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Impacts, Adaptation and Vulnerability

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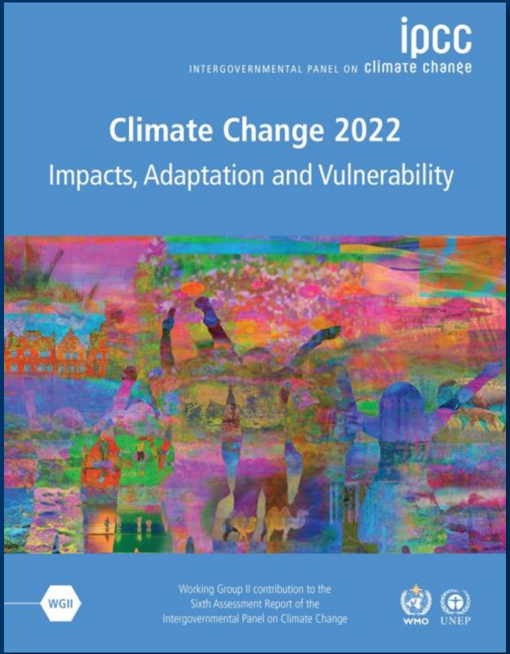
UK CLIMATE RESILIENCE PROGRAMME



"The science is clear.

Any further delay in concerted global action will miss a brief and rapidly closing window to secure a liveable future.

This report offers solutions to the world.

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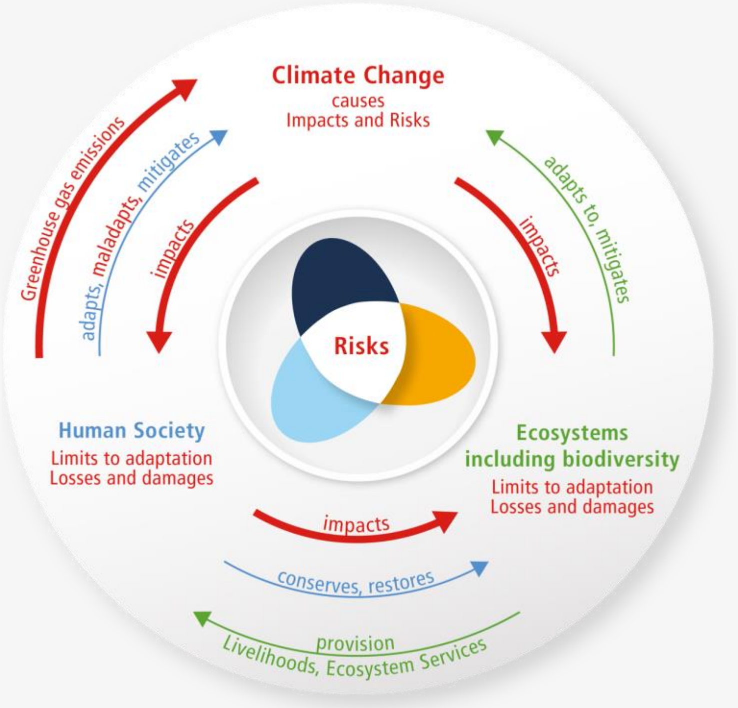
New understanding of interconnections



Climate change combines with unsustainable use of natural resources, habitat destruction, growing urbanization and inequity.

The risk propeller shows that risk emerges from the overlap of:

Climate hazard(s)

Vulnerability   Exposure

...of human systems, ecosystems and their biodiversity

3.3 – 3.6 billion people live in hotspots of high vulnerability to climate change.

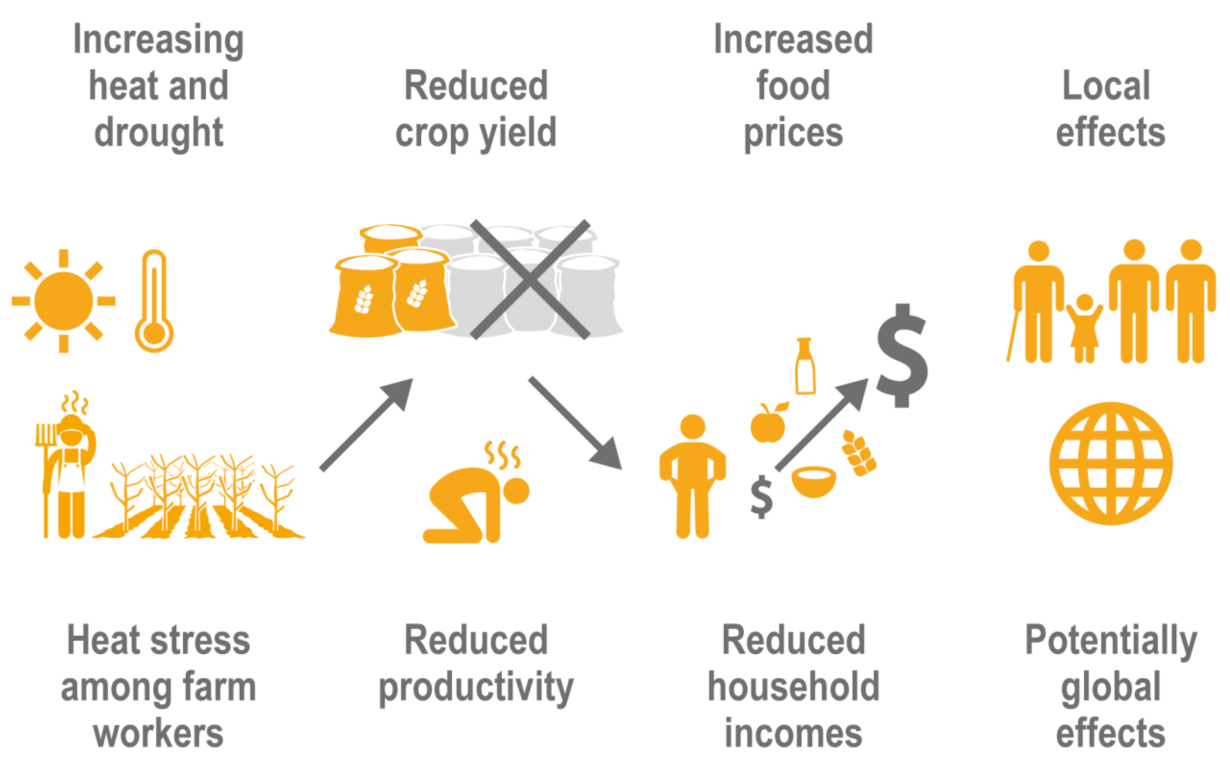
Overlapping challenges

- Limited access to water, sanitation and health services
- Climate-sensitive livelihoods
- High levels of poverty
- Weak leadership
- Lack of funding
- Lack of accountability and trust in government

[Denis Onyodi / KRCS CC BY-NC 2.0; Marco Dormino UN Photo CC BY-NC-ND 2.0; Markus Krisetya / Unsplash]

Simultaneous extreme events compound risks

Multiple extreme events that compound the risks are more difficult to manage



Nature’s crucial services at risk in a warming world

Pollination

Coastal protection

Tourism / recreation

Food source

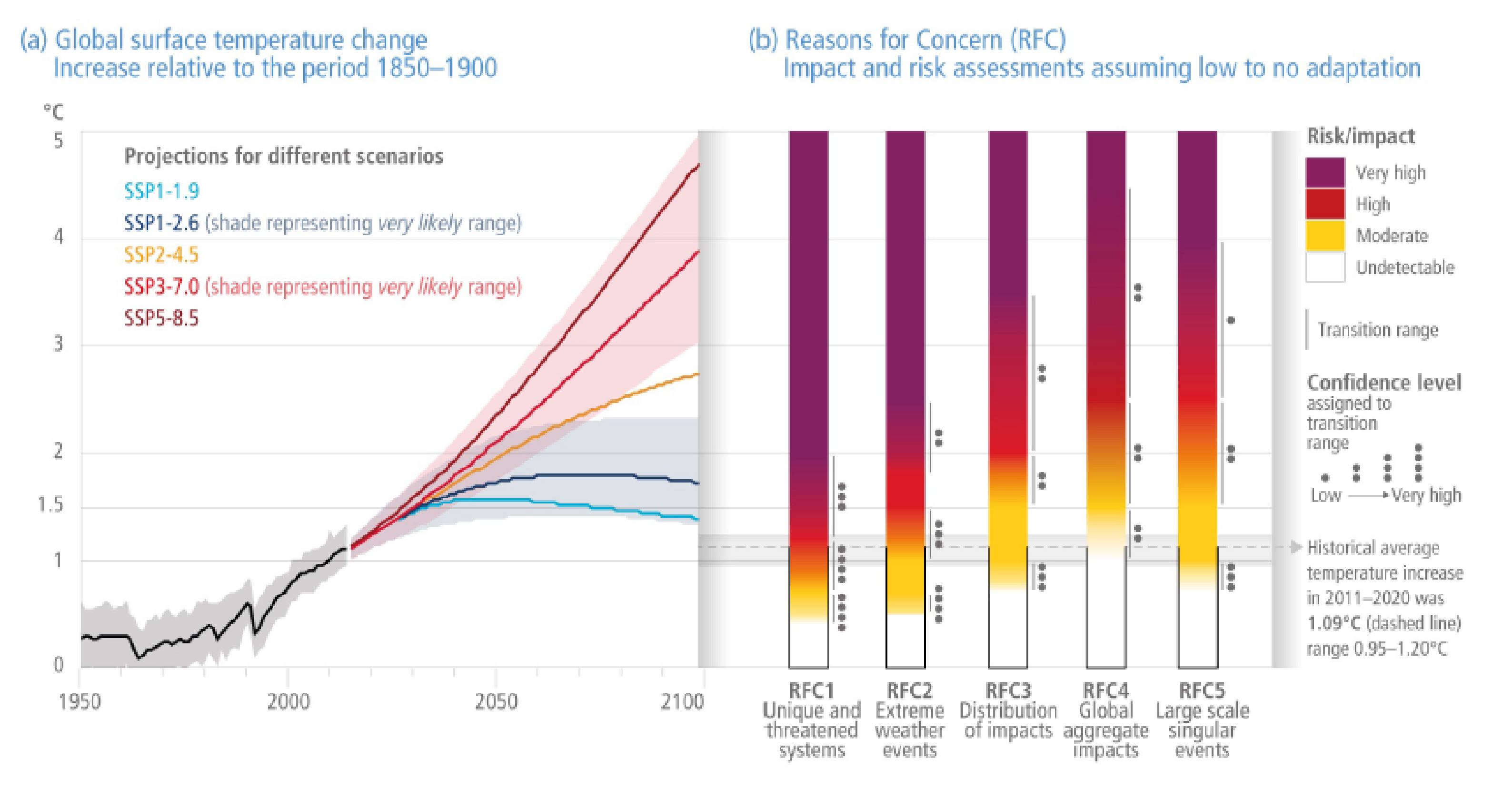
Health

Water filtration

Clean air

Climate regulation

Global and regional risks for increasing levels of global warming



Future global climate risks

Heat stress

Exposure to heat waves will continue to increase with additional warming.

Water scarcity

At 2°C, regions relying on snowmelt could experience 20% decline in water availability for agriculture after 2050.

Food security

Climate change will increasingly undermine food security.

Flood risk

About a billion people in low-lying cities by the sea and on Small Islands at risk from sea level rise by mid-century.

Action on adaptation has increased but progress is uneven and we are not adapting fast enough.

[Boskalis / Rijkswaterstaat]

Water management

Options on farms:

- Irrigation
- Rainwater storage, water-saving tech
- Moisture conservation in soils

Economic and ecological benefits; reduced vulnerability

Wider options:

- Securing drinking water
- Flood and drought risk management
- Working with nature, land-use planning

Effectiveness declines with increased warming

Improving food security

Effective options:

- Cultivar improvements
- Agroforestry
- Farm and landscape diversification
- Community-based adaptation
- Strengthening biodiversity

Wider benefits:

- Food security and nutrition
- Health and well-being
- Livelihoods

SUSTAINABLE DEVELOPMENT GOALS

2 ZERO HUNGER

3 GOOD HEALTH AND WELL-BEING

[Jacquelyn Turner / CCAFS CC BY-NC-SA 2.0; FAO / Riccardo De Luca]

[Chuttersnap, Jordan Brierley / Unsplash; SDOT Photos CC BY-NC 2.0]

Transforming cities

By 2050 urban areas could be home to two-thirds of the world's population.

Effective options

- Nature-based and engineering approaches together
- Establishing green and blue spaces
- Urban agriculture
- Social-safety nets for disaster management

Wider benefits

- Public health improvements
- Ecosystem conservation

11 SUSTAINABLE CITIES AND COMMUNITIES

Maladaptation

Adaptation that results in unintended consequences

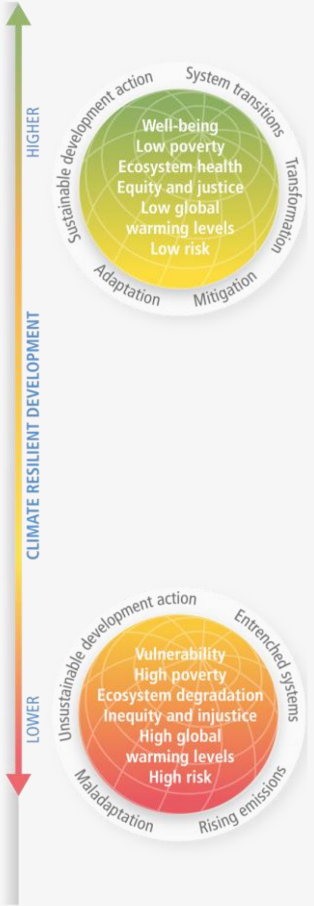
The most disadvantaged groups are most affected by maladaptation.

There are limits to adaptation

- Even effective adaptation cannot prevent all losses and damages
- Above 1.5°C some natural solutions may no longer work.
- Above 1.5°C, lack of fresh water could mean that people living on small islands and those dependent on glaciers and snowmelt can no longer adapt.
- By 2°C it will be challenging to farm multiple staple crops in many current growing areas.

Climate Resilient Development.

- Reduced climate risks – adaptation
- Reduced greenhouse gas emissions – mitigation
- Enhanced biodiversity
- Achieved the Sustainable Development Goals

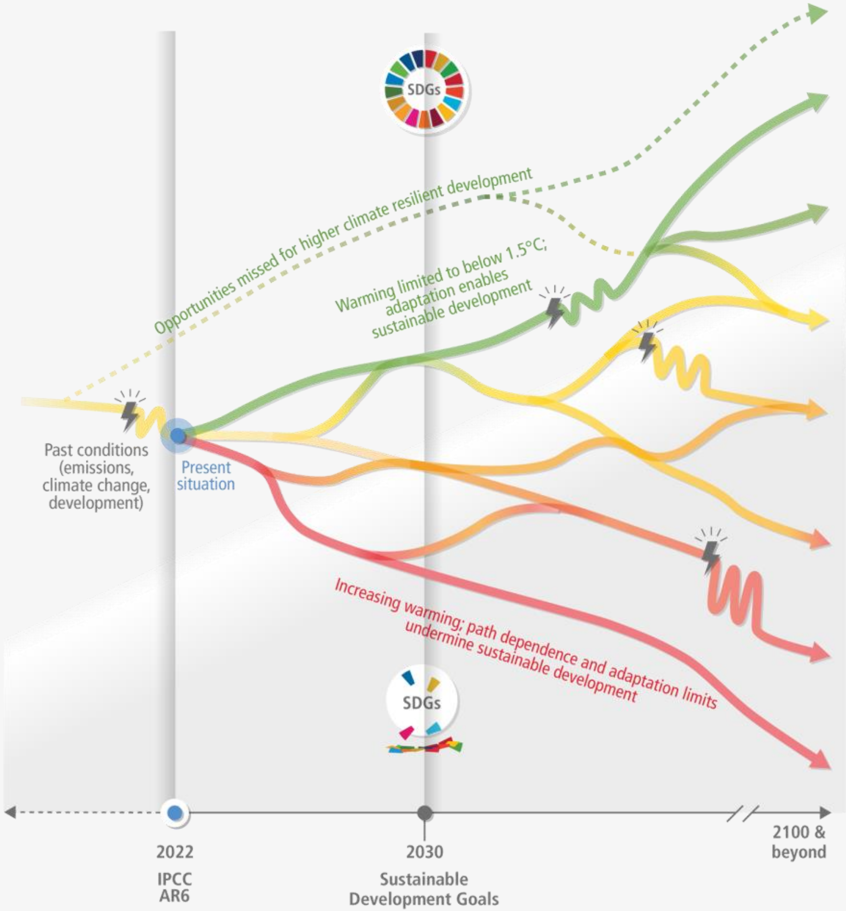


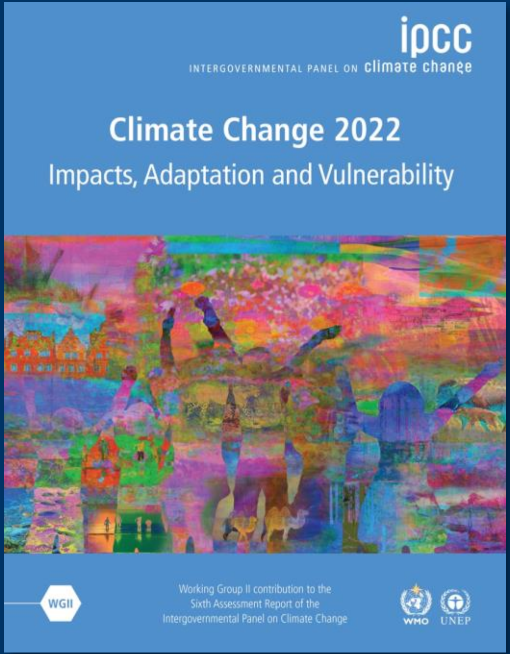
Climate Resilient Development: The Solutions Framework

- Is considered across government and all of civil society
- Involves everyone – forming partnerships
- Draws on wide-ranging knowledge (scientific, Indigenous, local, practical)
- Conserves and restores ecosystems
- Involves marginalized groups
- Prioritises equity and justice
- Reconciles different interests, values and world views
- Requires scaled-up investment and international cooperation

Climate resilient development is already challenging at current global warming levels.

The prospects will become further limited if warming exceeds 1.5°C and may not be possible if warming exceeds 2°C.





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Impacts, Adaptation and Vulnerability

The AR6 Climate impact, risk and adaptation assessment for Europe

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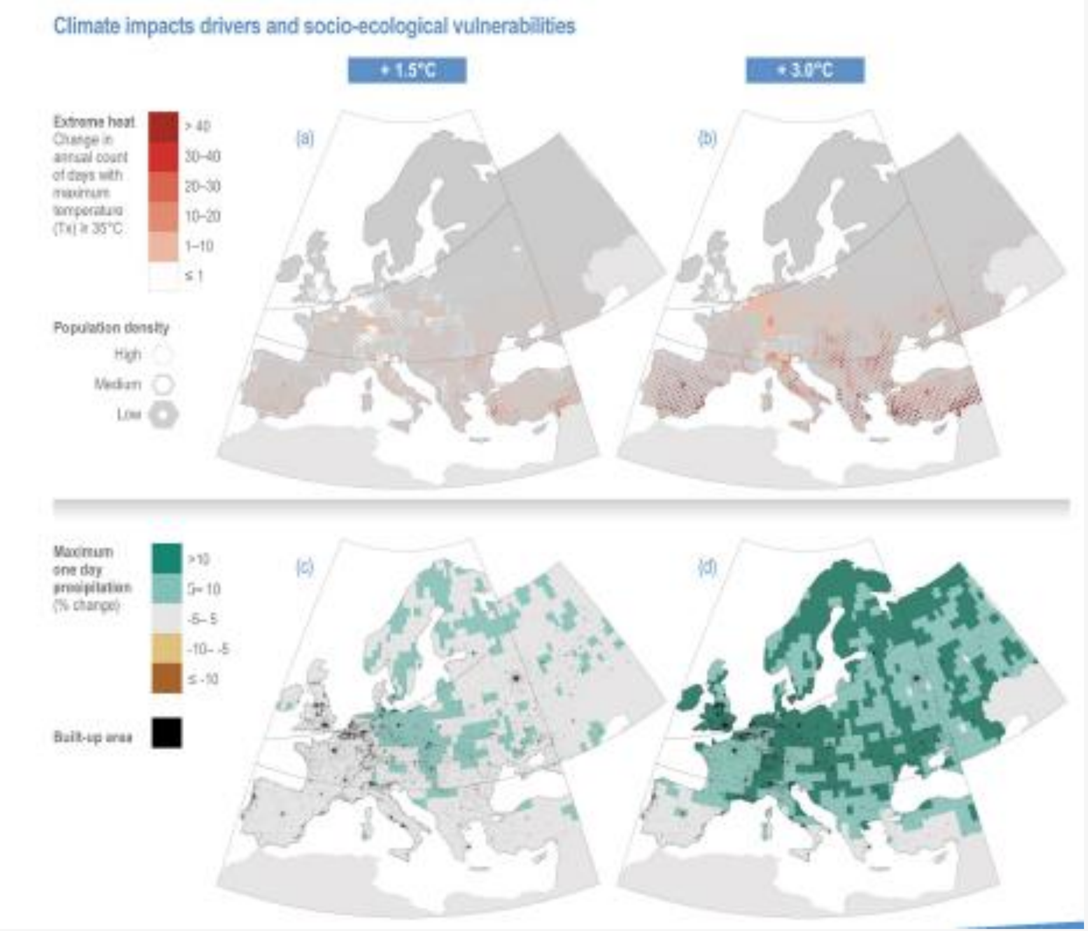
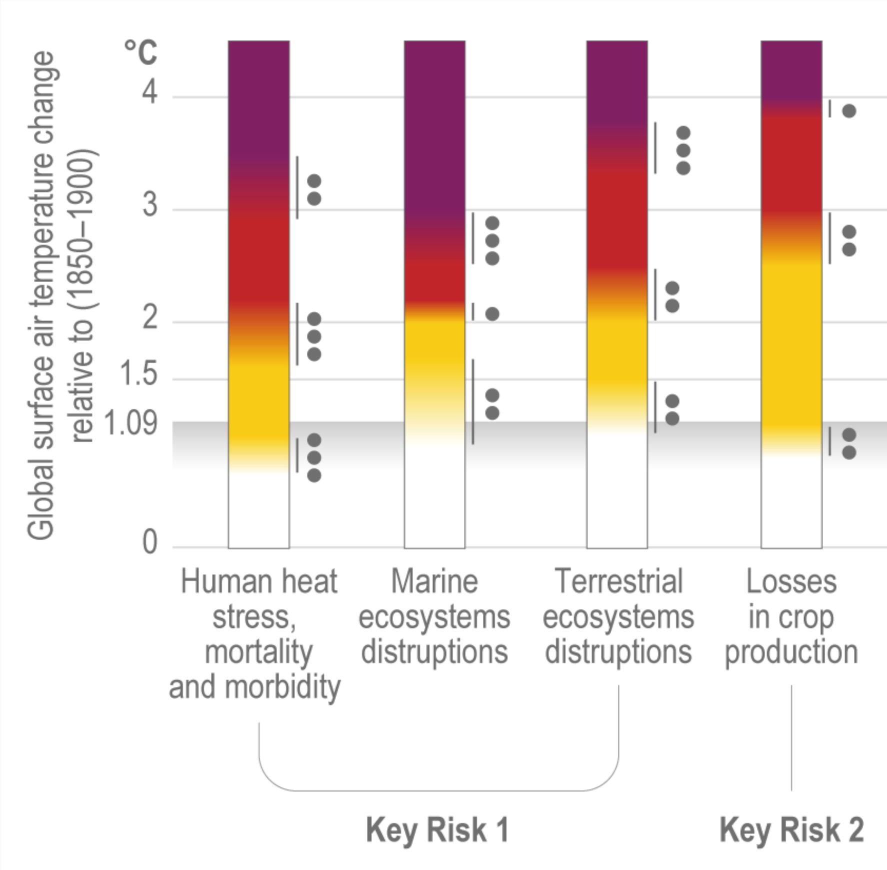
[Renan / Unsplash]



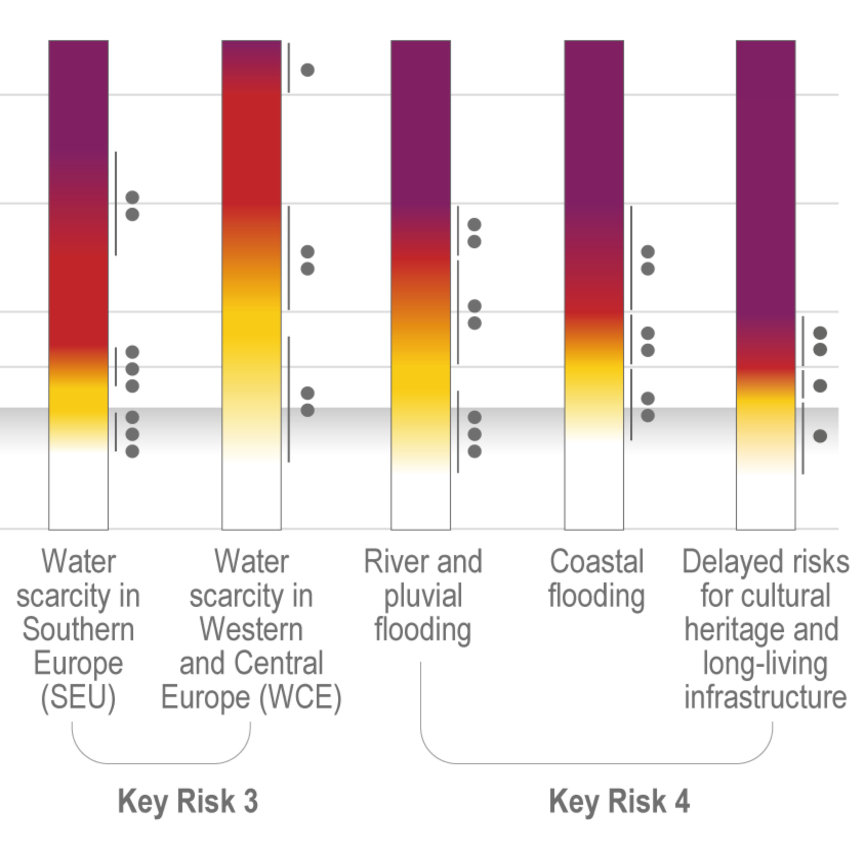
Our current 1.1ºC warmer world is already affecting natural and human systems in Europe

As impacts vary both across and within European regions, sectors, and societal groups, inequalities have deepened.



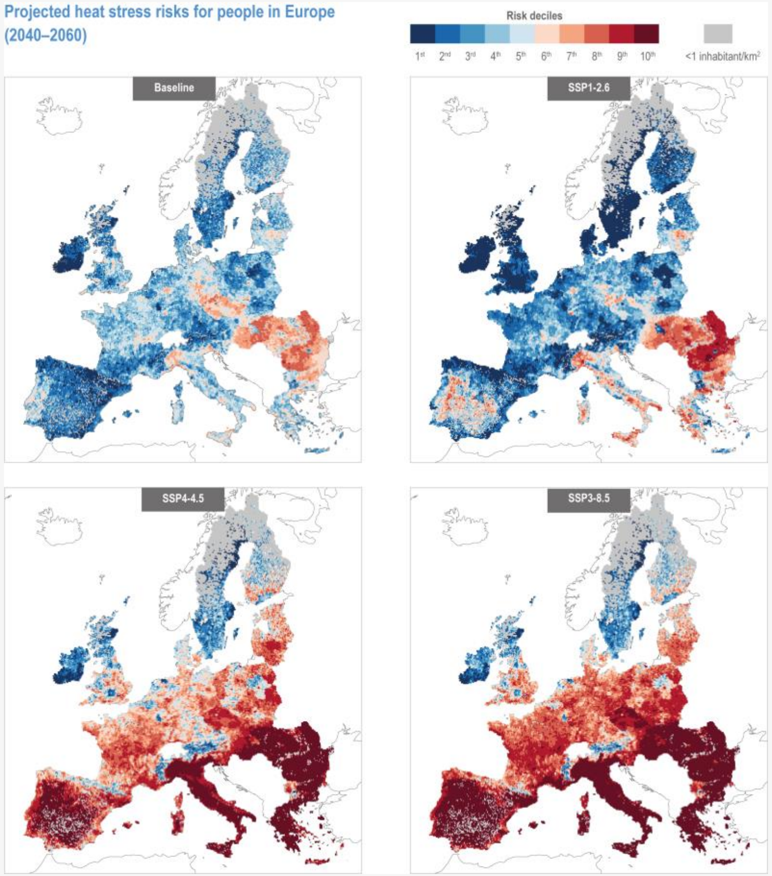
[AR6-WGII, Figure 13.28]

- The number of deaths and people at risk of heat stress will increase two- to threefold at 3°C compared with 1.5°C GWL
- Warming will decrease suitable habitat space for current terrestrial and marine ecosystems and irreversibly change their composition, increasing in severity above 2°C GWL
- Due to a combination of heat and drought, substantive agricultural production losses are projected for most European areas over the 21st century, which will not be offset by gains in Northern Europe



[AR6-WGII, Figure 13.28]

- Risk of water scarcity will become high at 1.5ºC and very high at 3ºC GWL in Southern Europe and increase from moderate to high in Western Central Europe.
- Due to warming, changes in precipitation and sea level rise (SLR), risks to people and infrastructures from coastal, riverine and pluvial flooding will increase in Europe.



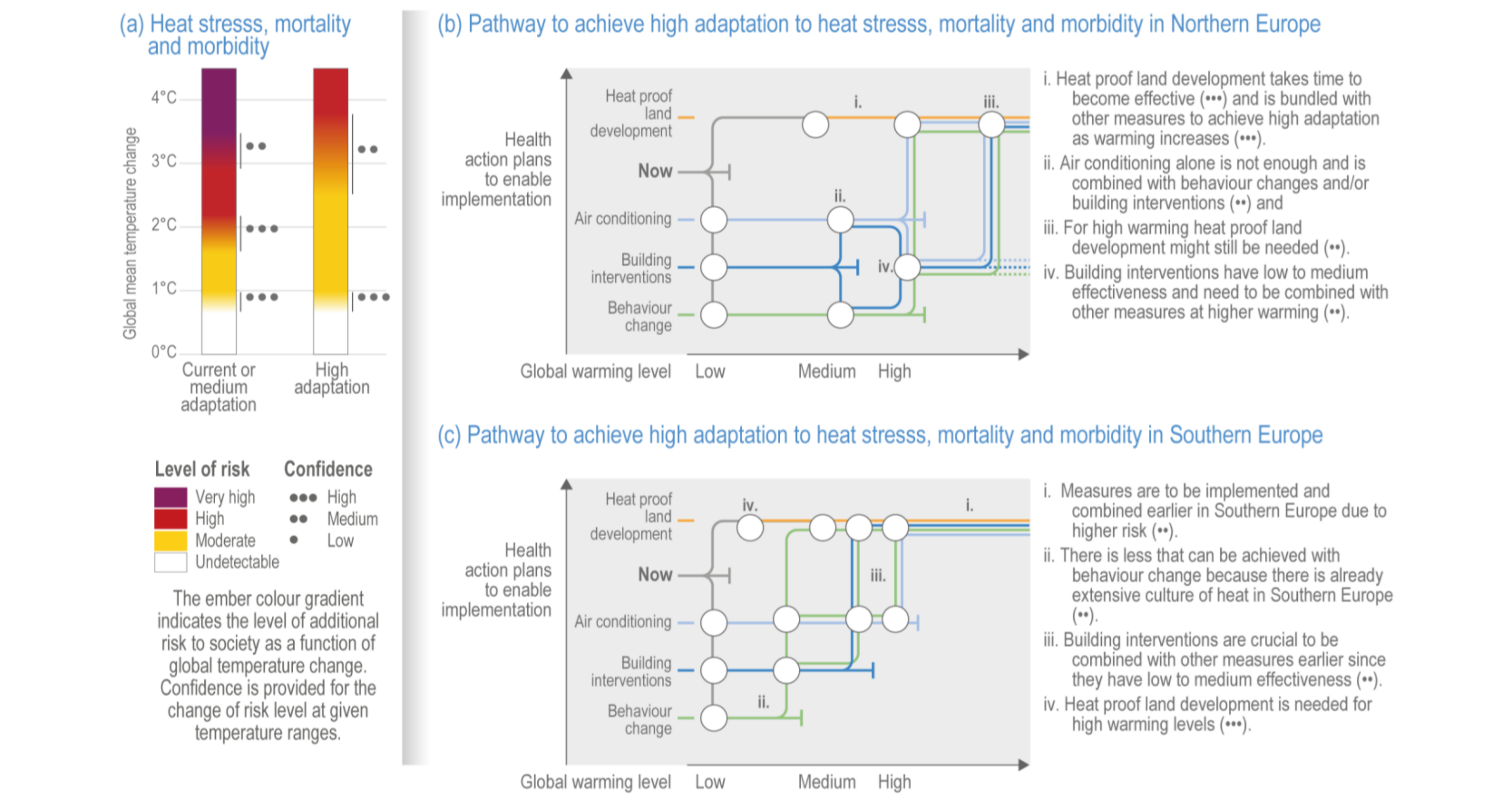
Heat stress risk for people under different warming and population increase

Risk will become severe more rapidly in Southern and Western Central Europe and urban areas

Thermal comfort hours during summer will decrease significantly, by as much as 74% in Southern Europe at 3ºC GWL.

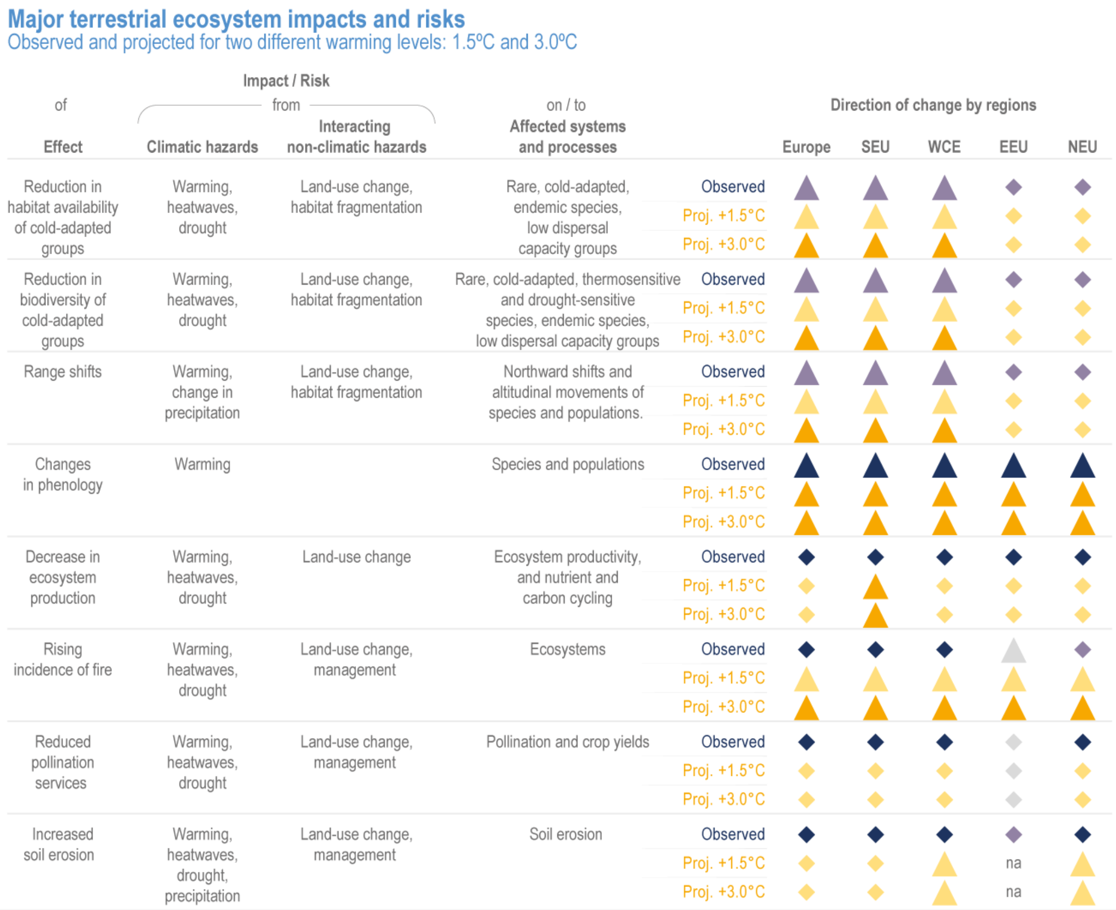
> 3ºC GWL, limits to the adaptation of people and existing health systems, particularly in Southern Europe, Eastern Europe

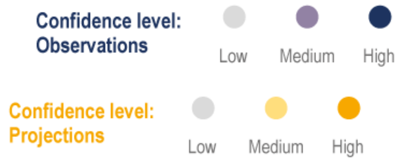
BE & adaptation pathways: Risks to human health from heat



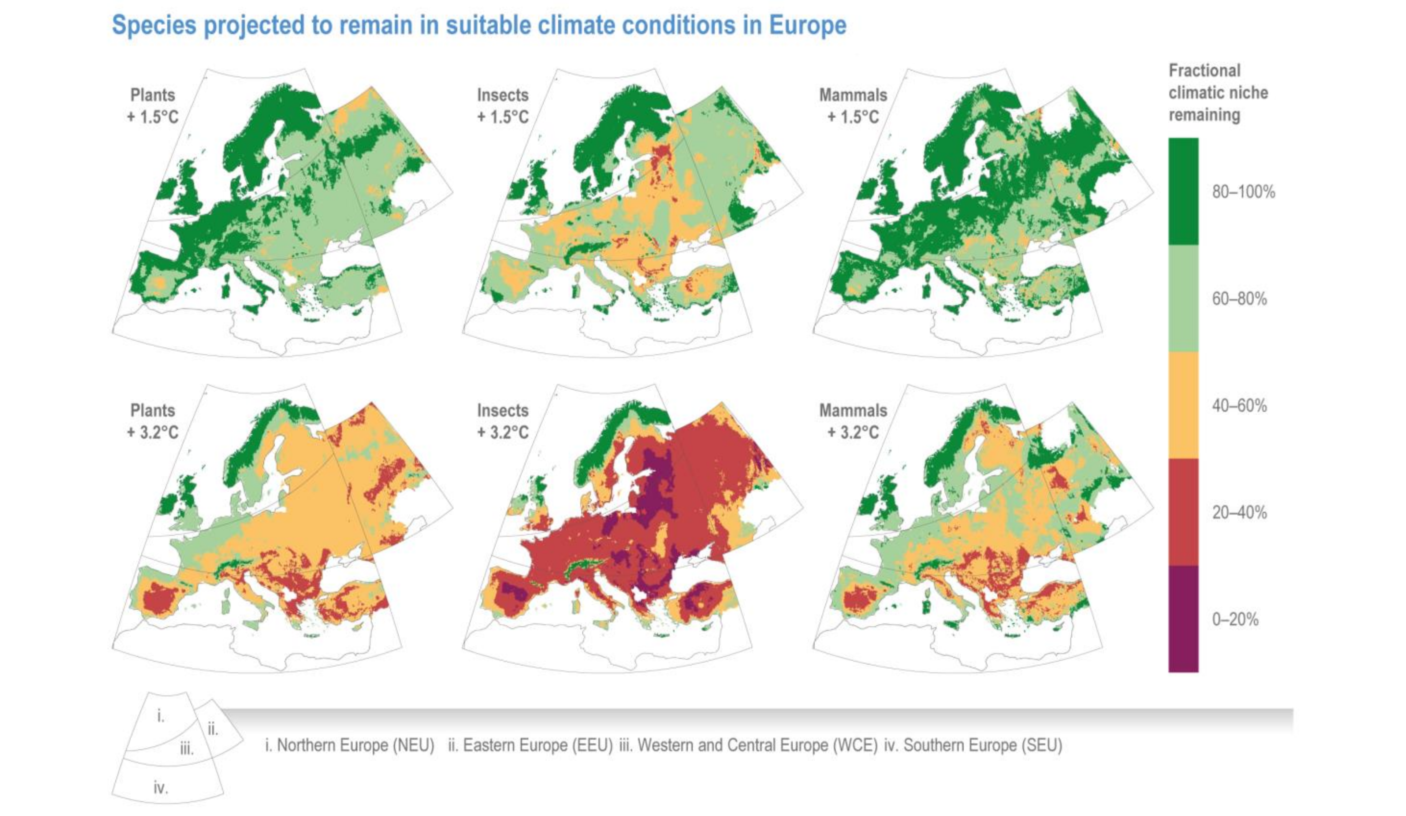
Impacts and risk for terrestrial ecosystems

Fire-prone areas are projected to expand across Europe, threatening biodiversity and carbon sinks.

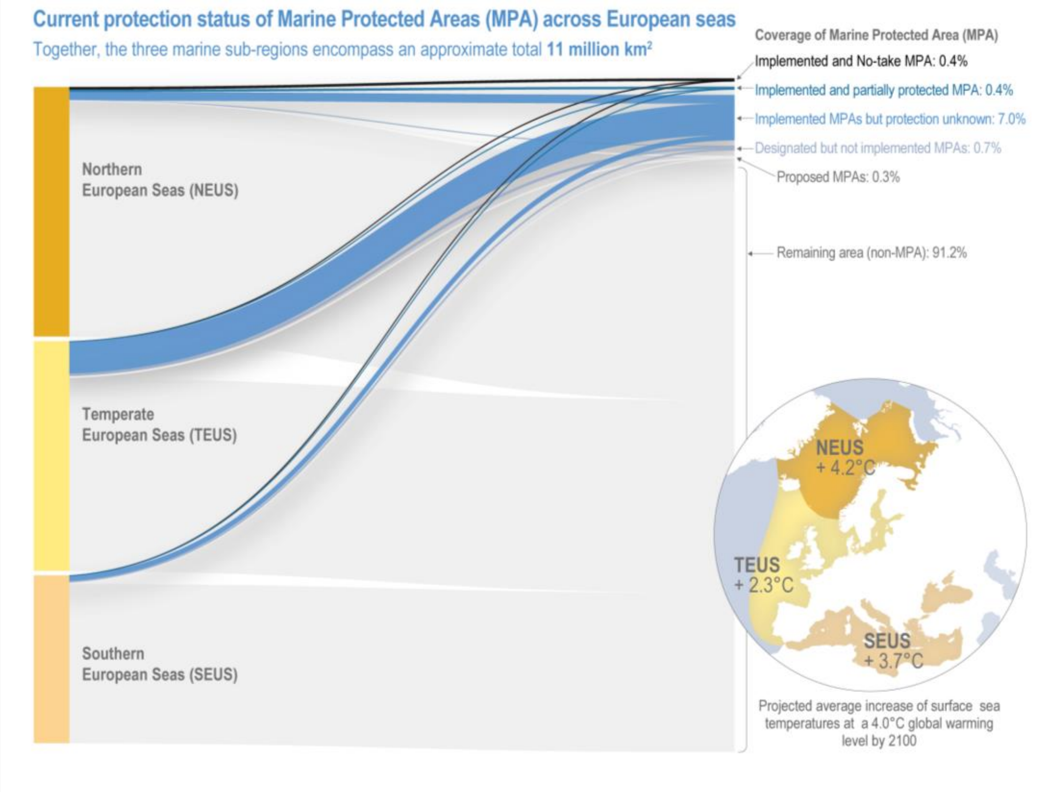




Impacts and risk for terrestrial ecosystems



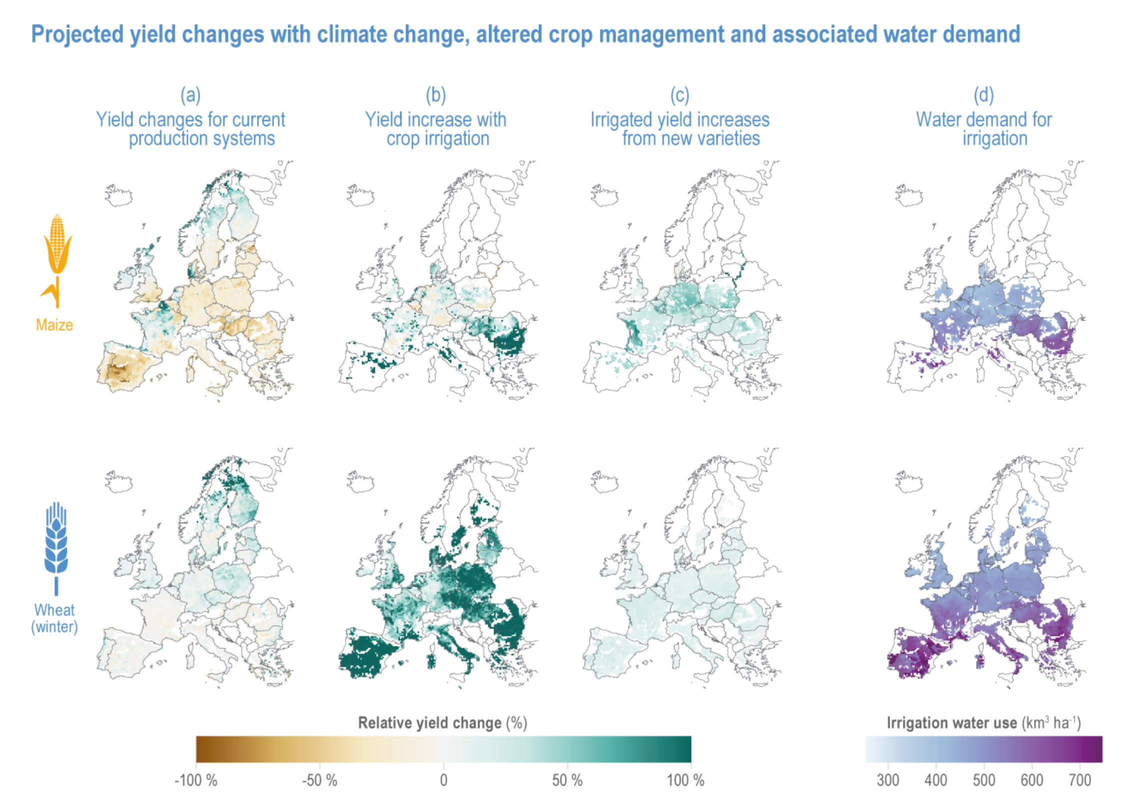
Protection needs coordination and stewardship



Adaptation actions
- habitat restoration
- protection,
- fire and forest management
- agroecology

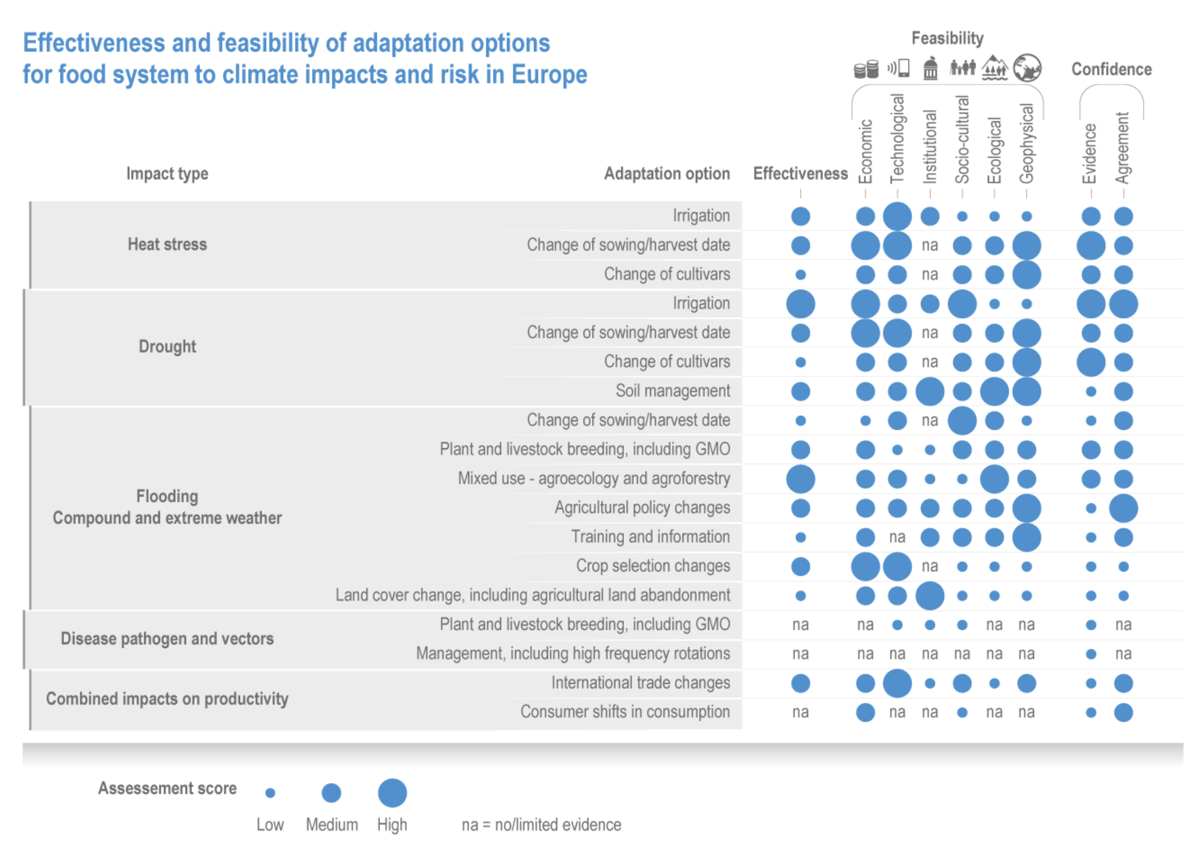
increase the resilience of ecosystems and their services.

Trade-offs between adaptation and mitigation options will result in risks for the integrity and function of ecosystems.



Yield losses for maize up to 50% at 3ºC GWL, especially in SEU.
Yields of some crops (e.g., wheat) may increase in NEU > 2ºC.
Irrigation is an effective adaptation option for agriculture
Ability to adapt using irrigation will be increasingly limited by water availability, especially > 3ºC

Feasibility of adaptation options for key sectors

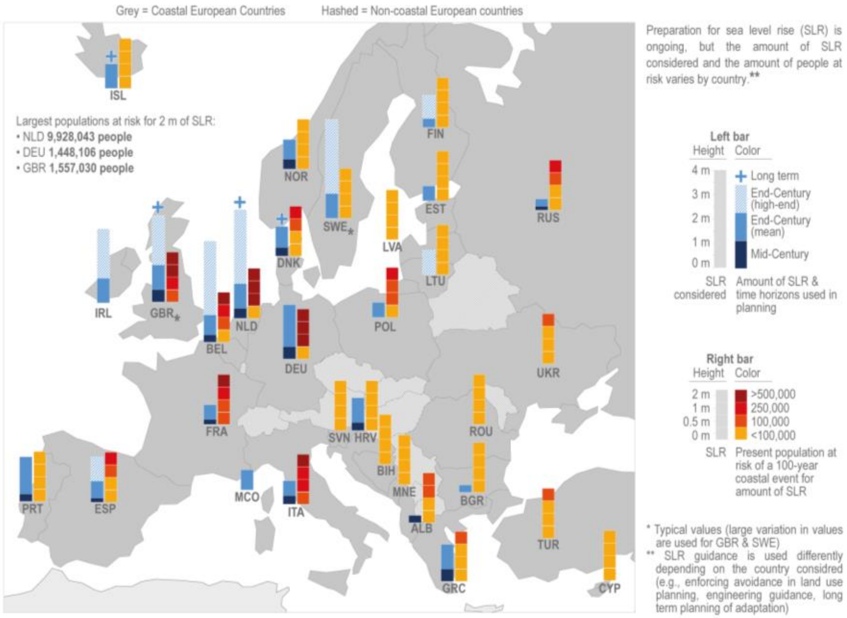


irrigation,
vegetation cover,
changes in farming practices,
crop and animal species,
and shifting planting
(KR2: agriculture);

Key Risk Sea level rise

Risk and national adaptation planning to sea level rise in Europe

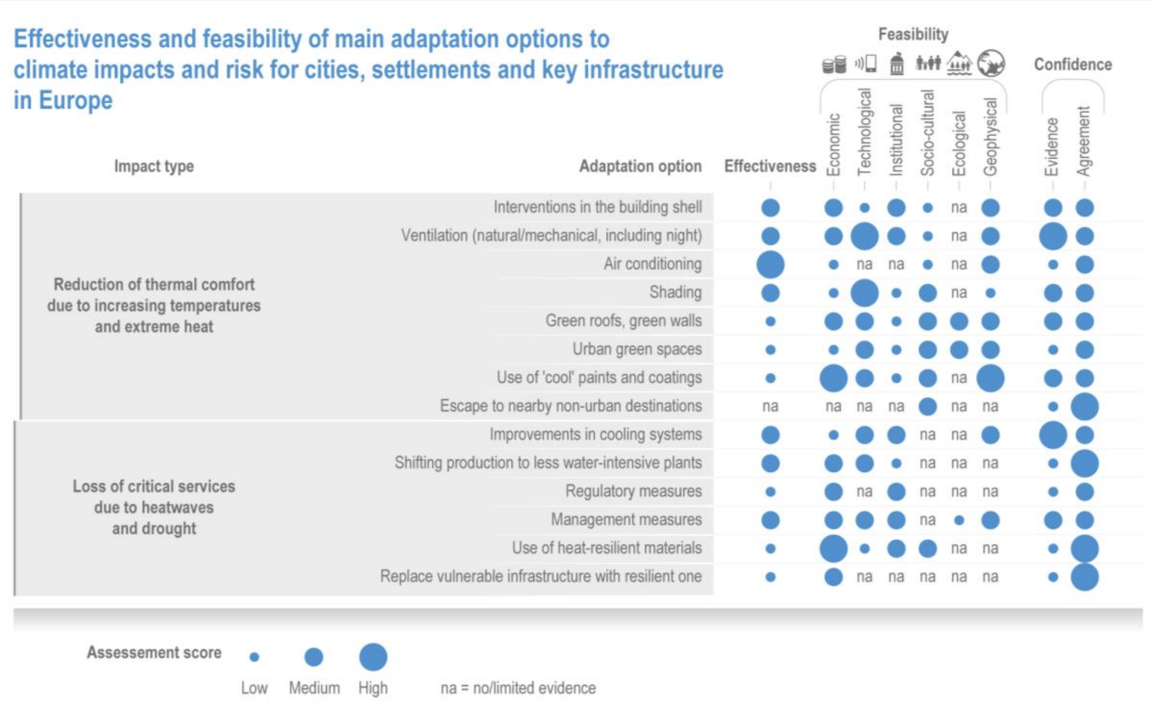
(a) Amount of sea level rise used in national level planning per country and population at risk by amount of sea level rise per country



SLR poses risks to people and infrastructures from coastal, riverine and pluvial flooding will increase in Europe

inundation and extreme flooding will increase

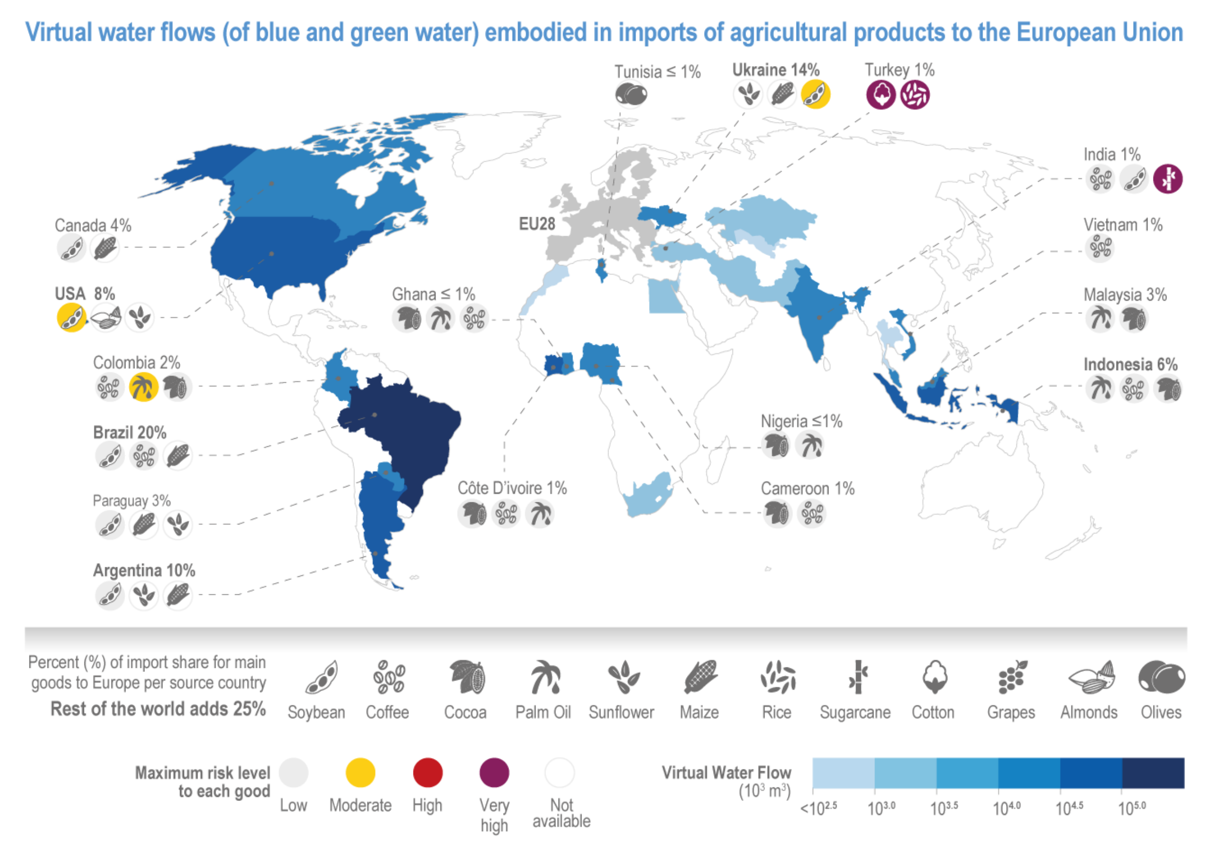
- 3ºC GWL, damage costs and people affected by precipitation and river flooding may double
- Coastal flood damage is projected to increase at least tenfold by the end of the 21st century, and even more or earlier with current adaptation and mitigation
- SLR an existential threat for coastal communities and their cultural heritage, particularly beyond 2100



>2ºC GWL widespread impacts on infrastructure and businesses

- increased risks for energy supply
- transport infrastructure,
- increases in air conditioning needs
- high water demand

European cities are hotspots for multiple risks of increasing temperatures and extreme heat, floods and droughts



Climate risks from outside Europe are emerging due to a combination of the position of European countries in the global supply chain and shared

There is emerging evidence that climate risks in Europe may also impact financial markets, food production and marine resources beyond Europe.

Climate resilient development

Adaptation is happening across Europe, but not at the scale, depth and speed to avoid the risks

Existing and planned adaptation measures not sufficient to avoid residual risk, > 1.5ºC GWL

Residual risk: losses of habitat and ecosystem services, heat related deaths, crop failures, water rationing during droughts and loss of land

At > 3ºC GWL, a combination of many, maybe even all, adaptation options are needed,

Windows of opportunity to accelerate climate-resilient development (CRD) e.g., budget cycles, policy reforms and evaluations, infrastructure investment cycles; extreme events, COVID-19 recovery programmes.

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Ecosystems

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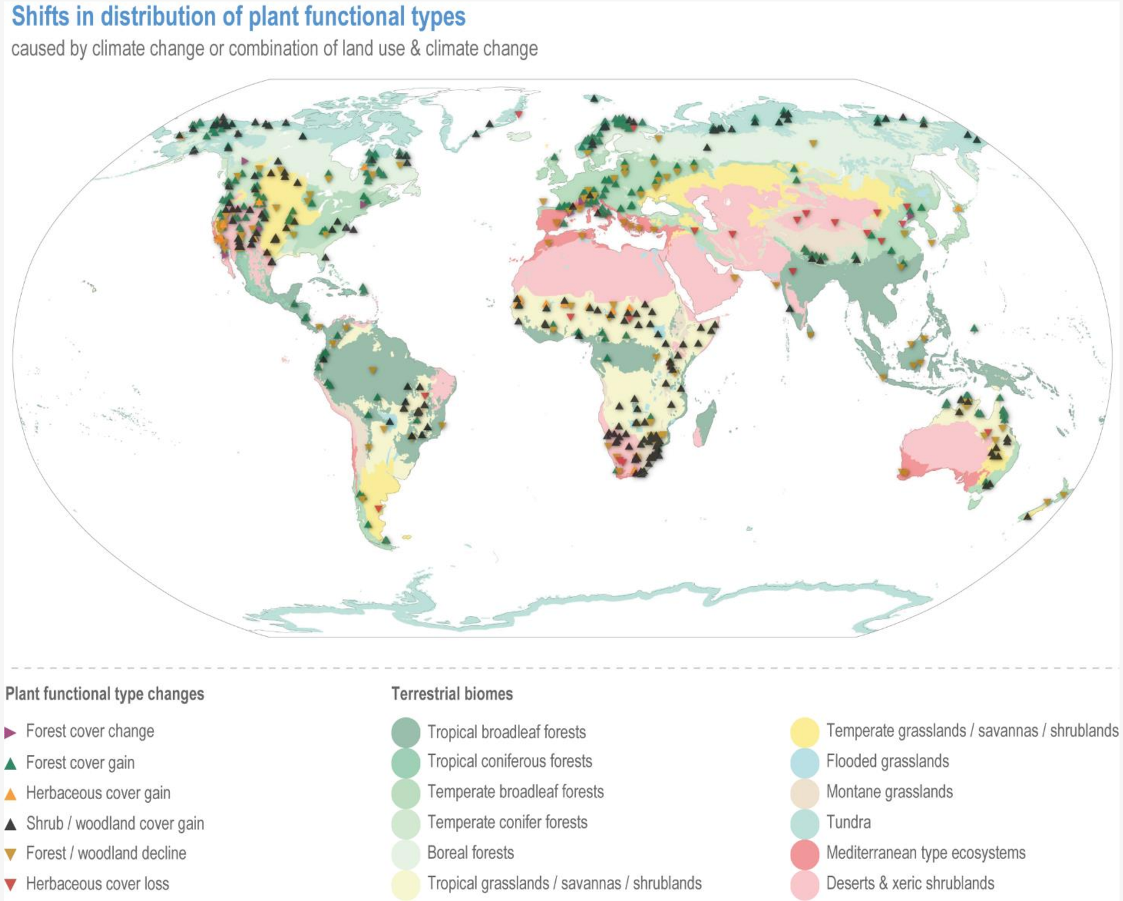
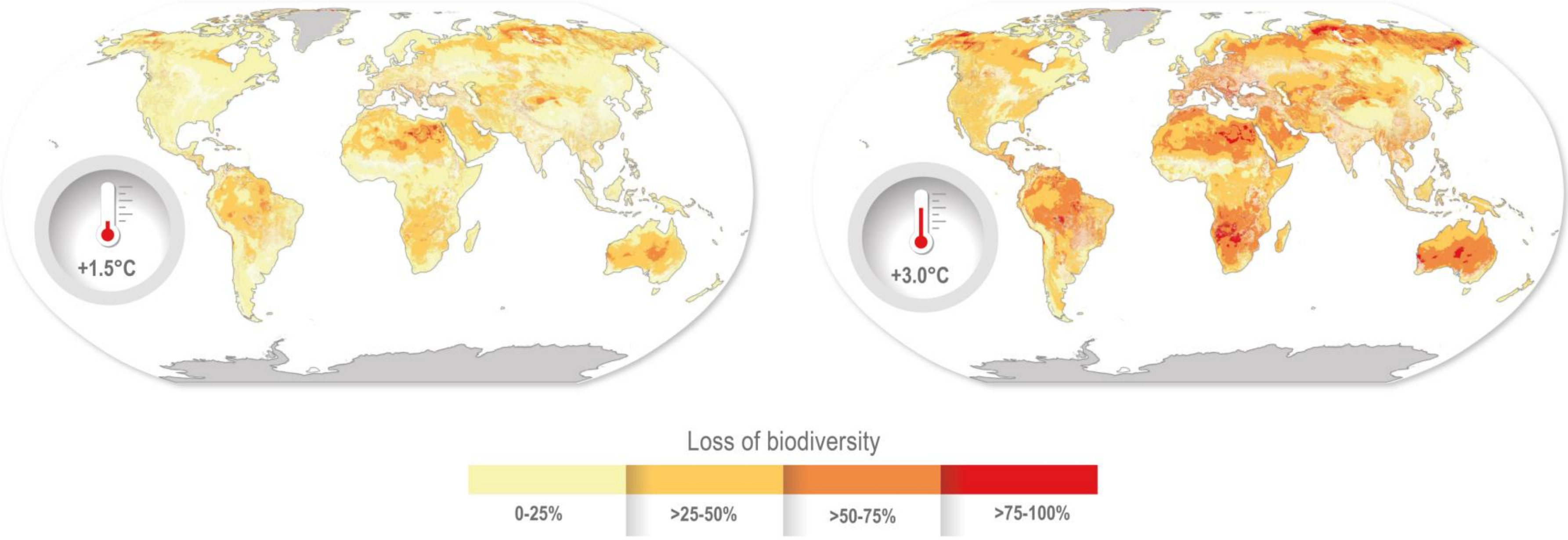
Observed Impacts (selected findings)

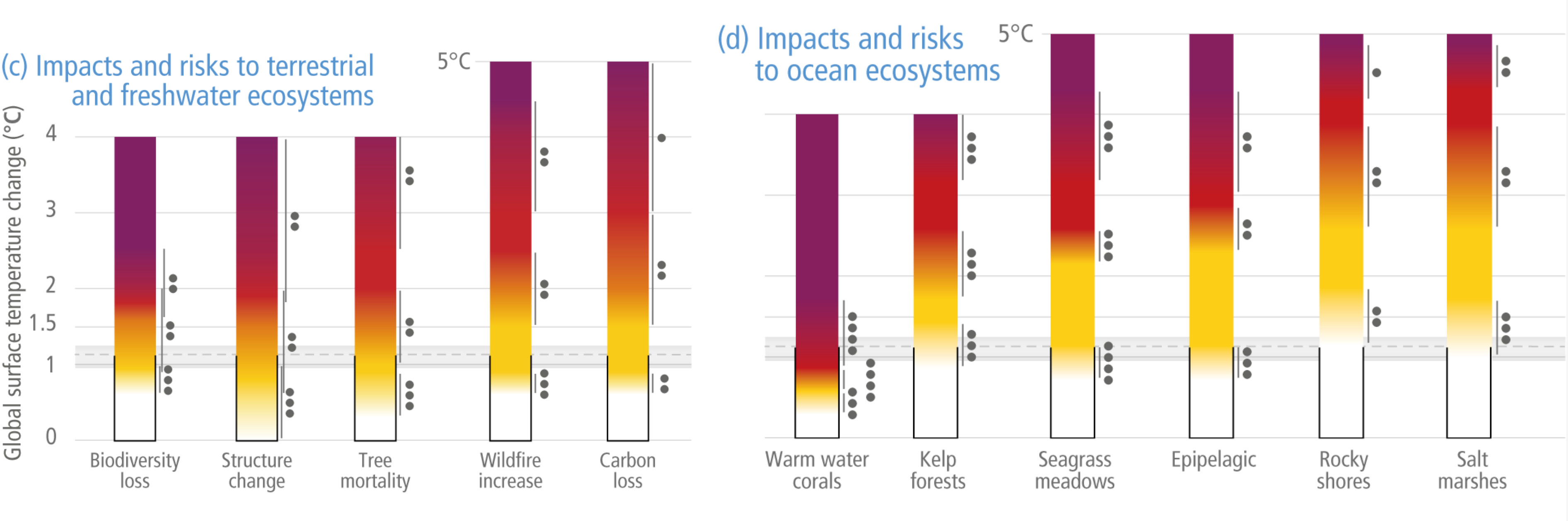
- It is *very likely* that many observed changes in ranges, phenology, physiology and morphology of terrestrial and freshwater species can be attributed to regional and global climate changes, particularly increases in frequency and severity of extreme events (*very high confidence*)
- Approximately half of species assessed globally have shifted their ranges to higher latitudes or elevations.
- Biome shifts and structural changes within ecosystems have been detected at an increasing number of locations.
- Global extinctions or near-extinctions have been linked to regional climate change in 3 documented cases
- Climate-caused local population extinctions have been detected in 47% of 976 species examined and associated with increases in hottest yearly temperatures.


Shifts in distribution of plant functional types
caused by climate change or combination of land use & climate change
Plant functional type changes
Forest cover change
Forest cover gain
Herbaceous cover gain
Shrub / woodland cover gain
Forest / woodland decline
Herbaceous cover loss
Terrestrial biomes
Tropical broadleaf forests
Tropical coniferous forests
Temperate broadleaf forests
Temperate conifer forests
Boreal forests
Tropical grasslands / savannas / shrublands
Temperate grasslands / savannas / shrublands
Flooded grasslands
Montane grasslands
Tundra
Mediterranean type ecosystems
Deserts & xeric shrublands

Biodiversity loss at different warming levels



Risks to ecosystems



Adaptation for ecosystems

- The resilience of biodiversity and ecosystem services can be increased by adaptation including ecosystem **protection and restoration** (*high confidence*)
- There is new evidence that species can persist in **refugia** where conditions are locally cooler, when they are declining elsewhere (*high confidence*)
- Ecosystem restoration and resilience building cannot prevent all impacts of climate change, and **adaptation planning needs to manage inevitable changes** to species distributions, ecosystem structure and processes (*very high confidence*).
- Many adaptation plans and strategies have been developed but there is limited evidence of the extent to which adaptation is taking place and virtually no **evaluation** of the effectiveness of adaptation measures.

Ecosystem-based Adaptation (EbA) and Nature-based Solutions (NbS)

- EbA can deliver climate change adaptation for people with multiple additional benefits, including for biodiversity (*high confidence*).
- Examples of feasible and effective EbA include **natural flood management** on coast and rivers, **urban cooling**, **reducing wildfire risk**.
- To realise potential benefits and avoid harm, it is essential that EbA is deployed in the right places and with the right approaches for that area, with inclusive governance (*high confidence*).
- EbA and other NbS are vulnerable to climate change. They may need to adapt if they are to remain effective and will increasingly be under threat at higher warming levels.
- There are risks of maladaptation and environmental damage from some approaches to land-based mitigation. Documented examples of adverse impacts of, include afforestation of grasslands, savannas and peatlands and risks from bioenergy crops.
- The term NbS is highly controversial in some countries

Safeguarding biodiversity and ecosystems is fundamental to climate resilient development

SPM.D.4 Safeguarding biodiversity and ecosystems is fundamental to climate resilient development, in light of the threats climate change poses to them and their roles in adaptation and mitigation (*very high confidence*). Recent analyses, drawing on a range of lines of evidence, suggest that maintaining the resilience of biodiversity and ecosystem services at a global scale depends on effective and equitable conservation of approximately 30% to 50% of Earth's land, freshwater and ocean areas, including currently near-natural ecosystems (*high confidence*). {2.4, 2.5, 2.6, 3.4, Box 3.4, 3.5, 3.6, 12.5, 13.3, 13.4, 13.5, 13.10, CCB NATURAL, CCB INDIG}

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