



UNIVERSITY OF ABERDEEN

Hydrological impact assessment of afforestation and change in tree-species composition – a regional case study for the federal state of Brandenburg (Germany)

Martin WATTENBACH^{*/5}, Marc ZEBISCH², Fred HATTERMANN³, Pia GOTTSCHALK⁵, Horst GOEMANN⁴, Peter KREINS⁴, Franz BADECK³, Petra LASCH³, Felicitas SUCKOW³, Frank WECHSUNG³

^{*/5} School of Biological Sciences, University of Aberdeen, Cruickshank Building, Aberdeen, AB24 3UU, UK

² EURAC research, Institute for Alpine Environment, Viale Druso 139100 Bolzano, Italy

³ Potsdam Institute for Climate Impact Research Dep.: Global Change & Natural Systems P.O. Box 60 12 03, 14412 Potsdam, Germany

⁴ Institute of Rural Studies of the Federal Agricultural Research Centre, Bundesallee 50 38116 Braunschweig, German

outline

- The state of Brandenburg
- The scenarios for the case study
- Modelling cascade to derive land use pattern from economic boundary conditions
- A brief introduction to the forest version of SWIM model (Soil Water Integrated Model)
 - The forest sub-module
 - Spatial distribution of forest age and type
 - Forest water cycle interaction
- Aggregated results for the state
- Regional pattern
- Global uncertainty

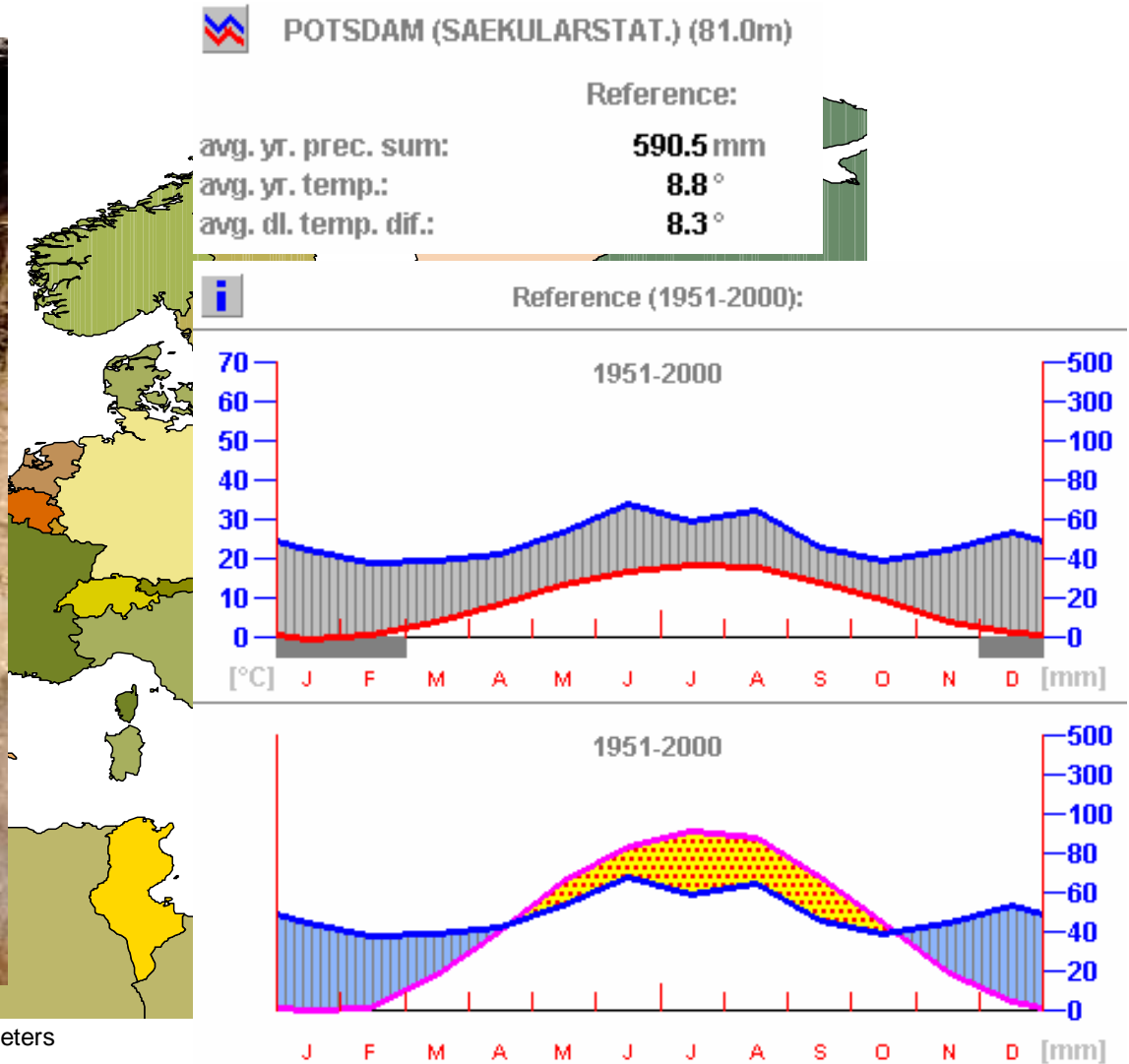
area under study

Sandy soils
Europe

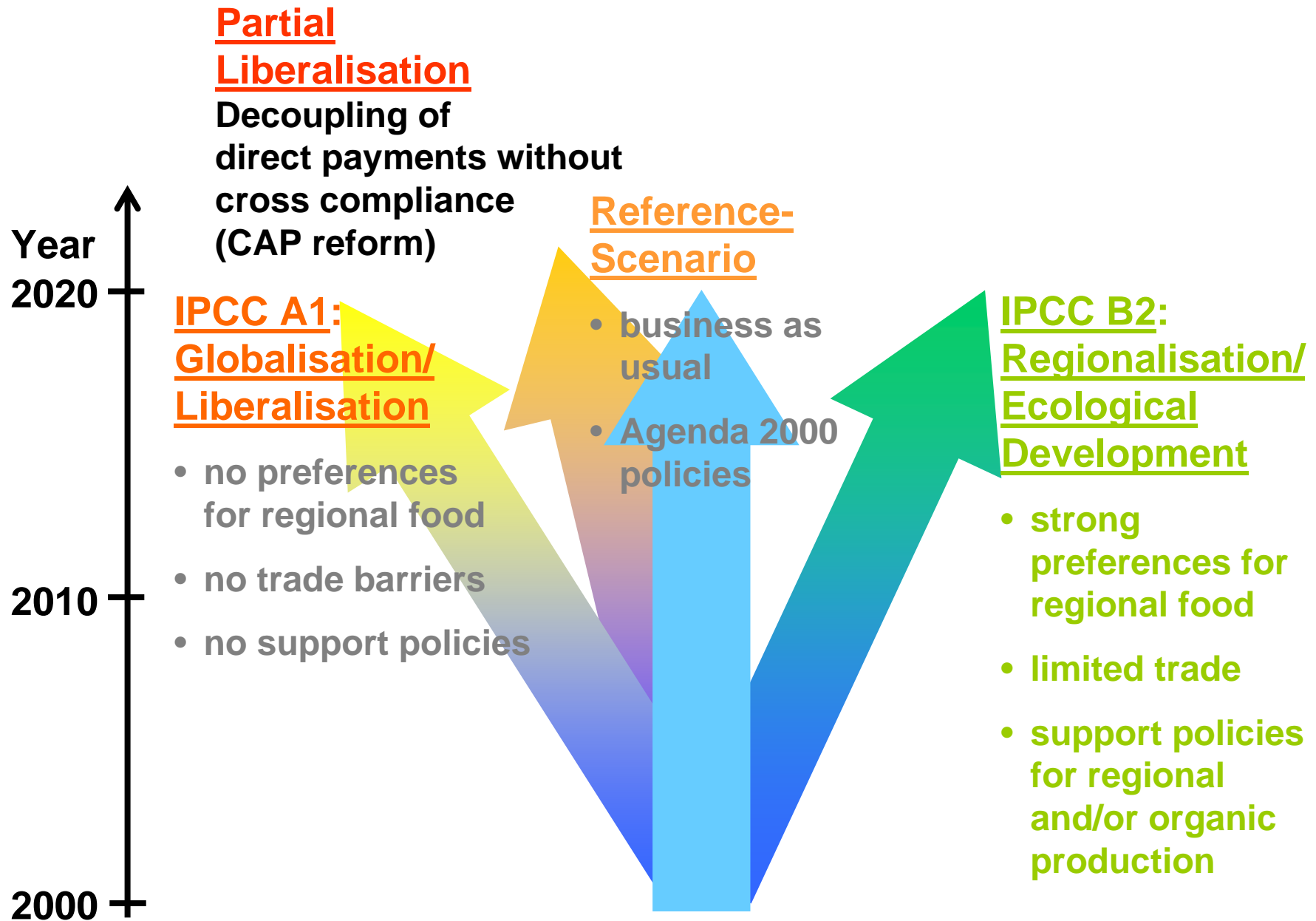


0 1000 2000 Kilometers

subcontinental climate



Driving force



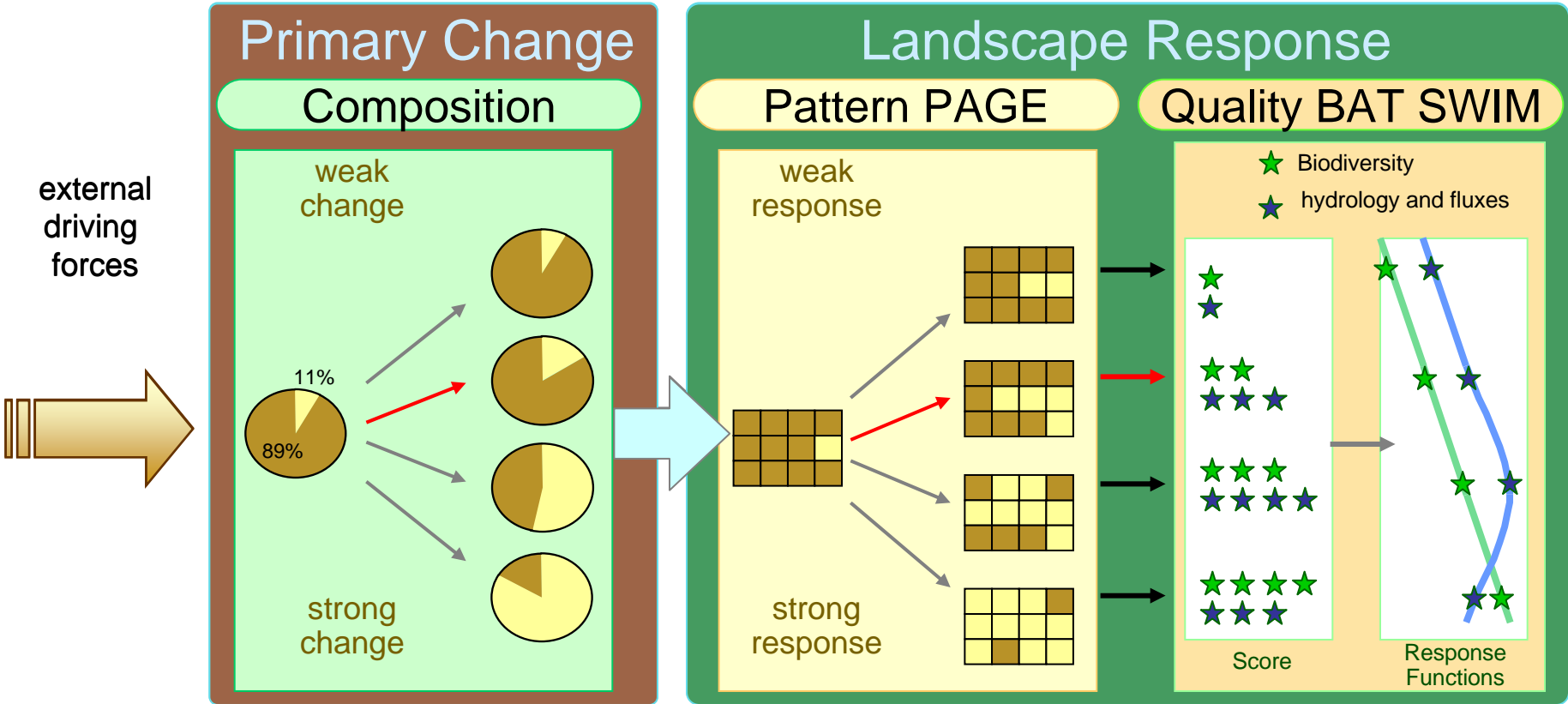
models

RAUMIS: Model for estimating the regional distribution of national agricultural production (district level)

PAGE: Pattern Generator pixel level (GIS model)

BAT: Biodiversity Assessment Tool (GIS-model)

SWIM: Ecohydrological watershed model



Tasks:

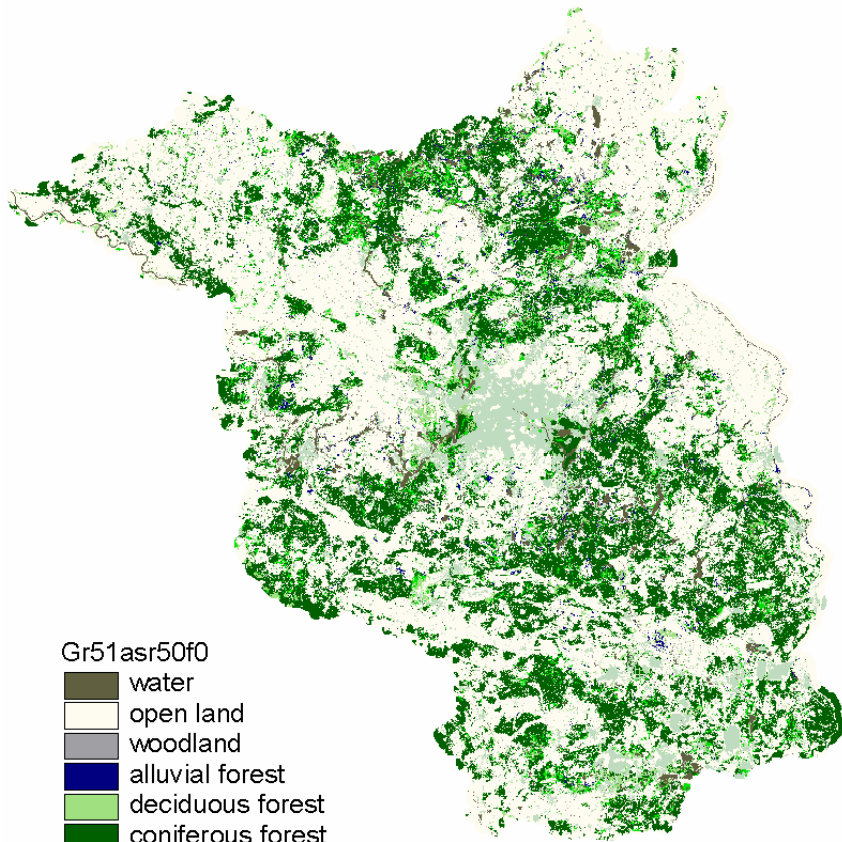
Scenario Definitions

Pattern Generation

Evaluation of Quality

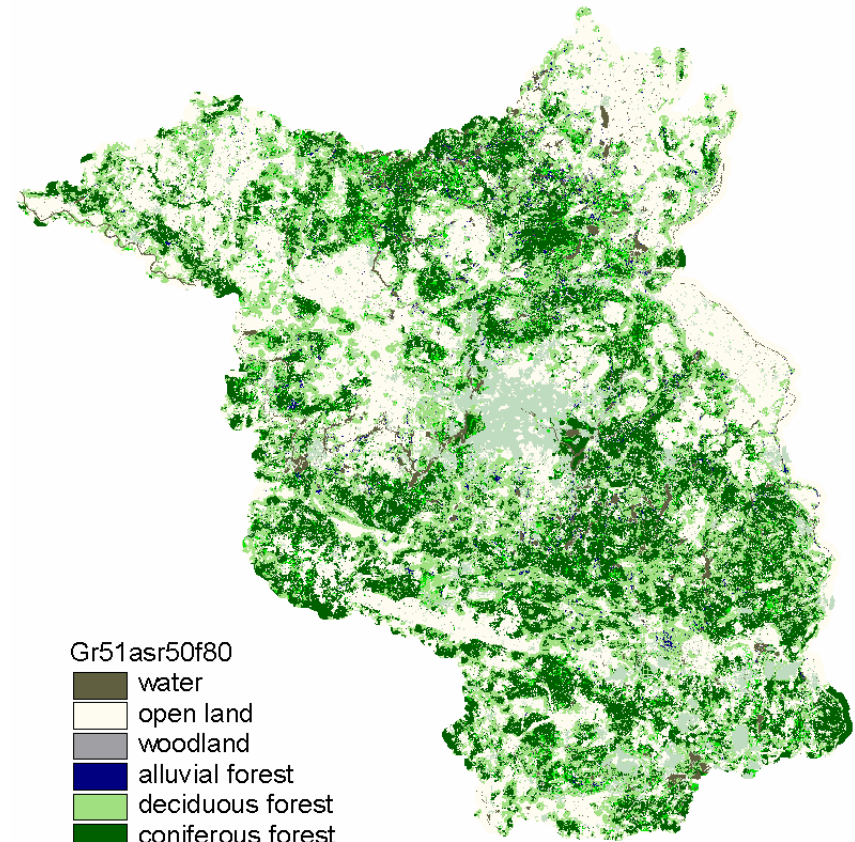
Szenario I: succession at fallow land

succession 0%



- Gr51asr50f0
- water
 - open land
 - woodland
 - alluvial forest
 - deciduous forest
 - coniferous forest
 - mixed forest
 - settlement
 - No Data

succession 80%



- Gr51asr50f80
- water
 - open land
 - woodland
 - alluvial forest
 - deciduous forest
 - coniferous forest
 - mixed forest
 - settlement
 - No Data

0 100 Kilometers

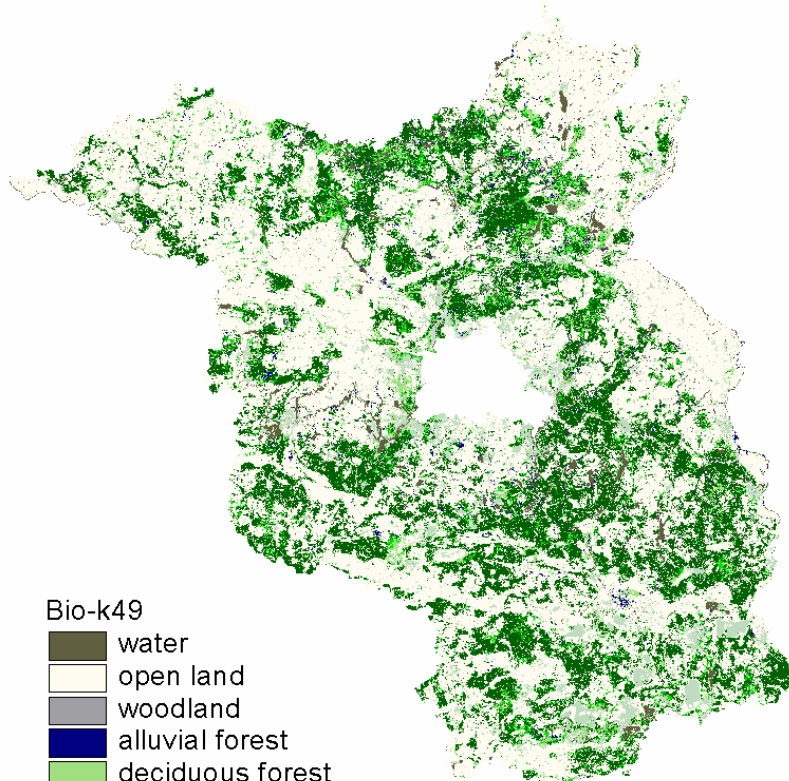


0 100 Kilometers



Szenario II: change of species composition

recent land use



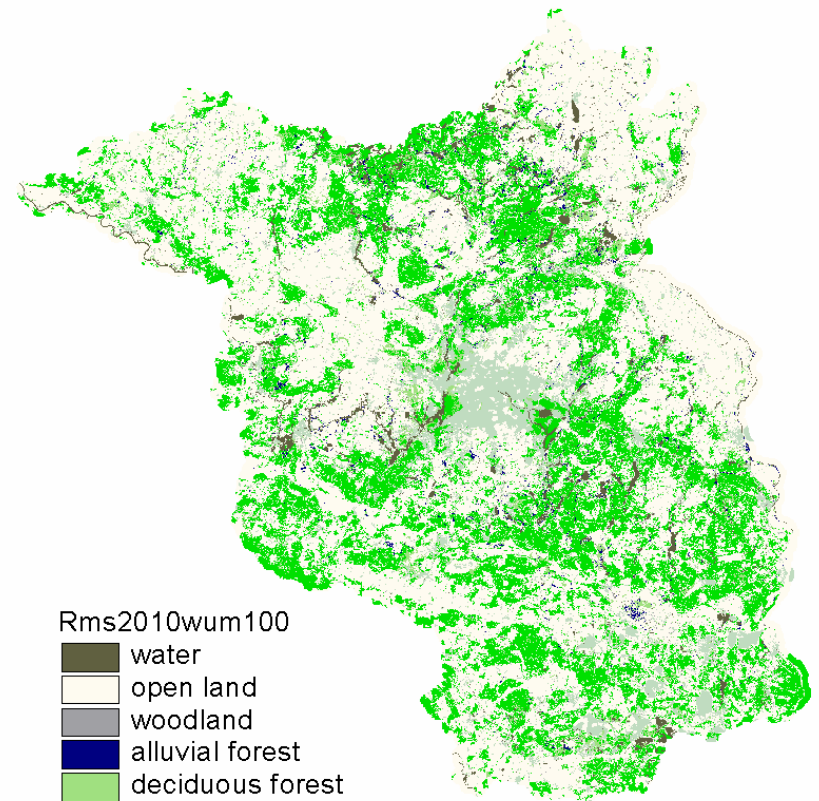
Bio-k49

- water
- open land
- woodland
- alluvial forest
- deciduous forest
- coniferous forest
- mixed forest
- settlement
- No Data

20 0 20 Kilometers



100% deciduous forest



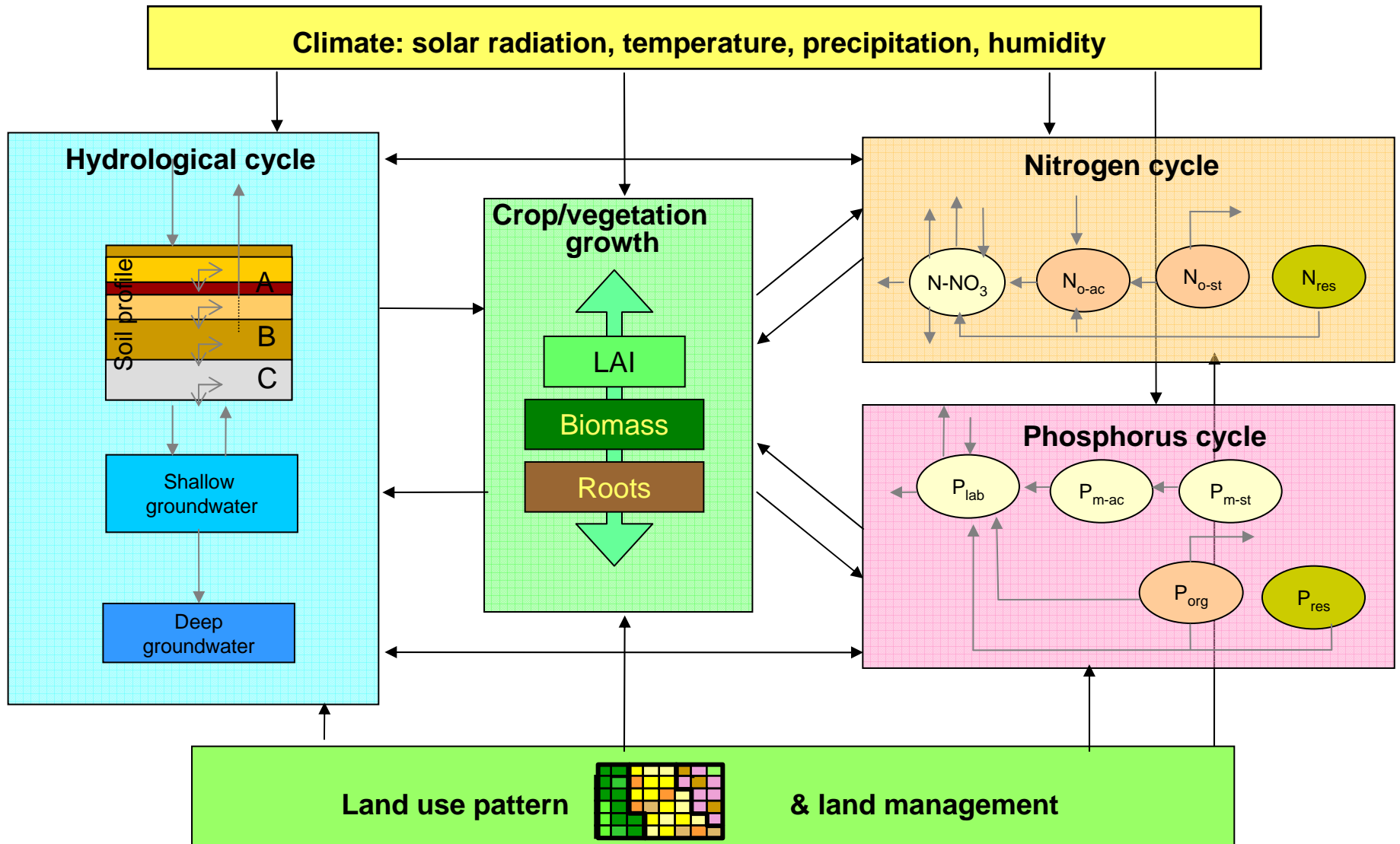
Rms2010wum100

- water
- open land
- woodland
- alluvial forest
- deciduous forest
- coniferous forest
- mixed forest
- settlement
- No Data

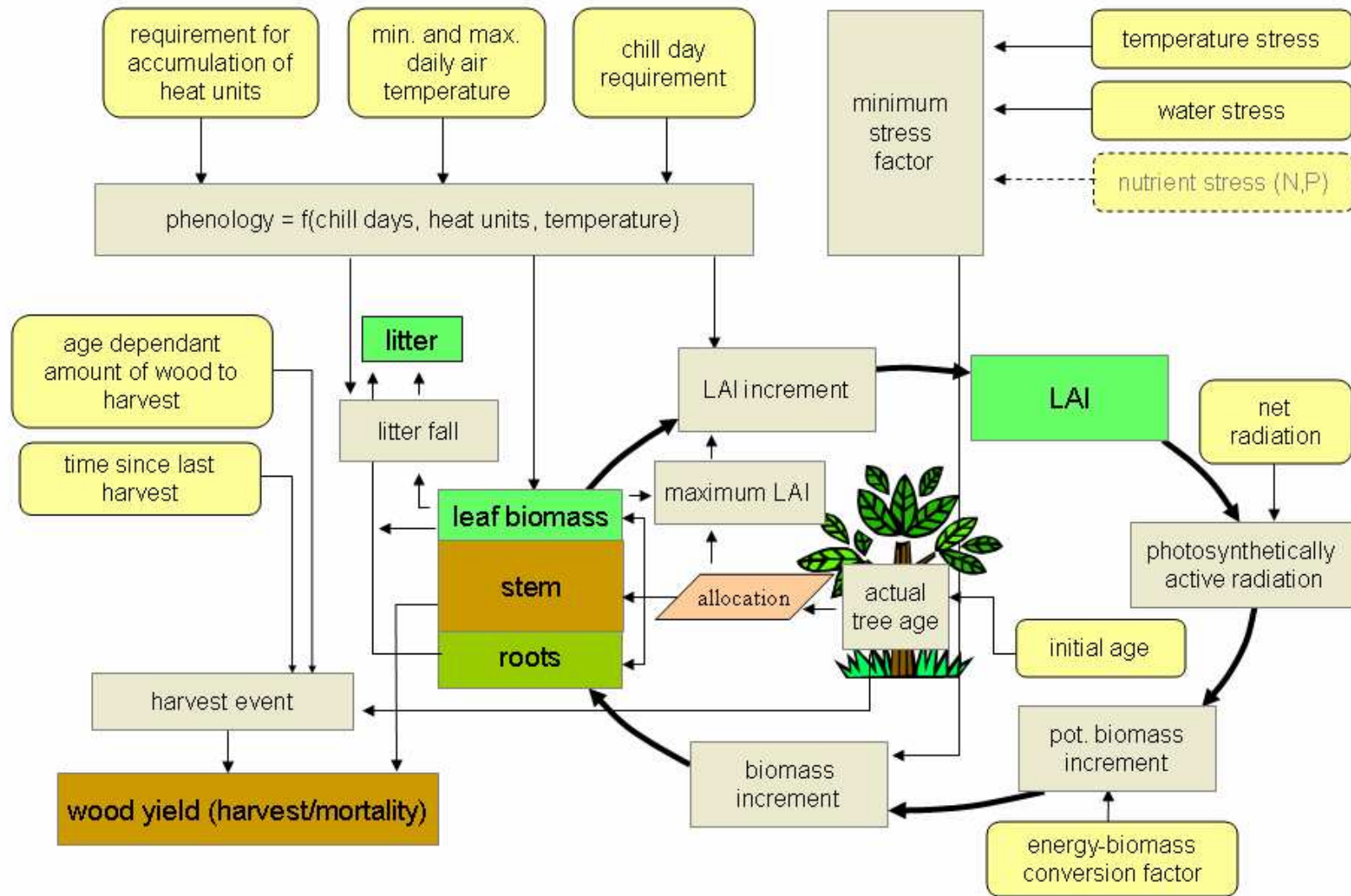
20 0 20 Kilometers



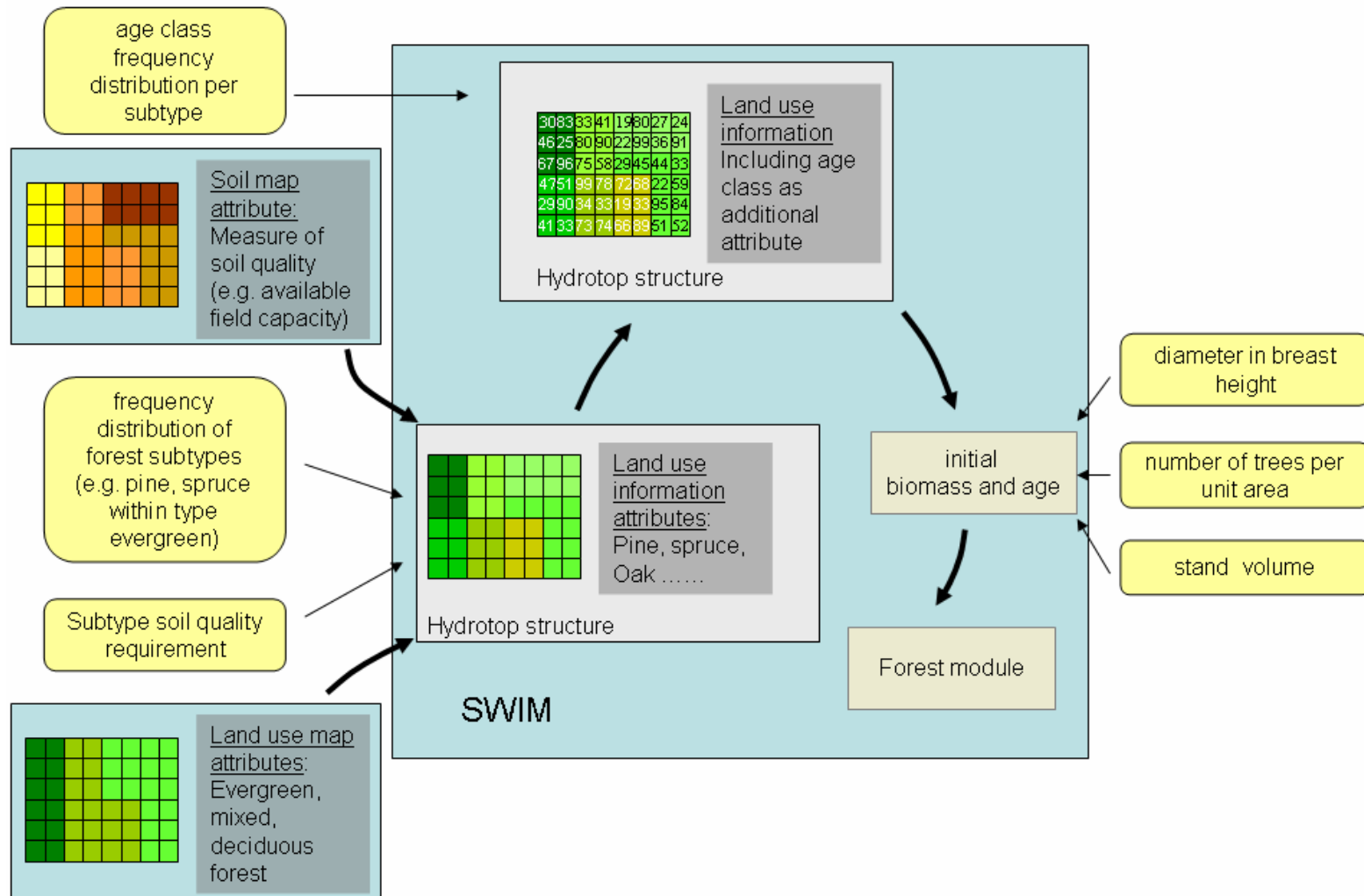
Soil and Water Integrated Model (SWIM)



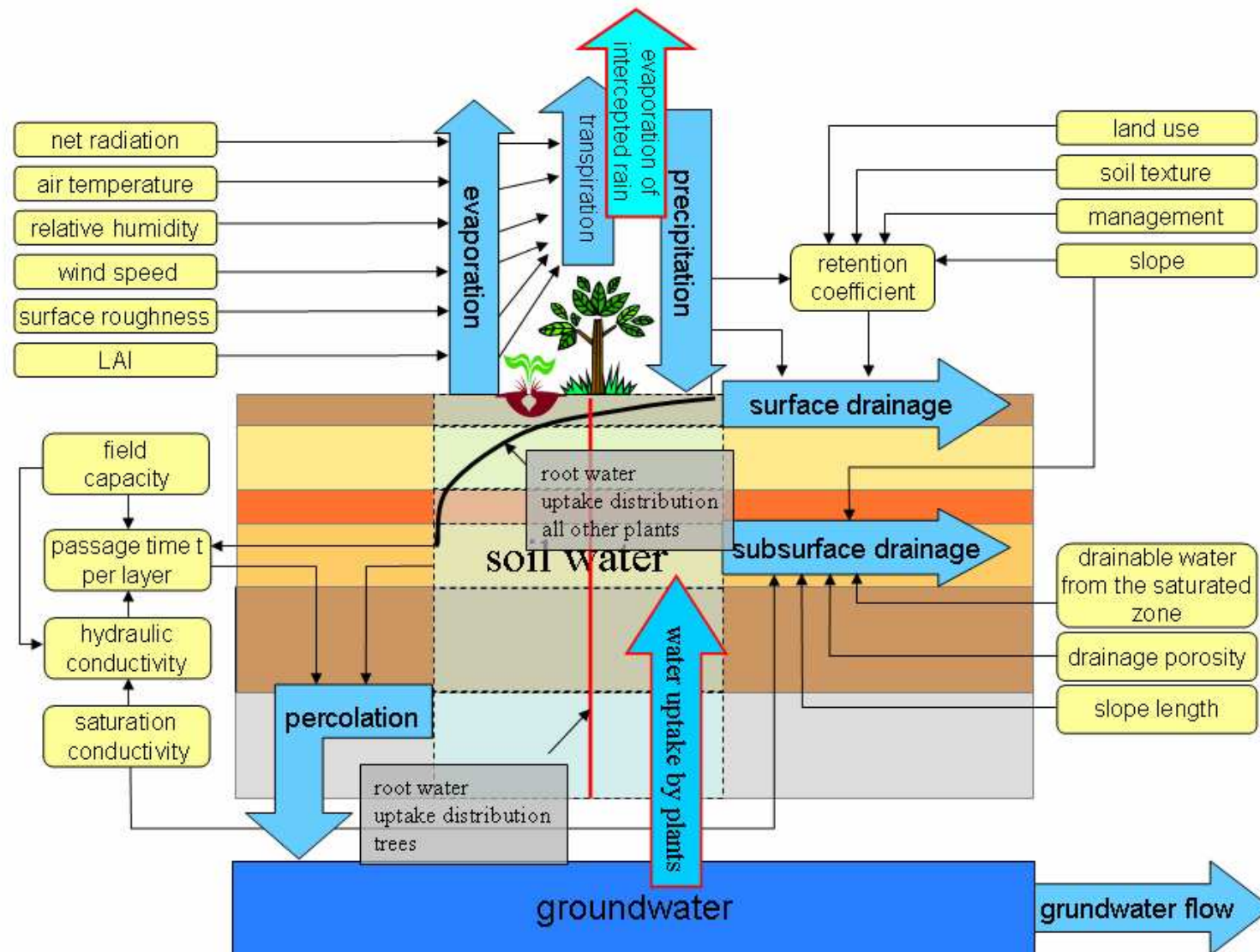
The forest sub-module



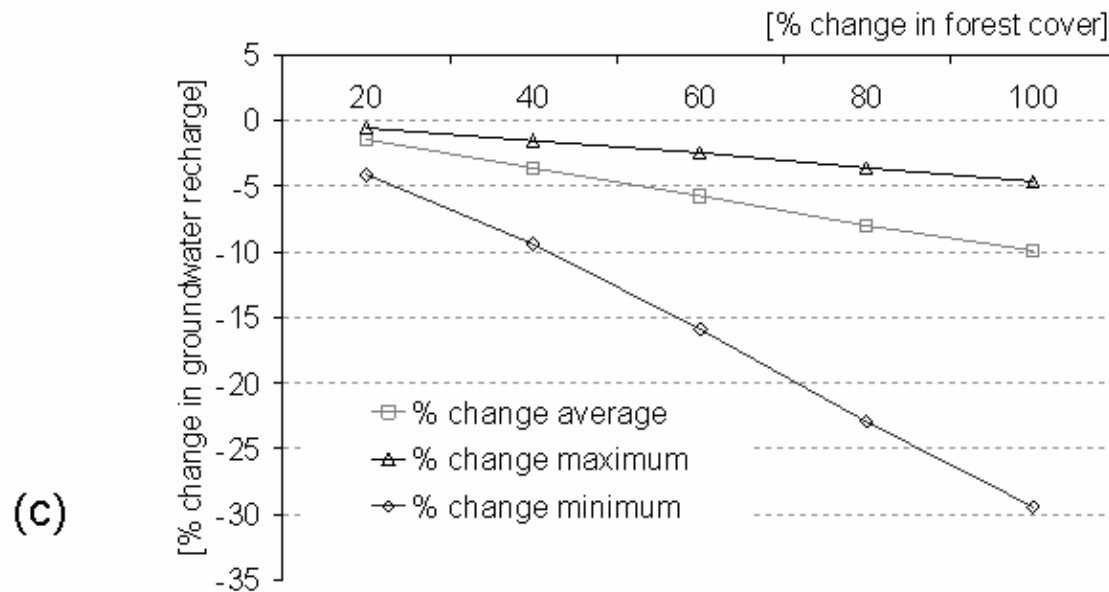
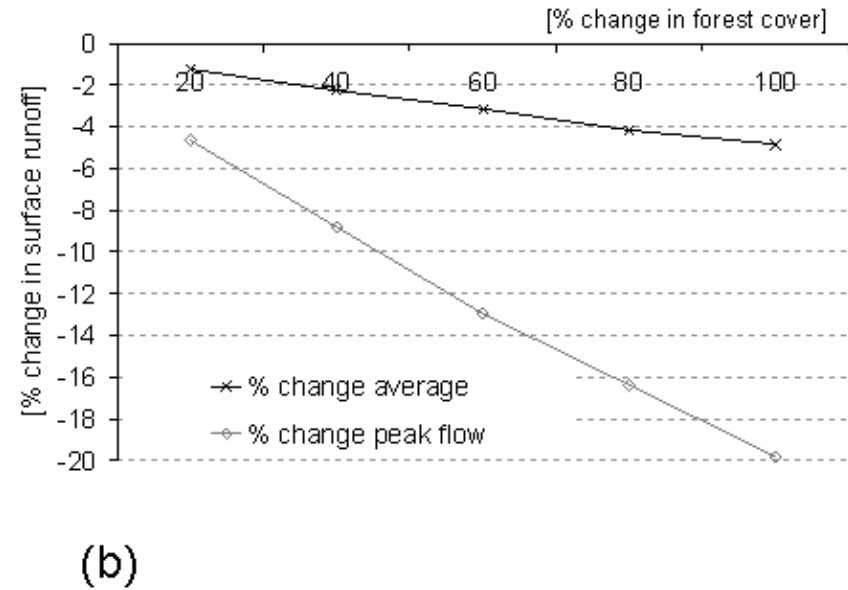
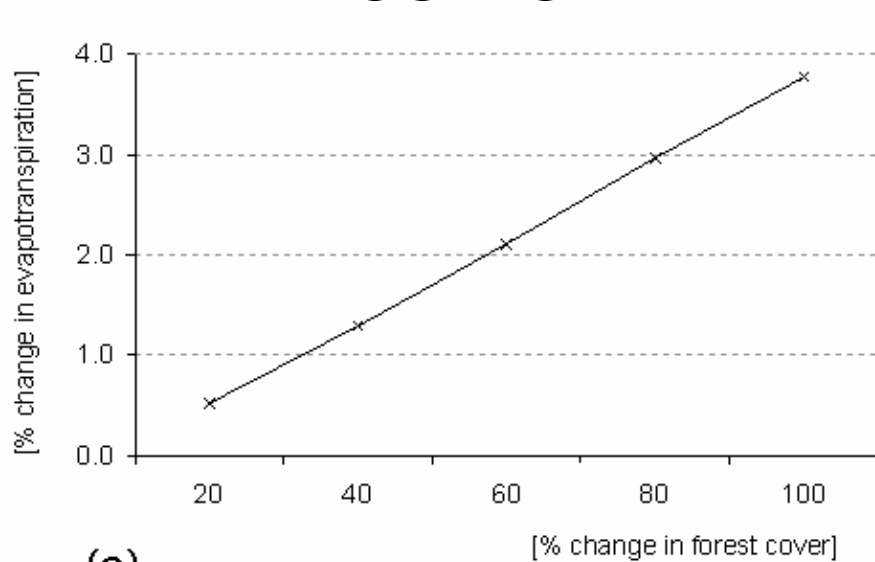
The spatial forest generator



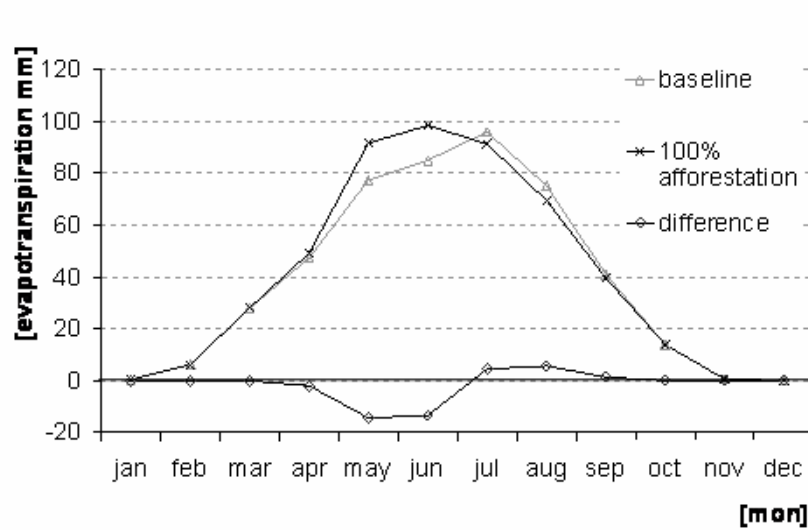
Forest water cycle interaction



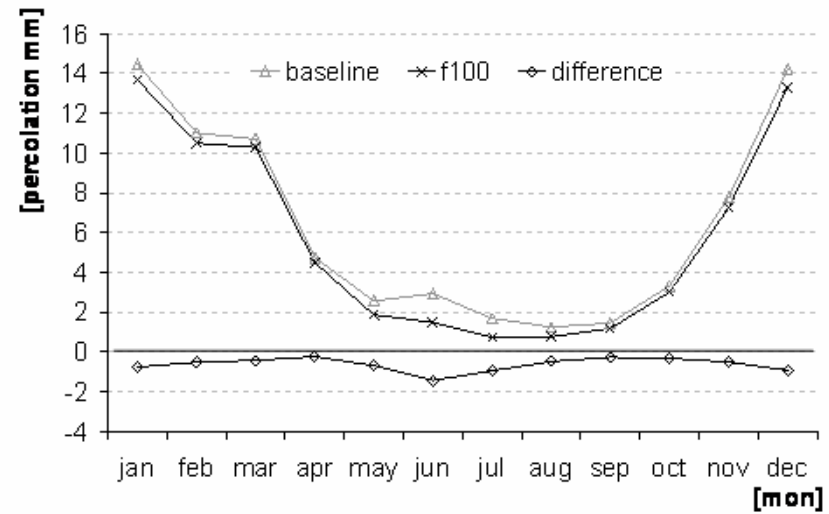
Aggregated response scenario I



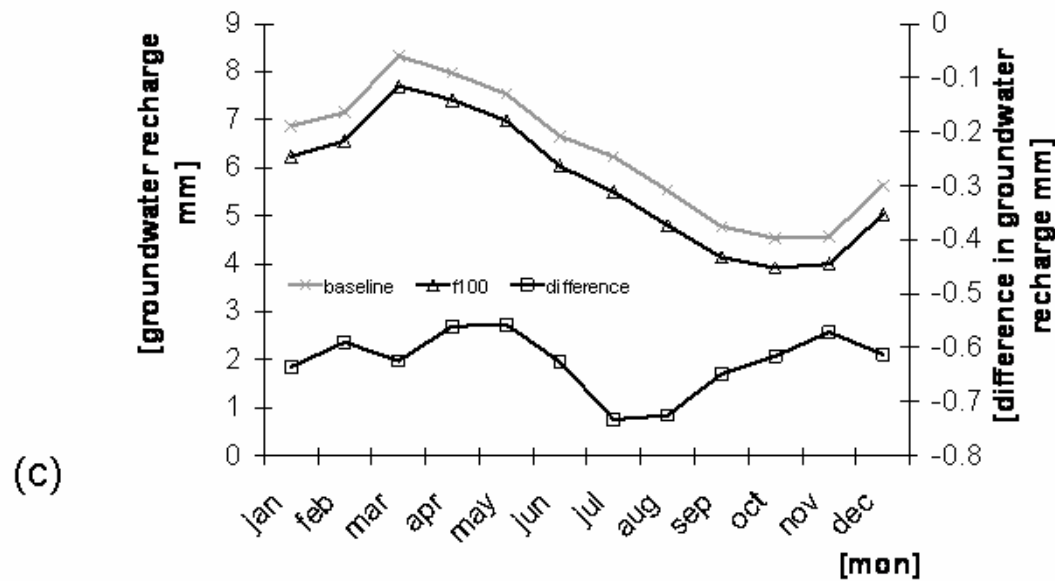
Aggregated monthly response scenario I



(a)

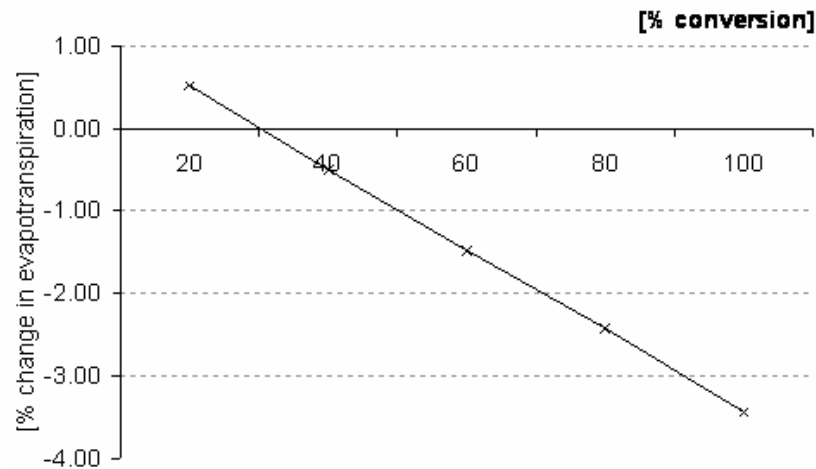


(b)

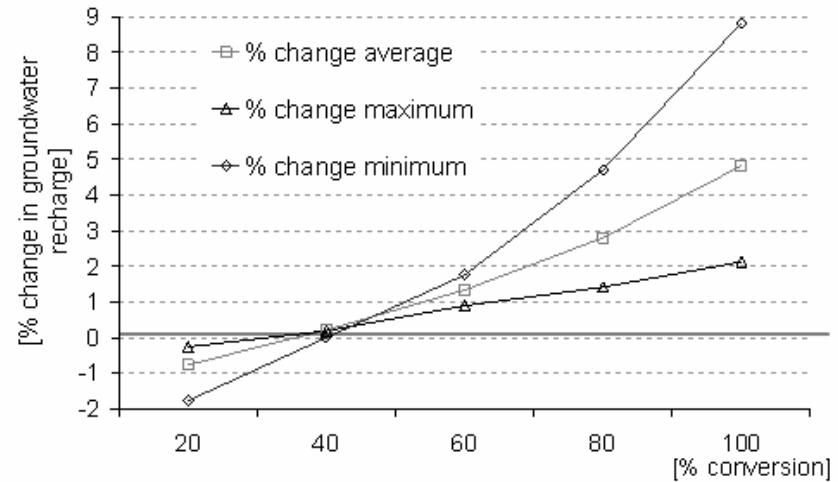


(c)

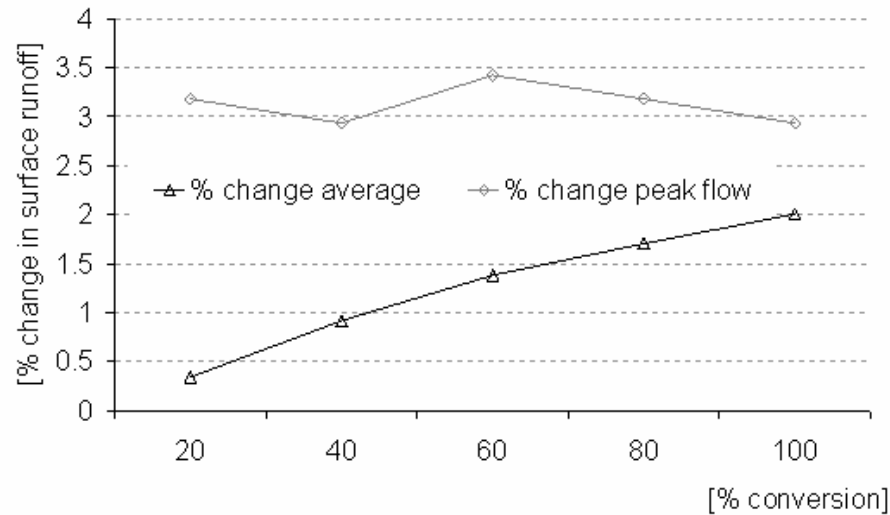
Aggregated response scenario II



(a)



(b)

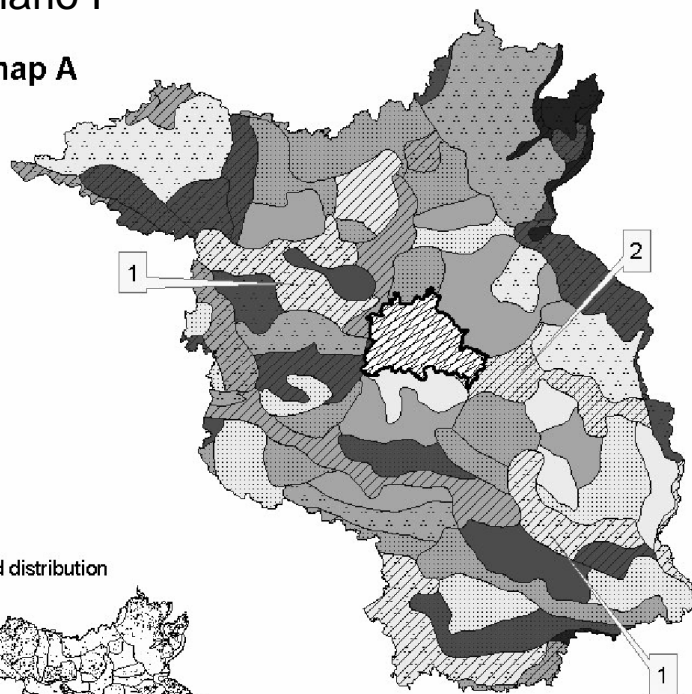


(c)

Spatial pattern

Scenario I

map A



map B
cropland distribution



cropland

0 20 40 kilometre



mean change in
evapotranspiration
(liberalisation scenario)

landscape units

Berlin

reponse classes

Class I

Class II

Class III

mm

0 - 20

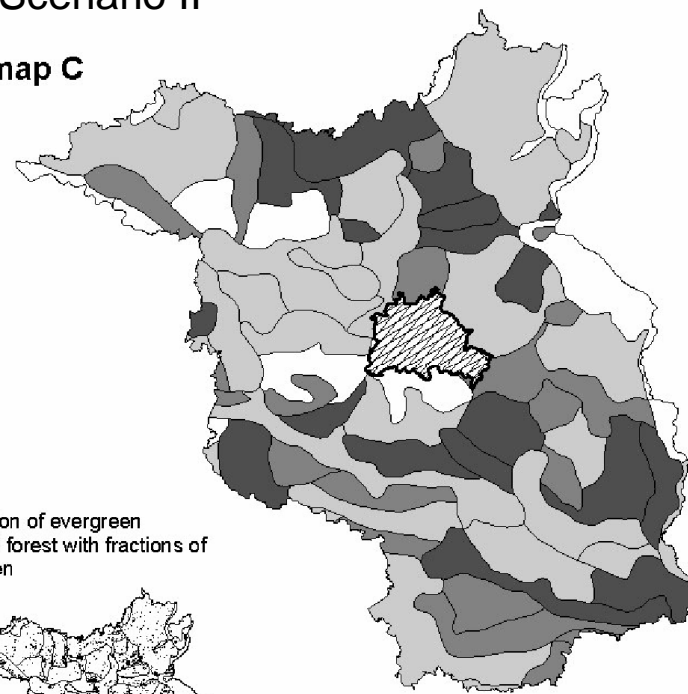
20 - 30

30 - 40

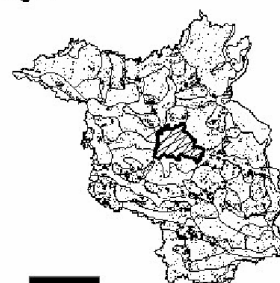
40 <

Scenario II

map C



map D:
distribution of evergreen
or mixed forest with fractions of
evergreen



forest

0 20 40 kilometre



mean change in
evapotranspiration
(forest management scenario)

landscape units

Berlin

mm

0 - 10

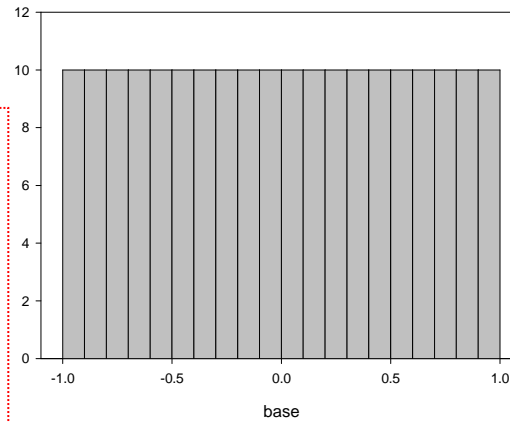
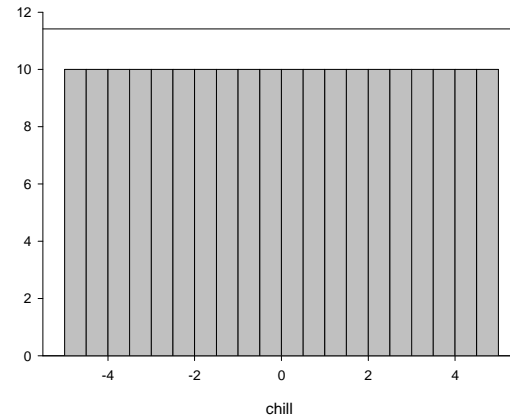
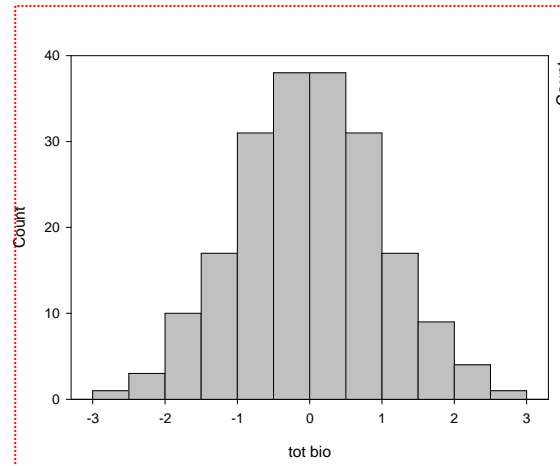
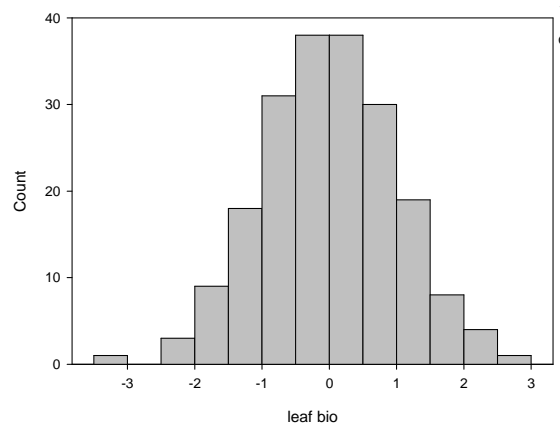
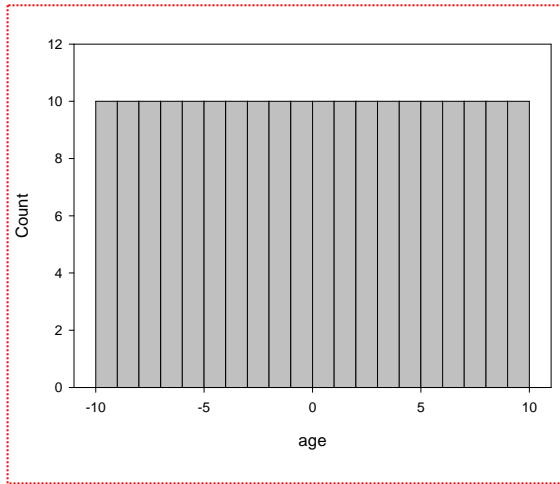
10 - 20

20 - 30

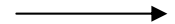
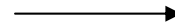
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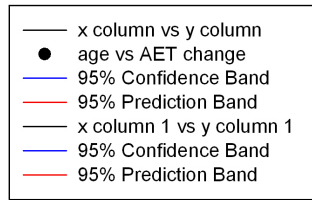
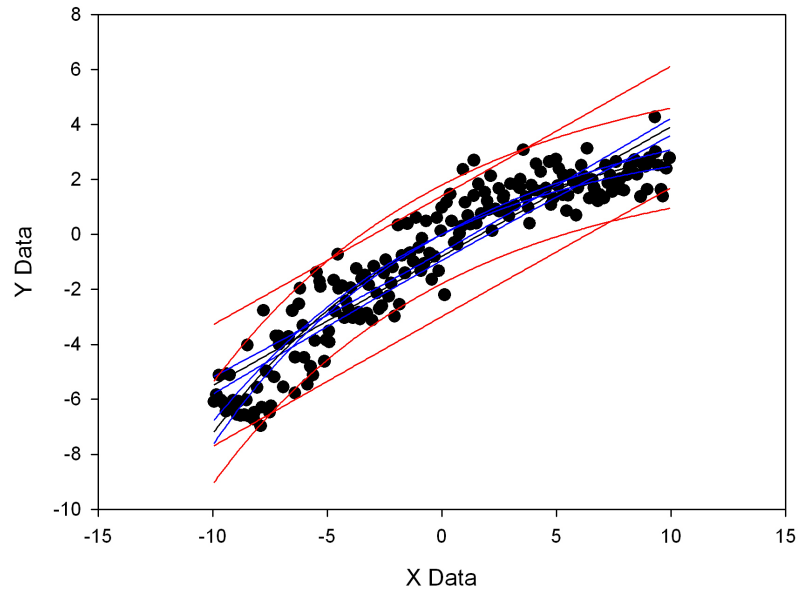
uncertainty

Input pdf's



SWIM
200
Monte Carlo
runs
over 10 years





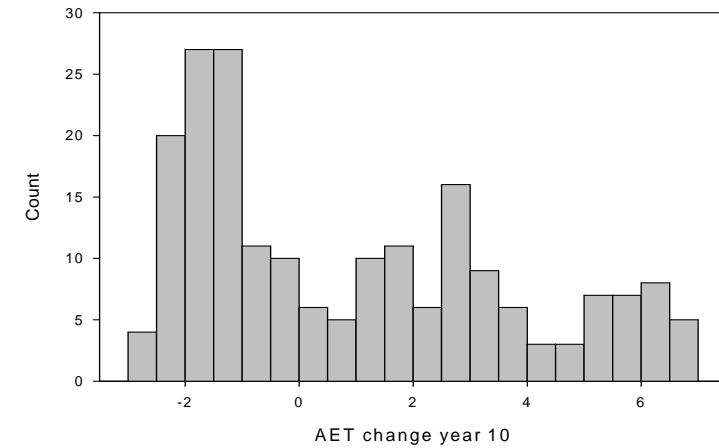
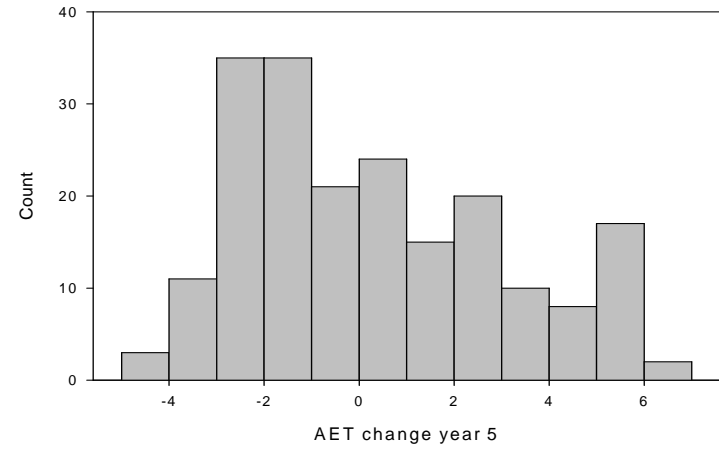
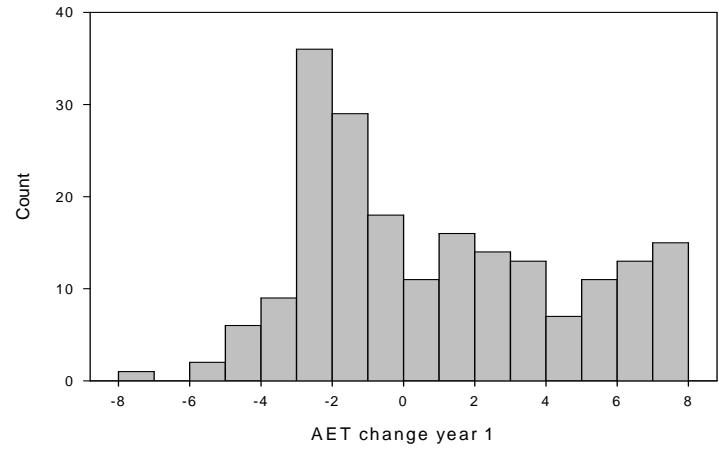
$f=a*(1-\exp(-b*x)):$

R **Rsqr**
 0.9511 0.9047
Coefficient

a 4.4966 <0.0001
b 0.0960 <0.0001

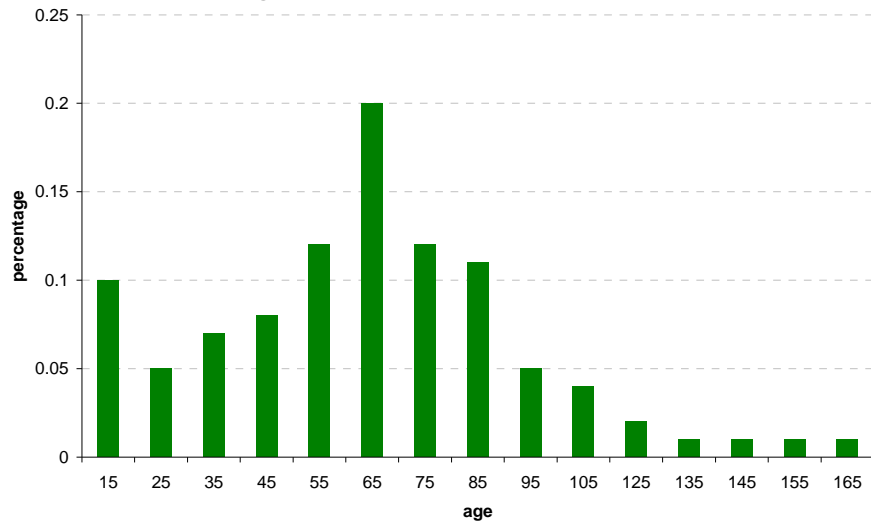
Linear:
R **Rsqr**
 0.9264 0.8583

Coefficient **P**
y0 -0.7943 <0.0001
a 0.4710 <0.0001

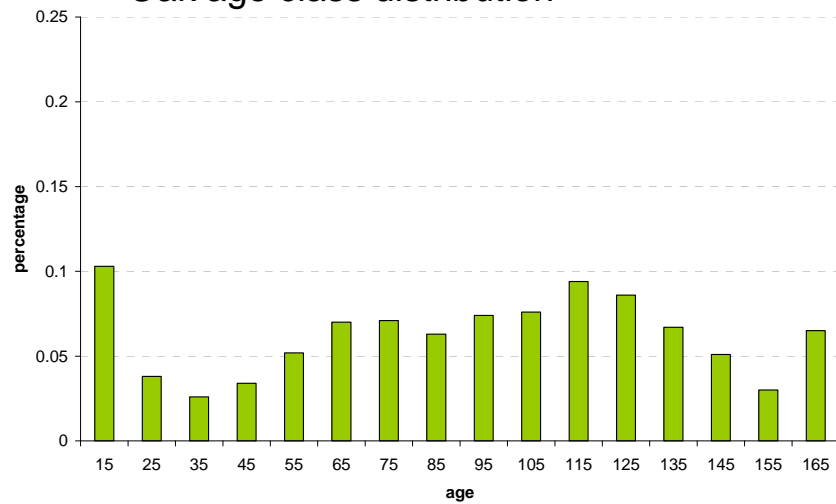


results

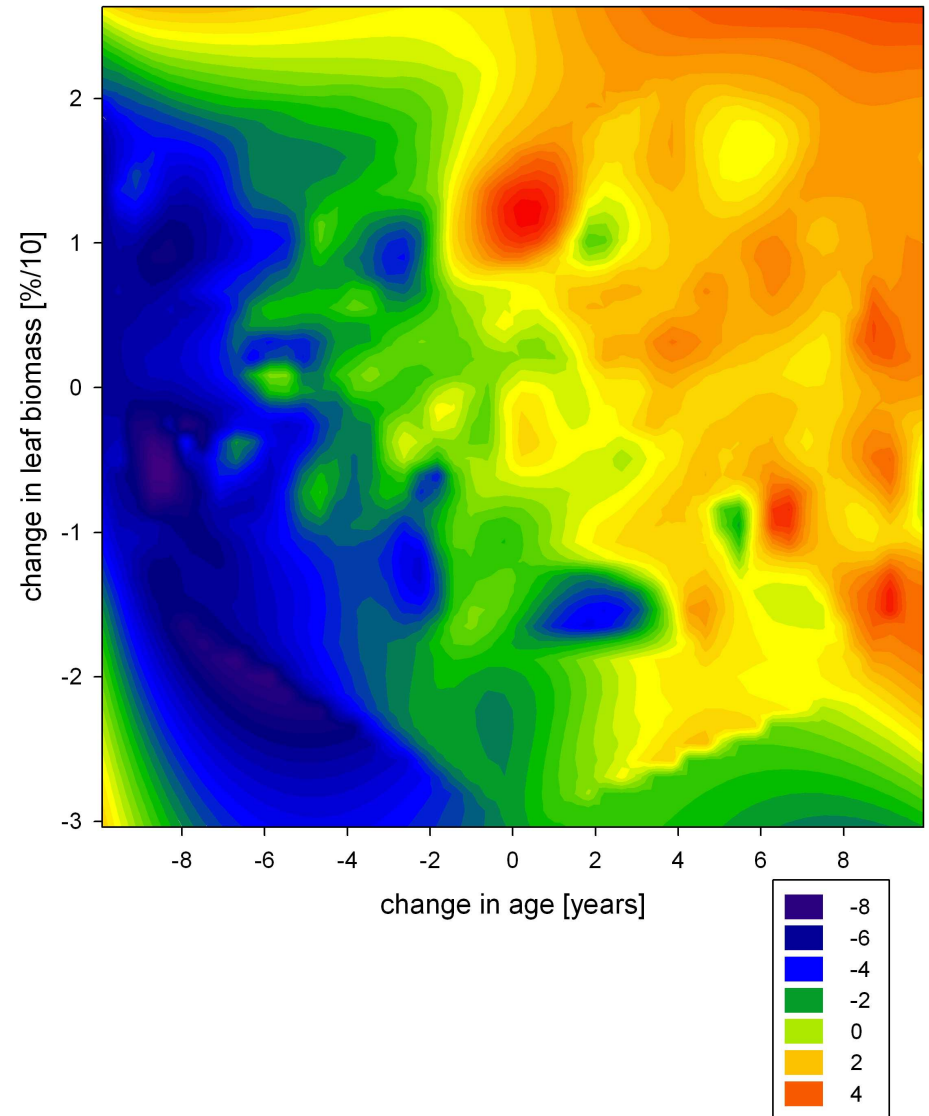
Pine age class distribution



Oak age class distribution



change in mean AET



conclusions

- The forest module proved to be useful to simulate land use change on the scale of a federal state
- afforestation of abandoned arable land has a negative impact on the regional water balance
- a change in species composition from Scots Pine to Common Oak results in a positive impact on the regional water balance
- The global uncertainty analysis unveiled the dominant role of age as the main factor to explain variance in the AET
- however, even with age identified as the main factor the complex interaction of parameters needs to be in focus



Thank you !