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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Recent temperature records, the 1.5°C limit and what this means...

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

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

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

04 Is 1.5°C still feasible?
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?

Source: http://data.giss.nasa.gov/gistemp/
No!

And here is why:
Natural variability strongly affects global mean temperatures on short time scales...

2015 Monthly Temperatures

- Monthly Nasa GISS TEMP Land Sea
- Annual Nasa GISS TEMP Land Sea
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
Anomalies in the Arctic and El Nino

February 2016

L-OTI(°C) Anomaly vs 1880-1900

1.63
What does this entail for long-term warming trajectories?

1.5°C scenarios

Annual Global Mean Temperature variations added to 1.5°C pathways may temporarily exceed 1.5°C

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


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

<table>
<thead>
<tr>
<th>Heat wave (warm spell) duration [month]</th>
<th>1.5°C</th>
<th>2°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>1.1 [1;1.3]</td>
<td>1.5 [1.4;1.8]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reduction in annual water availability [%]</th>
<th>1.5°C</th>
<th>2°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mediterranean</td>
<td>9 [5;16]</td>
<td>17 [8;28]</td>
</tr>
</tbody>
</table>

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

Schleussner et al. (2016)
The difference between 1.5°C and 2°C – A reason for concern

<table>
<thead>
<tr>
<th>Fraction of global coral reefs at risk of annual bleaching</th>
<th>1.5°C</th>
<th>2°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2050</td>
<td>about 90%</td>
<td>near 100%</td>
</tr>
<tr>
<td>2100</td>
<td>about 70%</td>
<td>near 100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crop yield reduction risk</th>
<th>1.5°C</th>
<th>2°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% of current crop-producing regions may experience yield reductions of</td>
<td>Wheat: 14% Maize: 8% Rice: 8% Soy: 10%</td>
<td>Wheat: 19% Maize: 12% Rice: 16% Soy: 12%</td>
</tr>
</tbody>
</table>

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

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

Photo: XL Catlin Seaview Survey

Half of Australia’s Great Barrier Reef coral ‘dead or dying’: Scientists

NORTHERN SECTOR
522 reefs surveyed
81% severely bleached
<1% not bleached

CENTRAL SECTOR
226 reefs surveyed
33% severely bleached
10% not bleached

SOUTHERN SECTOR
163 reefs surveyed
1% severely bleached
25% not bleached
Only 1.5°C may prevent long-term multi-meter sea-level rise...

![Graph showing long-term sea-level rise against temperature](image)


Schleussner et al. (2016)
Instability of Antarctic ice sheet might lead to up to 1m additional sea-level rise in 2100...

If destabilized, the Antarctic ice sheet could contribute much more to sea-level rise then previously thought.

Deconto & Pollard (2016)
1.5°C, 2°C and tipping points in the earth system

<table>
<thead>
<tr>
<th>Number of crossed thresholds of abrupt shifts in earth system models</th>
<th>1.5°C</th>
<th>2°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20%</td>
<td>50%</td>
</tr>
</tbody>
</table>

- 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

Drijfhout et al. (2015)
Levermann et al. (2012)
Global economic impacts are significantly lower at 1.5°C...

For scenario without climate policies (RCP8.5), exceeding 1.5°C and 2°C in quick succession

Percentage change in GDP per capita

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

Where do we stand in relation to 1.5°C?
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.

Relative effort increase to limit to 1.5°C

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

- 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...

http://climateanalytics.org/hot-topics
Additional Material
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)
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