

A regional assessment of land-based carbon mitigation potentials: bioenergy, BECCS, reforestation, and forest management

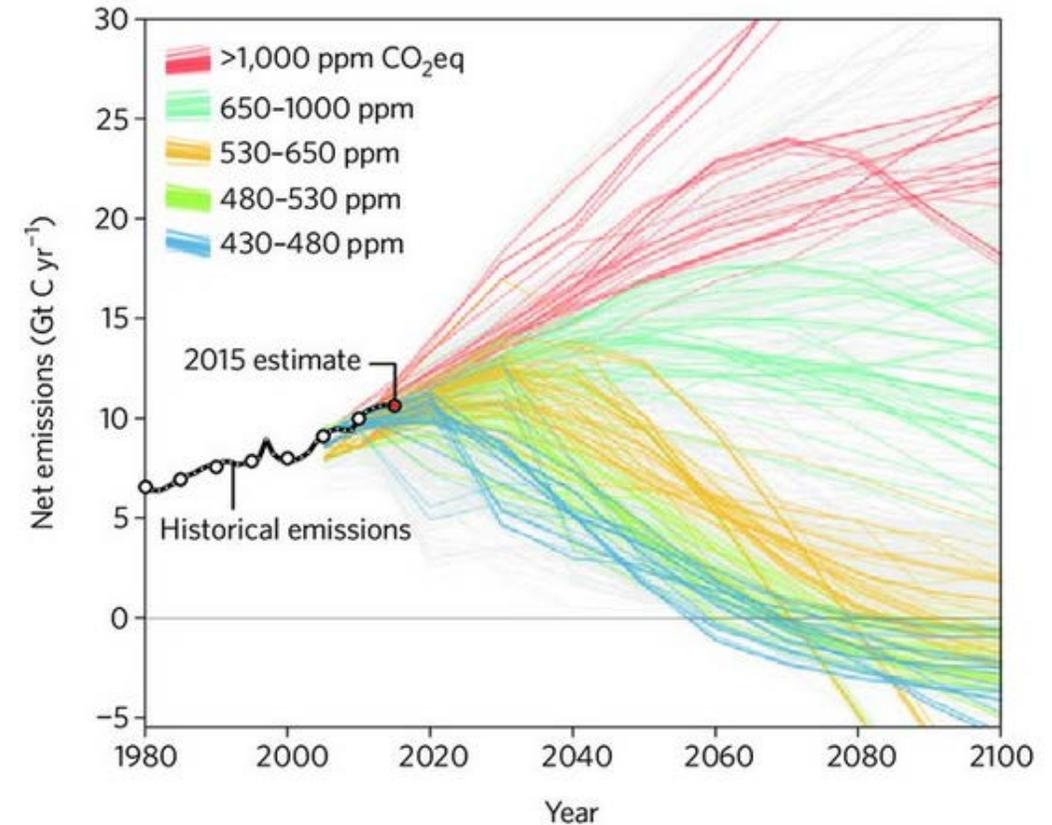
Andreas Krause¹, Thomas Knoke¹, Anja Rammig¹

¹ Technical University of Munich, TUM School of Life Sciences Weihenstephan, Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, Germany

andy.krause@tum.de

Motivation

- Land-based solutions play a prominent role in climate mitigations scenarios
- These scenarios are typically developed at global scale but in practice mitigation projects have to be realized regionally or locally
- What is the carbon mitigation potential of different land management options in Bavaria?



Smith et al. 2016

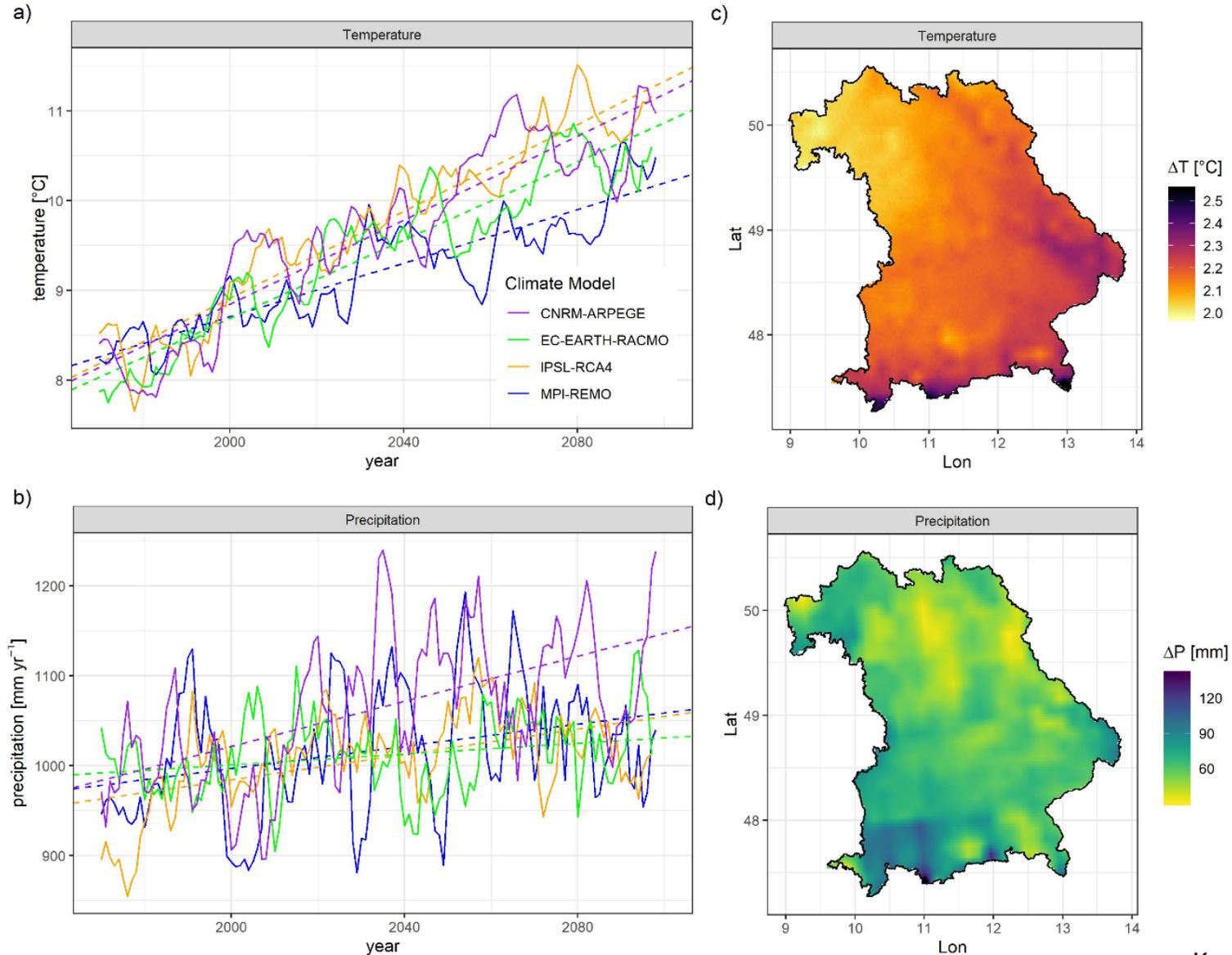
LPJ-GUESS ecosystem model

climate, CO₂, nitrogen, land use

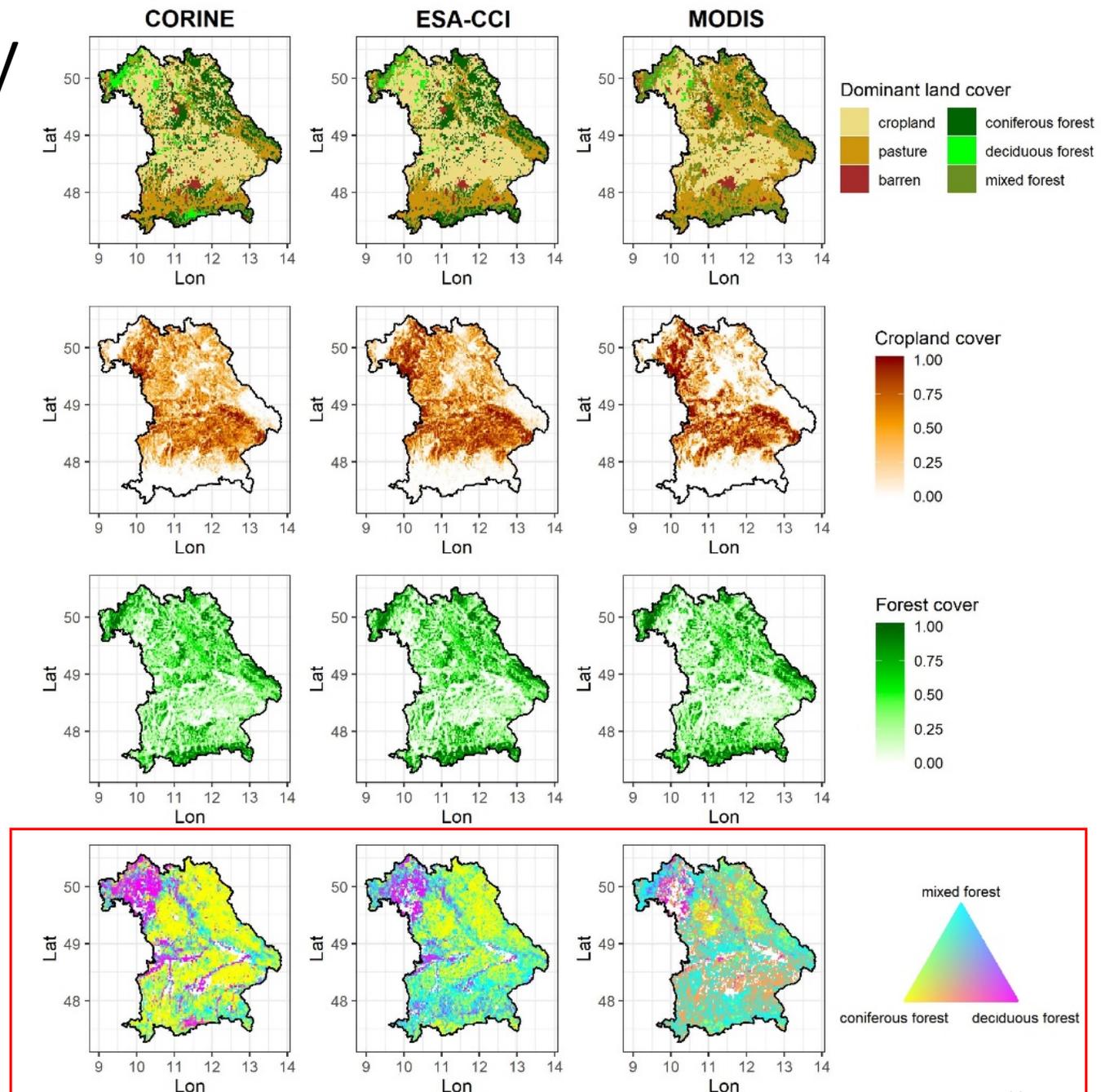


Animation by P. Papastefanou

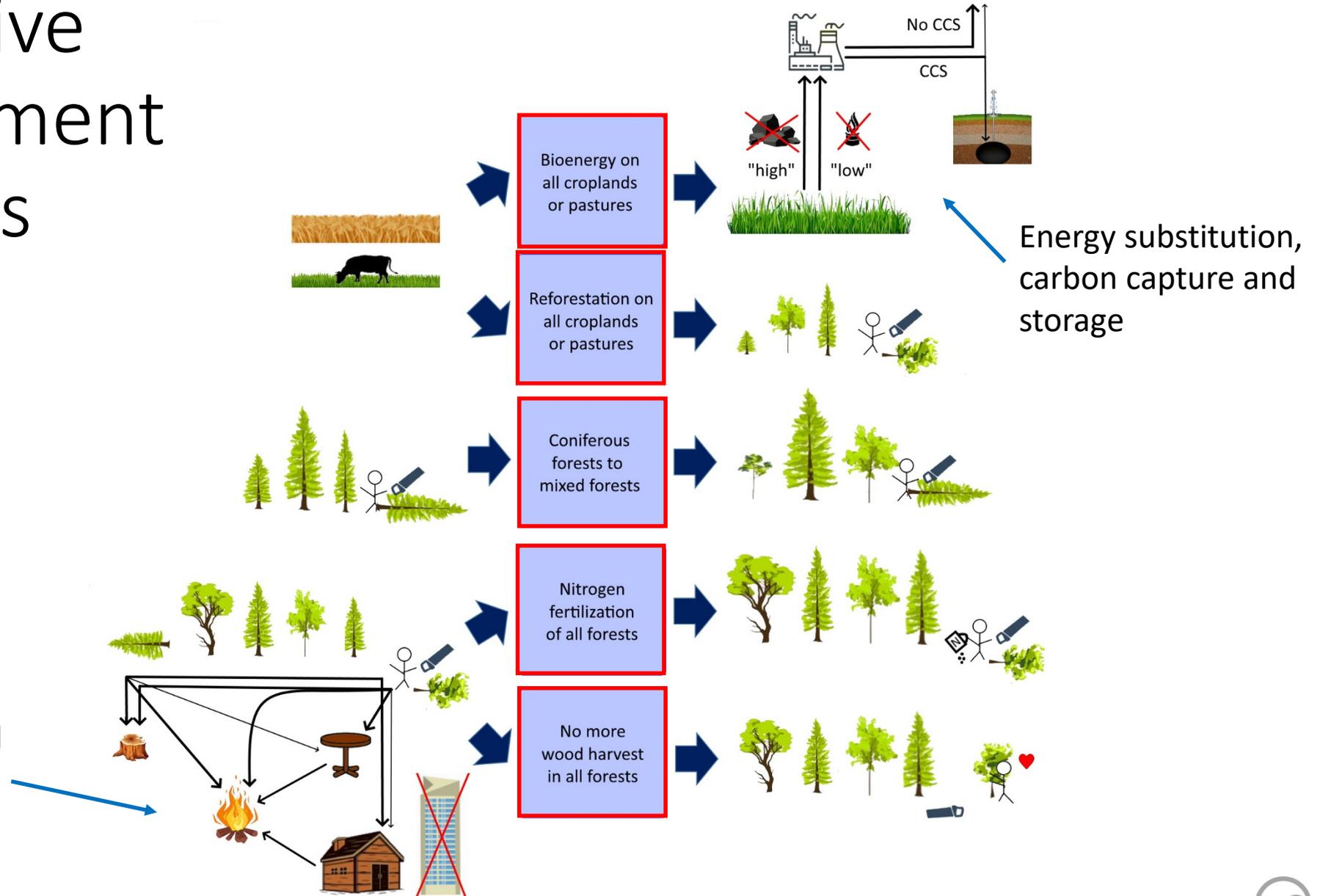
Forcing climate (EURO-CORDEX, RCP4.5)



Present-day land cover

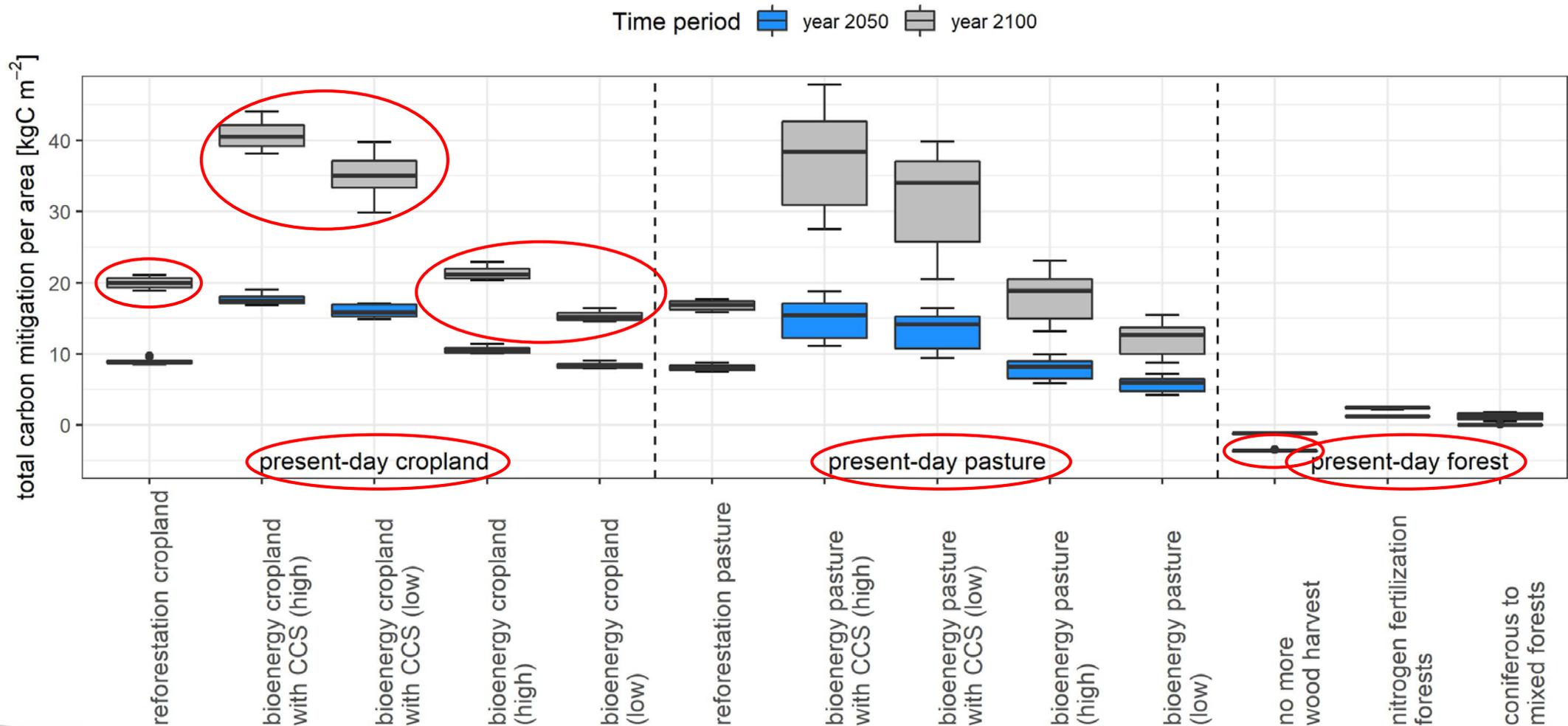


Alternative management scenarios

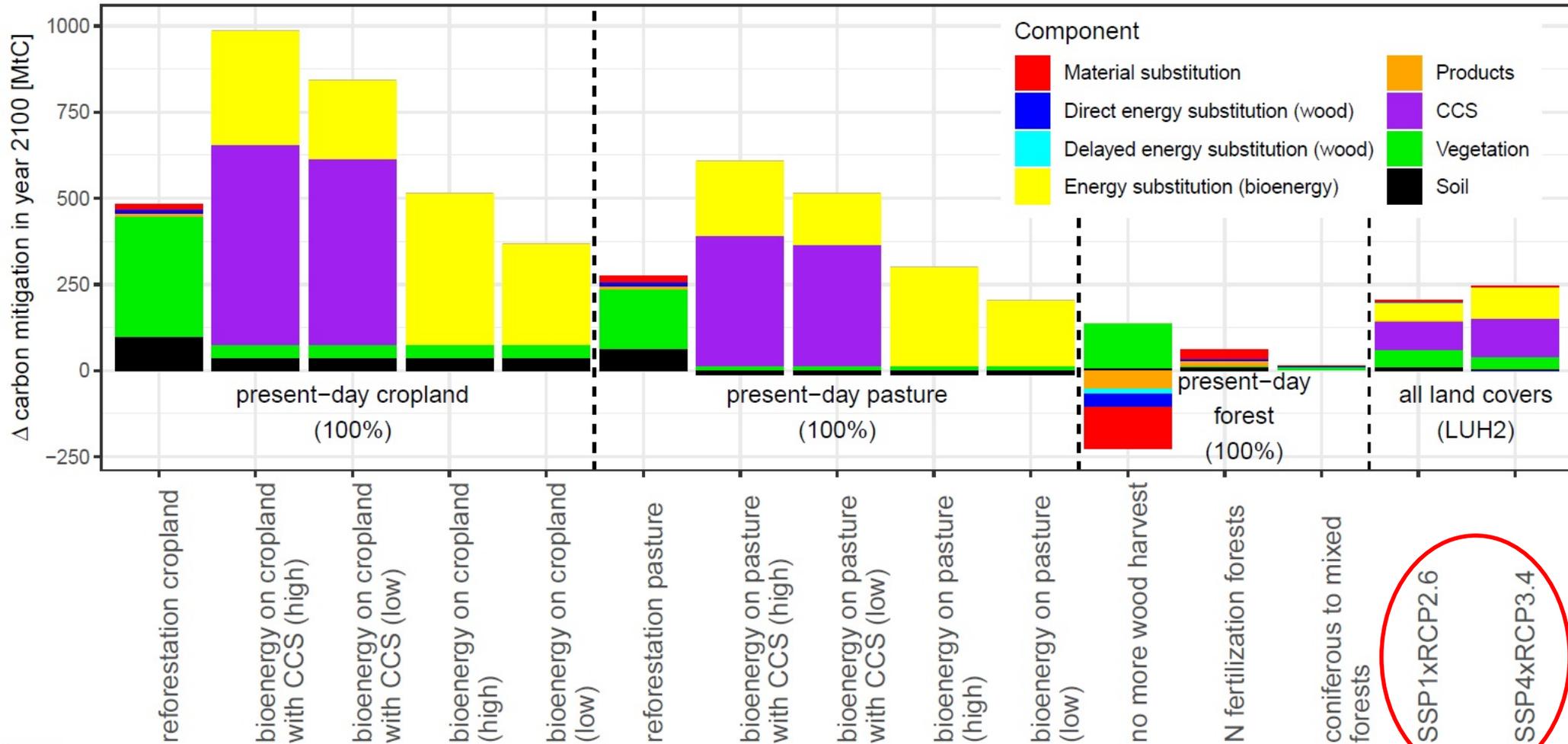


Energy and material substitution, wood products

Carbon mitigation via alternative management



Carbon mitigation via alternative management



Summary

- Without the carbon capture and storage technology, reforestation offers similar carbon mitigation potential as the cultivation of bioenergy crops
- If bioenergy crops are combined with CCS the mitigation potential is $\sim 2x$ larger
- In the forestry sector carbon mitigation potential is limited
- Land-based carbon mitigation can not substitute rapid fossil fuel emission reductions

Paper



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App

<https://andreaskrause.shinyapps.io/VegetationssimulatorBayern/>

Kohlenstoffspeicherung in Ökosystemen im Klima- und Landnutzungswandel

Jahr
 2020 | 2053 | 2100
 2020 2036 2052 2068 2084 2100

Klimaszenario (für ein mittleres Emissionsszenario - RCP4.5)
 Starke Temperaturzunahme, geringe Niederschlagszunahme, weniger Regentage

Landnutzungsszenario
 Stickstoffdüngung von Wäldern

Geplottete Variable
 Kohlenstoff in Nadelbäumen

Darstellung
 Absolut

Die hier gezeigten Daten stammen aus dem Vegetationsmodell LPJ-GUESS. Als Eingabedaten dienen verschiedene Klima- und Landnutzungsszenarien (siehe auch Krause et al., 2020).

Kohlenstoffspeicher werden in kgC/m² angegeben, wobei 1 kgC etwa 3,67 kgCO₂ entspricht. Zum Vergleich: die jährlichen CO₂ Emissionen durch fossile Brennstoffe in Bayern betragen gut 20 MtC bzw. 0,3 kgC/m². Zu beachten ist, dass einige Prozesse die zum Baumsterben führen können (z.B. Borkenkäferbefall, Windwurf) im Modell nicht explizit simuliert werden. Die Anfälligkeit insbesondere von

