Recent temperature records, the 1.5°C limit and what this means for vulnerable countries

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New York

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CLIMATE ANALYTICS

Recent temperature records, the 1.5ºC limit and what this means…

01

Has the 1.5ºC limit been broken?
Observations of recent warming compared to long-term temperature projections

02

New results on differential impacts and risks at 1.5ºC

03

Latest scientific findings
Tipping points, Sea level rise and ice sheet response, Heat extreme, Coral reef bleaching, Economic impacts

04

Is 1.5ºC still feasible?

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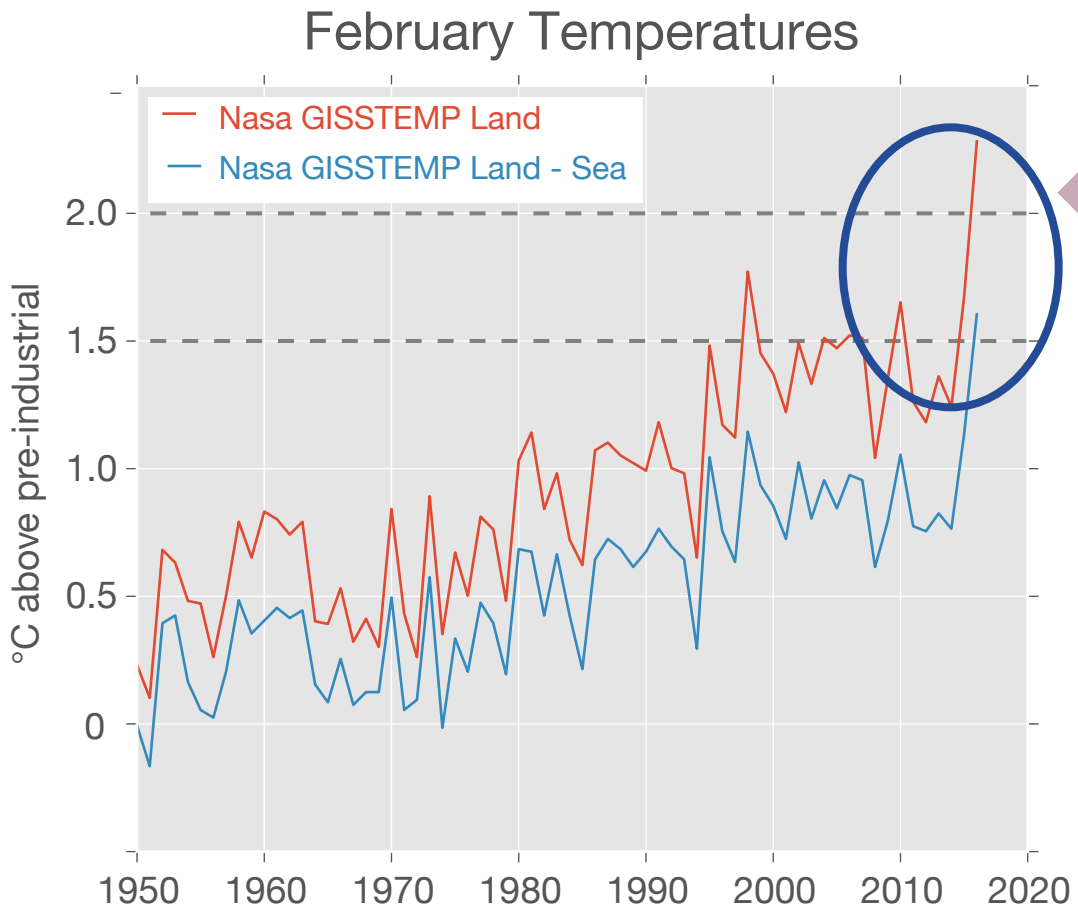
In February 2016 global mean temperatures spiked to more than 1.5° C above pre-industrial levels…



Does this mean that a long-term global mean temperature limit of 1.5°C is out of sight?

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Source http://data.giss.nasa.gov/gistemp/

No!

And here is why:

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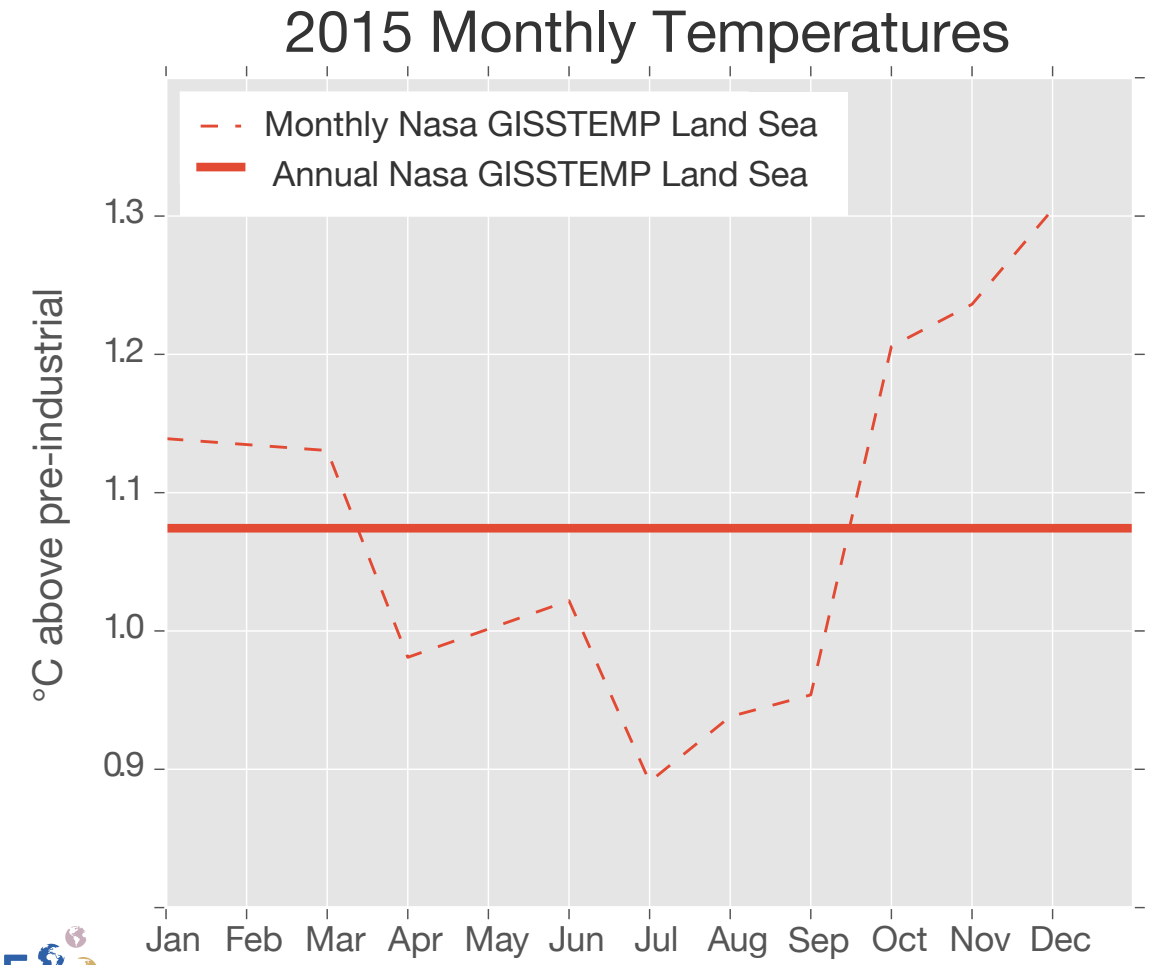
Natural variability strongly affects global mean temperatures on short time scales…



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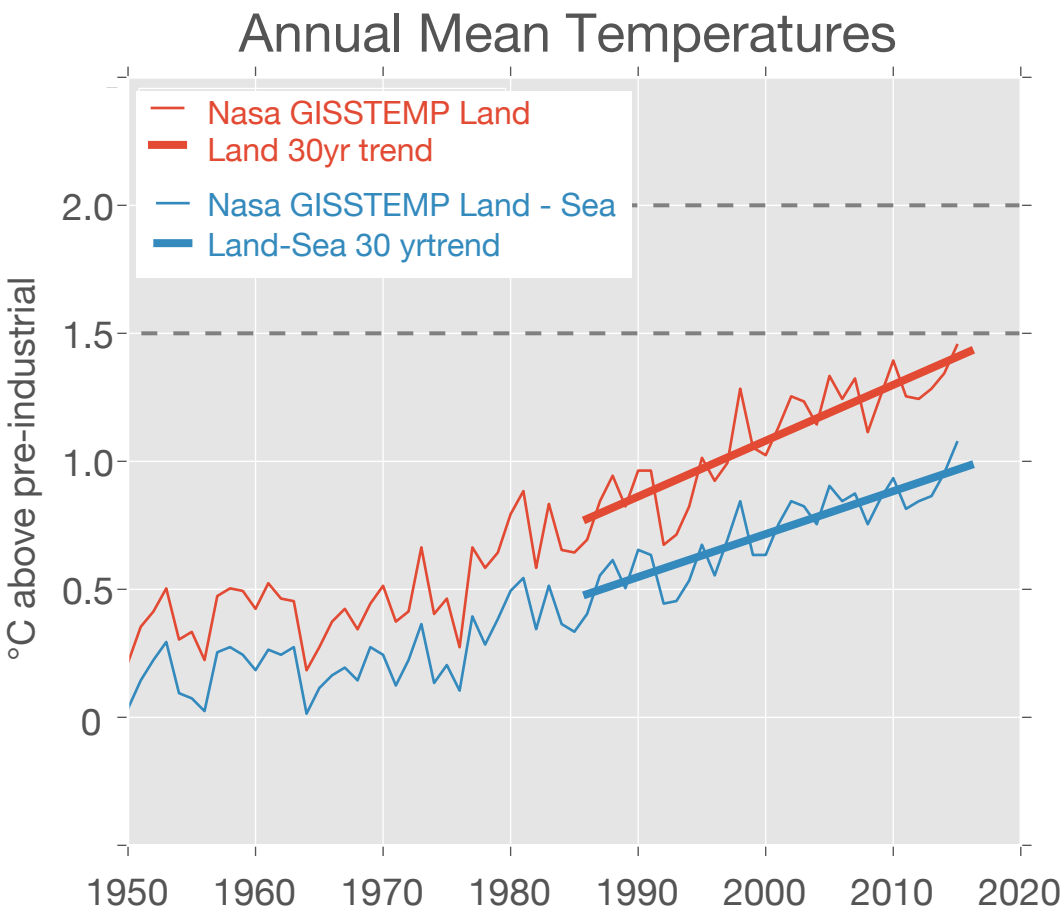
Long-term warming of about 1°C above pre-industrial is in line with the 30 year long-term trend…

- On longer time scales, signatures of natural variability (positive as well as negative) vanish

Observed warming is in line with long-term trend



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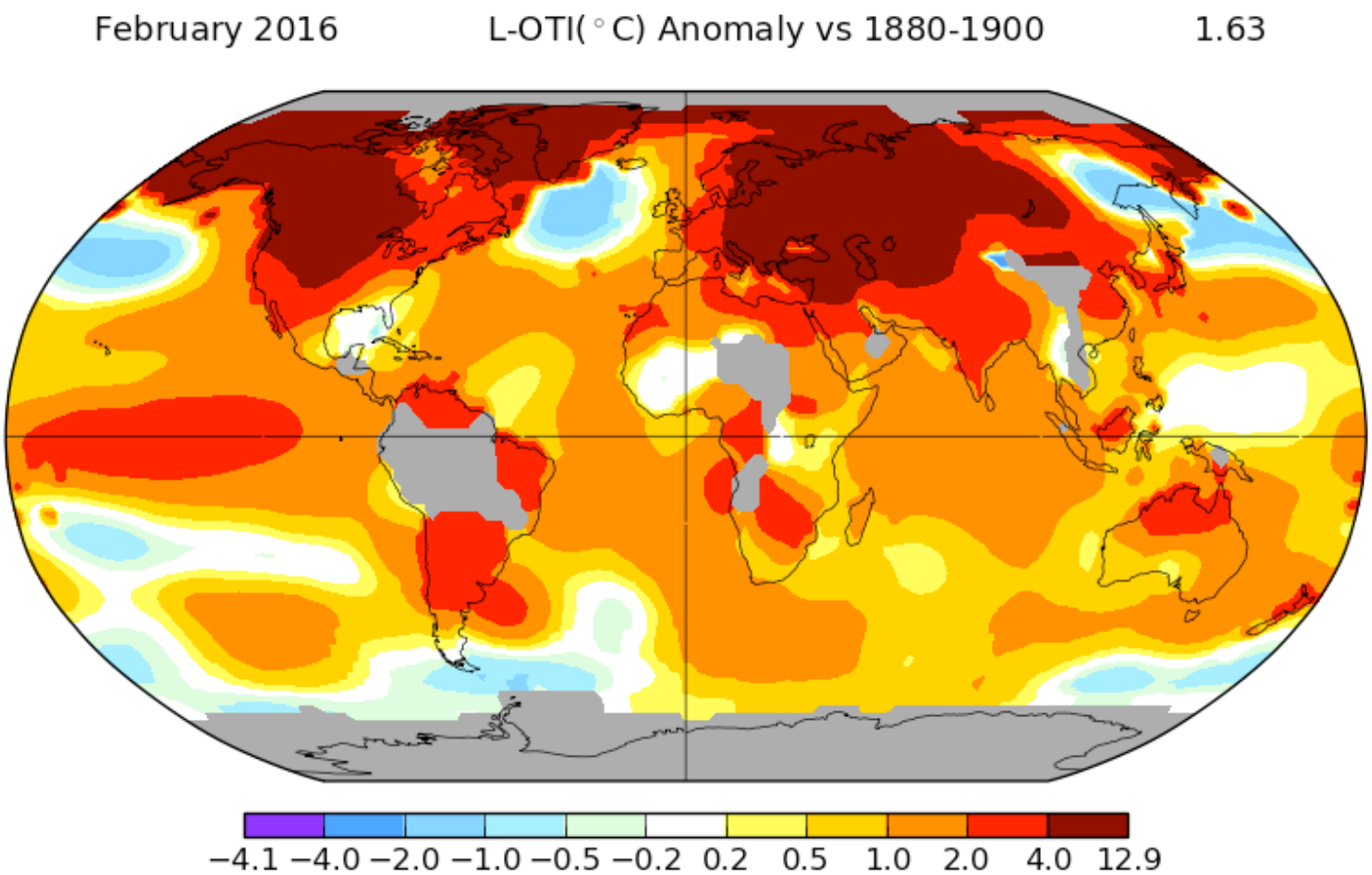
Anomalies in the Arctic and El Nino



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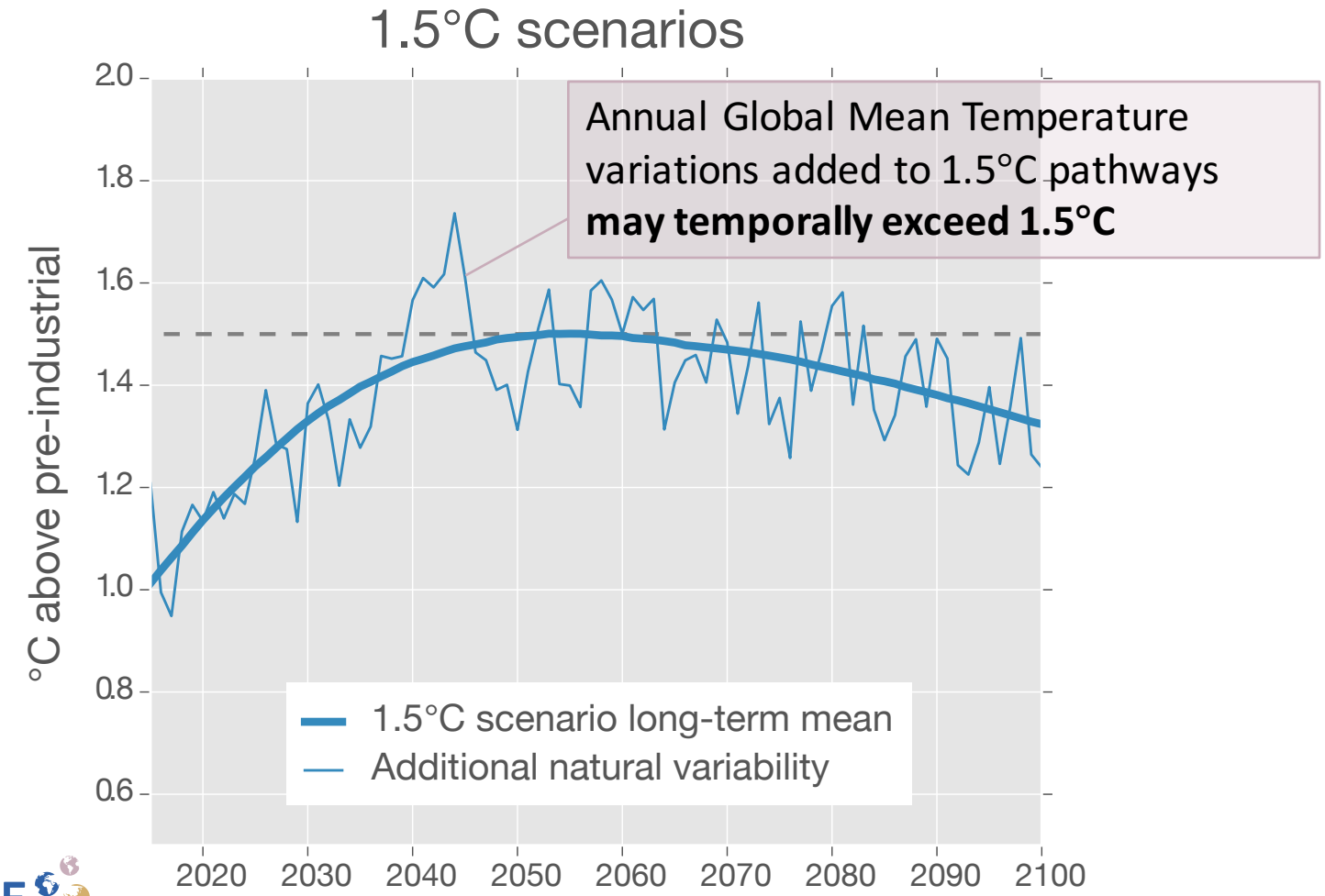
What does this entail for long-term warming trajectories?



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Note: "Additional natural variability" depicted here is typical of the past and was added to long-term 1.5°C pathway for illustrative purposes only

New results on differential impacts and risks at 1.5°C and 2°C

- **New study led by Climate Analytics scientists out today** is first to address the difference in climate impacts between 1.5°C and 2°C warming for 11 key impact indicators including extreme events, water availability, crop yields, coral reef degradation and sea-level rise
    - Schleussner et al.: Differential climate impacts for policy-relevant limits to global warming: the case of 1.5°C and 2 °C Earth Syst. Dynam., 7, 1–25, 2016 doi:10.5194/esd-7-1-2016
- **Regional perspective:** Assessment of 25 world regions providing detailed information at regional and sectoral level
- **Significant differences between 1.5°C and 2°C** on the regional level for all indicators considered

Schleussner et al.: Differential climate impacts for policy-relevant limits to global warming: the case of 1.5°C and 2 °C Earth Syst. Dynam., 7, 1–25, 2016 doi:10.5194/esd-7-1-2016

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The difference between 1.5°C and 2°C – A reason for concern

	1.5°C	2°C
Heat wave (warm spell) duration [month]		
Global	**1.1** [1;1.3]	**1.5** [1.4;1.8]
Reduction in annual water availability [%]		
Mediterranean	**9** [5;16]	**17** [8;28]

- 50% increase in heat-wave length
- Near-doubling of water availability reduction in dry subtropical region

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Schleussner et al. (2016)

The difference between 1.5°C and 2°C – A reason for concern

	1.5°C	2°C
Fraction of global coral reefs at risk of annual bleaching		
2050	about 90%	near 100%
2100	about 70%	near 100%
Crop yield reduction risk		
50% of current crop-producing regions may experience yield reductions of	Wheat: 14% Maize: 8% Rice: 8% Soy: 10%	Wheat: 19% Maize: 12% Rice: 16% Soy: 12%

- Decisive for the future of tropical coral reefs
- Substantial risk increase for regional crop yield reductions

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Schleussner et al. (2016)

Unprecedented global, mass coral bleaching event under way…

Images from December 2014 (left) and February 2015 show coral bleaching in the Pacific waters around American Samoa.

ECOLOGY

El Niño's warmth devastating reefs worldwide

Recent aerial surveys of Australia's Great Barrier Reef find massive coral bleaching

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Science (2016)

April 20, 2016: 93% of Australian Great Barrier Reef bleached

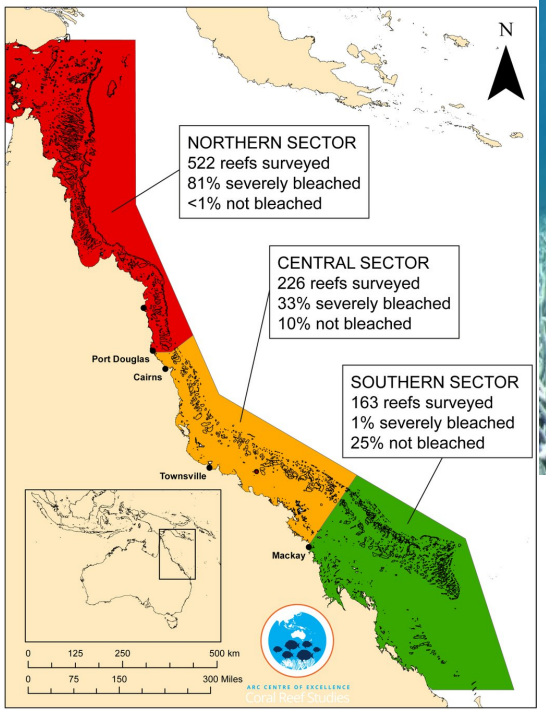

Photo: XL Catlin Seaview Survey

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Only 1.5°C may prevent long-term multi-meter sea-level rise…

Global Sea-level Ris

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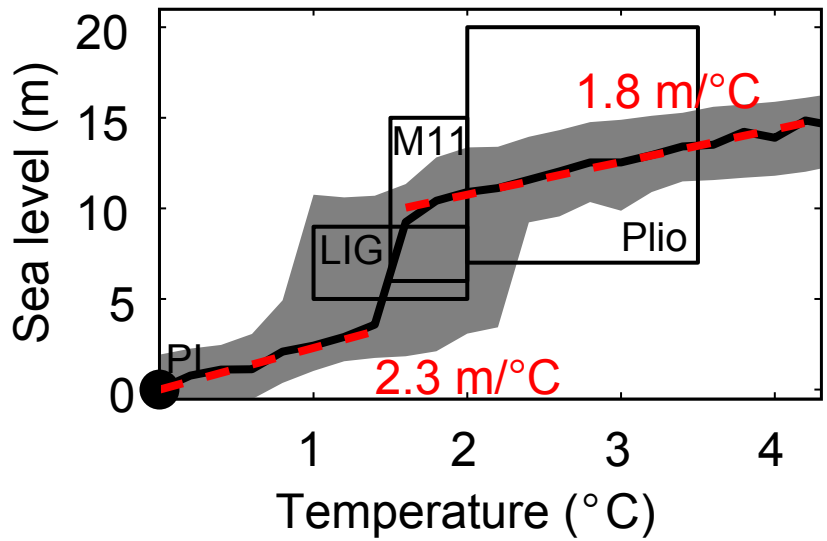
2081-210

Long-term Sea-level rise



Levermann, A. et al. PNAS (2013).

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Schleussner et al. (2016)

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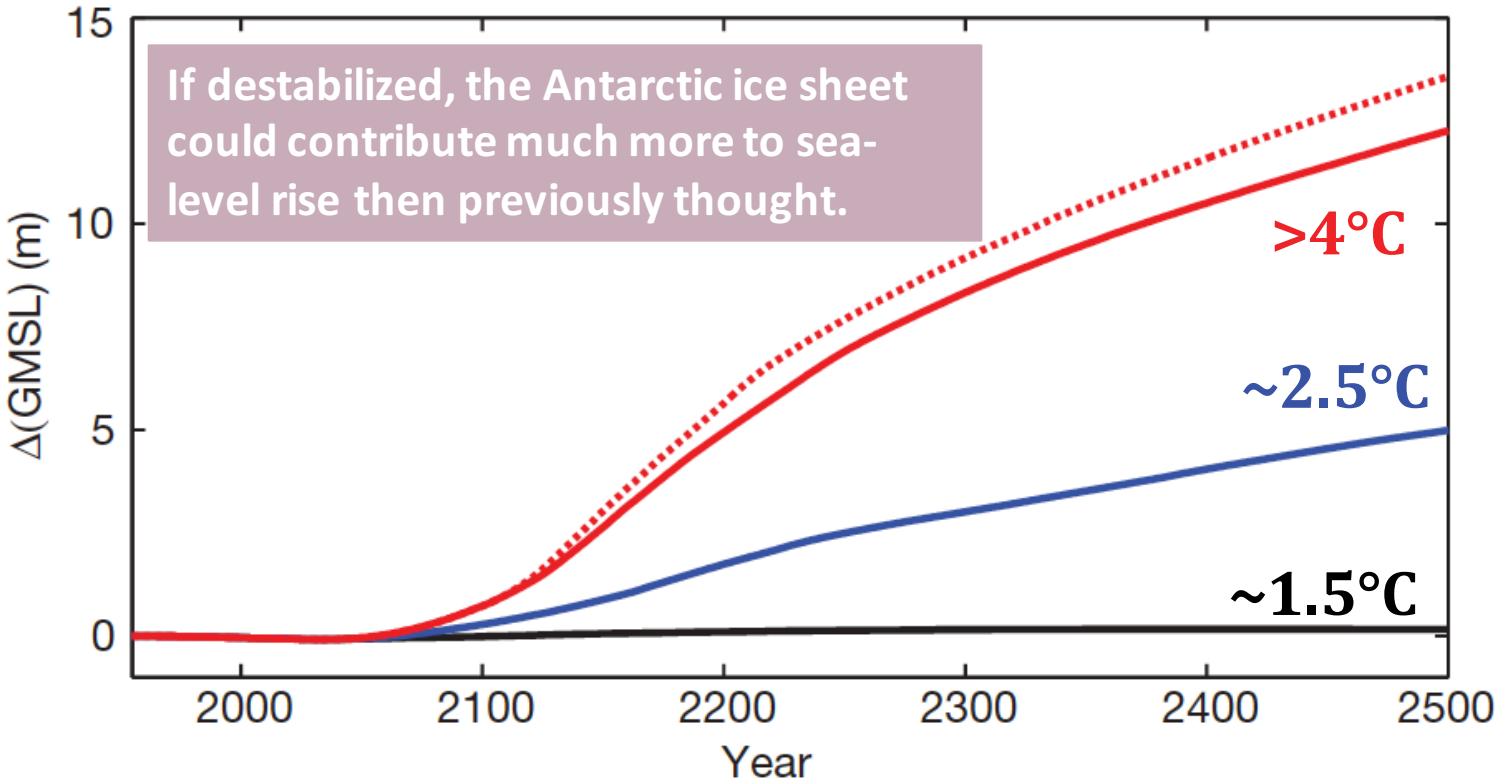
Instability of Antarctic ice sheet might lead to up to 1m additional sea-level rise in 2100…



Deconto & Pollard (2016)

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1.5°C, 2°C and tipping points in the earth system

	1.5°C	2°C
Number of crossed thresholds of abrupt shifts in earth system models	**20%**	**50%**

- Scientific review (meta-analysis) of multiple abrupt shifts in climate system reveal steep increase between 1.5° C and 2° C
- Risk for "tipping" of Greenland and parts of West-Antarctic ice-sheet increase rapidly

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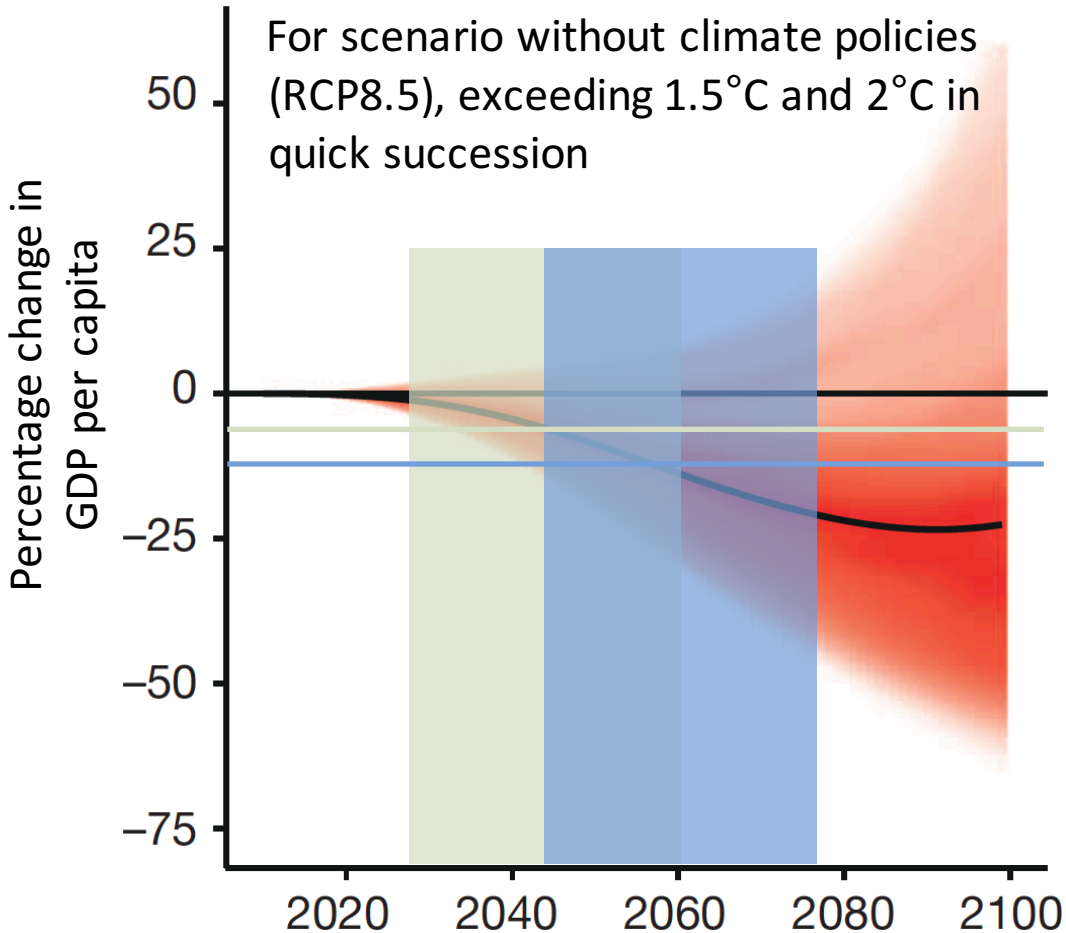
Drijfhout et al. (2015)
Levermann et al. (2012)

Global economic impacts are significantly lower at 1.5°C…



For illustrative purposes only

Approximate time 2.0°C is reached

Mean 2°C economic risk

Approximate time 1.5°C is reached

Mean 1.5°C economic risk

Adapted from Burke, M., Hsiang, S. M., & Miguel, E. (2015). Global non-linear effect of temperature on economic production. Nature.

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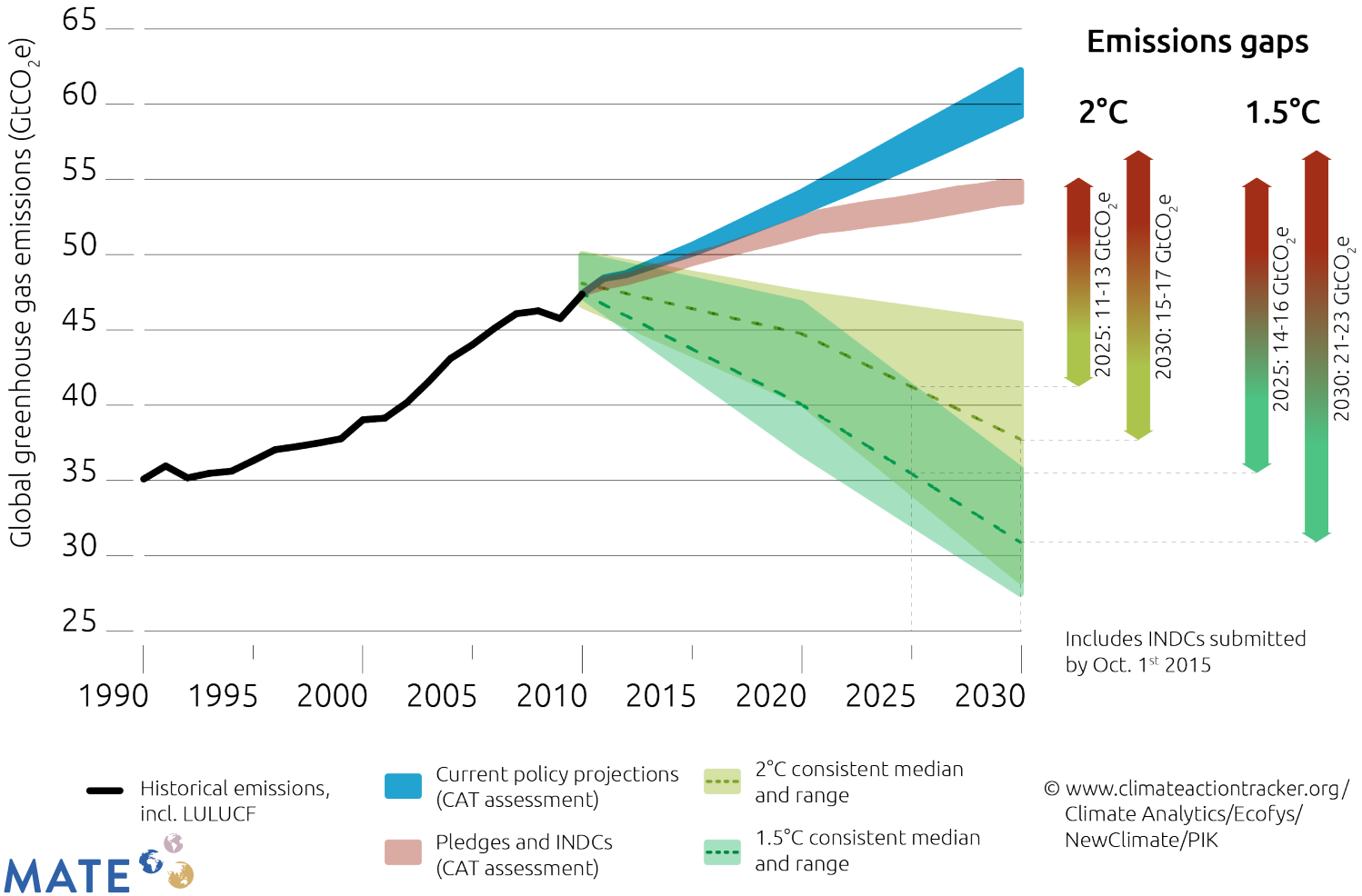
Where do we stand in relation to 1.5°C?



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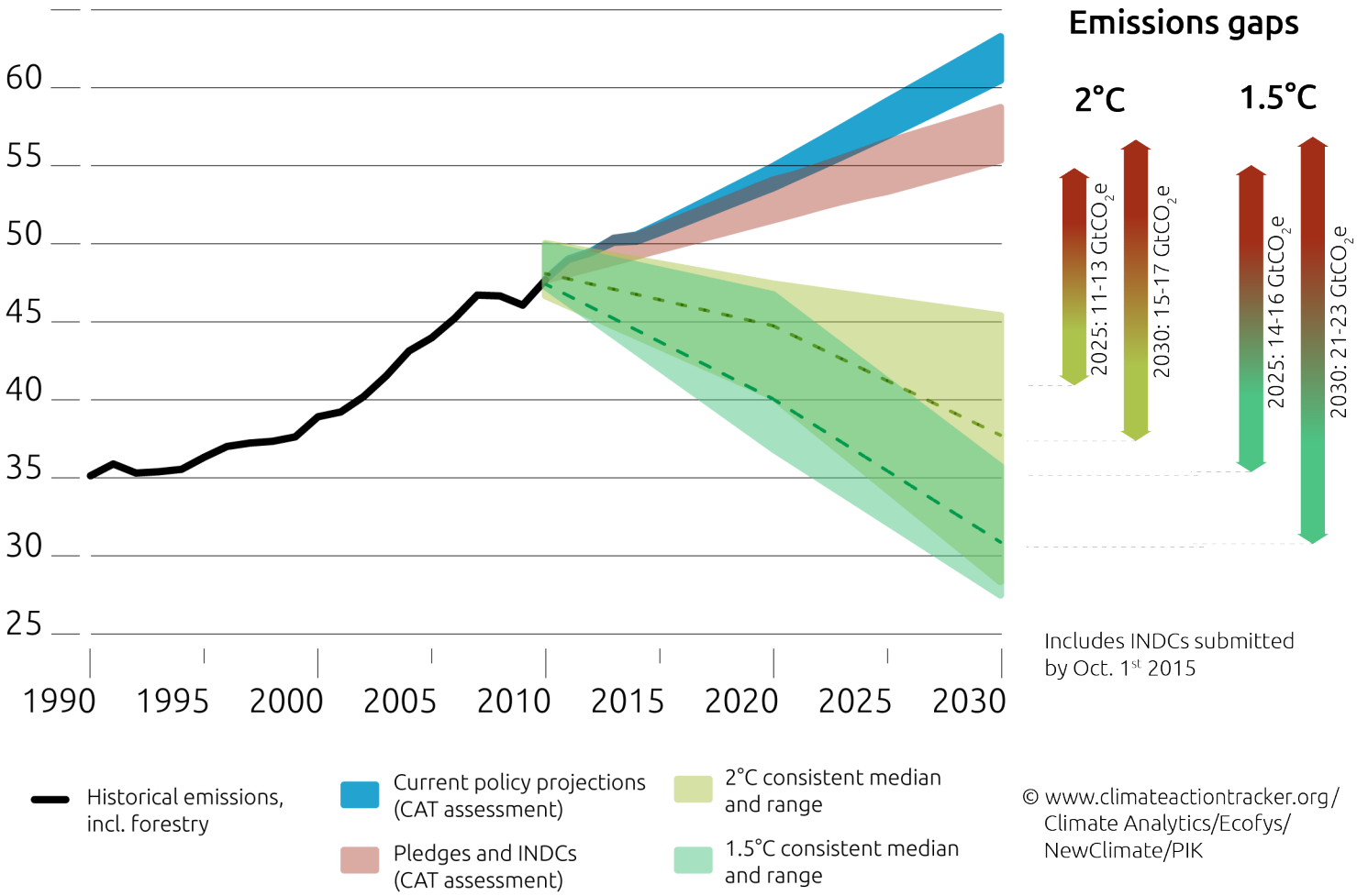
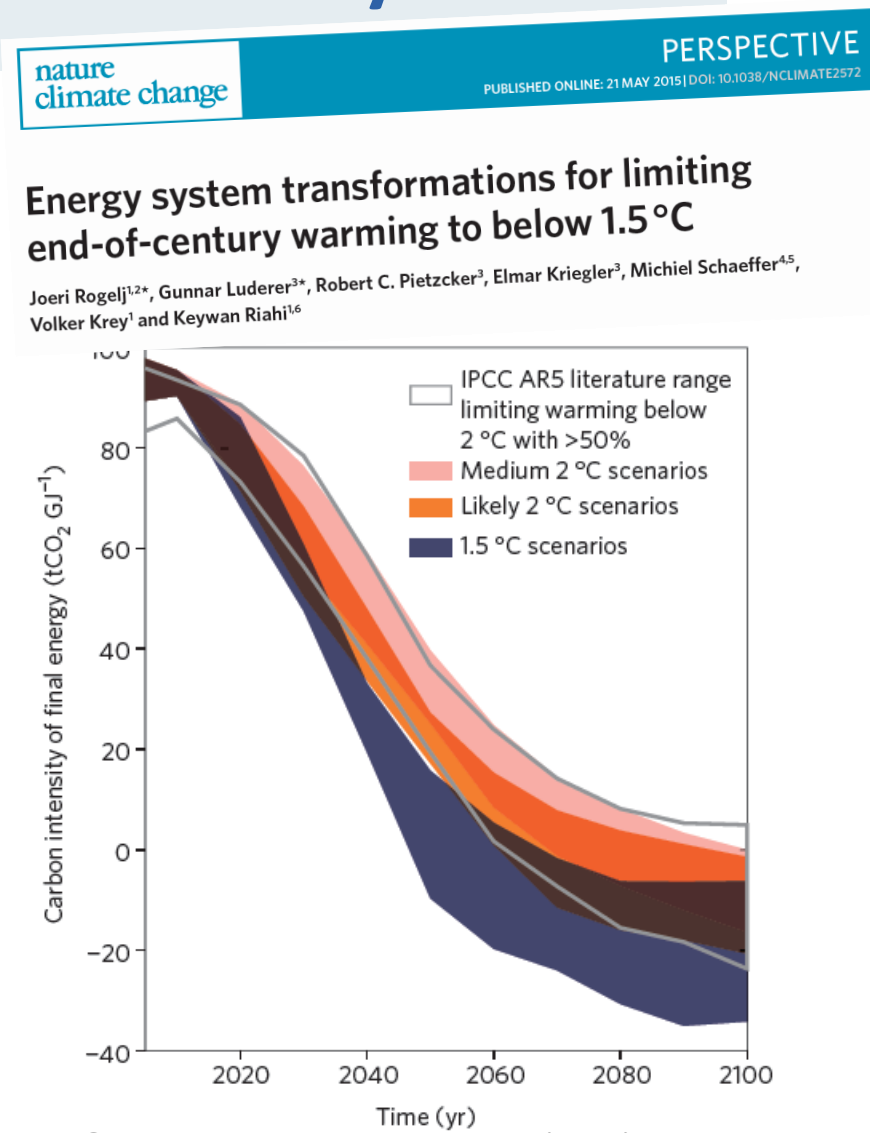


Energy system transformations required for limiting warming to below 1.5°C by 2100…

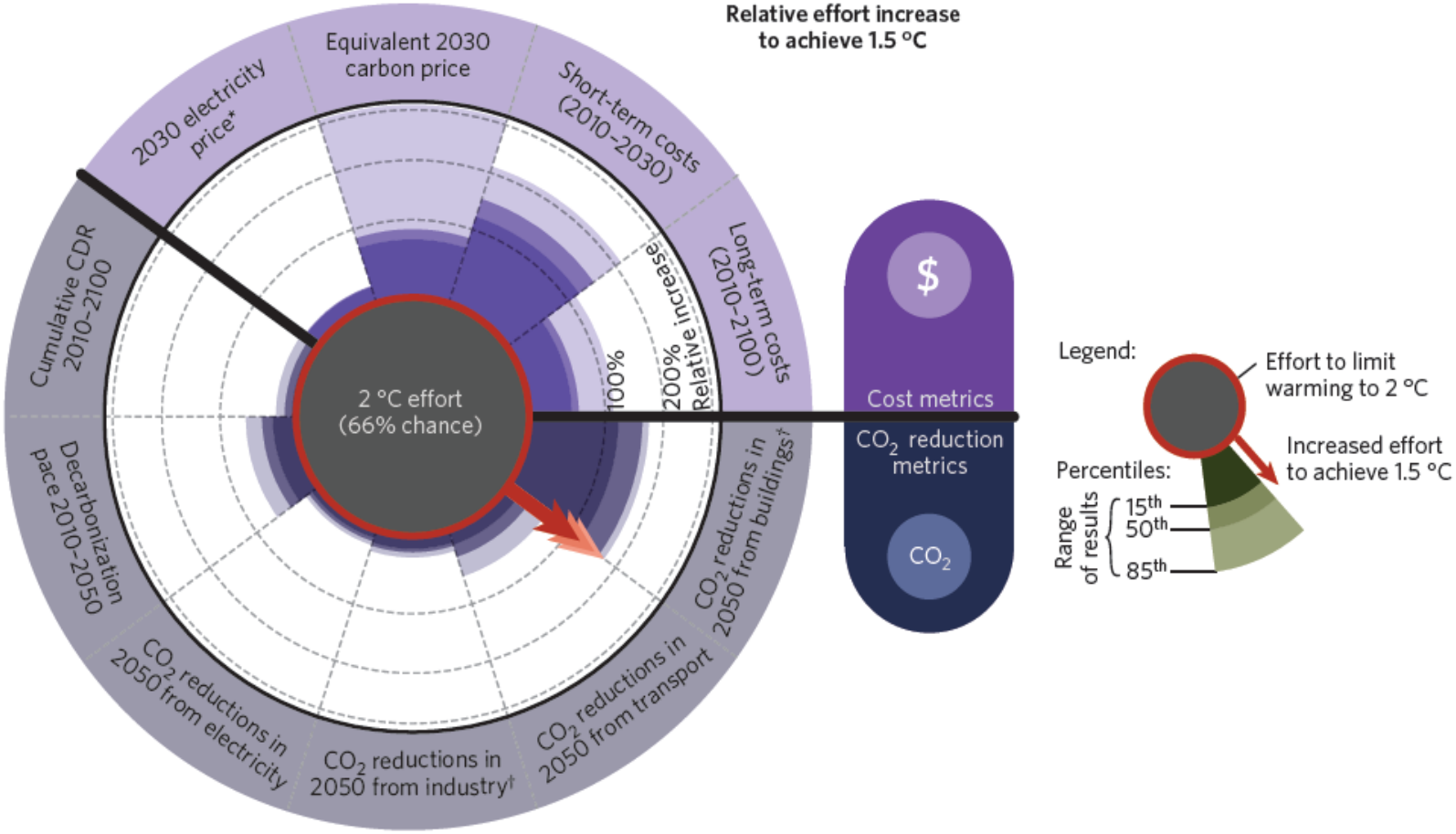
- Requires the same technologies and transformations in the energy system as holding warming to below 2° C during the 21st century
- Decarbonisation of the energy system needs to be faster and more pronounced.



CLIMATE ANALYTICS

Rogelj, J., Luderer, G., Pietzcker, R.C., Kriegler, E., Schaeffer, M., Krey, V., Riahi, K. (2015) "Energy system transformations for limiting end-of-century warming to below 1.5°C." Nature Climate Change, 5, 519-527

Relative effort increase to limit to 1.5°C



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Limiting warming below 1.5C by 2100 is feasible – but time is running out…

1.5° C

- Costs of renewable energy are declining rapidly (*One half of new power in 2014 was renewable)*
- Renewable energies are a development opportunity for small islands and many LDCs.
- Including a decarbonisation goal by 2050 would send an important signal to the energy industry and finance sector.

You can find additional information about climate impacts and feasibility of the 1.5°C target on our website…

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Home >

Hot Topics

1.5°C temperature limit - key facts

Since 2009 over a hundred Small Island Developing States, Least Developed Countries and many others have been calling for limiting global temperature rise to below 1.5°C above pre-industrial levels. This page is an information pool for material around the below 1.5°C temperature limit. It covers these questions:

- **Why 1.5°C? Science, impacts and risks**
- **What will it take to limit warming below 1.5°C?**
- **What is needed in the Paris Agreement for 1.5°C?**

Why 1.5°C? Science, impacts and risks.

1.5°C risks and feasibility – key points

This fact sheet provides key points on risks to ecosystems, food security and sustainable development associated with 1.5°C warming. It also provides responses to arguments commonly made against 1.5°C and provides the scientific evidence for each point made.

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http://climateanalytics.org/hot-topics

Additional Material

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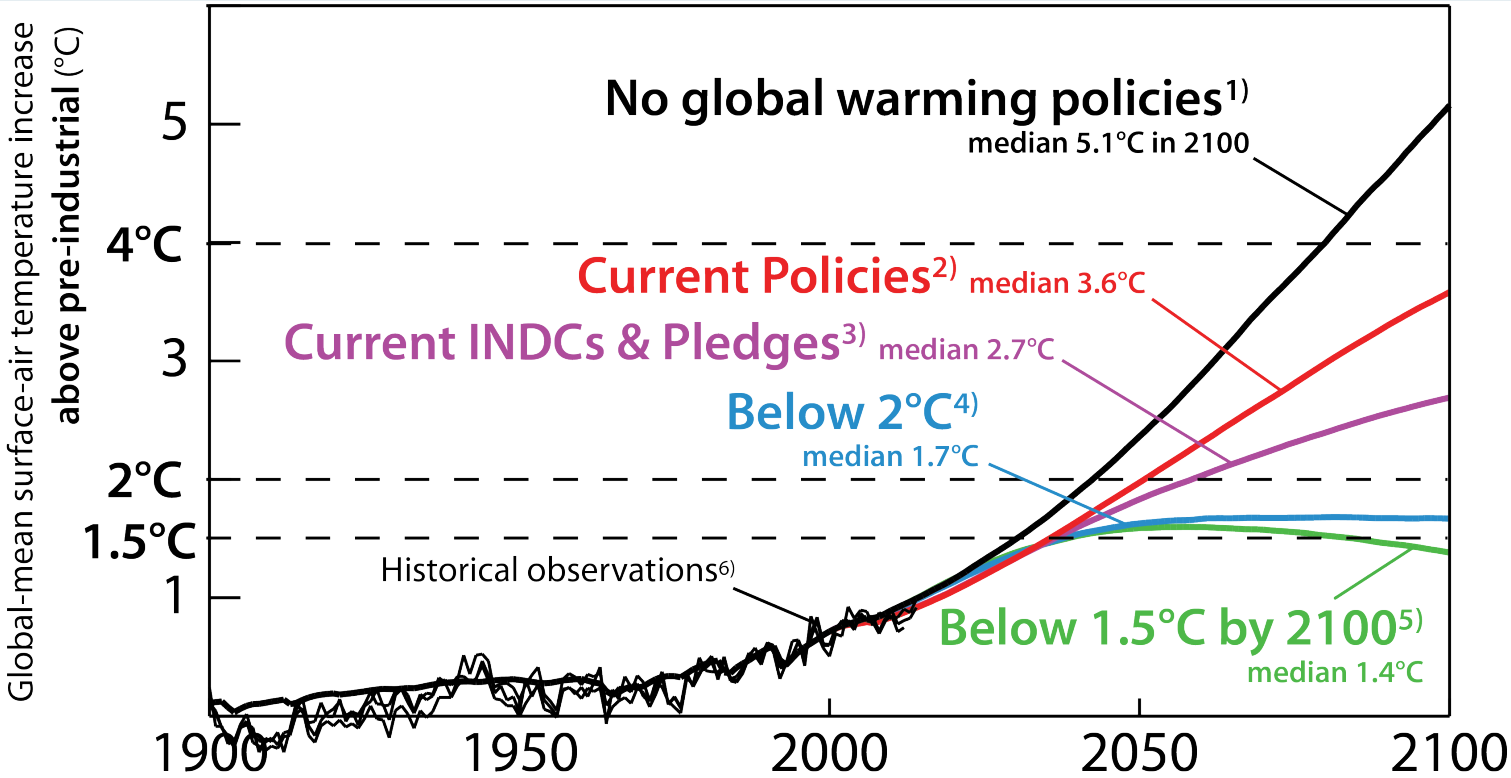
Where do we stand? INDCs represent a strong deviation from ”business as usual”…



1) Highest scenario assessed by IPCC AR5 WGI (RCP8.5). If carbon-cycle/climate models are driven by emissions, rather than prescribed concentrations, central warming estimates in IPCC AR5 project 4.5°C warming averaged over 2081-2100 for RCP8.5, close to the model used in this paper at 4.6°C

2) Current policies presently in place around the world (http://climateactiontracker.org/global.html)

3) Unconditional pledges or promises that governments have made, including in submitted INDCs as of 1 October 2015 (http://climateactiontracker.org/global.html)

4) Lowest scenario assessed by IPCC AR5 WGI (RCP2.6)

5) Low-emission pathway leading to warming below 1.5°C by 2100 with >50% chance (Rogelj et al 2015)

6) Historical observations from three datasets (IPCC AR5 WGI SPM)

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Bioenergy not an issue unique to either below 1.5°C or below 2°C …

Bioenergy demand for a 1.5°C goal is not higher than for below 2°C, but needs to be introduced faster and reach large scale 5-10 years earlier.

- In all (IPCC) energy-economic scenarios bioenergy plays a large role, hence any issues with bioenergy must be addressed irrespective of temperature limit.
- Bioenergy must rely on "second generation" options, derived from agricultural and forestry residues, dung and organic waste to prevent conflicts with food security
- For 1.5 and 2°C large-scale negative emission technology needed - combines modern biomass energy systems with carbon capture and storage

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