DESIMAP – Computational benefits via artificial intelligence?

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DESIMAP

Academy Project funding for early-career researchers

Background

Decision 22.5.2019, start 1.9.2019, granted to J.V. @ host institute LUKE

What happened then?

J.V. to Uni. Helsinki. Permission to move the funding from LUKE.

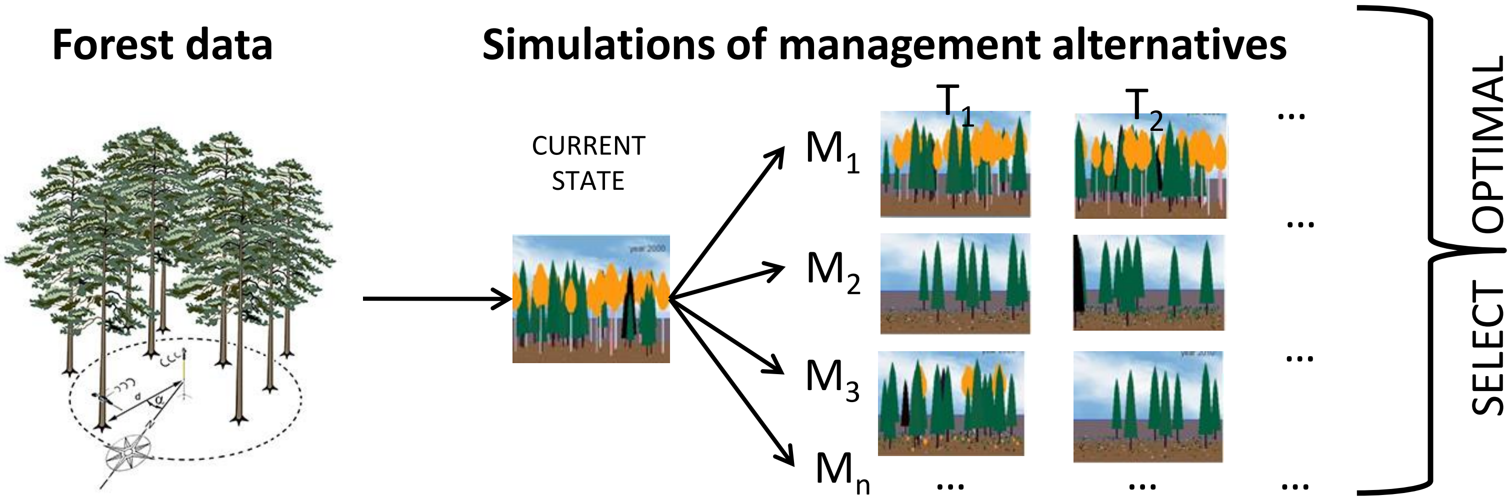
Next?

Uni. Helsinki permission to move the funding? Decision from the Academy?

DESIMAP

Deep learning of Ecosystem Service Indicator Maps for Agile and Precise forest planning (DESIMAP)

Forest data **Simulations of management alternatives**



CONVENTIONAL SIMULATION-OPTIMIZATION

DESIMAP PROPOSAL

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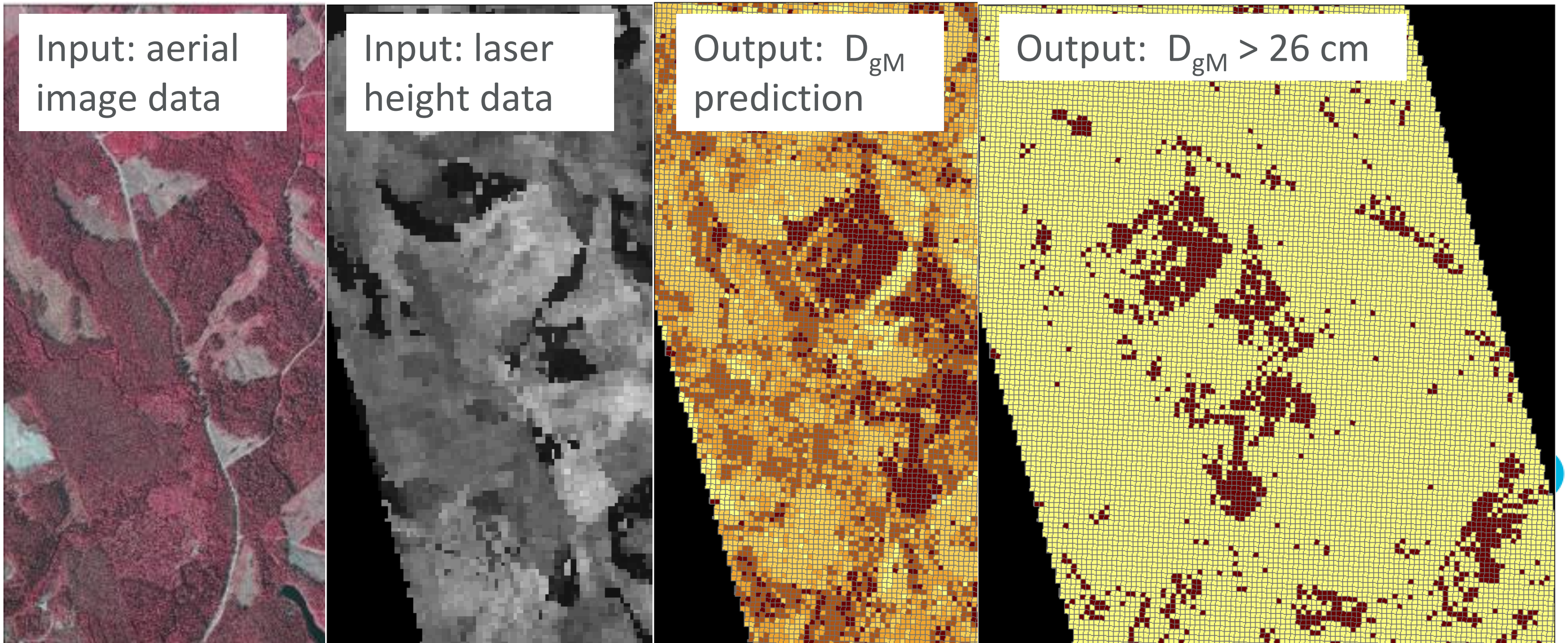
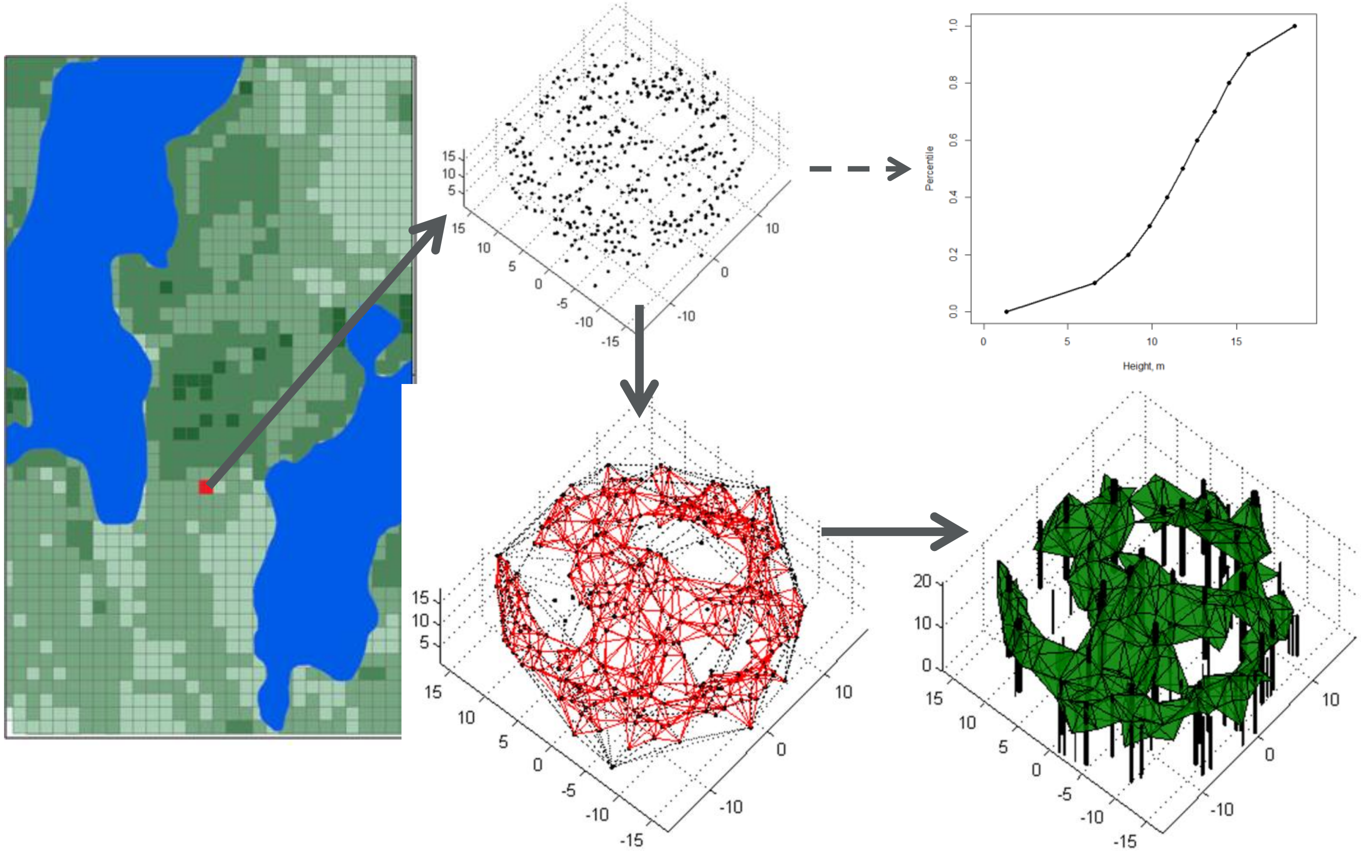
New sources of forest information: input/output example

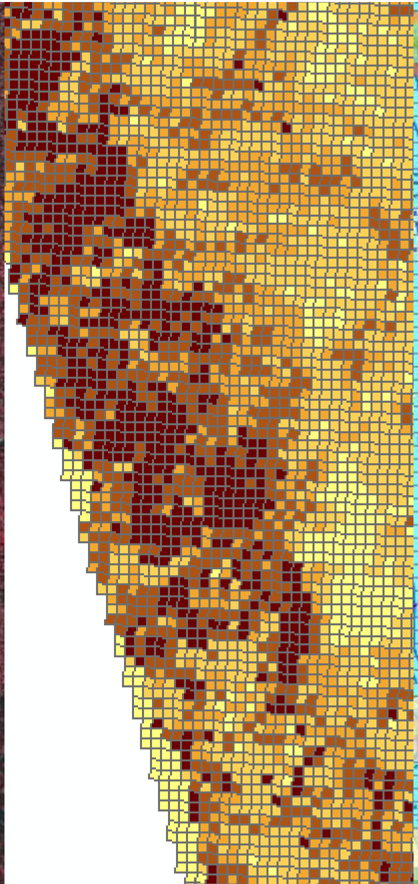
Hyytiälä, Forest inventory and planning project 2012

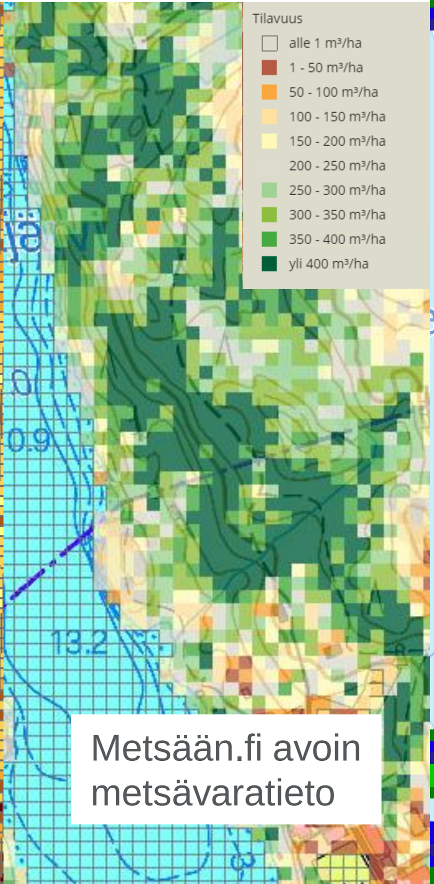


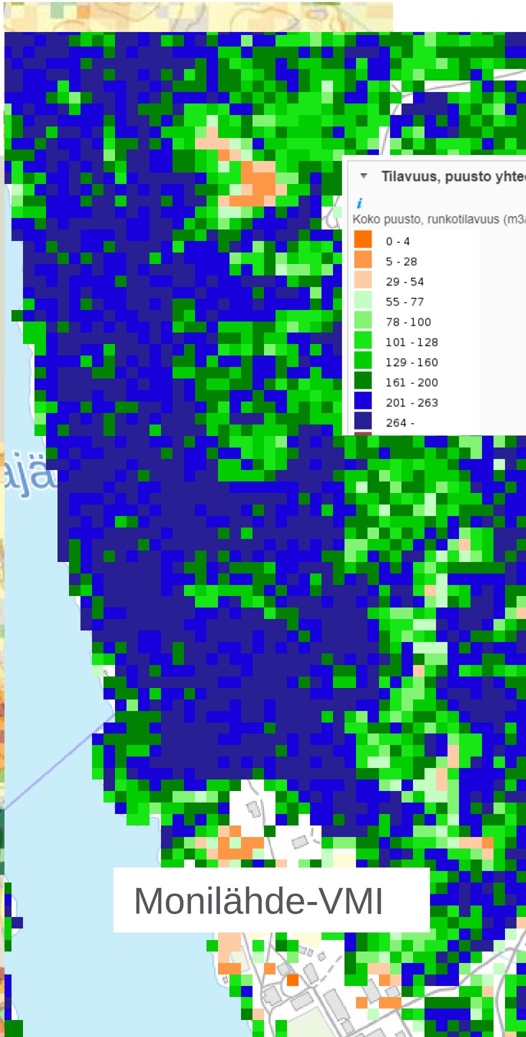


Percentile
Height, m

Challenge 1: what info is correct / optimal?



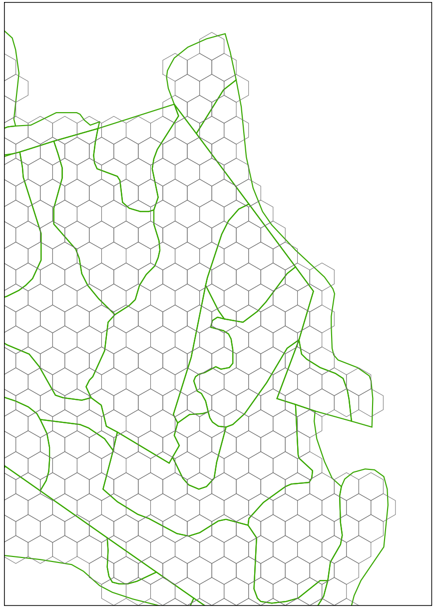




Possibility / Challenge 2: new computation units

Using raster grid cells, it is possible to plan areas without assuming fixed stand boundaries (which limit the efficient use of the resources!)

- Spatial optimization with raster cells or micro-segments



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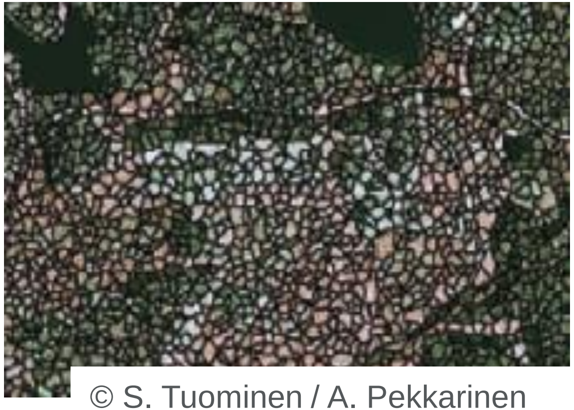

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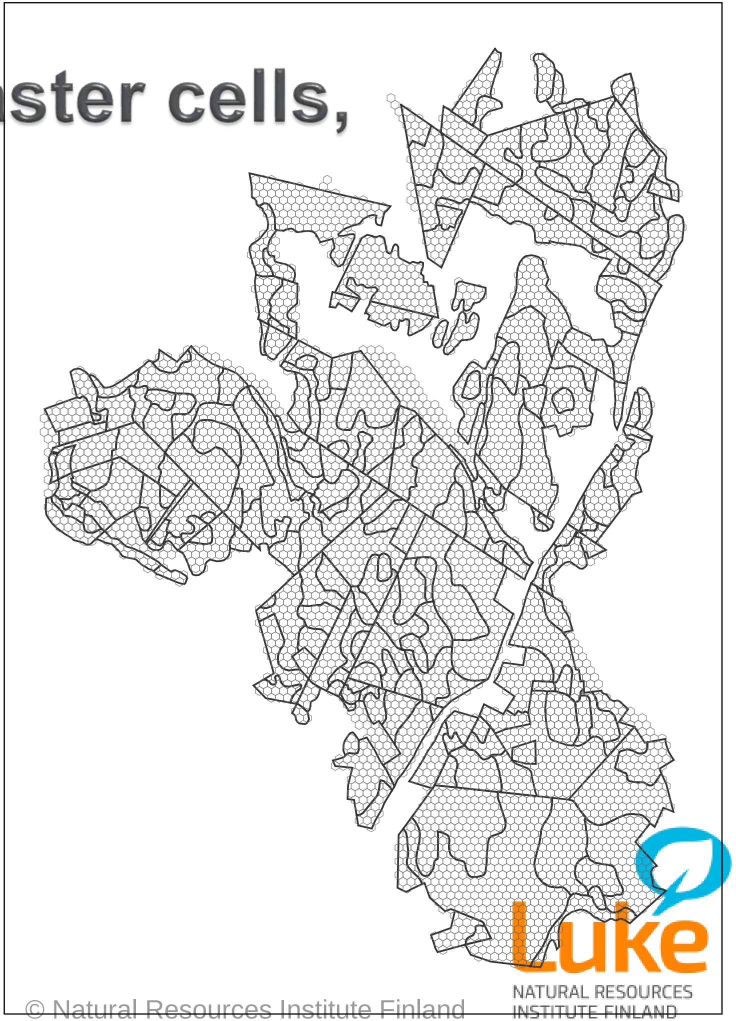
Possibilities to aggregate raster cells, Heinonen et al. 2007

FIXED STANDS

RASTER CELLS



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Example of increased computation burden

Heinonen et al. 2007: 242 fixed stands ->

4612 raster cells

A planning area could consist of 100 000 stands with 10 decision alternatives per average stand (different types of treatments divided to 5-year planning periods)

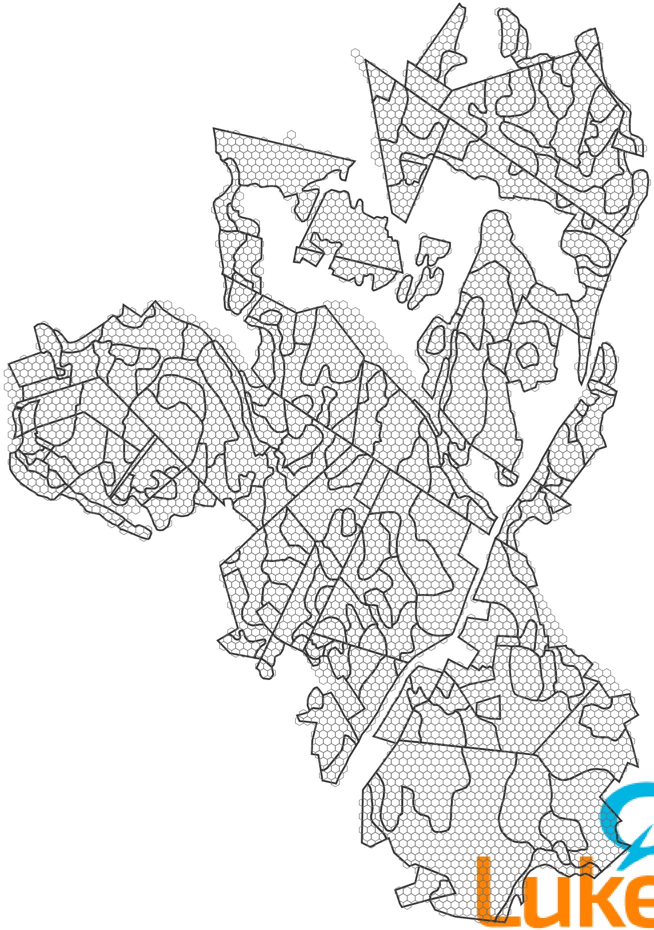
➔ 10^{100000} combinations to be considered in optimization

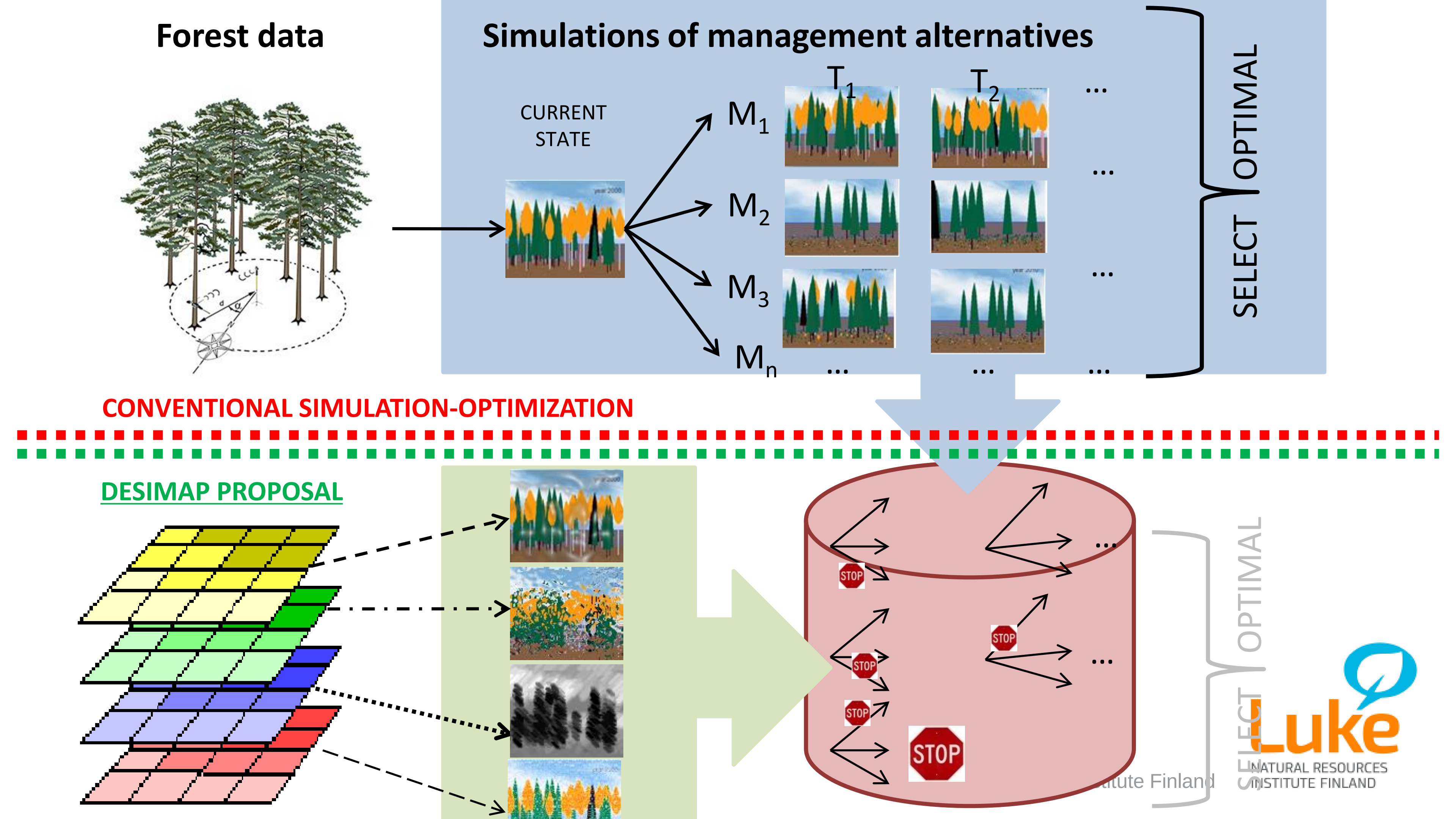
Consider operational planning: one year periods

-> 5 times more treatments per stand

Consider using raster cells as computation units: an average stand of Heinonen et al. includes 19 grid cells

➔ $(5 \times 10)^{(19 \times 100000)}$ combinations




Forest data
Simulations of management alternatives
CURRENT STATE
T1
T2
M1
M2
M3
Mn
SELECT OPTIMAL
CONVENTIONAL SIMULATION-OPTIMIZATION
DESIMAP PROPOSAL
STOP
SELECT OPTIMAL
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WP2: Spatiotemporal modelling of the production possibilities of forest from large, uncertain high-resolution data.

Data sources

- Uncertainty maps by combining predictions from multiple grid data sources
- NFI time series
- Map comparisons, field validation

The potential of deep learning to discover spatial patterns and trends?

- Review of potential of CNNs, RNNs, LSTMs, …
- Versus more traditional machine learning solutions

WP3: Optimization of discrete event system via learning based simulation.

Re-structure simulation-optimization-problem (of alternative management schedules) as more generic scheduling problem to be solved by deep learning

- Deep reinforcement learning to learn from successes of earlier planning tasks
- Versus ”common sense shortcuts”

Evaluation: computational time reduction and accuracy in finding the optimal treatment schedule

- decision space determined either by the intelligent OR conventional simulation (& optimization)

Thank you!

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