SIXTH ASSESSMENT REPORT
Working Group I – The Physical Science Basis

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IPCC Working Group I Report
Pacific Outreach

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The 6th IPCC Assessment Cycle

- May 2019: Emission inventories
- October 2018: 1.5°C
- Sept. 2019: Ocean & cryosphere
- August 2019: Land
- Sept. 2022: The Synthesis Report
- March 2022: Mitigation of Climate Change
- February 2021: Climate Change Impacts, Adaptation and Vulnerability
- August 2021: Ocean & cryosphere
- September 2023: Global stocktake 2023

IPCC 2021
Impacts, Adaptation and Vulnerability

Mitigation of Climate Change

IPCC 6th Assessment Reports
Huge amount of information and expertise

- **14,000** scientific publications assessed
- **78,000+** review comments
- **234** authors from **65** countries
Recent changes in the climate are widespread, rapid, and intensifying, and unprecedented in thousands of years.
Changes in global surface temperature relative to 1850-1900

Warming: unprecedented in at least 2000 years

1.1 °C warmer

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**Key indicators: unprecedented**

- **CO₂ concentration**: Highest in at least 2 million years.
- **Sea level rise**: Fastest rates in at least 3000 years.
- **Arctic sea ice area**: Lowest level in at least 1000 years.
- **Glaciers retreat**: Unprecedented in at least 2000 years.

It is indisputable that human activities are causing climate change, making extreme climate events, including heat waves, heavy rainfall, and droughts, more frequent and severe.
Human influence on climate is unequivocal
Observed warming is driven by emissions from human activities, with greenhouse gas warming partly masked by aerosol cooling.
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Human influence on extremes

- **Extreme heat**
  - More frequent
  - More intense

- **Heavy rainfall**
  - More frequent
  - More intense
  - Increased severe cyclones

- **Drought**
  - Increase in some regions

- **Fire weather**
  - More frequent

- **Ocean**
  - Warming
  - Acidifying
  - Losing oxygen


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Unless there are immediate, rapid, and large-scale reductions in greenhouse gas emissions, limiting warming to 1.5°C will be beyond reach.
Choices about our future

Current trajectory

- **Very high CO₂ emissions**
  - ~5°C
- **High CO₂ emissions**
  - ~4°C

Paris Agreement commitments

- **Intermediate CO₂ emissions**
  - ~3°C
- **Low CO₂ emissions**
  - ~2°C
- **Very low CO₂ emissions**
  - ~1.5°C

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- Under all emission scenarios we are likely to exceed 1.5°C in the 2030’s. Earlier under high emissions.
- The Very Low scenario has us temporarily exceeding 1.5°C then coming back under
Climate change is already affecting every region on Earth, in multiple ways.

The changes we experience will increase with further warming.
Variation in temperature projections

...at 1.5°C

...at 2°C

...at 4°C

Change (°C) 0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 -

Warmer

Marine heatwave changes

Observed
1985-2014

Low
2081-2100

Very High
2081-2100


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Changes in rainfall: spatially variable

- At 1.5°C
- At 2°C
- At 4°C

- Increased potential evaporation can cause drying
- Intensification of the sub-tropical ridge and changes to the SPCZ

Relatively small absolute changes may appear as large % changes in regions with dry baseline conditions.

Cyclones

- The Pacific overall is projected to face fewer but more intense tropical cyclones under all emissions scenarios
  - but more frequent in the subtropical central Pacific
- Proportionally more Category 4-5 cyclones
- Sea level rise exacerbating the potential for storm surge
- Rainfall intensity will increase with all emissions scenarios, doubling at 4°C
- Some continuing poleward movement of cyclonic activity in the western North Pacific

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El Niño–Southern Oscillation (ENSO) changes

- ENSO will remain the dominant mode of interannual variability (virtually certain)
- ENSO influence is projected to strengthen and shift eastward (medium confidence)
- It is very likely that ENSO rainfall variability will increase significantly from 2050 in the intermediate to very high emissions scenarios
• Accelerating: 1901-1971 was 1.3 mm/yr; 2006-2018 was 3.7mm/yr
• Can’t rule out increases of 5m by year 2150

Ocean acidification

c) Global ocean surface pH (a measure of acidity)

- **Very low** CO₂ emissions
- **Low** CO₂ emissions
- **Intermediate** CO₂ emissions
- **High** CO₂ emissions
- **Very high** CO₂ emissions

Ocean acidification
Higher emissions – less % CO$_2$ is taken up

**ATMOSPHERE**

**SSP1-1.9**

Very Low

**SSP1-2.6**

Low

**SSP2-4.5**

Intermediate

**SSP3-7.0**

High

**SSP5-8.5**

Very High

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The climate we experience in the future depends on our decisions now.
The basis of the carbon budget approach

Global surface temperature increase since 1850-1900 (°C) as a function of cumulative CO₂ emissions (GtCO₂) to 2050

1000 GtCO₂ = 0.45°C
(0.27°C - 0.63°C)
### ‘C-budget’ for different temperatures & probabilities

<table>
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<th>T&lt;sup&gt;a&lt;/sup&gt; Target (ºC)</th>
<th>17%</th>
<th>33%</th>
<th>50%</th>
<th>67%</th>
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<td>2300</td>
<td>1700</td>
<td>1350</td>
<td><strong>1150</strong></td>
<td>900</td>
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</tbody>
</table>

- Stay within a carbon budget
- Reach net zero CO<sub>2</sub> emissions
- Strong and sustained reductions in other GHGs

IPCC 2021 (Extract from Table SPM.2)
Thankyou

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Every half a degree matters
Every year matters
Every choice matters

Howden and Colvin 2018