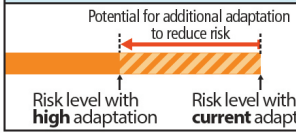
Assessment Box SPM.2 Table 1.

**Climate-related drivers of impacts**

Warming trend | Extreme temperature | Drying trend | Extreme precipitation | Precipitation | Snow cover | Damaging cyclone | Sea level | Ocean acidification | Carbon dioxide fertilization

**Level of risk & potential for adaptation**



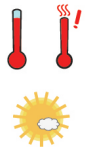

## Africa

| Key risk | Adaptation issues & prospects | Climatic drivers | Timeframe | Risk & potential for adaptation |
|---|---|---|---|---|
| Compounded stress on water resources facing significant strain from overexploitation and degradation at present and increased demand in the future, with drought stress exacerbated in drought-prone regions of Africa (*high confidence*)<br>[22.3-4] | • Reducing non-climate stressors on water resources<br>• Strengthening institutional capacities for demand management, groundwater assessment, integrated water-wastewater planning, and integrated land and water governance<br>• Sustainable urban development | | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C 4°C | Very low – Medium – Very high |
| Reduced crop productivity associated with heat and drought stress, with strong adverse effects on regional, national, and household livelihood and food security, also given increased pest and disease damage and flood impacts on food system infrastructure (*high confidence*)<br>[22.3-4] | • Technological adaptation responses (e.g., stress-tolerant crop varieties, irrigation, enhanced observation systems)<br>• Enhancing smallholder access to credit and other critical production resources; Diversifying livelihoods<br>• Strengthening institutions at local, national, and regional levels to support agriculture (including early warning systems) and gender-oriented policy<br>• Agronomic adaptation responses (e.g., agroforestry, conservation agriculture) | | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C 4°C | Very low – Medium – Very high |
| Changes in the incidence and geographic range of vector- and water-borne diseases due to changes in the mean and variability of temperature and precipitation, particularly along the edges of their distribution (*medium confidence*)<br>[22.3] | • Achieving development goals, particularly improved access to safe water and improved sanitation, and enhancement of public health functions such as surveillance<br>• Vulnerability mapping and early warning systems<br>• Coordination across sectors<br>• Sustainable urban development | | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C 4°C | Very low – Medium – Very high |

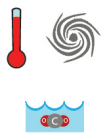
## Europe

| Key risk | Adaptation issues & prospects | Climatic drivers | Timeframe | Risk & potential for adaptation |
|---|---|---|---|---|
| Increased economic losses and people affected by flooding in river basins and coasts, driven by increasing urbanization, increasing sea levels, coastal erosion, and peak river discharges (*high confidence*)<br>[23.2-3, 23.7] | Adaptation can prevent most of the projected damages (*high confidence*).<br>• Significant experience in hard flood-protection technologies and increasing experience with restoring wetlands<br>• High costs for increasing flood protection<br>• Potential barriers to implementation: demand for land in Europe and environmental and landscape concerns | | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C 4°C | Very low – Medium – Very high |
| Increased water restrictions. Significant reduction in water availability from river abstraction and from groundwater resources, combined with increased water demand (e.g., for irrigation, energy and industry, domestic use) and with reduced water drainage and runoff as a result of increased evaporative demand, particularly in southern Europe (*high confidence*)<br>[23.4, 23.7] | • Proven adaptation potential from adoption of more water-efficient technologies and of water-saving strategies (e.g., for irrigation, crop species, land cover, industries, domestic use)<br>• Implementation of best practices and governance instruments in river basin management plans and integrated water management | | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C 4°C | Very low – Medium – Very high |
| Increased economic losses and people affected by extreme heat events: impacts on health and well-being, labor productivity, crop production, air quality, and increasing risk of wildfires in southern Europe and in Russian boreal region (*medium confidence*)<br>[23.3-7, Table 23-1] | • Implementation of warning systems<br>• Adaptation of dwellings and workplaces and of transport and energy infrastructure<br>• Reductions in emissions to improve air quality<br>• Improved wildfire management<br>• Development of insurance products against weather-related yield variations | | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C 4°C | Very low – Medium – Very high |

## Asia

| Key risk | Adaptation issues & prospects | Climatic drivers | Timeframe | Risk & potential for adaptation |
|---|---|---|---|---|
| Increased riverine, coastal, and urban flooding leading to widespread damage to infrastructure, livelihoods, and settlements in Asia (*medium confidence*)<br><br>[24.4] | • Exposure reduction via structural and non-structural measures, effective land-use planning, and selective relocation<br>• Reduction in the vulnerability of lifeline infrastructure and services (e.g., water, energy, waste management, food, biomass, mobility, local ecosystems, telecommunications)<br>• Construction of monitoring and early warning systems; measures to identify exposed areas, assist vulnerable areas and households, and diversify livelihoods<br>• Economic diversification |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C / 4°C | Very low – Medium – Very high |
| Increased risk of heat-related mortality (*high confidence*)<br><br>[24.4] | • Heat health warning systems<br>• Urban planning to reduce heat islands; improvement of the built environment; development of sustainable cities<br>• New work practices to avoid heat stress among outdoor workers |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C / 4°C | Very low – Medium – Very high |
| Increased risk of drought-related water and food shortage causing malnutrition (*high confidence*)<br><br>[24.4] | • Disaster preparedness including early-warning systems and local coping strategies<br>• Adaptive/integrated water resource management<br>• Water infrastructure and reservoir development<br>• Diversification of water sources including water re-use<br>• More efficient use of water (e.g., improved agricultural practices, irrigation management, and resilient agriculture) |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C / 4°C | Very low – Medium – Very high |

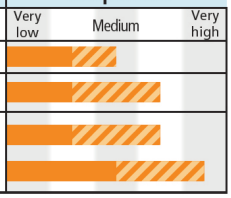
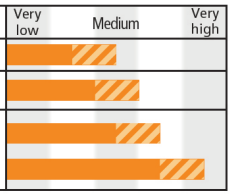
## Australasia

| Key risk | Adaptation issues & prospects | Climatic drivers | Timeframe | Risk & potential for adaptation |
|---|---|---|---|---|
| Significant change in community composition and structure of coral reef systems in Australia (*high confidence*)<br><br>[25.6, 30.5, Boxes CC-CR and CC-OA] | • Ability of corals to adapt naturally appears limited and insufficient to offset the detrimental effects of rising temperatures and acidification.<br>• Other options are mostly limited to reducing other stresses (water quality, tourism, fishing) and early warning systems; direct interventions such as assisted colonization and shading have been proposed but remain untested at scale. |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C / 4°C | Very low – Medium – Very high |
| Increased frequency and intensity of flood damage to infrastructure and settlements in Australia and New Zealand (*high confidence*)<br><br>[Table 25-1, Boxes 25-8 and 25-9] | • Significant adaptation deficit in some regions to current flood risk.<br>• Effective adaptation includes land-use controls and relocation as well as protection and accommodation of increased risk to ensure flexibility. |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C / 4°C | Very low – Medium – Very high |
| Increasing risks to coastal infrastructure and low-lying ecosystems in Australia and New Zealand, with widespread damage towards the upper end of projected sea-level-rise ranges (*high confidence*)<br><br>[25.6, 25.10, Box 25-1] | • Adaptation deficit in some locations to current coastal erosion and flood risk. Successive building and protection cycles constrain flexible responses.<br>• Effective adaptation includes land-use controls and ultimately relocation as well as protection and accommodation. |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C / 4°C | Very low – Medium – Very high |

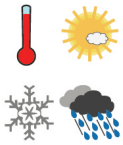
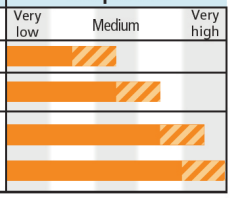
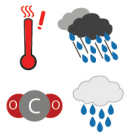
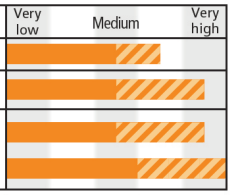
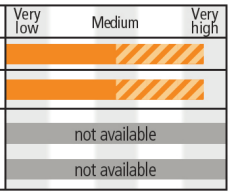
## North America

| Key risk | Adaptation issues & prospects | Climatic drivers | Timeframe | Risk & potential for adaptation |
|---|---|---|---|---|
| Wildfire-induced loss of ecosystem integrity, property loss, human morbidity, and mortality as a result of increased drying trend and temperature trend (*high confidence*)<br><br>[26.4, 26.8, Box 26-2] | • Some ecosystems are more fire-adapted than others. Forest managers and municipal planners are increasingly incorporating fire protection measures (e.g., prescribed burning, introduction of resilient vegetation). Institutional capacity to support ecosystem adaptation is limited.<br>• Adaptation of human settlements is constrained by rapid private property development in high-risk areas and by limited household-level adaptive capacity.<br>• Agroforestry can be an effective strategy for reduction of slash and burn practices in Mexico. |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C / 4°C | Very low – Medium – Very high |

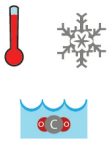
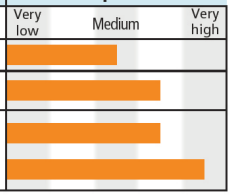
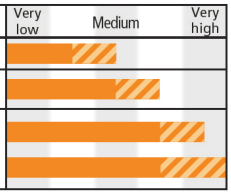
## North America (continued)

| Key risk | Adaptation issues & prospects | Climatic drivers | Timeframe | Risk & potential for adaptation (Very low / Medium / Very high) |
|---|---|---|---|---|
| Heat-related human mortality (*high confidence*) [26.6, 26.8] | • Residential air conditioning (A/C) can effectively reduce risk. However, availability and usage of A/C is highly variable and is subject to complete loss during power failures. Vulnerable populations include athletes and outdoor workers for whom A/C is not available.<br>• Community- and household-scale adaptations have the potential to reduce exposure to heat extremes via family support, early heat warning systems, cooling centers, greening, and high-albedo surfaces. |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C<br>Long-term (2080-2100) 4°C |  |
| Urban floods in riverine and coastal areas, inducing property and infrastructure damage; supply chain, ecosystem, and social system disruption; public health impacts; and water quality impairment due to sea-level rise, extreme precipitation, and cyclones (*high confidence*) [26.2-4, 26.8] | • Implementing management of urban drainage is expensive and disruptive to urban areas.<br>• Low-regret strategies with co-benefits include less impervious surfaces leading to more groundwater recharge, green infrastructure, and rooftop gardens.<br>• Sea-level rise increases water elevations in coastal outfalls, which impedes drainage. In many cases, older rainfall design standards are being used that need to be updated to reflect current climate conditions.<br>• Conservation of wetlands, including mangroves, and land-use planning strategies can reduce the intensity of flood events. |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C<br>Long-term (2080-2100) 4°C |  |

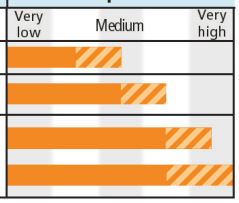
## Central and South America

| Key risk | Adaptation issues & prospects | Climatic drivers | Timeframe | Risk & potential for adaptation (Very low / Medium / Very high) |
|---|---|---|---|---|
| Water availability in semi-arid and glacier-melt-dependent regions and Central America; flooding and landslides in urban and rural areas due to extreme precipitation (*high confidence*) [27.3] | • Integrated water resource management<br>• Urban and rural flood management (including infrastructure), early warning systems, better weather and runoff forecasts, and infectious disease control |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C<br>Long-term (2080-2100) 4°C |  |
| Decreased food production and food quality (*medium confidence*) [27.3] | • Development of new crop varieties more adapted to climate change (temperature and drought)<br>• Offsetting of human and animal health impacts of reduced food quality<br>• Offsetting of economic impacts of land-use change<br>• Strengthening traditional indigenous knowledge systems and practices |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C<br>Long-term (2080-2100) 4°C |  |
| Spread of vector-borne diseases in altitude and latitude (*high confidence*) [27.3] | • Development of early warning systems for disease control and mitigation based on climatic and other relevant inputs. Many factors augment vulnerability.<br>• Establishing programs to extend basic public health services |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C<br>Long-term (2080-2100) 4°C |  not available not available |

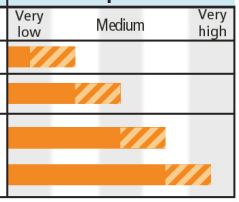
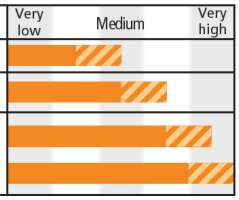
## Polar Regions

| Key risk | Adaptation issues & prospects | Climatic drivers | Timeframe | Risk & potential for adaptation (Very low / Medium / Very high) |
|---|---|---|---|---|
| Risks for freshwater and terrestrial ecosystems (*high confidence*) and marine ecosystems (*medium confidence*), due to changes in ice, snow cover, permafrost, and freshwater/ocean conditions, affecting species' habitat quality, ranges, phenology, and productivity, as well as dependent economies [28.2-4] | • Improved understanding through scientific and indigenous knowledge, producing more effective solutions and/or technological innovations<br>• Enhanced monitoring, regulation, and warning systems that achieve safe and sustainable use of ecosystem resources<br>• Hunting or fishing for different species, if possible, and diversifying income sources |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C<br>Long-term (2080-2100) 4°C |  |
| Risks for the health and well-being of Arctic residents, resulting from injuries and illness from the changing physical environment, food insecurity, lack of reliable and safe drinking water, and damage to infrastructure, including infrastructure in permafrost regions (*high confidence*) [28.2-4] | • Co-production of more robust solutions that combine science and technology with indigenous knowledge<br>• Enhanced observation, monitoring, and warning systems<br>• Improved communications, education, and training<br>• Shifting resource bases, land use, and/or settlement areas |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C<br>Long-term (2080-2100) 4°C |  |

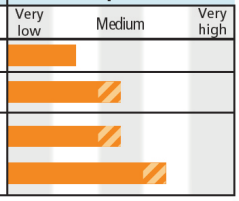
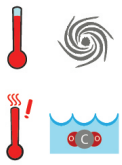
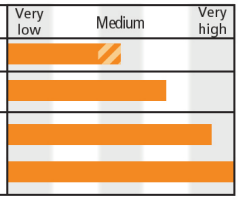
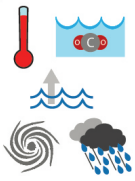
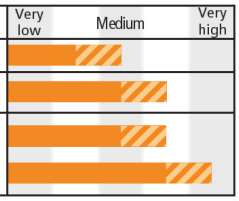
## Polar Regions (continued)

| Key risk | Adaptation issues & prospects | Climatic drivers | Timeframe | Risk & potential for adaptation |
|---|---|---|---|---|
| Unprecedented challenges for northern communities due to complex inter-linkages between climate-related hazards and societal factors, particularly if rate of change is faster than social systems can adapt (*high confidence*)<br><br>[28.2-4] | • Co-production of more robust solutions that combine science and technology with indigenous knowledge<br>• Enhanced observation, monitoring, and warning systems<br>• Improved communications, education, and training<br>• Adaptive co-management responses developed through the settlement of land claims |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C 4°C |  |

## Small Islands

| 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*)<br><br>[29.6, 29.8, Figure 29-4] | • Significant potential exists for adaptation in islands, but additional external resources and technologies will enhance response.<br>• Maintenance and enhancement of ecosystem functions and services and of water and food security<br>• Efficacy of traditional community coping strategies is expected to be substantially reduced in the future. |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C 4°C |  |
| 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*)<br><br>[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.<br>• 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<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C 4°C |  |

## The Ocean

| Key risk | Adaptation issues & prospects | Climatic drivers | Timeframe | Risk & potential for adaptation |
|---|---|---|---|---|
| Distributional shift in fish and invertebrate species, and decrease in fisheries catch potential at low latitudes, e.g., in equatorial upwelling and coastal boundary systems and sub-tropical gyres (*high confidence*)<br><br>[6.3, 30.5-6, Tables 6-6 and 30-3, Box CC-MB] | • Evolutionary adaptation potential of fish and invertebrate species to warming is limited as indicated by their changes in distribution to maintain temperatures.<br>• Human adaptation options: Large-scale translocation of industrial fishing activities following the regional decreases (low latitude) vs. possibly transient increases (high latitude) in catch potential; Flexible management that can react to variability and change; Improvement of fish resilience to thermal stress by reducing other stressors such as pollution and eutrophication; Expansion of sustainable aquaculture and the development of alternative livelihoods in some regions. |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C 4°C |  |
| Reduced biodiversity, fisheries abundance, and coastal protection by coral reefs due to heat-induced mass coral bleaching and mortality increases, exacerbated by ocean acidification, e.g., in coastal boundary systems and sub-tropical gyres (*high confidence*)<br><br>[5.4, 6.4, 30.3, 30.5-6, Tables 6-6 and 30-3, Box CC-CR] | • Evidence of rapid evolution by corals is very limited. Some corals may migrate to higher latitudes, but entire reef systems are not expected to be able to track the high rates of temperature shifts.<br>• Human adaptation options are limited to reducing other stresses, mainly by enhancing water quality, and limiting pressures from tourism and fishing. These options will delay human impacts of climate change by a few decades, but their efficacy will be severely reduced as thermal stress increases. |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C 4°C |  |
| Coastal inundation and habitat loss due to sea-level rise, extreme events, changes in precipitation, and reduced ecological resilience, e.g., in coastal boundary systems and sub-tropical gyres (*medium* to *high confidence*)<br><br>[5.5, 30.5-6, Tables 6-6 and 30-3, Box CC-CR] | • Human adaptation options are limited to reducing other stresses, mainly by reducing pollution and limiting pressures from tourism, fishing, physical destruction, and unsustainable aquaculture.<br>• Reducing deforestation and increasing reforestation of river catchments and coastal areas to retain sediments and nutrients<br>• Increased mangrove, coral reef, and seagrass protection, and restoration to protect numerous ecosystem goods and services such as coastal protection, tourist value, and fish habitat |  | Present<br>Near-term (2030-2040)<br>Long-term (2080-2100) 2°C 4°C |  |