Terrestrial Environmental Observatories

Karlsruhe Institute of Technology

GHG exchange of grassland ecosystems along a climate sequence in the TERENO pre-Alps Observatory

Kiese R, Lu H, Fu J, Diaz-Pines E, Papen H, Schmid HP

Graswang (860m)

Rottenbuch (750m)

Fendt (600m)

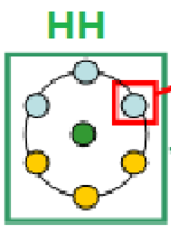
Field Setup: In-situ climate change / space for time

Karlsruhe Institute of Technology

Δ Temperature ~ 2.5 °C

Δ Precipitation ~ 500 mm

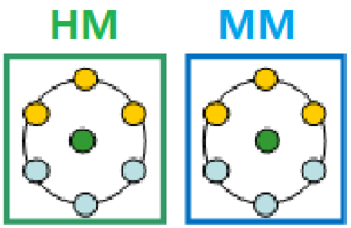
High (860m) /Graswang:
6 lysimeter
1600mm / 5°C



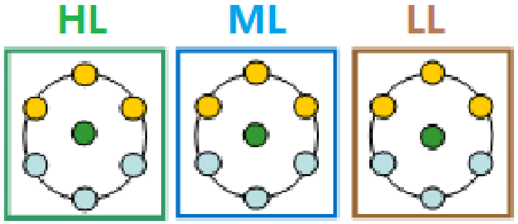
single lysimeter

lysimeter unit consisting of 6 single lysimeters and central service station

Medium (750m) Rottenbuch:
12 lysimeter
1400 / 6.5°C



Low (600m) /Fendt:
18 lysimeter
1030 / 8.2°C



= intensive managment

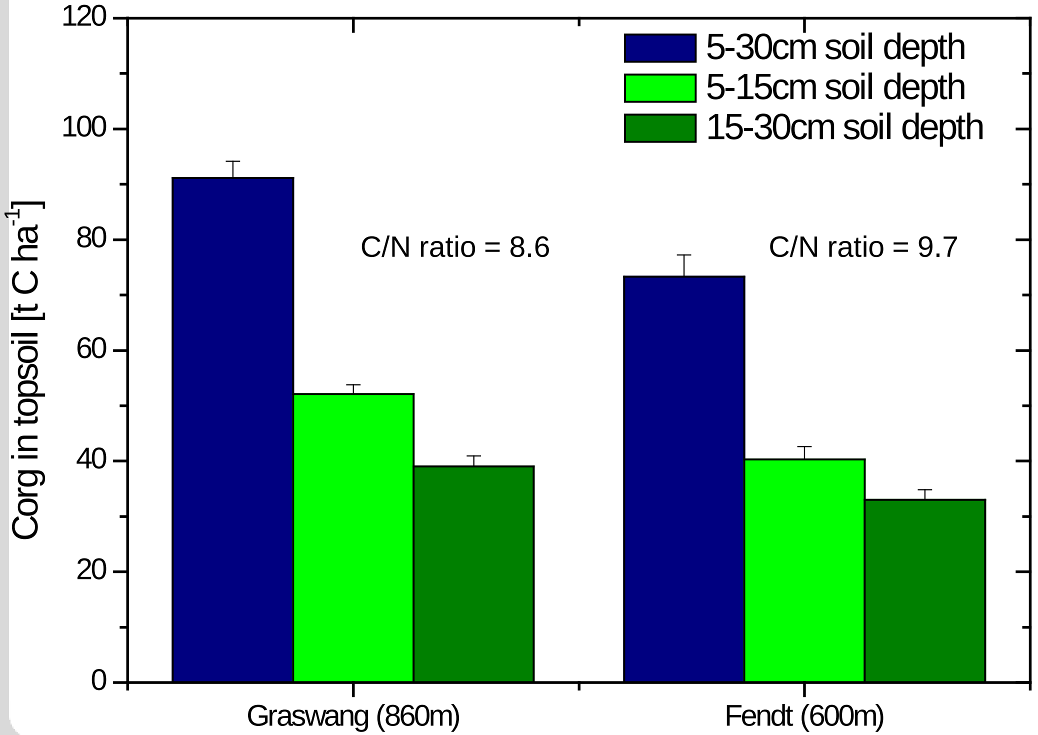
= extensive managment

Hypothesis

Climate change will…

- accelerate soil C-/N- turnover and associated soil emission of CO_2 and N_2O but will have less impact on soil CH_4 uptake

Why? ➡ 20% higher SOC/ N_{tot} at higher altitude



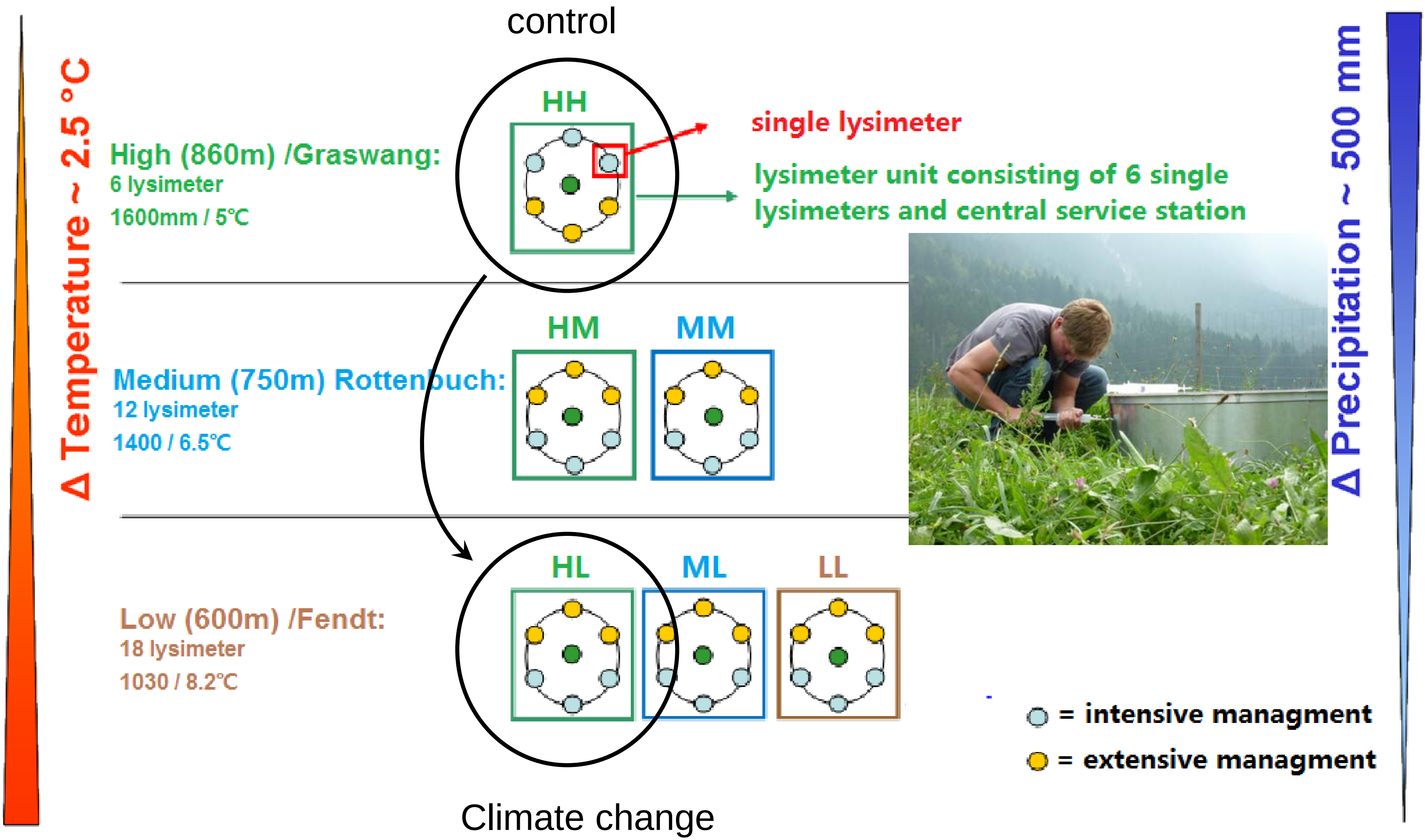
<u>soil</u> parent material: **glacial till**
soil texture: **clay loam**

Main Objectives

Characterization and quantification of climate change effects on ...

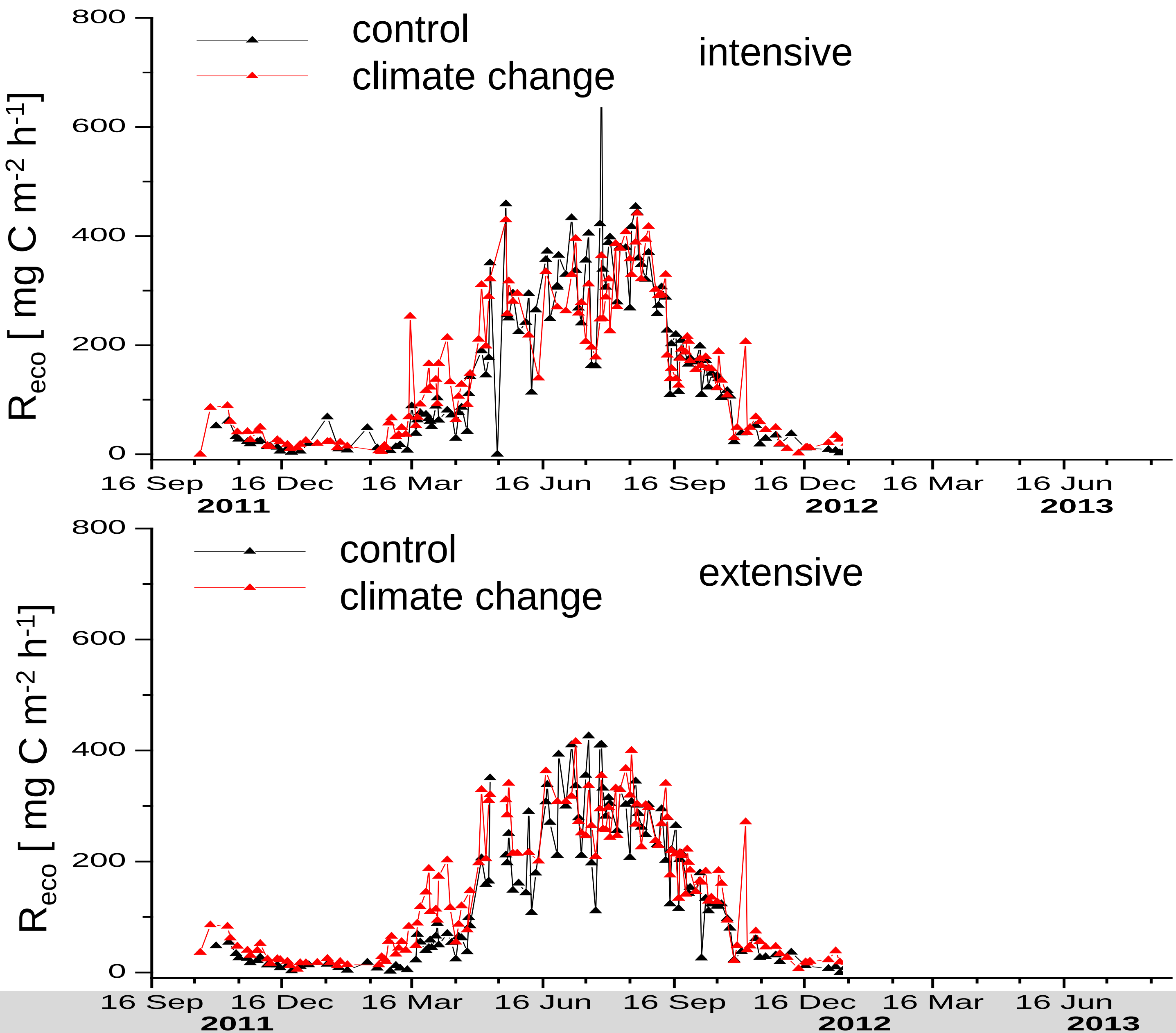
- **biosphere-atmosphere exchange of greenhouse gases**
- changes of coupled C-/N-cycles/ storage of grassland ecosystems (see poster)
- vegetation and microbial biomass and diversity/ activity (see poster)
- terrestrial hydrology, C and N losses via seepage water (see poster)

Results:

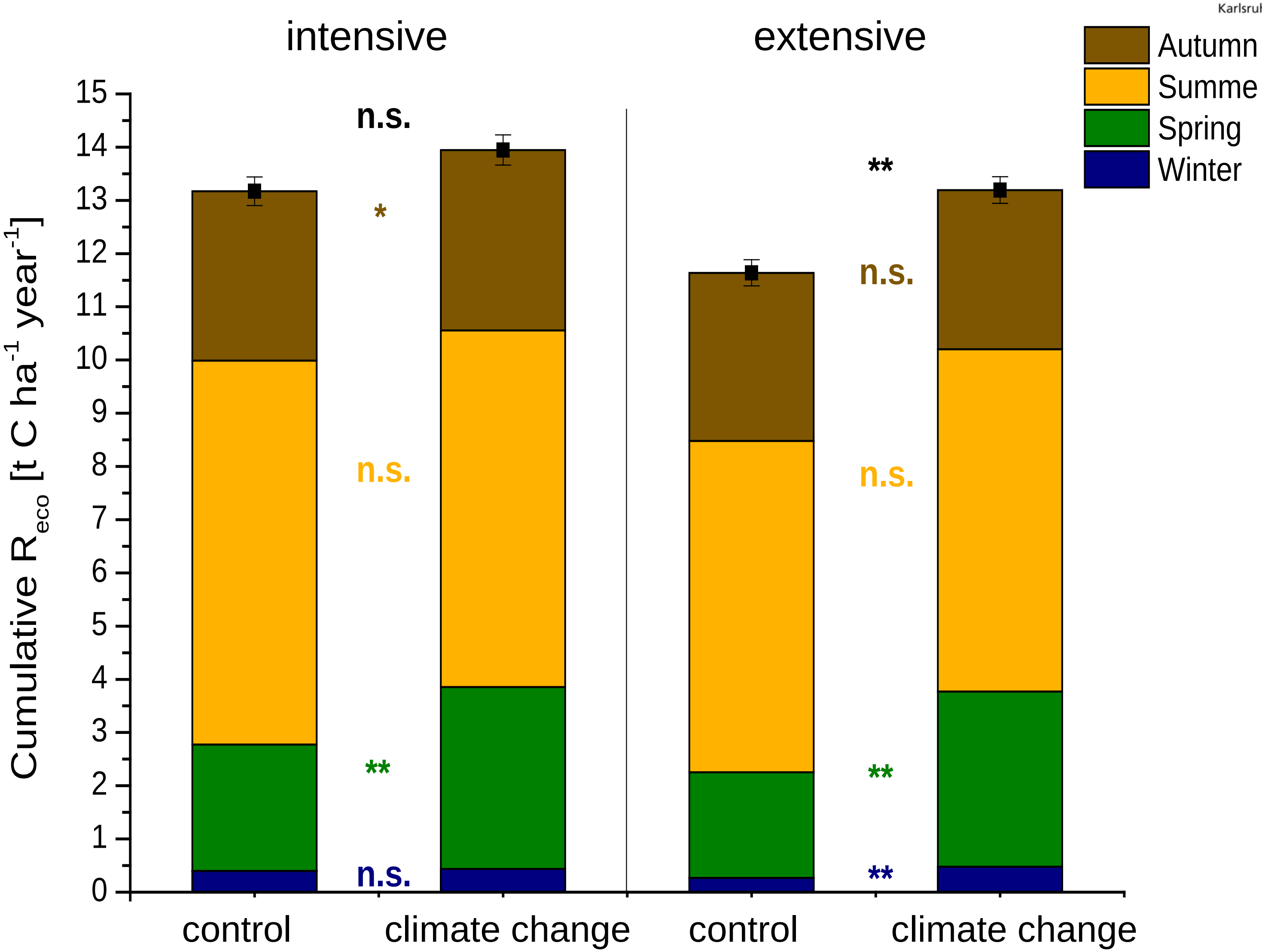


control
Δ Temperature ~ 2.5 °C
Δ Precipitation ~ 500 mm
HH
High (860m) /Graswang:
6 lysimeter
1600mm / 5°C
single lysimeter
lysimeter unit consisting of 6 single lysimeters and central service station
HM
MM
Medium (750m) Rottenbuch:
12 lysimeter
1400 / 6.5°C
HL
ML
LL
Low (600m) /Fendt:
18 lysimeter
1030 / 8.2°C
= intensive managment
= extensive managment
Climate change

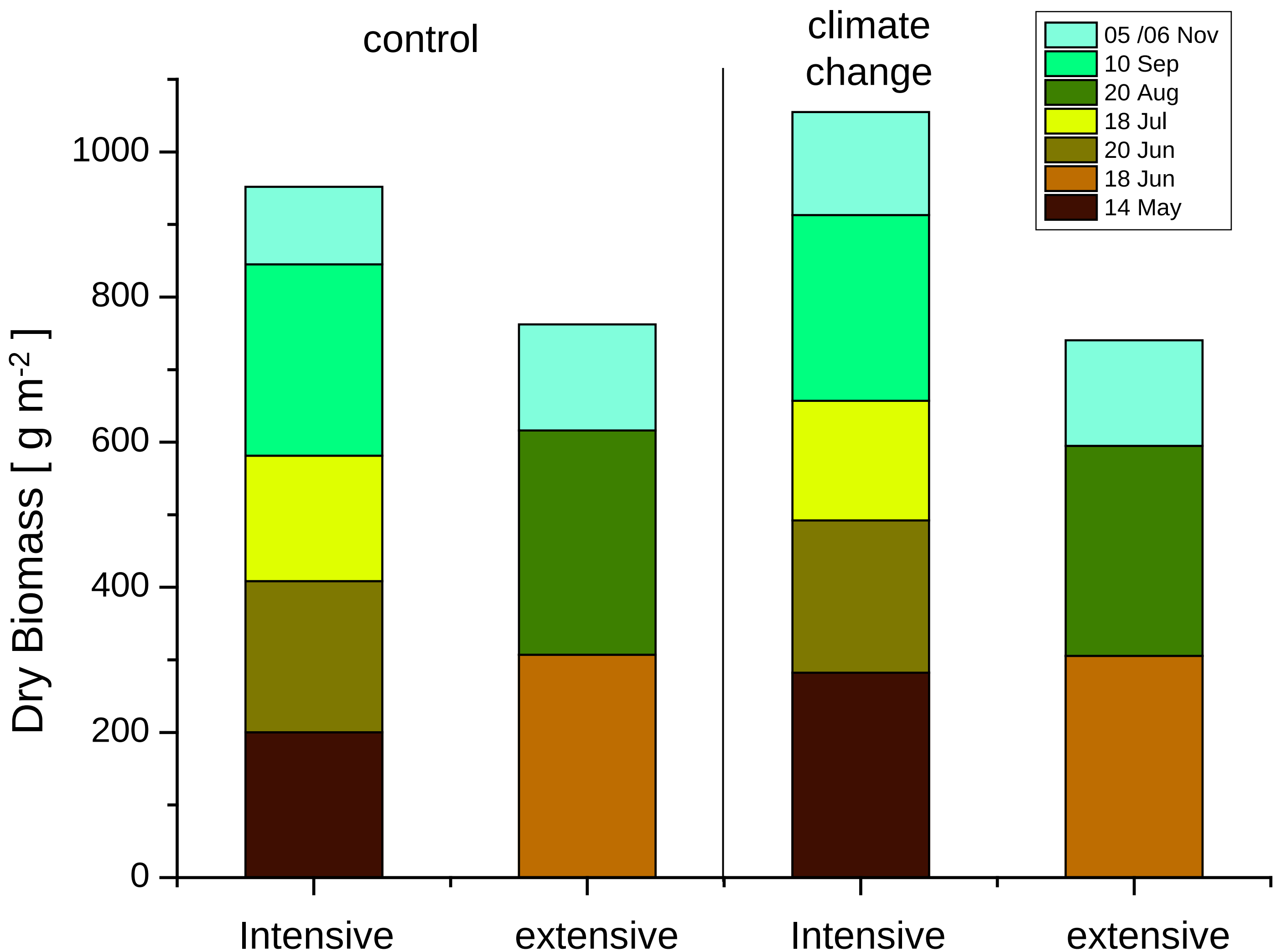
Results: Soil respiration (2-3 measurements pre week)



Results: Soil respiration (cumulative fluxes)

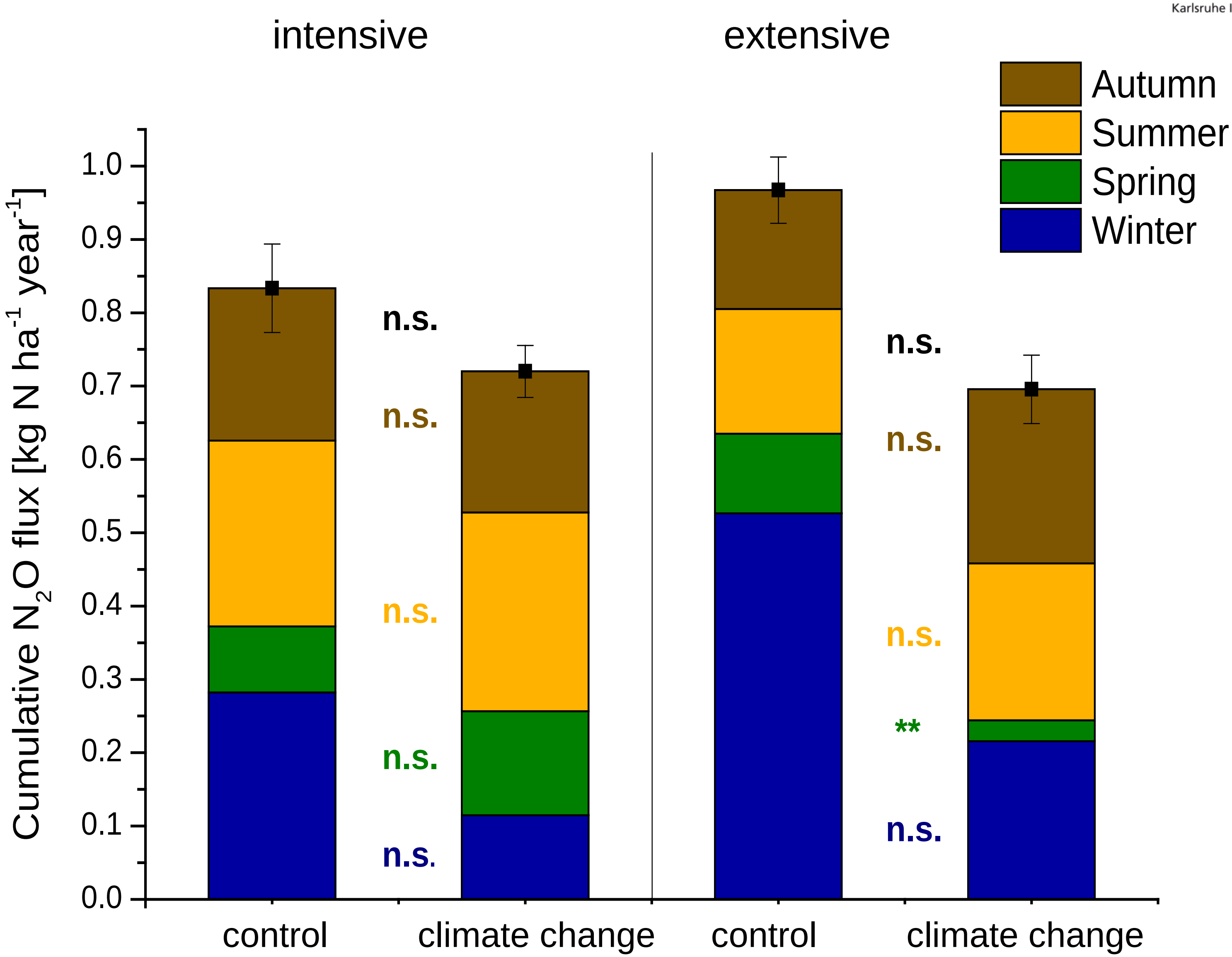


Results: Harvest of aboveground plant biomass

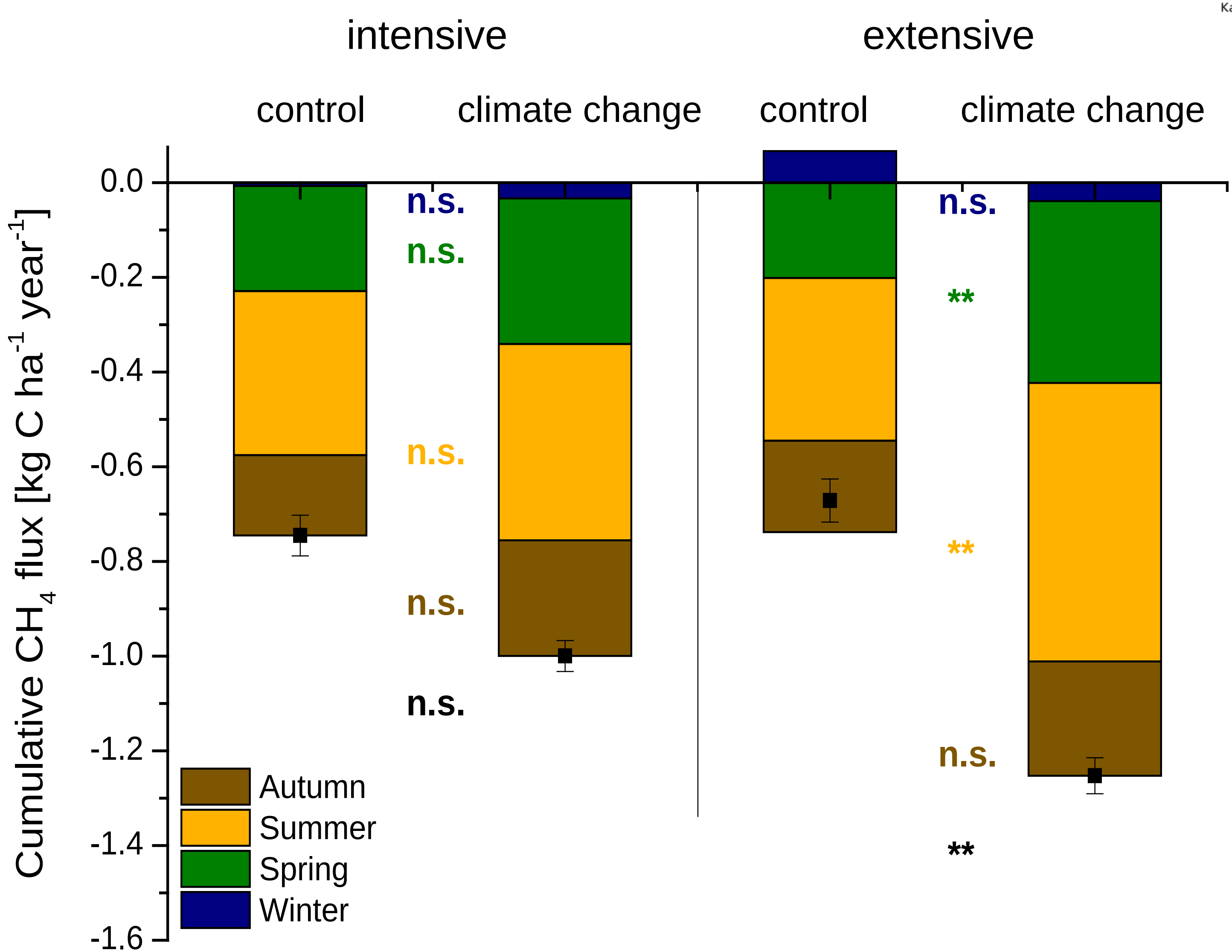


intensive management 4-5 t C ha^{-1} extensive management 3.5 t C ha^{-1}

Results: N_2O flux (cumulative fluxes)



Results: CH_4 flux (cumulative fluxes)



Conclusions

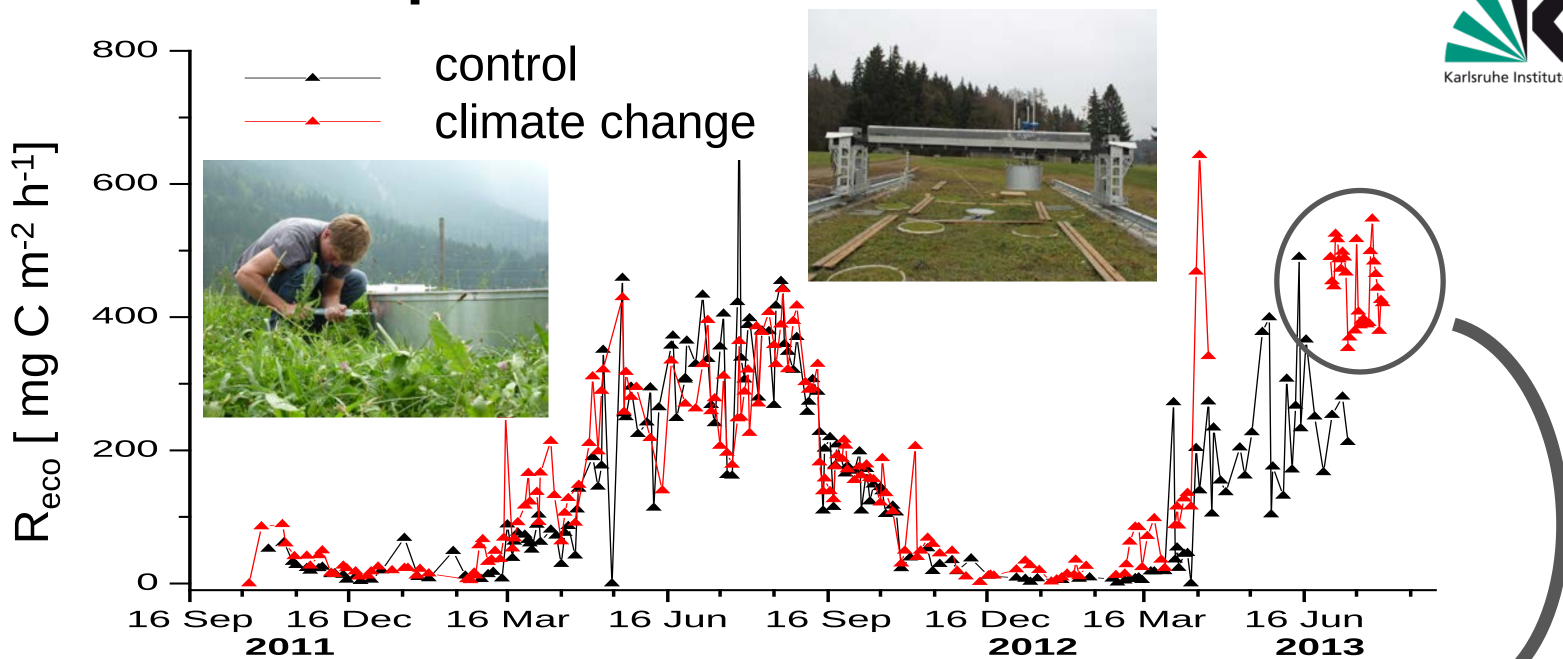
- **Climate change/ Translocation leads to…**
- increased CH_4 uptake in all seasons
- increased CO_2 emission mainly in spring and autumn
- increased N_2O emission in spring-summer-autumn,
- but overall higher at higher elevation due to significant winter emissions by freeze/ thaw events
- elevated DOC and TN concentrations in the whole soil profile but export via seepage water is marginal

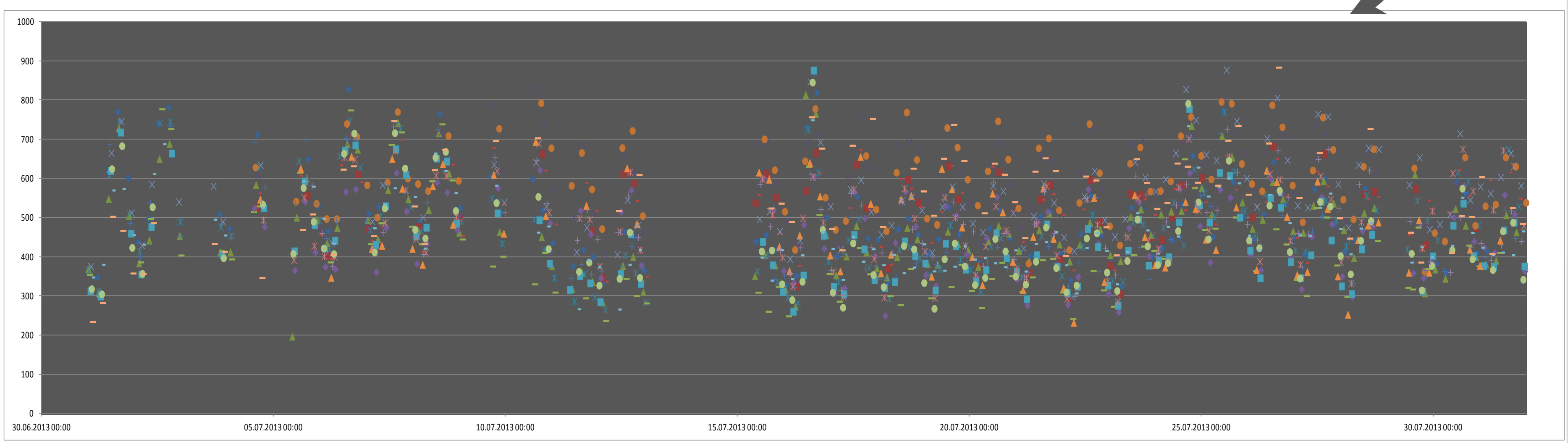
- **Influence of climate change is more pronounced under extensive management**

- **Seasonal and diurnal patterns of CO_2 emission**

- **Event based patterns of CH_4 and N_2O emission, i.e. rainfall, freeze-thaw, fertilization**

Results: Soil respiration continued



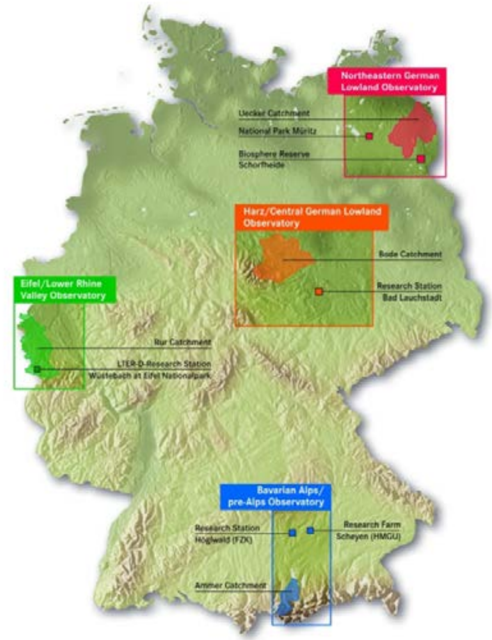


Thank you for your attention

Karlsruhe Institute of Technology

TERENO
Terrestrial Environmental Observatories

Pre-Alps Observatory



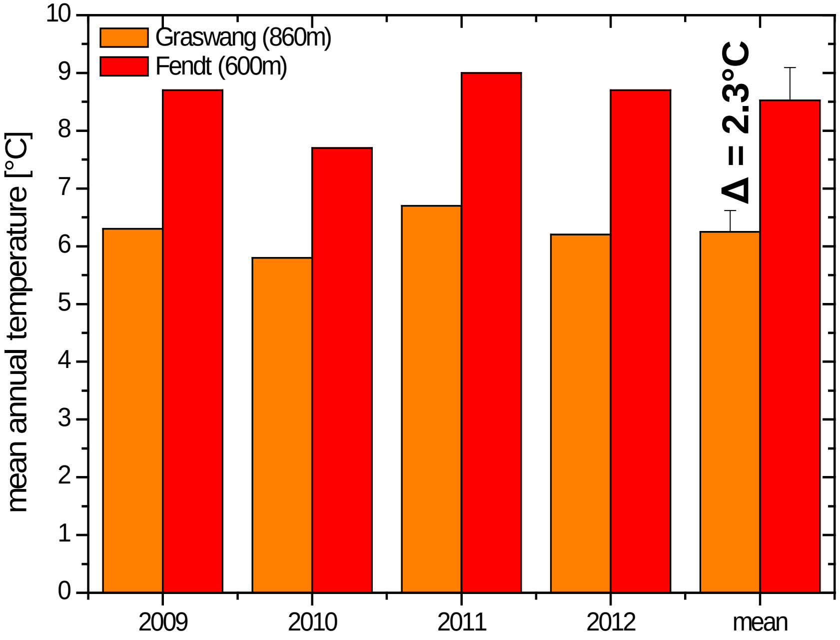
Graswang (860m)

Rottenbuch (750m)

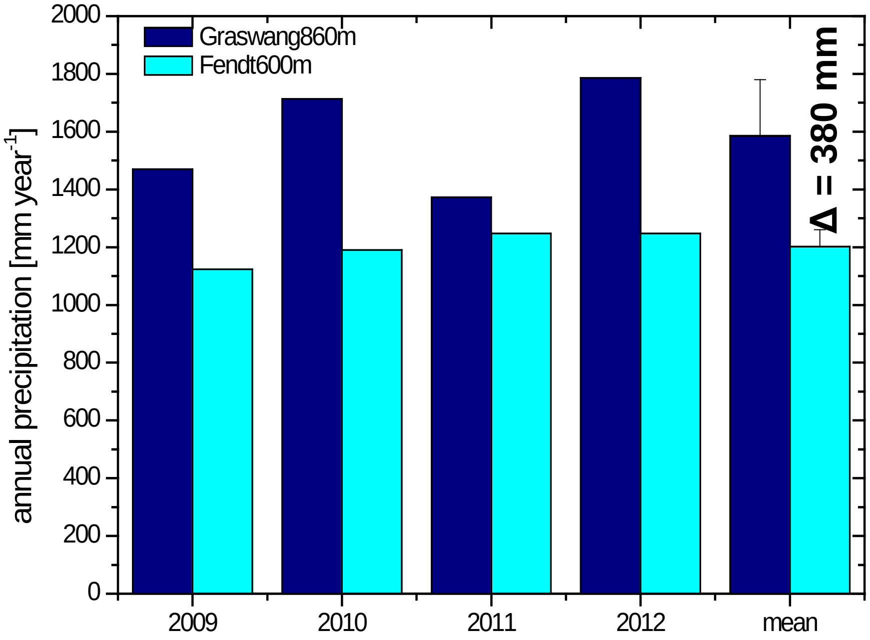
Fendt (600m)

Climate characteristics

mean annual air temperature

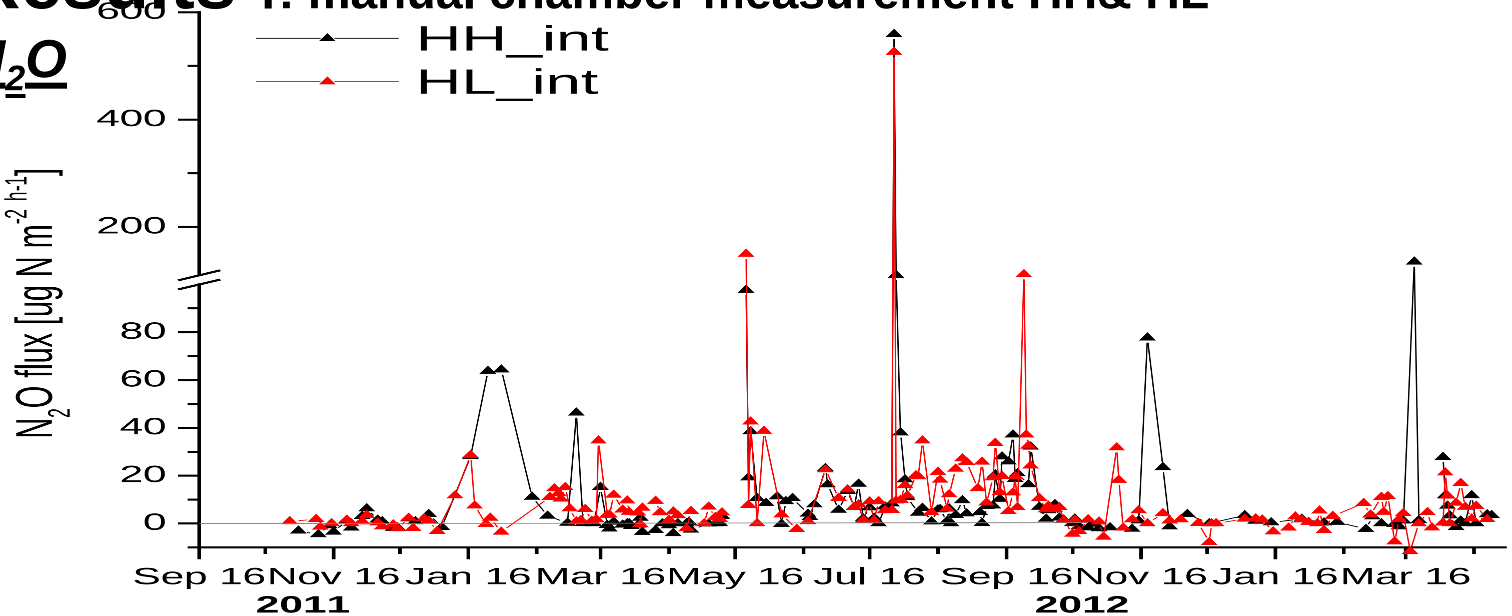


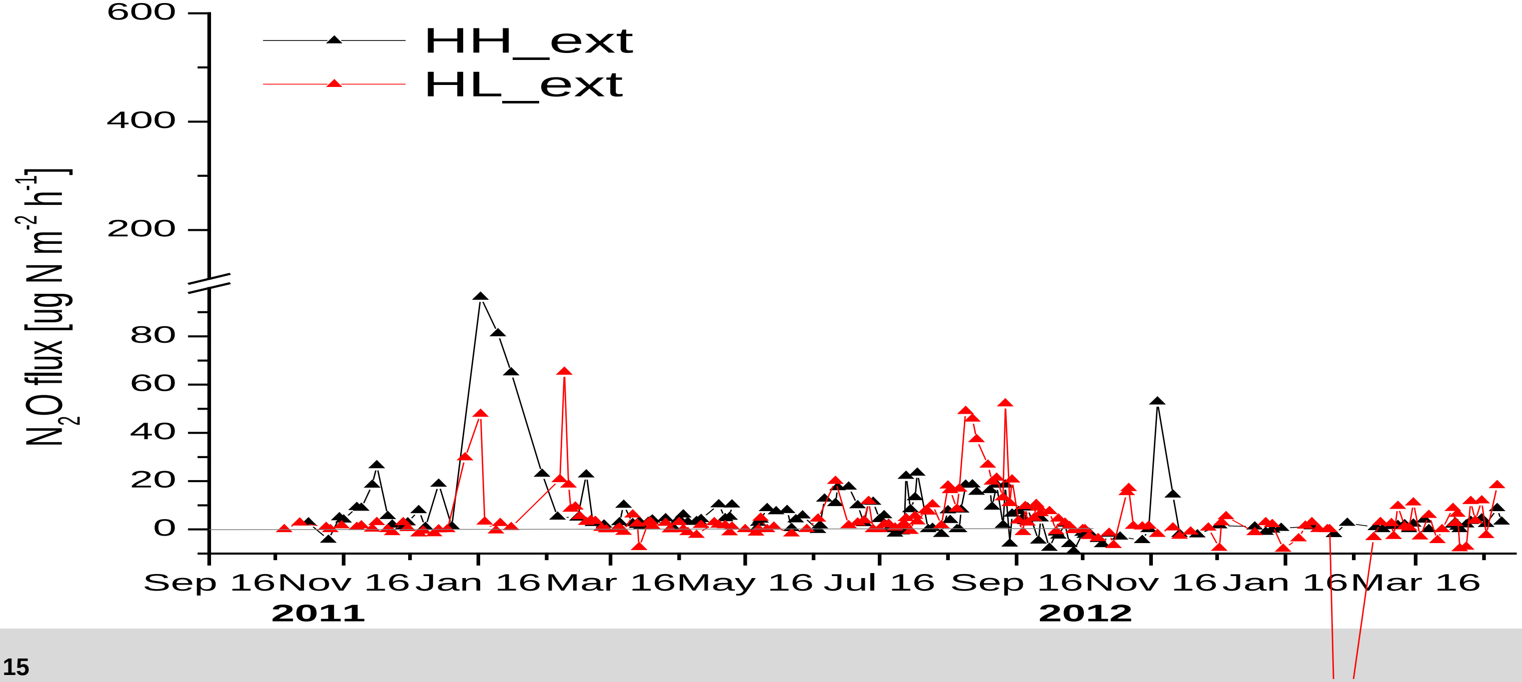
annual precipitation



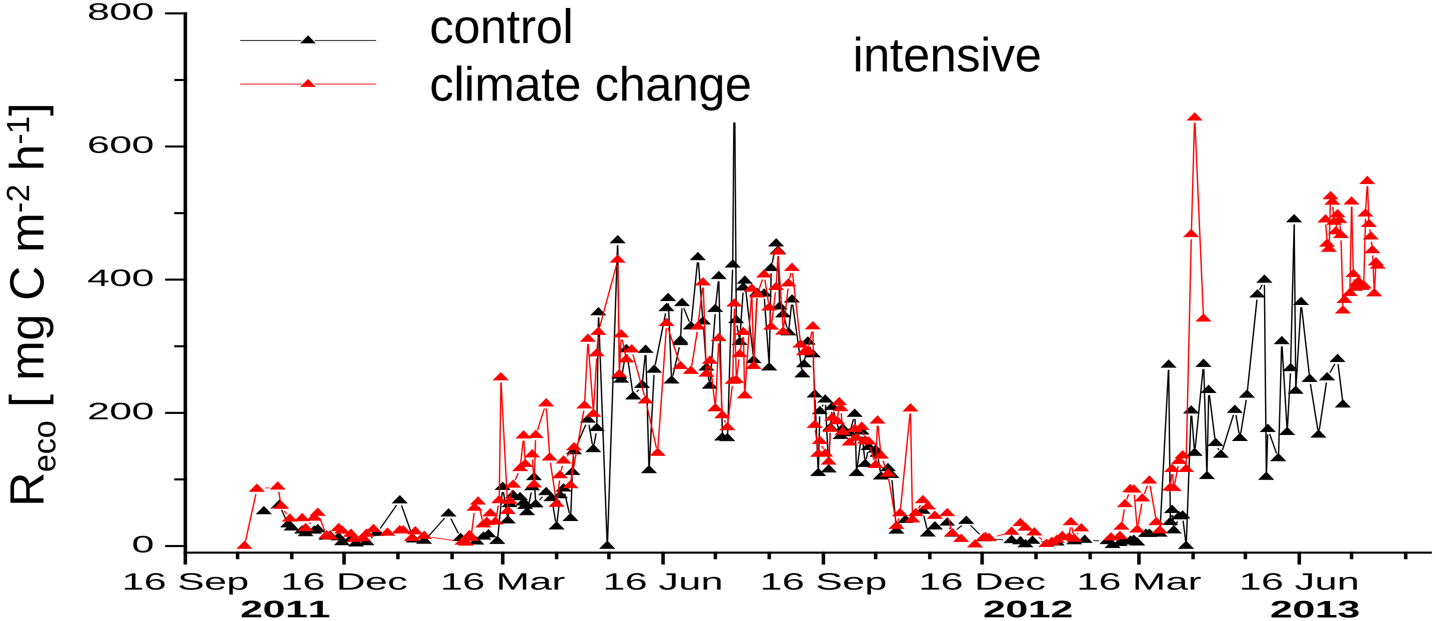
Results Ⅰ: manual chamber measurement HH& HL

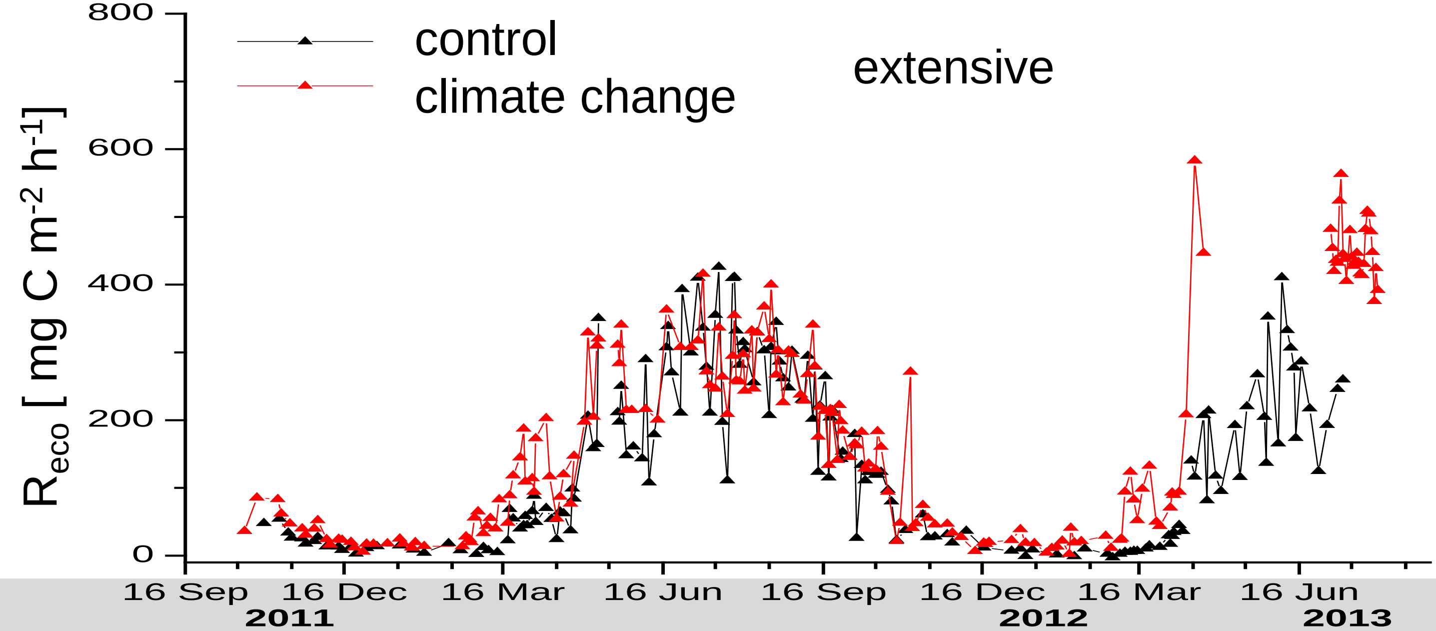
N₂O





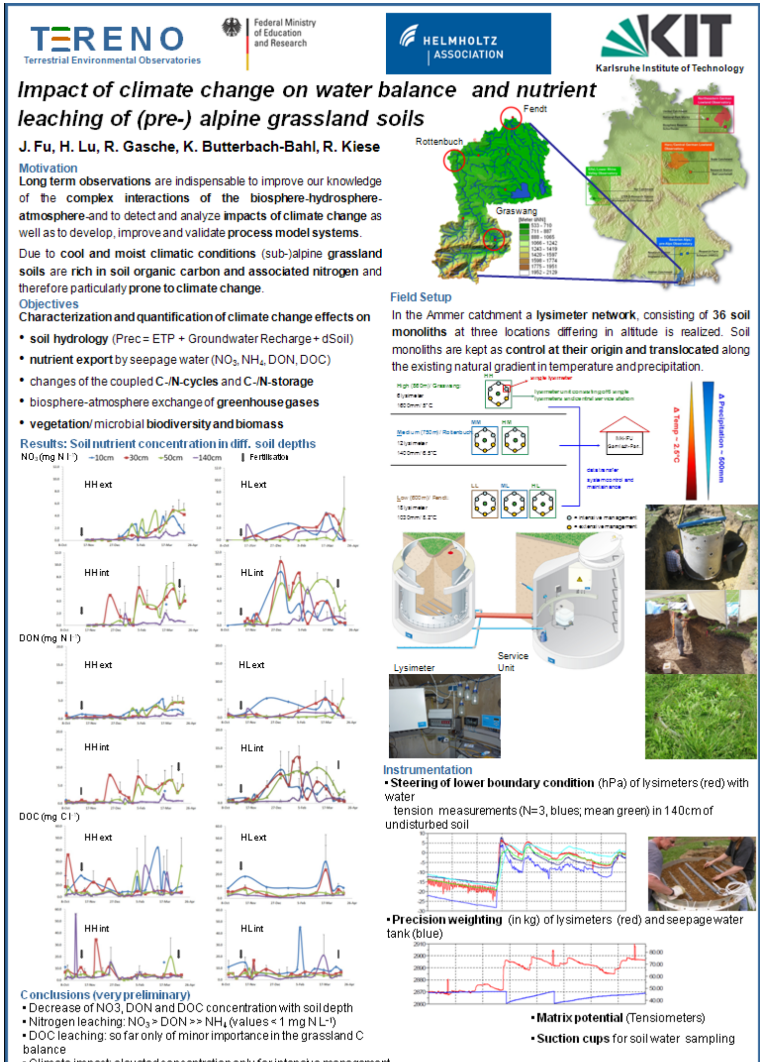
Results: Soil respiration (2-3 measurements pre week)



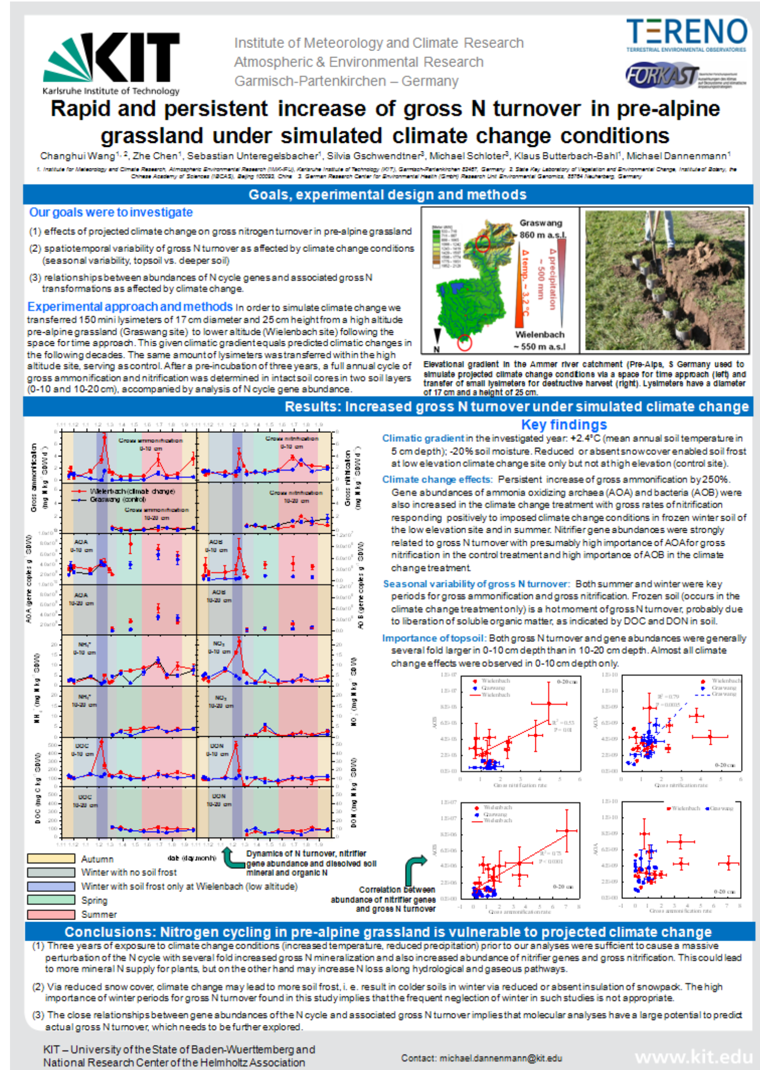


Additional work on posters

Nutrient leaching



N turnover processes



Outlook

- Correction of manual CO_2 emission measurements taking into account diurnal patterns of the automatic measurements
- Potentially revise of presented findings of soil CO_2 emissions
- Situation will be improved with automatic system in Fendt (low elevation)
- Measurement will be continued (long term effect of translocation ?) and supported by studies on

  - nutrient leaching (DIN, DON, DIC, DOC)

  - NEE / plant biomass / $^{12}C/^{13}C$ for separation of autotrophic vs. heterotrophic respiration (Na Wang)