Fifth Assessment Report
Intergovernmental Panel on Climate Change:
The Key Messages

Michael Oppenheimer
Princeton University
At
Princeton E-ffiliates Partnership
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Global Mean Temperature, Sea Level Changing

(a) Globally averaged combined land and ocean surface temperature anomaly

(b) Globally averaged sea level change
Greenhouse gas emissions, largely from fossil fuels, responsible
Sources of emissions

Energy production remains the primary driver of GHG emissions

- 35% Energy Sector
- 24% Agriculture, forests and other land uses
- 21% Industry
- 14% Transport
- 6.4% Building Sector

2010 GHG emissions

AR5 WGIII SPM
Many Impacts Now Attributable to Climate Change
Emission Scenarios and Warming

(a) Annual anthropogenic CO₂ emissions

- WGIII scenario categories:
  - > 1000
  - 720–1000
  - 580–720
  - 530–580
  - 480–530
  - 430–480

- Historical emissions
- RCP scenarios:
  - RCP8.5
  - RCP6.0
  - RCP4.5
  - RCP2.6

(b) Warming versus cumulative CO₂ emissions

- Total human-induced warming
- Observed 2000s
- Baselines

Cumulative anthropogenic CO₂ emissions from 1870 (GtCO₂)

Temperature relative to 1861–1880 (°C)
Projected Warming and Sea Level Rise
Geographic Picture of Warming

(a) Change in average surface temperature (1986–2005 to 2081–2100)

(b) Change in average precipitation (1986–2005 to 2081–2100)
When Considering Potential Impacts:
Adaptation (reducing vulnerability and exposure) is Critical but Usually Suboptimal

**Vulnerability:**
The predisposition of a person or group to be adversely affected

**Exposure:**
Being in the wrong place at the wrong time
### A Key Risk: Heat Index

*(From “Risky Business”, Not IPCC)*

<table>
<thead>
<tr>
<th>ACP Humid Heat Stroke Index</th>
<th>Peak Wet-Bulb Temperature</th>
<th>Characteristics of the hottest part of day</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>74°F to 80°F</td>
<td>Uncomfortable. Typical of much of summer in the Southeast.</td>
</tr>
<tr>
<td>II</td>
<td>80°F to 86°F</td>
<td>Dangerous. Typical of the most humid parts of Texas and Louisiana in hottest summer month, and the most humid summer days in Washington and Chicago.</td>
</tr>
<tr>
<td>III</td>
<td>86°F to 92°F</td>
<td>Extremely dangerous. Comparable to Midwest during peak days of 1995 heat wave.</td>
</tr>
<tr>
<td>IV</td>
<td>&gt;92°F</td>
<td>Extraordinarily dangerous. Exceeds all US historical records. Heat stroke likely for fit individuals undertaking less than one hour of moderate activity in the shade.</td>
</tr>
</tbody>
</table>
US Extreme Heat Risk
(from “Risky Business”, not IPCC)

Category III+ Wet-bulb Temperature

1 week+
Cat III,
1 day+
Cat IV

Most of
summer
Cat III,
1 month
Cat IV

Category III+ Wet-bulb Temperature
Crop Yield Declines Outpace Increases

All emission scenarios and adaptation levels Relative to late 20th C
Coastal Flooding: Flood frequency multiplier for 0.5m global mean sea level rise

Figure 13.25 | The estimated multiplication factor (shown at tide gauge locations by colored dots), by which the frequency of flooding events of a given height increase for (a) a mean sea level (MSL) rise of 0.5 m (b) using regional projections of MSL for the RCP4.5 scenario, shown in Figure13.19a.
Example: Hurricane Sandy

Sandy-like flood (3.7m) returns more often due to higher sea level (up to 1m) and strong tropical cyclones (Lin et al 2012) (Not from IPCC)

Return period decreases
An Aggregation of Risk

a) Global average surface temperature change

b) Level of additional risk due to climate change
Implied Emissions Reductions

(A) Risks from climate change...  (B) ...depend on cumulative CO₂ emissions...

(C) ...which in turn depend on annual GHG emissions over the next decades
Limiting Temperature Increase to 2°C

Global GHG emissions reduction of 40-70% in 2050 compared to 2010

Net zero or negative GHG emissions in 2100

Global emissions to curb within next 5-15 years
Act Aggressively Now?
Aggregate Cost of Emissions Mitigation, in Context

Global Mitigation Costs and Consumption Growth in Baseline Scenarios

Percentage Point Reduction in Annualized Consumption Growth Rate over 21st Century [%-point]

- 0.03 (0.01-0.05)
- 0.04 (0.01-0.09)
- 0.06 (0.03-0.13)
- 0.06 (0.04-0.14)

Reduction in Consumption Relative to Baseline [%]

- 2030
- 2050
- 2100

CO₂eq concentrations in 2100 [ppm CO₂eq]
The window for action is rapidly closing

65% of our carbon budget compatible with a 2°C goal already used

Total Carbon Budget: 790 GtC

Amount Used 1870-2011: 515 GtC

Amount Remaining: 275 GtC
Can policy makers think ahead?