Drivers and impacts of intensifying disturbance regimes in Europe's forests

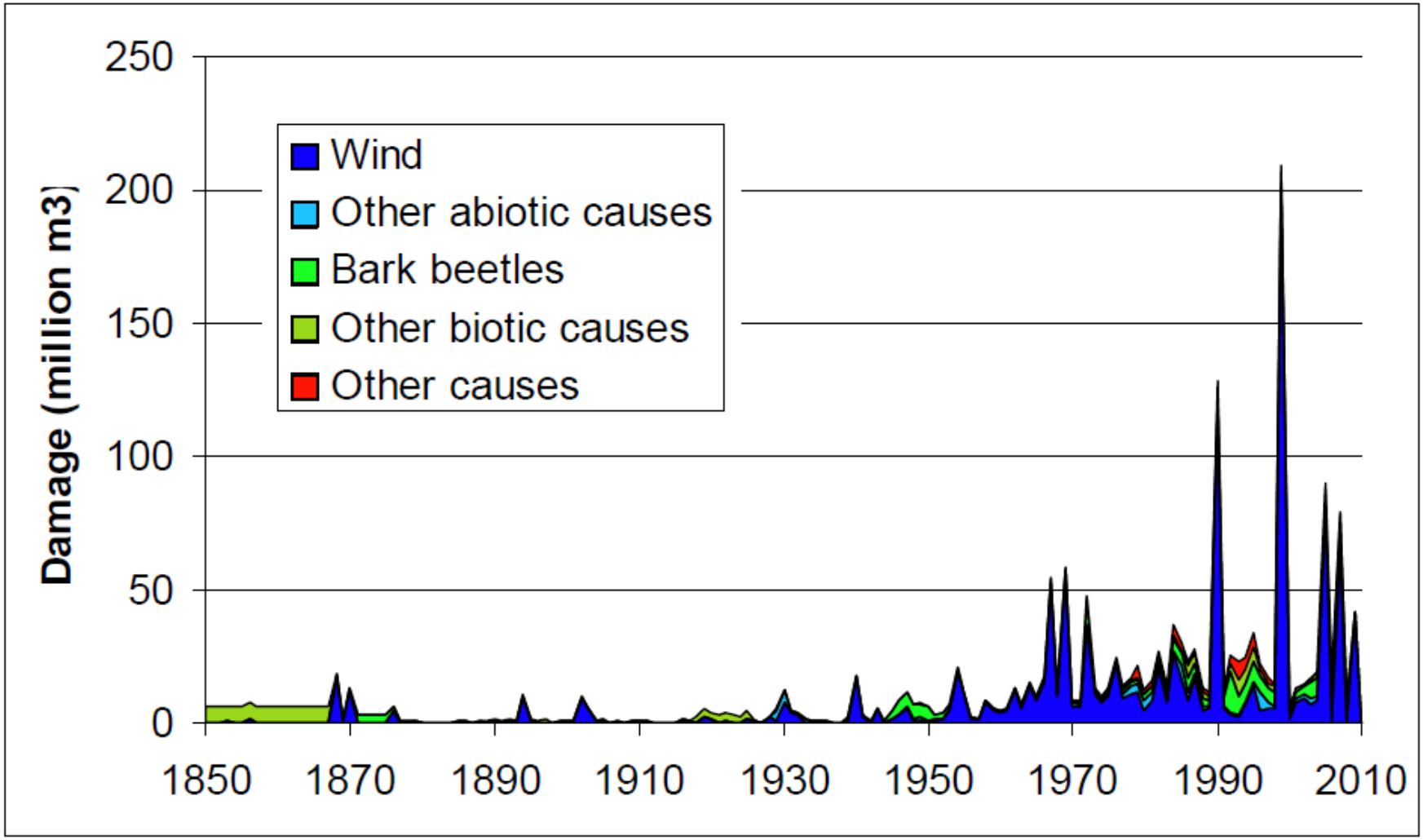
Rupert Seidl, Mart-Jan Schelhaas

University of Natural Resources and Applied Life Sciences, Vienna
Department of Forest and Soil Sciences

TOURS 2012

MOTIVE

disturbances are increasing at continental scale



source: Schelhaas (2008), Gardiner et al. (2010)

objectives

- understand what drives the intensification in disturbance regimes
  - together with Manfred J. Lexer (BOKU Vienna)

Global Change Biology

Global Change Biology (2011) 17, 2842–2852, doi: 10.1111/j.1365-2486.2011.02452.x

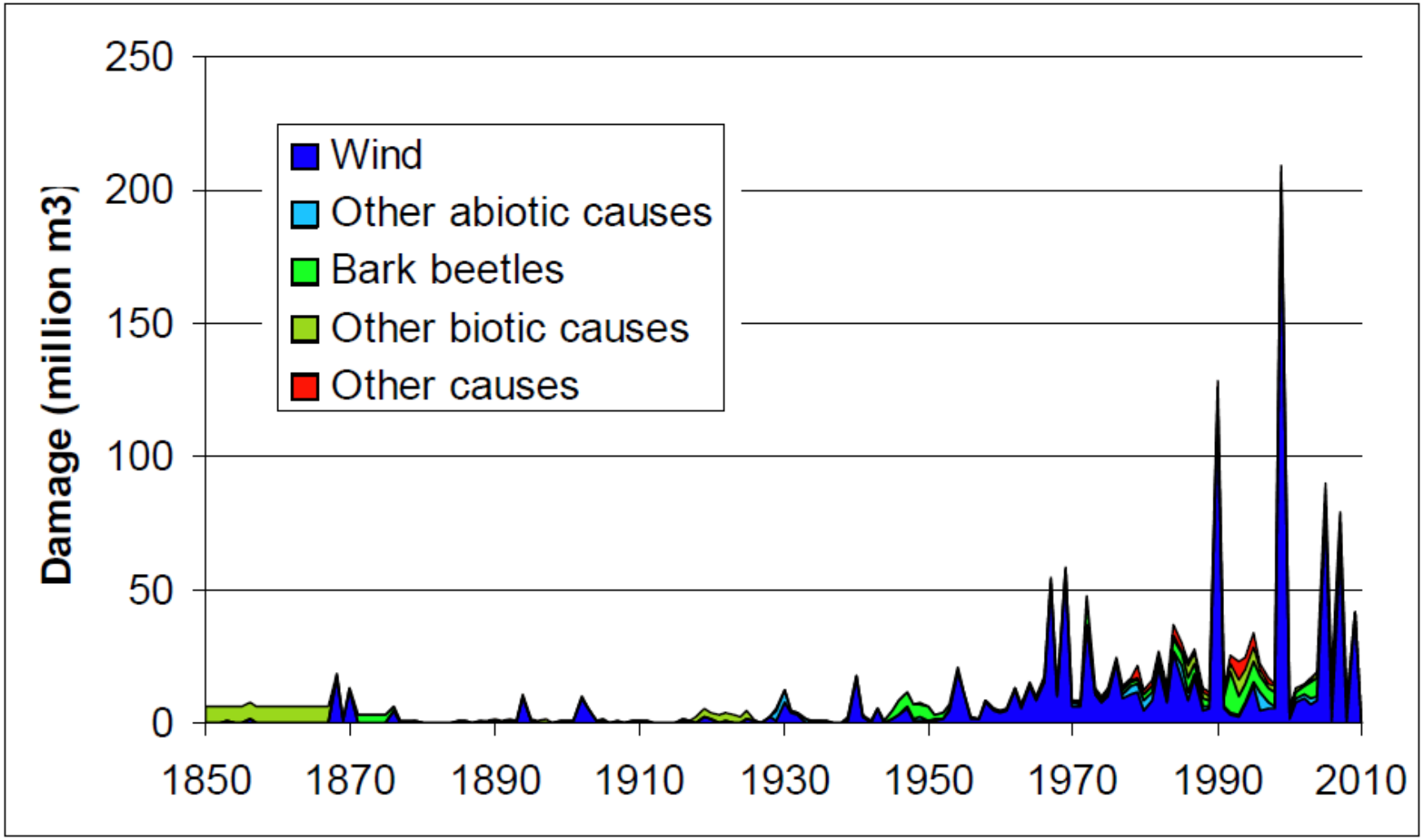
Unraveling the drivers of intensifying forest disturbance regimes in Europe

RUPERT SEIDL*†, MART-JAN SCHELHAAS‡ and MANFRED J. LEXER†

- assess potential trajectories of disturbance damage in the future
  - together with Hans Verkerk (EFI, Joensuu)

WORK IN PROGRESS

disturbances are increasing at continental scale



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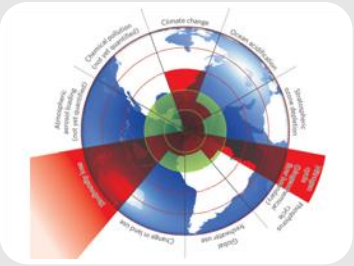
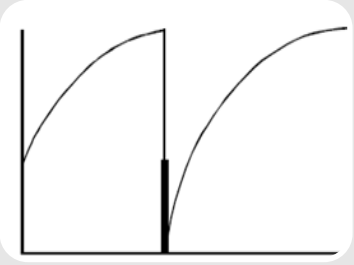
why study disturbances at continental scale?



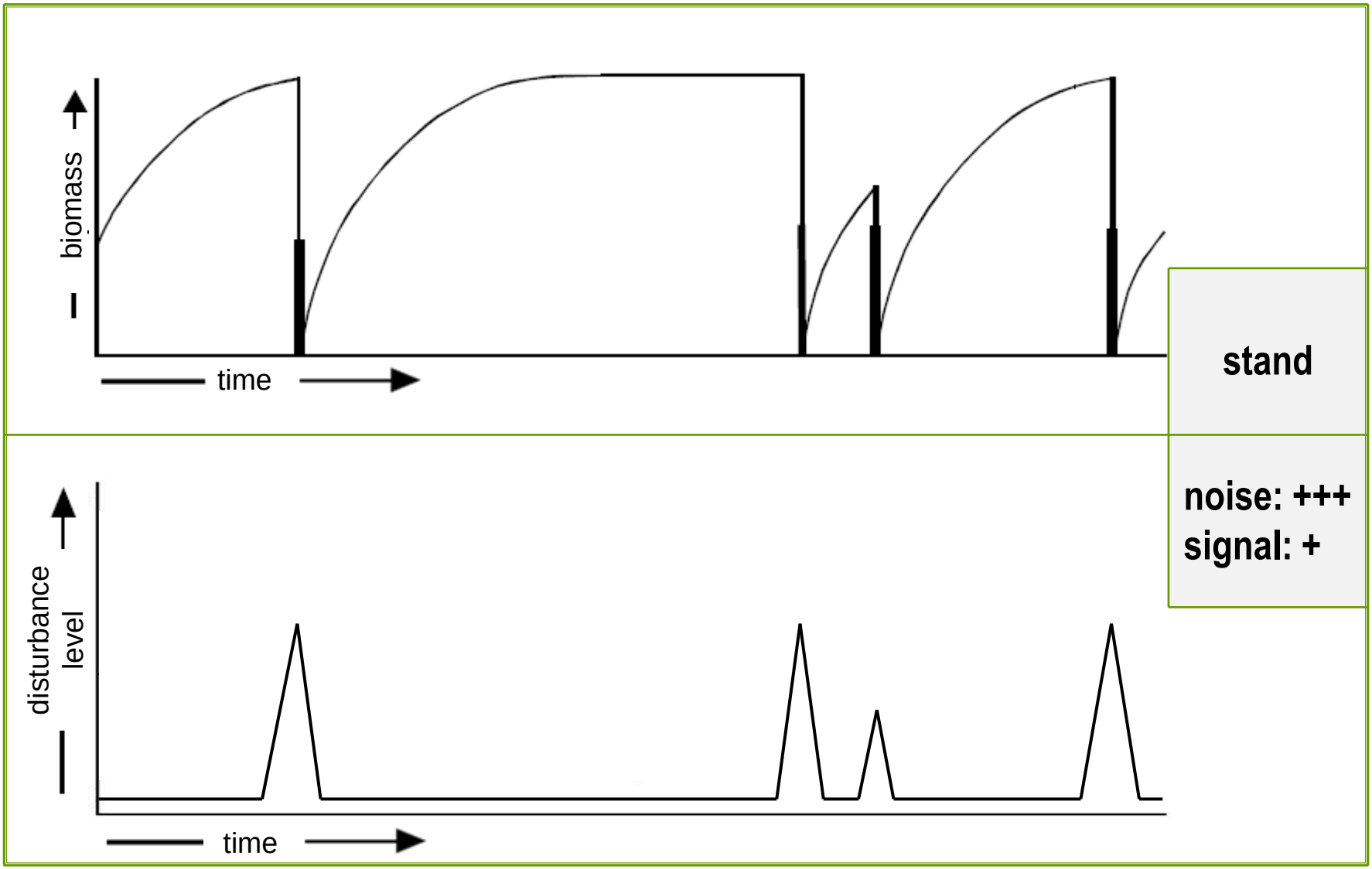
we‘re facing continental (and global) changes of the earth system

relevance for policy-makers

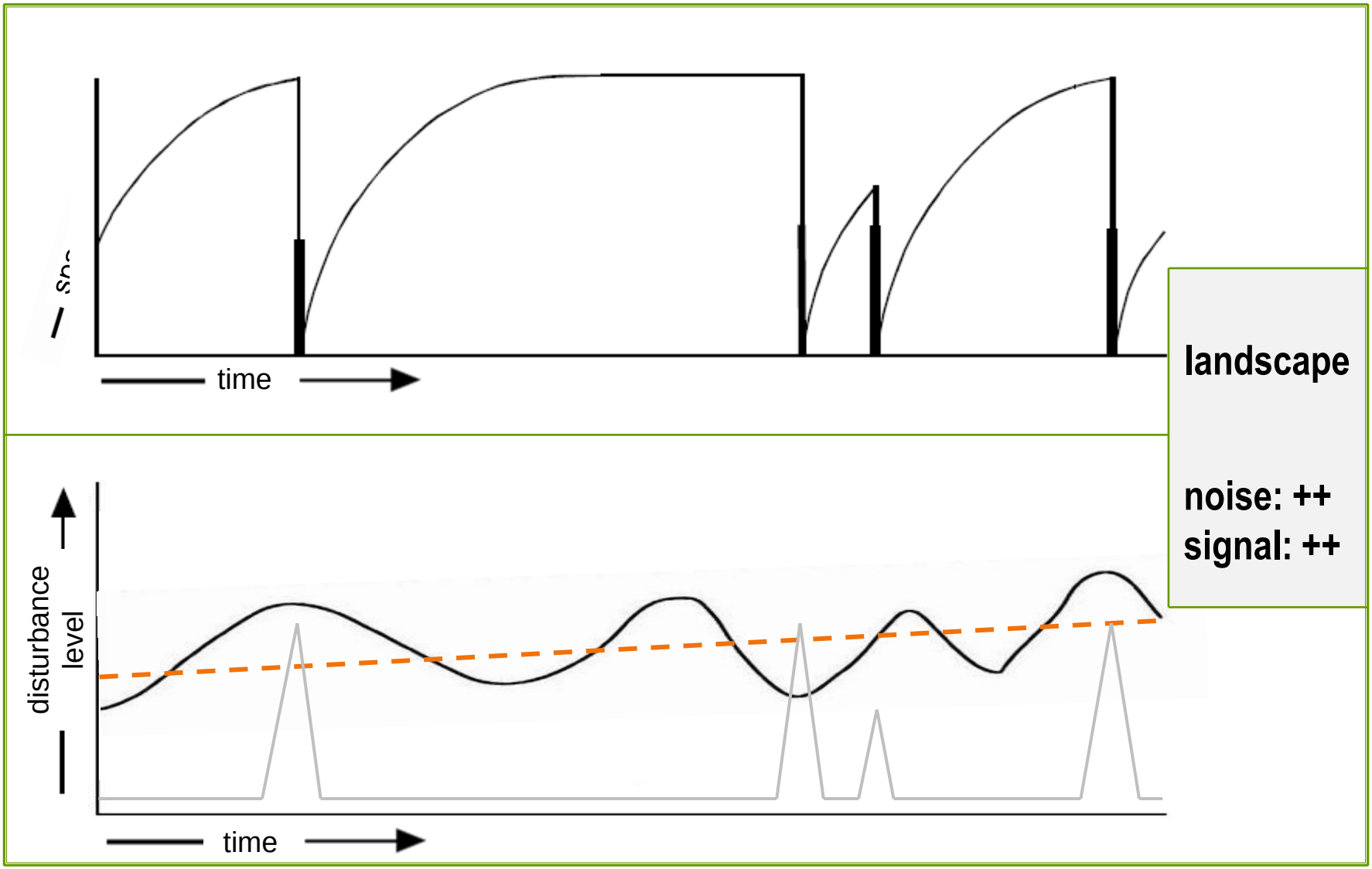


signal-to-noise ratio in assessing changes in the disturbance regime

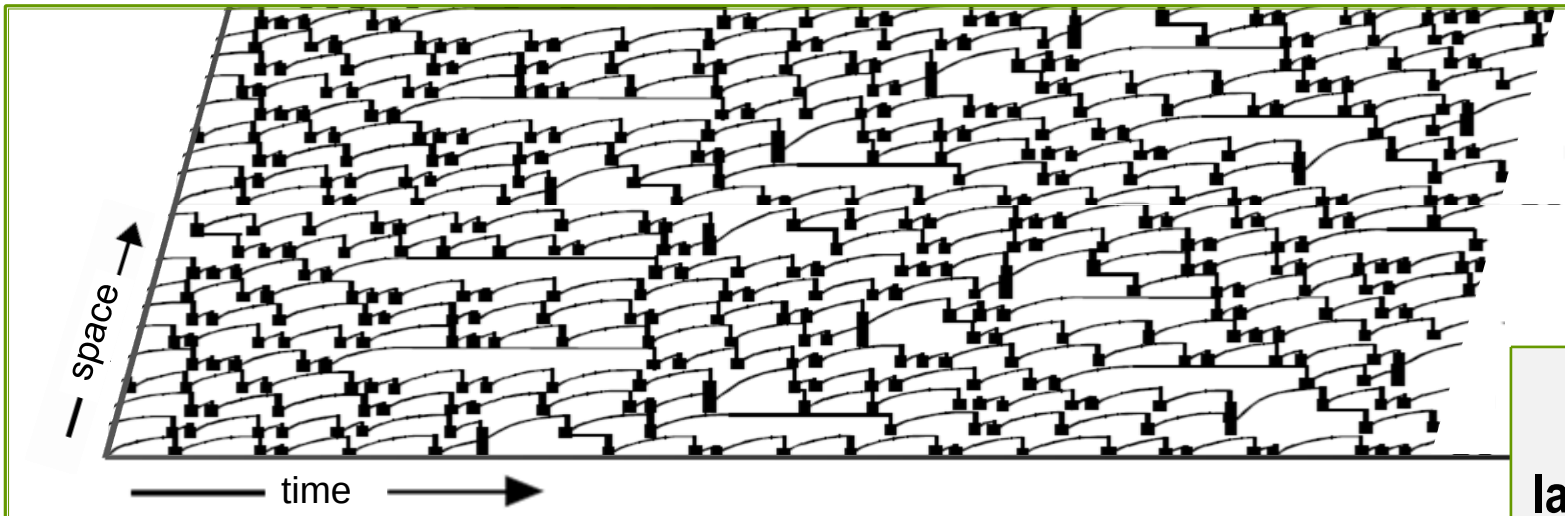
scale and the signal-to-noise ratio



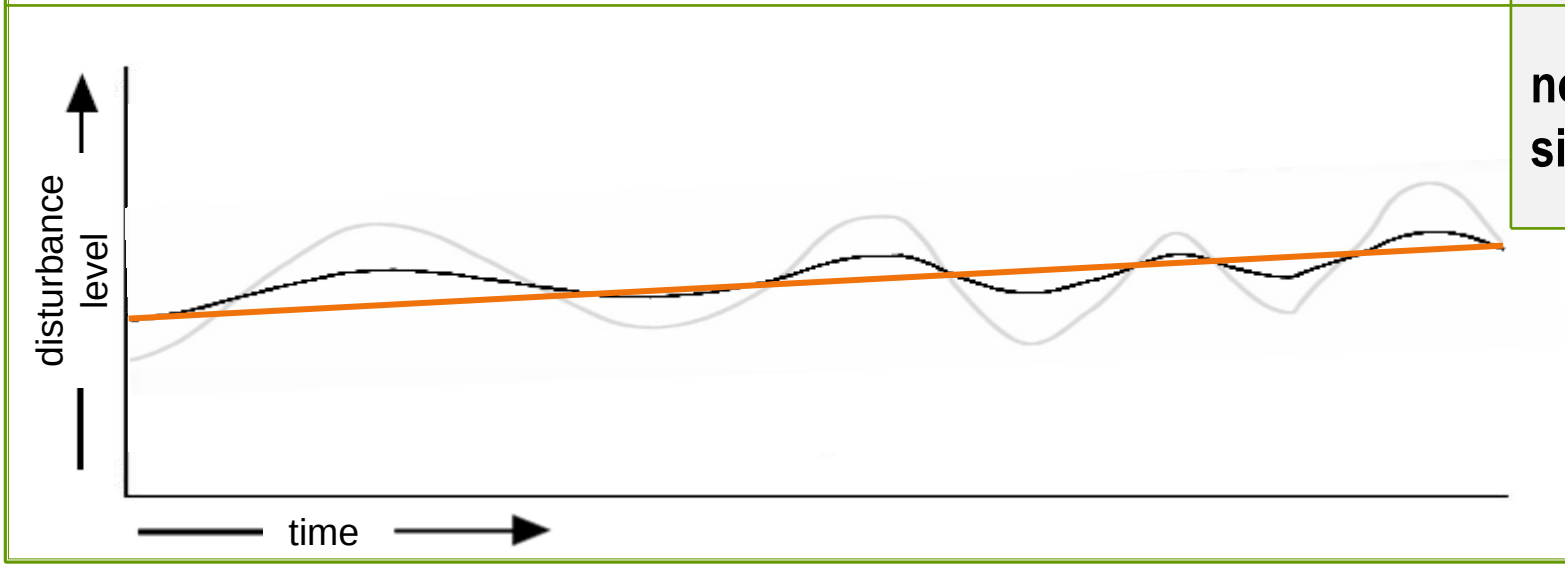
scale and the signal-to-noise ratio



scale and the signal-to-noise ratio

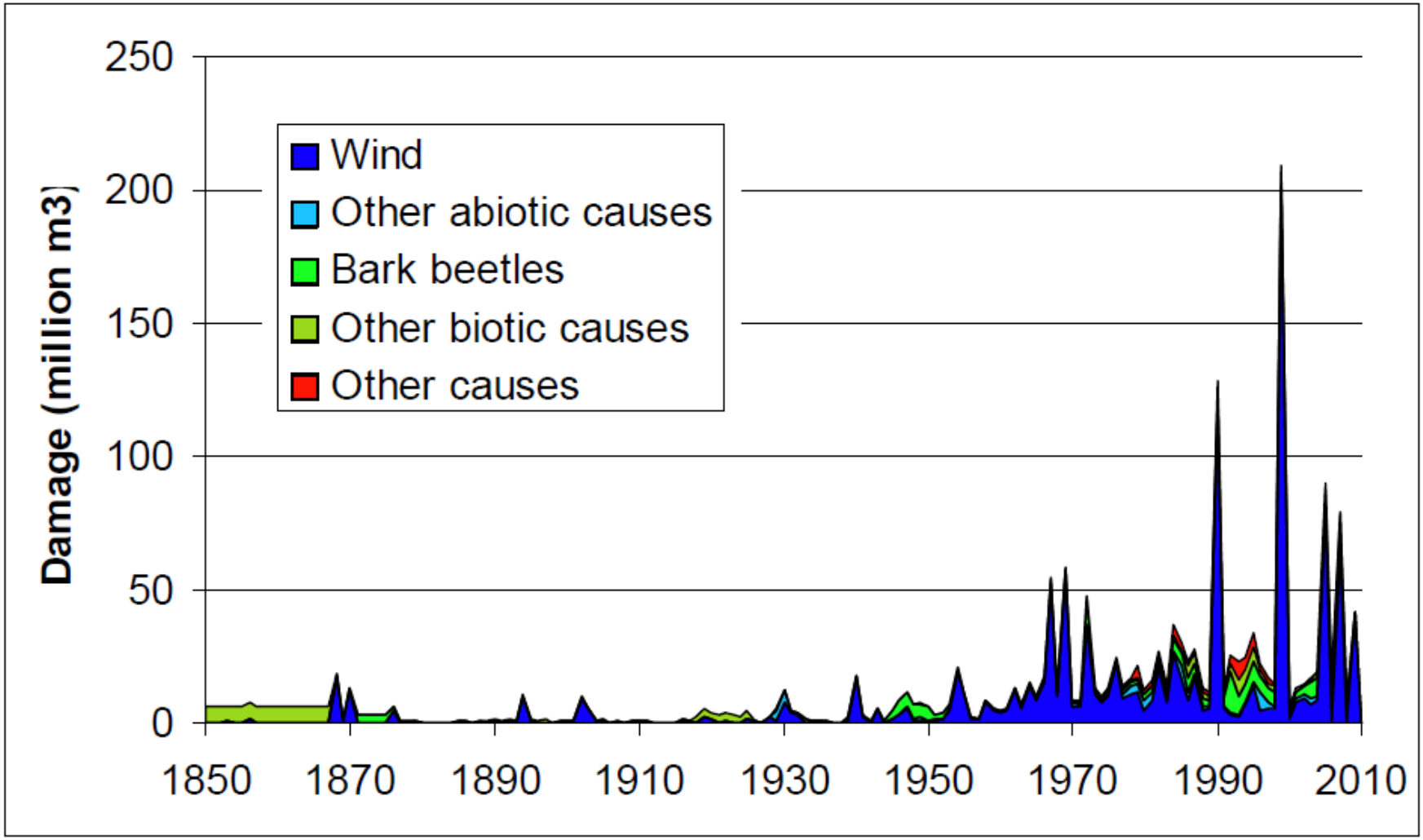


larger landscape



noise: +
signal: +++

disturbances are increasing at continental scale



source: Schelhaas (2008), Gardiner et al. (2010)

hypotheses for increase in disturbances

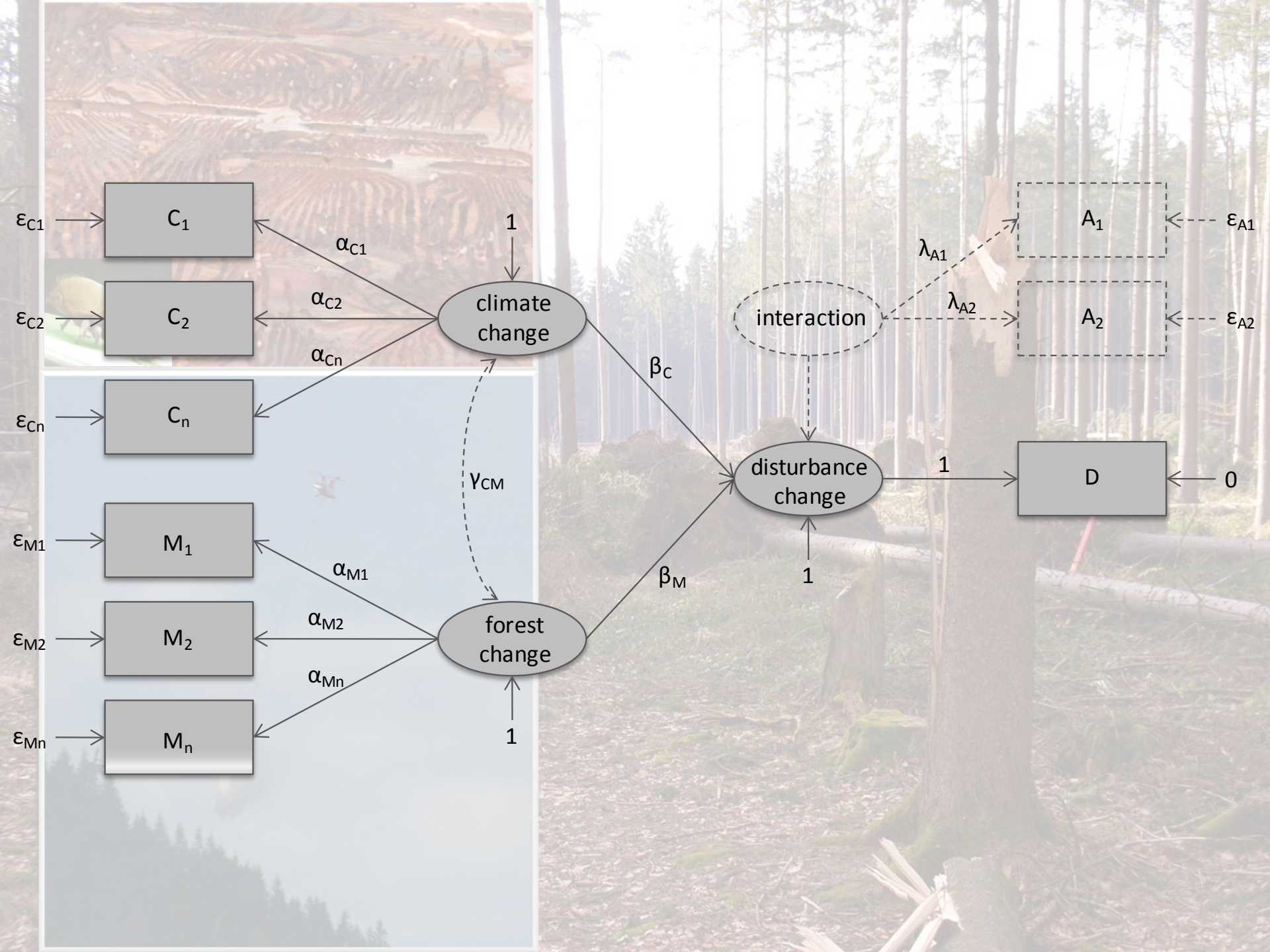
- climate change
  - less soil frost = less resistance against winter storms
  - warmer temperatures = boosted population levels of biotic disturbance agents
  - more frequent drought = increased susceptibility to disturbances (fire, beetles)

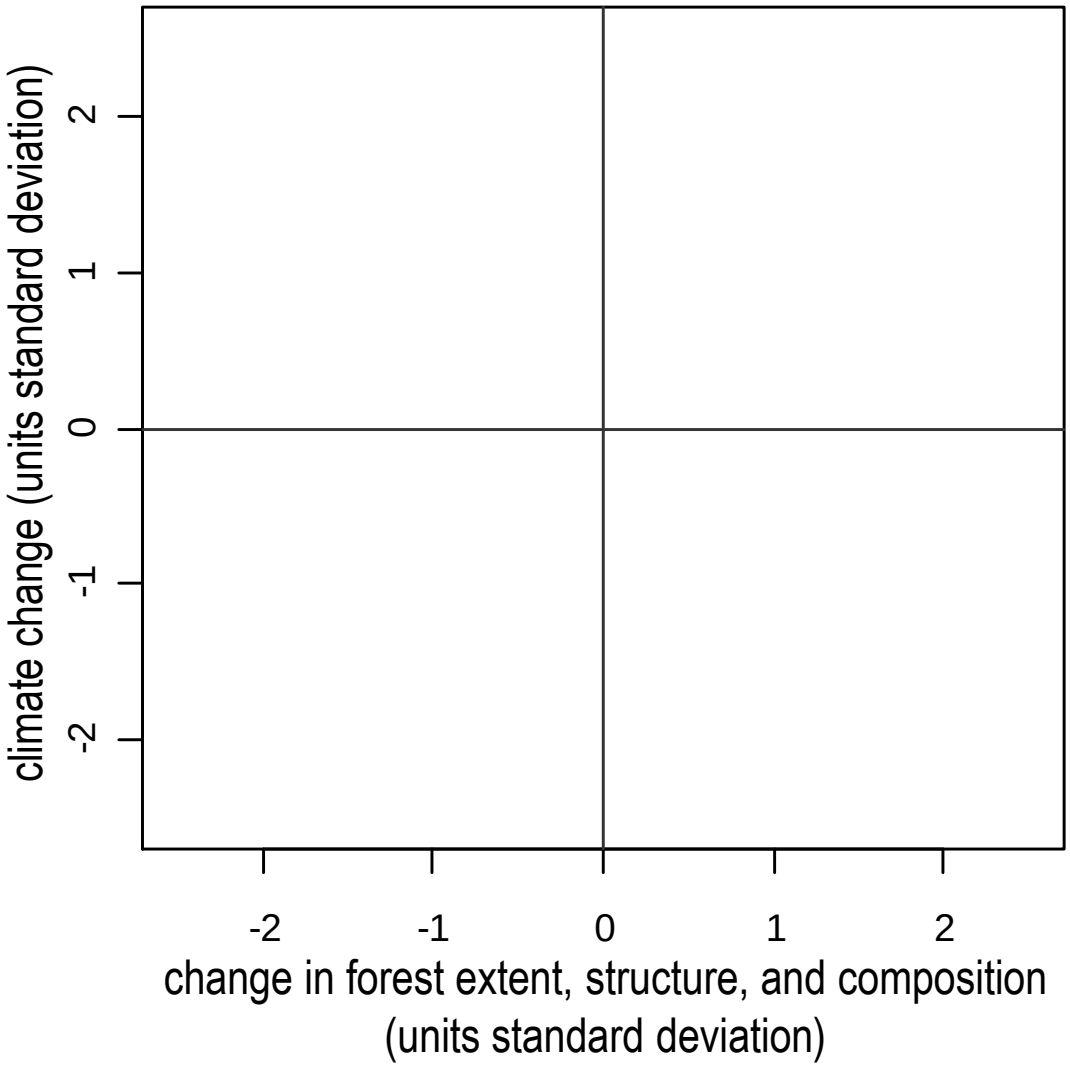
- changes in forest extent, structure, and composition
  - increased forest area and growing stock = higher damage potential
  - more secondary coniferous forests = increased susceptibility
  - aging forests = increasing susceptibility

objectives and materials

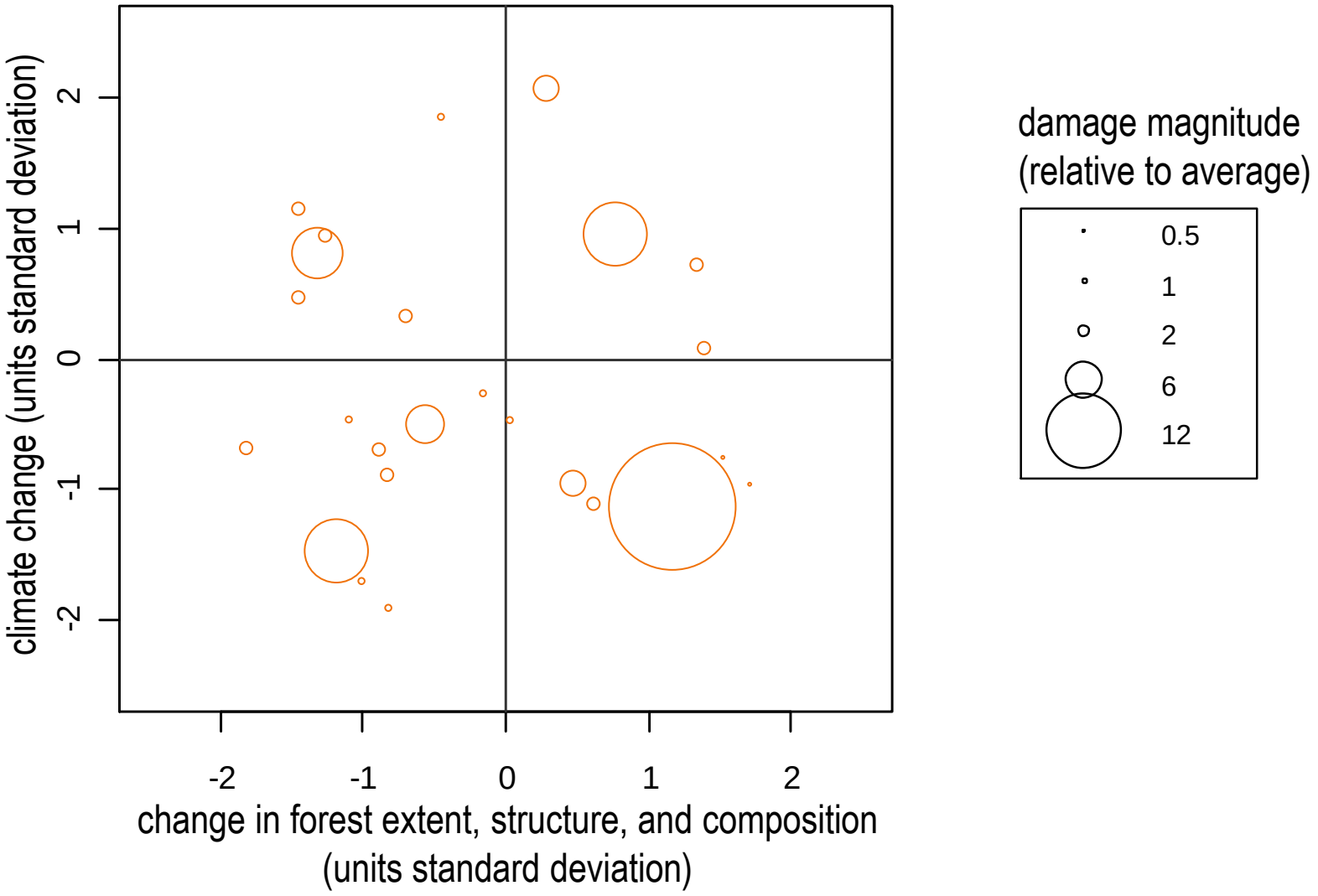
- objectives
  - unravel the drivers of disturbance increases in Europe (climate vs. forest change)
  - disturbance agents: wind, bark beetle, wildfire

- materials
  - obs. disturbance levels, climate reanalysis data, forest inventory data (1958-2001)
  - 23 countries in Europe (forest area: 136.6 Mill. ha)

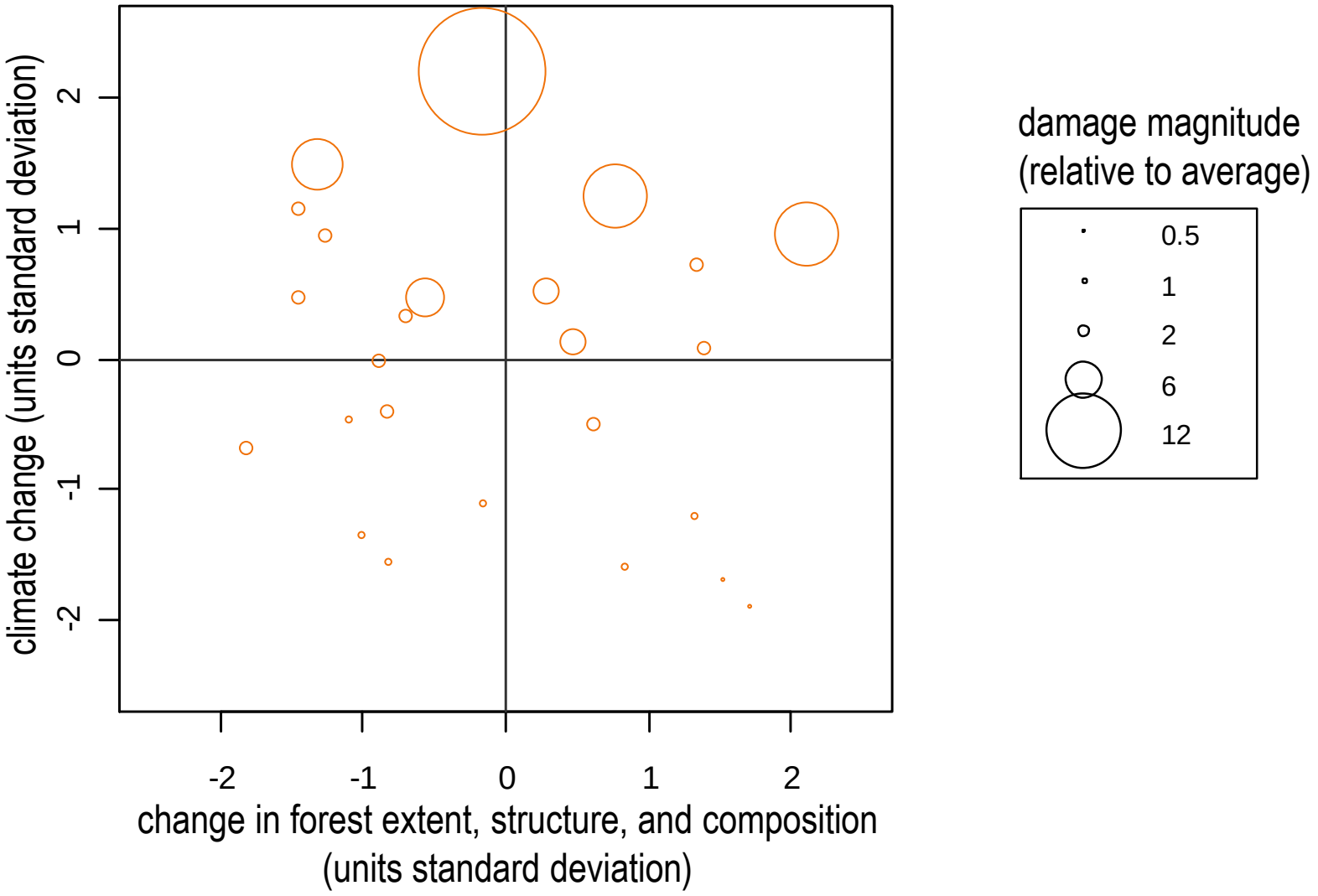

ε_{C1}
C_1
α_{C1}
1
climate change
ε_{C2}
C_2
α_{C2}
α_{Cn}
ε_{Cn}
C_n
γ_{CM}
ε_{M1}
M_1
α_{M1}
ε_{M2}
M_2
α_{M2}
forest change
α_{Mn}
ε_{Mn}
M_n
1
β_C
β_M
disturbance change
1
A_1
ε_{A1}
λ_{A1}
interaction
λ_{A2}
A_2
ε_{A2}
1
D
0


climate change (units standard deviation)
2
1
0
-1
-2
-2
-1
0
1
2
change in forest extent, structure, and composition
(units standard deviation)

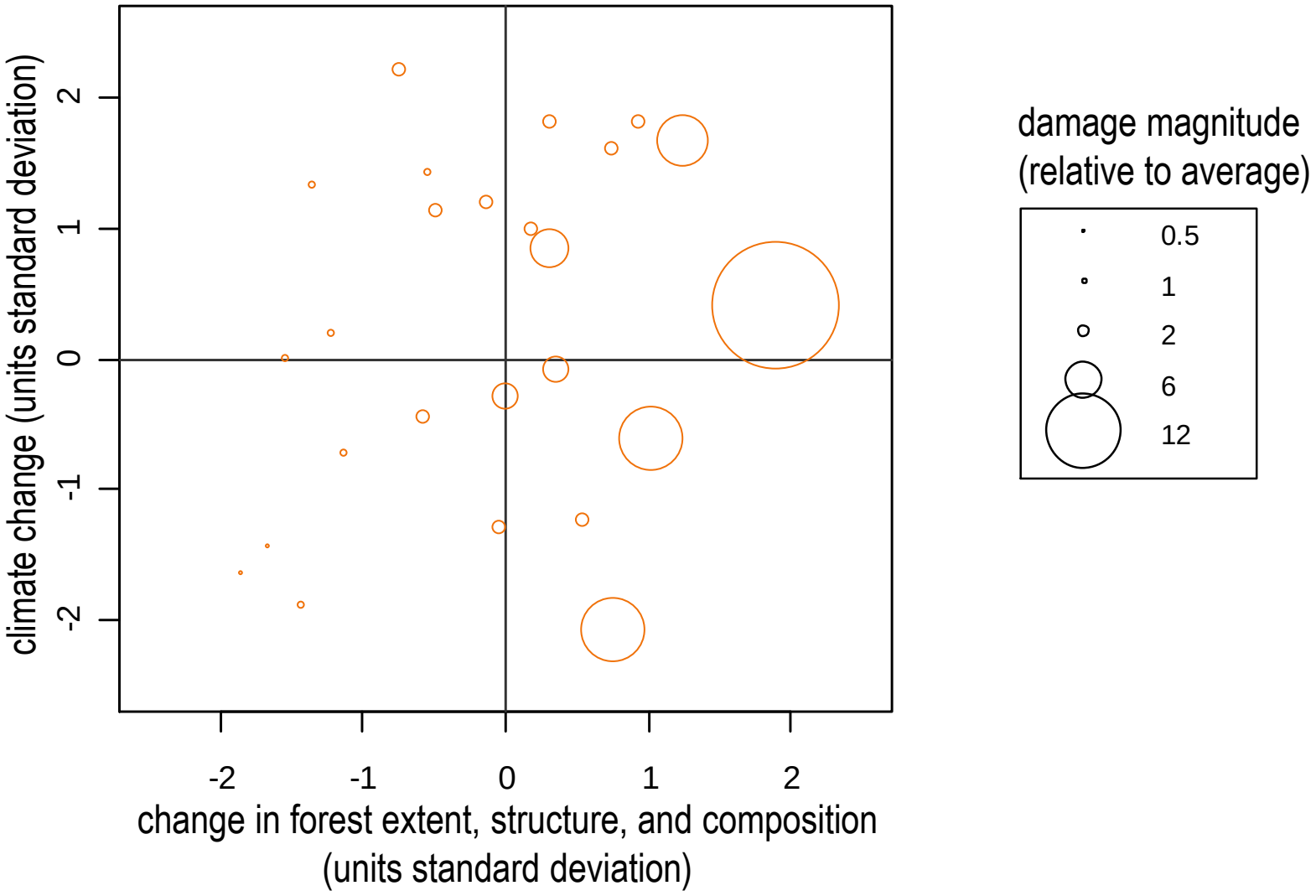
no effect of climate or vegetation on disturbance



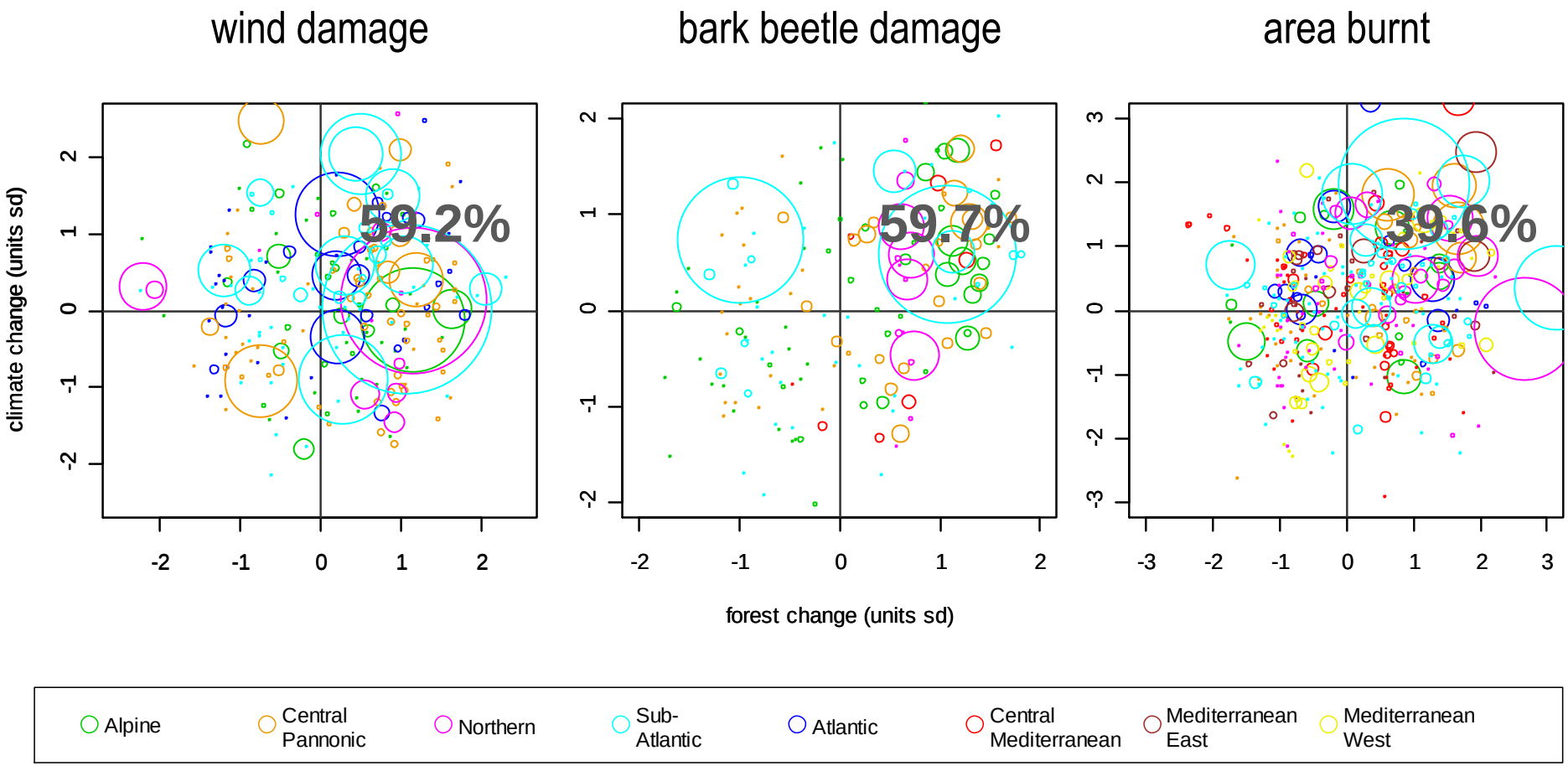
climate effect, no vegetation effect



vegetation effect, no climate effect

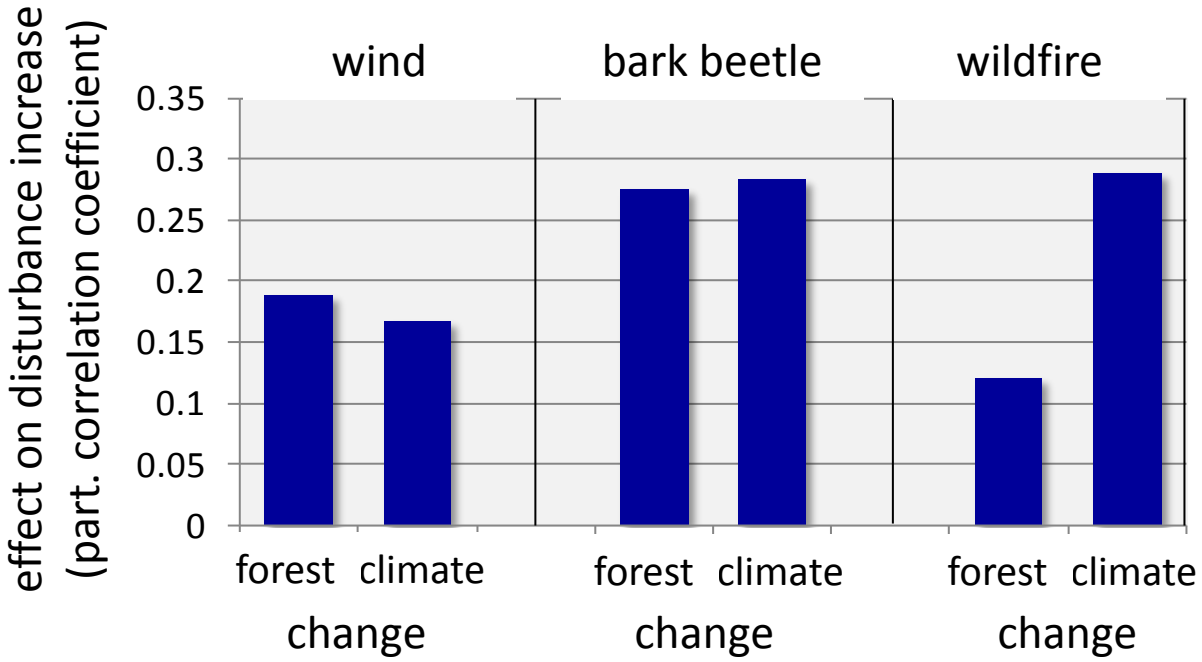


what conditions for extreme disturbance events?

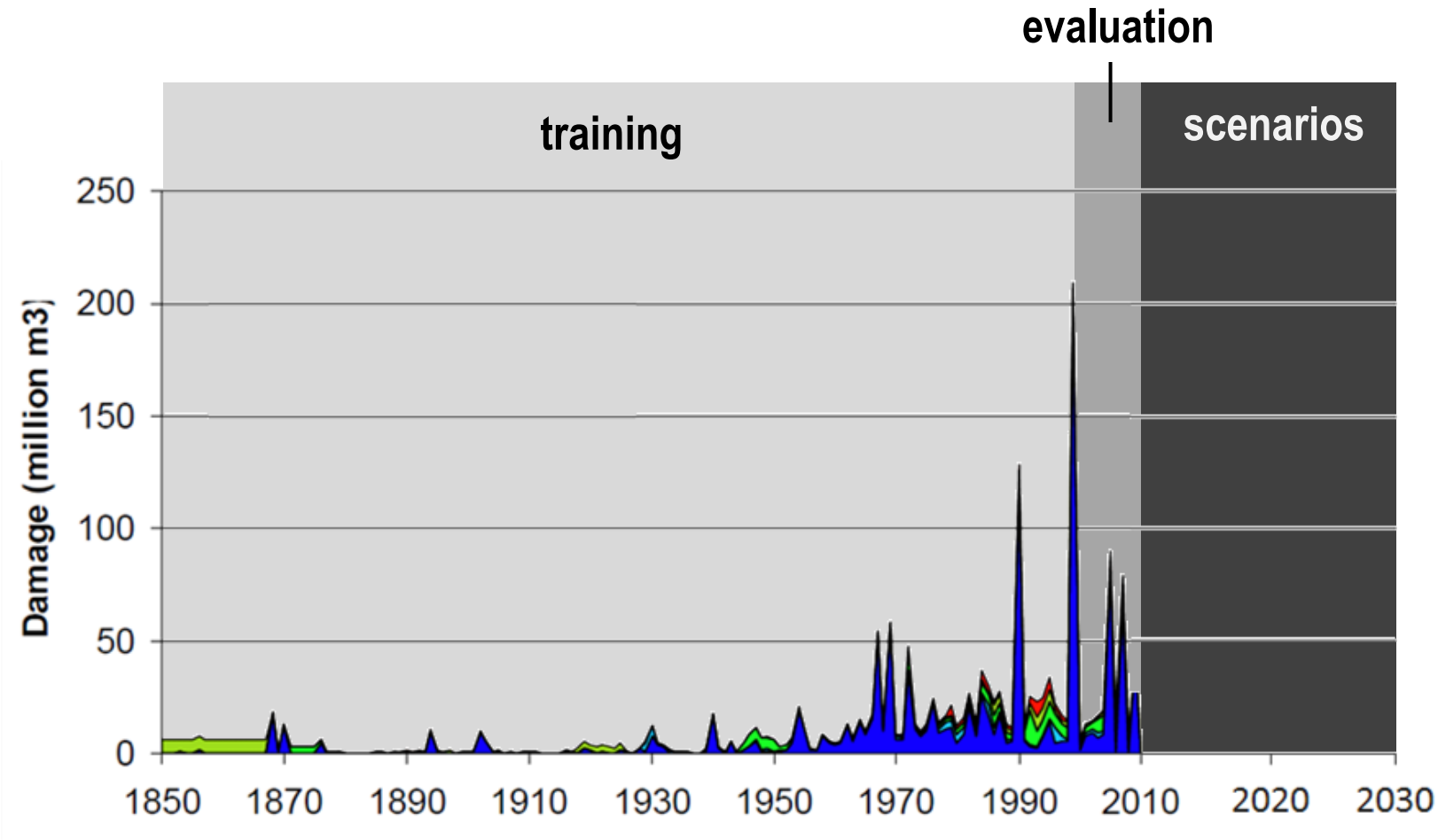


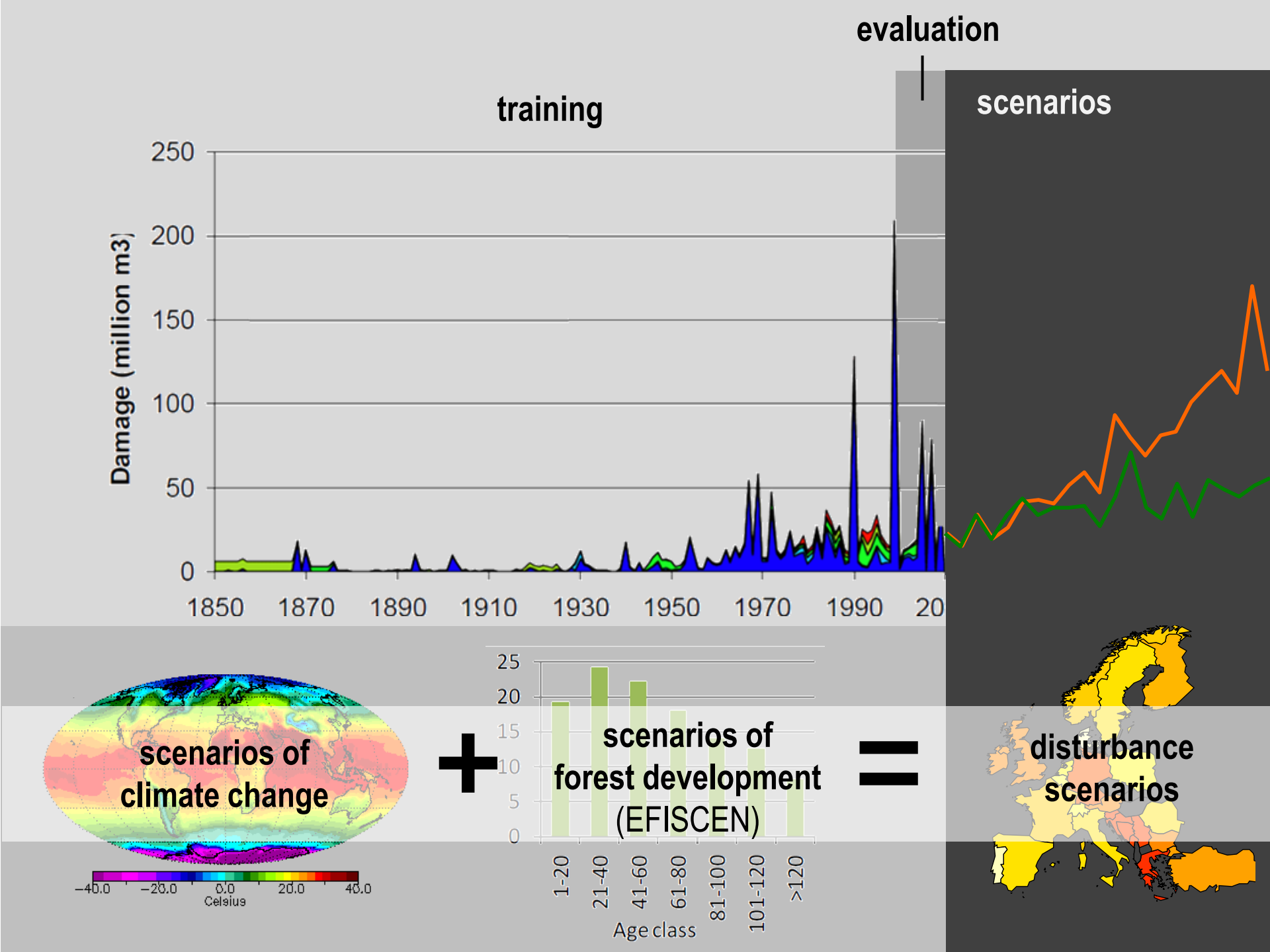
what contributed to observed increases

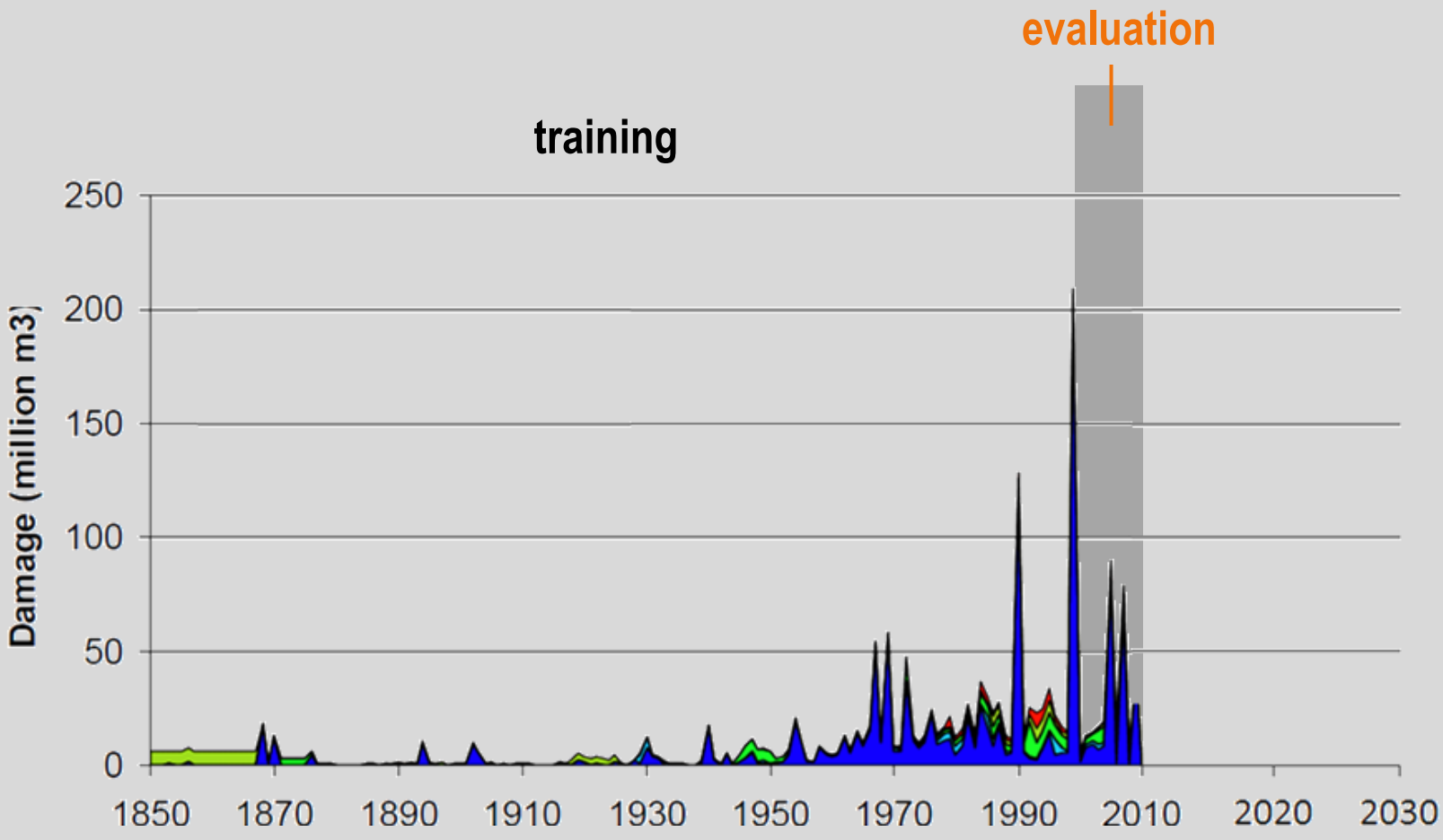
- climate *and* forest changes contributed in the same order of magnitude to continental-scale increases in wind and bark beetle damage
- increase in wildfires strongly climate-driven




How will disturbance damage
develop in the future?


evaluation
training
scenarios
Damage (million m3)
250
200
150
100
50
0
1850
1870
1890
1910
1930
1950
1970
1990
2010
2020
2030


evaluation
training
scenarios
Damage (million m3)
250
200
150
100
50
0
1850
1870
1890
1910
1930
1950
1970
1990
20
scenarios of
climate change
−40.0
−20.0
0.0
20.0
40.0
Celsius
+
25
20
15
10
5
0
scenarios of
forest development
(EFISCEN)
1-20
21-40
41-60
61-80
81-100
101-120
>120
Age class
=
disturbance
scenarios


evaluation
training
Damage (million m3)
250
200
150
100
50
0
1850
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1890
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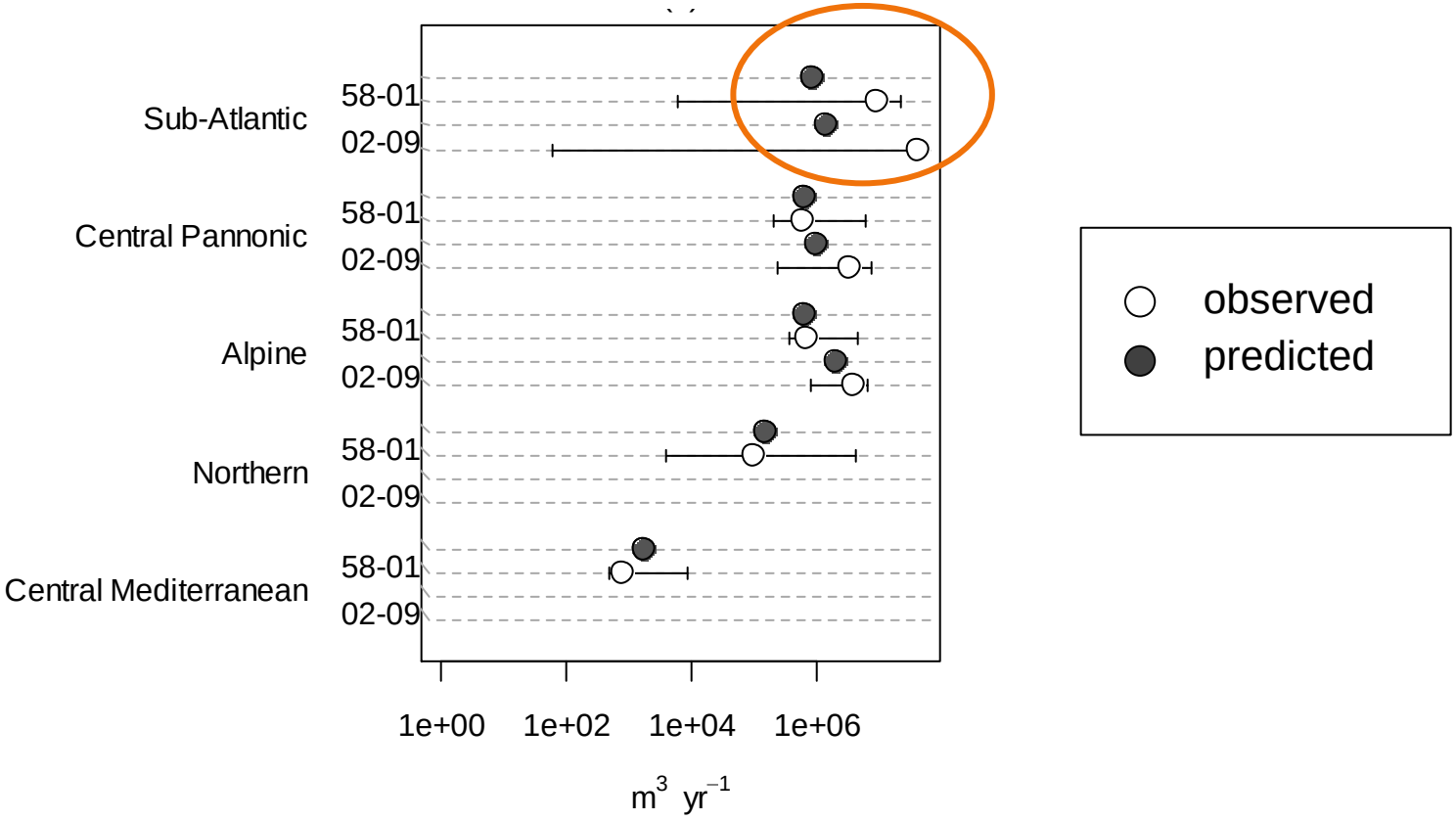
1970
1990
2010
2020
2030

prerequisite: ability to predict independent data

- evaluation example: bark beetle damage



TOURS 2012

INTERNATIONAL CONFERENCE

Tackling climate change: the contribution of forest scientific knowledge

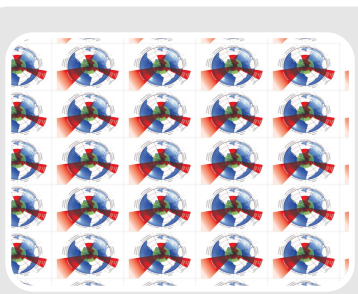
May 21 – 24 , 2012, Tours (France)

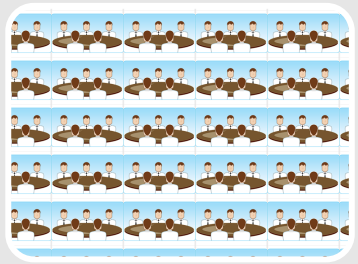
CONFERENCE INTERNATIONALE

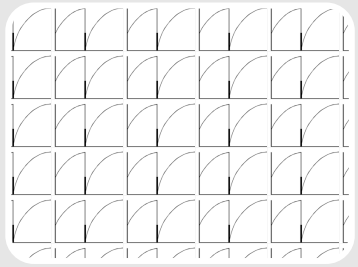
Faire face au changement climatique : la contribution de la science forestière

21—24 Mai 2012, Tours (France)

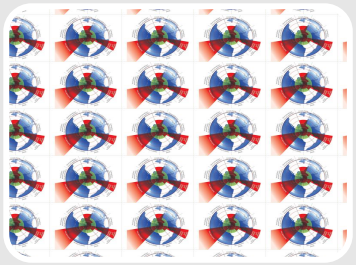
the question of scale revisited

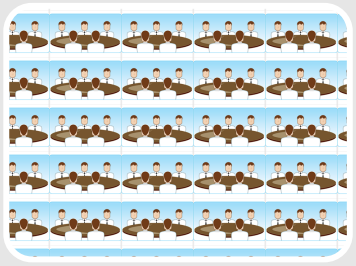


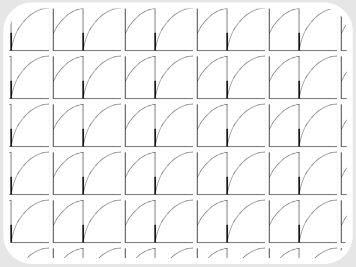


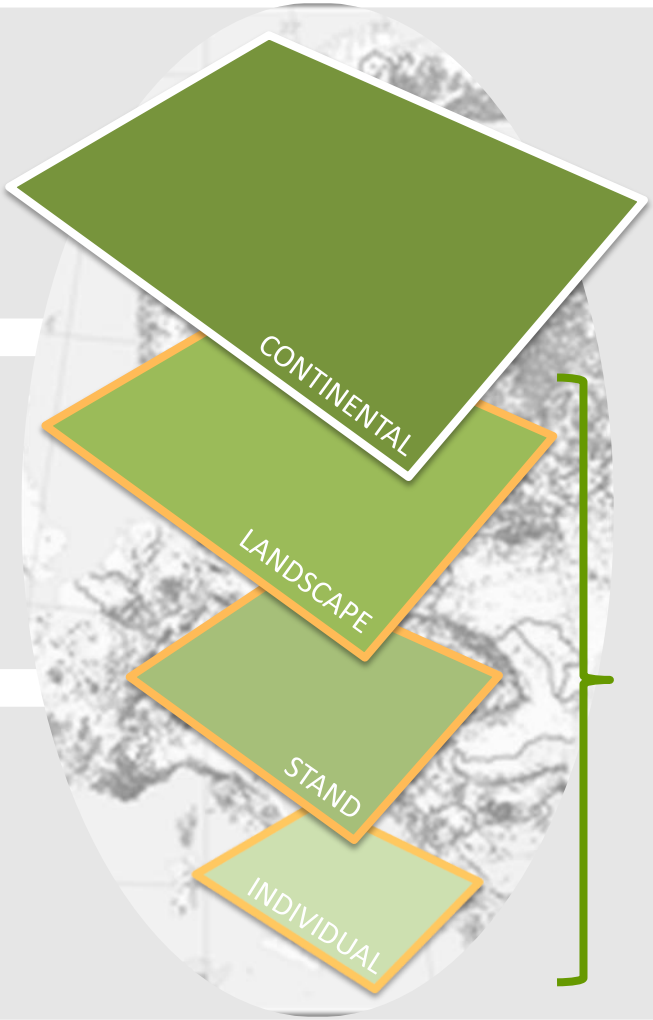


the question of scale revisited







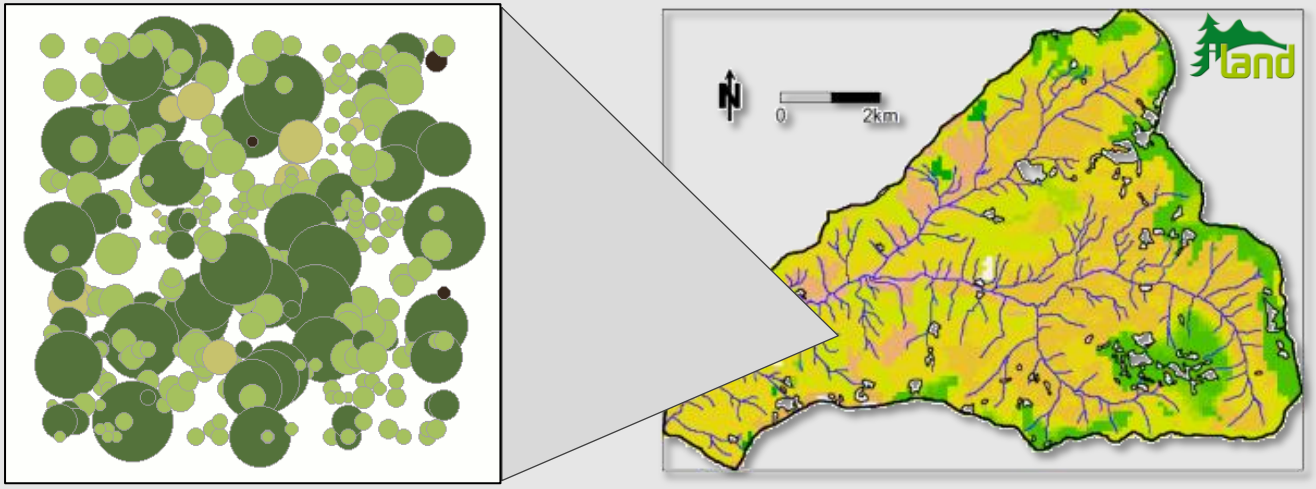


addressing
intensifying
disturbance regimes
in management

management (and modeling) at multiple scales

- bottom-up emergence of ecological resilience
- top-down impacts of climate change, large disturbance

the individual-based landscape and disturbance model (iLand)



download: http://iLand.boku.ac.at

Seidl et al. (2012, Ecol. Model.)

take home messages

- intensifying disturbance regimes are related to changes in climate AND changes in forest structure, composition and extent

- we hypothesize a continuation of the current trend towards more disturbance-prone conditions also for the near- to mid-term future (tests pending)

- managing disturbances will be a central issue in tackling climate change, and it'll require the consideration of processes (and their interactions) at/across multiple scales

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rupert.seidl@boku.ac.at
http://iland.boku.ac.at