Global climate change aspects
Key findings from the 2021 IPCC climate report

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www.ipcc.ch/report/ar6/wg1
Human influence has warmed the climate

Changes in global surface temperature relative to 1850–1900 from direct observations (1850–2020)

+1.1°C

Figure SPM.1

Observed

Figure SPM.2
Observed warming is driven by emissions from human activities, with greenhouse gas warming partly masked by aerosol cooling.

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Evidence from attribution studies

Evidence from the assessment of radiative forcing and climate sensitivity
The illustrative set of five SSP scenarios span a broader range of greenhouse gas and air pollutant futures than assessed in earlier WGI reports.

**Shared Socioeconomic Pathway (SSP) Scenarios**

- **Very high**: CO₂ emission pathways without any climate change mitigation
- **High**: CO₂ emission pathway
- **Intermediate**: CO₂ emission pathway
- **Low**: CO₂ emission pathways in which CO₂ emissions decline to net zero around or after 2050
- **Very low**
Assessed future global surface temperature is based on multiple lines of evidence.

- Scenario-based CMIP6 projections
- Constrained projected change
- Emulated change
- Equilibrium climate sensitivity (ECS): 3°C (very likely 2°C-5°C)
- Transient climate response (TCR): 1.8°C (very likely 1.2°C-2.4°C)

A 2-layer energy balance (emulator) model
Global surface temperature will continue to increase until at least the mid-century under all emission scenarios considered.

Figure SPM.8

Global surface temperature change relative to 1850-1900

- Very high
- High
- Intermediate
- Low
- Very low

1.5°C
Global warming of 1.5°C and 2°C will be exceeded unless deep reductions in CO\(_2\) and other greenhouse gas emissions occur in the coming decades.

![Global surface temperature change relative to 1850-1900](Figure SPM.8)
With every increment of global warming, changes in regional mean temperature, precipitation, and soil moisture and changes in extremes and climatic impact-drivers get larger.
Continued global warming is projected to further intensify the global water cycle, including its variability, global monsoon precipitation and the severity of wet and dry events.

https://interactive-atlas.ipcc.ch/
Many changes in the climate system become larger with increasing global warming

- Frequency and intensity:
  - Hot extremes and marine heatwaves
  - Heavy precipitation (+7% per °C)
  - Drought in some regions

- Proportion of intense tropical cyclones

- Snow cover, permafrost, Arctic sea ice loss

**Figure SPM.5**
Projections of global mean sea level are consistent with assessed changes in global surface temperature
Global mean sea level will continue to rise over thousands of years with a rate and magnitude depending on global greenhouse gas emissions.

Figure SPM.8

Global mean sea level rise relative to 1900 (m)
Global mean sea level will continue to rise over thousands of years with a rate and magnitude depending on global greenhouse gas emissions.

**Figure SPM.8**

- **Very high** CO₂ emissions
- **Likely (66% ranges**
- **Low** CO₂ emissions
Global mean sea level will continue to rise over thousands of years with a rate and magnitude depending on global greenhouse gas emissions.

By around 2160 (2120 - 2230) for intermediate emissions (3°C), global mean sea level rise exceeding 1 m above 1995-2014 level will be reached by around 2020 (2150 – 2300+)

by around 2020 (2150 – 2300+) for low emissions (<2°C)
Future emissions cause future additional warming, with total warming dominated by past and future CO$_2$ emissions

Change in global surface temperature in 2081-2100 relative to 1850-1900 (°C)

- **Very low**
- **Low**
- **Intermediate**
- **High**
- **Very high**

**CO$_2$ emissions**

*Figure SPM.4*
Every tonne of CO$_2$ emissions adds to global warming

Global surface temperature increase since 1850-1900 (°C) as a function of cumulative CO$_2$ emissions (GtCO$_2$)

Figure SPM.10
An updated assessment of the total and remaining carbon budget

- Emissions to date: 2390 GtCO₂ over 1850-2019 period
- Human-induced historical warming
- Warming per tonne CO₂ emitted
- Warming evolution after CO₂ emissions reach net zero
- Future warming from non- CO₂ emissions
- Earth system feedback otherwise not captured
The proportion of CO$_2$ emissions taken up by land and ocean carbon sinks is smaller in scenarios with higher cumulative CO$_2$ emissions.

Figure SPM.7

Total cumulative CO$_2$ emissions taken up by land and oceans (colours) and remaining in the atmosphere (grey) from 1850 to 2100.
Strong, rapid and sustained reductions in CH₄ emissions would limit the warming effect resulting from declining aerosol pollution and improve air quality.

Box TS.7, Figure 1
Differences in trends in global surface temperature would begin to emerge from natural variability within around the next 20 years.
Limiting global warming reduces consequences of climate change that can impact society and natural systems.
Thank you.

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