# **FOREXCLIM: For**ests and **ex**treme weather events: Solutions for risk resilient management in a changing **clim**ate

Anja Rammig

April 24, 2018

FOREXCLIM

SumForest

Federal Office for Agriculture and Food

# FOREXCLIM: Research Partners

**Professorship for Land Surface-Atmosphere Interactions**
Anja Rammig, Ekaterina Sycheva

**Institute of Forest Management**
Thomas Knoke, Carola Paul, Claudia Chreptun

**Dept. of Physical Geography and Ecosystem Science**
Ben Smith, Mats Lindeskog

**Dept. of Forestry and Renewable Forest Resources**
Andrej Ficko, Gal Fidej

**FSC** (Forest Stewardship Council)
Marion Karmann
**EUSTAFOR** (European State Forest Association)
Piotr Borkowski

Professorship for Land Surface-Atmosphere Interactions
TUM School of Life Sciences Weihenstephan
Technical University of Munich

# FOREXCLIM: Main questions and hypotheses

(1) What is the risk of extreme weather event-induced forest damage in Europe and what ecological and financial impacts will extreme weather events have on major European tree species and forest types in the coming decades?

*H(1): The risk of extreme events-induced impacts on forests will increase in the future.*


Professorship for Land Surface-Atmosphere Interactions
TUM School of Life Sciences Weihenstephan
Technical University of Munich

# FOREXCLIM: Main questions and hypotheses

(1) What is the risk of extreme weather event-induced forest damage in Europe and what ecological and financial impacts will extreme weather events have on major European tree species and forest types in the coming decades?

(2) How should current forest management regimes in Europe be adapted to make stand structures and tree species composition portfolios robust to the impacts of extreme weather events?

*H(2): Close to nature forestry is an advantageous strategy to balance financial return and ES from European forests while reducing risk associated with increased extremes under future climate.*

Professorship for Land Surface-Atmosphere Interactions
TUM School of Life Sciences Weihenstephan
Technical University of Munich

# FOREXCLIM: Main questions and hypotheses

(1) What is the risk of extreme weather event-induced forest damage in Europe and what ecological and financial impacts will extreme weather events have on major European tree species and forest types in the coming decades?

(2) How should current forest management regimes in Europe be adapted to make stand structures and tree species composition portfolios robust to the impacts of extreme weather events?

(3) How does uncertainty about future climate, timber market prices and forest ecosystem functioning under changed climate influence optimal forest management regimes?

*H(3): Both management objectives, multifunctionality and reducing adverse effects of increasing uncertainty due to climate change require diversifying management alternatives.*

Professorship for Land Surface-Atmosphere Interactions
TUM School of Life Sciences Weihenstephan
Technical University of Munich

# FOREXCLIM: Approach

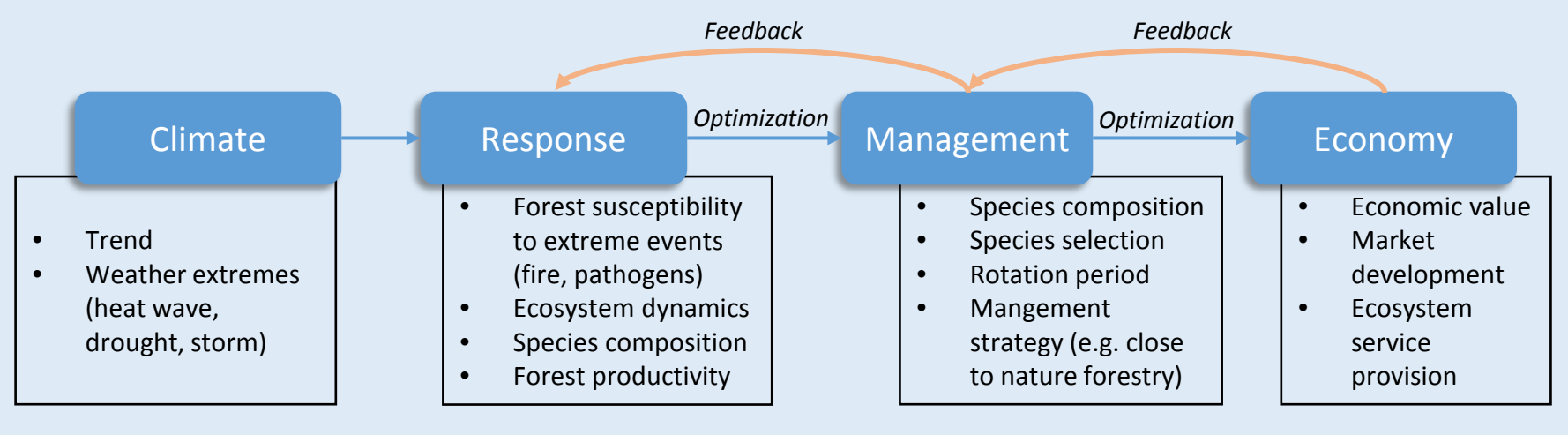
*Risk-resilient multifunctional European forest landscapes in the future.*

→ Changing climate
→ Changing forest dynamics
→ Changing timber markets
→ Different forest management strategies
→ Different weights of social/economic/ecologic aspects (ecosystem services)

Professorship for Land Surface-Atmosphere Interactions
TUM School of Life Sciences Weihenstephan
Technical University of Munich

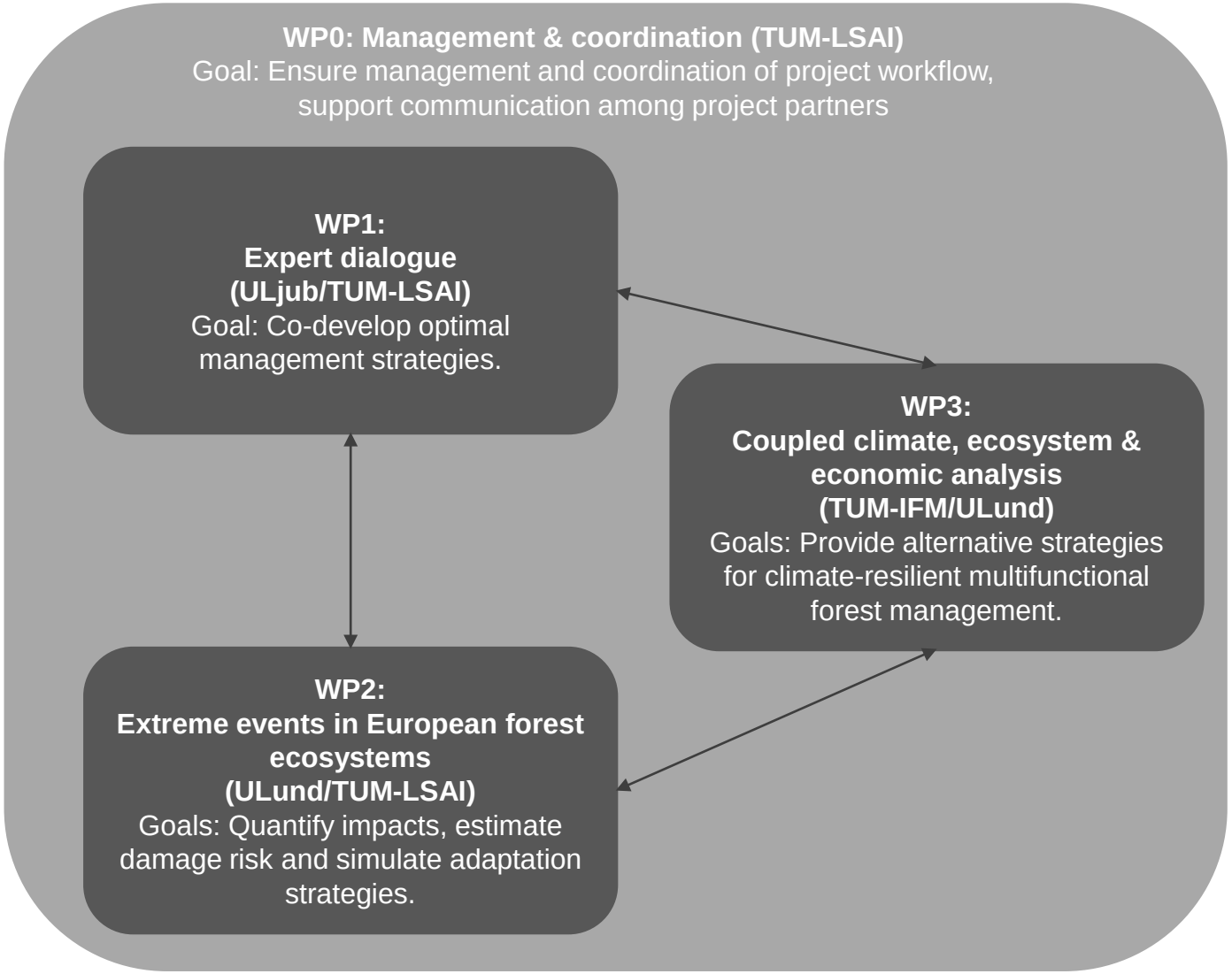
# FOREXCLIM: Approach

## Model-based analysis



Professorship for Land Surface-Atmosphere Interactions
TUM School of Life Sciences Weihenstephan
Technical University of Munich

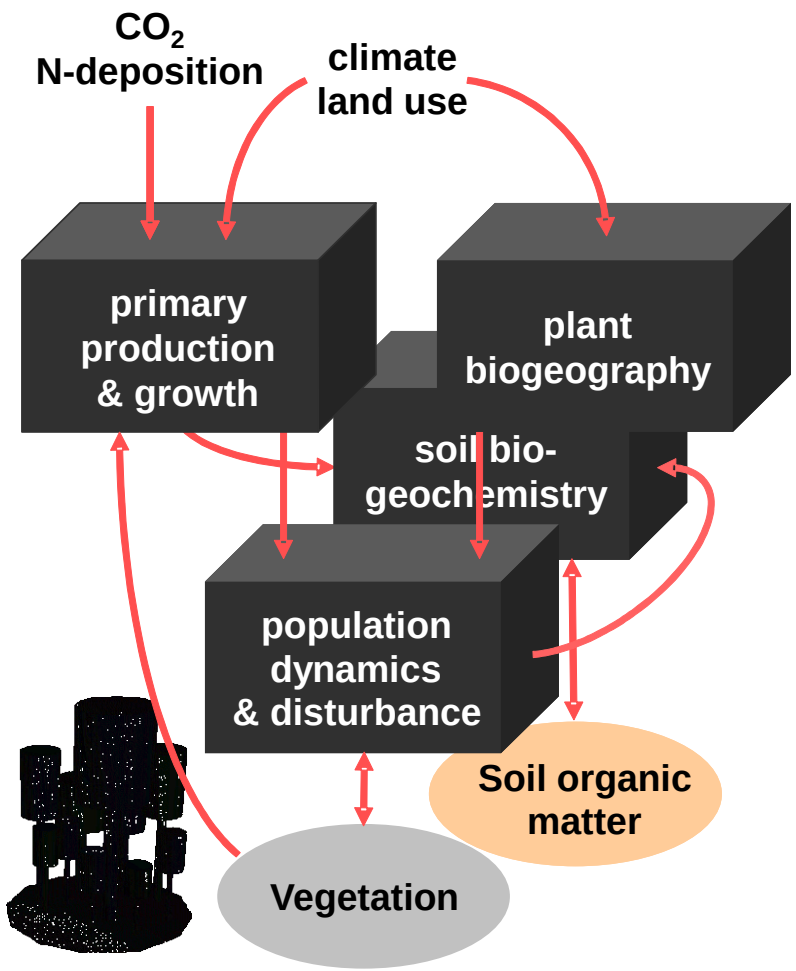
# FOREXCLIM: Workpackages



# Current work: Get models running…

Professorship for Land Surface-Atmosphere Interactions
TUM School of Life Sciences Weihenstephan
Technical University of Munich

# The dynamic vegetation model LPJ-GUESS*:

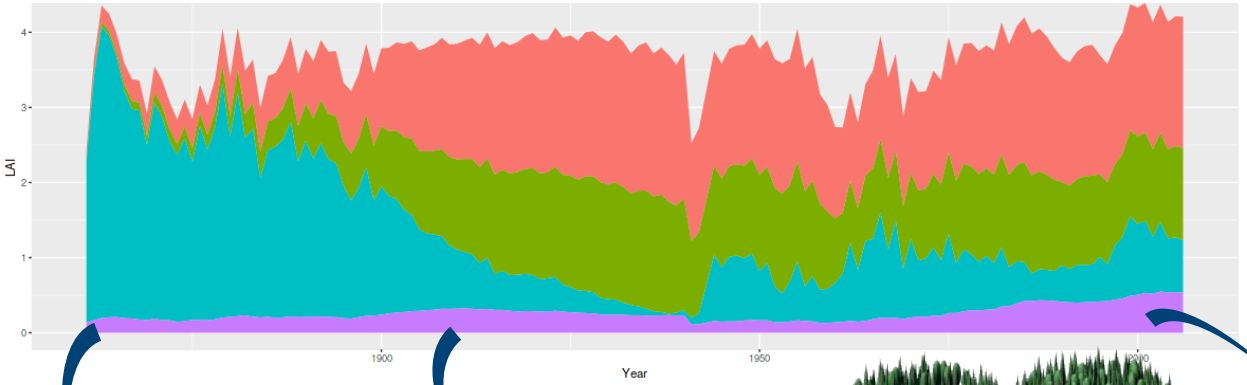



*LPJ-GUESS – a global ecosystem model
Smith et al. 2001, 2014
www.nateko.lu.se/lpj-guess

Professorship for Land Surface-Atmosphere Interactions
TUM School of Life Sciences Weihenstephan
Technical University of Munich

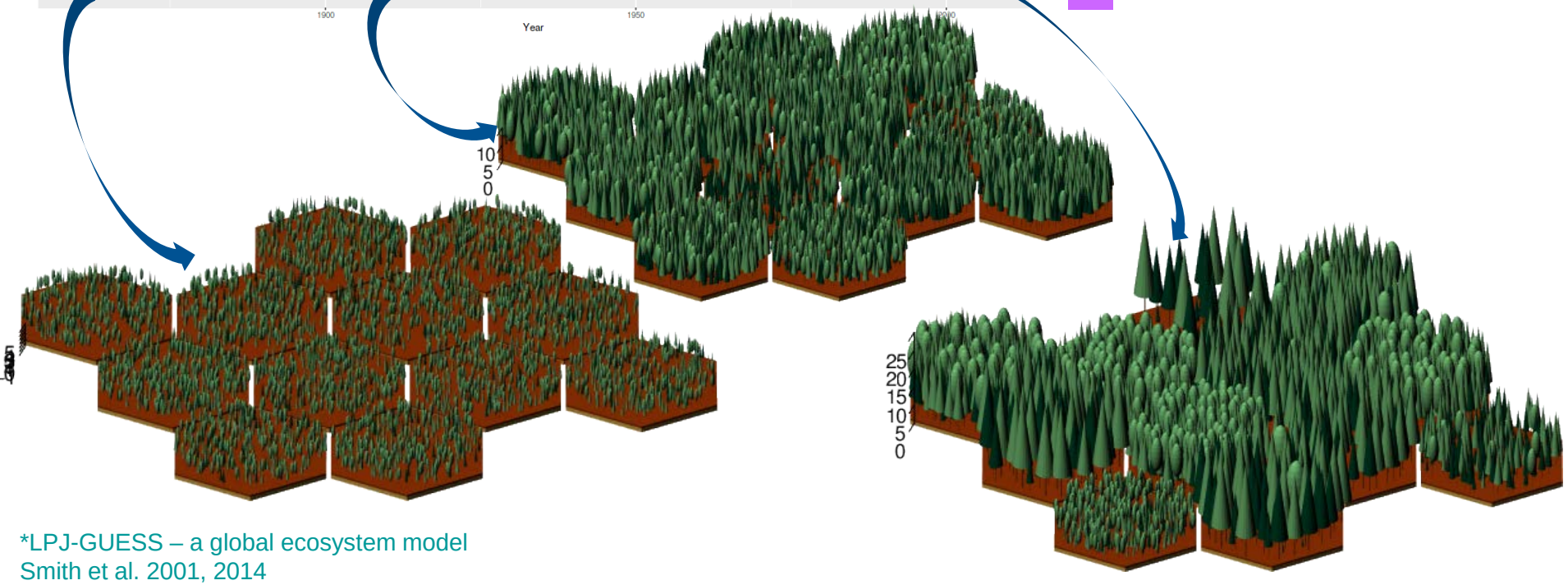
# The dynamic vegetation model LPJ-GUESS*:

An example simulation of succession of boreal forest in Canada




Forest types

- Boreal needleleaved evergreen (early succesional)
- Boreal needleleaved evergreen (late succesional)
- C3-Grasses
- Broadleaved summergreen

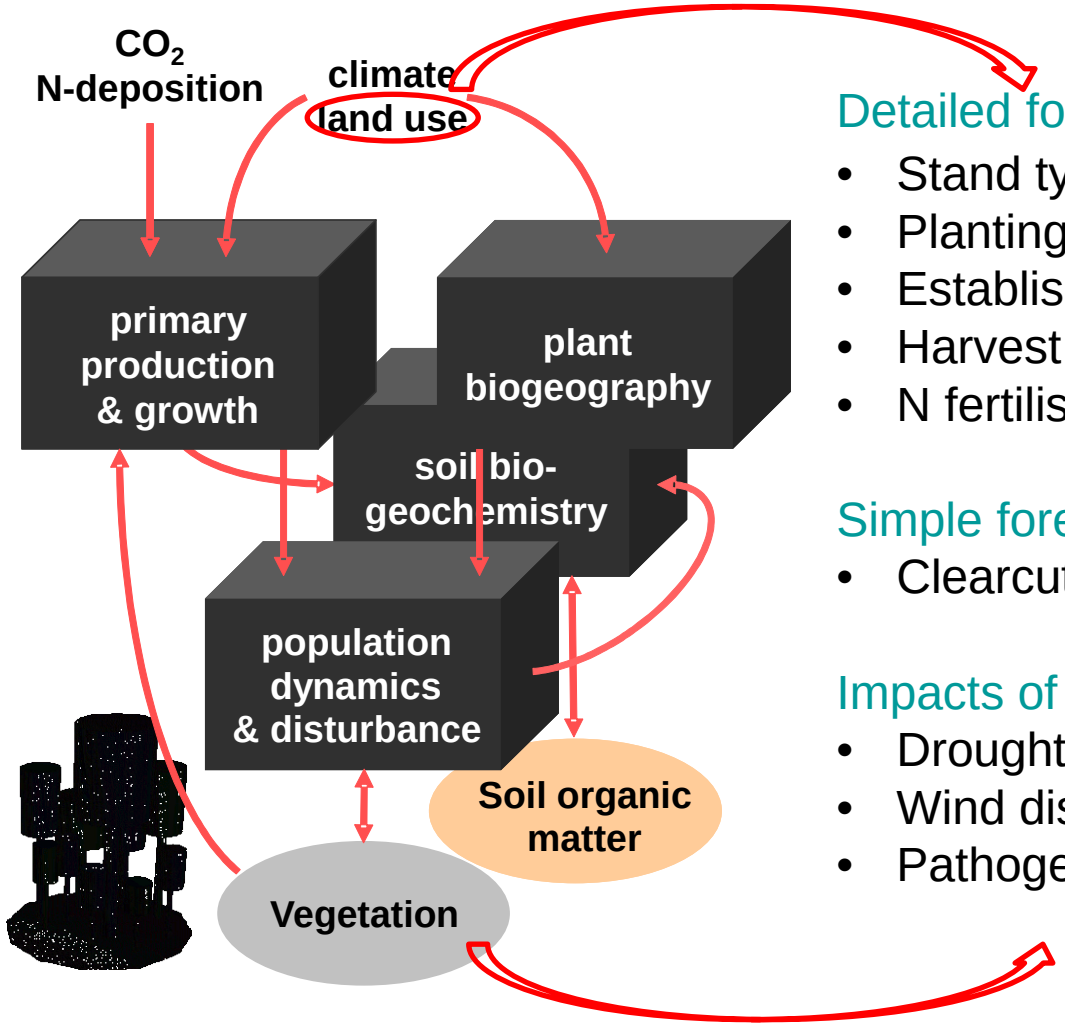



*LPJ-GUESS – a global ecosystem model
Smith et al. 2001, 2014
www.nateko.lu.se/lpj-guess

**Figures from Steinkamp et al. 2018**

Professorship for Land Surface-Atmosphere Interactions
TUM School of Life Sciences Weihenstephan
Technical University of Munich

# Setting up forest management in LPJ-GUESS*:




## Detailed forestry:

- Stand types/management types with:
- Planting systems (PFT selections)
- Establishment rules (e.g. all natural PFTs)
- Harvest systems (clearcut, continuous)
- N fertilisation

## Simple forestry used with LUH2:

- Clearcut + creation of new stand

## Impacts of extreme events:

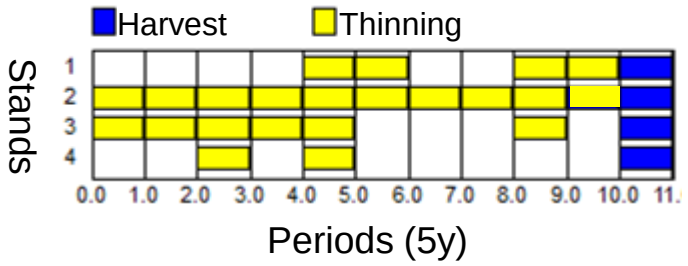
- Drought mortality
- Wind disturbance
- Pathogens

*LPJ-GUESS – a global ecosystem model
Smith et al. 2001, 2014
www.nateko.lu.se/lpj-guess

Professorship for Land Surface-Atmosphere Interactions
TUM School of Life Sciences Weihenstephan
Technical University of Munich

# Setting up management decisions in YAFO 4.0*

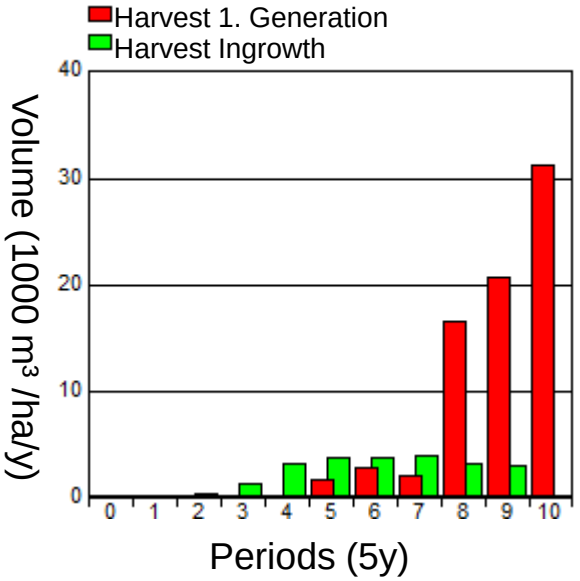
YAFO is a planning-support tool for the development of management plans under uncertainty focusing on the forest enterprise level.




## Coupling with LPJ-GUESS:

- Provide input data for calculation of management scenarios (felling plans) to be optimized with respect to financial considerations and ecological constraints.

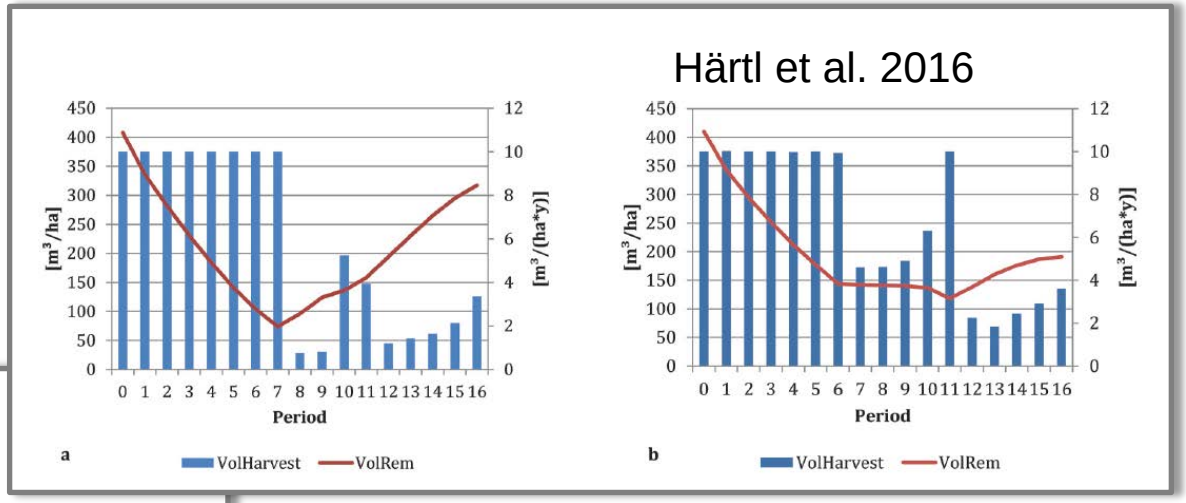
- Determine objective function to consider risks and uncertainties due to natural calamities and timber price fluctuations.

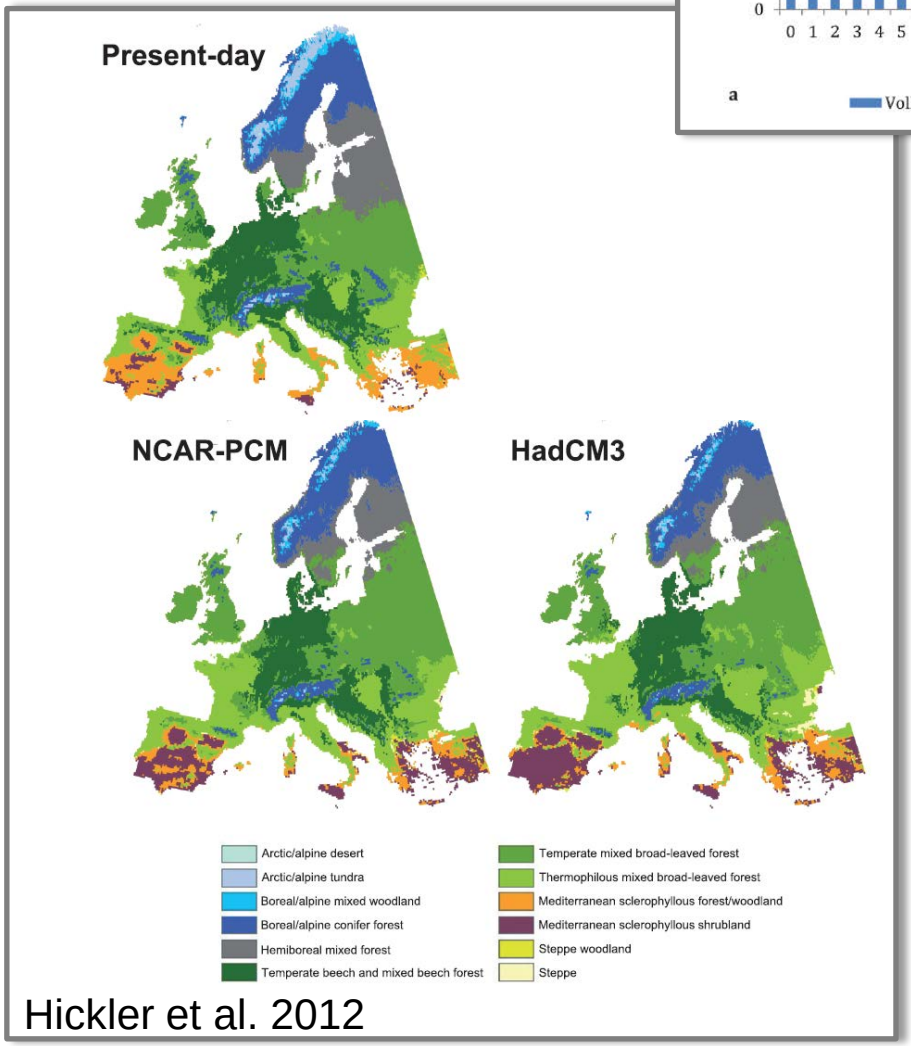



*Yafo – Yet another forest optimizer
Härtl et al. 2013
http://www.forestdss.org/wiki/index.php?title=YAFO

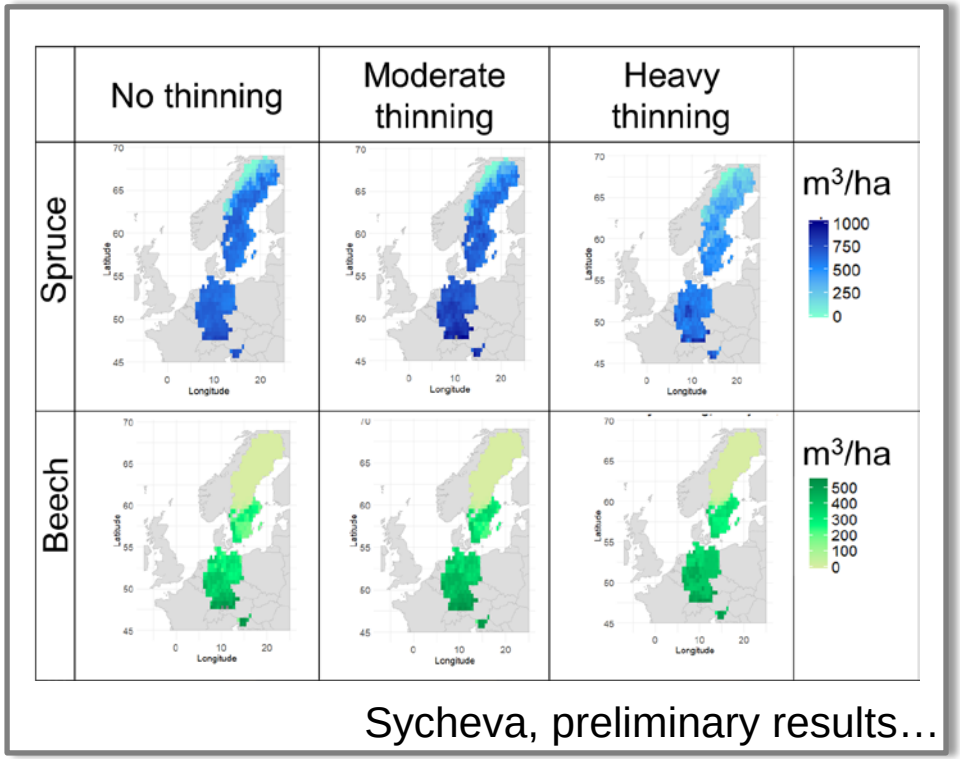
Professorship for Land Surface-Atmosphere Interactions
TUM School of Life Sciences Weihenstephan
Technical University of Munich

# Expected outcome…




Hickler et al. 2012




Sycheva, preliminary results…


FORECLIM
Sum forest
Federal Office for Agriculture and Food