Forest productivity shifts under climate change in Europe – a model-based analysis with 4C

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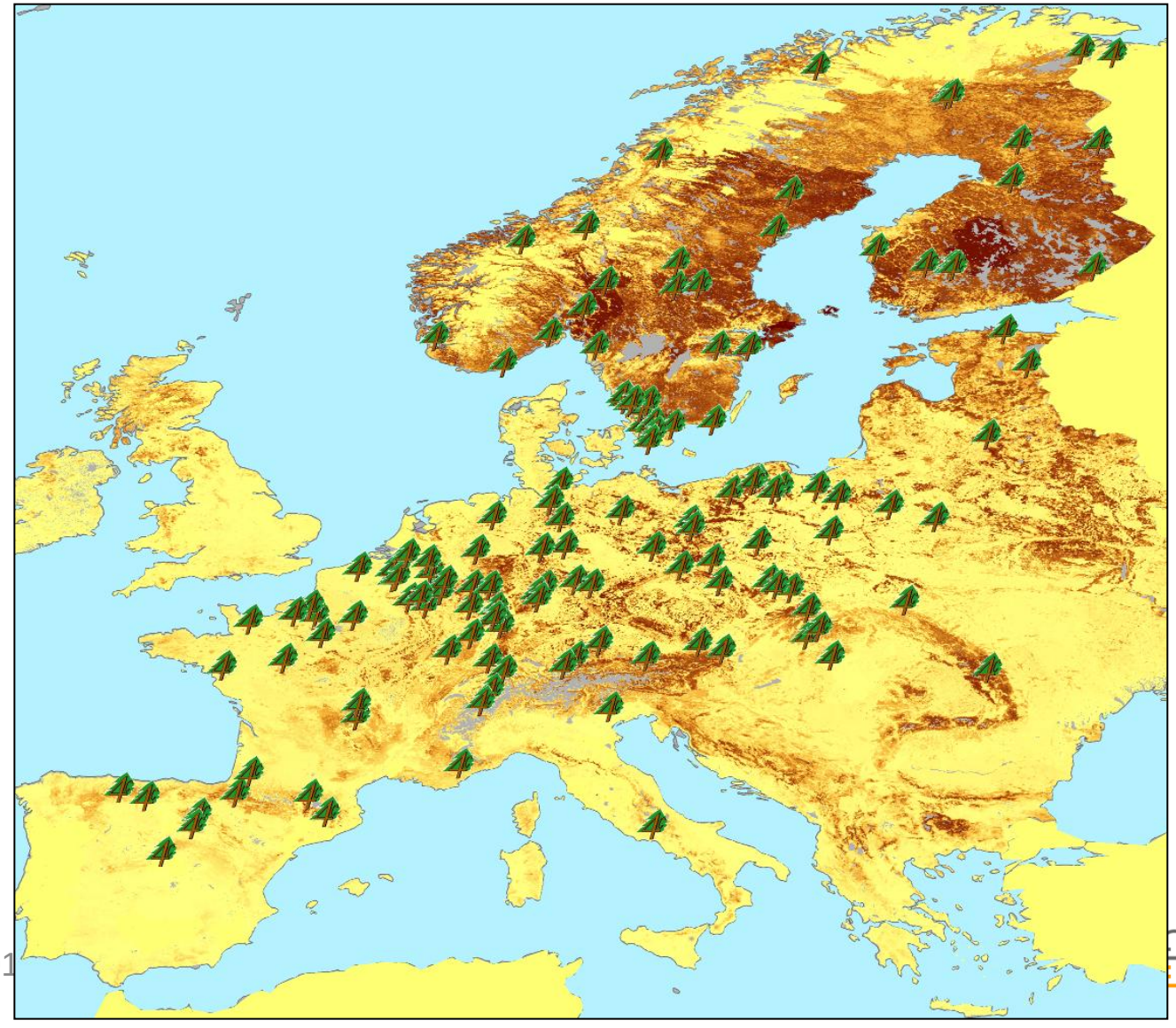
PIK

Questions

- What are the potential impacts of climate change on forest productivity in Europe?
- What are the regional variations of projected productivity shifts for the main tree species?
- What are the main factors influencing the impacts of changing environmental conditions?

Method

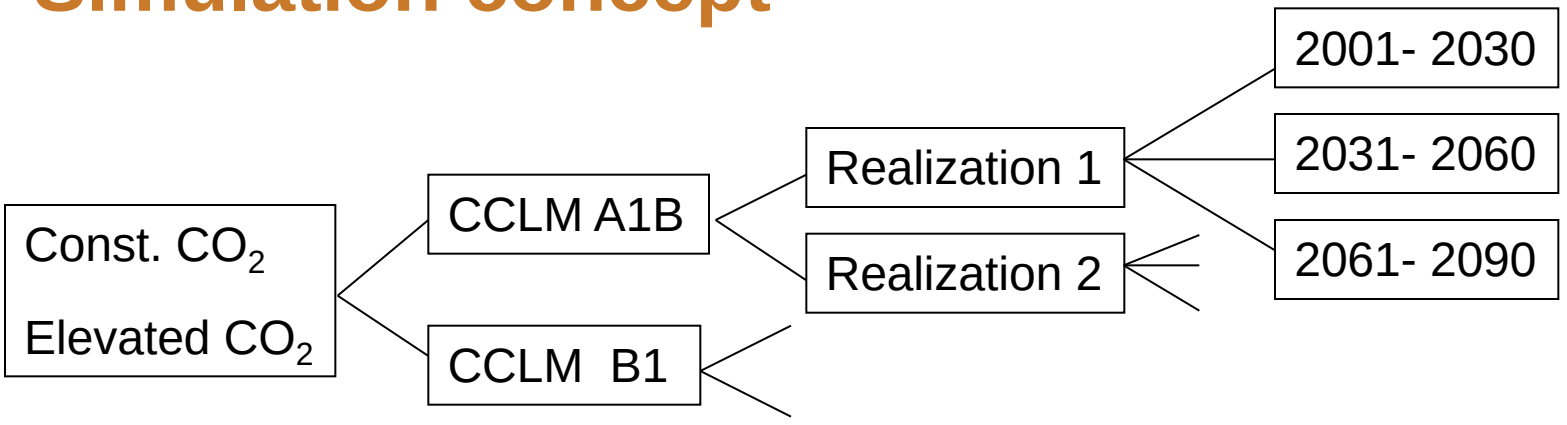


Method

Application of the process-based forest growth model **4C**

- at 132 Level II forest stands in Europe (ICP Forests)
- Four tree species (pine, spruce, beech, oak)
- Single tree data from the Level II database
- Soil data: European soil database & TEMS
- Climate data: CCLM past & future (A1B, B1)
- Model validation for 9 sites with soil/growth/flux data (Poster Suckow et al.)

Simulation concept

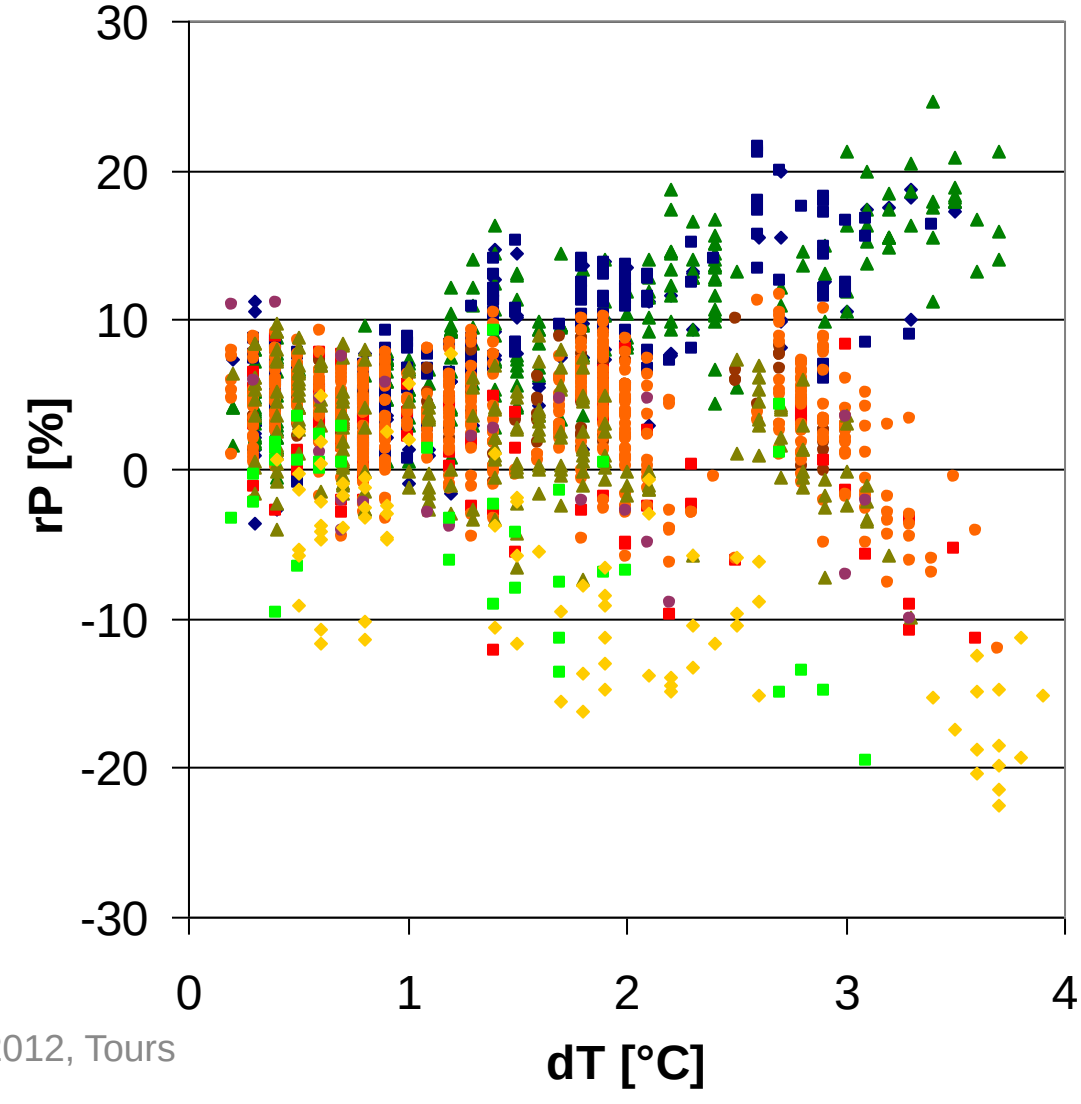


2 realizations for the base period 1971-2000 + 24 ‘scenarios‘ per site

Analysis of **NPP** and of relative change of NPP (rNPP) compared with the base period (1971-2000) without considering disturbances

Regional and statistical analysis for Environmental Zones (Metzger et al. 2005) and four main tree species

Climate scenarios and Environmental Zones

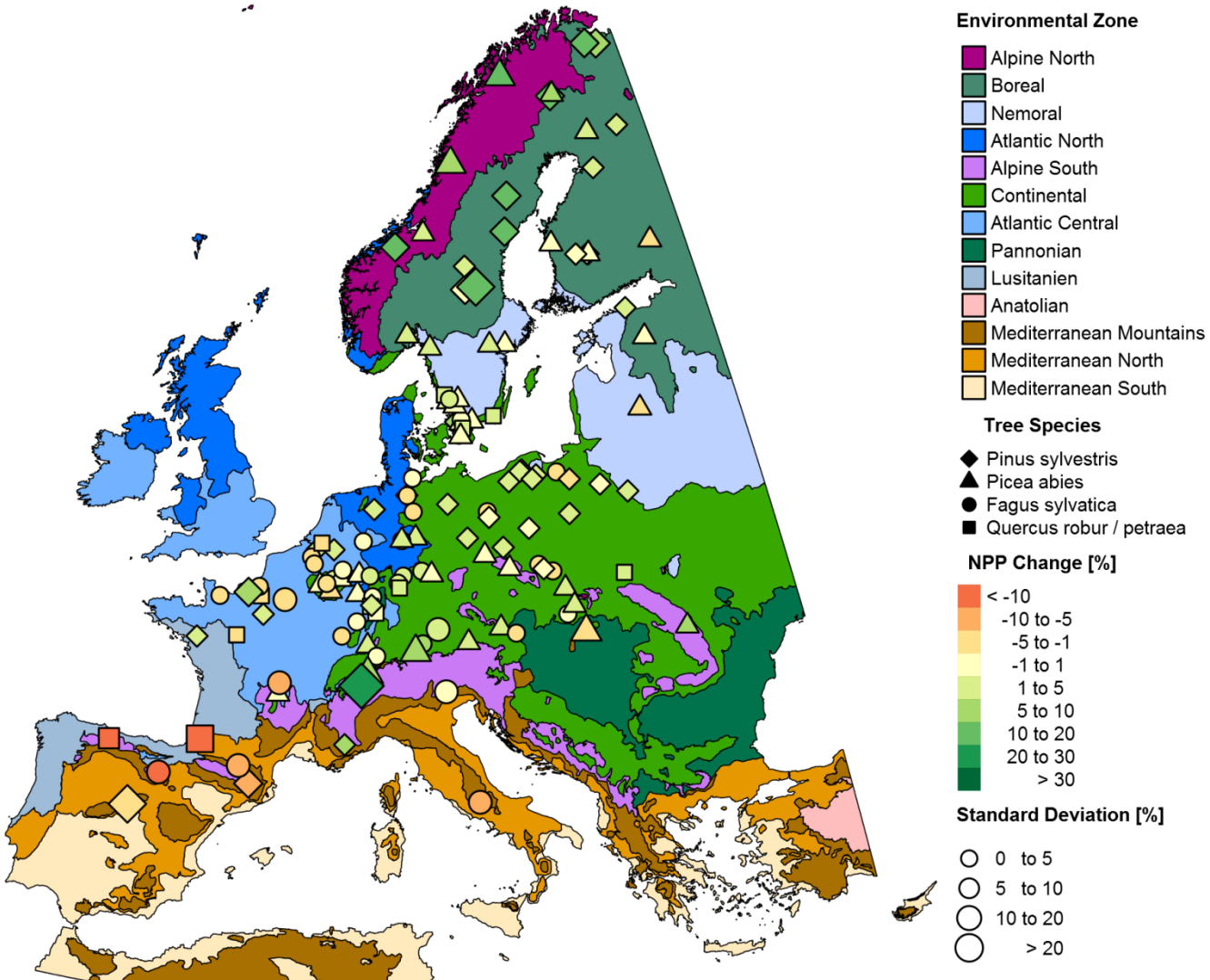


Environmental Zones (Metzger et al. 2005)

- ALN
- BOR
- NEM
- ATN
- ALS
- CON
- ATC
- PAN
- LUS
- MDM

NPP changes under A1B and B1, constant CO_2

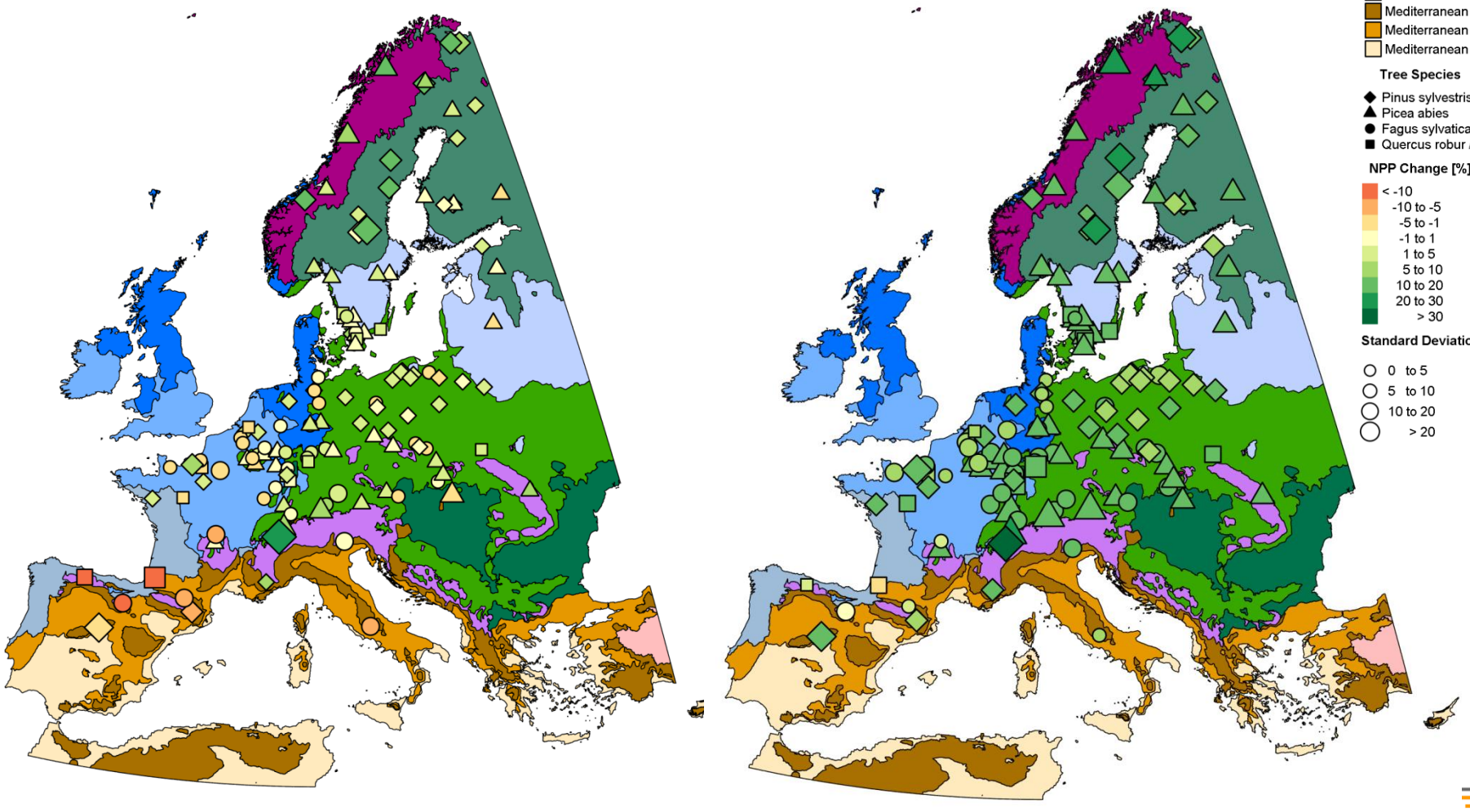
Pine
Spruce
Beech
Oak



NPP changes under A1B and B1

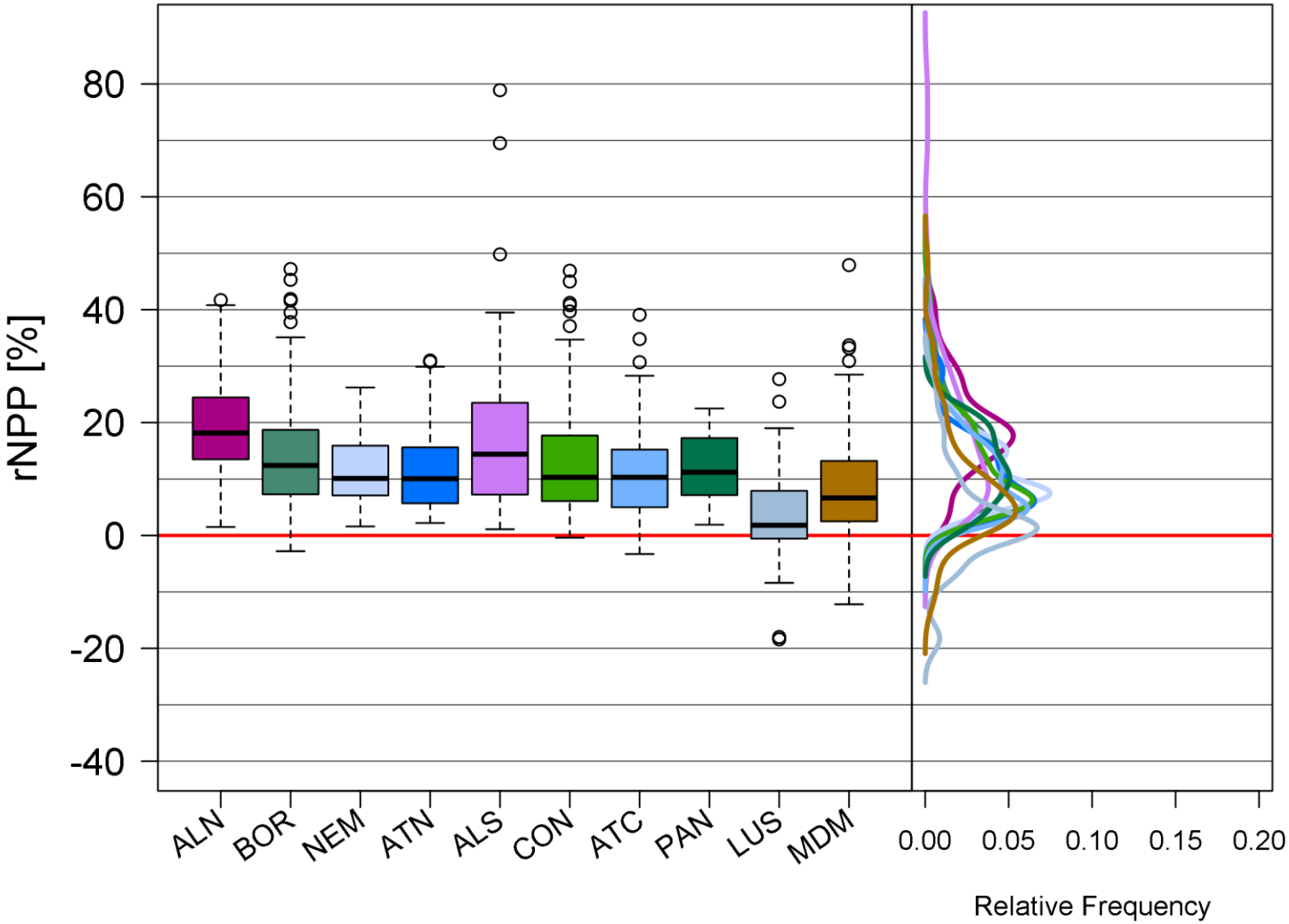
constant CO_2

elevated CO_2

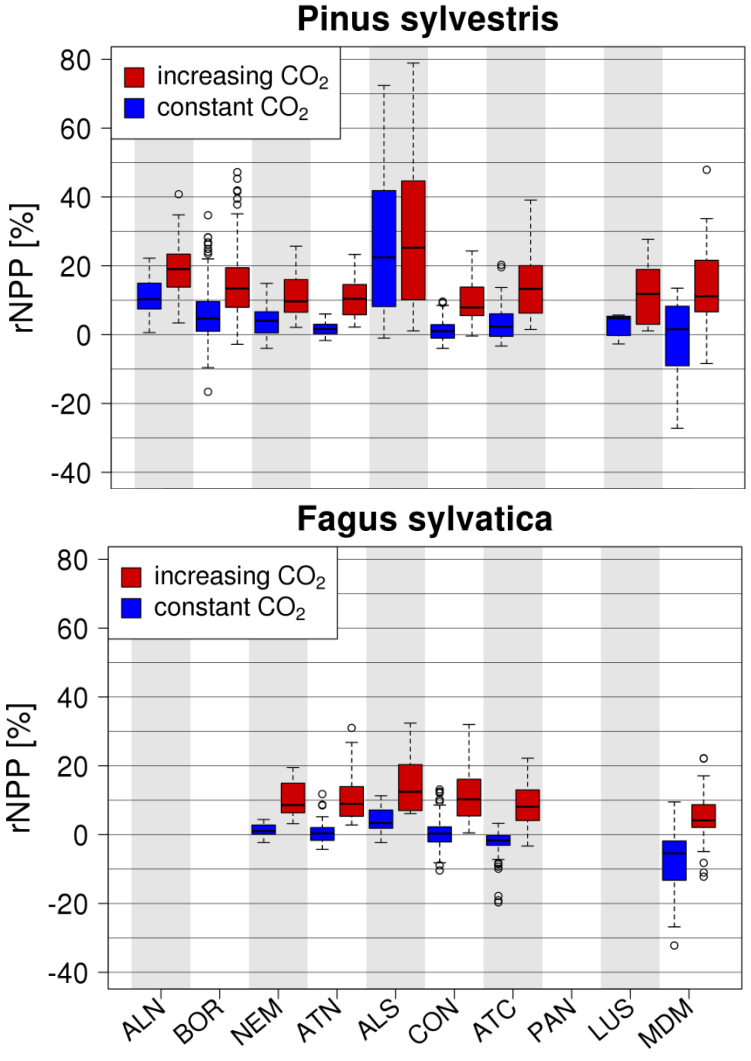


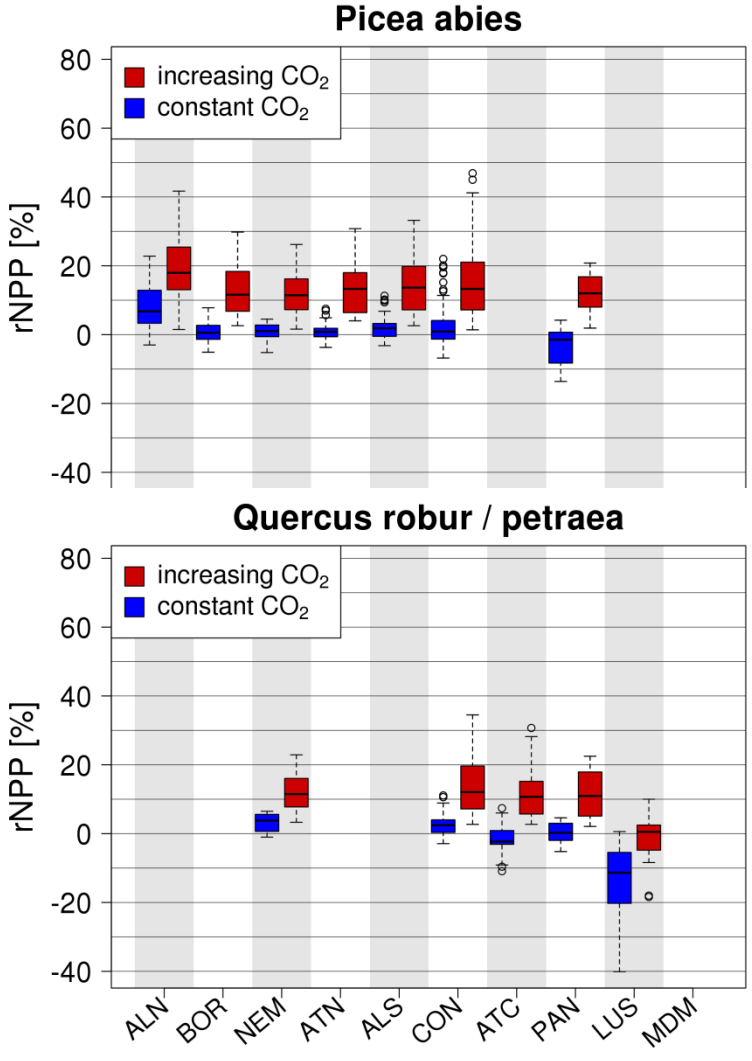
NPP changes over all scenarios and species

elev. CO_2

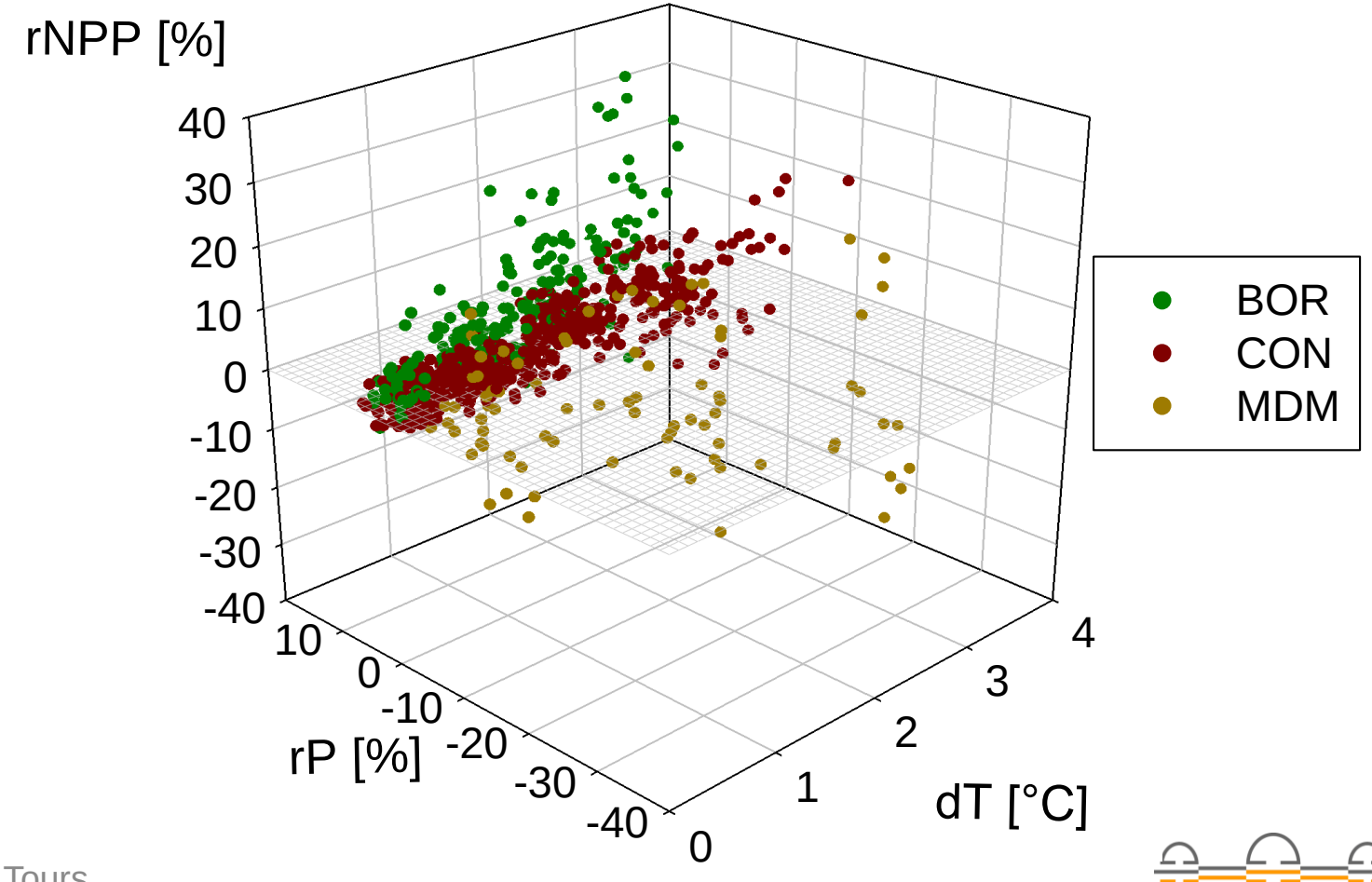


NPP change per species and Environmental Zone



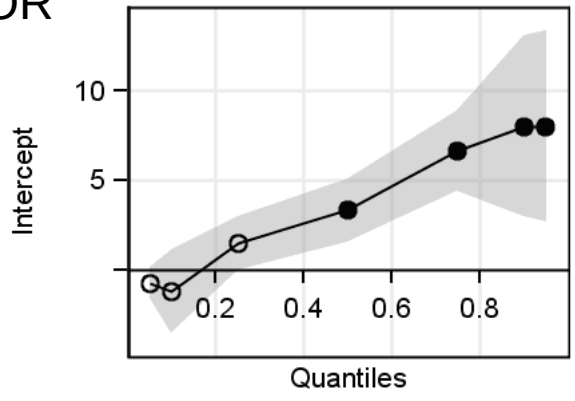


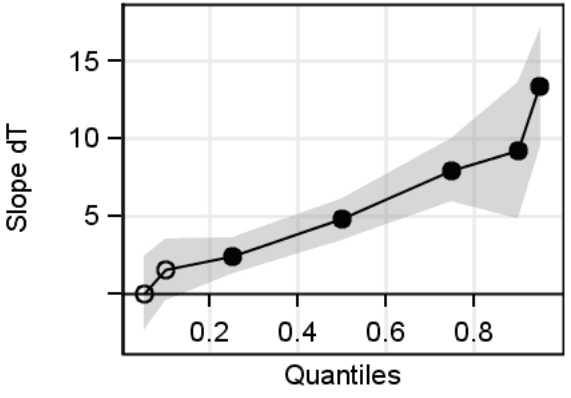
Change of NPP over temperature and precipitation change

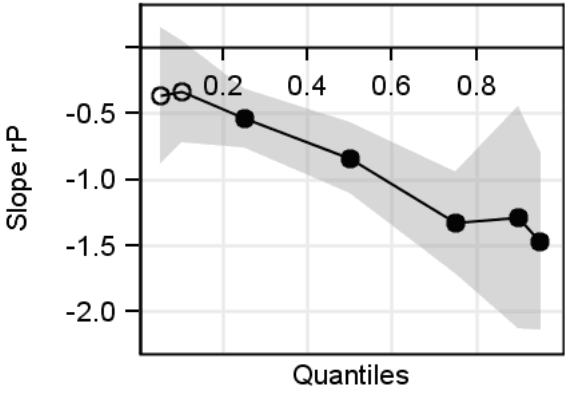


Quantile regression of rNPP as function of temperature and precipitation change

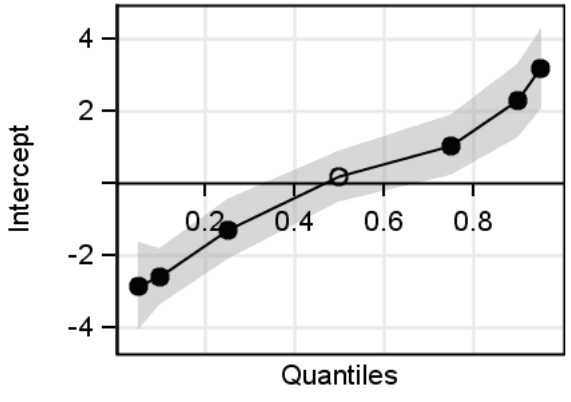
BOR

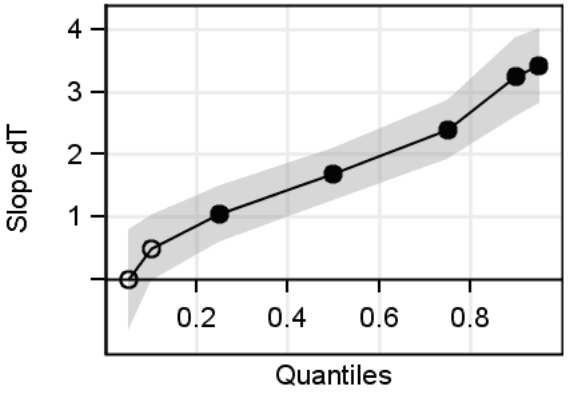


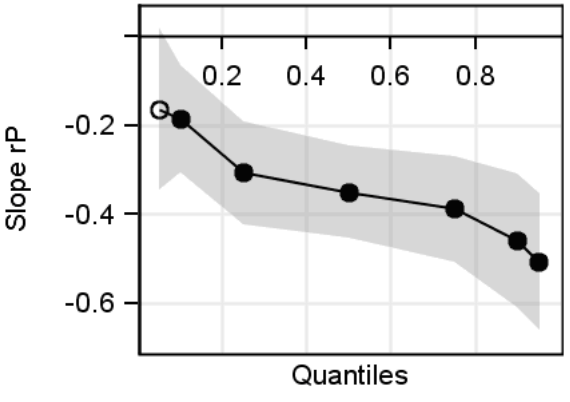




CON







Conclusions & ongoing activities

- Benefiting: northern and high altitude sites (ALN, BOR, ALS) with sufficient nutrient supply, not water limited
- In-between: CON
- Losing: southern sites with decreasing precipitation (MDM, Vayreda GCB 2012)
- Modelled effect of elevated CO_2 concentration predominates temperature and precipitation impacts
- Conifers gain more than broadleaved trees in the northern and central regions

- Analysis of NPP changes using quantile regression
- Additional climate and N deposition scenarios to enlarge the wide span of changing climatic and environmental conditions

Acknowledgements

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Thank you for your attention