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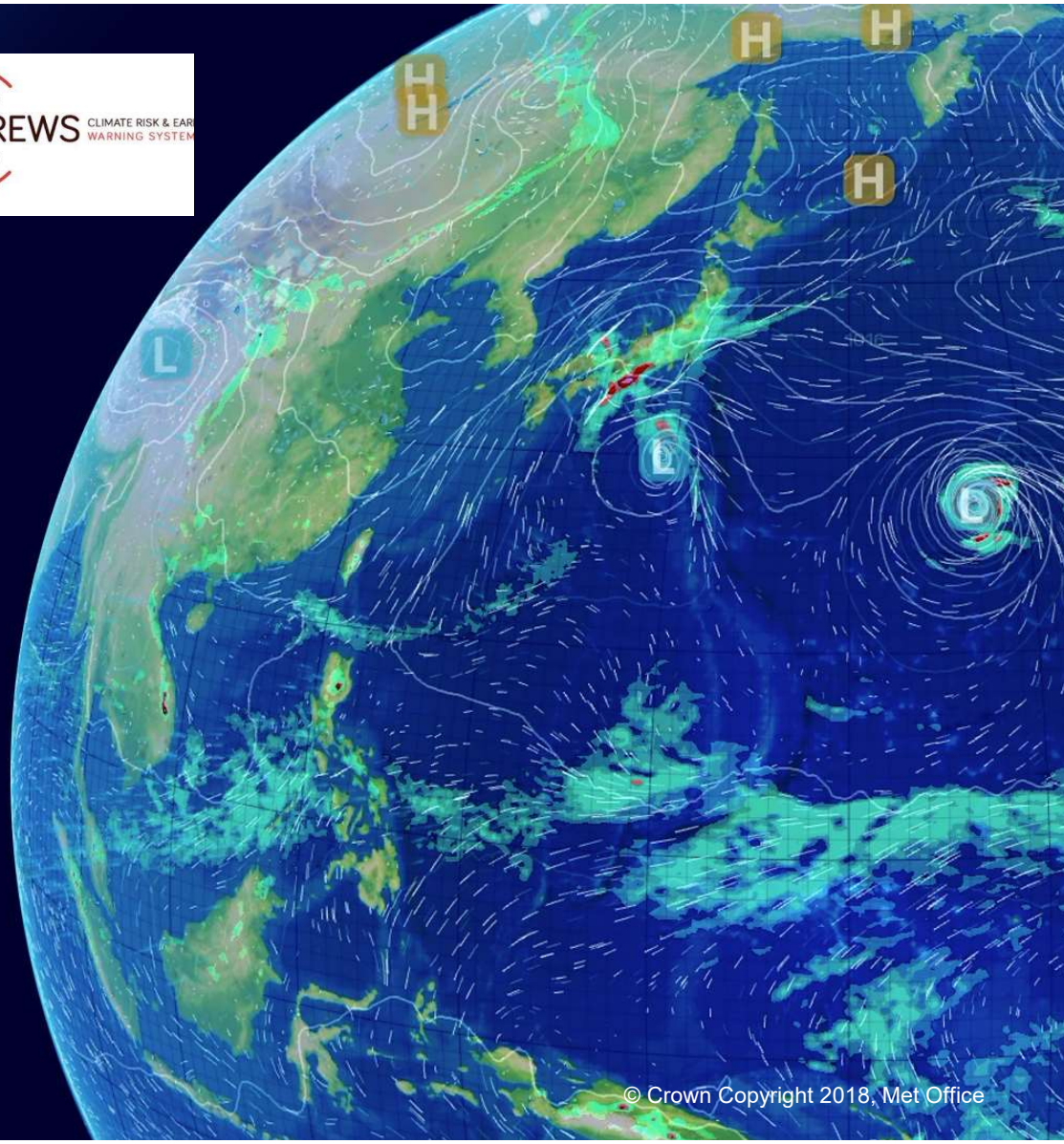
Climate change overview

Richard Jones
Met Office Hadley Centre



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Fundamentals of climate change science and global and regional changes

The effect of greenhouse gases and the warming caused by the enhanced greenhouse effect

Observed global and regional warming and demonstrating this is attributable to human activities

Global and regional temperatures and sea-level will continue to change along with many other climate indices.

Implications for risks and adaptation and new areas of research

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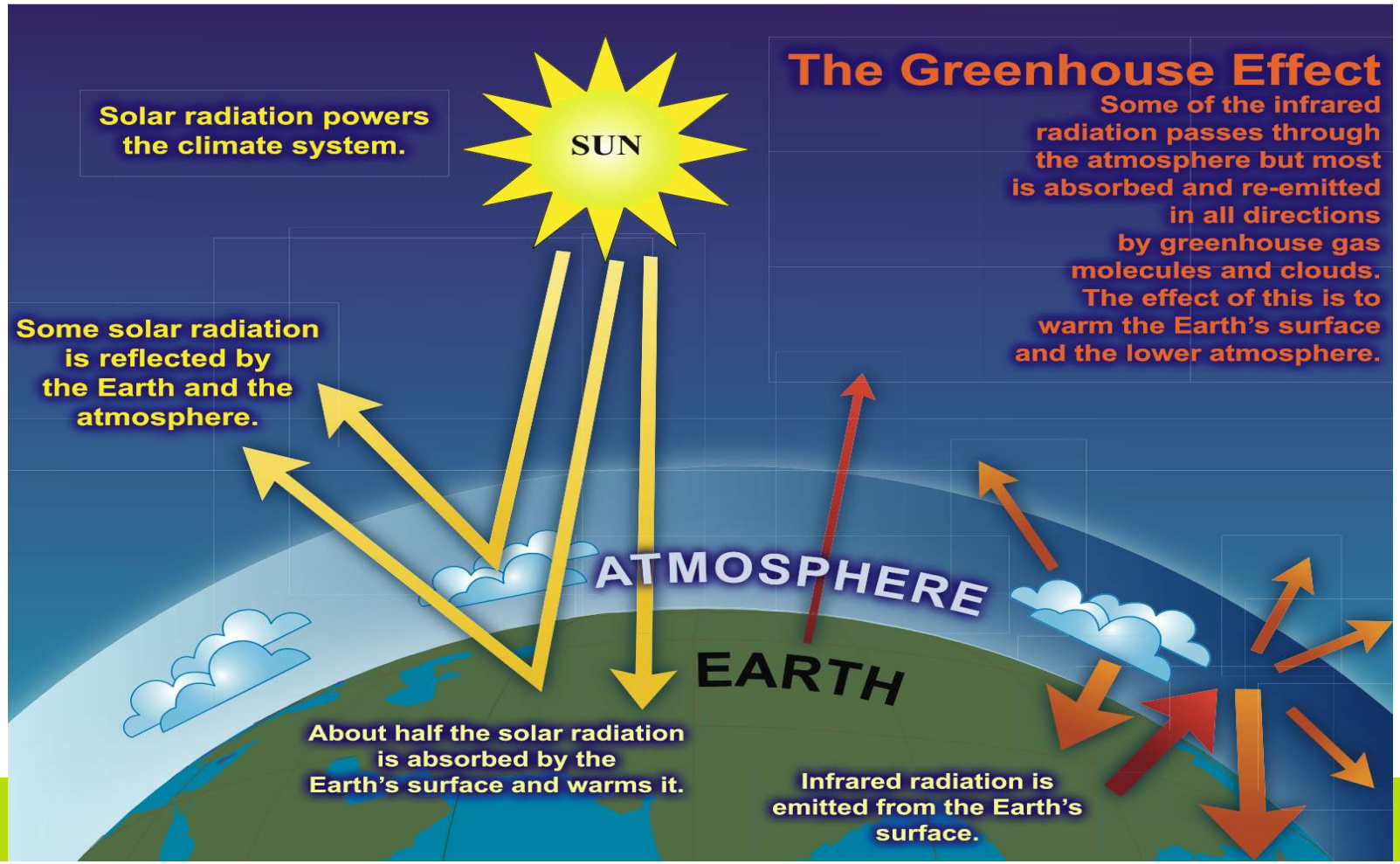
The greenhouse effect and its role in climate change



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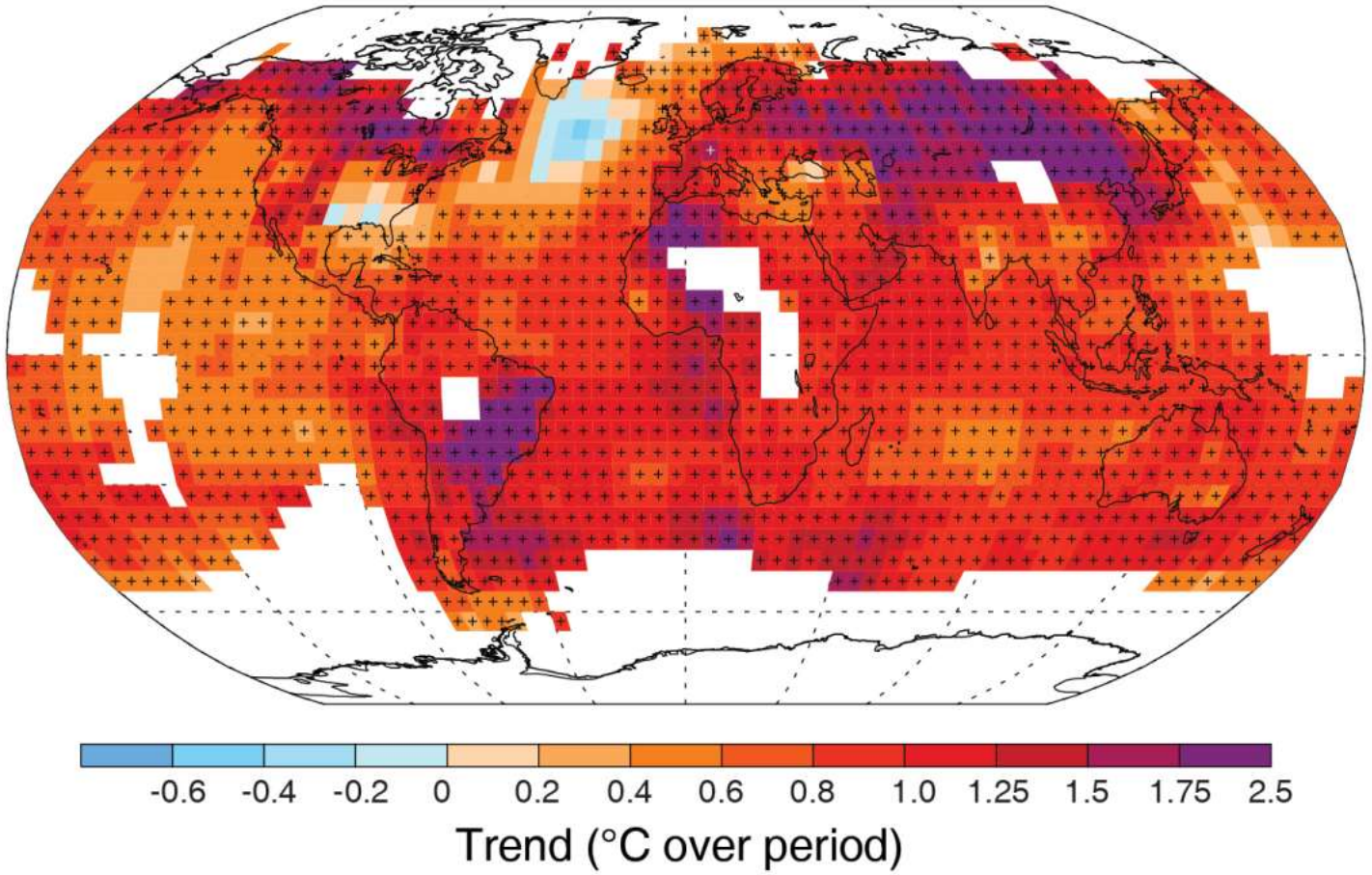
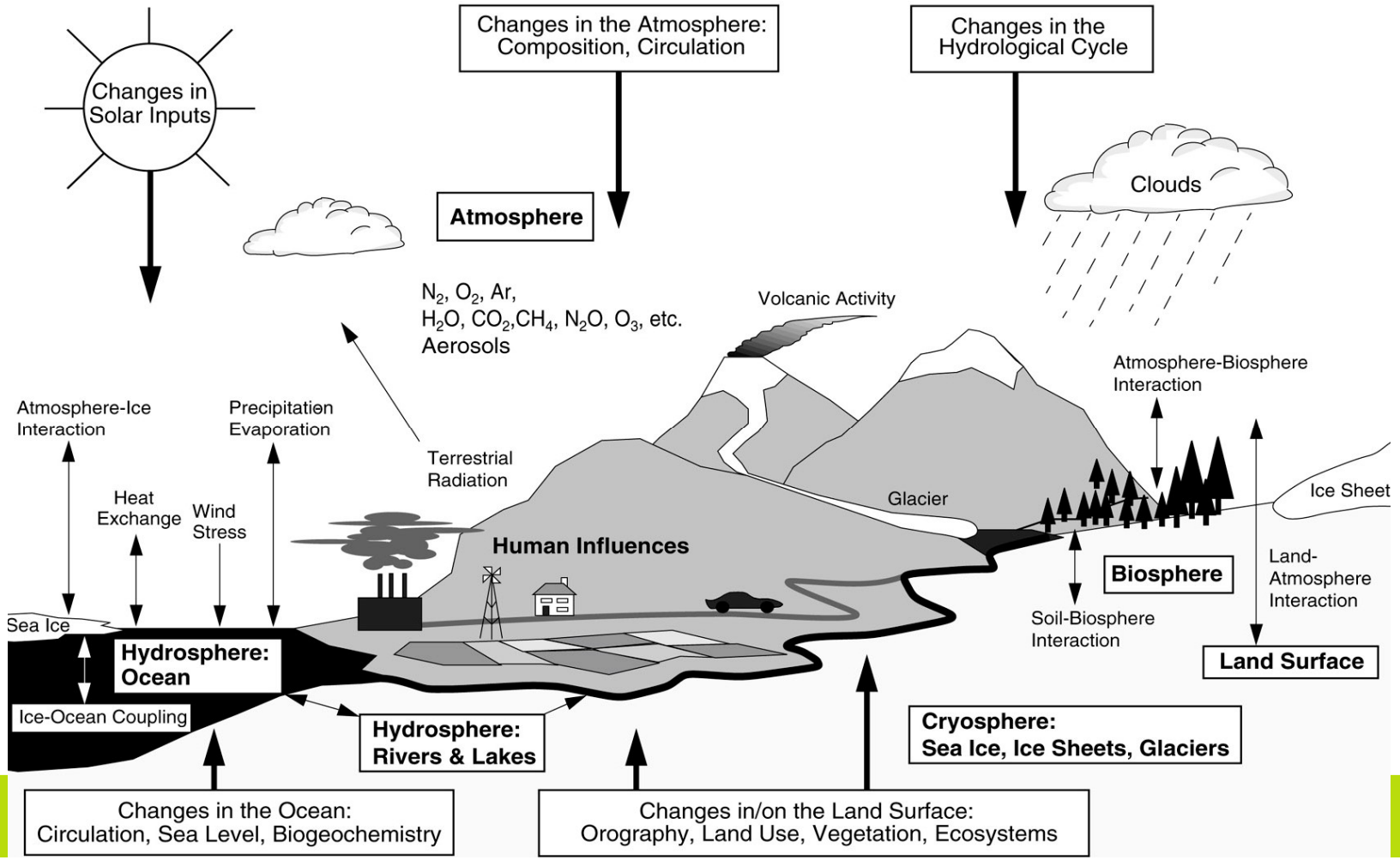
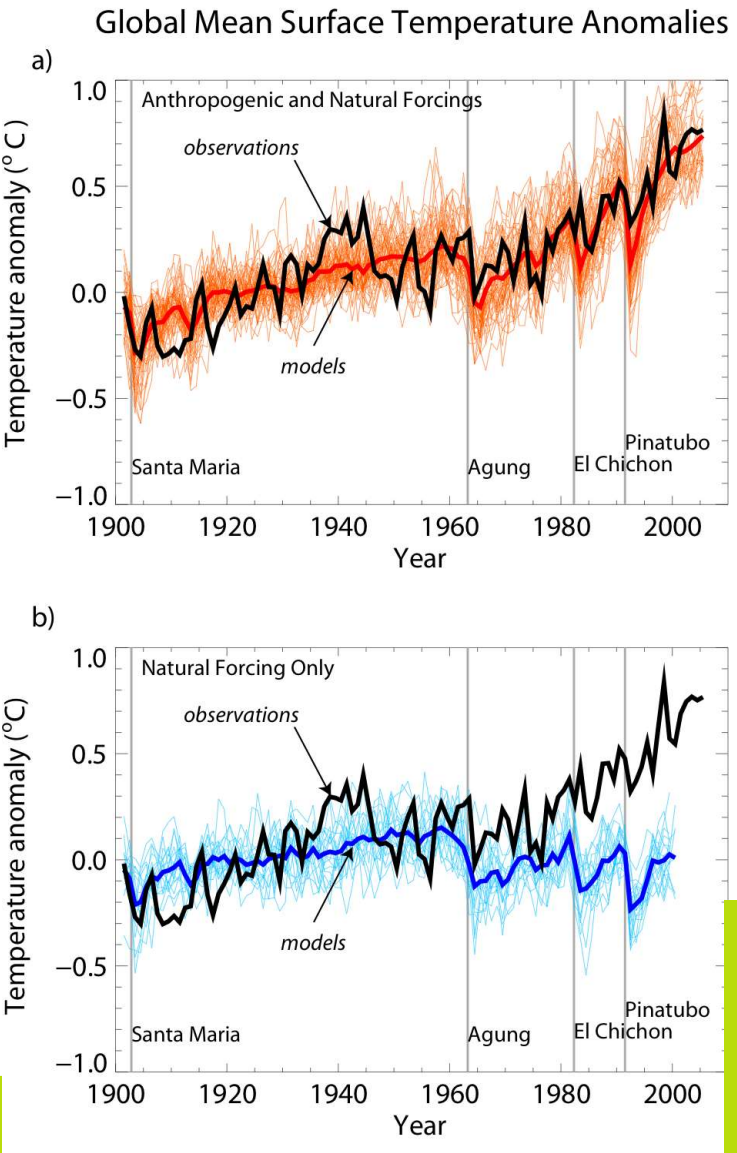
Increasing CO_2 enhances the greenhouse effect and warms the climate



To understand climate change we use models representing all relevant earth system processes





Climate models run for the recent past simulate the observed warming …

… if they include observed changes in greenhouse gases and aerosols (and volcanoes and solar output) …

… but not if only changes in volcanoes and solar output (natural factors)

Using global models with observed anthropogenic and natural factors is key to this understanding – and our confidence in their projections

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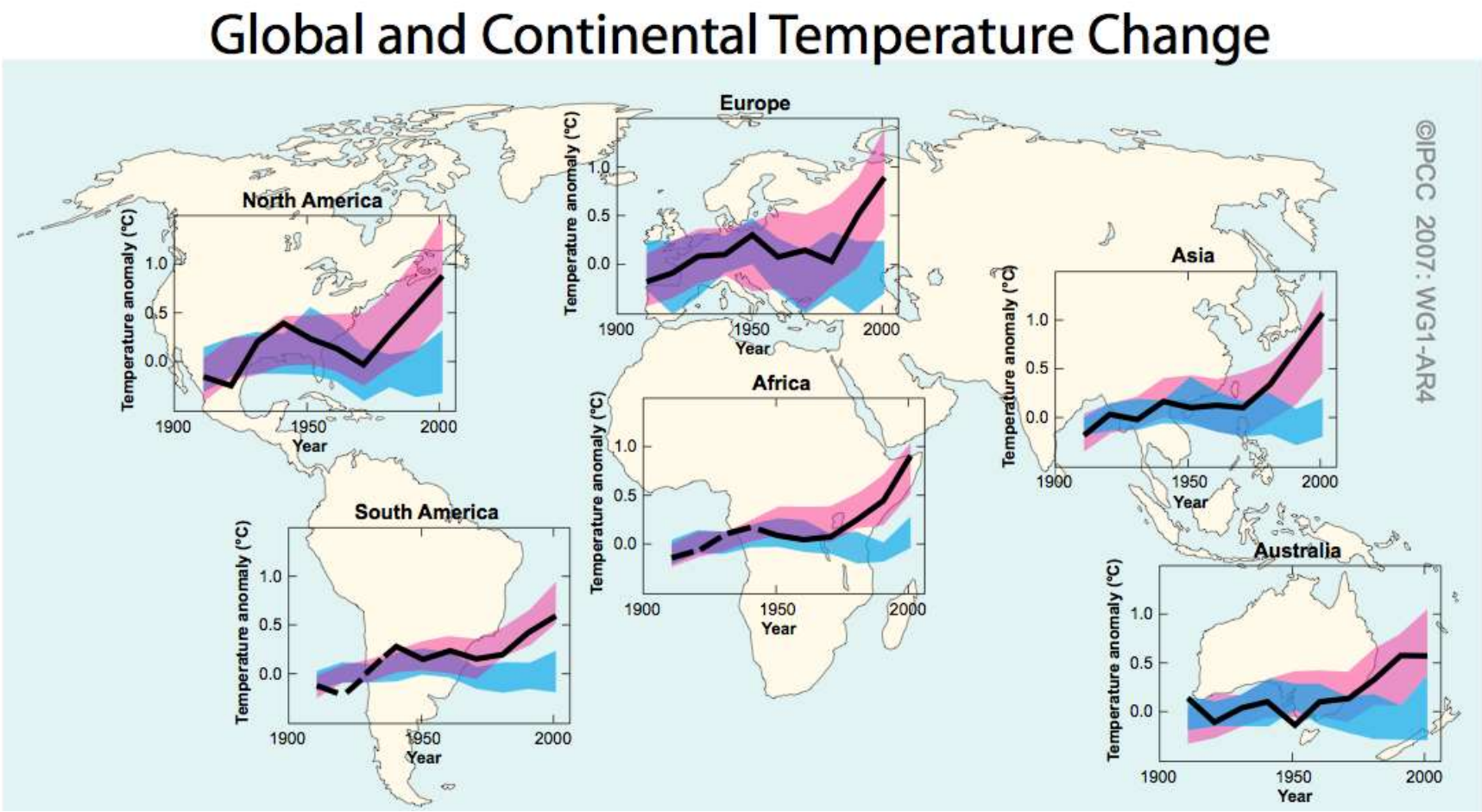
Attributing regional climate change

Human-induced warming discernible on all inhabited continents



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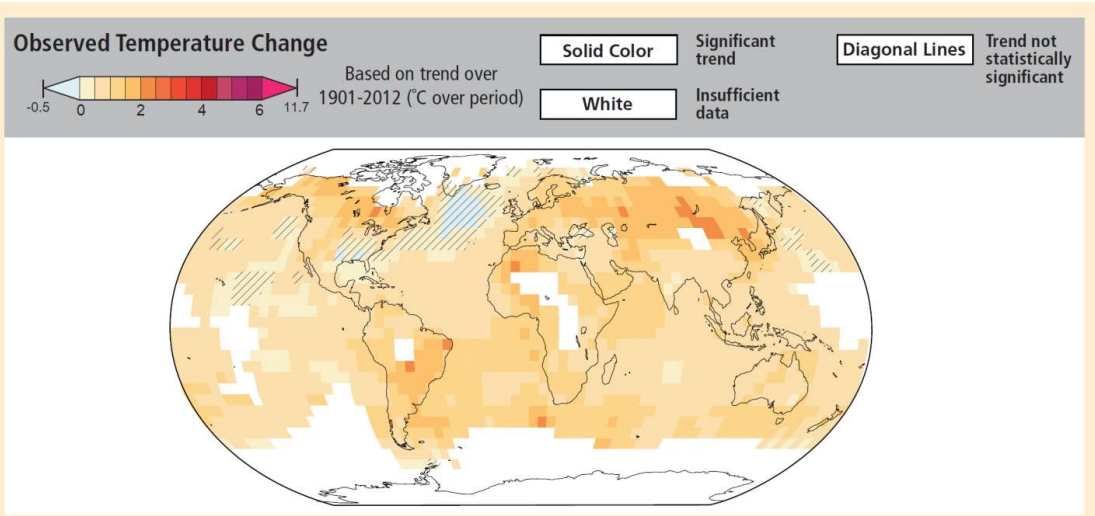
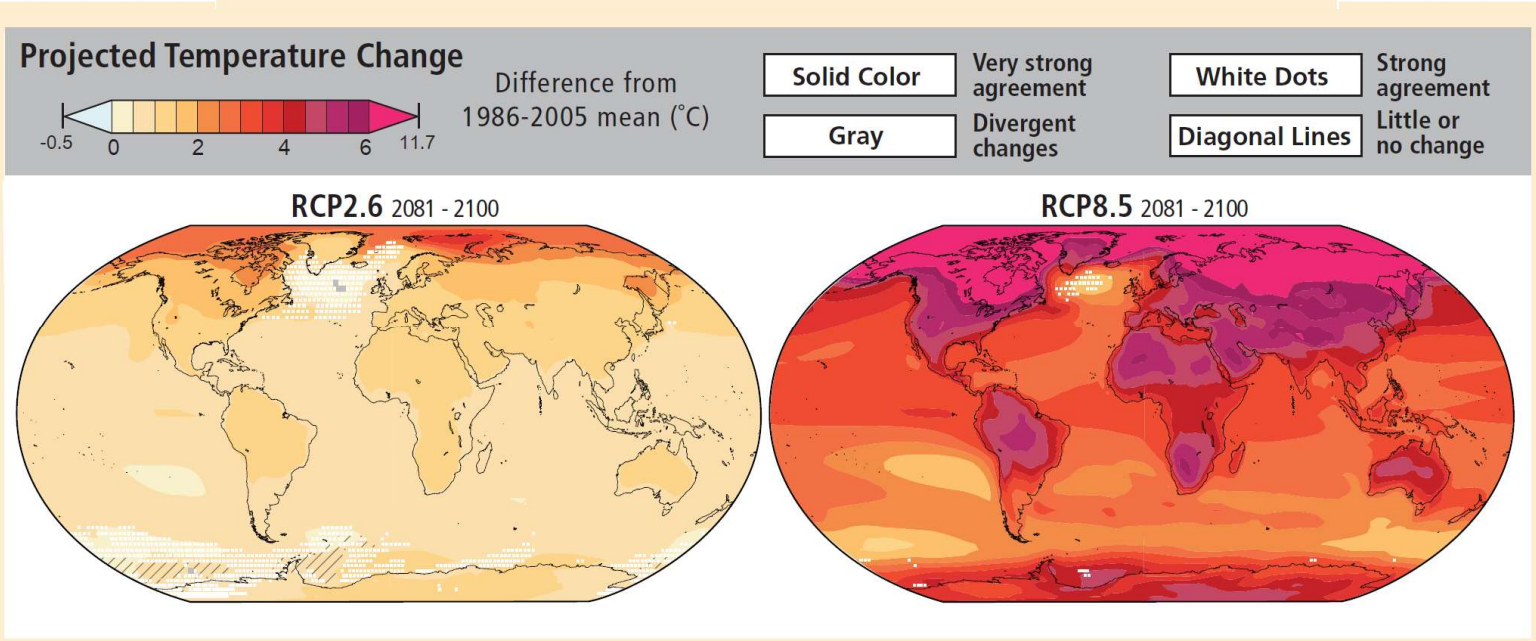
Projected future climate change from a modern baseline: Significant extra warming even if strong mitigation is implemented; business as usual emissions would greatly amplify the further warming.





IPCC AR5-WG II

Future temperature and sea-level change with high and low emissions

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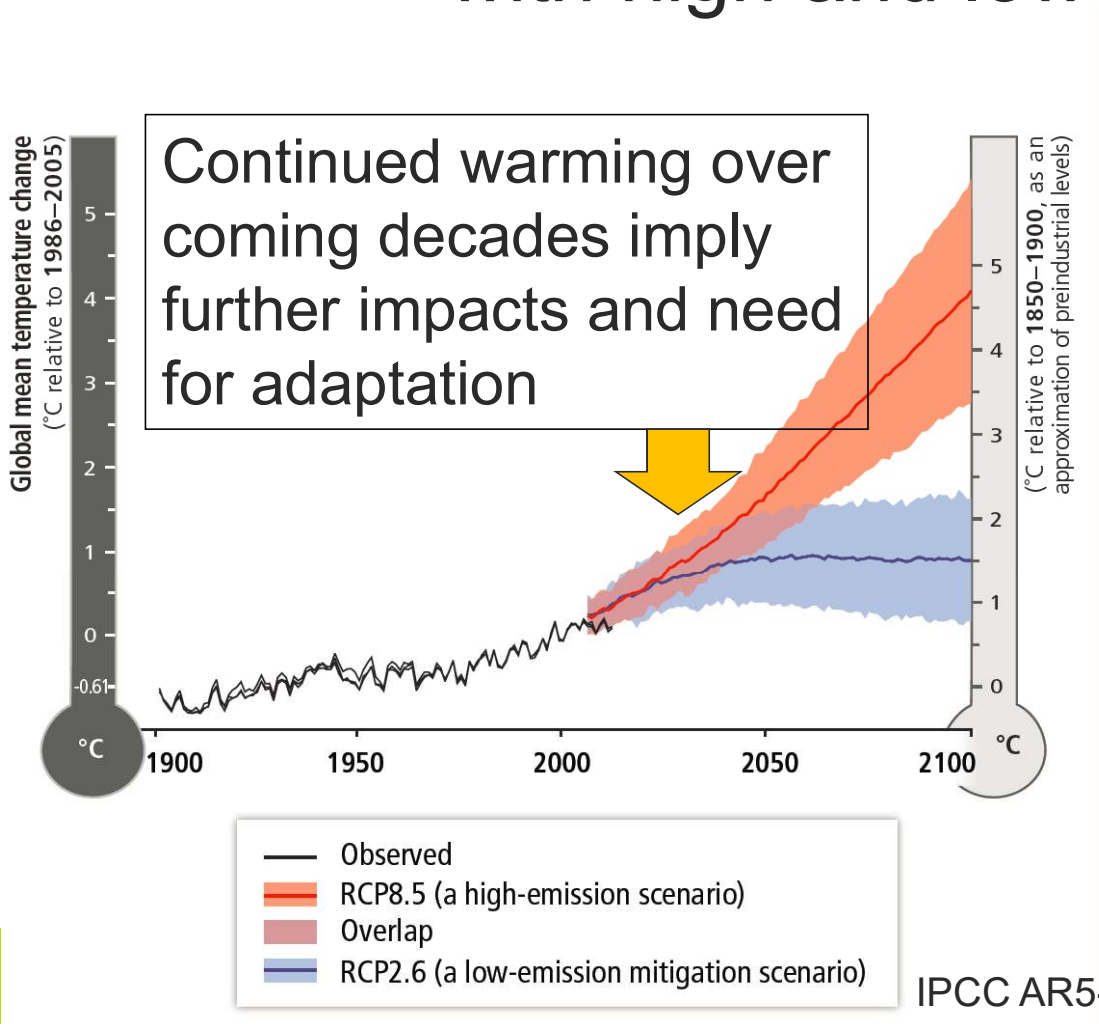

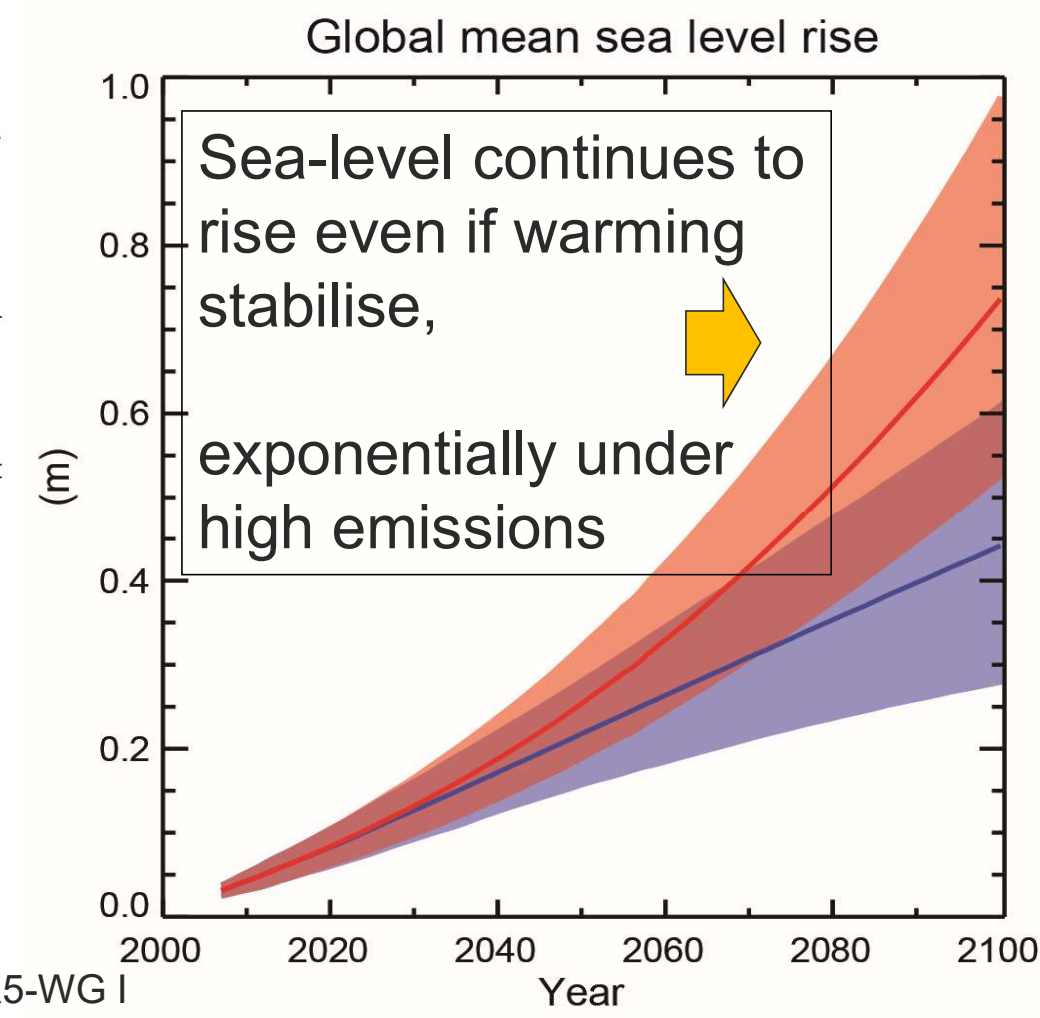

IPCC AR5-WG I

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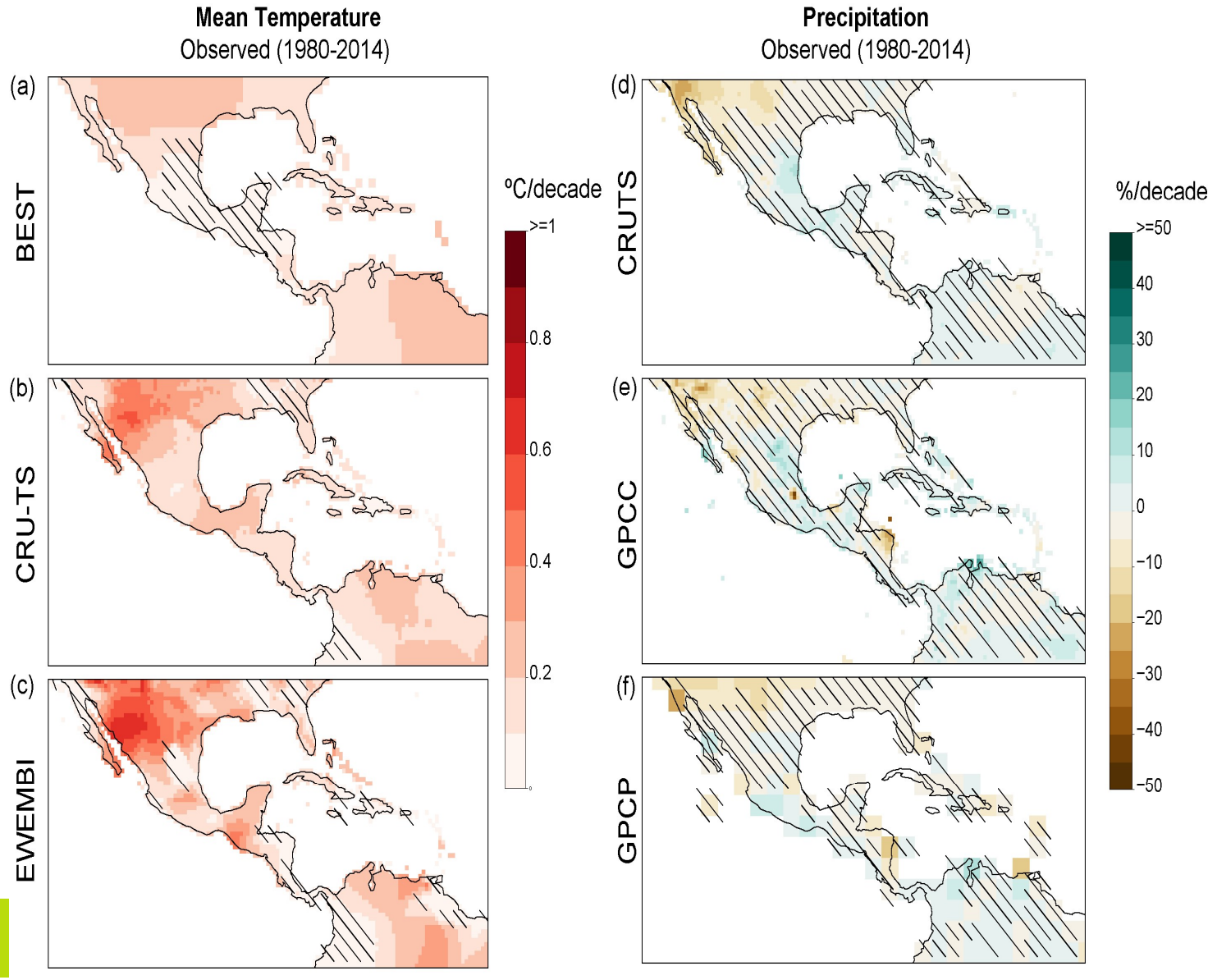
Observed temperature & precipitation change over Central America:

Clear warming trends;

Few significant trends in precipitation (and in areas of agreement in these).



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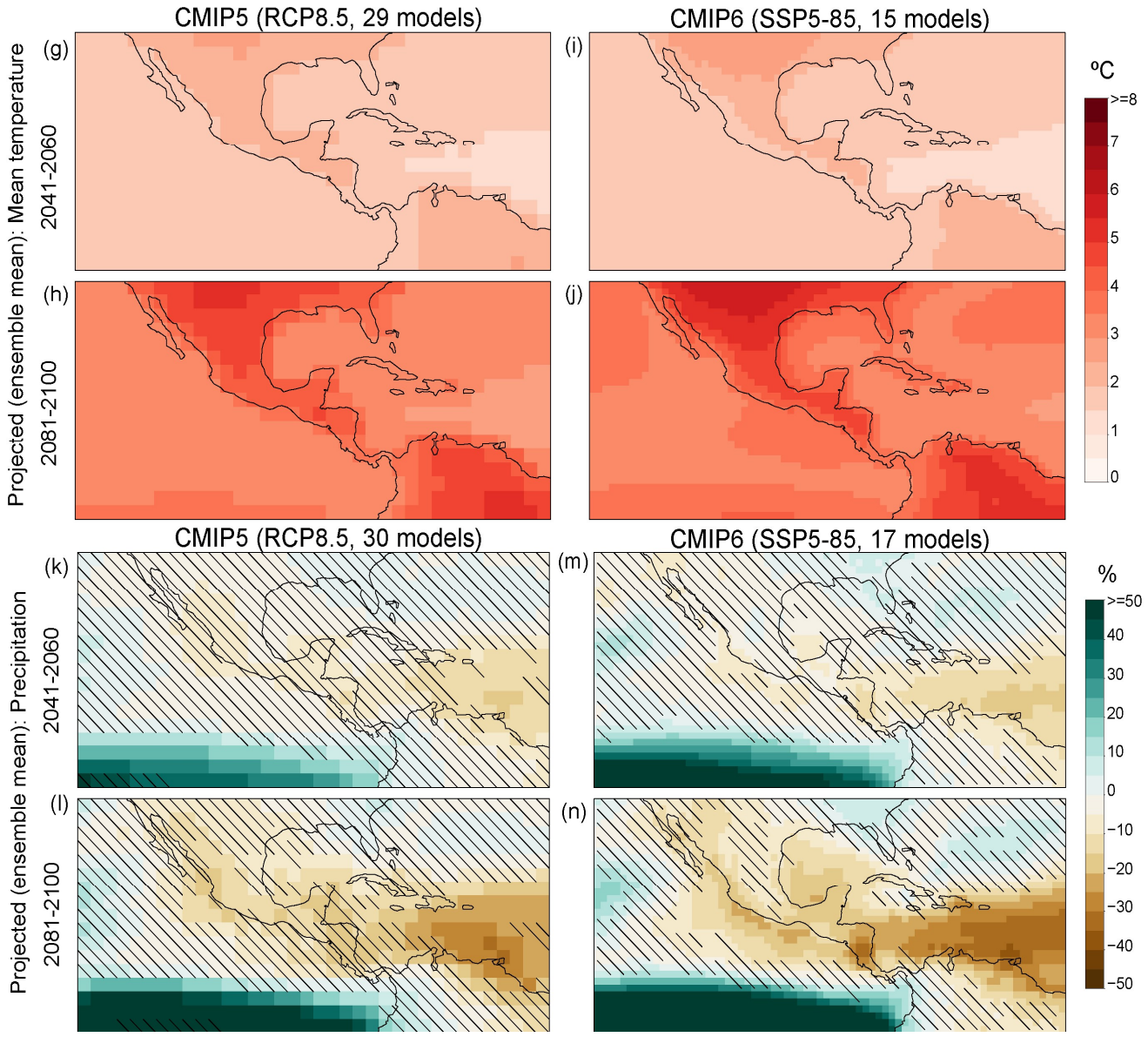
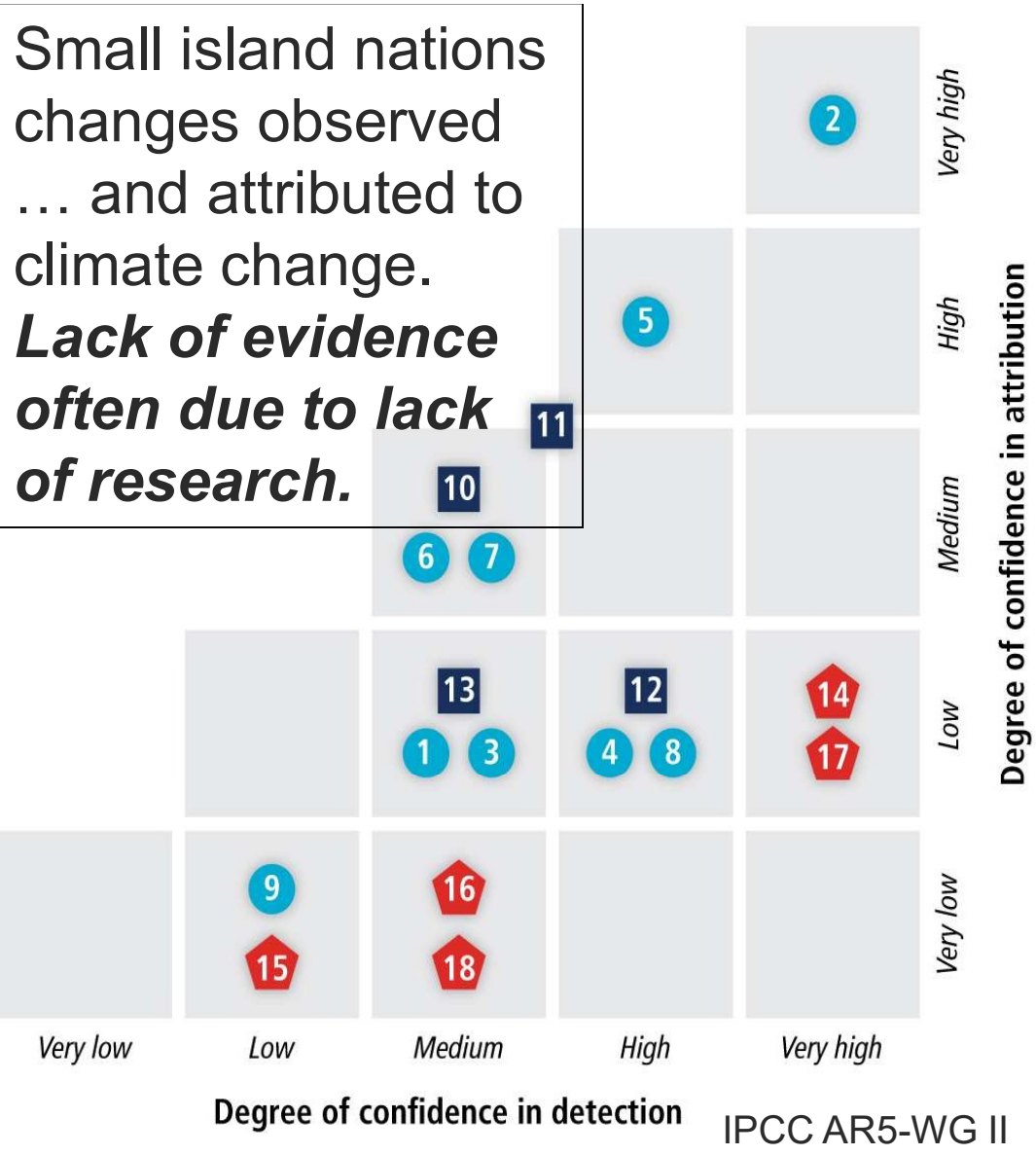
Projected temperature and precipitation change over Central America in middle and end of century

Similar messages from the new CMIP6 GCMs compared to those from CMIP5 (AR5)

Clear signal of reduced annual precipitation over much of the Caribbean



Small island nations changes observed … and attributed to climate change. ***Lack of evidence often due to lack of research.***



IPCC AR5-WG II

Coastal systems

1. Greater rates of sea level rise relative to global means
2. Sea level rise consistent with global means
3. Marine inundation of low-lying areas
4. Shoreline erosion
5. Coral bleaching in small island marine environments
6. Increased resilience of coral reefs and shorelines in the absence of direct human disturbance
7. Acidification of surface waters
8. Degraded coastal fisheries
9. Degradation of mangroves and seagrass

Terrestrial systems

10. Saline incursion degrading ecosystems
11. Altitudinal species shift
12. Incremental degradation of groundwater quality
13. Island marine overtopping and rapid salinization of groundwater

Human systems

14. General environmental degradation and loss of habitat in urban locations
15. Reduced tourism
16. Human susceptibility to climate-induced diseases
17. Casualties and damage during extreme events
18. Re-location of communities/migration

Key risks in small islands and potential for adaptation

Climate-related drivers of impacts							
Warming trend	Extreme temperature	Drying trend	Extreme precipitation	Damaging cyclone	Sea level	Ocean acidification	Sea surface temperature

Key risk	Adaptation issues & prospects	Climatic drivers	Timeframe	Risk & potential for adaptation
Loss of livelihoods, coastal settlements, infrastructure, ecosystem services, and economic stability (*high confidence*) [29.6, 29.8, Figure 29-4]	• Significant potential exists for adaptation in islands, but additional external resources and technologies will enhance response. • Maintenance and enhancement of ecosystem functions and services and of water and food security • Efficacy of traditional community coping strategies is expected to be substantially reduced in the future.		Present Near term (2030–2040) Long term (2080–2100) 2°C 4°C	Very low / Medium / Very high
Decline and possible loss of coral reef ecosystems in small islands through thermal stress (*high confidence*) [29.3.1.2]	Limited coral reef adaptation responses; however, minimizing the negative impact of anthrogopenic stresses (ie: water quality change, destructive fishing practices) may increase resilience.		Present Near term (2030–2040) Long term (2080–2100) 2°C 4°C	Very low / Medium / Very high
The interaction of rising global mean sea level in the 21st century with high-water-level events will threaten low-lying coastal areas (*high confidence*) [29.4, Table 29-1; WGI AR5 13.5, Table 13.5]	• High ratio of coastal area to land mass will make adaptation a significant financial and resource challenge for islands. • Adaptation options include maintenance and restoration of coastal landforms and ecosystems, improved management of soils and freshwater resources, and appropriate building codes and settlement patterns.		Present Near term (2030–2040) Long term (2080–2100) 2°C 4°C	Very low / Medium / Very high

IPCC AR5-WG II

Which changes have not or cannot be adapted to?

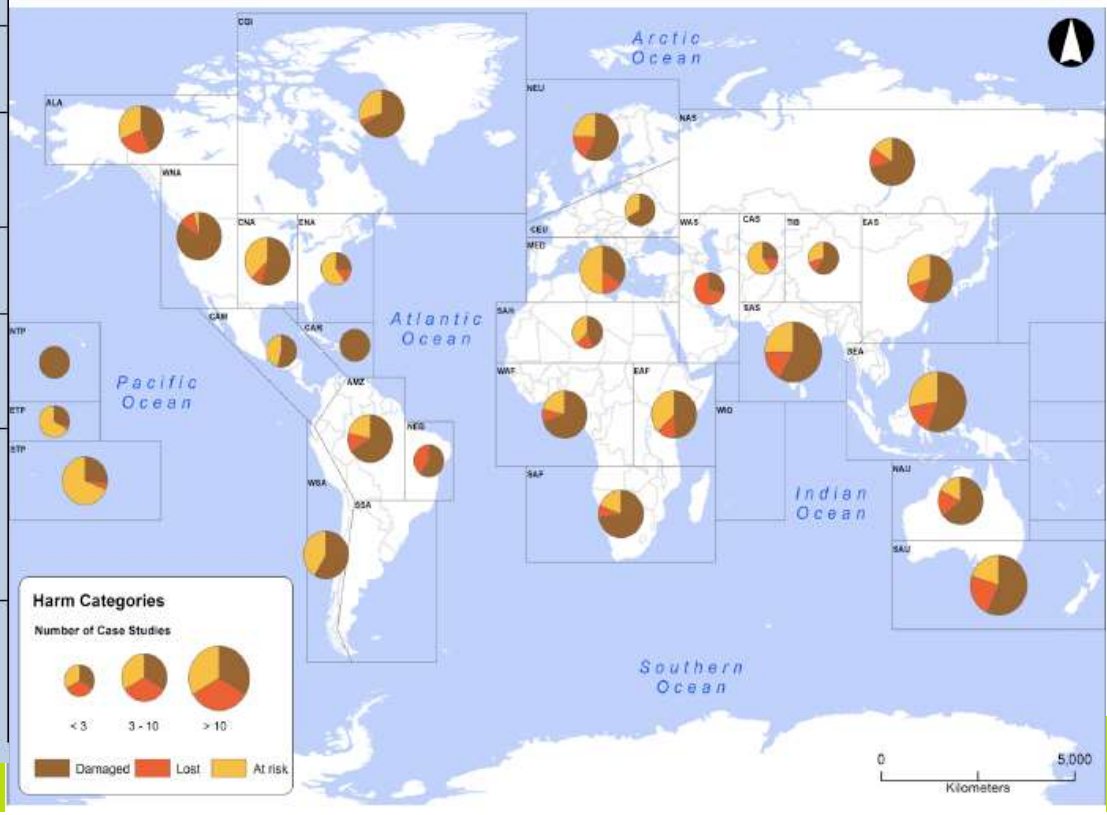
Assessing loss and damage in systems which cannot adapt

Table 5.2: Soft and hard adaptation limits in the context of 1.5°C and 2°C of global warming

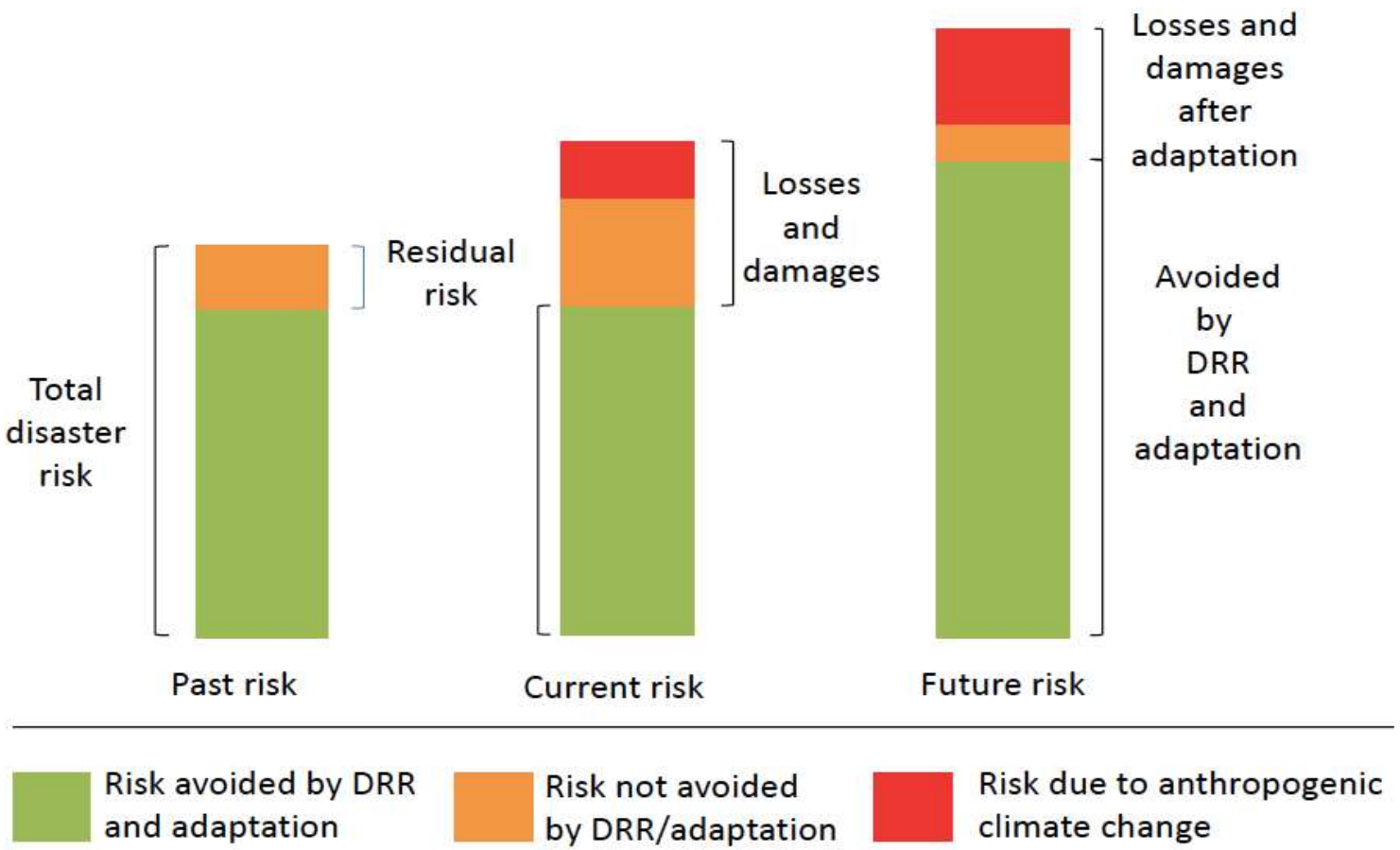
System/Region	Example
Coral reefs	Loss of 70-90% of tropical coral reefs by mid-century under 1.5°C scenario (total loss under 2°C scenario) (se Chapter 3, Sections 3.4.4 and 3.5.2.1, Box 3.4)
Biodiversity	6% of insects, 8% of plants and 4% of vertebrates lose over 50% of the climatically determined geographic range at 1.5°C (18% of insects, 16% of plants, 8% of vertebrates at 2°C) (see Chapter 3, Section 3.4.3.3)
Poverty	24-357 million people exposed to multi-sector climate risks and vulnerable to poverty at 1.5°C (86-1,220 million at 2°C) (see Section 5.2.2)
Human health	Twice as many megacities exposed to heat stress at 1.5°C compared to present, potentially exposing 350 million additional people to deadly heat wave conditions by 2050 (see Chapter 3, Section 3.4.8)
Coastal livelihoods	Large-scale changes in oceanic systems (temperature, acidification) inflict damage and losses to livelihoods, income, cultural identity and health for coastal-dependent communities at 1.5°C (potential higher losses at 2°C) (see Chapter 3, Sections 3.4.4, 3.4.5, 3.4.6.3, Box 3.4, Box 3.5, Cross-Chapter Box 6; Chapter 4, Section 4.3.5; Section 5.2.3)
Small Island Developing States	Sea level rise and increased wave run up combined with increased aridity and decreased freshwater availability at 1.5°C warming potentially leaving several atoll islands uninhabitable (see Chapter 3, Sections 3.4.3, 3.4.5, Box 3.5; Chapter 4, Cross-Chapter Box 9)

Roy et al., 2018-IPCC SR15 Chapter 5

Evidence on risks of or experienced harm – Tschakert et al., 2019



Risks beyond existing risk management strategies – important new questions for research

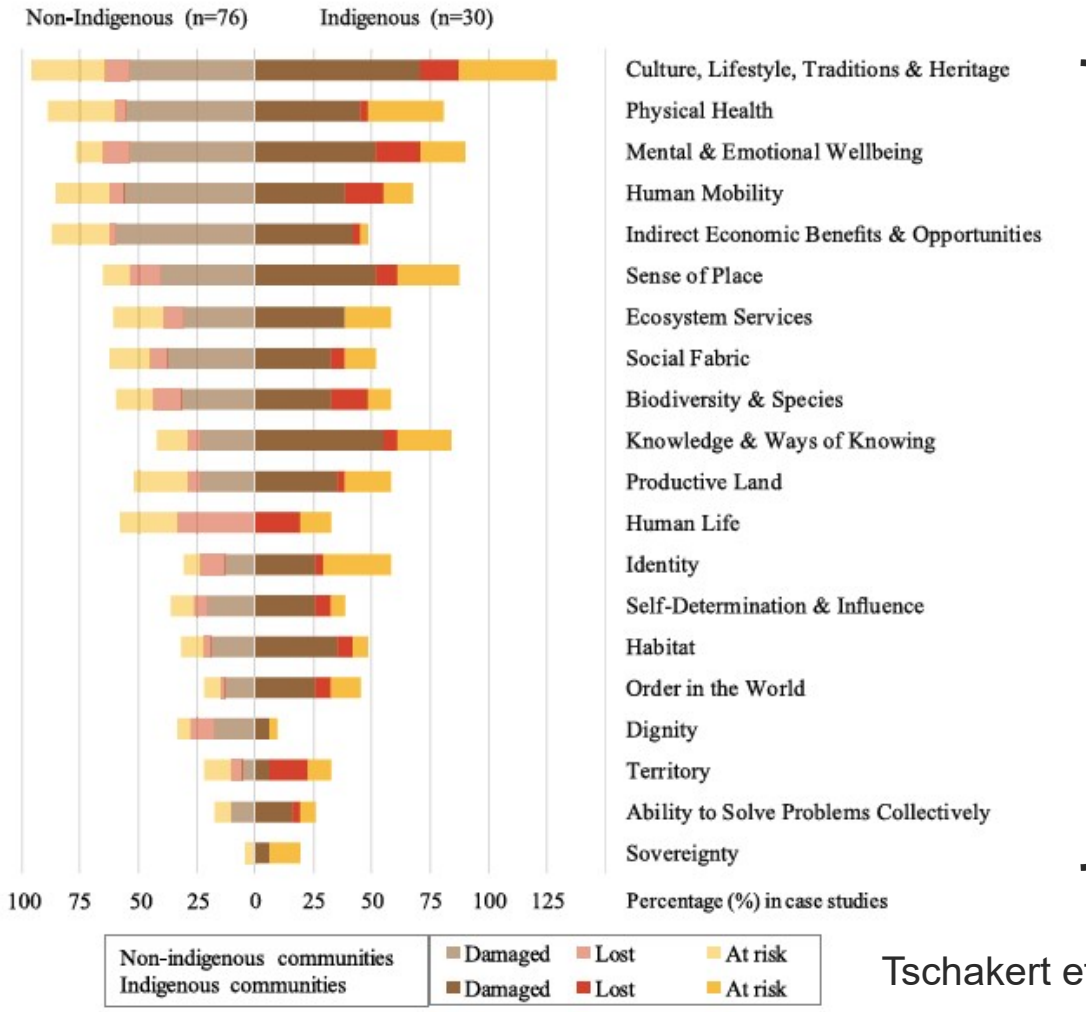


Quantifying what is lost or damaged even after enhanced DRR and adaptation

What is required in terms of enhanced DRR and adaptation to avert and minimize losses and damages

Bouwer, L.M., 2019

What is unavoidable / permanent / irreversible?



Many different categories of potential or experienced harm affecting people, their communities, ecosystems that are currently being documented/researched – but uneven distribution of studies which are far from comprehensive

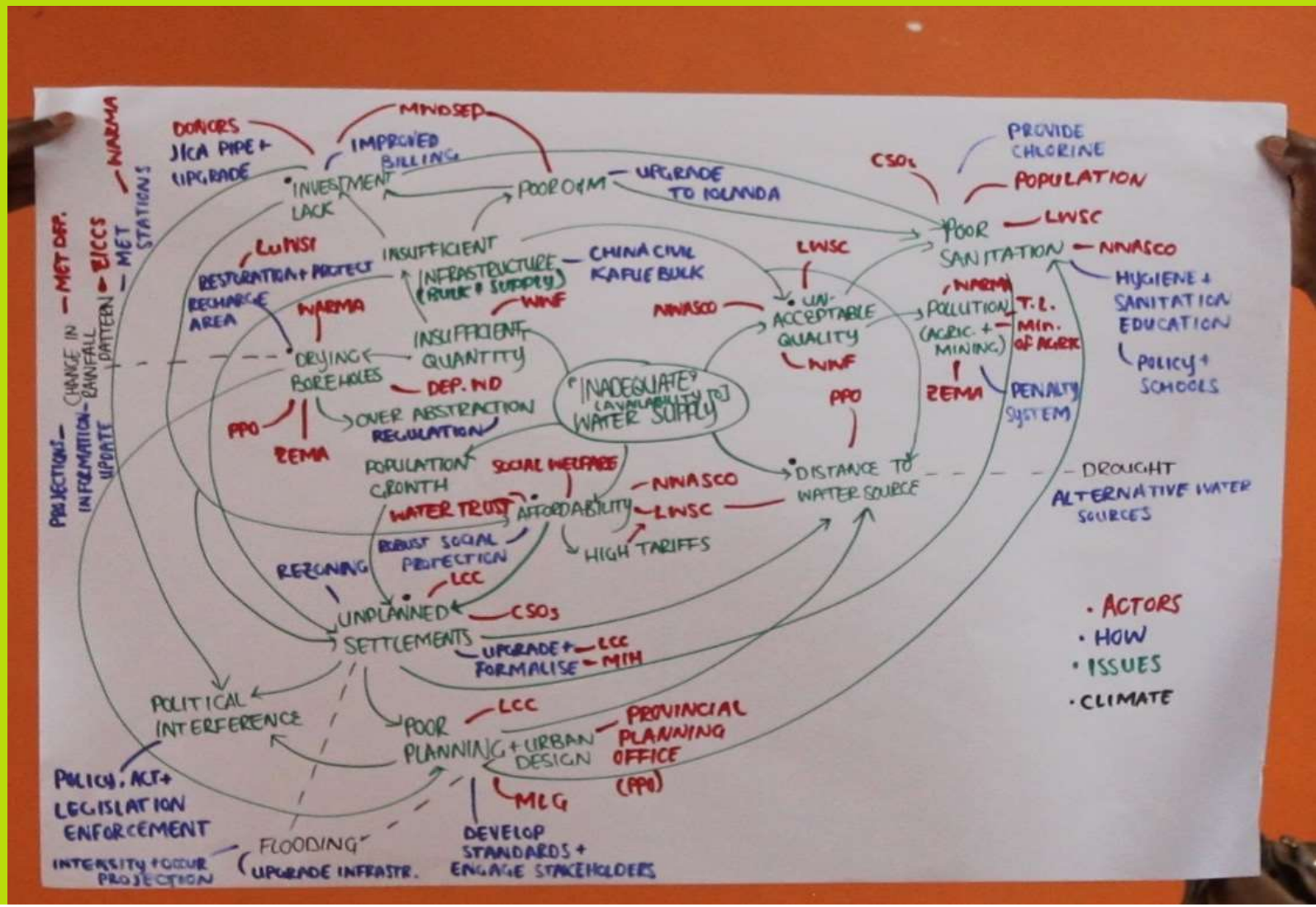
Tschakert et al., 2019

New research on communicating information on climate change

Its a lot more than just conveying messages

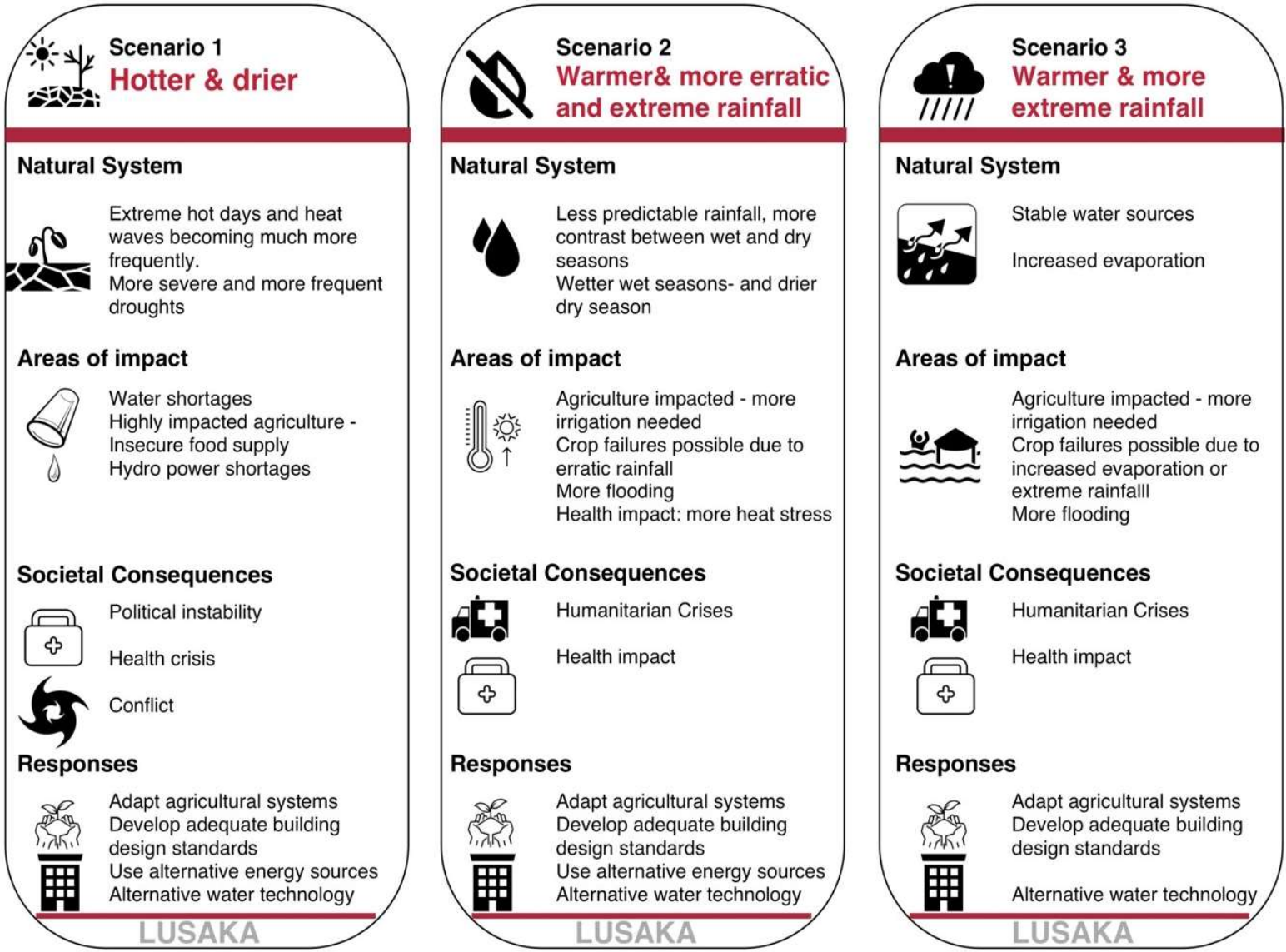
First you need to understand your problems – and these are often complex.

Need to define issues, actors, options – and then where the climate links in.



One approach is to use narratives to capture essential aspects of this complexity – but as part of a process:

- Where science is humble and power is balanced;
- Transparency and assessibility are promoted;
- Trust in evidence & people is built;
- Values and ethics are evident.



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And finally some opportunities to engage in IPCC

IPCC AR6 WG II report chapters currently in Expert Review – until Dec 13

IPCC AR6 WG I report chapters will be open for Government and Expert review March-April 2020

Deadline for papers to be submitted for citation in WG II report – June 2020

Relevant grey literature (project reports, etc.) citable in IPCC reports