



Managing climate by managing land

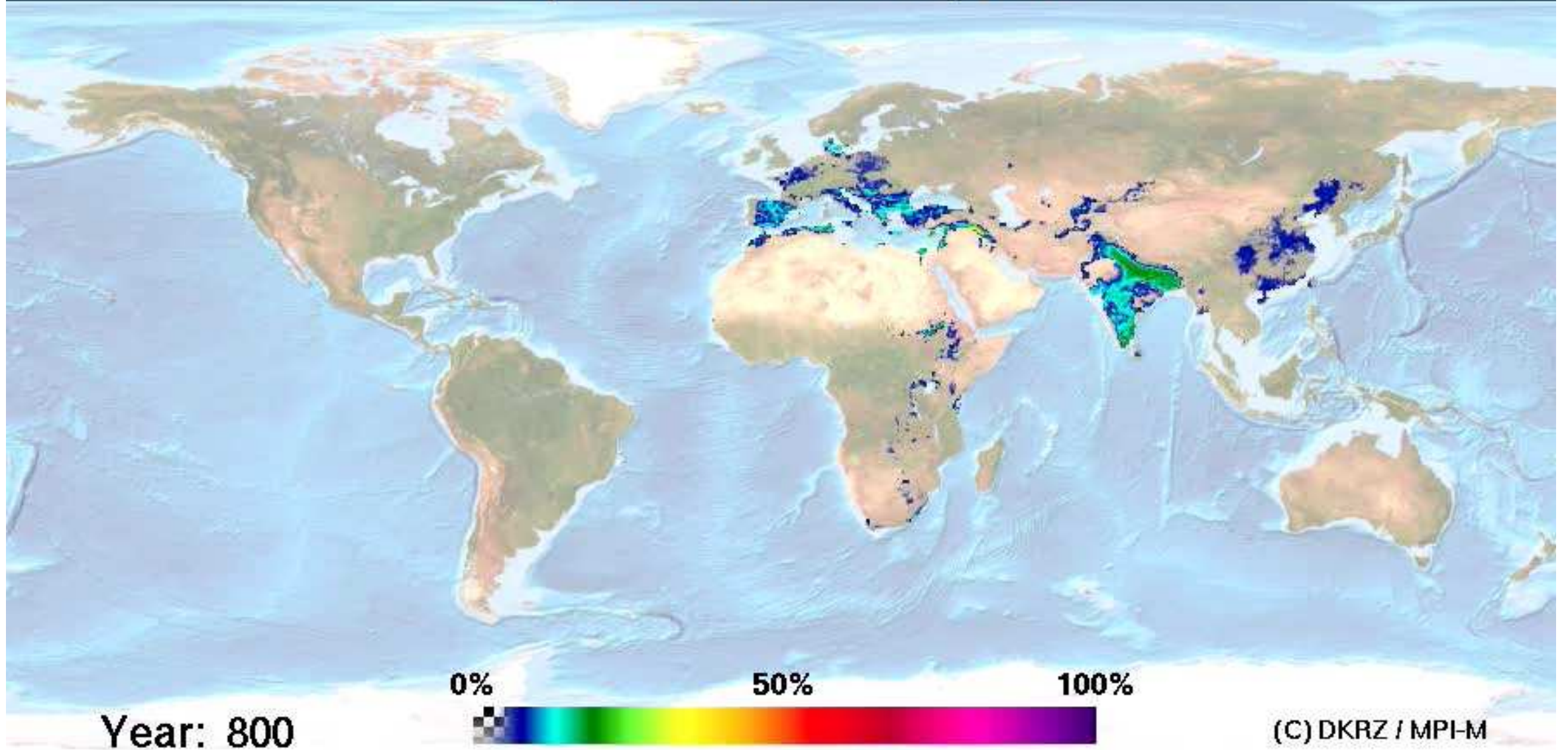
Julia Pongratz
Ludwig-Maximilians-Universität München,
Department of Geography

EGU GIFT workshop, 2024/04/17

Managing climate by
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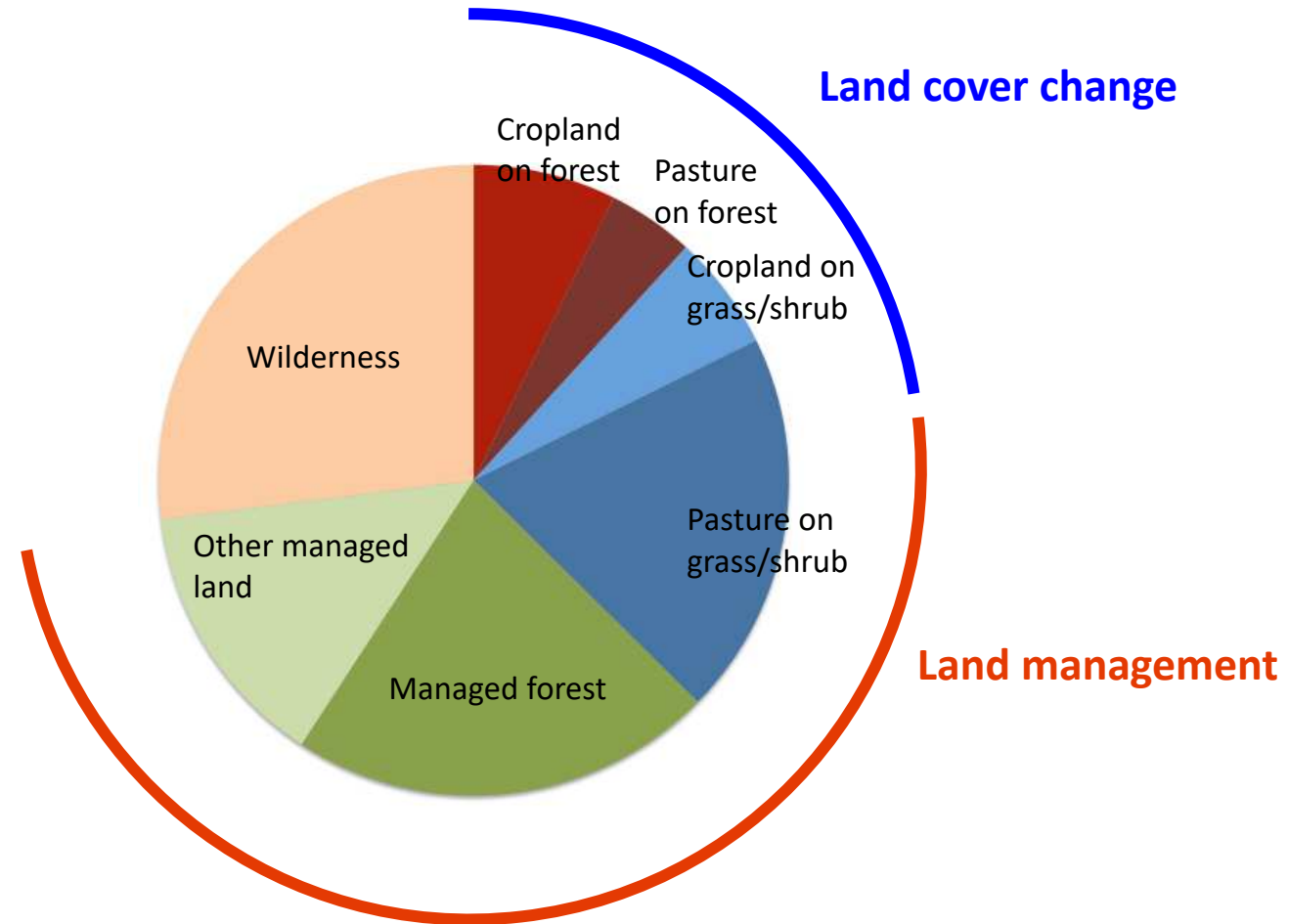
Expansion of Cropland



Present-day land use extent

¾ of the Earth's ice-free land surface is under management

Usage of land area



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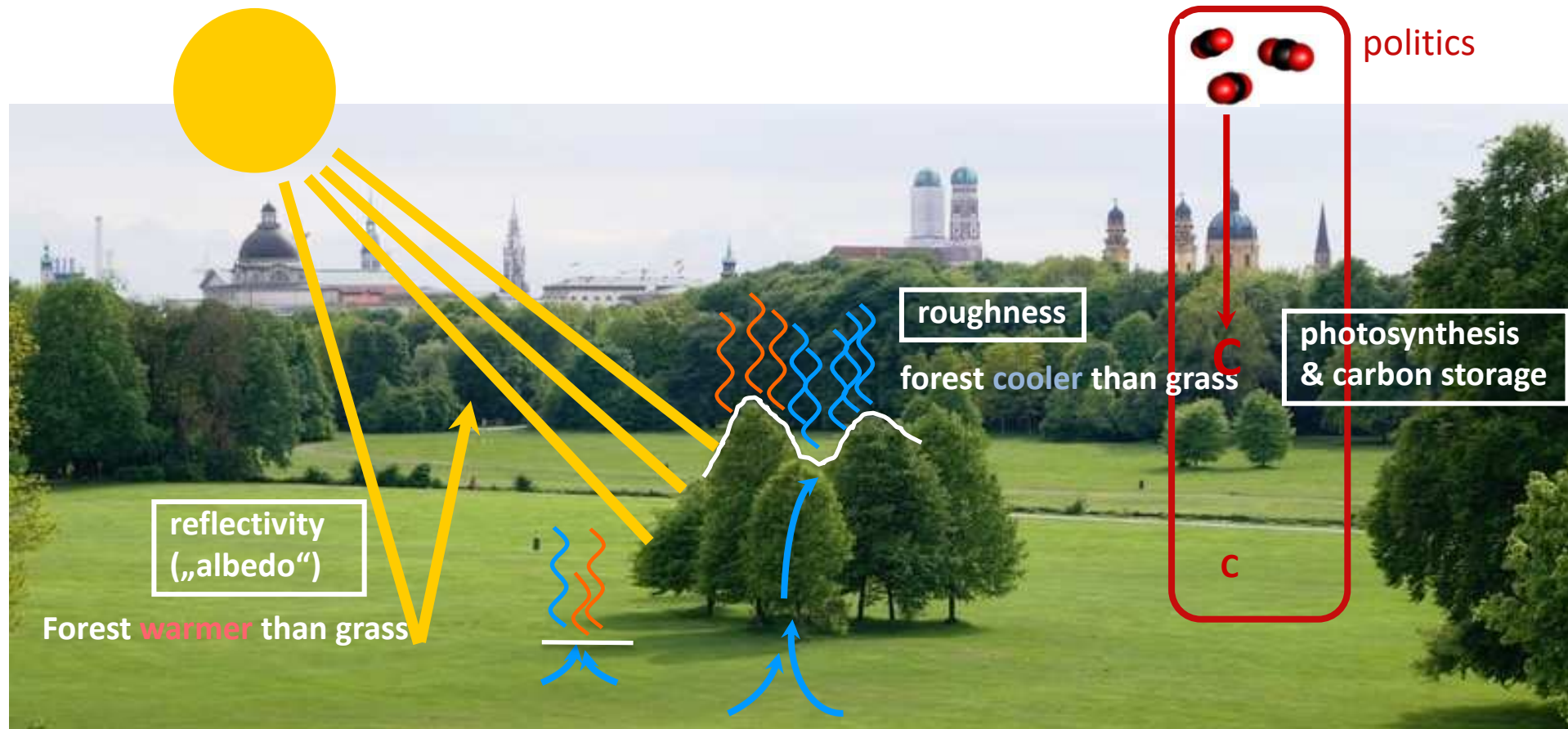


Land-atmosphere interactions

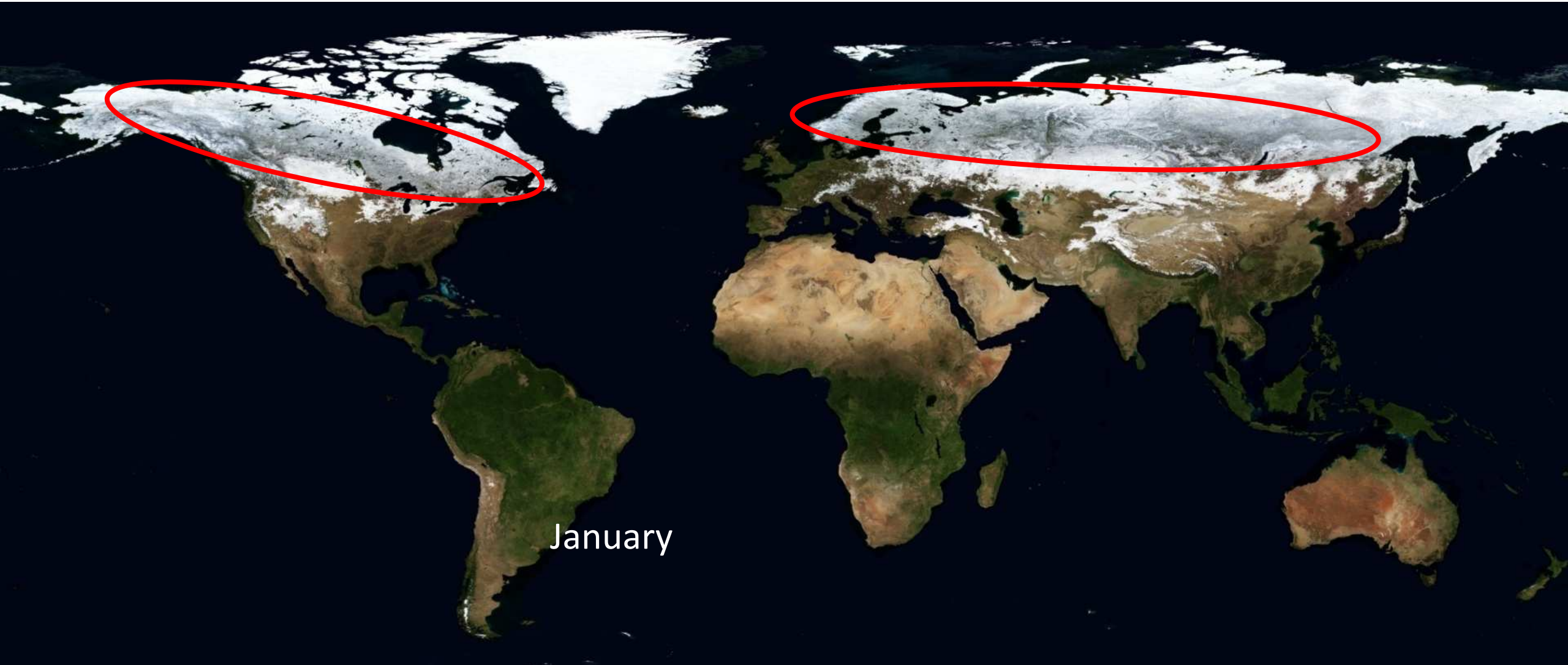
- Altered surface energy fluxes, hydrology
- Altered carbon and nutrient balance

Biogeophysical effects

Biogeochemical effects



Energy and heat fluxes due to land use change



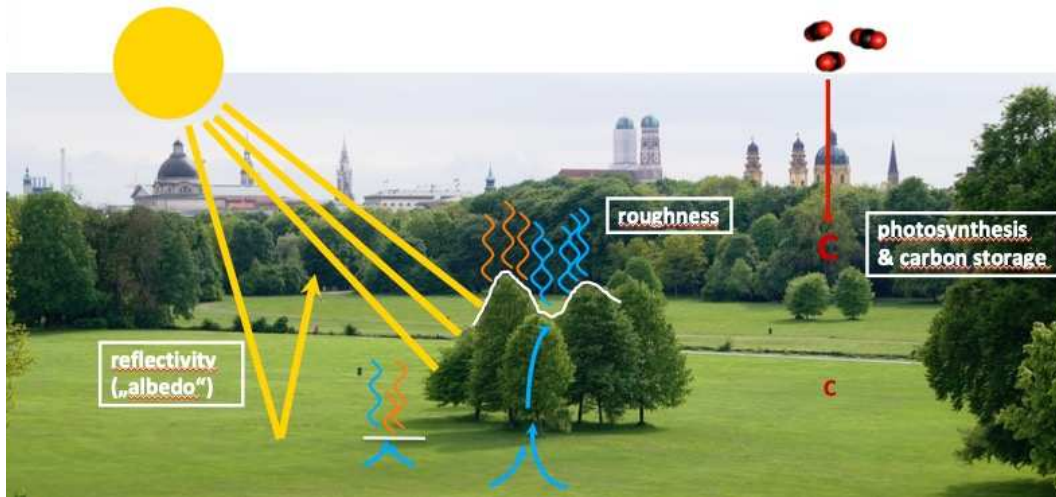
Energy and heat fluxes due to land use change

“Rabbit fence” in Western Australia



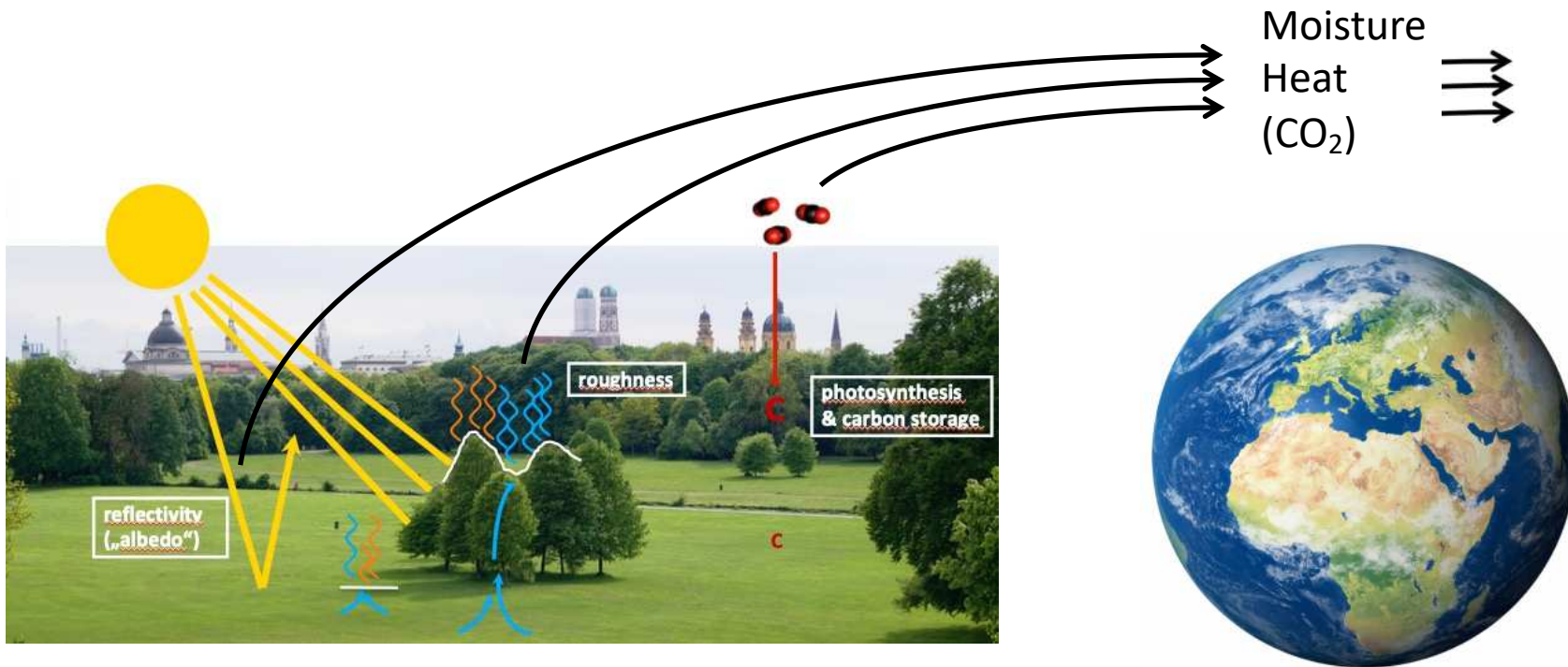
Local vs non-local effects of deforestation

Local effects...



Local vs non-local effects of deforestation

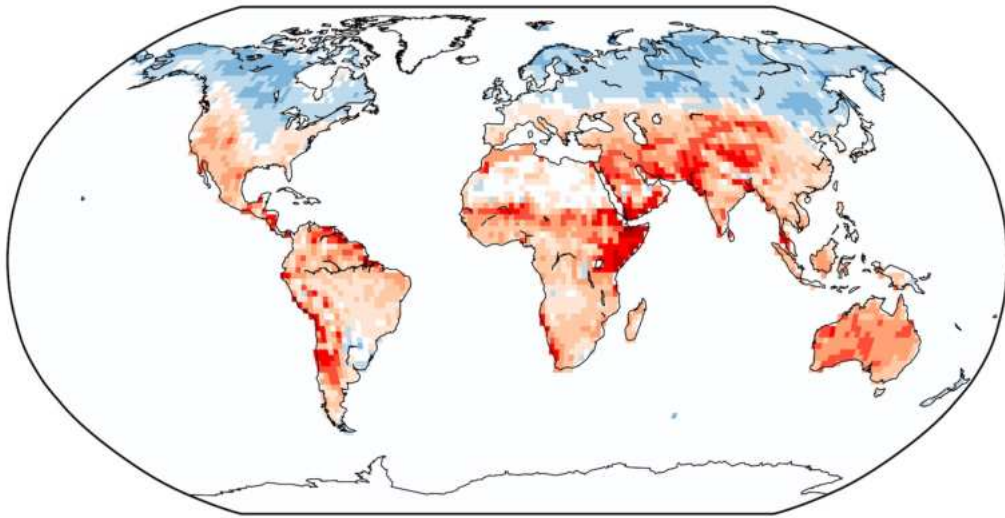
Local effects..... become non-local.



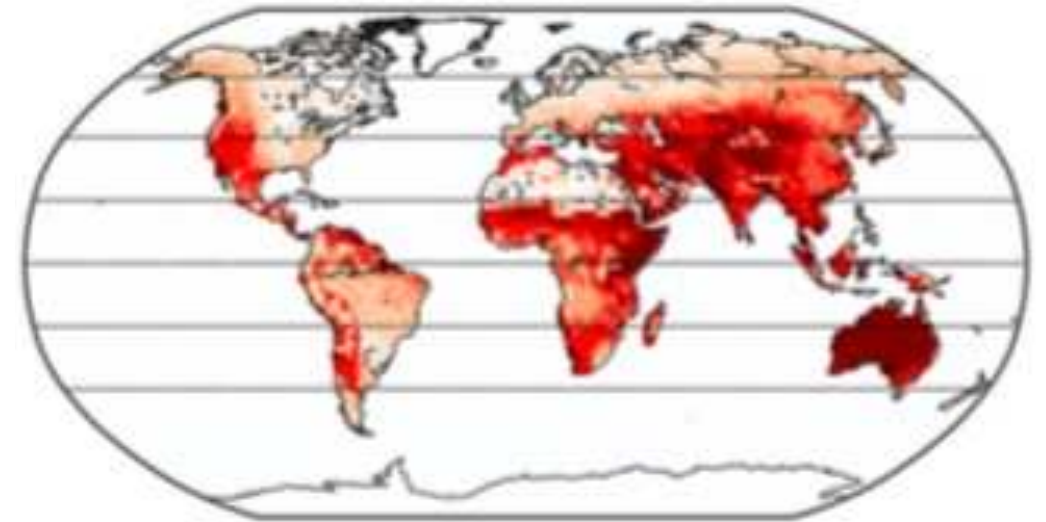
What would happen in a location if we cleared all its forest?

Local change in surface temperature

Annual mean



Maximum temperatures



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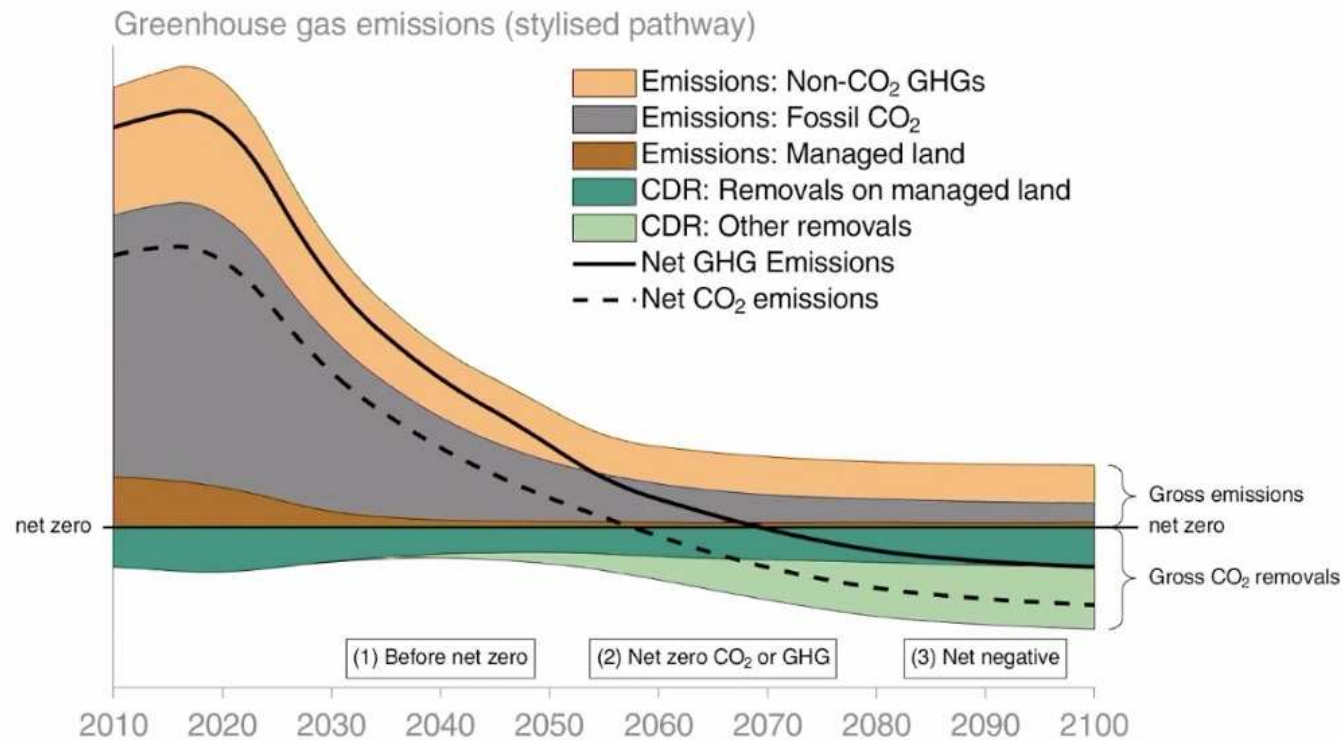
Paris Agreement



The need for Carbon Dioxide Removal (CDR)

- All 1.5°C scenarios include some CDR
- Multiple roles of CDR (complementary to deep emissions reductions):

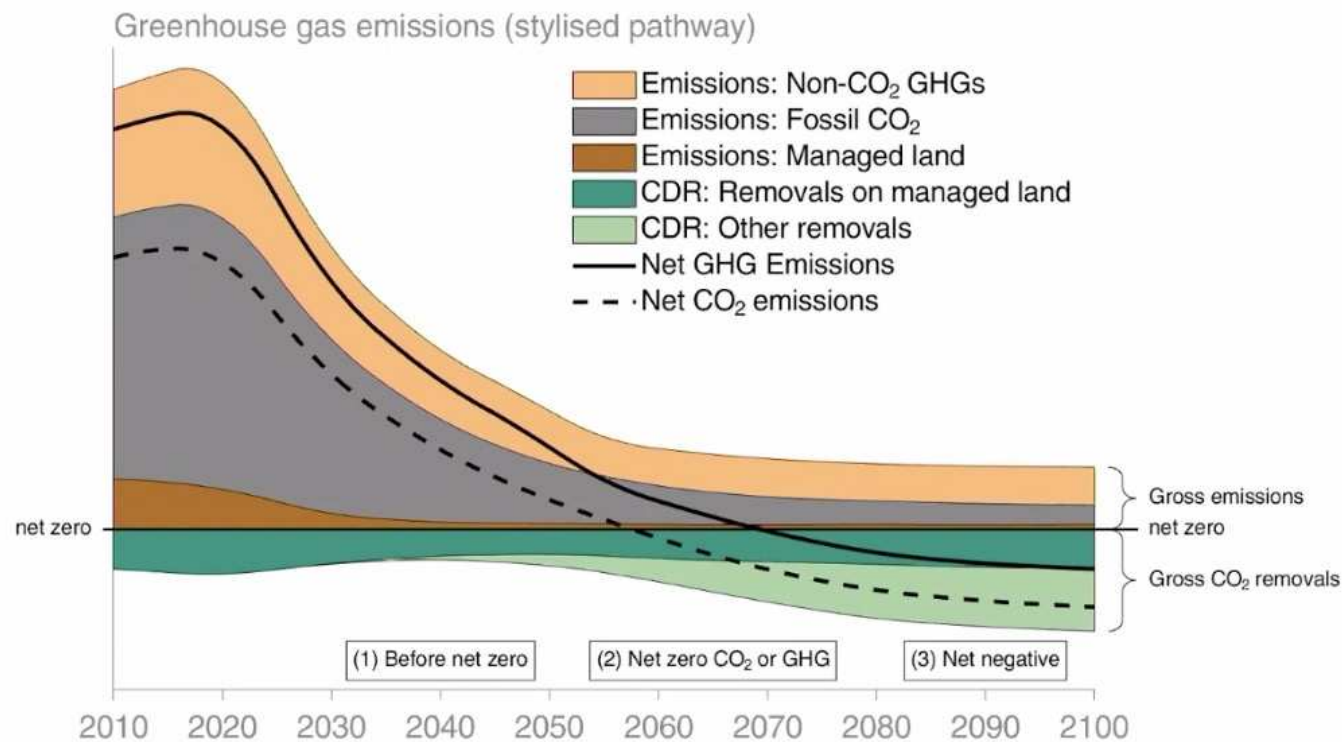
IPCC AR6 WG3 (Ch. 12)



The need for Carbon Dioxide Removal (CDR)

- All 1.5°C scenarios include some CDR
- Multiple roles of CDR (complementary to deep emissions reductions):

IPCC AR6 WG3 (Ch. 12)



→ We no longer need to discuss *if* we do CDR – the Paris Agreement obliges us to do so – but *through which methods, by whom and where!*

The need for Carbon Dioxide Removal (CDR)

- “The deployment of CDR to counterbalance hard-to-abate residual emissions is unavoidable if net zero CO₂ or GHG emissions are to be achieved.” (AR6 WG3)

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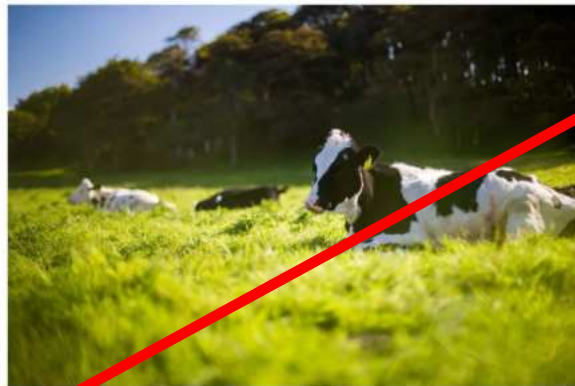
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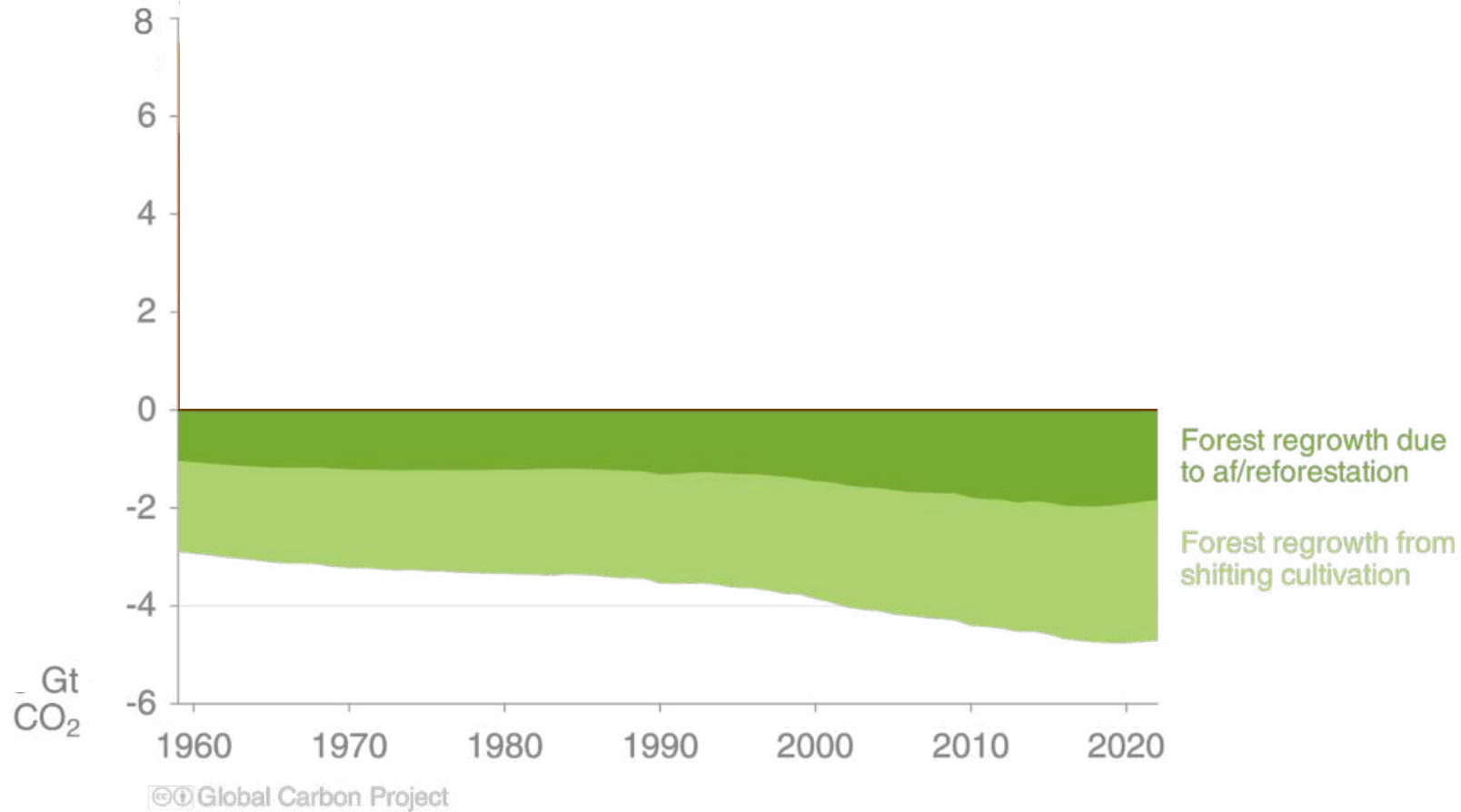
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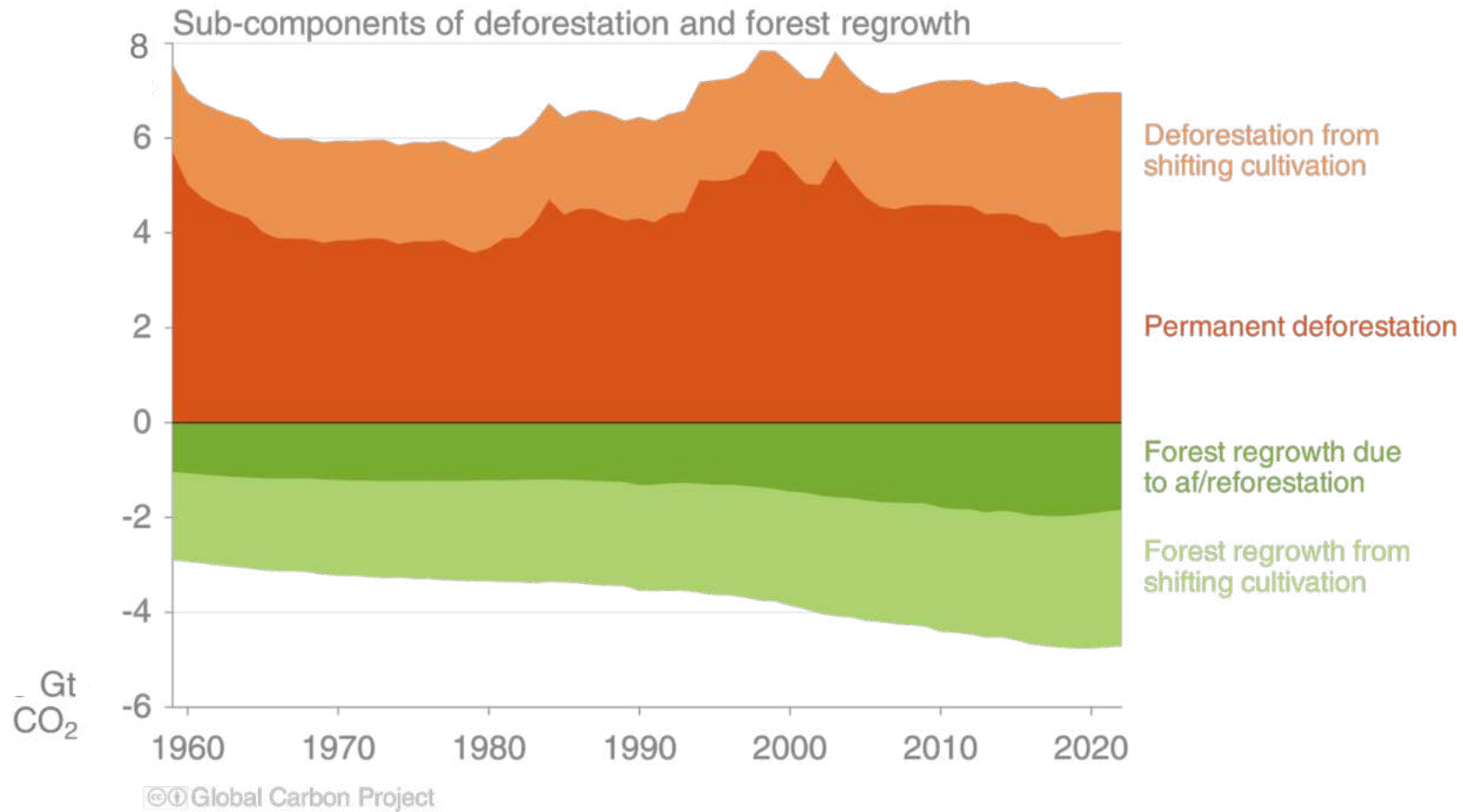
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5-15% of current emissions levels are typically seen as “hard to abate” residual emissions.

We already remove a lot of CO₂ from the atmosphere!

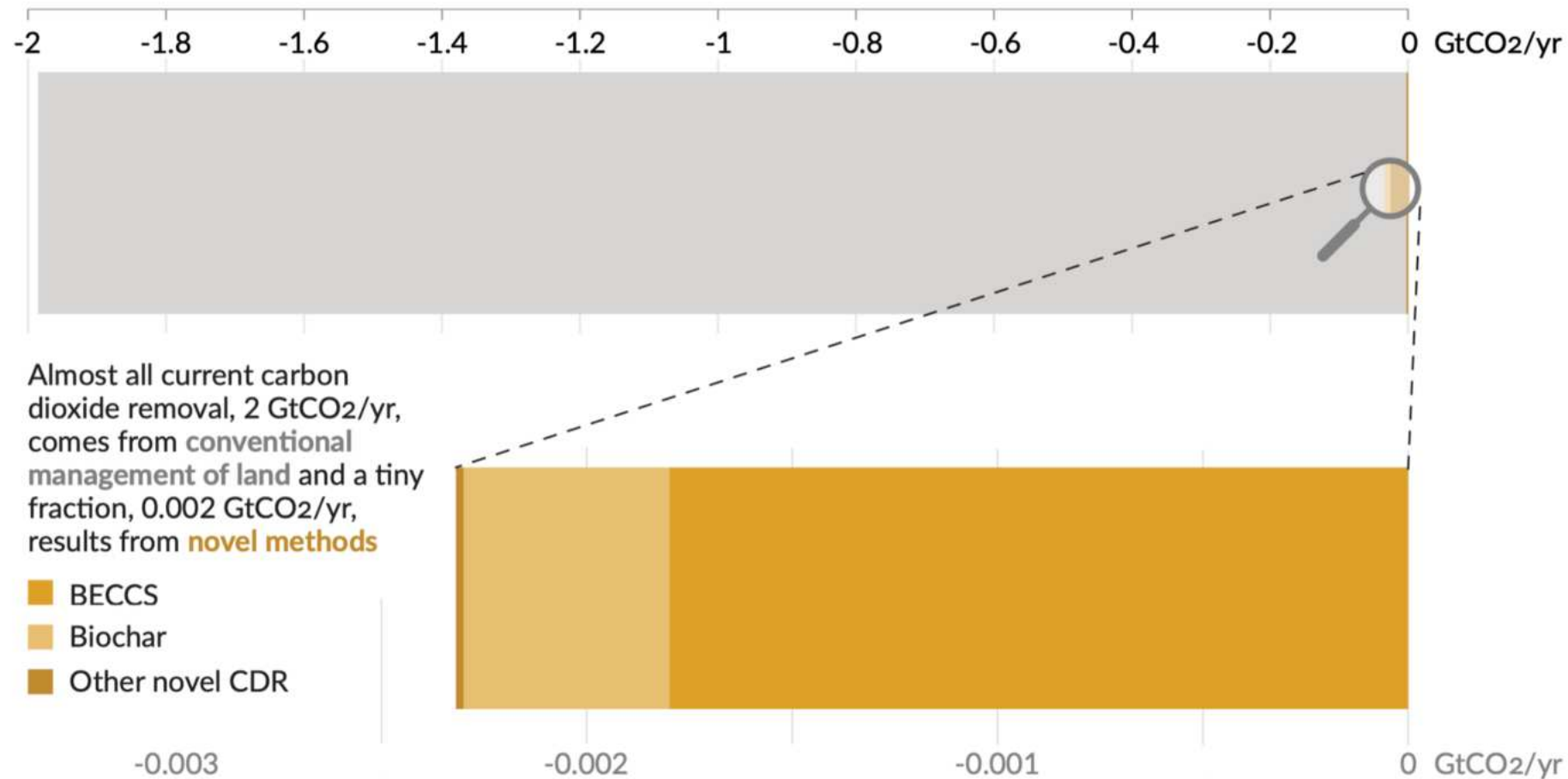


We already remove a lot of CO₂ from the atmosphere! – Oh...

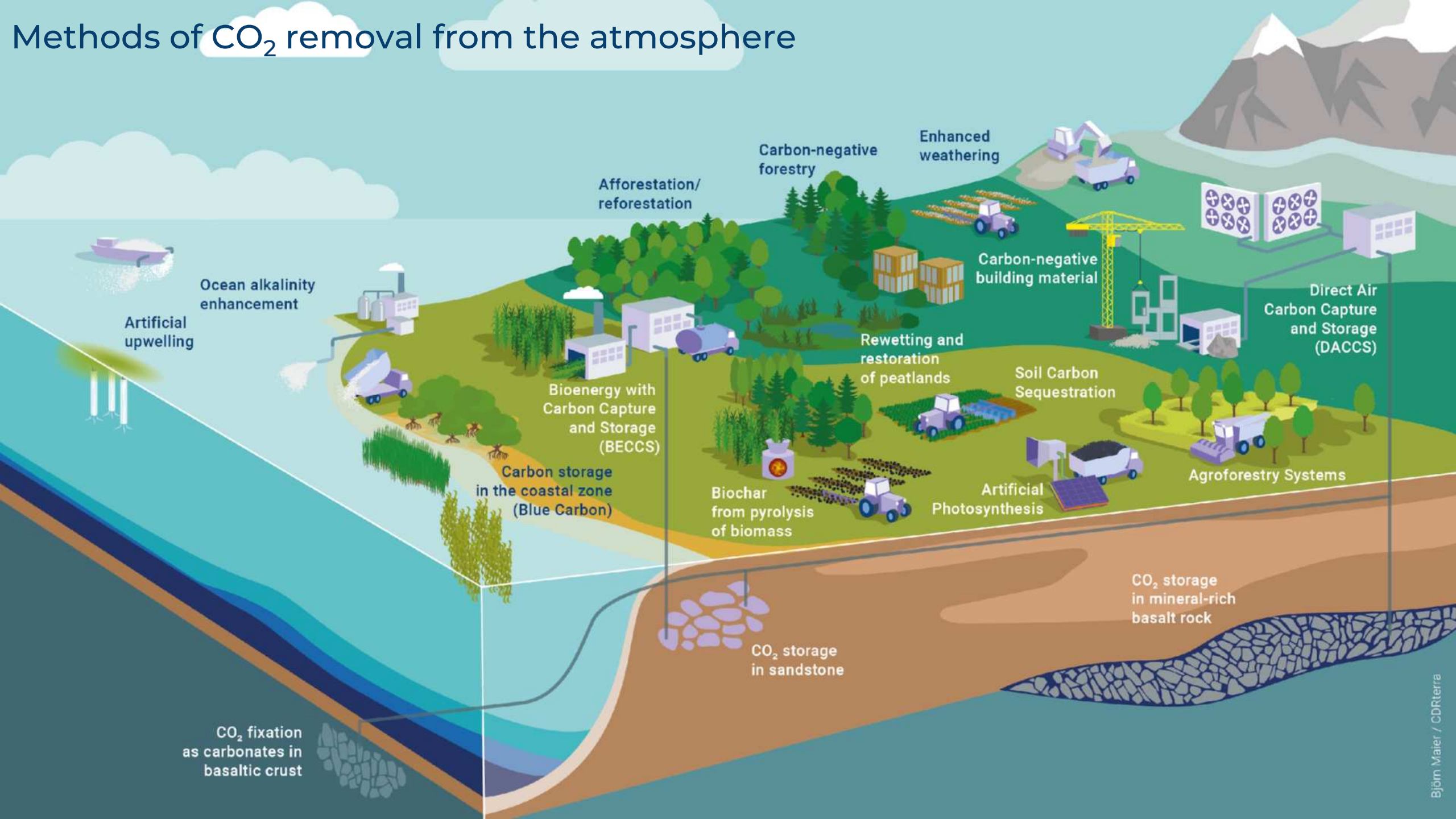


The size of current Carbon Dioxide Removal (CDR)

- Current CDR is around 2 GtCO₂/yr
- 99.9% from **conventional CDR** and only 0.1% from **novel CDR**.













































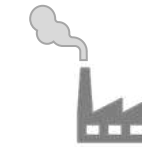
Methods of CO₂ removal from the atmosphere



Possible Side Effects and Risks

→ Presentation by Sally Soria-Dengg on Monday: available as school material!

CDR Method	Technical readiness   	Side effects		Permanence  
		+	-	
Afforestation 			  	
BECCS 			   	
Biochar 			 	
Enhanced weathering 			 	
DACCS 				
Soil carbon sequestration 		 		



Air pollution



Ground/Water pollution



Albedo



Biodiversity



Ecosystem changes



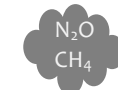
Soil quality



Food security



Mining and extraction



Trace GHGs

Summary

- $\frac{3}{4}$ of the ice-free land surface is managed
- Land use affects climate in two ways:
 - via biogeophysical (energy, water) mechanisms
 - Several degrees C change locally!
 - biogeochemical (CO₂) mechanisms
 - Currently emissions of ca. 5 GtCO₂ per year, of which 2 GtCO₂ are permanent af/reforestation
- Countries rely on land-use for Carbon Dioxide Removal, so comprehensive evaluation of all side-effects is required