Modelling tropical forests and biodiversity in Peru and South America

Sarah Bereswill, Kirsten Thonicke, Boris Sakschewski,
Maik Billing, Werner von Bloh

B-EPICC

BRAZIL EAST AFRICA PERU INDIA CLIMATE CAPACITIES

PIK

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P I K

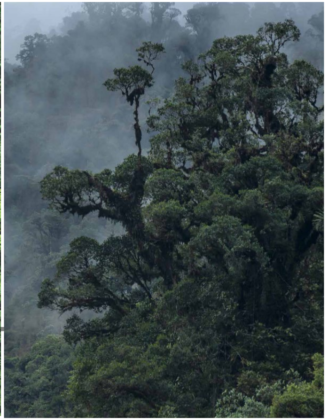
1. Background – Forest and Biodiversity in Peru

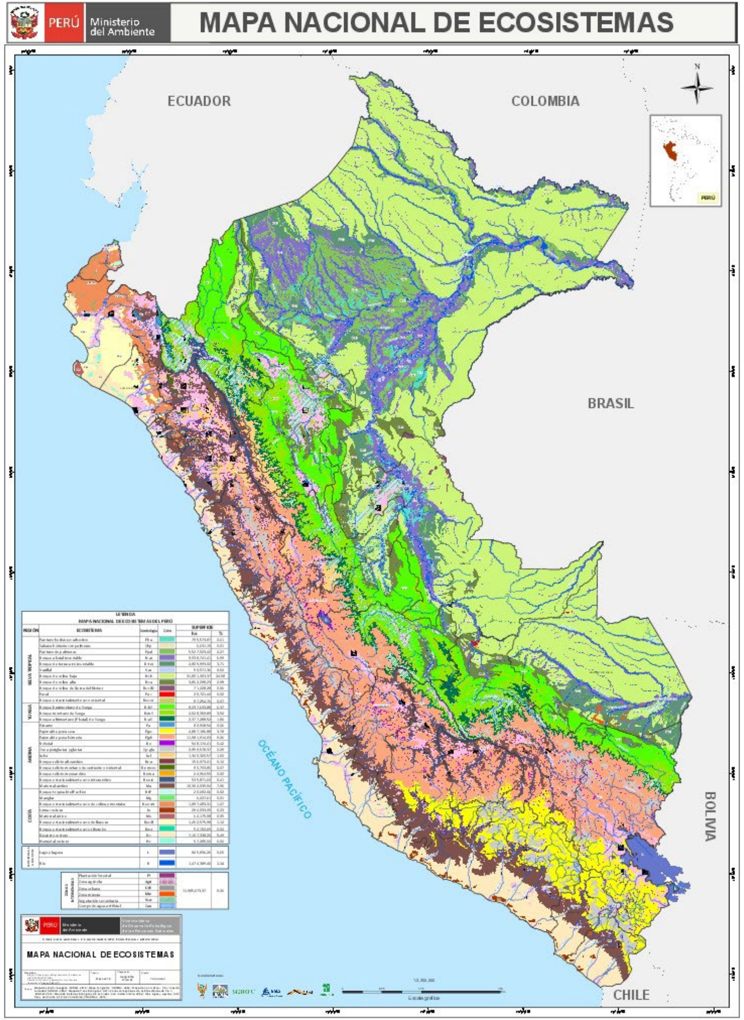
Bosques

- More than 60% of the Peruvian territory is covered by forests, Peru has the second highest coverage of Amazonian forest in the world (FAO,2020; MINAM et al. 2015)
- Forest types ranging from wet lowland Amazonian over premontane to cloud forest ecosystems

Biodiversidad

- Peru one of the world's mega-diverse countries
- Global Biodiversity hotspot: Andean forest ecosystems





http://www.bosques.gob.pe/archivo/1455ad_perureinodebosques.pdf

1. Background – B-EPICC's workpackage on Forests & Biodiversity

Forest loss

- Deforestation and degradation
- Emissions
- Biodiversity loss

Climate change

- amplifies negative effect

Research questions

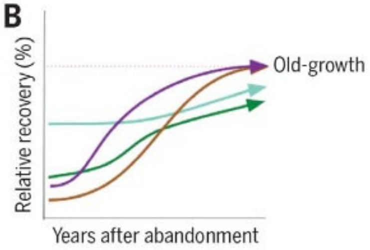
- Quantify contribution of forest recovery to ecosystem services **(carbon sequestration)**
- Address potential **recovery of biodiversity**
- Simulate forest recovery trajectories under the impact of **climate change**

Forest restoration & natural regrowth → Important contribution of secondary forests for climate change mitigation (high C sequestration potential)

1. Background – Potential of secondary forests: C sink and biodiversity recovery

Key questions:

- **Which forest attributes take how long to recover?**
- **Under which conditions?**



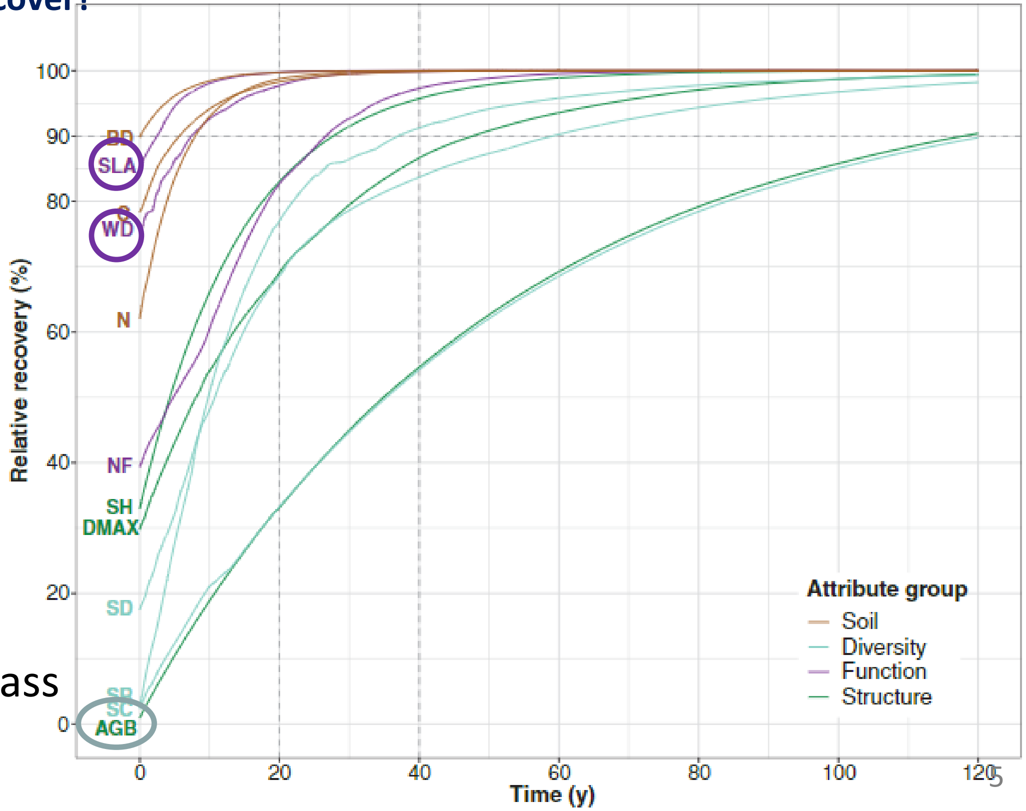
diversity

Poorter et al., 2021

FOREST ECOLOGY

Multidimensional tropical forest recovery

Lourens Poorter[1*], Dylan Craven[2], Catarina C. Jakovac[1,3], Masha T. van der Sande[1], Lucy Amissah[4], Frans Bongers[1], Robin L. Chazdon[5,6], Caroline E. Farrior[7], Stephan Kambach[8], Jorge A. Meave[9], Rodrigo Muñoz[1,9], Natalia Norden[10], Nadja Rüger[8,11,12], Michiel van Breugel[13,14,15], Angélica María Almeyda Zambrano[16], Bienvenu Amani[17], José Luis Andrade[18], Pedro H. S. Brancalion[19], Eben N. Broadbent[20], Hubert de Foresta[21], Daisy H. Dent[12,22], Géraldine Derroire[23], Saara J. DeWalt[24], Juan M. Dupuy[18], Sandra M. Durán[25,26], Alfredo C. Fantini[27], Bryan Finegan[28], Alma Hernández-Jaramillo[2], José Luis Hernández-Stefanoni[18], Peter Hietz[30], André B. Junqueira[31], Justin Kassi N'dja[32],



biomass

1. Background – Potential of secondary forests: C sink and biodiversity recovery

Key questions:

- **Impact of previous land use history and disturbance level?**
- **Assumed recovery rates reliable vs. observations?**

Contents lists available at ScienceDirect

Global Ecology and Conservation

journal homepage: www.elsevier.com/locate/gecco

Original Research Article

Aboveground biomass in secondary montane forests in Peru: Slow carbon recovery in agroforestry legacies

Susan Aragón [a,*], Norma Salinas [a], Alex Nina-Quispe [a], Vicky Huaman Qquellon [a], Gloria Rayme Paucar [a], Wilfredo Huaman [a], Percy Chambi Porroa [a], Juliana C. Olarte [a], Rudi Cruz [a], Julia G. Muñiz [b], Carlos Salas Yupayccana [a], Tatiana E. Boza Espinoza [a], Richard Tito [a], Eric G. Cosio [a], Rosa Maria Roman-Cuesta [c,d]

[a] *Institute for Nature, Earth and Energy (INTE) Pontificia Universidad Católica del Perú (PUCP), Av. Universitaria 1801, Lima 15088, Peru*
[b] *Escuela de Biología, Universidad Nacional San Antonio Abad del Cusco, Av. de la Cultura s/n, Cusco 08003, Peru*
[c] *Department of Environmental Sciences, Laboratory of Geoinformation Science and Remote Sensing, University of Wageningen, P.O. Box 476700AA, Wageningen, The Netherlands*
[d] *Center for International Forestry Research (CIFOR), P.O. Box 0113 BOCBD, Bogor 16000, Indonesia*

Methods

- Forest plots in abandoned tea plantation compared to similar elevation primary forest
- 1780 masl in La Convención province, Cuzco Region, in southern Peru

Key results

- Even more than 30 years after abandonment, high presence of agroforestery legacy species
- Aboveground biomass was clearly lower (42-59 Mg ha-1) vs. Based on standard IPCC growth rates for secondary montane forests (106 Mg ha-1)

1. Background – Potential of secondary forests: C sink and biodiversity recovery

ARTICLE

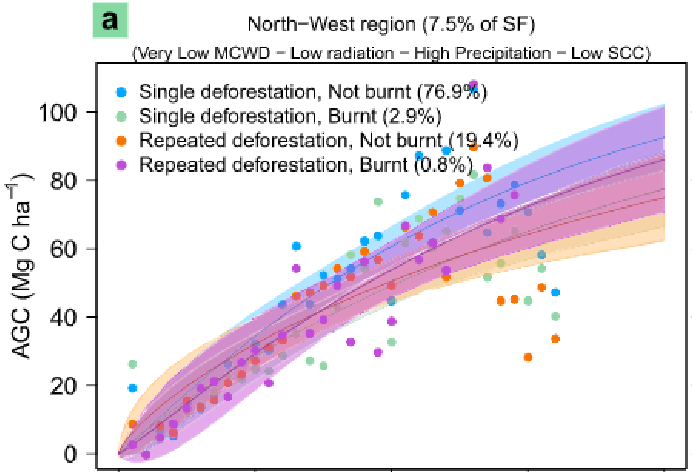
https://doi.org/10.1038/s41467-021-22050-1 OPEN

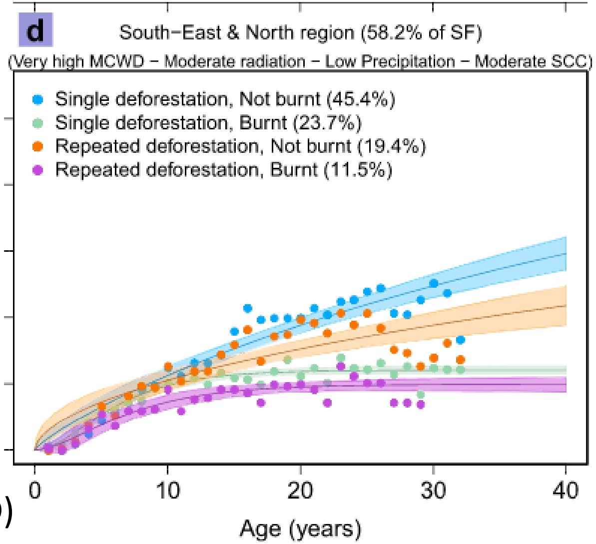
Large carbon sink potential of secondary forests in the Brazilian Amazon to mitigate climate change

Viola H. A. Heinrich[1✉], Ricardo Dalagnol[2], Henrique L. G. Cassol[2], Thais M. Rosan[3], Catherine Torres de Almeida[2], Celso H. L. Silva Junior[2], Wesley A. Campanharo[2], Joanna I. House[1,4], Stephen Sitch[3], Tristram C. Hales[5], Marcos Adami[6], Liana O. Anderson[7] & Luiz E. O. C. Aragão[2,3]

Climatic conditions and repeated disturbance may lower C sink potential of secondary forests

Heinrich et al., 2021





Single vs. Repeated deforestation, burnt or not burnt

Low Maximum Climatic Water Deficit (MCWD)

High Maximum Climatic Water Deficit (MCWD)

2. Modeling capabilities at PIK

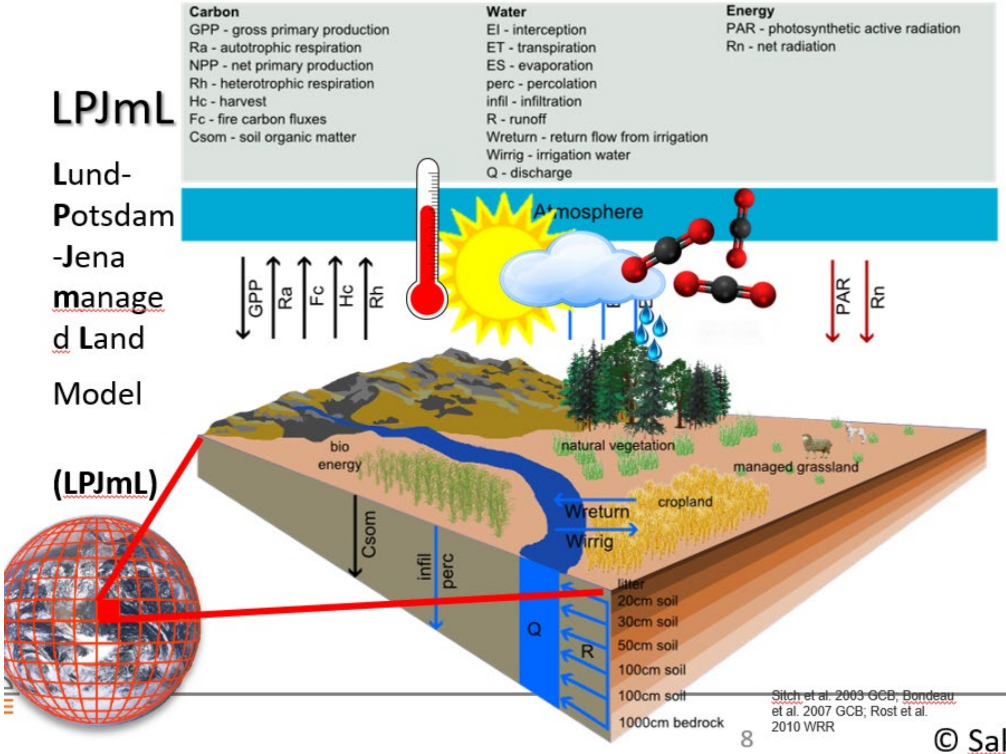
We apply DGVMs (Dynamic Global Vegetation Models) to understand how forest ecosystems evolve under different climate change and land-use scenarios.

2. Modeling capabilities at PIK
LPJmL model

Tools @ PIK: Dynamic Global Vegetation Models

- LPJmL (Lund-Potsdam-Jena managed Land)

‚big leaf approach‘: PFTs (plant functional types) cover part of grid cell
e.g. tropical broadleaved evergreen, needle-leaved boreal etc



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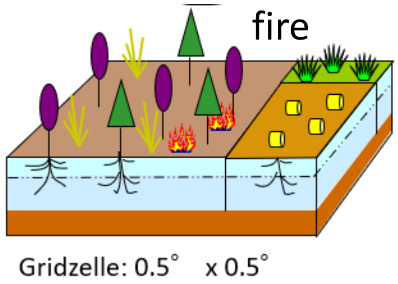
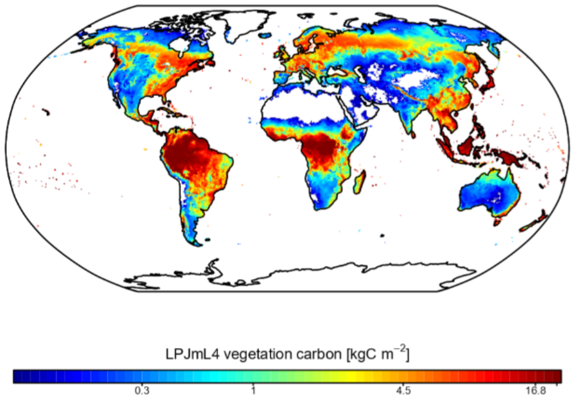


Land-use
Crops
Irrigation



Schaphoff et al., 2018

2.1 The LPJmL-FIT model (flexible individual traits)

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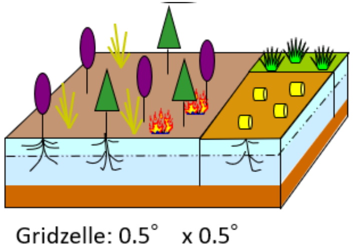
Tools @ PIK: Dynamic Global Vegetation Models

- LPJmL (Lund-Potsdam-Jena managed Land)



- LPJmL-FIT:
  LPJmL with **F**lexible **I**ndividual **T**raits

adress diversity of forests

Sakschewski et al., 2015

‚big leaf approach': **PFTs (plant functional types)** cover part of grid cell
e.g. tropical broadleaved evergreen, needle-leaved boreal etc

Individual trees characterized by unique set of functional traits compete and form a forest community adapted to local climate and resources

Sakschewski et al., 2015: Leaf and stem economics spectra drive diversity of functional plant traits in a dynamic global vegetation model.
https://onlinelibrary.wiley.com/doi/abs/10.1111/gcb.12870

2.1 The LPJmL-FIT model (flexible individual traits)

Global Change Biology

Global Change Biology (2015) 21, 2711–2725, doi: 10.1111/gcb.12870

Leaf and stem economics spectra drive diversity of functional plant traits in a dynamic global vegetation model

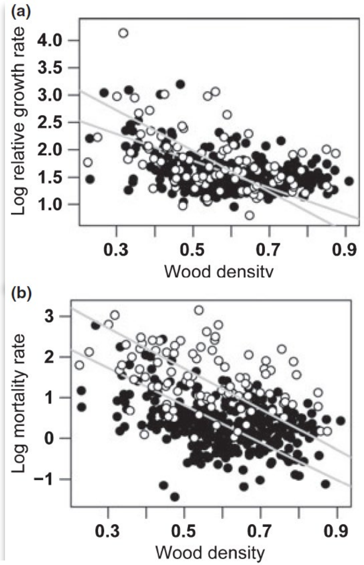
BORIS SAKSCHEWSKI[1,2], WERNER VON BLOH[1,2], ALICE BOIT[1,2], ANJA RAMMIG[1,2], JENS KATTGE[3], LOURENS POORTER[4], JOSEP PEÑUELAS[5,6] and KIRSTEN THONICKE[1,2]

[1]*Potsdam Institute for Climate Impact Research (PIK), Telegraphenberg A31, Potsdam, 14473, Germany,* [2]*Berlin-Brandenburg Institute of Advanced Biodiversity Research (BBIB), Berlin, 14195, Germany,* [3]*Max-Planck-Institute for Biogeochemistry, Jena, 07745, Germany,* [4]*Forest Ecology and Forest Management Group, Wageningen University, PO Box 47, Wageningen, 6700AA, The Netherlands,* [5]*Global Ecology Unit CREAF-CSIC-UAB, CSIC, Cerdanyola del Vallés, 08193 Catalonia, Spain,* [6]*CREAF, Cerdanyola del Vallès, 08193 Catalonia, Spain*

Dynamic Global Vegetation Models: PFTs (plant functional types) with **fixed** set of functional traits

- LPJmL-FIT incorporates empirical ranges of **five traits** of tropical trees extracted from the TRY global plant trait database
- specific leaf area (**SLA**), leaf longevity (**LL**), leaf nitrogen content (N_{area}), maximum carboxylation rate of Rubisco per leaf area ($v_{cmax,area}$), and wood density (**WD**).

2.1 The LPJmL-FIT model (flexible individual traits)



Incorporation of two ecological concepts to diversify functional traits

Wright *et al.* 2004

Chave *et al.* 2009

Published: 22 April 2004

The worldwide leaf economics spectrum

Ian J. Wright, Peter B. Reich, ... Rafael Villar + Show authors

Nature **428**, 821–827 (2004) | Cite this article

42k Accesses | **5147** Citations | **61** Altmetric | Metrics

ECOLOGY LETTERS

Full Access

Towards a worldwide wood economics spectrum

Jerome Chave, David Coomes, Steven Jansen, Simon L. Lewis, Nathan G. Swenson, Amy E. Zanne

First published: 10 March 2009 | https://doi.org/10.1111/j.1461-0248.2009.01285.x | Citations: 1,737

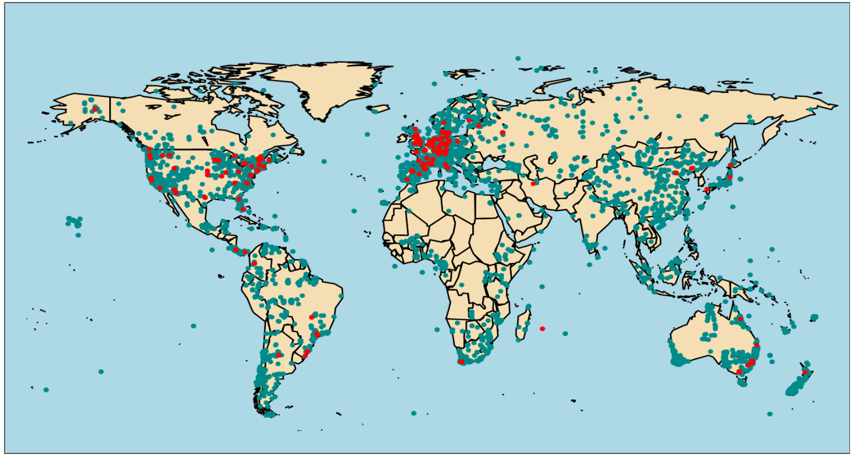
The leaf traits are linked by empirically established trade-offs based on the **leaf economics spectrum (LES)** (Reich *et al.*, 1997, 1999; Wright *et al.*, 2004; Shipley *et al.*, 2006) which describes a set of leaf trade-offs explaining worldwide leaf investment strategies

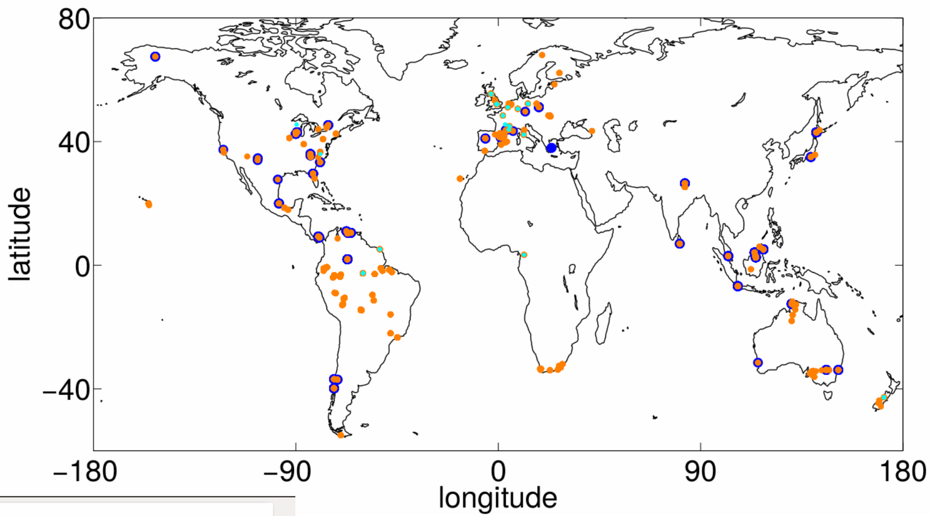
WD is linked to tree mortality following the idea of **the stem economics spectrum (SES**, Baraloto *et al.*, 2010).

2.1 The LPJmL-FIT model (flexible individual traits)

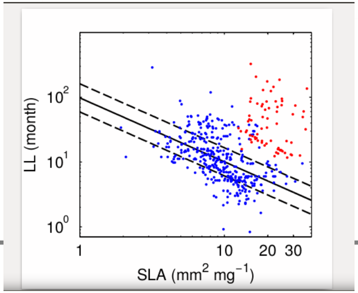
TRY database – filter for global entries for broadleaved-trees

Sakschewski et al., 2015





- Measurement sites
- Institutes

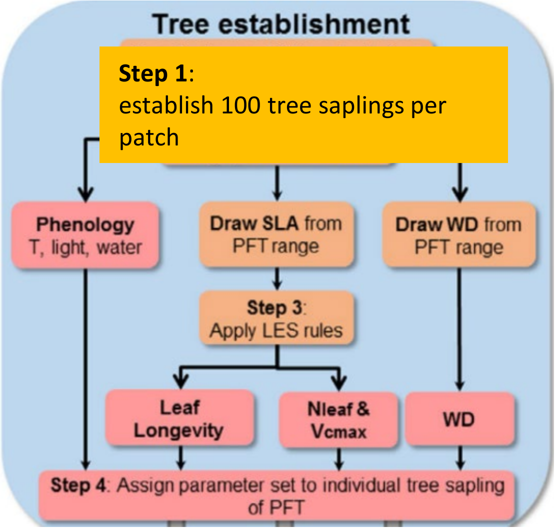


- Regression LL-SLA fit derived from TRY data
- ‚trade-off‘: thin/soft leaves (high SLA) highly productive but shortlived; thicker leaves (low SLA) higher LL as more resistant to physical stress and herbivory

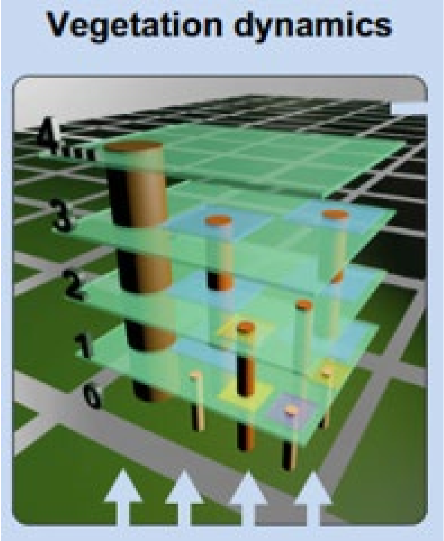
https://www.try-db.org/TryWeb/Home.php

2.1 The LPJmL-FIT model (flexible individual traits)

Functional Unit: Individual tree

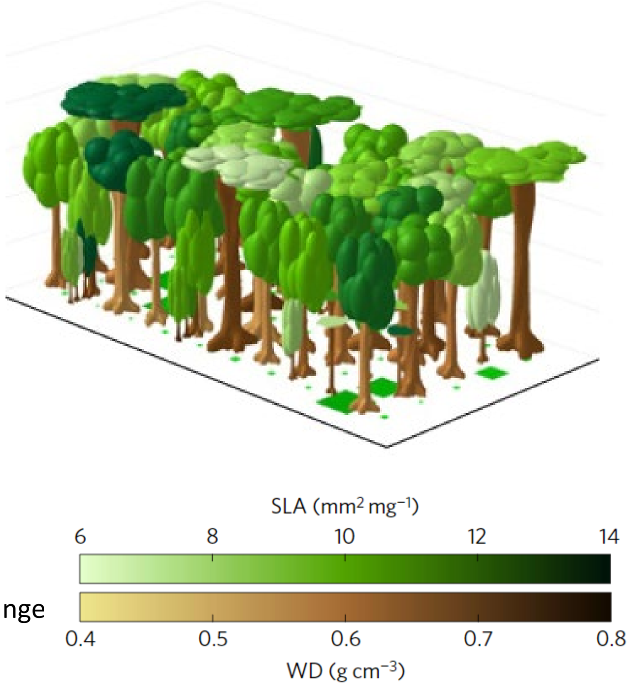


Saplings grow and compete for light and water resources



Light competition: reaching canopy layers

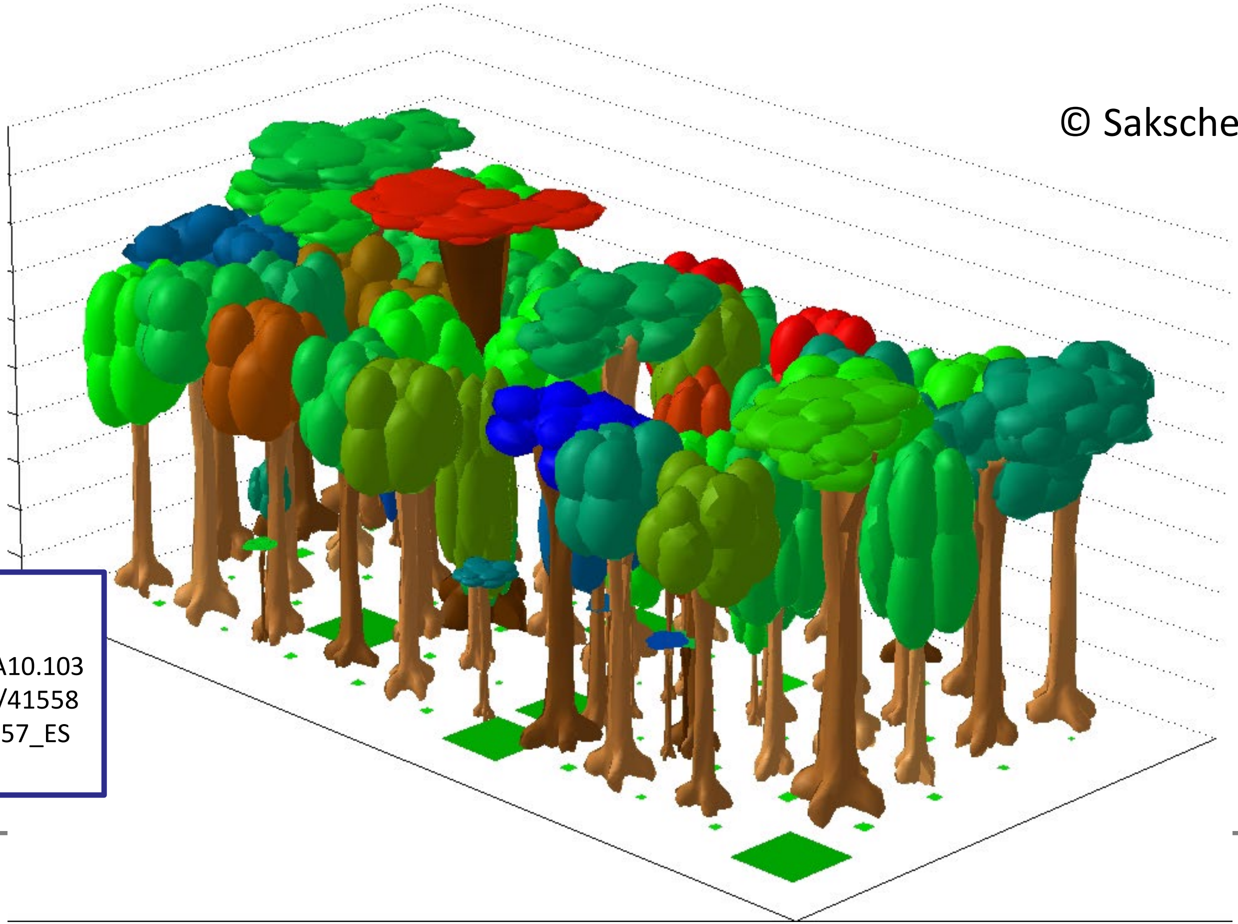
Established forest community with herbaceous understorey



- LPJmL-FIT establishes individual trees with a number of variable traits
- These traits range within their globally observed boundaries in natural ecosystems because their range are constrained by empirically derived trade-offs following the theory of LES and SES.

P I K

2.1 The LPJmL-FIT model (flexible individual traits)



© Sakschewski

Watch animation at:
https://static-content.springer.com/esm/art%3A10.1038%2Fnclimate3109/MediaObjects/41558_2016_BFnclimate3109_MOESM457_ESM.mov

P I K

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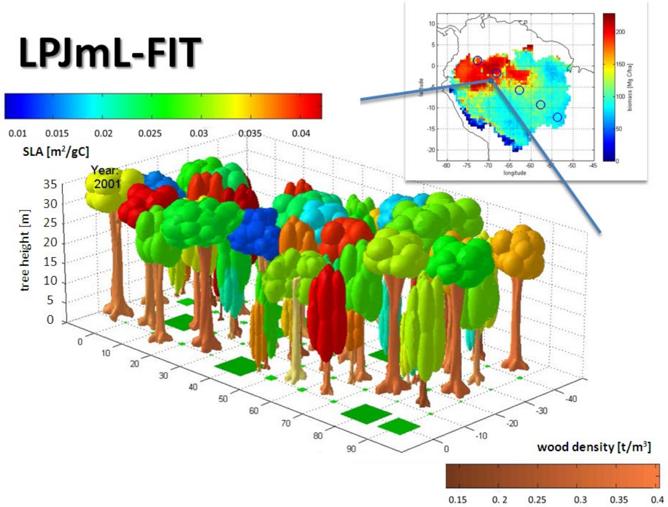
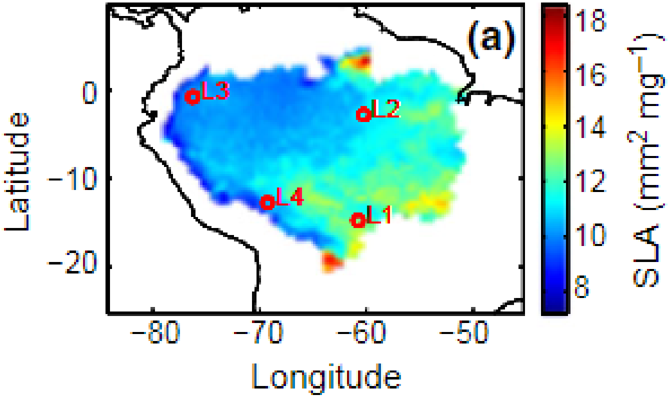
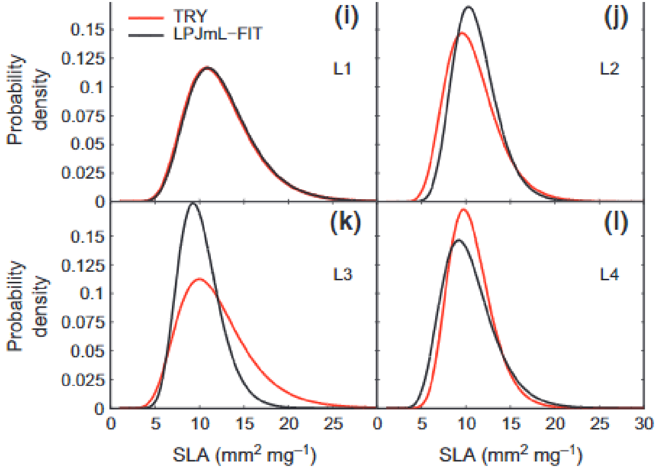


Validation of modeled vs. Observed trait distributions





Sakschewski et al., 2015

2.2 Case study I: Resilience of forests to climate change

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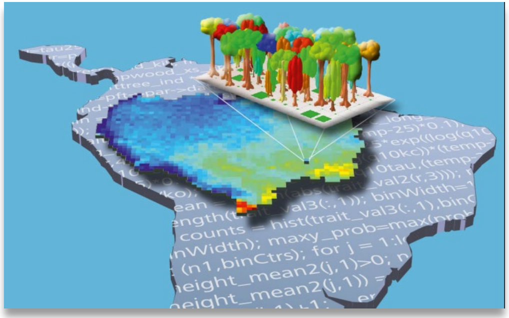
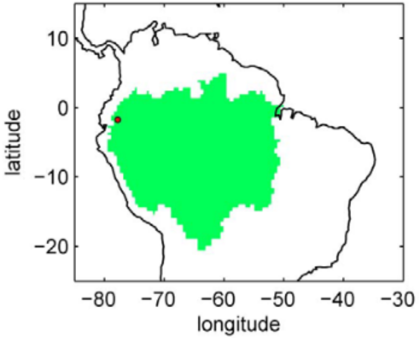


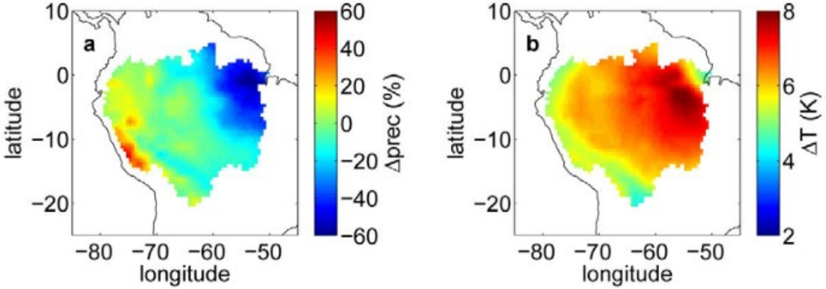
LETTERS
PUBLISHED ONLINE: 29 AUGUST 2016 | DOI: 10.1038/NCLIMATE3109
nature climate change

Resilience of Amazon forests emerges from plant trait diversity

Boris Sakschewski[1,2]*, Werner von Bloh[1,2], Alice Boit[1,2], Lourens Poorter[3], Marielos Peña-Claros[3], Jens Heinke[1,2], Jasmin Joshi[4] and Kirsten Thonicke[1,2]



400ha of forest simulated in Ecuador



Climate input: Strong CC scenario (RCP 8.5)

Biodiversity as an ‚insurance' for the resilience of forests under climate change?

Sakschewski *et al. 2016*
Nature Clim. Change

LETTERS
PUBLISHED ONLINE: 29 AUGUST 2016 | DOI: 10.1038/NCLIMATE3109
nature climate change

2.2 Case study I: Resilience of forests to climate change

Resilience of Amazon forests emerges from plant

los Peña-Claros[3],

2 PFTs: ‘tropical broadleaved evergreen tree’ and ‘tropical broadleaved rain-green tree’ (fixed trait values)

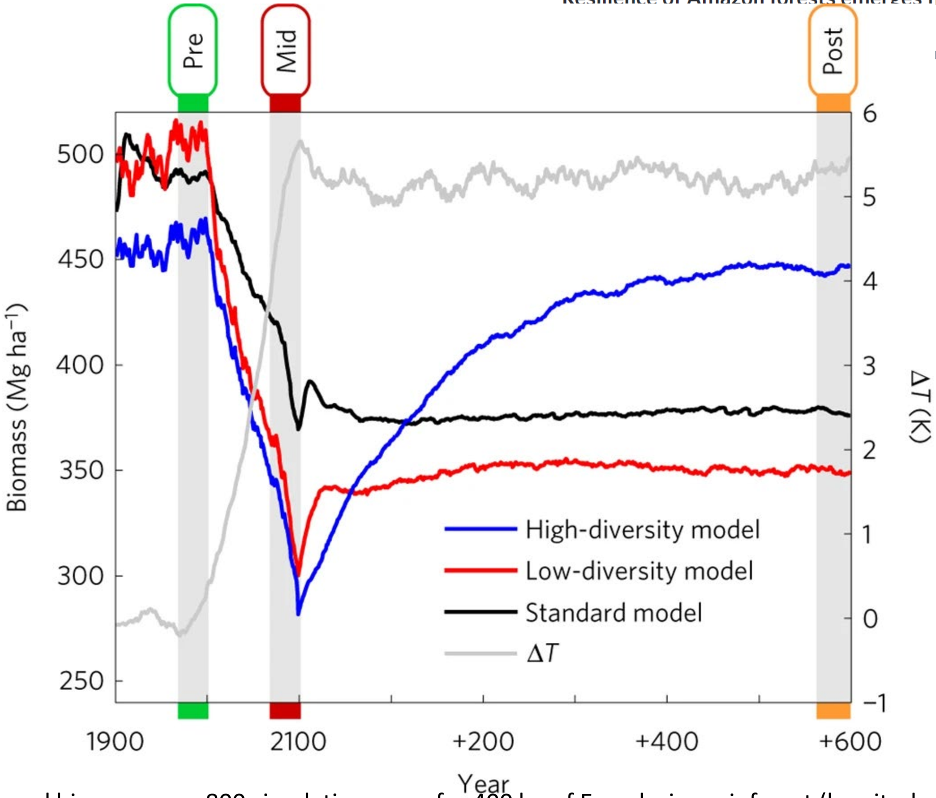
Low-diversity model (individual trees)

Standard model (average individuals)

Vs. Individual trees with randomly assigned different trait combinations →

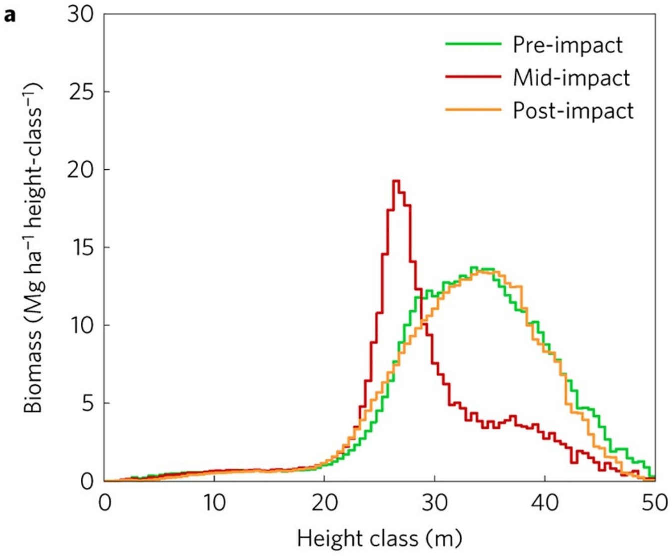
High-diversity model

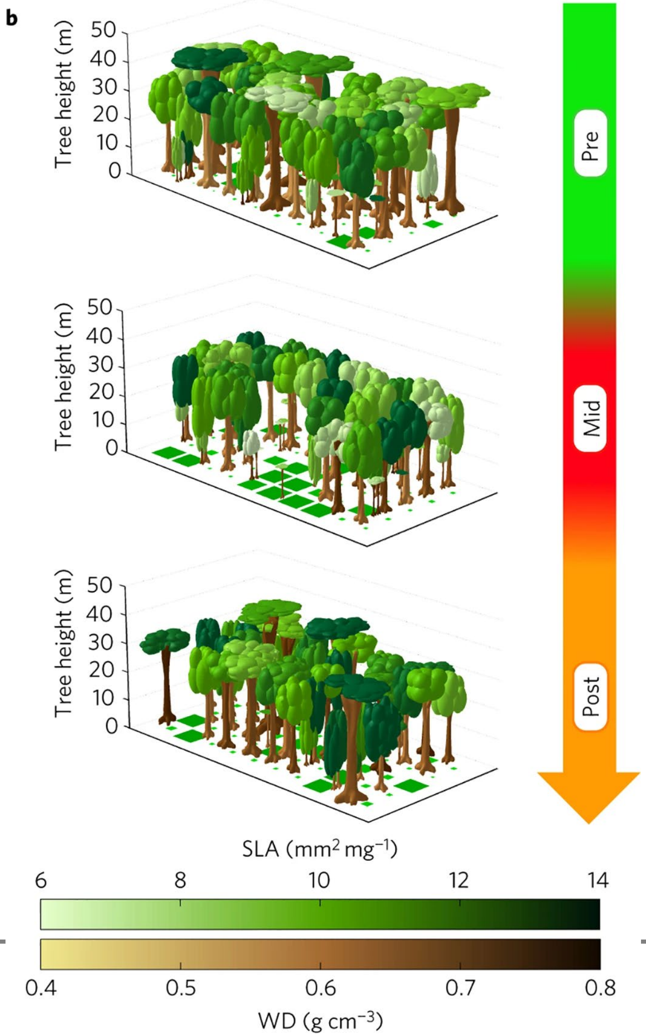
Plant trait	min	max
SLA (mm^2 mg^{-1})	2.28	31.85
LL (month)	1.70	91.60
N_{area} (g m^{-2})	0.96	4.30
$Vcmax_{area25°}$ (μmol m^{-2} s^{-1})	30.47	101.88
WD (g cm^{-3})	0.14	1.30



Annual biomass over 800 simulation years for 400 ha of Ecuadorian rainforest (longitude: 77.75° W; latitude: 1.25° S, Supplementary Fig. 10) from three different versions of the vegetation model LPJmL under a severe climate change scenario (RCP 8.5 HadGEM2). Δ*T*: annual temperature difference to the mean temperature of pre-impact time (1971–2000) in K.

2.2 Case study I: Resilience of forests to climate change





a, Mean biomass contribution of tree height classes for pre-, mid- and post-impact time (Methods). **b**, Visualization of model output (also see Supplementary Movie 1) showing 0.5 ha of the 400 ha of Ecuadorian rainforest in a selected year during pre-, mid-, and post-impact time, respectively (top to bottom). Different crown (stem) colours denote different SLA (WD) values of individual trees. Crown size, stem diameter and tree height are scaled by model output. Green squares indicate tree gaps covered by herbaceous plants.

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Resilience of Amazon forests emerges from plant trait diversity

Boris Sakschewski[1,2]*, Werner von Bloh[1,2], Alice Boit[1,2], Lourens Poorter[3], Marielos Peña-Claros[3], Jens Heinke[1,2], Jasmin Joshi[4] and Kirsten Thonicke[1,2]

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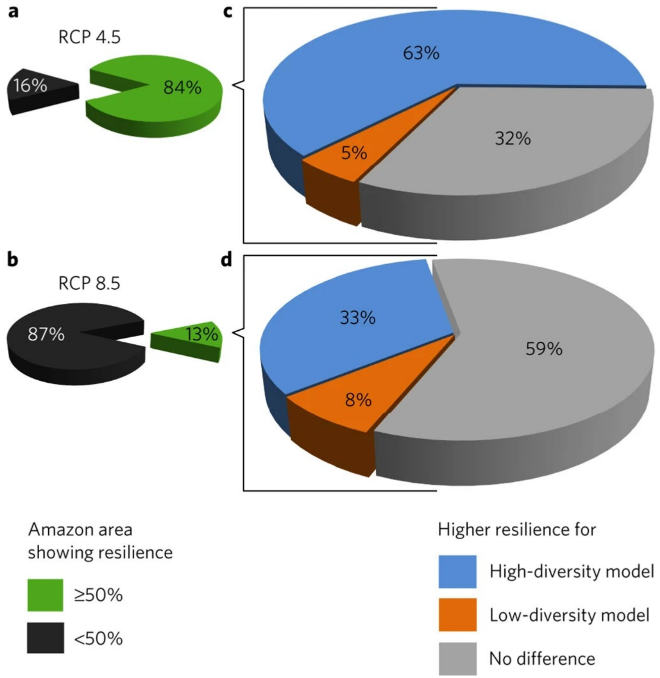


high-diversity model is always more resilient, even though the positive contribution of plant trait diversity to biomass resilience is **limited by climate change intensity**

2.3 Case study II: Functional diversity of forests along a climate gradient

2.3 Case study II: Functional diversity of forests along a climate gradient

LPJmL-FIT model adapted for Europe

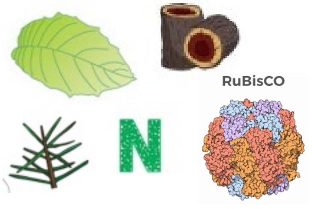
Received: 6 May 2019 | Revised: 5 December 2019 | Accepted: 12 December 2019
DOI: 10.1111/jbi.13809

RESEARCH PAPER
Journal of Biogeography WILEY

Simulating functional diversity of European natural forests along climatic gradients

Kirsten Thonicke[1] | Maik Billing[1,2] | Werner von Bloh[1] | Boris Sakschewski[1] | Ülo Niinemets[3] | Josep Peñuelas[4,5] | J. Hans C. Cornelissen[6] | Yusuke Onoda[7] | Peter van Bodegom[8] | Michael E. Schaepman[9] | Fabian D. Schneider[10] | Ariane Walz[2]

Trait pool



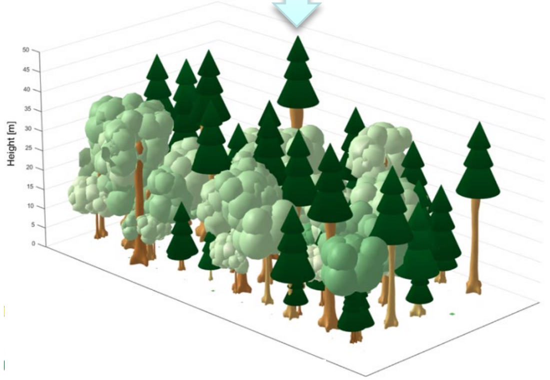
Diaz et al. 2016

Tree sapling with individual parameter set

Competitive filtering

Climate, soil

Environmental filtering



B-NL T-NL
BL-S BL-E

boreal vs. temperate
broadleaved vs. needle-leaved

Co-existence of different plant strategies

PIK

Thonicke, Billing et al., J Biogeogr 2020, https://doi.org/10.1111/jbi.13809

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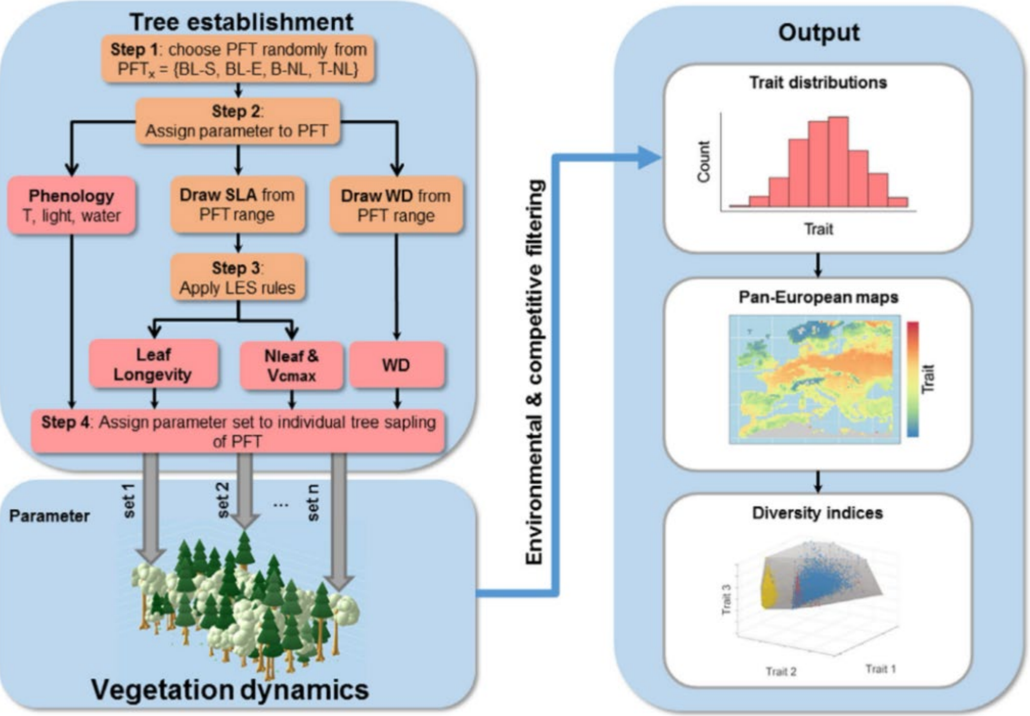
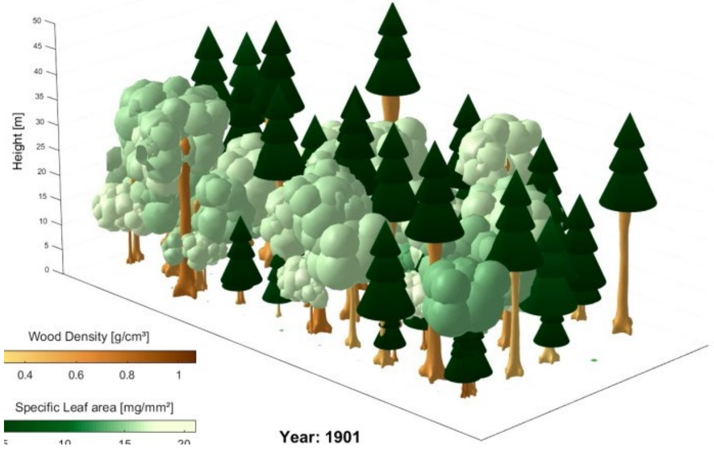


LPJmL-FIT model
adapted for Europe

boreal vs. temperate
broadleaved vs. needle-leaved



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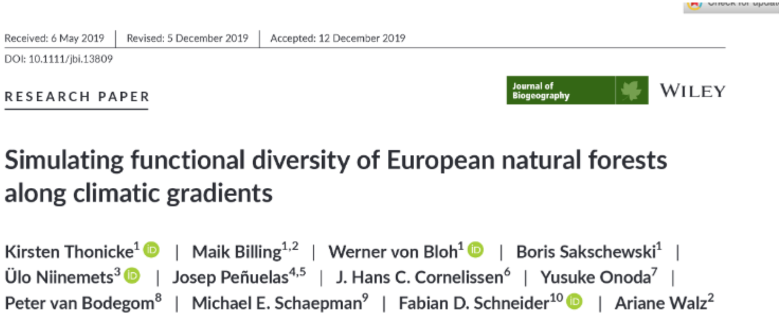

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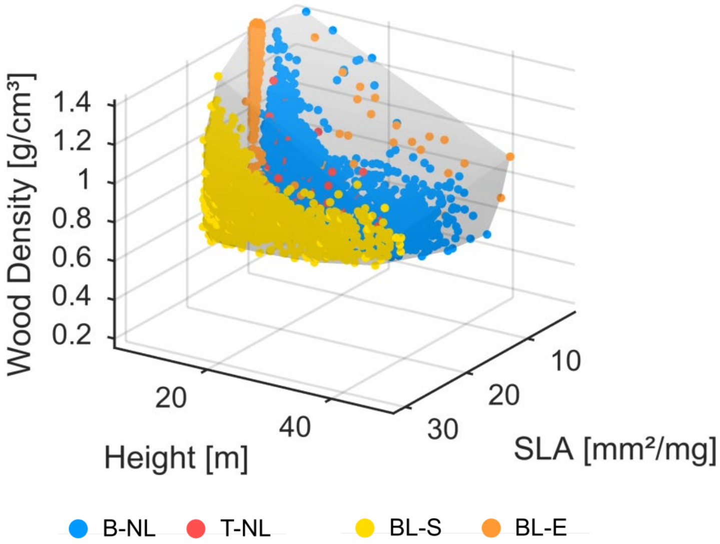
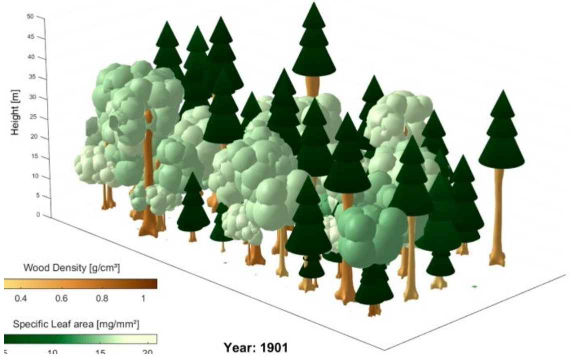
Journal of Biogeography WILEY

Simulating functional diversity of European natural forests along climatic gradients

Kirsten Thonicke[1] | Maik Billing[1,2] | Werner von Bloh[1] | Boris Sakschewski[1] | Ülo Niinemets[3] | Josep Peñuelas[4,5] | J. Hans C. Cornelissen[6] | Yusuke Onoda[7] | Peter van Bodegom[8] | Michael E. Schaepman[9] | Fabian D. Schneider[10] | Ariane Walz[2]



Functional Diversity

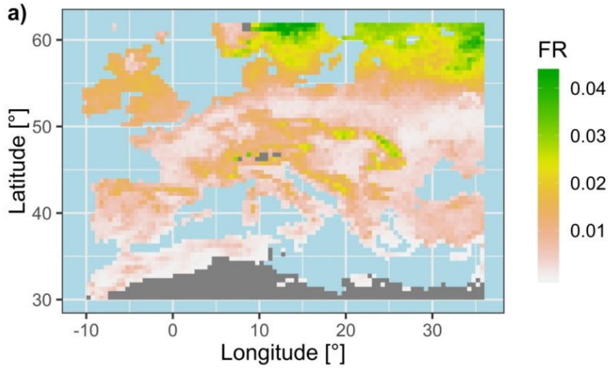


- 3D trait space – each tree is one point
- High functional richness means that in the ecosystem a broad range of nices is occupied
- It can be an indicator of resilience of ecosystems to disturbance

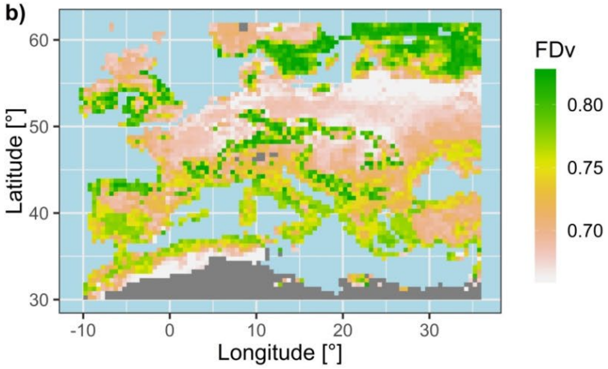
Thonicke, Billing et al., J Biogeogr 2020, https://doi.org/10.1111/jbi.13809

2.3 Case study II: Functional diversity of forests along a climate gradient

Functional richness



Functional Divergence



In megadiverse ecosystems, **functional diversity** is an important measure

Functional Richness:

Span of occupied niches
size of potentially available, environmental niches

Functional Divergence:

Degree of *niche differentiation*
High Divergence -> high competitive exclusion

Thonicke, Billing et al., J Biogeogr 2020, https://doi.org/10.1111/jbi.13809

2.4 Case Study III: Flexible rooting schemes improve evapotranspiration simulation

2.4 Flexible rooting schemes improve evapotranspiration simulation

- DGVMs **oversimplify** representation of belowground dynamics (root growth, distribution, water uptake, nutrient dynamics)

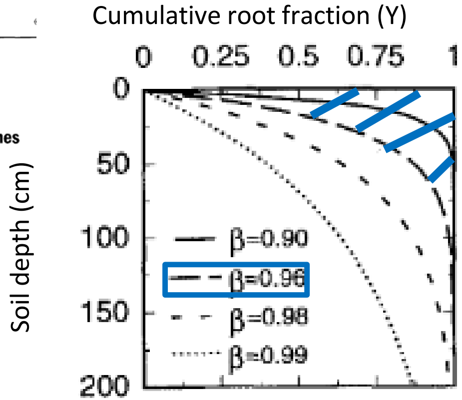
BEFORE:
- LPJmL4.0: fixed root biomass distribution with depth and fixed rooting depth for all trees and tree saplings!
- Limits the access of trees to water

Oecologia (1996) 108:389–411

R.B. Jackson · J. Canadell · J.R. Ehleringer
H.A. Mooney · O.E. Sala · E.D. Schulze

A global analysis of root distributions for terrestrial biomes

Jackson et al 1996



PFT	β_{root}
TrBE	0.962
TrBR	0.961
TeNE	0.976
TeBE	0.964
TeBS	0.966
BoNE	0.943
BoBS	0.943
BoNS	0.943
TrH	0.972
TeH	0.943
PoH	0.943

Sakschewski et al., 2021
Improved root growth and biomass distribution in LPJmL model

Biogeosciences, 18, 4091–4116, 2021
https://doi.org/10.5194/bg-18-4091-2021

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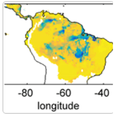
Research article 12 Jul 2021

Variable tree rooting strategies are key for modelling the distribution, productivity and evapotranspiration of tropical evergreen forests



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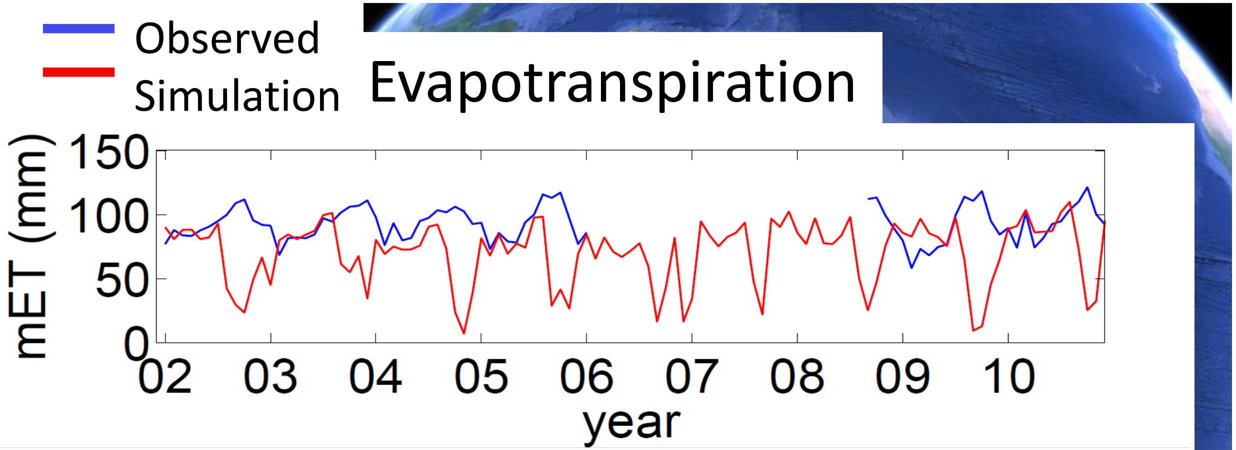
https://bg.copernicus.org/articles/18/4091/2021/bg-18-4091-2021-discussion.html

2.4 Flexible rooting schemes improve evapotranspiration simulation

The problem with the ‚fixed roots‘ approach



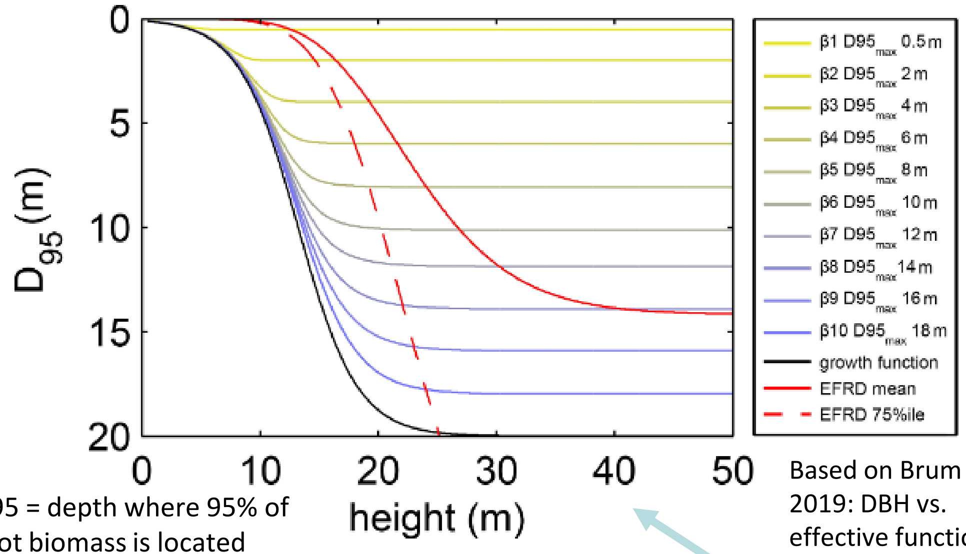
Trees have water access during dry season

Santarém, Brazil
Up to 4 months with P < 100 mm

Photo: Boris S.

2.4 Flexible rooting schemes improve evapotranspiration simulation

NEW: logistic growth function: root systems grows with tree height



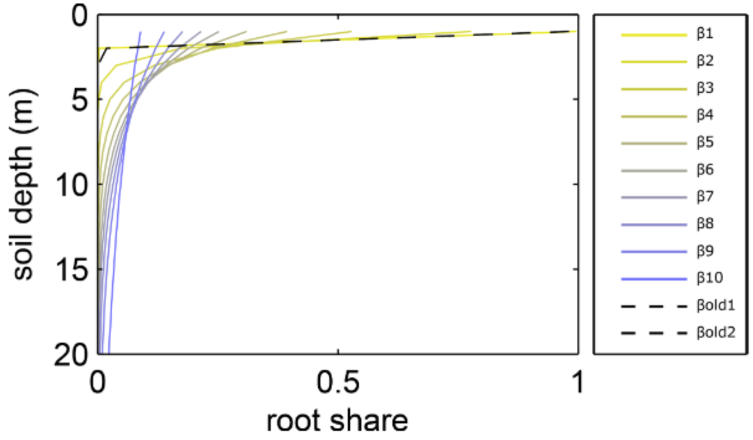
D95 = depth where 95% of root biomass is located

Based on Brum et al., 2019: DBH vs. effective functional rooting depth

Figure A2. Relation between tree height and rooting depth in LPJmL4.0-VR. Black line: implemented general growth function of rooting depth (Eq. A5). Lines with colour scale from yellow to blue: growth functions of rooting depth for each of the 10 sub-PFTs (Sect. 2.2.3). Here temporal rooting depth is expressed as D_{95} and eventually reaches D_{95_max} (Eq. A3). Solid red line: mean effective functional rooting depth over tree height (EFRD) adapted from Brum et al. (2019) using Eq. (A5). Dashed red line: respective 75th-percentile EFRD over tree height adapted from Brum et al. (2019). Please also see Supplementary Video 1 for a visualization of root growth and development of below-ground carbon pools over time available at http://www.pik-potsdam.de/~borissa/LPJmL4_VR/Supplementary_Video_1.pptx.

$$D = \frac{S}{1 + e^{-kSh} \cdot \left(\frac{S}{D_0} - 1\right)},$$

NEW: introduce various possible root biomass distributions (ß parameter)– competition for water



Journal of Ecology

BRITISH ECOLOGICAL SOCIETY

RESEARCH ARTICLE | Free Access

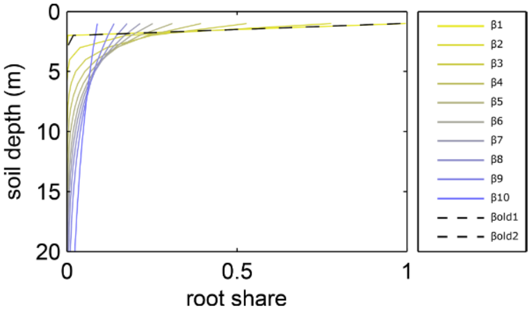
Hydrological niche segregation defines forest structure and drought tolerance strategies in a seasonal Amazon forest

Mauro Brum, Matthew A. Vadeboncoeur, Valeriy Ivanov, Heidi Asbjornsen, Scott Saleska, Luciana F. Alves, Deliane Penha, Jadson D. Dias, Luiz E. O. C. Aragão, Fernanda Barros, Paulo Bittencourt, Luciano Pereira, Rafael S. Oliveira ... See fewer authors

2.4 Flexible root growth scheme I

10 different ß paramters describe fine root biomass distribution with depth

© Sakschewski



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Research article 12 Jul 2021

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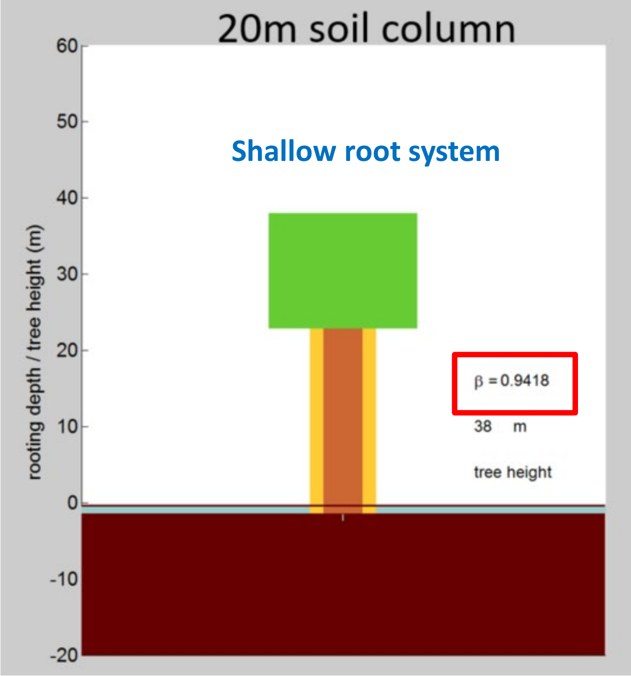
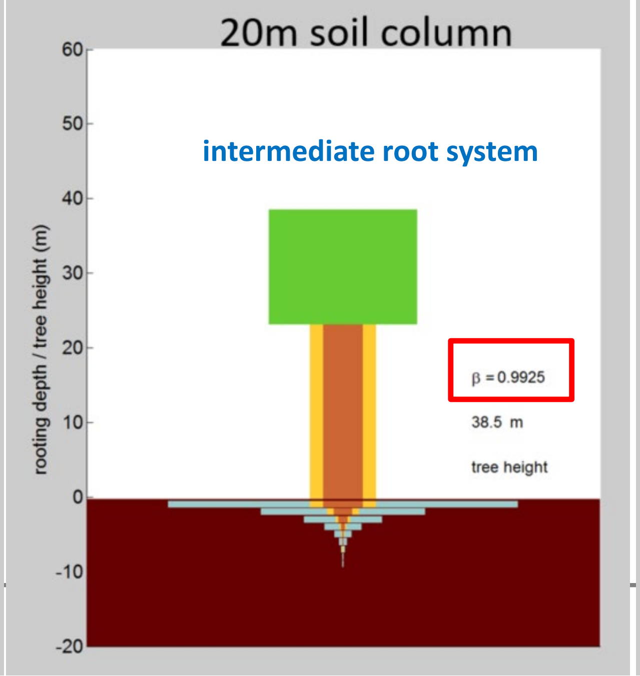
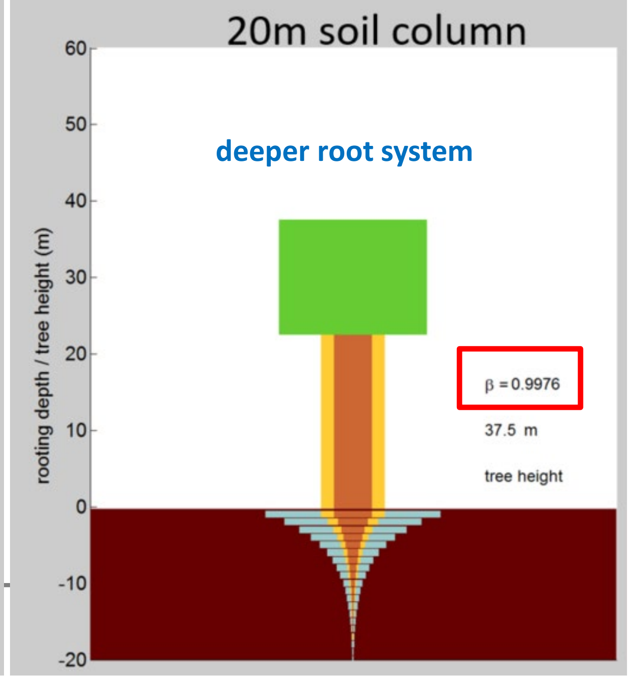
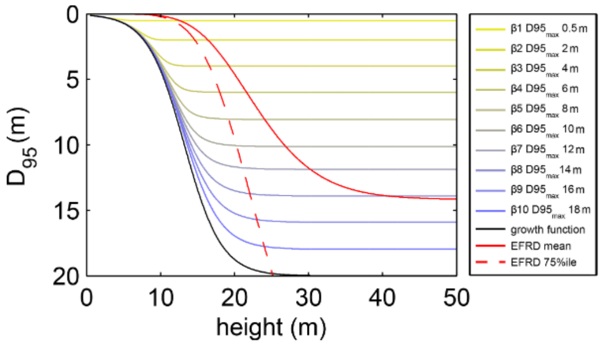






2.4 Flexible root growth scheme II

Depth of root system grows with increasing tree height (logistic function), root biomass distribution depends on ß parameter

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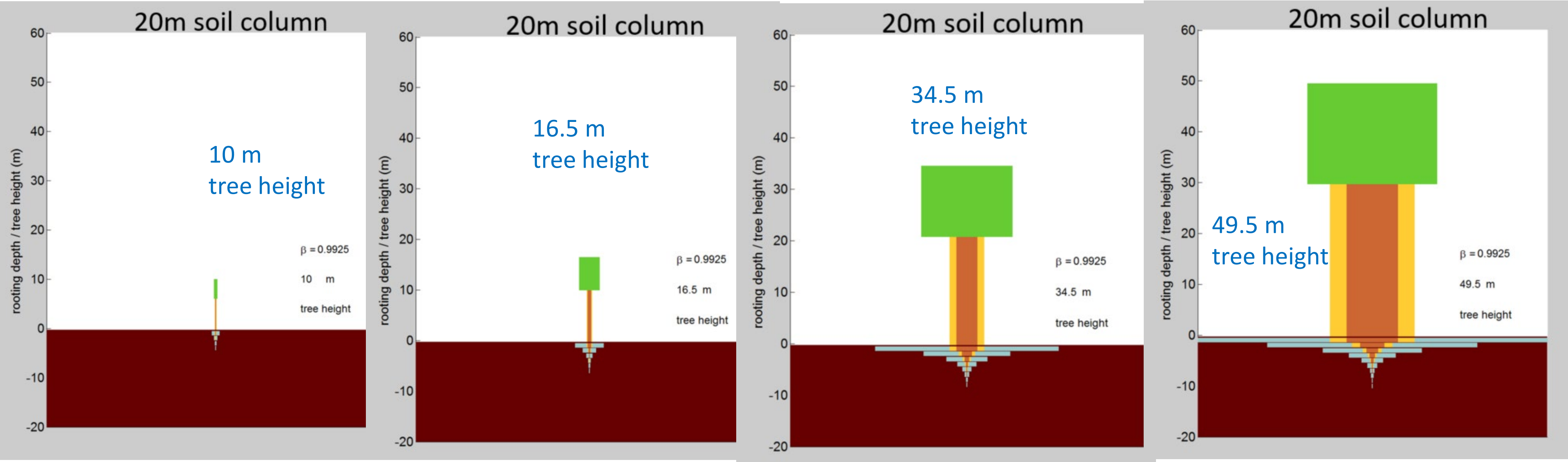
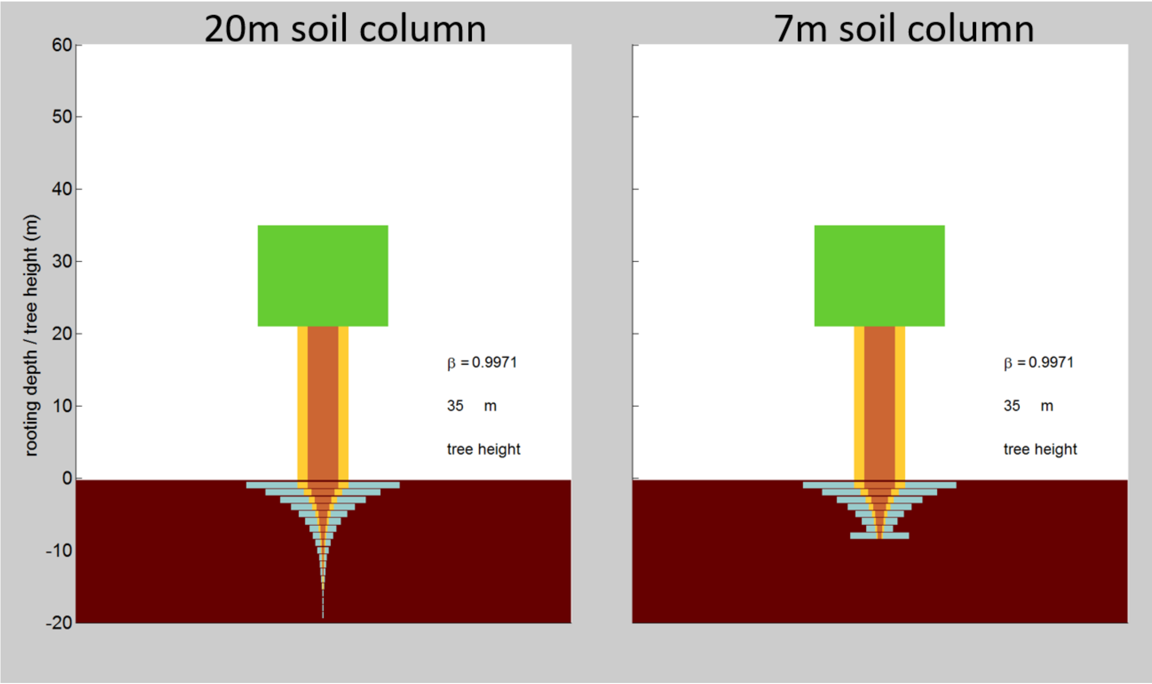


2.4 Flexible root growth scheme III



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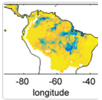

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Once bedrock layer is reached, new root biomass is allocated to last soil layer until tree reaches its final height

3.4 Flexible rooting schemes improve evapotranspiration simulation

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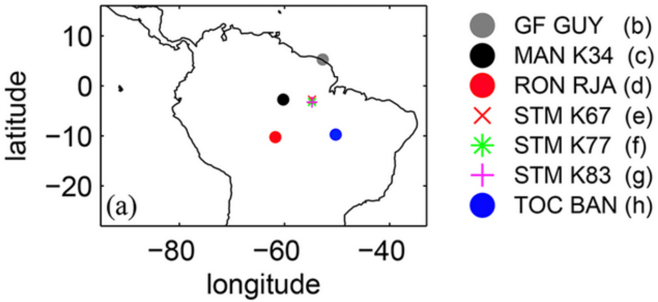
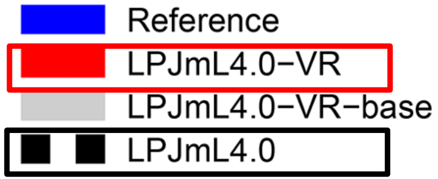
FLUXNET sites used for ET and NPP validation

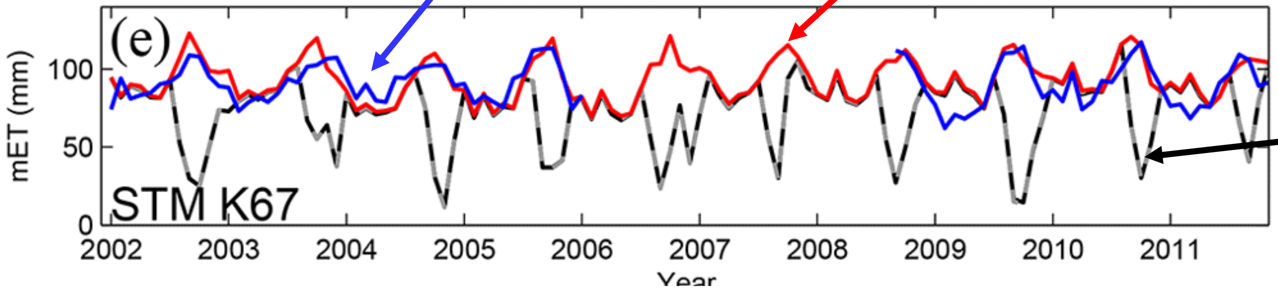
Site name	Short name	Country	LPJmL coordinate	
			latitude	longitude
Ecotone Bananal Island (BR-Ban)	TOC_BAN	Brazil	−9.75	−50.25
Manaus-ZF2 K34/BR-Ma2	MAN_K34	Brazil	−2.75	−60.25
Santarem-Km67-Primary Forest/BR-Sa1	STM_K67	Brazil	−2.75	−54.75
Santarem-Km77-Pasture/BR-Sa2	STM_K77	Brazil	−3.25	−54.75
Santarem-Km83-Logged Forest/BR-Sa3	STM_K83	Brazil	−3.25	−54.75
Rond.-Rebio Jaru Ji Parana-Tower B/BR-Ji3	RON_RJA	Brazil	−10.25	−61.75
Guyaflux	GF_GUY	French Guiana	5.25	−52.75





new ‚flexible‘ root approach

observation



old ‚fixed‘ root approach

Trees in LPJmL can now sustain ET during the dry season as they can access water from deeper soil layers

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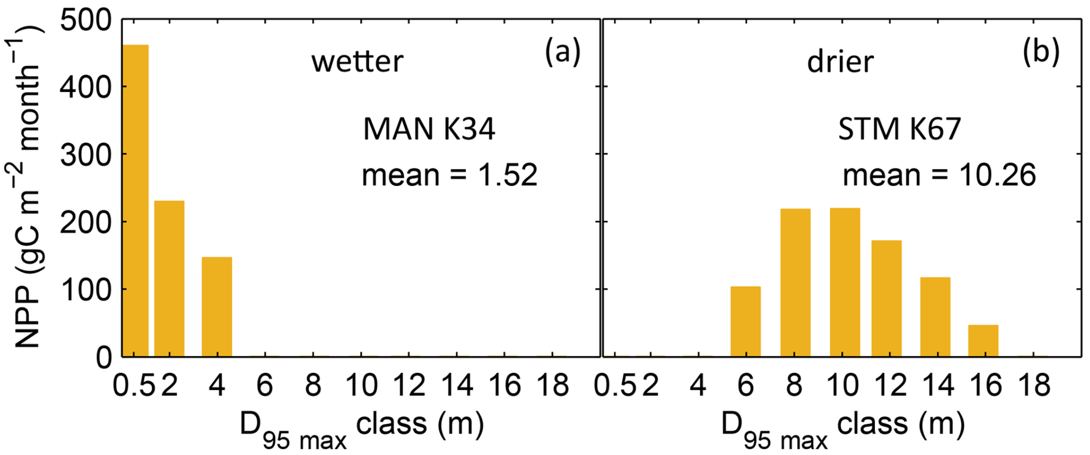
2.4 Flexible rooting schemes improve evapotranspiration simulation



Manaus:
mean annual precipitation: 2609 mm
Mean MCWD: -222 mm
Sub-PFT with D95_max = 0.5m contributes most to overall NPP
NPP-weighted D95_max = 1.52 m

Santarém:
mean annual precipitation: 2144 mm
Mean MCWD: -465 mm
Sub-PFT with D95_max = 10m contributes most to overall NPP
NPP-weighted D95_max = 10.26 m

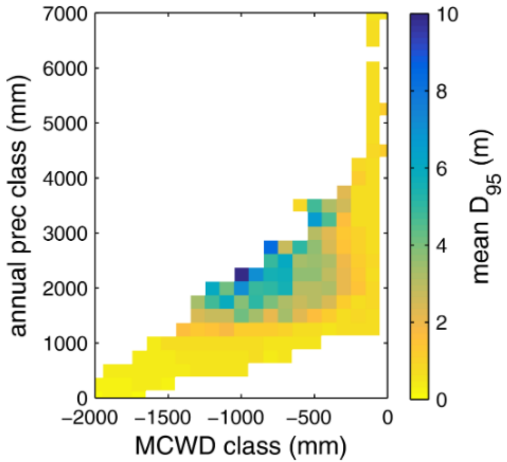


Figure B5. Mean rooting depth depicted as mean $\overline{D_{95}}$ over classes of MCWD and annual precipitation sums. Class step size for precipitation was set to 250 mm, and class size for MCWD was set to 50 mm. Regions with high amounts of annual rainfall and lower seasonality exclusively favour shallow-rooted forests (low $\overline{D_{95}}$). $\overline{D_{95}}$ increases with decreasing MCWD (increasing seasonal drought stress) and decreasing sums of annual precipitation. Below 1200 mm of annual rainfall or −1100 mm of MCWD, $\overline{D_{95}}$ sharply decreases again. Note this figure does not consider soil depth. The colour-scale maximum is set to 10 m.

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3. Outlook on planned activities for B-EPICC Project in Peru

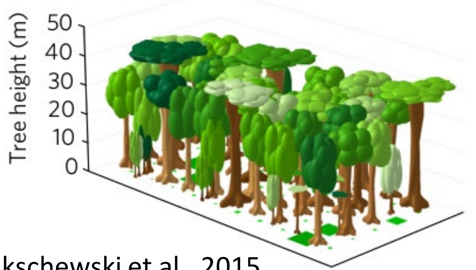
P I K

3. Outlook on planned activities for B-EPICC Project in Peru

Research questions

- Quantify contribution of forest recovery to ecosystem services (C storage, local evapotranspiration)
- Address potential recovery of biodiversity
- Climate change impact on forest recovery

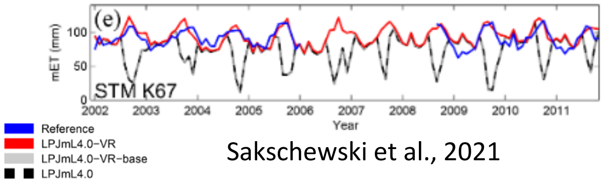
LPJmL-FIT:
LPJmL with Flexible Individual Traits



Sakschewski et al., 2015

- Biomass, **ET**, functional richness
- Functional **biodiversity** of forest communities
- **Successional Pathways** of forests re-growing on abandoned land
- Forest resilience
- **Climate change** and land-use scenarios

Flexible tree root growth improved ET simulation



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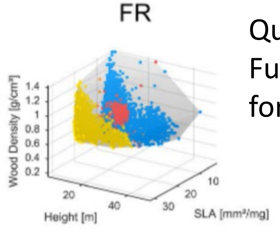
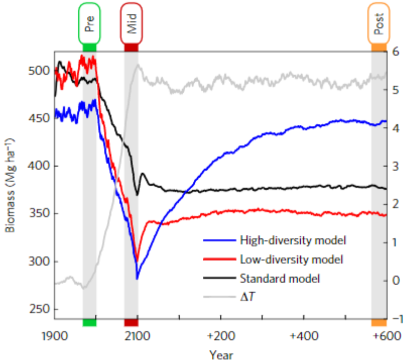


Quantifying Biodiversity: Functional richness of the forest community

Thonicke et al., 2020



Diverse forests more resilient to climate change

Sakschewski et al., 2016

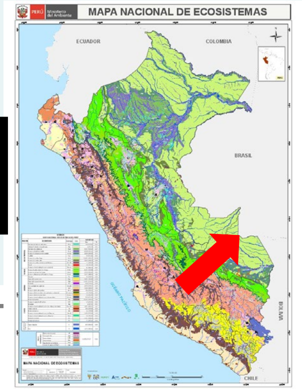
Sakschewski et al., 2021: Variable tree rooting strategies are key for modelling the distribution, productivity and evapotranspiration of tropical evergreen forests. https://doi.org/10.5194/bg-18-4091-2021
Sakschewski et al., 2016: Resilience of Amazon forests emerges from plant trait diversity. https://www.nature.com/articles/nclimate3109

4. Outlook on planned activities for B-EPICC Project in Peru

Workpackage I: Validation of LPJmL-FIT in Peru

- Initialize LPJmL-FIT for selected forest sites in Peru
- Study sites along climate and elevation gradient
- Validation: Biomass, functional traits (SLA, WD, height), ET and NPP measurements, root distribution
- Cloud forests
- Current climate

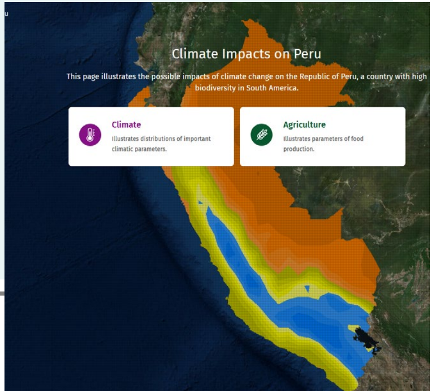
collaboration with PUCP (Pontificia Universidad Católica del Perú)



Workpackage II: Modeling the potential of Perus secondary forests for climate change mitigation and biodiversity recovery

- Apply adapted LPJmL-FIT across Peru
- Set-up trajectories of forest recovery
- Consider land-use history
- Transient runs under future climate change scenarios

collaboration with institutions in Peru



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4. Discussion & Questions

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