The Intergovernmental Panel on Climate Change (IPCC) has some agenda-setting power for global climate policy. This explains recent worries about the fact that the governments had decided in 2009 that the IPCC's Fifth Assessment Report (AR5) was to explicitly address geoengineering options, which could then possibly legitimate the serious consideration of such options in global climate policy negotiations. Such worries, however, neglect two factors. Firstly, the IPCC has a long history of dealing with geoengineering and, secondly, the IPCC performs its assessments without endorsing any options and being based on what is available in the primary literature. Still, there is no way to deny that the way the IPCC summarises the science does have an influence on how a particular subject is subsequently discussed in policy-making. For that reason, it is already interesting to look back at the emergence of the geoengineering debate within the IPCC.

From my analysis of IPCC reports, a few trends become clear. Geoengineering – in all of its forms and using the term 'geoengineering' – has been part of all last four rounds of IPCC reports since 1996, at the level of both individual chapters and Summaries for Policymakers (SPMs). Geoengineering has also never been endorsed by the IPCC. However, in some of the IPCC reports further study of geoengineering options has been promoted, and the latest IPCC report (AR5 WGIII, 2014) made it clear that reaching a two-degree target would in many scenarios entail large-scale afforestation and/or production of bioenergy with carbon dioxide capture and storage (BECCS).

From the First Assessment Report (1990) to the Fourth Assessment Report (2007)

In the First Assessment Report (FAR) of 1990 the reference made to geoengineering was limited to the discussion of large-scale reforestation and afforestation, with the Summary for Policymakers (SPM) of the FAR WGIII report explicitly mentioning these as being part of scenarios that would keep CO_2 concentrations within certain bounds. No other options for either Carbon Dioxide Removal (CDR) or Solar Radiation Management (SRM) were mentioned anywhere in the FAR, and the term 'geoengineering' was not yet used by the IPCC.

The Second Assessment Report (SAR) of 1996 was the first IPCC report that assessed 'geoengineering' options, which in the SAR WGII Summary for Policymakers (SPM) were considered 'likely to be ineffective, expensive to sustain, and/or to have serious environmental and other effects that are in many cases poorly understood'. In chapter 25 on mitigation (still part of WGII at that time), geoengineering (both CDR and SRM) was discussed in a section on 'concepts for counterbalancing climate change'. Still, only SRM examples were given in the SPM.

Five years later, the Third Assessment Report (TAR) of 2001 mentioned geoengineering in its WGIII (mitigation) SPM under 'gaps in knowledge': it argued that 'some basic inquiry in the area of geo-engineering' was warranted. Interestingly, in contrast with the SAR, only CDR examples were given in the SPM this time.

In the Fourth Assessment Report (AR4) of 2007, the two examples mentioned in the SPM (of WGIII) were ocean fertilisation (CDR) and stratospheric aerosols (SRM), and geoengineering options were assessed to 'remain largely speculative and unproven, and with the risk of unknown side-effects'. It was also noted that '[r]eliable cost estimates for these options have not been published'.

The Fifth Assessment Report (2014): Working Group I

It must be admitted that the assessment of geoengineering options in the Fifth Assessment Report (AR5) of 2014 has been the most extensive of all IPCC reports, mainly because much literature has appeared in the eight years before AR5. Still, even though an IPCC expert meeting on geoengineering held in 2011[1] had received some attention, it came as a surprise to some that the WGI SPM (which was approved by governments on 27 September 2013) contained a final paragraph, which read as follows:

> Methods that aim to deliberately alter the climate system to counter climate change, termed geoengineering, have been proposed. Limited evidence precludes a comprehensive quantitative assessment of both Solar Radiation Management (SRM) and Carbon Dioxide Removal (CDR) and their impact on the climate system. CDR methods have biogeochemical and technological limitations to their potential on a global scale. There is insufficient knowledge to quantify how much CO_2 emissions could be partially offset by CDR on a century timescale. Modeling indicates that SRM methods, if realizable, have the potential to substantially offset a global temperature rise, but they would also modify the global water cycle, and would not reduce ocean acidification. If SRM were terminated for any reason, there is *high confidence* that global surface temperatures would rise very rapidly to values consistent with the greenhouse gas forcing. CDR and SRM methods carry side effects and long-term consequences on a global scale.

However, comparable text had been part of the first draft of chapter texts, which was circulated to experts for their review in December 2011. While the first draft of the SPM (of October 2012) – oddly enough – did not contain any reference to geoengineering, the paragraph quoted above did appear – in very comparable form – in the final draft that was distributed to governments in June 2013. And when the paragraph first came up for discussion in the Plenary approval session in Stockholm in September 2013, no country raised its flag. Apparently, every government could live with the text as initially proposed by the authors, which was slightly amended in response to government review comments. Thus, there really was no debate on geoengineering in the IPCC WGI Plenary in Stockholm in September 2013. And I must say that the paragraph's wording was very carefully crafted indeed.

The Fifth Assessment Report (2014): Working Group III

Similarly to the FAR of 1990, the AR5 WGIII SPM of 2014 emphasised again that for strong mitigation scenarios, large-scale afforestation could be needed to remove carbon from the atmosphere. But the main IPCC message

[1] See: http://www.ipcc-wg3.de/meetings/expert-meetings-and-workshops/em-geoengineering

pertaining to geoengineering in 2014 became that in many of the mitigation scenarios assessed, the geoengineering option of bioenergy production with carbon dioxide capture and storage (BECCS) had been used. The authors of AR5 WGIII SPM, however, did not use the term 'geoengineering', preferring to refer explicitly to only these two geoengineering options. This was because only BECCS and afforestation had featured in their assessment of mitigation scenarios, and they were afraid that 'geoengineering' might carry a negative association.

But on the third day of the WGIII Plenary, it became clear that one country could not agree to the proposed text and the way geoengineering was framed in the SPM. The first intergovernmental geoengineering debate within the IPCC was born, only to be resolved after four sessions of a contact group that extended over the last three days of the Plenary. I will here recount some of the discussions on geoengineering that were held in the Plenary and in the contact group, which I co-chaired together with a delegate from Brazil.

In the Plenary, it was pointed out by one country that the geoengineering options assessed by the IPCC were at odds with the UN Framework Convention on Climate Change and amounted to another invasion of developing countries by the developed countries. Furthermore, there is significant uncertainty pertaining to the effectiveness and side-effects of geoengineering options. Policy-makers must receive balanced information about these kinds of technologies and their limitations. This is a moral issue: the IPCC carries a special responsibility to give the most comprehensive and clear portrayal of uncertainties, risk and limitations of geoengineering methods and technologies. The country further added that the IPCC should develop an ethical protocol for its own assessments.

In the contact group, after having spent most of the time discussing how to prevent too much focus from the IPCC on mitigation scenarios that would keep the 2°C target within sight (the IPCC could then be seen to propose that this target would have to be met), there was wide agreement among countries to request that the authors include the following part of the approved WGI text on geoengineering in a footnote:

According to WGI, CDR methods have biogeochemical and technological limitations to their potential on the global scale. There is insufficient knowledge to quantify how much CO_2 emissions could be partially offset by CDR on a century timescale. CDR methods carry side-effects and long-term consequences on a global scale.'

Furthermore, the following text was added to the bold text of the paragraph on reaching the 2°C target through 'overshoot scenarios' that involve negative emissions: 'The availability and scale of these [afforestation and BECCS, acp] and other Carbon Dioxide Removal (CDR) technologies and methods are uncertain and CDR technologies and methods are, to varying degrees, associated with challenges and risks.

Thus I conclude that while governments were satisfied with the way ge-

oengineering options were assessed in the Final Draft of AR5 WGI, they wanted more emphasis on the uncertainties and risks of large-scale afforestation and BECCS than was contained in the Final Draft of AR5 WGIII (even though these uncertainties and risks were already contained in one location in the text). By making use of some of the already approved text from WGI, it was not difficult to accommodate this wish from governments. Still, many issues, such as those pertaining to the governance of geoengineering and geoengineering research, were left untouched by the IPCC summaries, and it should be expected that were geoengineering to feature in future IPCC reports (e.g., a Special Report on Geoengineering), such issues will likely receive more attention.

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