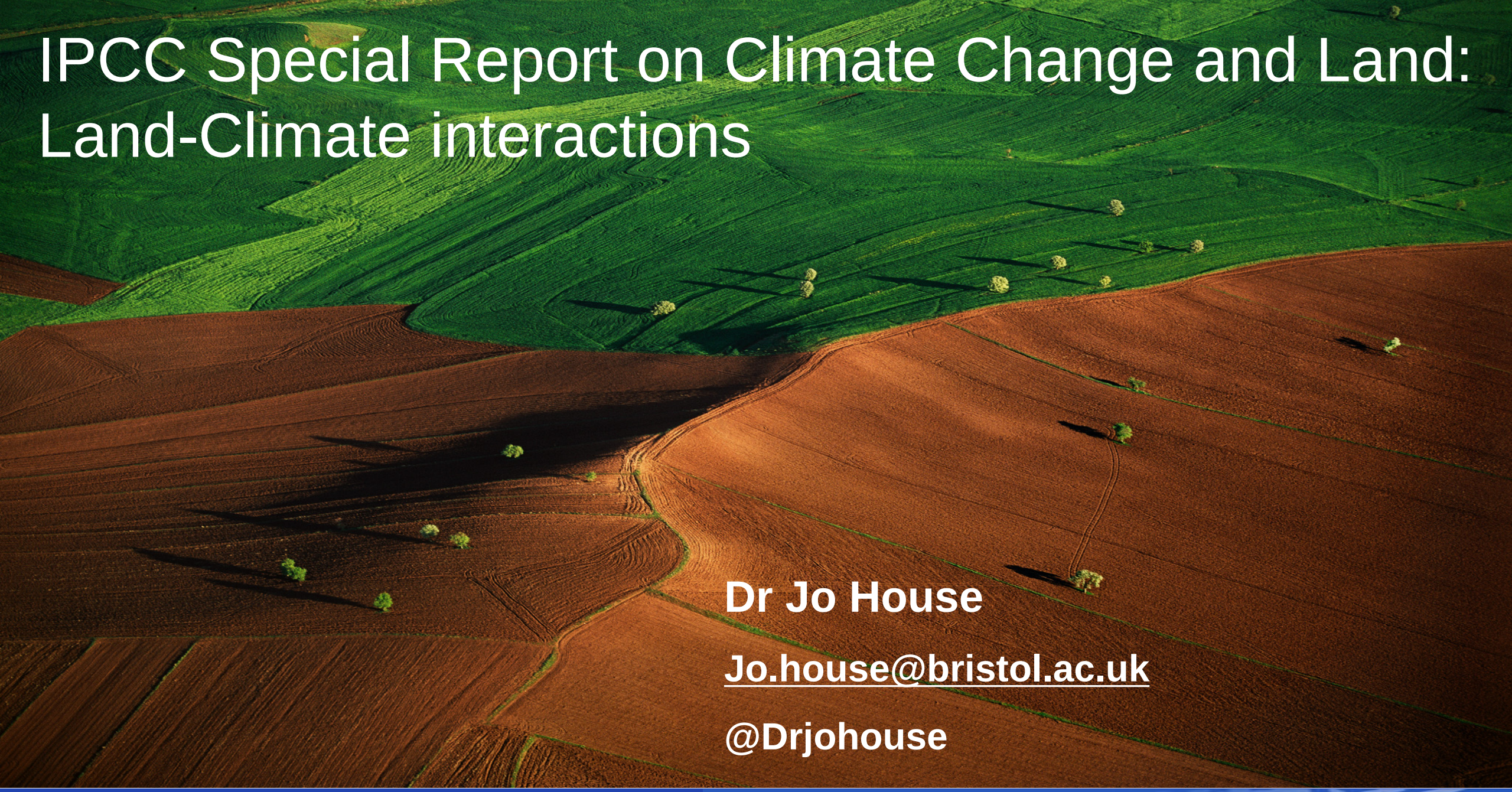
IPCC Special Report on Climate Change and Land: Land-Climate interactions



Dr Jo House

Jo.house@bristol.ac.uk

@Drjohouse

Key messages

- Land is at risk due to climate change, but also contributes to climate change, thus sustainable land management is critical for climate mitigation and adaptation.
  - Climate change poses risks to biodiversity and food production
  - Agriculture, forestry and land use contribute around a third of greenhouse gas emissions
  - Mitigation is limited by the need to feed people and by available land

Climate impacts on land

Model projections of climate change from 1986-2005 to 2081-2100

Scenario: RCP2.6 = 0.9 to 2.3‘C RCP8.5 = 3.2 to 5.4’C

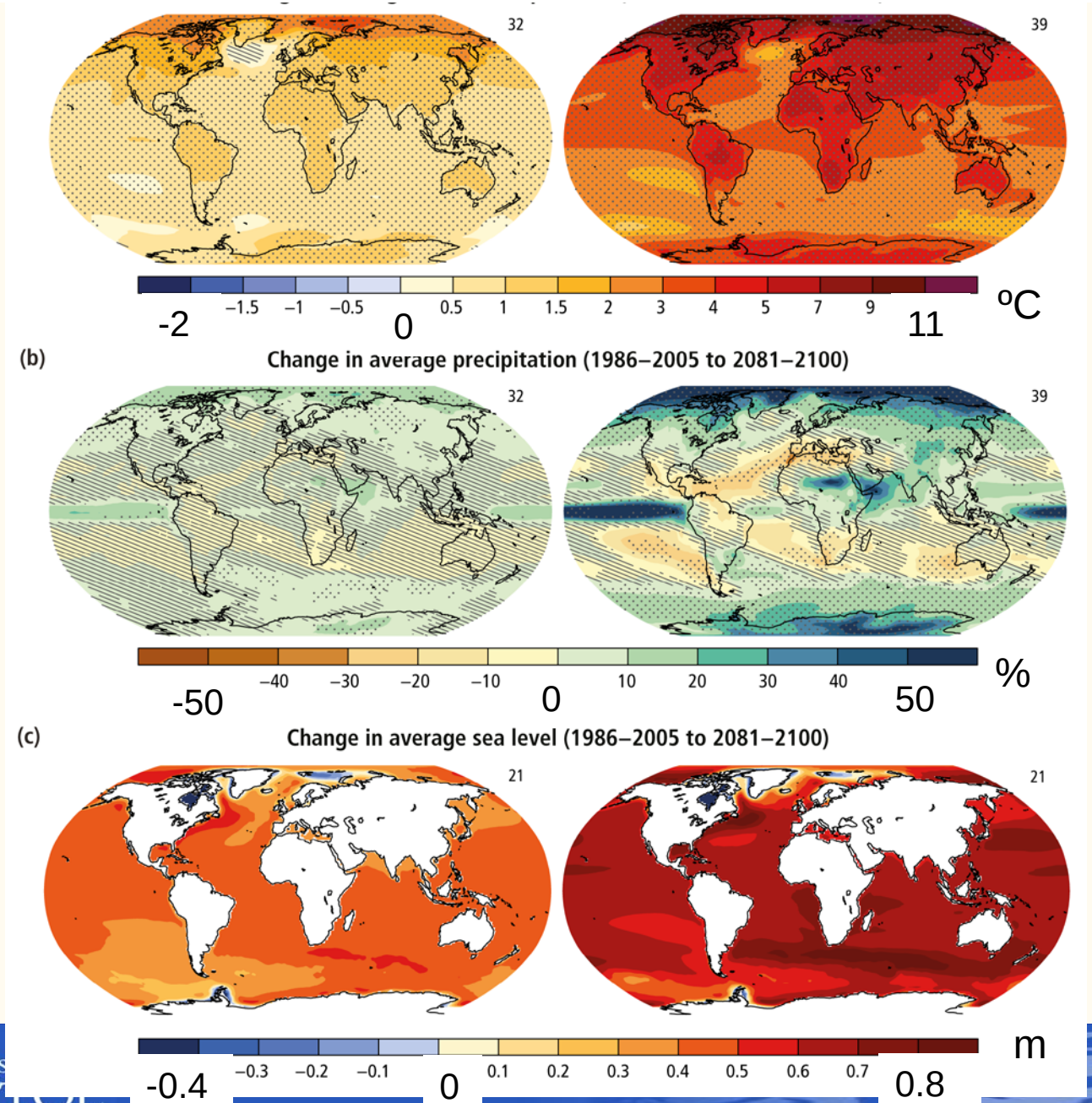
Temperature

Precipitation

Sea level

Changes are not equal everywhere

Graphs show annual average change, not extremes.



IPCC 5th Assessment Report, Synthesis Report fig 2.2.

Model projections of climate change from 1986-2005 to 2081-2100

Changes are not equal everywhere

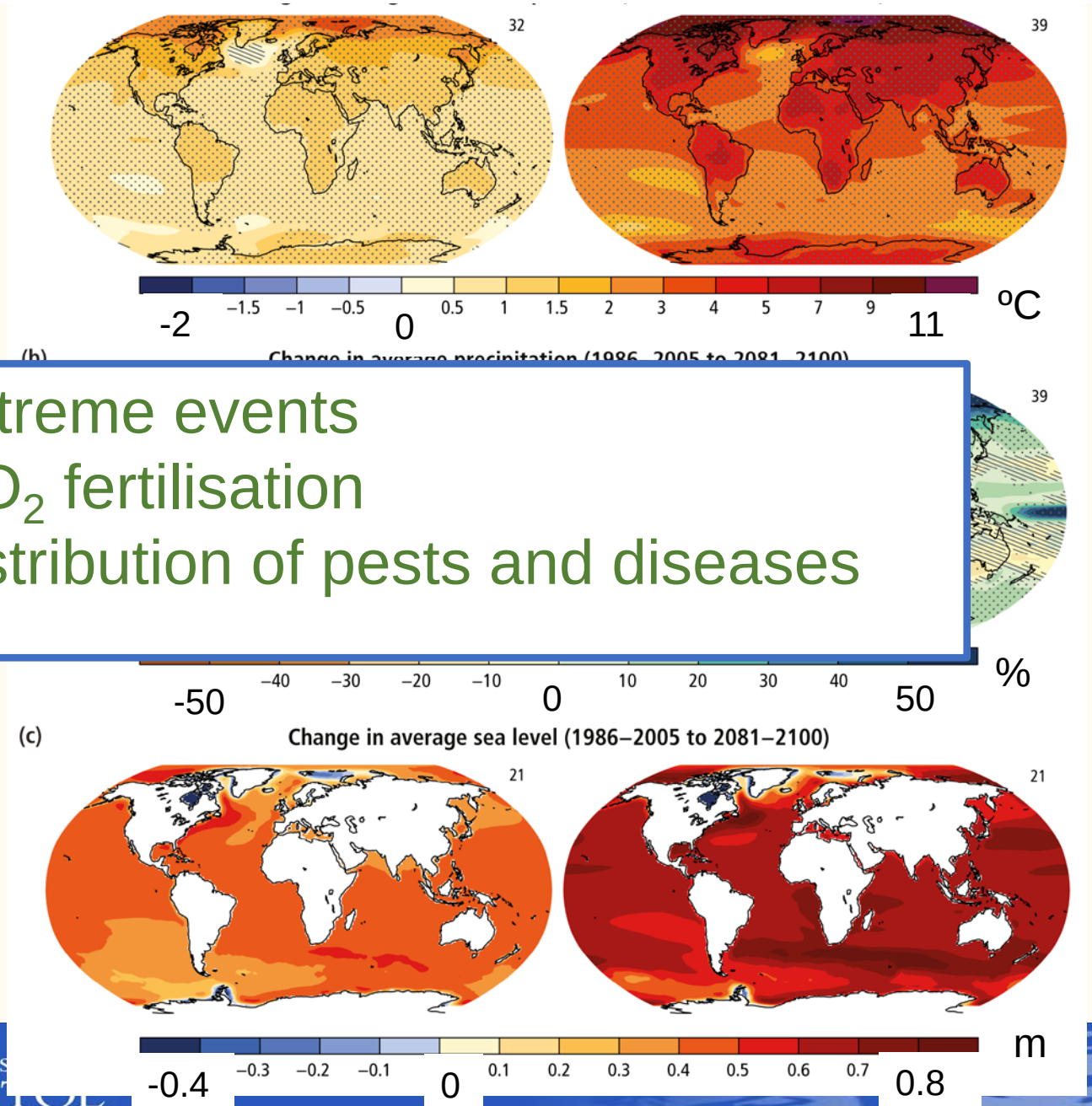
Graphs show annual average change, not extremes.

Scenario: RCP2.6 = 0.9 to 2.3‘C RCP8.5 = 3.2 to 5.4’C

Temperature

Precipi

Sea level



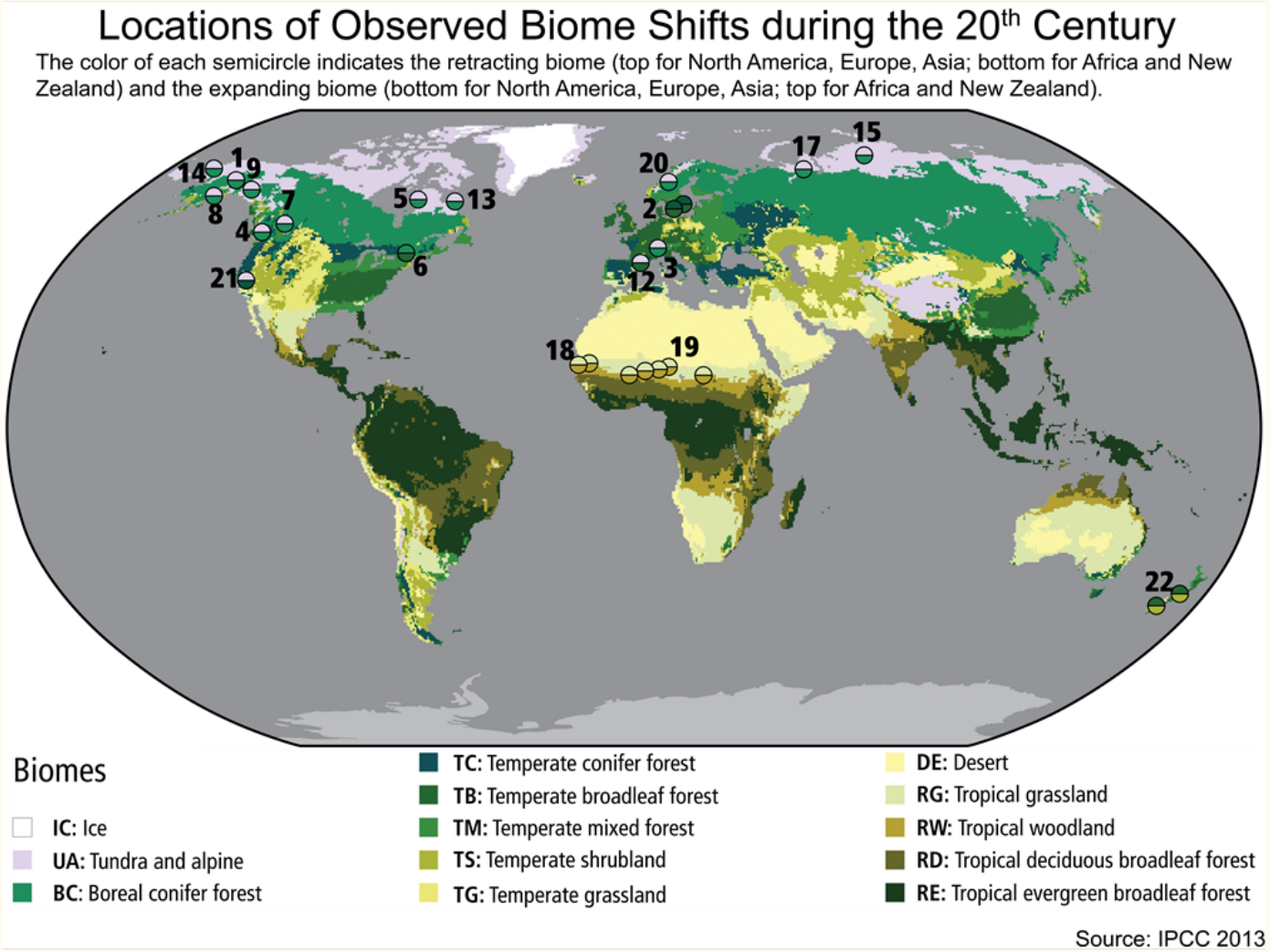
- extreme events
- CO_2 fertilisation
- distribution of pests and diseases

IPCC 5th Assessment Report, Synthesis Report fig 2.2.

Biome shifts and productivity changes during the 20th Century

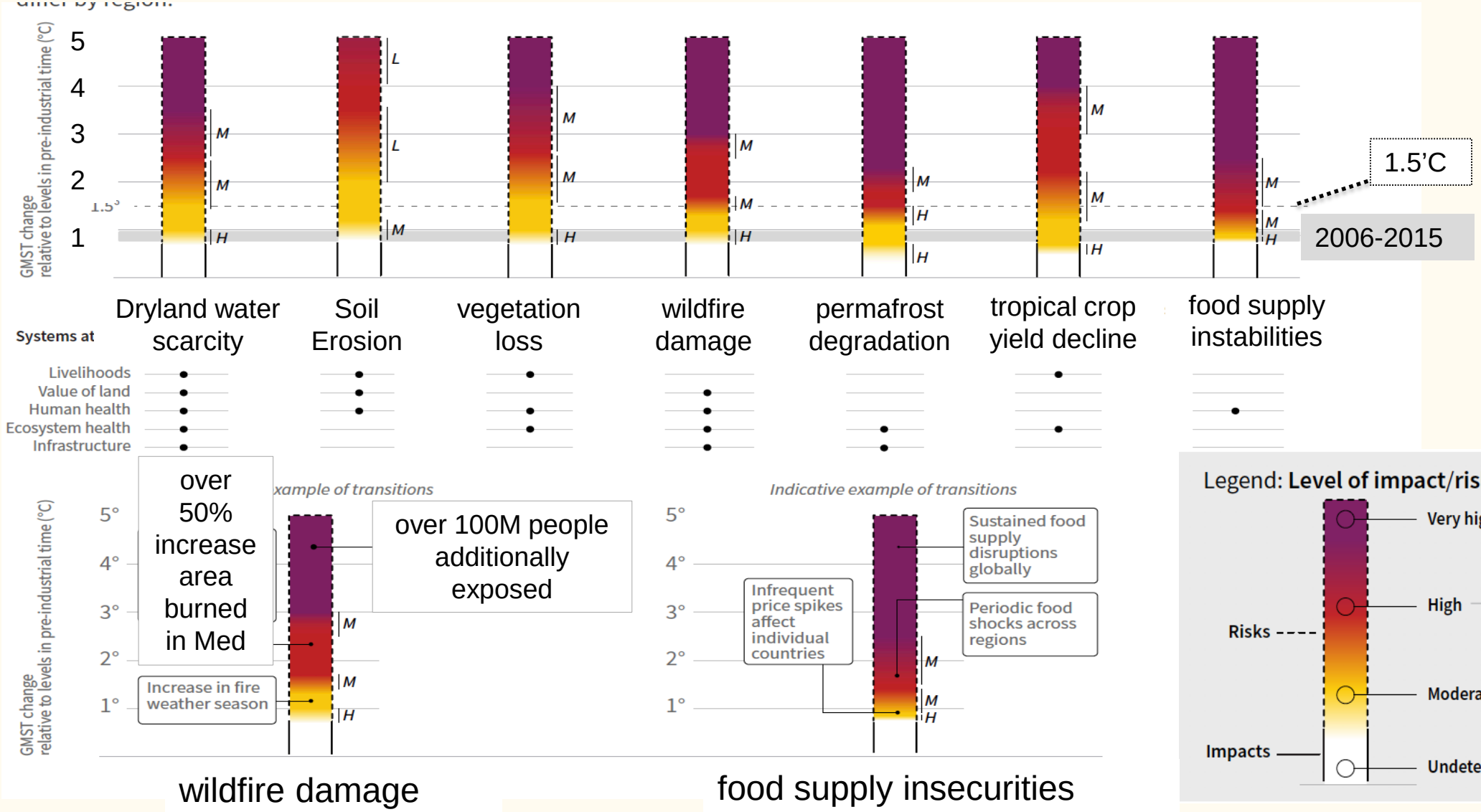
- Anthropogenic warming has resulted in shifts of climate zones, primarily as an increase in dry climates and decrease of polar climates (*high confidence*).

- Ongoing warming is projected to result in new, hot climates in tropical regions and to shift climate zones poleward in the mid- to high latitudes and upward in regions of higher elevation (*high confidence*)



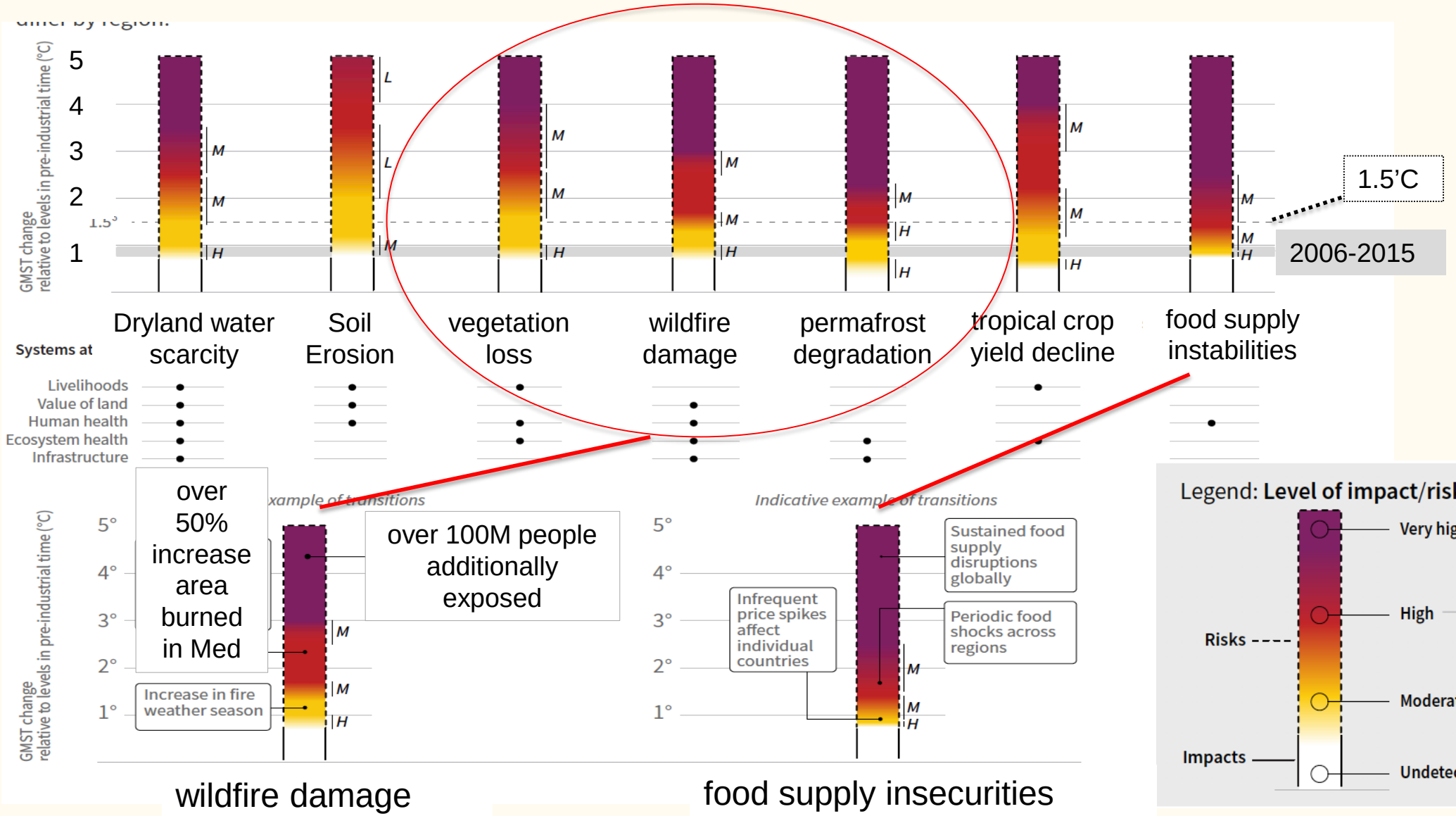
Risks to humans and ecosystems from climate change

temperature change relative to pre industrial 'C



Risks to humans and ecosystems from climate change

temperature change relative to pre industrial 'C



wildfire damage

food supply insecurities

Natural disturbances and extremes, fires, floods, pests and diseases;

- Increase in frequency and intensity in some places, reduction in others
- fires burning in tropical forests where unexpected

Land impacts on climate

Extent of land use and management, 2015

1 % infrastructure

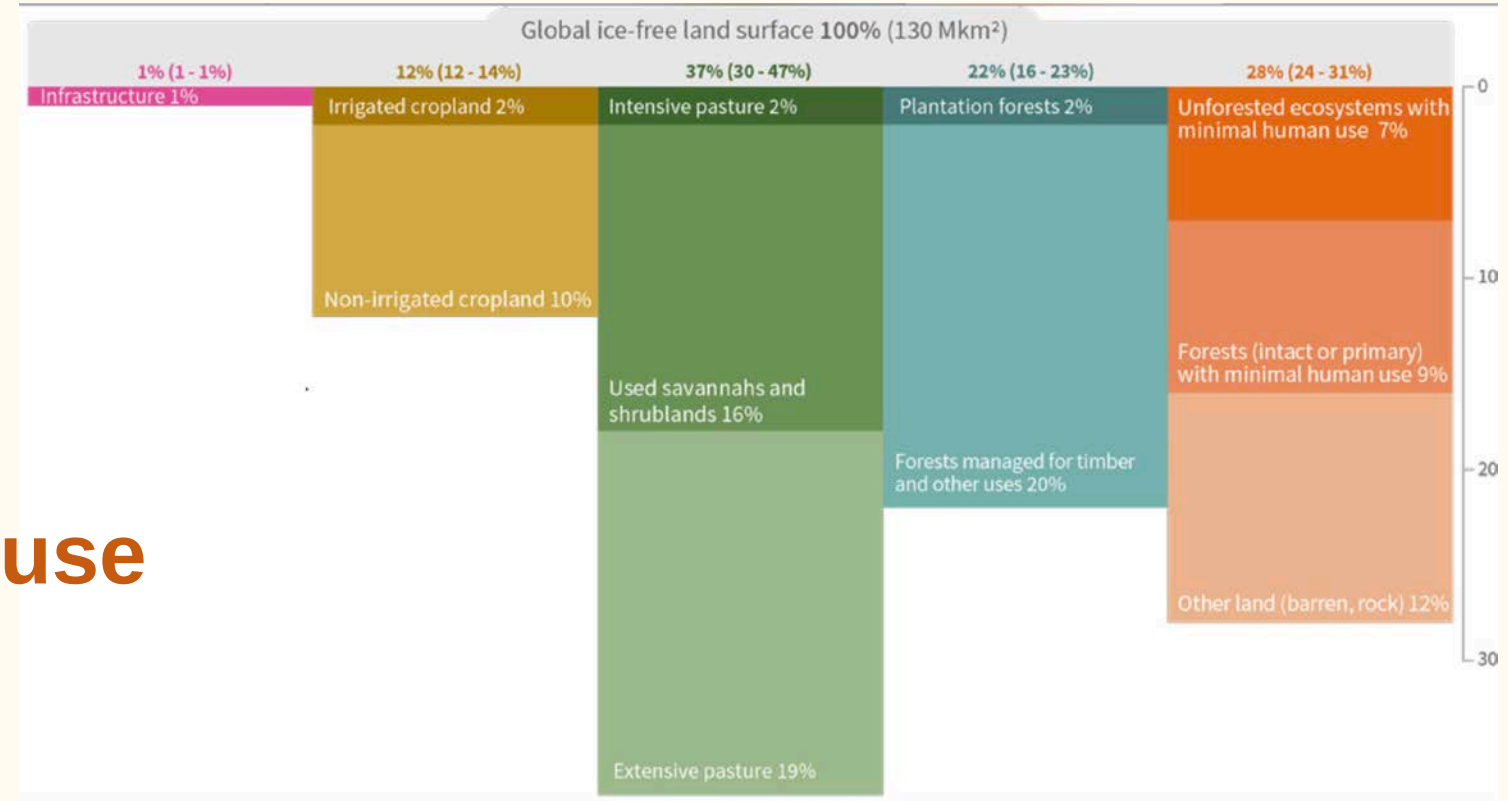
12% cropland

37% pasture

22% managed forests

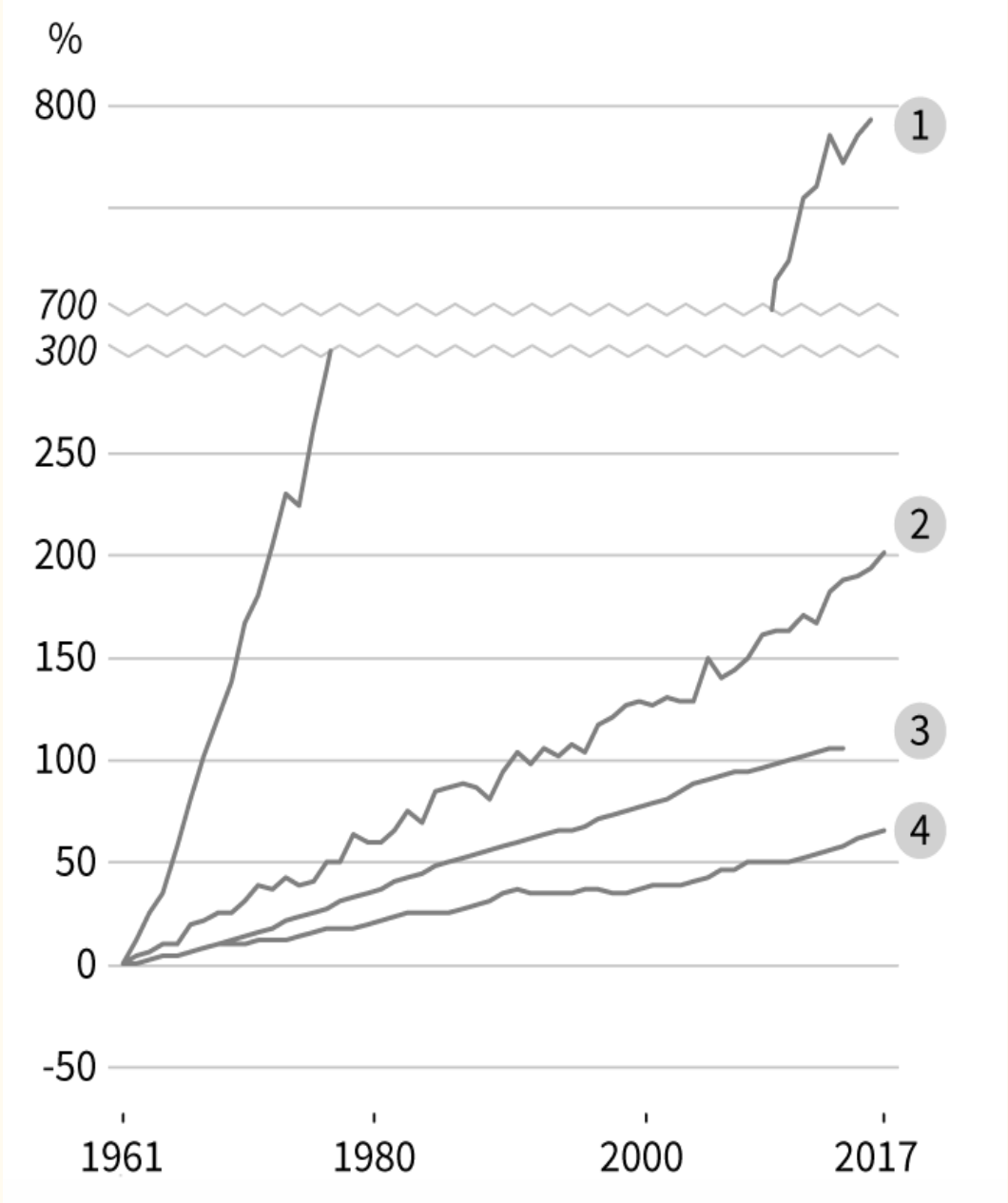
16% minimal human use

12% barren, etc.



IPCC SRCCL SPM fig1

Changing trends in intensity of agriculture from 1961 to 2017 has supported increased production, but also caused greenhouse gas emissions



Inorganic fertiliser use 800% increase – emits nitrous oxide

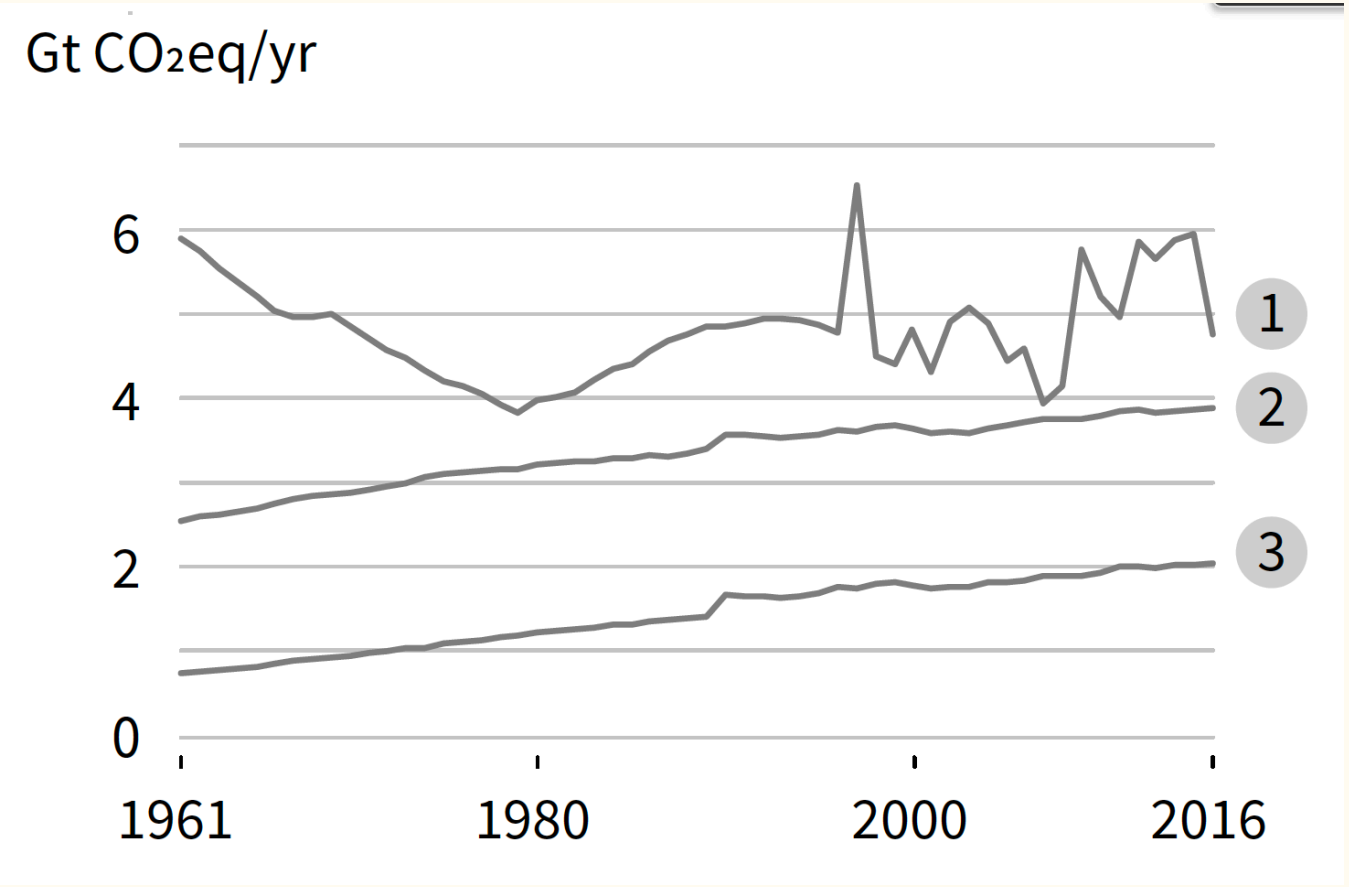
Increase in cereal yields around 200%

Increase in irrigation water volume

Total number of ruminant livestock

IPCC SRCCL SPM fig1

Change in anthropogenic greenhouse gas emissions 1961-2016



Agriculture, Forestry and Other Land Use (AFOLU) activities accounted for 23% of total net anthropogenic emissions of GHG during 2007-2016

1. 13% of carbon dioxide CO_2 from deforestation, afforestation, and other land cover change
2. 44% of methane CH_4 from agriculture
3. 82% of nitrous oxide N_2O from agriculture

Including pre- and post-production activities in the global food: 21-37% of total net anthropogenic GHG emissions

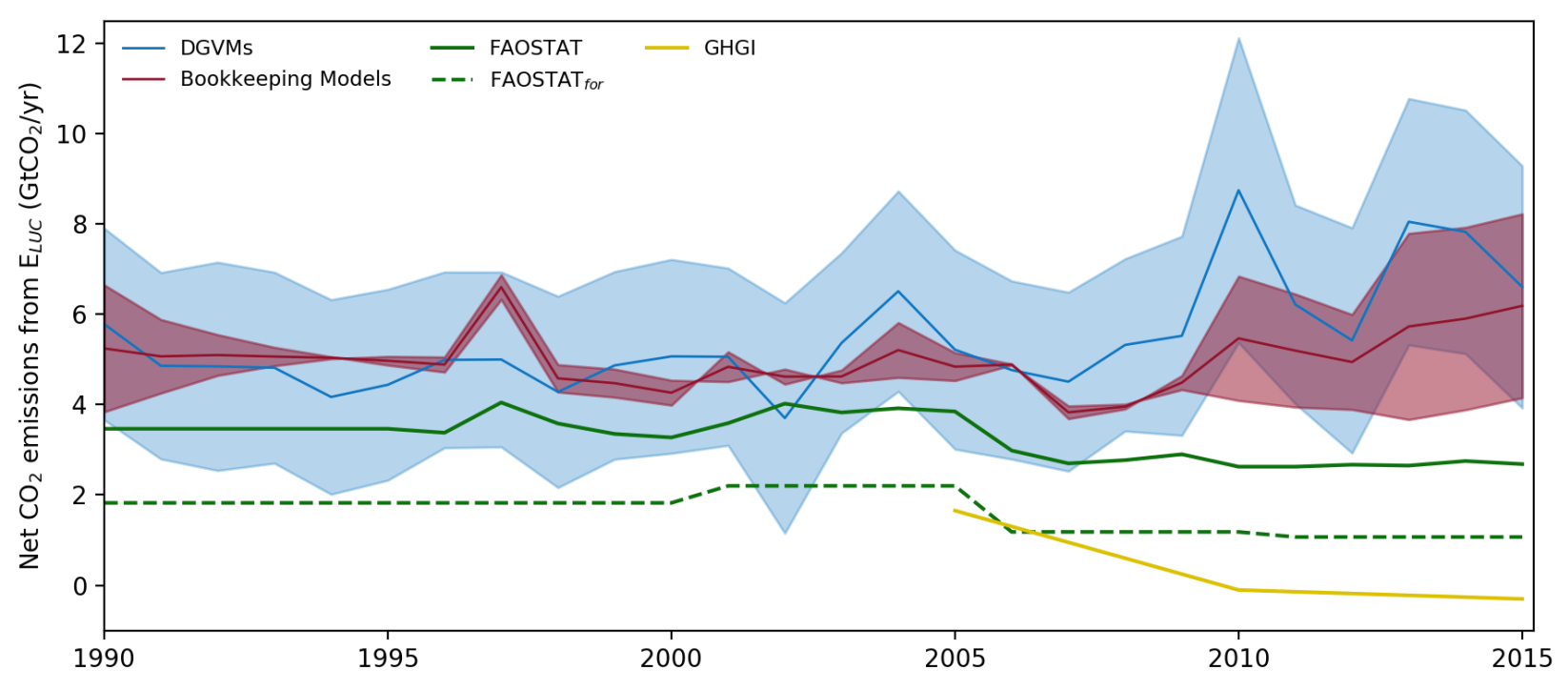
Natural land sink of CO_2

The natural response of land to human-induced environmental change caused a net sink of around 11.2 $GtCO_2$ yr^{-1} during 2007-2016 (equivalent to 29% of total CO_2 emissions) *(medium confidence*)

The persistence of the sink is uncertain due to climate change (*high confidence*).

Borneo, Central Kalimantan photo Jo House

Carbon dioxide net emissions and removals from land use, land use change and forestry



National greenhouse gas inventories (yellow) show much smaller net emissions than global models (red and blue)

They assume some of the sink due to environmental change to be anthropogenic if it occurs on “managed lands”

Needs to be reconciled for the Paris Agreement Global Stocktake 2023

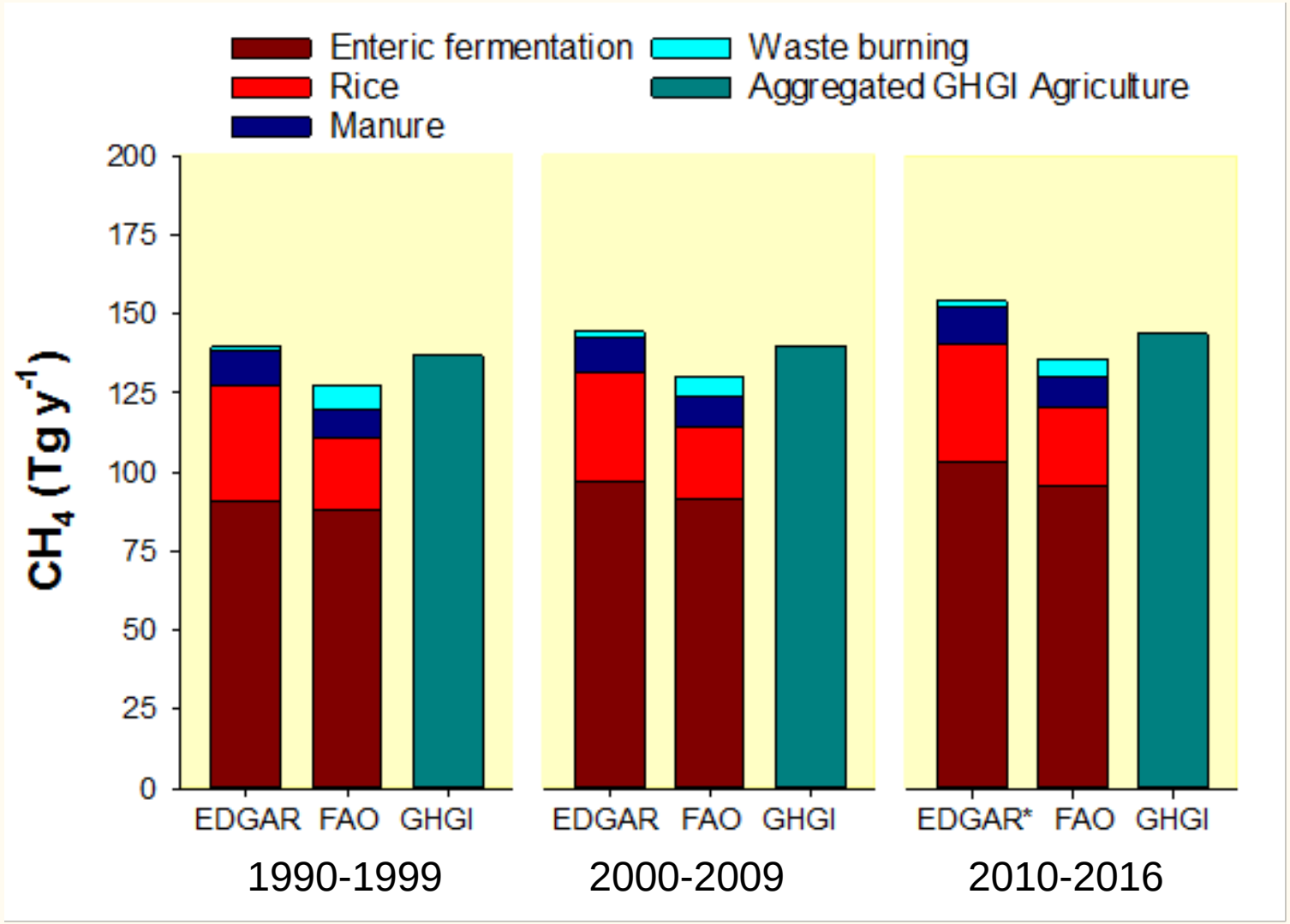
Average agricultural methane (CH_4) emissions estimates from 1990 to 2016

waste burning

manure

rice

ruminant animals

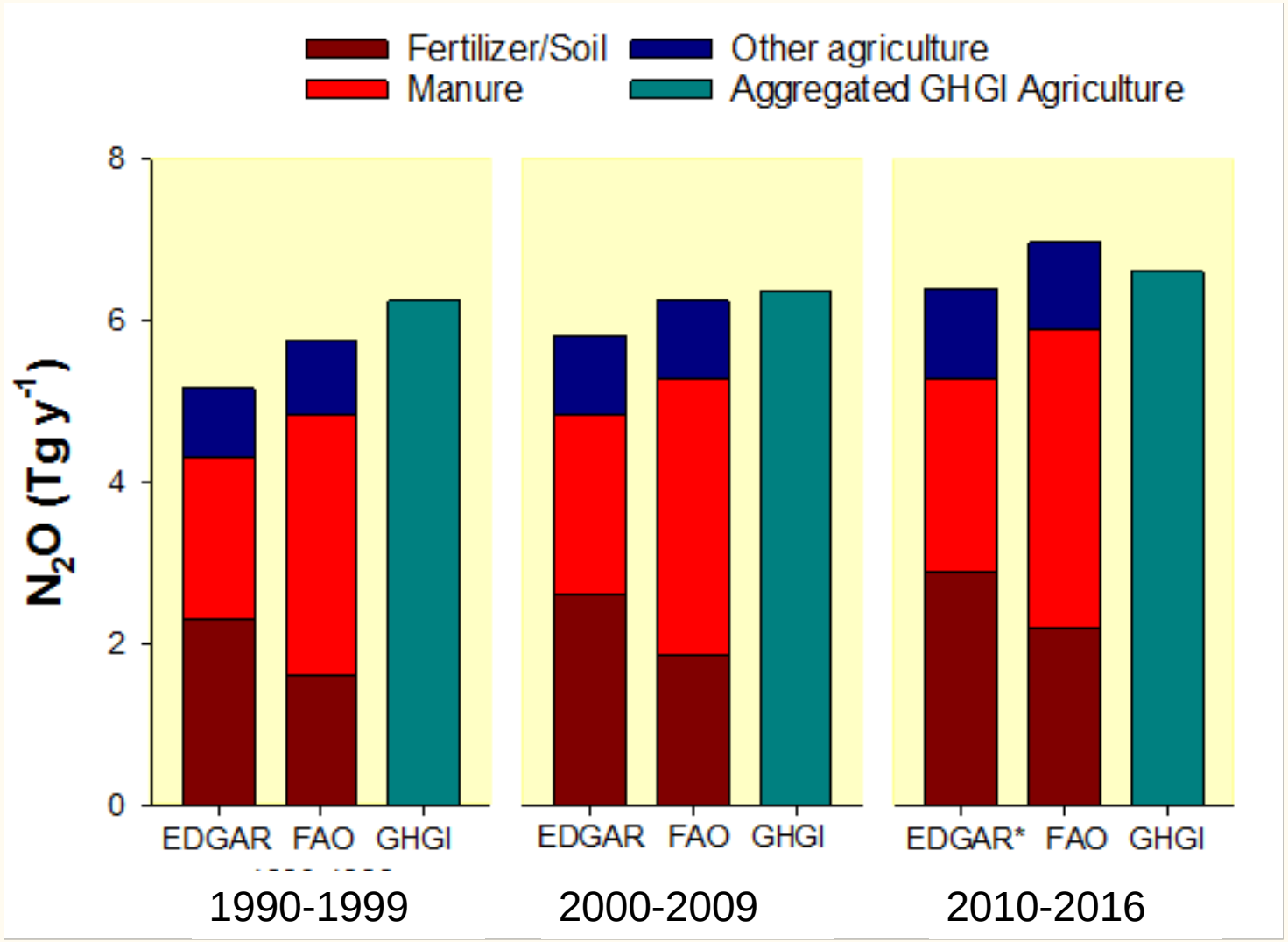


Average agricultural nitrous oxide (N_2O) emissions estimates from 1990 to 2016

other agriculture

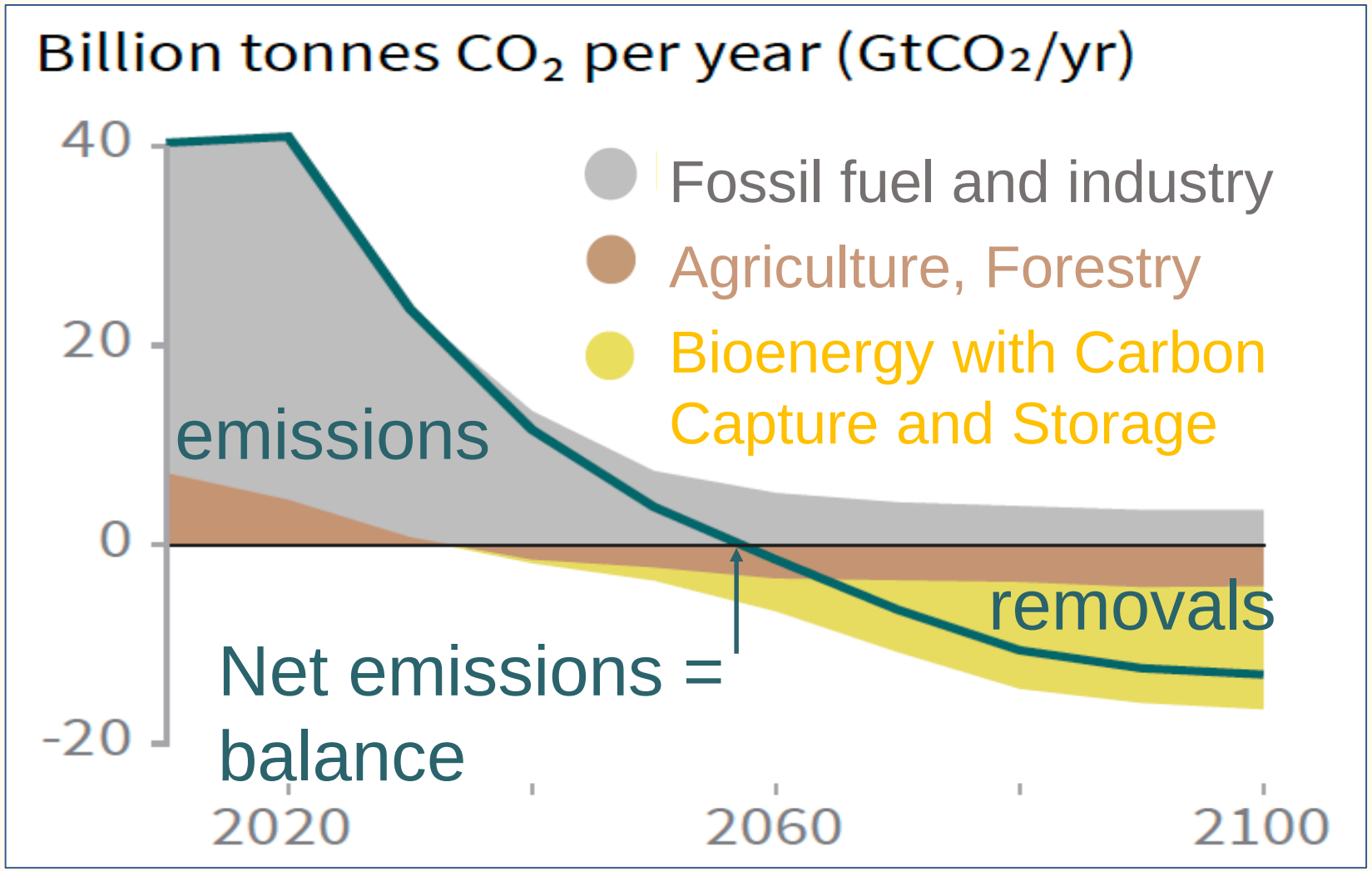
manure

fertiliser/soil

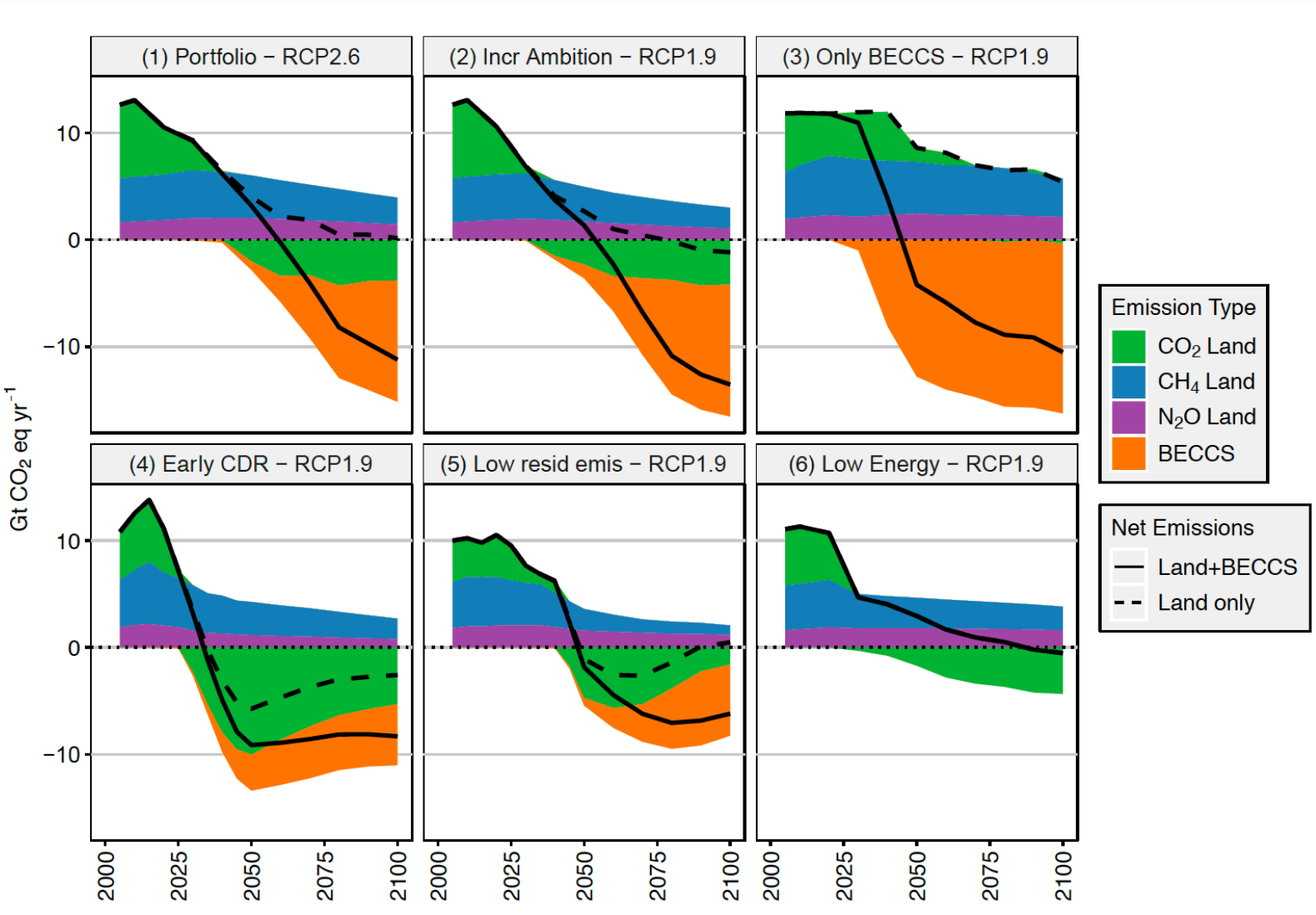


Responding: mitigation and adaptation

How do we get to 1.5 degrees?



Land use Change in 1.5 and 2 ‘C consistent pathways



There are multiple different pathways that can limit warming

Less bioenergy would require more afforestation to meet targets

- Bioenergy area change 0-750 Mha (roughly size od India)
- Forest area -200 to 7200 Mha change

Mitigation in the land sector

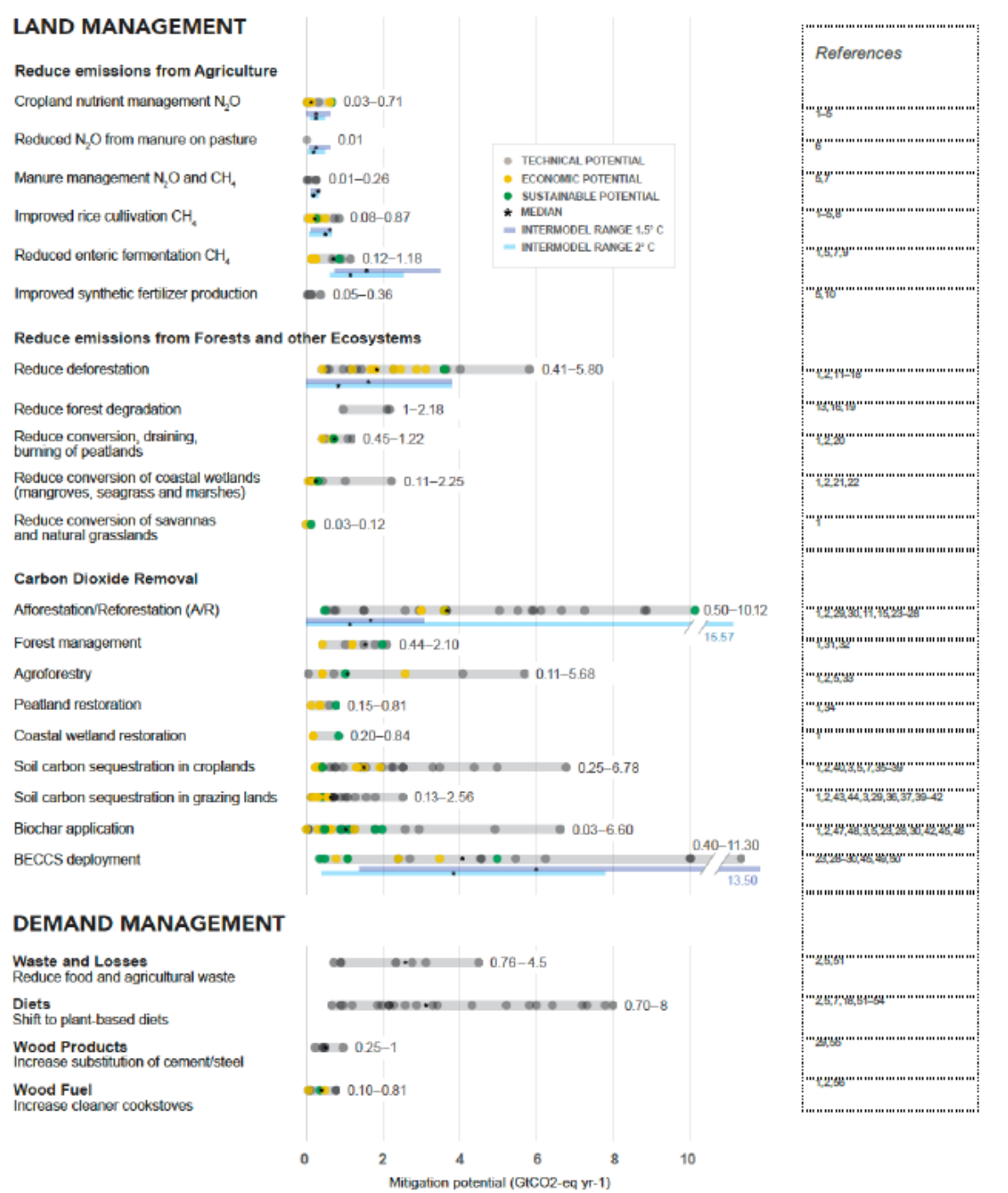
IPCC SRCCL fig 2.24, from Roe et al Nature climate change 2019

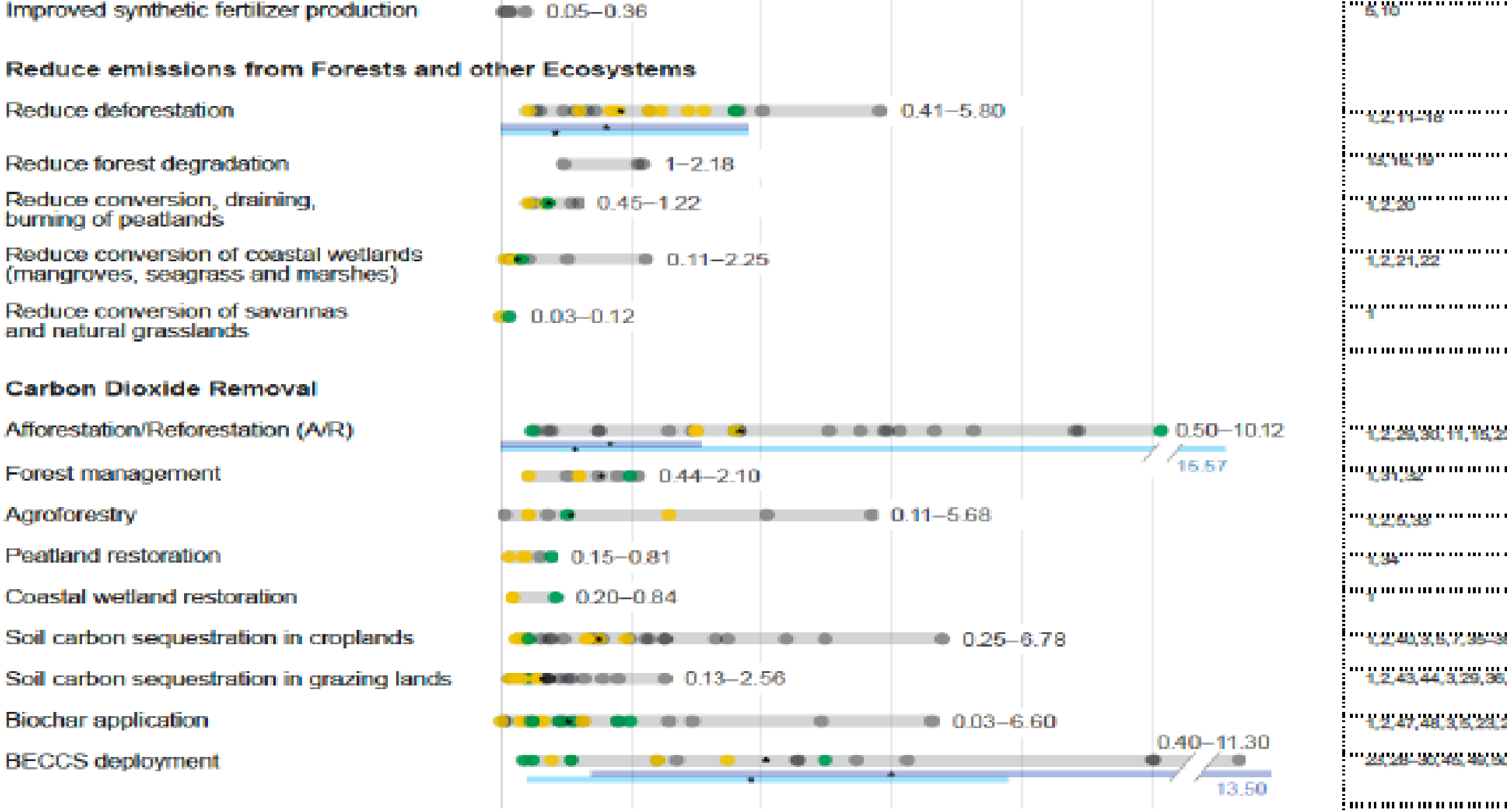
reduced emissions from agriculture

reduced emissions from forests and other ecosystems

carbon dioxide removal

Demand management




Improved synthetic fertilizer production
0.05–0.36
Reduce emissions from Forests and other Ecosystems
Reduce deforestation
0.41–5.80
Reduce forest degradation
1–2.18
Reduce conversion, draining, burning of peatlands
0.45–1.22
Reduce conversion of coastal wetlands (mangroves, seagrass and marshes)
0.11–2.25
Reduce conversion of savannas and natural grasslands
0.03–0.12
Carbon Dioxide Removal
Afforestation/Reforestation (A/R)
0.50–10.12
15.57
Forest management
0.44–2.10
Agroforestry
0.11–5.68
Peatland restoration
0.15–0.81
Coastal wetland restoration
0.20–0.84
Soil carbon sequestration in croplands
0.25–6.78
Soil carbon sequestration in grazing lands
0.13–2.56
Biochar application
0.03–6.60
BECCS deployment
0.40–11.30
13.50
DEMAND MANAGEMENT

Key messages

- Land is at risk due to climate change, but also contributes to climate change, thus sustainable land management is critical for climate mitigation and adaptation.
  - Climate change poses risks to biodiversity and food production
  - Agriculture, forestry and land use contribute around a third of greenhouse gas emissions
  - Mitigation is limited by the need to feed people and by available land

Thankyou. Jo.house@bristol.ac.uk