Global warming of 1.5°C

(... in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty)

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Temperature spiral

Global Mean Temperature in °C relative to 1850 – 1900
Graph: Ed Hawkins (Climate Lab Book) – Data: HadCRUT4 global temperature dataset
Animated version available on http://openclimatedata.net/climate-spirals/temperature
IPCC reasons for concern / climate change risks (O’Neill et al., Nat Climate Change 2017)
Regional key risks and potential for risk reduction: Small Islands

**Losses**
- Loss of livelihoods, settlements, infrastructure, ecosystem services and economic stability

**Risk to coastal areas**
- Risk for low-lying coastal areas

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**Representative key risks for each region for**

- **Physical Systems**
  - Glaciers, snow, ice and/or permafrost
  - Rivers, lakes, floods and/or drought
  - Coastal erosion and/or sea level effects

- **Biological Systems**
  - Terrestrial ecosystems
  - Wildfire
  - Marine ecosystems

- **Human & Managed Systems**
  - Food production
  - Livelihoods, health and/or economics

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**Small islands**

- Risk level with high adaptation
- Potential for additional adaptation to reduce risk
- Risk level with current adaptation

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IPCC, AR5, SYR, SPM 8
Cumulative emissions (budgets) approximately determine global warming.

Based on IPCC AR5, Synthesis report (2014)

NB: The higher the probability the lower the budget.
The window for action is rapidly closing

65% of the carbon budget compatible with a 2°C goal is already used
NB: this is with a probability greater than 66% to stay below 2°C

Total Carbon Budget: 2900 GtCO₂

Amount Used 1870-2011: 1900 GtCO₂

Amount Remaining: 1000 GtCO₂

NB: Emissions in 2011: 38 GtCO₂/yr

AR5 WGI SPM
Stabilization of atmospheric concentrations requires moving away from the baseline – regardless of the mitigation goal.

Based on AR5 WGIII Figure 6.7
WGIII Scenarios groups : key characteristics

<table>
<thead>
<tr>
<th>CO₂eq Concentrations in 2100 (CO₂ eq)</th>
<th>Category label (conc. range)</th>
<th>Subcategories</th>
<th>Change in CO₂eq emissions compared to 2010 (in %)</th>
<th>Temperature change in 2100 - median climate sensitivity</th>
<th>Likelihood of staying below specific temperature levels (relative to 1850-1900 = « pre-industrial »)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>2050</td>
<td>2100</td>
<td></td>
</tr>
<tr>
<td>&lt; 430</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Only a limited number of individual model studies have explored levels below 430 ppm CO₂eq</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>450 (430 – 480)</td>
<td>Total range¹</td>
<td>-72 to -41</td>
<td>-118 to -78</td>
<td>1.5-1.7</td>
<td>Likely (66%) to stay below 2°C, &lt; 50% chances to stay below 1.5°C</td>
</tr>
<tr>
<td>500 (480 – 530)</td>
<td>No overshoot of 530 ppm CO₂eq</td>
<td>-52 to -42</td>
<td>-107 to -73</td>
<td>1.7-1.9</td>
<td>&gt; 50% chances to stay below 2°C</td>
</tr>
<tr>
<td></td>
<td>Overshoot of 530 ppm CO₂eq</td>
<td>-55 to -25</td>
<td>-114 to -90</td>
<td>1.8-2.0</td>
<td>About 50% chances to stay below 2°C</td>
</tr>
<tr>
<td>550 (530 – 580)</td>
<td>No overshoot of 580 ppm CO₂eq</td>
<td>-47 to -19</td>
<td>-81 to -59</td>
<td>2.0-2.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overshoot of 580 ppm CO₂eq</td>
<td>-16 to 7</td>
<td>-183 to -86</td>
<td>2.1-2.3</td>
<td>Likely (66%) to stay below 3°C, &lt; 50% chances to stay below 2°C</td>
</tr>
<tr>
<td>580 – 650</td>
<td>Total range</td>
<td>-38 to 24</td>
<td>-134 to -50</td>
<td>2.3-2.6</td>
<td></td>
</tr>
</tbody>
</table>

Based IPCC AR5 WGIII table SPM.1 (incomplete : higher emissions scenarios not shown)
AR5 SYR: Carbon dioxide « budgets »

<table>
<thead>
<tr>
<th>Net anthropogenic warming</th>
<th>&lt;1.5°C</th>
<th></th>
<th>&lt;2°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraction of simulations meeting goal</td>
<td>66%</td>
<td>50%</td>
<td>33%</td>
</tr>
<tr>
<td>Complex models, RCP scenarios only</td>
<td>2250</td>
<td>2250</td>
<td>2550</td>
</tr>
<tr>
<td>Simple model, WGIII scenarios</td>
<td>No data</td>
<td>2300 to 2350</td>
<td>2400 to 2950</td>
</tr>
</tbody>
</table>

Cumulative CO₂ emissions from 1870 in GtCO₂

<table>
<thead>
<tr>
<th>Complex models, RCP scenarios only</th>
<th>400</th>
<th>550</th>
<th>850</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple model, WGIII scenarios</td>
<td>No data</td>
<td>550 to 600</td>
<td>600 to 1150</td>
</tr>
</tbody>
</table>

Cumulative CO₂ emissions from 2011 in GtCO₂

ranges likely to change at least due to more studies

(Source: AR5 Synthesis report table 2.2)
Emissions in sectors: baselines and «likely < 2°C»

Direct CO₂ emissions by major sectors, and non-CO₂ emissions, for baseline and mitigation scenarios

AR5 SYR figure SPM.14
Paris agreement

- Article 2:
  - (...) to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:
    - Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;
    - Increasing the ability to adapt (...) and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production;
    - Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development
A IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty

Proposed outline (as adopted in October 2016; report to be finalized in 2018):

- Summary for policy makers (max 10 pages)
- Chapters:
  - 1. Framing and context
  - 2. Mitigation pathways compatible with 1.5°C in the context of sustainable development
  - 3. Impacts of 1.5°C global warming on natural and human systems
  - 4. Strengthening and implementing the global response to the threat of climate change
  - 5. Sustainable development, poverty eradication and reducing inequalities
- Boxes (integrated case studies/regional and cross-cutting themes),
- FAQs (10 pages)
Global warming of 1.5°C

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  - 5. Sustainable development, poverty eradication and reducing inequalities
- Boxes (integrated case studies/regional and cross-cutting themes)
- FAQs
- Understanding 1.5°C; reference levels, probability, transience, overshoot, stabilization (…)
- Pathways compatible with 1.5°C compared with 2°C (…) Technological, environmental, institutional and socio-economic opportunities and challenges
- Key global and regional climate changes, vulnerabilities, impacts, and risks at 1.5°C, taking into account adaptation potential (…)
- Current and emerging adaptation and mitigation options, including negative emission methodologies, & associated opportunities & challenges (…) Case studies
- Linkages between achieving SDGs and 1.5°C (…)
Comparison of global emission levels in 2025 and 2030 resulting from the implementation of the intended nationally determined contributions

UNFCCC, Aggregate effect of the intended nationally determined contributions: an update http://unfccc.int/resource/docs/2016/cop22/eng/02.pdf
Total global emissions: $41.9 \pm 2.8 \text{ GtCO}_2$ in 2015, 49% over 1990
Percentage land-use change: 36% in 1960, 9% averaged 2006-2015

Tentative and personal conclusions
(writing of the SR1.5 is not over yet!)

1.5°C matters: lower impacts, adaptation less costly than in 2°C world, even if there is a temporary overshoot above 1.5°C

It is very ambitious to reduce emissions enough for a 1.5°C long-term average temperature above pre-industrial objective; a little easier with overshoot

The slower radical changes in emission patterns take place, the more we may need uncertain or risky technologies, such as large use of carbon dioxide removal from the atmosphere (possibly at the expense of bio-energy competition with food production) or geoengineering in the form of solar radiation management

Decision making needs the best scientific information possible – the IPCC SR 1.5 will be essential to raise ambition within the Talanoa Dialogue, but much can be done without waiting for it
Useful links:

- [www.ipcc.ch](http://www.ipcc.ch): IPCC (reports and videos)
- [www.skepticalscience.com](http://www.skepticalscience.com): excellent responses to contrarians arguments
- On Twitter: @JPvanYpersele and @IPCC_CH