Climate Change 2013: The Physical Science Basis and the Human Response Needed

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The Intergovernmental Panel on Climate Change (IPCC) is a major effort by the scientific community to provide evidence to decision makers and the general public on the mechanisms and effects of climate change. This time, 259 authors from 39 different countries worked on voluntary basis, as it is the IPCC way of proceeding, to produce Climate Change 2013: The Physical Science Basis of the IPCC Fifth Assessment Report. This is the outcome of the Working Group I, a full report of more than 2,000 pages, the major findings of which are furnished in a Summary for Policymakers.

In a sense, we could say that the report does not bring huge novelties other than to confirm the previous IPCC reports and to add much more evidence to the major issues that the IPCC previously shared. The IPCC is very careful in the way its assertions are presented, and considers the strength of the available evidence (limited, medium or robust), the degree of agreement (low, medium, high), or the level of confidence (very low, low, medium, high, and very high).

In a similar way, the assessed likelihood of an outcome or a result is indicated using the following terms: virtually certain 99–100% probability, very likely 90–100%, likely 66–100%, about as likely as not 33–66%, unlikely 0–33%, very unlikely 0–10%, exceptionally unlikely 0–1%. Additional terms, such as extremely likely 95–100%, more likely than not >50–100%, and extremely unlikely 0–5%, were also used when appropriate.

What for some can be considered as an obscure way of presenting things, especially for the press that often looks for dramatic headlines, is a demonstration that the IPCC wants to keep a strong stand in its scientific contributions to the challenges of climate change. They are not replacing politicians nor civil society, as these are the stakeholders called to take decisions, but the IPCC is making an essential contribution in providing the evidence needed to move forward.

The IPCC does not do research itself. It is a collaborative work of hundreds of scientists that review the research produced in the last years on these topics and produce a broad assessment. The big difference between the previous Climate Change 2007 (IPCC Fourth Assessment Report) and the present is the amount of research developed within this period. Hundreds of universities and research centres oriented their activity towards climate change and related issues. Again, nothing totally new, but a stronger confirmation of the main alerts and indicators were proposed. The following is a quick description of the findings.

Global warming

It is now considered even more certain (> 95%) that human influence is the dominant cause of the observed warming since the mid-20th century. Natural internal variability and natural external factors (e.g. the sun) contributed virtually nothing to the warming since 1950.
The measured global temperature curve from several data sets (Top: annual values; Bottom: averaged values over a decade)

The future temperature development in the highest emissions scenario (red) and in a scenario with successful climate mitigation (blue) – the “4-degree world” and the “2-degree world

The last 30 years were probably the warmest since at least 1,400 years. The future warming by 2100 – with comparable emission scenarios – is about the same as in the previous report. For the highest scenario, the best estimate warming by 2100 is still 4 degrees C.

**Sea level rise**

Sea levels are rising faster now than in the previous two millennia, and the rise will continue to accelerate – regardless of the emissions scenario, even with strong climate mitigation. This is perhaps the biggest change over the 4th IPCC report: a much more rapid sea level rise is now projected (28-98 cm by 2100). This is more than 50% higher than the old projections (18-59 cm) when comparing the same emission scenarios and time periods.

**Land and sea ice**
Over the last two decades, the Greenland and Antarctic **ice sheets are losing mass**, glaciers continued to shrink almost worldwide, and Arctic sea ice and Northern Hemisphere spring snow cover continued to decrease in extent.

In the new IPCC report, the **critical temperature limit** at which a total loss of the Greenland ice sheet will occur, is estimated as 1 to 4 degrees C of warming above pre-industrial temperature. With unabated emissions, the Arctic Ocean will likely become **virtually ice-free in summer** before the middle of the century. In the last report, this was not expected until near the end of the century.

**Rainfall**

The IPCC expects that **dry areas become drier** due to global warming, and **moist areas even wetter**. Extreme rainfall is likely already increasing in North America and Europe. Future extreme precipitation events are very likely to become more intense and more frequent over most land areas of the humid tropics and mid-latitudes.

![Surface Ocean CO2 and pH](image)

Measured CO2 concentration and pH in seawater, with low pH meaning higher acidity

**Oceans**

At high emissions, the IPCC expects a **weakening of the Atlantic Ocean circulation** (commonly known as the Gulf Stream system) by 12% to 54% by the end of the century. The CO2 emissions not only cause climate change but also an increase in the CO2 concentration in seawater, and **the oceans acidify** due to the carbonic acid that forms.

**What do we do? The challenges of lifestyle change, more active civil society engagement, and adaptation**

Scientists provide us with the best they can, now it’s the time for stakeholders (states, companies, NGOs, and civil society) to develop their views. As we have seen it is a most difficult and tricky game. Diplomacy and international institutions are in very bad shape (Copenhagen, Kyoto Protocol, just to mention the most visible failures), the financial crisis has become a nightmare for the real economy (unemployment, crusades to promote growth whatever the consequences), and the environment has been downgraded as an urgent concern in the public opinion polls.
The IPCC will produce several reports in 2014: the Working Group II report on socio economics aspects and adaptation by March, the Working Group III report on mitigation by April, and the final Synthesis Report, which is the most politically valuable as this will be approved by government representatives, is expected by October 2014.

At this stage, it is critical we focus attention and action on what the IPCC Fifth Assessment Report is also indicating beyond the scientific studies. One is that human activity is crucial in our current situation and that lifestyle changes and civil society engagement are imperative. The second is adaptation and which is the real challenge. As we go through the report, we can realize that the situation is very likely to change in a significant way. The challenge will be to adapt to new – and uneasier – conditions, a major challenge for individuals and communities.