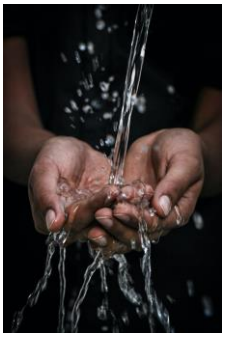
Climate information relevant for Water Resources Management

This fact sheet presents Sixth Assessment Report Working Group I (AR6 WGI) assessments for changes in climate factors connected to responses in water resources management, highlighting climate information and data needs that inform sectoral assessments and further actions for adaptation and resilience planning.

This fact sheet focuses on the assessment of climatic variables (temperature, precipitation, wind, etc.). Impacts and adaptation options for water resources are assessed in Chapter 4 of the Working Group II contribution to the IPCC AR6.



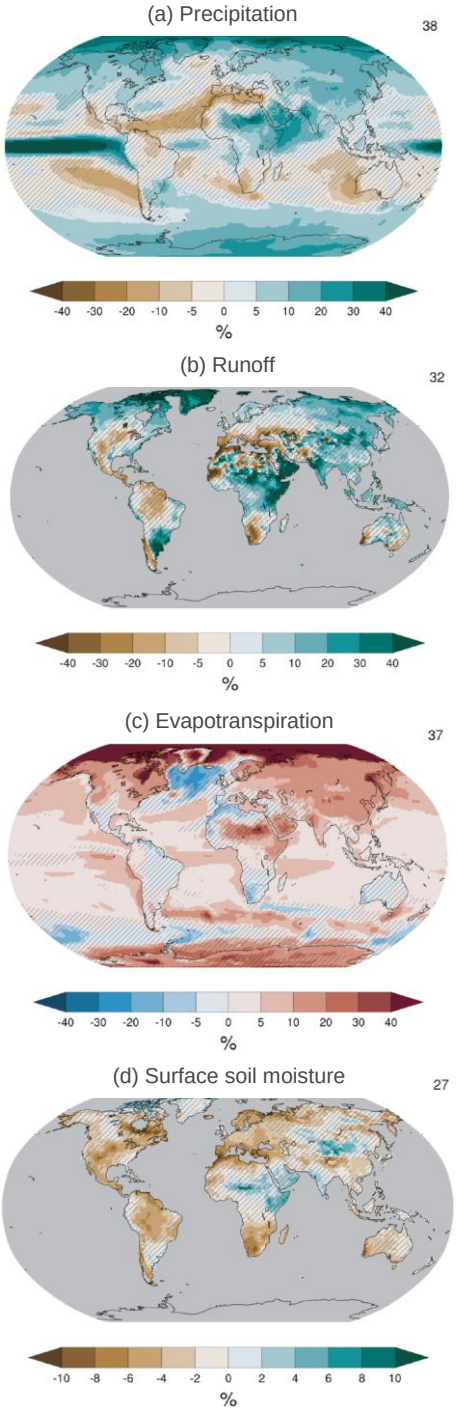


Figure 1: Projected changes in long-term water cycle variables for an intermediate scenario SSP2-4.5 (2081–2100 vs. 1995–2014) {TS Box.6, Figure 1}

Substantial and widespread changes in the global water cycle, in combination with widespread but non-uniform human-caused interventions, affect options for sustainable, economically efficient and equitable allocation of water resources. The global water cycle will continue to intensify as global temperatures rise (*high confidence*), with precipitation and surface water flows over most land regions projected to become more variable within seasons and from year to year. A warmer climate will intensity very wet and very dry weather and climate events and seasons. {WGI SPM.B3.1 and B3.2}

CONCURRENT CHANGES IN CLIMATIC IMPACT-DRIVERS

- Climate change-induced shifts in the distribution and event probabilities of water cycle variables have occurred. {TS.4.3.1} The supply, storage, quality, and distribution of water resources (including cryospheric and groundwater reservoirs) and streamflow is affected differently by these shifts. Every region of the world will experience concurrent changes in multiple climate features by mid-century (*high confidence*). (Figure 1)

WET AND DRY

- Global warming has increased the contrasts in precipitation amounts between wet and dry seasons and weather regimes over tropical land areas (*medium confidence*), and there is a detectable precipitation increase in the northern high latitudes (*high confidence*). {TS.4.3.1}
- The frequency and intensity of heavy precipitation events have increased over a majority of land regions with good observational coverage (*high confidence*). Extreme precipitation will increase almost worldwide, even where seasonal mean precipitation is projected to decrease, and pluvial flooding will increase in many regions around the world on almost all continents (*high confidence*). {TS.4.3.1}
- Global hydrological models project a larger fraction of land areas to be affected by an increase rather than by a decrease in river floods (*medium confidence*). {TS.4.3.1}
- The total land area subject to increasing drought frequency and severity will expand (*high confidence*). Increased evapotranspiration due to growing atmospheric water demand will decrease soil moisture in many regions (*high confidence*). Water cycle variability and extremes are projected to increase faster than average changes in most regions. {Executive Summary, Chapter 8}

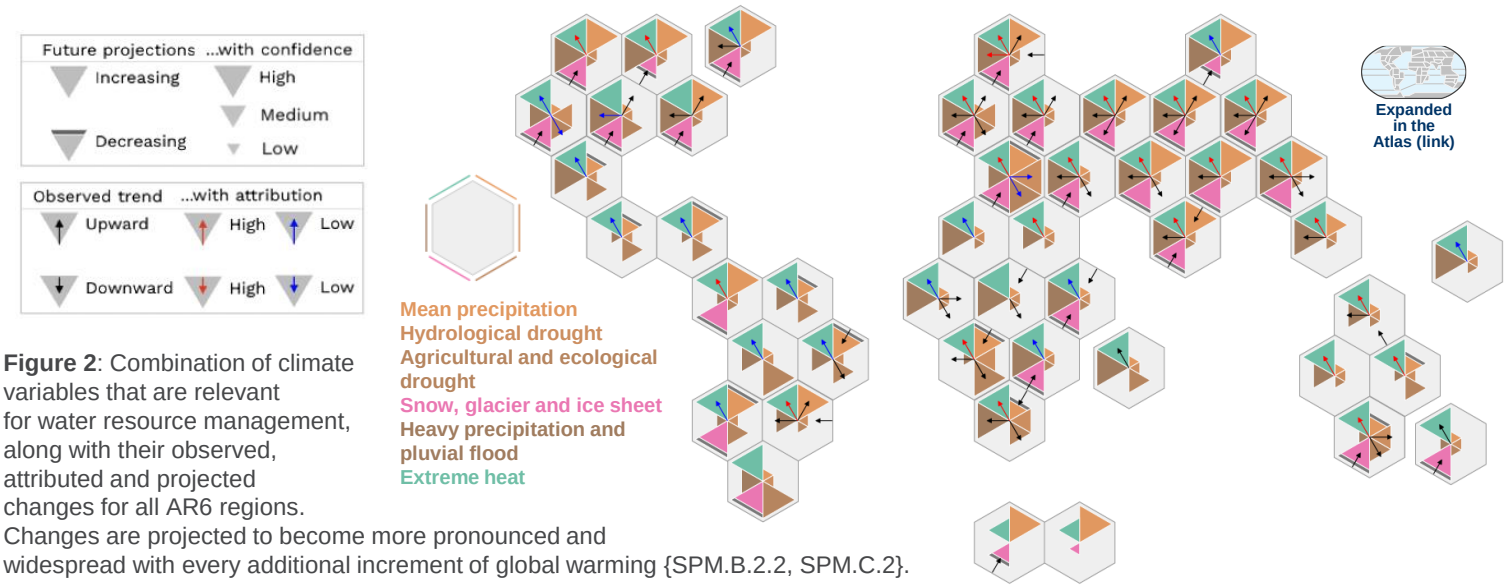


Figure 2: Combination of climate variables that are relevant for water resource management, along with their observed, attributed and projected changes for all AR6 regions. Changes are projected to become more pronounced and widespread with every additional increment of global warming {SPM.B.2.2, SPM.C.2}.

- A majority of land areas have experienced decreases in available water in dry seasons due to changes in evapotranspiration (*medium confidence*). {TS4.3.1} Groundwater depletion has occurred since at least the start of the 21st century as a consequence of groundwater withdrawals for irrigation in agricultural areas in drylands (e.g., in Western North America and South and East Asia) (*high confidence*). {Ch. 8, ES}
- In Southern Africa, the Mediterranean, North Central America, Western North America, the Amazon regions, South-Western South America, and Australia, increases in drought, aridity and/or fire weather are projected (*high confidence*). {TS.4.3.2} Increases in frequency and intensity of hydrological droughts become larger with increasing global warming in some regions (*medium confidence*). {SPM.B.2.2} In the Mediterranean, south-western South America, and western North America, increased evapotranspiration will decrease soil moisture, and future aridification will exceed the magnitude of changes seen in the last millennium (*high confidence*). {Ch 8 ES}
- There is *medium confidence* that river floods will increase across most Asian regions, in New Zealand and northern Australia by the end of this century. {12.4.2.2 and 12.4.3.2}. There is *low confidence* that river floods will increase in Northern Hemisphere polar regions and West and Central Europe under a low emissions scenario (SSP1-2.6), and *high confidence* for a river flood increase under a high emissions scenario (SSP5-8.5). {12.4.5.2}
- Global land monsoon precipitation decreased from the 1950s to the 1980s, partly due to fine particles in the air (aerosols), but has increased since then in response to global warming and large-scale multi-decadal variability (*medium confidence*). Over South and South-east Asia, East Asia and the central Sahel, monsoon precipitation is projected to increase, whereas over North America and the far western Sahel it is projected to decrease (*medium confidence*). {Box TS.13}

SNOW AND ICE

- Other than the Arctic and high Arctic, it is *virtually certain* that snow cover will experience a decline over most land regions during the 21st century, in terms of water equivalent, extent and annual duration. There is *high confidence* that the global warming-induced earlier onset of spring snowmelt with higher peak spring and winter streamflow at the expense of summer streamflow, and increased melting of glaciers have already contributed to seasonal changes in streamflow in high-latitude and low-elevation mountain catchments. {Ch. 8 ES}
- Nevertheless, it is *very likely* that some high-latitude regions will experience an increase in winter snow water equivalent due to the effect of increased snowfall prevailing over warming-induced increased snowmelt. {TS.4.3.1}
- Glaciers will continue to shrink. Widespread degradation of permafrost in the Arctic and mountainous regions will also continue (*high confidence*). {TS.4.3.1}

COASTAL AND OCEANIC

- Relative sea level rise may increase the risk of salt water intrusion into coastal surface and groundwater reservoirs. {12.3.5.1} With the exception of a few regions with substantial land uplift, relative sea level rise is *very likely* to *virtually certain* (depending on the region) to continue along the 21st century, contributing to increased coastal flooding in low-lying areas (*high confidence*) and coastal erosion along most sandy coasts (*high confidence*) over the 21st century. {TS.4.3.1}