Knowledge gaps related to observation systems: IPCC AR6 WG1

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ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Talk outline

- Structure of WG1 in AR6
- Handshakes to later WGs
- Observational needs for WG1 report
- Observational shortcomings and open questions
- Immediate needs
- Timeline

Approved outline

Summary for Policy Makers
Technical Summary

Large-scale climate change

Chapter 1: Framing, context, methods
Chapter 2: Changing state of the climate system
Chapter 3: Human influence on the climate system
Chapter 4: Future global climate: scenario-based projections and near-term information
Chapter 5: Global carbon and other biogeochemical cycles and feedbacks
Chapter 6: Short-lived climate forcers
Chapter 7: The Earth's energy budget, climate feedbacks, and climate sensitivity
Chapter 8: Water cycle changes
Chapter 9: Ocean, cryosphere, and sea level change
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

Annexes incl. a Regional Atlas and Technical Annexes
Glossary

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Climate processes

Annexes incl. a Regional Atlas and Technical Annexes
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Regional climate information

Annexes incl. a Regional Atlas and Technical Annexes
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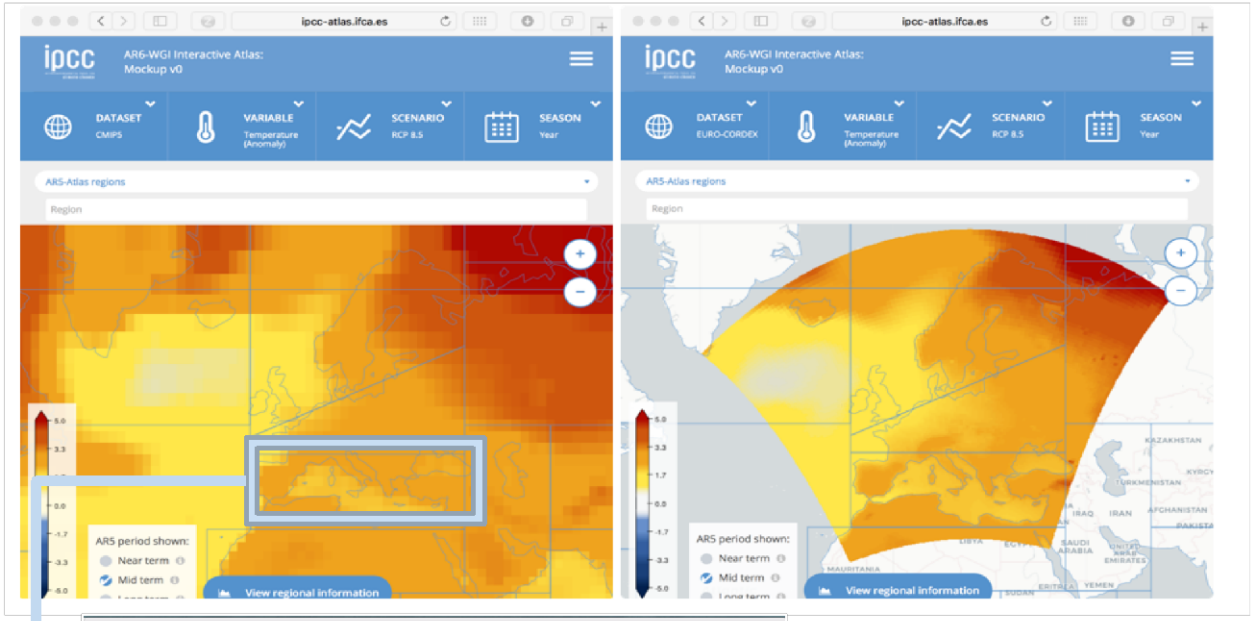
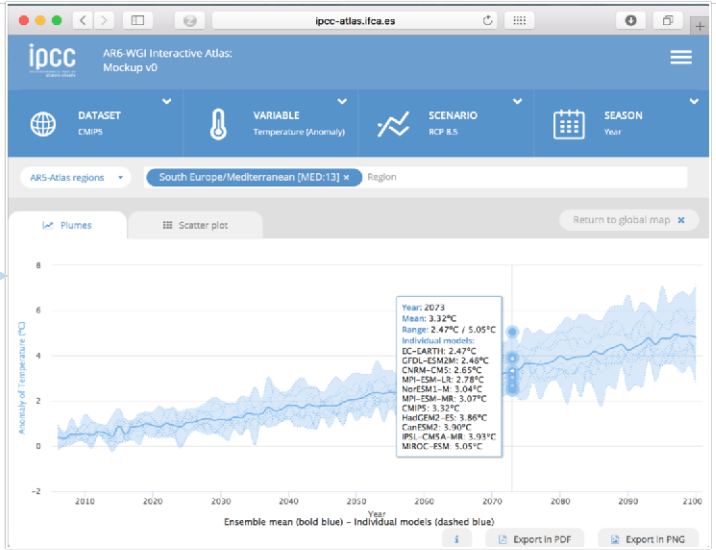
The IPCC-AR6 Interactive Atlas (➔ FoD)





Visuals:

New options for regional information (PDFs, annual cycle, ...).

Datasets:

Focusing on **CMIP5** and **CORDEX** data.

Variables/indices:

- Temp. and precip.
- **Indices (hazards)**

Pre-defined flexibility:

- Seasons
- Regions
- Scenarios:
  - RCP 2.6, 4.5, 8.5
  - **Warming 1.5, 2, 3º**
- **Baselines**

http://ipcc-atlas.ifca.es

Observational needs for WG1

- To support the equivalent statement this time around to change being unequivocal Chapter 2 need:
    - Long term datasets of key indicators
    - Paleo evidence of those same indicators wherever available to provide context of unusualness

- To support the process based chapters 5-9 we need:
    - Globally comprehensive datasets
    - Physical consistency of products across ECVs

- To support regional chapters 10-12 and Atlas we need:
    - Regional detail
    - Information on extremes as well as mean state changes

What observations will be used?

- Paleo proxy based estimates
- In-situ based datasets
- Satellite products
- Reanalyses including 20th Century reanalyses
- Blended products

- All used products must have a peer reviewed publication basis
- Cut off for submission is Dec 31st (yes, I know …)

Selection of 'Global' indicators

Selected large-scale indicator of climate change	Used in Chapters			Additional regional or process-based assessments undertaken in chapters
	2	3	4	
Atmosphere				
Surface and upper air temperatures				7,11,12, Atlas
Hydrological cycle components (surface humidity, PWV, Precipitation, streamflow, E-P)				8, 11, Atlas
Tropospheric circulation (Sea level pressure and winds, Hadley / Walker circulation, global monsoons, blocking, storm tracks and jets)				11
Stratospheric circulation (sudden stratospheric warmings, QBO, Brewer Dobson circulation, zonal winds)				11
Cryosphere				
Sea-ice extent/area and thickness			Only Arctic	9
Seasonal snow cover (extent, duration, depth)				9
Glacial mass				9
Ice sheet mass				9
Permafrost				5,9
Oceans				
Temperature / Heat Content				9
Salinity				9
Sea-level				9
Circulation				
Biosphere				
Atmospheric CO_2 including changes in seasonal cycles of growth rates				5
Ocean CO_2 / O_2				5
Ocean pH				5
Ocean productivity (colour)				
Community assemblages and ranges				
Terrestrial vegetation (LAI, FAPAR, NDVI)				
Growing season				

Box 2.1:

- Introduces spatial scales of consideration in 2-3-4
- Outlines and justifies choice of indicators
- Ditto for modes of variability (not shown)
- Places 2-3-4 in context of downstream chapters

Observational shortcomings and open questions

?

The long (and entirely unsurprising) wish list

- Long-term observations of key indicators
- Improved proxy estimates of key indicators
- Observations of critical processes such as ice sheet dynamics
- Observations in hard to monitor locations (rainforests, polar environments, high mountains, deep oceans)
- Observations at temporal and spatial resolution to provide regionally actionable information
- Continuity of key satellite missions
- Improved reanalyses products
- Better uncertainty quantification including improved usability (ensemble based products?)

- Some specifics …

Closing the major budgets

- Implicit or explicit in charge of:
  - Chapter 5 (Carbon)
  - Chapter 7 (Energy)
  - Chapter 8 (Hydrological)

- Requires all components to be adequately sampled. Even the smaller components (e.g. sparsity of borehole temperature measurements an issue for energy budget closure)

Rescuing the unknown knowns

- Many observations are not exploited because one of the following applies:
    - They are in hard copy or image format only
    - They are not shared owing to IPR restrictions
    - They are in arcane formats
- These are observations which we have collectively gone to the trouble of making. Why are so many unexploitable in assessment activities such as IPCC?
- The extra costs are small and the potential benefits huge.
- How can we better ensure that we can exploit the historical observations

Seeding knowns into the matrix

- The vast majority of observations we have ever made lack traceability to SI or community standards.
- This yields an irreducible uncertainty as we are effectively chasing a huge number of unknown data issues around a massive and sparse martrix no matter which way we try to do data assessment.
- For the next generation of scientists can we deliberately put in a suite of known values by instigating and maintaining for generations hence carefully managed reference networks with absolute traceability?

GMST or GSAT?

- Since AR5 increasing recognition that SST /= SAT over long-term under transient warming
- Model-based chapters would prefer to use GSAT
- Current estimate is that GMST change needs to be inflated by 5% (3-7%) but it's a low confidence assessment
- At what scales can an adjustment be applied? Is it invariant? Effects of changing sea-ice?
- We need to provide a much stronger basis for this. **This is a critical need**. Anyone with ideas there are a cadre of authors who would be interested in working with you on papers to provide a more rigorous basis. Come talk to me.

Global stocktake

- The AR6 assessment is tasked with informing the global stocktake
- We are presently struggling to clarify how the WG1 should contribute to that. We can definitely do so by:
    - Monitoring the global GHG concentrations
    - Giving an updated assessment of GMST / GSAT
- We assume that parties are looking for national inventory certification in some way shape or form but have very low confidence that current observations can or could enable this?

Next steps

Parochial immediate needs

- If we have experts in the room who may be able to help in return for Contributing Authorship to Chapter 2 in the following ways please see me afterwards:
    - Arise an entirely new section on Ocean productivity (presumably using Ocean colour)
    - Review and revise section on Ocean O2/CO2
    - Review and revise section on Ocean pH
    - Review and revise sections on Ecosystem changes and growing season length
- Note that these would be needed this week!

Timeline

- Please review the FOD (don't wait til the SOD!). Review will be open May-Jun this year. Note that observations are a component of MANY chapters so please review all relevant chapters not just chapter 2.

- SOD will be open for review Mar-Apr of 2020 (but note that our submission is due Jan 12th 2020 so don't complain about numbers not through 2019!)

- Final report will appear early 2021

- Literature cutoffs are Dec 2019 (submission) and Jun 2020 (acceptance) and please please please remember we can't use your work if it isn't published in the peer reviewed literature!