Climate information relevant for Forestry

This fact sheet presents AR6 WGI assessment statements connected to forestry and aims to inform sectoral stakeholders about the relevance of climatic impact-drivers (CIDs). The *WGI fact sheets on Terrestrial and Freshwater Ecosystems, Health, Water Resource Management, Disaster Management and Insurance, and Agriculture* provide other relevant information since the forestry sector is highly dependent on human and water resources, and together with agriculture could create agroforestry.

***Impacts and adaptation** options for forestry are assessed in AR6 WGII {2.5.4, FAQ.2.6, 5, regional chapters and CCP7 on Tropical Forests}. **Mitigation** aspects are assessed in AR6 WGIII {TS.5.6.1, TS.5.7, 7.2, 7.4, 7.6}.*

The main CIDs that influence the forestry sector are **mean temperature**, **agricultural and ecological drought**, **fire weather** and **concentration of carbon dioxide**. Additionally, **extreme heat**, **frost** and **aridity** as well as **severe wind storms**, **air pollution weather** and **solar radiation at surface** have *high* to *moderate* confidence levels in the assessments depending on whether tropical or temperate and boreal forests are considered. {12.3}

HEAT AND COLD

- In all regions, there is *high confidence* that **mean temperature** and **heat extremes** will increase. The frequency of **frost days** will *very likely* decrease for all scenarios and all time horizons. {12.4}
- Afforestation at high latitudes would decrease albedo and increase local warming, while at low latitudes, the cooling effect of enhanced evapotranspiration could exceed the warming effect due to albedo decrease. {5.6.2.2.1}
- It is *virtually certain* that **atmospheric CO_2 concentration** will increase in all emissions scenarios until net zero emissions are achieved. These changes will lead to climate states with no recent analogue that are of particular importance for specific regions such as tropical forests. {12.4}

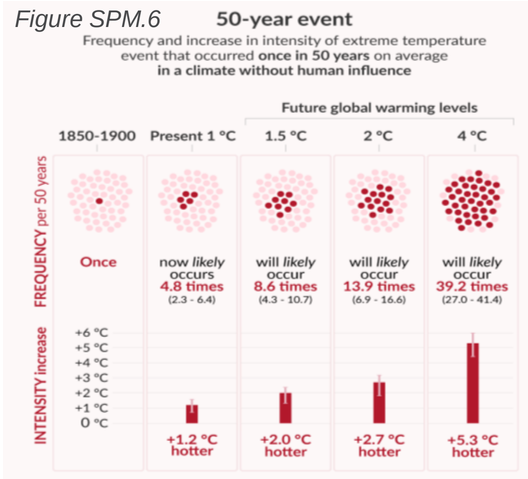


Figure SPM.6

WATER CYCLE CHANGE

- Both afforestation and reforestation affect the hydrological cycle through increased volatile organic compounds (VOC) emissions and cloud albedo, enhanced **precipitation, pluvial and river floods,** and increased transpiration, with potential effects on **runoff** and, especially in dry areas, on water supply. {5.6.2.2.1} Water cycle changes bring prolonged **drought**, longer dry seasons, and increased **fire weather** to many tropical forests (*medium confidence*). {10.5, 12.3, 12.4}.

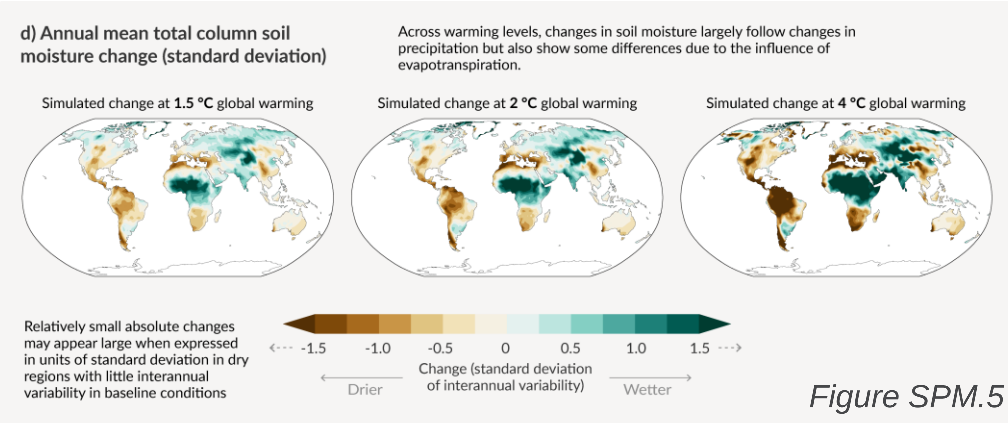
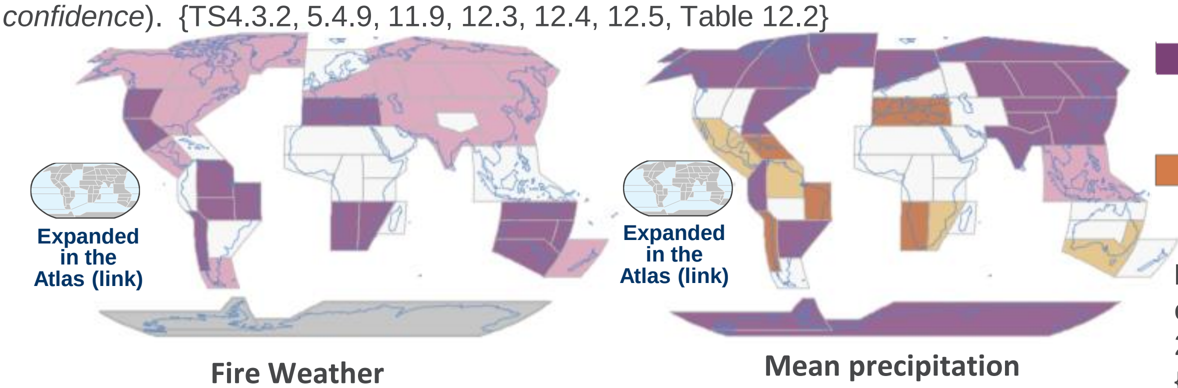


Figure SPM.5

Based on multiple independent analyses of in situ, satellite, and phenological data, there is *high confidence* that the geographical distribution of **climate zones** has shifted poleward and upslope in many parts of the world, **vegetation green leaf area** and/or mass has increased globally since the early 1980s, and the length of the **growing season** has increased over much of the extratropical Northern Hemisphere since at least the mid-20th century {2.3.4}

Extensive deployment of **bioenergy with carbon capture and storage (BECCS)** and afforestation would require larger amounts of freshwater resources than used by the previous vegetation, altering the water cycle at regional scales (*high confidence*) with potential consequences for downstream uses, biodiversity, and regional climate, depending on prior land cover, background climate conditions, and scale of deployment (*high confidence*). {CCB 5.1} For more on pros and cons of BECCS, see WGII {2.6, Box 2.2, 4.7.6, 18.3.1, CWG Box BIOECONOMY} and WGIII {7.4, 12.3, TS5.7}.

- Some types of regions found in different continents face common climate challenges regardless of their location. These include tropical forests that are increasingly prone to **fire weather** (*medium confidence*). Climate model simulations project significant **fire weather index** increases in boreal forests of Arctic Russia and North-east North America, as well as in other types of forests in Africa, Australia, Mediterranean, and South and North America (*medium* to *high confidence*). Increases in one or more of **droughts**, **aridity** and **fire weather** with *high confidence* will affect forestry in a number of regions (Southern Africa, the Mediterranean, North Central America, Western North America, the Amazon regions, South-Western South America, and Australia). The probability of crossing uncertain regional thresholds (e.g., high severity fires, forest dieback) increases with climate change (*high confidence*). {TS4.3.2, 5.4.9, 11.9, 12.3, 12.4, 12.5, Table 12.2}



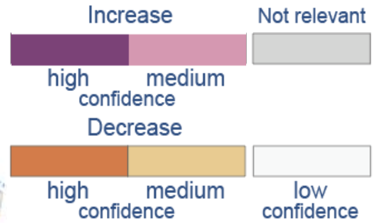


Figure 3: The CID future changes consistent with 2°C global warming {Interactive Atlas}

CONCURRENT CHANGES IN CIDs

- Higher concentrations of CO_2 can increase photosynthesis rates and primary production within natural ecosystems, but combined **heat** and **drought** stress can reduce forest primary productivity and even cause tree mortality at higher extremes. {12.3}
- Under dry conditions, the enhanced **agricultural and ecological droughts** associated with the human forcing would increase plant water stress, with effects on widespread forest dieback and mortality, and stronger risk of megafires. {11.6.5.5}
- Due to short-term or lack of homogeneity in observations, and not sufficient resolution or accurate parametrizations in models, there is *low confidence* in past and future changes in nearly all regions for several CIDs that can impact forestry (**hail, ice, severe wind and dust storms, heavy snowfall, and avalanches**), although this does not indicate that these CIDs will not be affected by climate change {12.4}.

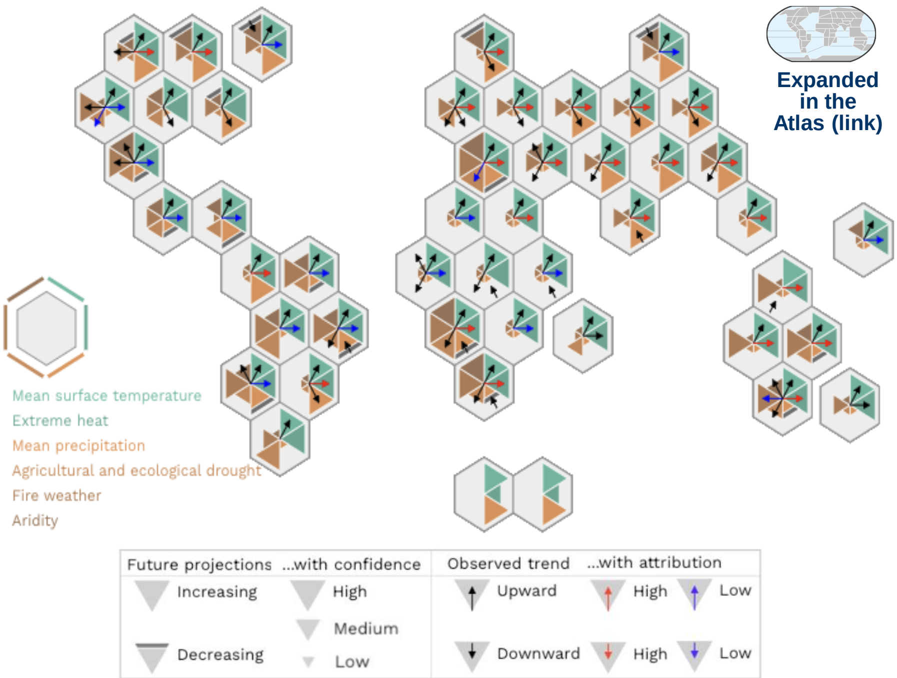


Figure 4: Concurrent changes in AR6 reference regions in climatic impact-drivers (from up clockwise): mean surface temperature, extreme heat, mean precipitation, agricultural and ecological drought, fire weather and aridity {Interactive Atlas}

- Some of ecological and climate risks arise from **droughts**, **fires**, insect outbreaks, diseases, erosion, and other disturbances. **Sustainable forest management** can help to manage some of these risks, while in some cases it can increase and maintain forest sinks through harvest, transfer of carbon to wood products, and their use to store carbon and substitute emissions-intensive construction materials. Forest genomics techniques can increase the success of both reforestation and conservation initiatives, accelerating breeding for tree health and productivity. Secondary forest regrowth and restoration of degraded forests and non-forest ecosystems can play a large role in carbon sequestration (*high confidence*) with high resilience to disturbances and additional benefits such as enhanced biodiversity {5.6.2.2.1}.

More information on sustainable forest management and potential sequestration potential by Agriculture, Forestry and Other Land Uses (AFOLU) can be found in AR6 WGII {2.6, 5.6} and WGIII {7.4, 7.6, TS.5.6} respectively.