

Chapter outline of the Working Group I contribution to the IPCC Sixth Assessment Report (AR6)

Approved at the 46th Session of the IPCC, Montreal, Canada

Annex I: Recommendations for consideration by chapter author teams

Annex II: Tracked changes from the WGI outline proposal from the AR6 WGI Scoping Meeting

Summary for Policy Makers

Technical Summary

Chapter 1:

Framing, context, methods

Executive Summary

- Synthesis of key findings from AR5 and earlier assessment reports, and connections to AR6 Special Reports
- Framing of the physical science information relevant for mitigation, adaptation, and risk assessment in the context of the Global Stocktake
- Assessment approach
- Observational and reanalysis developments since the AR5
- Model and experimental design developments since the AR5
- Emissions and forcing scenarios
- Treatment and evaluation of uncertainty throughout the report

Frequently Asked Questions

Chapter 2:

Changing state of the climate system

Executive Summary

- Multi-millennial context, pre-industrial to present day
- Natural and anthropogenic forcings
- Radiative forcing
- Large-scale indicators of observed change in the atmosphere, ocean, cryosphere, land, and biosphere
- Modes of variability

Frequently Asked Questions

Chapter 3:

Human influence on the climate system

Executive Summary

- Overview of model performance and development since the AR5
- Simulated large-scale indicators of change in the atmosphere, ocean, cryosphere, land, and biosphere
- Simulated modes of variability
- Natural variability versus anthropogenically-forced change
- Attribution of large-scale observed changes

Frequently Asked Questions

Chapter 4:

Future global climate: scenario-based projections and near-term information

Executive Summary

- Projections of global mean surface temperature and other key global indicators
- Evaluation of multi-model ensemble methods
- Large scale patterns of climate change
- Committed climate response, climate targets, overshoot, irreversibility, abrupt change
- Climate response to greenhouse gas removal scenarios
- Climate response to solar radiation management scenarios
- Interplay between internal variability and response to forcings, including short-lived forcings
- Variability and unexpected changes of global mean surface temperature
- Near-term predictability, sources and capabilities
- Synthesis of climate information in the near-term

Frequently Asked Questions

Chapter 5:

Global carbon and other biogeochemical cycles and feedbacks

Executive Summary

- Feedbacks between climate and biogeochemical cycles, including paleoclimate information
- Ocean acidification
- Historical trends and variability of CO₂, CH₄ and N₂O; sources and sinks
- Projections of global biogeochemical cycles from near-term to long-term
- Abrupt change, irreversibility
- Model evaluation, emergent constraints
- Transient climate response to cumulative emissions and remaining carbon budgets for climate targets
- Biogeochemical implications of land and coastal management mitigation options and greenhouse gas removal
- Biogeochemical implications of solar radiation management scenarios

Frequently Asked Questions

Chapter 6:

Short-lived climate forcings

Executive Summary

- Key emissions: global overview, natural, anthropogenic, historical and scenarios
- Observed and reconstructed concentrations and radiative forcing
- Direct and indirect-aerosol forcing
- Implications for greenhouse gas lifetimes
- Implications of different socio-economic and emission pathways, including urbanisation, for radiative forcing
- Connections to air quality and atmospheric composition

Frequently Asked Questions

Chapter 7:

The Earth's energy budget, climate feedbacks, and climate sensitivity

Executive Summary

- Energy budget and its changes through time
- Radiative forcing: definitions, estimates, and its representation in models
- Climate feedbacks
- Sensitivity of the climate system: methods and uncertainty
- Empirical constraints on the sensitivity of the climate system, including paleoclimate
- Global warming potential, global temperature change potential, and other metrics

Frequently Asked Questions

Chapter 8:

Water cycle changes

Executive Summary

- Observations, models, methods and their reliability
- Past, present and projected changes, trends, variability and feedbacks in the physical components of the water cycle
- Circulation, processes and phenomena (e.g. monsoon systems) affecting moisture and precipitation patterns, including extremes
- Cloud-aerosol processes affecting the water cycle
- Changes in seasonality of natural storage and water availability
- Abrupt change
- Confidence in projections

Frequently Asked Questions

Chapter 9:

Ocean, cryosphere, and sea level change

Executive Summary

- Past and future changes in ocean circulation and properties (trends, variability and extremes)
- Past and future changes in marine and terrestrial cryosphere
- Evaluation of models and projection methods
- Detection and attribution
- Past global and regional sea level changes
- Projections of global and regional sea level change
- Abrupt change and long-term commitment
- Extreme water levels (tides, surge and ocean waves)

Frequently Asked Questions

Chapter 10:

Linking global to regional climate change

Executive Summary

- Regional phenomena, drivers, feedbacks and teleconnections
- Regional scale observations and reanalyses
- Interplay between internal variability and forced change at the regional scale, including attribution
- Evaluation of model improvements, methods, including downscaling and bias adjustment and regional specificities
- Confidence in regional climate information, including quantification of uncertainties
- Scale specific methodologies e.g. urban, mountains, coastal, catchments, small islands
- Approaches to synthesizing information from multiple lines of evidence

Frequently Asked Questions

Chapter 11:

Weather and climate extreme events in a changing climate

Executive Summary

- Extreme types, encompassing weather and climate timescales and compound events (including droughts, tropical cyclones)
- Observations for extremes and their limitations, including paleo
- Mechanisms, drivers and feedbacks leading to extremes
- Ability of models to simulate extremes and related processes
- Attribution of changes in extremes and extreme events
- Assessment of projected changes of extremes and potential surprises
- Case studies across timescales

Frequently Asked Questions

Chapter 12:

Climate change information for regional impact and for risk assessment

Executive Summary

- Framing: physical climate system and hazards
- Region-specific integration of information, including confidence
- Information (quantitative and qualitative) on changing hazards: present day, near term and long term
- Region-specific methodologies
- Relationship between changing hazards, global mean temperature change, scenarios and emissions

Frequently Asked Questions

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Options for cross-WG integration including Regional Atlas

Cross Working Group Glossary

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List of Acronyms

List of Contributors

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Annex I

In addition to this proposed revised outline, a list of recommendations for consideration by chapter author teams has been compiled to capture the full range of inputs from the WGI Session:

- Ensuring consistency where topics are addressed in multiple chapters, e.g. Chapter 5 - transient climate response to cumulative emissions - and Chapter 7 - sensitivity of the climate system: methods and uncertainty.
- Need for clear communication and use of non-technical language in Headline Statements and SPM, FAQs, Executive Summaries.
- Consider performing a consultation beyond author teams to identify FAQs
- Facilitate navigation of the report with a clear Index.
- Attention to climate change information related to specific regions, e.g. the Sahel, the Himalayas/Third Pole, Central America.
- Lessons learned from seasonal prediction for regional climate aspects.
- Attention to model reproducibility, e.g. in the context of successive phases of multi-model intercomparison projects (CMIP6 with CMIP5) and in the context of model development, where appropriate in chapters (and in relevant Annexes).
- Treatment of uncertainties as part of the assessment process throughout the report, e.g. for the assessment of multi-model ensemble methods, regional information, water cycle information, transient climate response to cumulative emissions and remaining carbon budgets for climate targets.
- The timeframe of assessment beyond 2100, e.g. for sea level and abrupt change.
- The assessment of SLCFs should include compounds that have warming and cooling effects and cover an appropriate range of timescales.
- A comprehensive assessment of carbon and biogeochemical feedbacks and the natural and anthropogenic sources and sinks, including regional aspects.
- The physical components of the water cycle include biogeophysical processes.
- Consider low probability and high impact extreme events.
- Coastal mitigation options would include, for instance, blue carbon.
- Consider past, present and projected changes, trends, variability and feedbacks in the physical components of the water cycle in the context of the climate system

Annex II

Chapter outline of the Working Group I contribution to the IPCC Sixth Assessment Report (AR6)

TRACKED CHANGES from the WGI Outline proposed from the AR6 WGI Scoping Meeting

The amendments are highlighted in yellow when adding text, and in 'strickethrough' when deleting text.

Summary for Policy Makers

Technical Summary

Chapter 1:

Framing, context, methods

Executive Summary

- Synthesis of key findings from AR5 **and earlier assessment reports**, and connections to AR6 Special Reports
- ~~Framing in the context of the Global Stocktake, mitigation, adaptation, and risk assessment~~
- Framing **of the physical science information relevant for** mitigation, adaptation, and risk assessment **in the context of the Global Stocktake**
- Assessment approach
- Observational and reanalysis developments since the AR5
- Model and experimental design developments since the AR5
- Emissions and forcing scenarios
- Treatment **and evaluation** of uncertainty **throughout the report**

Frequently Asked Questions

Chapter 2:

Changing state of the climate system

Executive Summary

- Multi-millennial context, pre-industrial to present day
- Natural and anthropogenic forcings
- Radiative forcing
- Large-scale indicators of **observed** change in the atmosphere, ocean, cryosphere, land, and biosphere
- Modes of variability

Frequently Asked Questions

Chapter 3:

Human influence on the climate system

Executive Summary

- Overview of model performance and development since the AR5
- Simulated large-scale indicators of change in the atmosphere, ocean, cryosphere, land, and biosphere
- Simulated modes of variability
- Natural variability versus anthropogenically-forced change
- Attribution of large-scale observed changes

Frequently Asked Questions

Chapter 4:

Future global climate: scenario-based projections and near-term information

Executive Summary

- Projections of global mean surface temperature and other key global indicators
- Evaluation of multi-model ensemble methods
- Large scale patterns of climate change
- **Committed climate response** Commitment, climate targets, overshoot, irreversibility, abrupt change
- ~~Response to Greenhouse gas removal and solar radiation management~~
- **Climate** response to greenhouse gas removal **scenarios**
- **Climate** response to solar radiation management **scenarios**
- Interplay between internal variability and forced change **response to forcings, including short-lived forcings**
- Variability and unexpected changes of global mean surface temperature
- Near-term predictability, sources and capabilities
- ~~Responses to short-lived forcings, including volcanoes in context of near term predictability~~
- Synthesis of climate information in the near-term

Frequently Asked Questions

Chapter 5:

Global carbon budgets and other biogeochemical cycles and feedbacks

Executive Summary

- Feedbacks between climate and biogeochemical cycles, including paleoclimate information
- Ocean acidification
- Historical trends and variability of CO₂, CH₄ and N₂O; sources and sinks
- Projections of global biogeochemical cycles from near-term to long-term
- Abrupt change, irreversibility
- Model evaluation, emergent constraints
- Transient climate response to cumulative emissions and remaining carbon budgets for climate targets
- ~~Impacts of mitigation options including greenhouse gas removal and solar radiation management on biogeochemical cycles~~
- **Biogeochemical implications of land and coastal management** mitigation options including greenhouse gas removal
- **Biogeochemical implications** of solar radiation management **scenarios**

Frequently Asked Questions

Chapter 6:

Short-lived climate forcers and air quality

Executive Summary

- Key emissions: natural, anthropogenic, historical and scenarios
- Observed and reconstructed concentrations and radiative forcing
- Direct and indirect-aerosol forcing
- Implications for greenhouse gas lifetimes
- ~~Future air pollution, including cities~~
- ~~Implications of different shared socio-economic pathways~~
- Implications of different socio-economic **and emission** pathways, **including urbanisation, for radiative forcing and air quality**
- **Connections to air quality and atmospheric composition**

Frequently Asked Questions

Chapter 7:

The Earth's energy budget, climate feedbacks, and climate sensitivity

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- Energy budget and its changes through time
- Radiative forcing: definitions, estimates, and its representation in models
- Climate feedbacks
- Sensitivity of the climate system: methods and uncertainty
- Empirical constraints on the sensitivity of the climate system, including paleoclimate
- Global warming potential, global temperature change potential, and other metrics

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Chapter 8:

Water cycle changes

Executive Summary

- Observations, models, methods and their reliability
- Past, present and projected changes, trends, variability and feedbacks in the **physical components of the** water cycle
- ~~Circulation, processes and phenomena affecting moisture and precipitation patterns (e.g. cloud-aerosol processes, monsoon)~~
- ~~Extremes~~
- Circulation, processes and phenomena (e.g. cloud-aerosols, monsoon **systems**), affecting moisture and precipitation patterns, **including extremes**
- **cloud-aerosol processes affecting the water cycle**
- Changes in seasonality of natural storage and water availability
- Abrupt change
- Confidence in projections

Frequently Asked Questions

Chapter 9:

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- Past and future changes in ocean circulation and properties (trends, variability and extremes)
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Chapter 10:

Linking global to regional climate change

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- Regional scale observations and reanalyses
- Interplay between internal variability and forced change at the regional scale, including attribution
- Evaluation of *model improvements*, methods, including downscaling and bias adjustment *and regional specificities*
- Confidence in regional climate information, including quantification of uncertainties
- Scale specific methodologies e.g. urban, mountains, coastal, catchments, *small islands*
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Chapter 11:

Weather and climate extreme events in a changing climate

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- Event types ~~definitions~~ *encompassing* weather and climate timescales and compound events *(including droughts, tropical cyclones)*
- Observations for extremes and their limitations, including paleo
- Mechanisms, drivers and feedbacks leading to extremes
- Ability of models to simulate extremes and related processes
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