Impact of climate and management on grassland yields in the pre-alpine region of South Germany

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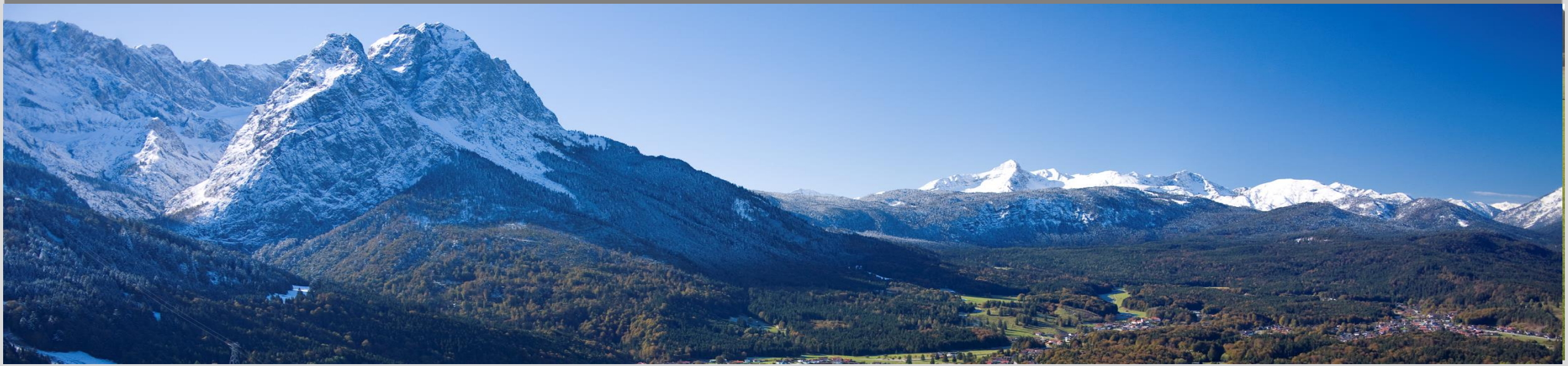
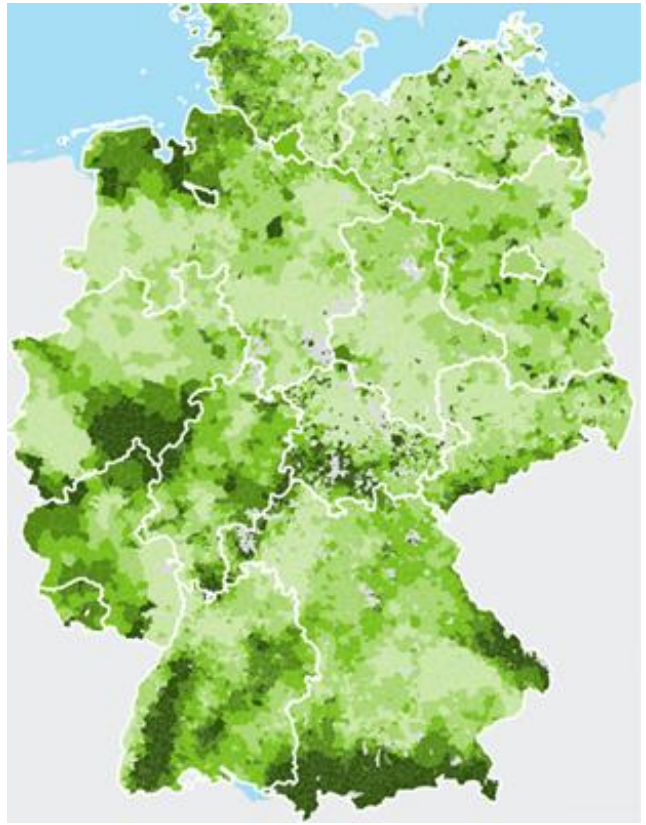


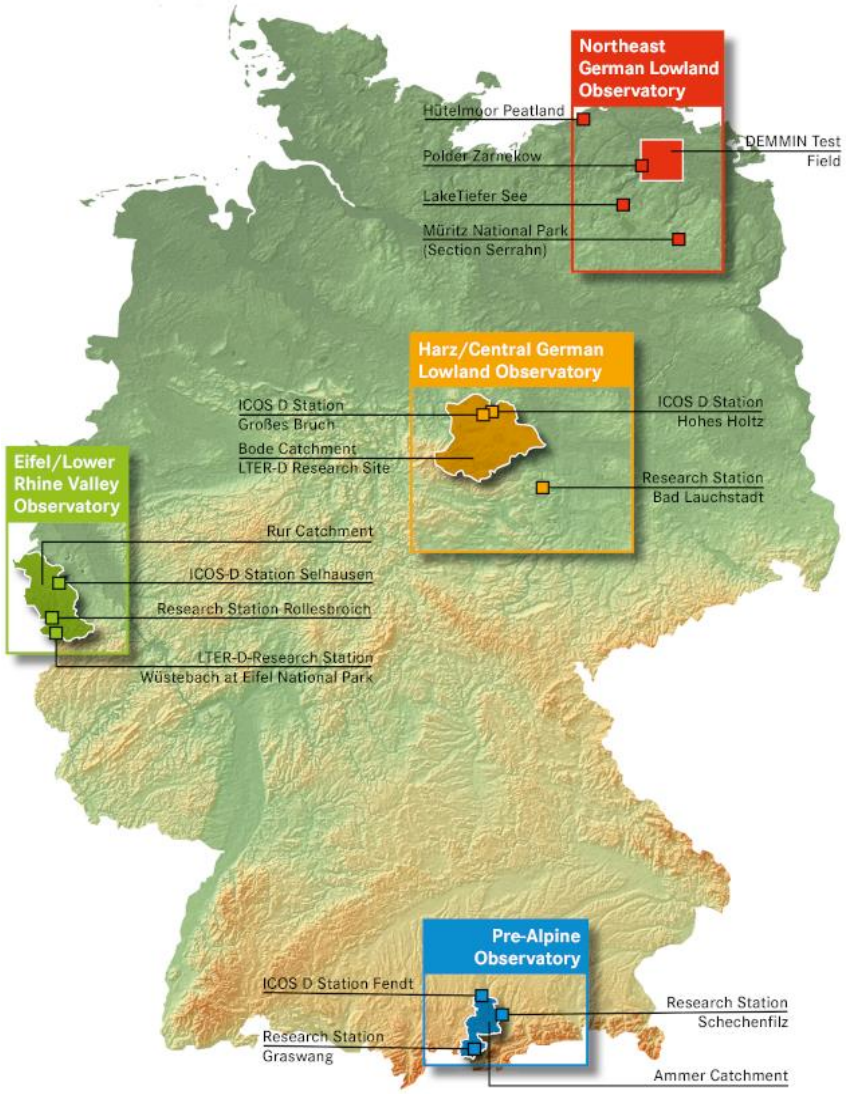
Motivation: Grassland ….

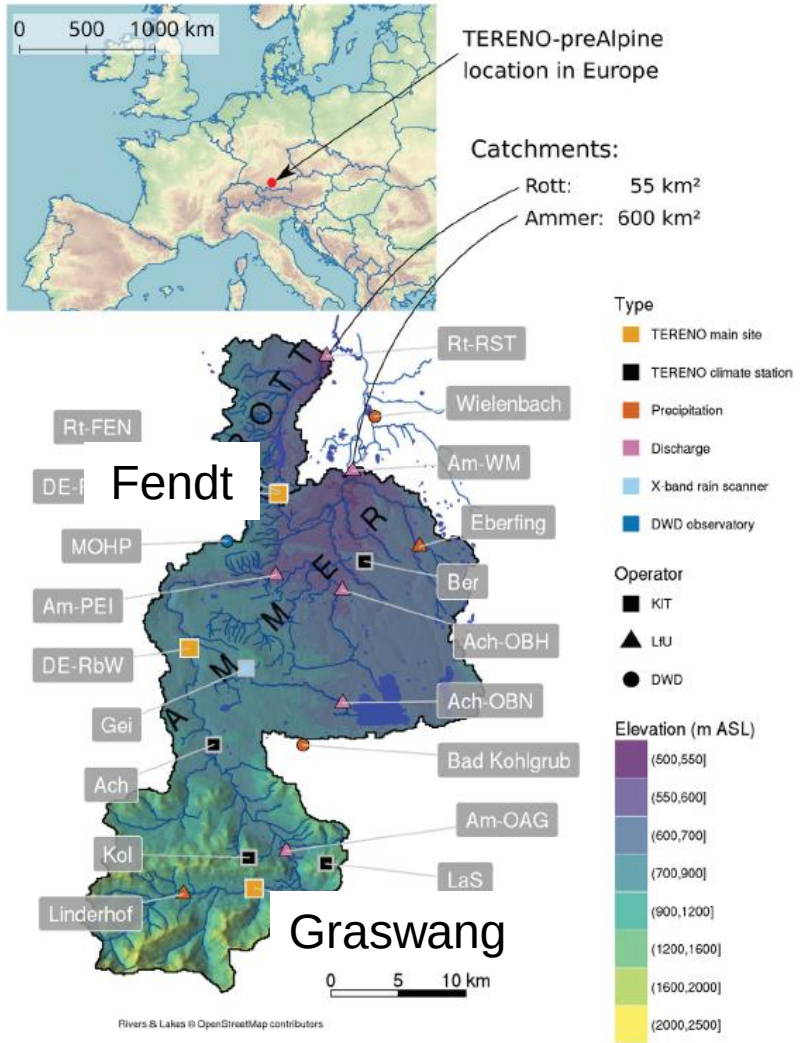
- is the dominating land-use in pre-alpine and alpine regions
- represents 30% of the total agricultural area of Germany
- provides economic value via fodder used for milk and meat production
- supports key soil functions such as C and N storage, nutrient and water retention, and biodiversity



Soil functions jeopardized by rapid climate and land-use/ management changes

Pre-Alpine Observatory (650 km²):





Space for time/ climate warming lysimeter translocation experiment

Graswang 860m:
MAT: 6.8 °C
MAP: 1297 mm

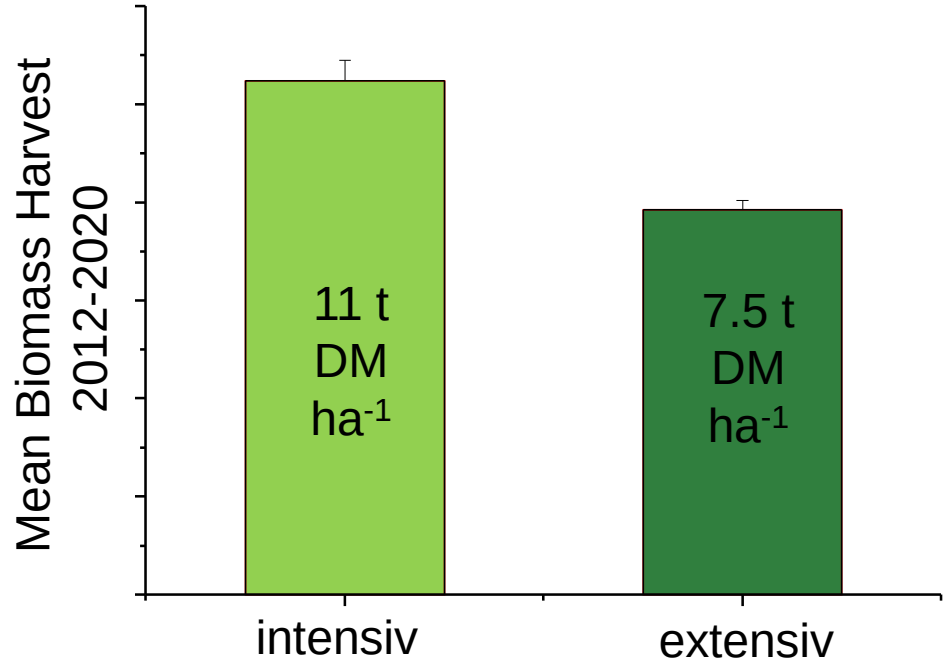
Fendt 600m
MAT: 8.9°C
MAP: 962mm

+ 2 °C

Intensive and extensive management according to farmer´s practice

Intensiv:
4-6 cuts / 4-5 manure
2000 kg C / 200 kg N

Extensiv:
2-3 cuts / 1-2 manure
750 kg C / 85 kg N

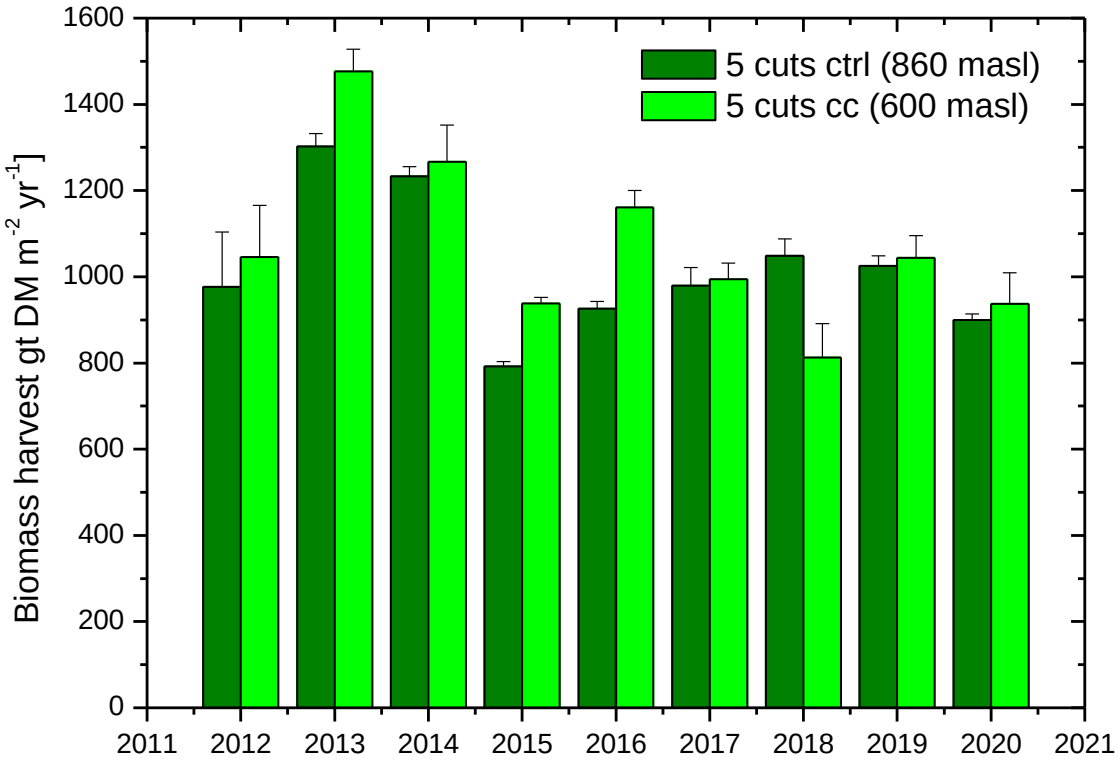


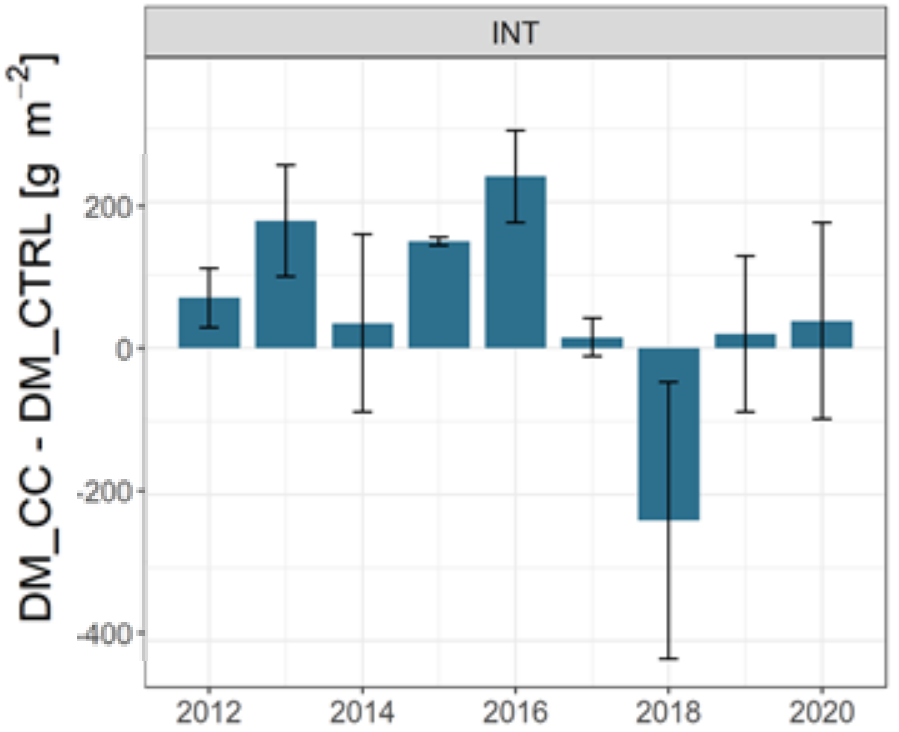
N_2O < 1kg N ha^{-1} yr^{-1}

NO_3: 5-10 kg N ha^{-1} yr^{-1}

Time series of biomass harvest (2011-2020) control vs. climate change

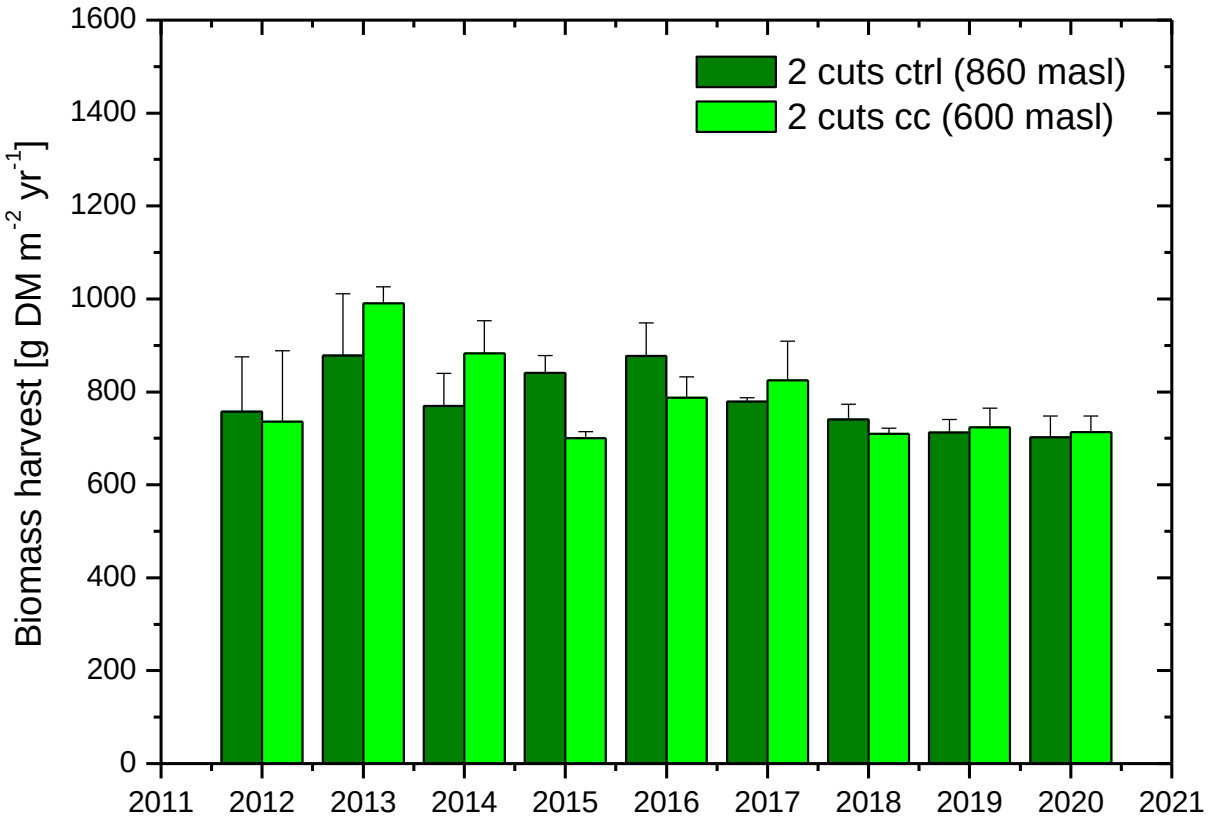
Intensive Management

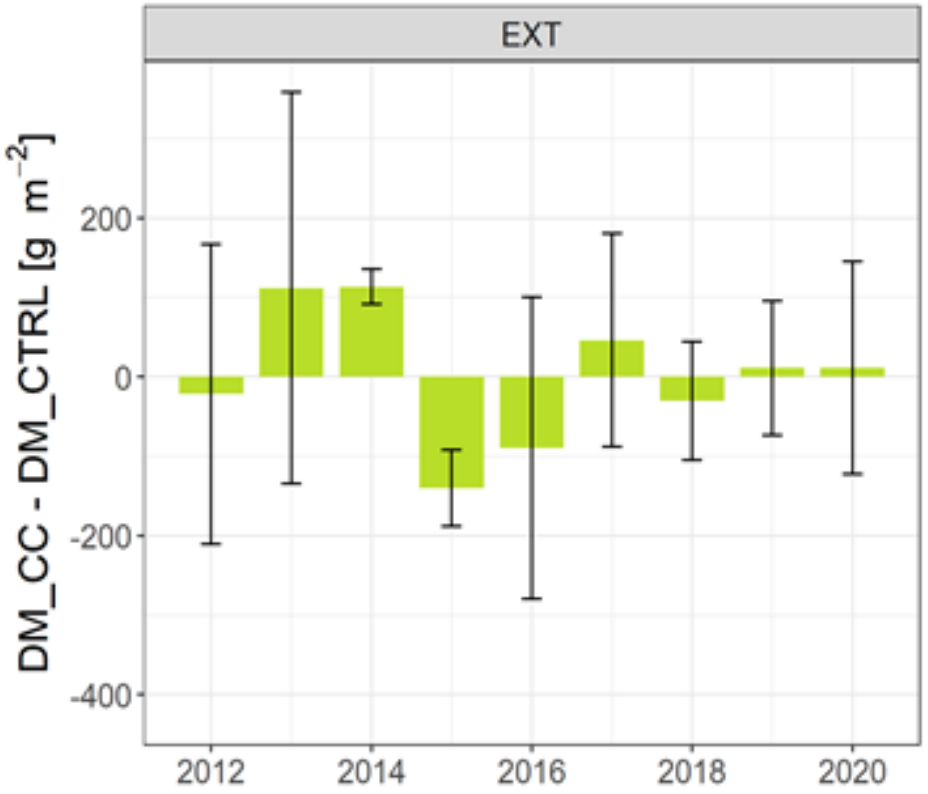




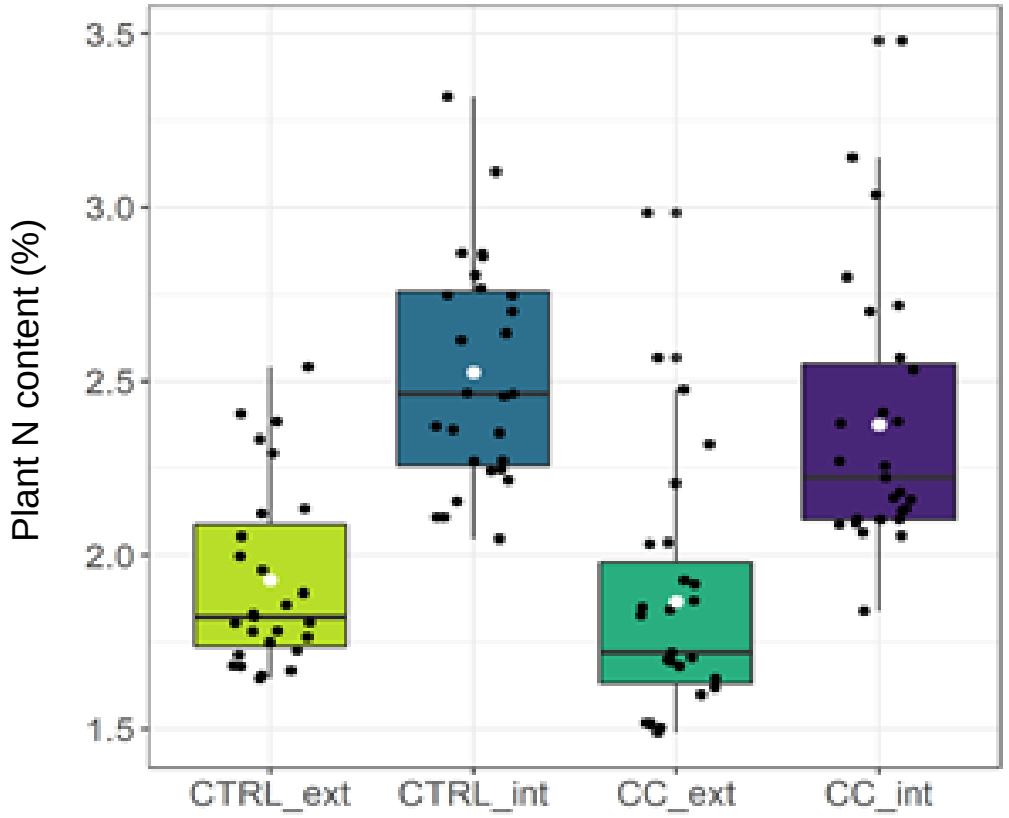
Time series of biomass harvest (2011-2020) control vs. climate change

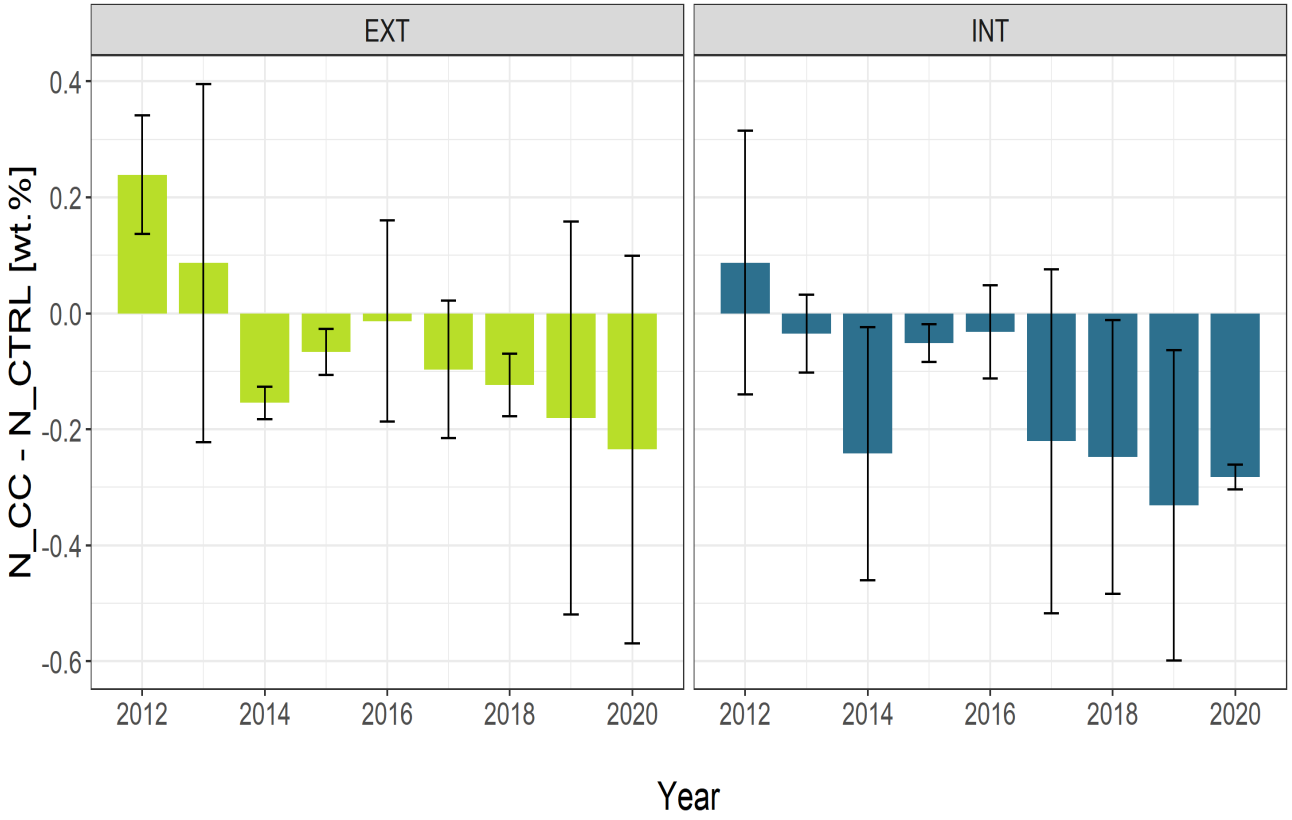
Extensive Management



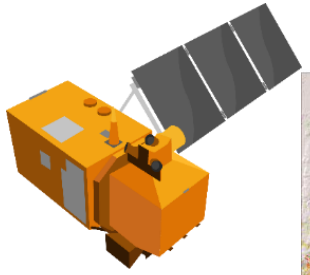


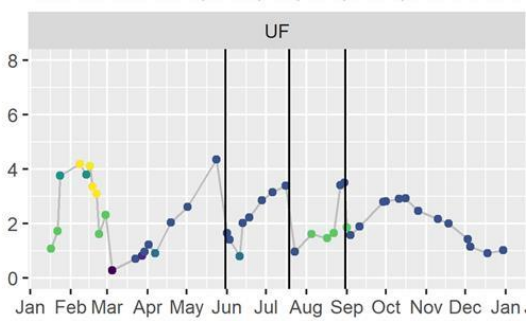
Impact of climate and mangement on plant N content



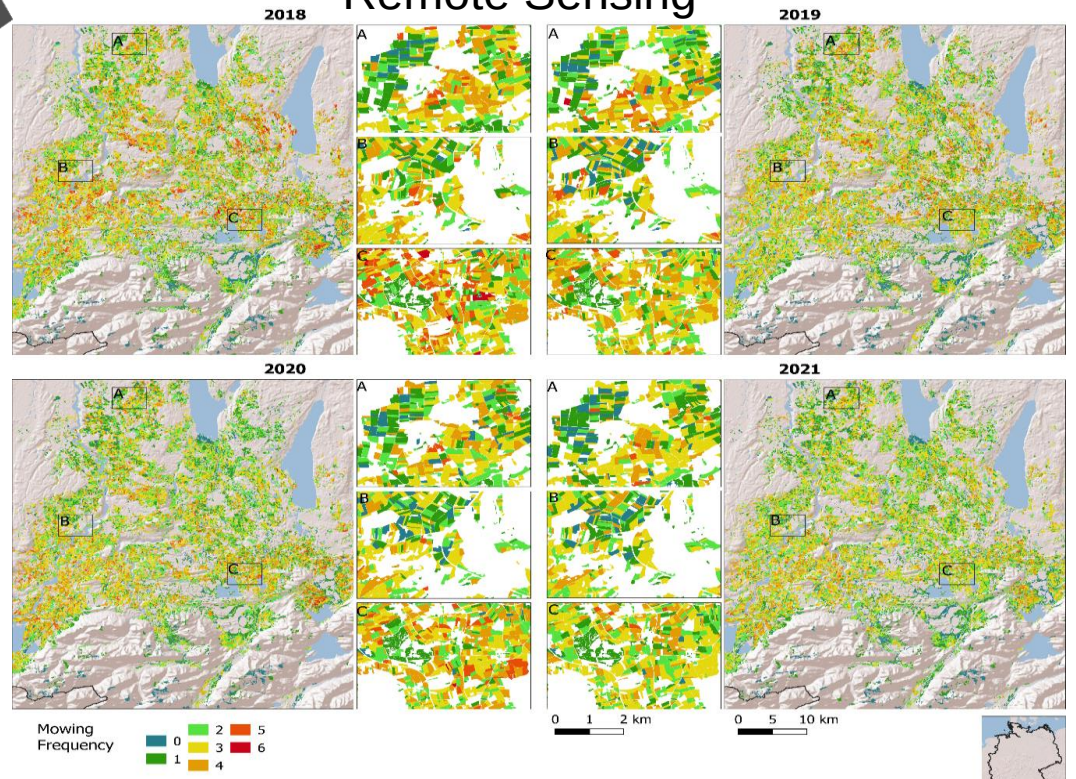


Regional upscaling approach



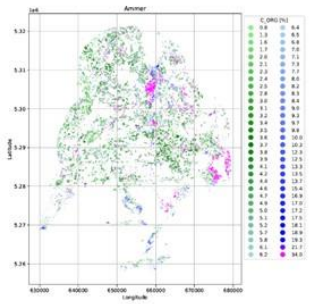


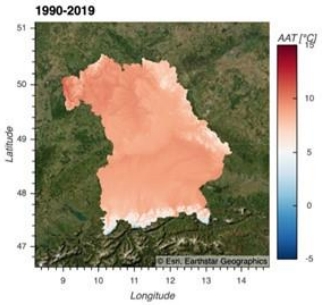
Remote Sensing



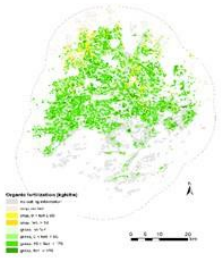
Biogeochemical Modelling (LandscapeDNDC)

Soil + **Climate** + **Management**

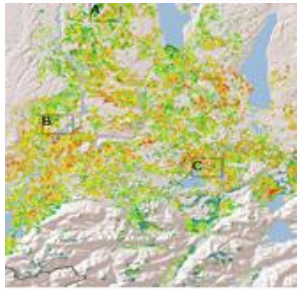




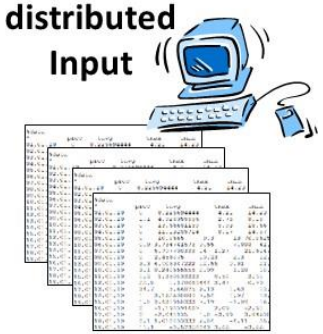
Manure



Cutting frequency

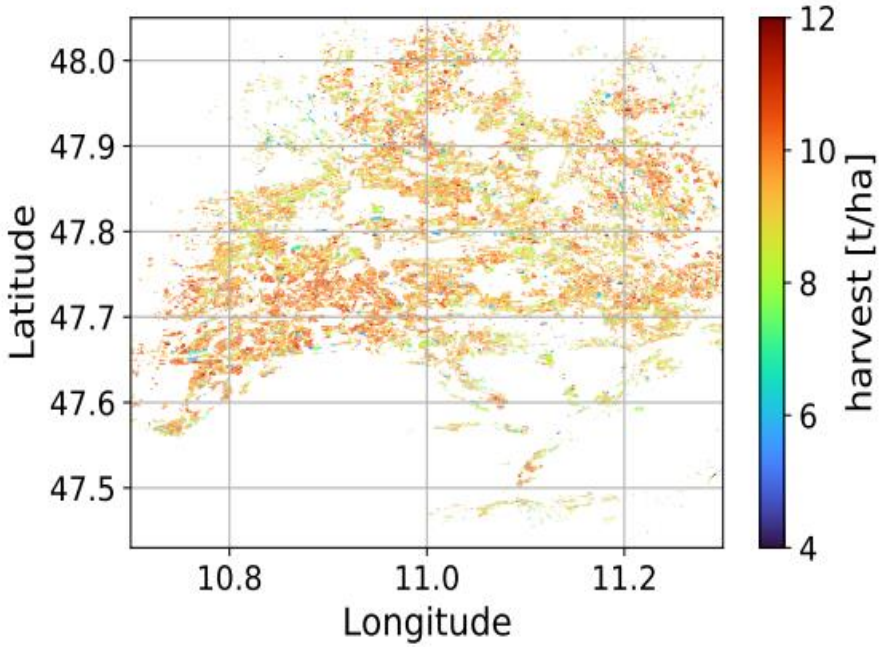


Spatially distributed Input



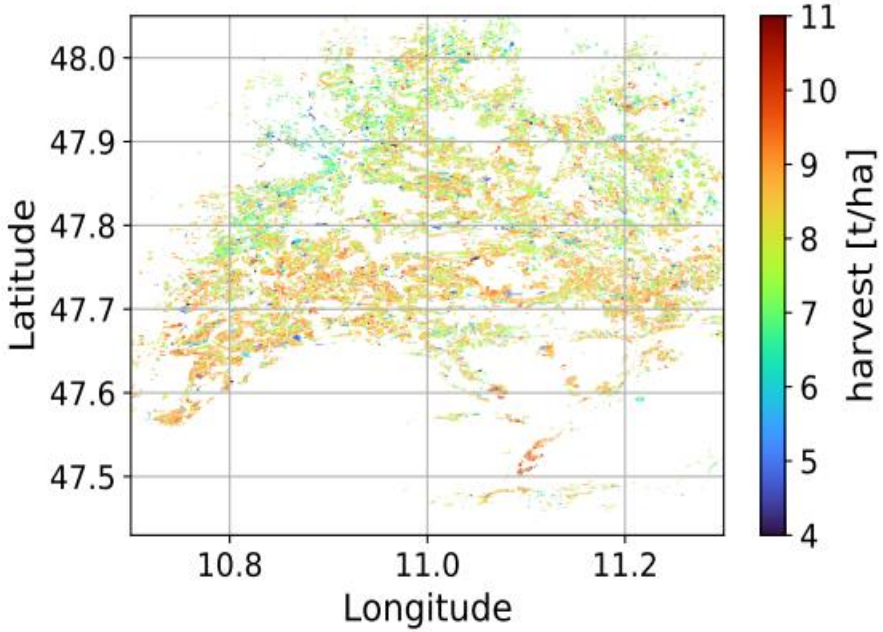
Grassland yields and N_2O emission

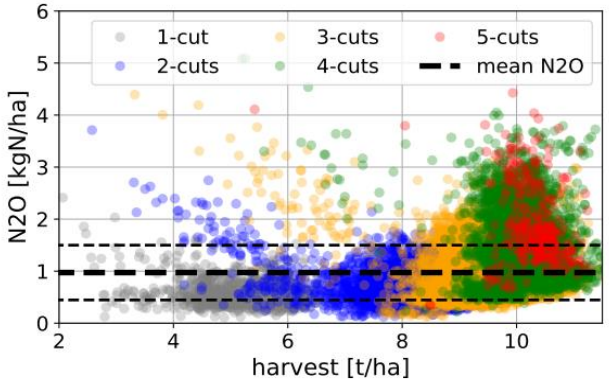
normal year



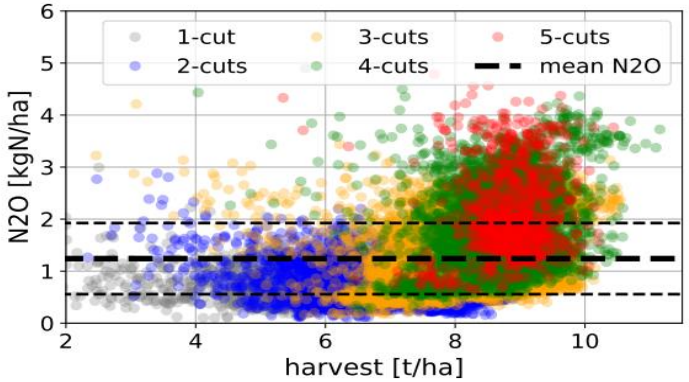
10% yield reduction

drought year

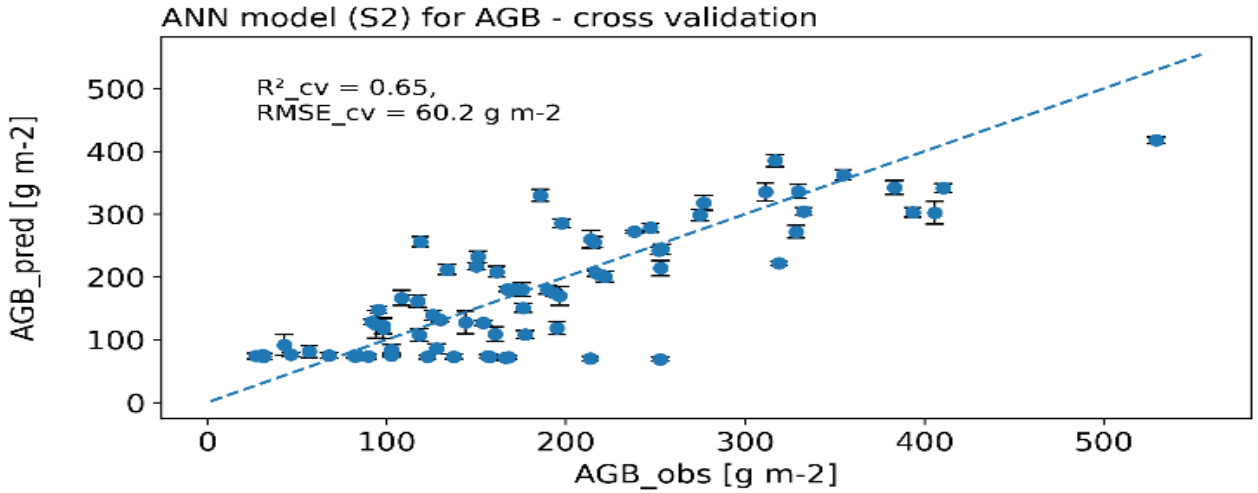


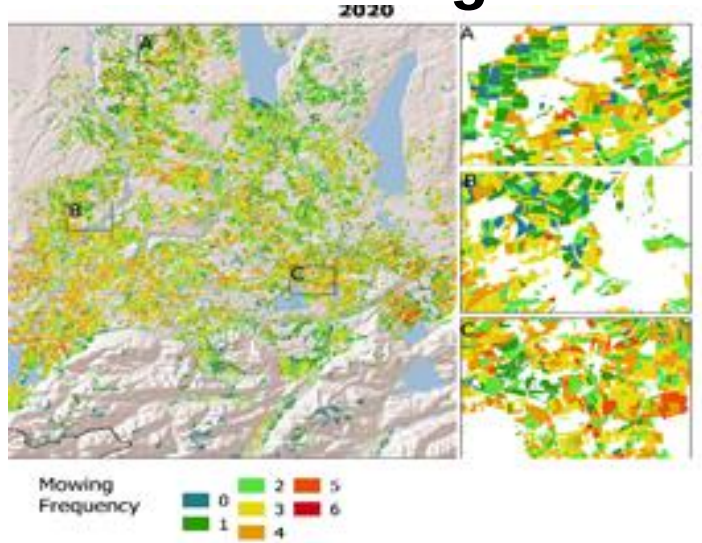


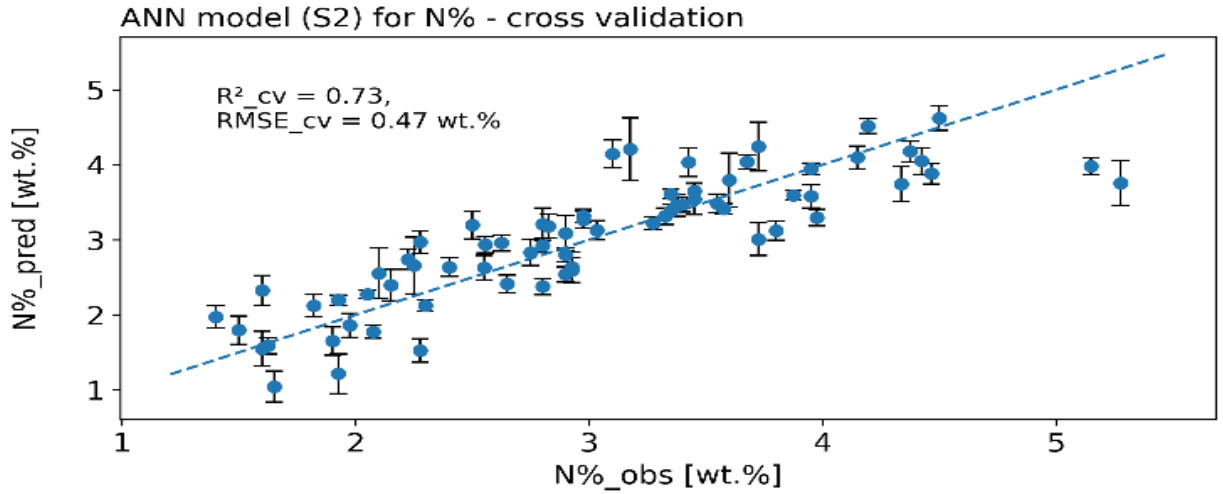
20% increase N_2O emission

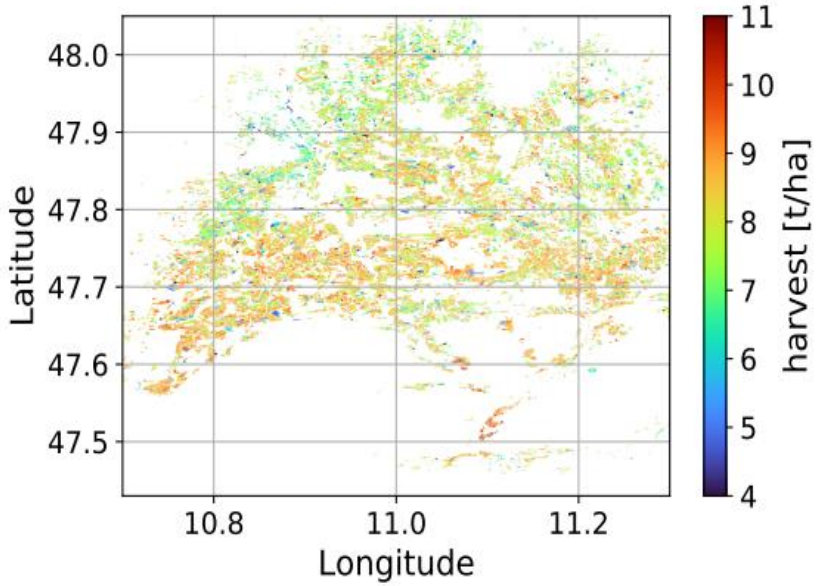


Outlook: Remote Sensing (Sentinel 2) and Biogeochemical modelling



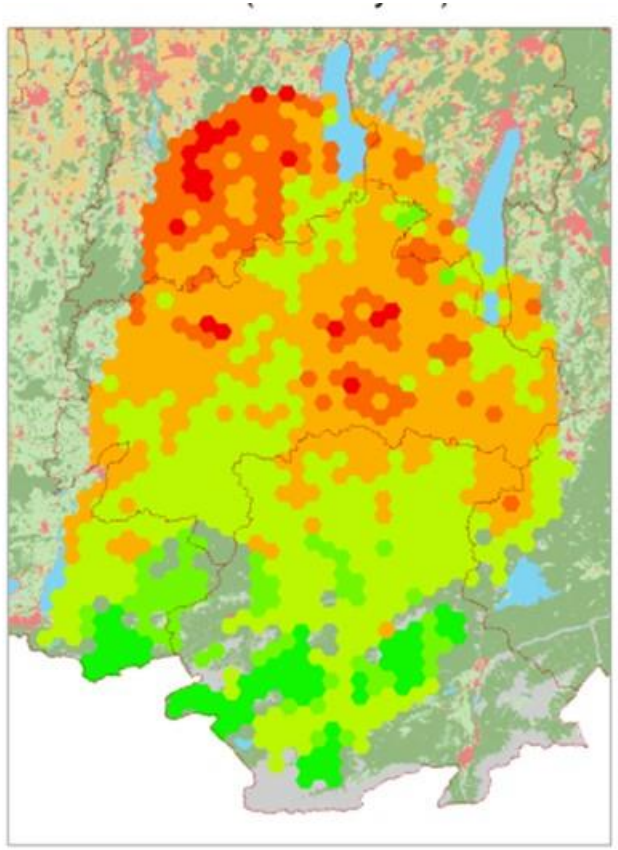


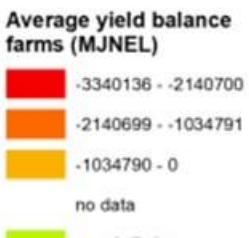




Outlook: Regional upscaling of grassland functions/ services

Yields vs. feed demand





Intensive Management

Productivity

≠

SOC storage

+

Extensive Management

Biodiversität

Summary

In temperature limited regions climate change will increase yields, except under severe drought conditions

Risk of sever drought increases from high 1200m to lower 600m elevation in the study region (1000 mm MAP)

Grassland productivity is highly supported by mineralization of soil organic nitrogen

Soil N mineralization increase under climate change but decreases at severe drought conditions

Overall, increased mineralization leads to decreasing soil organic N and C stocks with risks on important soil functions e.g. fertility, C sequestration on the long term

To make use of the climate changed induced yield stimulation and stabilization of SOC and N, fertilization rates need to be adapted

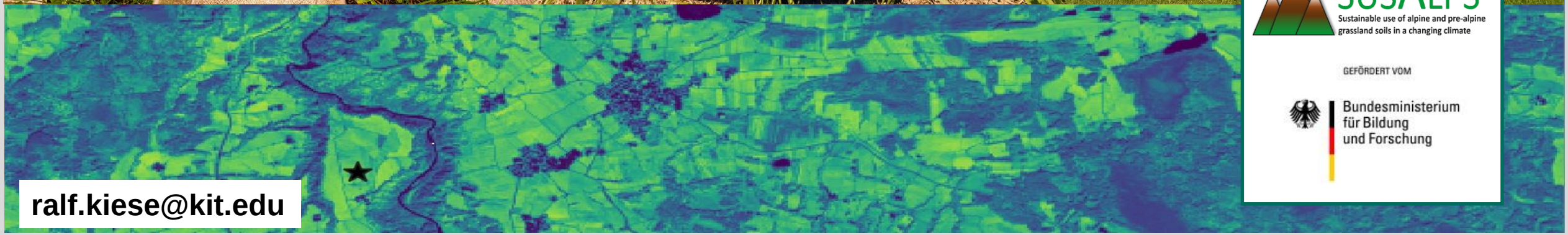
Optimizing grassland ecosystem services (productivity, SOC/N, biodiversity) need to be done on farm and landscape scale

Thanks for your attention

TERENO
TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

SUSALPS
Sustainable use of alpine and pre-alpine grassland soils in a changing climate

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung



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