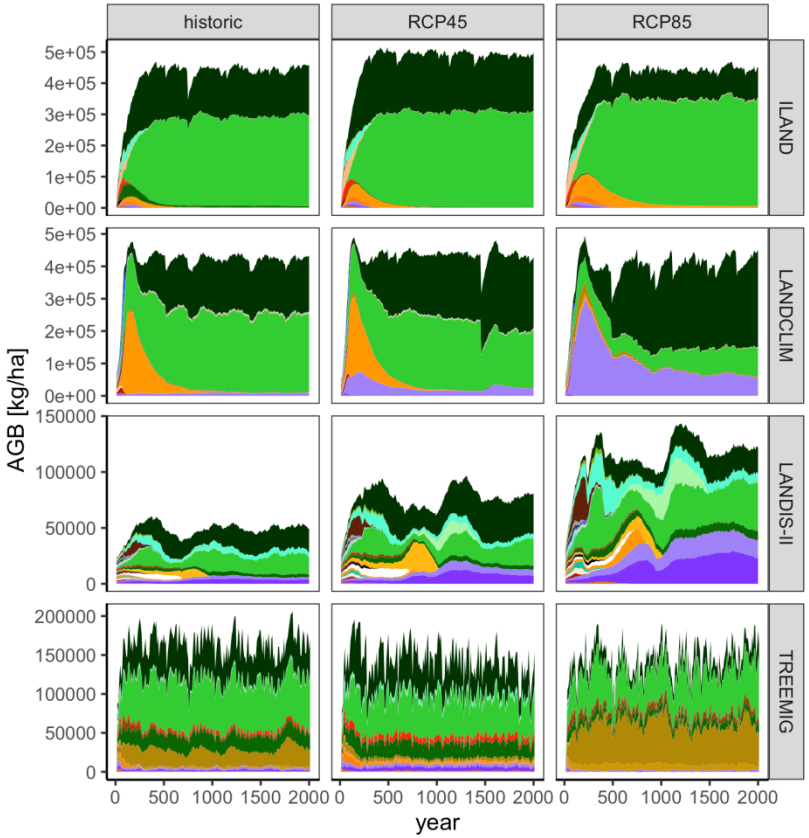
- Generic landscape setup
  - 1 ha stands in grid form
  - normal forest age class distribution (no skewness)
- Disturbances prescribed for all models
  - every model simulates the same sequence of disturbances
  - impact varies between models
- Simple age-class forest management
  - 2 thinnings
  - clear-cut at the end of the rotation period
  - Rotation period 100 years in Rosalia, 150 years in Dischma

Which species to choose?

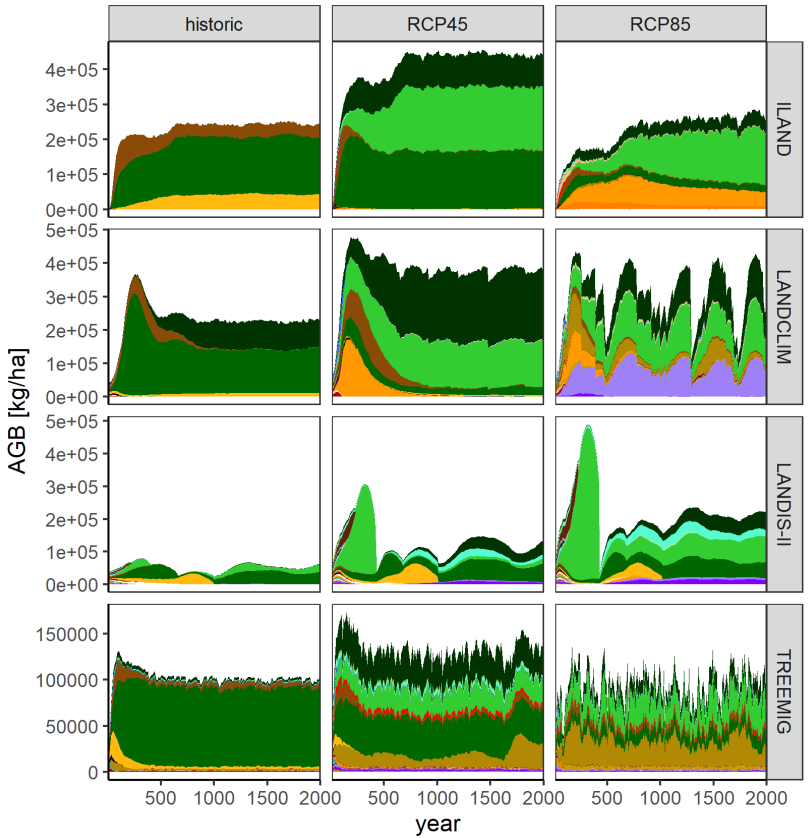
- Divide both landscapes in elevational belts
  - Dischma: < 1,900 m, 1,900 – 2250, > 2,250 m
  - Rosalia: < 600 m, >= 600 m
- PNV runs from bare ground
  - all four models
  - 2,000 years
- Derive species pools
  - for every elevational belt in both landscapes
  - tree species that have more than 20 % biomass at any point during the 2000 years



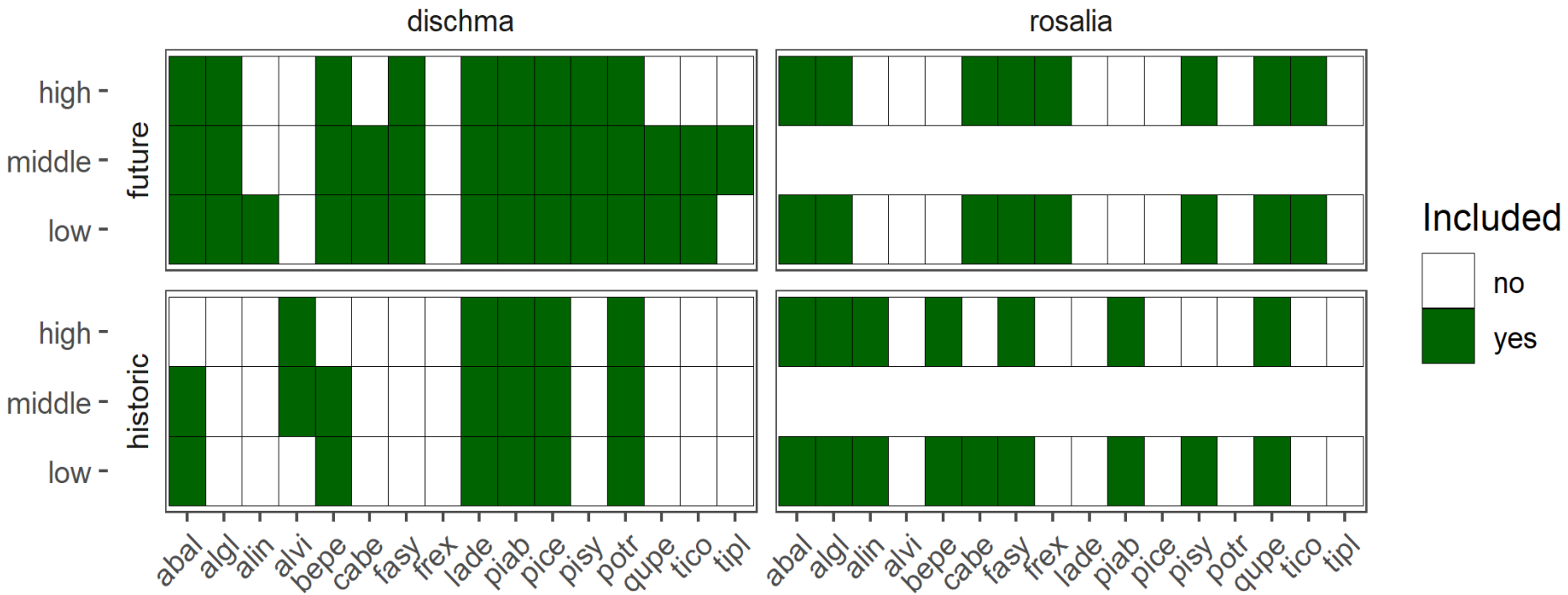
PNV ROSALIA



PNV DISCHMA

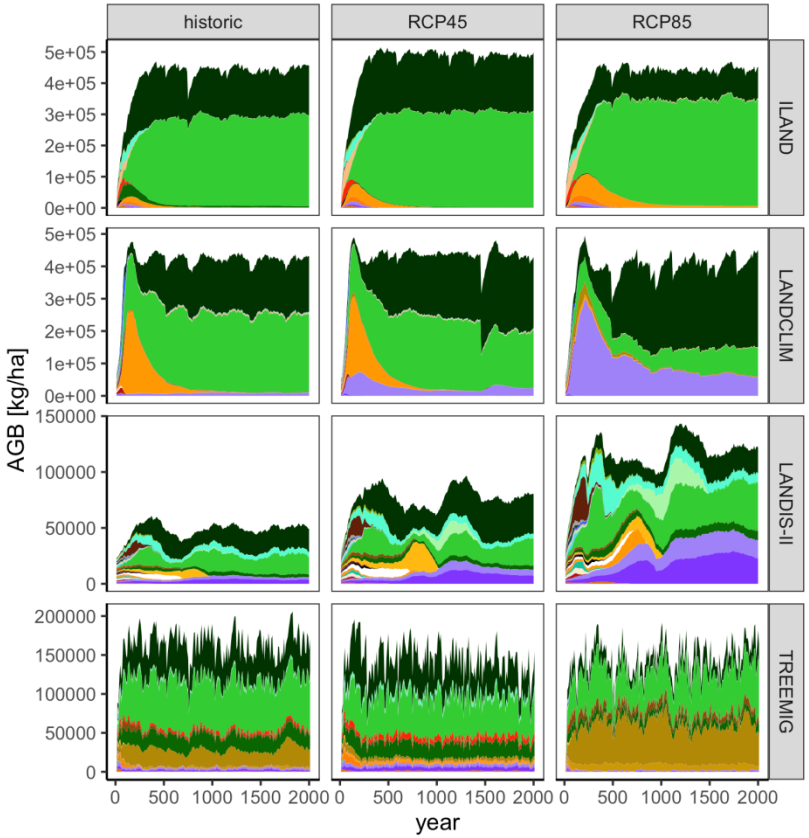


Species pools



Stumbling blocks

PNV ROSALIA



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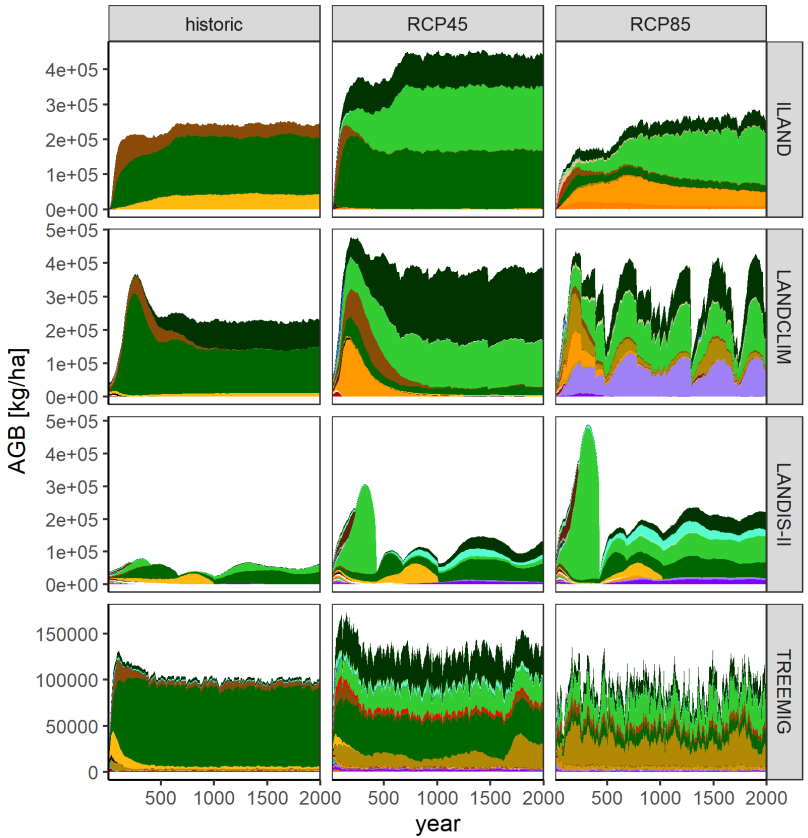

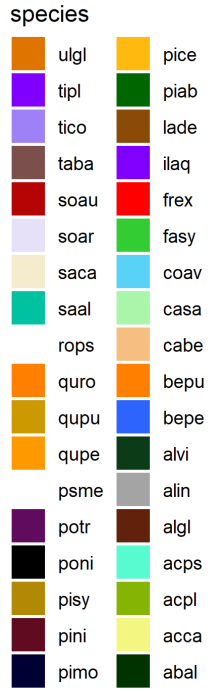

Way forward – two tracks

Track A: Focus on diversity effects on ecosystem service provisioning, using all four models

Track B (fast track): Focus on diversity effects on resilience to disturbances, using ForClim and iLand

Track B – disturbance resilience

Why focus on disturbances?

Important topic in current forest management in Europe

Heavily requested by EFI (Marcus, Hans) at the initial meeting in Wageningen

The more structurally detailed models in Track B allow for increased inferential potential wrt disturbances

Track B – disturbance resilience

Implementation

Use similar simulation protocol as in Track A (synergies!)

Study how alpha and beta diversity can

(i) mitigate disturbance impacts and

(ii) moderate disturbance-induced variation

Way forward

Plan for the Zvolen meeting

- Take stock of where we are with Track A and how to move forward
- Operationalize Track B so that simulations can start next week

Overall plan

- Track B finished by the FORMASAM final event
- Track B finished asap after that