SIMANFOR: A Cloud Forest Decision Support System

Bravo, Felipe
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Michalakopoulos, Spyros
Ordoñez, Cristóbal

SMART ECOSYSTEMS Research Group
UVa iuFOR

Universidad de Valladolid

Some definitions:

MODEL: Abstraction of the dynamics of a forest stand that may include various components (e.g., growth, mortality, etc.) and have various approaches (empirical, physiological, successional, etc.) and prediction scales for both the object to be modeled (forest, cohort, tree, etc.) and the projection time of the results (days, years, decades, etc.)

PARAMETRIZATION:

SIMULATOR:

SCENARIO:

Some definitions:

MODEL: Abstraction
PARAMETRIZATION: Parameters, values, rules, etc., which enable the abstraction represented by the models to describe the evolution of specific forest stands with defined species composition, productivity, etc.

SIMULATOR:

SCENARIO:

Some definitions:

MODEL: Abstraction
PARAMETRIZATION: Specific representation
SIMULATOR: Digital tool that can run different silvicultural scenarios using forest-based input data and provide useful information for decision-making.

SCENARIO:

Some definitions:

MODEL: Abstraction
PARAMETRIZATION: Specific representation
SIMULATOR: Digital tool

SCENARIO: Specific silvicultural path defined to accomplish defined objectives in a given stand

Some definitions:

MODEL: Abstraction

PARAMETRIZATION: Specific representation

SIMULATOR: Digital tool

SCENARIO: Silvicultural path

Some definitions:

MODEL: Abstraction

PARAMETRIZATION: Specific representation

SIMULATOR: Digital tool

SCENARIO: Silvicultural path

$$\Delta d = e^{\beta_0 + \sum_{i=1}^{n} X_i * \beta_i}$$

SITE = SI, f(altitude, soil) — 2

x

SIZE = d, d^2 — 2

x

AGE = 1/A — 1

x

DENSITY = N, G , G^{-1} — 3

x

COMPETITION = BAL, CCFL, d/dg — 3

x

VIGOR = f(CR) — 1

36

Some definitions:

MODEL: Abstraction

PARAMETRIZATION: Specific representation

$$\Delta DBH = e^{\left[a_0 + a_1 \cdot \ln(DBH+1) + a_2 \cdot DBH^2 + a_3 \cdot \left(\frac{CR+k_1}{1+k_1}\right) + a_4 \cdot \ln(SI) + a_5 \cdot \left(\frac{BAL^2}{\ln(SBA+k_2)}\right) + a_6 \cdot \sqrt{SBA}\right]}$$

Bravo, F. (2005) https://doi.org/10.5281/zenodo.11621952

Best player for each position

=

Best equation for each process

Sometimes the combinations of best player led to win

Sometimes, **not!!**

Some definitions:

MODEL: Abstraction

PARAMETRIZATION: Specific representation

SIMULATOR: Digital tool

SCENARIO: Silvicultural path

Ecological Informatics 77 (2023) 102246

Contents lists available at ScienceDirect

Ecological Informatics

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

Evaluation and validation of forest models: Insight from Mediterranean and scots pine models in Spain

A. Vázquez-Veloso [a,b,*], V. Pando [a,c], C. Ordóñez [a,b], F. Bravo [a,b]

Models Evaluation

SIMANFOR

Ecological Modelling 499 (2025) 110912

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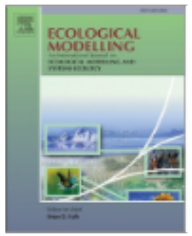


Check for updates

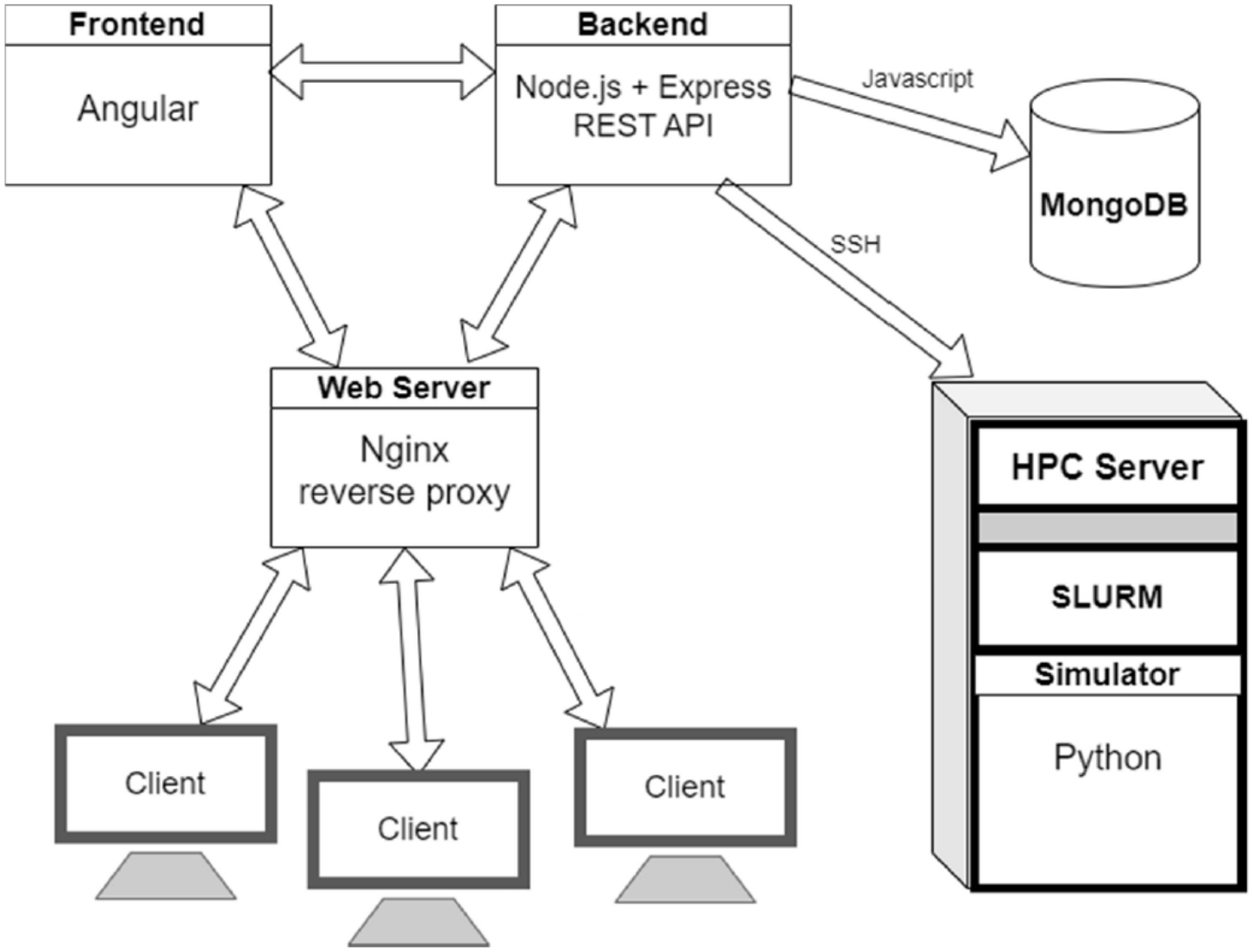
SIMANFOR cloud Decision Support System: Structure, content, and applications

F. Bravo *, C. Ordóñez, A. Vázquez-Veloso, S. Michalakopoulos

SMART Ecosystems Group, Departamento de Producción Vegetal y Recursos Forestales, Instituto Universitario de Investigación en Gestión Forestal Sostenible (iuFOR), ETS Ingenierías Agrarias, Universidad de Valladolid, Avda. de Madrid 57, 34004 Palencia, Spain

Bravo et al. (2025)

https://www.simanfor.es



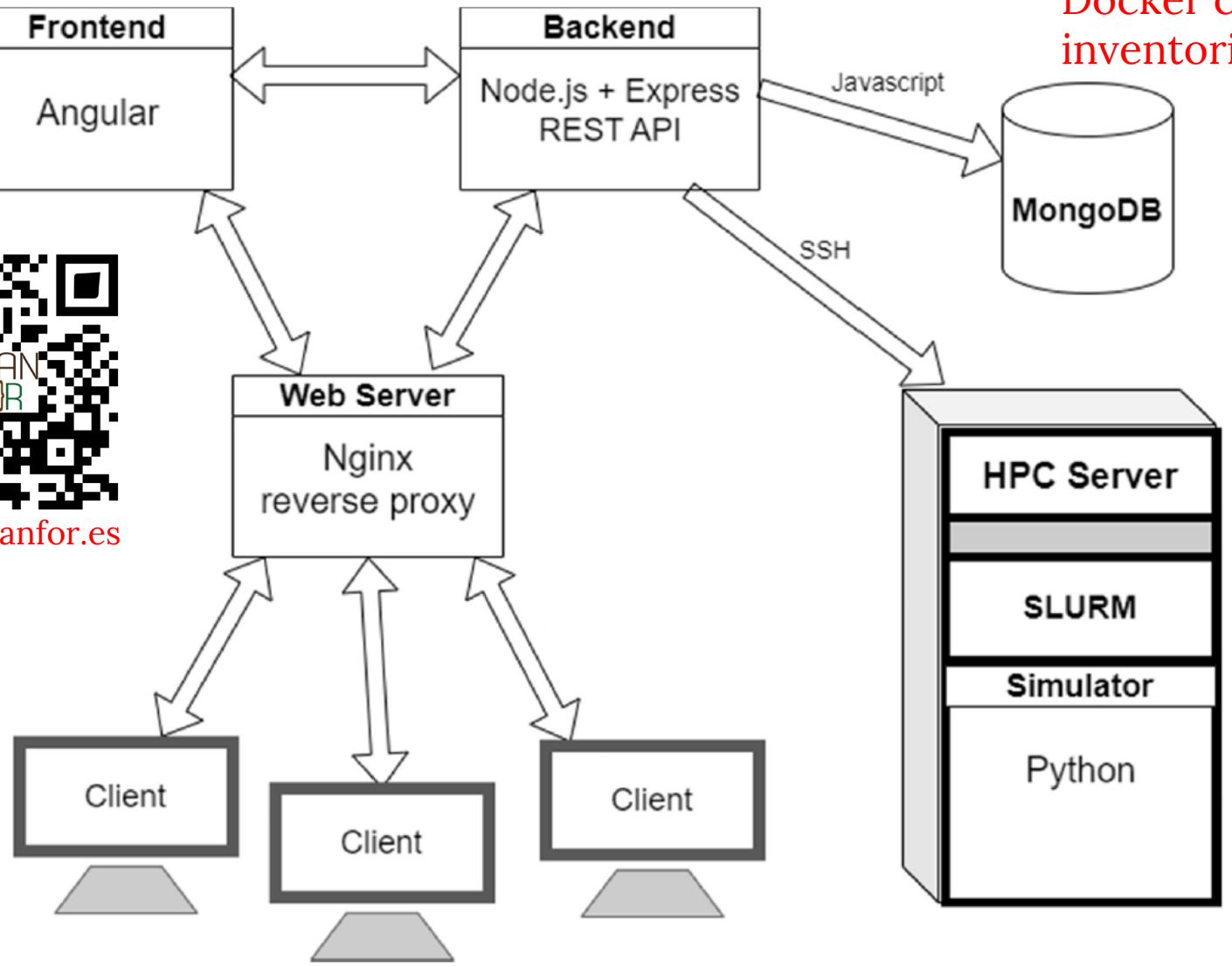
Modular architecture

Local/Remote execution

Web interface

Simulator core

Docker container (Entities: inventories, models, scenarios, users..)



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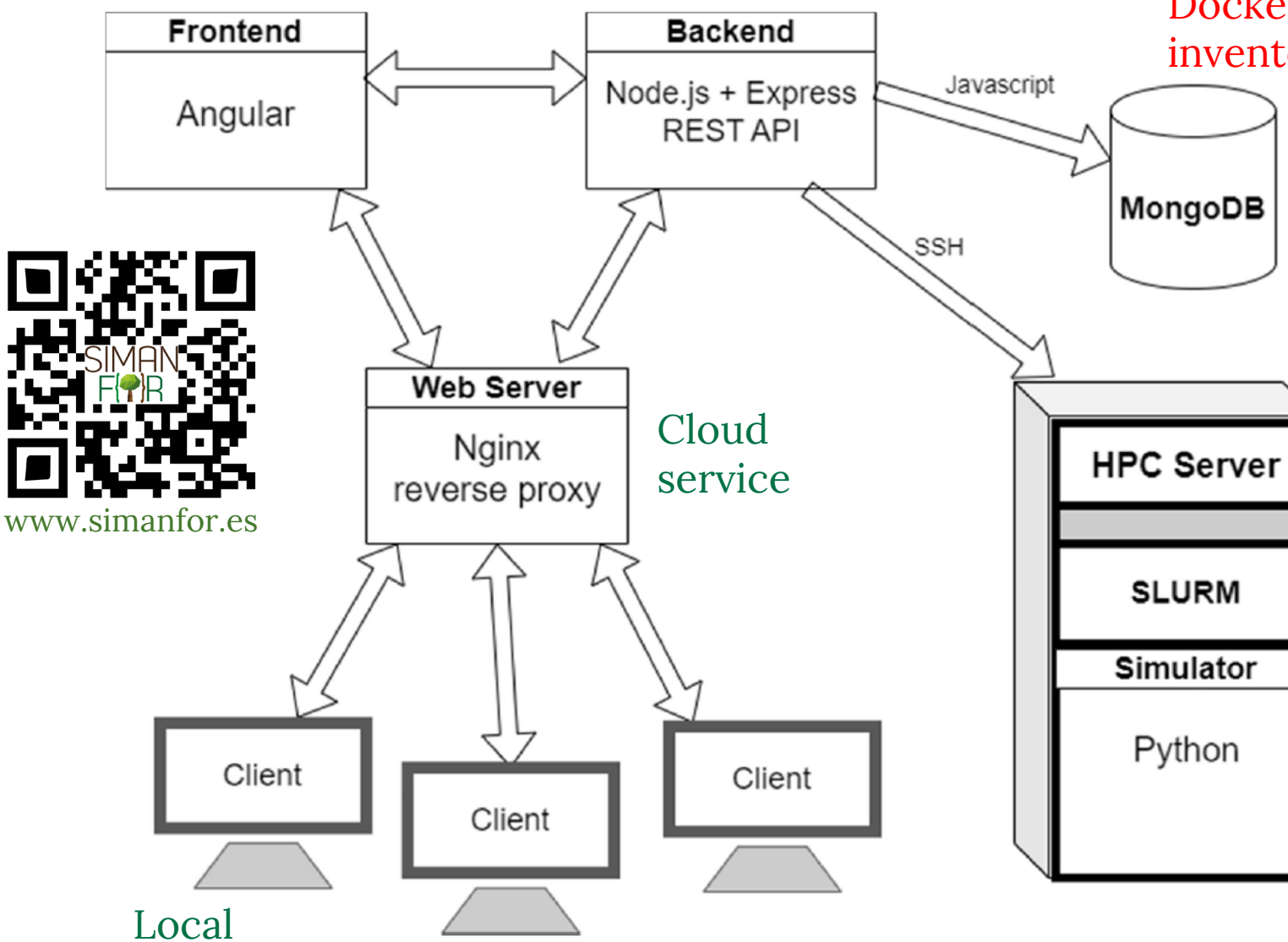


www.simanfor.es

Cloud service

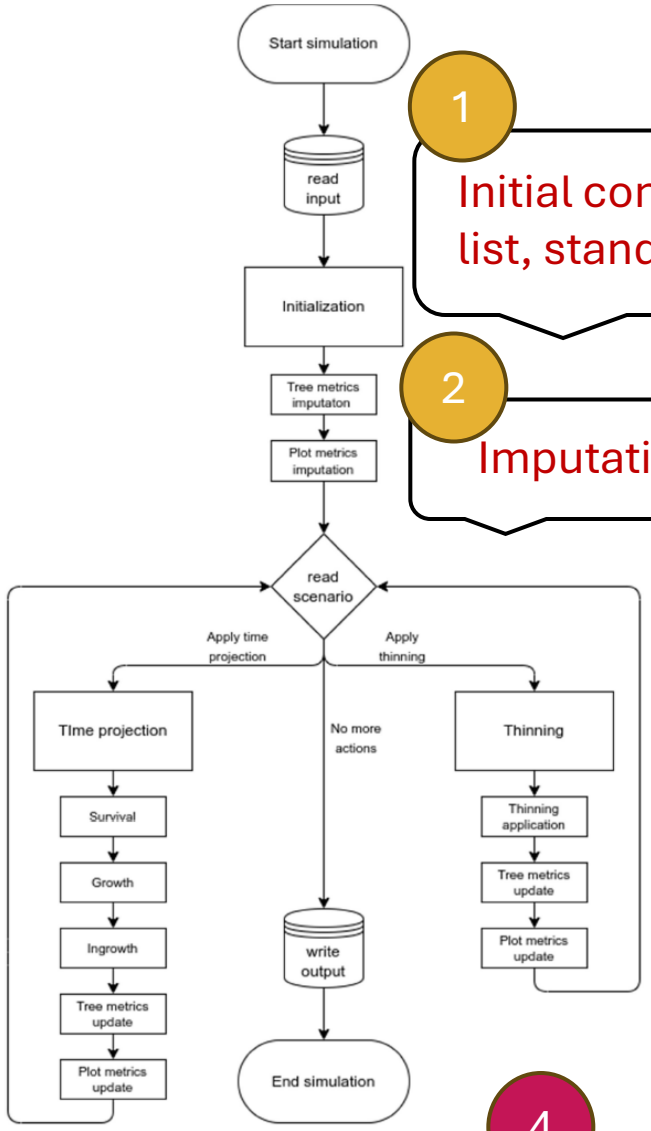
Modular architecture

Local/Remote execution

High Performance Computing

Local stand-alone

Simulations



1

Initial condition (tree list, stand variable…)

2

Imputation

3

Thinning:
NO/YES
Type (systematic, from below, from above (with/without reserve of crop trees…)
Criteria (N, G, V)
Intensity (%)
Ages of intervention (exact, maximum, minimum)

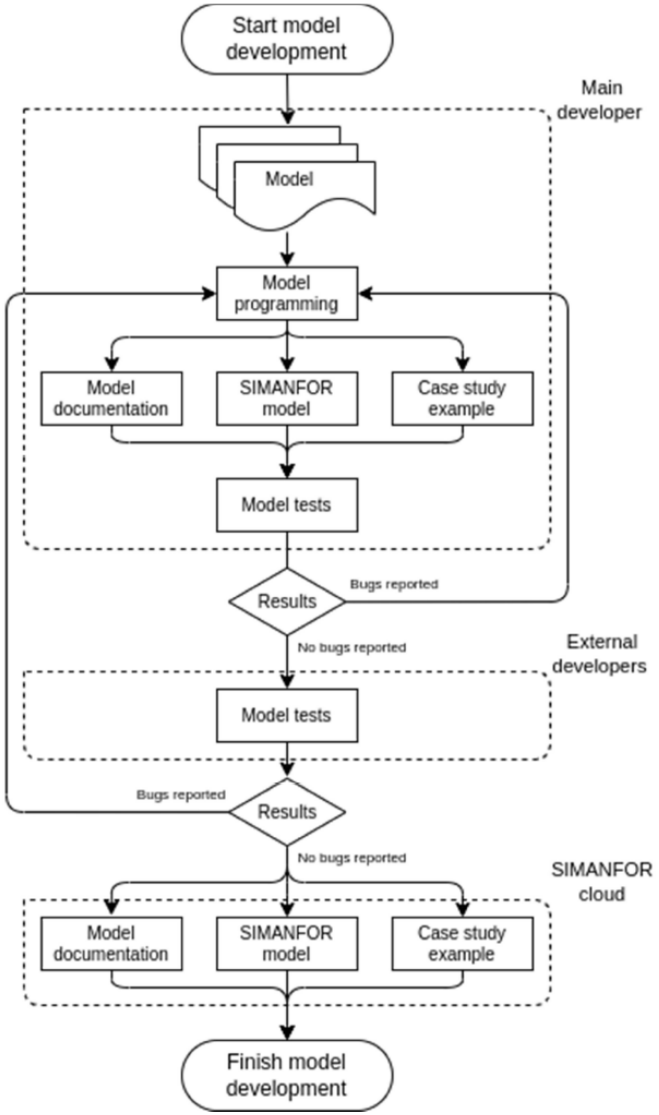
4

Time projection
Submodels aplication

4

Final output

Models/parametrizations implementation



1. UVa's team
2. Interested teams test
3. Model ready for use

1 Education

Insight on quantative forestry
Explore alternative silvicultural paths
Assessment of ecosystem services
Evaluation of stand dynamic, allometry

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It is a Master in Data Science. **Data Science** is one of the most important tools for Environmental Management. If you are a university graduate in degrees related to nature and the rural environment, or you are interested in these subjects, you can study the DATAFOREST master's degree (More details in the ADMISSION link). In addition, if you want to obtain more information, solve doubts or register, but you are out of time, you can write to us at master.gestion.forestal@uva.es.

PDF master information

2 Research

Explore situations without observational or experimental data
Generate comprehensive growth and yield synthetic datasets
Develop methodologies for model evaluation and validation

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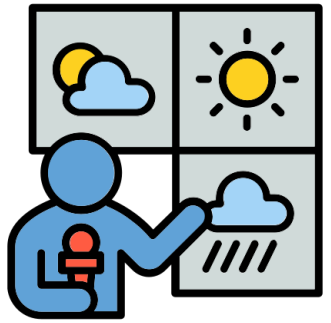
https://doi.org/10.1016/j.ecoinf.2023.102246

3 Management

Yield simulations for forest planning
Assessment and comparison of alternative silvicultural paths
Explore management strategies under limited silvicultural experience



Small4Good

https://small4good.eu/

Trade-offs

European Journal of Forest Research (2025) 144:893–907
https://doi.org/10.1007/s10342-024-01752-3

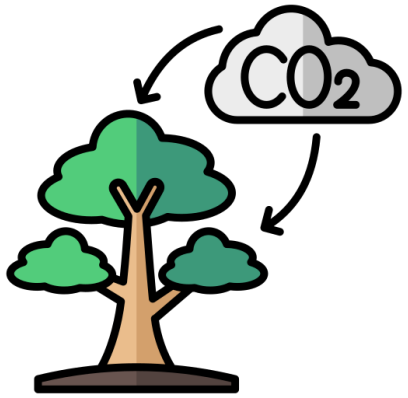
RESEARCH

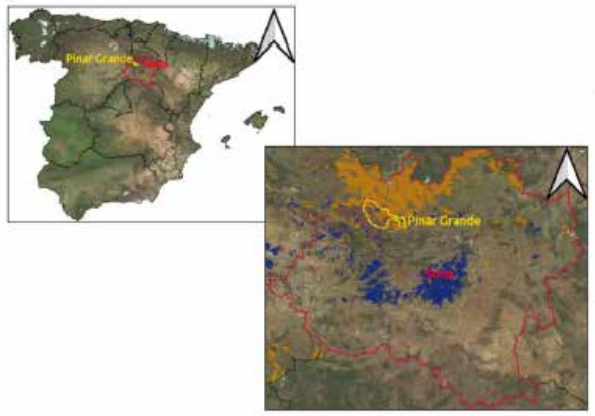
Trade-offs and management strategies for ecosystem services in mixed Scots pine and Maritime pine forests

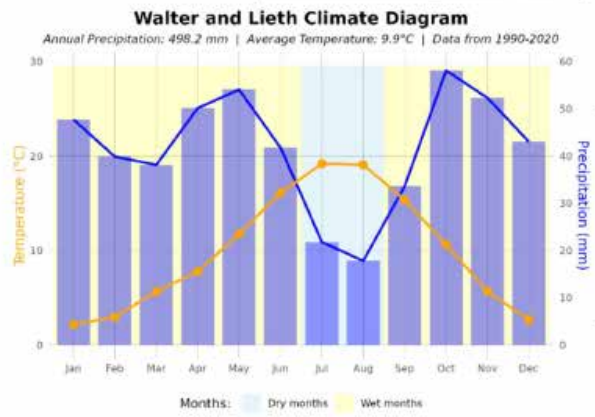
A. Vázquez-Veloso[1] · I. Ruano[1] · F. Bravo[1]

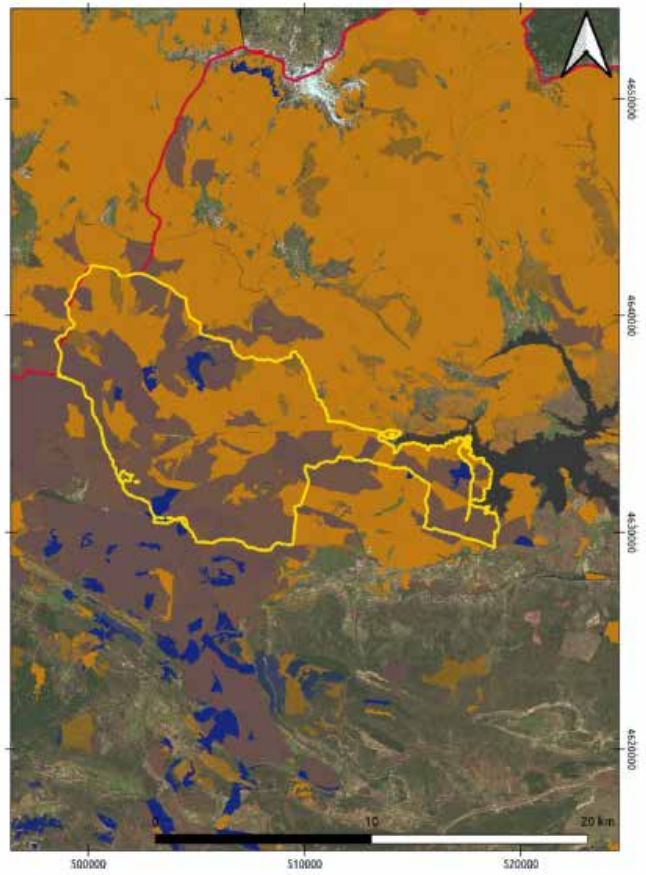
Vázquez-Veloso et al. (2025)

Mixed pine forests (*Pinus sylvestris*/*Pinus pinaster*) Northern Spain









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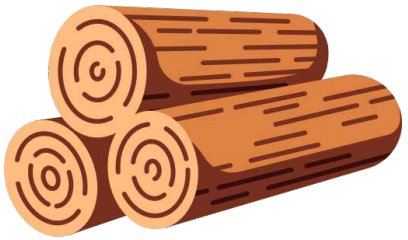

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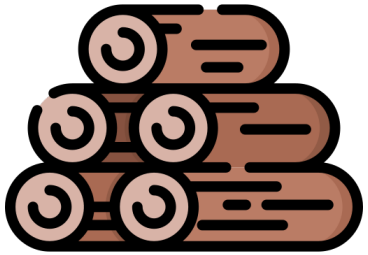
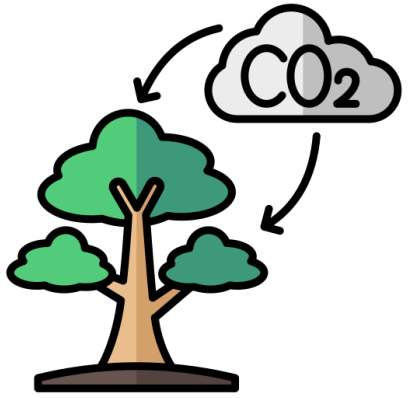


Trade-offs



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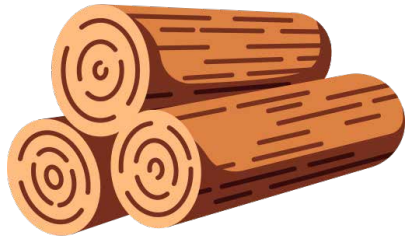

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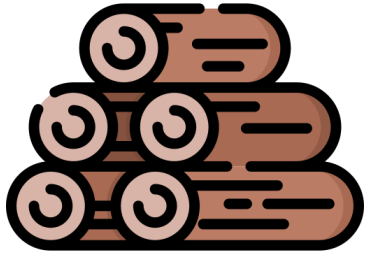
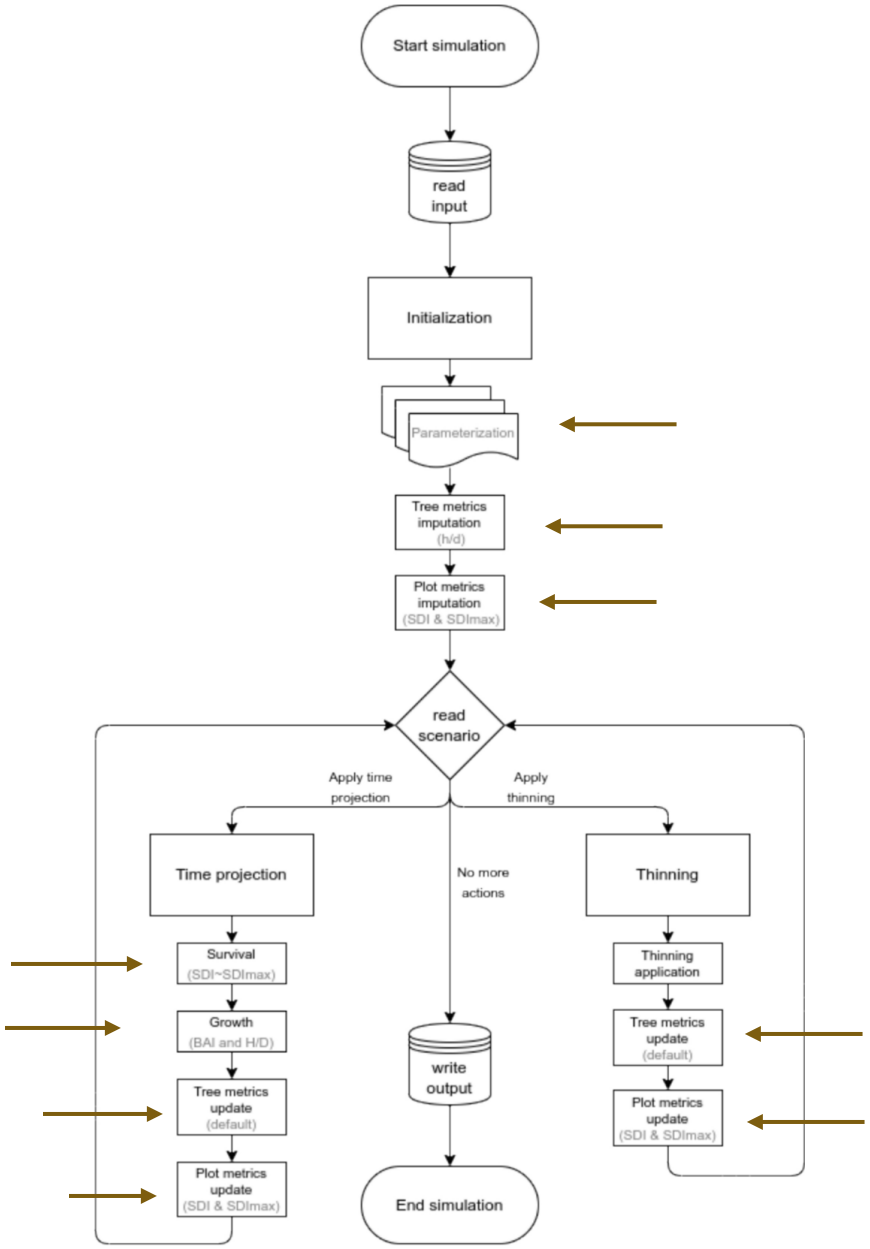


Trade-offs



Model adaptation

Mixing effects
Climate sensitive
Non-wood products

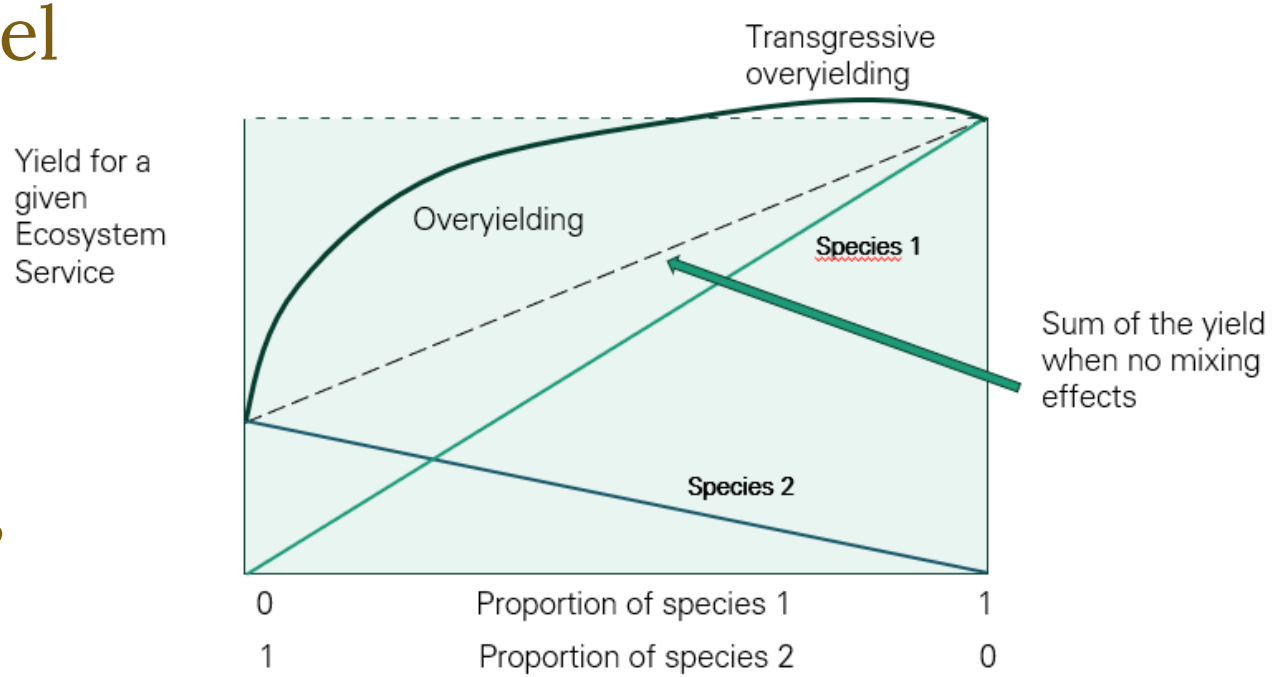
Mixing effects representation

- Species substitution in the model (no mixing effect)

- Multiplier to represent over/under yielding

- Differential competition indices

- Process models



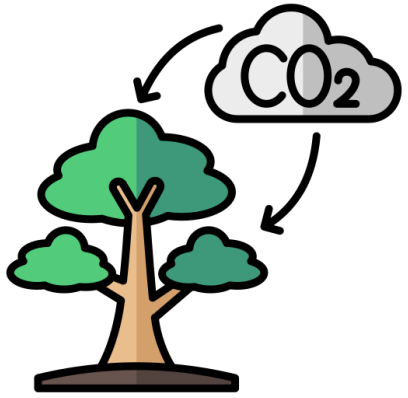
Forest Systems
28 (1), eR002, 18 pages (2019)
eISSN: 2171-9845
https://doi.org/10.5424/fs/2019281-14342
Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria O. A., M. P. (INIA)

REVIEW ARTICLE

OPEN ACCESS

Modelling approaches for mixed forests dynamics prognosis. Research gaps and opportunities

Felipe Bravo[1,2], Marek Fabrika[3], Christian Ammer[4], Susana Barreiro[5,6], Kamil Bielak[7], Lluis Coll[8], Teresa Fonseca[5,9], Ahto Kangur[10], Magnus Löf[11], Katarina Merganičová[19], Maciej Pach[12], Hans Pretzsch[13], Dejan Stojanović[14], Laura Schuler[15], Sanja Peric[16], Thomas Rötzer[13], Miren del Río[1,17], Martina Dodan[16] and Andrés Bravo-Oviedo[1,17,18]



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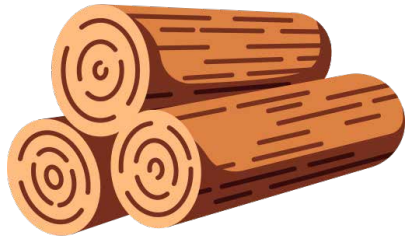

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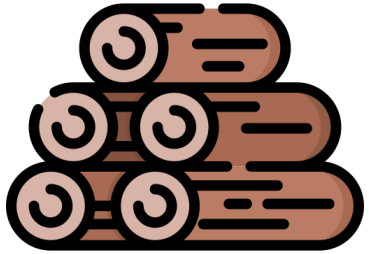
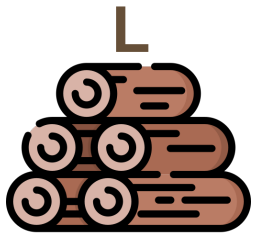


50% - 50%



Silviculture 1

Silviculture 2

...

Silviculture 4

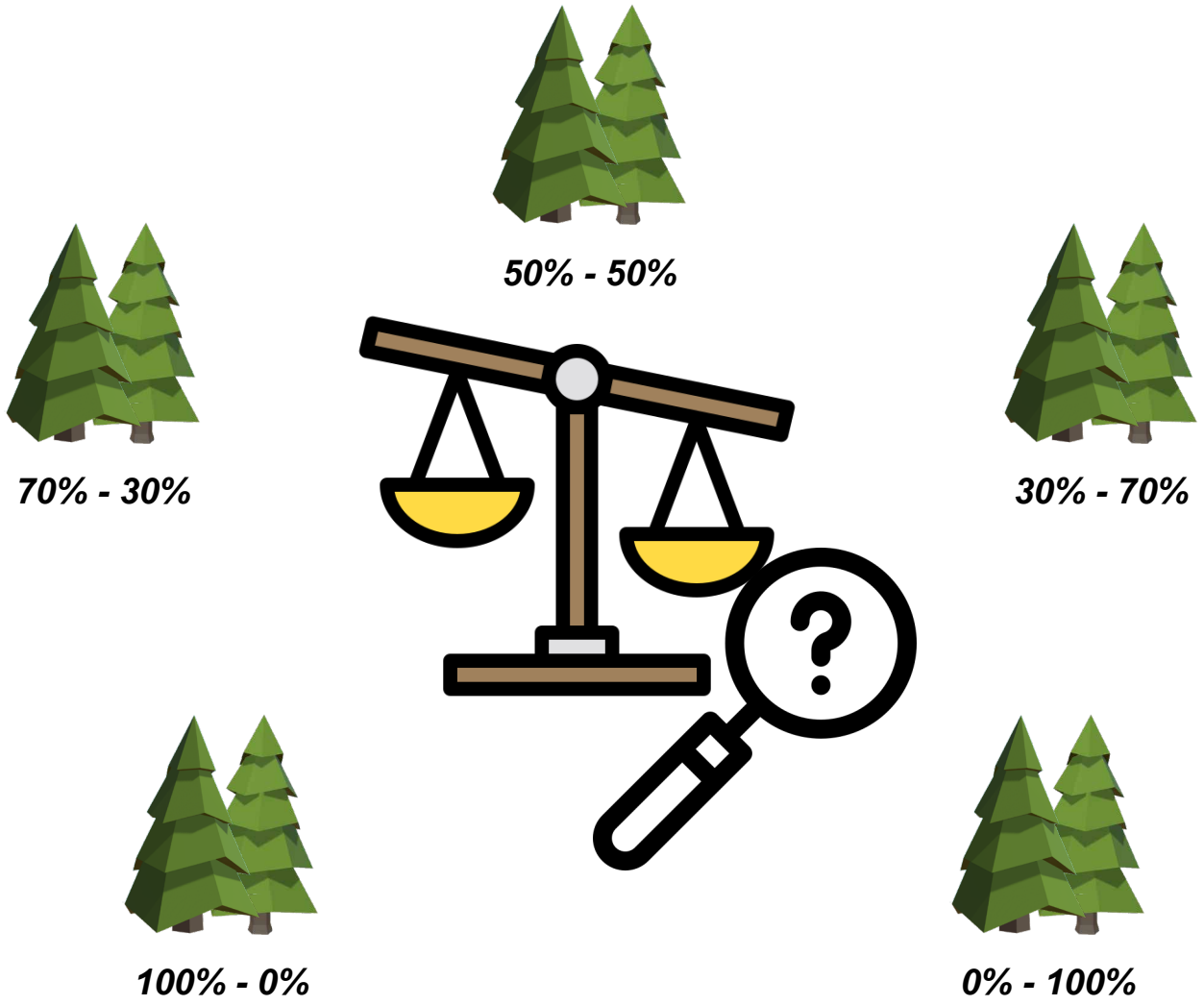
50% - 50%

70% - 30%

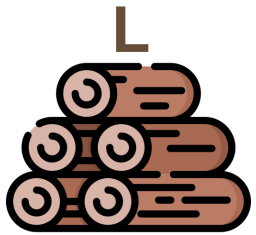
30% - 70%

100% - 0%

0% - 100%


50% - 50%
70% - 30%
30% - 70%
100% - 0%
0% - 100%

Silviculture 1



50% - 50%

70% - 30%

100% - 0%

Trade-offs

Ecosystem services

Stand type	Silvicultural scenarios	(m³·ha⁻¹)	Ecosystem services (m³·ha⁻¹)	(kg·ha⁻¹·year⁻¹)	Carbon (tn·ha⁻¹)
PS	WOOD	0.00	193.19	54.16	302.25
	MUSHROOM	0.00	262.05	54.33	382.46
	CARBON	0.00	251.13	55.18	364.94
	BAU	0.00	204.70	49.81	293.92
	CONTROL	0.00	220.76	36.49	237.28
PS70	WOOD	56.51	318.06	29.23	324.23
	MUSHROOM	22.32	456.82	39.76	420.35
	CARBON	22.66	437.71	39.25	406.74
	BAU	17.14	355.86	31.32	324.80
	CONTROL	0.00	335.80	22.36	279.02
PS50	WOOD	79.43	353.15	21.83	321.47
	MUSHROOM	24.50	532.82	32.45	424.68
	CARBON	20.31	495.92	31.77	411.37
	BAU	0.00	391.82	24.42	327.84
	CONTROL	0.00	370.16	17.56	293.46
PS30	WOOD	75.54	407.90	17.98	315.19
	MUSHROOM	25.61	568.22	25.80	418.00
	CARBON	27.42	539.59	25.14	405.10
	BAU	0.00	411.78	18.65	321.54
	CONTROL	0.00	392.80	13.71	292.53
PP	WOOD	59.00	428.63	14.80	299.31
	MUSHROOM	25.90	580.78	16.00	399.33
	CARBON	38.08	562.45	15.47	386.54
	BAU	0.00	425.65	12.93	302.47
	CONTROL	0.00	433.86	8.24	277.44

higher

lower

Questions? Let's talk

1. Do you know in North America a **similar tool** to SIMANFOR?
2. Can you describe three **strenghts/weaknesses** for SIMANFOR?
3. Do you want to **explore** SIMANFOR?

Talk Funded by **Plantation Management Research Cooperative,** Warnell School of Forestry and Natural Resources, University of Georgia

Plantation Management Research Cooperative
Warnell School of Forestry & Natural Resources
UNIVERSITY OF GEORGIA

SIMANFOR development and content funded by Castilla and León regional government through the project **"Escalera de Excelencia (CLU-2025-2-07) - iuFOR Institute Unit of Excellence of the University of Valladolid",** co-financed by the European Regional Development Fund (ERDF "Europe drives our growth") and Spanish Ministry of Science and Innovation through the project **Integrated Forest Management across Complexity Gradients IMFLEX** Grant PID2021-126275OB-C21 funded by MCIN/AEI/10.13039/501100011033 and by "ERDF A way of making Europe"

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