Climate Change:
- Modeling the Impact on Plant Distribution Patterns -

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Background

Plant species are facing the effects of climate change:
- potential range shifts of plants
- impacts on biotic interactions
- potential increasing extinction rates
- consequence for biodiversity is becoming increasingly important

We have to assess risks for biodiversity and estimate patterns of species vulnerability triggered by climate change.

Objectives

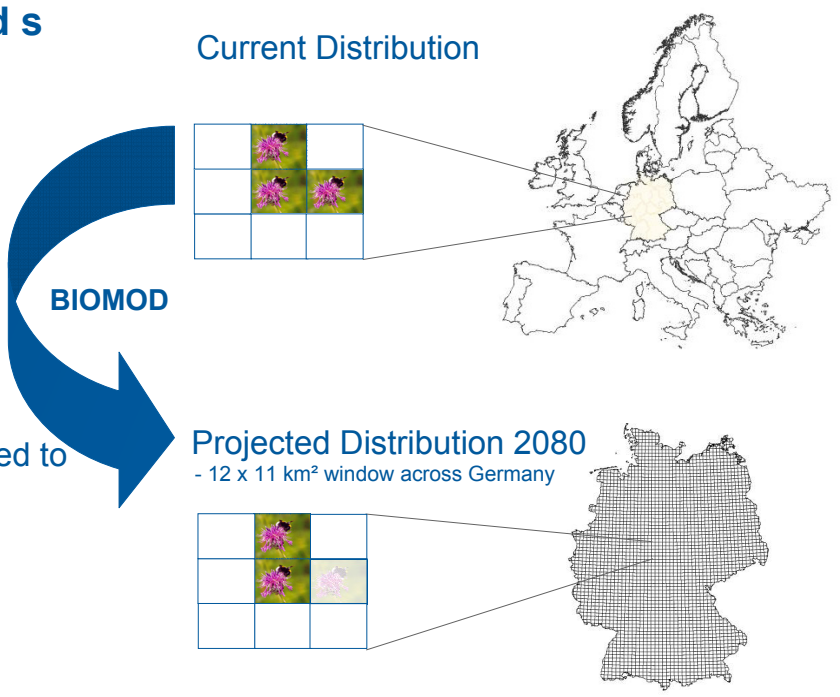
We want to determine the environmental limits of higher plant species with their given spatial distribution by an ecological niche modeling approach.
The aim of our study is to assess:
→ consequences of climate change on the distribution of higher plant species in Germany
→ expected changes of range size and species turnover in Germany

Methods

A) Gather data of current occurrence of plant species to environmental predictors across Europe
- → Species data (553 species, AFE & FLORKART)
- → Land use data (PELCOM)
- → Soil information (ESDB)
- → Climatic information (ALARM)

B) Gather data of three representative climate change scenarios and land use change till 2080 (IPCC ~ +2, +3, +4°C)

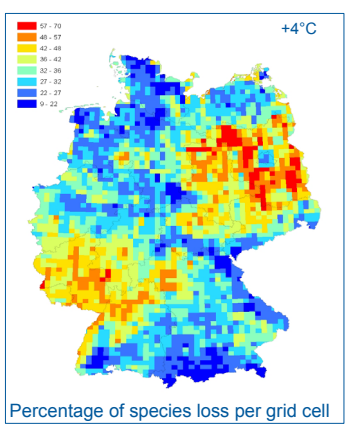
C) A procedure based on generalized linear modeling (GLM) was used to
- determine the environmental niche of the current European 50 x 50 km² distribution of plants by climatic, land use and soil predictors
- downscale to a ca. 12 x 11 km² grid (national grid system)
- allow projections of species distribution across Germany in 2080
- evaluate spatial patterns in species richness scores and range size between current and future projection



Results

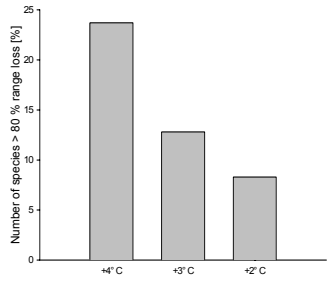
Species richness:
- If no migration is assumed percentage of species loss from current to future projection could exceed nearly 70% per grid cell (+ 4°C scenario)

Mean percentage of species loss per cell	
+2°C	15 %
+3°C	20 %
+4°C	35 %



Percentage of species loss per grid cell

Range loss:
- contrast between current and future projection (+ 4°C scenario) suggests :
- → ca. 24% of species loose > 80% of current range
- → ca. 5% of species disappear from any grid cell of the current range
- → 18% of species gain >50% of their current range
- under the other more moderated scenarios expected change is less severe



Model uncertainties:
- models are correlative in nature
- → do not account for real causal interactions
- errors associated with downscaling, i.e. modeling at different resolutions
- → model accuracy trained at 50 x 50 km² coarse resolution - do not perform as good estimators for future projections

Conclusion

- We outlined a niche based model to downscale species distribution data to a national grid system linked to climate change.
- Our results coincide with the direction of previous studies that species could be threatened by climate change.
- Downscaled future projections uncover major trends linked to different change scenarios for 553 species in Germany.
- Spatial artifacts could be caused by coarse scale of original data and model errors.

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