How can terrestrial systems (land sector) help deliver the Paris Agreement targets?

Photo: Stephanie Roe

Stephanie Roe

Community Climate Intervention Strategies I June 2020

University of Virginia

Why land sector?

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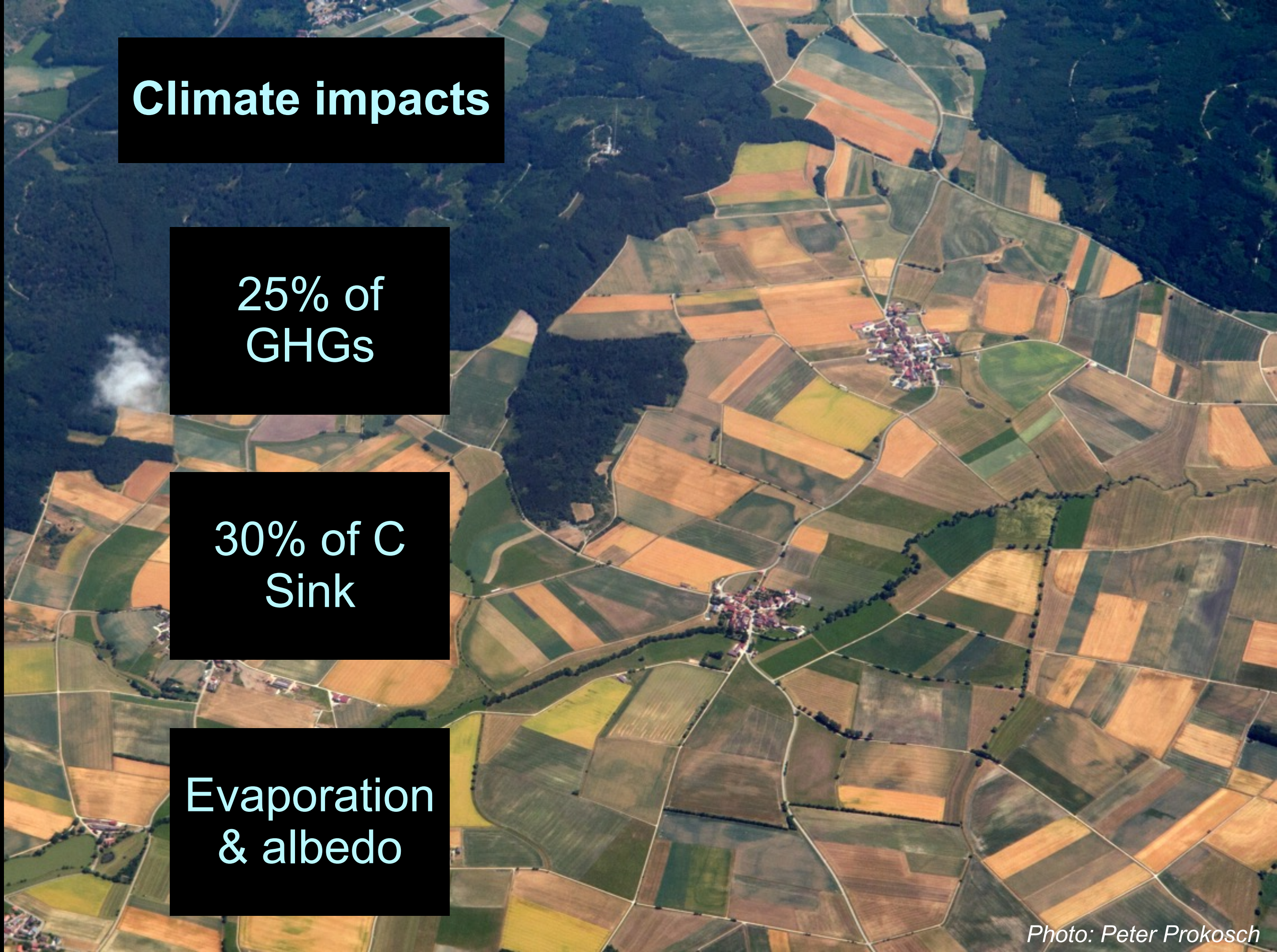
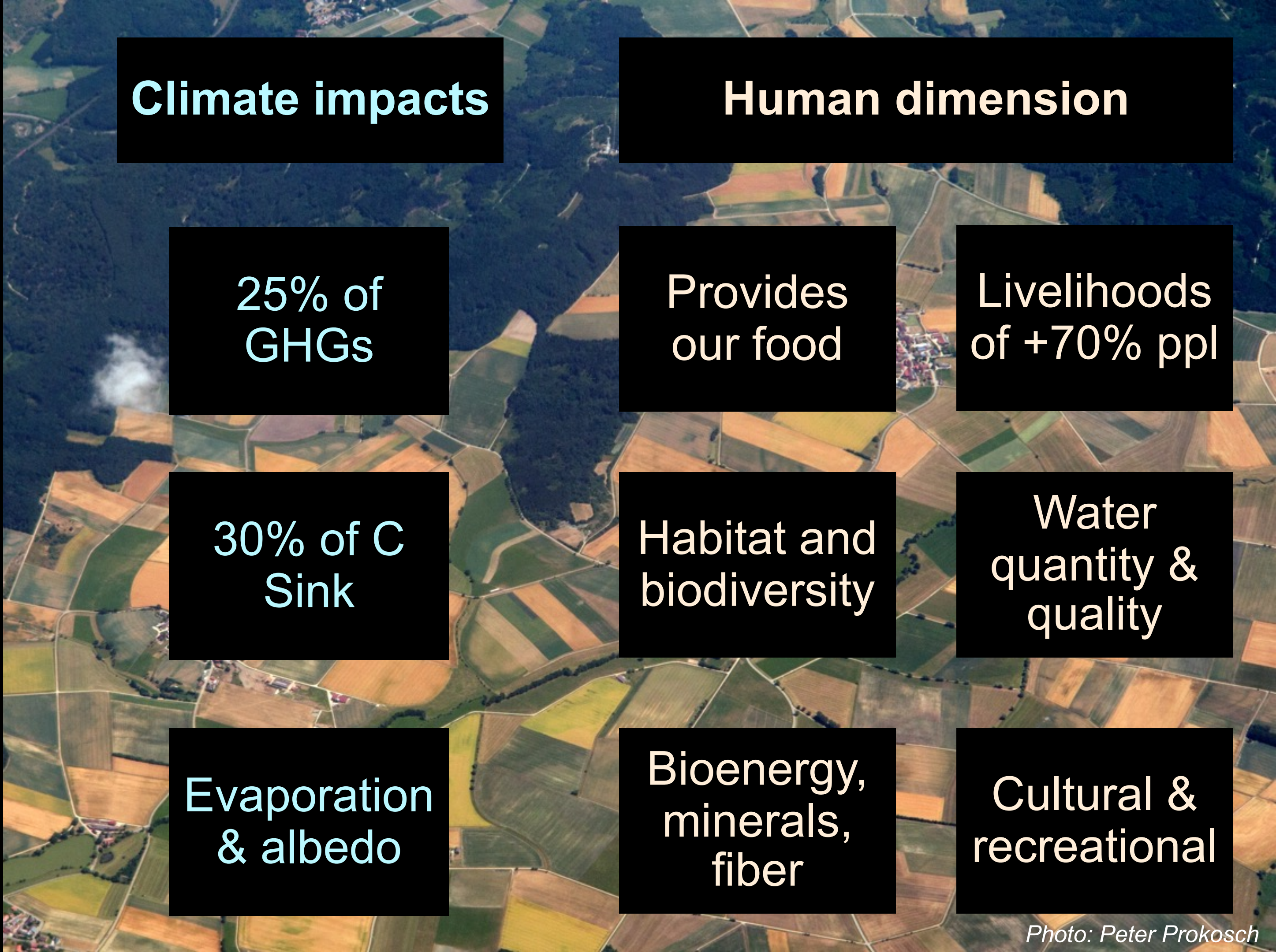


Photo: Peter Prokosch

Why land sector?



Climate impacts

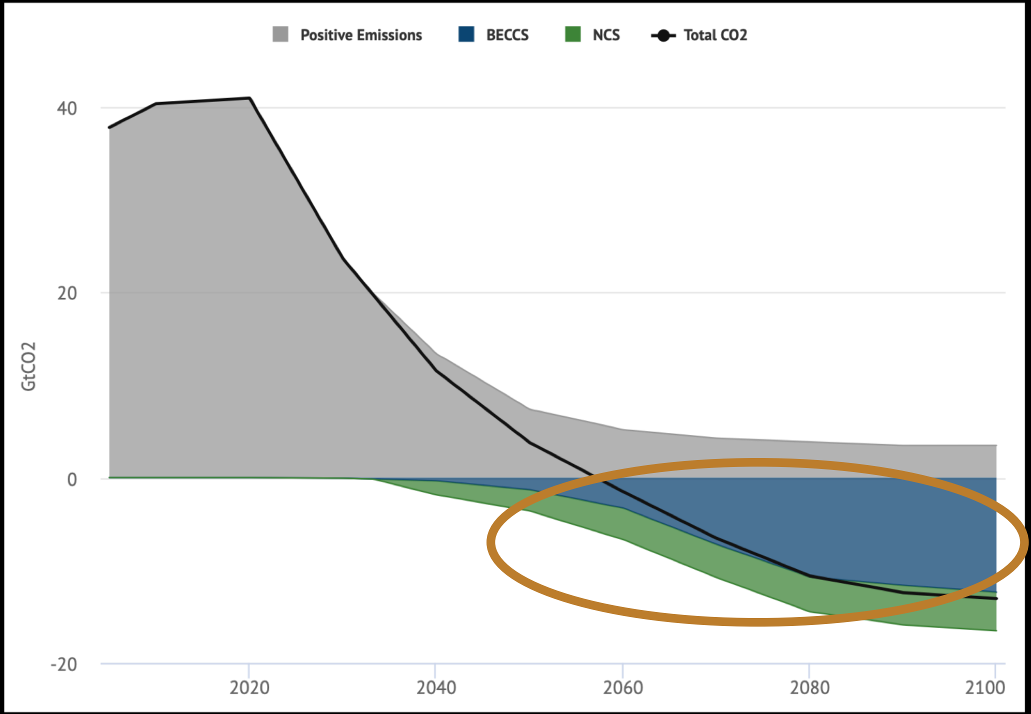
- 25% of GHGs
- 30% of C Sink
- Evaporation & albedo

Human dimension

- Provides our food
- Livelihoods of +70% ppl
- Habitat and biodiversity
- Water quantity & quality
- Bioenergy, minerals, fiber
- Cultural & recreational

Photo: Peter Prokosch

Illustrative 1.5°C Pathway



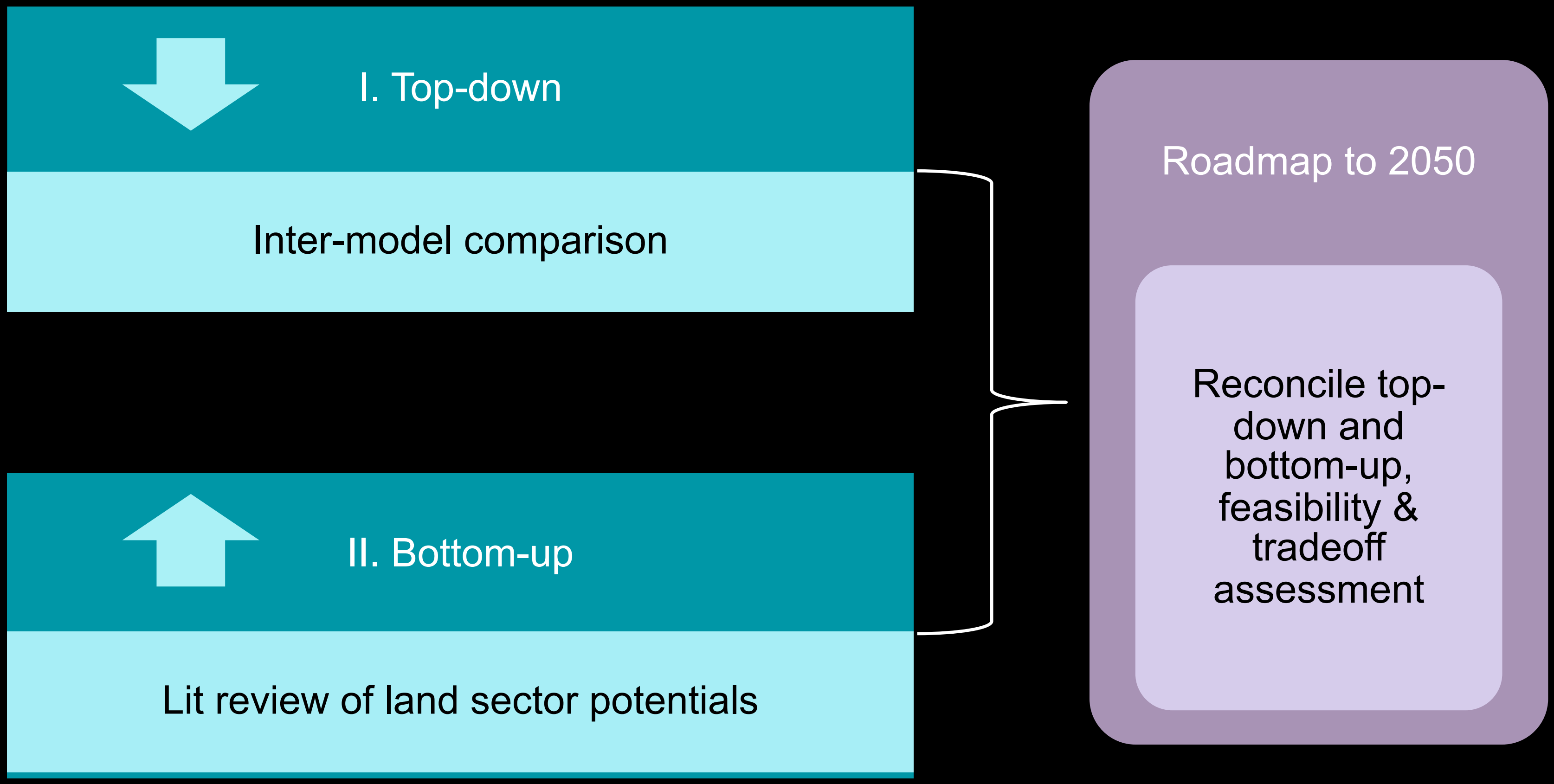
Rogelj et al via Carbon Brief (2018)

Research questions from land-use community (NGO practitioners, policy makers, philanthropies):

In the 1.5°C and 2°C pathways, what can the land sector feasibly contribute?

What could be prioritized, when and where?

How can we account for trade-offs and also help deliver SDGs?

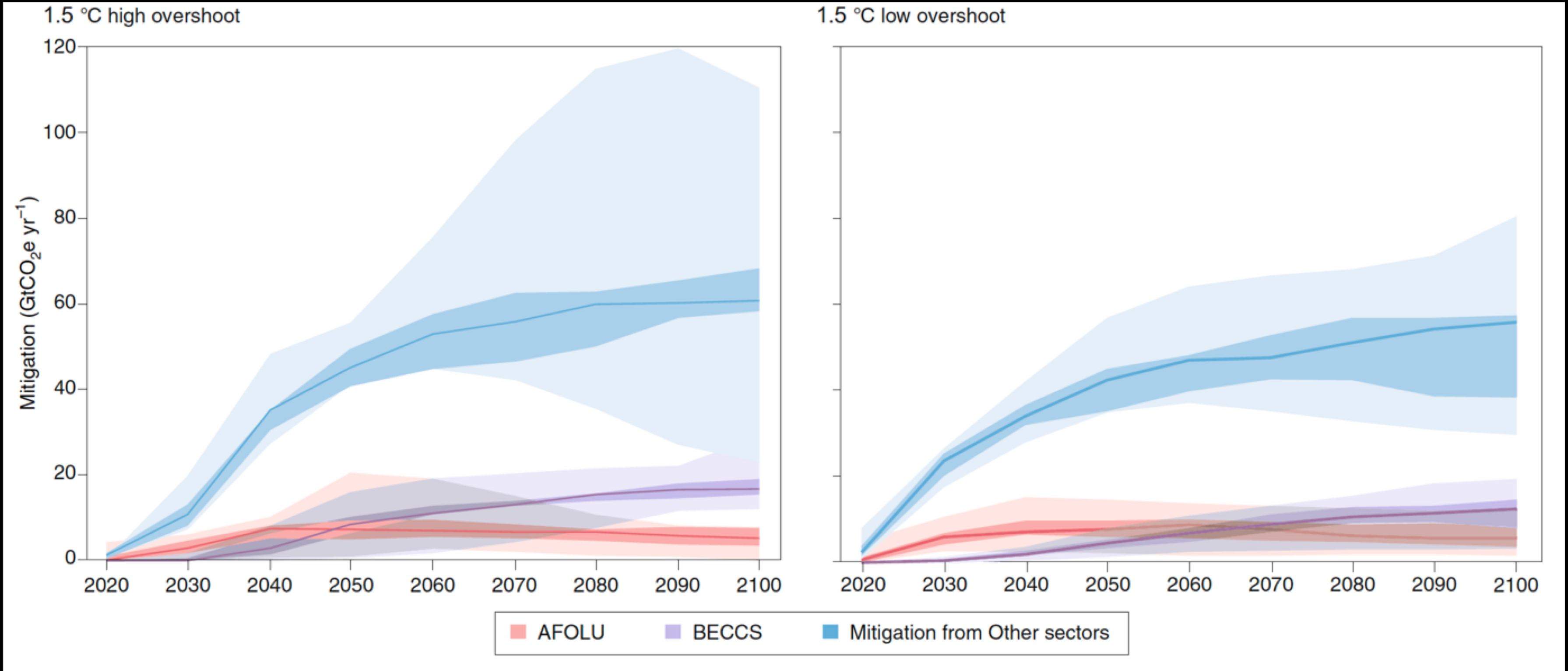

I. Top-down
Inter-model comparison
II. Bottom-up
Lit review of land sector potentials
Roadmap to 2050
Reconcile top-down and bottom-up, feasibility & tradeoff assessment

Top-down assessment

Integrated assessment model comparison (activities across multiple sectors)

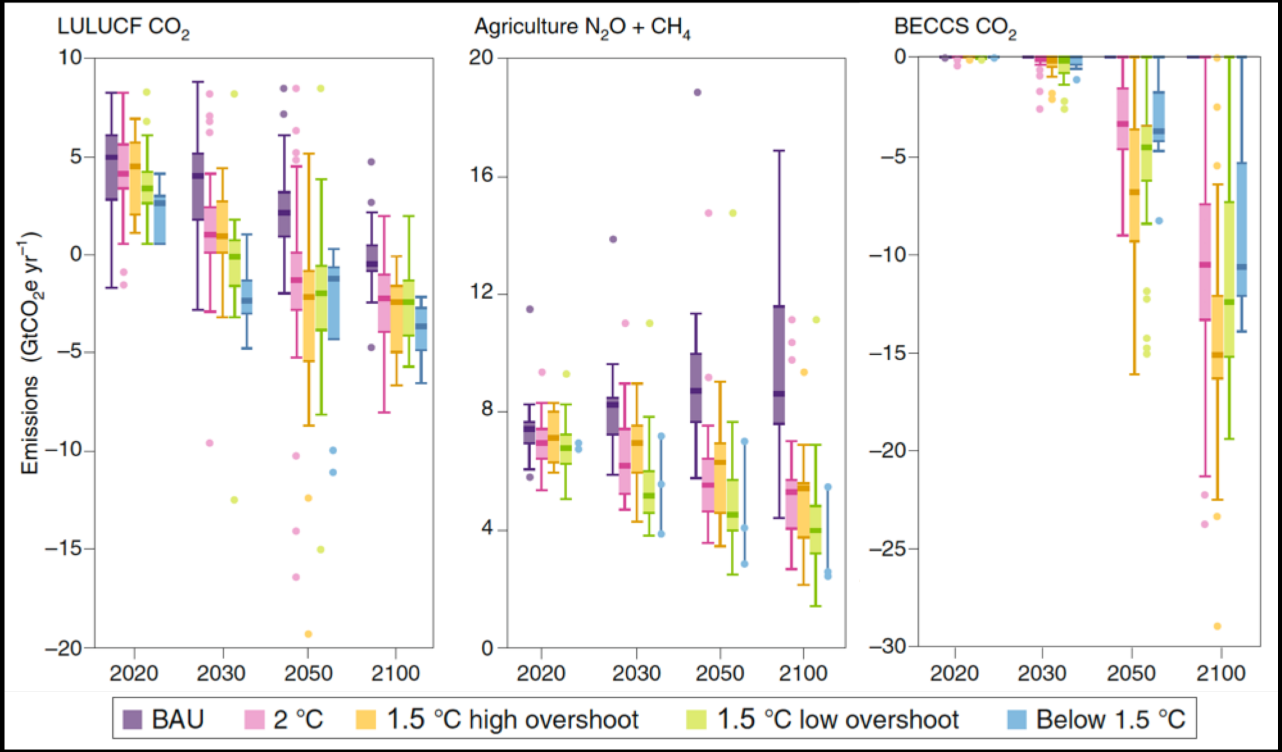
IAMC 1.5°C and SSP Database

In 1.5°C pathways, 4-40% (median 25%) of total mitigation comes from land



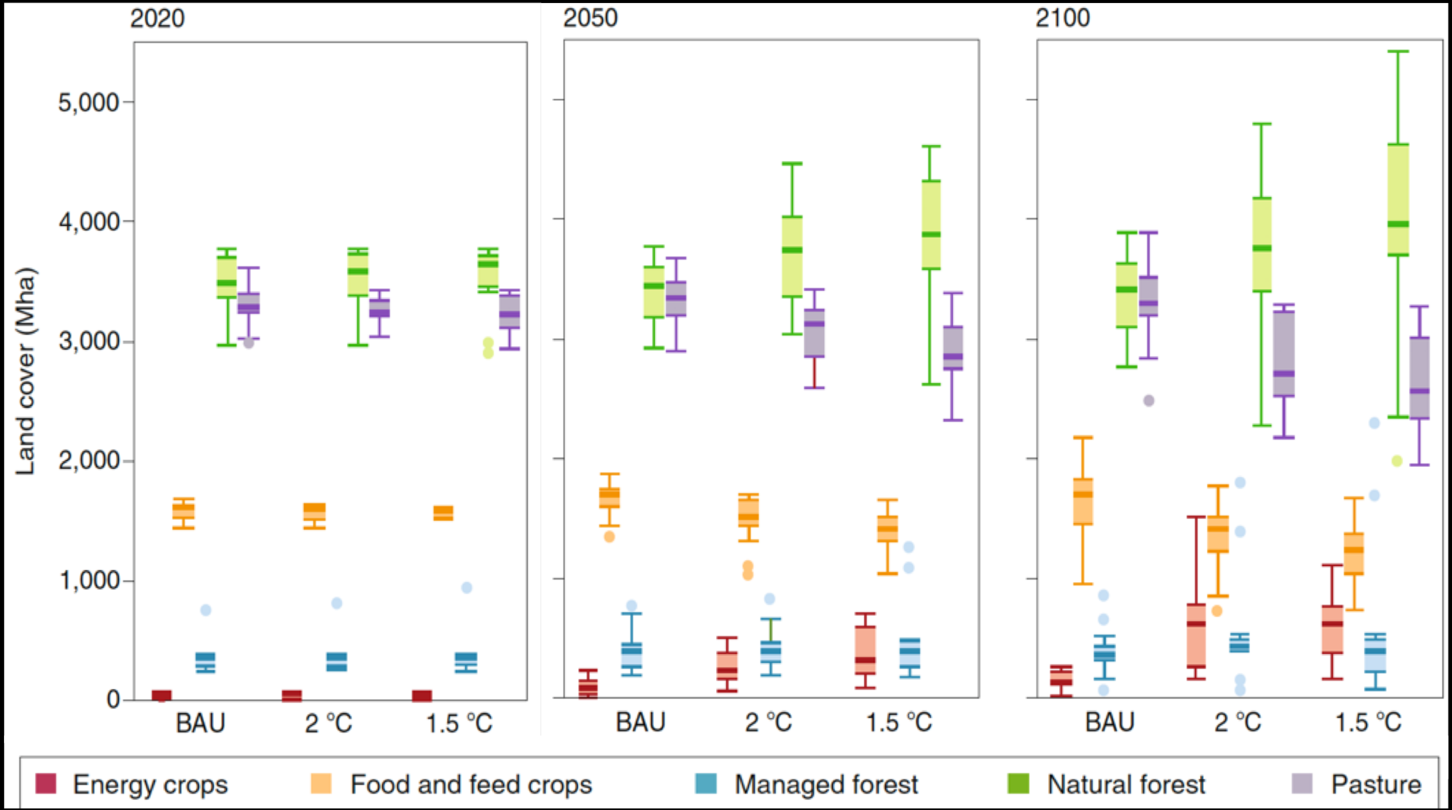
Roe et al 2019, Nat. Clim. Chang.

BAU no mitigation in agriculture and BECCS, 1.5°C and 2°C = large cut from LUC & Agriculture by 2030, and BECCS deployment by 2050



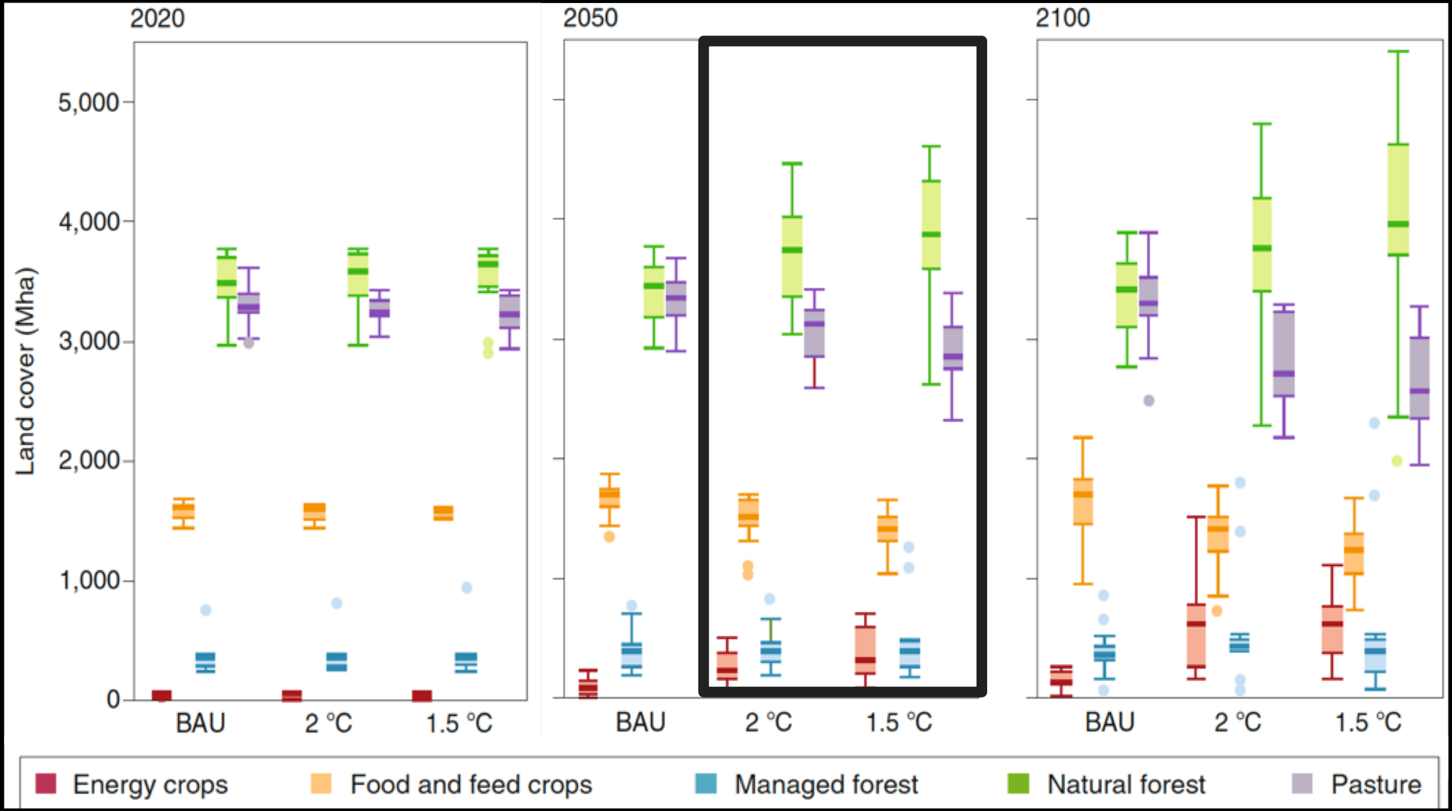
Roe et al 2019, Nat. Clim. Chang.

1.5°C and 2°C pathways produce large changes in land cover



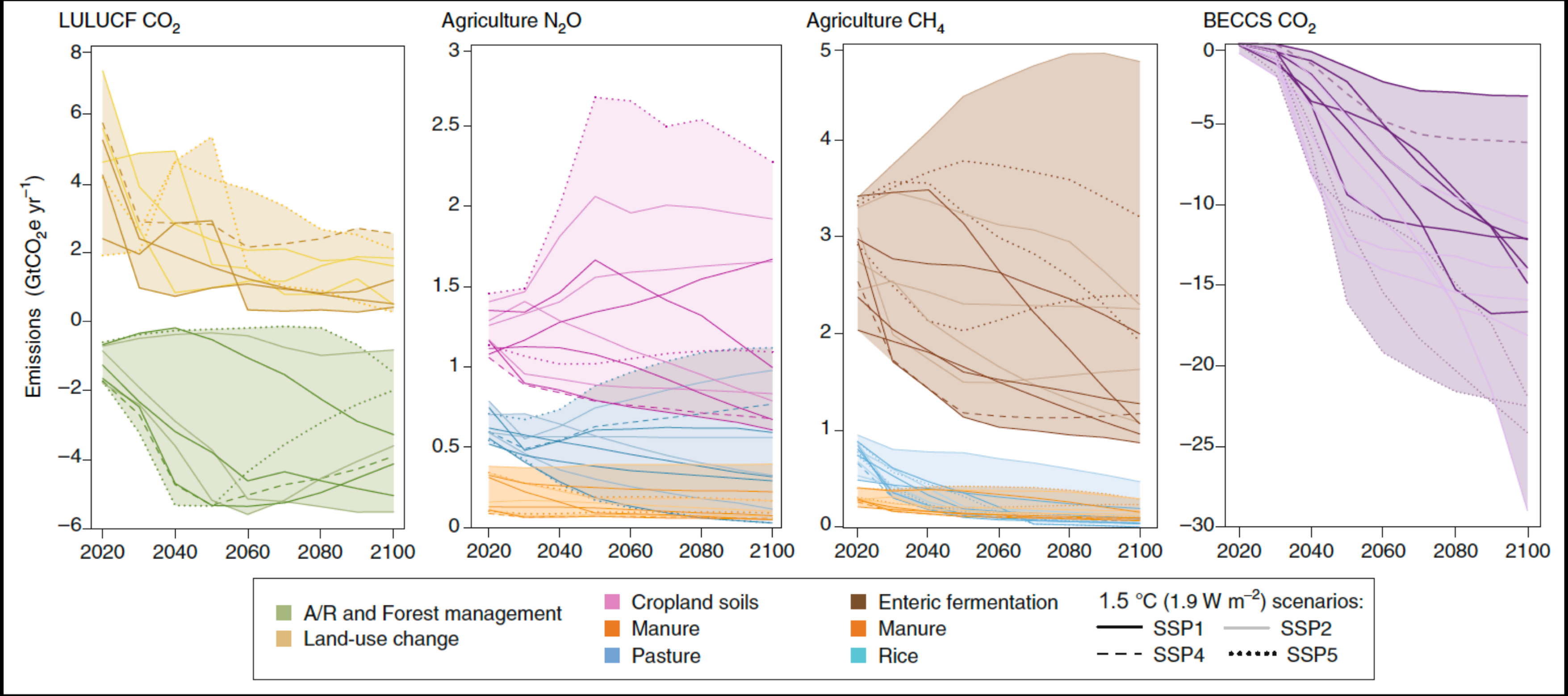
Roe et al 2019, Nat. Clim. Chang.

Pasture and crop lands decrease, energy crops increase, natural forests increase



Roe et al 2019, Nat. Clim. Chang.

Large variation in emissions trajectories; limited portfolio of land-based measures in models



Roe et al 2019, Nat. Clim. Chang.

Some takeaways (top-down assessment)

1. Limitation: IAMS optimize for cost, however, do not measure economic costs and impacts due to climate change
2. IAMs can explore inter-sectoral effects, and some have ability to explore social and env trade-offs. But inter-model comparison relies on the lowest common denominator. Varying complexity and the use of different definitions makes it difficult to answer questions on benefits and consequences.
3. To be more relevant to policy makers and practitioners, would it be worthwhile in some instances, to reduce the number of models and scenarios that are compared to be able to answer trade-off questions?
4. How can model assessments and comparisons better incorporate socioeconomic and environmental ‘safeguards’ to avoid undesirable scenarios?

Photo credit : Peter Prokosch

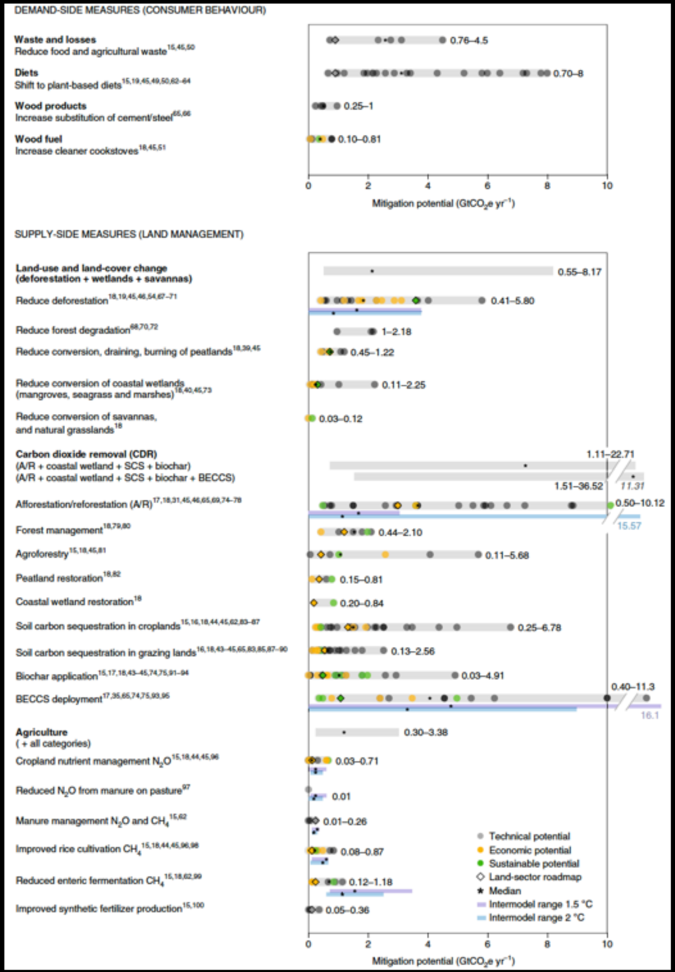
Bottom-up assessment

Literature review of single activity separately or within single sector

Much larger portfolio of land-based activities in the literature

24 mitigation activities:

- Land use change
- Agriculture
- Consumer behavior
- CDR



Roe et al 2019, Nat. Clim. Chang.

CDR activities have highest potential and largest range

Roe et al 2019, Nat. Clim. Chang.

Restoring Forests Could Help Put a Brake on Global Warming, Study Finds

Timeline: How BECCS became climate change's 'saviour' technology

Tree planting 'has mind-blowing potential' to tackle climate crisis

Research shows a trillion trees could be planted to capture huge amount of carbon dioxide

GOV.UK

Government launches new scheme to boost tree-planting

Woodlands and forests will play an important role in the UK's efforts to hit ... By planting more trees and creating new woodland, land managers ...

Nov 4, 2019

Ethiopia plants 350m trees in a day to help tackle climate crisis

National 'green legacy' initiative aims to reduce environmental degradation

"A Trillion Trees" is a great idea—that could become a dangerous climate distraction

Reforestation is critical for lots of reasons, but it's no substitute for cutting emissions.

Farming could be absorber of carbon by 2050, says report

Veganism and trees could help stop agriculture contributing to global heating, study says

Can regenerative agriculture reverse climate change? Big Food is banking on it.

Regenerative agriculture works to draw carbon out of the atmosphere and into the soil, but there's an ongoing debate on how much carbon can be stored there and for how long.

Soil Carbon: The Secret Weapon to Battle Climate Change?

Carbon farming is the hot (and overhyped) tool to fight climate change

Using farms to capture and store more carbon in soil is becoming trendy, but the science is still not settled on how much it can help to address climate change.

Some takeaways (bottom-up assessment)

1. More spatially explicit studies are needed
2. Mitigation potentials do not yet incorporate biophysical climate impacts, nor impacts from climate change, more research needed
3. Types of management and implementation, by geography drive certain risks and benefits

Photo credit : Peter Prokosch

Mitigation potential in 2050

Top down (IAMs)

Land-based activities (AFOLU and BECCS) = 0.9–36.6 (median **~14**) $GtCO_2e\ yr^{-1}$

Bottom-up (Literature)

Land-based activities (AFOLU and BECCS) = 2.4–48.1 (**~15**) $GtCO_2e\ yr^{-1}$

Mitigation potential in 2050

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Land-based activities (AFOLU and BECCS) = 0.9–36.6 (median **~14**) $GtCO_2e\ yr^{-1}$

AFOLU = 0.9–20.5 (median **9.1**) $GtCO_2e\ yr^{-1}$
>>8 activities

Bottom-up (Literature)

Land-based activities (AFOLU and BECCS) = 2.4–48.1 (**~15**) $GtCO_2e\ yr^{-1}$

AFOLU = 2–36.8 (median **10.6**) $GtCO_2e\ yr^{-1}$
>>23 activities

Mitigation potential in 2050

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>>8 activities

BECCS = 0–16.1 (median **4.7**) $GtCO_2e\ yr^{-1}$

Bottom-up (Literature)

Land-based activities (AFOLU and BECCS) = 2.4–48.1 (**~15**) $GtCO_2e\ yr^{-1}$

AFOLU = 2–36.8 (median **10.6**) $GtCO_2e\ yr^{-1}$
>>23 activities

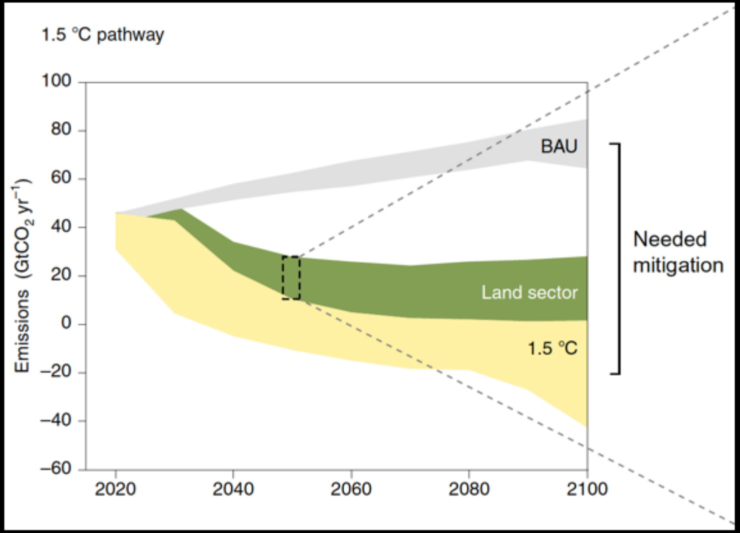
BECCS = 0.4–11.3 (median **4.0**) $GtCO_2e\ yr^{-1}$

Roadmap to 2050

Reconciling top-down and bottom-up, adding feasibility + tradeoffs

Roadmap for land-based climate mitigation in 2050

15 $GtCO_2e\ yr^{-1}$ =
30% total mitigation



Roe et al 2019, Nat. Clim. Chang.

Feasibility & Sustainability

Risks

Other benefits

Biodiversity, Water, Soil, Air, Resilience, Food security, Livelihoods

International policies & commitments

Sustainable Development Goals, Aichi Targets (UNCBD), New York Declaration on Forests

Roadmap for land-based climate mitigation in 2050

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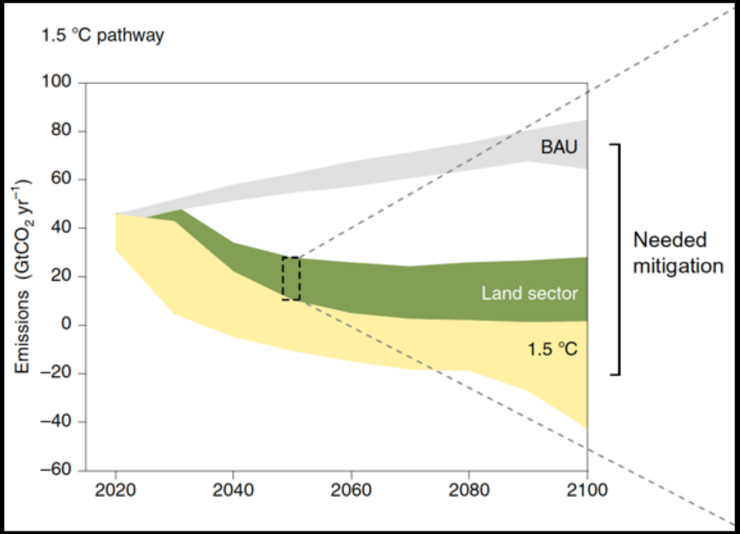
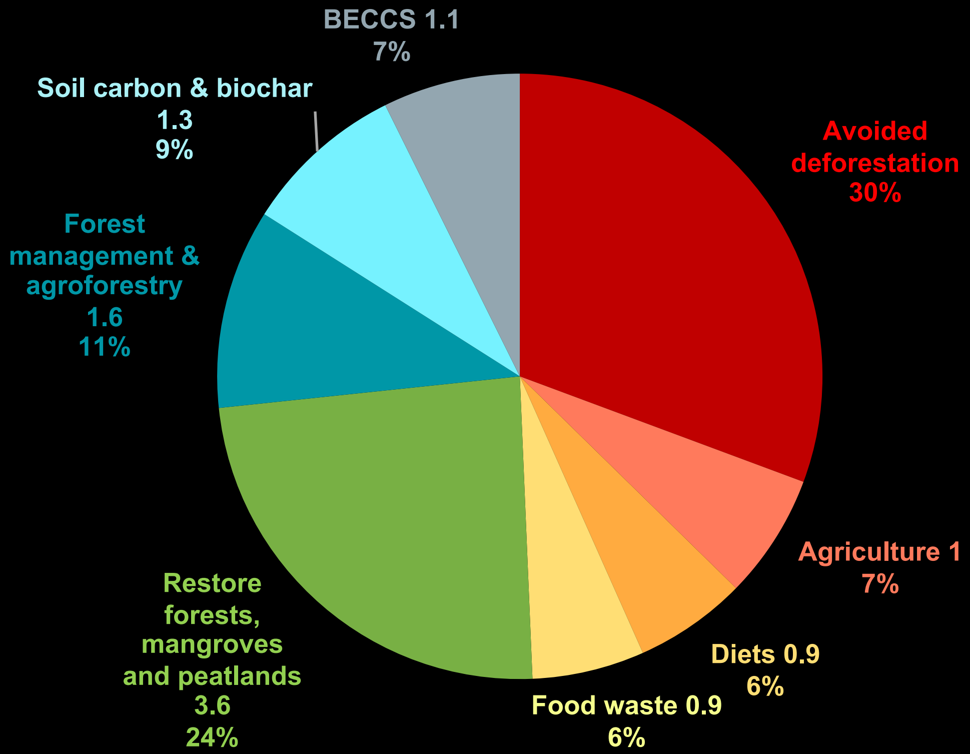
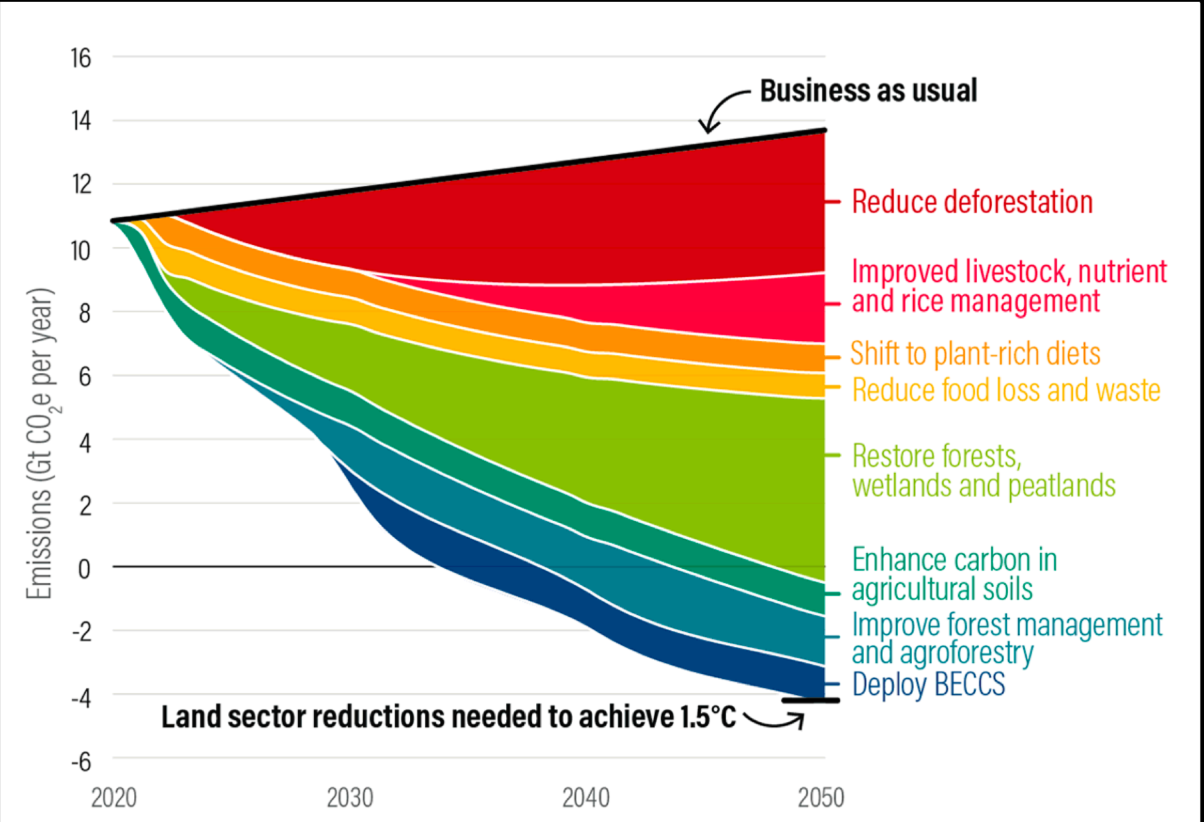


Roe et al 2019, Nat. Clim. Chang.



Roadmap for land sector in 2050



Roe et al 2019, Nat. Clim. Chang.

Roadmap mitigation

30 %
15 $GtCO_2e/yr$

Total mitigation

14.8%
7.4 $GtCO_2e/yr$

Gross emissions reductions

15.2%
7.6 $GtCO_2e/yr$

Carbon removals

Roadmap mitigation

Natural carbon sink

Le Quere et al 2018, Global Carbon Project

Roadmap mitigation			Natural carbon sink	
30 % 15 $GtCO_2e/yr$	Total mitigation	**+**	**29 %** 11.6 $GtCO_2/yr$	Land
14.8% 7.4 $GtCO_2e/yr$	Gross emissions reductions		**22%** 8.9 $GtCO_2/yr$	Ocean
15.2% 7.6 $GtCO_2e/yr$	Carbon removals		**44%** 17.3 $GtCO_2/yr$	Atmosphere

Roadmap mitigation			Natural carbon sink	
			Le Quere et al 2018, Global Carbon Project	
30 % 15 GtCO_2e/yr	Total mitigation	+	**29 %** 11.6 GtCO_2/yr	Land
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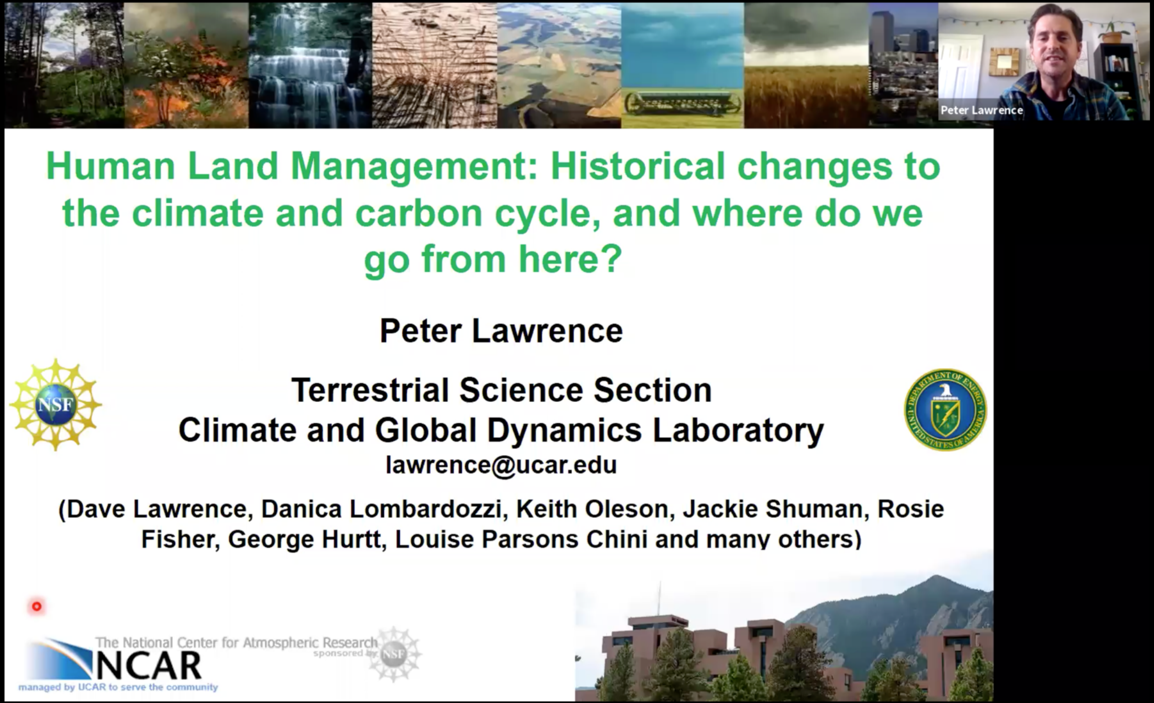
15.2% 7.6 GtCO_2e/yr	Carbon removals		**44%** 17.3 GtCO_2/yr	Atmosphere

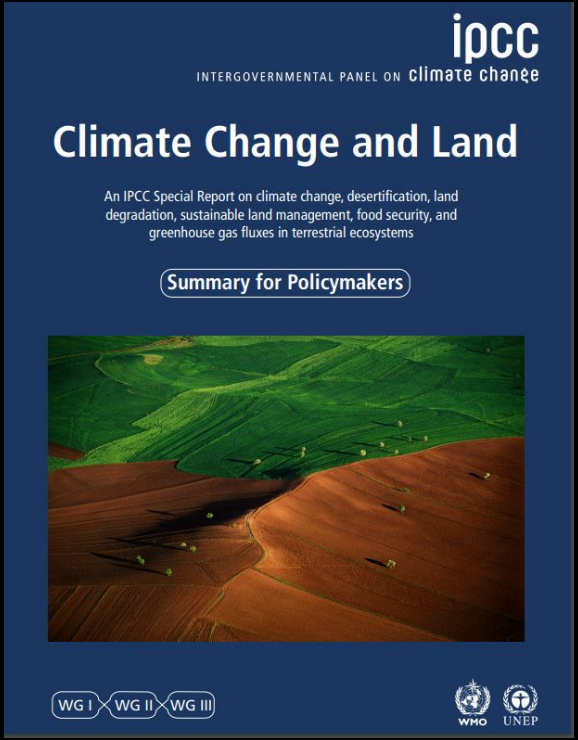
***Mitigation #s do not reflect future climate change, but new research is coming**

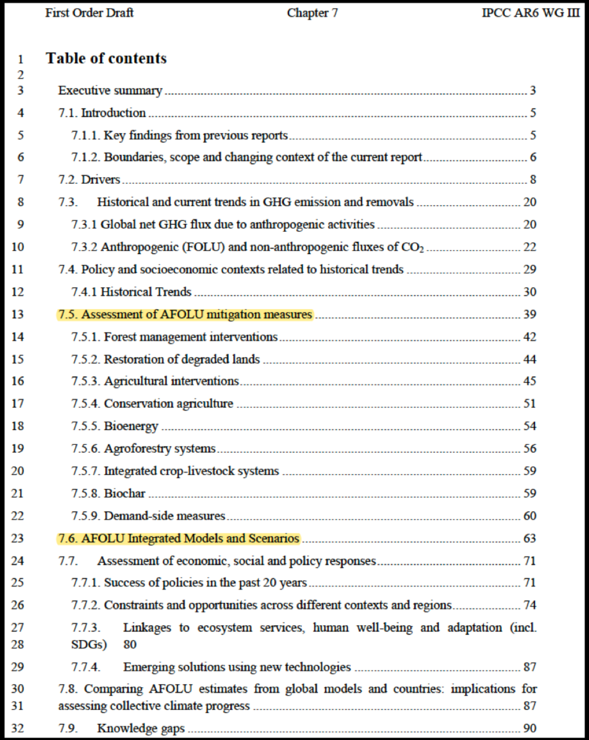
Example of new research on A/R mitigation potentials in different climate futures



Link:
https://seminar.cgd.ucar.edu/archive/2020/CGD_20200512_peter_lawrence.mp4

Mitigation potentials in SRCCL and AR6 WGIII Land Chapter





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In AR6:

New model outputs, some added mitigation activities, similar comparability

Updated bottom-up assessment

Countries have requested a deeper assessment on regional applicability: potentials, feasibility, risks and benefits

Conclusions

1. Better land management could feasibly and sustainably contribute ~30% of mitigation to deliver on the 1.5 °C goal of the Paris Agreement [70% still needs to come from energy transformation!]
2. 30% mitigation potential is on top of the ~30% of carbon emissions that land already sequesters naturally
3. Equates to ~50% emissions reductions per decade (85% total decrease by 2050), and about a ten-fold increase in carbon removals
4. Carbon removals would be a ~60% increase to existing carbon sink
5. These numbers do not consider the impacts from future climate, but should
6. Not all mitigation measures, and types of implementation are the same >> should be optimized to deliver on other goals e.g. SDGs
7. It would be helpful if models can help provide more nuance on #5 and #6

Photo credit : Peter Prokosch

Thank You

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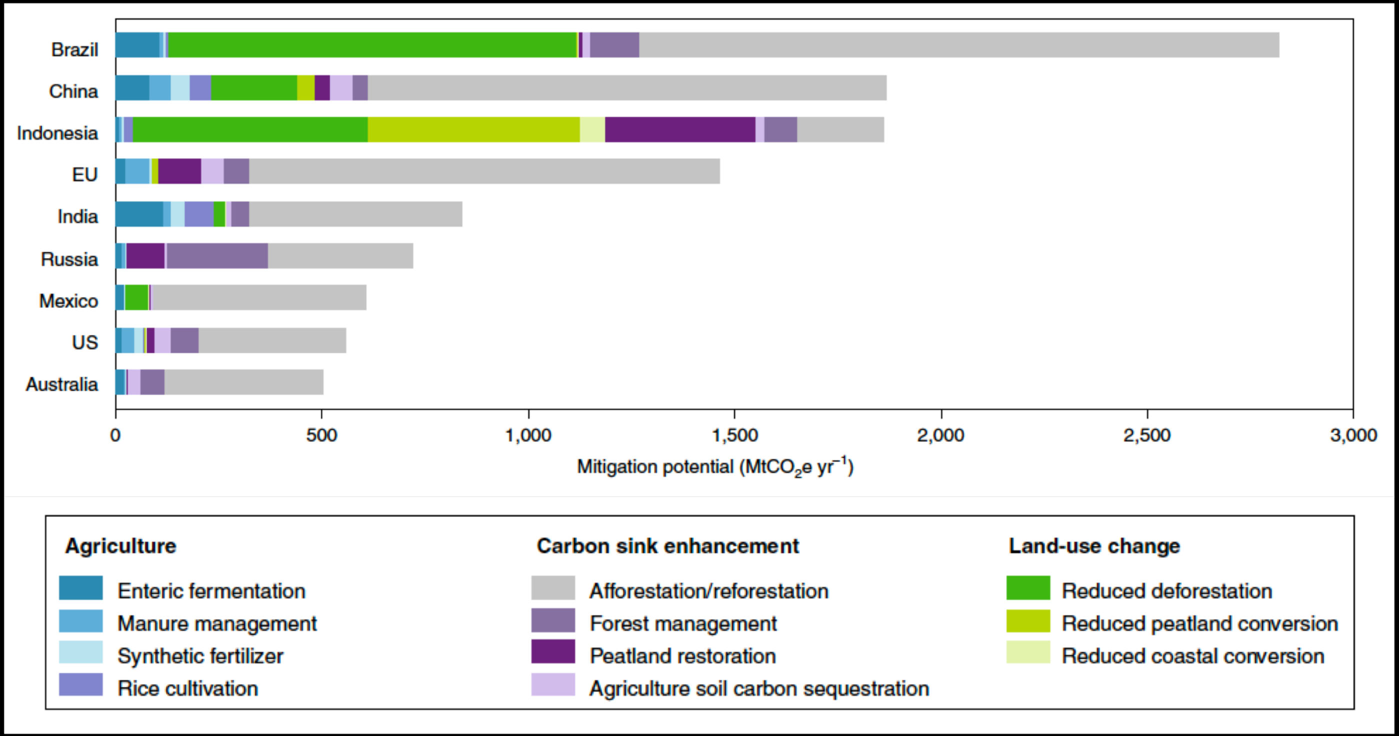
Photo credit: Casey Horner

Annex

The top ten countries with the highest mitigation potential represent 55% of current land sector emissions



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