OVERVIEW ON CLIMATE CHANGE

20 FEBRUARY 2025

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Technology, Innovation and Society (TIS)

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

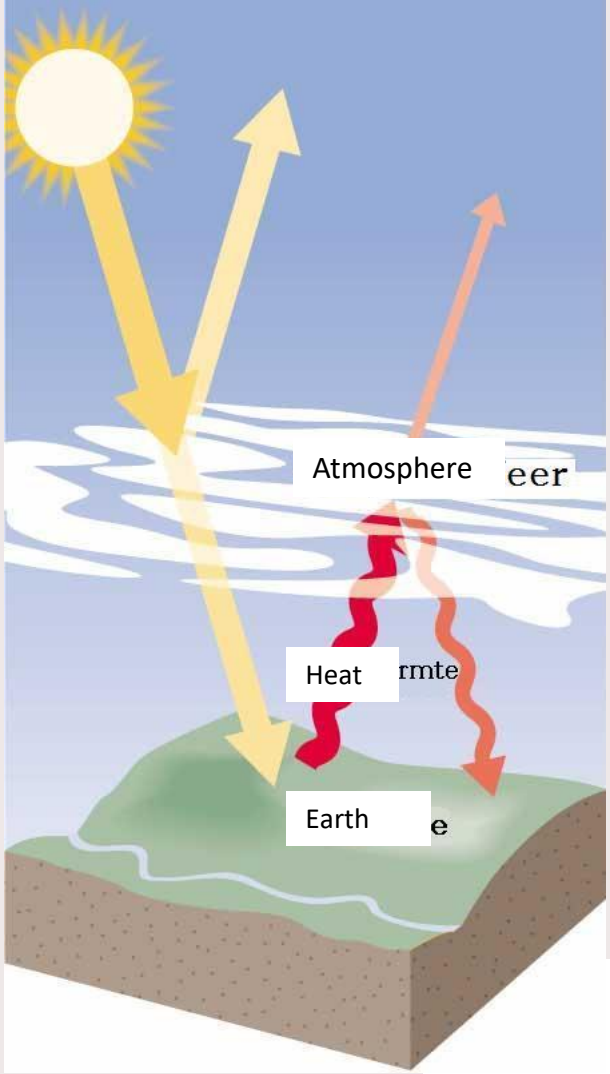
The greenhouse effect

Thanks to the atmosphere, the globe traps heat, due to three factors:

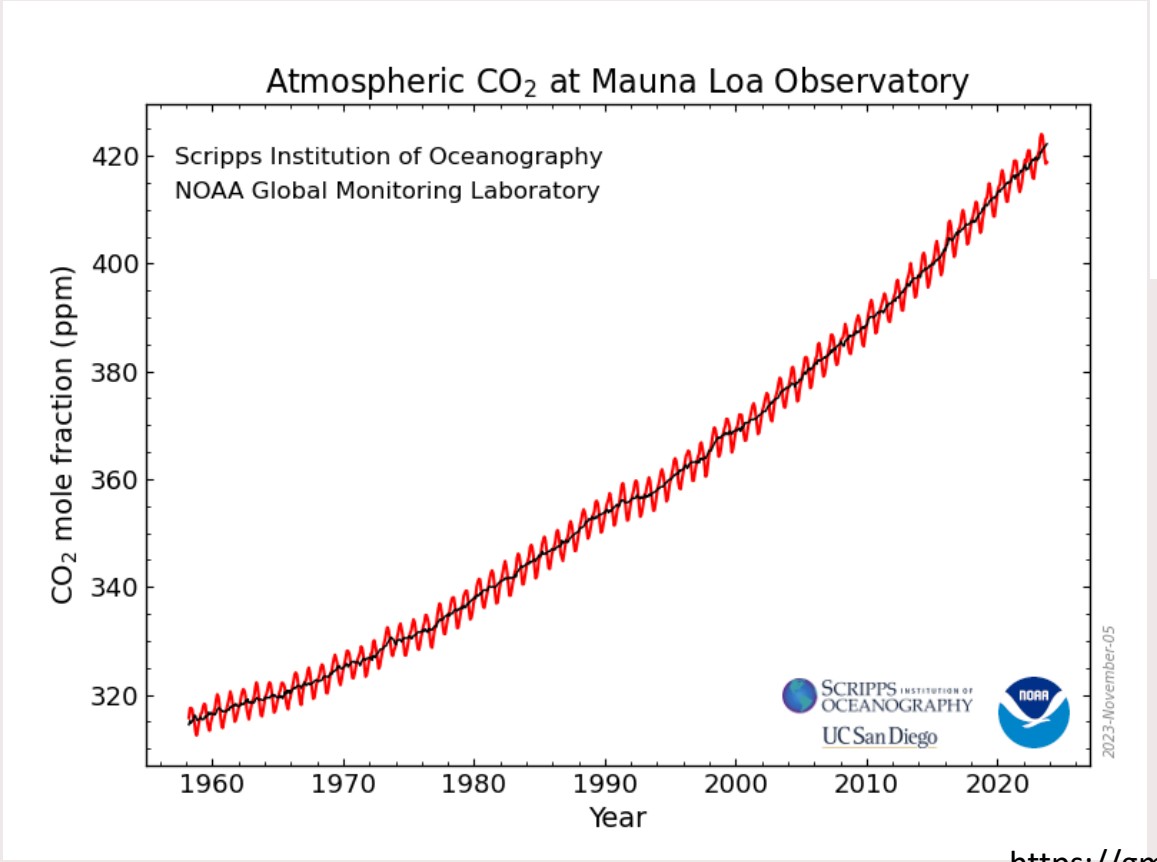
1) Radiation from the sun (high-energetic, UV) which arrives at the earth's surface, loses energy, and is converted into infrared radiation

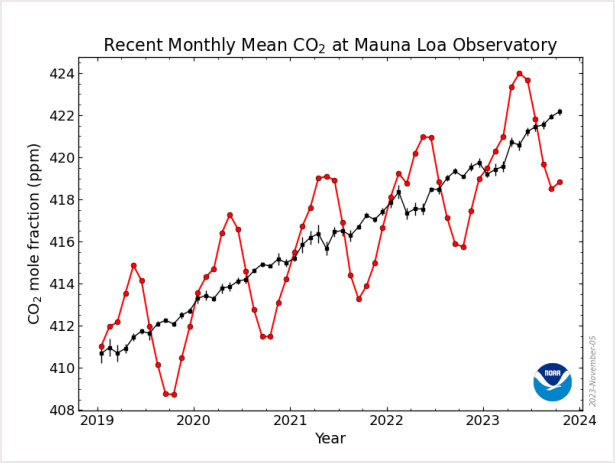
2) Albedo is fraction of sunlight reflected

3) Greenhouse gases absorb the IR (not UV!) and lead to heating



CO_2 concentration is steadily rising

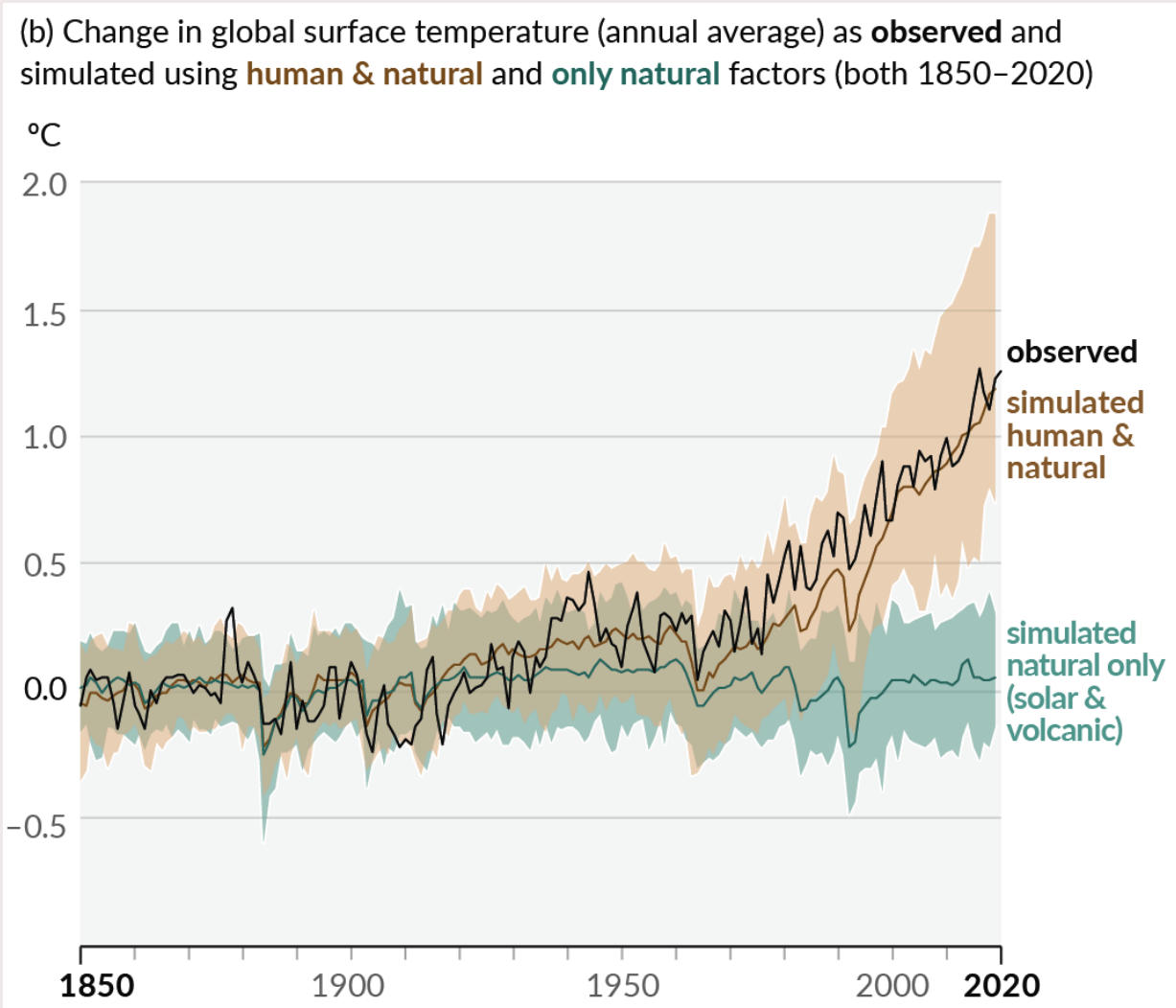




https://gml.noaa.gov/ccgg/trends/

TU/e

Current temperature increase cannot be credibly explained without human-caused greenhouse gases



IPCC AR6 WGI 2021:
Figure SPM.1b

Causal chain is clear

People want to do things, activities

Fulfilling needs: nutrition, communication, shelter, status, happiness

Use of energy through fossil fuels

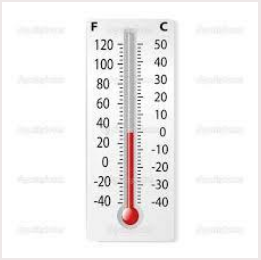
Changing land use and agriculture

Greenhouse gas emissions (tCO_2-eq)

Concentration greenhouse gases (ppm of ppb)

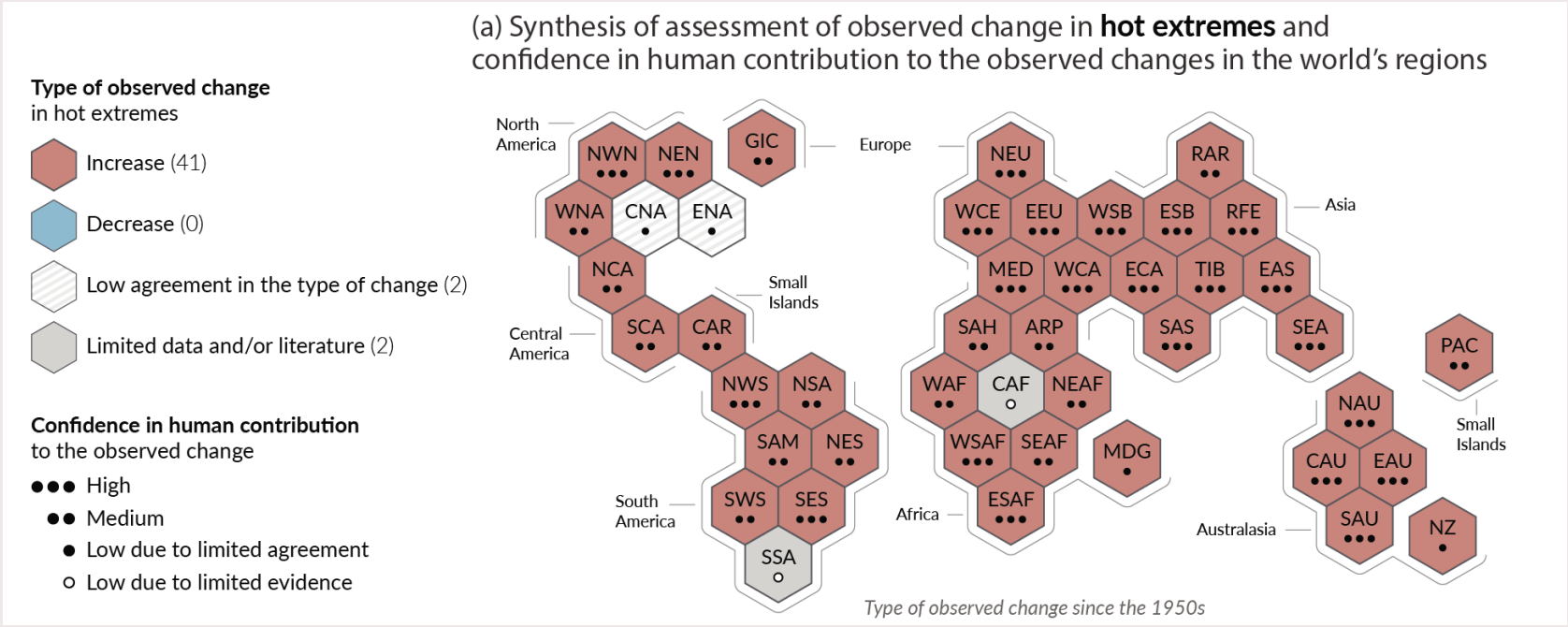
CO_2 CH_4 N_2O HFCs (ppm/ppb)

Radiative forcing (W/m^2)
Temperature (^oC)



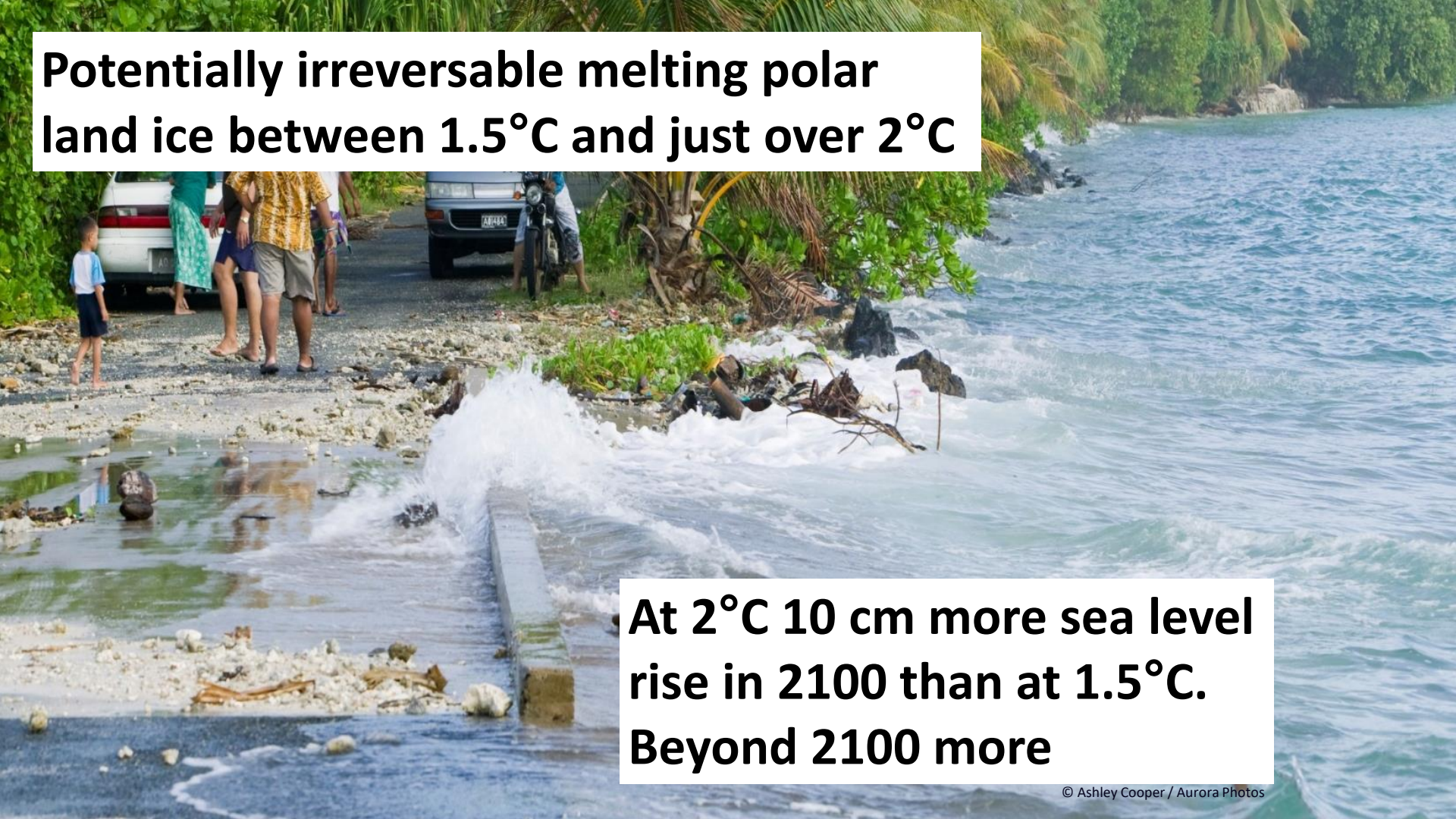
- Sea level rise
- Melting glaciers
- Precipitation patterns
- Stronger hurricanes

We are seeing consequences all over the world



IPCC AR6 WGI 2021: Figure SPM.3


At 2°C warming all warm-water corals gone vs 10-30% left at 1.5°C
Photo courtesyOve Hoegh-Guldberg


Potentially irreversable melting polar land ice between 1.5°C and just over 2°C
At 2°C 10 cm more sea level rise in 2100 than at 1.5°C. Beyond 2100 more
© Ashley Cooper / Aurora Photos


At 2°C: every 10 years completely ice-free North Pole.
At 1.5°C every 100 years
In 2050 hundreds of millions of people more at risk at 2°C compared to 1.5°C

Climate governance:
Key moments in the climate negotiations

1992: UNFCCC, Rio

- Prevent dangerous anthropogenic interference
- Common but differentiated responsibilities and respective capabilities

1997: Kyoto Protocol

- Emission reduction targets for rich countries (by 2008-2012 c. 1990)
- Emissions trading

2009: Copenhagen Accord

- Summit failed: no new treaty
- Two-degrees limit agreed
- Quantification of climate finance (US$100 billion/year by 2020)

2015: Paris Agreement

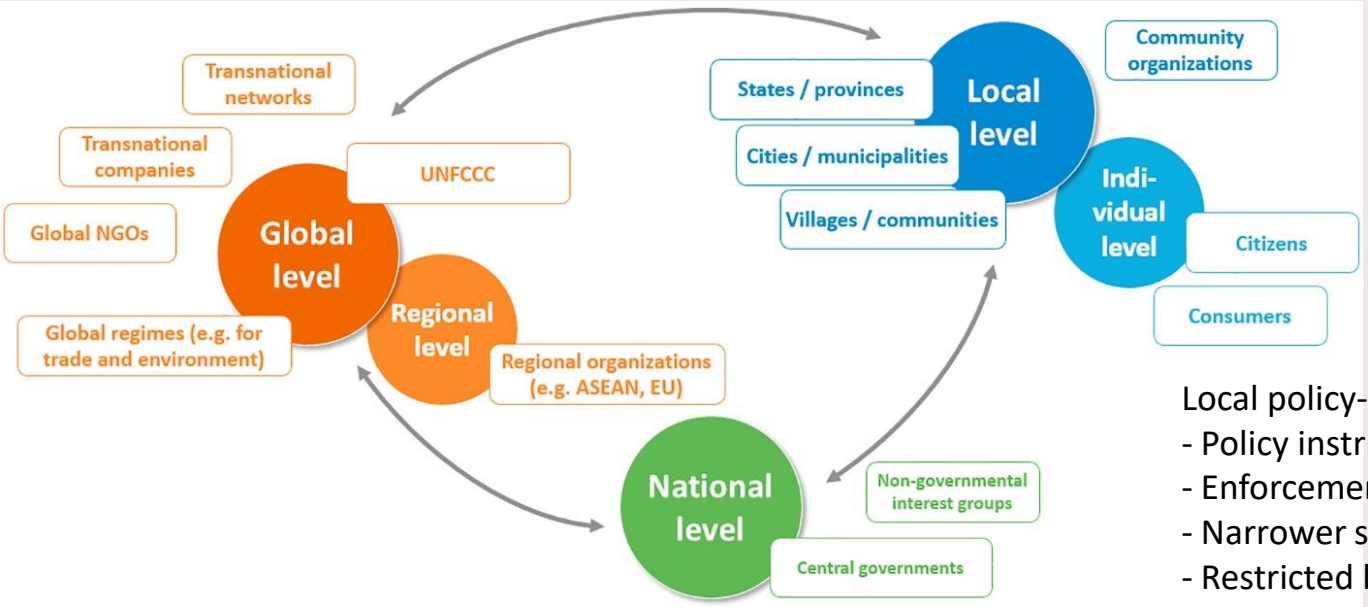
- Top-down approach abandoned
- Universal Nationally Determined Contributions (NDCs)

Climate policy is ‘multi-level’

Global climate governance:

1. providing guidance and signal to actors
2. setting rules to facilitate collective action
3. enhancing transparency and accountability
4. offering support (finance, technology, capacity-building)
5. promoting knowledge and learning

Limited enforcement power



National policy-making:
- Policy instruments
- Enforcement power
- Spending power

Local policy-making:
- Policy instruments
- Enforcement
- Narrower scope
- Restricted budgets and capacity

Figure: Marquardt, Jens, 2017: Journal of Cleaner Production 54:167-175
Oberthür, Hermwille, Rayner, 2021: Earth System Governance 8 (2021) 100104

About Pieter Pauw

Dr Pieter Pauw (1984) is an assistant professor at the Eindhoven University of Technology (TU/e), where he conducts research and provides policy advice on international climate finance and climate policy. Pauw is an Associate at Stockholm Environment Institute and Clingendael Institute. Since January 2024, Pauw is the editor of the renowned journal Climate Policy.

Before joining the TU/e, Pieter worked at the FS-UNEP Centre at the Frankfurt School of Finance & Management and German Development Institute (now IDOS) in Bonn. Pieter did projects in countries including the Netherlands, Ghana, Kenya, Botswana, Cameroon and Zambia.

He published more than 150 scientific papers, book chapters, reports and op-eds and is a lead author of the UNEP Adaptation Gap Report series. Pieter gives interviews to media regularly.

What Do Farmers Need to Know About Climate Change to Take Action?

Climate change impacts, adaptation and mitigation

Brent M. Simpson, FAO Consultant

Global FFS Platform

Webinar series on Climate Change and Farmer Field School

Session 2: Equipping farmers for climate action: key concepts and tools for FFS

Date |20th February 2025| Time: 3:00pm – 4:30pm

Climate Change
Impacts on
Agriculture

(In 10 minutes)

Climate Change
Adaptation of
Agriculture

Climate Change
Mitigation in
Agriculture

Climate Change ***Impacts*** on Agriculture

some initial ideas:

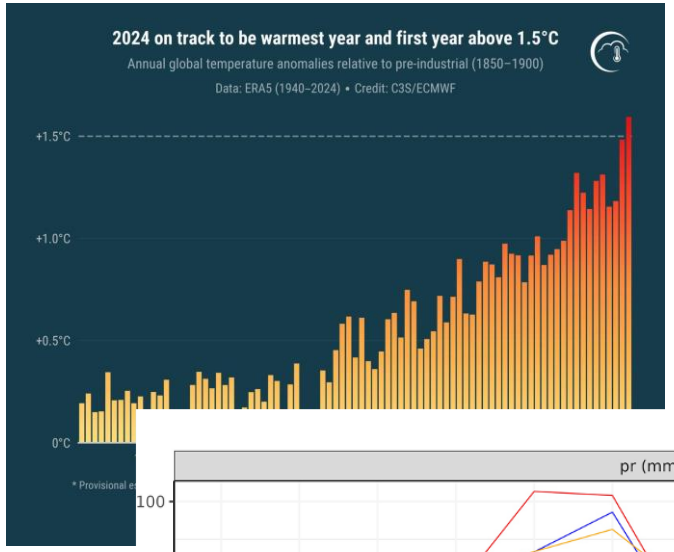
Climate change is affecting the basic environmental conditions upon which every living thing on the planet depends.

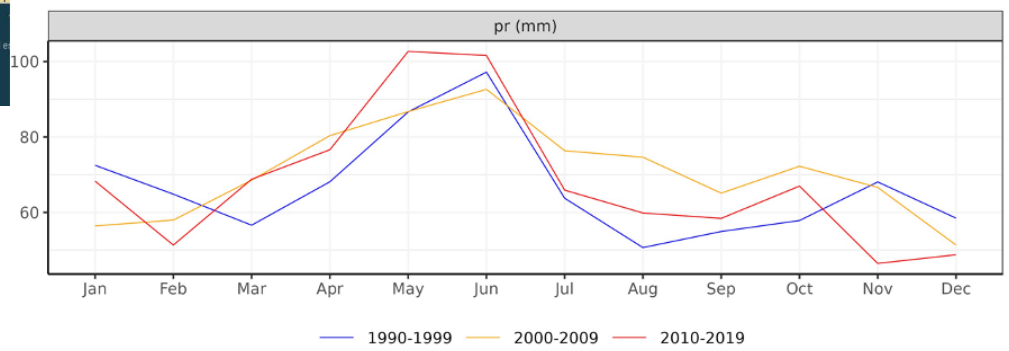
Every species – tree, plant, animal, fish – prospers under certain environmental conditions, can tolerate others and will perish beyond some limit.

Climate Change ***Impacts*** on Agriculture

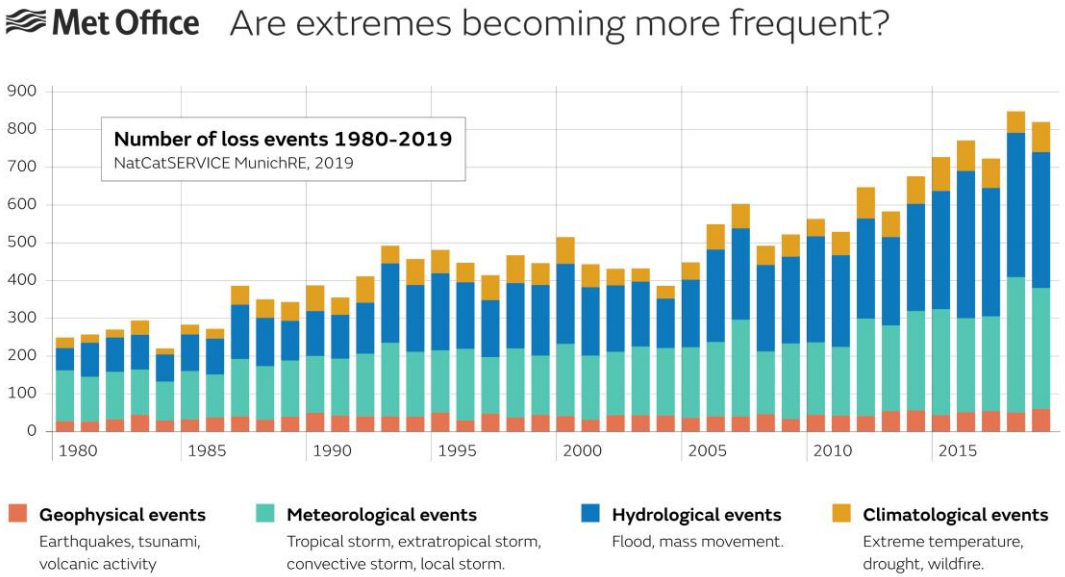
includes:

Slow-onset changes
in global temperature and local precipitation





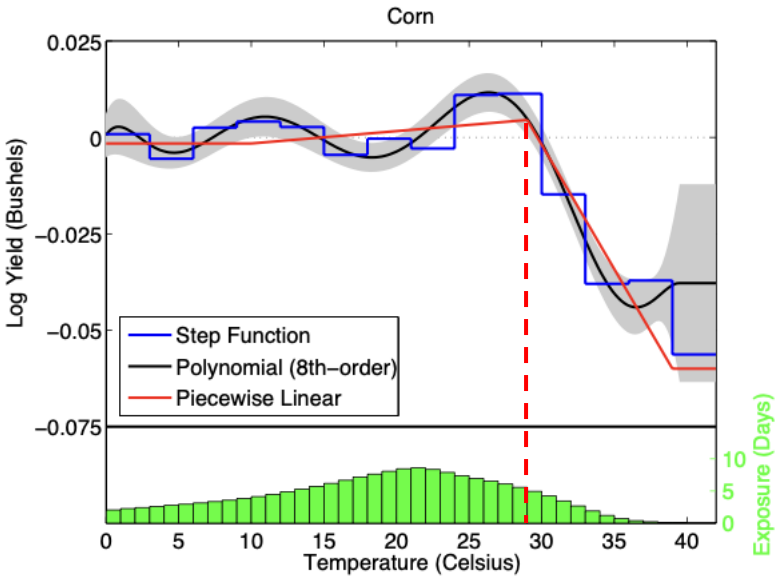
Rapid-onset, or changes in **extreme events** – frequency and severity of floods, droughts, storms, etc



Climate Change ***Impacts*** on Agriculture

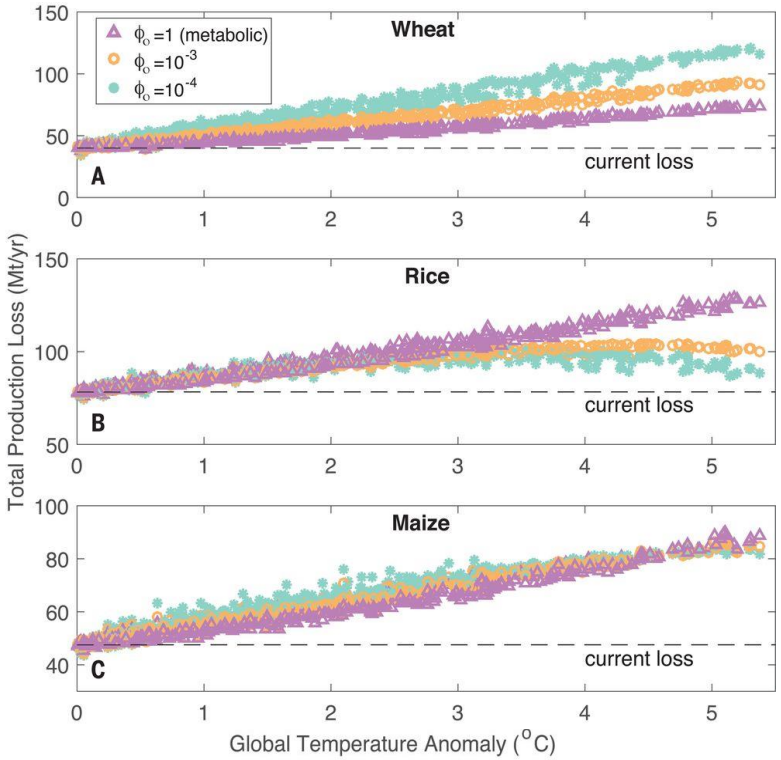
has:

Direct impacts through changes in precipitation and temperature



Source: Schlenker and Roberts. 2009. Nonlinear Temperature Effects Indicate Severe Damages to U.S. Crop Yields under Climate Change. PNAS, Vol. 106(37): 15594–15598.

Indirect impacts through changes in pest, disease and weed pressure

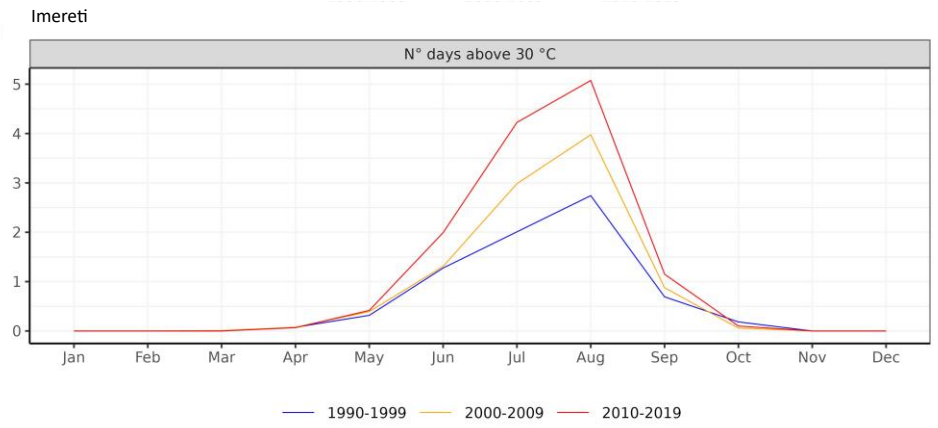


Source: Deutsch et al., 2018. Increase in Crop Losses to Insect Pests in a Warming Climate. Science, Vol. 361(6405):916-919.

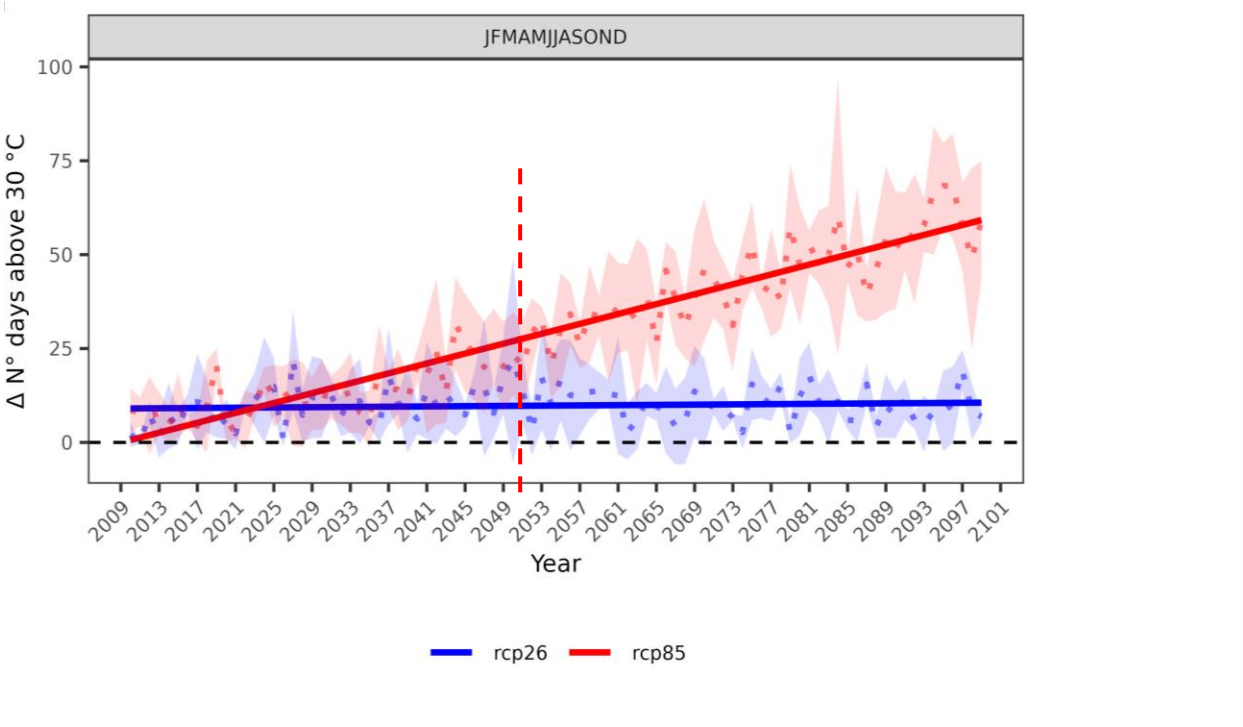
Climate Change ***Impacts*** on Agriculture

includes both:

Observed **past** changes



Projected **future** changes



Climate Change ***Impacts*** on Agriculture

some additional thoughts:

- Climate change is different from weather variability that farmers are used to
- Climate change is an on-going process, not a replacement of one set of weather conditions with another
- With climate change, timing is everything – when something happens can make all the difference as to the impacts it will have
- Climate change is not just one thing, multiple changes are occurring – at the same time, in varying combinations, in sequence, sometimes with effects going in opposite directions

Climate Change ***Adaptation*** of Agriculture

some initial ideas:

Each adaptation offers a "*window of opportunity*" in providing benefits, but at some point will need to be replaced by new adaptations

Deciding when to make a change, the "*switching point,*" is perhaps farmers greatest challenge in climate change adaptation

there are no "super" adaptations that can withstand all possible climate change stresses

It depends on the context, household needs and personal preferences

Climate change impacts are complex – "*unpacking*" the source of observed climate change impacts is essential

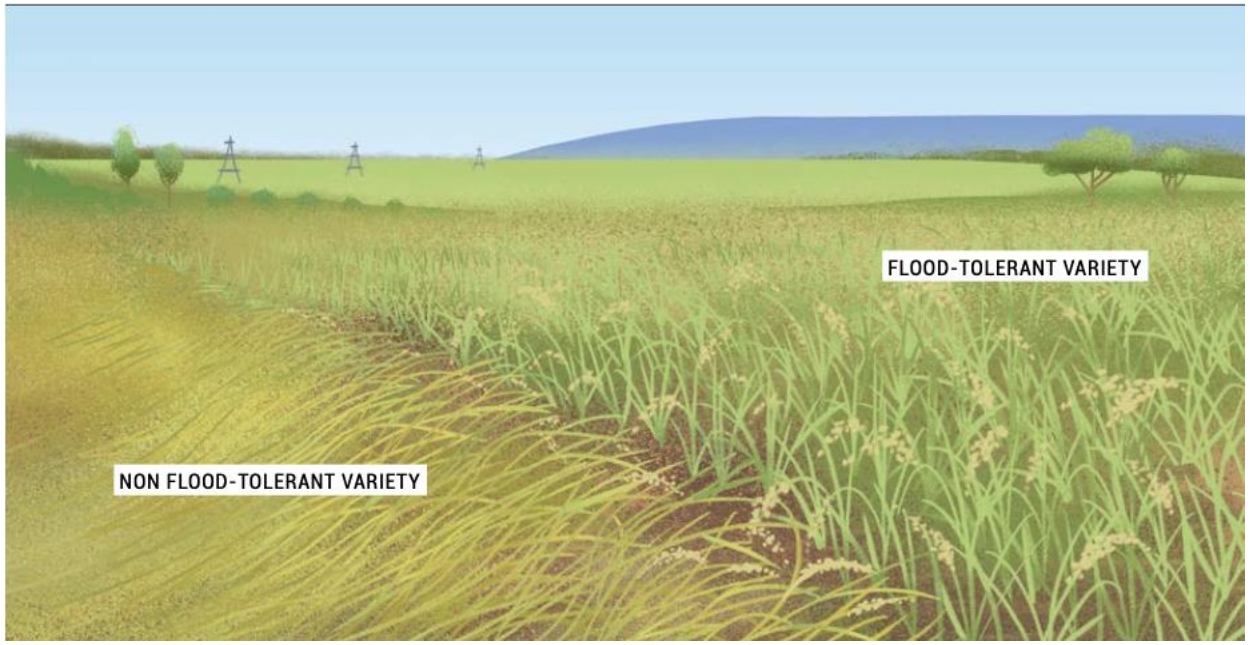
Valid information is your greatest friend.

if the problem is not correctly defined, solutions will likely not be effective

Climate Change ***Adaptation*** of Agriculture

is the result of:

Exposure (timing and location)



Sensitivity (the characteristics of the variety, species or activity)

Climate Change ***Adaptation*** of Agriculture

is achieved by:

Climate Change ***Adaptation*** of Agriculture

using different tools:

- Genetic changes (using new varieties or different species that are more resistant or tolerant to climate change stresses)
- Environmental changes (altering the physical production environment so that changes in the weather do not have the same impact)
- Management changes (making different management decisions, such as when to plant, or how to plant)

Climate Change ***Adaptation*** of Agriculture

responses will need to be:

- ✓ technically sound (starting with accurate problem identification)
- ✓ make financial sense to farmers
- ✓ implemented at the necessary social scale and
- ✓ supported by all the non-technical elements required for them to work

Remember

- ➢ Every adaptative action will have its own climate change vulnerability
- ➢ No change is permanent, just as the climate will continue to evolve, farmers practices will need to continue to evolve as well
- ➢ There are limits to what adaptive actions can achieve

Climate Change ***Mitigation*** in Agriculture

some initial ideas:

Carbon is neither created, nor destroyed –

the same amount of carbon exists on the planet now as there has ever been.

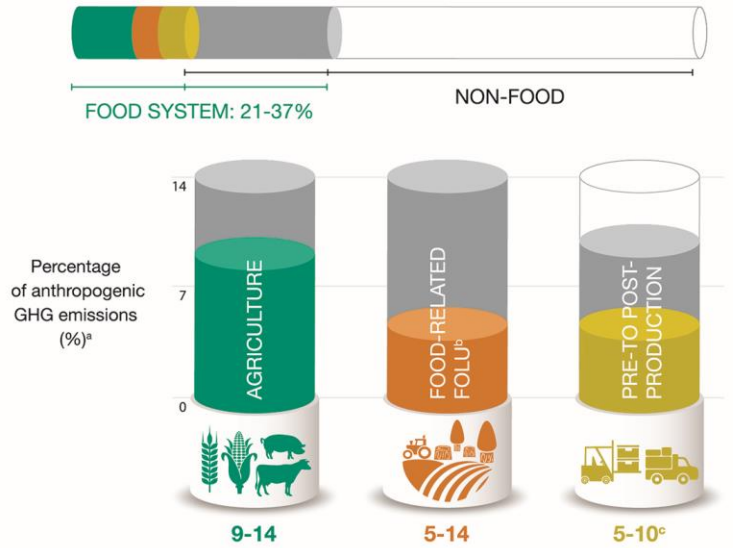
Farmer's will increasingly be involved in managing the movement of carbon on their farms

Climate Change ***Mitigation*** in Agriculture

is essential:

Feeding the world's population is
responsible for 1/3 of all GHG emissions

Global greenhouse gas emissions from the food system



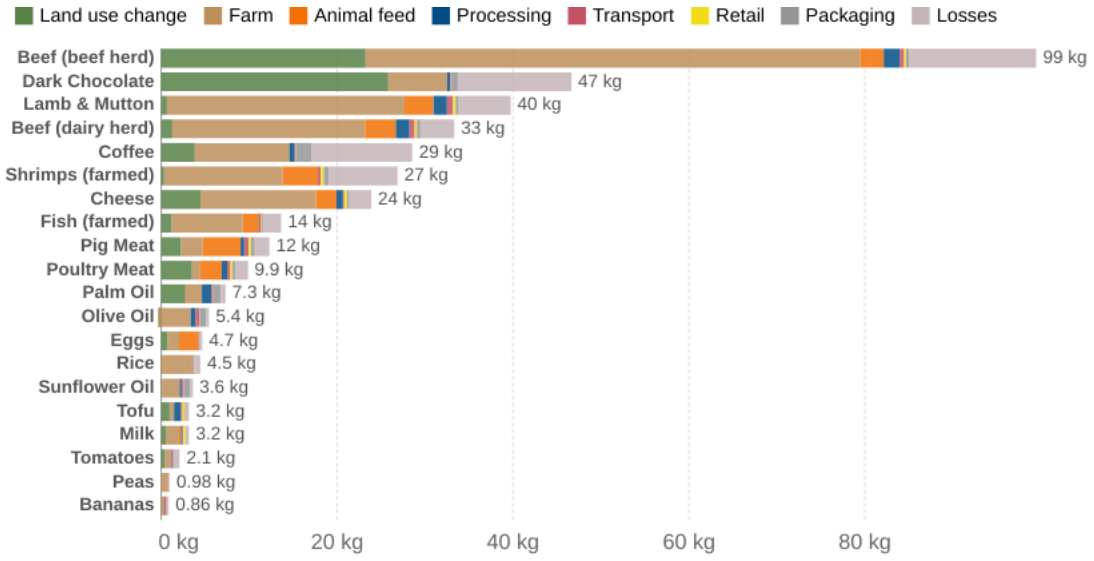
Data source: *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*

[a]Computed using a total emissions value for the period 2007–2016 of 52 $GtCO_2$-eq per year
[b]Forestry and Other Land Use
[c]Rounded to nearest fifth percentile due to assessed uncertainty in estimates

Climate Change ***Mitigation*** in Agriculture

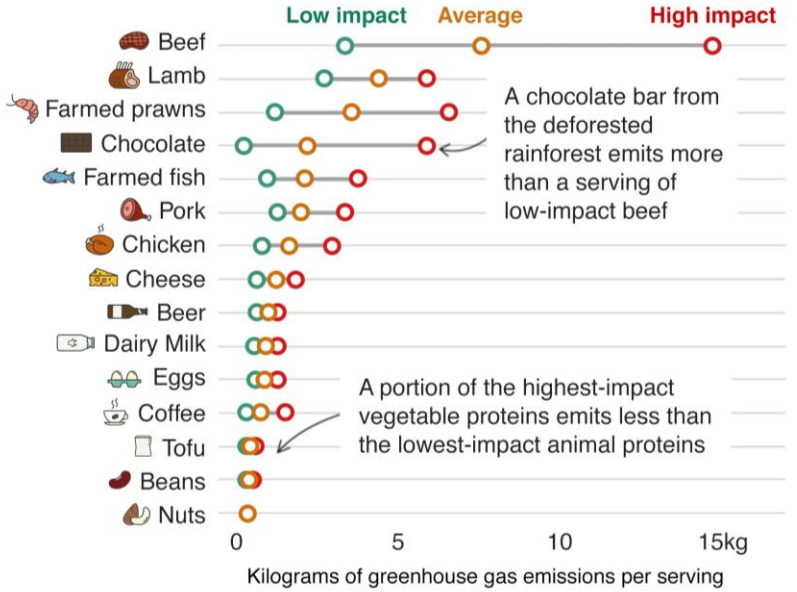
not all food sources or production methods are equal:

GHG emissions in commodity supply chains are not equal



Source: Our World in Data; Poore, J. and T. Nemecek. 2018. Reducing Food's Environmental Impacts Through Producers and Consumers. Science, Vol. 360(6392):987-992

GHG emissions for different production methods are not equal

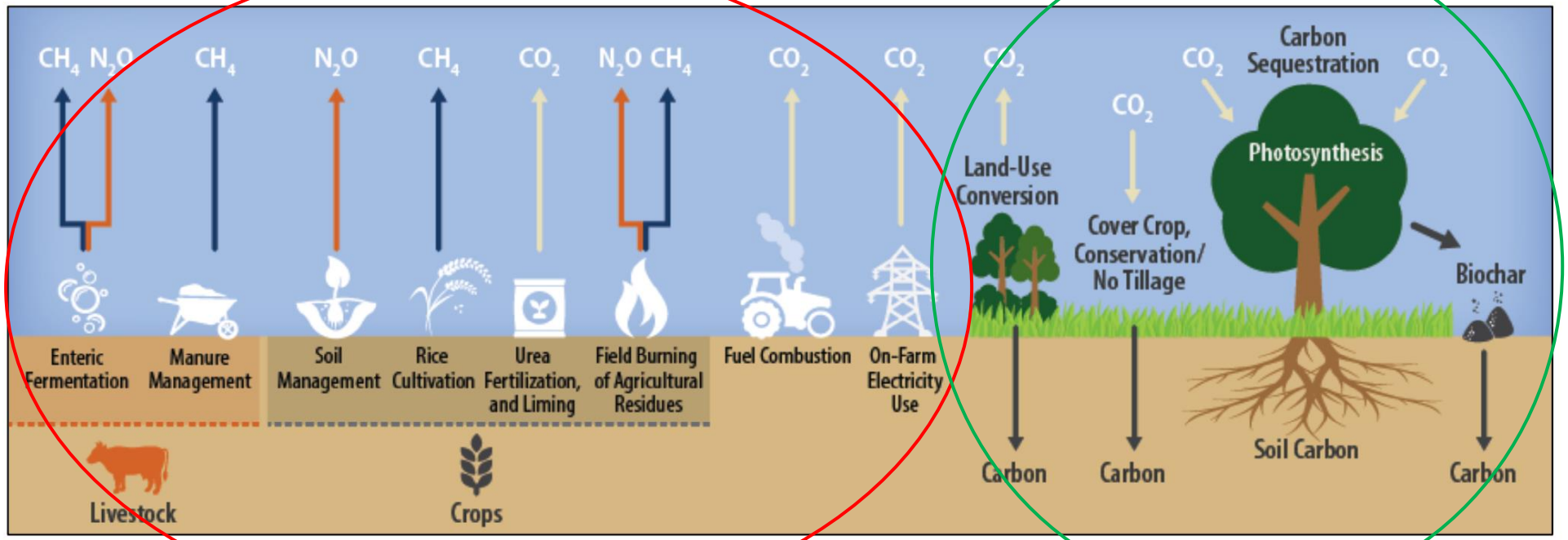


Source: BBC; Poore, J. and T. Nemecek. 2018. Reducing Food's Environmental Impacts Through Producers and Consumers. Science, Vol. 360(6392):987-992

Climate Change ***Mitigation*** in Agriculture

involves emission reductions and sequestration:

Emission Reductions



Source: CRS

Sequestration

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