NMBU - MINA
Project - CLIMATE SMART FORESTRY NORWAY

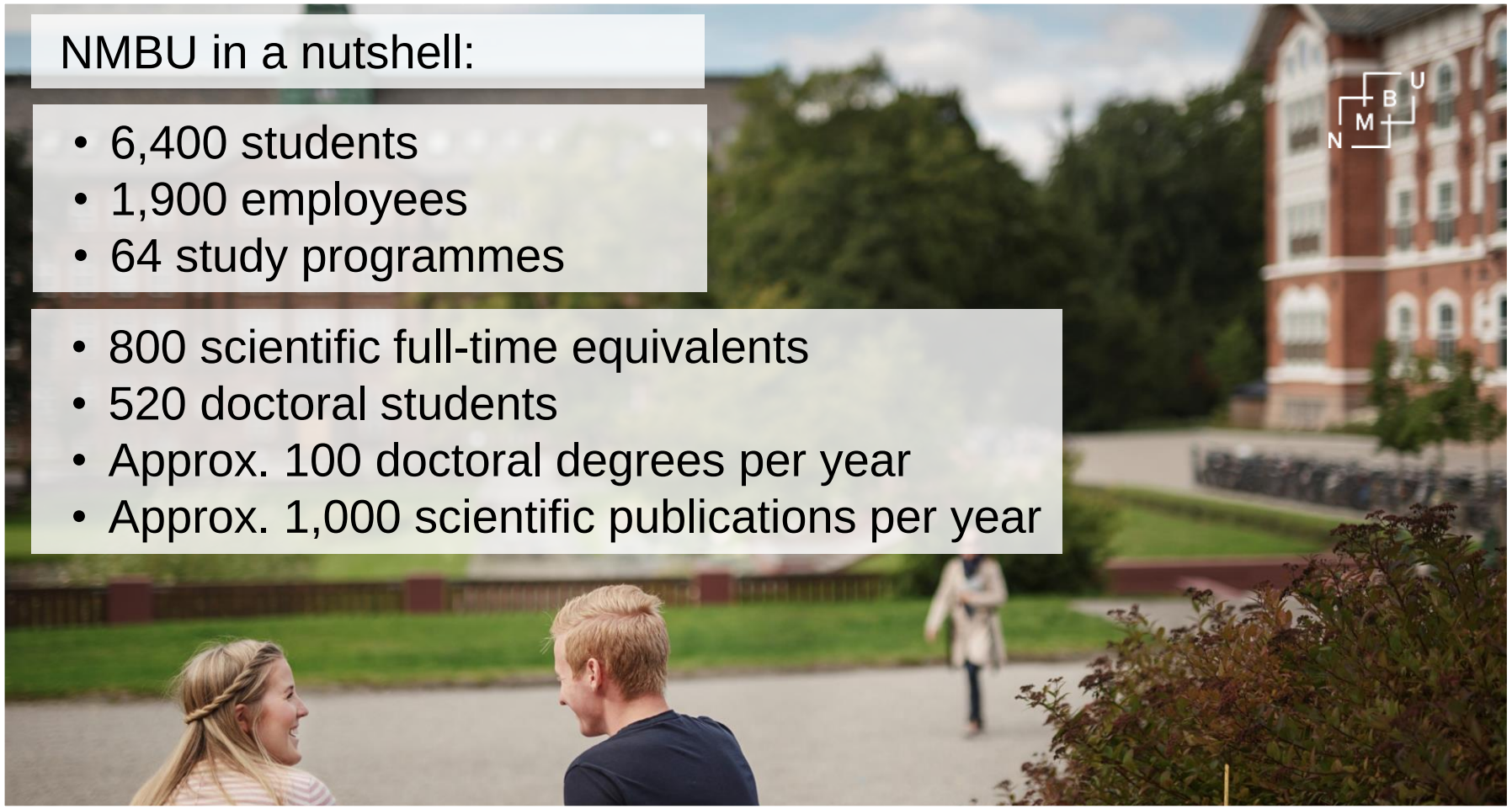
Visit, University of Bialystok, Poland, 06.09.2022

Tron Eid

Faculty of Environmental Sciences and Natural Resource Management

Outline

- Norwegian University of Life Sciences (NMBU)
- Faculty of Environmental Sciences and Natural Resource Management (MINA)
  - Key figures
  - Research and study programmes
- Climate Smart Forestry Norway (CSFN)
  - Background, objectives and planned activities
  - Models, tools and scenarios
    - Natural disturbances under climate change
    - Bark beetle attacks – some preliminary results
    - Challenges on the way forward



NMBU in a nutshell:

- 6,400 students
- 1,900 employees
- 64 study programmes

- 800 scientific full-time equivalents
- 520 doctoral students
- Approx. 100 doctoral degrees per year
- Approx. 1,000 scientific publications per year

Research and education

- Animal and human health
- Animal health and animal welfare
- Basic and applied life sciences
- Bio production
- Development studies and globalization
- Ecology, climate change and renewable energy
- Economics and social sciences
- Exploitation and conservation of natural resources
- Food production and food safety
- Landscape architecture and spatial planning
- Teacher training in natural sciences and natural resource management
- Technology
- Veterinary medicine

Faculties

- Biosciences
- Chemistry, Biotechnology and Food Science
- **Environmental Sciences and Natural Resource Management**
- Landscape and Society
- School of Economics and Business
- Science and Technology
- Veterinary Medicine

Faculty of Environmental Sciences and Natural Resource Management (MINA)

Numbers (MINA)

Employees: 200

MSc and BsC Students: 650

PhD Students: approx. 100

Study programmes MINA

Bachelor:

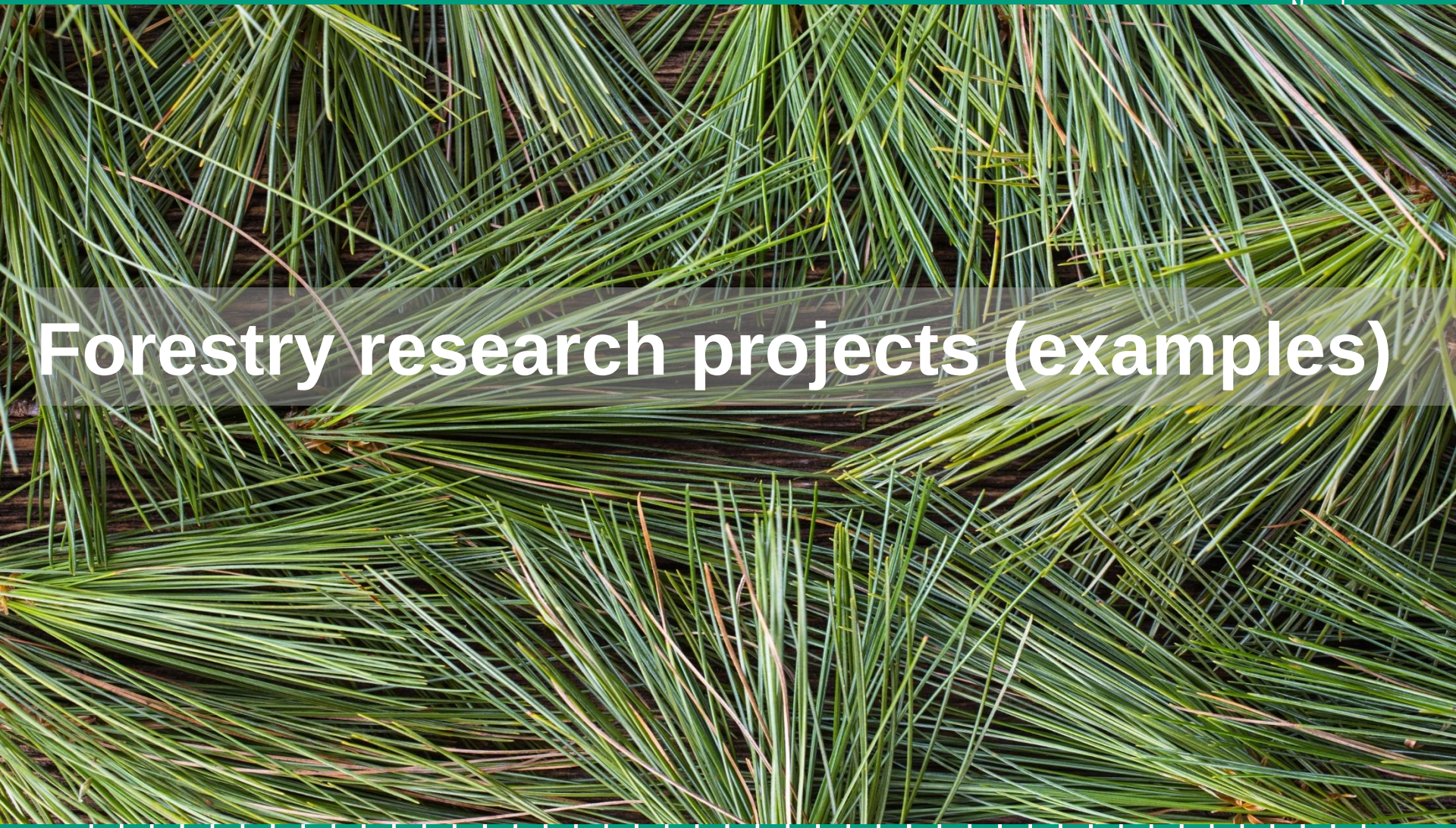
- Ecology and natural resource management
- Environment and natural resources
- **Forest science**
- Renewable energy

2-year master:

- Ecology (In English)
- Environment and natural resources
- **Forest science**
- Nature-based tourism
- Natural resource management
- Renewable energy

Areas of research MINA

- Behavioral ecology
- Biodiversity, evolutionary genetics and conservation biology
- **Bioeconomy**
- Chemistry
- **Ecology**
- Ecophysiology
- Ecotoxicology
- **Forest management**
- Geology
- Hydrology
- Impacts of land use and habitat changes
- Limnology
- Natural resource management
- Nature-based tourism
- Pedology
- Population and community ecology
- Radioecology
- Renewable energy
- **Resource surveying**
- **Silviculture**
- Soils (biogeochemistry and plant nutrition)
- **Wood technology**
- Zoology



Forestry research projects (examples)

Silviculture, growth and yield

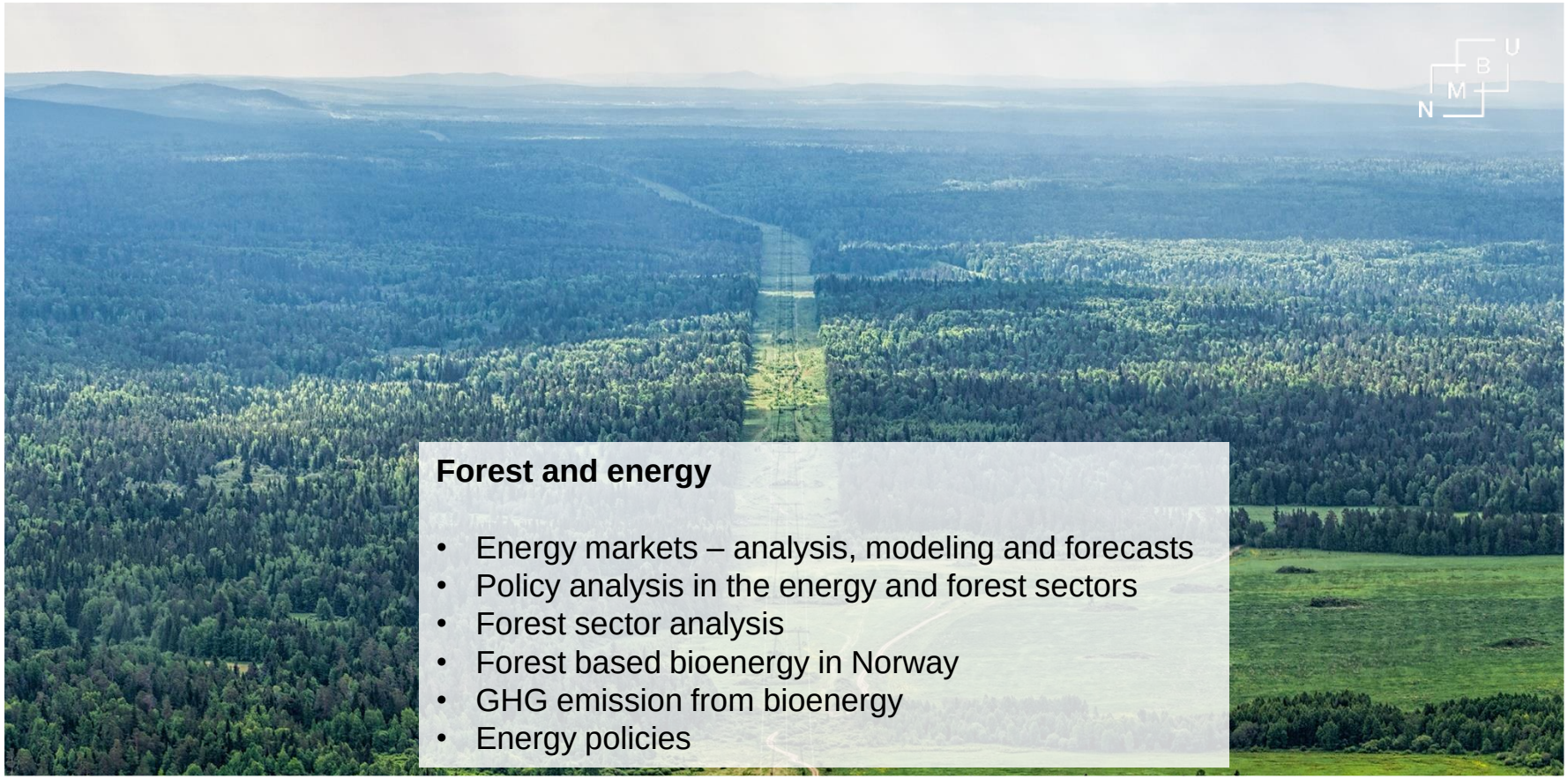
- Individual tree based growth models
- Effect of thinning on growth and yield
- Effect of initial density on growth and yield
- Growth trends
- Growth of mixed forests

Forest inventory

- Photogrammetry in forestry
- Airborne laser scanning
- GIS and GPS in forestry
- Statistical methods in natural resource surveys

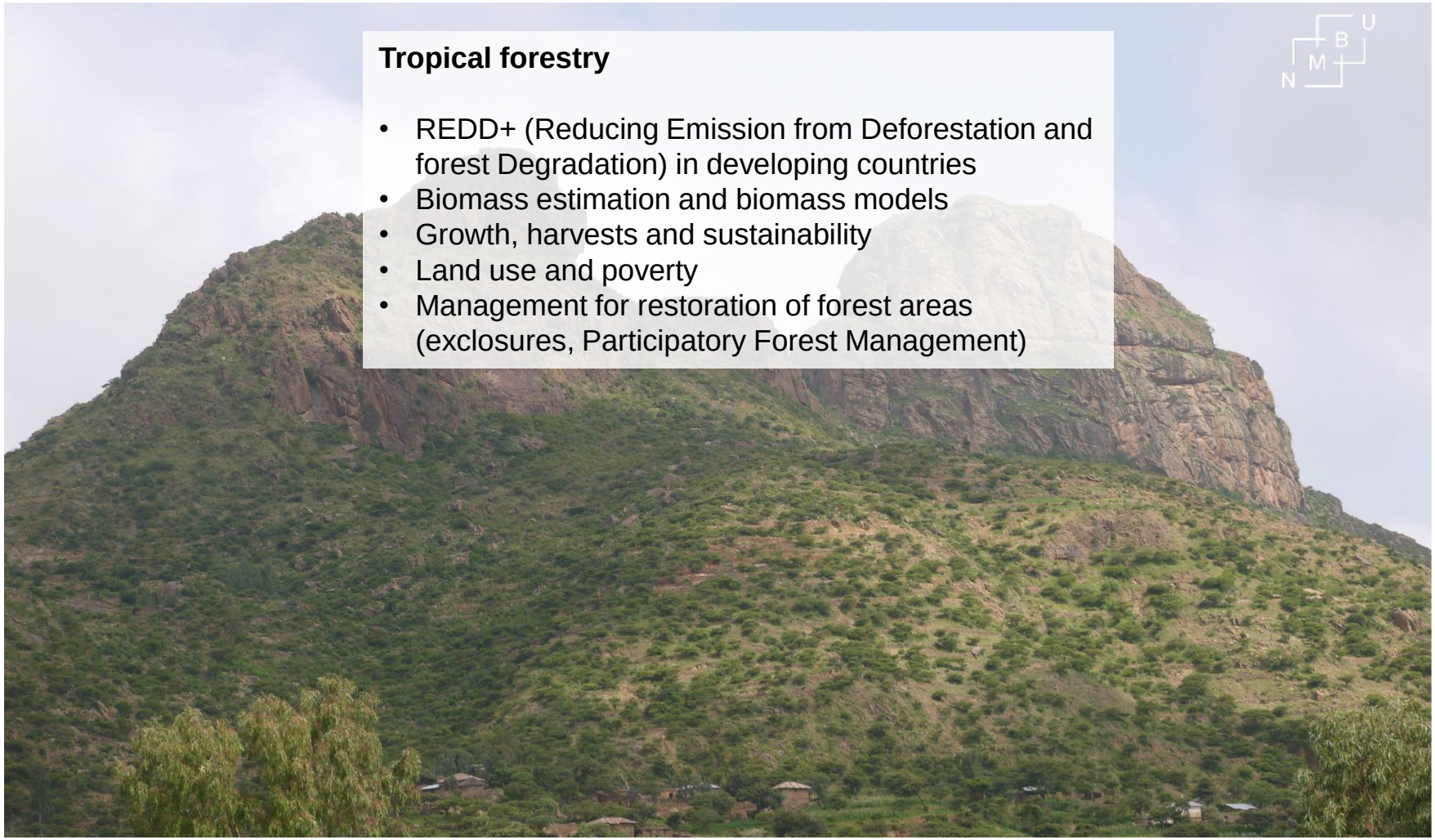
Forest Ecology

- Effects of climate change on growth phenology and defense in trees and plants
- Ecosystem transformations driven by climate change
- Effects of climate change on phenology and development of *Populus tremula*
- Provenance trials with beech in Norway



Forest and energy

- Energy markets – analysis, modeling and forecasts
- Policy analysis in the energy and forest sectors
- Forest sector analysis
- Forest based bioenergy in Norway
- GHG emission from bioenergy
- Energy policies



Tropical forestry

- REDD+ (Reducing Emission from Deforestation and forest Degradation) in developing countries
- Biomass estimation and biomass models
- Growth, harvests and sustainability
- Land use and poverty
- Management for restoration of forest areas (exclosures, Participatory Forest Management)

Towards a climate-smart policy and management framework for **conservation and use of dry forest ecosystem services and resources** in Ethiopia

- https://www.nmbu.no/en/projects/node/41318

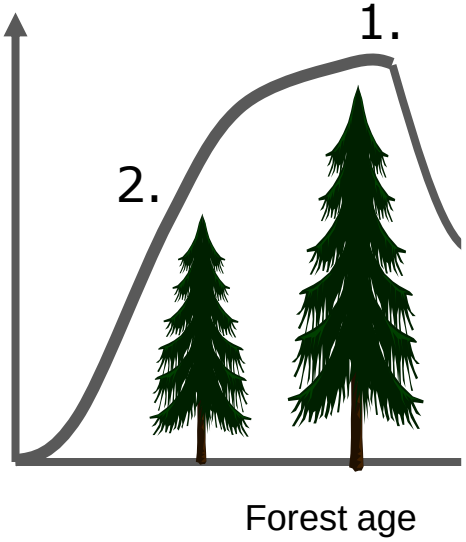
Climate Smart Forestry Norway (CSFN)

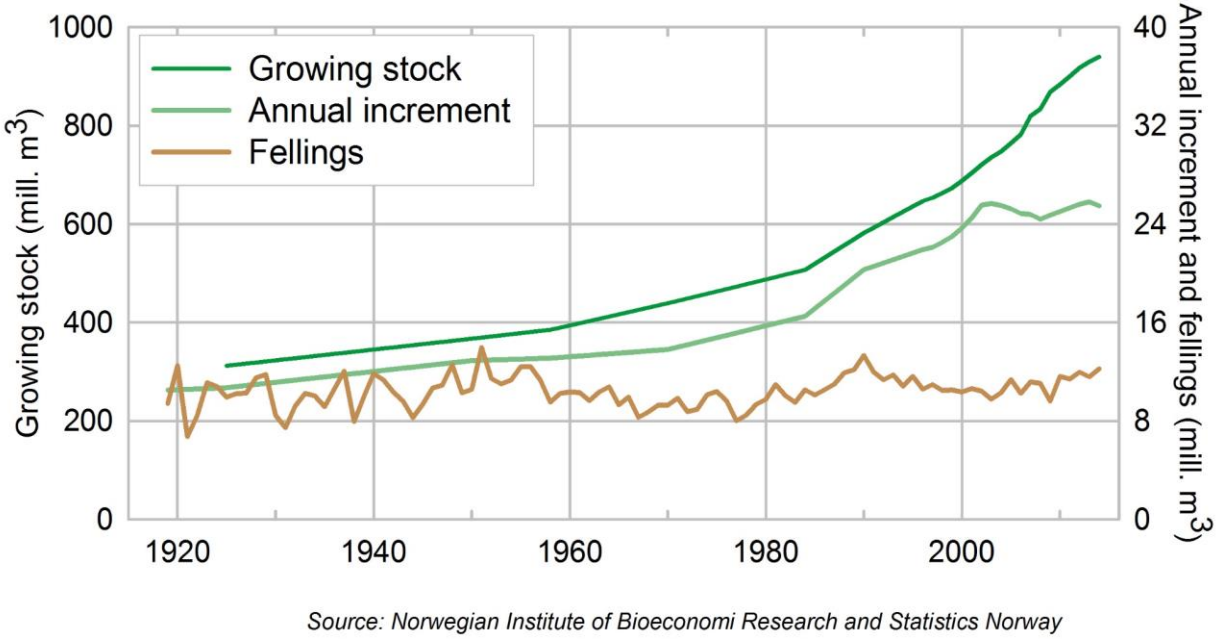
- Background
  - Forests are important for the climate. The current net growth of Norwegian forest sequesters CO_2 equal to 45-50% of the annual GHG-emissions in the country.
  - **Norway's forests are showing signs of a decreasing sequestration strength due to maturing forests. An ageing forest is associated with higher risk of significant carbon emissions and economic losses due to natural disturbances that are likely to increase in frequency and severity with climate change.**
  - Need to address key research gaps, specifically related to natural disturbance risk analysis and modelling.
  - Need to identify robust management approaches from multiple perspectives.

- CSFN lead by MINA (2020-2025), PM: Erik Trømborg

Background - we have to choose...

1. High storage, low sequestration of CO_2 (and wood supply)
2. Low storage, high sequestration of CO_2 (and wood supply)





Source: Norwegian Institute of Bioeconomi Research and Statistics Norway

Background - natural disturbances will increase with CC…

Bark beetle attacks

Root rot

Wind and snow damages

Forest fires

Background – complexities….

How should different forest types in Norway be managed to adapt to risk of natural disturbances and build forest resilience while increasing forest growth and carbon storage?

What are the most cost-effective carbon mitigation and adaptation options in the Norwegian forestry context?

Under climate changes……

With 100 000 forest owners……

Objectives CSFN (as of application)

- To improve the scientific foundation for CSF by developing a framework for holistic assessments of forest management that **simultaneously consider carbon, other biophysical forcings (albedo), substitution, and risk of natural disturbance while acknowledging forest owners to have a sustainable income from their forests**

Sub-objectives:

1. A framework for quantifying probability and effects of natural disturbance linked to forest structure and CC
2. A holistic climate impact assessment framework including both radiative and non-radiative biogeophysical climate forcings
3. A framework for assessing substitution benefits related to relevant forest product life cycles, and assess market and resource potentials for a more climate friendly product palette
4. An analytic framework and tools for integrating risk of natural disturbance in forest management decision making
5. The CSF Norway assessment framework combining 1-4, and provide and design specific guidance for implementing CSF in Norway at stand- and landscape-level

Partners and funding

Forskningsrådet
The Research Council of Norway

Luke
NATURAL RESOURCES
INSTITUTE FINLAND

NIBIO
NORWEGIAN INSTITUTE OF
BIOECONOMY RESEARCH

WAGENINGEN
UNIVERSITY & RESEARCH

NMBU	1,320
NIBIO	5,00
LUKE	1,50
Wageningen	0,80
Total mill. Euro	2,050

Management and work packages

WP0: Project management and communication
Erik Trømborg, NMBU

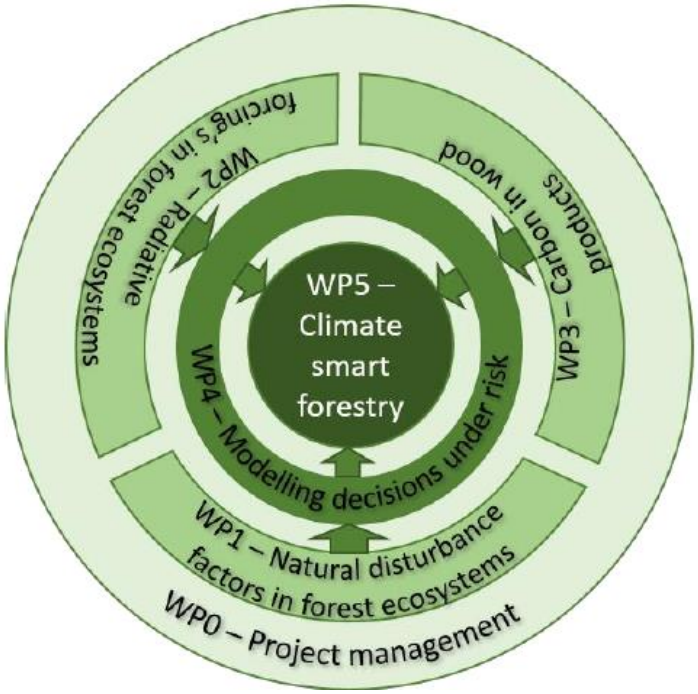
WP1. Natural disturbances
Clara Antón-Fernández, NIBIO

WP2. Radiative forcings
Ryan Bright, NIBIO

WP3. Carbon in wood products
Maarit Kallio, NMBU

WP4. Risk modelling
Annika Kangas, LUKE

WP5. Climate smart forestry – modelling and synteses
Tron Eid, NMBU



Objectives (simplified and focused on natural disturbances)

- **Objective**
  - The main objective is to develop a scientific framework for holistic assessments of **forest management under climate change** that simultaneously consider **carbon** and **risk of natural disturbances (wind and snow damages, bark beetle attacks, root rot)** while acknowledging forest owners to have a **sustainable income** from their forests.

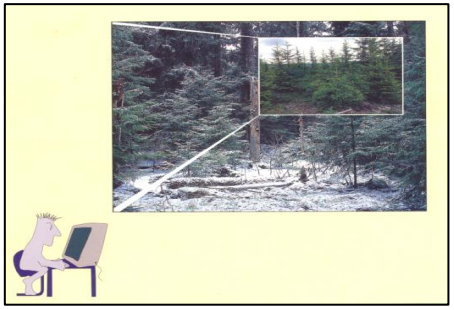
1....

2.…

3. Develop an analytic framework and **tools for integrating risk of natural disturbances** in forest management decision making

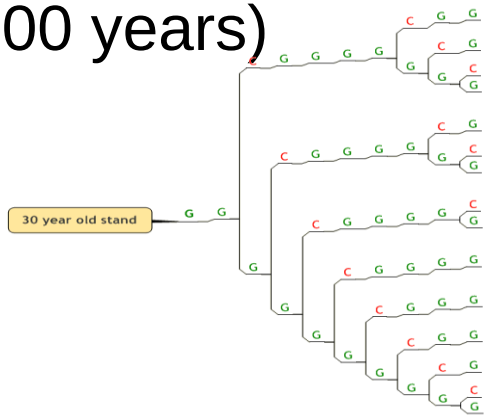
4.…

Present tool: Gaya-JLP



- Gaya (Stand simulator), JLP (decision module by means of linear programming) – developed over 30 years

- Stand simulator (e.g. projections over 100 years)
  - Growth models
  - Income and cost models
  - Carbon accounting
  - →Treatment options for all stands

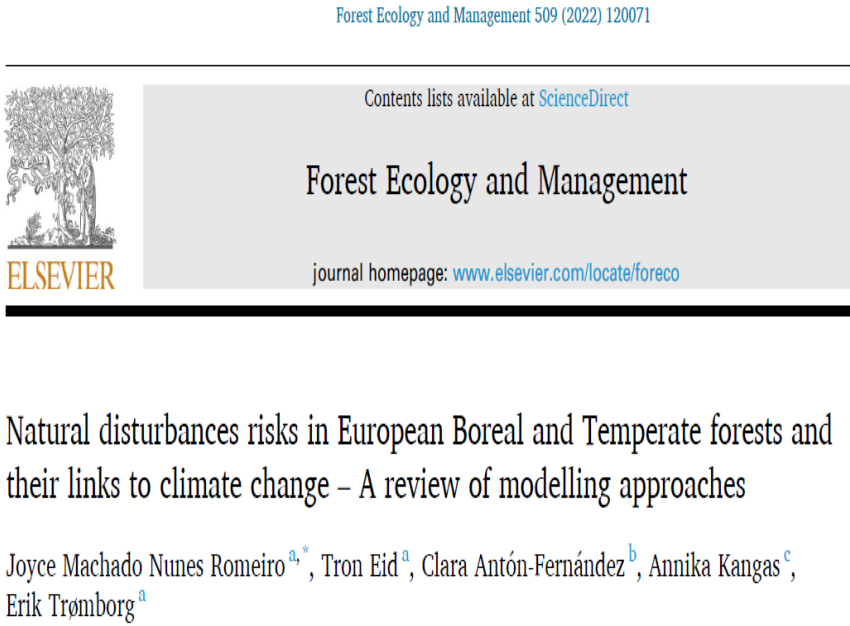


- Decision module (“forest level”)
  - Objective function (e.g. maximize profit or carbon stored, subject to biomass harvest level or biomass left in forest)

How do we adapt the tool to cope with «Climate Smart Forestry»?

- We need to develop the present tool beyond the traditional focus on biomass growth, income and costs, and carbon accounting, by means of;
-
  - Climate models (and scenarios)
  - Natural disturbance models quantifying **probabilities and effects of damages from** bark beetles, wind throw, snow brakeage, root rot, etc.

  →All models have to be linked to forest structure variables (age, density, site index, etc.) used in the stand simulator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journal homepage: www.elsevier.com/locate/foreco

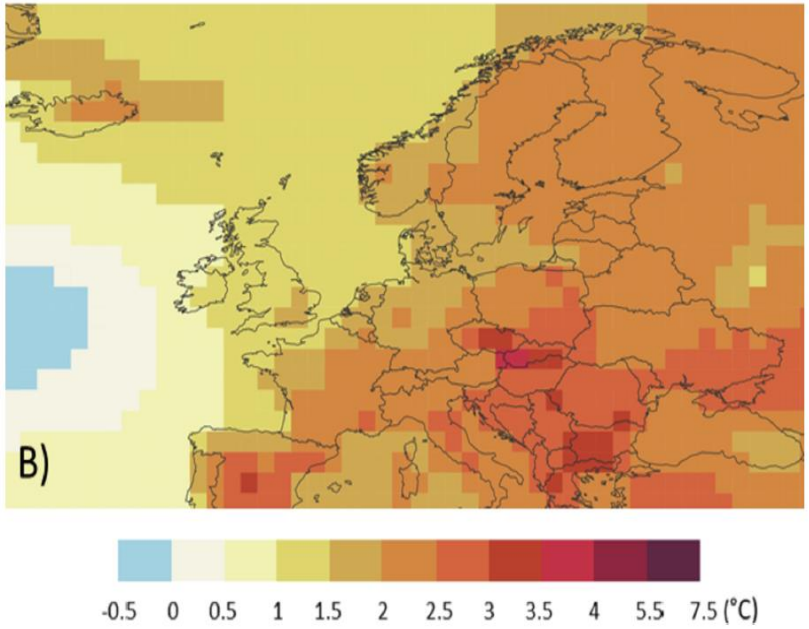
ELSEVIER

Natural disturbances risks in European Boreal and Temperate forests and their links to climate change – A review of modelling approaches

Joyce Machado Nunes Romeiro [a,*], Tron Eid [a], Clara Antón-Fernández [b], Annika Kangas [c], Erik Trømborg [a]

Climate models (scenarios for changes in temperature and precipitation)

- Example summer temperatures in Europe: changes for the period 2050-2070 relative to 1980-2000
- RCP4.5 scenario from IPCC (2014) where the global mean temperature increases between 2.6 ◦C and 4.8 ◦C.



- Corresponding models for precipitation

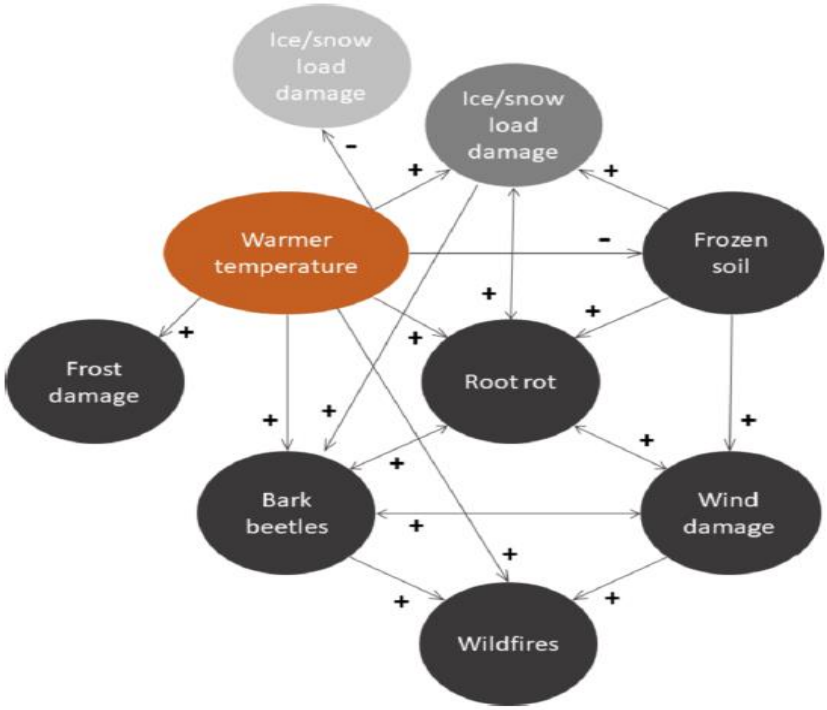
IPCC, 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Core Writing Team, R. K. Pachauri, & L. Meyer (eds.)). IPCC, Geneva, Switzerland.

Probabilities and effects of natural disturbances within increasing temperature

- Figure: direct, indirect and cascading effects of increased temperature under different disturbances in European boreal and temperate forests

- Examples increased temperature and bark beetles;
  - direct: several generations per year
  - indirect: more vet snow in winter, more brakeage and weakened trees, increased occurrence of bark beetles
  - cascading: synergies between root rot occurrence and bark beetle outbreak

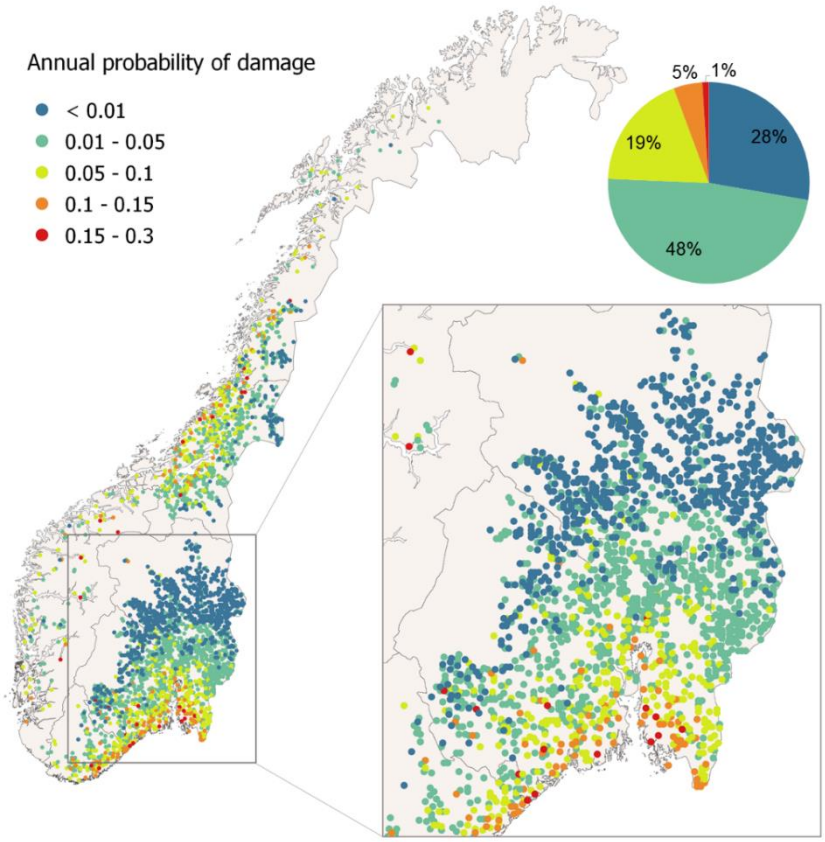
- Complexity! Challenging to develop models, simplification necessary



Models for bark beetle attacks

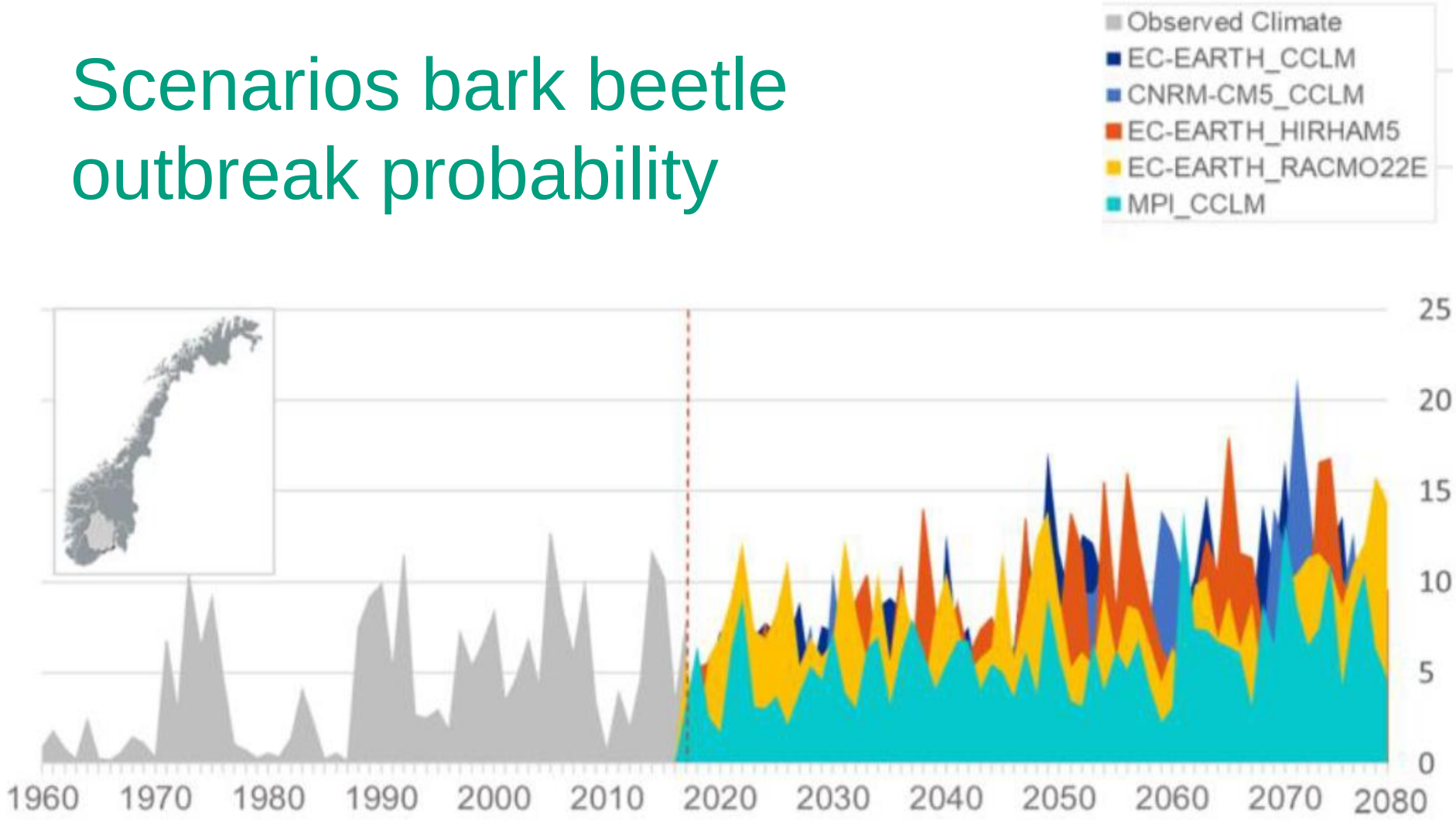
- "Bark beetle risk in Norwegian forests under current and changing climate conditions" (Joyce Romeiro, PhD-student at MINA)
- Models developed in Austria evaluated for Norwegian conditions
  - 1) probability of attack
  - 2) effects given an attack

  →current and future climate (temp and precipitation)
- Based on forest structure and climate variables from NFI permanent sample plots



Seidl, R., Schelhaas, M. J., Lindner, M., & Lexer, M. J. (2009). Modelling bark beetle disturbances in a large scale forest scenario model to assess climate change impacts and evaluate adaptive management strategies. *Regional Environmental Change*, *9*(2), 101–119.

Scenarios bark beetle outbreak probability



- Figure 6. Annual probability of bark beetle damage averaged for region Vestviken. The dotted red line marks the end of the historical climate data

Next steps CSFN

- Risk analyses to map potential adaptions of forest management to climate change
  - Bark beetle attacks (new models)
  - Root rot attacks (old models)
  - Wind and snow damage (new models)
- Direct effects only. Indirect and cascading effects are much more complicated!
- What we know for certain before any calculations: we need approaches spreading the risks, i.e. larger variation in forest management;

  →species variation, size variation

Thank you!