POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

Klimawandel in Ozeanien

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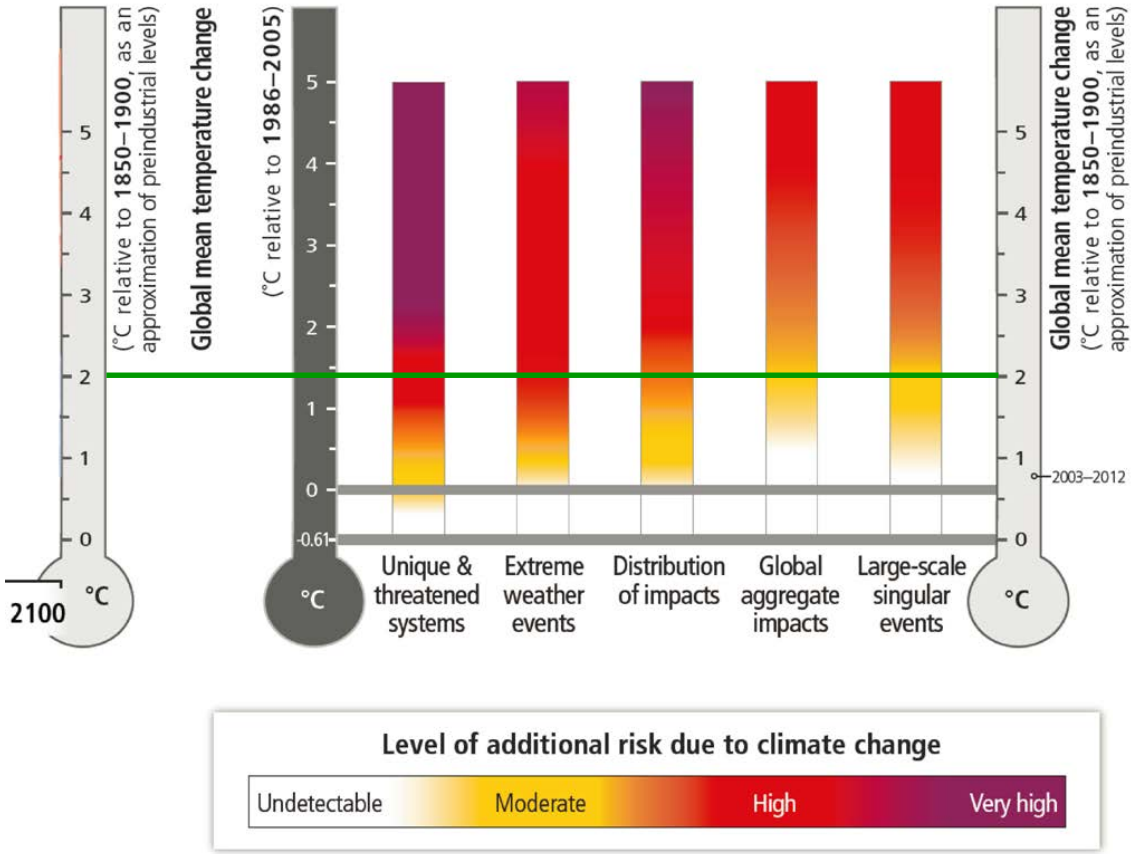
Auswärtiges Amt, Referat 404
Klima- und Umwelt-Außenpolitik
22. Mai 2018, Potsdam

Leibniz Gemeinschaft

MCC Mercator Research Institute on Global Commons and Climate Change

Technische Universität Berlin

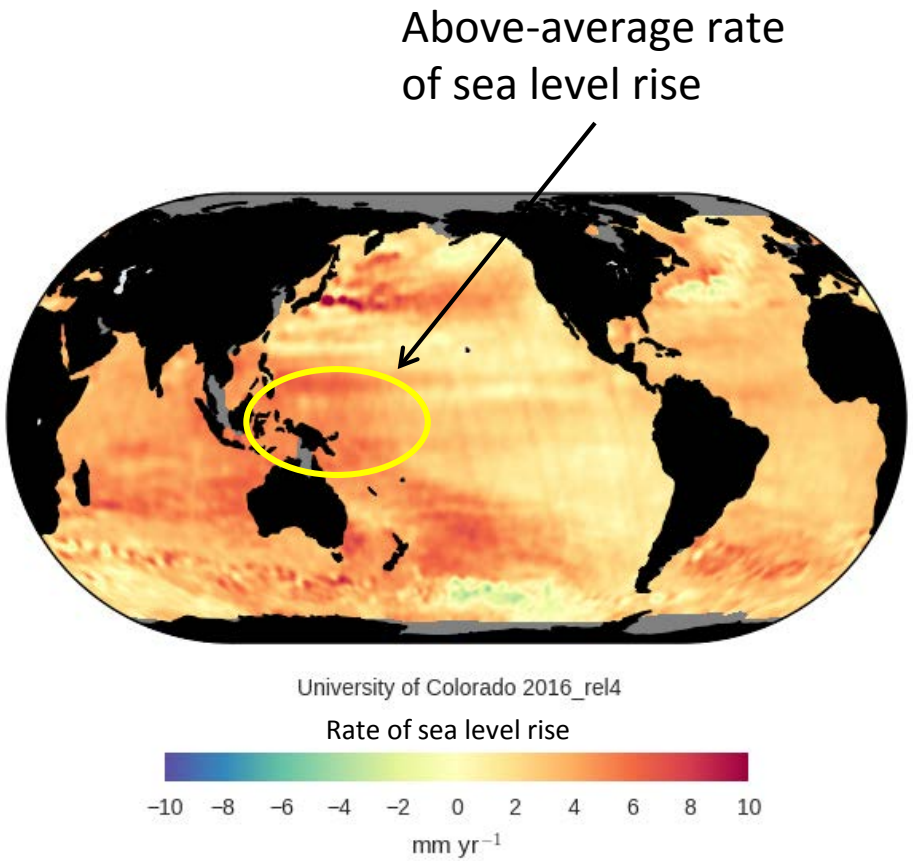
Climate Projections and Associated Risks



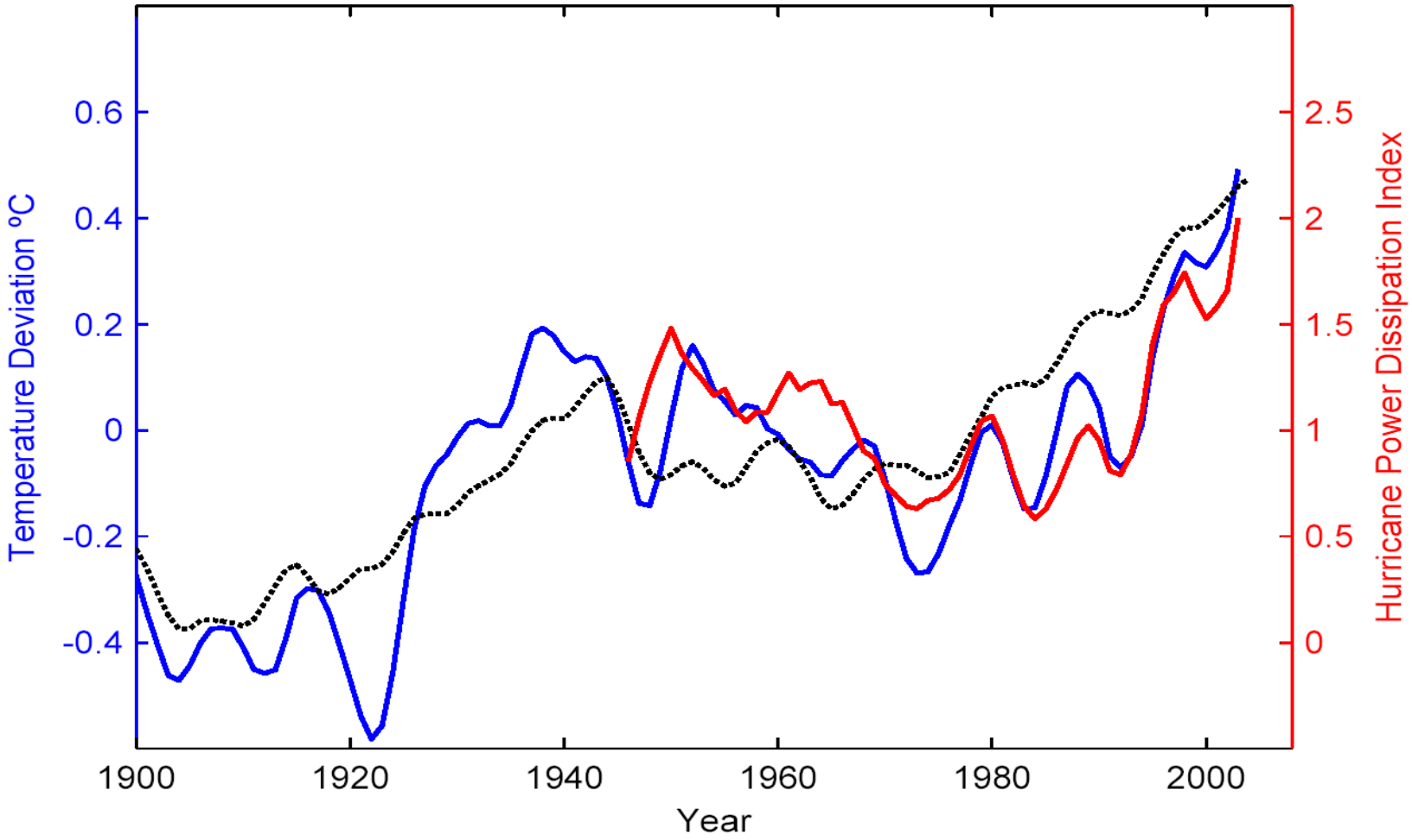
Source: Slide by H. J. Schellnhuber

Unequally Distributed Sea-Level Rise Increase

- Melting ice sheets and thermal expansion lead to rising sea levels
- Sea level rise in the West Pacific occurs faster, affecting islands like Kiribati or Fiji
- Impacts of sea-level rise:
  - Shrinking land mass
  - Salinization of ground water lenses and soil
  - Storm tides strongly intensified by sea level rise



Warming Sea Surface increases Cyclone Intensity



Severe Tropical Cyclone Gita

The Guardian International edition

Cyclone Gita: Tonga devastated by worst storm in 60 years

Winds of more than 230km/h recorded as parliament building flattened and power lines brought down

Photograph: Social Media/Reuters

Impacts of tropical storms:

- Higher risks of storm surges
- Damage of infrastructure and diseases
- Salinization

Surrounded by water, impacted by drought

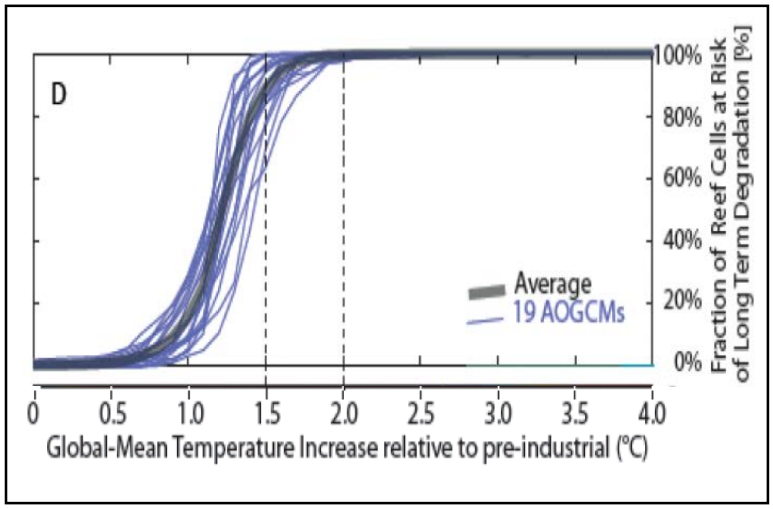
- Societal impacts:
  - High vulnerability caused by reliance on local fruits due to widespread subsistence-farming
  - Heating of surrounding water leads to temporary loss or migration of marine food stock
  - Health problems (e.g. diabetes) due to drought-related reliance on imported food
  - Fire hazards

Photograph: The Pacific Adaptation to Climate Change Project

2013 drought on Ailuk Atoll, Marshall Islands

Coral Bleaching:
A Hazard beyond Biodiversity Loss

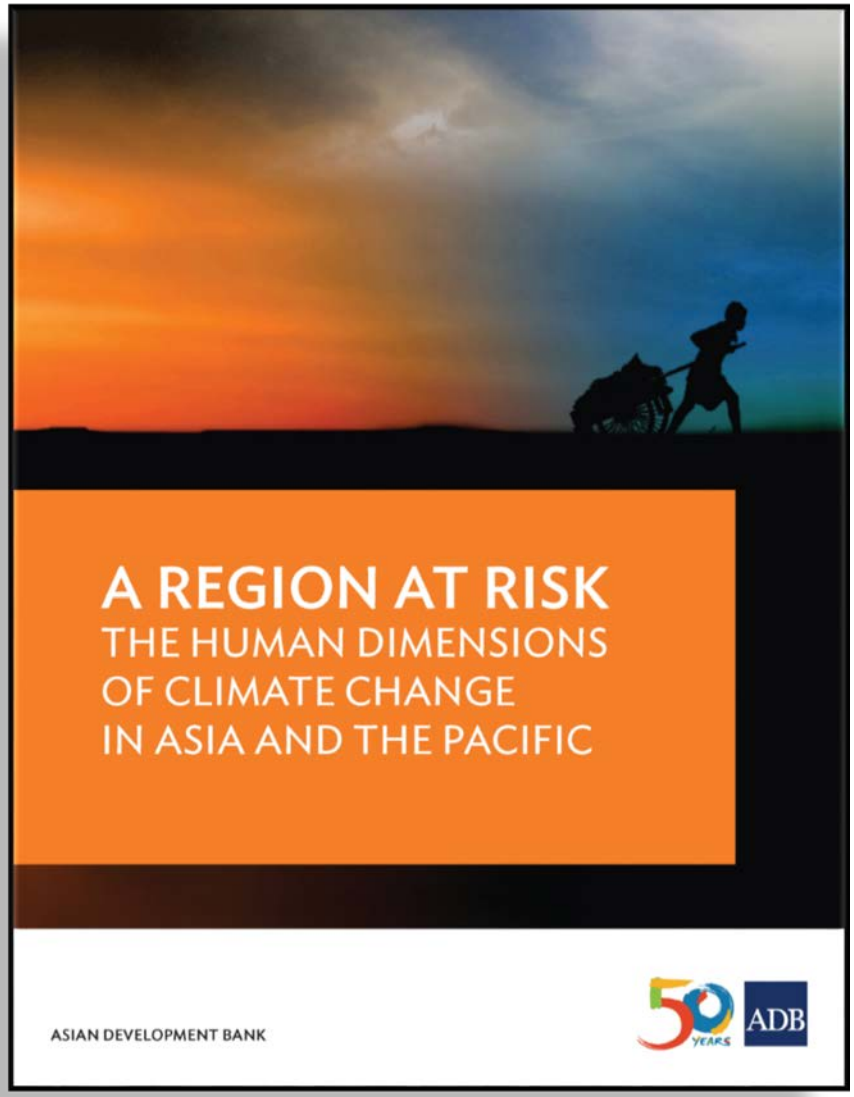
- Acidification and increasing sea surface temperatures lead to coral bleaching and coral death
- Societal impacts:
  - Protective function of coral reefs against storm surges is lost
  - (Traditional) fishing becomes difficult as shallow water fish move further out
  - Fish stocks will decrease in reaction to habitat losses



Frieler et al. (2012):

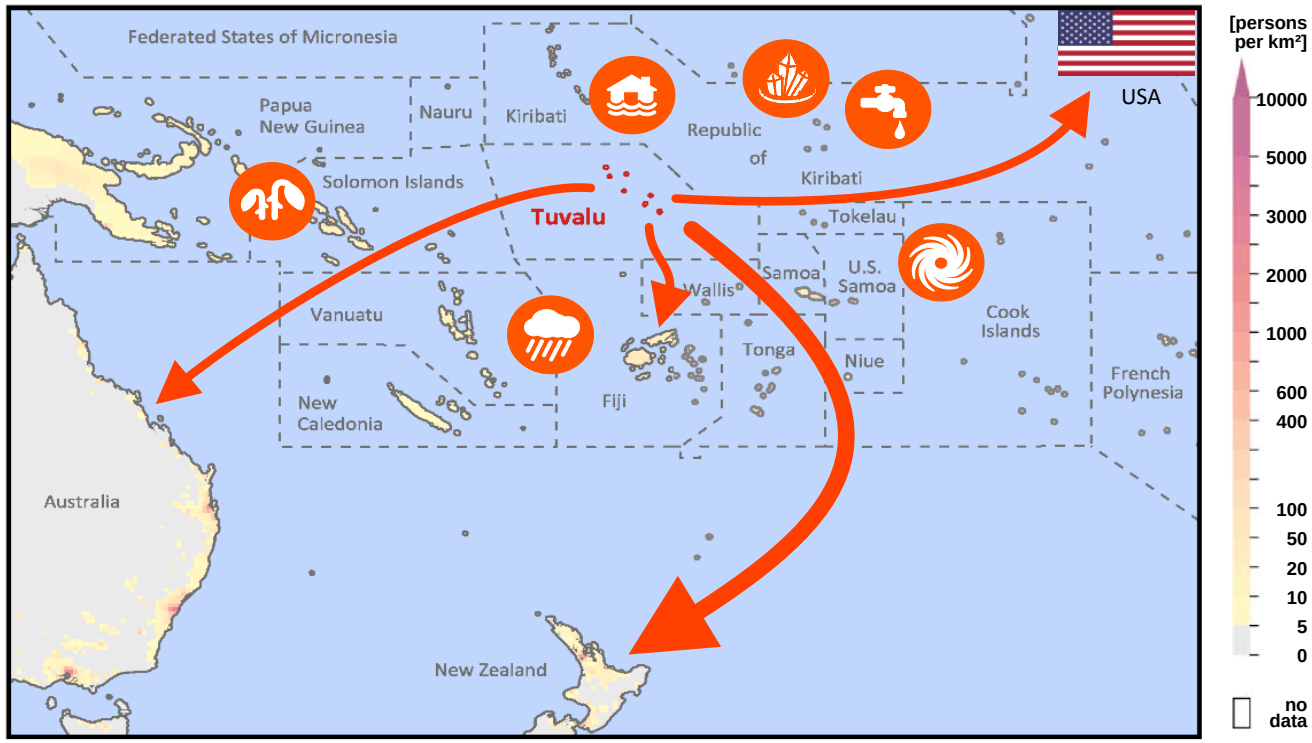
Preserving >10% of coral reefs worldwide would require limiting warming to *below* 1.5 °C

PIK – ADB Report



Vinke, K.; Schellnhuber, H.-J.; Laplante, B.; Coumou, D.; Geiger, T.; Glanemann, N.; Huber, V.; Kropp, J.; Kriewald, S.; Lehmann, J.; Levermann, A.; Lobanova, A.; Lu, X.; Knaus, M.; Otto, C.; Reyer, C.; Robinson, A.; Rodgers, C.; Rybski, D.; Schewe, J.; Willner, S.; Wortmann, M.; Zhao, F.; Zhou, B. (2017)

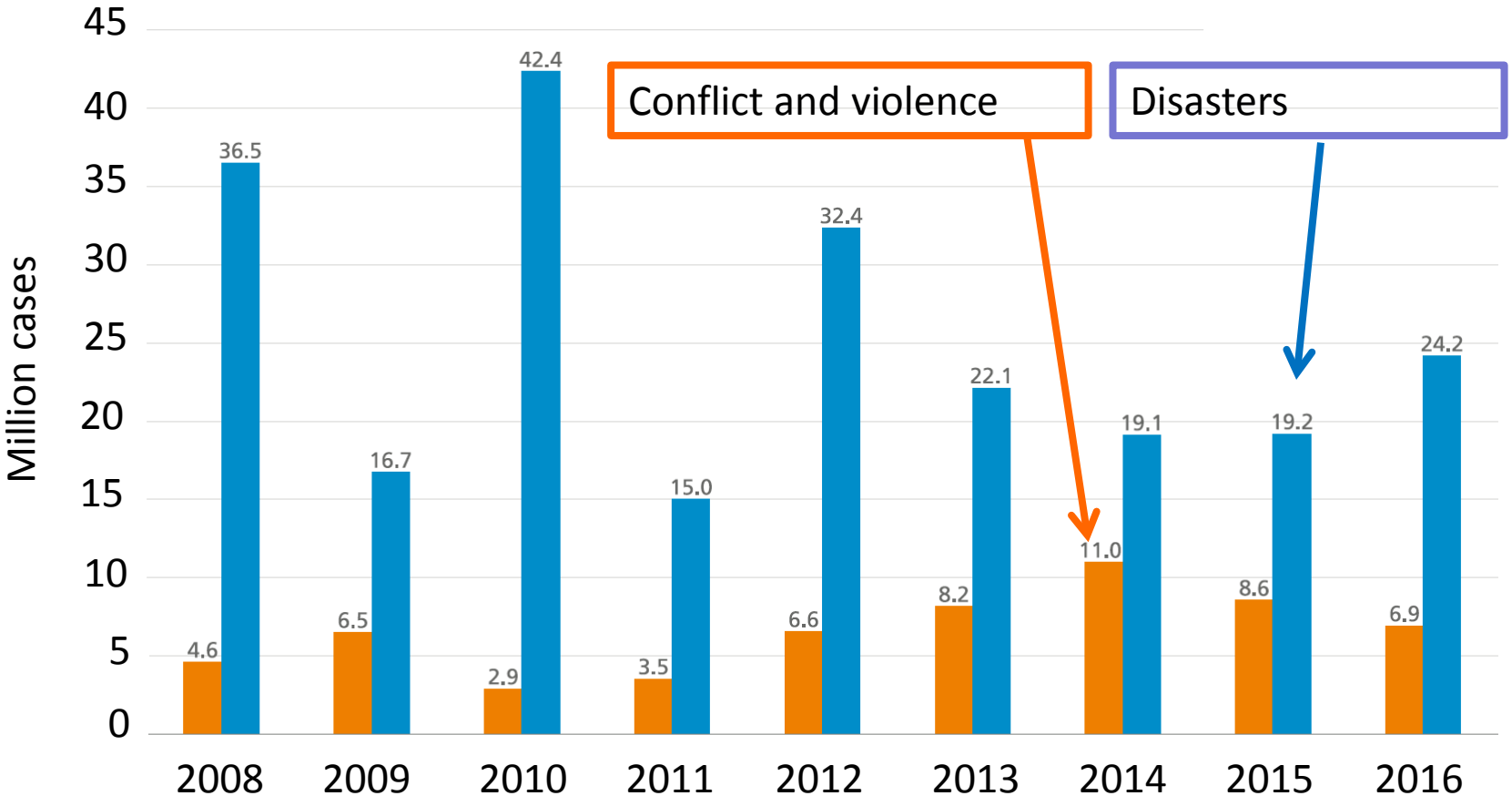
Climate Change & Migration: Possible Routes from Tuvalu



Vinke, Schellnhuber, Laplante et al. (2017)

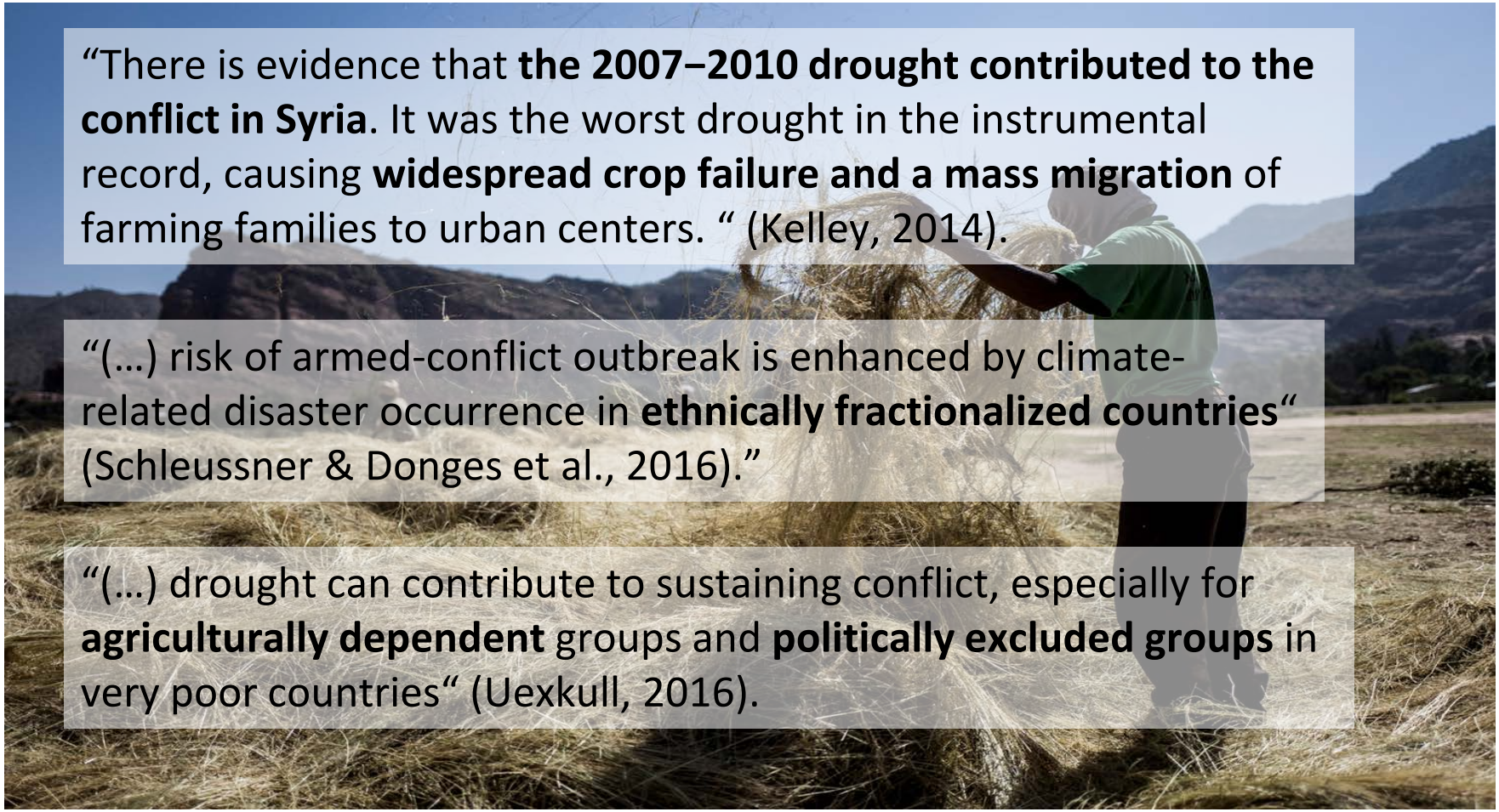
Climate Effects on Migration

Internal Displacement Monitoring Centre, Norwegian Refugee Council, 2017



Weather-related disasters displace millions every year!

Climate Change and Conflicts – State of the Art in Three Quotes



"There is evidence that **the 2007–2010 drought contributed to the conflict in Syria**. It was the worst drought in the instrumental record, causing **widespread crop failure and a mass migration** of farming families to urban centers. " (Kelley, 2014).

"(…) risk of armed-conflict outbreak is enhanced by climate-related disaster occurrence in **ethnically fractionalized countries**" (Schleussner & Donges et al., 2016)."

"(…) drought can contribute to sustaining conflict, especially for **agriculturally dependent** groups and **politically excluded groups** in very poor countries" (Uexkull, 2016).

Photo: Tigray, Ethiopia, Source: Silas Koch

Climate Change is an international Security Issue

"Climate change will be one of the major threats to the **stability** of states and societies in the decades to come" – *Report commissioned by the G7, 2015.*

Fragility hotspots

Ranking of countries with high levels of instability, disaster risk, poverty, and climate change vulnerability.

Rüttinger et al., G7 report, 2015

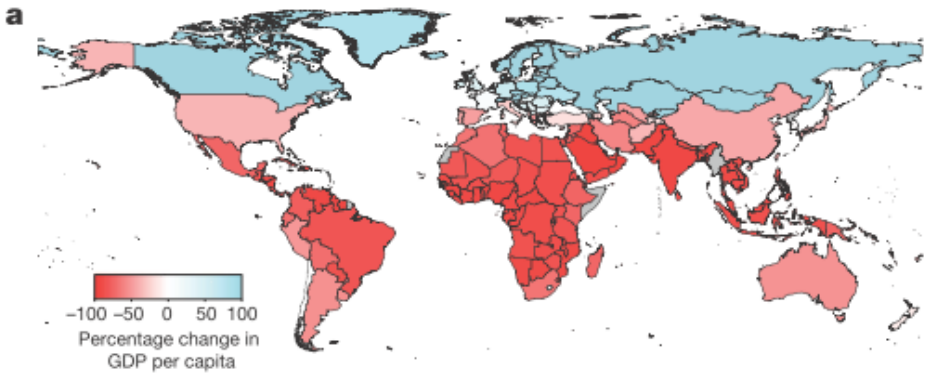
Climate events or trends are rarely the sole cause of conflict, migration, or social instability. However, there is mounting evidence that they have **exacerbated** existing social risks or inequalities, or acted as triggers, in past conflicts and migration. Future climate change will lead to extreme weather events and adverse climatic conditions far **beyond past experiences**.

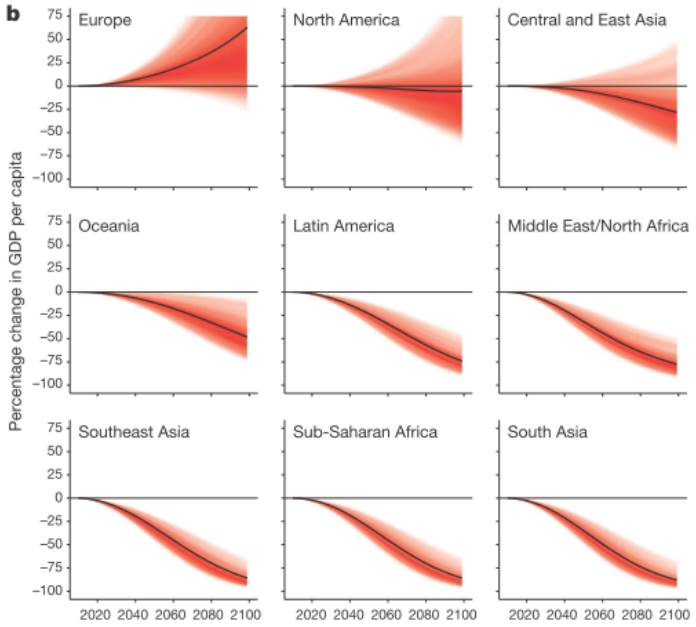
LETTER

nature

Global non-linear effect of temperature on economic production

Marshall Burke[1,2]*, Solomon M. Hsiang[3,4]* & Edward Miguel[4,5]



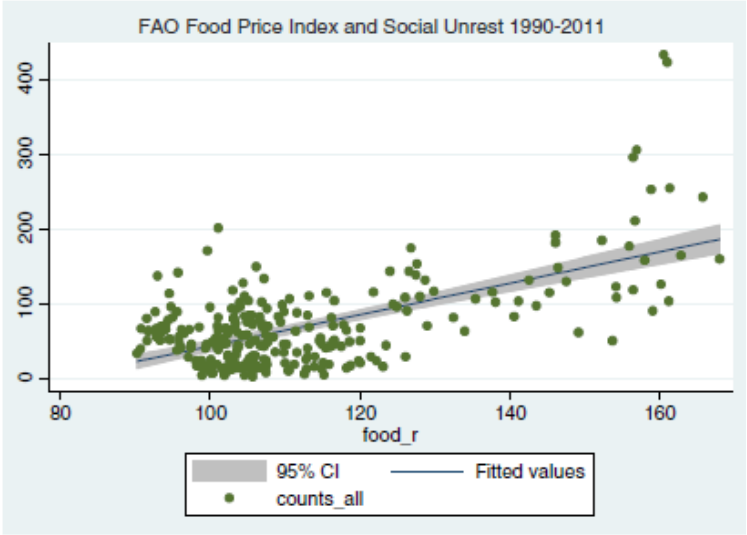


Source: Nature, doi: 10.1038/nature15725

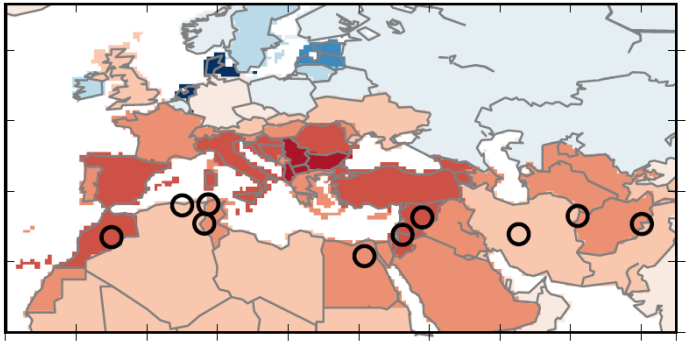
Climate Effects on Conflict Risk

Bellemare, 2014, AJAE

Food price spikes in 2007 and 2010 were associated with **social unrest** in developing and emerging countries around the world – and were triggered by weather-related crop failures. (Bellemare, 2014; Schewe et al., 2017)

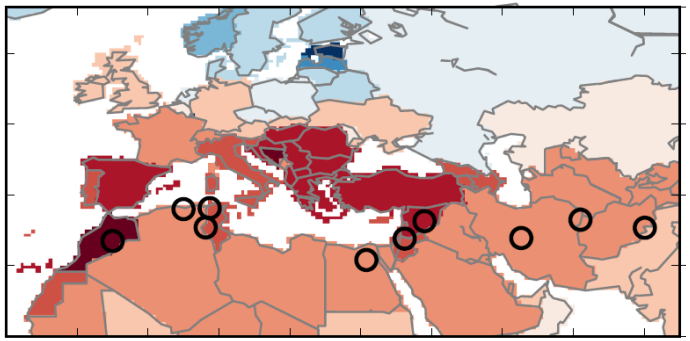


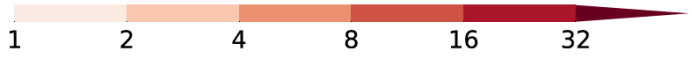
1°C historical warming



O Water scarcity related conflicts 2010 – present, pacinst.org

2°C future warming



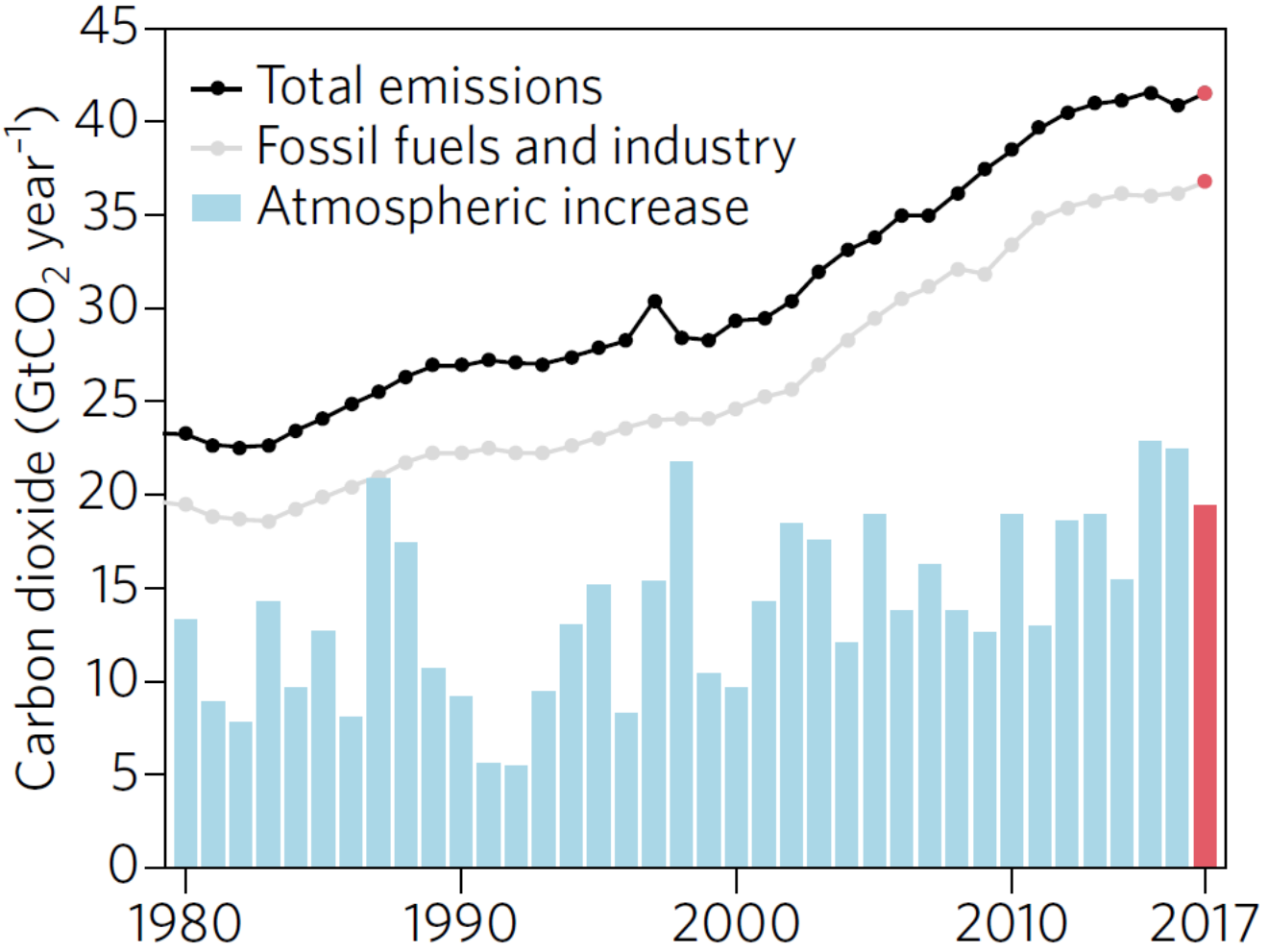


Multi-Model Median Change Factor

The **Mediterranean** region has seen conflicts over water in the past. It has seen substantial drying due to historical climate change, and will become even drier in the future.

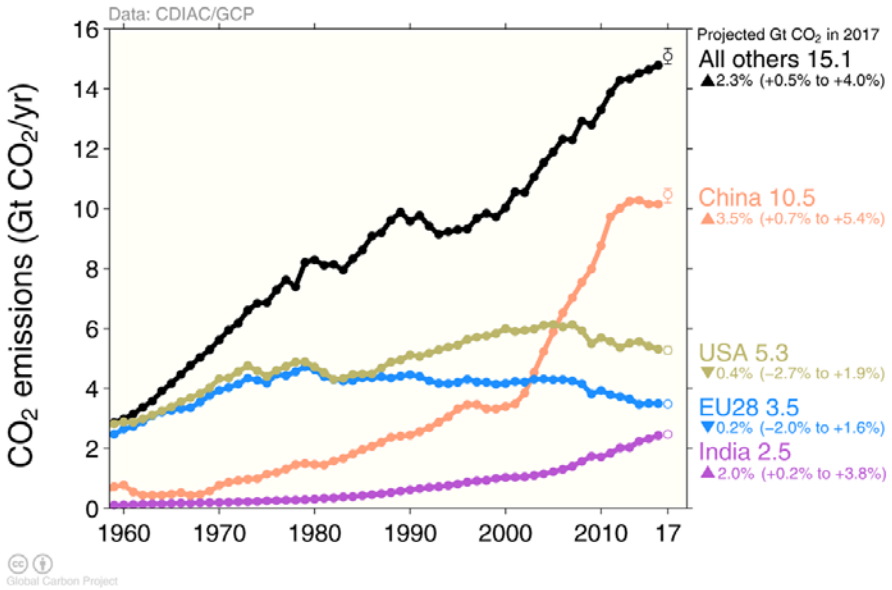
Lange et al., to be submitted

Emissions are rising.

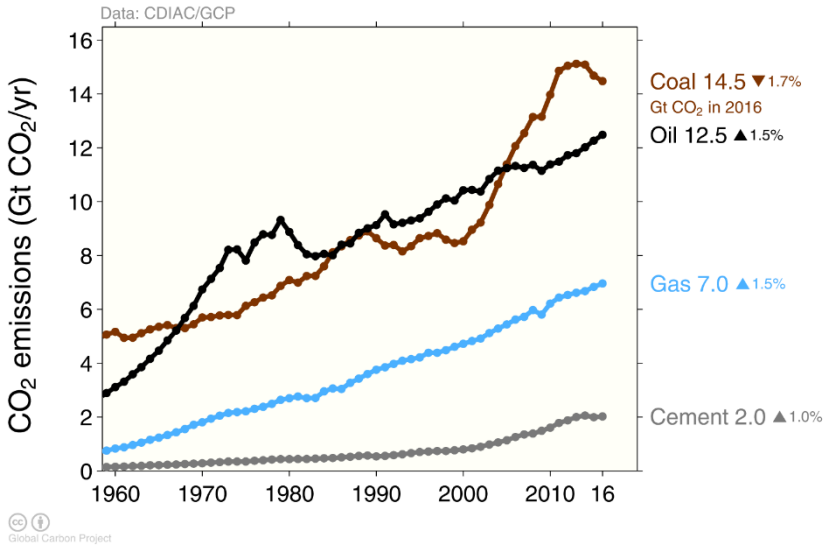


Source: Peters et al. (2017)

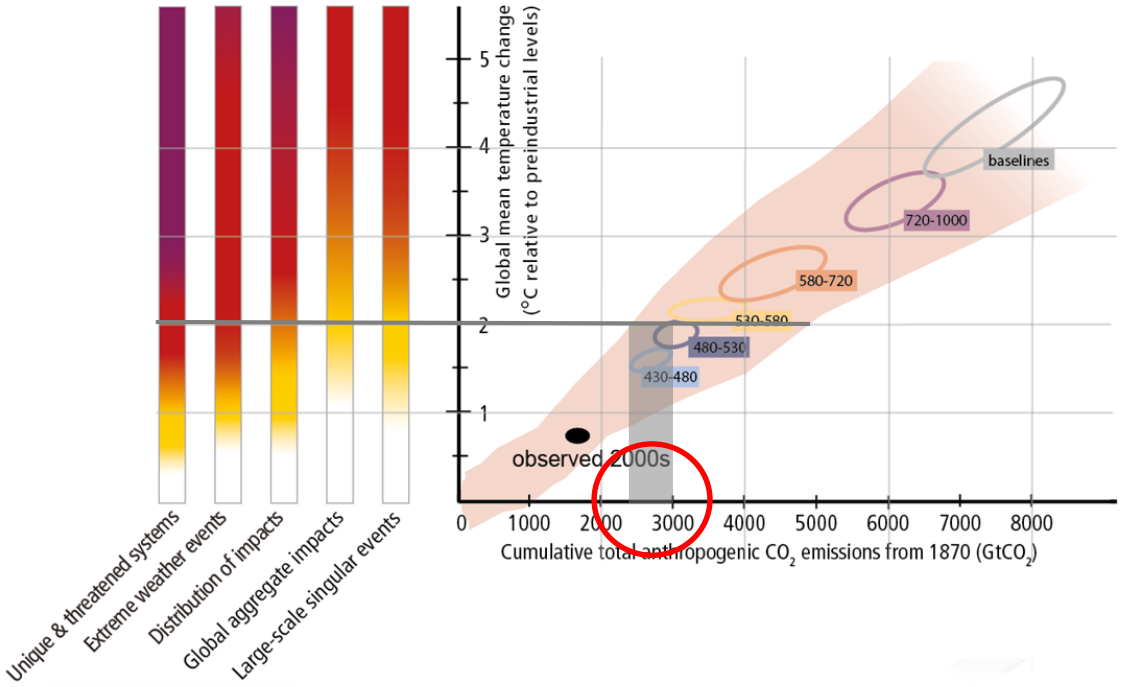
Does Climate Policy already show effects?



Quelle: Global Carbon Project 2017

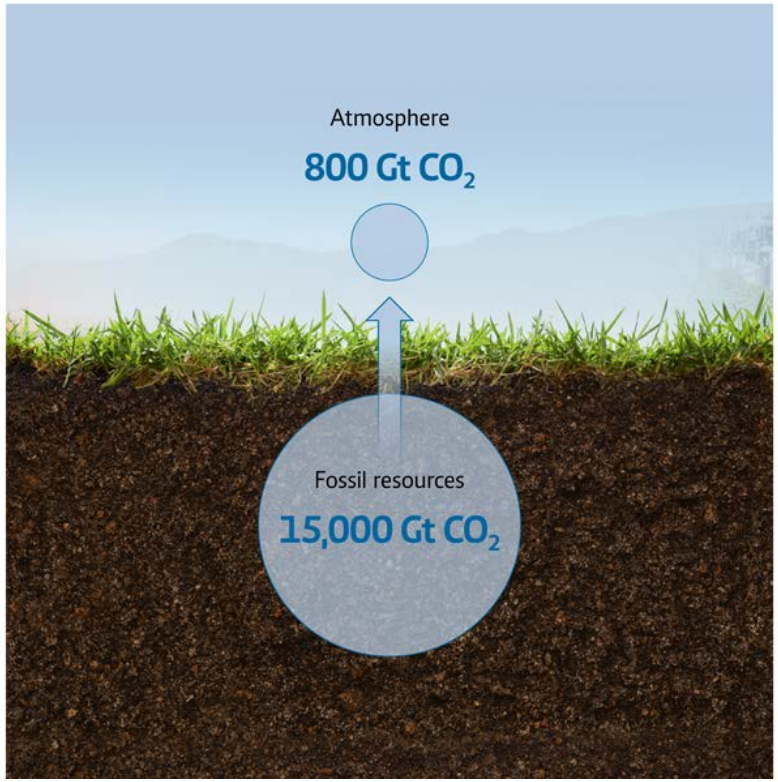


Risks from climate change depend on cumulative CO_2 emissions...



Based on SYR Figure SPM.10

The climate problem at a glance

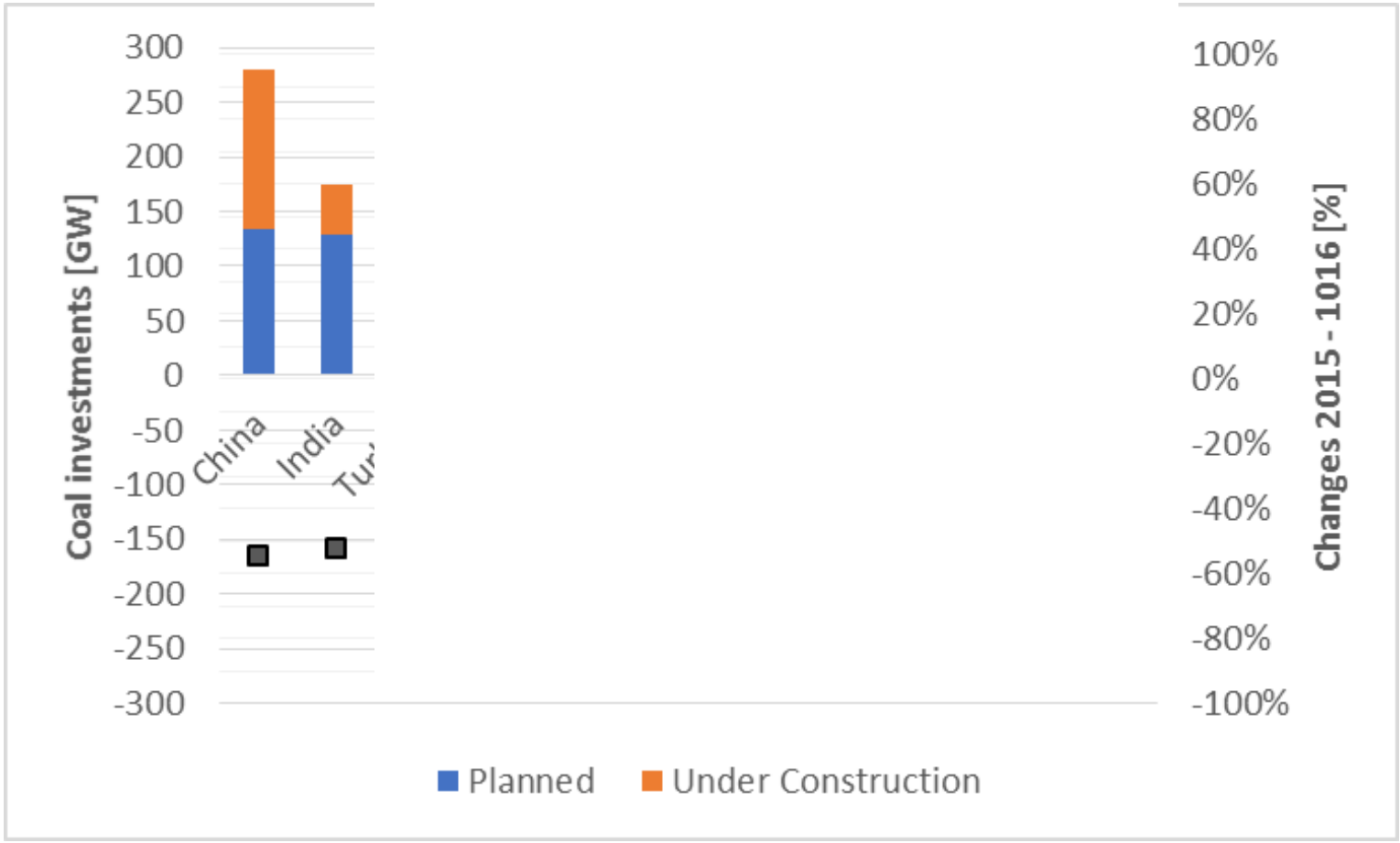


Resources and reserves to remain underground until 2100 (median values compared to BAU, AR5 Database)

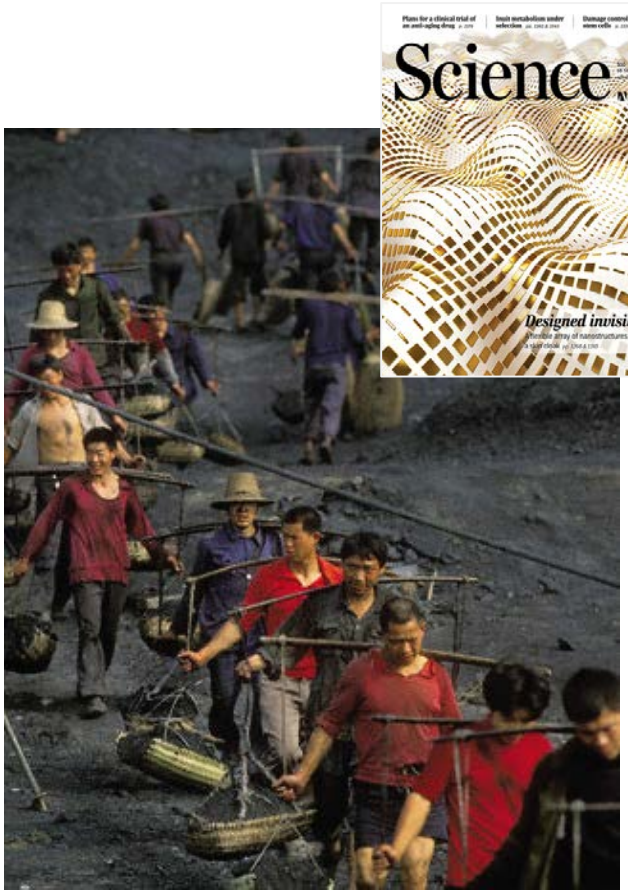
Until 2100	With CCS [%]	No CCS [%]
Coal	70	89
Oil	35	63
Gas	32	64

Source: Bauer et al. (2014); Jakob, Hilaire (2015)

The Coal Pipeline in 2016



Renaissance of Coal
Social Costs vs subsidies



ENERGY

King Coal and the Queen of Subsidies

The window for fossil fuel subsidy reform is closing fast

By **Ottmar Edenhofer**

Coal is the most important energy source for the Chinese economy (see the photo). Other rapidly growing economies in Asia and Africa also increasingly rely on coal to satisfy their growing appetite for energy. This renaissance of coal is expected to continue in the coming years (*1*) and is one of the reasons that global greenhouse gas (GHG) emissions are increasing despite the undisputed worldwide technological progress and expansion of wide emissions are expected to continue to rise. After all, a reduction in coal demand in one region reduces world market prices, incentivizing an increasing demand in other regions (*6*).

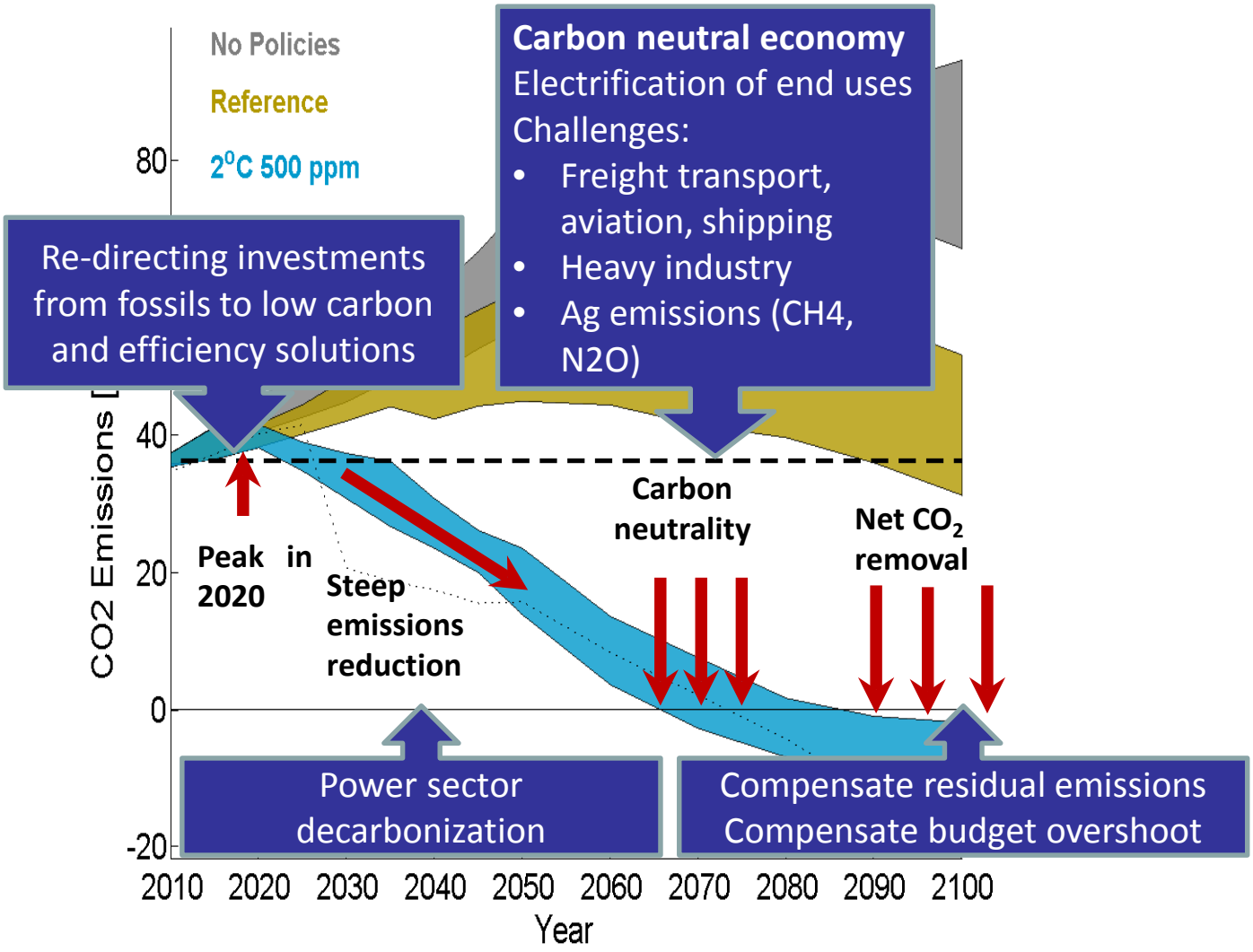
What explains this renaissance of coal? The short answer is the relative price of coal. The price of coal-based electricity generation remains much lower than that of renewable power when the costs of renewable intermittency are taken into account.

As a result of technological progress and economies of scale, the costs of generating

"one ton of CO_2 receives, on average, more than 150 US$ in subsidies "

Source: Science, 18 September 2015, Vol. 349, Issue 6254, 1286 ff.

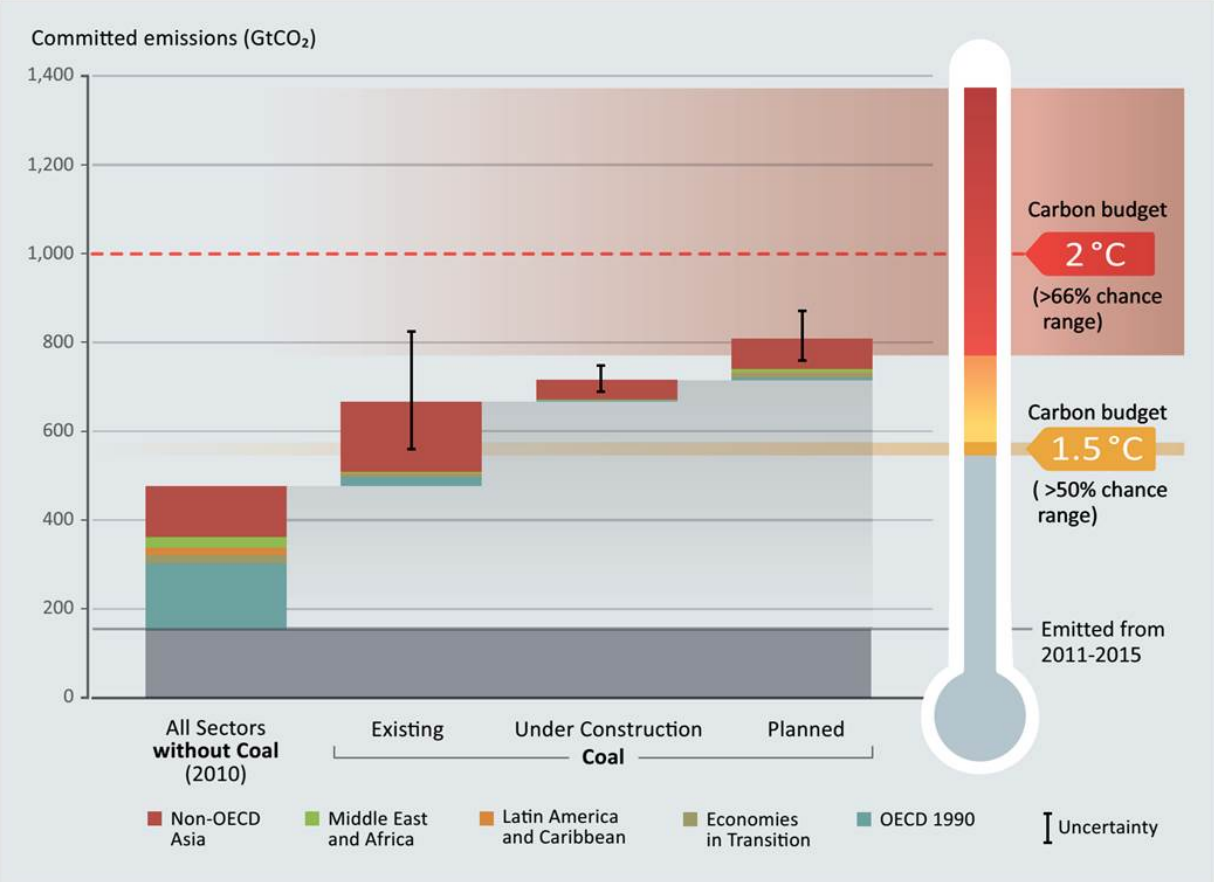
General structure of mitigation pathways



LIMITS Study: Kriegler, Tavoni et al., 2013, Clim Change Econ 04:1340008

The success story of coal

- Cheap and abundant coal is the driver of a „re-carbonisation“ of the energy system in some parts of the world



UNEP (2017) based on Edenhofer et al. (2018)

Report of the High-Level Commission on Carbon Prices

Results obtained by Stiglitz-Stern-Commission

- Based on the analysis of three approaches:
  technical roadmaps, national roadmaps, global models

- Necessary carbon price for implementing the Paris Agreement:
  40-80 $/t CO_2 until 2020 and 50-100 $/t CO_2 until 2030

- This assumes that carbon pricing will be complemented by activities and policies such as efficiency standards, R&D, urban development, healthy climate for investments, etc.

- Stress on the relevance of the income side. Put to use in order to reduce other taxes, invest in clean infrastructure, etc.

Source: Stiglitz, Stern et al. CPLC (2017)