



# Prioritizing conservation and restoration based on the overall climatic value of forests

---

Edouard Davin (ETH Zurich)

# Mitigation potential of forests

## Carbon Dioxide Removal

### Afforestation/Reforestation (A/R)

Forest management

Agroforestry

Peatland restoration

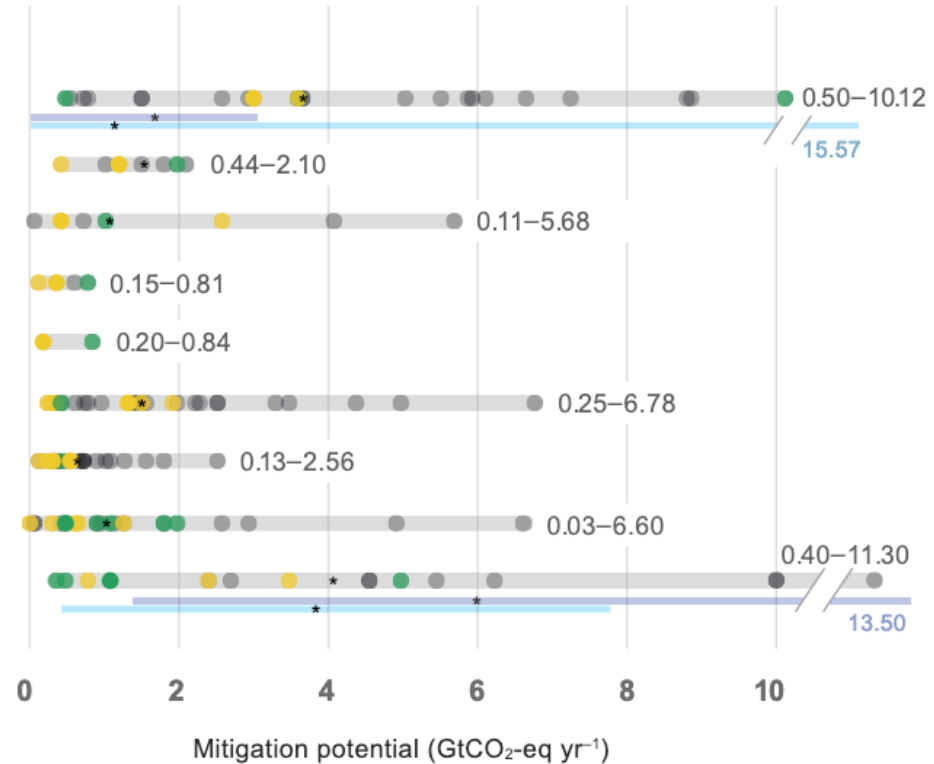
Coastal wetland restoration

Soil carbon sequestration in croplands

Soil carbon sequestration in grazing lands

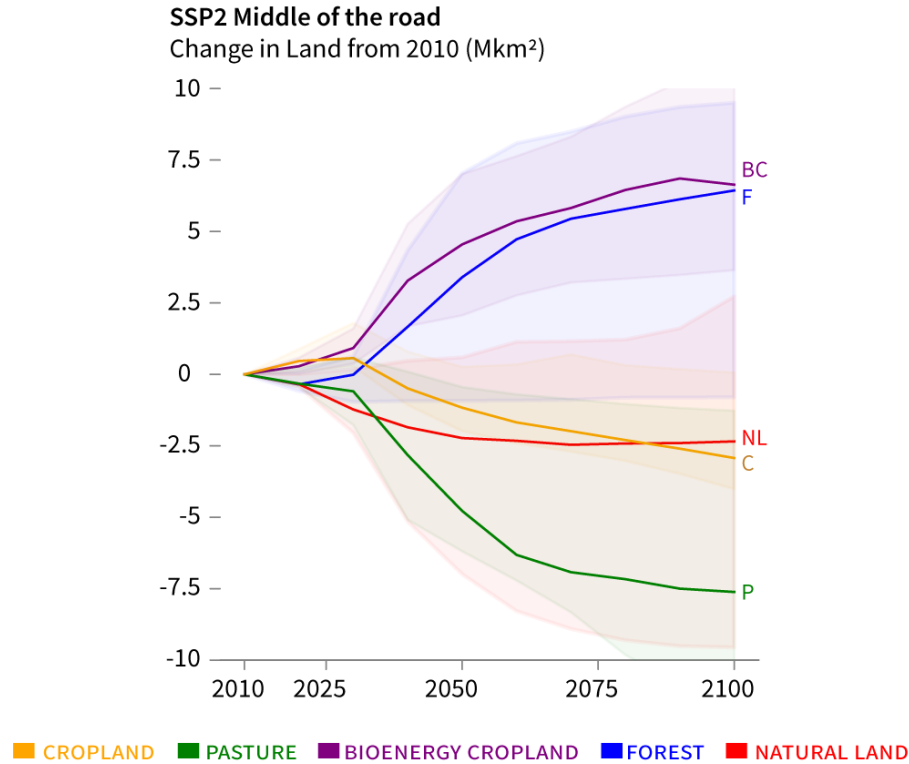
Biochar application

BECCS deployment



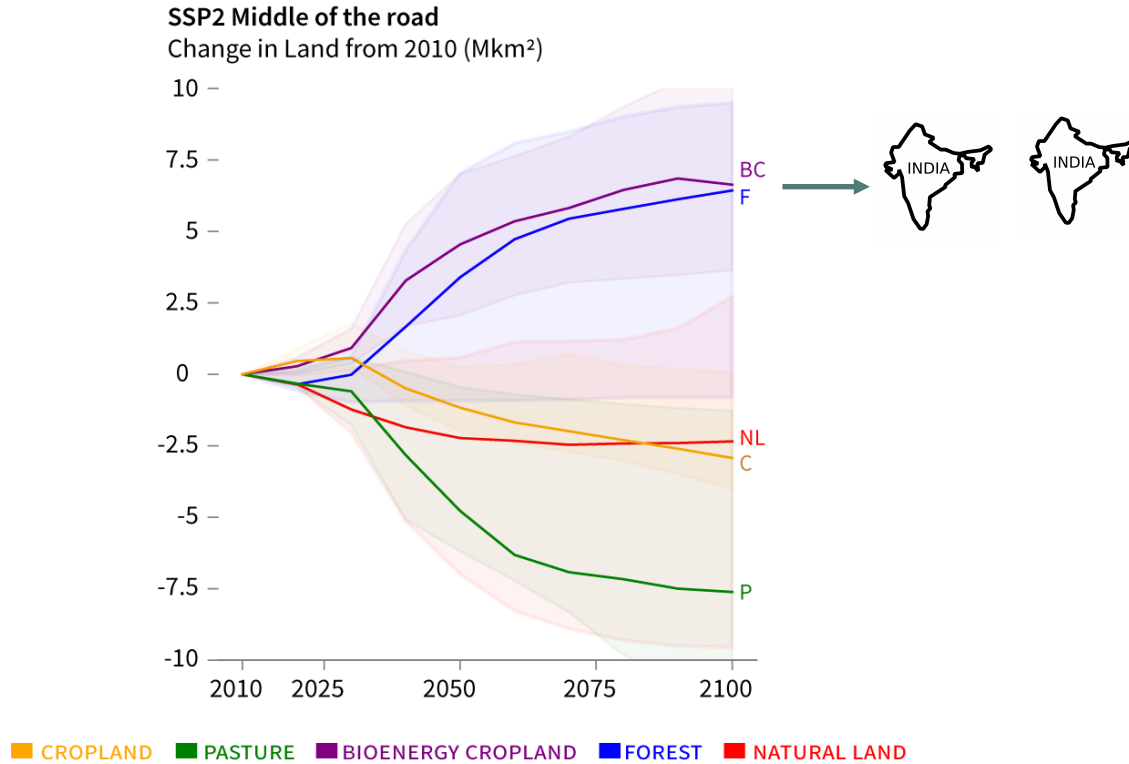
IPCC, SRCCL, 2019

# Forests under the Paris Agreement



IPCC, SRCCL, 2019

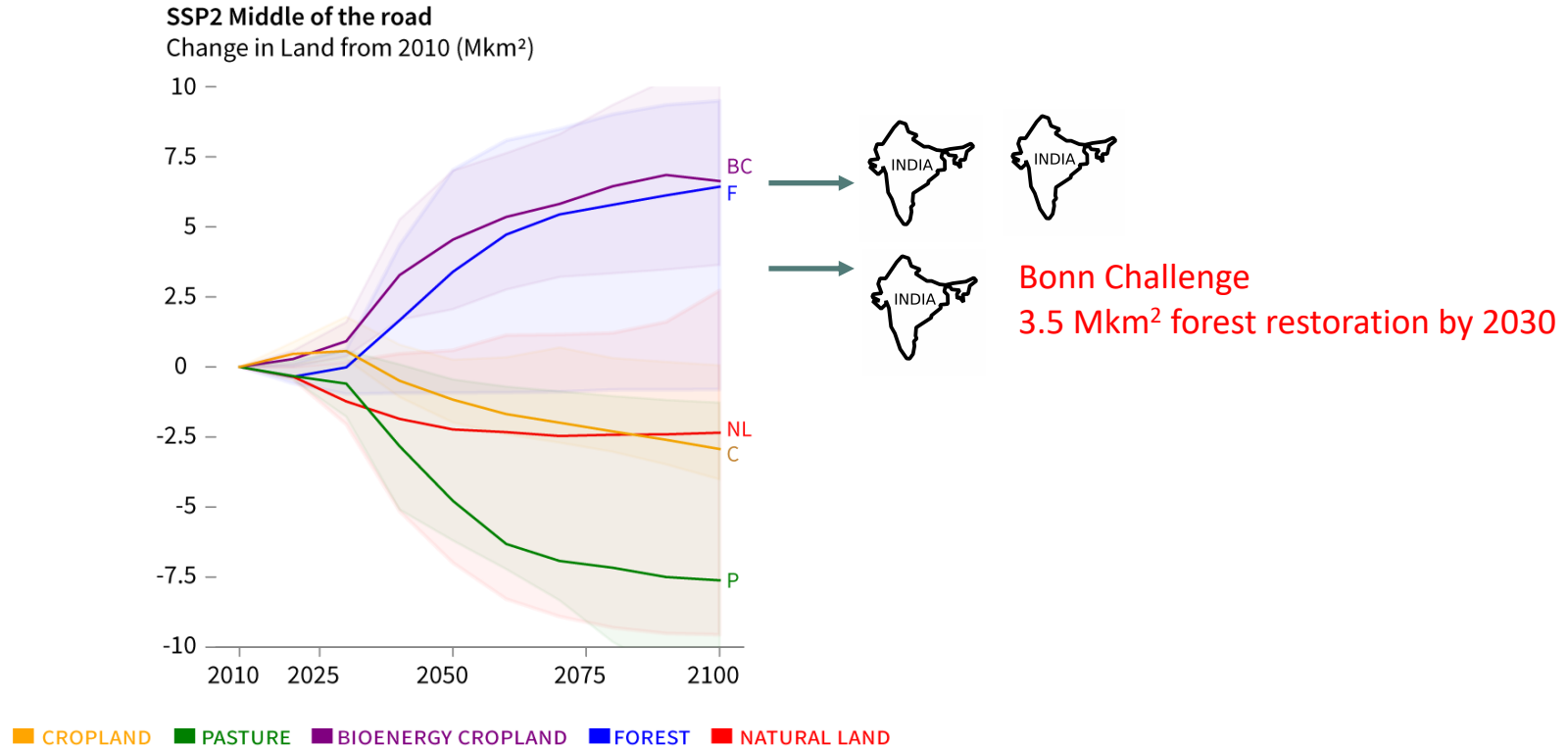
# Forests under the Paris Agreement



IPCC, SRCCL, 2019



# Forests under the Paris Agreement

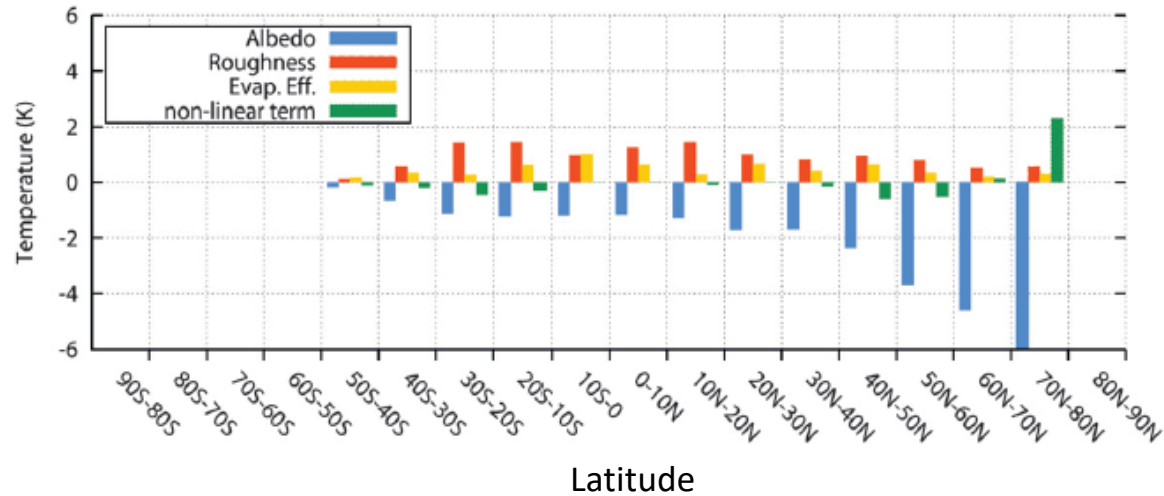
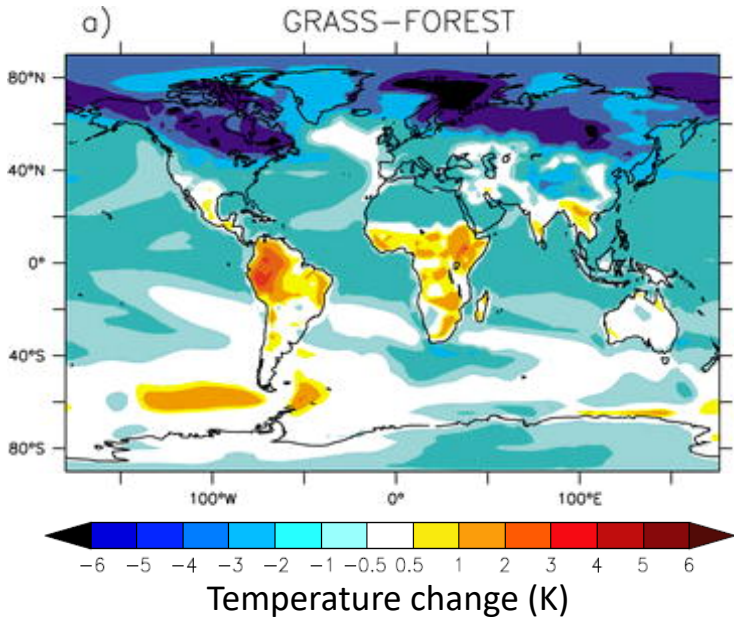


IPCC, SRCCL, 2019

# Challenges with large-scale forestation

- Uncertain mitigation benefit and C storage permanency
- Trade-offs with other objectives (e.g., food security)
- Albedo (and other biogeophysical effects)

# Biogeophysical effect of forests



*Davin and de Noblet-Ducoudré, J. Clim., 2010*

# Overarching questions

Overall climatic value of forests comprises BGC and BGP effects

- How to factor in BGP effect when evaluating climate mitigation through forests?
- What are priority areas for forestation or forest conservation?

# Approach

- Data-driven approach to quantify the combined BGC and local BGP effect of re/afforestation and avoided deforestation
- Metrics to combine BGC and BGP based on the Transient Climate Response to cumulative Emissions (TCRE)
- Scenario-agnostic

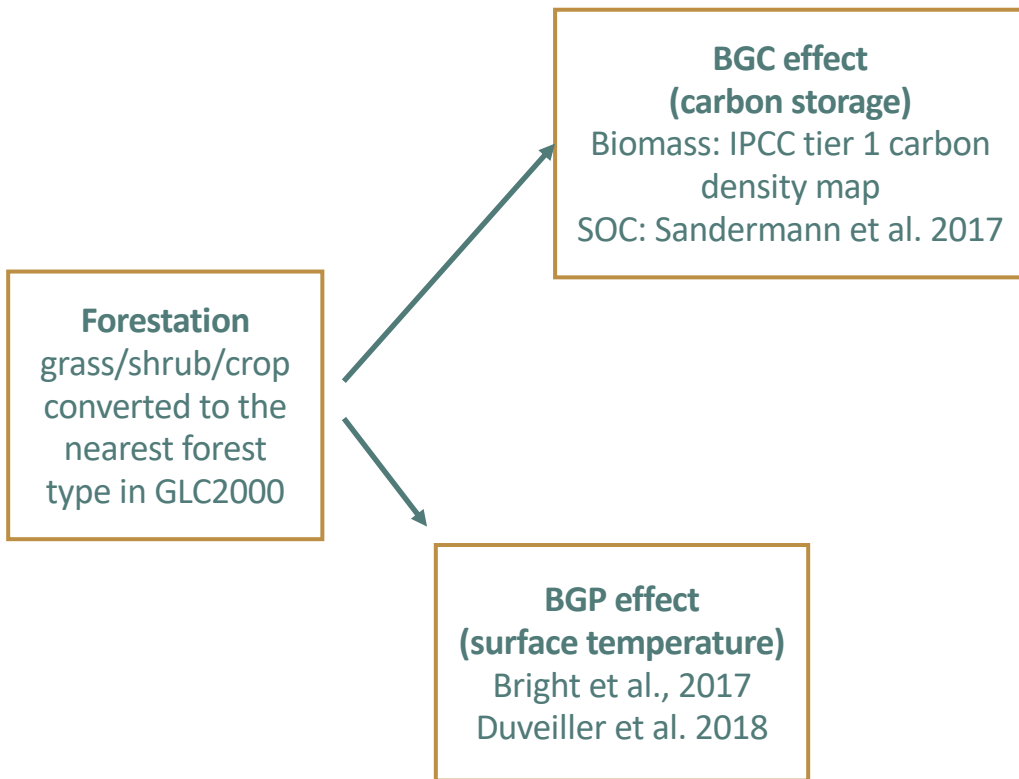


Michael Windisch

## **Forestation**

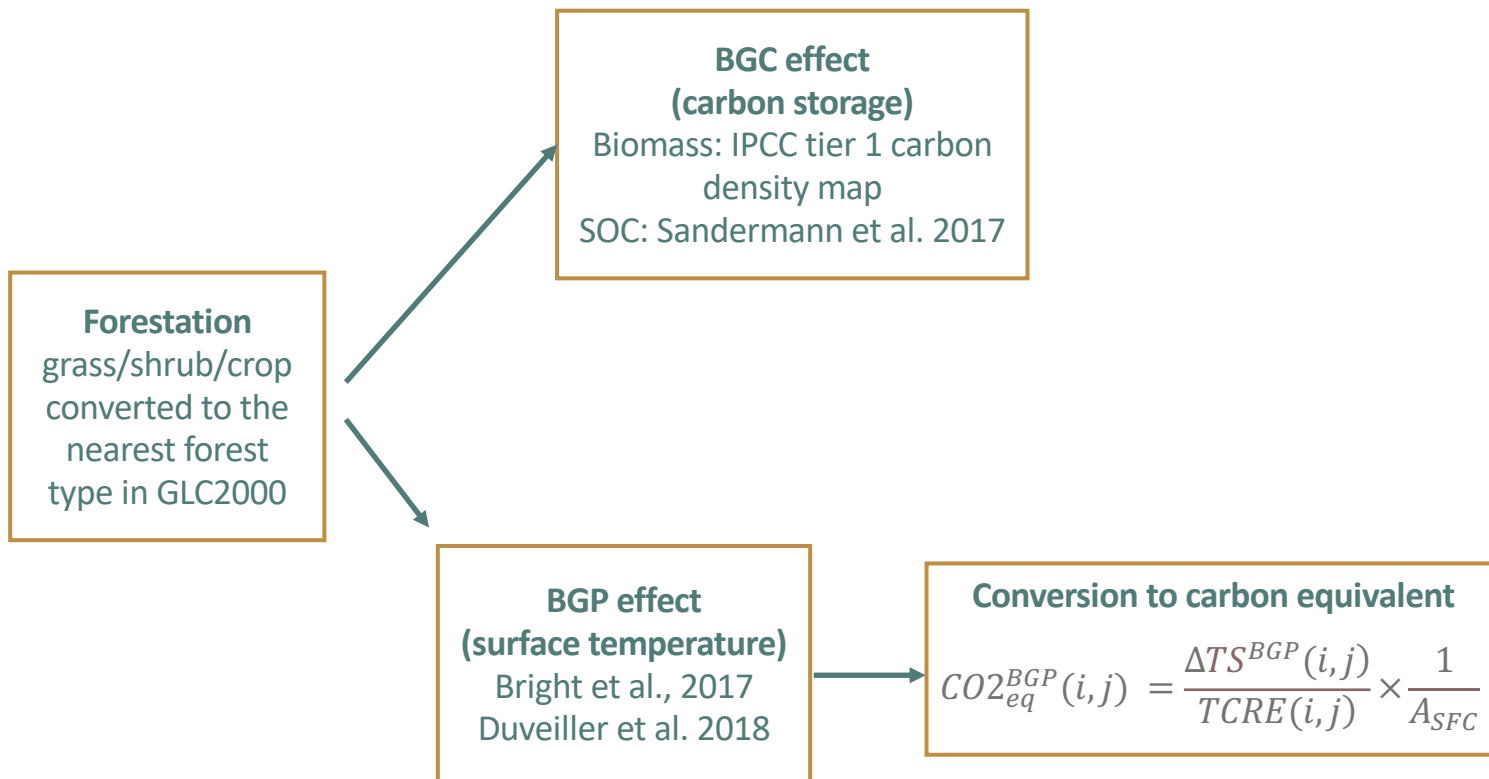
grass/shrub/crop  
converted to the  
nearest forest  
type in GLC2000

# Methodology

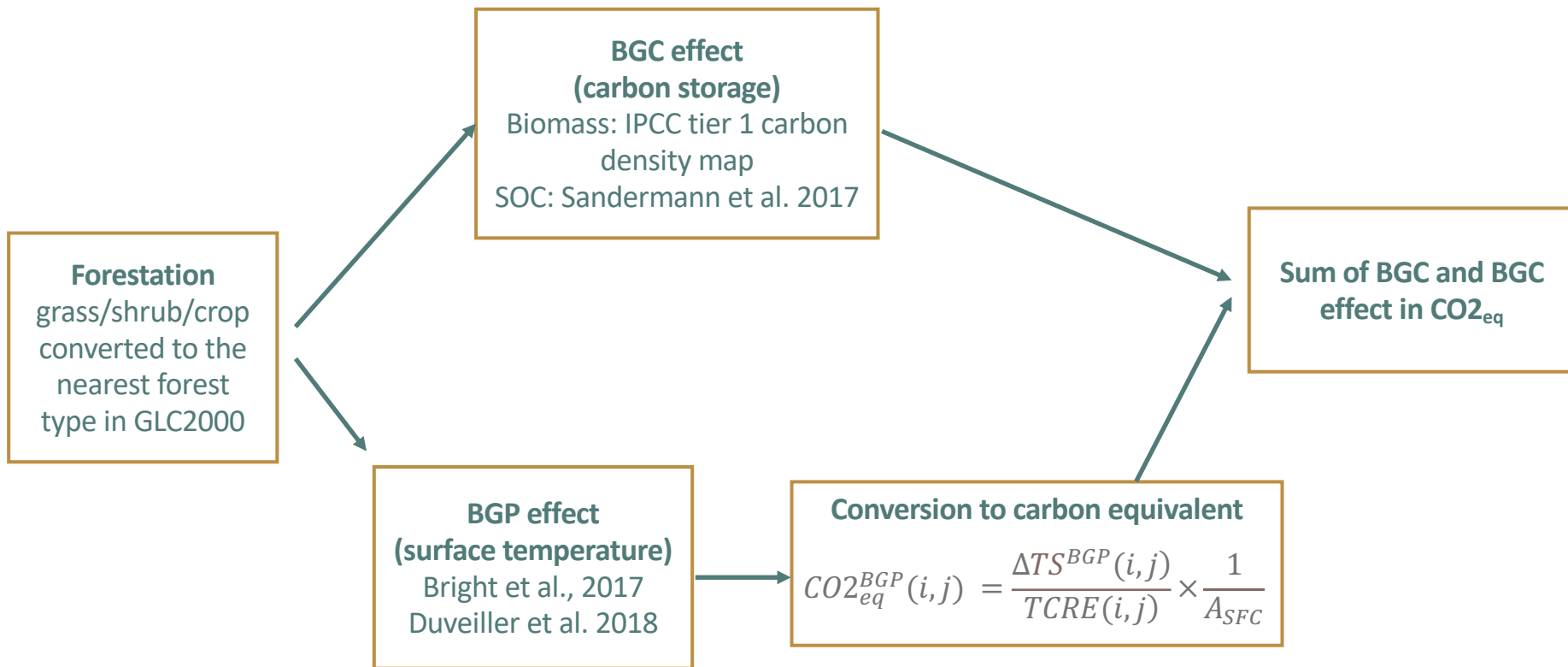




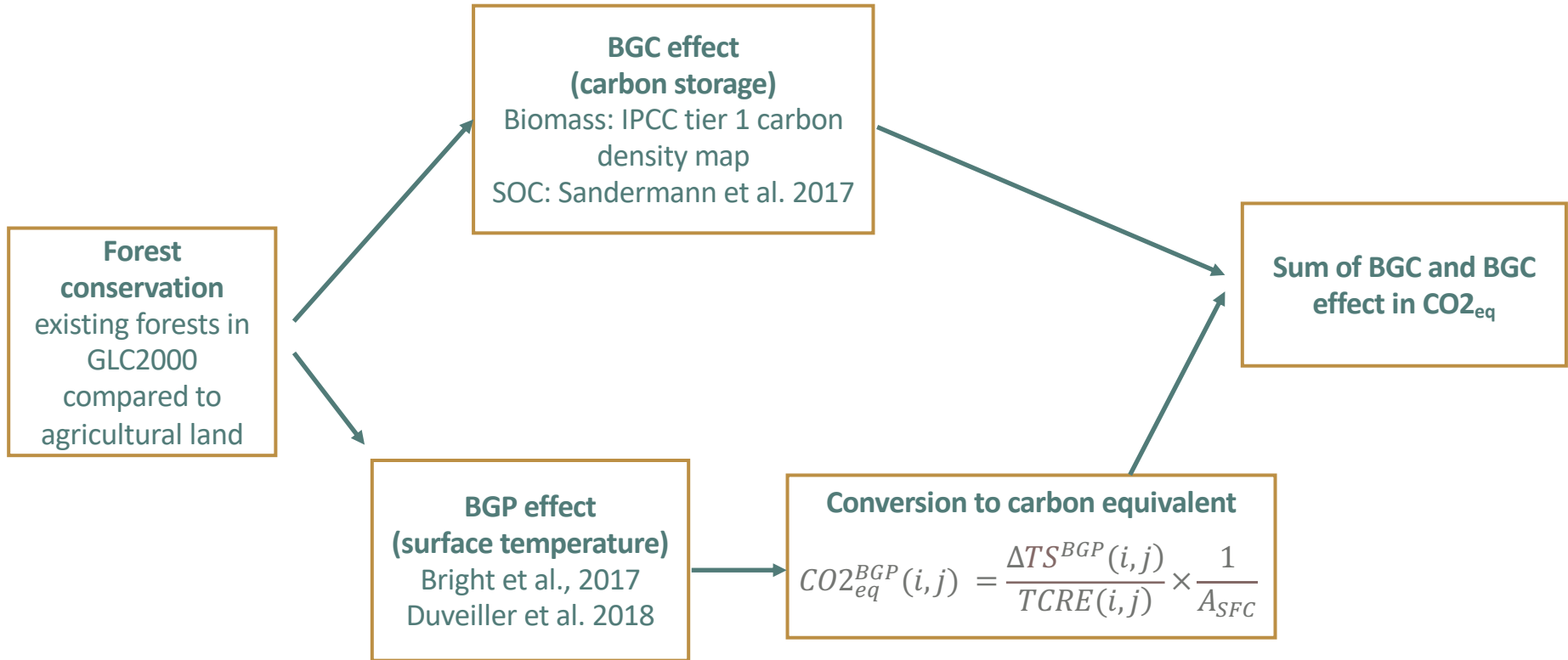
# Methodology



# Methodology



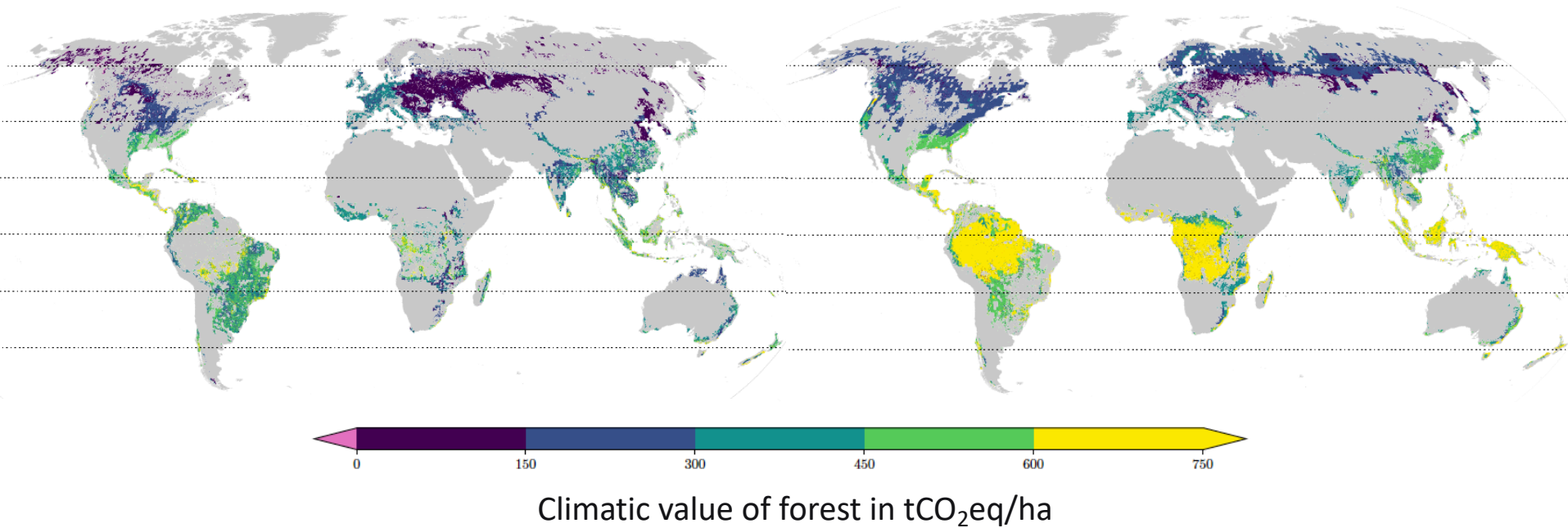
# Methodology



# Combined BGC and BGP effect

Forestation

Forest conservation

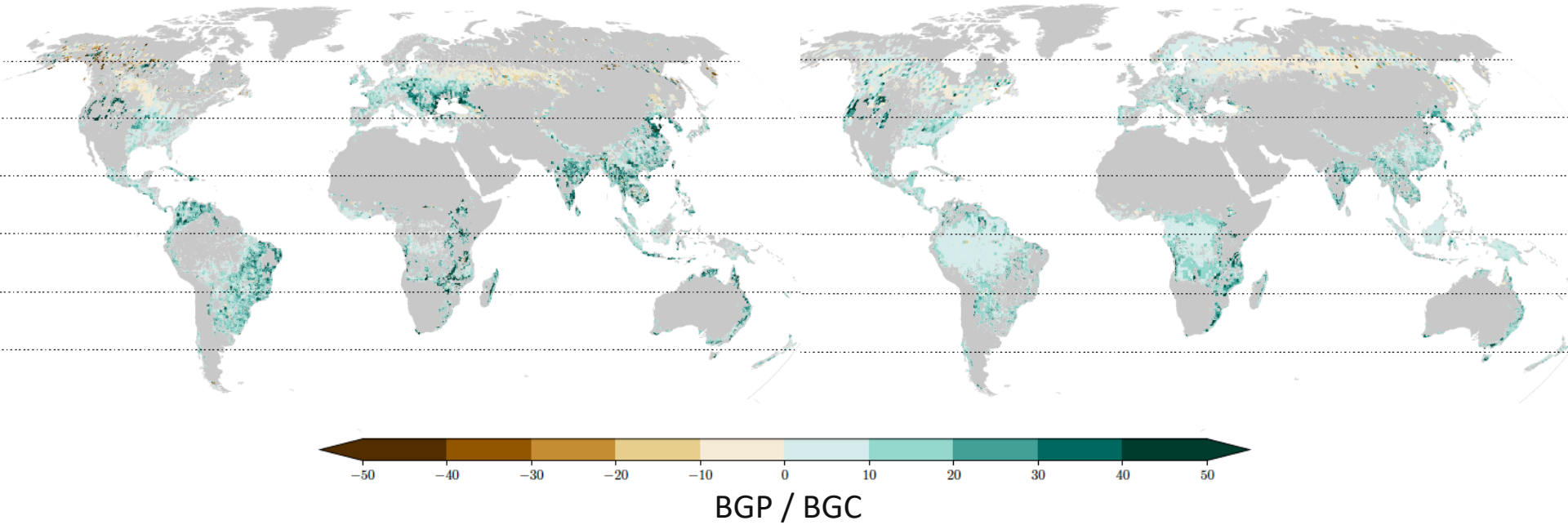


*Windisch et al., Nature CC, in revision*

# Relative strength of BGP effect

Forestation

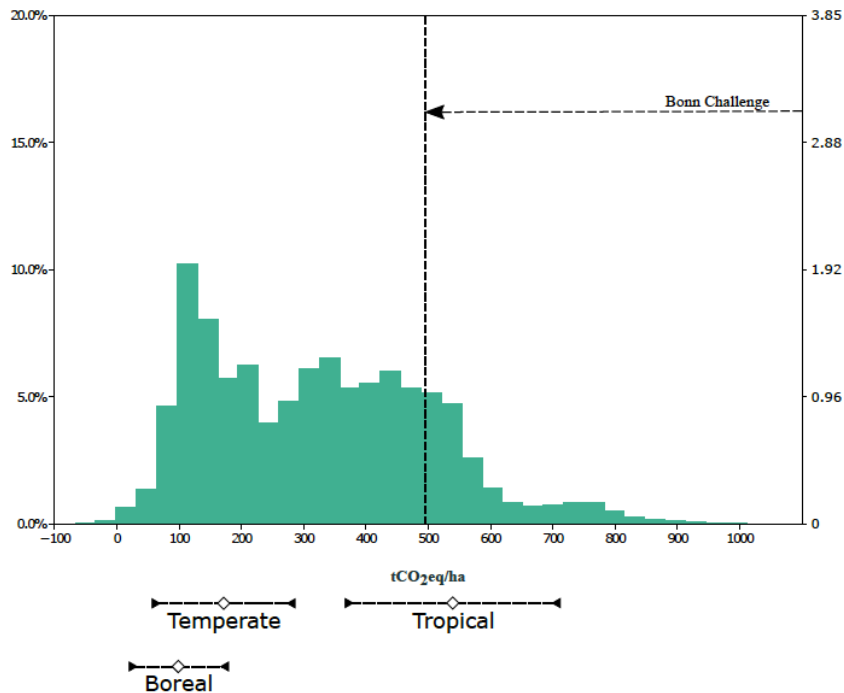
Forest conservation



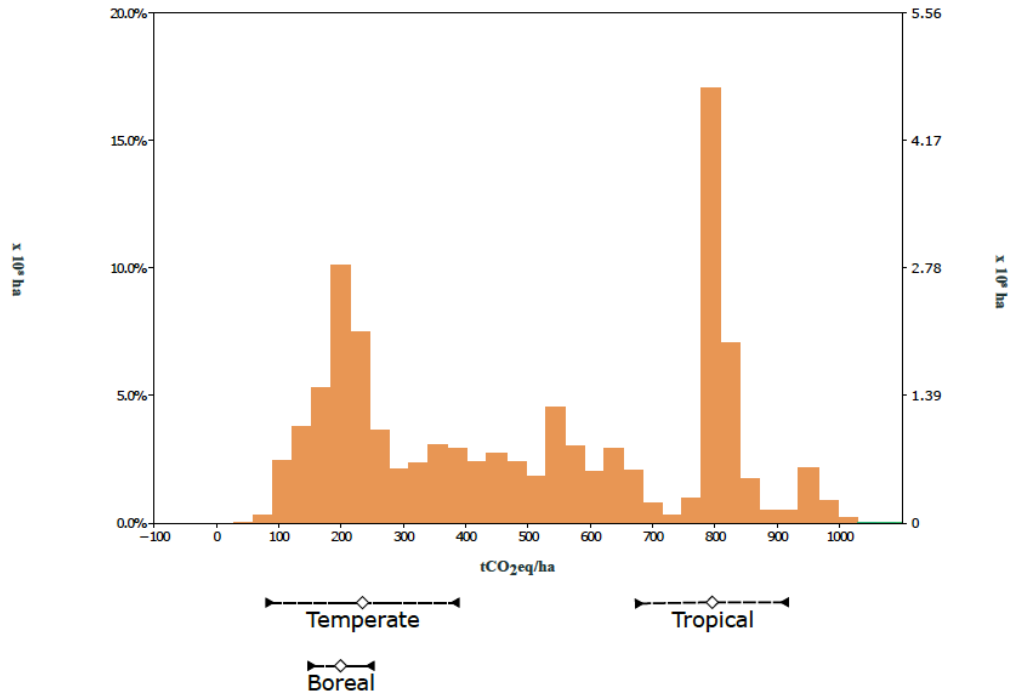
*Windisch et al., Nature CC, in revision*

# Distribution of forestation and conservation sites

## Forestation



## Forest conservation



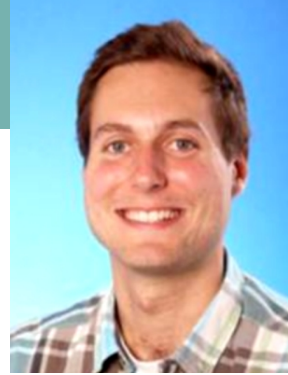
*Windisch et al., Nature CC, in revision*

# Caveats

- Non-local effects ignored
- Scale mismatch between BGP and BGC effects
- Assumption of “climate-independence” of the BGC and BGP effects
- Tree types/species
- Temperature-centric approach



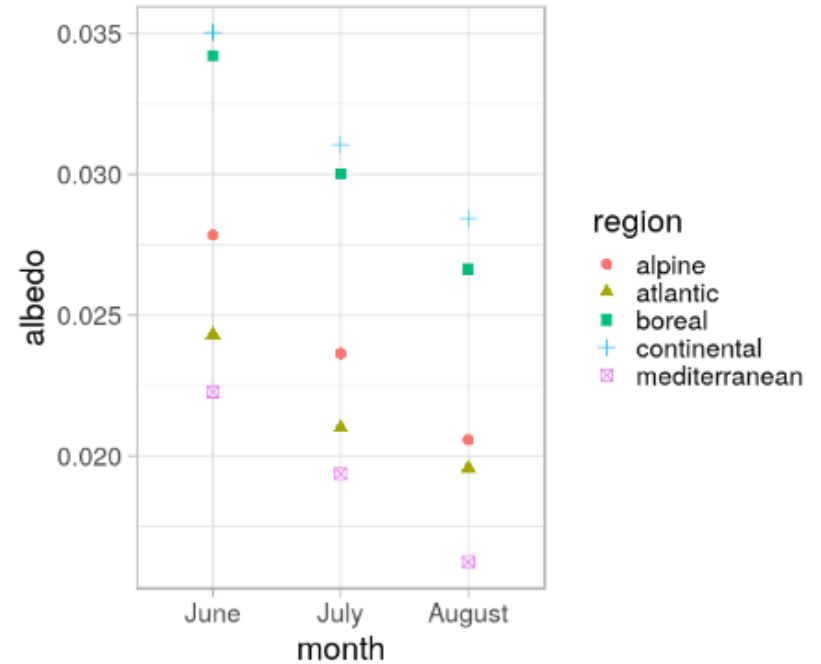
# Broadleaf versus needleleaf trees



**Jonas Schwaab**

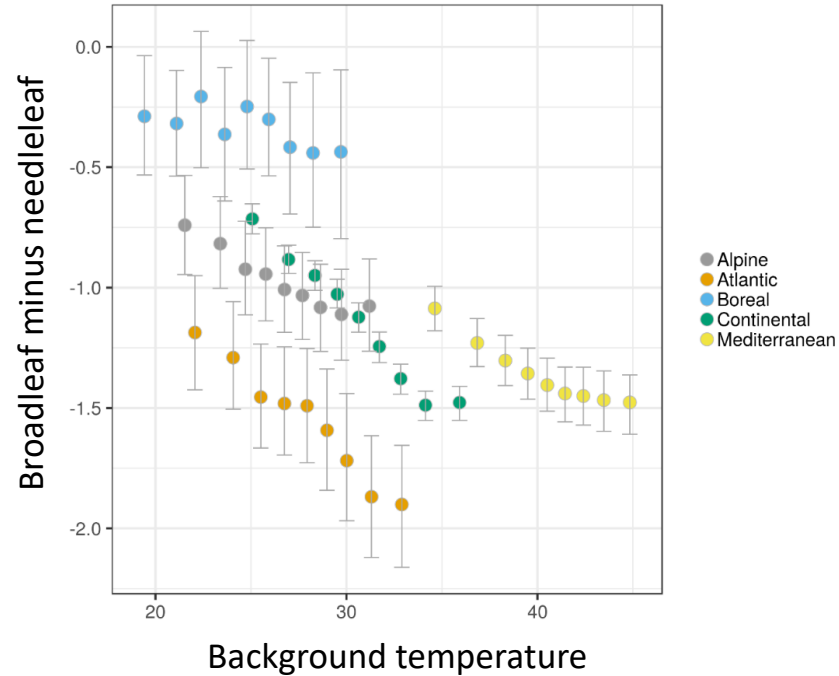
*Schwaab et al., Sci. Reports, 2020*

# Broadleaf versus needleleaf trees



*Schwaab et al., Sci. Reports, 2020*

# Broadleaf versus needleleaf trees

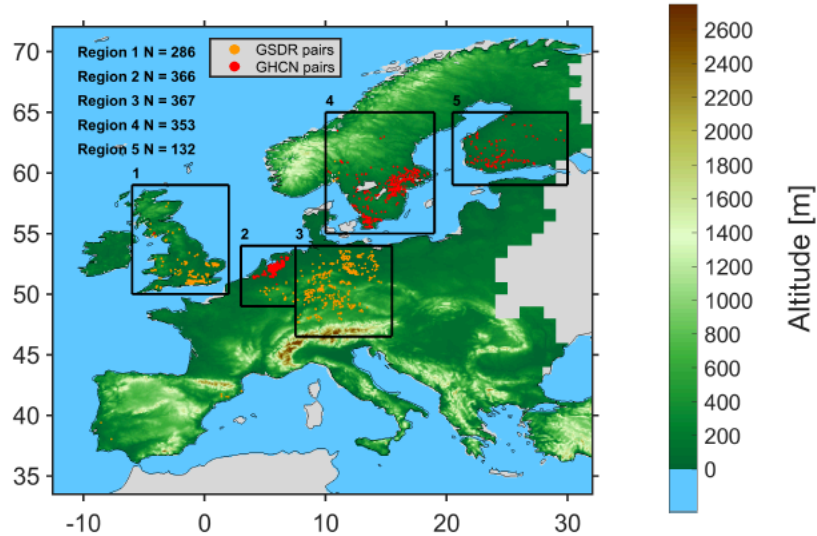


*Schwaab et al., Sci. Reports, 2020*

# Effect of forestation on precipitation



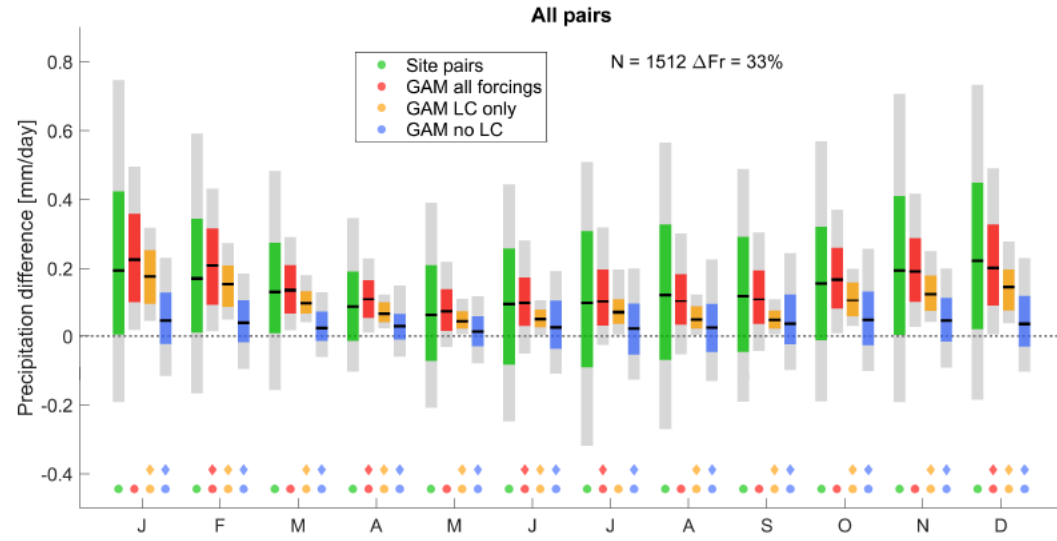
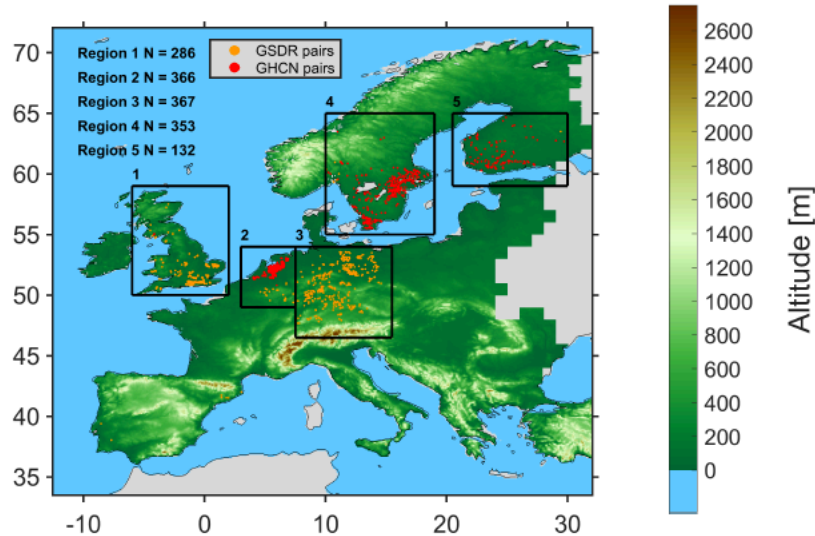
Ronny Meier



*Meier et al., Nature Geo., in review*

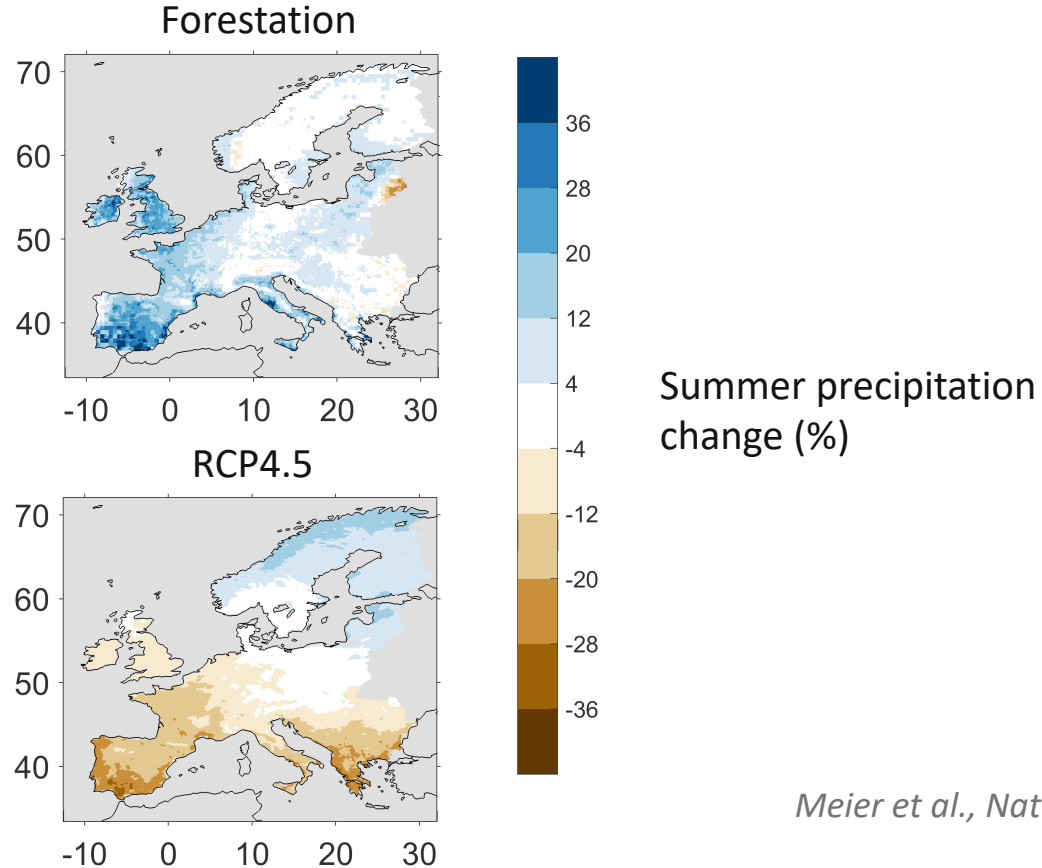
# Effect of forestation on precipitation

## Forest minus agricultural land



Meier et al., Nature Geo., in review

# Effect of forestation on precipitation



*Meier et al., Nature Geo., in review*

# Take-home messages

- Albedo change can be either a trade-off (forestation) or a co-benefit (e.g., broadleaf trees, no-till farming, cover crops)
- Albedo change does not happen alone (e.g. changes in evapotranspiration)
- Implementation of mitigation policies should consider the overall climatic impacts even beyond surface temperature