La biodiversité en Europe face au changement climatique

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Climate change and European biodiversity

- Risks for European ecosystems due to climate change
- Biodiversity: „confrontation de différents points de vue“
- Biodiversity and ecosystem services
- Recent European assessments

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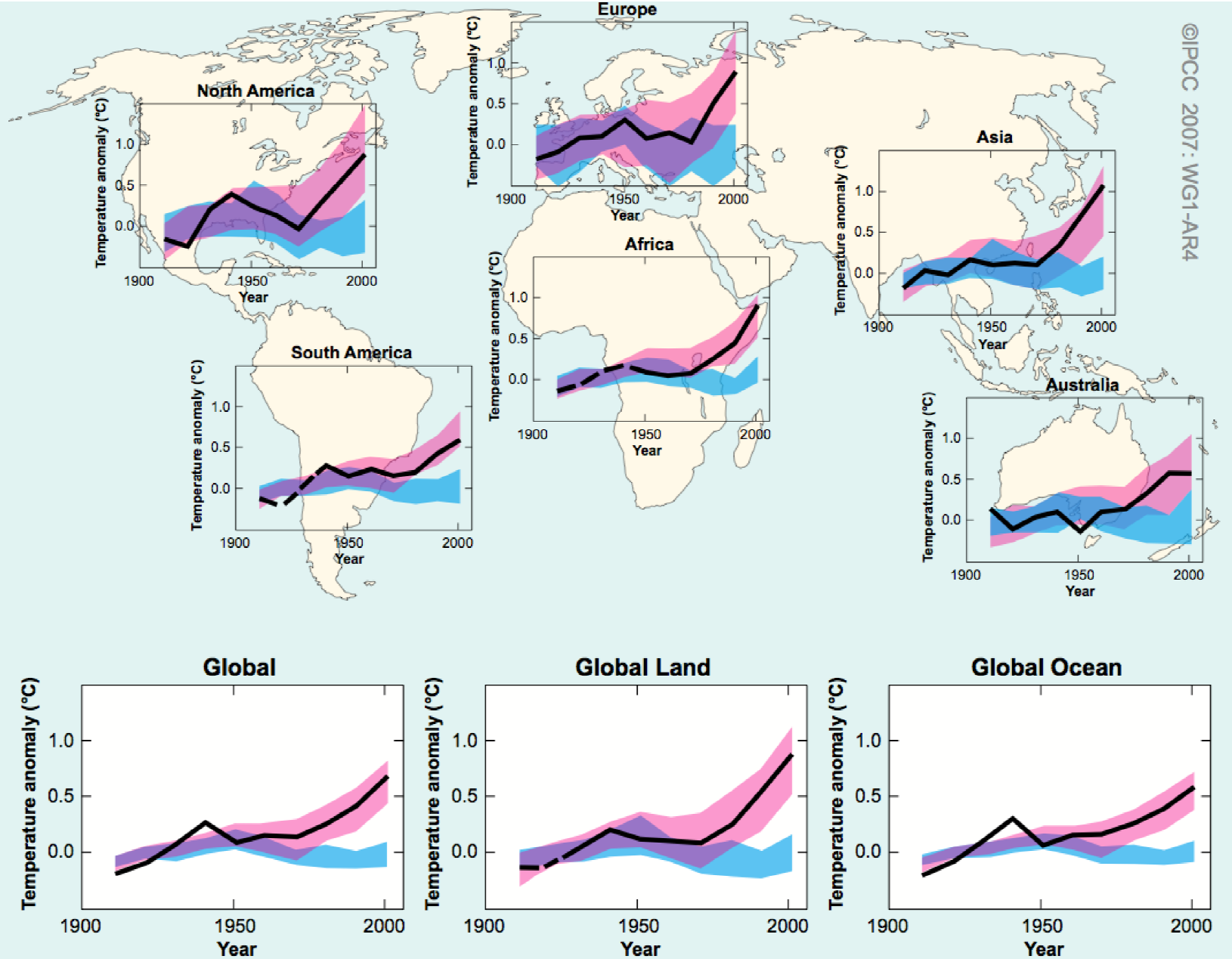
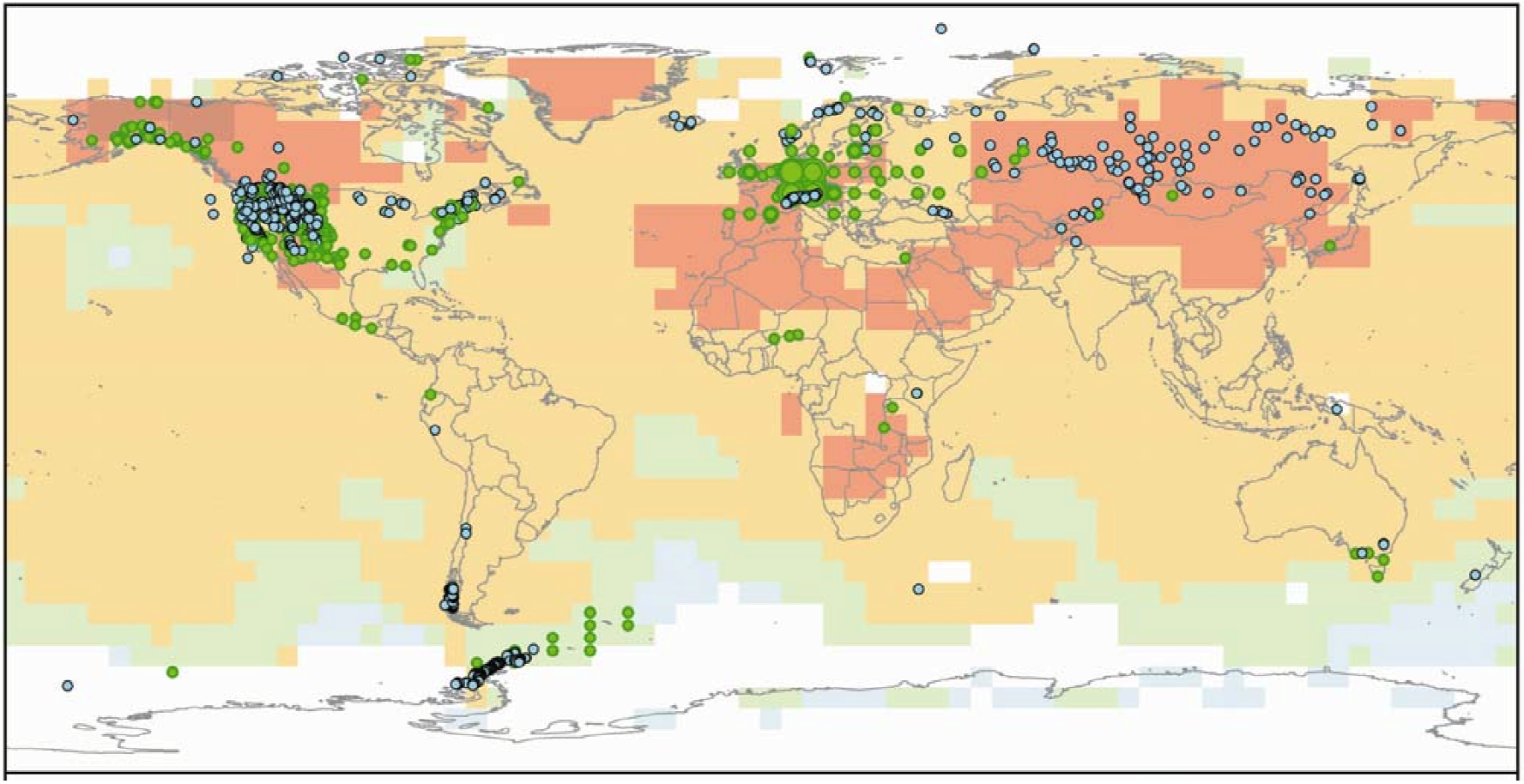
IPCC 4AR: Observed temperature change



the river Elbe 2002

Observed change in physical and biological systems




Lorraine, France, August 2003

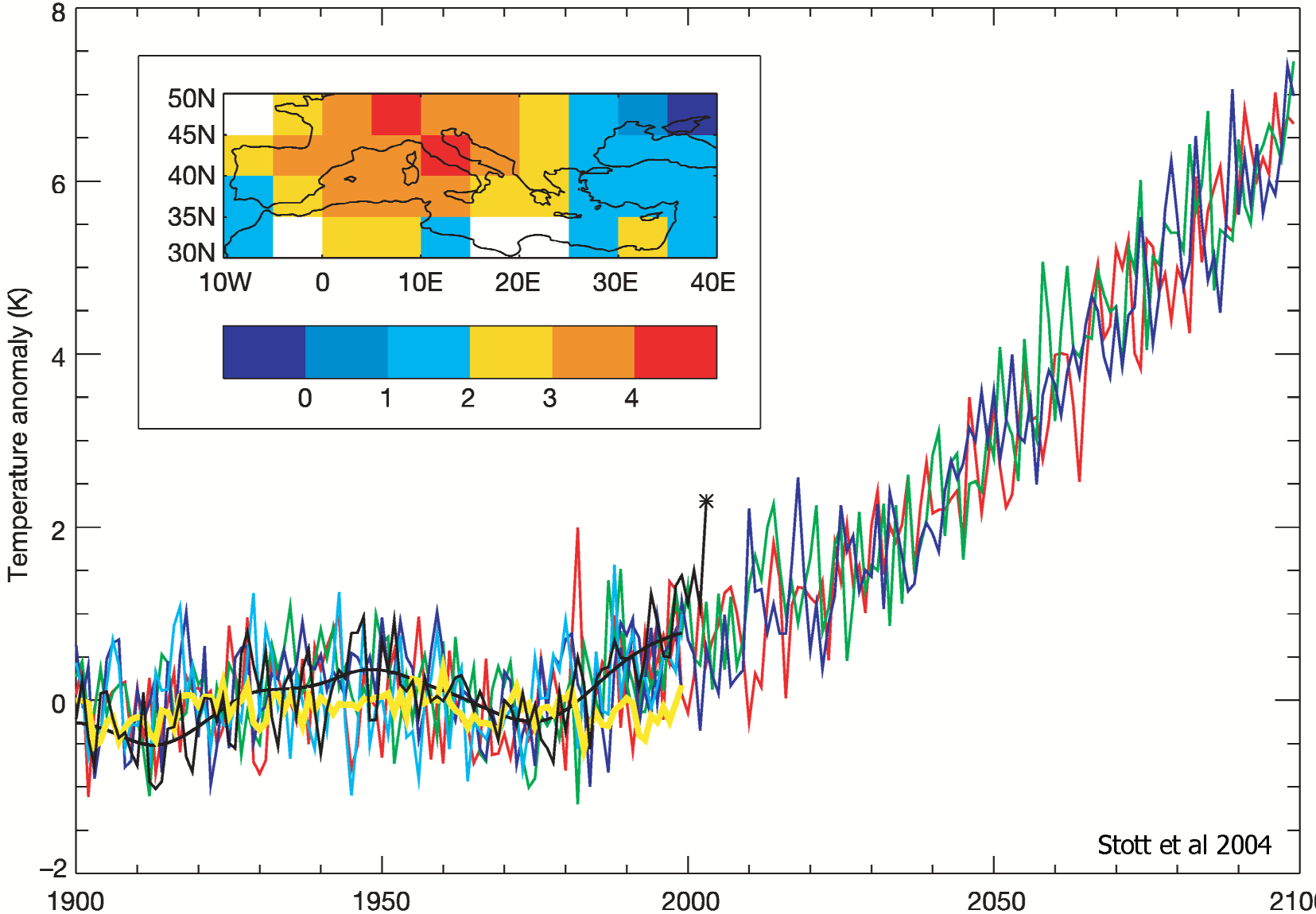
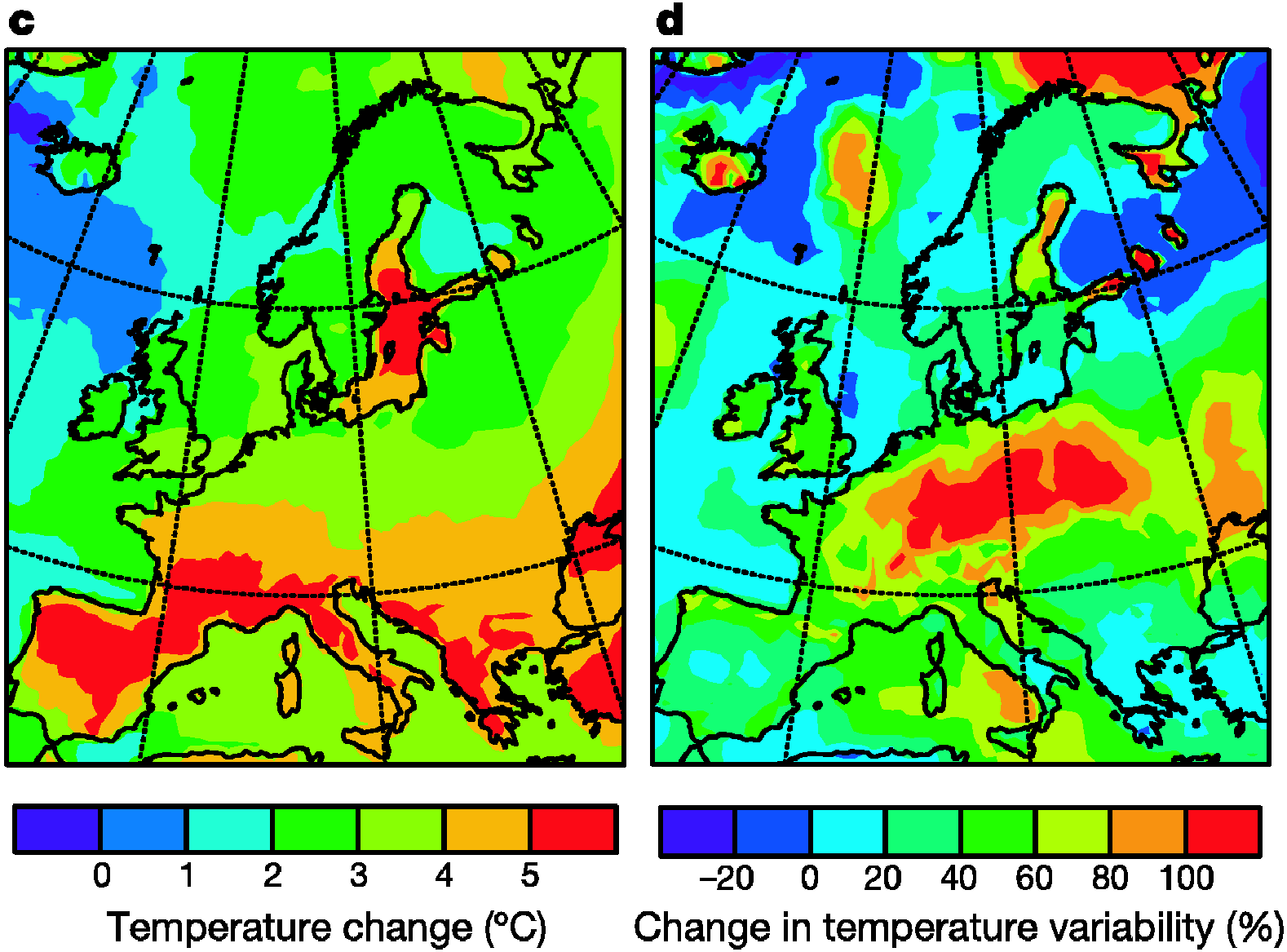


Figure 1 June–August temperature anomalies (relative to 1961–90 mean, in K) over the region shown in inset. Shown are observed temperatures (black line, with low-pass-filtered temperatures as heavy black line), modelled temperatures from four HadCM3 simulations including both anthropogenic and natural forcings to 2000 (red, green, blue and turquoise lines), and estimated HadCM3 response to purely natural natural forcings (yellow line). The observed 2003 temperature is shown as a star. Also shown (red, green and blue lines) are three simulations (initialized in 1989) including changes in greenhouse gas and sulphur emissions according to the SRES A2 scenario to 2100[22]. The inset shows observed summer 2003 temperature anomalies, in K.



Results from an RCM climate change scenario representing current (CTRL 1961–90) and future (SCEN 2071–2100) conditions. **c**, Associated temperature change (SCEN–CTRL, °C). **d**, Change invariability expressed as relative change in standard deviation of JJA means ((SCEN–CTRL)/CTRL, %).

Schär et al 2004

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Biodiversity: „confrontation de différents points de vue“

- Biological views on biodiversity
  - „Biodiv. means species richness“
  - „Biodiv. means genetic, phenotypic, taxonomic, community and landscape diversity“
  - „Biodiv. means presence of keystone species“
  - ...
  - „Non-biologists must not speak about biodiv.“

Interacting Scales in Biogeochemistry

global biogeochemistry

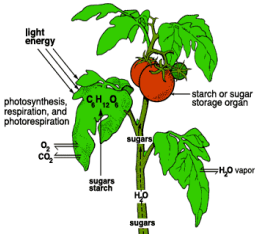
disturbance and succession
storms, fire

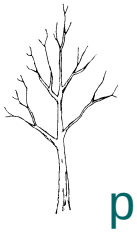
evolution

Biosphere

Ecosystems

carbon allocation
and growth

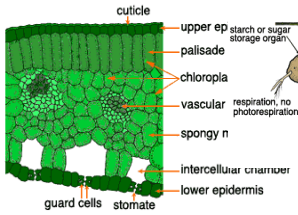


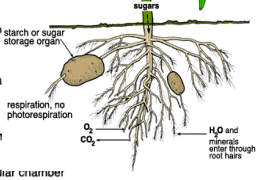


geographical
distribution of
vegetation types

Plants

plant seasonality

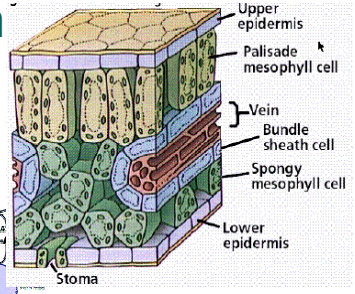




plant
metabolism

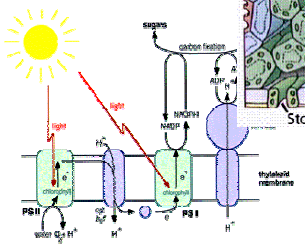
competition for resources
and ecological strategies

Leaves



water- and
nutrient budget

Cells



photosynthesis

Molecules

Seconds **Minutes** **Hours** **Years** **Decades** **Centuries**

From Wolfgang Lucht, PIK

Biodiversity: „confrontation de différents points de vue“

- Societal views on biodiversity
  - „Biodiv. means protecting nature“
  - „Biodiv. means species richness“
  - „Biodiv. means presence of charismatic species“
  - ...
  - „Biodiv. is a word used by green activists who want us to return to the stone age“

Biodiversity: „confrontation de différents points de vue“

- Political/ethical views on biodiversity
  - „Biodiv. means nature reserves“
  - „Biodiv. is an essential need for humankind“
  - „Biodiv. is a luxury for rich people who already have everything“
  - „In order to manage biodiv., it must be associated a monetary value“
  - „Associating monetary value to biodiv. is unethical – the value of biodiv. is intrinsic“
  - „Biodiv. is a part of god‘s creation“

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Ecosystem services


food production


slope stability


tourist attraction


fire prevention


water storage


biodiversity


pollination


fibre production


fodder production


flood protection


carbon sequestration


beauty


recreation


stabilising micro-climate


game reserve


shelter for life stock

Ecosystem services are...

...benefits people obtain from ecosystems

These include:

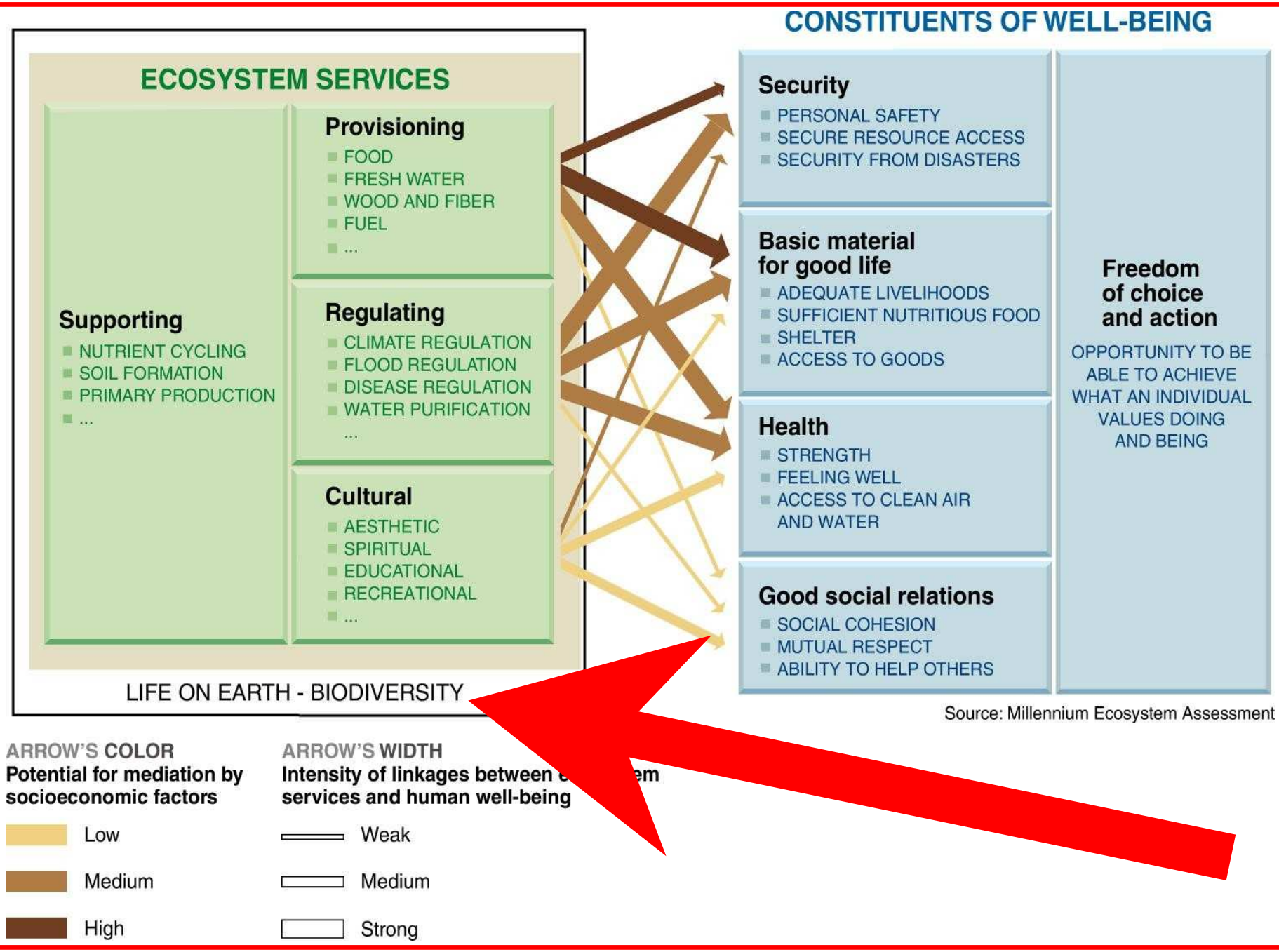
- **provisioning services** (e.g., food and water)
- **regulating services** (e.g., regulation of floods, drought, land degradation, and disease)
- **supporting services** (e.g., soil formation and nutrient cycling)
- **cultural services** (e.g., recreational, spiritual, religious and other nonmaterial benefits.

Ecosystem services also are...

...a useful and reproducible way to **quantify the importance of ecosystem functioning for society**

This does **not** imply that an economic value must be assigned to each service

Biodiversity is a key factor for many ecosystem services, and current research aims at **better quantification** of this role of biodiversity


ECOSYSTEM SERVICES
Provisioning
FOOD
FRESH WATER
WOOD AND FIBER
FUEL
...
Regulating
CLIMATE REGULATION
FLOOD REGULATION
DISEASE REGULATION
WATER PURIFICATION
...
Cultural
AESTHETIC
SPIRITUAL
EDUCATIONAL
RECREATIONAL
...
Supporting
NUTRIENT CYCLING
SOIL FORMATION
PRIMARY PRODUCTION
...
LIFE ON EARTH - BIODIVERSITY
CONSTITUENTS OF WELL-BEING
Security
PERSONAL SAFETY
SECURE RESOURCE ACCESS
SECURITY FROM DISASTERS
Basic material for good life
ADEQUATE LIVELIHOODS
SUFFICIENT NUTRITIOUS FOOD
SHELTER
ACCESS TO GOODS
Health
STRENGTH
FEELING WELL
ACCESS TO CLEAN AIR AND WATER
Good social relations
SOCIAL COHESION
MUTUAL RESPECT
ABILITY TO HELP OTHERS
Freedom of choice and action
OPPORTUNITY TO BE ABLE TO ACHIEVE WHAT AN INDIVIDUAL VALUES DOING AND BEING
Source: Millennium Ecosystem Assessment
ARROW'S COLOR
Potential for mediation by socioeconomic factors
Low
Medium
High
ARROW'S WIDTH
Intensity of linkages between
services and human well-being
Weak
Medium
Strong

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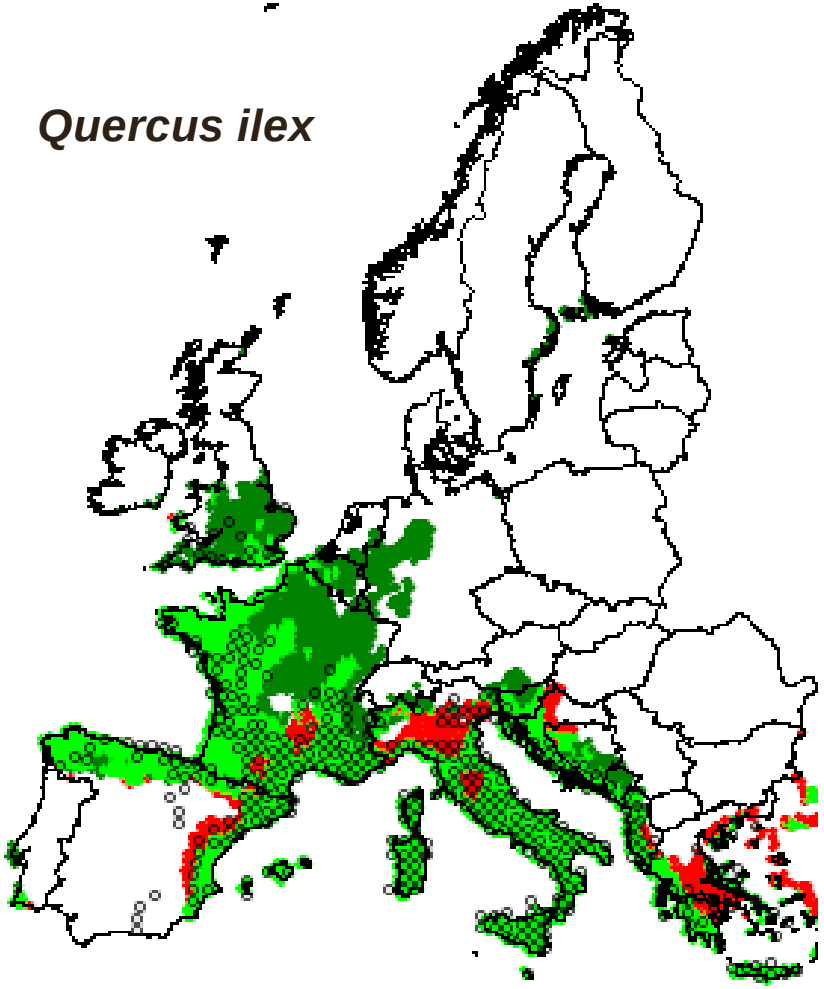
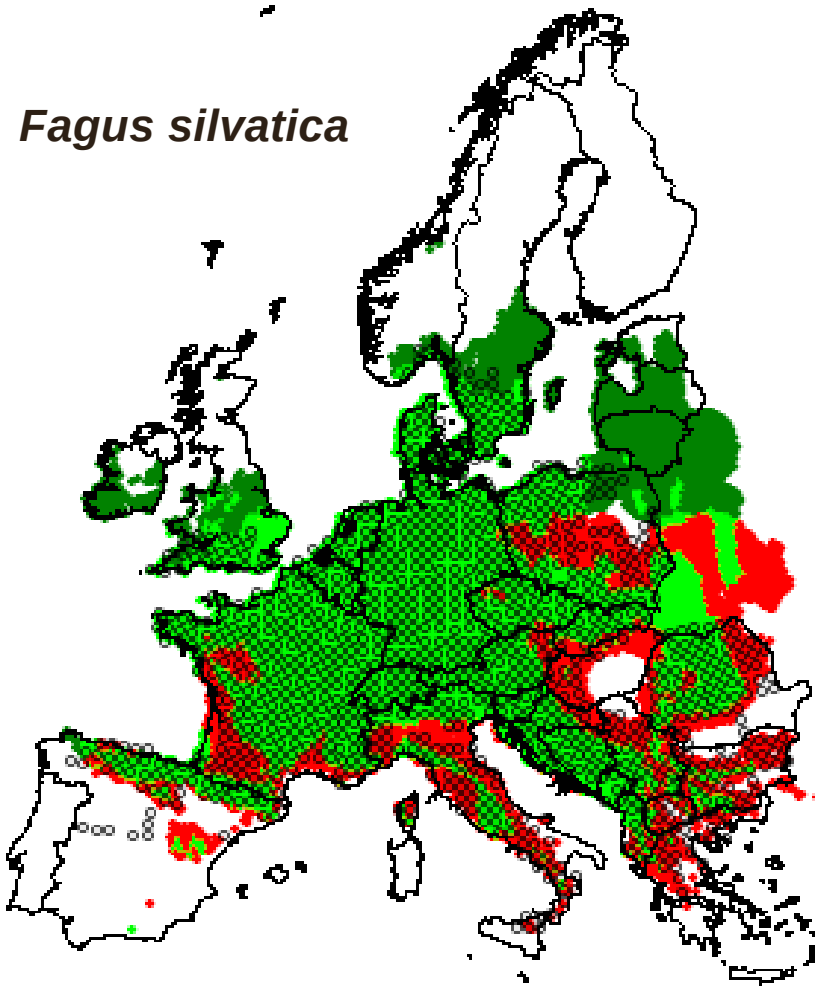
Biodiversity change by species
HadCM3 – A1FI

Red: habitat lost; clear green : habitat stable; dark green: new suitable habitat

Quercus ilex



Fagus silvatica



Thuiller 2003 GCB

species richness

species loss

species turnover

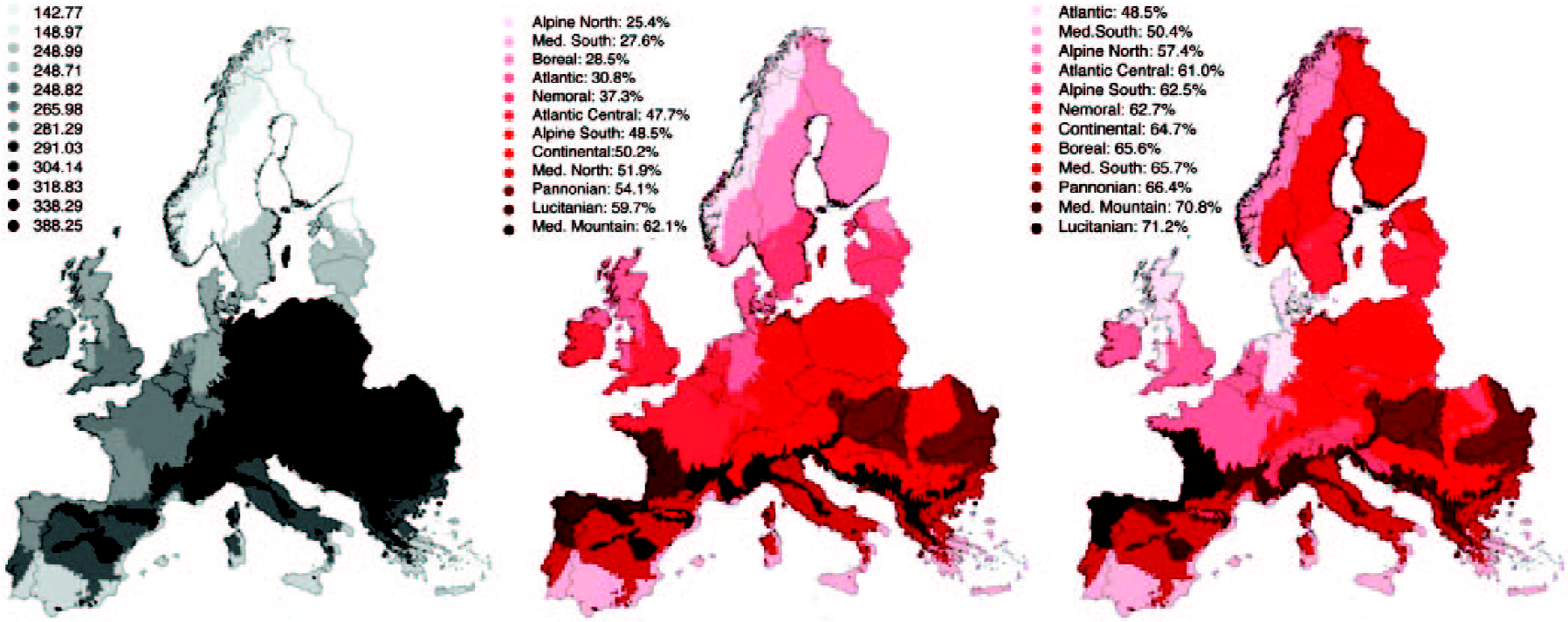
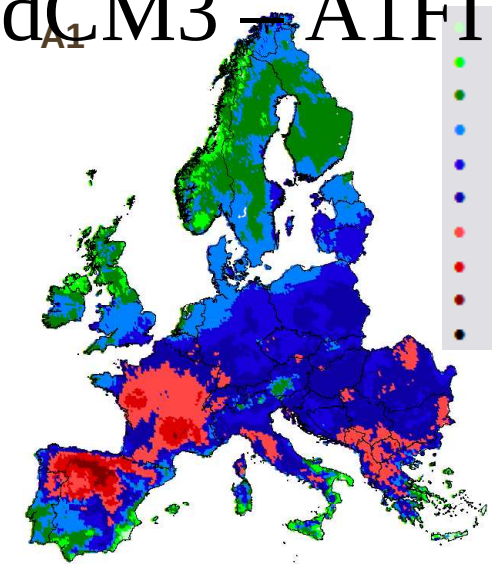


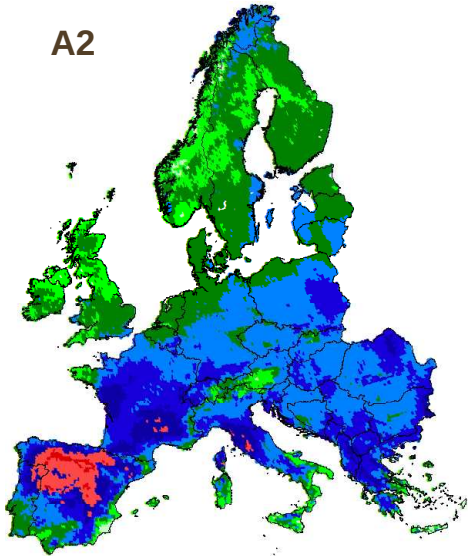
Fig. 5. Spatial sensitivity of plant diversity in Europe ranked by biogeographic regions. Mean percentage of current species richness (*Left*) and species loss (*Center*) and turnover (*Right*) by environmental zones under the A1-HadCM3 scenario.

Thuiller et al. 2005, PNAS

Biodiversity change by species numbers
HadCM3 – A1FI



0 - 10%
10 - 20%
20 - 30%
30 - 40%
40 - 50%
50 - 60%
60 - 70%
70 - 80%
80 - 90%
90 - 100%



ECONOMIC

T°↗ 4,9°
Economic growth
Homogeneous word

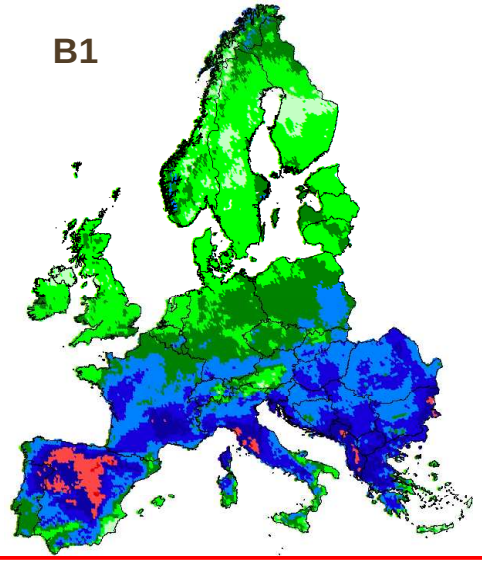
T°↗ 4,1°
Economic growth
Heterogeneous word

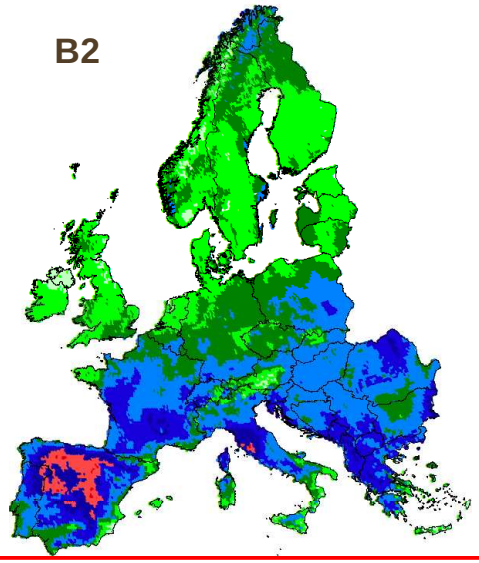
GLOBAL

REGIONAL

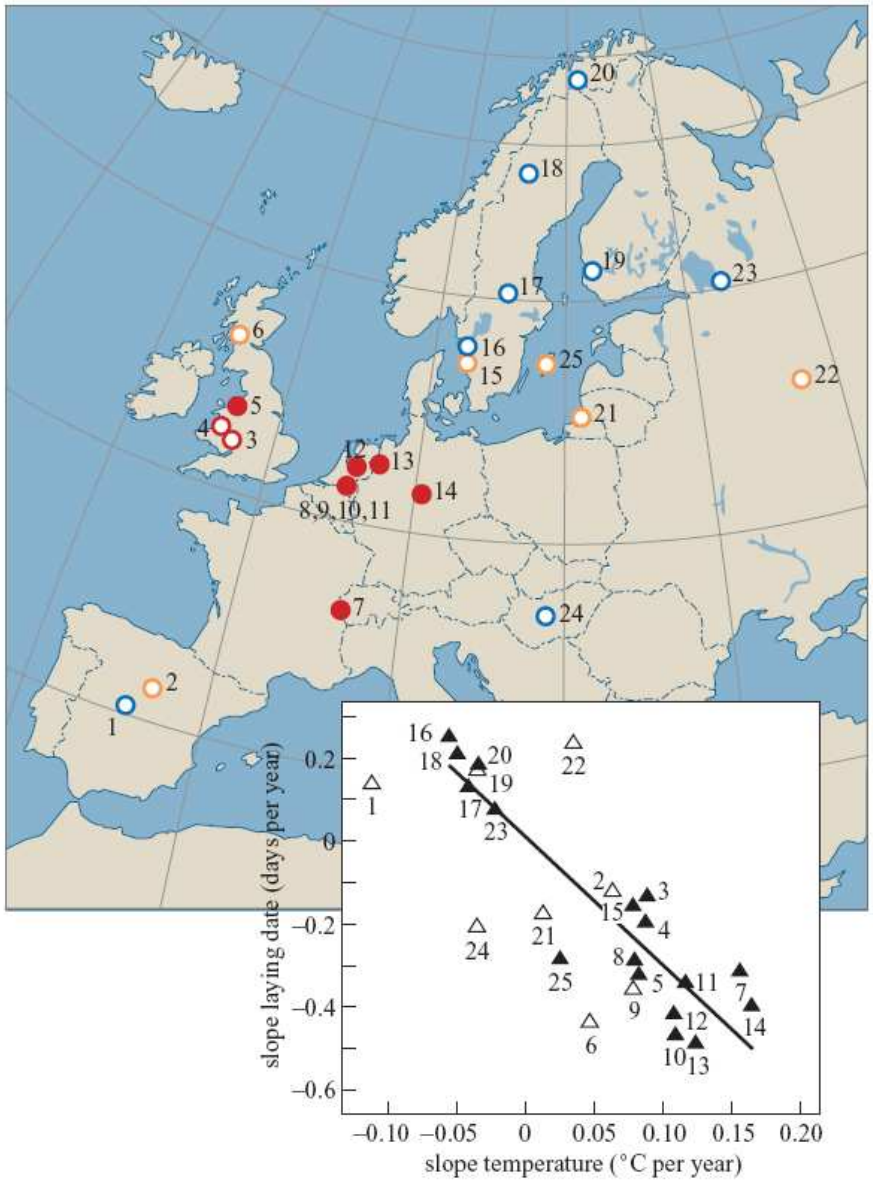
T°↗ 2,3°
Economic and environmental viability
Homogeneous word

T°↗ 3°
Environmental policy
Heterogeneous word



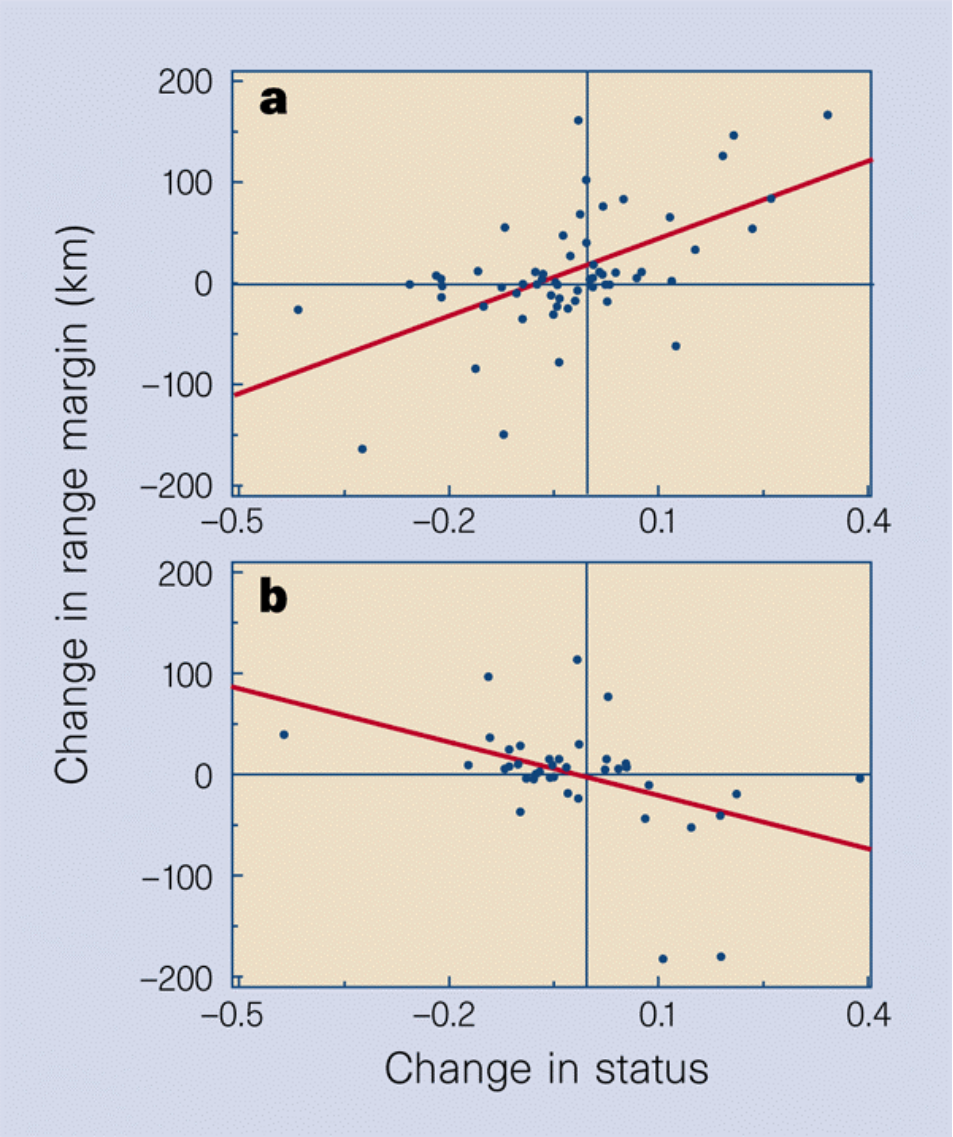


SUBSTAINABLE DEVELOPMENT



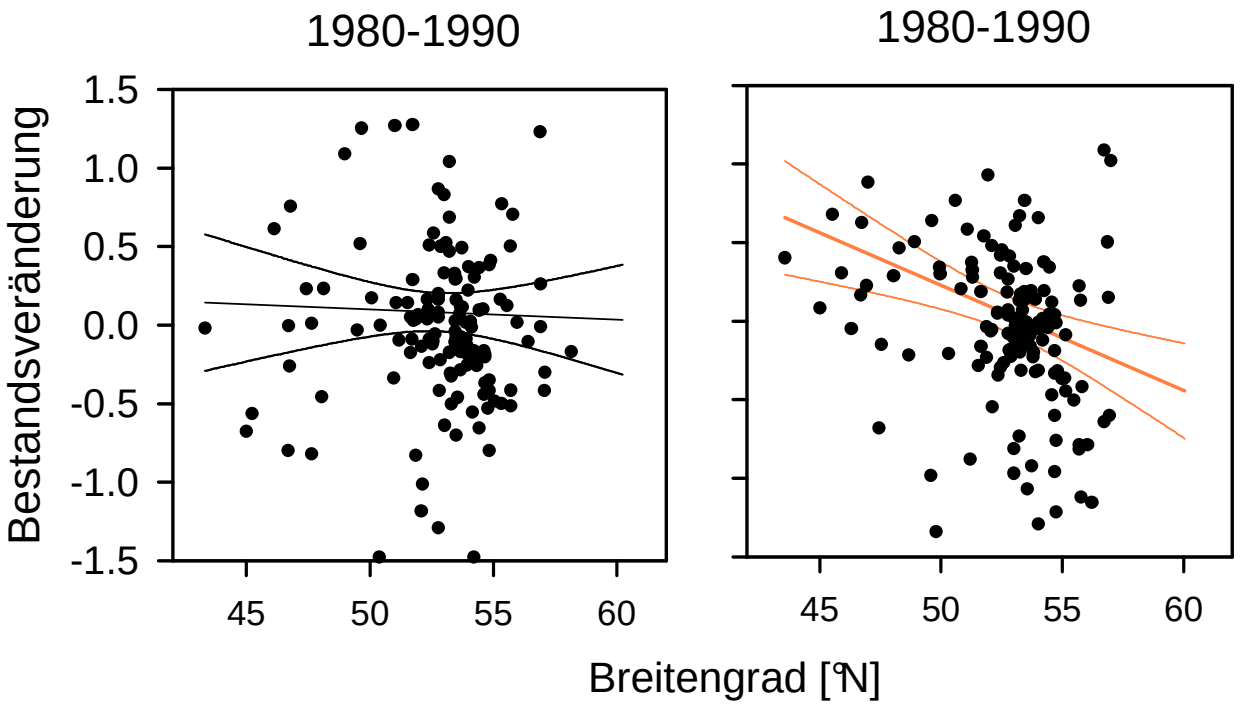
Onset of breeding of
Ficedula hypoleuca
in Europe

Both et al.
Proc. Royal Society London B 2004



Temporal shift of northern (a) and southern (b) limit of bird distribution areas in UK

Thomas & Lennon *Nature* 1999

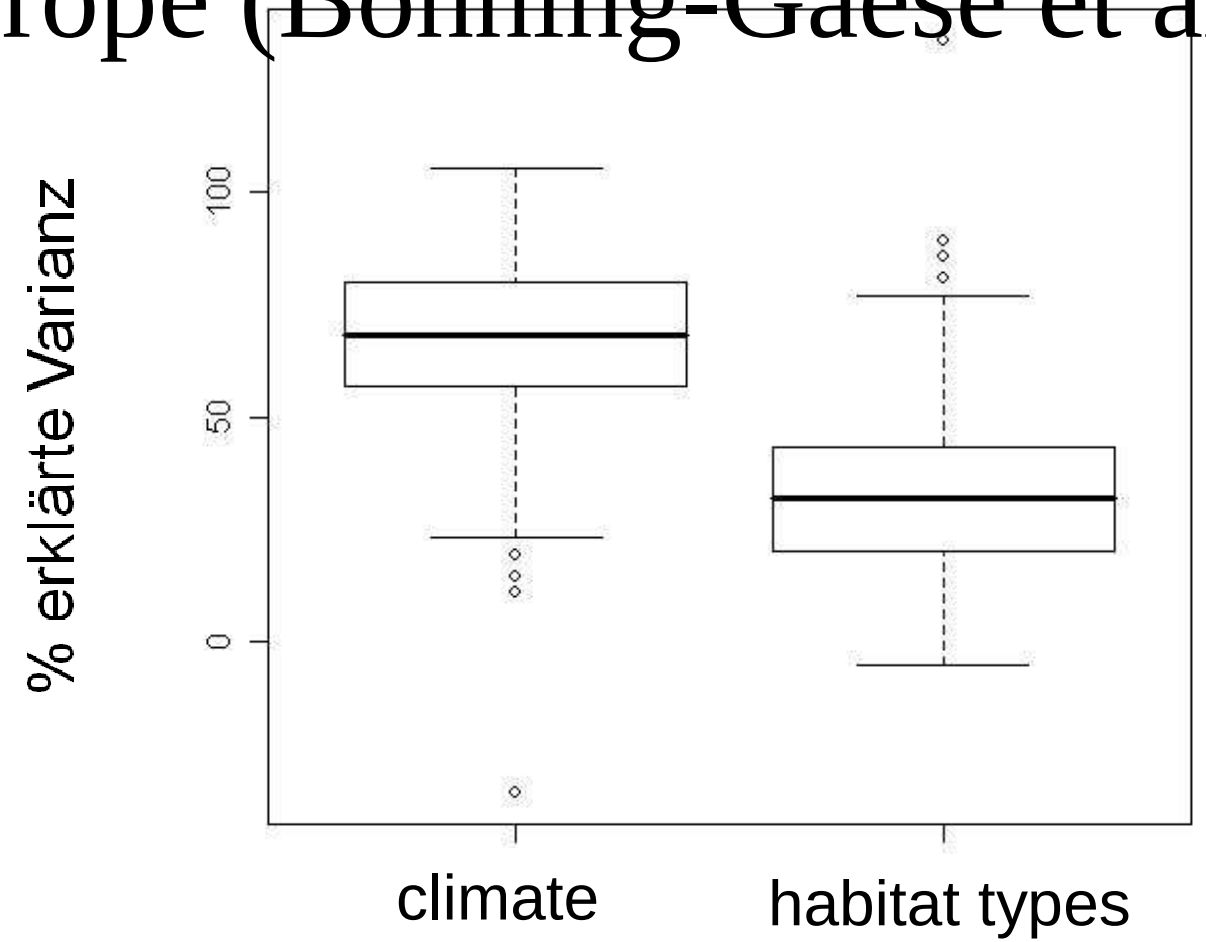


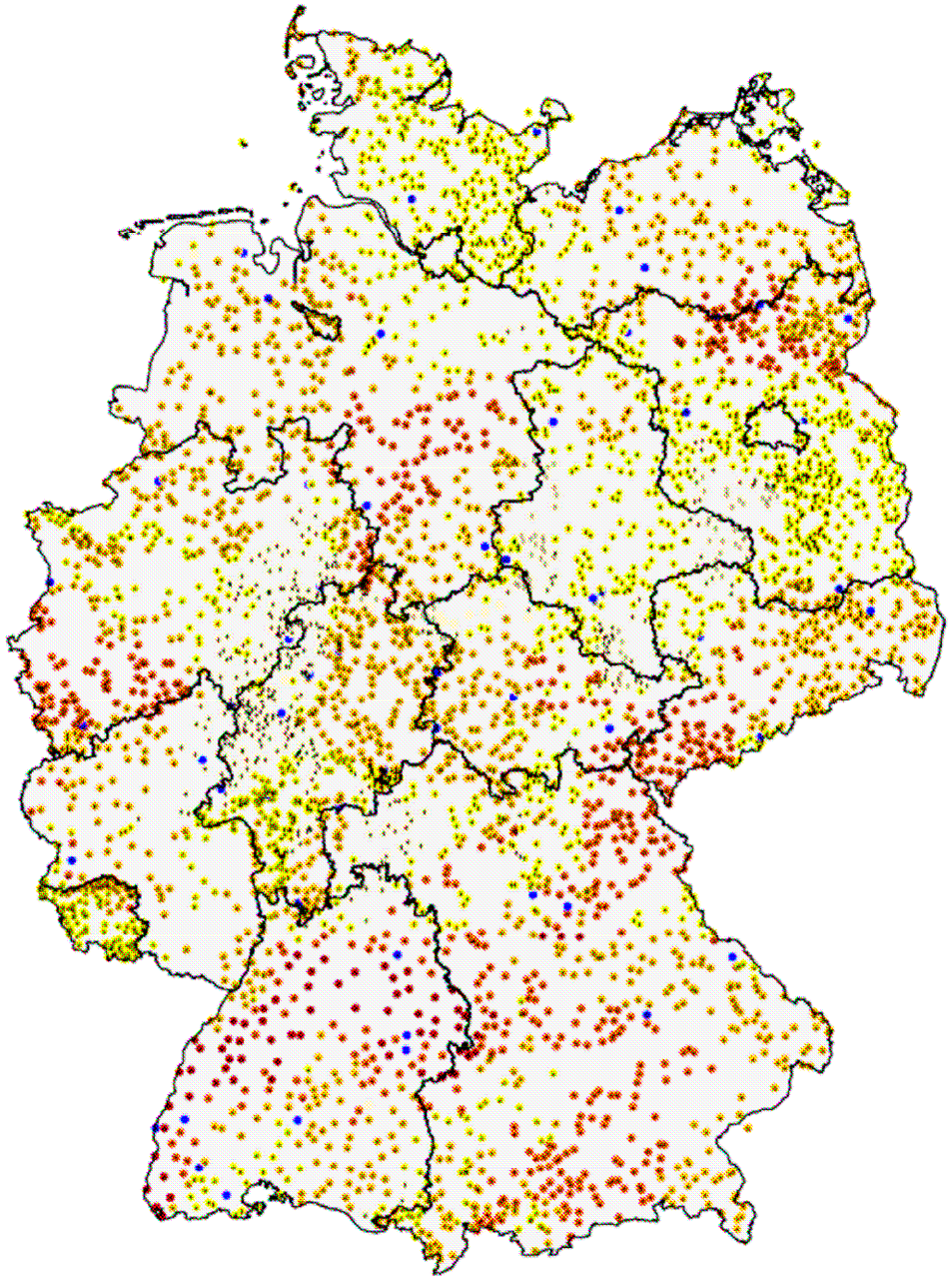
Böhning-Gaese & Bauer *Conservation Biology* 1996

Lemoine, Bauer, Peintinger & Böhning-Gaese, *in review*

Statist. Signifikanz	1980-1990	1990-2000	
breeding habitat	**0.035**	0.077	
migration	**0.022**	**0.033**	
latitude	0.78	**0.0008**	ANCOVA

Bird response to climate change in Europe (Böhning-Gaese et al.)





Trend der Durchschnittstemperatur von 1951-2003 in FFH-Schutzgebieten

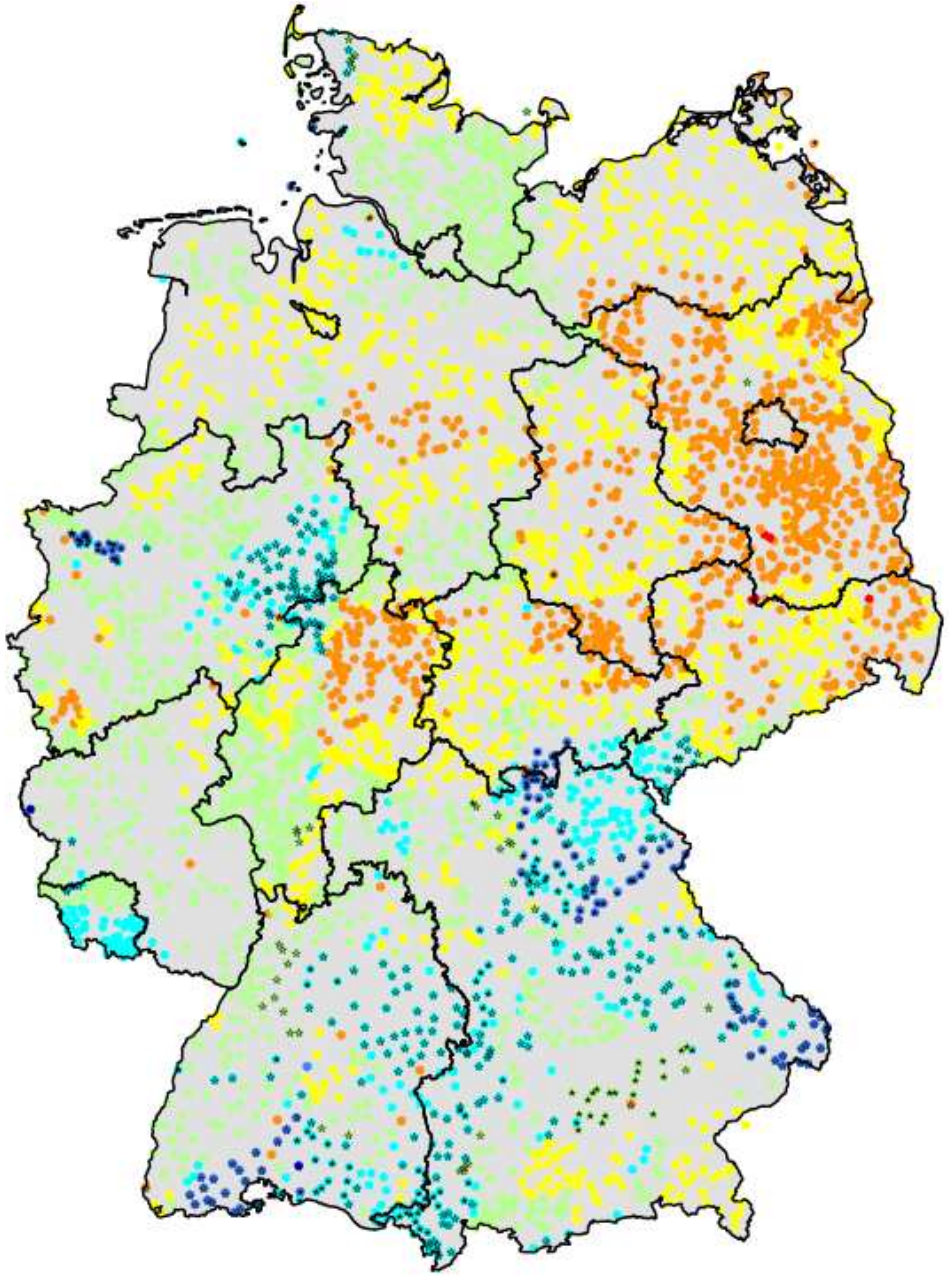
Signifikanzniveau

- < 0.0001
- < 0.001
- < 0.01
- < 0.05

Temperaturtrend (1951-2003)

- negativ (-0.03-0)
- 0 - 1.0 °C
- 1.0 - 1.2 °C
- 1.2 - 1.4 °C
- 1.4 - 1.6 °C
- 1.6 - 1.8 °C

Max. 1.7 Kaiserstuhl



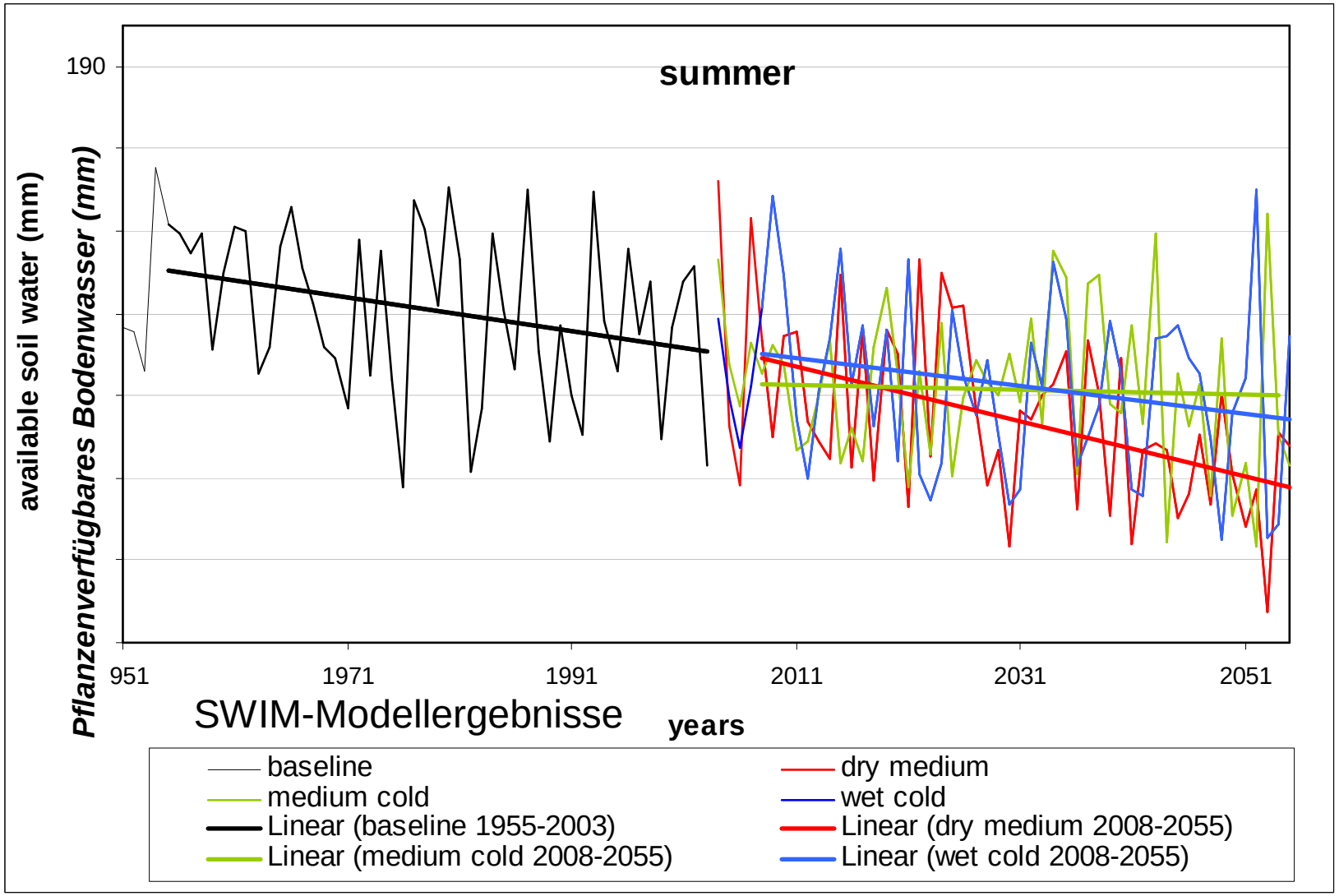
Trend der Niederschlagsmengen von 1951-2003 in FFH-Schutzgebieten

Niederschlagstrend (1951-2003) [mm]

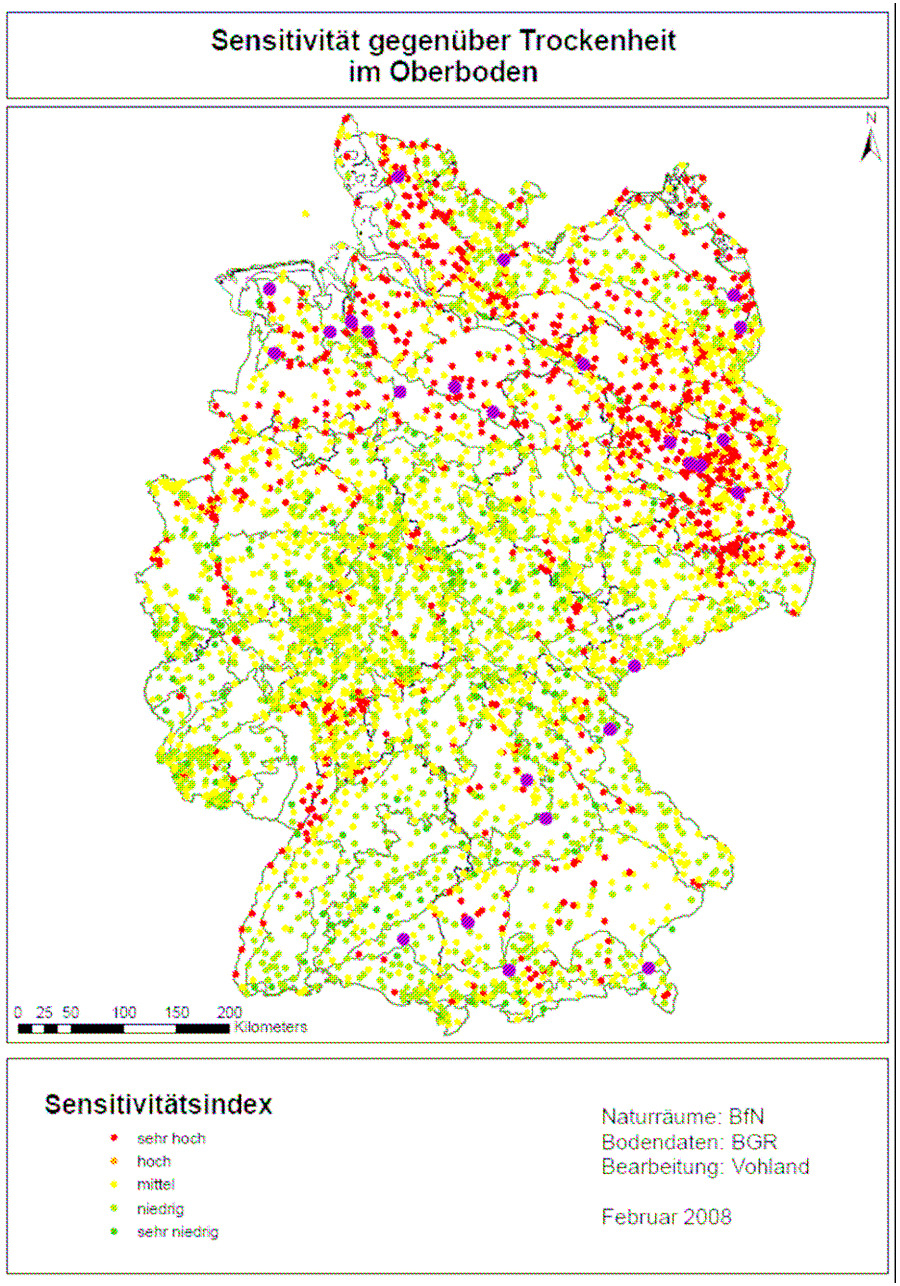
- - 100 - -50
- - 50 - 0
- 0 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 250

Signifikanzniveau

- ★ 0.003830 - 0.050000
- ☆ 0.050001 - 0.100000



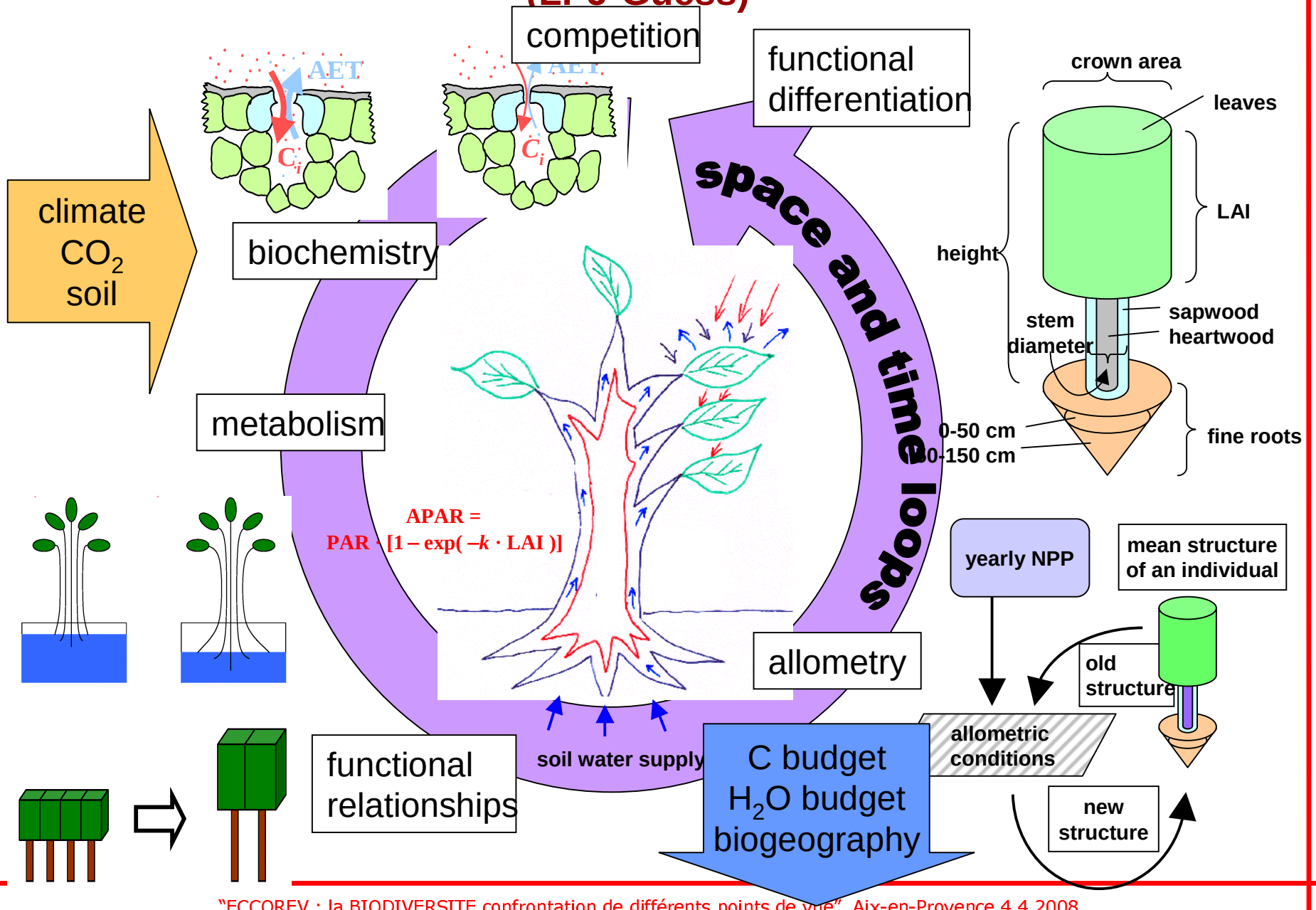
Holsten A., Vetter T., Vohland K., Krysanova V., in prep.



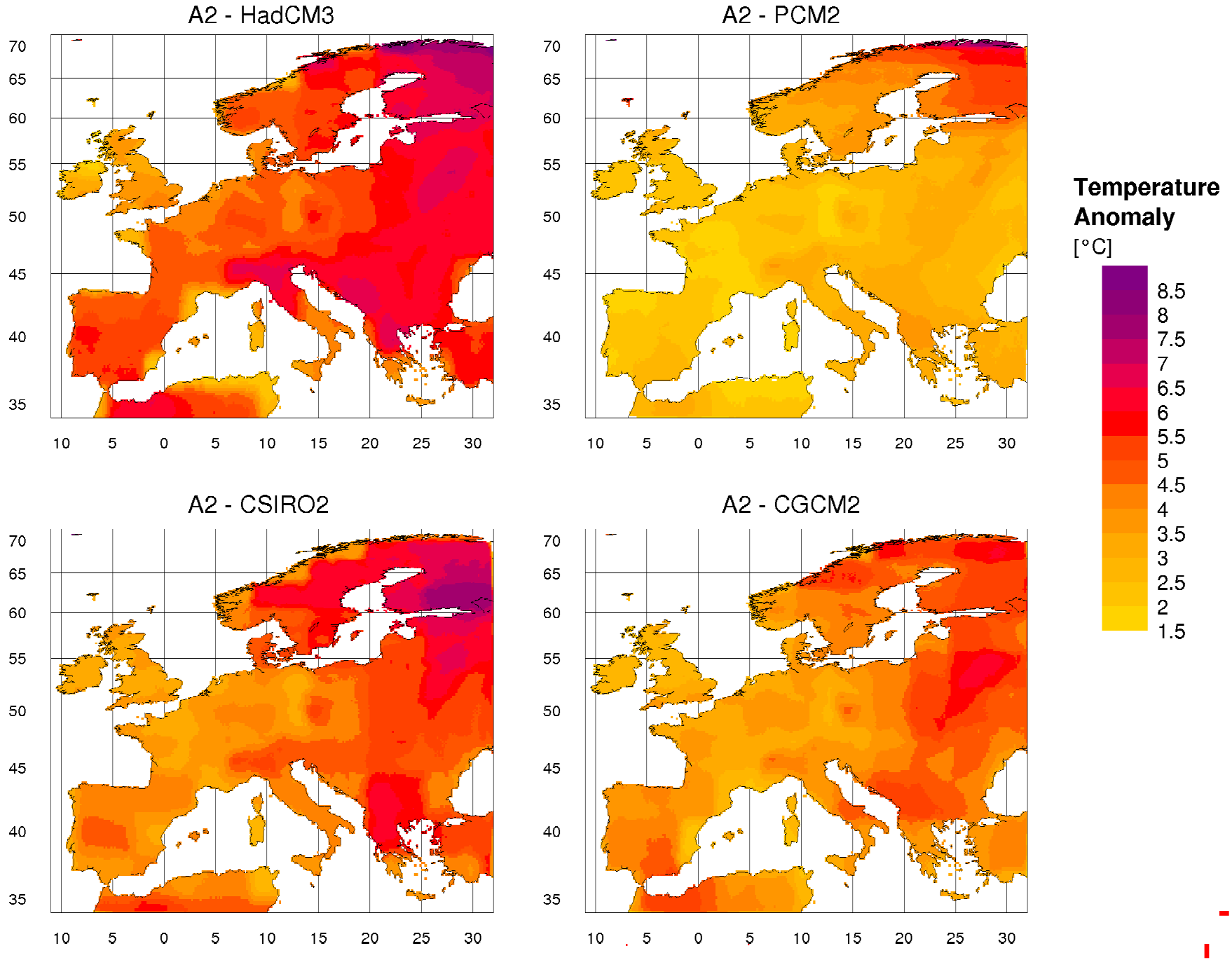
Drought risk sensitivity in protected areas

as a function of soil type and climate conditions

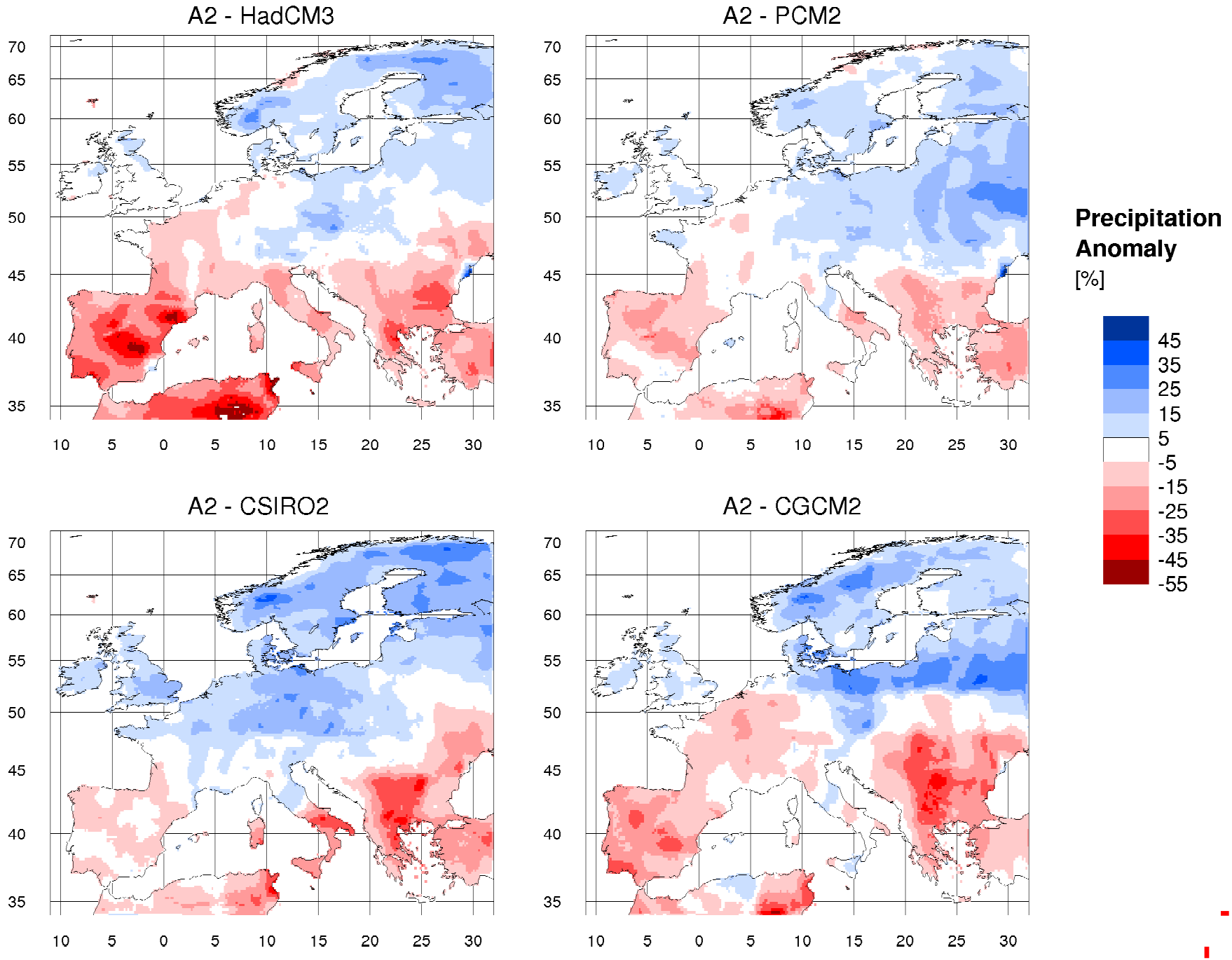
Prozessbasierte Abschätzung sich ändernder Lebensraumtypen (LPJ-Guess)



a) Anomaly in Temperature (2071-2100 vs. 1971-2000)

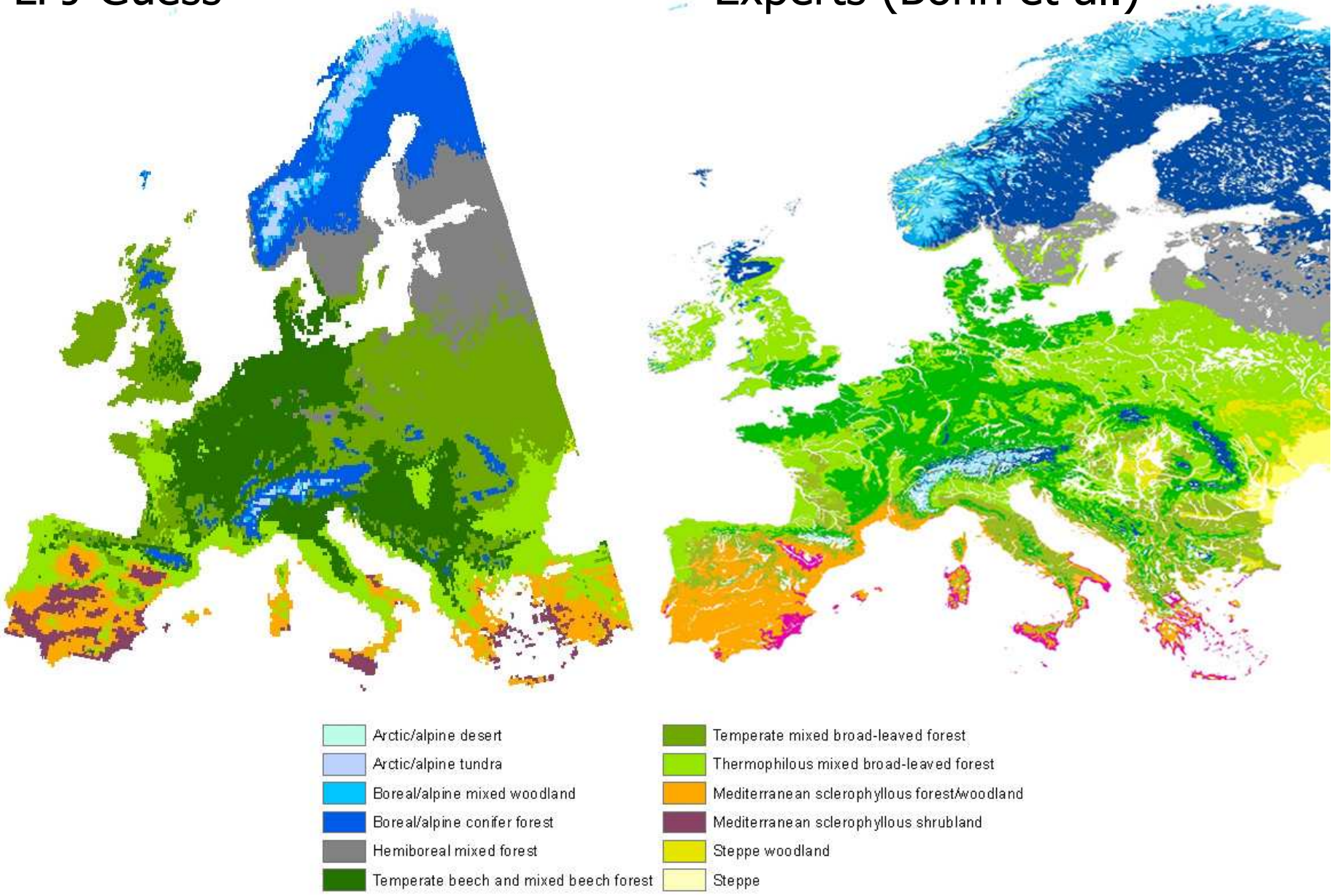


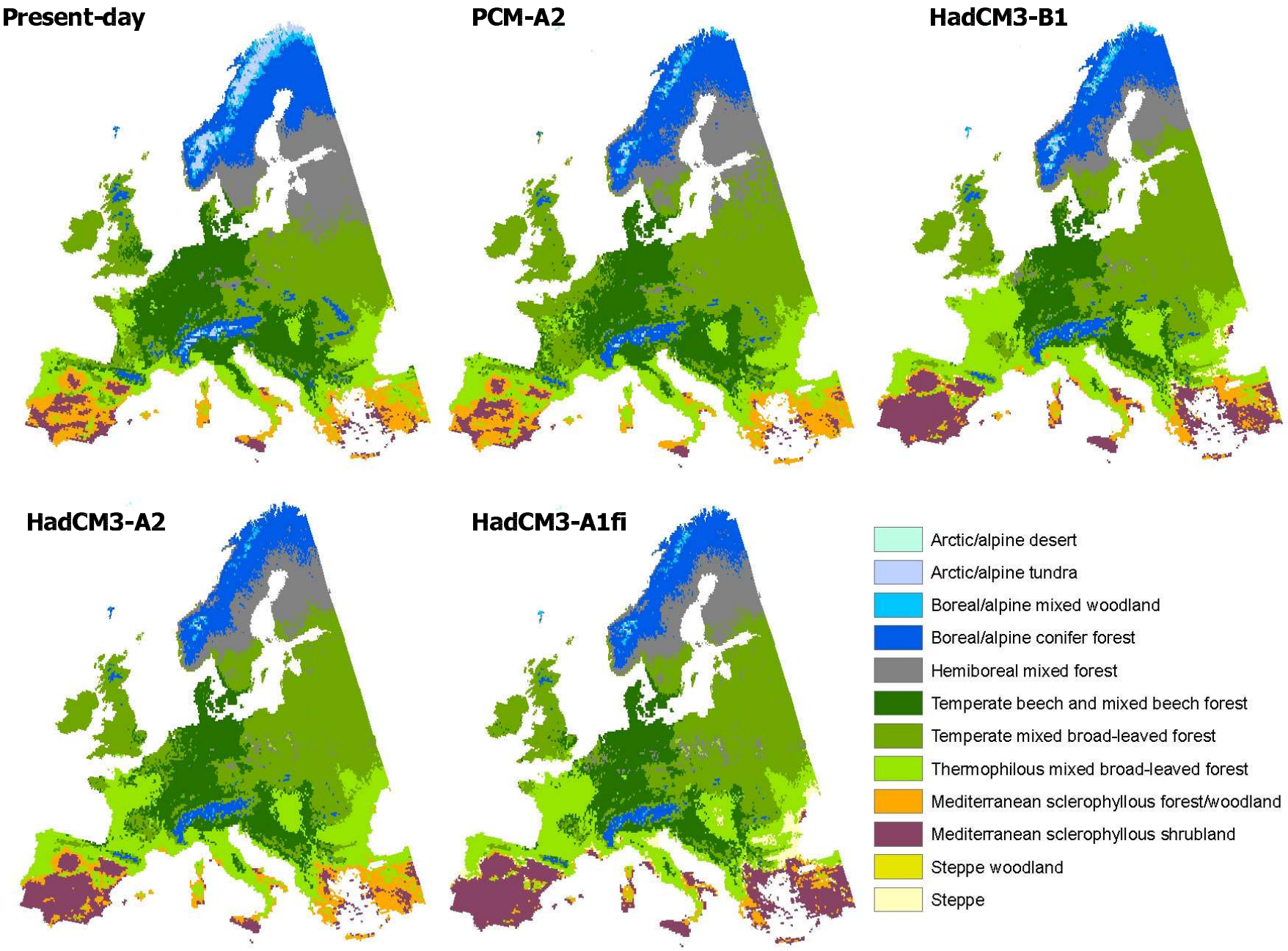
b) Anomaly in Precipitation (2071-2100 vs. 1971-2000)



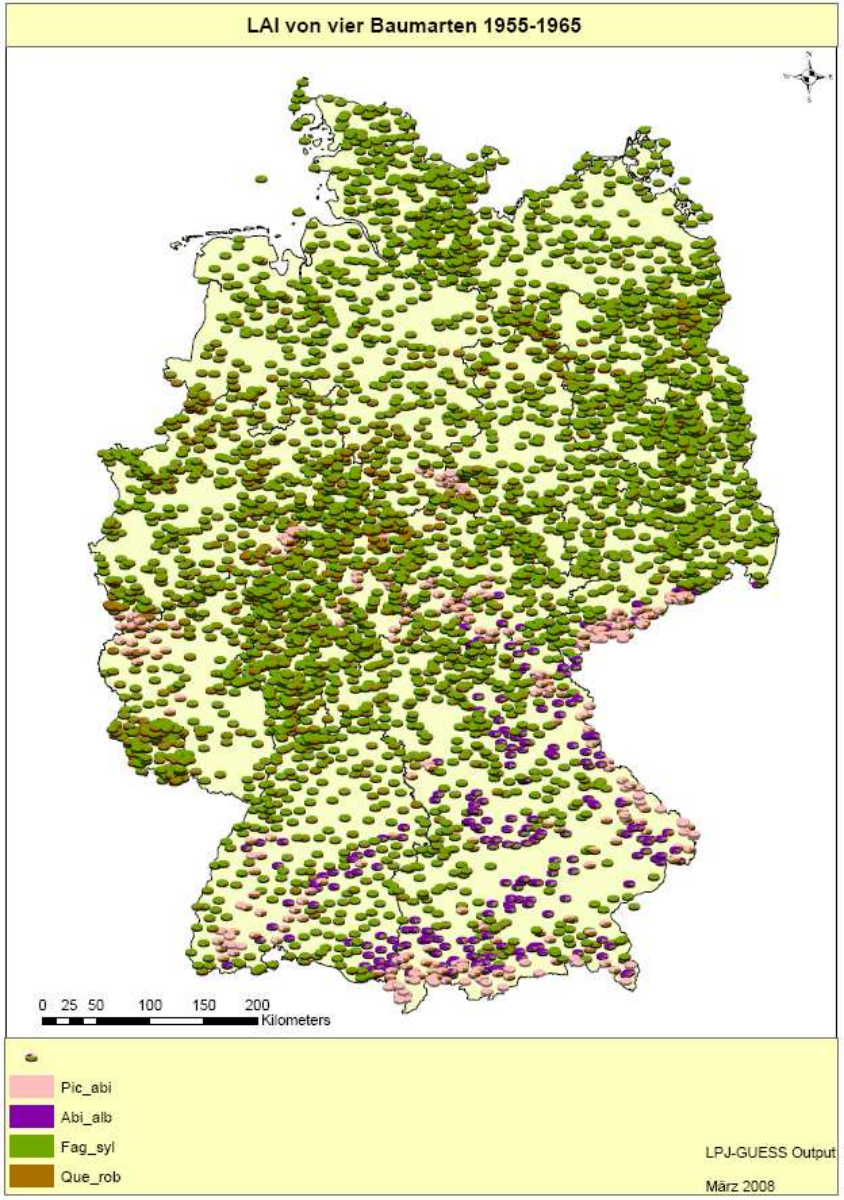
LPJ-Guess

Experts (Bohn et al.)

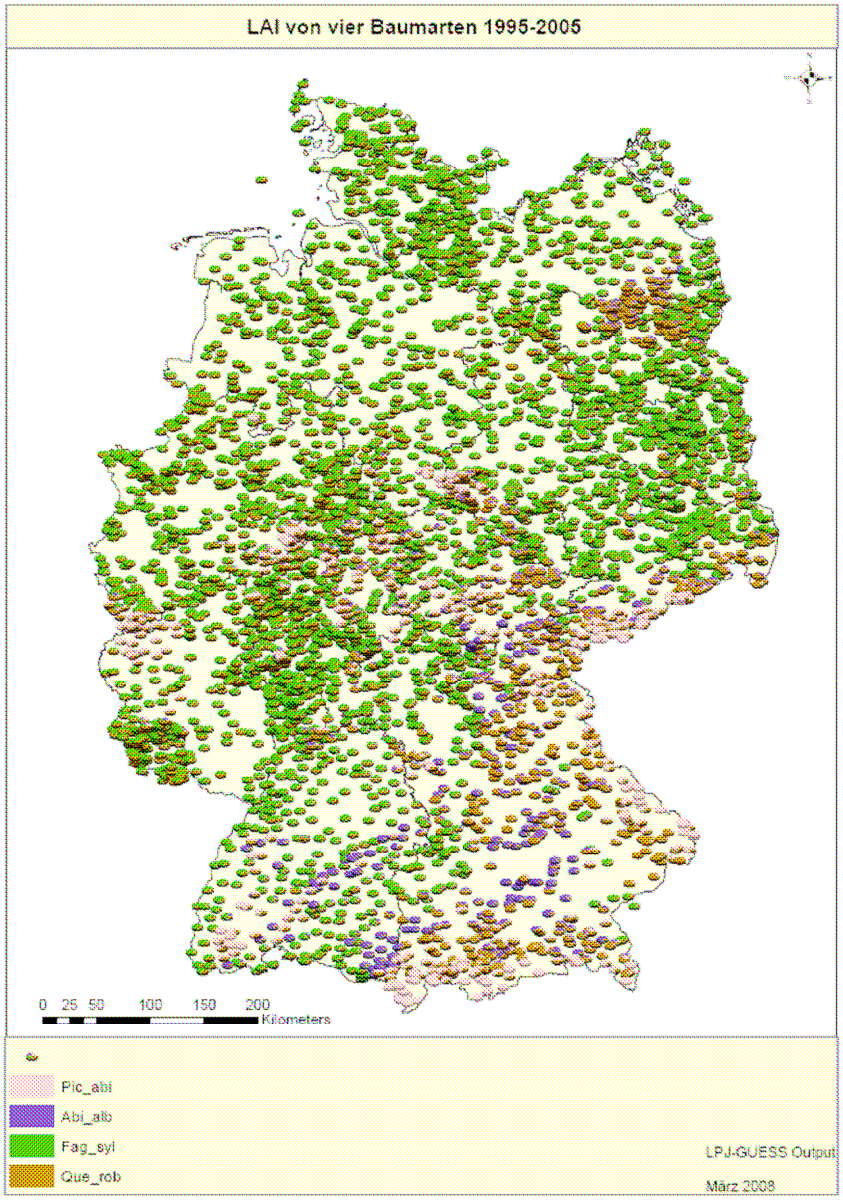



Present-day
PCM-A2
HadCM3-B1
HadCM3-A2
HadCM3-A1fi
Arctic/alpine desert
Arctic/alpine tundra
Boreal/alpine mixed woodland
Boreal/alpine conifer forest
Hemiboreal mixed forest
Temperate beech and mixed beech forest
Temperate mixed broad-leaved forest
Thermophilous mixed broad-leaved forest
Mediterranean sclerophyllous forest/woodland
Mediterranean sclerophyllous shrubland
Steppe woodland
Steppe

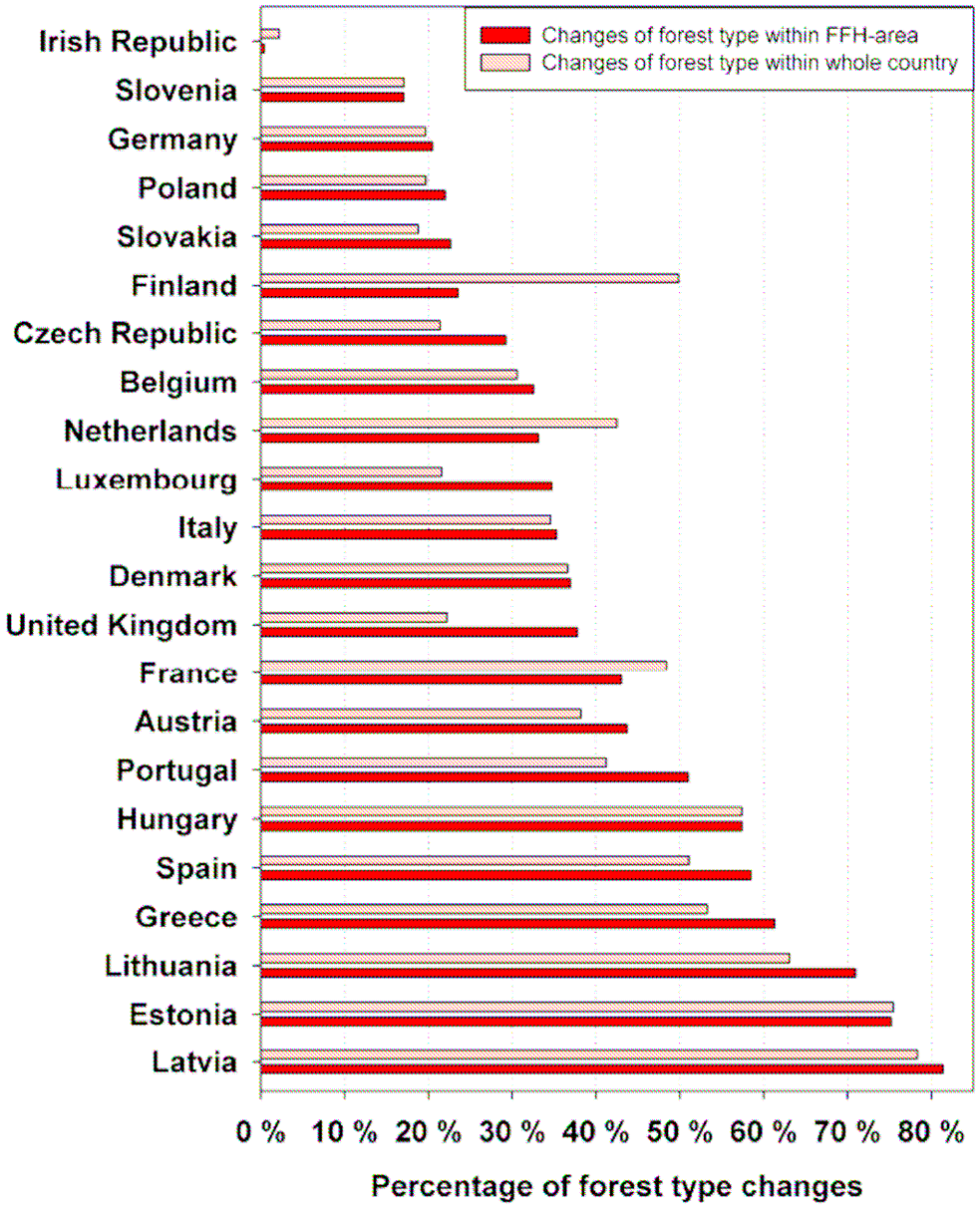
1955-1965



1995-2005



Lebensräume



Hickler et al., in prep

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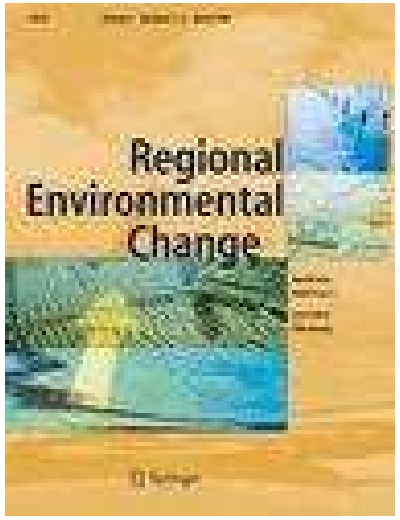
Conclusion:

- Climate change affects European biodiversity in multiple ways
- Research and assessment needs to be intensified
- But urgent need for action exists already today



Regional Environmental Change

The goal of Regional Environmental Change is to publish scientific research and opinion papers that improve our understanding of the extent of these changes, their causes, their impacts on people, and the options for society to respond. "Regional" refers to the full range of scales between local and global, including regions defined by natural criteria, such as watersheds and ecosystems, and those defined by human activities, such as urban areas and their hinterlands.
http://www.springerlink.com/content/103880/

ALTER-Net Summer School „Biodiversity and Ecosystem Services“ Peyresq, Alpes de Haute Provence, Sep 2-15, 2008

www.pik-potsdam.de/alter-net

Photograph: Peyresq, France, where 35 students discussed vulnerability of ecosystems in September 2003