SIXTH ASSESSMENT REPORT
Working Group I – The Physical Science Basis

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

15th March 2022

Understanding the Physical Basis of Climate Change – The regional scenario

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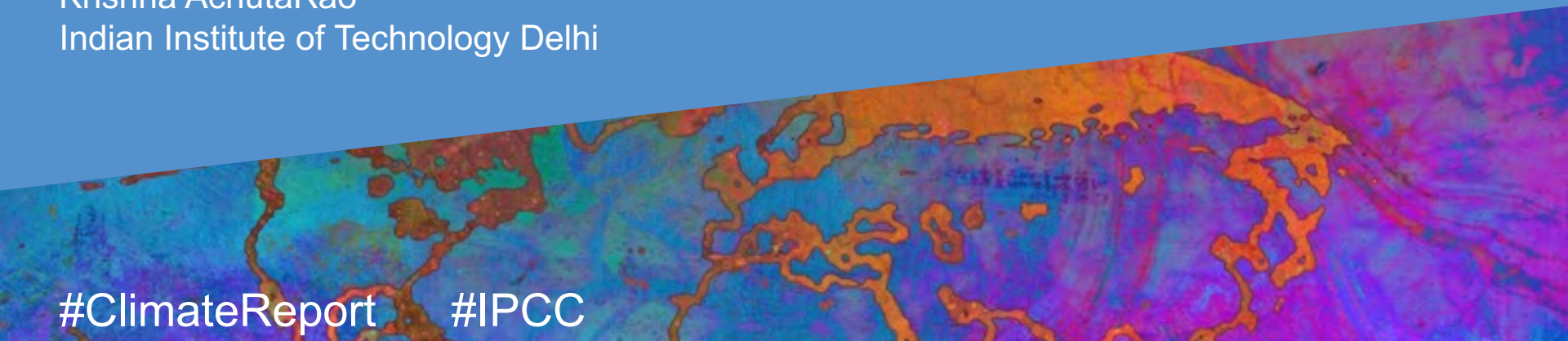

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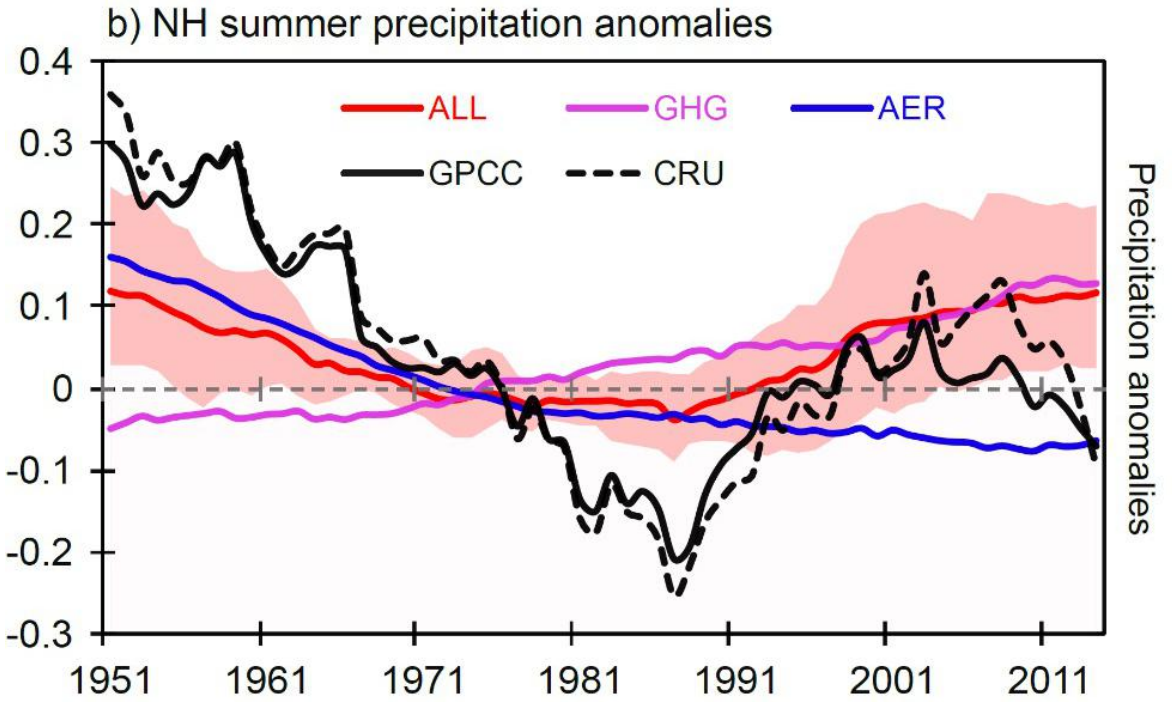
Regional Assessment

- Process Chapters
  - **Chapter 8:** Water Cycle Changes
- 4 Chapters on Regional Assessments
  - **Chapter 10:** Linking global to regional climate change
  - **Chapter 11:** Weather and climate extreme events in a changing climate
  - **Chapter 12:** Climate change information for regional impact and for risk assessment
  - **Atlas**

- "Distilling ***regional climate information from multiple lines of evidence*** and taking ***the user context*** into account will increase the fitness, usefulness and relevance for ***decision-making*** and ***enhances the trust*** users will have in applying it (*high confidence*)" [Chapter 10]

- "The use of ***multiple sources of observations*** and ***tailored diagnostics*** to evaluate climate model performance ***increases trust in future projections of regional climate*** (*high confidence*)" [Chapter 10]

- "Currently, ***scarcity and reduced availability of adequate observations*** increase the ***uncertainty*** of long term temperature and precipitation estimates (*virtually certain*)" [Chapter 10]



Anthropogenic aerosols have driven detectable large-scale water cycle changes since at least the mid-20th century

Box 8.1, Figure 1

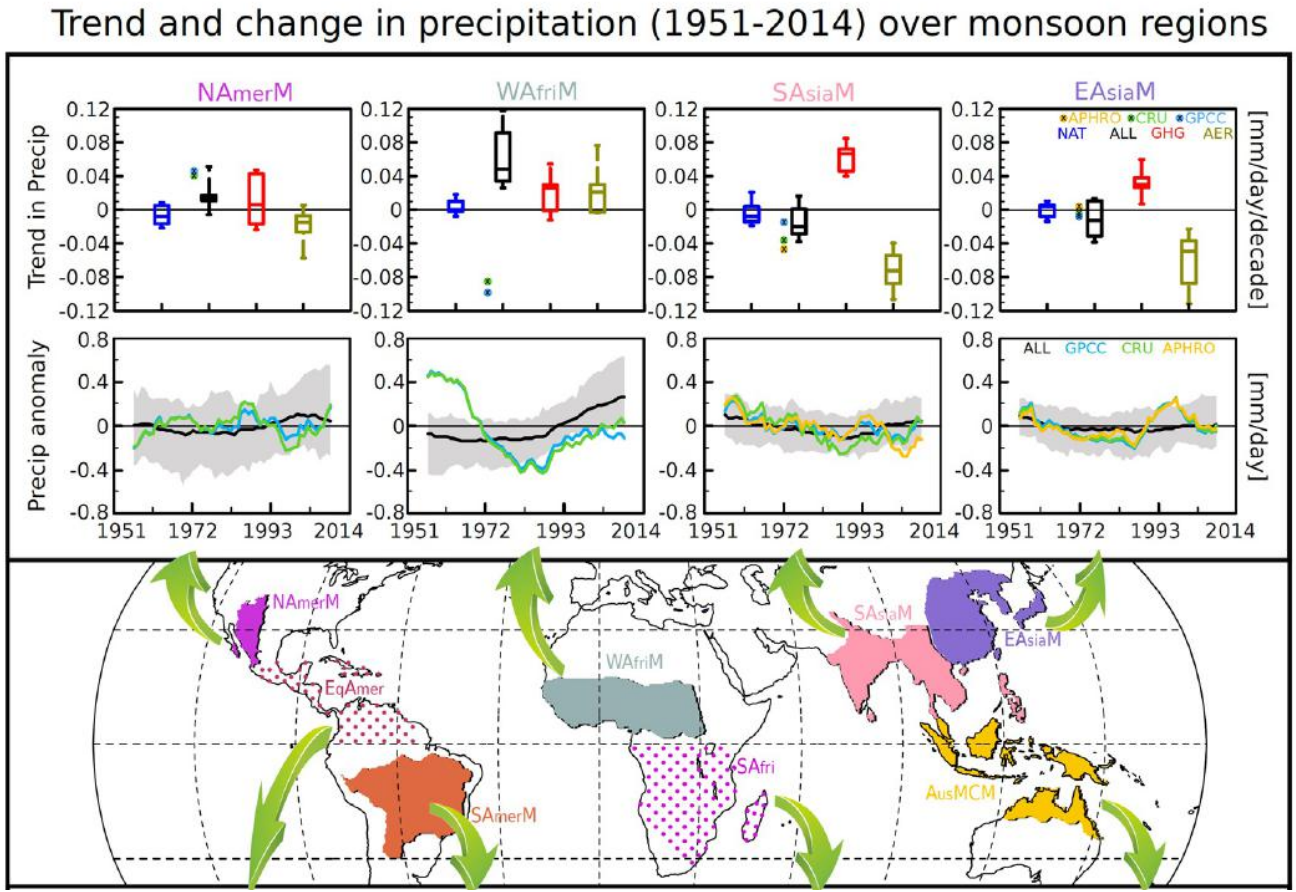

Trend and change in precipitation (1951-2014) over monsoon regions
NAmerM
WAfriM
SAsiaM
EAsiaM
Trend in Precip
[mm/day/decade]
APHRO CRU GPCC
NAT ALL GHG AER
Precip anomaly
[mm/day]
ALL GPCC CRU APHRO
1951 1972 1993 2014
NAmerM
EqAmer
SAmerM
WAfriM
SAfri
SAsiaM
EAsiaM
AusMCM

Figure 8.11

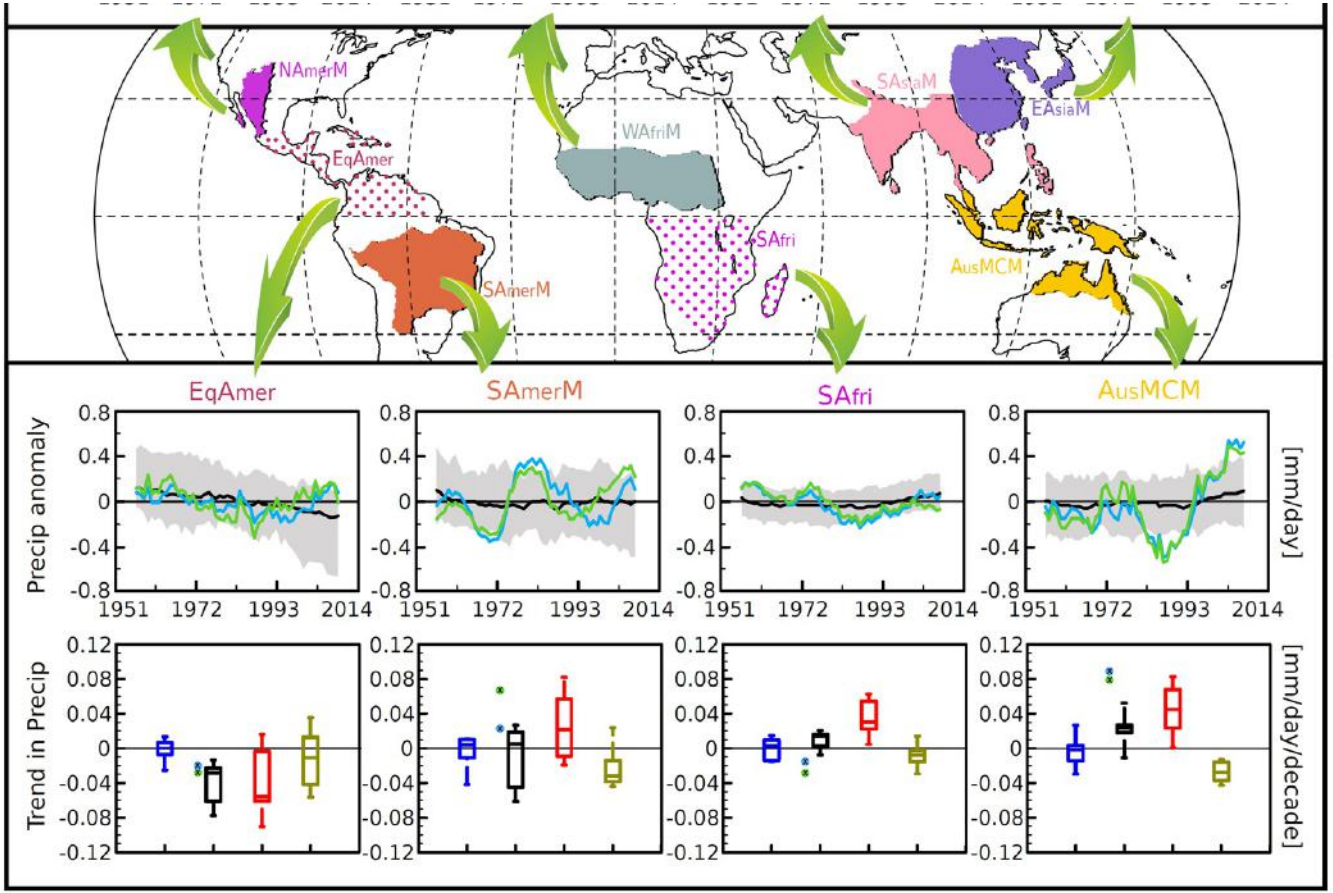
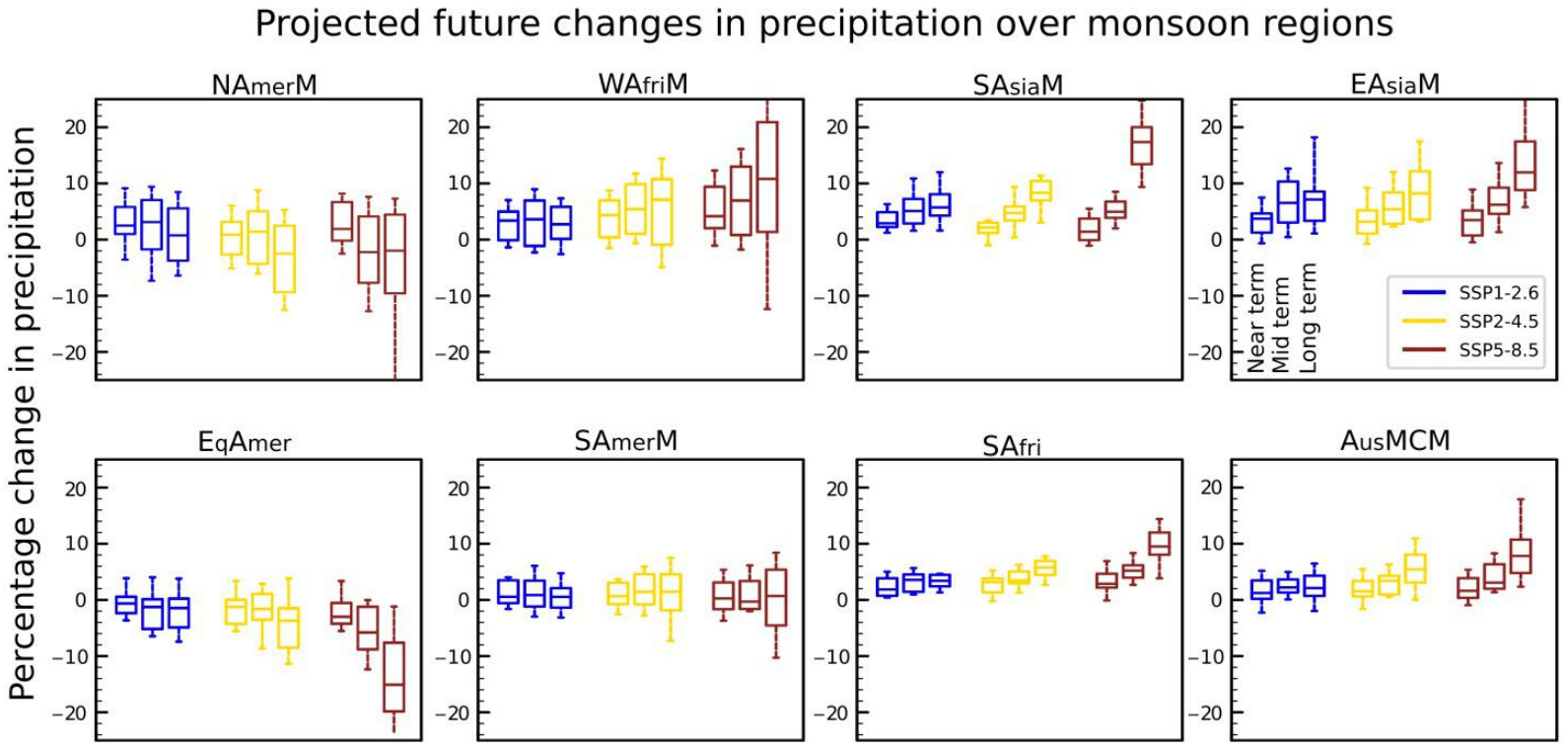

NAmerM
EqAmer
WAfriM
SAsiaM
EAsiaM
SAfri
AusMCM
SAmerM
EqAmer
SAmerM
SAfri
AusMCM
Precip anomaly
[mm/day]
0.8
0.4
0
-0.4
-0.8
1951
1972
1993
2014
Trend in Precip
[mm/day/decade]
0.12
0.08
0.04
0
-0.04
-0.08
-0.12

Figure 8.11



Near-term (2021–2040) Medium term (2041-2060) Long term (2081-2100)

Figure 8.22

Trends in terrestrial water storage (TWS) (cm per year) based on GRACE observations from April 2002 to March 2016

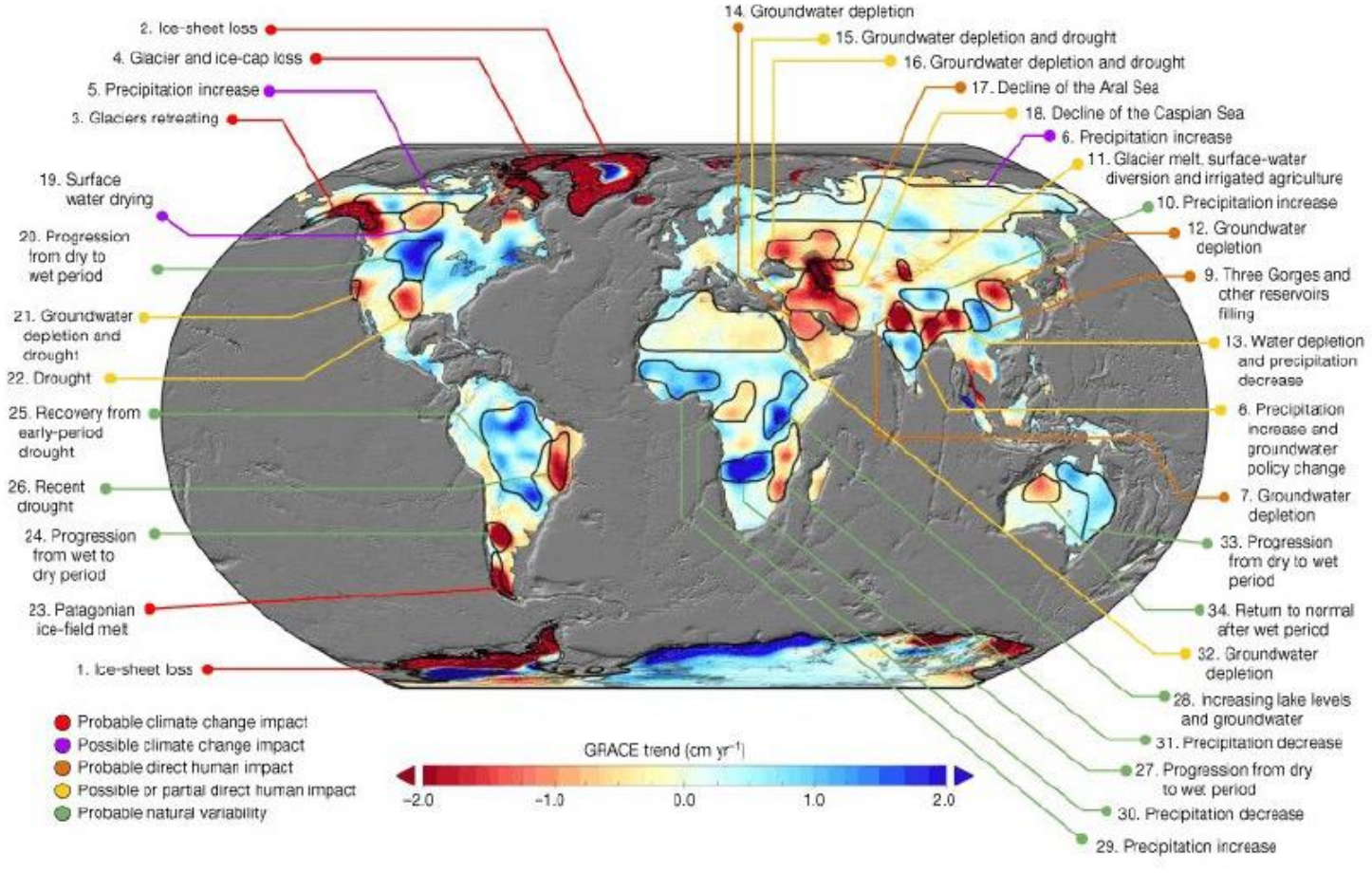


Figure 8.10

Extremes


Temperature extremes


Heavy precipitation


Floods


Droughts


Storms

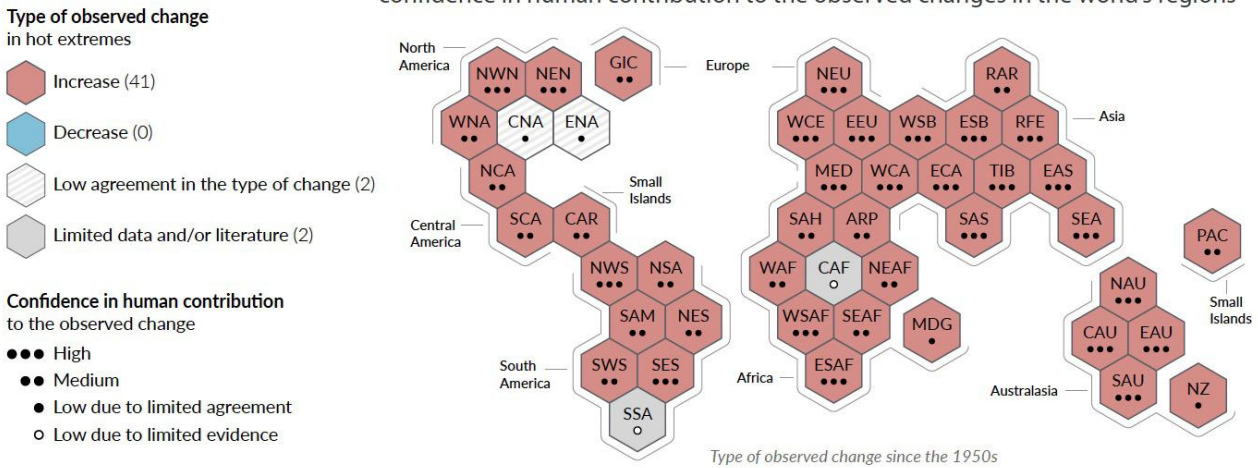

Compound events

- ***Human-induced climate change*** is already affecting many weather and climate extremes in ***every region*** across the globe.
- ***Evidence of observed changes*** in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, ***has strengthened*** since AR5.

Hot Extremes

Climate change is already affecting every inhabited region across the globe with human influence contributing to many observed changes in weather and climate extremes

a) Synthesis of assessment of observed change in **hot extremes** and confidence in human contribution to the observed changes in the world's regions

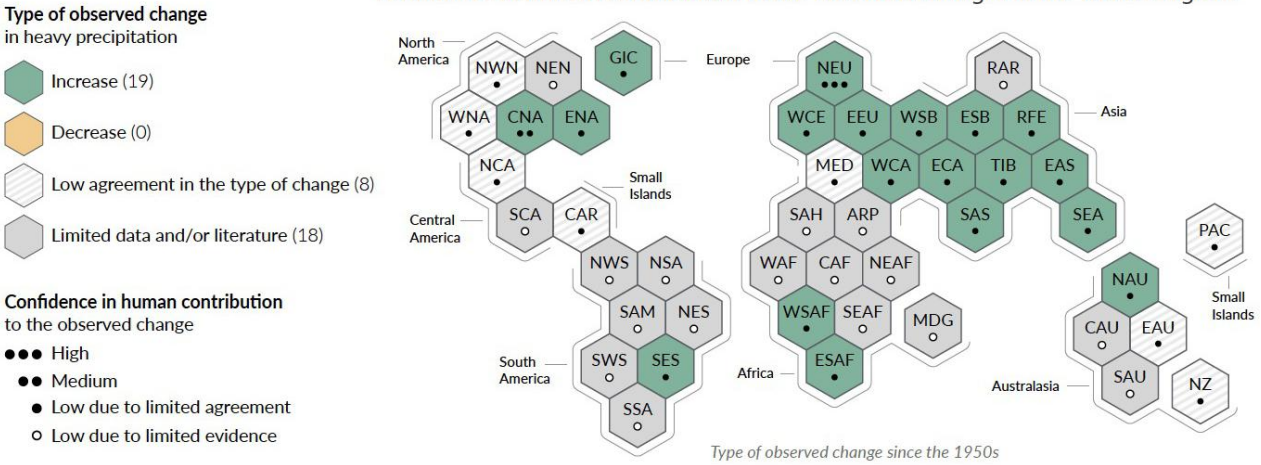


Some recent hot extremes observed over the past decade would have been extremely *unlikely* to occur without human influence on the climate system.

Heavy Precipitation

Climate change is already affecting every inhabited region across the globe with human influence contributing to many observed changes in weather and climate extremes

b) Synthesis of assessment of observed change in **heavy precipitation** and confidence in human contribution to the observed changes in the world's regions

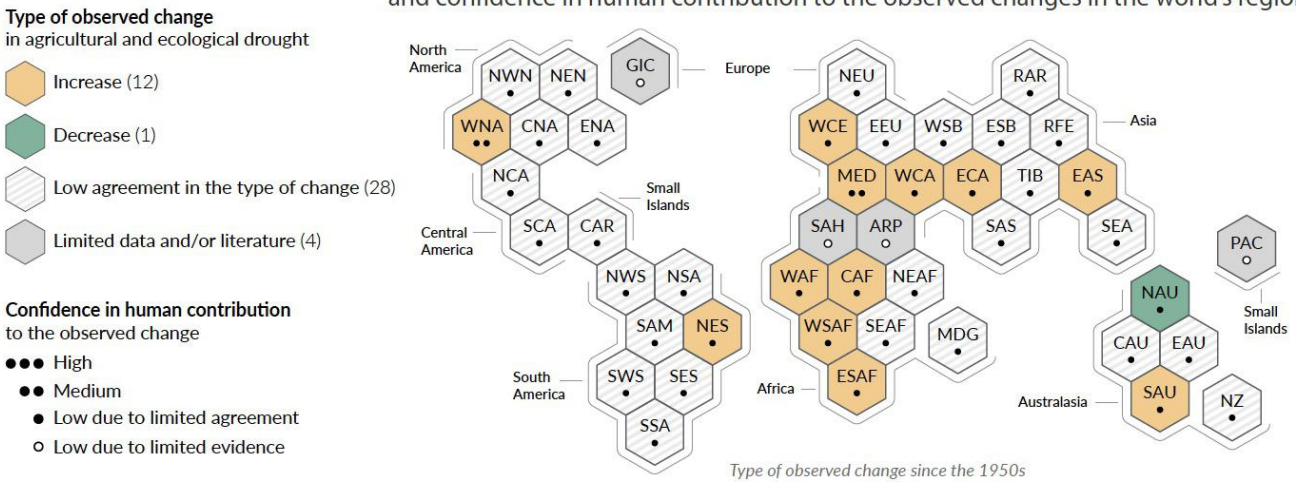


Human influence, in particular greenhouse gas emissions, is *likely* the main driver of the observed global scale intensification of heavy precipitation in land regions.

Drought

Climate change is already affecting every inhabited region across the globe with human influence contributing to many observed changes in weather and climate extremes

c) Synthesis of assessment of observed change in **agricultural and ecological drought** and confidence in human contribution to the observed changes in the world's regions



Human-induced climate change has contributed to increases in agricultural and ecological droughts in some regions due to evapotranspiration increases *(medium confidence)*.

Compound Extremes

- In some situations, phenomena causing severe impacts go well beyond a single extreme event or a single climate variable
- Can include interaction of climatic conditions, such as
  - Sea level rise and storm surges
  - Precipitation in combination with strong winds
  - Drought and heatwave
  - Flood and sea level rise
- Increasing trend observed
- Indian coast will be under the combined threat of increasing cyclones+ extreme rainfall + storm surge + sea level rise

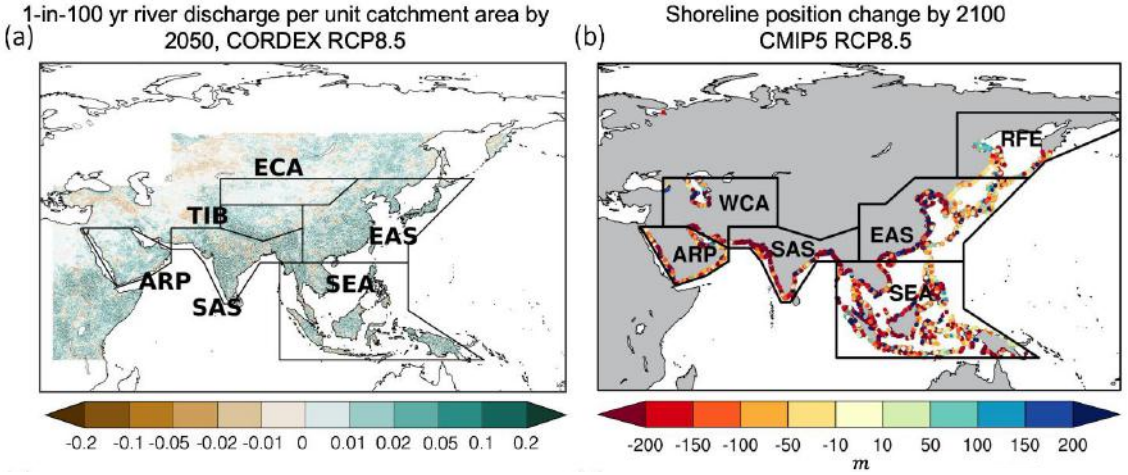
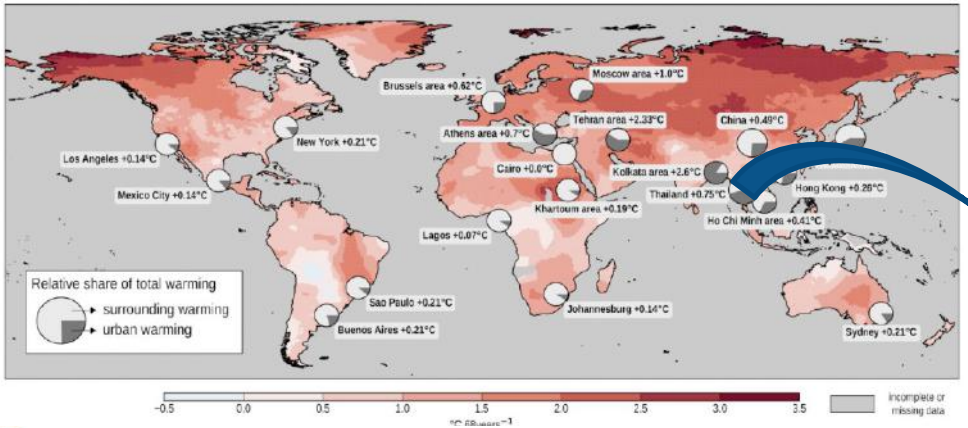
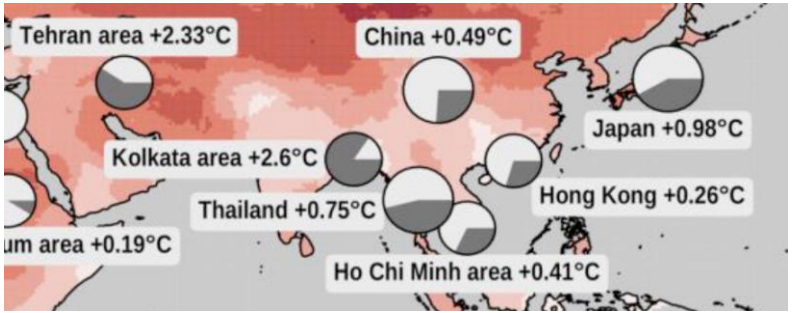


Figure 12.6

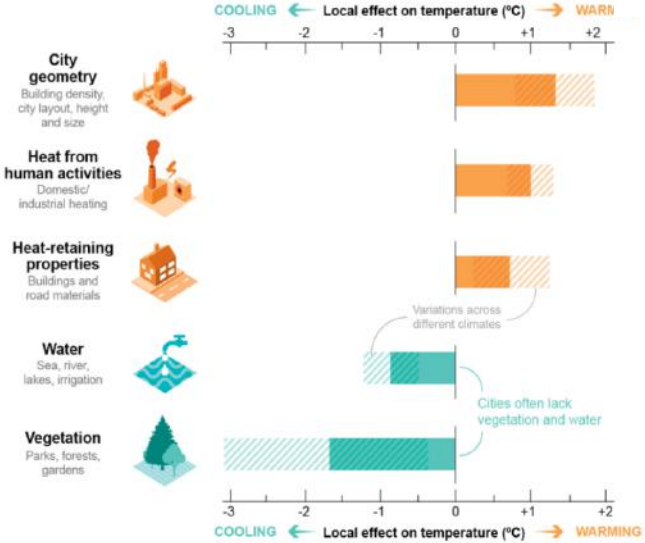
Urban Climate



Box 10.3 Figure 1



FAQ 10.1, Figure 2

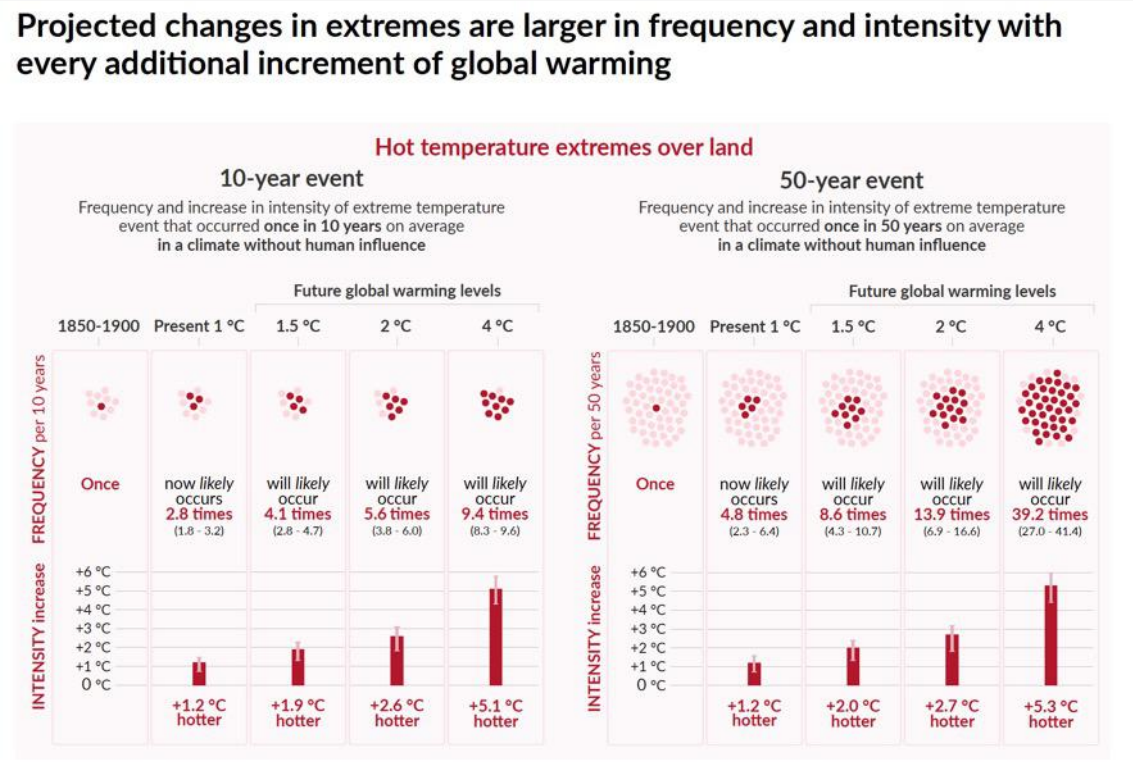


Urbanization intensifies extreme precipitation, especially in the afternoon and early evening, over the urban area and its downwind region

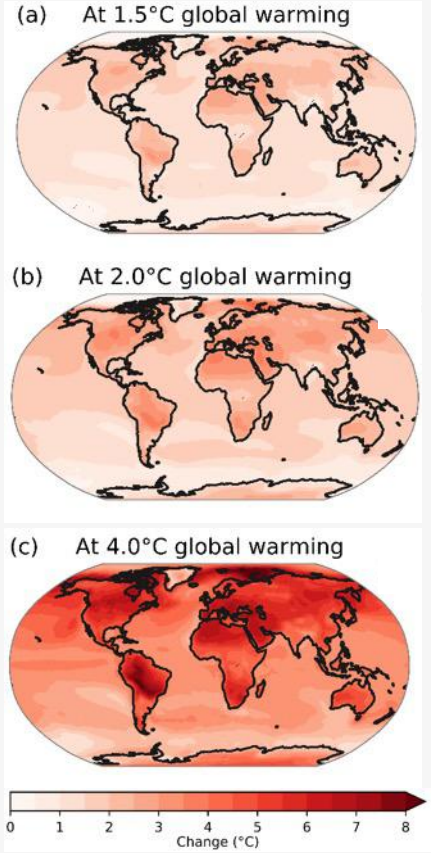
[Credit: Yoda Adaman | Unsplash]

> 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.

Projected Hot Extremes



Annual maximum temperature



Cross-Chapter Box 11.1 Fig. 3

“Every additional 0.5°C of global warming causes clearly discernible increases in the intensity and frequency of hot extremes, including heatwaves.

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Projected Heavy Precipitation and Drought

Projected changes in extremes are larger in frequency and intensity with every additional increment of global warming

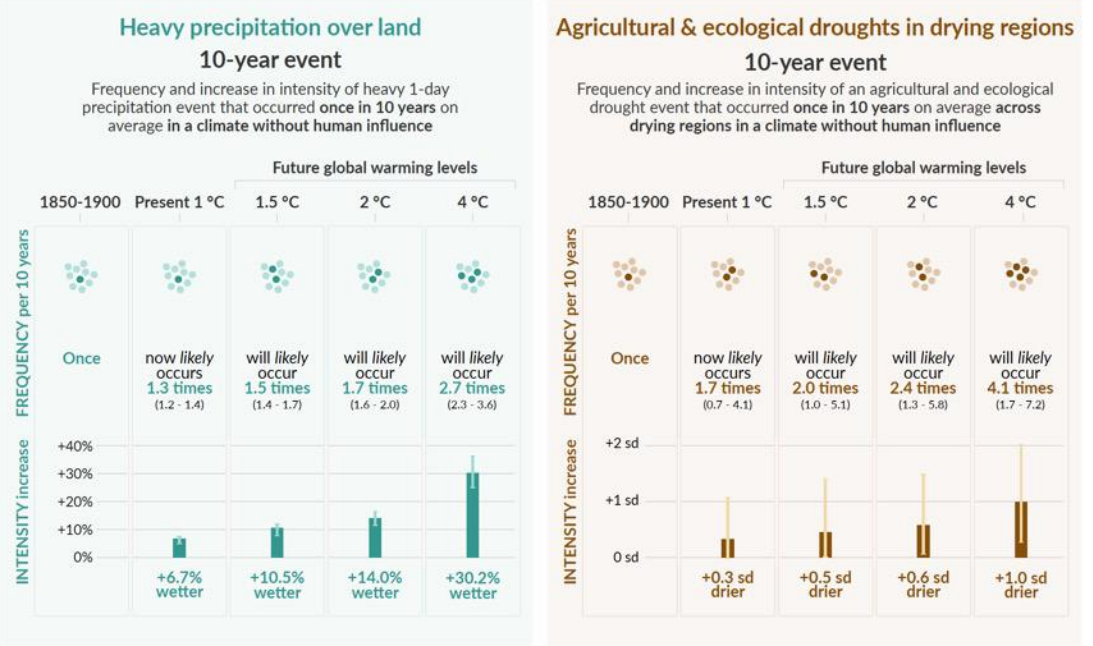
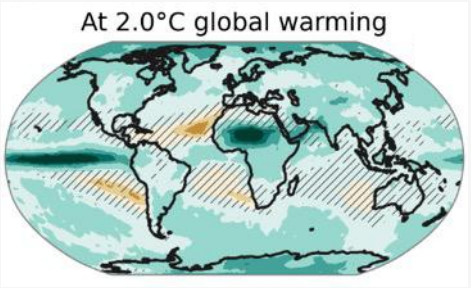
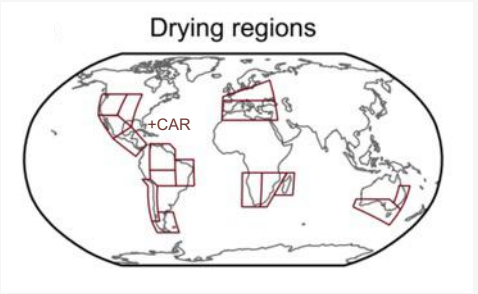


Fig. SPM.6

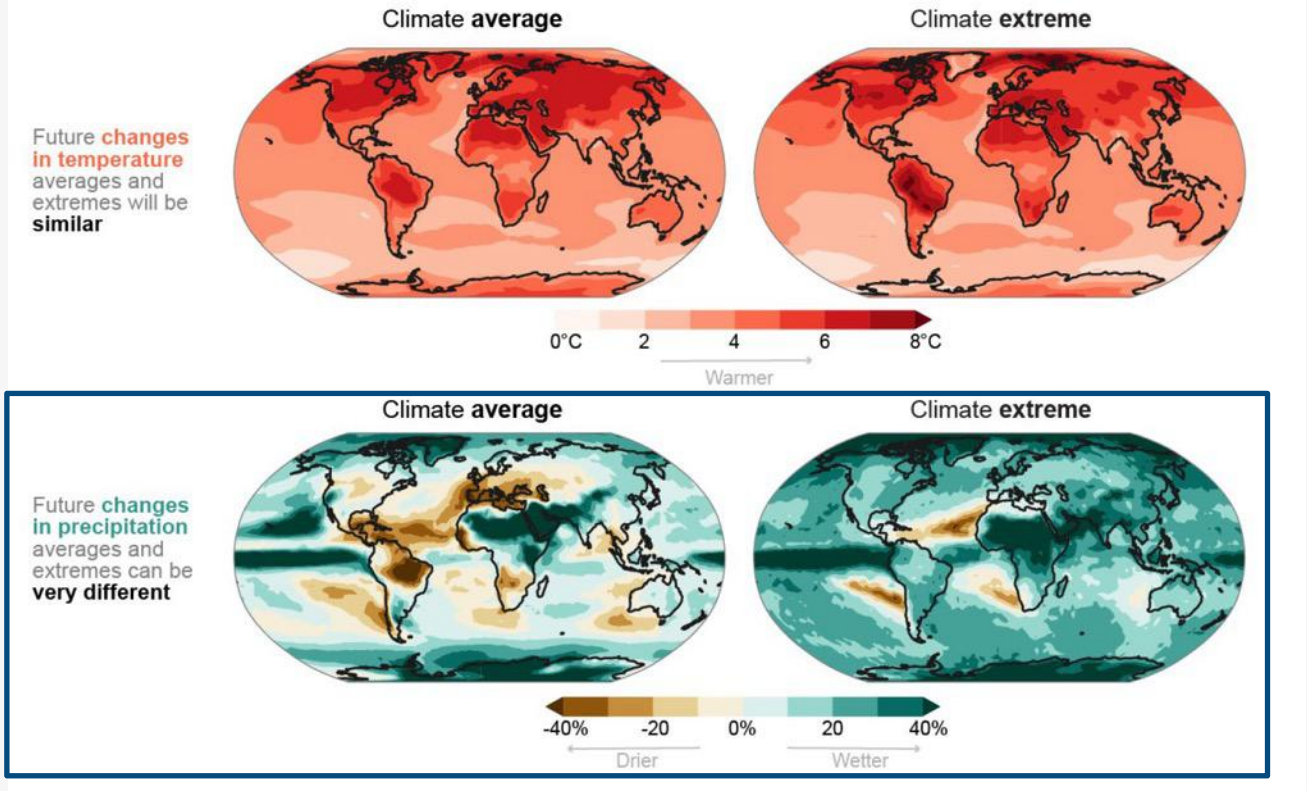
Annual maximum daily precipitation change (Rx1day)



Regions with assessed drying at 2°C of global warming



Projected changes in extremes vs means

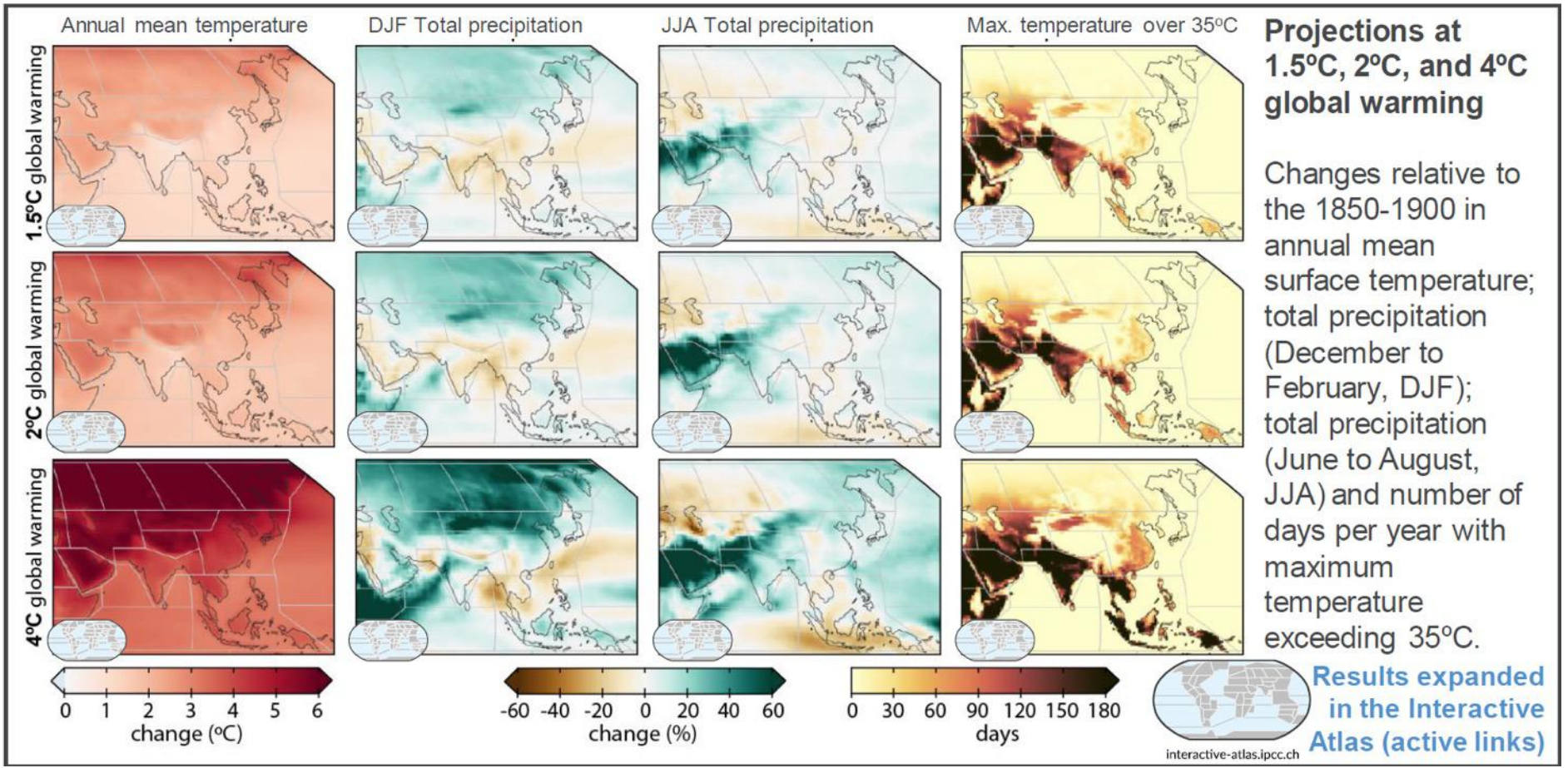


FAQ 11.1 Fig. 1

[Credit: Hong Nguyen | Unsplash]

“Climate change is already affecting every region on Earth, in multiple ways.

The changes we experience will increase with further warming.



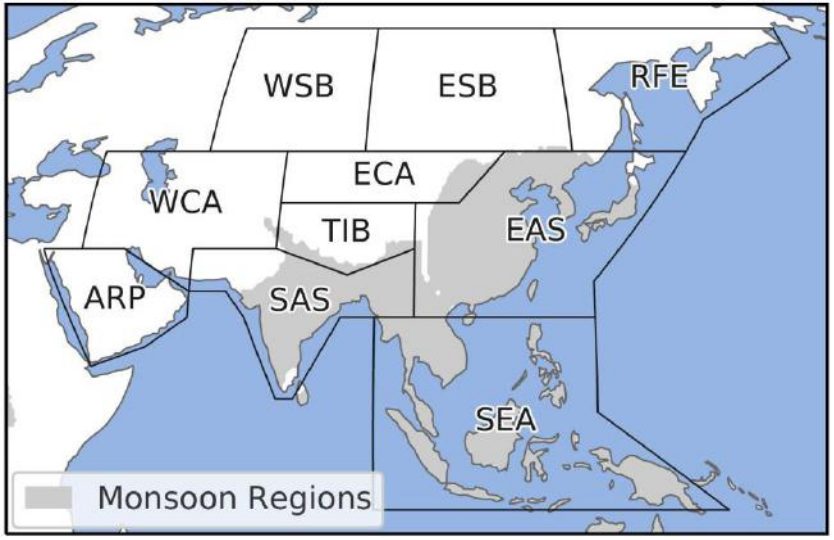
Projections at 1.5°C, 2°C, and 4°C global warming

Changes relative to the 1850-1900 in annual mean surface temperature; total precipitation (December to February, DJF); total precipitation (June to August, JJA) and number of days per year with maximum temperature exceeding 35°C.

Results expanded in the Interactive Atlas (active links)

Key Messages for South Asia

- The South Asian monsoon has ***weakened*** in the second half of the 20th century (high confidence). The dominant cause of the observed decrease of South and Southeast Asian monsoon precipitation since mid-20th century is ***anthropogenic aerosol forcing***.
- Heatwaves and humid heat stress will be more ***intense and frequent*** during the 21st century.
- Extreme precipitation ***has increased and will increase*** in the future.
- Droughts have increased (medium confidence), however the ***future changes have low confidence*** due to poor model performances.

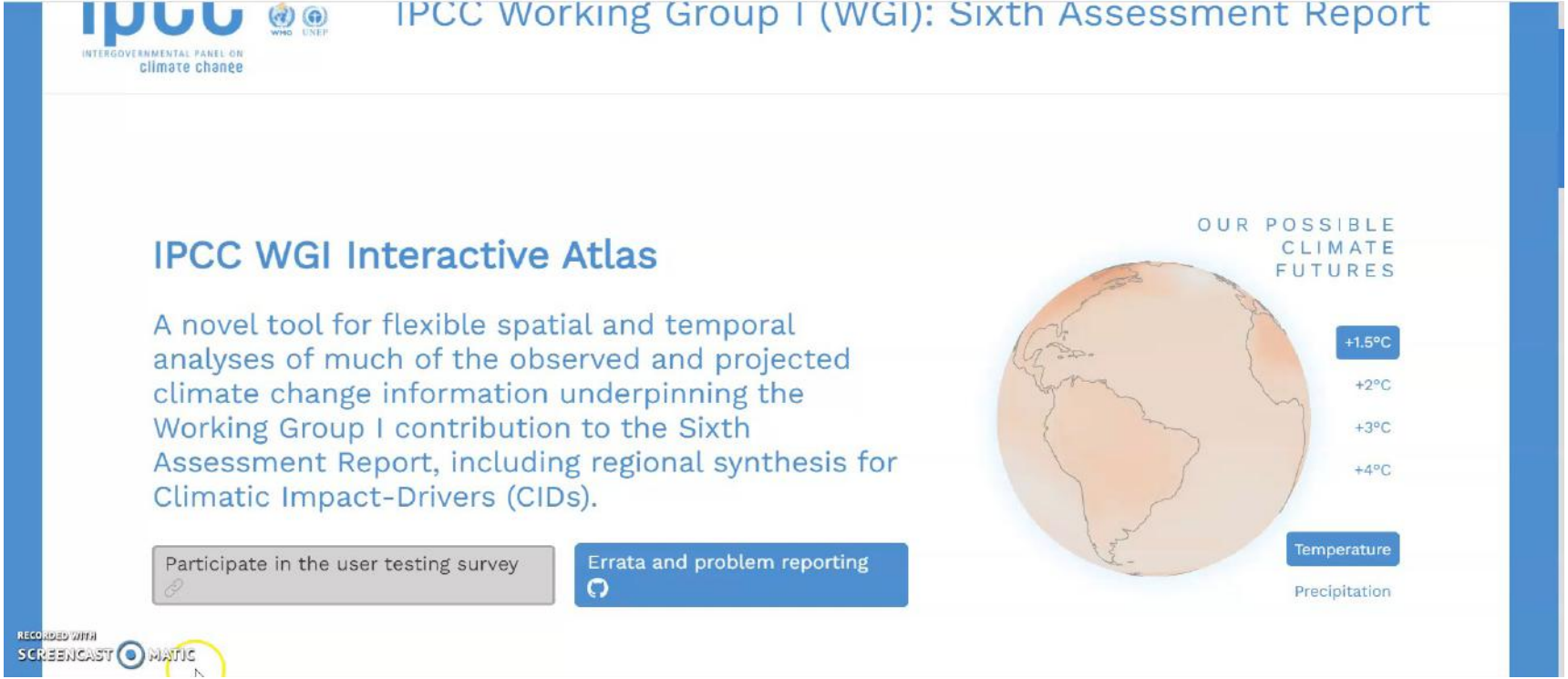


South Asia (SAS)

- Heat waves and humid heat stress will be more intense and frequent during the 21st century (medium confidence).
- Both annual and summer monsoon precipitation will increase during the 21st century, with enhanced interannual variability (medium confidence).

Interactive Atlas

- https://interactive-atlas.ipcc.ch/



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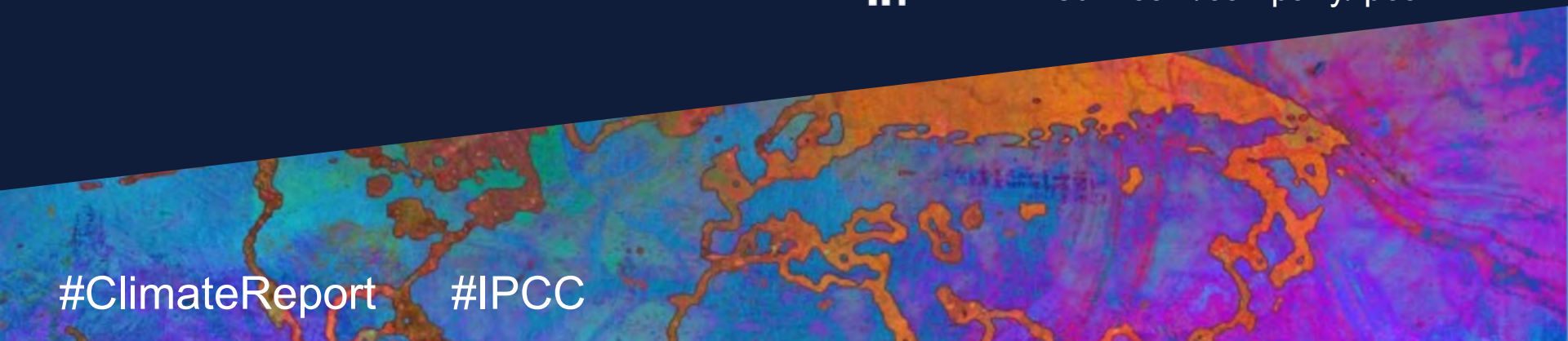

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