POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

Integrating impacts, mitigation and inequality – state of the art and road ahead

Elmar Kriegler, Franziska Piontek

Leibniz Association

Potsdam Institute for Climate Impact Research (PIK)

Founded in 1992. Total budget 23 M€ in 2018.
Around 315 staff members &
100+ guest researchers

- What we do: Addressing crucial scientific questions in the fields of global change, climate impacts and sustainable development
- Who we are: Researchers from the natural and social sciences, working together to generate interdisciplinary insights and to provide society with sound information for decision making
- How we work: Our main methods are systems and scenario analysis, modelling, computer simulation and data integration.

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Potsdam Institute for Climate Impact Research (PIK)

Directors of PIK:
Ottmar Edenhofer & Johan Rockström

Research Departments

RD1 Earth System Analysis
Oceans, Atmosphere and Biosphere in Past, Present and Future
Stefan Rahmstorf, Wolfgang Lucht

RD2 Climate Resilience
Climate Impacts and Adaptation
Hermann Lotze-Campen, Sabine Gabrysch

RD3 Transformation Pathways
Climate Risks and Sustainable Development
Elmar Kriegler (acting), Katja Frieler (acting)

RD4 Complexity Science
Machine Learning, Nonlinear Methods and Decision Strategies
Jürgen Kurths, Anders Levermann

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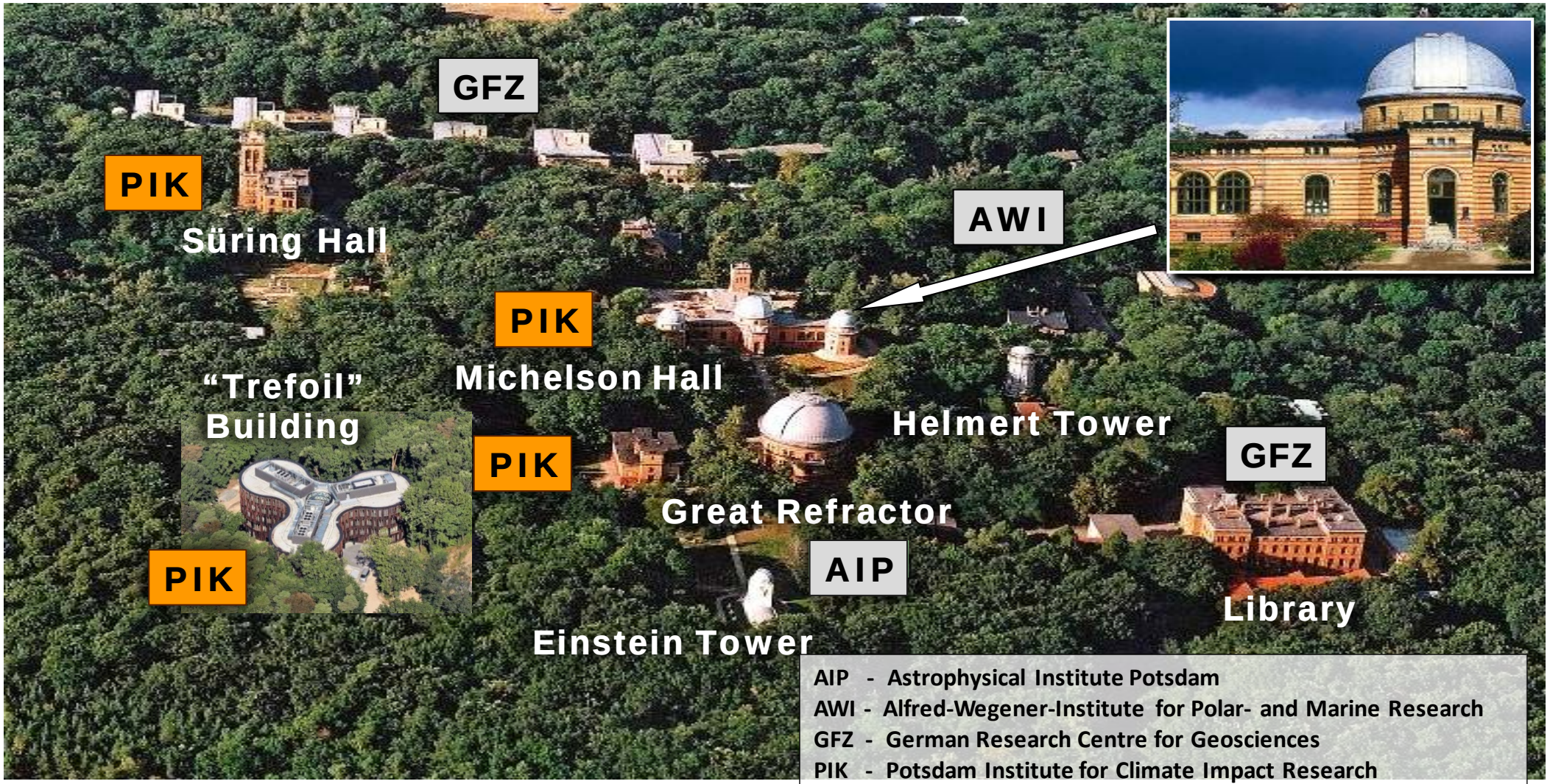
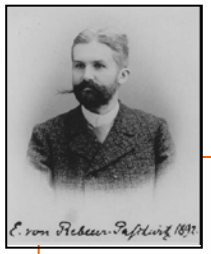
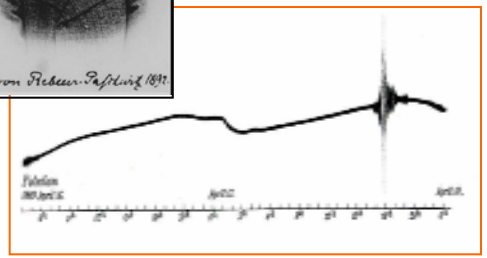
Science Park „Albert Einstein“ at Telegraph Hill



Telegraphenberg: Scientific Breakthroughs



Ernst von Rebeur-Paschwitz
1861-1895



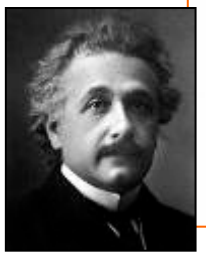
1889 First Record of
Teleseismic Earthquake

1832/33 Opto-Mechanical
Telegraph Line Station
No. 4 Potsdam

Secular Station Potsdam

Reinhard Süring
1866-1950

First Solution of Einstein‘s Equations



Albert Einstein
1879-1955

Karl Schwarzschild
1873-1916

1904 Interstellar Matter
Large Refractor

Johannes Hartmann
1865-1936

Friedrich Robert Helmert
1843-1917

1870-1950 Potsdam Datum Point
Helmert Tower

1881 Michelson Experiment

Albert Abraham Michelson, 1852-1931

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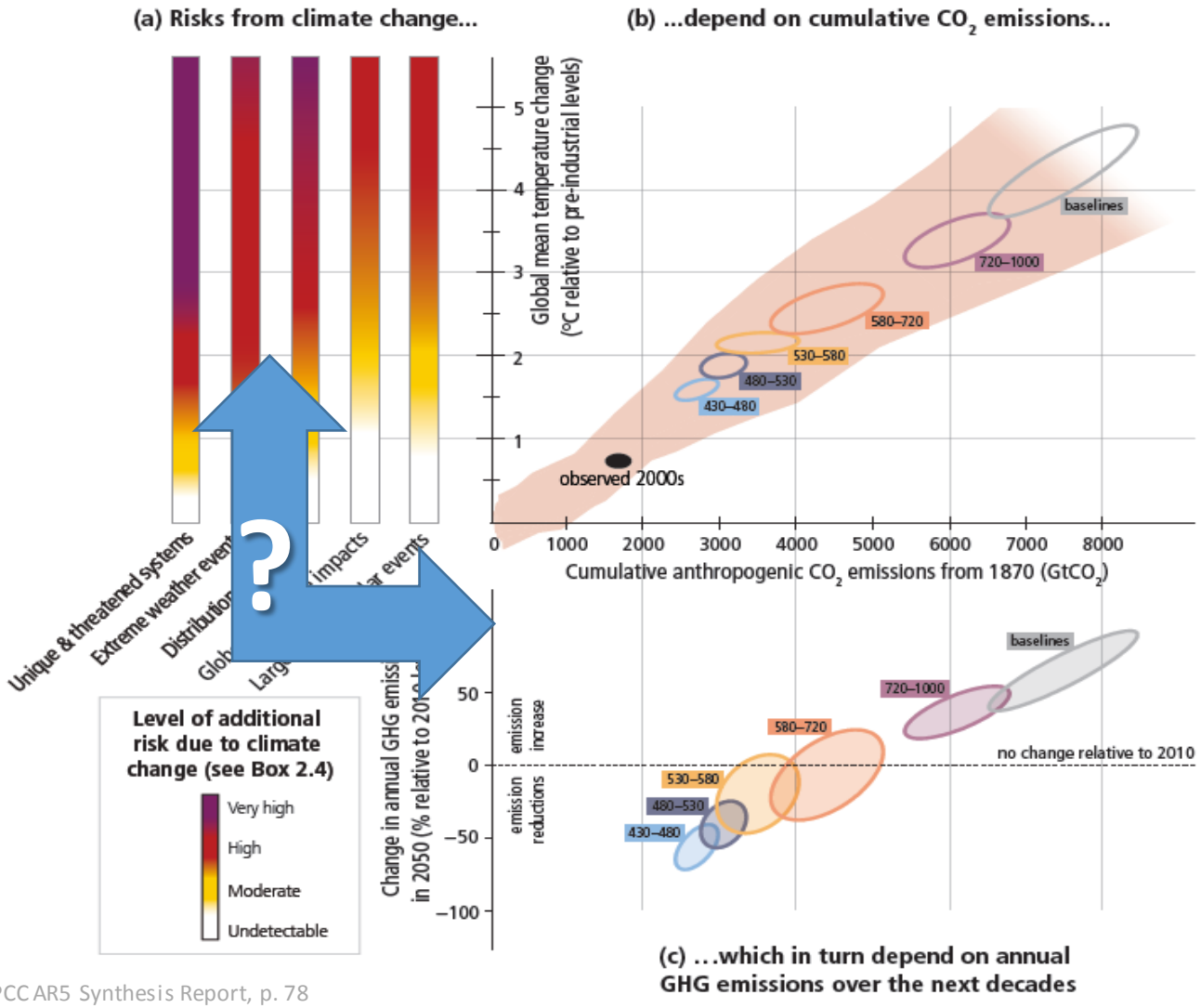
Integrating mitigation and climate impacts has been a challenge for climate change research

We need a more integrated assessment of mitigation, climate impacts and inequality in transformation pathways …



IPCC AR5 Synthesis Report, p. 78

… to better inform societies about the transformational choices they are facing.

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The IPCC is in great need to better integrate mitigation, inequality and impacts in the 6th Assessment Cycle

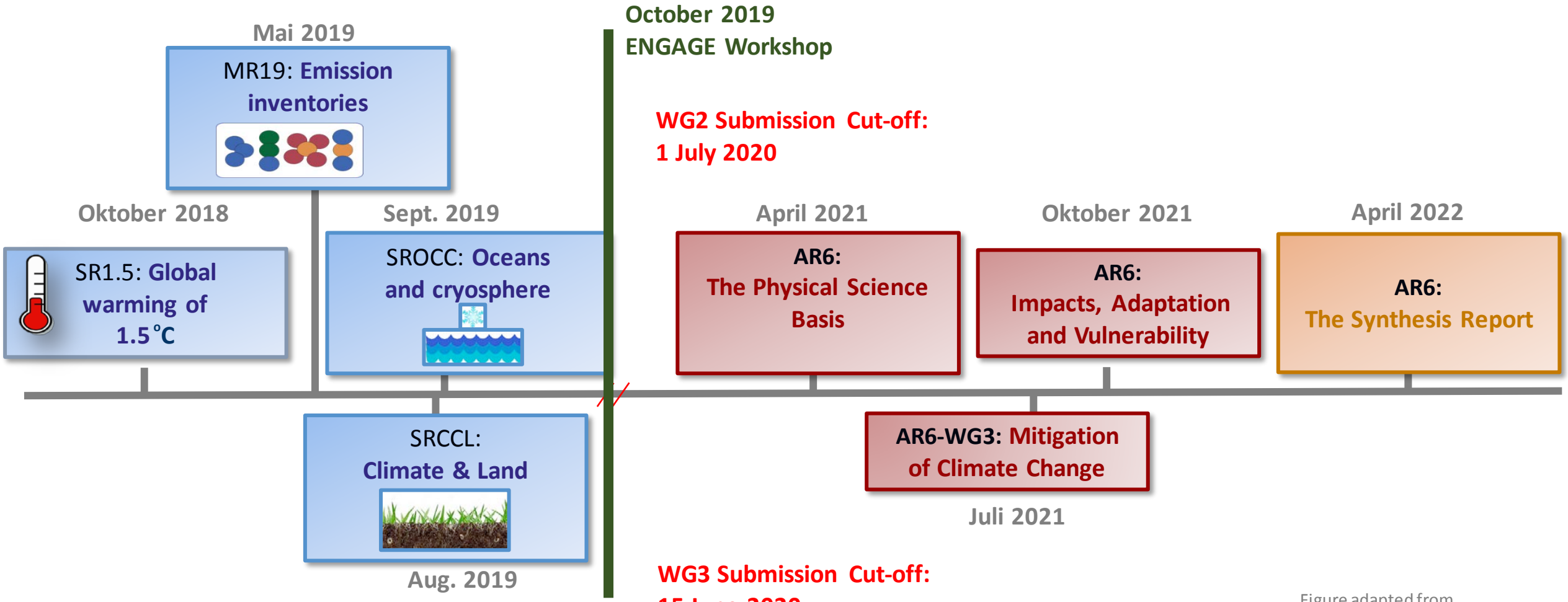

Figure adapted from Jan Fuglestvedt

WG2 and WG3 are tasked with joint assessment of costs and benefits of mitigation in the context of sustainable development

WG3 Chapter 3: Mitigation pathways compatible with long-term goals

…

- Modelled emission pathways compatible with the Paris Agreement, including the long-term temperature goal
- Role of changing climate on emissions

…

- Economics of mitigation and development pathways, including mitigation costs, investment needs, employment effects, etc.

…

- Links to sustainable development including risks, co-benefits, synergies, trade-offs and spill-over effects
- Links to adaptation including risks, co-benefits, synergies, trade-offs and spill-over effects
- Benefits of mitigation, including information from WG II
- Risk analysis of emission pathways considering uncertainty about climate response

WG2 Chapter 18: Climate resilient development pathways*

- Synergies and trade-offs of sustainable development (including SDGs), adaptation and mitigation, including the social effects of greenhouse gas emissions
- Adaptation pathways, including transformation and economic diversification, technologies, and strategies that strengthen resilience, reduce inequalities, and improve climate related human wellbeing
- Synthesis of risks and levels of adaptation in climate resilient pathways
- Lessons from case studies at different scales

**connection to WG III*

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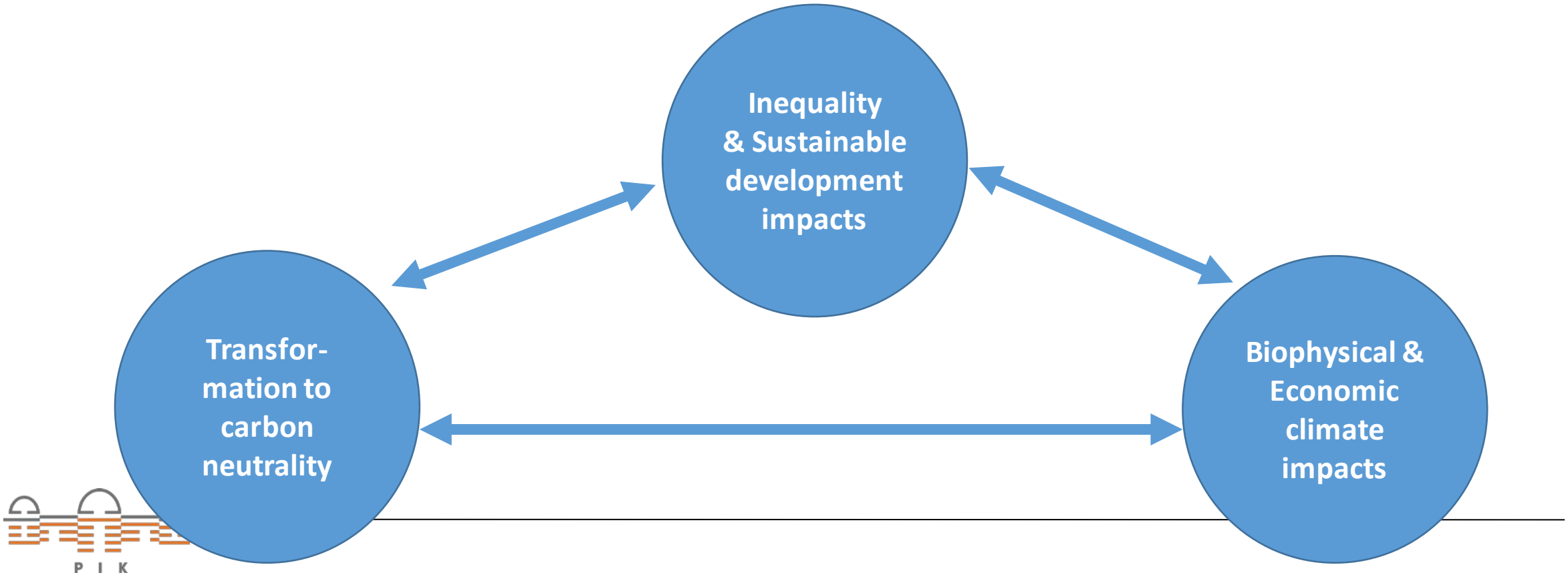
Goal of the symposium:
Make progress on integration of mitigation and climate impacts along climate transformation pathways …

… to provide integrated and actionable knowledge on the benefits and trade-offs of transformative action to decision makers



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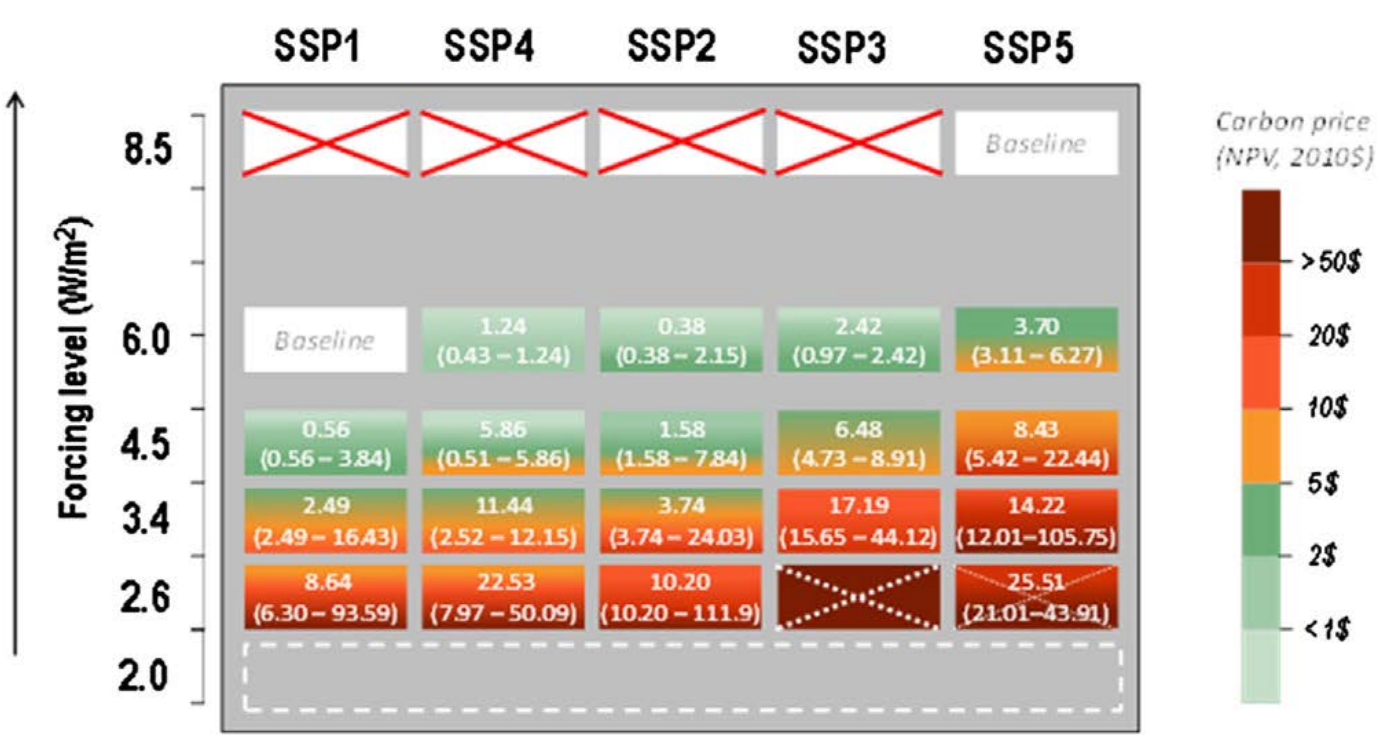
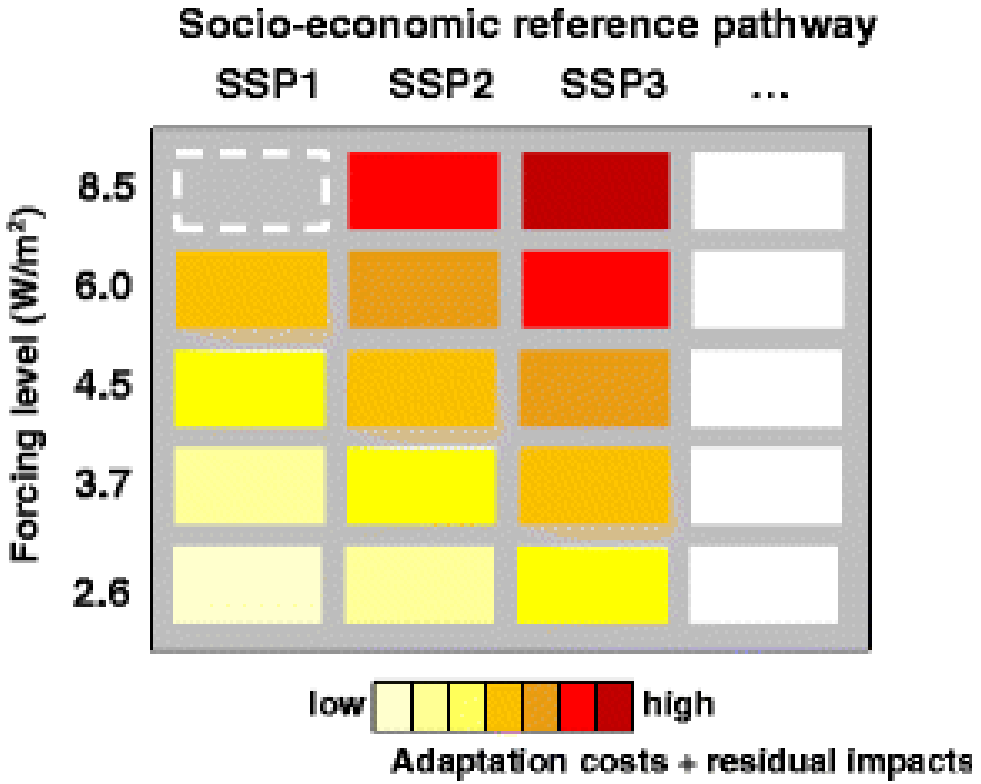
Cutting edge of integrated assessment research



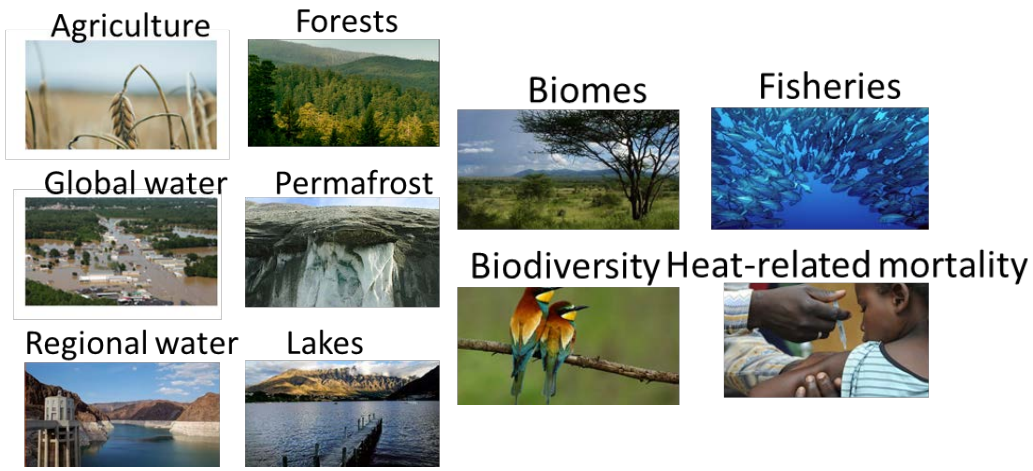
Riahi et al. (2016)



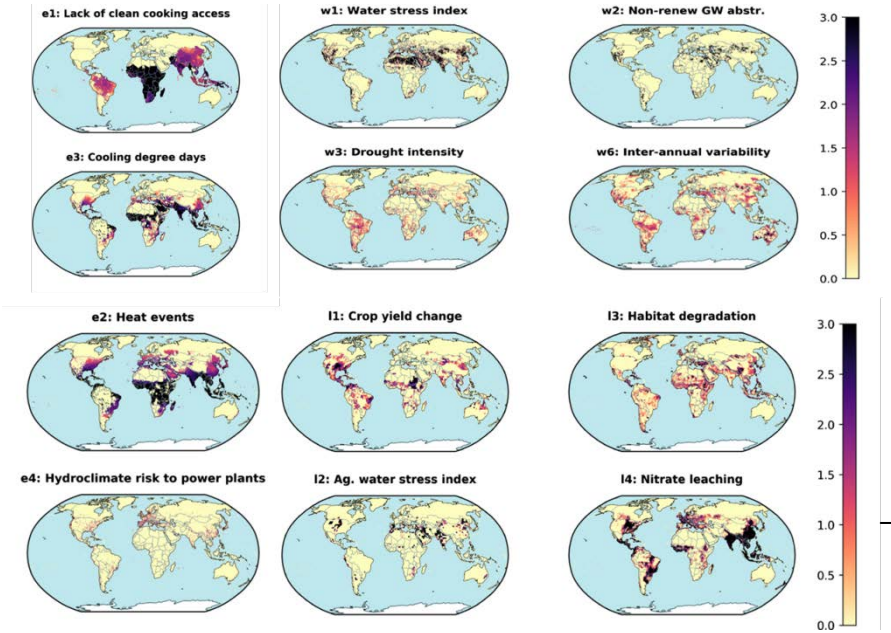
Van Vuuren et al. (2013)

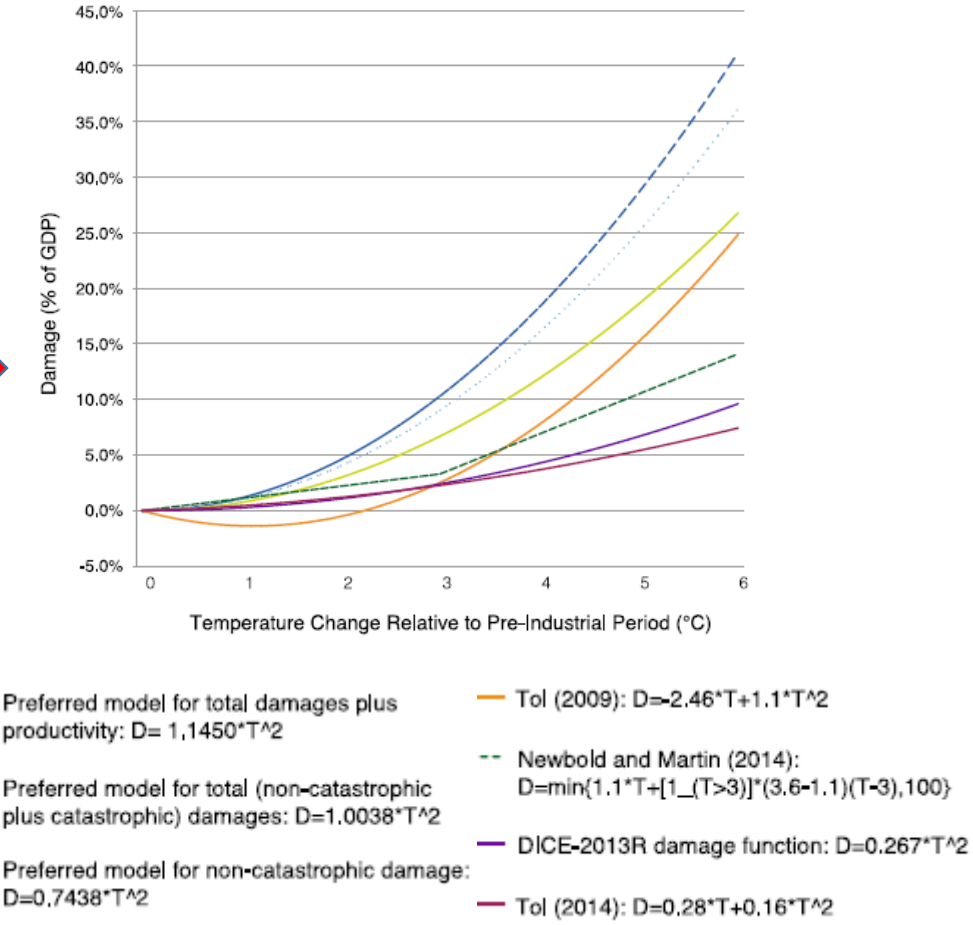
Mismatch between level of impact understanding: biophysical vs. economic impacts

ISIMIP



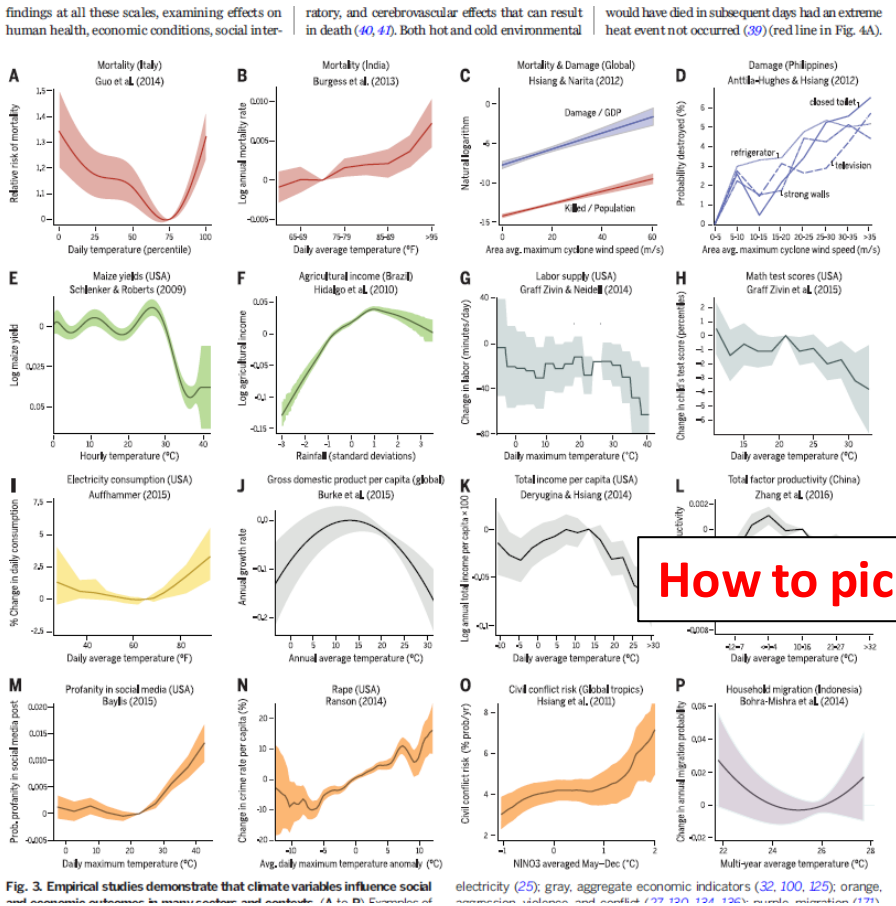
Byers et al. (2018)





Howard & Sterner 2017

Mismatch between level of impact understanding: channel representation

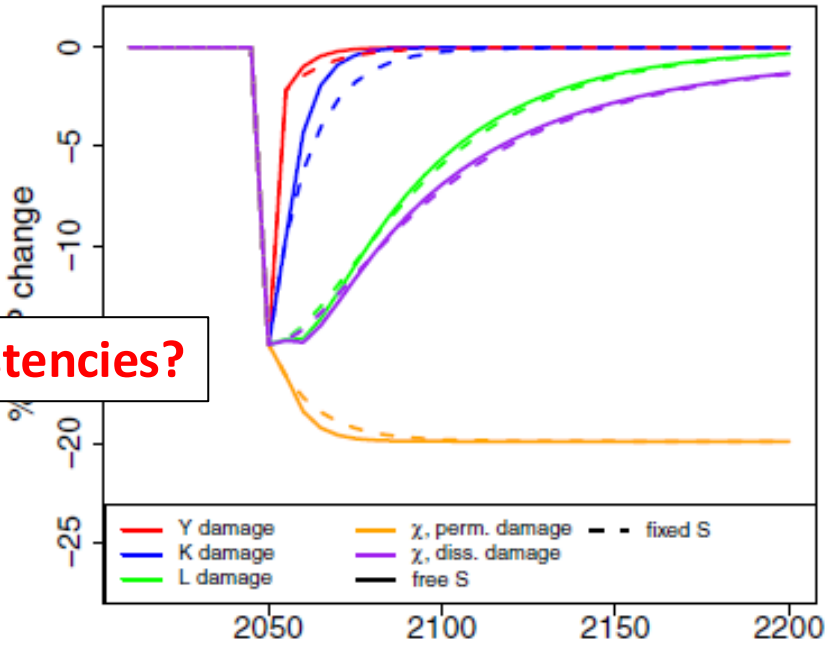


Carleton & Hsiang (2016)

Standard economic models feature:

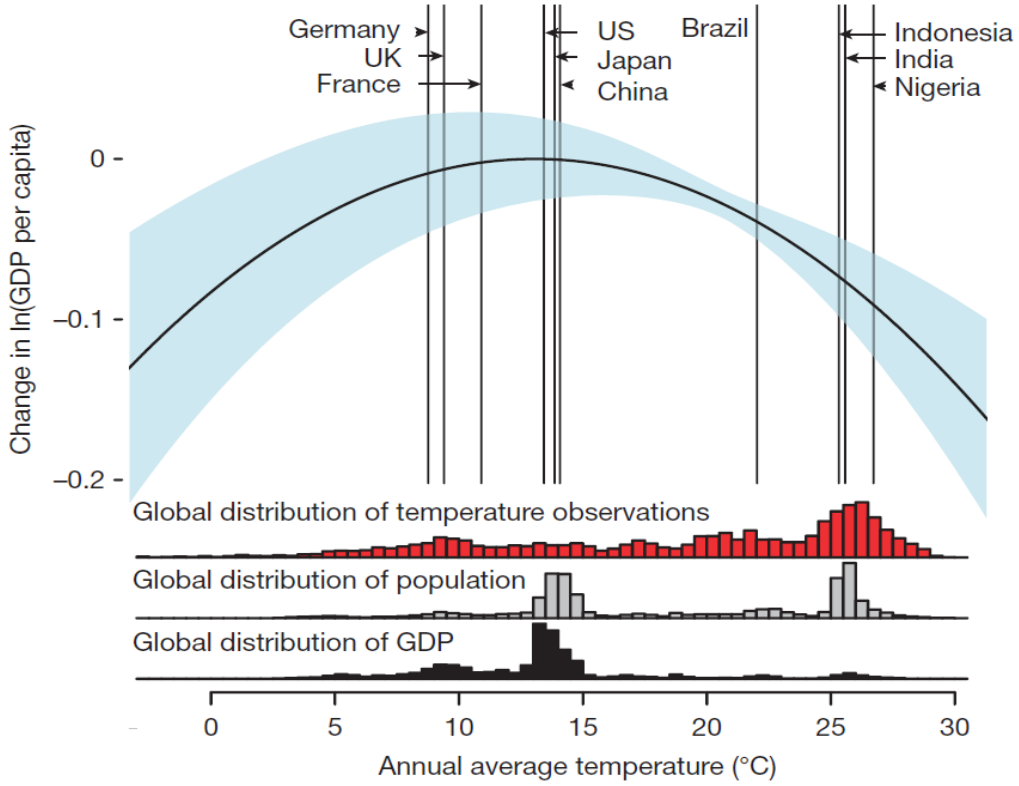
- Production factors: capital, labor, energy, (land)
- exogenous productivity growth

How to pick up dynamics and persistencies?

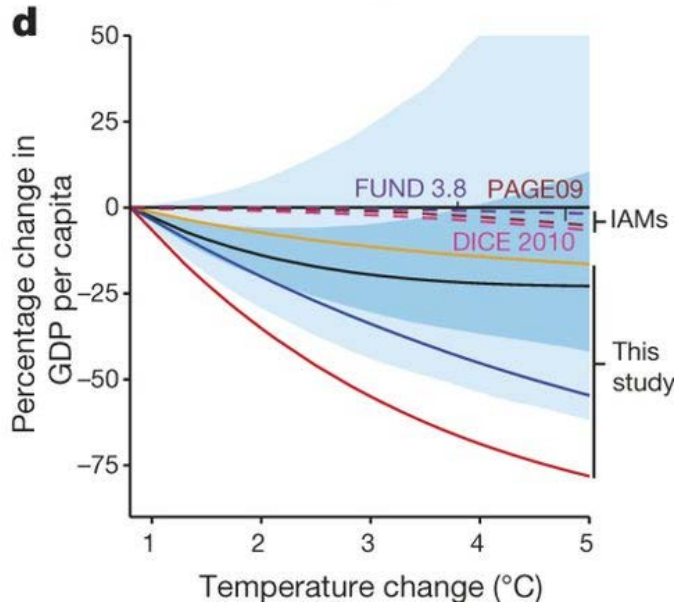


Piontek et al. (2018)

Mismatch between level of impact understanding: short-term vs. long-term



Long-term projections?

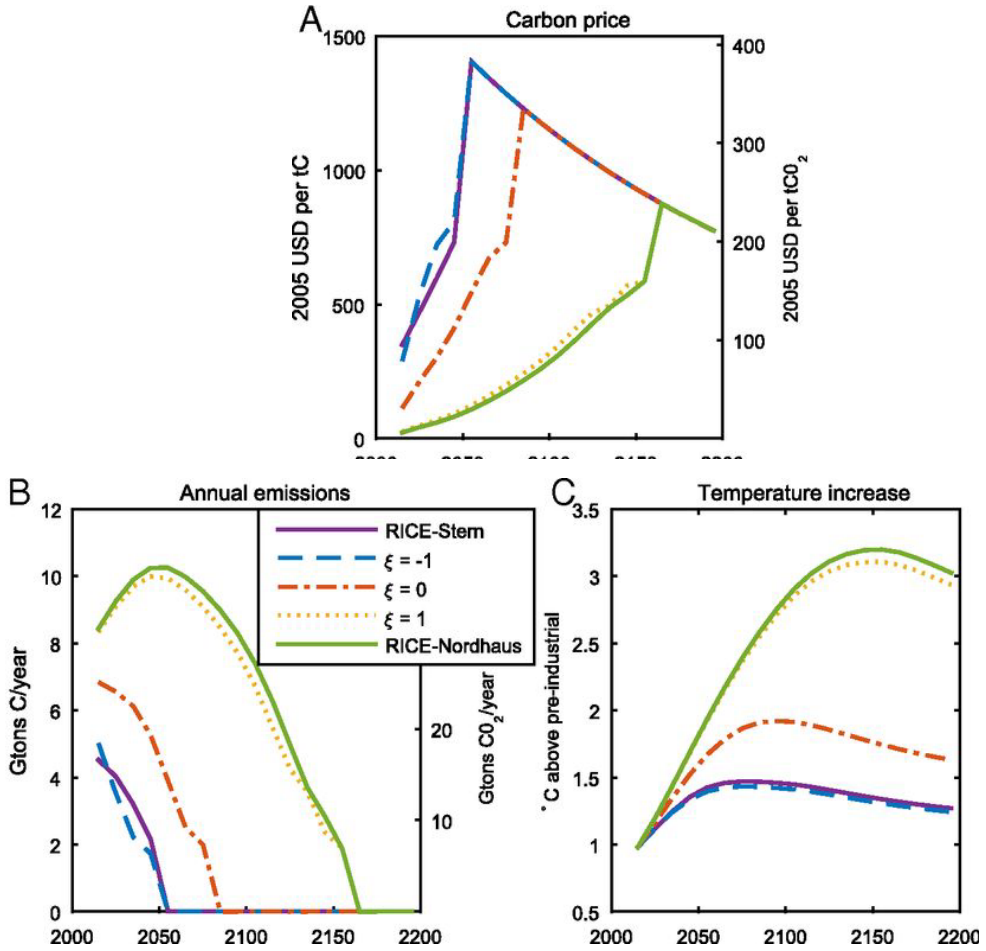


Burke et al. 2015

General lack of understanding for distributional effects

Model type	Increasing complexity of social heterogeneity[a]			
	Single HH	Prescribed distribution	Multiple HH types	Microsimulation
National, single sector	Most common	Mitigation: refs 59,61	Mitigation: refs 35,63,67,83	Mitigation: refs 60,62,64
				Impacts: ref. 84
National, CGE	Most common		Mitigation: refs 31,32,34,36,37,39,43,44,45, 46,73	Mitigation: refs 33,37,38,40,46,47,48,65
				Impacts: refs 51,72
Global process-IAM, partial equilibrium	Most common		Mitigation: ref. 66	Mitigation: ref. 8
Global process-IAM, CGE	Most common	Impacts: refs 10,50	Impacts: refs 53,85	Mitigation: ref. 55
				Impacts: ref. 52
Global CBA-IAM	Most common	Mitigation: ref. 29		

Rao et al. (2017): household heterogeneity in climate-economic models



Dennig et al. (2015): Empirical constraint for income elasticity of damage ξ?

Mismatch between impact assessments in IPCC reports

Ruth deFries et al. (2019)

Drastic assessment of biophysical impacts

"… very high risk of severe, widespread and irreversible impacts globally **(high confidence)**"

"The risks associated with temperatures at or above 4°C include … consequential constraints on common human activities and limited potential for adaptation in some cases **(high confidence).**"

"risks associated with extreme weather events are moderate to high at temperatures 1°C to 2°C above pre-industrial levels"

Muted assessment of economic damages

"Aggregate economic losses accelerate with increasing temperature (**limited evidence**, high agreement), but global economic impacts from climate change are currently difficult to estimate."

"… slow down economic growth, … prolong existing and create new poverty traps **(medium confidence)**"

"Risks to global aggregated economic growth due to climate change impacts are projected to be lower at 1.5°C than at 2°C by the end of this century **(medium confidence)**"

A. Oswald & N. Stern (2019): *„We are sorry to say that we think academic economists are letting down the world. Economics has contributed disturbingly little to discussions about climate change."*

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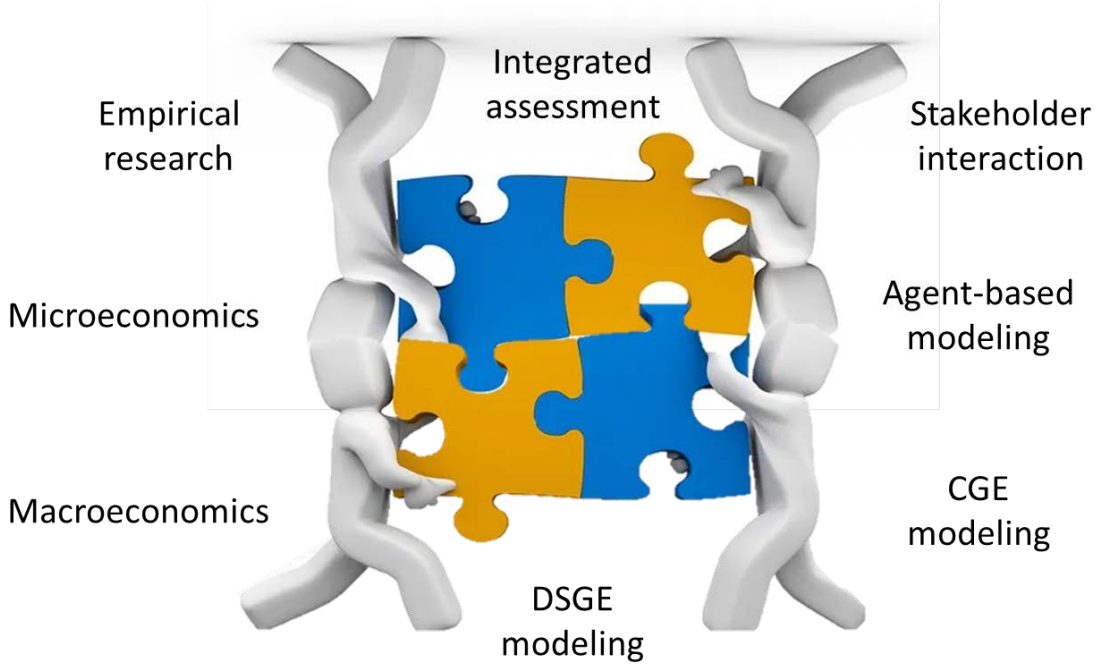
This workshop …

- brings together
  - experts from multiple relevant fields
  - experts with different modeling approaches
  - stakeholders



and through this seeks to

- assess the state of knowledge on economic impacts for AR6
- explore new concepts & methods to advance economic modeling of impacts
- explore the operationalization of empirical results for use in economic assessments
- focus attention on capturing distributional effects
- explore the options for and limits of IAMs in including impacts/inequality and the interplay with other economic modeling approaches („horses for courses“)

Workshop elements

Session I: *Linking empirical climate impact research with projections of future damages from climate change* → empirical modeling, DSGE, ABM, risk modeling

Session II: *Including inequality/poverty dimensions into integrated climate change scenarios* → empirics overview, scenario building, IAM development frontiers

Session III: *Integrating costs and benefits of climate strategies with a view to informing AR6* → applications in IAMs & CGEs

Stakeholders: Stefane Hallegatte (World Bank), Theresa Lober (Bank of England), Eric Fee (German Environment Agency), Olivia Gippner (DG Klima), David Bresch (ETH Zürich/Meteo Swiss)

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Potential outcomes

- Discussions, networks, research collaborations
- Input for current relevant projects on economics of climate change:
  - NAVIGATE → impacts and inequality (among many other things)
  - CHIPS → distributional effects
  - SLICE → economic impacts of extreme events
  - COACCH → assessment of climate change costs
- Commentary/perspective/review pulling together state of the art on costs & benefits as well as gaps to inform AR6?
- Joint cross-disciplinary special issue pulling together advances in the different areas?

Some housekeeping

- Presentations on central computer
- Group picture → in afternoon coffee break
- Sign data protection forms
- Dinner tonight
- Reimbursement: after workshop send in all original receipts/tickets
- All practical questions: Nicole Field, Eric Heidrich

Looking forward to productive discussions!