

Land use-climate feedbacks – Reconciling mitigation and adaptation

note: Day 3 will cover representation of land use in scenario and model development

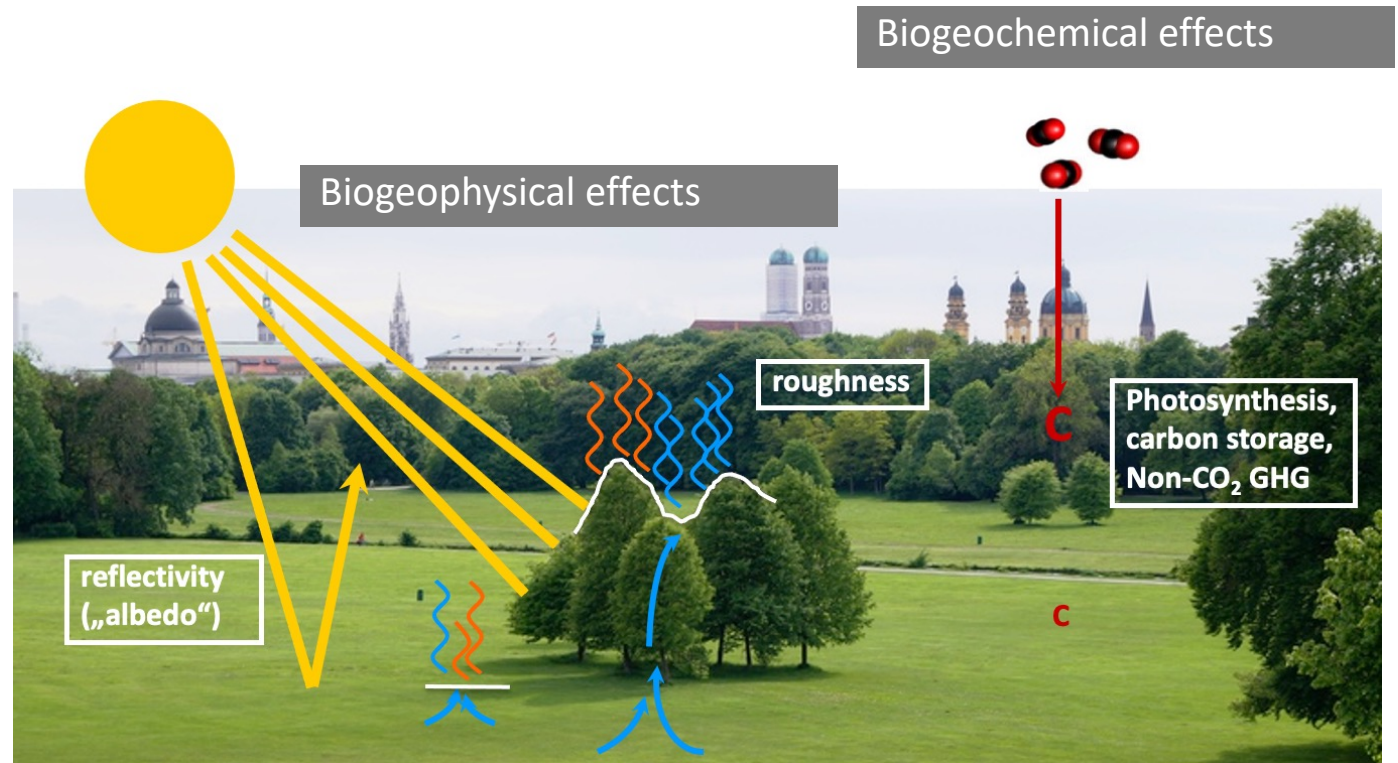
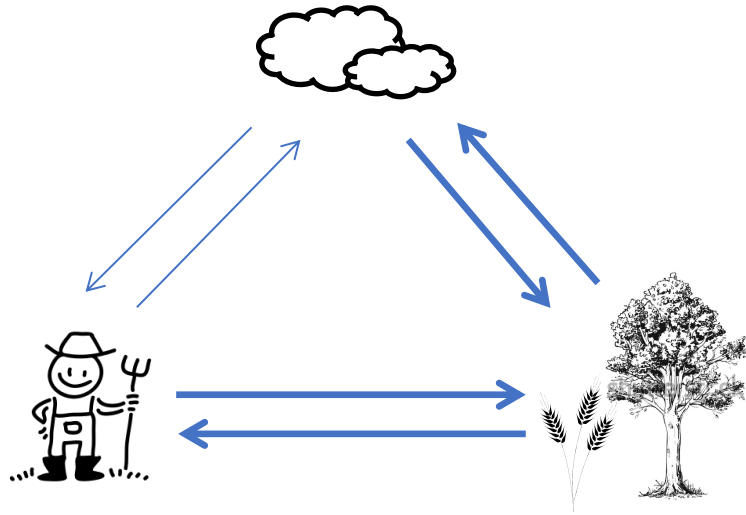
Julia Pongratz

with input from HERMITIAN Working group (modelling Human-
EnviRonMental InTeractions In the ANthropocene)

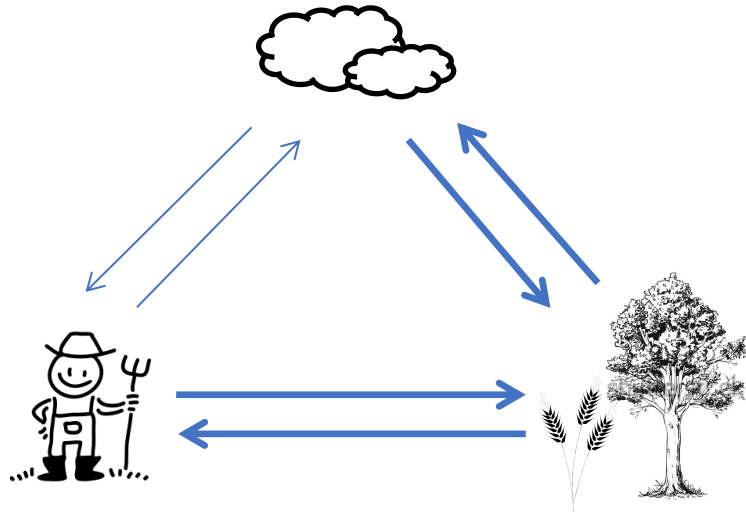
Victor Brovkin, Galina Churkina, Jonathan Donges, Matthias Garschagen,
Thomas Kastner, Tobias Kuemmerle, Mark Rounsevell, Jürgen Scheffran



Land use-climate feedbacks



Land use-climate feedbacks

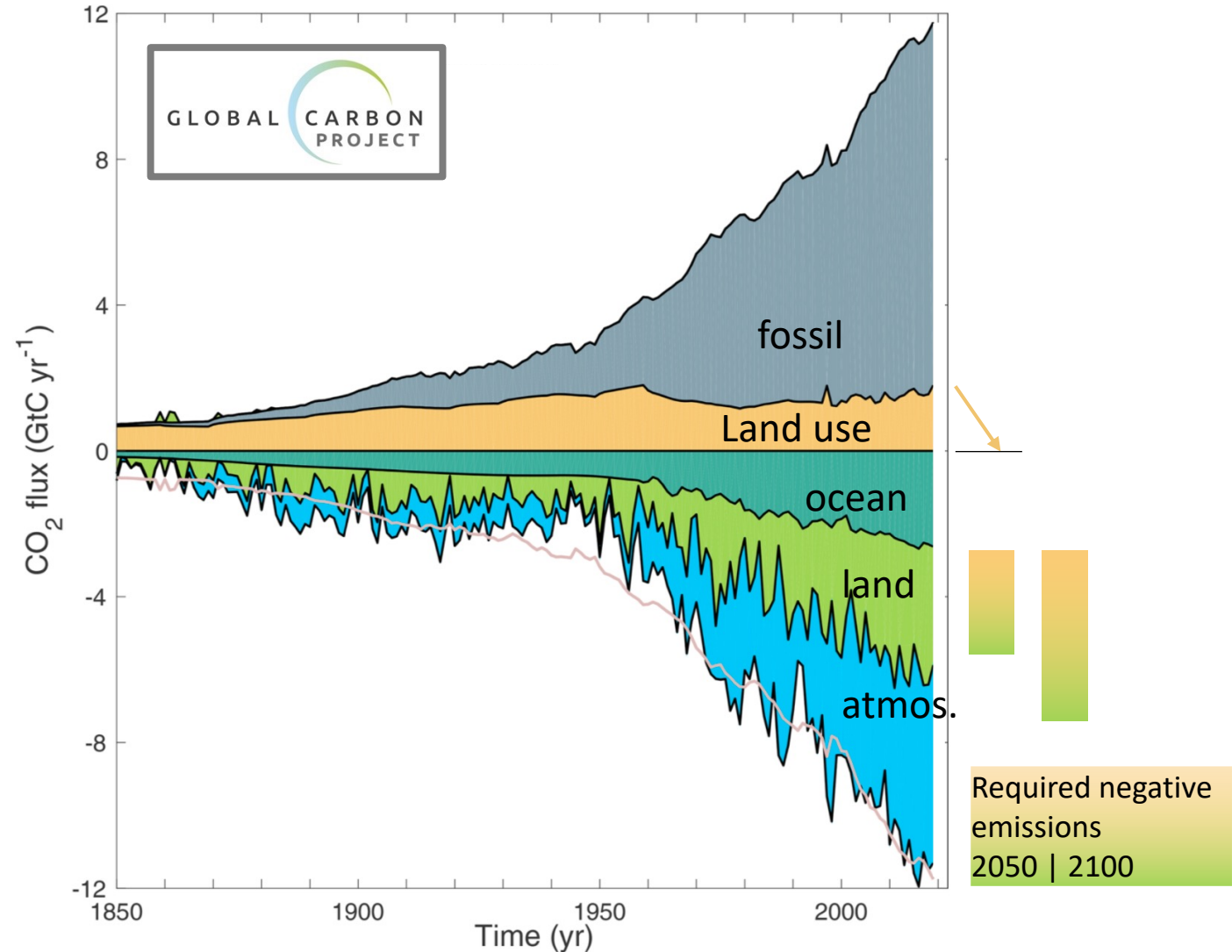


... as does climate change impact on ecosystems

US/Canada
heat wave,
July 2021

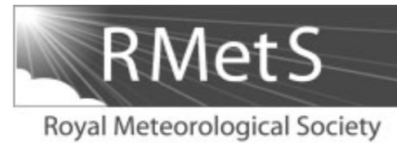


Reliance of humans on land for climate mitigation grows stronger....



A short history of land use in global climate assessments

INTERNATIONAL JOURNAL OF CLIMATOLOGY
Int. J. Climatol. (2010)
Published online in Wiley InterScience
(www.interscience.wiley.com) DOI: 10.1002/joc.2150



Research priorities in land use and land-cover change for the Earth system and integrated assessment modelling[§]

Kathy Hibbard^{a,*†}, Anthony Janetos,^b Detlef P. van Vuuren,^c Julia Pongratz,^d Steven K. Rose,^e
Richard Betts,^{f‡} Martin Herold^g and Johannes J. Feddema^h

CMIP5 preparations: For the first time,
land use is a forcing (LUH1)!



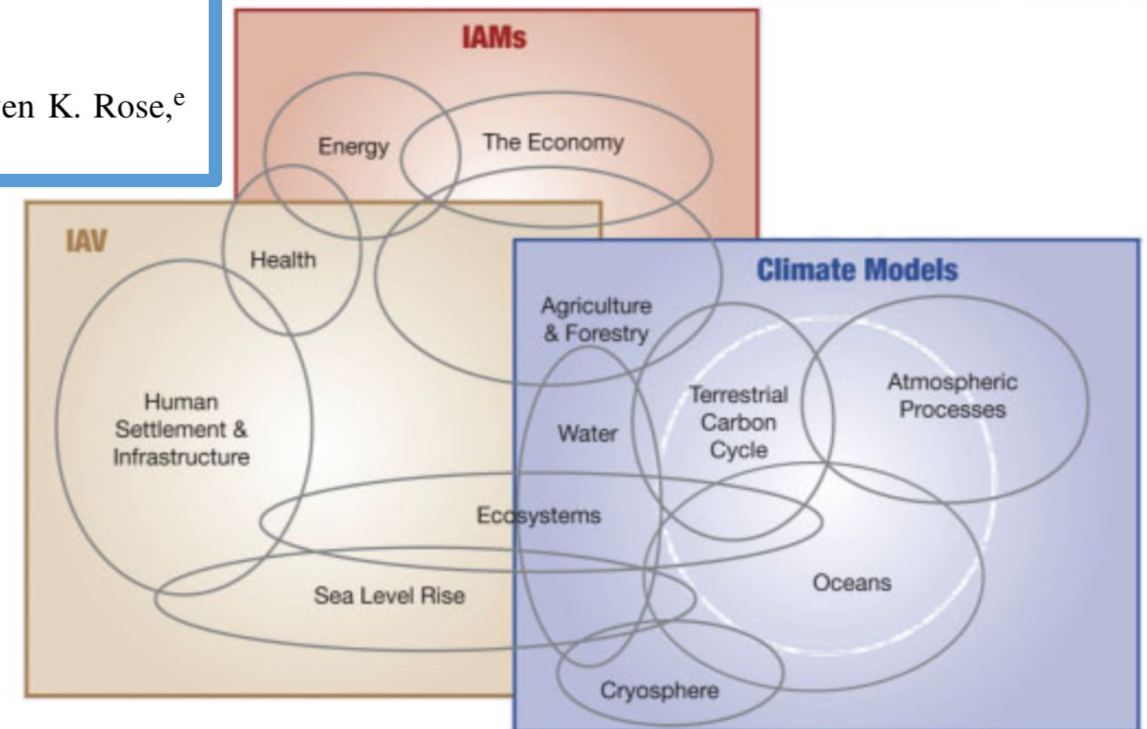
Land use likely one of the most important
reasons to couple IAMs and ESMs

IOP PUBLISHING
Environ. Res. Lett. 7 (2012) 024012 (10pp)

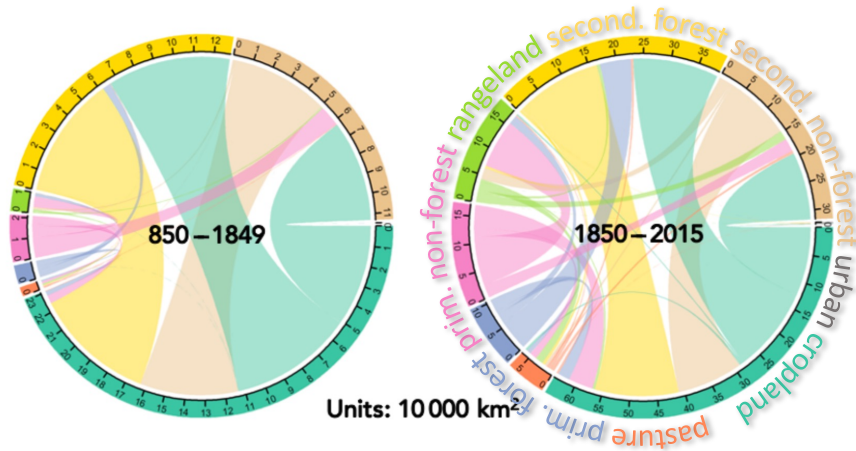
ENVIRONMENTAL RESEARCH LETTERS
doi:10.1088/1748-9326/7/2/024012

A comprehensive view on climate change: coupling of earth system and integrated assessment models

Detlef P van Vuuren^{1,2}, Laura Batlle Bayer³, Clifford Chuwah⁴,
Laurens Ganzeveld⁵, Wilco Hazeleger^{4,5}, Bart van den Hurk^{3,4},
Twan van Noije⁴, Brian O'Neill⁶ and Bart J Strengers¹



A short history of land use in global climate assessments

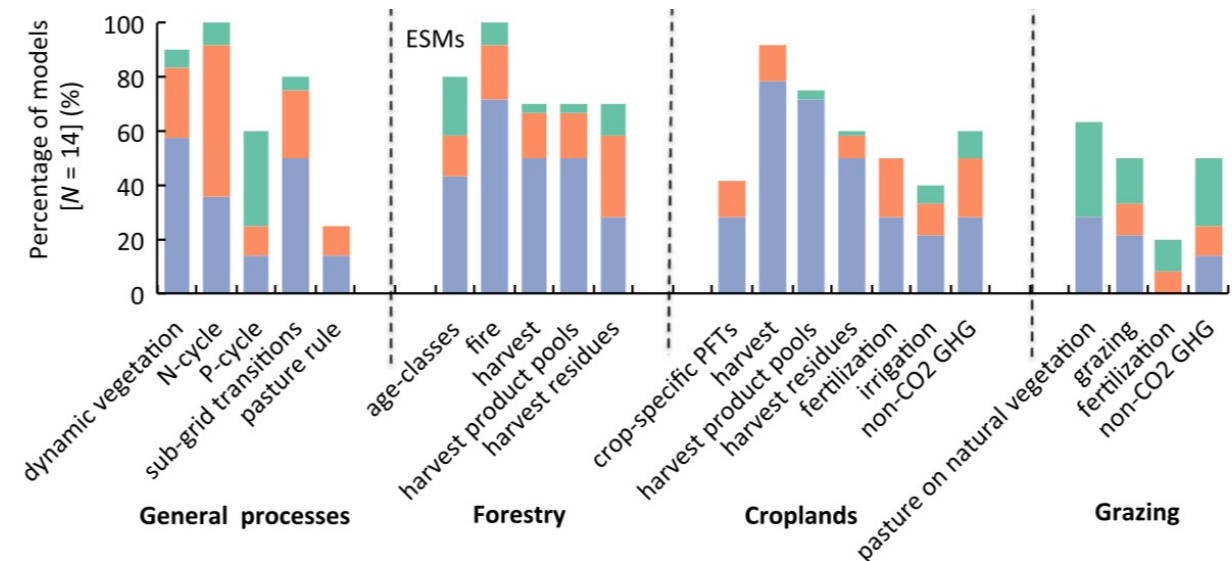


CMIP6: >50 times the information of CMIP6 (LUH2) (higher res; + irrigation, rice, wood harvest types, biofuels)

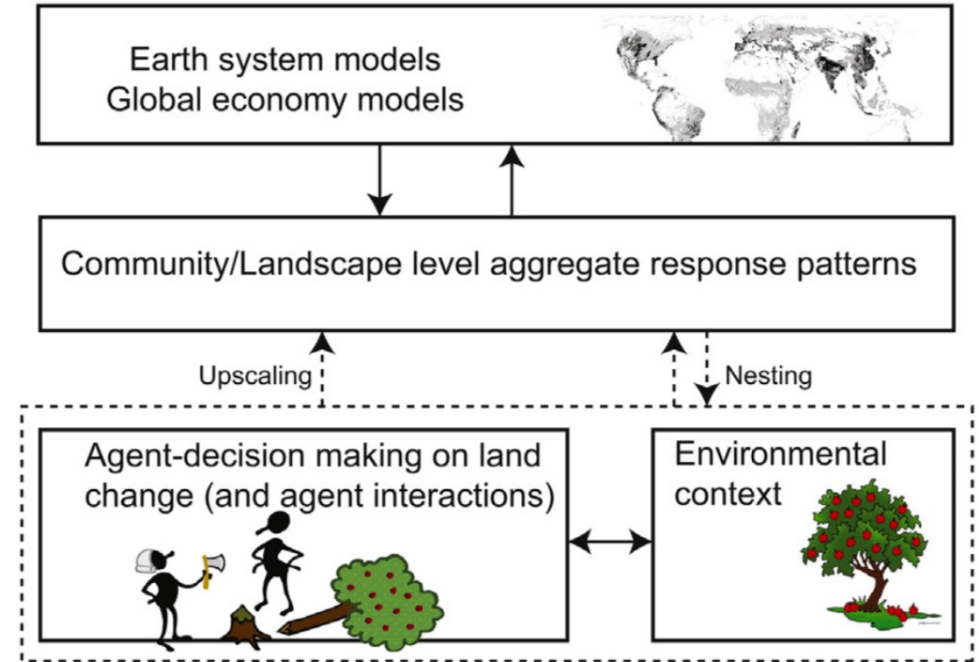
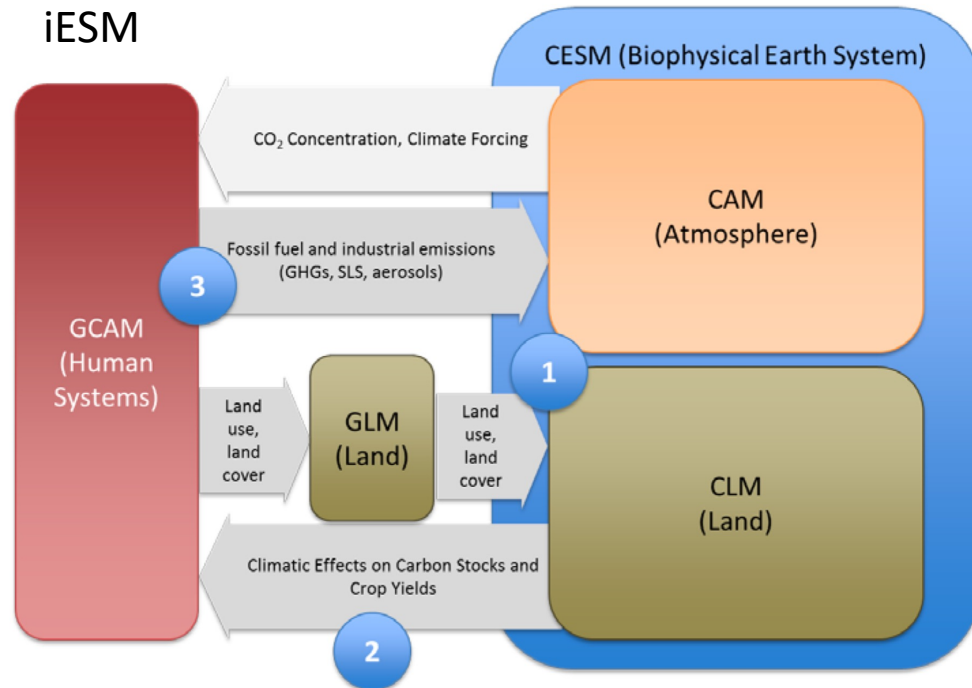
But this does not mean ESMs can use it...



New high-resolution datasets emerge, e.g. HILDA+



Coupling approaches around (global) land use

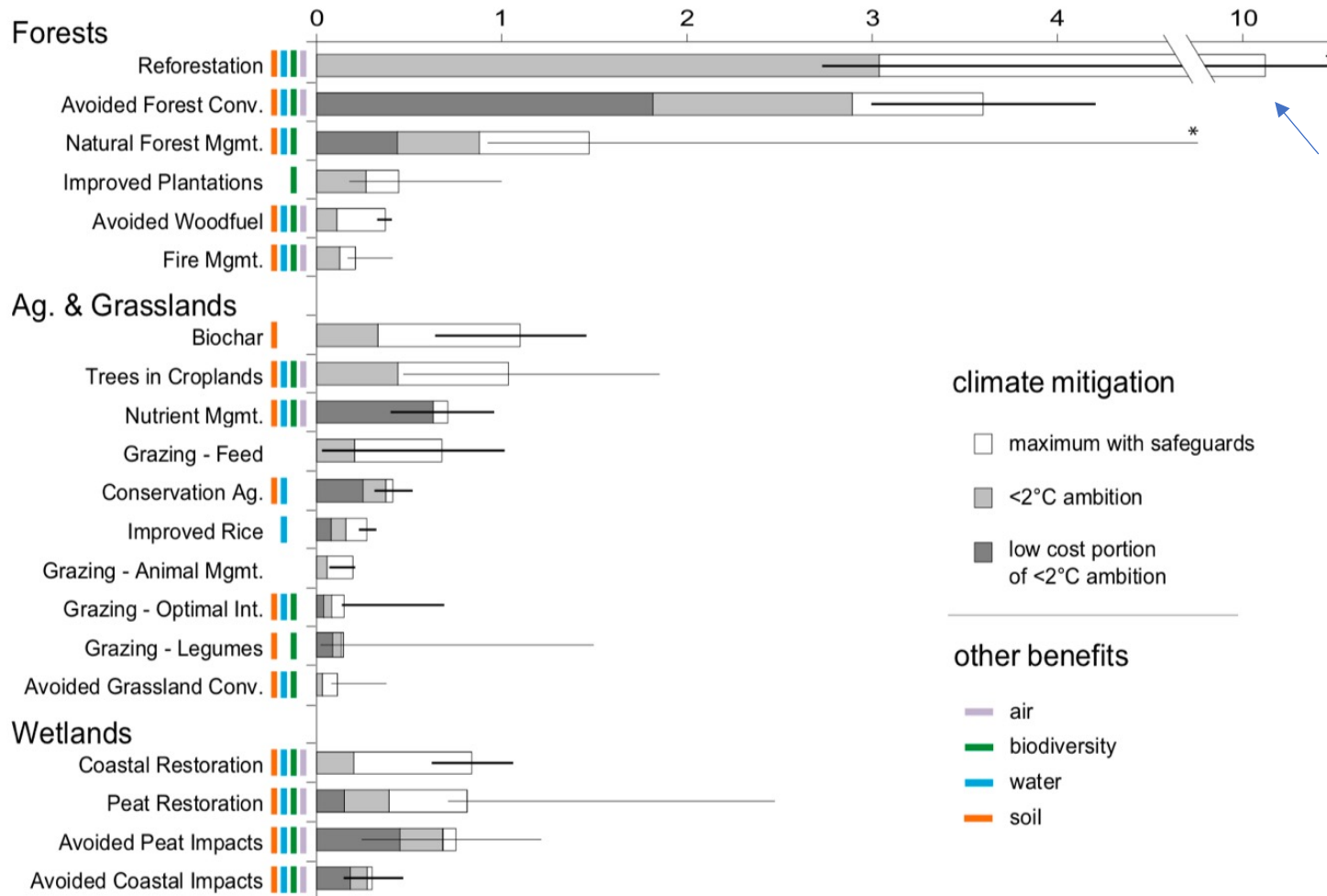


Other coupling around land use: see reviews by Calvin and Bond-Lamberty, ERL, 2018 & Robinson et al., ESD, 2018

Land use role for mitigation “clear”, but for adaptation largely unassessed

1 PgCO₂ = 0.27 PgC 

Global climate mitigation potential in 2030 (PgCO₂e/year)

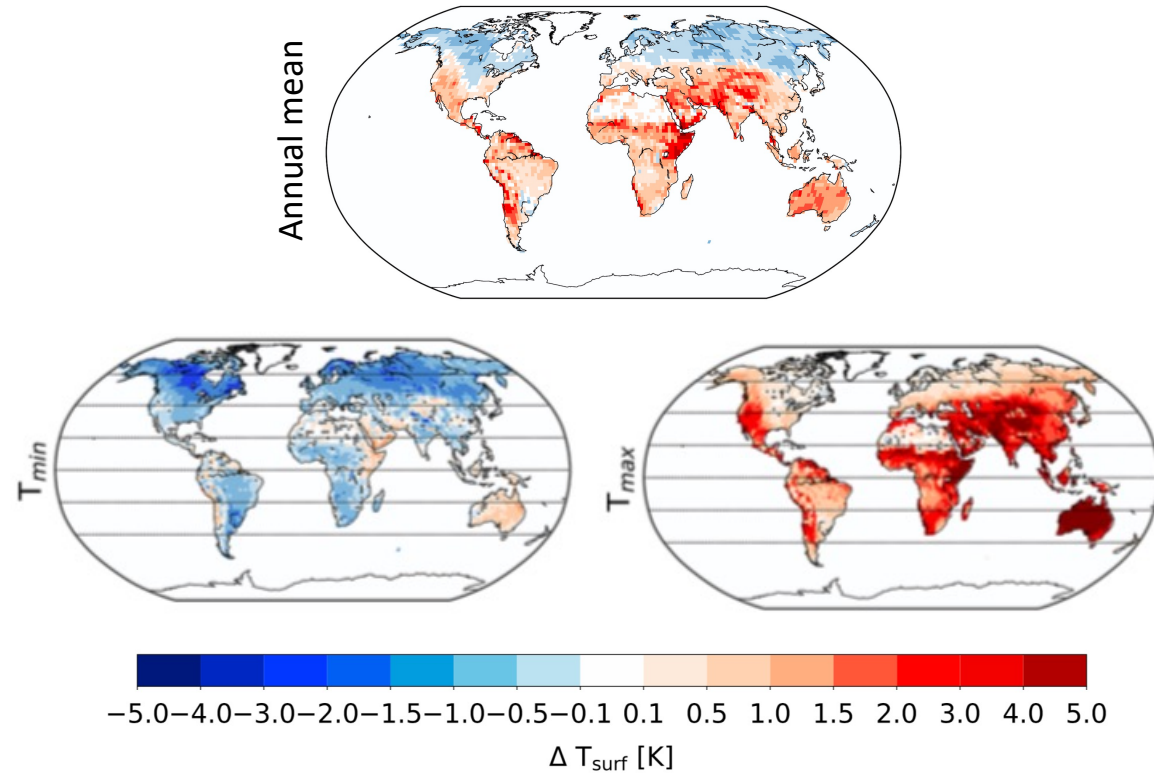


Highest potentials when CO₂-fertilization is accounted for (Sonntag et al., *GRL*, 2016)

Land use role for mitigation “clear”, but for adaptation largely unassessed

Surface temperature change for global deforestation

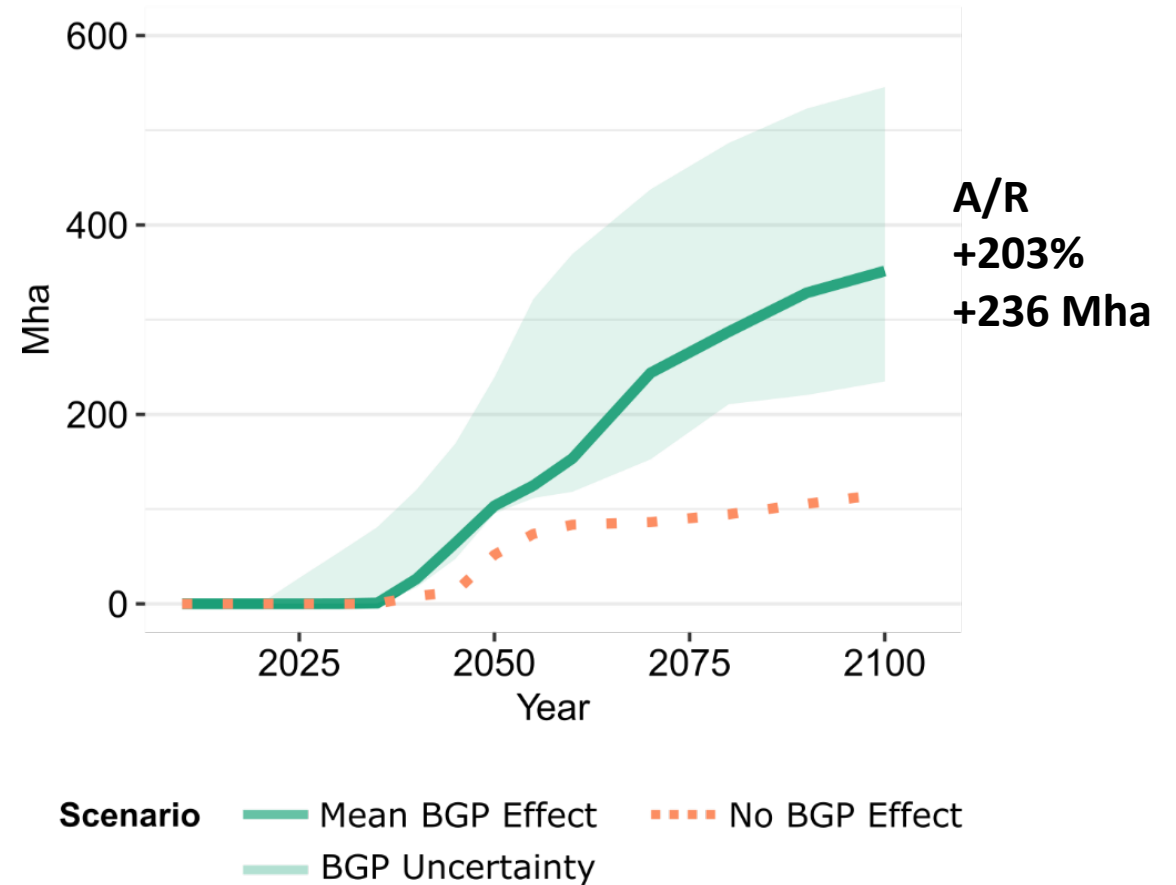
Massive local climate effects of terrestrial CDR methods
→ win-win of mitigation & adaptation (or trade-offs)!



Land use role for mitigation “clear”, but for adaptation largely unassessed

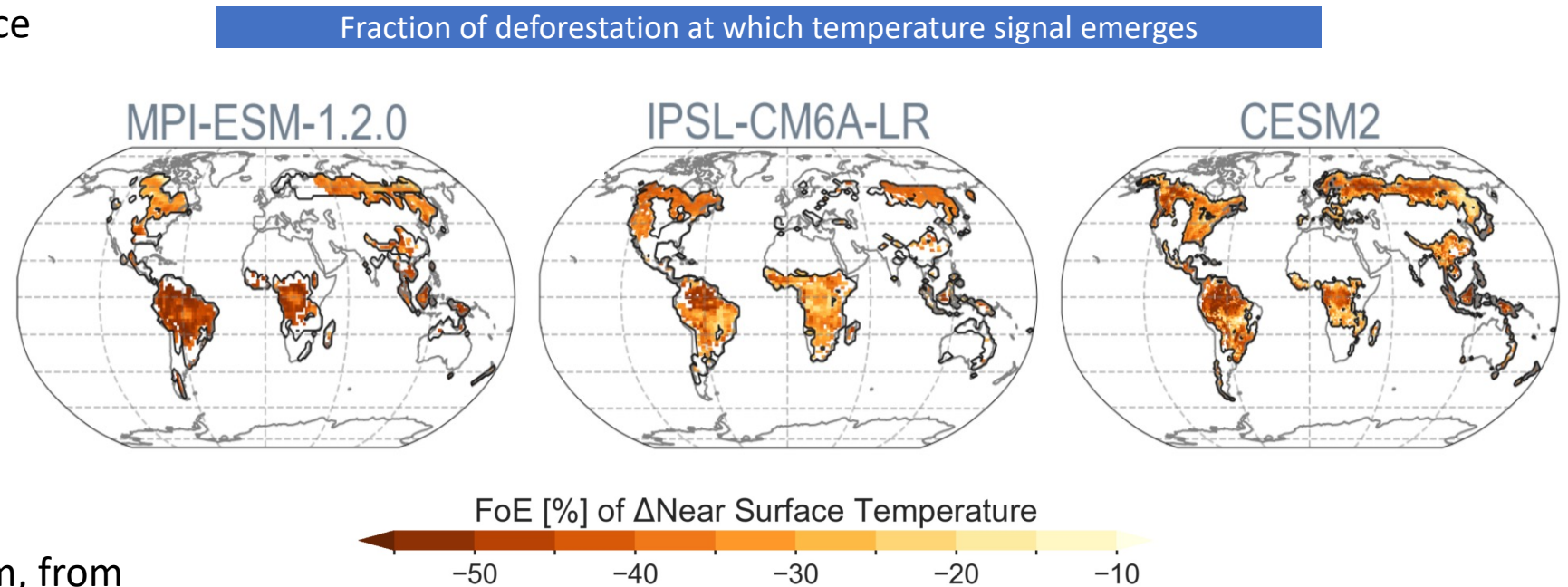
Integration of local temperature signal in IAM (MAgPIE) (via CO₂ equivalent) alters afforestation trajectory

→ Strong feedback between global climate change and land use via local climate impact



Land use role for mitigation “clear”, but for adaptation largely unassessed

Signal emergence may influence human decisions

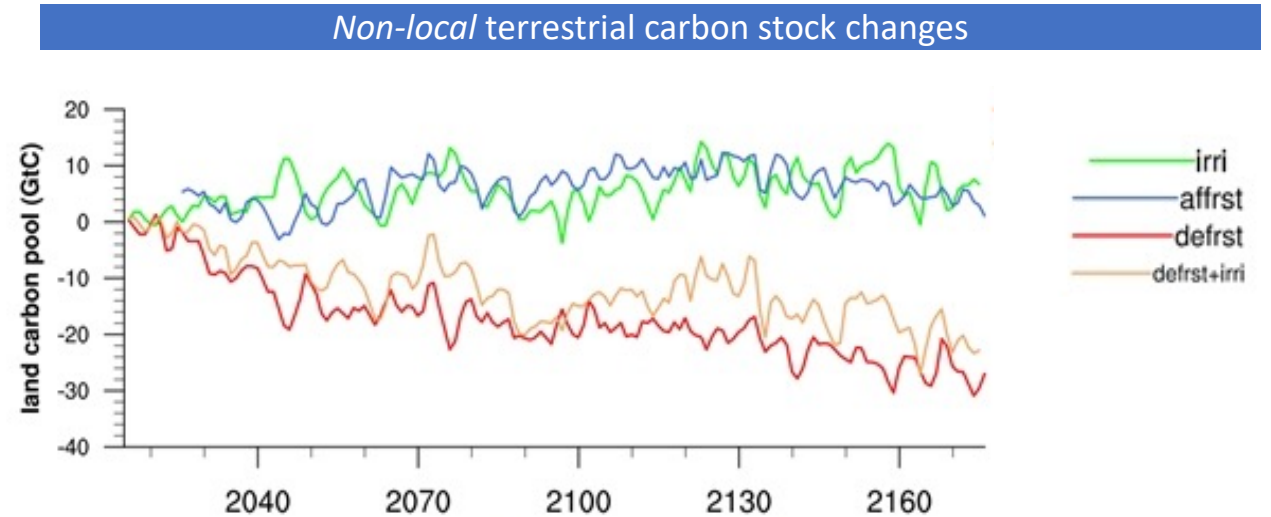
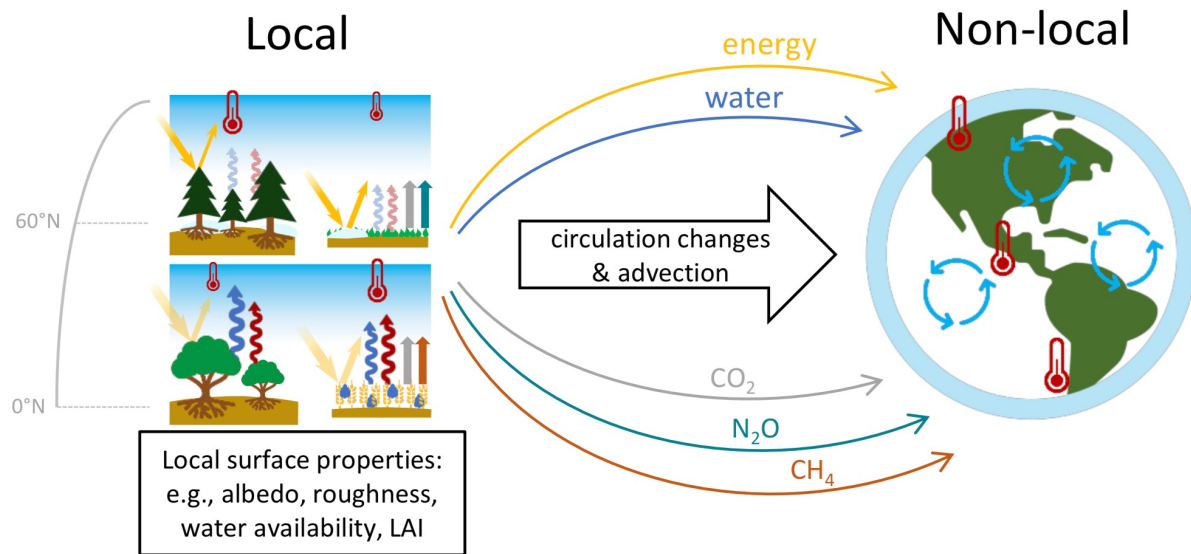


Cascade of delays in the system, from social acceptance of policy measure to implementation to climate signal...

Land use role for mitigation “clear”, but for adaptation largely unassessed

non-local effects of CDR

→ side-effects elsewhere need to be considered



Conclusions

- Push towards CDR in climate policy puts additional pressure on land
 - We need to consider synergies and trade-offs for the multiple usages of land on our way to climate neutrality
- Climate policy currently has narrow GHG focus; large potential to adapt living conditions for humans and ecosystems by local climate effects of land use change
- How should mitigation and adaptation best be linked?