

Ecosystem goods and services and human vulnerability

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with contributions
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Hermann Lotze-Campen,
Wolfgang Lucht and others

Ecosystem goods and services and human vulnerability

- A. Preamble – a view on vulnerability
- B. The European ecosystem vulnerability project ATEAM/AVEC – implications for the European carbon balance
- C. The carbon balance of the Amazon – more vulnerable to climate change or to deforestation?
- D. Conclusion

Ecosystem goods and services and human vulnerability

A. Preamble – a view on vulnerability

Vulnerability...

...is the degree to which
an ecosystem service is **sensitive** to
global change

plus

the degree to which the sector that relies
on this service is **unable to cope with**
the changes

Multiple drivers of ecosystem services

Driver

Climate Change

Climate Change

Land Cover Change

Biodiversity Loss

Nutrient Loading

Etc.

Response

Energy Sector

Biodiversity

Food Supply

Water

Ecosystems

Human Impact

Health

Economics

Social

Health

Economics

Social

IPCC

MA

Ecosystem goods and services

(as defined by the Millennium Ecosystem Assessment)

**Agricultural
Lands**

**Coastal
Zones**

**Forest
Lands**

**Freshwater
Systems**

**Arid Lands &
Grasslands**

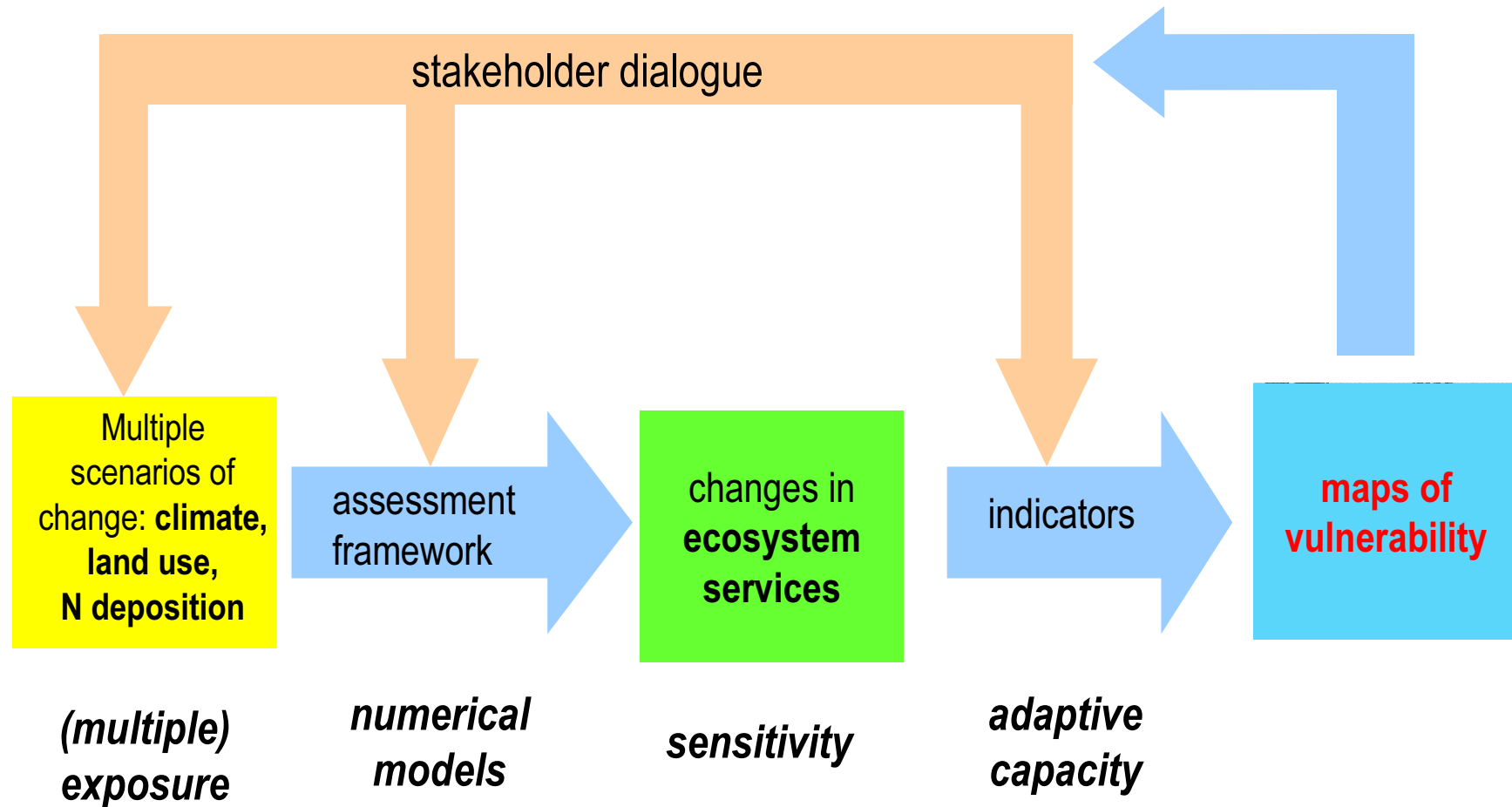


Food and Fiber Production
Provision of Pure and Sufficient Water
Maintenance of Human Health
Maintenance of Biodiversity
Storage of Carbon, Nitrogen, Phosphorus

Ecosystem goods and services and human vulnerability

B. The European ecosystem vulnerability project ATEAM/AVEC – implications for the European carbon balance

The ATEAM framework



Ecosystem services and indicators

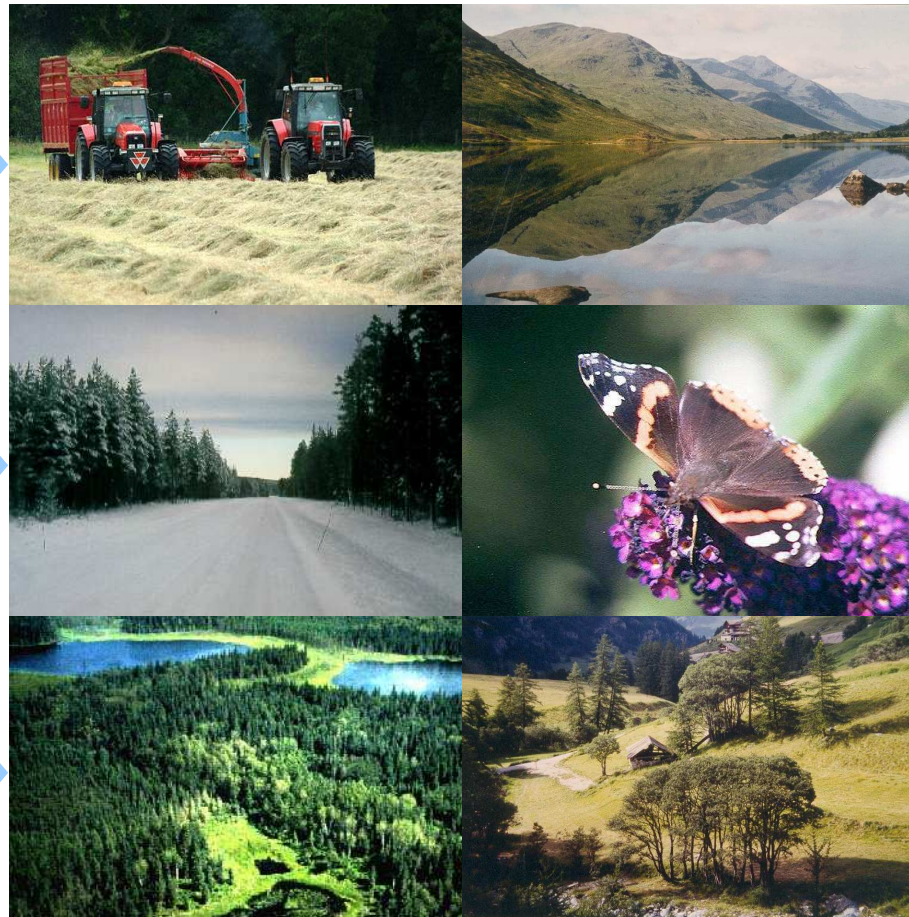
Sectors	Services	Indicators (examples)
Agriculture	Food & fibre production Biofuels	•Crop yield, yield variability & profitability •Physical suitability of crops
Forestry	Wood production Biofuels	•Tree productivity •Biomass energy wood suitability and yield
C storage & Energy	Carbon storage	•Carbon storage in Vegetation & Soil
Water	Water supply Drought & flood prevention	•Stream flow quantity & quality
Biodiversity & Nature Conservation	Aesthetics Landscape diversity	•Species richness & persistence •Habitat richness
Mountains	Tourism & Recreation Carbon and Water	•Snow dynamics •Slope stability

Multisectoral assessment in ATEAM

Agriculture

Forestry

**Carbon Storage
& Energy**

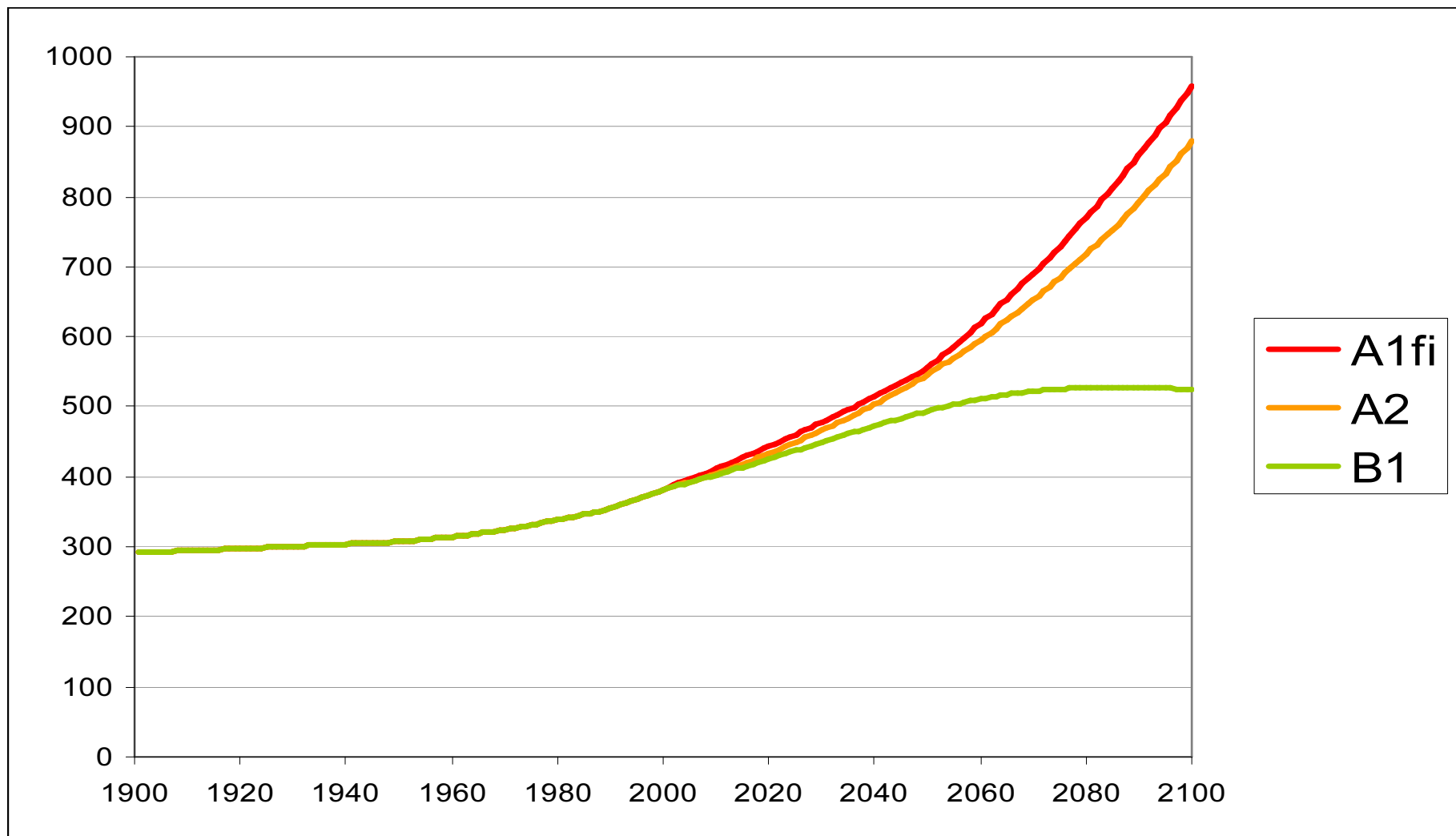


Water

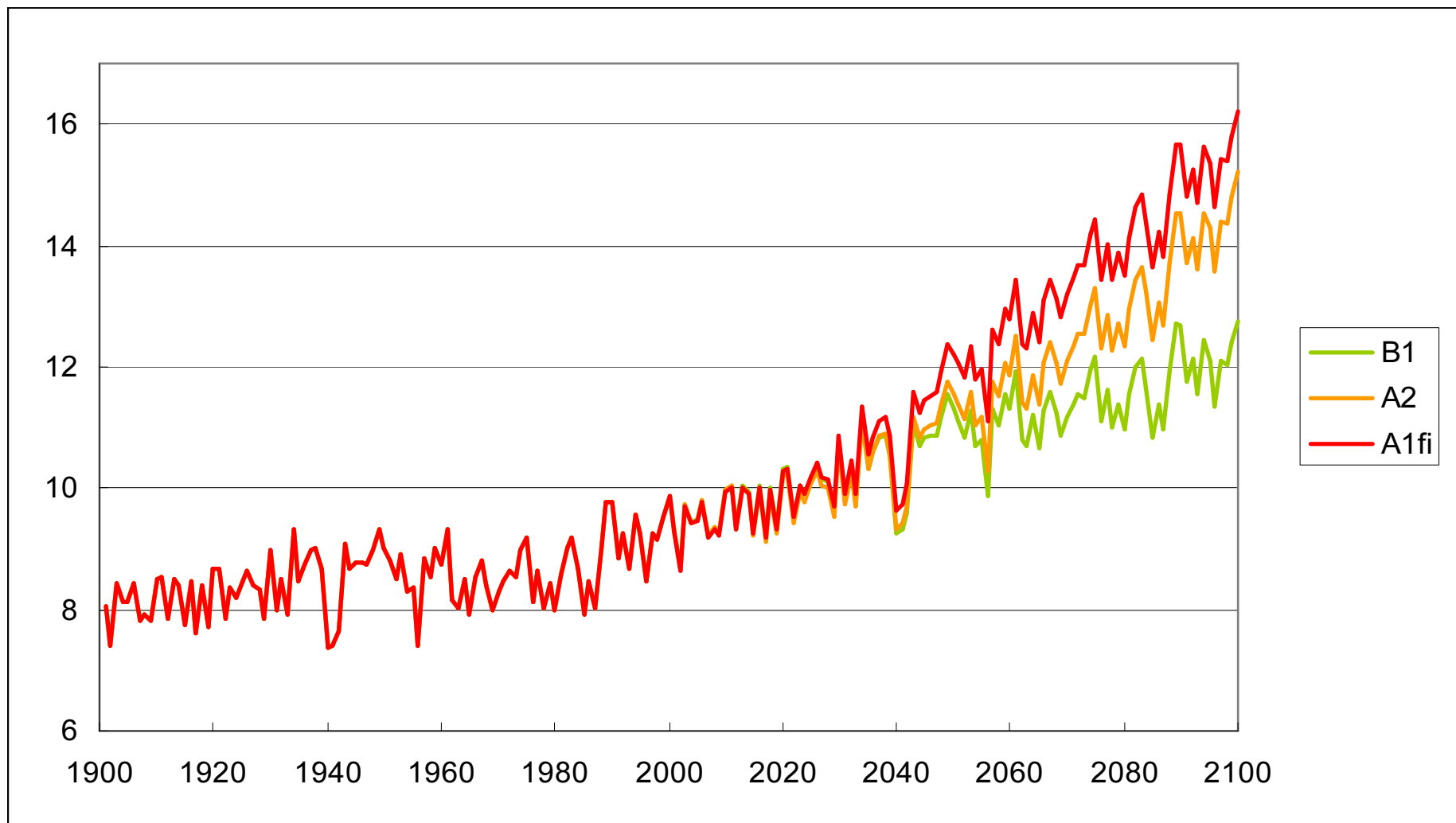
Biodiversity

Mountains

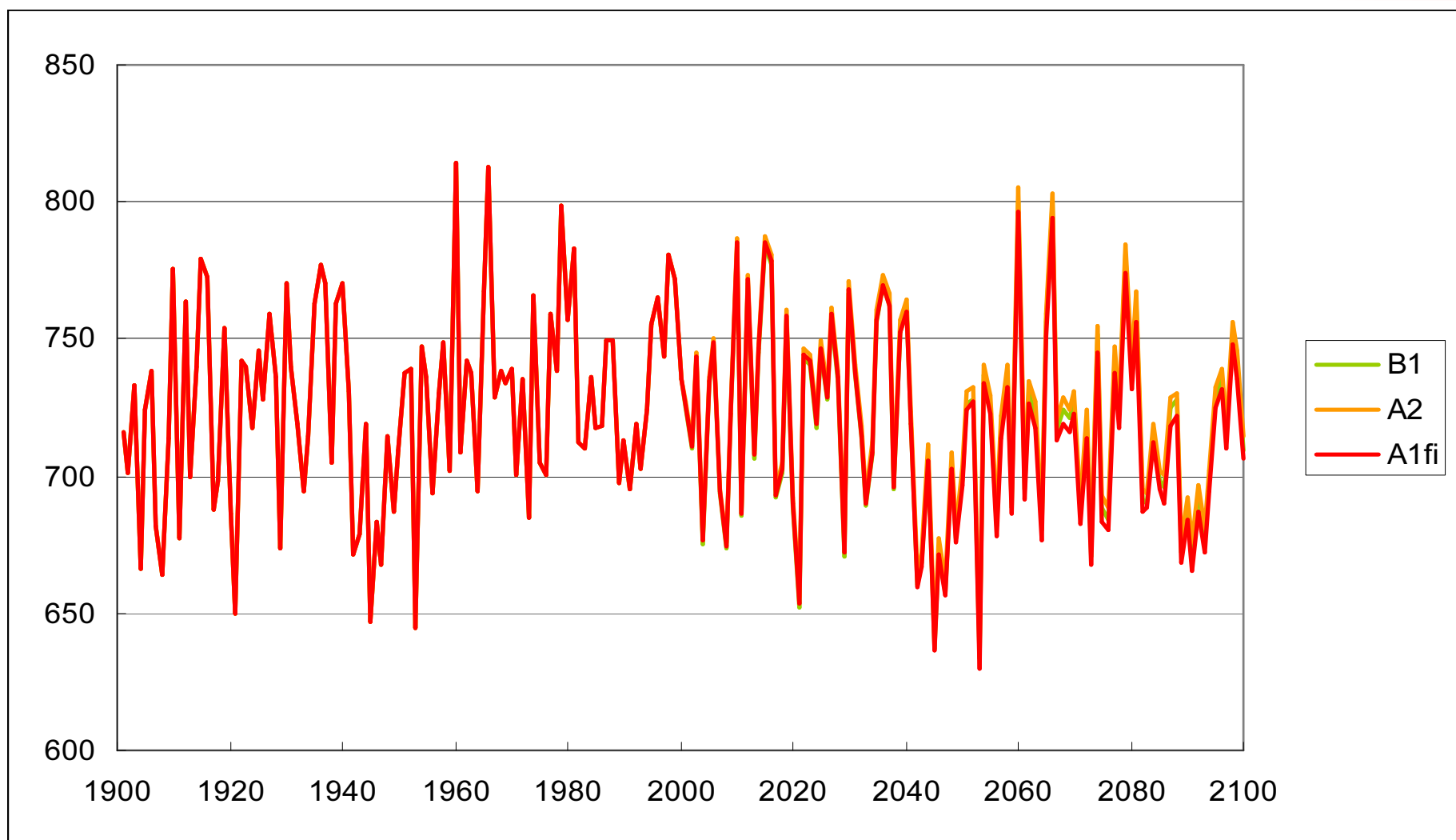
CO₂ concentration (ppmv)



Temperature (deg C)

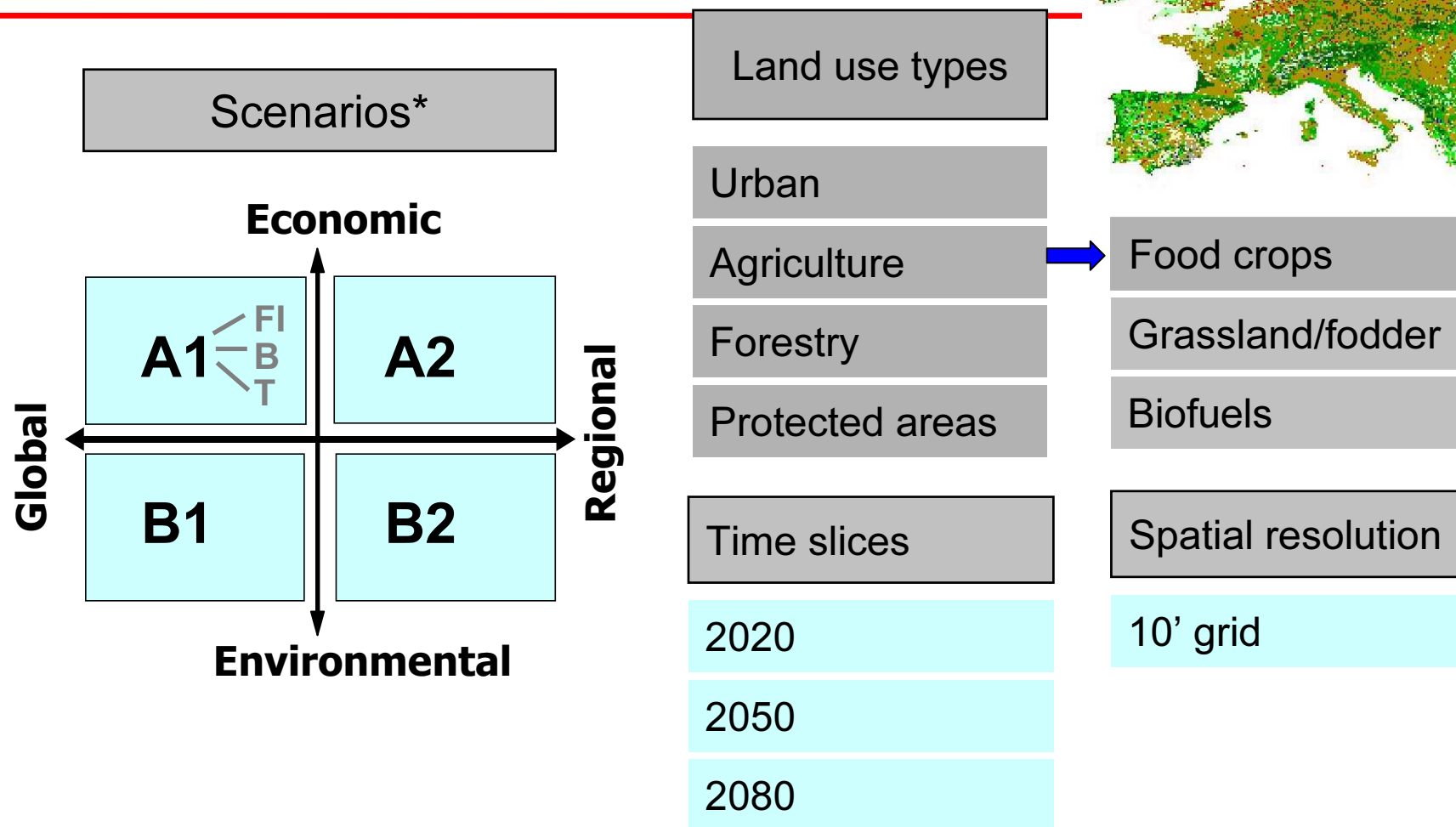


Precipitation (mm)



Methodology

ATEAM, Land use change

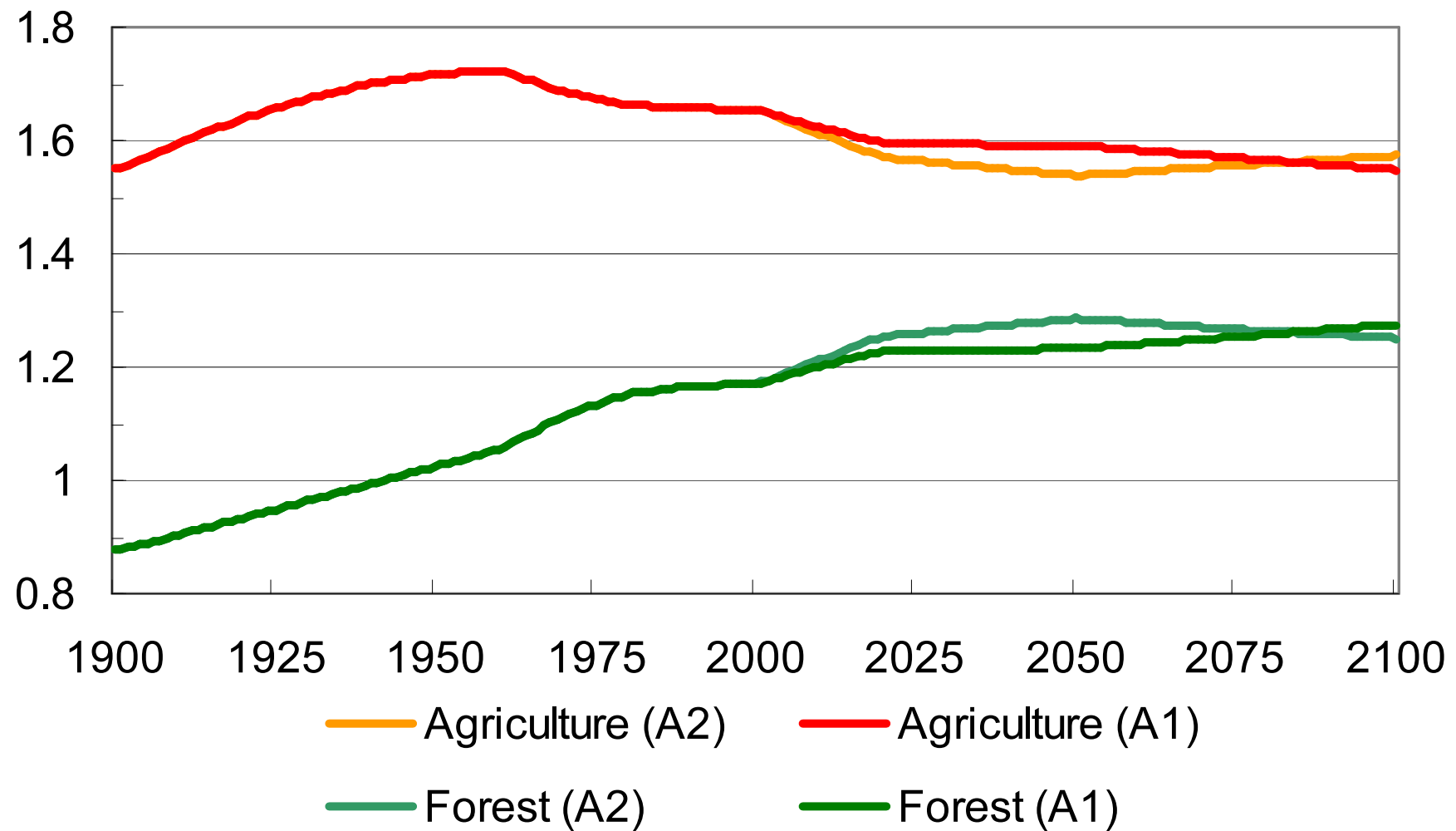


*IPCC Special Report on Emissions Scenarios (SRES)

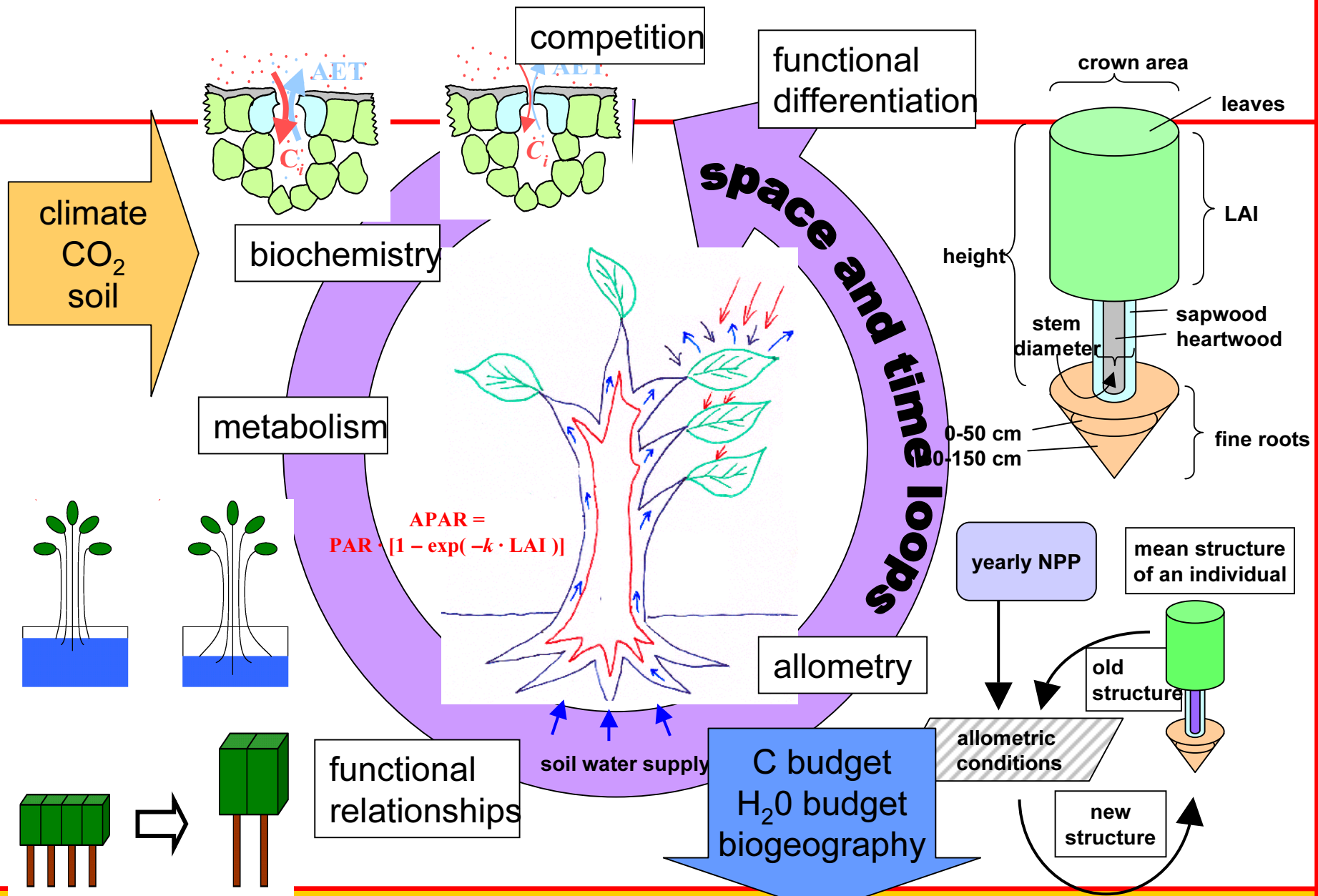
Global scenarios (SRES)

Scenario	Population	Economy	Environment	Equity	Technology	Globalization
A1FI						
A1B						
A1T						
B1						
A2						
B2						

Land use change (10^6 km^2)

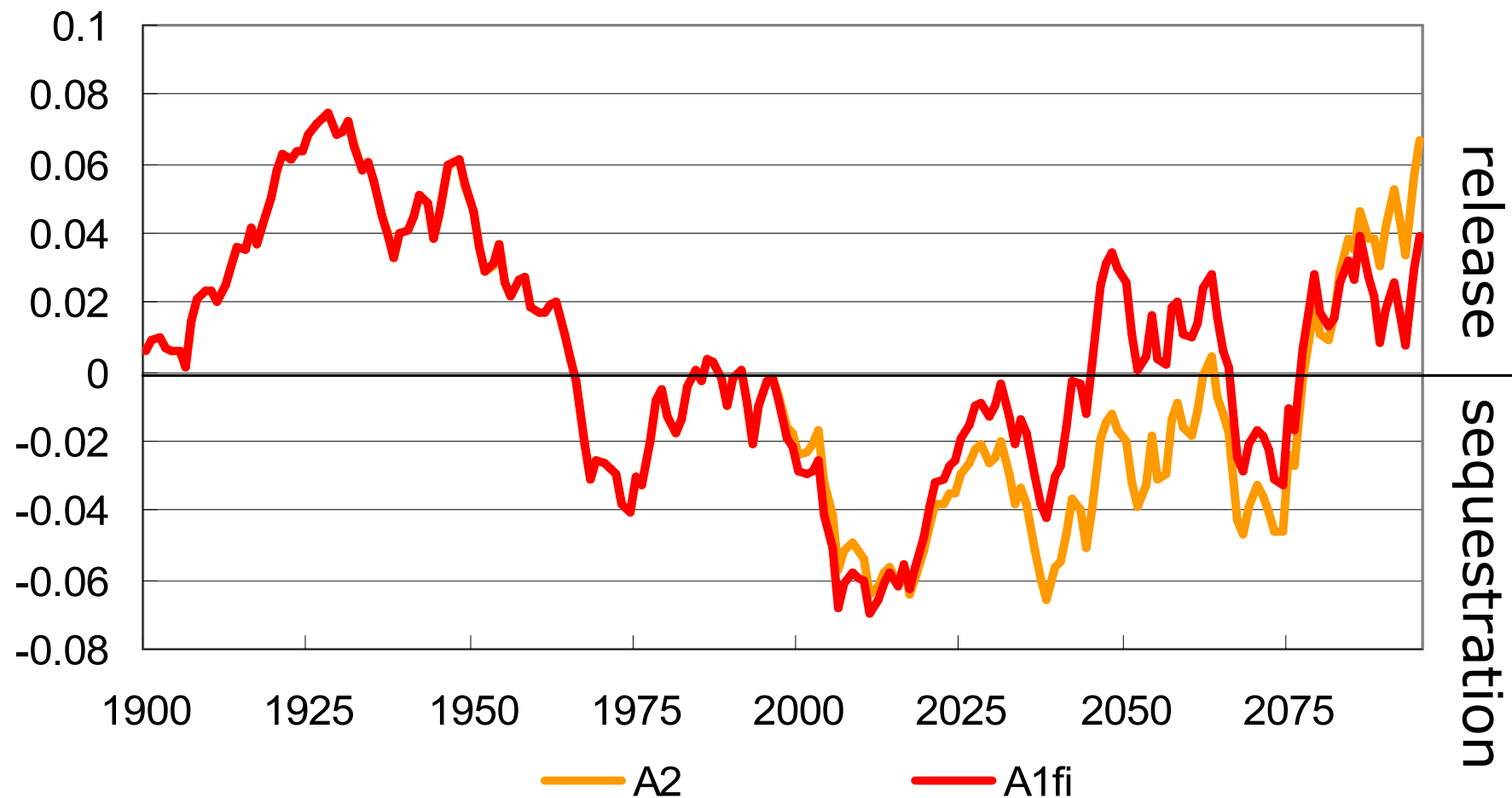


The LPJ DGVM

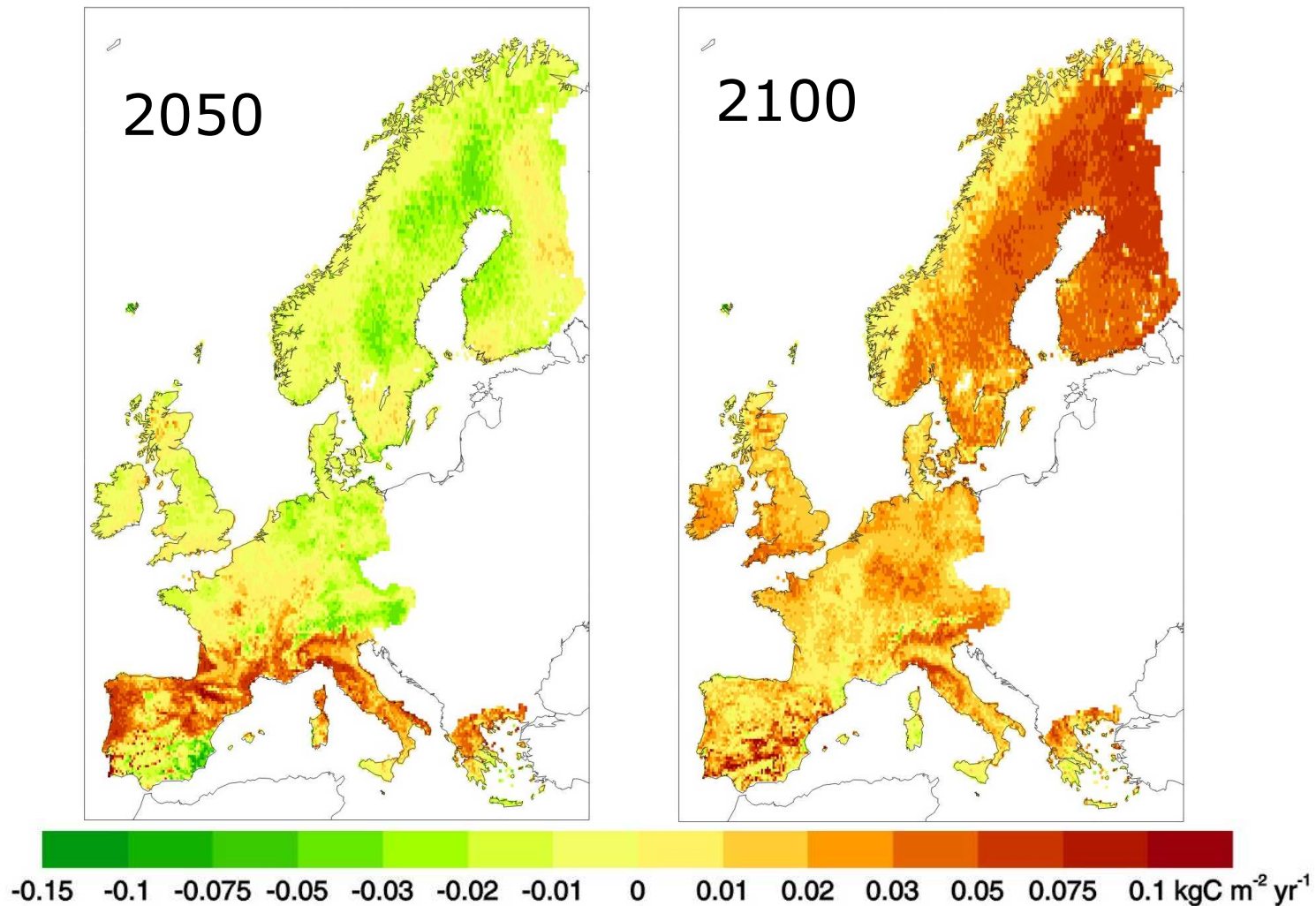


Ecosystem carbon storage

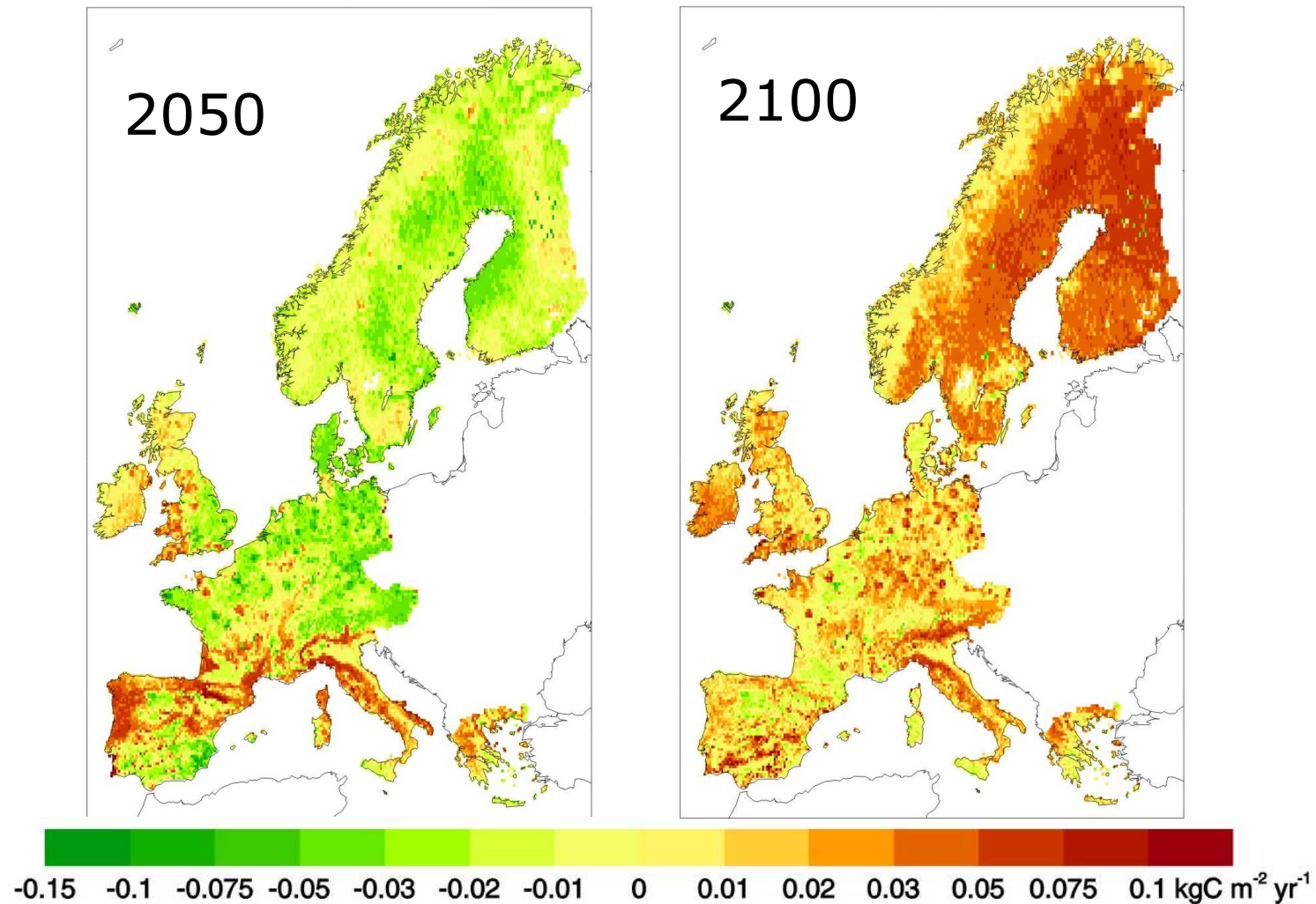
(NBE, Gt C/yr)



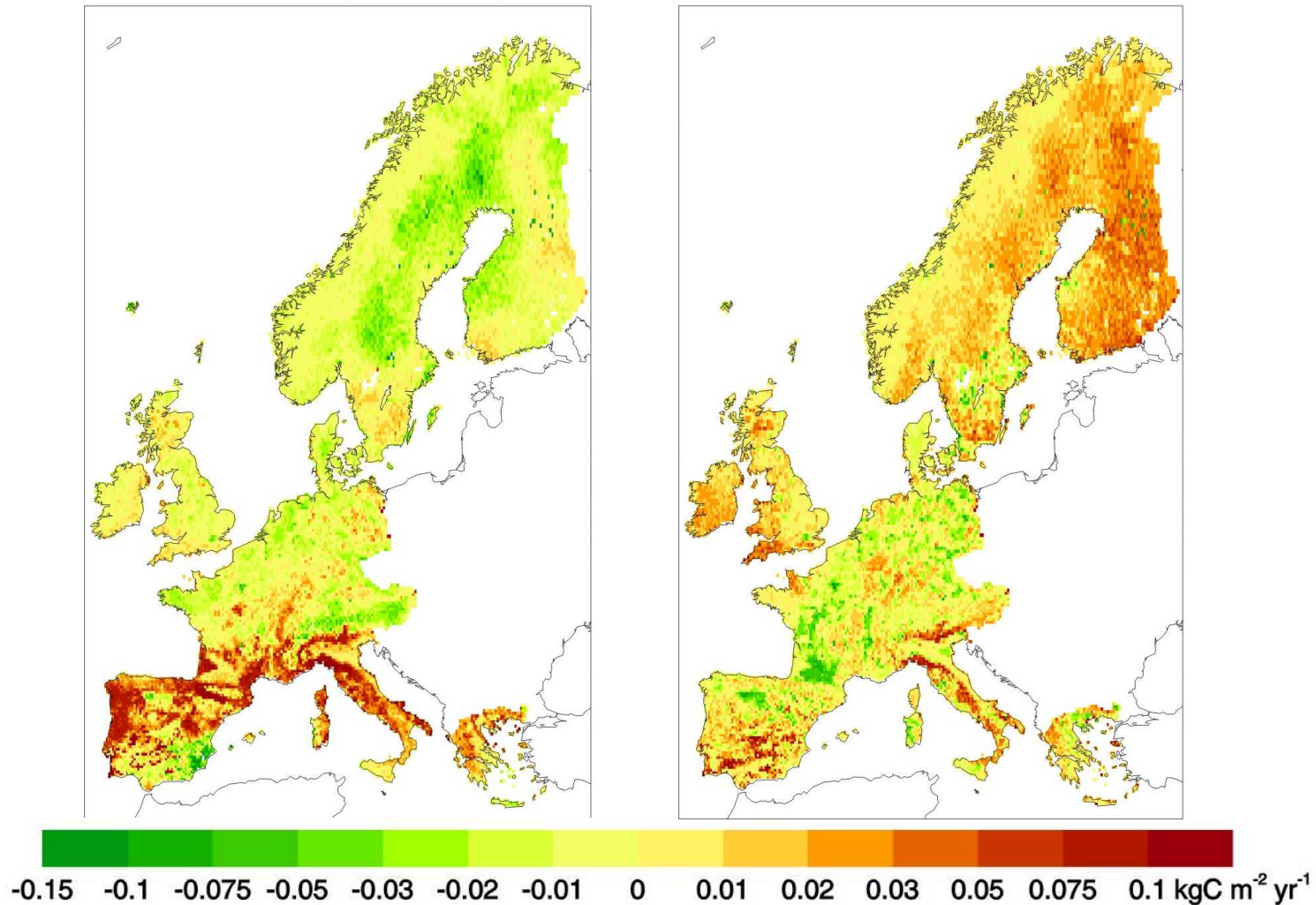
A2-CC scenario changing carbon storage



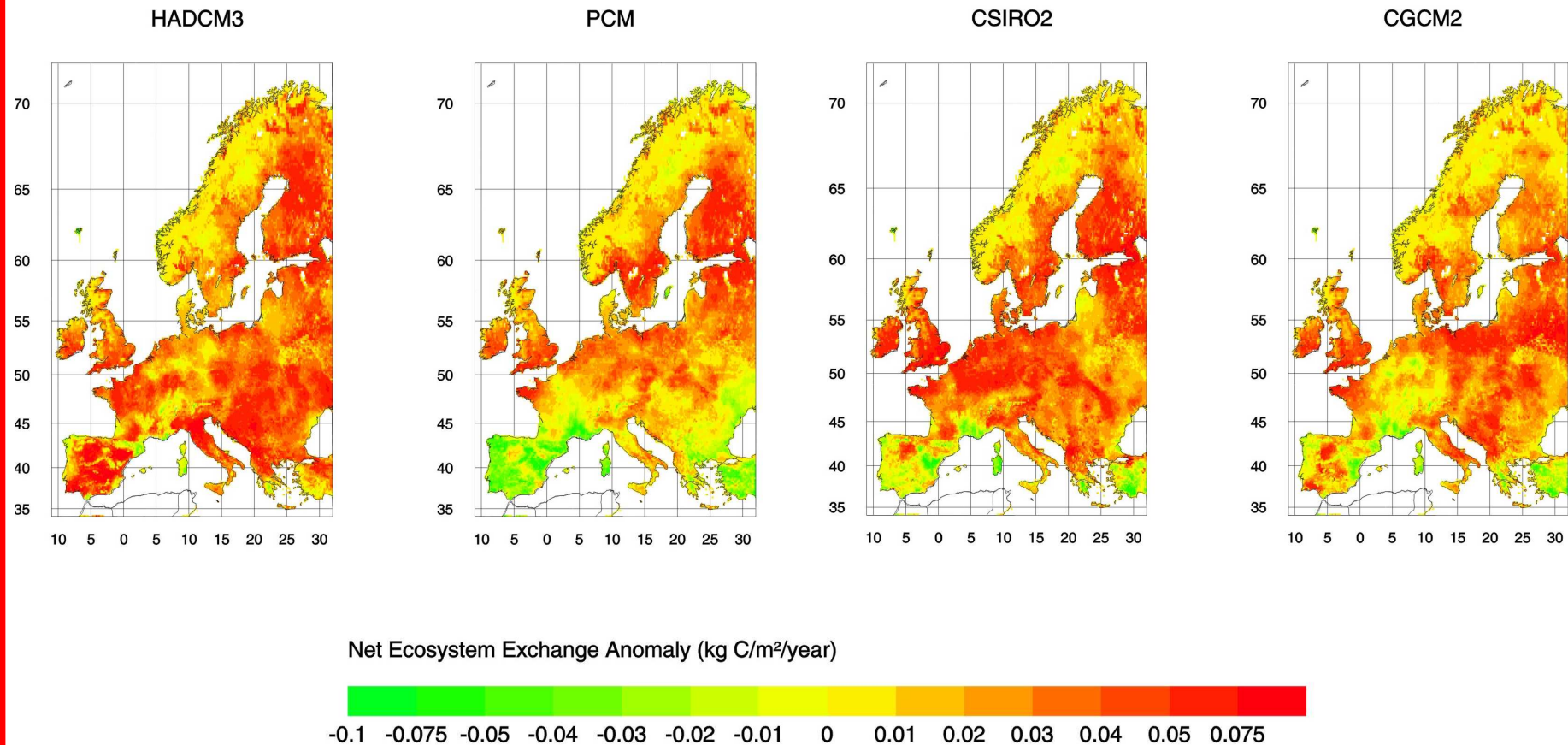
A2-LUCC scenario changing carbon storage



B1-LUCC scenario changing carbon storage

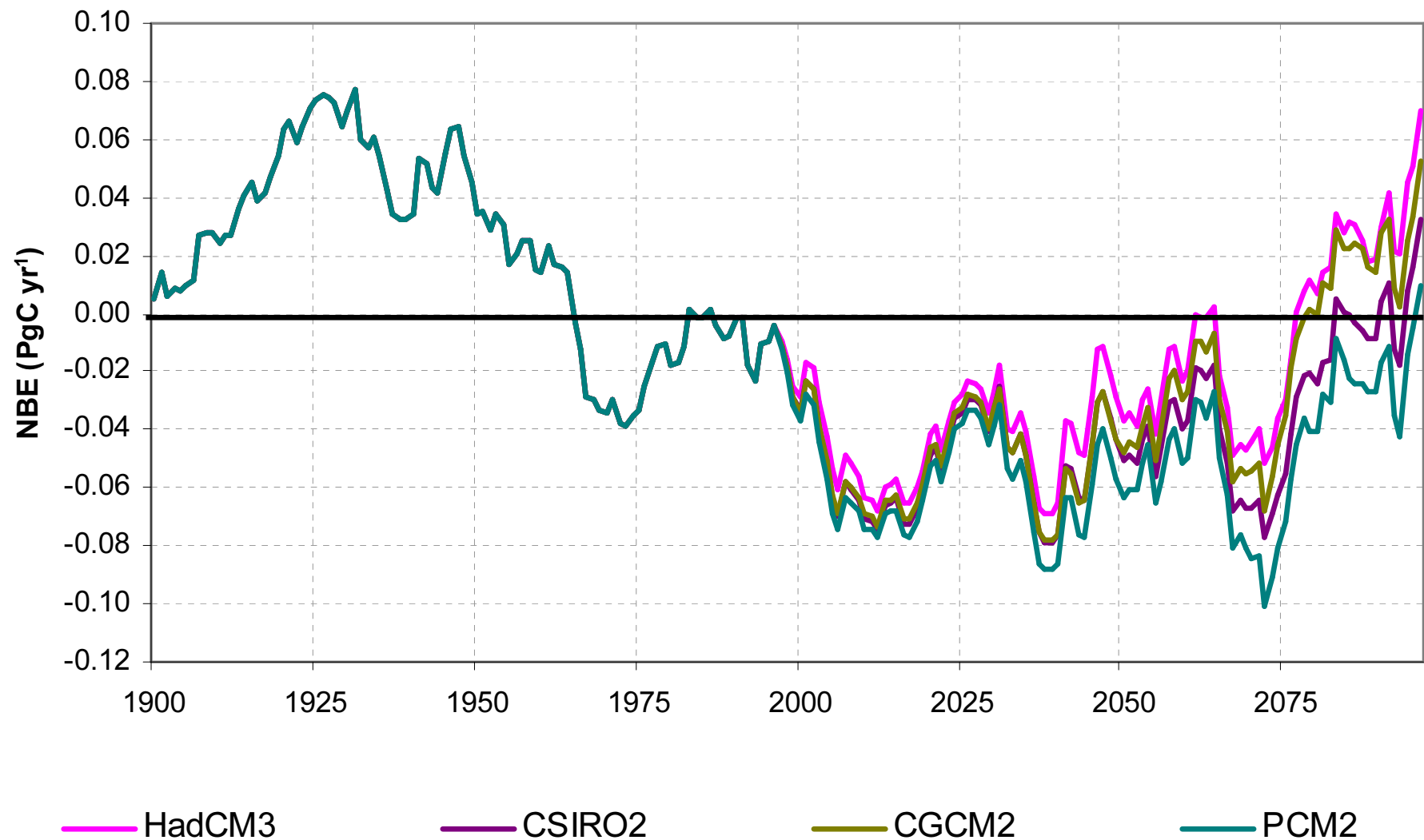


NEE Anomaly 2091-2100 (A2 Emission-Scenario)



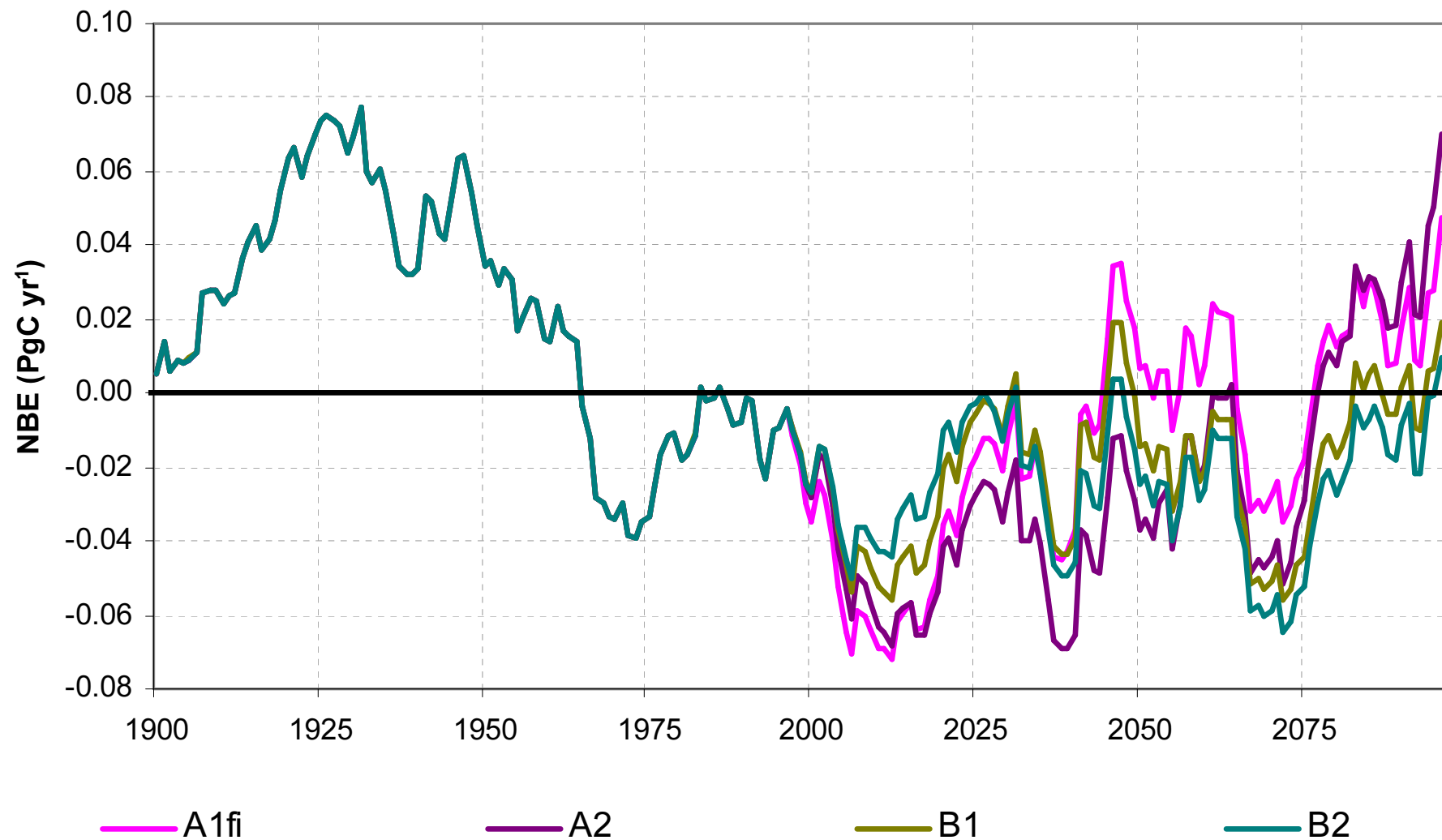
Climate model uncertainty

(same emission scenario: A2)



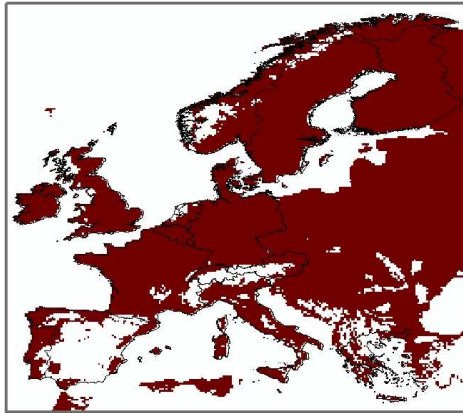
Emission scenario uncertainty

(same climate model: HadCM3)

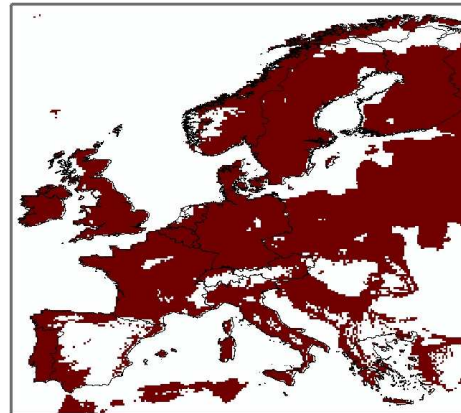


Biofuel suitability

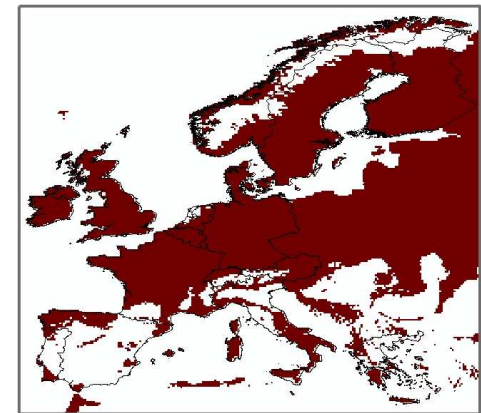
A1FI
2080
HADCM3



Liquids

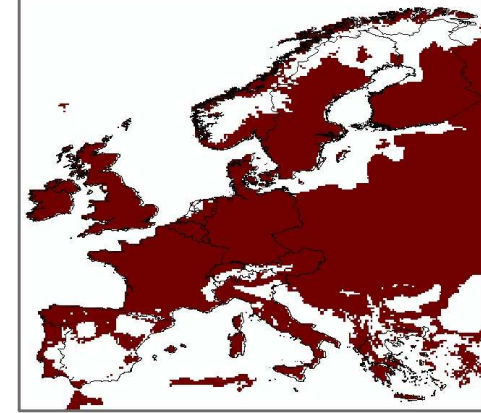
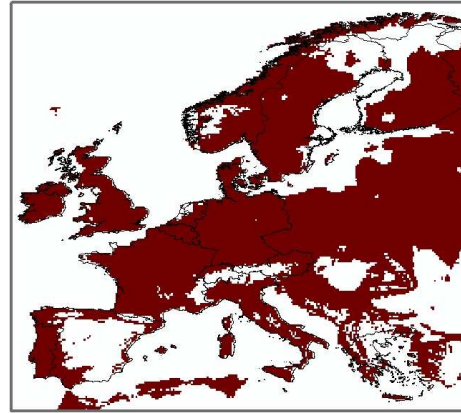
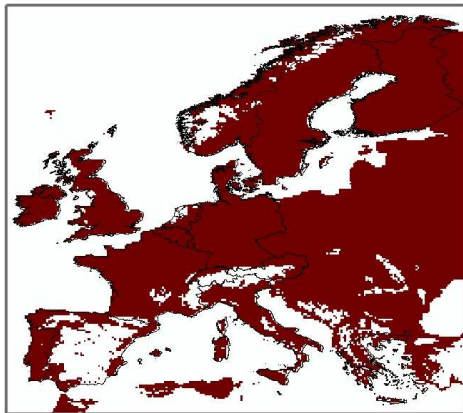


Non-woody



Woody

A2
2080
HADCM3



Source of data: Gill Tuck, Rothamsted Experimental Station

ATEAM Partners



Wageningen Universiteit
University of Life Sciences



Toledo
Spain



Barcelona, Spain



Laboratoire des Sciences du
Climat et de l'environnement

Paris, France



The Netherlands
European Forest Institute



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for Climate Change Research



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United Kingdom



Max Planck Institute for
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UNIVERSITY of ABERDEEN

Department of Plant & Soil Science



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Institute of Arable Crops
Research, Rothamsted,



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United Kingdom
Finnish Environment
SYKE Institute, Helsinki, Finland

United Kingdom
The University of Georgia
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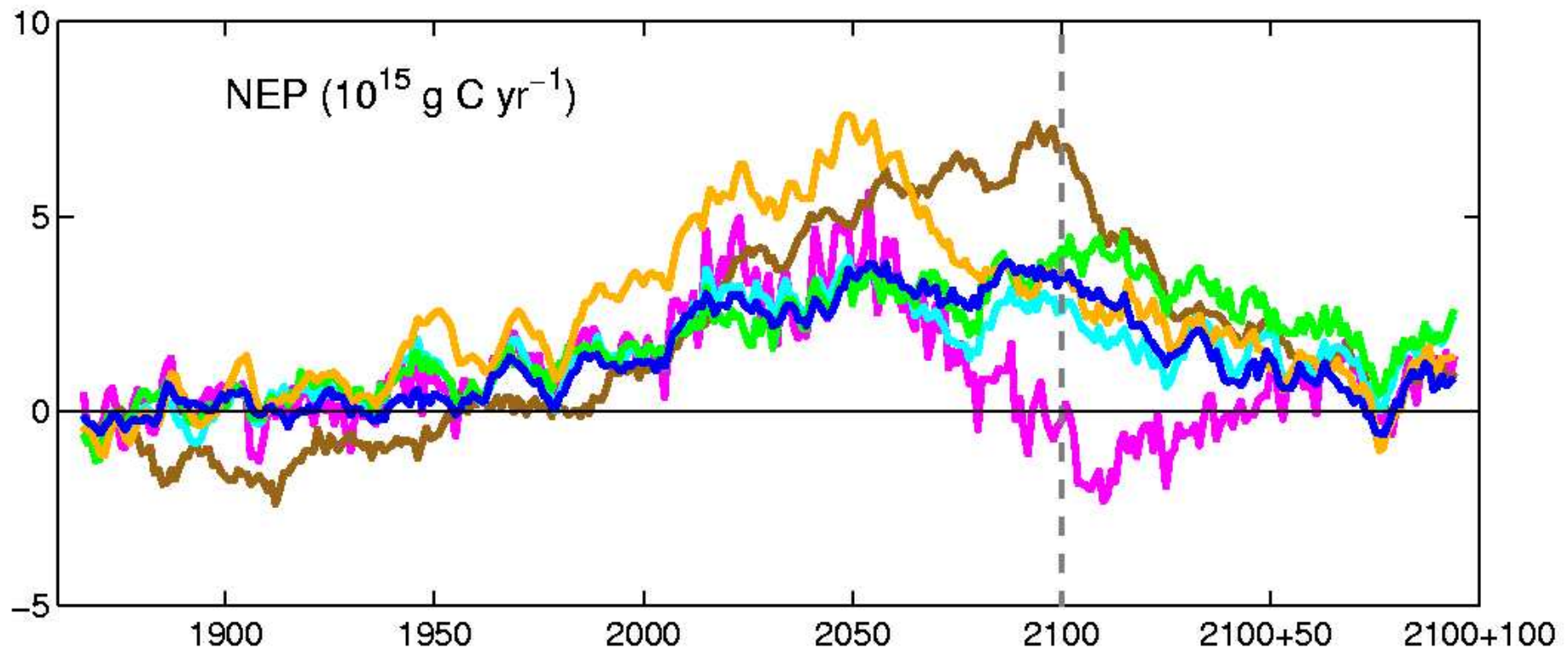


PIK, Germany

Ecosystem goods and services and human vulnerability

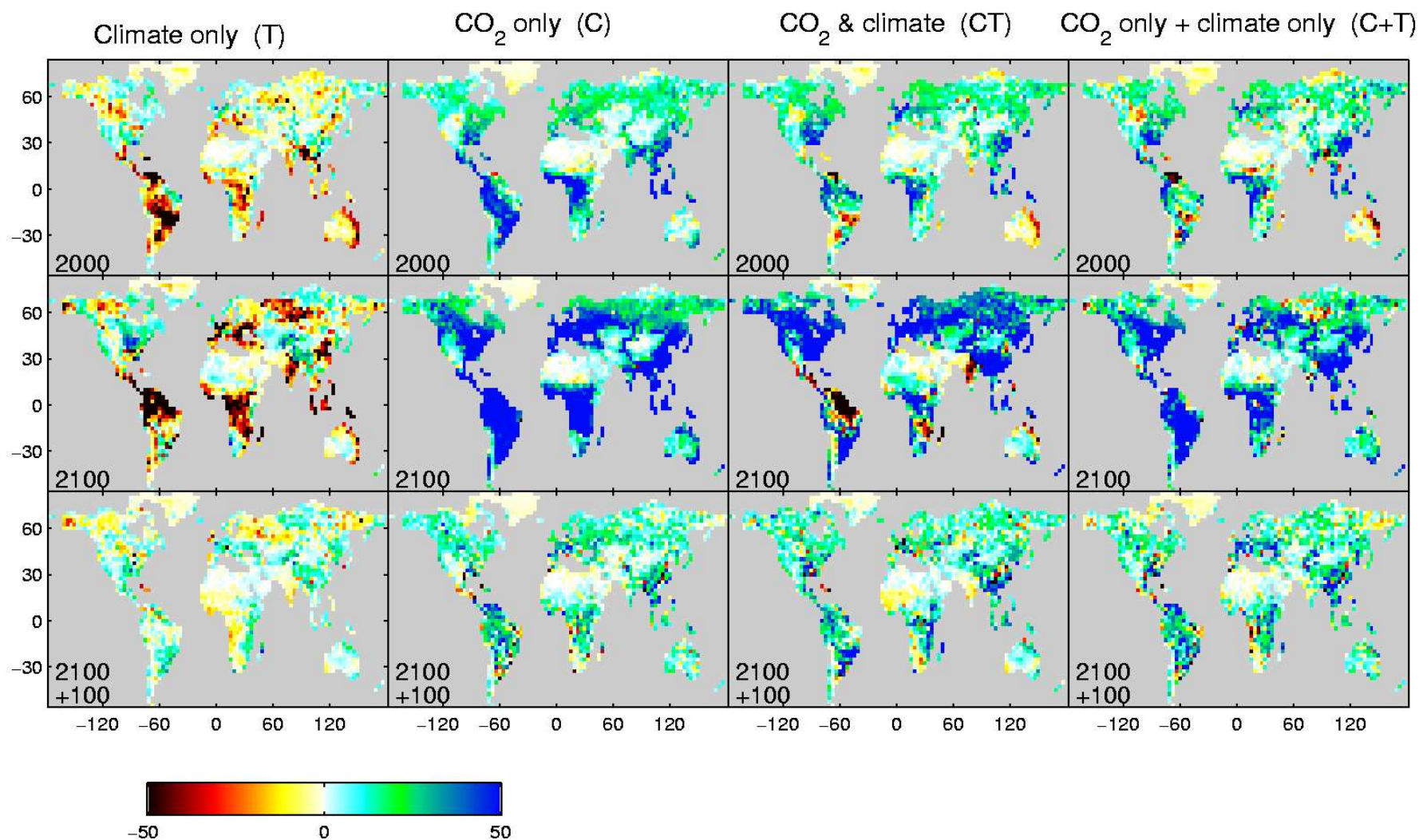
C. The carbon balance of the Amazon – more vulnerable to climate change or to deforestation?

Global net ecosystem productivity (NEP)

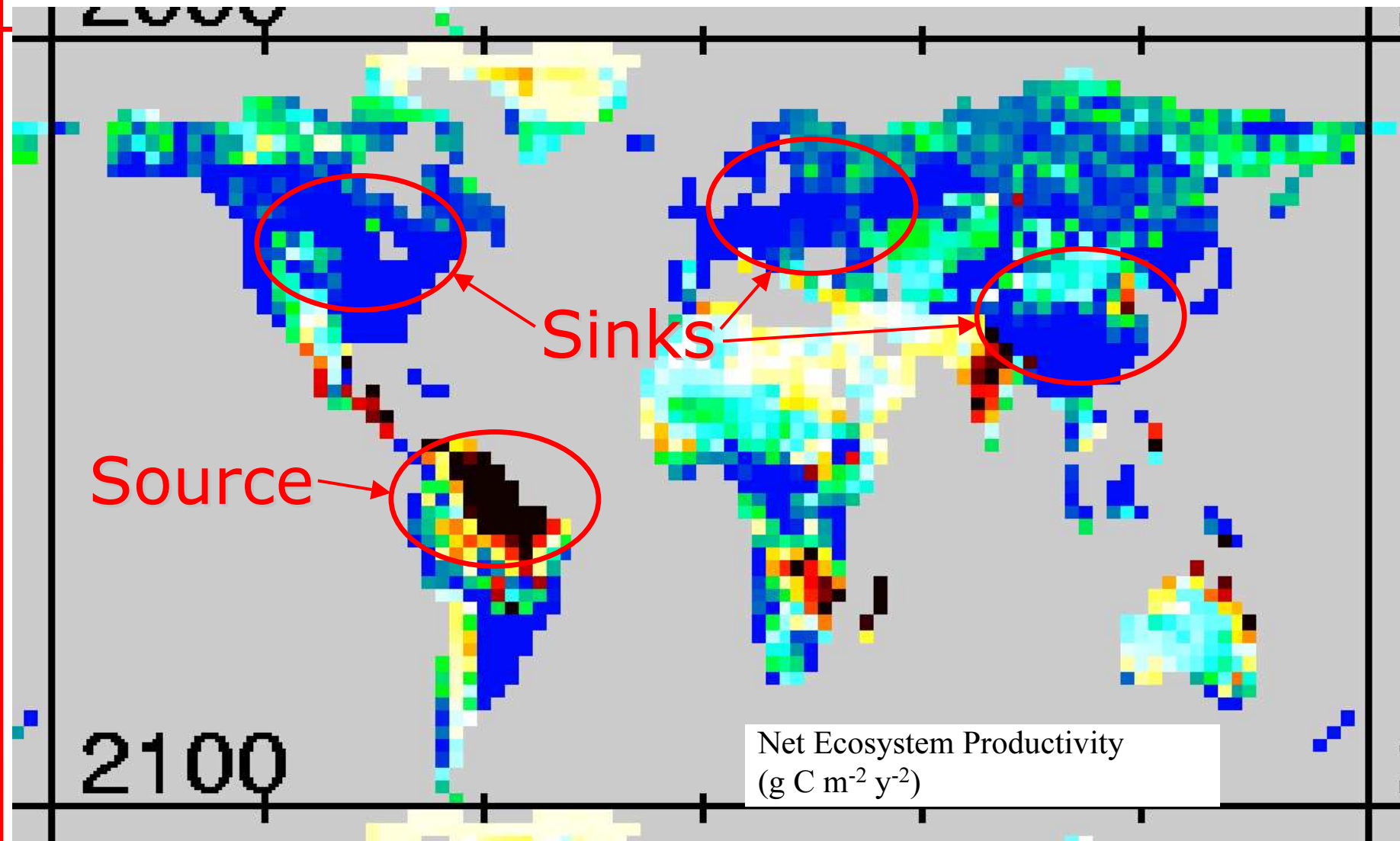


Net ecosystem productivity

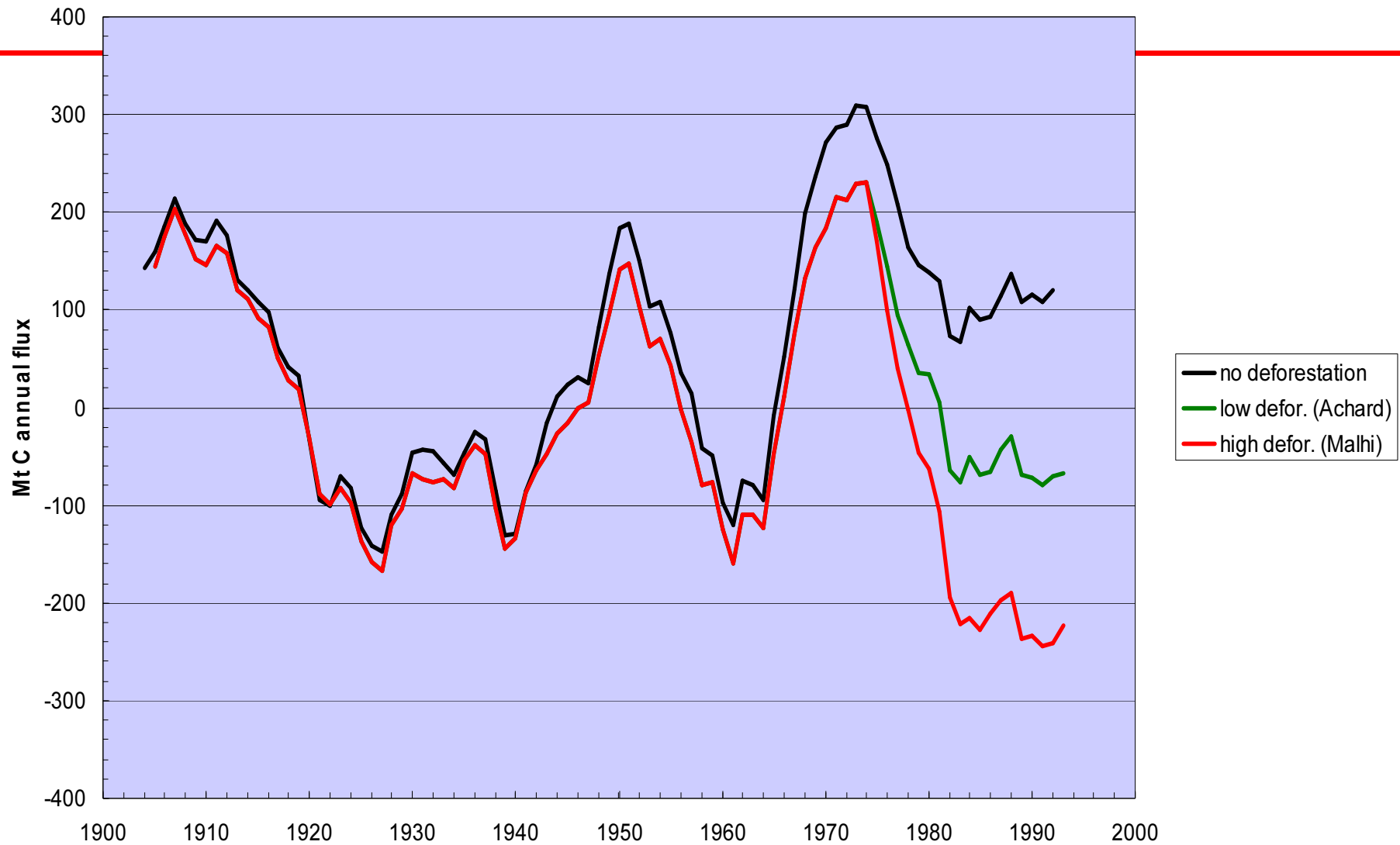
(g C m⁻² y⁻²)



Land biosphere C balance for different DGVMs



C balance of the Amazon for different rates of deforestation (10yr running means)

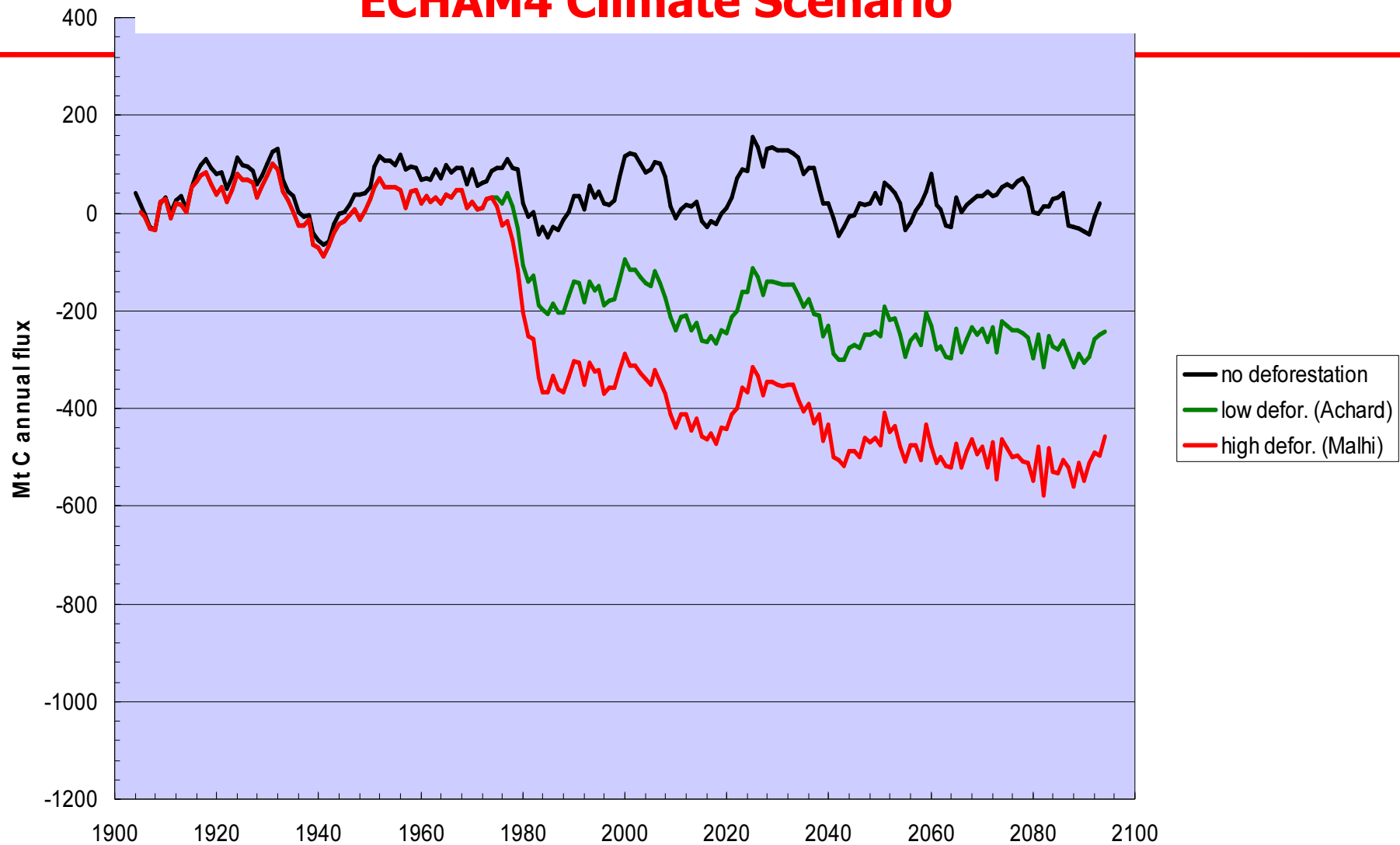


C balance of the Amazon for different rates of deforestation (10yr running means)



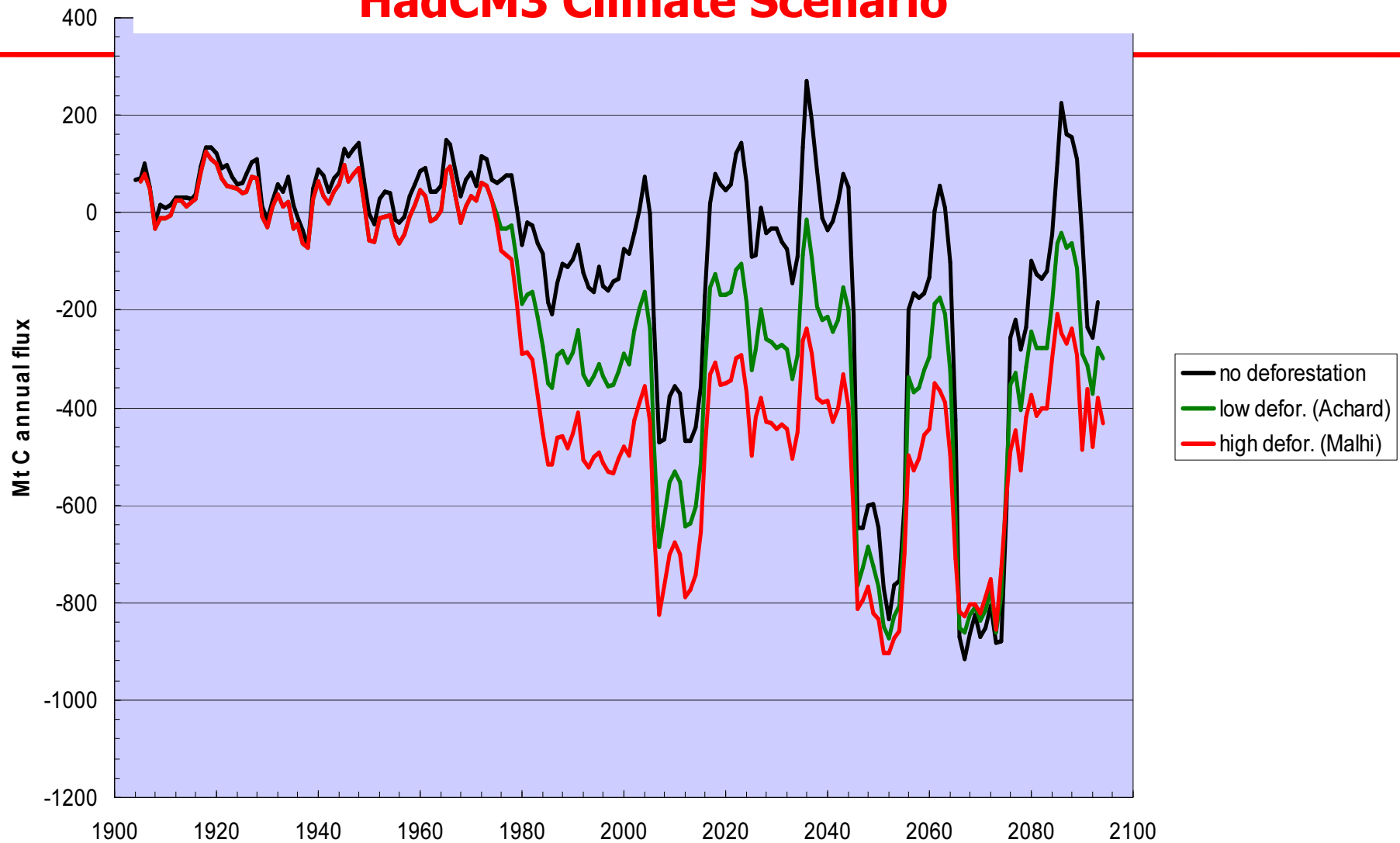
C balance of the Amazon for different rates of deforestation (10yr running means)

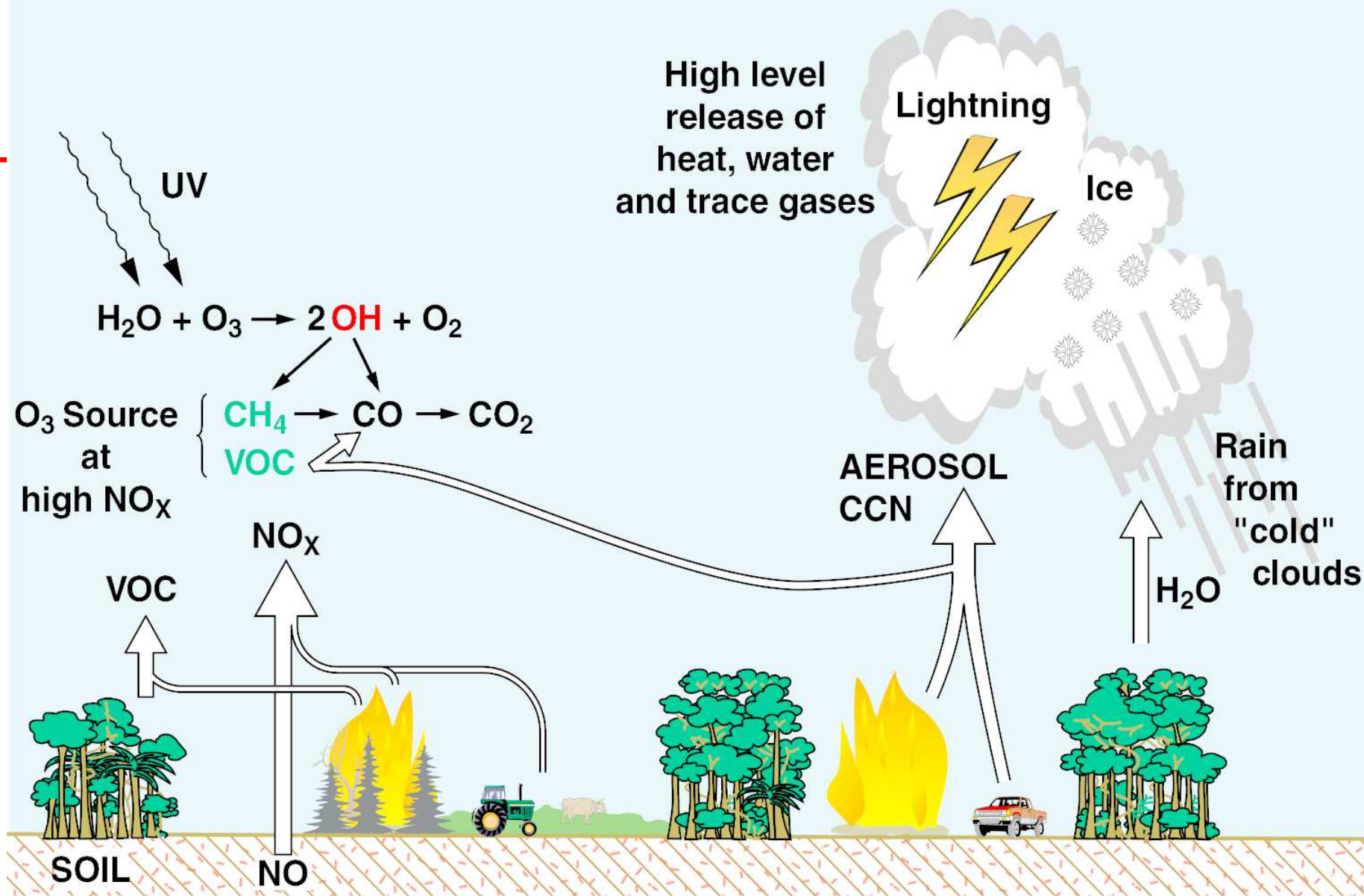
ECHAM4 Climate Scenario



C balance of the Amazon for different rates of deforestation (10yr running means)

HadCM3 Climate Scenario





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Ecosystem goods and services and human vulnerability

D. Conclusion

Summary

- Ecosystems...

 - ...provide multiple services

 - ...are sensitive to climate and land use change

 - ...can be assessed quantitatively in a multi-scenario approach

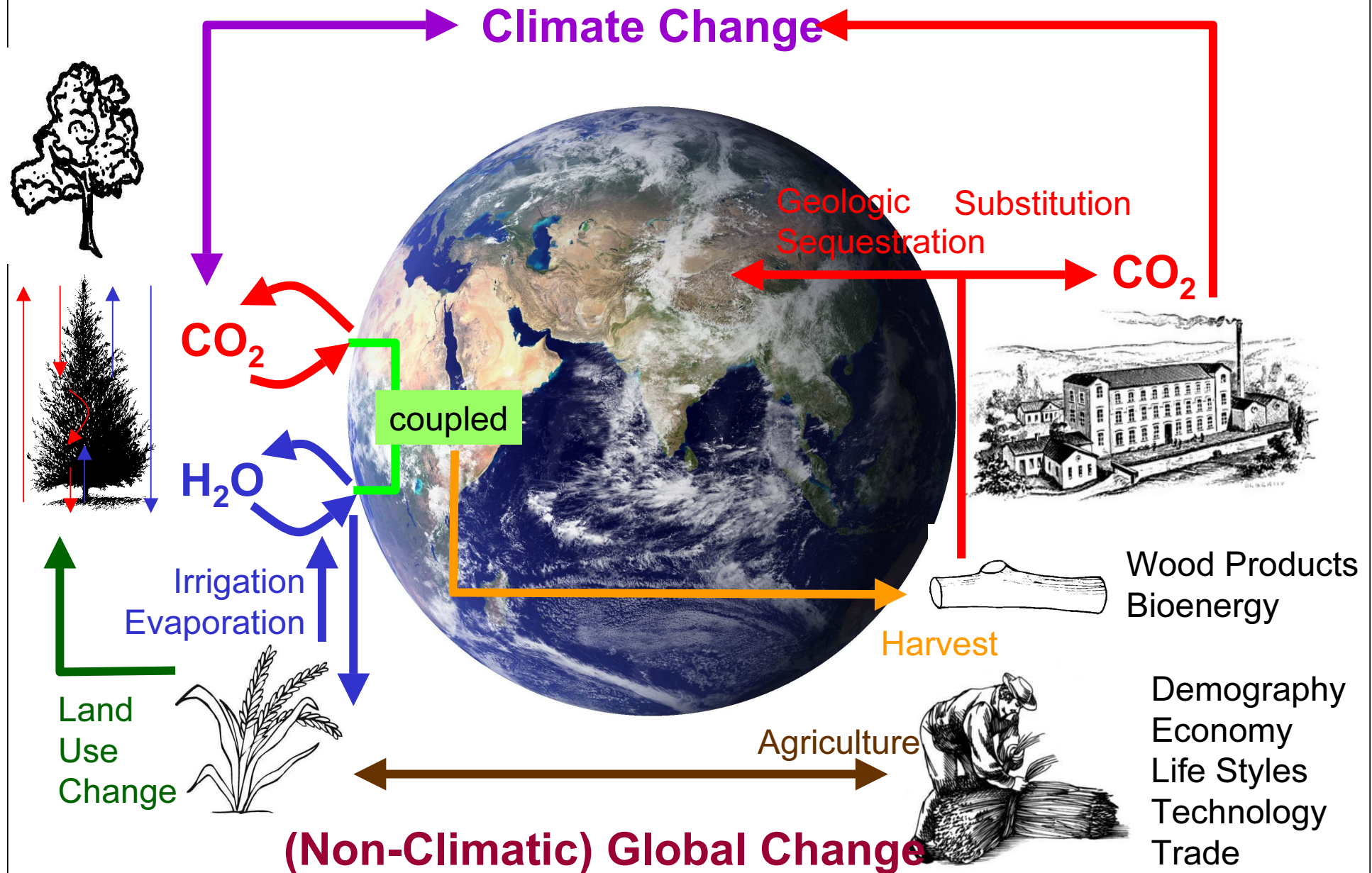
- Quantitative assessment is necessary...

 - ...for estimation of damage

 - ...planning of adaptive measures

Global Biogeochemistry

Socioeconomic Metabolism





Thank you very much for
your attention!

More information to be found at
<http://www.pik-potsdam.de/ateam>

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