Wise Adaptation: An useful approach to address climate change?

AP Climate Seminar 18 (Ha Noi)
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Contents

- IPCC AR4 remarks on impacts and adaptation
- “A Wise Adaptation” Report from MOEJ Expert Group
- Discussions

Projections from IPCC AR4

- Temperature, sea level rise
- Ecological and other impacts

Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would *very likely* be larger than those observed during the 20th century (Table SPM.1, Figure SPM.5).

- For the next two decades a warming of about 0.2°C per decade is projected for a range of SRES emissions scenarios. Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1°C per decade would be expected. Afterwards, temperature projections increasingly depend on specific emission scenarios.

Projected warming and Sea Level Rise

Table SPM.3. *Projected global average surface warming and sea level rise at the end of the 21st century. {10.5, 10.6, Table 10.7}*

Case	Temperature Change (°C at 2090-2099 relative to 1980-1999)[a]		Sea Level Rise (m at 2090-2099 relative to 1980-1999)
	Best estimate	*Likely* range	Model-based range excluding future rapid dynamical changes in ice flow
Constant Year 2000 concentrations[b]	0.6	0.3 – 0.9	NA
B1 scenario	1.8	1.1 – 2.9	0.18 – 0.38
A1T scenario	2.4	1.4 – 3.8	0.20 – 0.45
B2 scenario	2.4	1.4 – 3.8	0.20 – 0.43
A1B scenario	2.8	1.7 – 4.4	0.21 – 0.48
A2 scenario	3.4	2.0 – 5.4	0.23 – 0.51
A1FI scenario	4.0	2.4 – 6.4	0.26 – 0.59

Table notes:

[a] These estimates are assessed from a hierarchy of models that encompass a simple climate model, several Earth System Models of Intermediate Complexity and a large number of Atmosphere-Ocean General Circulation Models (AOGCMs).

[b] Year 2000 constant composition is derived from AOGCMs only.

Projections of Surface Temperatures

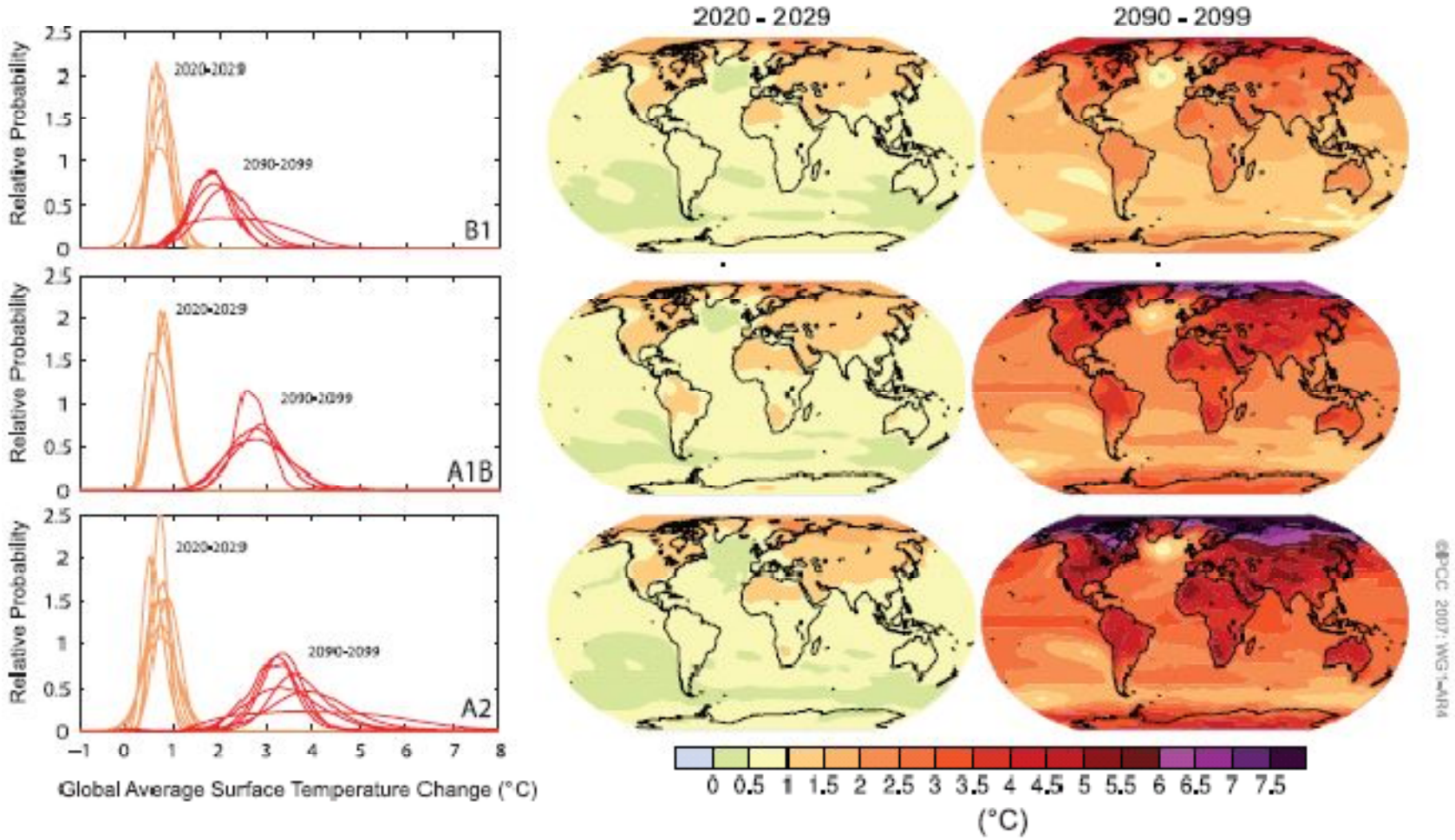


Figure SPM.6. *Projected surface temperature changes for the early and late 21st century relative to the period 1980–1999. The central and right panels show the AOGCM multi-model average projections for the B1 (top), A1B (middle) and A2 (bottom) SRES scenarios averaged over the decades 2020– 2029 (centre) and 2090–2099 (right). The left panels show corresponding uncertainties as the relative probabilities of estimated global average warming from several different AOGCM and Earth System Model of Intermediate Complexity studies for the same periods. Some studies present results only for a subset of the SRES scenarios, or for various model versions. Therefore the difference in the number of curves shown in the left-hand panels is due only to differences in the availability of results. [Figures 10.8 and 10.28]*

Projected Patterns of Precipitation Changes

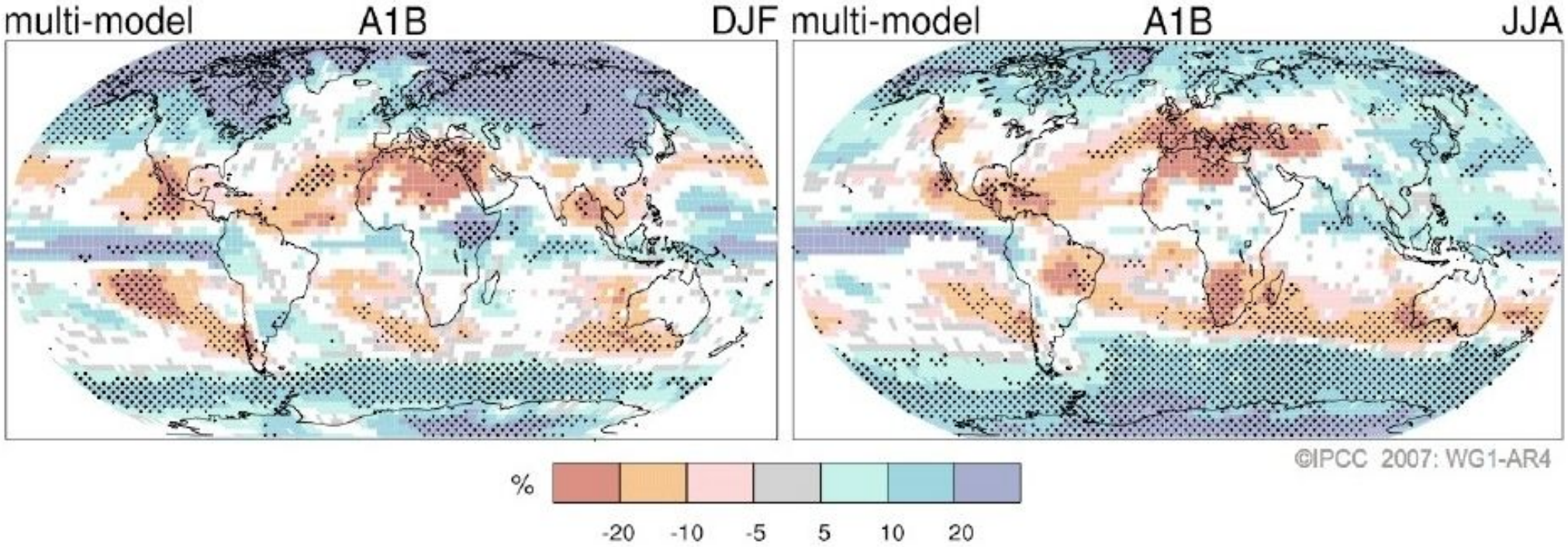


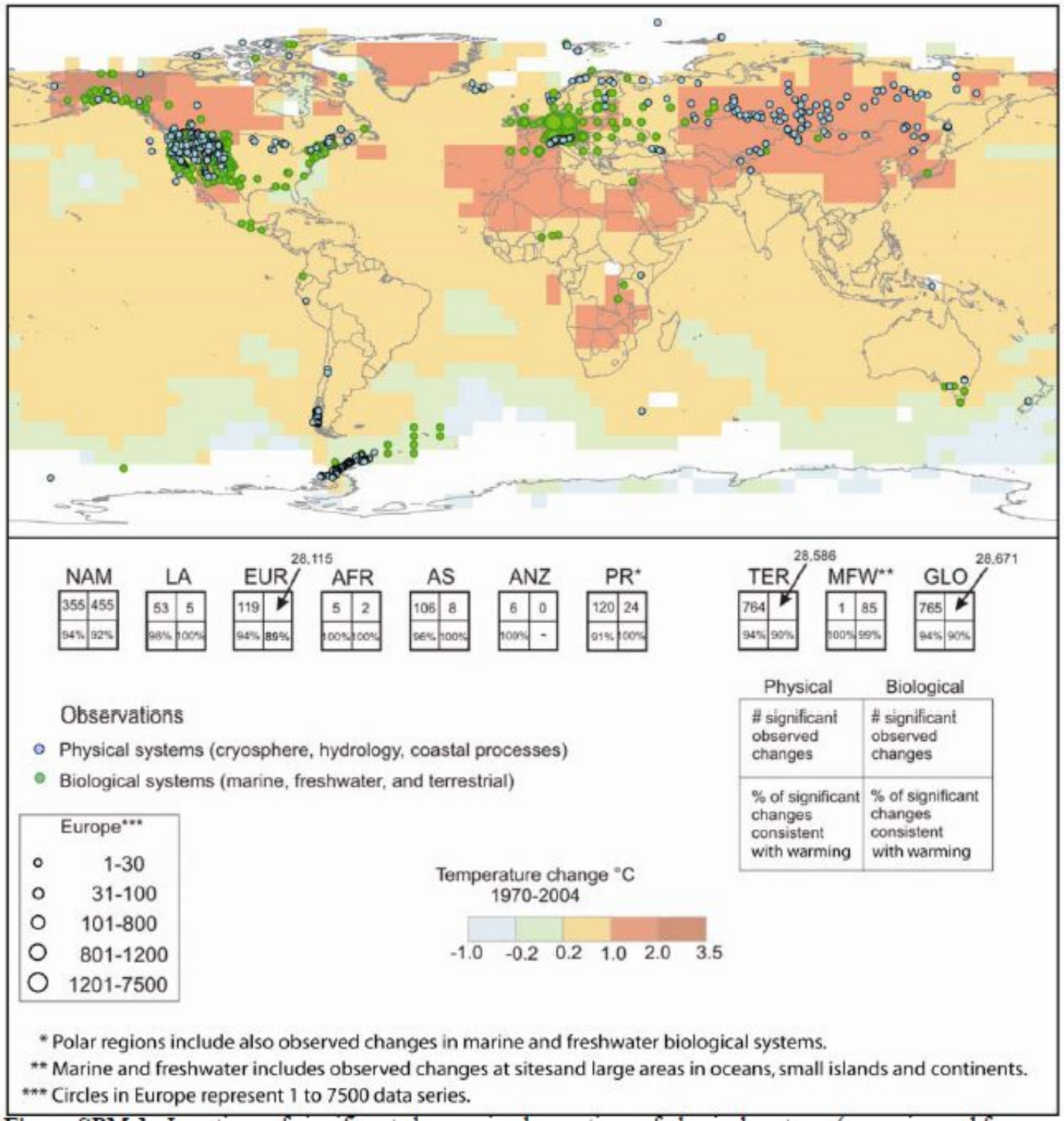
FIGURE SPM-6. Relative changes in precipitation (in percent) for the period 2090–2099, relative to 1980–1999. Values are multi-model averages based on the SRES A1B scenario for December to February (left) and June to August (right). White areas are where less than 66% of the models agree in the sign of the change and stippled areas are where more than 90% of the models agree in the sign of the change. {Figure 10.9}

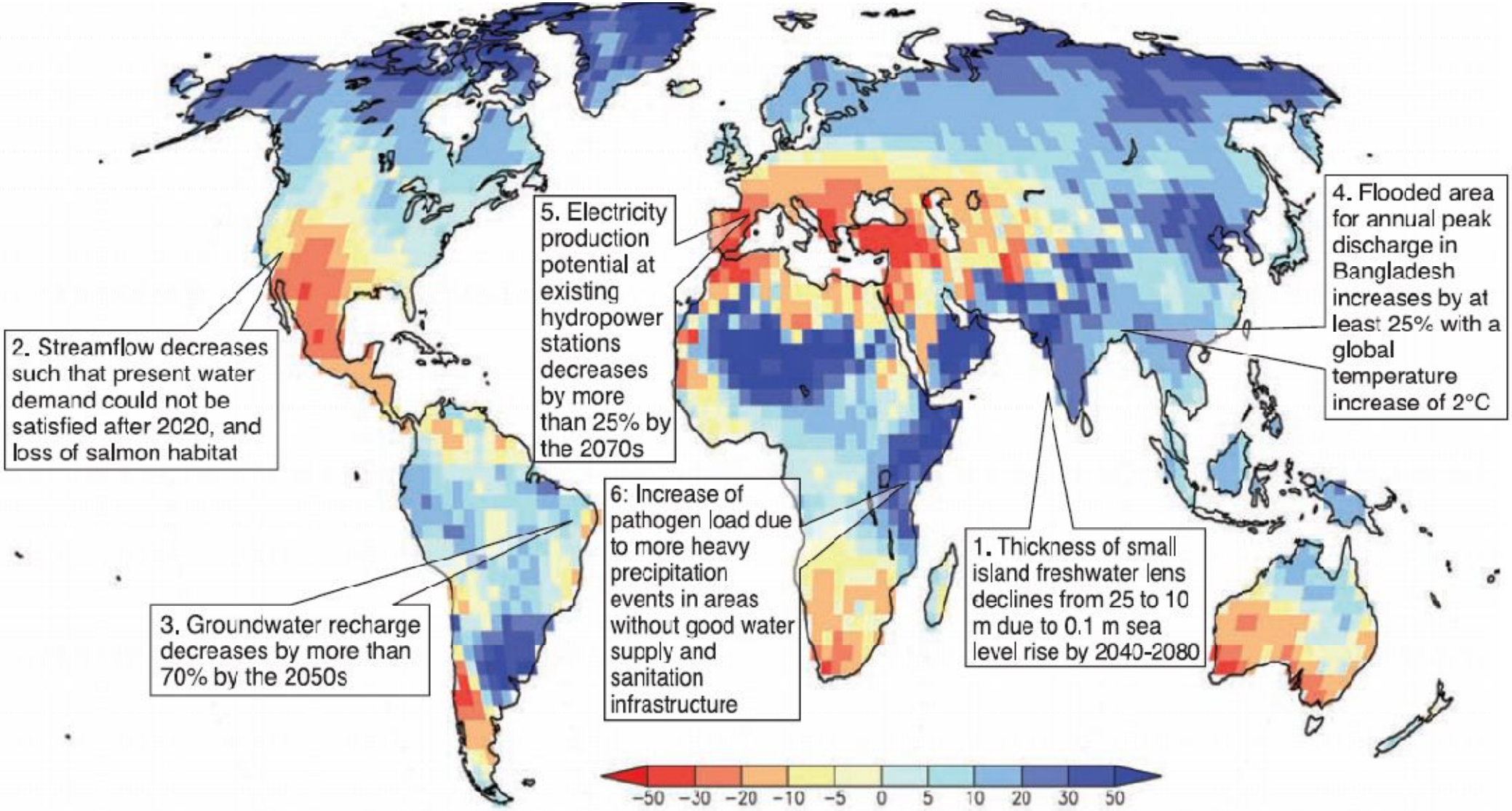
Reported Impacts.

Figure SPM-1

Locations of significant changes in observations of physical systems (snow, ice and frozen ground; hydrology; and coastal processes) and biological systems (terrestrial, marine, and freshwater biological systems), are shown together with surface air temperature changes over the period 1970-2004. A subset of about 29,000 data series was selected from about 80,000 data series from 577 studies.

These met the following criteria: (1) Ending in 1990 or later; (2) spanning a period of at least 20 years; and (3) showing a significant change in either direction, as assessed in individual studies. These data series are from about 75 studies (of which ~70 are new since the Third Assessment) and contain about 29,000 data series, of which about 28,000 are from European studies. White areas do not contain sufficient observational climate data to estimate a temperature trend. The 2 x 2 boxes show the total number of data series with significant changes (top row) and the percentage of those consistent with warming (bottom row) for (i) continental regions: North America (NAM), Latin America (LA), Europe (EUR), Africa (AFR), Asia (AS), Australia and New Zealand (ANZ), and Polar Regions (PR) and (ii) global-scale: Terrestrial (TER), Marine and Freshwater (MFW), and Global (GLO). The numbers of studies from the seven regional boxes (NAM, …, PR) do not add up to the global (GLO) totals because numbers from regions except Polar do not include the numbers related to Marine and Freshwater (MFR) systems. [F1.8, F1.9; Working Group I Fourth Assessment F3.9b]





Projections of impacts

Source: IPCC AR4

Phenomenon[a] and direction of trend	Likelihood of future trends based on projections for 21st century using SRES scenarios	Examples of major projected impacts by sector			
		Agriculture, forestry and ecosystems	Water resources	Human health	Industry, settlements and society
Over most land areas, warmer and fewer cold days and nights, warmer and more frequent hot days and nights	Virtually certain[b]	Increased yields in colder environments; decreased yields in warmer environments; increased insect outbreaks [5.8.1, 4.4.5]	Effects on water resources relying on snow melt; effects on some water supply [3.4.1, 3.5.1]	Reduced human mortality from decreased cold exposure [8.4.1, T8.3]	Reduced energy demand for heating; increased demand for cooling; declining air quality in cities; reduced disruption to transport due to snow, ice; effects on winter tourism [7.4.2, 14.4.8, 15.7.1]
Warm spells/ heatwaves. Frequency increases over most land areas	Very likely	Reduced yields in warmer regions due to heat stress; wildfire danger increase [5.8.1, 5.4.5, 4.4.3, 4.4.4]	Increased water demand; water quality problems, e.g., algal blooms [3.4.2, 3.5.1, 3.4.4]	Increased risk of heat-related mortality, especially for the elderly, chronically sick, very young and socially isolated [8.4.2, T8.3, 8.4.1]	Reduction in quality of life for people in warm areas without appropriate housing; impacts on elderly, very young and poor [7.4.2, 8.2.1]
Heavy precipitation events. Frequency increases over most areas	Very likely	Damage to crops; soil erosion, inability to cultivate land due to waterlogging of soils [5.4.2]	Adverse effects on quality of surface and groundwater; contamination of water supply; water stress may be relieved [3.4.4]	Increased risk of deaths, injuries, infectious, respiratory and skin diseases [8.2.2, 11.4.11]	Disruption of settlements, commerce, transport and societies due to flooding; pressures on urban and rural infrastructures; loss of property [T7.4, 7.4.2]
Area affected by drought increases	Likely	Land degradation, lower yields/crop damage and failure; increased livestock deaths; increased risk of wildfire [5.8.1, 5.4, 4.4.4]	More widespread water stress [3.5.1]	Increased risk of food and water shortage; increased risk of malnutrition; increased risk of water- and food-borne diseases [5.4.7, 8.2.3, 8.2.5]	Water shortages for settlements, industry and societies; reduced hydropower generation potentials; potential for population migration [T7.4, 7.4, 7.1.3]
Intense tropical cyclone activity increases	Likely	Damage to crops; windthrow (uprooting) of trees; damage to coral reefs [5.4.5, 16.4.3]	Power outages cause disruption of public water supply [7.4.2]	Increased risk of deaths, injuries, water- and food-borne diseases; post-traumatic stress disorders [8.2.2, 8.4.2, 16.4.5]	Disruption by flood and high winds; withdrawal of risk coverage in vulnerable areas by private insurers, potential for population migrations, loss of property [7.4.1, 7.4.2, 7.1.3]
Increased incidence of extreme high sea level (excludes tsunamis)[c]	Likely[d]	Salinisation of irrigation water, estuaries and freshwater systems [3.4.2, 3.4.4, 10.4.2]	Decreased freshwater availability due to salt-water intrusion [3.4.2, 3.4.4]	Increased risk of deaths and injuries by drowning in floods; migration-related health effects [6.4.2, 8.2.2, 8.4.2]	Costs of coastal protection versus costs of land-use relocation; potential for movement of populations and infrastructure; also see tropical cyclones above [7.4.2]

Examples of Impacts

Source: IPCC AR4

Table SPM-1

Illustrative examples of global impacts projected for climate changes (and sea-level and atmospheric carbon dioxide where relevant) associated with different amounts of increase in global average surface temperature in the 21st century. [T20.7] The black lines link impacts, dotted arrows indicate impacts continuing with increasing temperature. Entries are placed so that the left hand side of text indicates approximate onset of a given impact. Quantitative entries for water scarcity and flooding represent the additional impacts of climate change relative to the conditions projected across the range of SRES scenarios A1FI, A2, B1 and B2 (see Endbox 3). Adaptation to climate change is not included in these estimations. All entries are from published studies recorded in the chapters of the Assessment. Sources are given in the right hand column of the Table. Confidence levels for all statements are high.

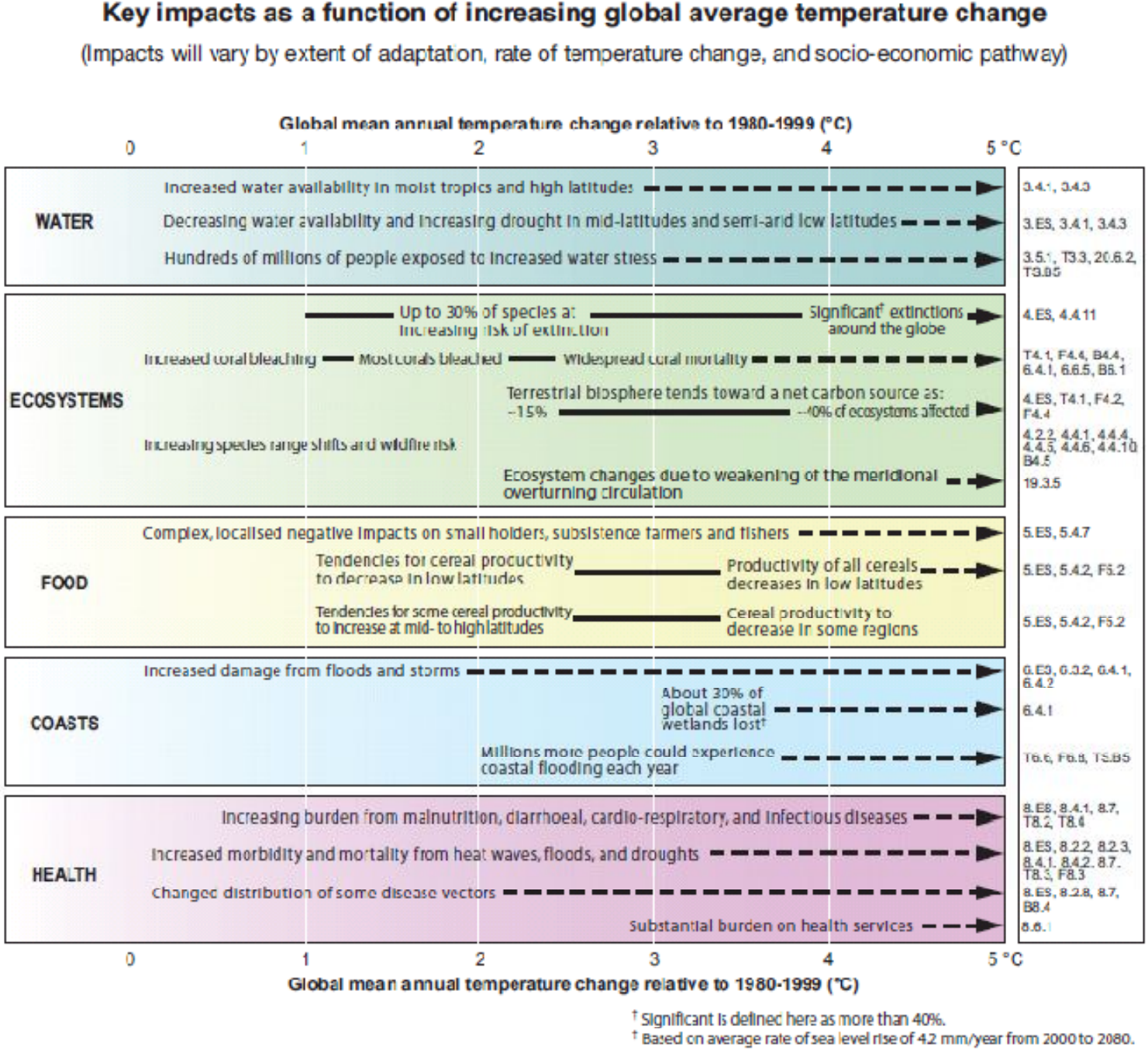


Figure SPM.2. *Illustrative examples of global impacts projected for climate changes (and sea level and atmospheric carbon dioxide where relevant) associated with different amounts of increase in global average surface temperature in the 21st century [T20.8]. The black lines link impacts, dotted arrows indicate impacts continuing with increasing temperature. Entries are placed so that the left-hand side of the text indicates the approximate onset of a given impact. Quantitative entries for water stress and flooding represent the additional impacts of climate change relative to the conditions projected across the range of Special Report on Emissions Scenarios (SRES) scenarios A1FI, A2, B1 and B2 (see Endbox 3). Adaptation to climate change is not included in these estimations. All entries are from published studies recorded in the chapters of the Assessment. Sources are given in the right-hand column of the Table. Confidence levels for all statements are high.*

Impacts have already been observed.

- **Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.**
  - snow, ice and frozen ground (including permafrost), hydrological systems, terrestrial biological systems, marine and freshwater biological systems, related changes in ice cover, salinity, oxygen levels and circulation and Ocean acidity
- **Other effects of regional climate changes on natural and human environments are emerging, although many are difficult to discern due to adaptation and non-climatic drivers.**

B. Current knowledge about future impacts (1)
Fresh water resources and their management

- By mid-century, annual average river runoff and water availability are projected to increase by 10-40% at high latitudes and in some wet tropical areas, and decrease by 10-30% over some dry regions at mid-latitudes and in the dry tropics, some of which are presently water stressed areas. In some places and in particular seasons, changes differ from these annual figures. ** D10 [3.4]
- Drought-affected areas will likely increase in extent. Heavy precipitation events, which are very likely to increase in frequency, will augment flood risk. ** N [Working Group I Fourth Assessment, 3.4]
- Adaptation procedures and risk management practices for the water sector are being developed in some countries and regions that have recognised projected hydrological changes with related uncertainties. *** N [3.6]
- In the course of the century, water supplies stored in glaciers and snow cover are projected to decline, reducing water availability in regions supplied by meltwater from major mountain ranges, where more than one-sixth of the world population currently lives. ** N [3.4]

B. Current knowledge about future impacts (2) Ecosystems

- The resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g., flooding, drought, wildfire, insects, ocean acidification), and other global change drivers (e.g., land use change, pollution, over-exploitation of resources). ** N [4.1 to 4.6]
- Over the course of this century net carbon uptake by terrestrial ecosystems is likely to peak before midcentury and then weaken or even reverse11, thus amplifying climate change. ** [4.ES]
- Approximately 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5-2.5oC. * N [4.4, T4.1]
- For increases in global average temperature exceeding 1.5-2.5° C and in concomitant atmospheric carbon dioxide concentrations, there are projected to be major changes in ecosystem structure and function, species' ecological interactions, and species' geographic ranges, with predominantly negative consequences for biodiversity, and ecosystem goods and services e.g., water and food supply. ** N [4.4]
- The progressive acidification of oceans due to increasing atmospheric carbon dioxide is expected to have negative impacts on marine shell forming organisms (e.g., corals) and their dependent species. * N [B4.4, 6.4]

B. Current knowledge about future impacts (3)

Food, fibre and forest products

- Crop productivity is projected to increase slightly at mid to high latitudes for local mean temperature increases of up to 1-3° C depending on the crop, and then decrease beyond that in some regions. * D [5.4]
- At lower latitudes, especially seasonally dry and tropical regions, crop productivity is projected to decrease for even small local temperature increases (1-2° C), which would increase risk of hunger. * D [5.4]
- Globally, the potential for food production is projected to increase with increases in local average temperature over a range of 1-3° C, but above this it is projected to decrease. * D [5.4, 5.ES]
- Adaptations such as altered cultivars and planting times allow low and mid- to high latitude cereal yields to be maintained at or above baseline yields for modest warming. * N [5.5]
- Increases in the frequency of droughts and floods are projected to affect local production negatively, especially in subsistence sectors at low latitudes. ** D [5.4, 5.ES]
- Regional changes in the distribution and production of particular fish species are expected due to continued warming, with adverse effects projected for aquaculture and fisheries. ** D[5.4.6]

B. Current knowledge about future impacts (4)
Coastal systems and low-lying areas

- Coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea-level rise and the effect will be exacerbated by increasing human-induced pressures on coastal areas. *** D [6.3, 6.4]
- Corals are vulnerable to thermal stress and have low adaptive capacity. Increases in sea surface temperature of about 1 to 3° C are projected to result in more frequent coral bleaching events and widespread mortality, unless there is thermal adaptation or acclimatisation by corals. *** D [B6.1, 6.4]
- Coastal wetlands including salt marshes and mangroves are projected to be negatively affected by sea-level rise especially where they are constrained on their landward side, or starved of sediment. *** D [6.4]
- Many millions more people are projected to be flooded every year due to sea-level rise by the 2080s.
- Those densely-populated and low-lying areas where adaptive capacity is relatively low, and which already face other challenges such as tropical storms or local coastal subsidence, are especially at risk. The numbers affected will be largest in the mega-deltas of Asia and Africa while small islands are especially vulnerable. *** D [6.4]
- Adaptation for coastal regions will be more challenging in developing countries than developed countries due to constraints on adaptive capacity. ** D [6.4, 6.5, T6.11]

C. Current knowledge about future impacts (5)
Industry, Settlement and Society

- Costs and benefits of climate change for industry, settlement, and society will vary widely by location and scale. In the aggregate, however, net effects will tend to be more negative the larger the change in climate. ** N [7.4, 7.6]
- The most vulnerable industries, settlements and societies are generally those in coastal and river flood plains, those whose economies are closely linked with climate-sensitive resources, and those in areas prone to extreme weather events, especially where rapid urbanisation is occurring. ** D [7.1, 7.3, 7.4, 7.5]
- Poor communities can be especially vulnerable, in particular those concentrated in high-risk areas. They tend to have more limited adaptive capacities, and are more dependent on climate-sensitive resources such as local water and food supplies. ** N [7.2, 7.4, 5.4]
- Where extreme weather events become more intense and/or more frequent, the economic and social costs of those events will increase, and these increases will be substantial in the areas most directly affected. Climate change impacts spread from directly impacted areas and sectors to other areas and sectors through extensive and complex linkages. ** N [7.4, 7.5]

B. Current knowledge about future impacts (6)
Health

- Projected climate change-related exposures are likely to affect the health status of millions of people, particularly those with low adaptive capacity, through: increases in malnutrition and consequent disorders, with implications for child growth and development; increased deaths, disease and injury due to heat waves, floods, storms, fires and droughts; the increased burden of diarrhoeal disease; the increased frequency of cardio-respiratory diseases due to higher concentrations of ground level ozone related to climate change; and, the altered spatial distribution of some infectious disease vectors. ** D [8.4, 8.ES, 8.2]
- Climate change is expected to have some mixed effects, such as the decrease or increase of the range and transmission potential of malaria in Africa. ** D [8.4]
- Studies in temperate areas12 have shown that climate change is projected to bring some benefits, such as fewer deaths from cold exposure. Overall it is expected that these benefits will be outweighed by the negative health effects of rising temperatures world-wide, especially in developing countries. ** D [8.4]
- The balance of positive and negative health impacts will vary from one location to another, and will alter over time as temperatures continue to rise. Critically important will be factors that directly shape the health of populations such as education, health care, public health prevention and infrastructure and economic development. *** N [8.3]

Africa

- By 2020, between 75 and 250 million of people are projected to be exposed to increased water stress due to climate change;By 2020, in some countries, yields from rain-fed agriculture could be reduced by up to 50%. Agricultural production, including access to food, in many African countries is projected to be severely compromised. This would further adversely affect food security and exacerbate malnutrition; Towards the end of the 21st century, projected sea-level rise will affect low-lying coastal areas with large populations. The cost of adaptation could amount to at least 5-10% of Gross Domestic Product (GDP);By 2080, an increase of 5-8% of arid and semi-arid land in Africa is projected under a range of climate scenarios (TS).

Asia

- By the 2050s, freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease; Coastal areas, especially heavily-populated megadelta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some megadeltas, flooding from the rivers; Climate change is projected to compound the pressures on natural resources and the environment, associated with rapid urbanization, industrialization and economic development; Endemic morbidity and mortality due to diarrhoeal disease primarily associated with floods and droughts are expected to rise in East, South and South-East Asia due to projected changes in the hydrological cycle.

Australia and New Zealand

- By 2020, significant loss of biodiversity is projected to occur in some ecologically rich sites including the Great Barrier Reef and Queensland Wet Tropics; By 2030, water security problems are projected to intensify in southern and eastern Australia and, in New Zealand, in Northland and some eastern regions; By 2030, production from agriculture and forestry is projected to decline over much of southern and eastern Australia, and over parts of eastern New Zealand, due to increased drought and fire. However, in New Zealand, initial benefits are projected in some other regions.;By 2050, ongoing coastal development and population growth in some areas of Australia and New Zealand are projected to exacerbate risks from sea level rise and increases in the severity and frequency of storms and coastal flooding.

Europe

- Climate change is expected to magnify regional differences in Europe's natural resources and assets. Negative impacts will include increased risk of inland flash floods, and more frequent coastal flooding and increased erosion (due to storminess and sea-level rise); Mountainous areas will face glacier retreat, reduced snow cover and winter tourism, and extensive species losses (in some areas up to 60% under high emissions scenarios by 2080);In Southern Europe, climate change is projected to worsen conditions (high temperatures and drought) in a region already vulnerable to climate variability, and to reduce water availability, hydropower potential, summer tourism and, in general, crop productivity; Climate change is also projected to increase the health risks due to heat-waves, and the frequency of wildfires.

Latin America

- By mid century, increases in temperature and associated decreases in soil water are projected to lead to gradual replacement of tropical forest by savanna in eastern Amazonia. Semi-arid vegetation will tend to be replaced by arid-land vegetation.There is a risk of significant biodiversity loss through species extinction in many areas of tropical Latin America;Productivity of some important crops is projected to decrease and livestock productivity to decline, with adverse consequences for food security. In temperate zones soybean yields are projected to increase. Overall, the number of people at risk of hunger is projected to increase (TS; *medium confidence*). Changes in precipitation patterns and the disappearance of glaciers are projected to significantly affect water availability for human consumption, agriculture and energy generation.

North America

- Warming in western mountains is projected to cause decreased snowpack, more winter flooding, and reduced summer flows, exacerbating competition for over-allocated water resources; In the early decades of the century, moderate climate change is projected to increase aggregate yields of rain-fed agriculture by 5-20%, but with important variability among regions. Major challenges are projected for crops that are near the warm end of their suitable range or which depend on highly utilized water resources; During the course of this century, cities that currently experience heat waves are expected to be further challenged by an increased number, intensity and duration of heat waves during the course of the century, with potential for adverse health impacts; Coastal communities and habitats will be increasingly stressed by climate change impacts interacting with development and pollution.

Polar Regions

- The main projected biophysical effects are reductions in thickness and extent of glaciers and ice sheets and sea ice, and changes in natural ecosystems with detrimental effects on many organisms including migratory birds, mammals and higher predators; For human communities in the Arctic, impacts, particularly those resulting from changing snow and ice conditions are projected to be mixed; Detrimental impacts would include those on infrastructure and traditional indigenous ways of life;In both polar regions, specific ecosystems and habitats are projected to be vulnerable, as climatic barriers to species invasions are lowered.

Small Islands

- Sea-level rise is expected to exacerbate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihood of island communities; Deterioration in coastal conditions, for example through erosion of beaches and coral bleaching is expected to affect local resources; By mid-century, climate change is expected to reduce water resources in many small islands, e.g., in the Caribbean and Pacific, to the point where they become insufficient to meet demand during low-rainfall periods. With higher temperatures, increased invasion by non-native species is expected to occur, particularly on mid- and high-latitude islands.

Ocean Acidification

- The uptake of anthropogenic carbon since 1750 has led to the ocean becoming more acidic with an average decrease in pH of 0.1 units. Increasing atmospheric CO2 concentrations lead to further acidification. Projections based on SRES scenarios give a reduction in average global surface ocean pH of between 0.14 and 0.35 units over the 21st century. While the effects of observed ocean acidification on the marine biosphere are as yet undocumented, the progressive acidification of oceans is expected to have negative impacts on marine shell-forming organisms (e.g. corals) and their dependent species.

Altered frequencies and intensities of extreme weather, together with sea level rise, are expected to have mostly adverse effects on natural and human systems.

- Examples for selected extremes and sectors are shown in Table SPM.3.
- IPCC will hold a “scoping meeting on SR Extreme Events” in April 2009.

C. Current knowledge about future impacts (18)
Large-scale Climate Events

- **Some large-scale climate events have the potential to cause very large impacts, especially after the 21st century.**
- **Some adaptation is occurring now, to observed and projected future climate change, but on a limited basis.**
- **Adaptation will be necessary to address impacts resulting from the warming which is already unavoidable due to past emissions.**
- **A wide array of adaptation options is available, but more extensive adaptation than is currently occurring is required to reduce vulnerability to future climate change. There are barriers, limits and costs, but these are not fully understood.**
- **Vulnerability to climate change can be exacerbated by the presence of other stresses.**
- **Future vulnerability depends not only on climate change but also on development pathway.**
- **Sustainable development can reduce vulnerability to climate change, and climate change could impede nations' abilities to achieve sustainable development pathways.**
- A wide array of adaptation options is available, but more extensive adaptation than is currently occurring is required to reduce vulnerability to climate change. There are barriers, limits and costs, which are not fully understood.

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Report by the MOEJ Committee on Climate Change Impacts and Adaptation Research (1)

- This report contains experts' views on possible impacts of climate change in Japan – For the sectors of: **Food, Water Environment and Water Resources, Natural Ecosystems, Disaster Prevention and Large Coastal Cities, Health, Citizen's Life and Urban Life, Developing Countries, Other Impacts**
- **Its main focus is on the climate impacts on Japan – indeed those impacts have been observed –**
- **But it also addresses issues of international relevance, and Japan's international role.**

Report by the MOEJ Committee on Climate Change Impacts and Adaptation Research (2)

For effective and efficient “wise adaptation”;

(1) To utilize the latest regional vulnerability assessments, monitoring and other results;
(2) review and combine diverse optional adaptation measures;
(3) from both a long-term and short-term perspective, consider the clearance against the temperature range that the adaptation measures can handle;
(4) appropriately incorporate adaptation into existing disaster damage prevention plans and other policies if they exist; and
(5) make natural and socioeconomic systems more flexible and adaptive.

- To achieve this, reviews need to be made from early stage as precaution. In particular, in order to achieve wise adaptation, the perspective of adaptation to climate change needs to be incorporated into existing policy areas and related plans, including land-use plans, city planning, agricultural policies, nature conservation policies and local government environmental policies. In line with this philosophy, efforts need to be made for the effective use of all resources by implementing additional adaptation measures for existing measures and funds.

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Discussion 1. Current Reporting on Vulnerability Assessment and Adaptation Planning

There are a number of reporting processes and reports, but scope and methods used differ and they do not yet provide comparable insights.

Adaptation Planning References

- UNFCCC Methods for V&A
  http://unfccc.int/adaptation/methodologies_for/vulnerability_and_adaptation/items/2674.php

- **UNEP Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies**
  http://www.falw.vu.nl/images_upload/151E6515-C473-459C-85C59441A0F3FB49.pdf

- UNFCCC Compendium on methods and tools to evaluate impacts of, and vulnerability and adaptation to, climate change
  http://unfccc.int/files/adaptation/methodologies_for/vulnerability_and_adaptation/application/pdf/consolidated_version_updated_021204.pdf

Climate Projection

- UNFCCC References
  http://unfccc.int/resource/cd_roms/na1/v_and_a/index.htm

  – COSMIC 2
    http://unfccc.int/resource/cd_roms/na1/v_and_a/Resoursce_materials/Climate/COSMIC2/default.htm

  – MAGIC Scengen
  – **Statistical DownScaling Model**
    https://co-public.lboro.ac.uk/cocwd/SDSM/

- IPCC-TGCIA Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment
  – http://www.ipcc-data.org/
    - References: TGICA_guidance_sdciaa_v2_final.pdf
  – scatter_plot_report.pdf
    - GCM Data Archive section
      http://www.mad.zmaw.de/IPCC_DDC/html/ddc_gcmdata.html

Adaptation Planning

- Sector Tools

  http://unfccc.int/resource/cd_roms/na1/v_and_a/index.htm

  – Vulnerabilities:
    - Agriculture: CROPWAT (Software)
    - Coastal areas: DIVA (Software)
    - Water Resources and control: WEAP
    - Health
    - Infrastructure
    - Biodiversity, ecology
    - Disasters (cf. climatic variability and extremes)

National Adaptation Progrmmes of Action (NAPA) by LDCs

- NAPA Guidelines

  http://unfccc.int/resource/docs/cop7/13a04.pdf#page=7

- NAPA Reports

  http://unfccc.int/adaptation/napas/items/2679.php

  NAPA has been submitted by;

  Bangladesh, Bhutan, Burundi, Cambodia, Comoros, Djibouti, Eritrea, Haiti, Kiribati, Lesotho, Madagascar, Malawi, Mauritania, Niger, Rwanda, Samoa, Senegal

Adaptation Reporting in Non-Annex I National Communications

- Guidelines

  http://unfccc.int/resource/docs/cop8/07a02.pdf#page=2

- User Manual
  - http://unfccc.int/resource/userman_nc.pdf

- GEF Operational Guidelines for Enabling Activities

  http://www.gefweb.org/Documents/enabling_activity_projects/enabling_activity_projects.html

Discussion 2: Financial estimates of climate impacts.

UNFCCC TP/2008/9, Mechanisms to manage financial risks from direct impacts of climate change in developing countries: “The Stern Review estimated that if no action were taken to mitigate climate change, damages could cost up to 20 per cent of global GDP. Failure to implement adaptation practices could compound the situation. Several sources, including the UNFCCC secretariat, UNDP, the Stern Review, the World Bank, OECD and Oxfam, have estimated adaptation costs for developing countries that range from a high of USD 86–109 billion a year (UNDP) to a low of USD 4 billion a year (Stern Review) to adapt to climate change.”

- Impacts of warming might be still small, and they may become bigger as temperature goes up. In this regard, what are these figures – for example, total costs or incremental costs?

Discussion 3:Integration and Mainstreaming

- Most of expected impacts of warming are not completely new. Human societies have experiences with most of them, and thus climate adaptation actions should make full use of them.
- Integration and mainstreaming is a prerequisite for efficient use of resources for development – national development funds, ODA, FDI, and new funding sources, including CDM.