UNIVERSITY OF EASTERN FINLAND

Mathematical Tools for Holistic Planning of Peatland Management

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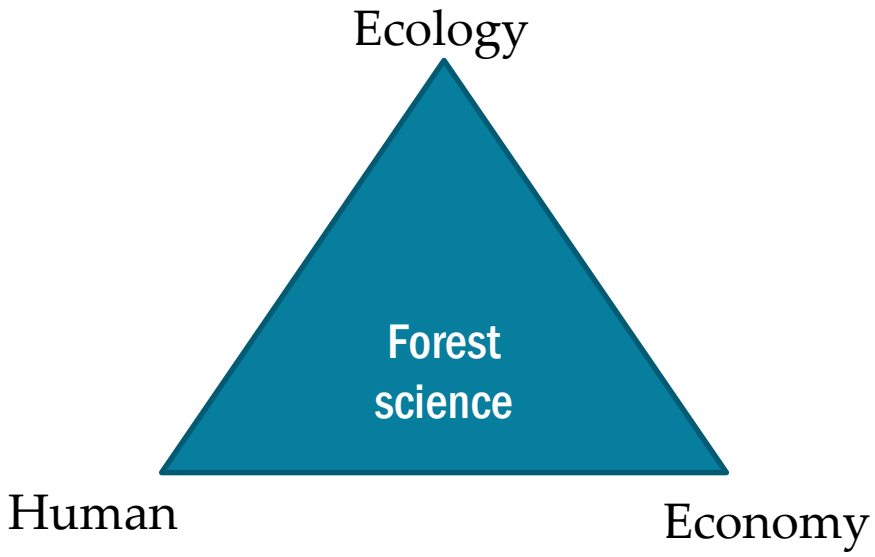
Annamari (Ari) Laurén

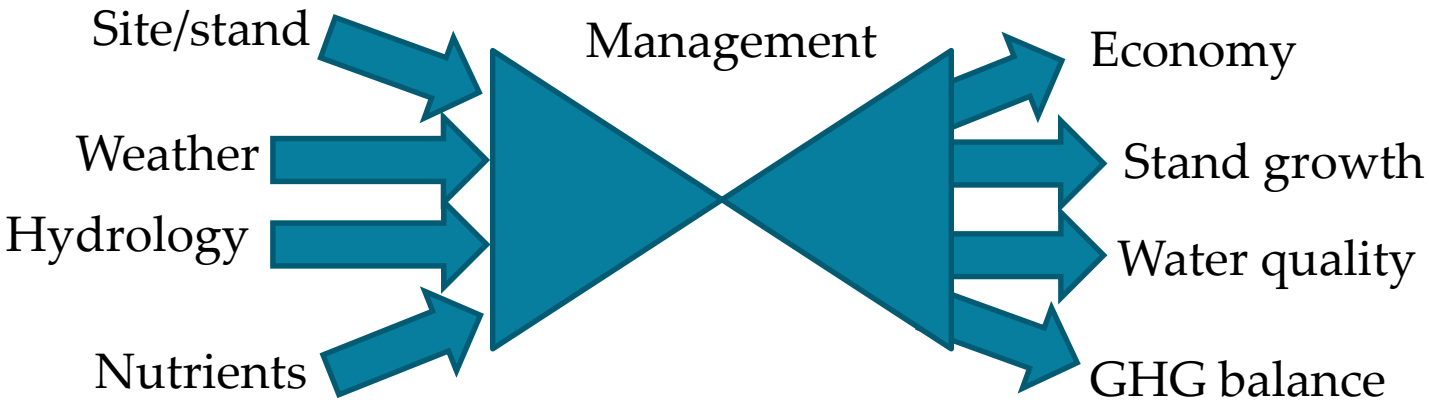
+ SUSI, Plantation and NutSpaFHy-teams

Pursue

Responsible forest management aims to find forest production schemes that are socially and environmentally bearable; socially and economically equitable; and environmentally and economically viable.



Shape of the task



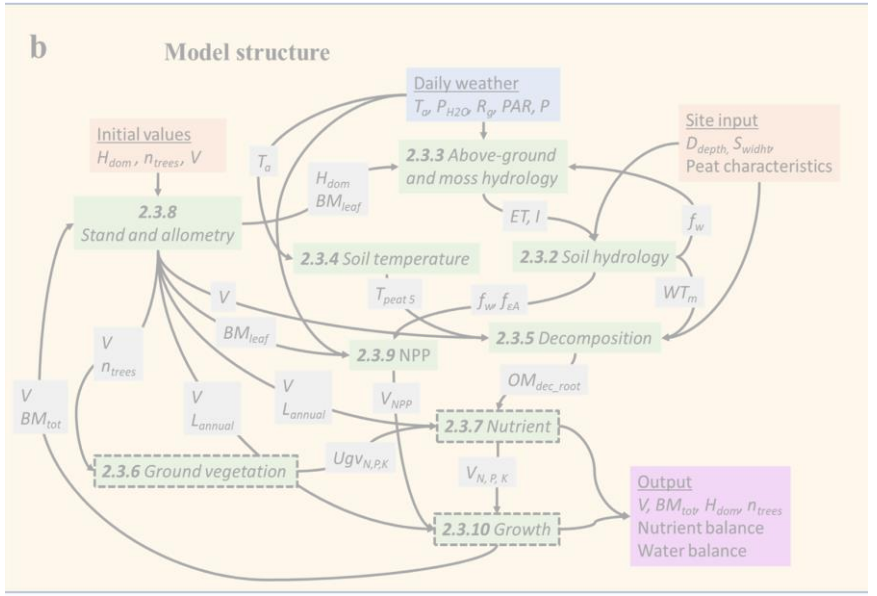
Means

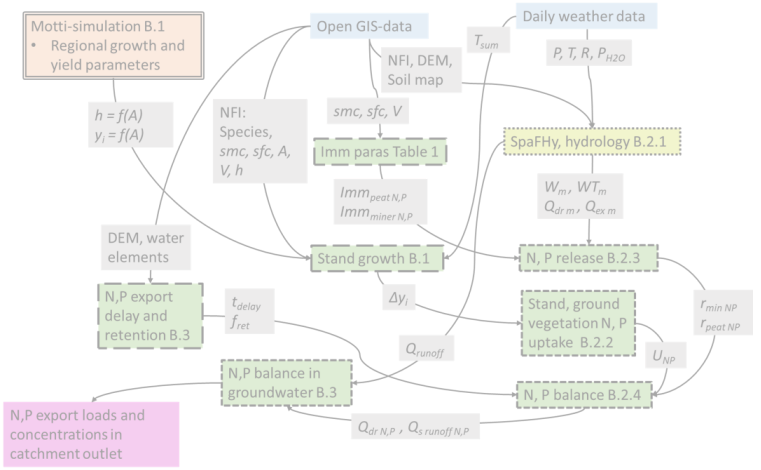
Ecosystem modelling

- Biogeochemical processes
- Hydrology, hydraulics, solute transport
- Growth and yield, photosynthesis
- Optimization techniques

Scales

- Stand, catchment, landscape



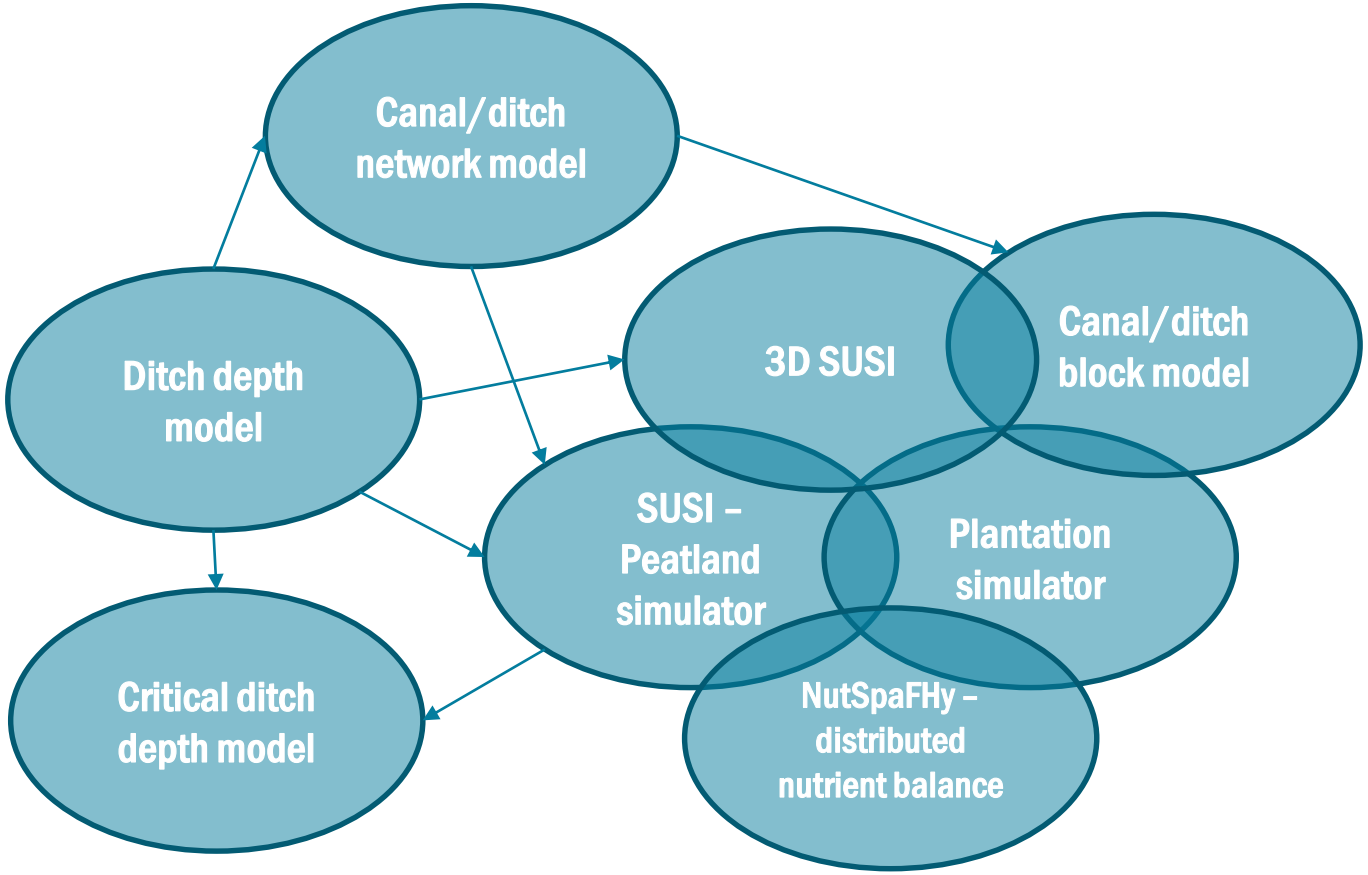


Tools:

Ecosystem models and model ecosystems

Input
Weather
GIS: Forest data, soil, terrain, waterbodies

Management
Clear cuts
CCFs
Fertilization
Weeding
Drainage
Restoration



Output
Growth and yield
Economic gain

GHG sinks & sources
C balances

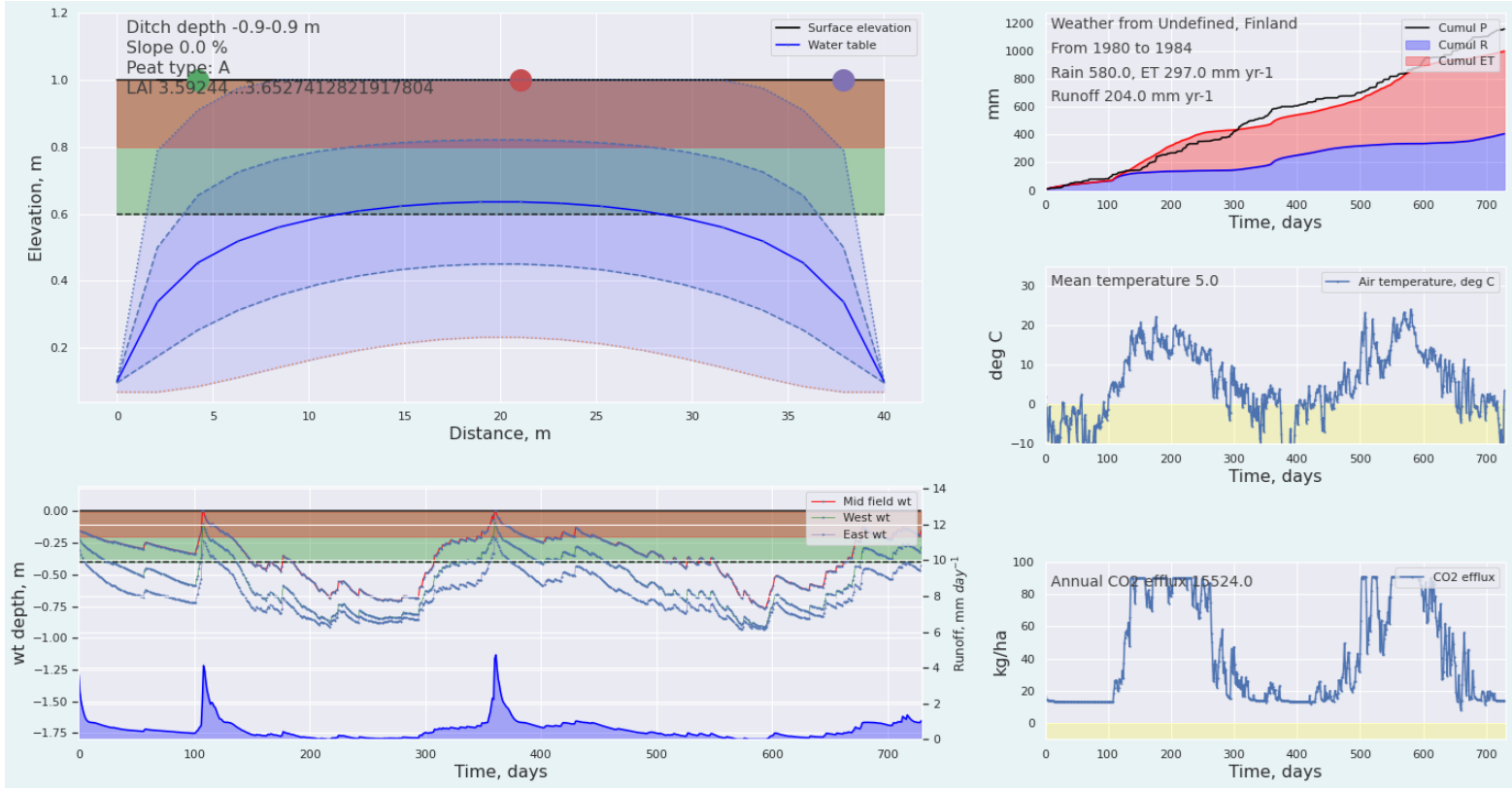
N, P, DOC export

Subsidence

Hotspots: GHG, Water quality

Laurén et al. 2021. Drainage and stand growth response in peatland forests. Description, testing, and application of mechanistic Peatland simulator SUSI. Forests12(3), 293; https://doi.org/10.3390/f12030293

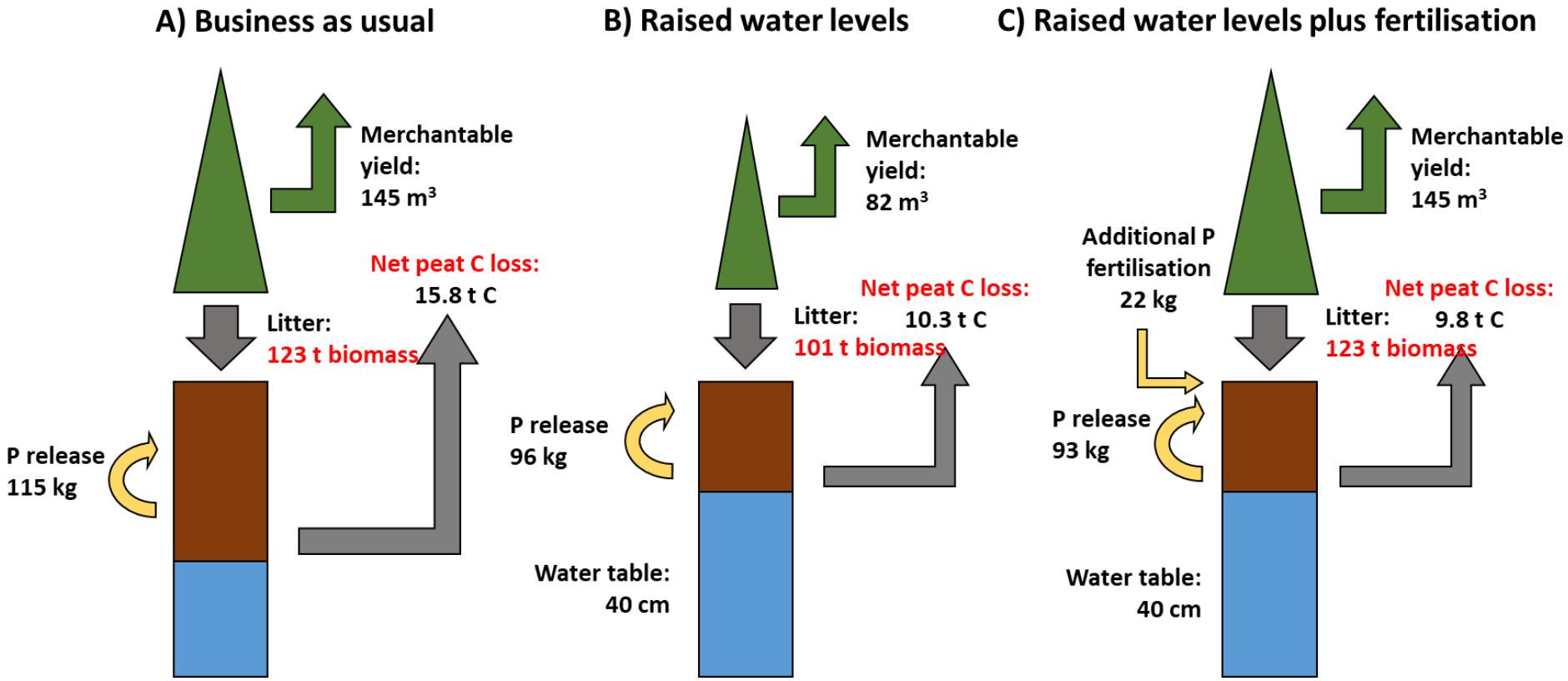
SUSI: Drainage, fertilization → stand growth, GHGs, nutrient export



ditch depth	initial volume	end volume	annual growrth	stand C bal	peat C bal	ch4 emiss	water table	log volume	pulp vol	Nleach
-0.3	92.98	106.822751	4.614250	260.962801	-3552.358123	-0.605303	-0.458744	0.0	103.753885	0.518923
-0.5	92.98	107.372531	4.797510	180.647017	-3965.231047	-2.078887	-0.522068	0.0	104.307682	0.740729
-0.7	92.98	107.725784	4.915261	112.173658	-4281.119286	-2.612092	-0.574157	0.0	104.663516	1.110693
-0.9	92.98	108.012738	5.010913	39.868507	-4587.770218	-2.968782	-0.627164	0.0	104.952566	1.607410

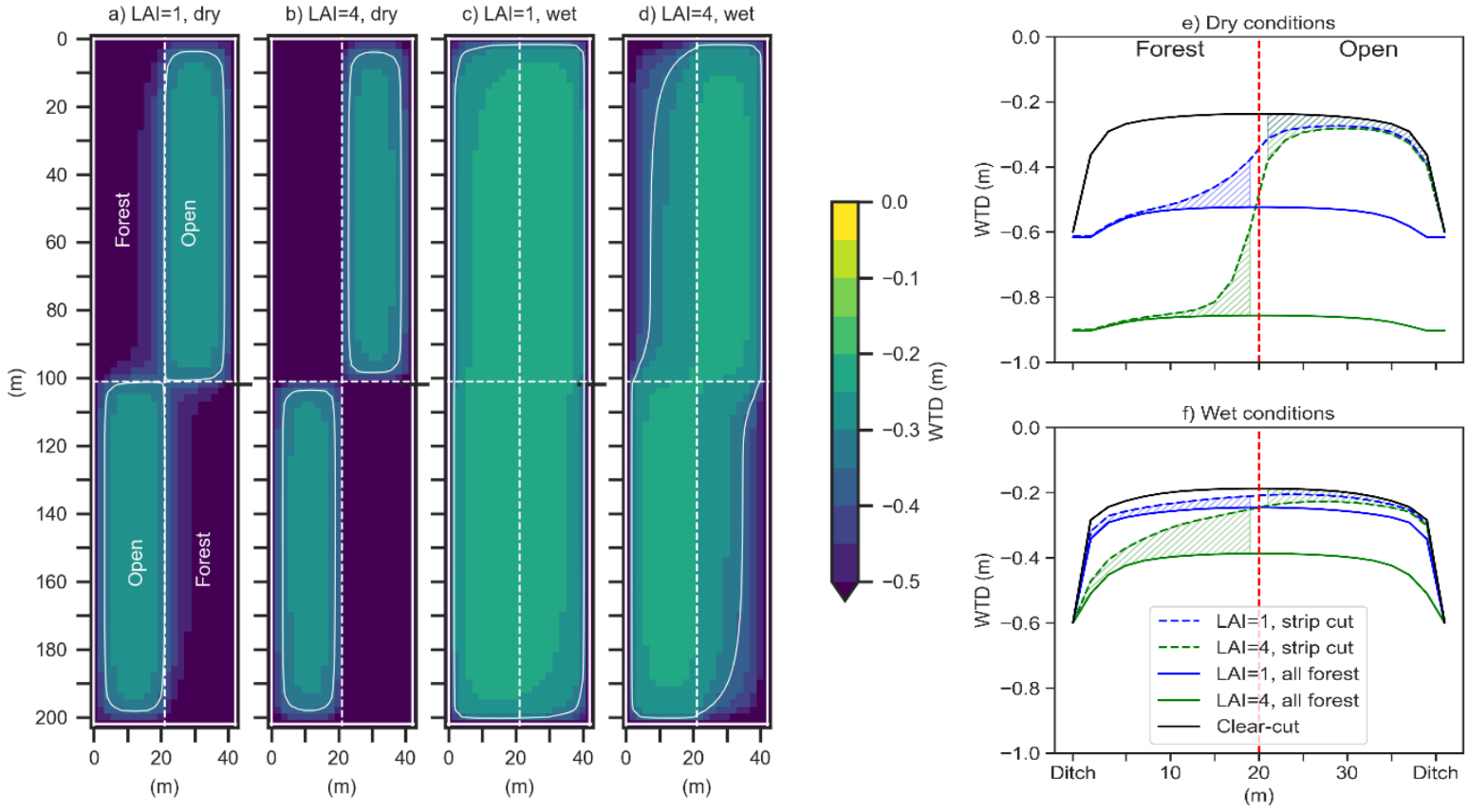
Laurén et al. 2021. Nutrient balance as a tool for maintaining yield and mitigating environmental impacts of Acacia plantation in drained tropical peatland – description of Plantation Simulator. Forests 2021, 12(3), 312; https://doi.org/10.3390/f12030312

Plantation simulator: drainage and nutrient management



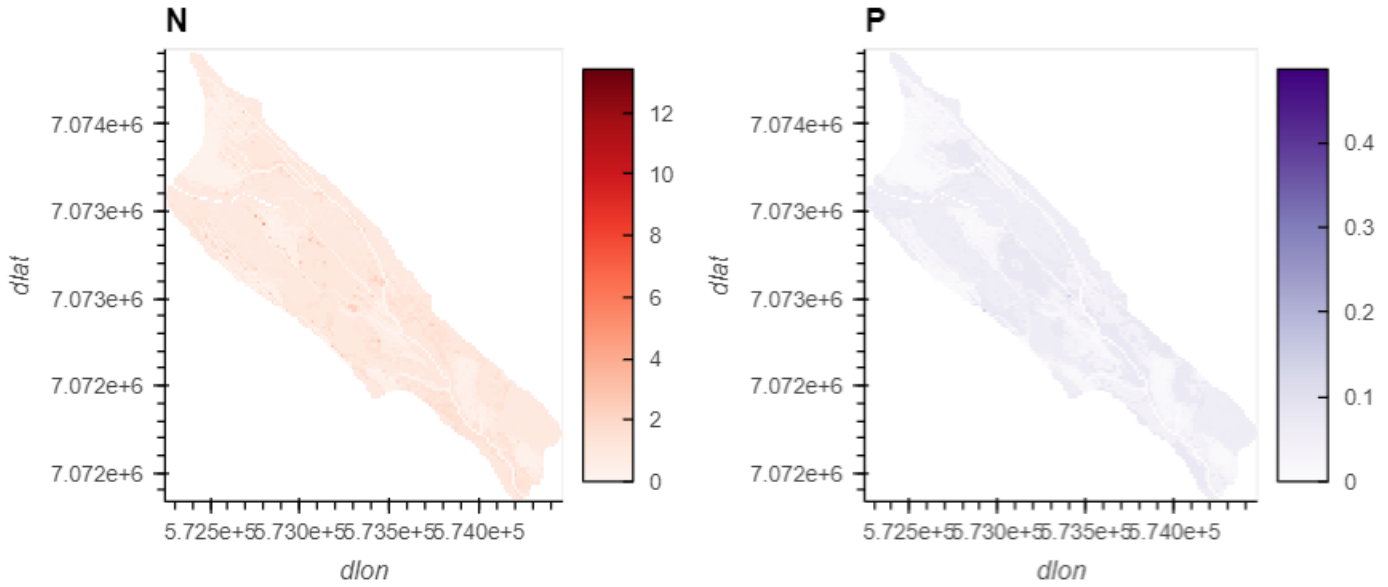
In prep.

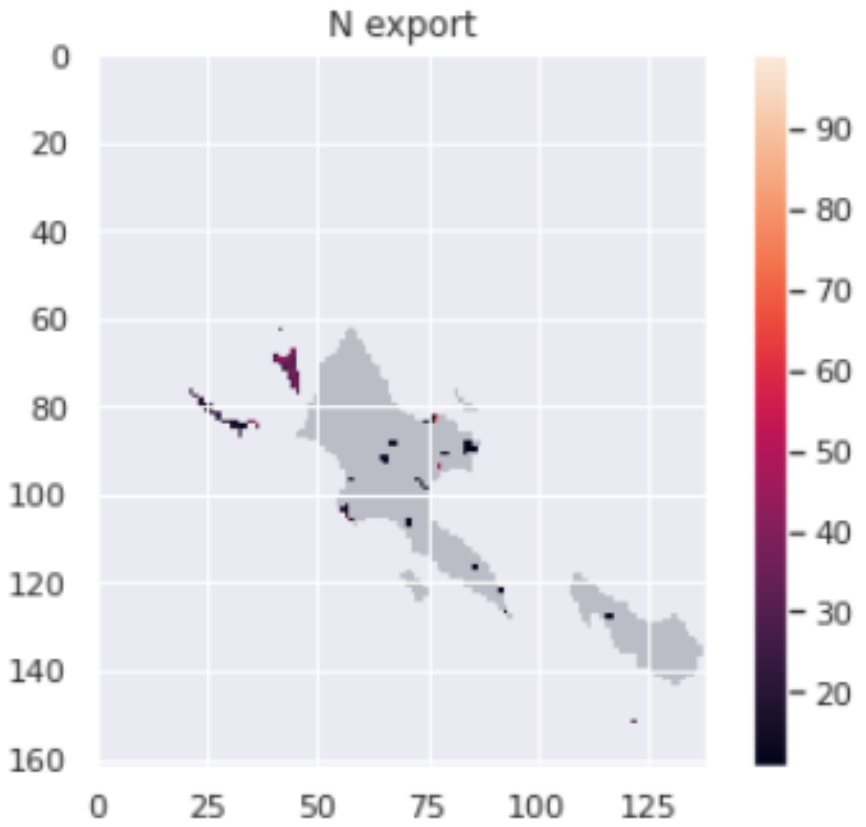
SUSI 3D: Continuous cover forestry, strip cuttings



Laurén et al 2021. NutSpaFHy - A Distributed Nutrient Balance Model to Predict Nutrient Export From Managed Boreal Headwater Catchments. Forests 12(6), 808; https://doi.org/10.3390/f12060808.

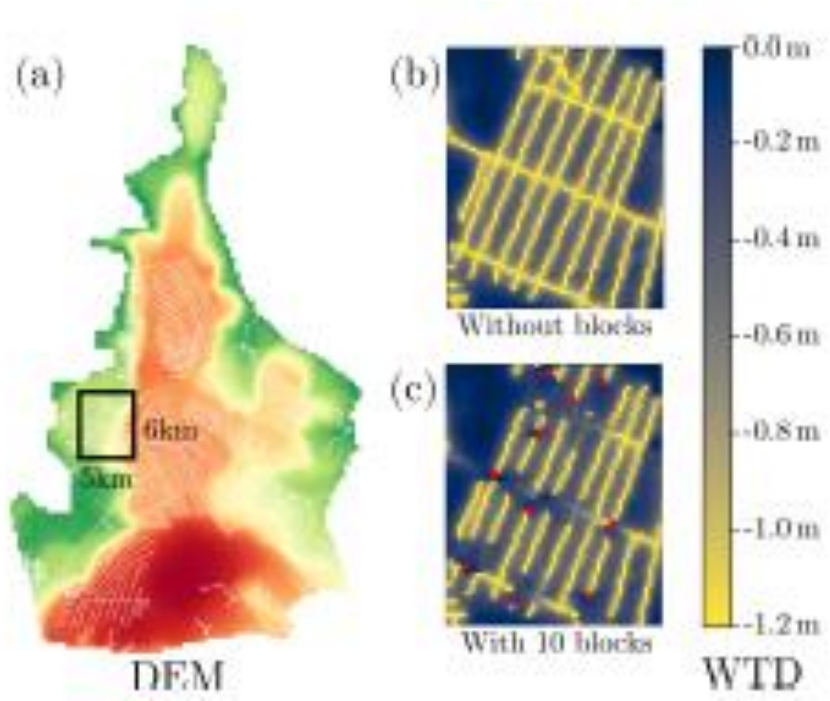
NutSpaFHy: Nutrient export hotspots → Locating water protection

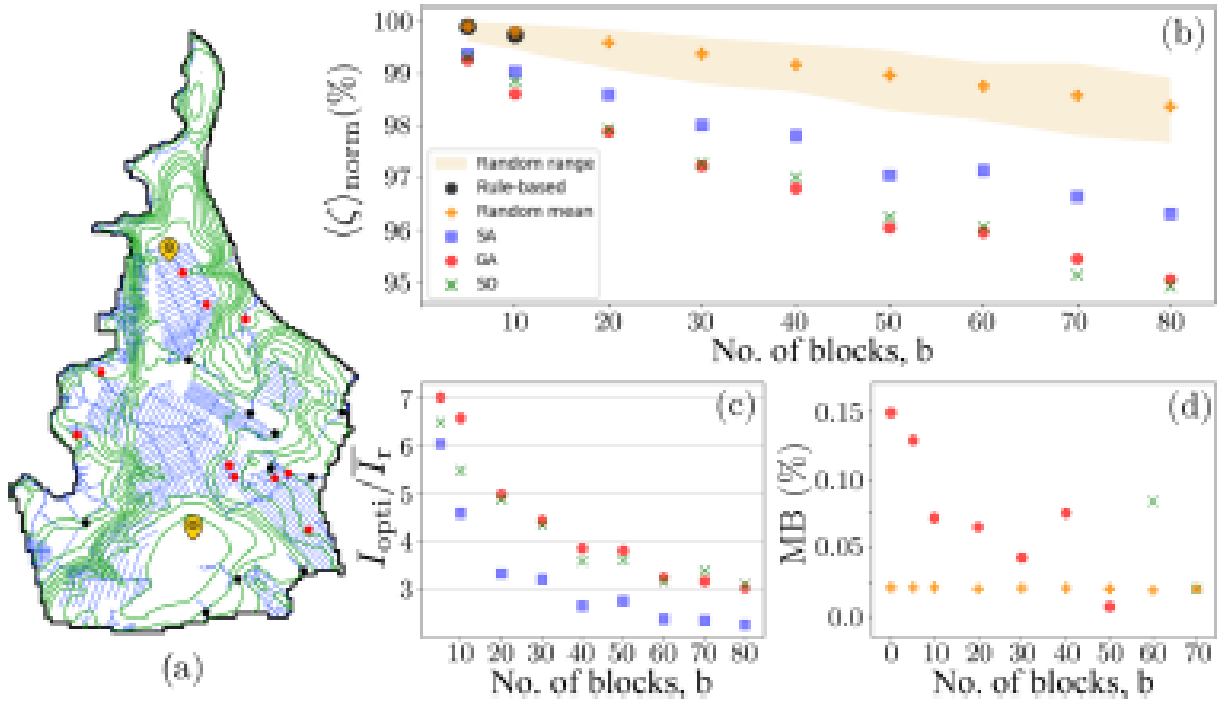




Urzainki et al. 2020. Canal blocking optimization in restoration of drained peatlands. Biogeosciences 17, 4769-4784. https://doi.org/10.5194/bg-17-4769-2020

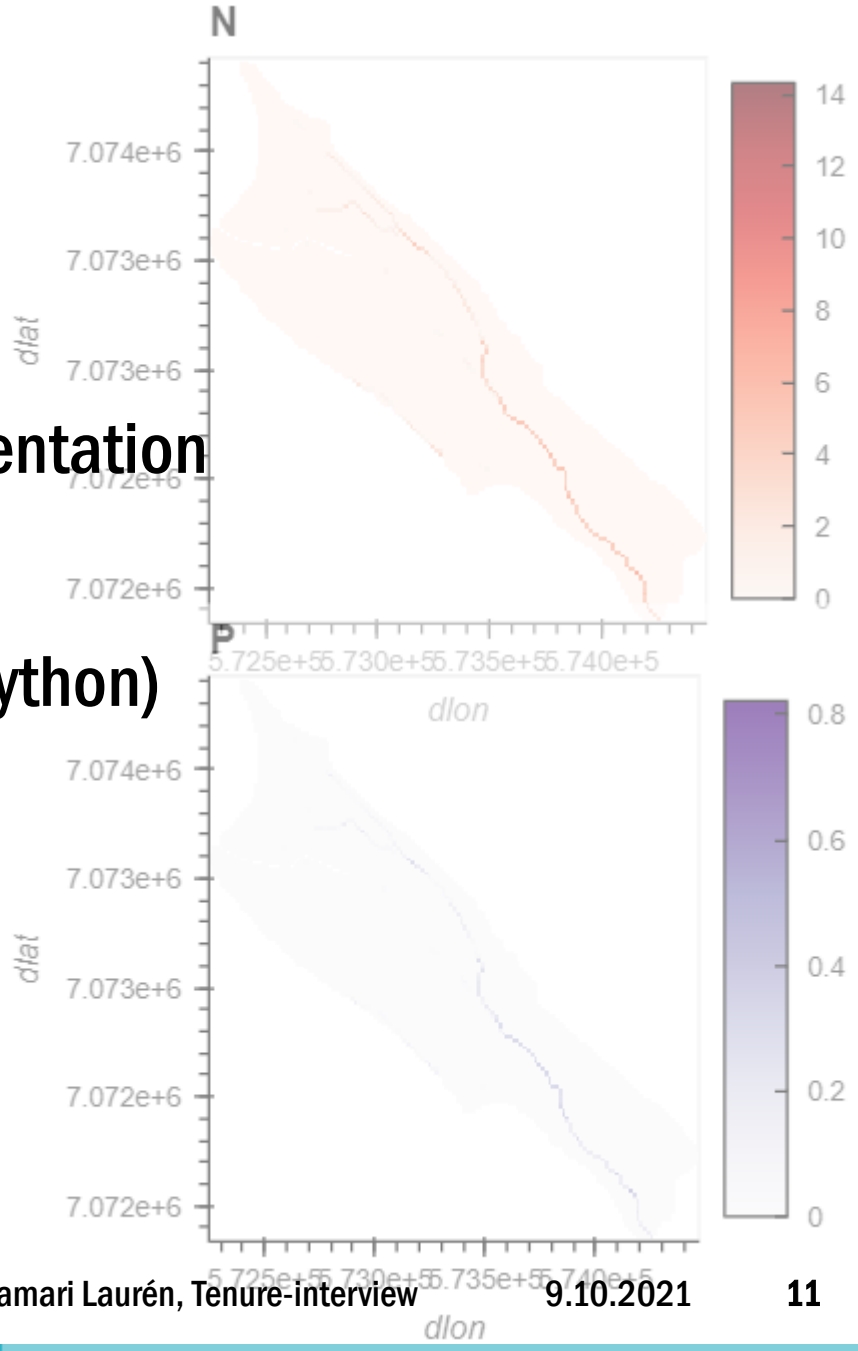
Restoration: where to block canals





Impact thru

- Open, transparent, accessible, usable, useful
- Easy access to research papers, model documentation
- Links to open data sources
- Modelling in open environments, open tools (Python)
- Open source codes: distribution thru GitHub
- Group development and version control (Git)
- Modular, no dead ends
- Easy, platform-independent user interfaces



How?

- Python + Google Colaboratory + GitHub
  - *https://github.com/annamarilauren*
- Examples:
  - Peatland simulator SUSI:
    https://colab.research.google.com/drive/1zGx1LMReip4qYFzYf6eTjL2TTnPl8mTR?usp=sharing
  - NutSpaFHy:

    https://colab.research.google.com/drive/1yb4cED0n4-QFUTHK1cUizyPafFjHsA-0?usp=sharing
  - Plantation simulator:
    https://colab.research.google.com/drive/1RuEgY22rZYLZXnAmmubxJ9ohLwvYyewM?usp=sharing

Vision: New era in forest management

- Responsible precision forest management in catchment/landscape scale with simultaneous evaluation of economic, environmental and societal aspects

- Data management, simulation models, result analyses, optimization, visualization, monitoring, continous improvement of model performace

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Thank you!

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