Impacts of Increased Agricultural Irrigation on Regional Groundwater Recharge

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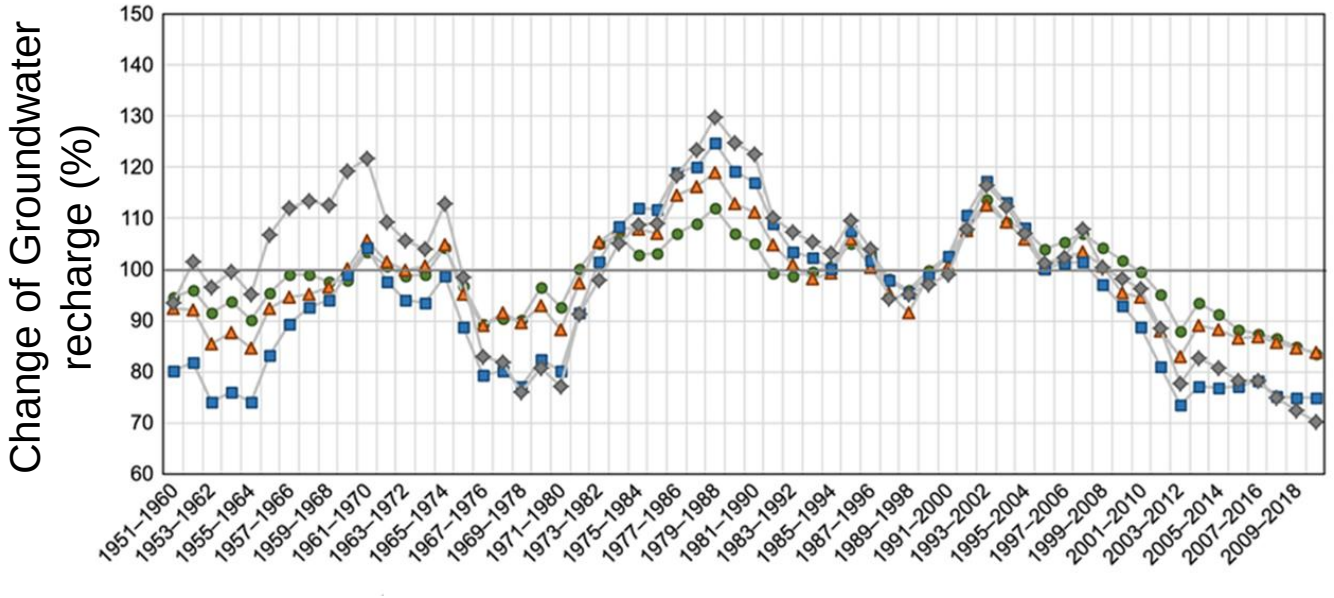
Ground water resources in southern Germany

- Decline in groundwater recharge
- More frequent and intense droughts during the growing season

→ Will increased irrigation demand leads to potential water use conflicts?

→ How will more frequent irrigation affect groundwater recharge?

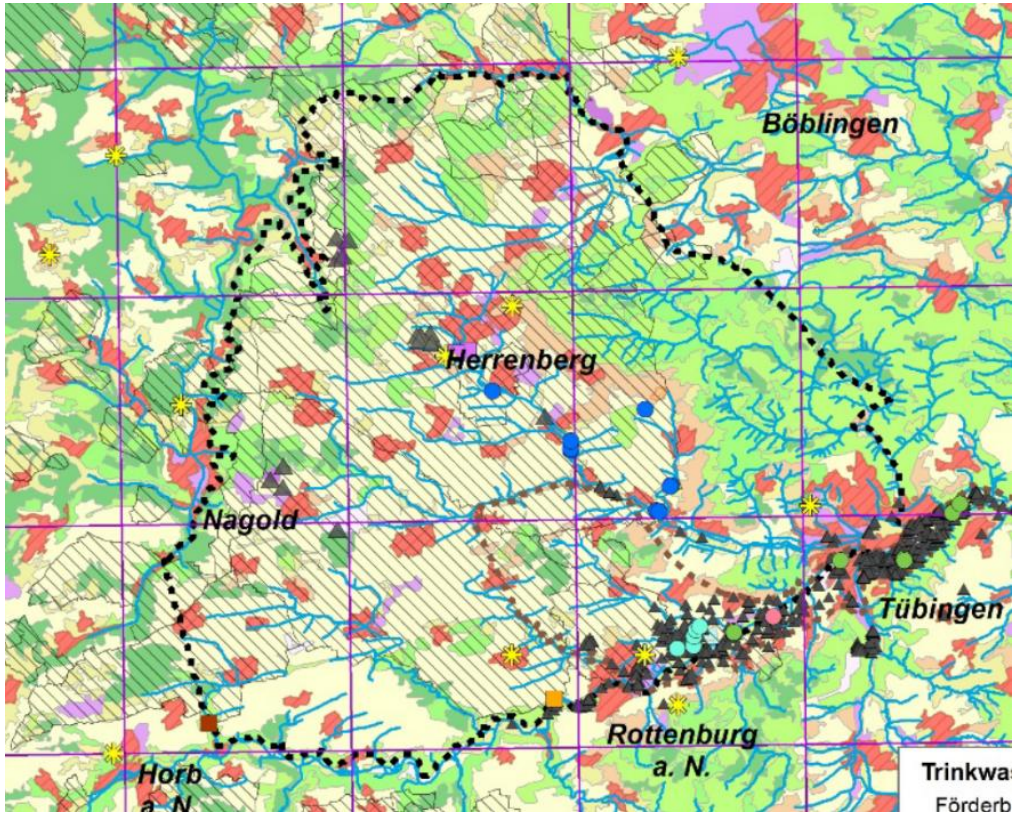


Change in groundwater recharge compared to 1971–2000: 10-year moving average for four southern German states (Gudera, 2021)

Case Study Area

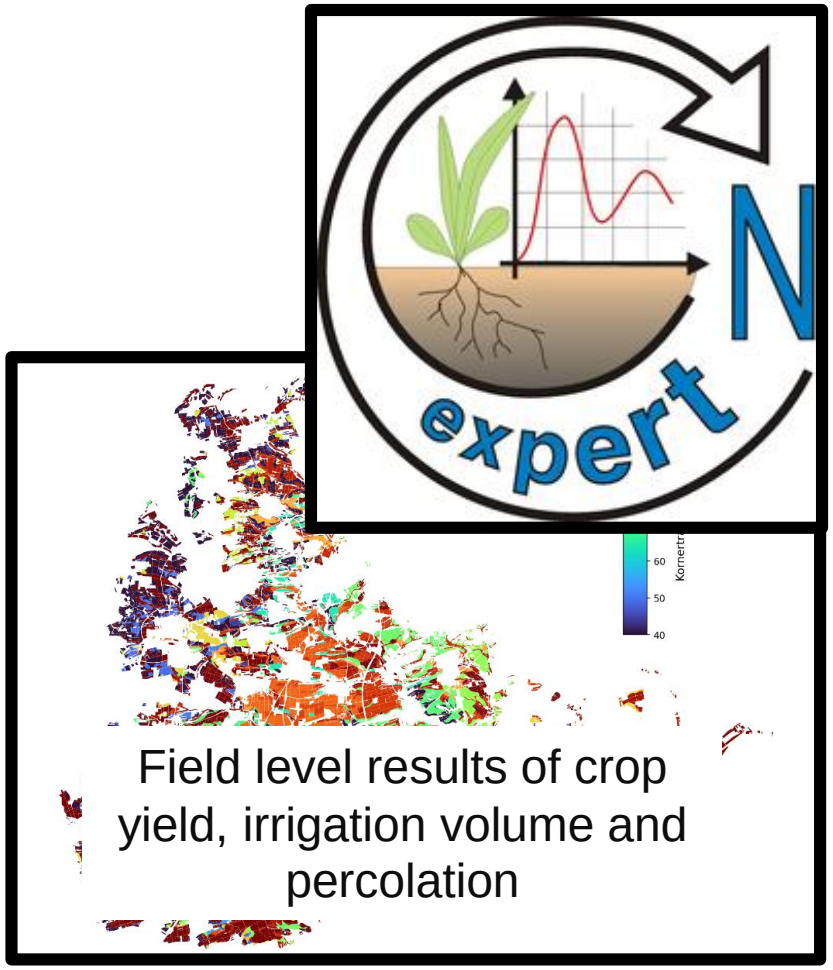
- Located approximately 20 km south of Stuttgart
- Covers an area of around 400 km²
- High proportion of arable land (over 40%)
- Main crops: winter wheat, spring barley, and winter rapeseed
- Currently no significant irrigation

→ High-resolution regional modelling of irrigation



Model setup

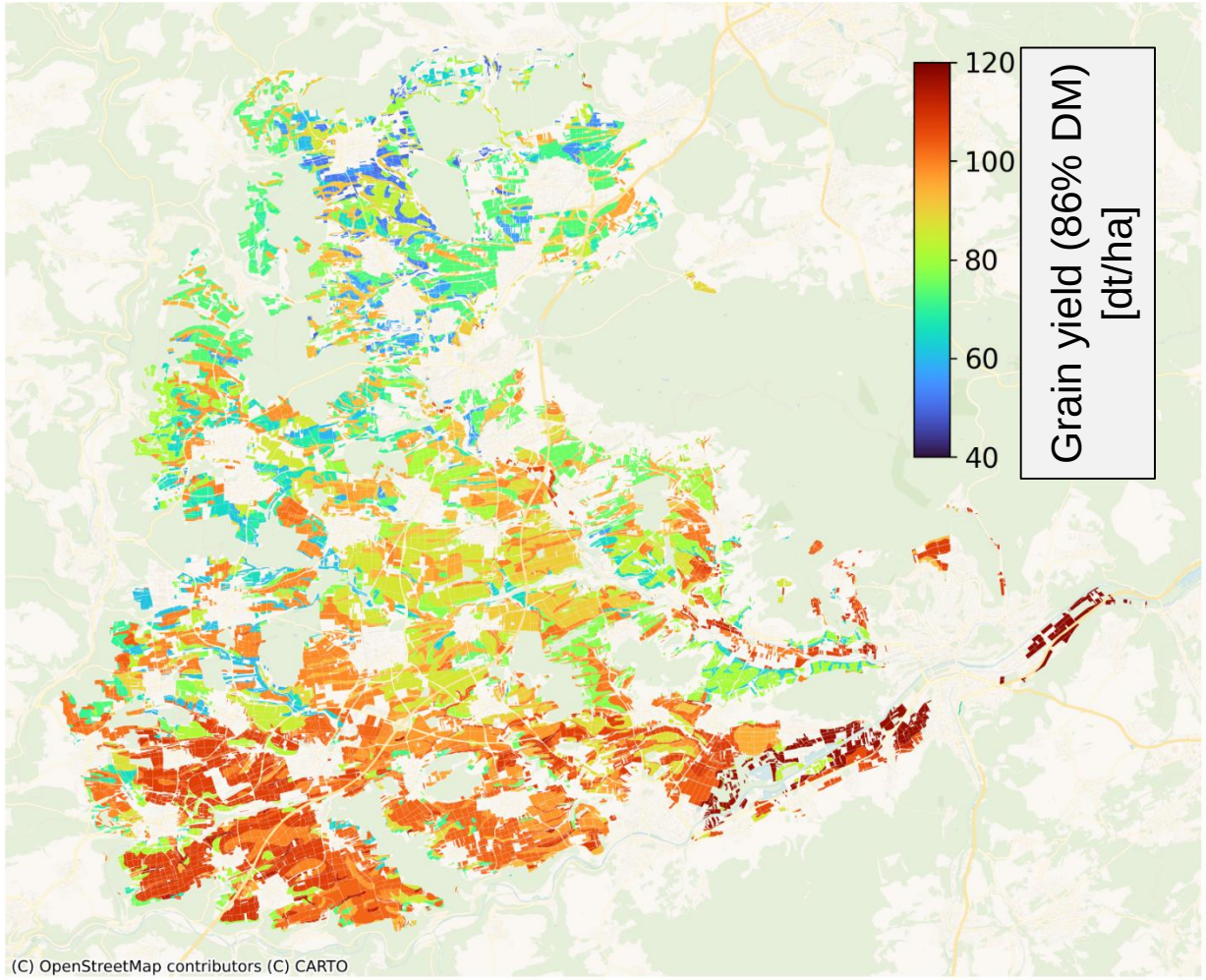
- Crop model: ExpertN-Spass Winter wheat
- 14 Projections of RCP 8.5 (KLIWA Ensemble)
- Irrigation schemes according to ALB-App
  - Irrigation when soil moisture drops below threshold
  - Threshold depends on plant‘s BBCH stage
- 3 Economical evaluation levels:
  - No economical constraints (all fields)
  - Irrigation economical when system available (+1.5 t/ha required)
  - Irrigation economical even when buying system (+3.5 t/ha required)



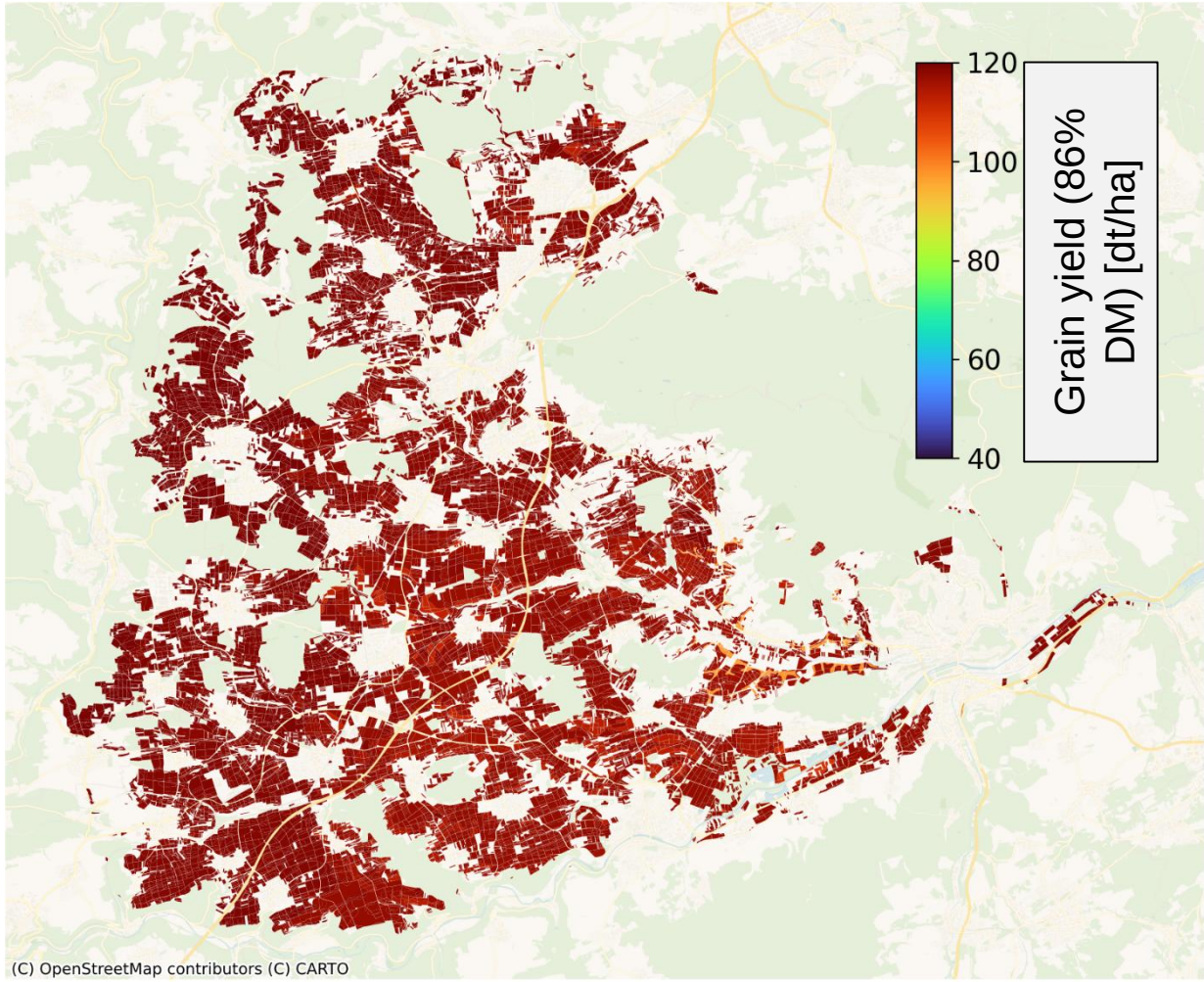
Field level results of crop yield, irrigation volume and percolation

→ Results presented as 30-year moving averages

Effect of irrigation on grain yield

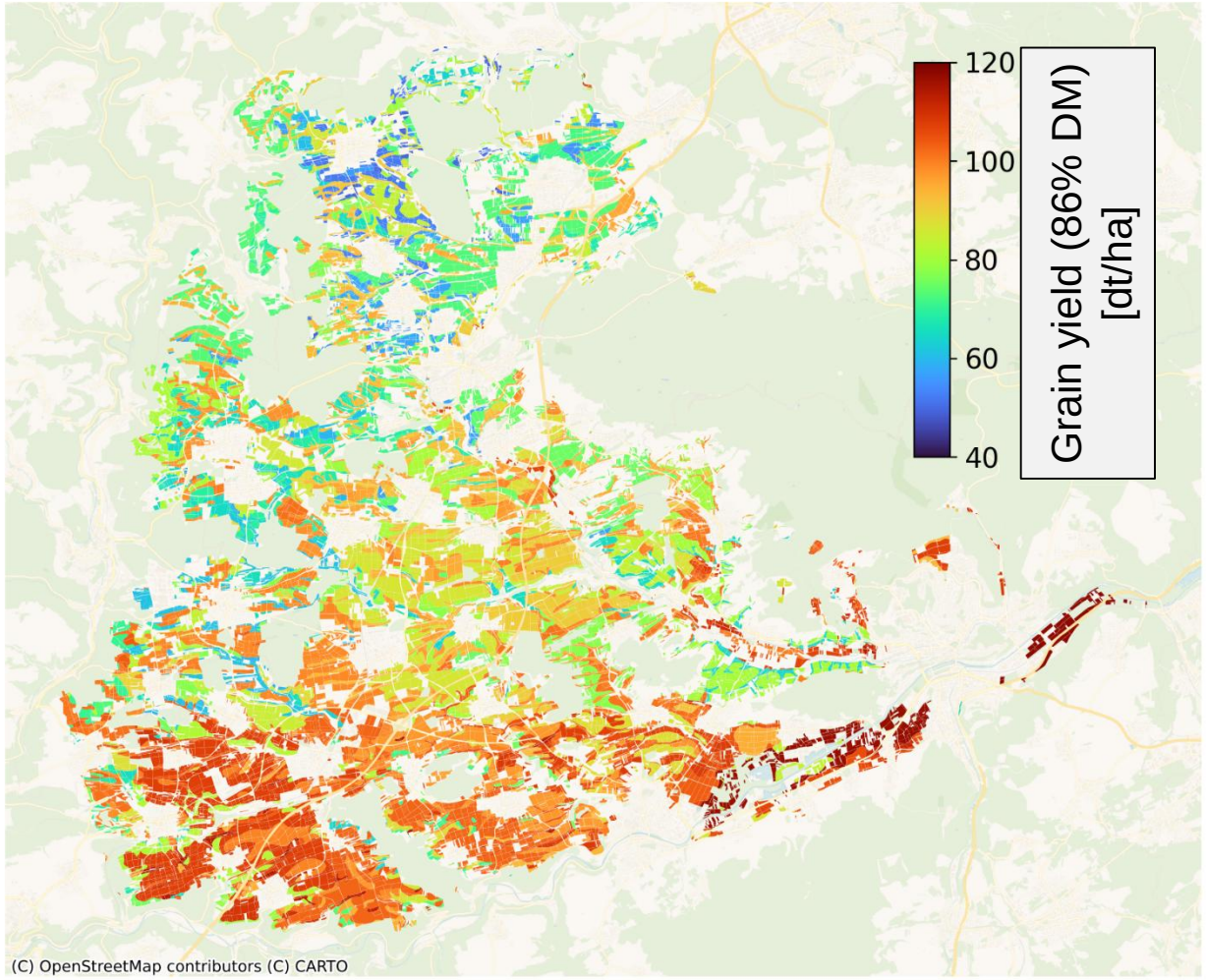


No irrigation

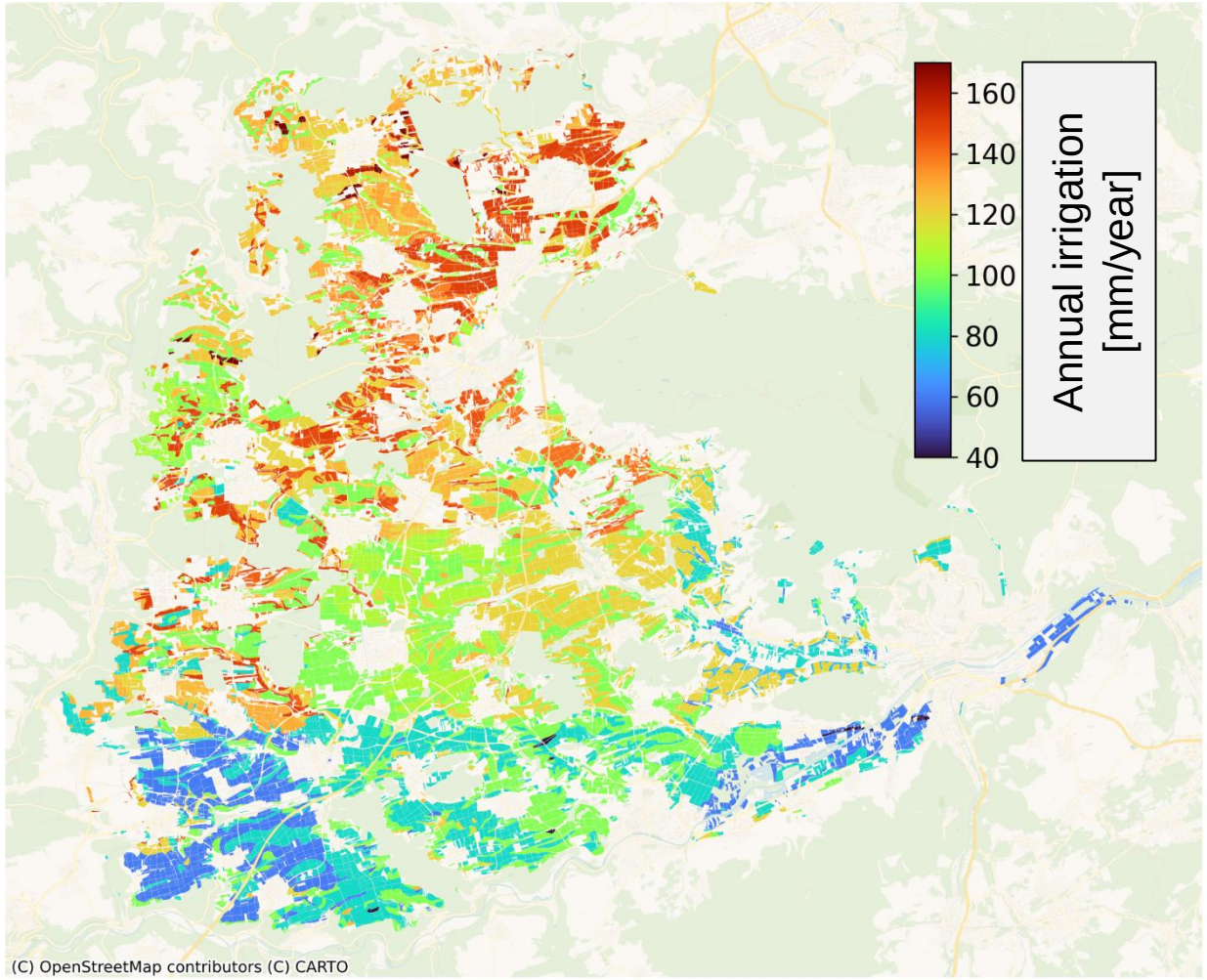


Irrigated

Spatial Distribution of Irrigation Water



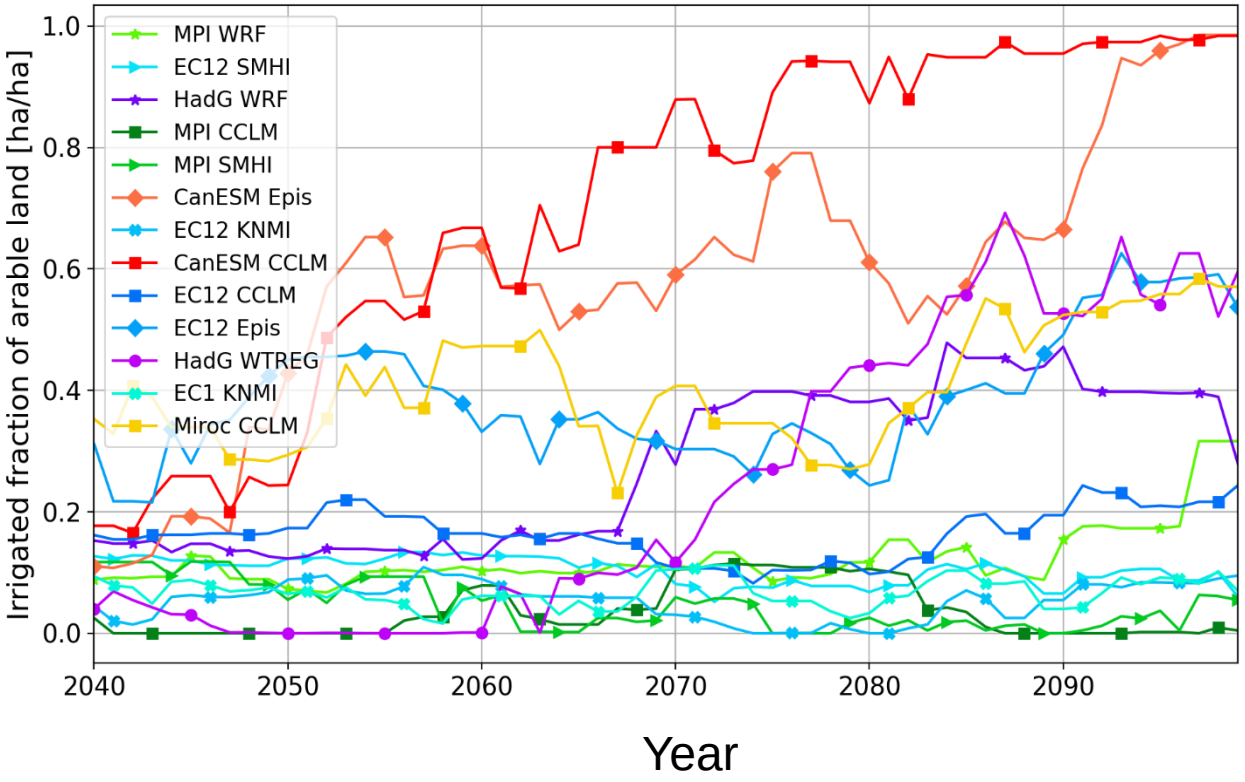
Grain yield – no irrigation



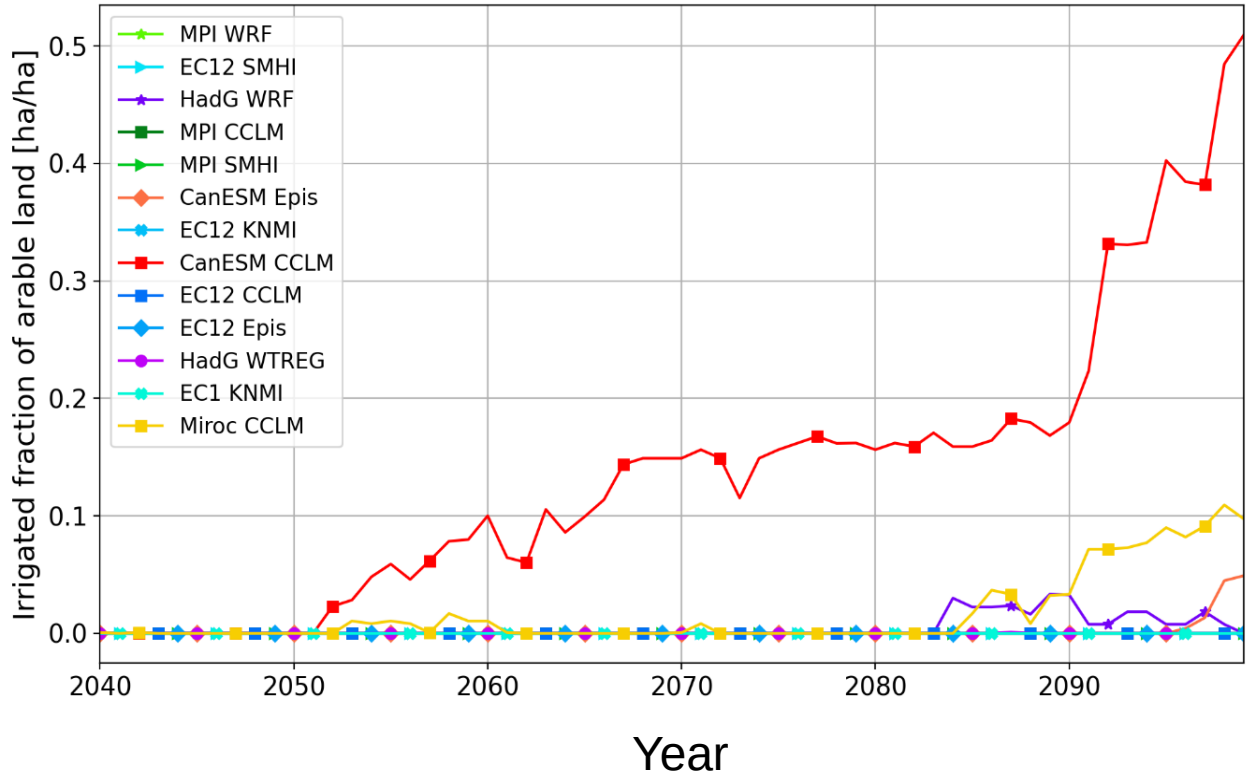
Irrigation volume (irrigated)

Areas meriting irrigation due to yield gains

Irrigation system already available

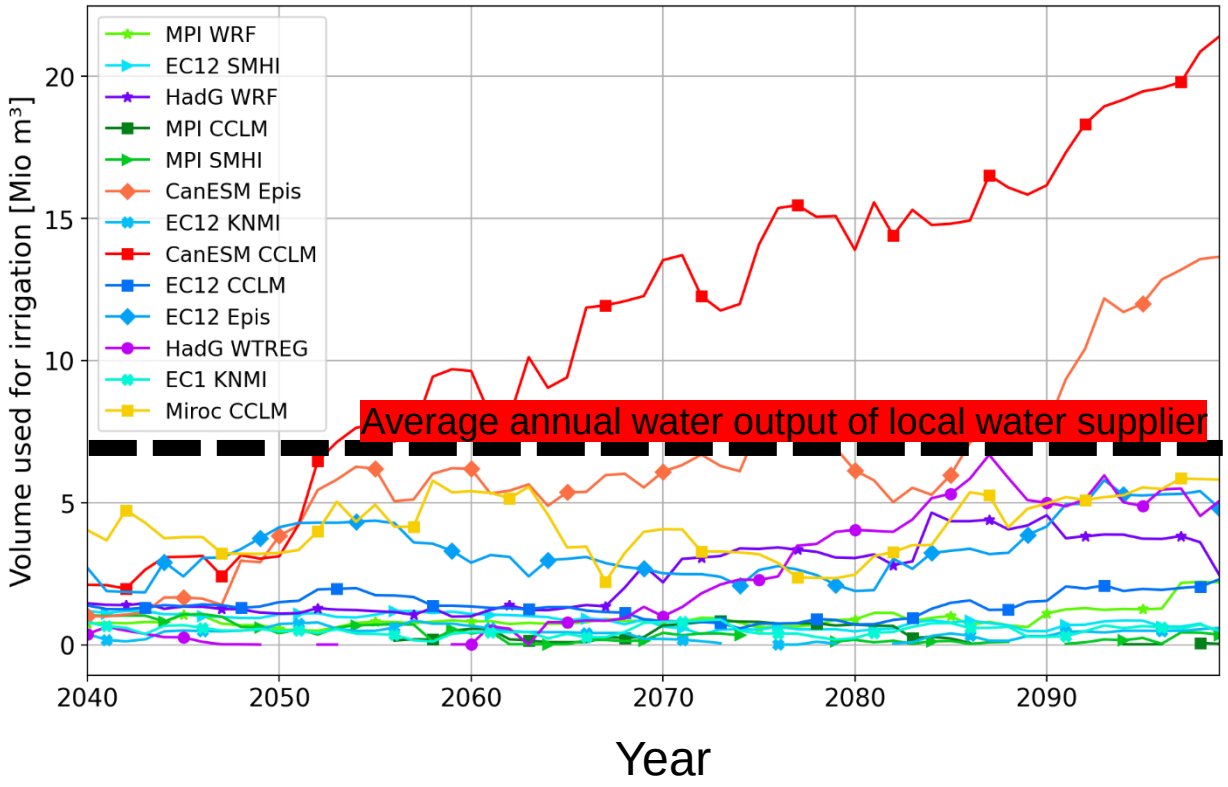


Irrigation infrastructure needs to be acquired



Irrigation water demand for the region

Irrigation system already available



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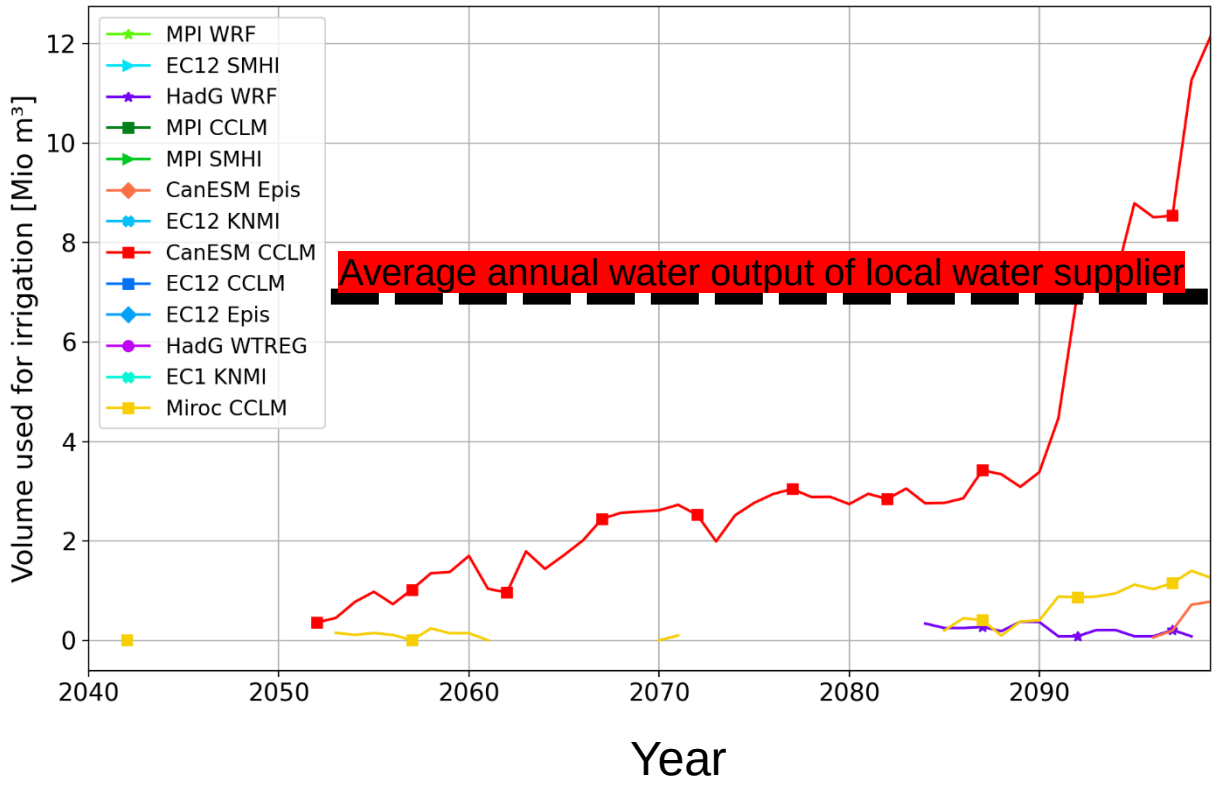
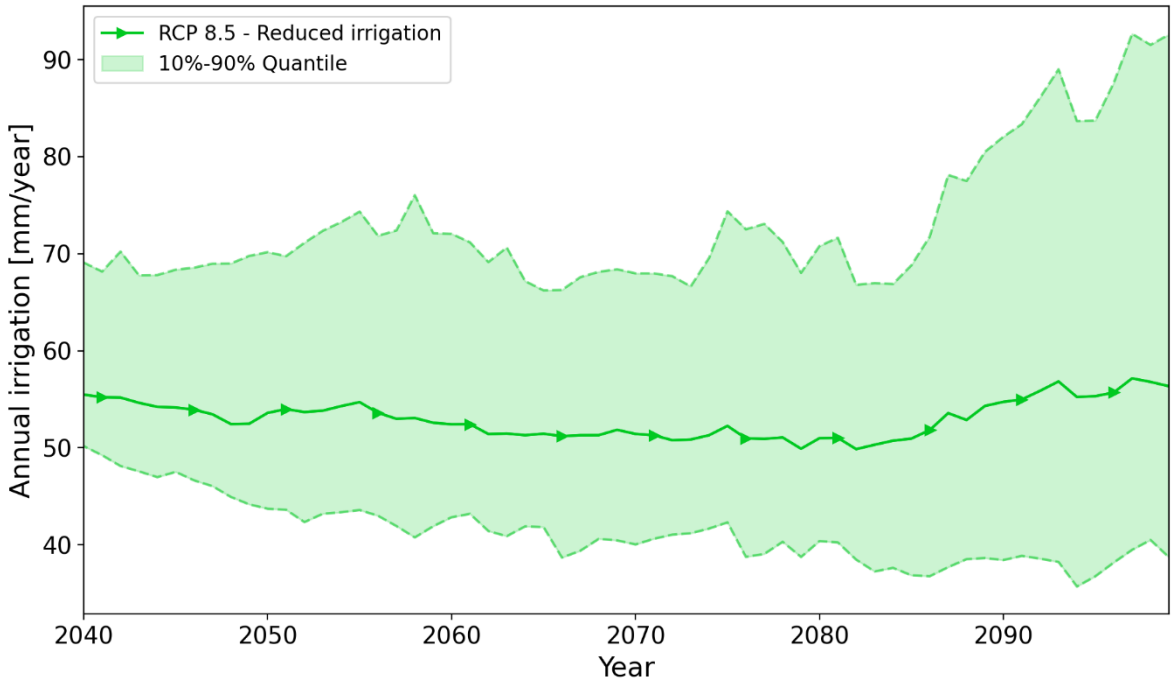
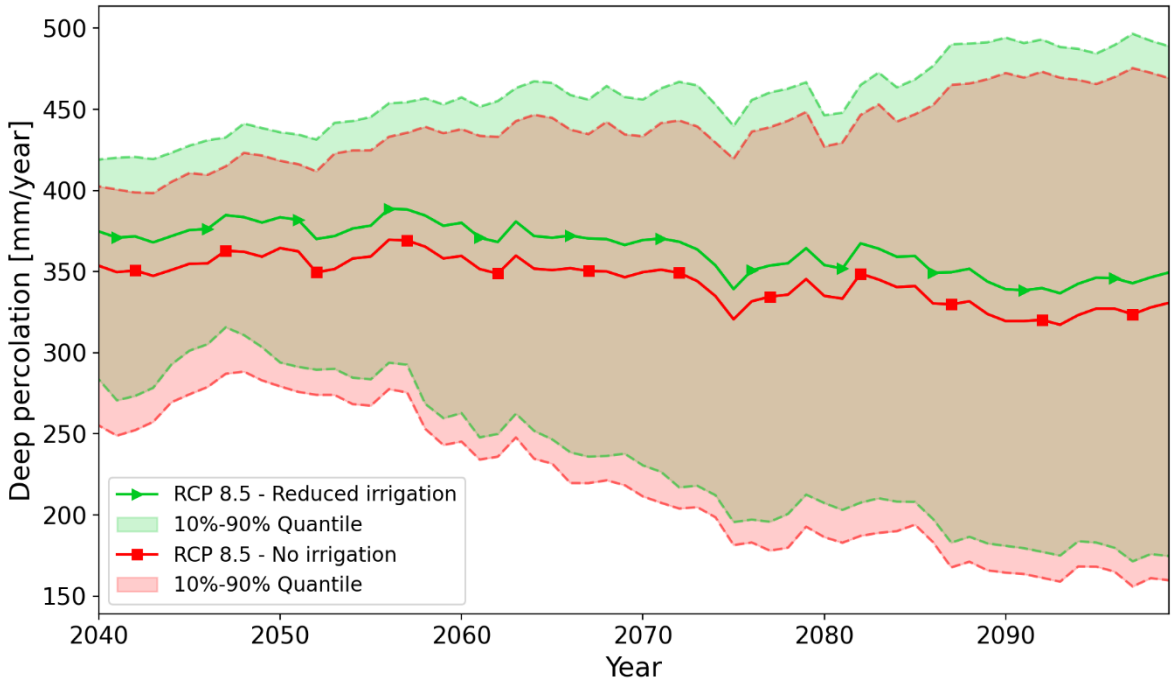


Impact of irrigation on deep percolation

Option: Irrigation system already available (Quantiles of all projection means)





Summary and outlook

- Under most scenarios, irrigating winter wheat will not be economically viable in the study region

- If irrigation systems were installed for other crops (or costs borne by subsidies), irrigation water use would be in the of the local water utility's annual supply

- Approximately 20% to 35% of the applied irrigation water contributes to groundwater recharge

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FONA Forschung für Nachhaltigkeit

LURCH Grundwasser nachhaltig bewirtschaften

Thank you for your attention

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