Climate change scenarios in context of the less than 2C global temperature target

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Background and premises

Science-policy dialogue and the global response to climate change

- Sendai Framework for Disaster Risk Reduction;
- Sustainable Development Goals;
- UNFCCC COP21 Paris Agreement: Defining moment in the quest to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system and reduce the risks and impacts of climate change.
- To strengthen the global response to the threat of climate change, through holding the increase of global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels.
- UNFCCC issued an invitation to the IPCC to provide a special report in 2018 on the impacts of global warming of 1.5 ºC above pre-industrial levels and related global greenhouse GHG emission pathways.

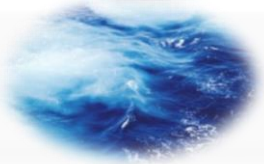
IPCC and the Paris Agreement 2015

IPCC Decision XLIII-5

"To take the outcomes of the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) into consideration when determining the IPCC programme of work and products for the sixth IPCC assessment cycle"

AR6 cycle Special Reports on

impacts of global warming of **1.5 ºC** above pre-industrial levels and related global greenhouse gas emission pathways by 2018



Climate change and **oceans** and the **cryosphere**

Climate change, **desertification**, **land degradation**, **sustainable land management**, **food security**, and **greenhouse gas fluxes in terrestrial ecosystems**

The Paris Agreement poses some challenges

Controversy with the 1.5 °C global temperature target

- Feasibility of the 1.5 °C objective risks to distract needed efforts for the understanding of risks and impacts of more severe warming scenarios between 2 °C and 4 °C. These are more likely to happen than the 1.5 °C, and will require adaptation measures planned well in advance.

Need to reconcile near-term and long-term mitigation pathways

- Greater emission reduction efforts will be required than those associated with the NDCs to hold the increase in global temperature to below 2 °C.
- Paris Agreement does not specify a date for the long-term goal, opening the possibility for overshoot scenarios, whereby global warming would exceed 1.5 °C or 2 °C before being driven down via negative-emission technologies

From Global to Local and Back

- National and global models and scenarios have to be made consistent with one another.

Key concepts to be understood

Radiative forcing

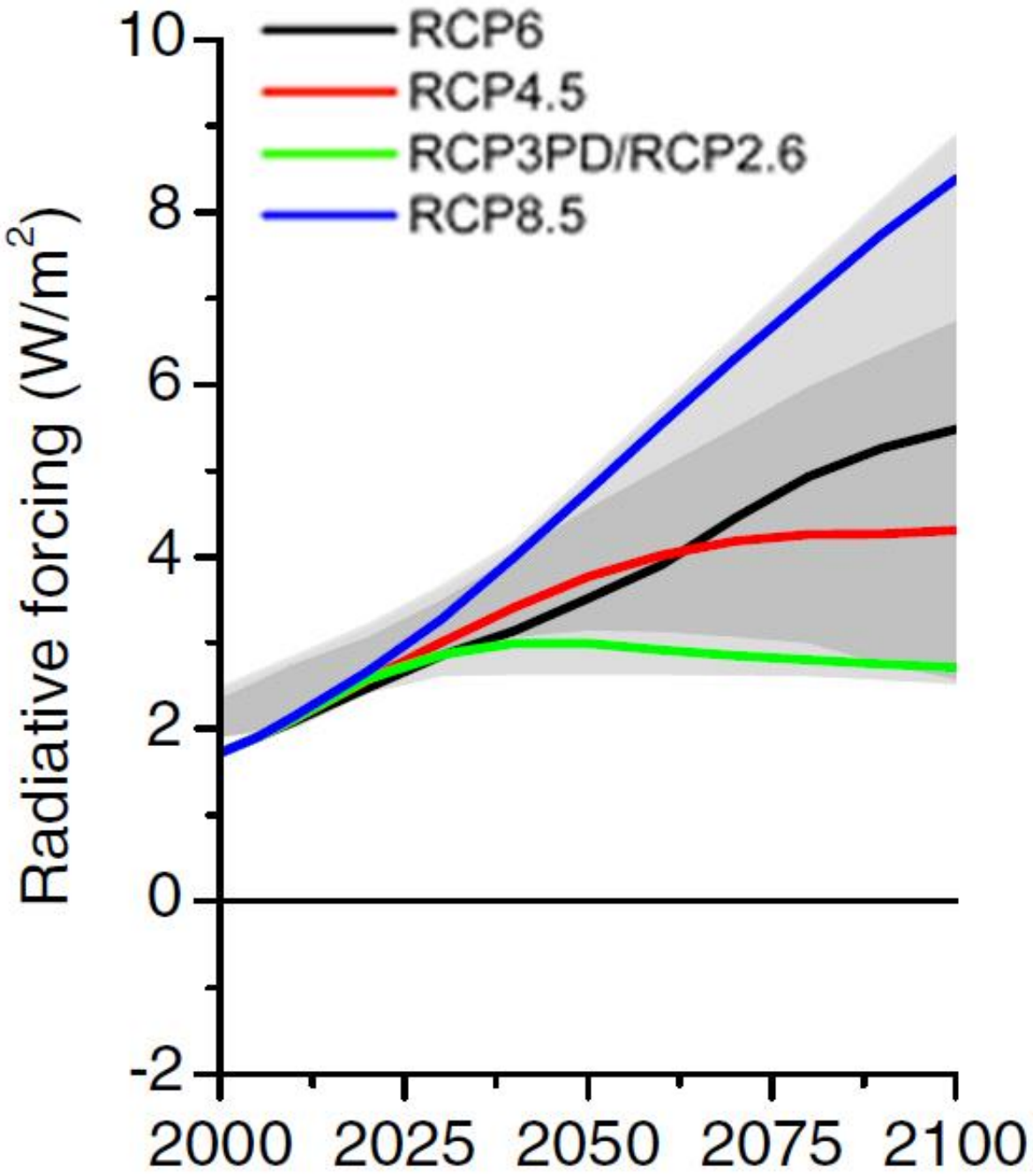
- Change in the net (down minus up) irradiance at the tropopause after allowing for stratospheric temperatures to readjust to radiative equilibrium. Radiative forcing is used to assess and compare the anthropogenic and natural drivers of climate change.

Climate scenarios

- Plausible representation of the future climate, based on an internally consistent set of climatological relationships, that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change.

Scenarios

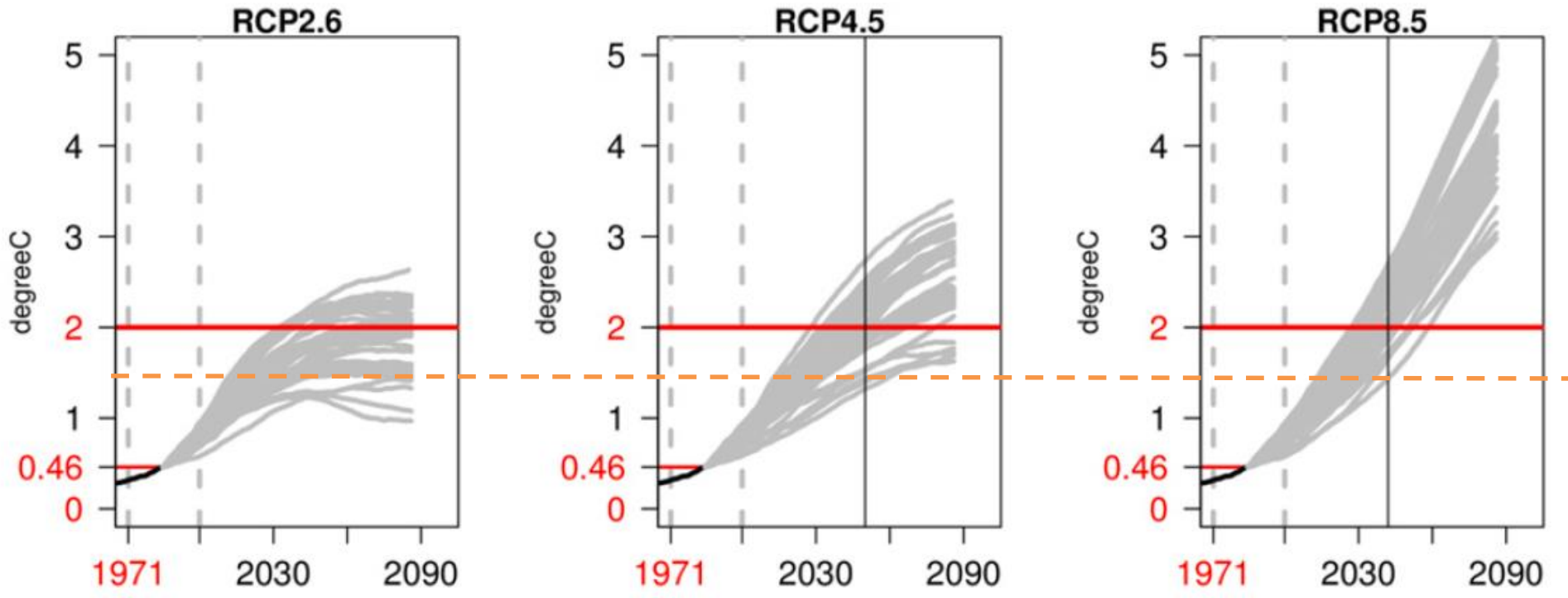
- Storyline that describes a potential future, developed to inform decision making under uncertainty. In AR5 development of IPCC scenarios fundamentally changed with introduction of RCPs (representative concentration pathways) and SSPs (shared socioeconomic pathways)



What is an RCP?

- Four greenhouse gas concentration (not emissions) trajectories adopted by the IPCC for its fifth Assessment Report (AR5) in 2014.
- Supersede Special Report on Emissions Scenarios (SRES) projections published in 2000.

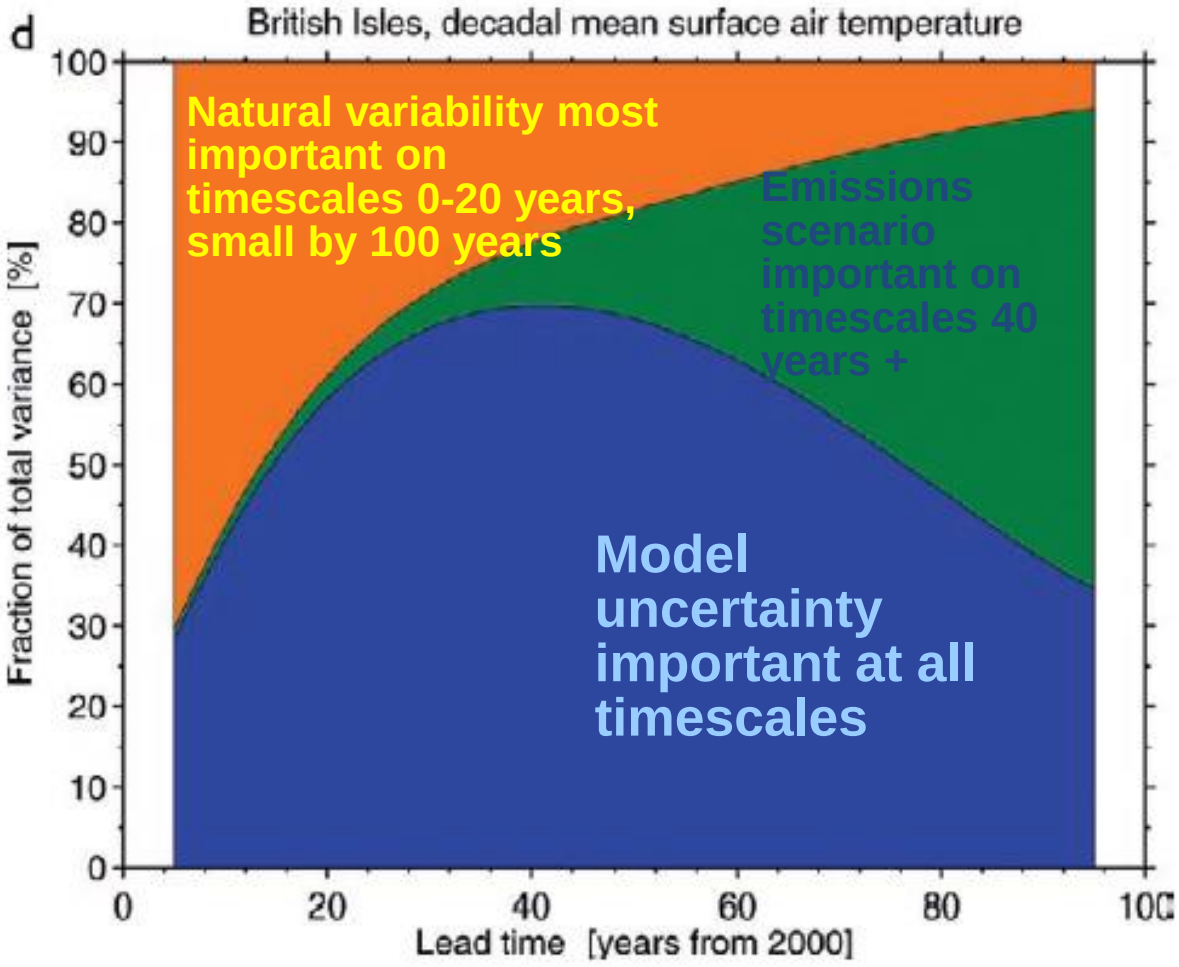
When is global climate likely to reach 1.5C warming above pre-industrial level (IPCC, AR5)?



Vautard et al, ERL, 2014

- Need for large ensembles of simulations (robustness)
- Methodological developments
- New scenario (SSP2.0)
- Research initiatives (HappiMIP)
- Climate sensitivity

Source of uncertainty in climate scenarios



That depends on the timescale that we are looking at…

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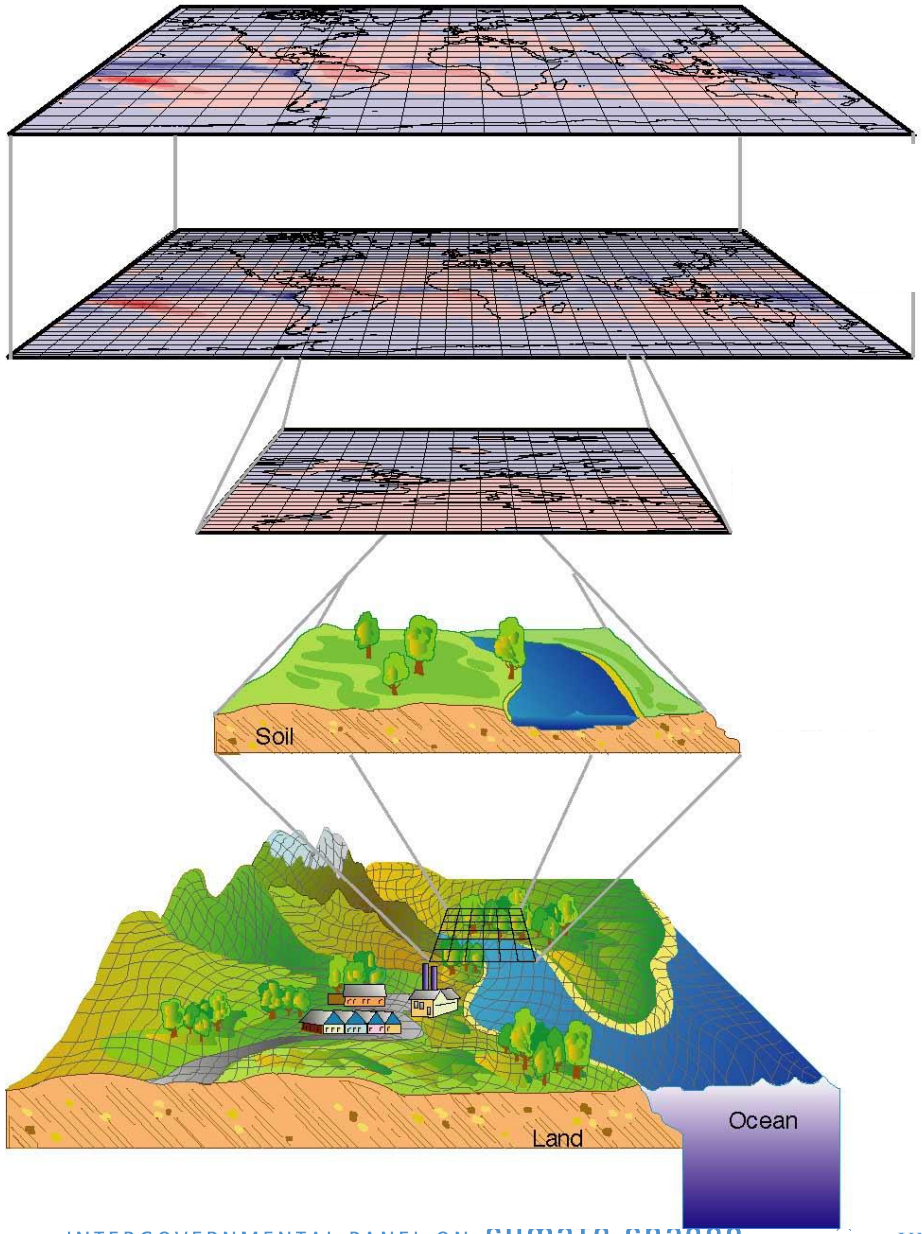
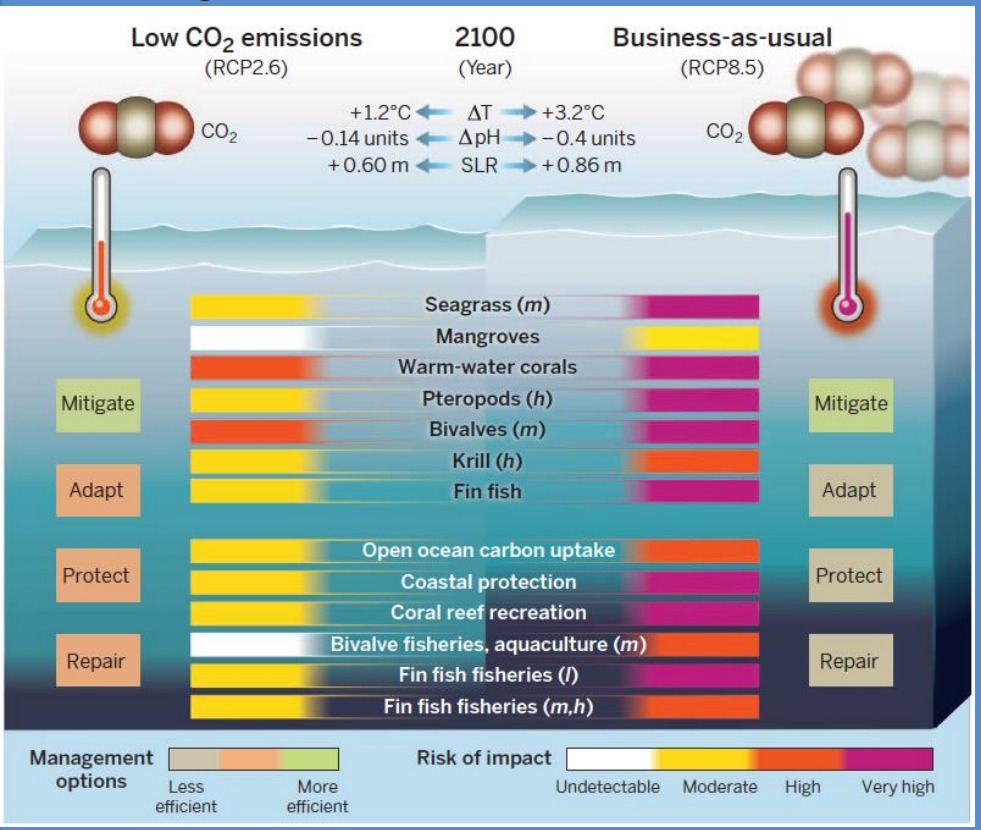
From global to regional climate projections

From GCM grid to regional/local point of interest



Emerging research on the impacts of 1.5˚ C versus 2˚ C

- Risks of catastrophic events
- Unacceptable impacts for vulnerable countries
- Emerging literature revisiting CMIP5 projections for different RCP scenarios through global mean surface temperature change



		1.5 °C	2 °C	
Heat wave (warm spell) duration [month]				
	Global	1.1 [1;1.3]	1.5 [1.4;1.8]	Tropical regions up to 2 months at 1.5 °C or up to 3 months at 2 °C
Reduction in annual water availability [%]				
	Mediterranean	9 [5;16]	17 [8;28]	Other dry subtropical regions like Central America and South Africa also at risk
Increase in heavy precipitation intensity [%]				
	Global	5 [4;6]	7 [5;7]	Global increase in intensity due to warming; high latitudes (>45 °N) and monsoon regions affected most.
	South Asia	7 [4;8]	10 [7;14]	
Global sea-level rise				
	in 2100 [cm]	40 [30;55]	50 [35;65]	1.5 °C end-of-century rate about 30 % lower than for 2 °C reducing long-term SLR commitment.
	2081–2100 rate [mm/yr]	4 [3;5.5]	5.5 [4;8]	
Fraction of global coral reefs at risk of annual bleaching [Constant case, %]				
	2050	90 [50;99]	98 [86;100]	Only limiting warming to 1.5 °C may leave window open for some ecosystem adaptation.
	2100	70 [14;98]	99 [85;100]	
Changes in local crop yields over global and tropical present day agricultural areas including the effects of CO_2-fertilization [%]				
Wheat	Global	2 [-6;17]	0 [-8;21]	Projected yield reductions are largest for tropical regions, while high-latitude regions may see an increase. Projections not including highly uncertain positive effects of CO_2-fertilization project reductions for all crop types of about 10 % globally already at 1.5 °C and further reductions at 2 °C.
	Tropics	-9 [-25;12]	-16 [-42;14]	
Maize	Global	-1 [-26;8]	-6 [-38;2]	
	Tropics	-3 [-16;2]	-6 [-19;2]	
Soy	Global	7 [-3;28]	1 [-12;34]	
	Tropics	6 [-3;23]	7 [-5;27]	
Rice	Global	7 [-17;24]	7 [-14;27]	
	Tropics	6 [0;20]	6 [0;24]	

Schleussner et al, ESR, 2016
Gattuso et al, Science, 2015

Considerations for the AR6

What innovations from previous IPCC assessment cycles?

- Strengthening regional assessment (larger focus on extreme events incl. attribution)
- Enhance involvement of social scientists (perception, indigenous knowledge)
- Inform adaptation strategies including internal variability and response to natural and anthropogenic forcings (e.g. major volcanic eruptions);
- Involve social scientists (perception, indigenous knowledge);
- Increase participation of authors from Developing Countries and Economy in transition;
- Consider stakeholders and end-users needs in scoping

How to contribute to the 1.5C special report?

- Your suggestions for the 1.5°C Special Report are welcome: ***https://www.ipcc.ch/report/sr15/pdf/sr15_prescoping_questionnaire.pdf***

Summary of challenges

- Current level of ambition (NDC) and long-term targets
- Policy discussions on loss and damage
- Ability to assess committed warming, near-term to long-term impacts, and differentiate between natural variability and response to 1.5°C warming

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- Impacts will not only depend on global mean surface temperature change but also on pathway (greenhouse gas emissions, short-lived gases, aerosols, land use)
- Focus on 1.5°C versus added value of assessing incremental risks for different stabilization targets, avoided impacts, and implications for mitigation ambition and rates of transformation, including risks of unconventional mitigation

THANK YOU FOR YOUR ATTENTION!

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