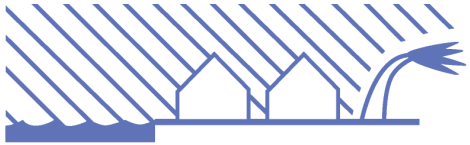
IPCC 5.
ASSESSMENT REPORT

WORKING GROUP 2
IMPACTS, ADAPTATION AND VULNERABILITY

Human interference with the climate system is occurring, and climate change poses risks for human and natural systems. The assessment of impacts, adaptation, and vulnerability in the Working Group II contribution to the IPCC's Fifth Assessment Report (WGII AR5) evaluates how patterns of risk and potential benefits are shifting due to climate change and how risks can be reduced through mitigation and adaptation.



TROPICAL CYCLONE ACTIVITY

IMPACTS

Effects on natural and human systems.

COASTAL FLOODING

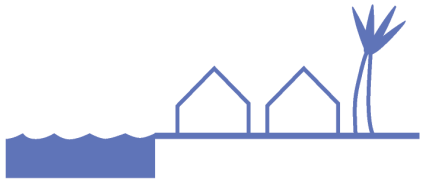
RISK

The potential for consequences where something of human value (including humans themselves) is at stake and where the outcome is uncertain.
Risk is often represented as the probability of hazardous events or trends occurring multiplied by the consequences if these events occur. This report assesses climate related risks.

CHANGING INFRASTRUCTURE

ADAPTATION

The process of adjustment to actual or expected climate and its effects, to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate.



FLOOD RISK REDUCED

MITIGATION

A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

OBSERVED IMPACTS OF CLIMATE CHANGE

Observed impacts of climate change are widespread and consequential. Recent changes in climate have caused impacts on natural and human systems on all continents and across the oceans.

The following pages explore:

- Observed Impacts on the Ocean
- Observed Impacts in Europe
- Impacts on Crop Yields
- Impacts on Migration Patterns of Species.

OCEAN WARMING, ACIDIFICATION AND LACK OF OXYGEN ARE CRITICAL FOR LIFE IN OCEANS.

1

Increased movements of plankton, fish and invertebrate communities northwards with warming accompanied by changing seasonal triggers. Increase in biodiversity and fish biomass at high latitude fringes.

2

Recent spread of tropical species invading from Indian and Atlantic Oceans. Increased frequency of mass mortality events of benthic plants and animals linked to extreme temperatures.

3

Expansion of seasonal hypoxic areas due to thermal stratification and eutrophication. Mass coral bleaching events leading to degradation of coral reefs and loss of associated biodiversity. Observed shifts in distributions of fish species.

4

Shoaling of aragonite saturation horizon at high latitudes reduces calcification and changes structure of plankton communities. Observed dissolution of shells of living polar pteropods suggests impacts have started.

5

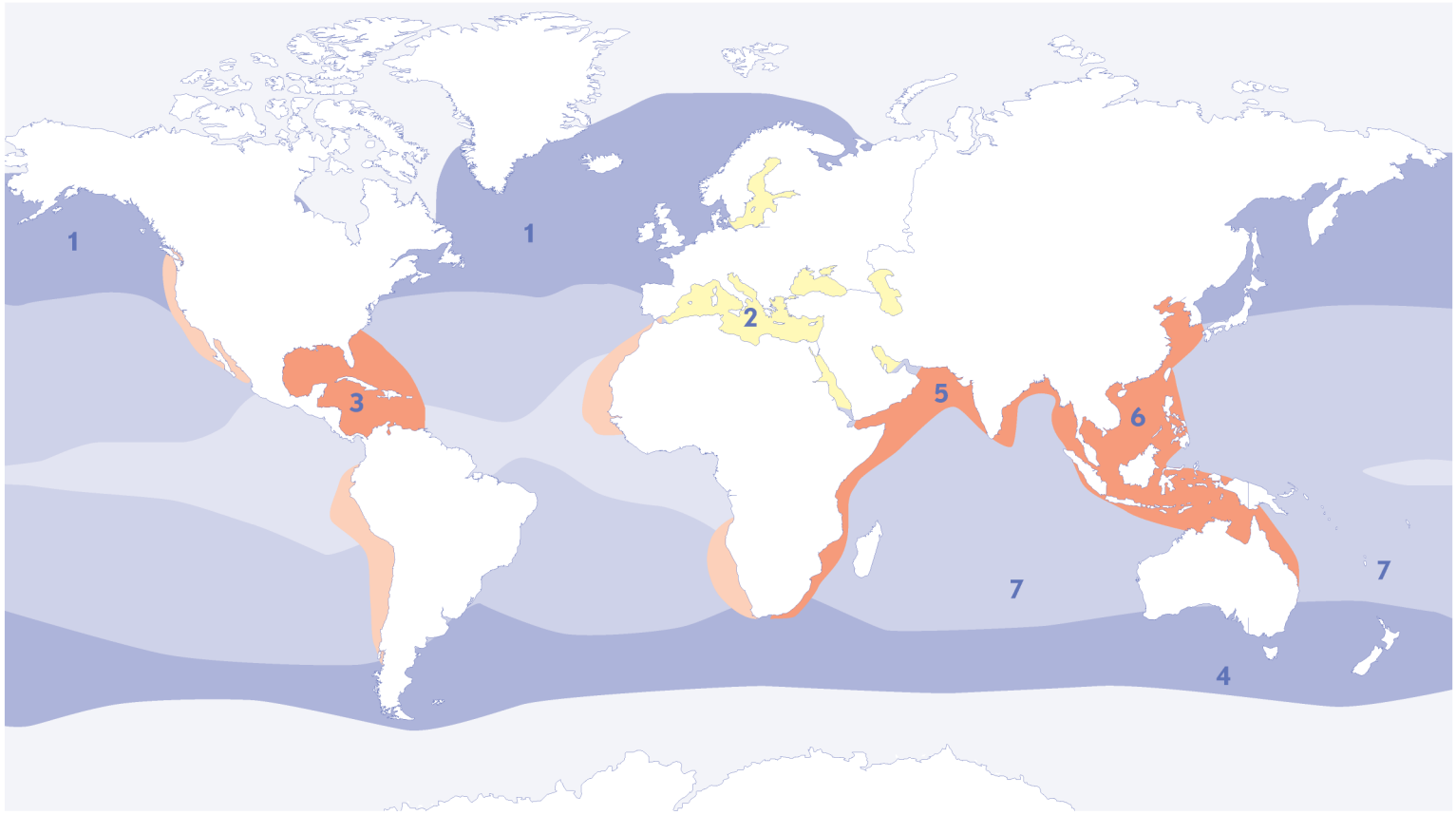
Half of the area of oxygen minimum zones (OMZs) found here and O_2 concentrations are declining in this region.

6

Mass coral bleaching observed in response to high temperature and temperature-driven decline in growth rates of some corals leading to degradation of coral reefs and loss of associated biodiversity.

7

Temperature-driven shifts in stocks of large pelagic fish create winners and losers among country and island economies.



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IMPACTS RELATED TO CLIMATE CHANGE IN EUROPE ARE DIVERSE.

Melting of glaciers and thawing of permafrost

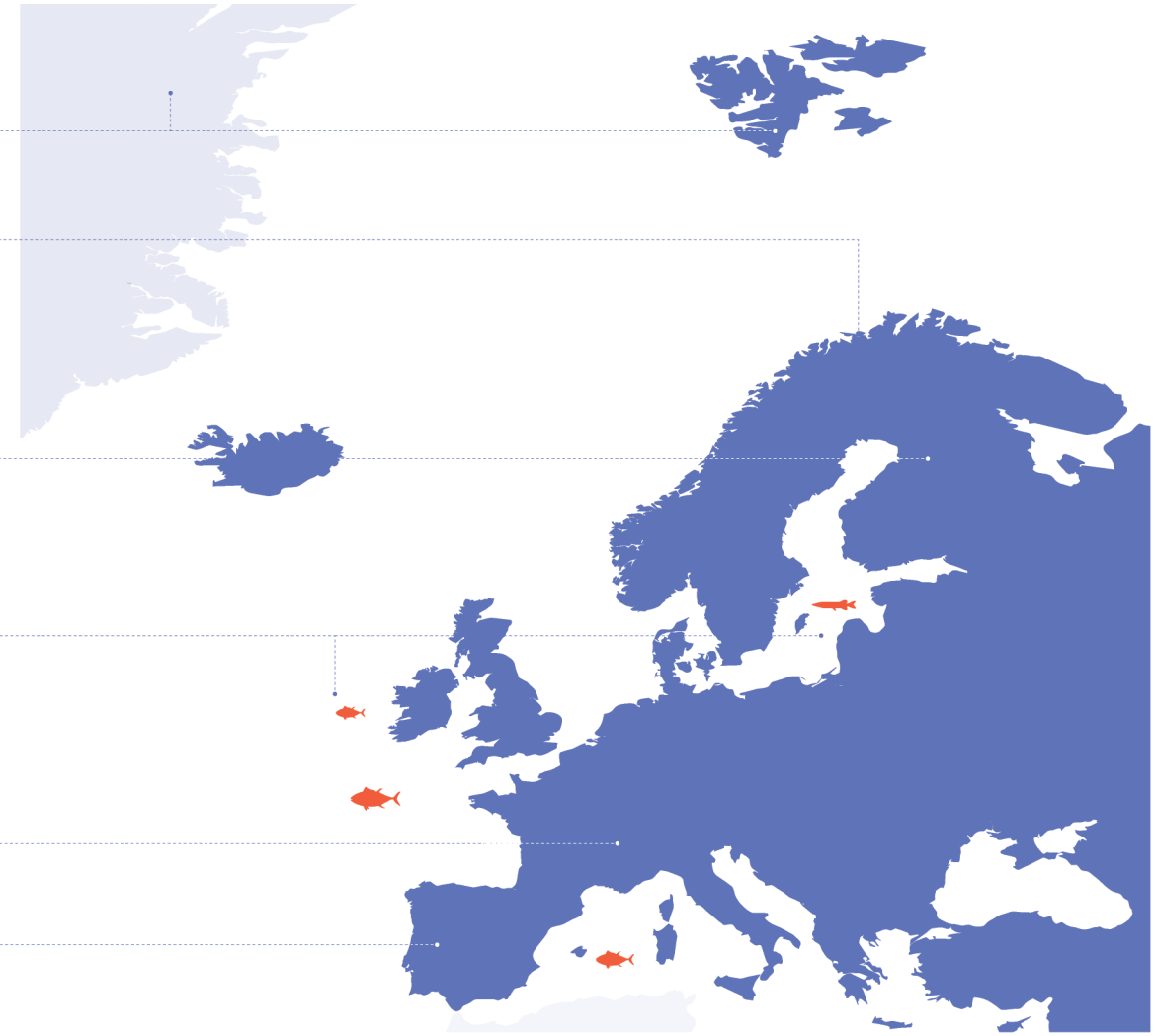
Changing conditions for many livelihoods, such as agriculture and tourism

Increased growth of forests in the Boreal region during the coming decades, with a gradual change in composition towards warmer-loving species than today.

Changes in marine species composition

Diminishing glaciers, rapidly melting snow and ice

Increased risk of wildfires



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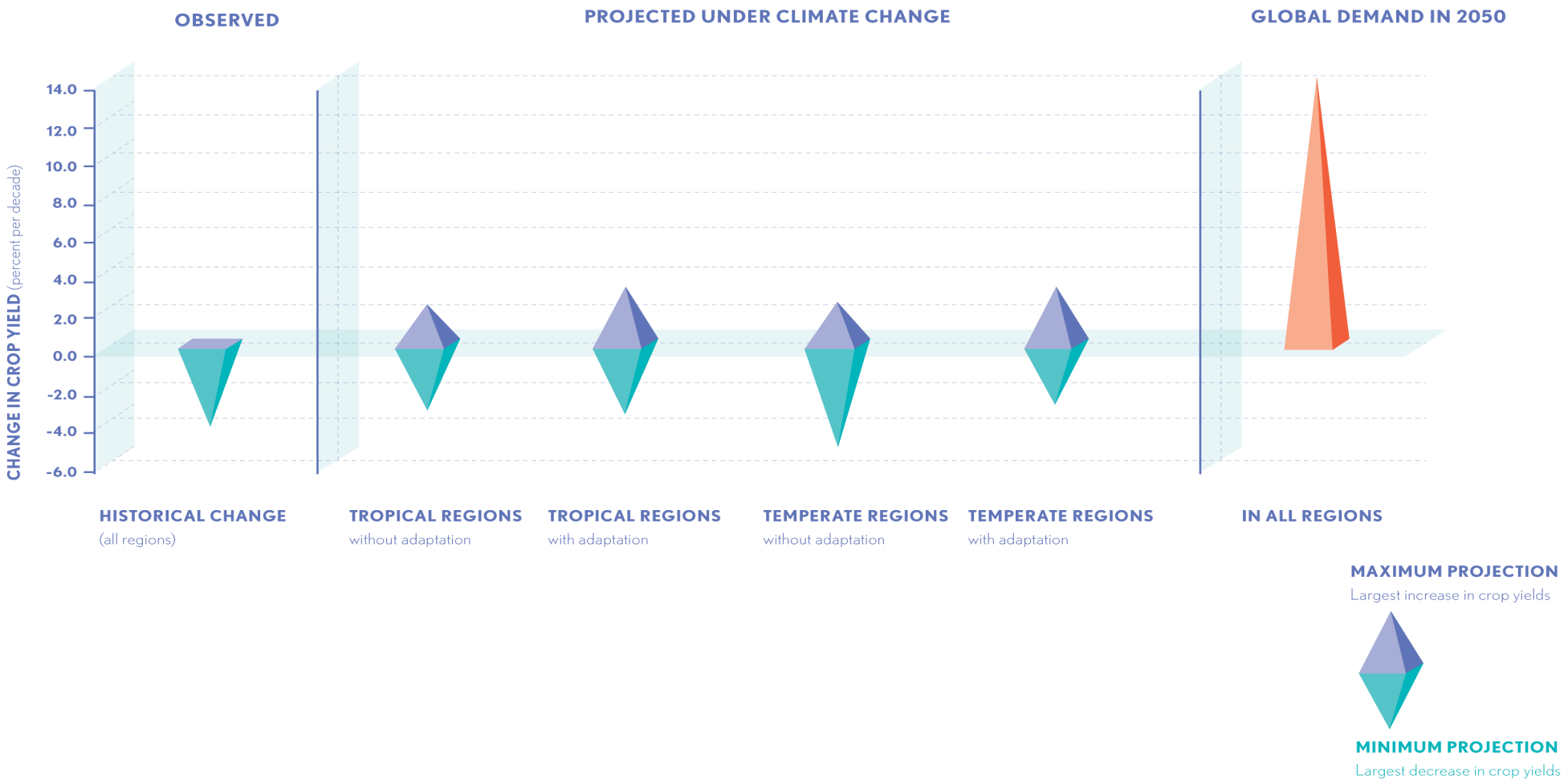
PROJECTED GLOBAL DEMAND TO FEED THE WORLD IN 2050 IS GREATER THAN THE HIGHEST ESTIMATES OF PROJECTED CROP YIELDS.



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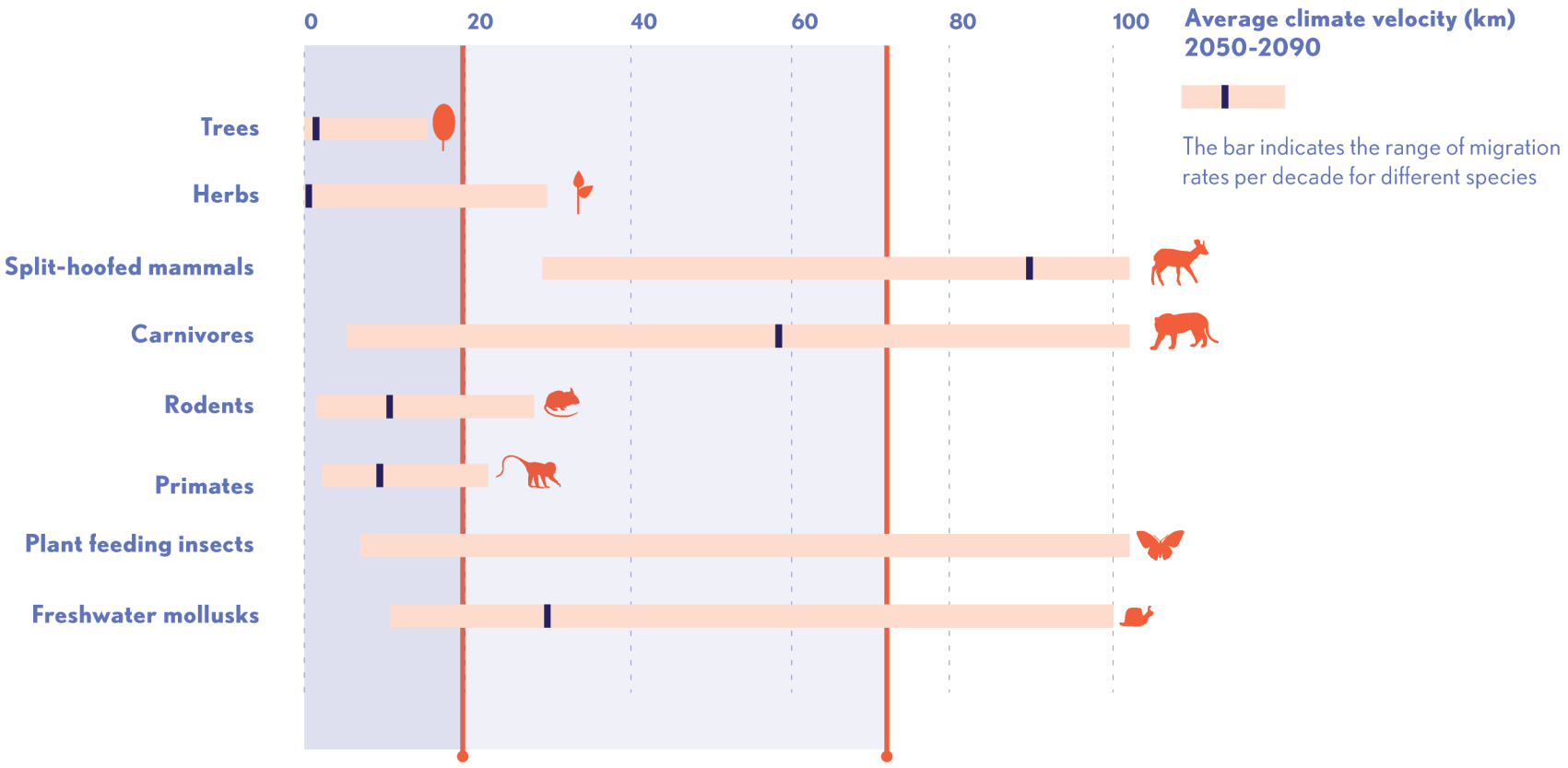
MOVEMENT OF SPECIES Distance that species must displace themselves in order to stay within current preferred climate conditions (km per decade).



Rapid warming (RCP 8.5) global average
Species must move at least 20 km per decade to adjust to changes in the climate. Most trees, herbs, as well as many rodents and primates are not able to move fast enough to remain within their preferred climate.

Rapid warming (RCP 8.5) flat areas
In flat areas species must move even farther in order to remain in favourable conditions.

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RISK

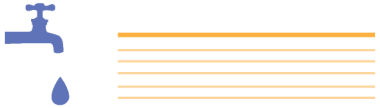
KEY RISKS

Risk of death, injury, and disrupted livelihoods in low-lying coastal zones and small island developing states, due to sea level rise, coastal flooding and storm surges.

Risk of food insecurity linked to warming, drought, and precipitation variability, particularly for poorer populations.

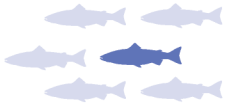
Risk of severe harm for large urban populations due to flooding.

Risk of loss of rural livelihoods and income due to insufficient access to drinking and irrigation water and reduced agricultural productivity, particularly for farmers with minimal capital in semi-arid regions.



Risks due to extreme events leading to breakdown of critical services, such as water, electricity, health and rescue services.

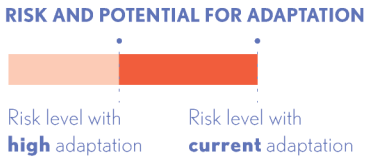
Risk of loss of marine and coastal ecosystems and the services they provide for coastal livelihoods, especially for fishing communities in the tropics and the Arctic.



Risk of loss of terrestrial and freshwater ecosystems and the services they provide for livelihoods.

Risk of mortality and morbidity during periods of extreme heat, particularly for vulnerable urban populations.

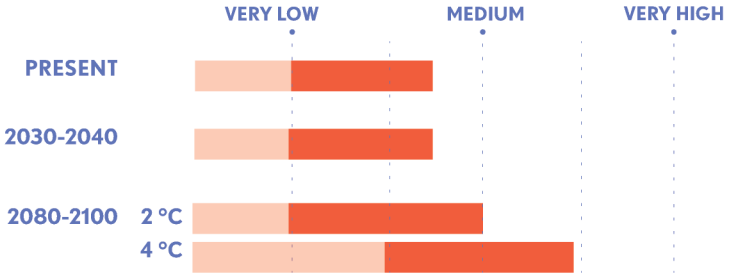
EUROPE



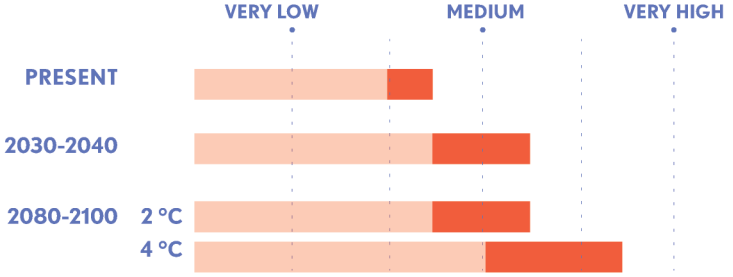
KEY RISK

RISK LEVEL

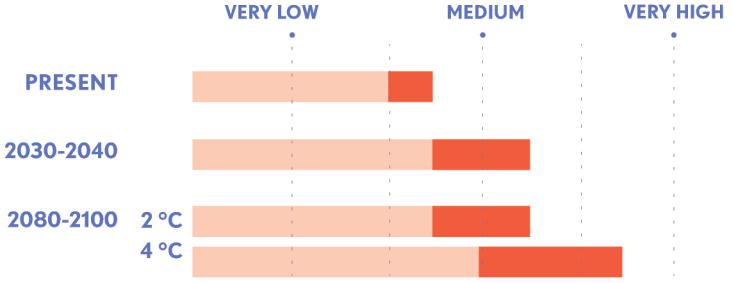
FLOODING



DECREASE IN WATER AVAILABILITY



INCREASE OF HEAT WAVES



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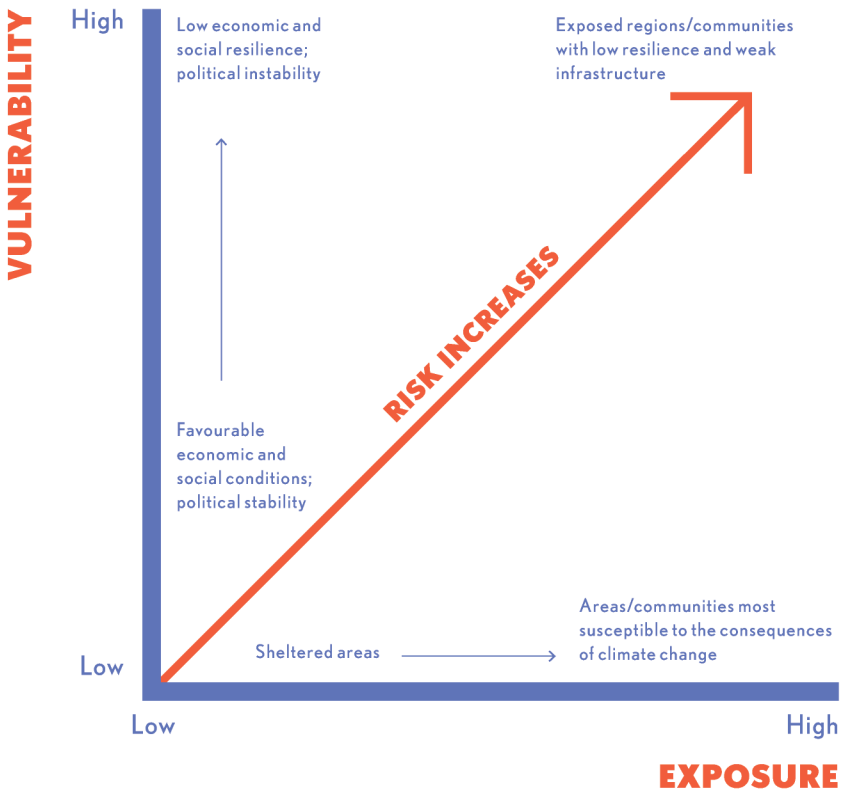
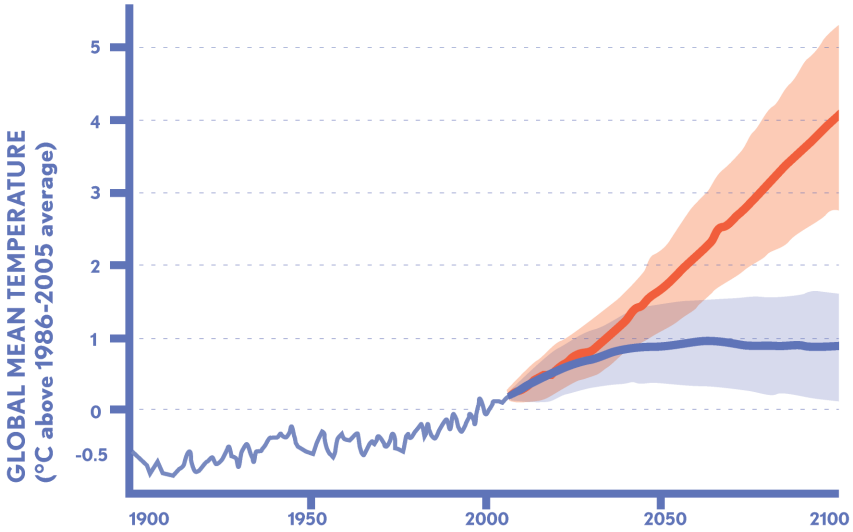


Both vulnerability and exposure contribute to risks. For example low lying coastal regions are exposed to sea level rise, but the risks depend also on the ability of society to cope with the exposure. The poorest and weakest societies face the greatest risks in terms of imperilled or reduced livelihoods due to climate change.

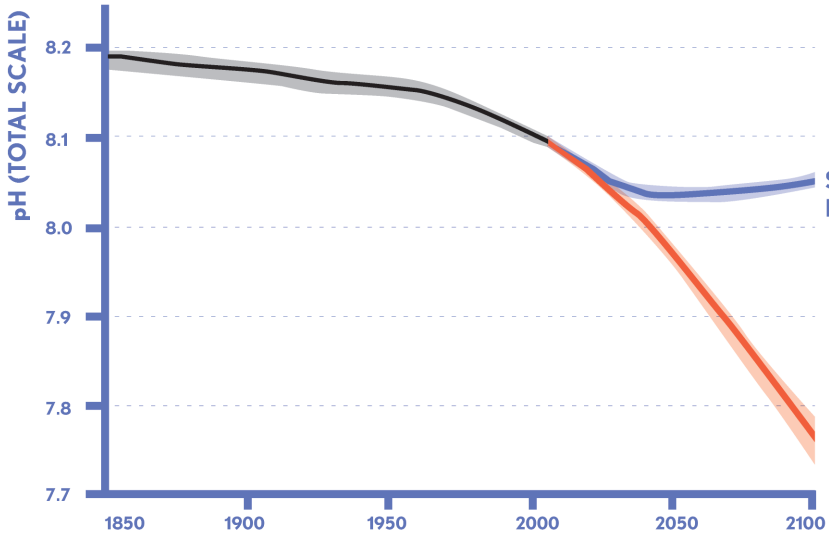
GLOBAL MEAN TEMPERATURE



Emissions of greenhouse gases continue to grow at current rate.
Hazards increase

Substantial reduction of greenhouse gas emissions.
Highly successful mitigation

OCEAN ACIDIFICATION



Substantial reduction of greenhouse gas emissions.
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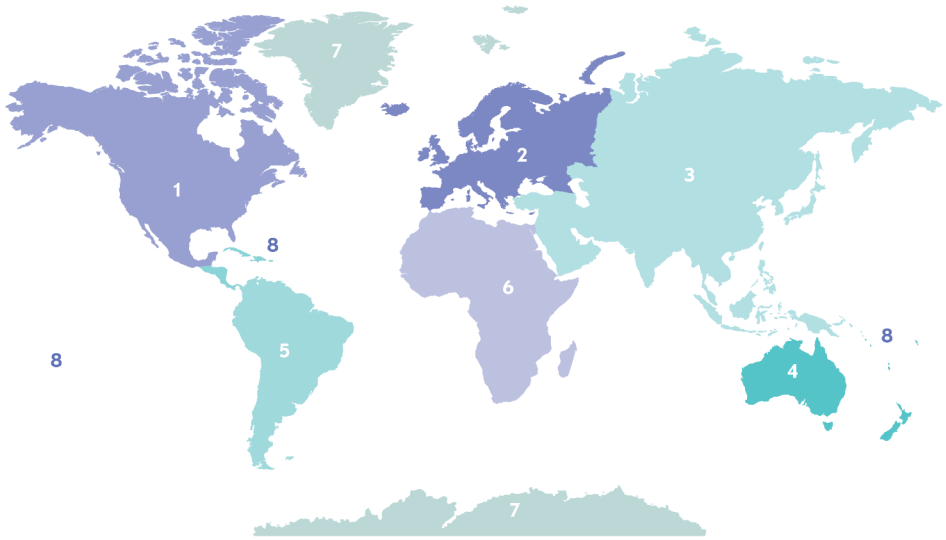
ADAPTATION

PRINCIPLES FOR EFFECTIVE ADAPTATION

From individuals to governments, actors across scales and regions have complementary roles in enabling adaptation planning and implementation, for example through increasing awareness of climate change risks, learning from experience with climate variability, and achieving synergies with disaster risk management.

Transformation in political, economic, and technological systems resulting from changes in world views and goals can facilitate adaptation and mitigation and promote sustainable development.

GOVERNMENTS AT VARIOUS SCALES ARE STARTING TO DEVELOP ADAPTATION PLANS AND POLICIES, AND ADAPTATION EXPERIENCE IS ACCUMULATING ACROSS REGIONS



1. NORTH AMERICA, governments are engaging in incremental adaptation assessment and planning, particularly at the municipal level, with some proactive adaptation anticipating future impacts for longer-term investments in energy and public infrastructure.

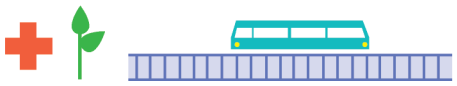
2. EUROPE, adaptation policy has been developed across scales, with some adaptation planning integrated into coastal and water management and into disaster risk management.

3. ASIA, water management practices, including water saving technologies and water reuse, offer considerable potential for increasing water productivity.

4. AUSTRALAISIA, planning for sea-level rise and, in southern Australia, for reduced water availability is becoming widely adopted.

5. CENTRAL AND SOUTH AMERICA, ecosystem-based adaptation including protected areas, conservation agreements and community management of natural areas is increasingly common, with benefits for improvements in livelihoods and preservation of traditional cultures.

6. AFRICA, most national governments are initiating governance systems for adaptation, and in predominantly isolated efforts, disaster risk management, adjustments in technologies and infrastructure and ecosystem-based approaches.



7. POLAR REGIONS, residents have a history of adapting to change, but the rate of climate change and complex interlinkages with societal, economic, and political factors represent unprecedented challenges for northern communities.

8. IN SMALL ISLANDS, diverse physical and human attributes and their sensitivity to climate-related drivers have been inconsistently integrated into adaptation planning.

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Mitigation of greenhouse gas emissions over the next few decades can substatially reduce risks of climate change in the second half of the 21st century.