Over to the diplomats

Guidance for mitigation action should come from the insights that global mean temperatures respond to cumulative carbon emissions and that there are risks beyond warming alone. Momentum for the negotiations requires a sense of opportunity.

Leaders from around the world have made at least a prospective commitment: they promised to agree on a binding climate change mitigation strategy in 2015. How this strategy can be forged is less clear. A United Nations Climate Summit has been called for 23 September 2014 in New York[1] to bring fresh ideas and momentum to the process. *Nature Geoscience* and *Nature Climate Change* take this opportunity to present scientific background for the upcoming climate talks in a joint Focus, along with opinion pieces on some of the crucial crunch points that the negotiators face: allocation of carbon budgets to countries, over-reliance on carbon removal from the atmosphere and making cooperative bottom-up diplomacy work (http://www.nature.com/ngeo/focus/climate-change-countdown/index.html).

In terms of climate science, there has been a key change in perspective since earlier negotiations. It has become clear that whether CO_2 emissions occur in a single burst next year or gradually over the next few decades makes little difference for global mean temperature change in the long run. At least in terms of CO_2, the total sum of emissions determines how warm the planet will become[2–4], regardless of when these emissions occur and how they change over time.

Another insight emerged as a corollary once temperature change projections were drawn up against cumulative carbon emissions (see Fig. 1b in the Commentary in the Focus; http://dx.doi.org/10.1038/ngeo2254): the warming response to cumulative emissions is almost perfectly linear. That is, the degree of warming per unit of CO_2 that reaches the atmosphere is roughly the same, whether we drastically reduce CO_2 emissions or carry on with unabated fossil fuel and cement use. The difference between the various emissions scenarios — from aggressive mitigation to business as usual — lies almost exclusively in how quickly, and how far, we move along the warming road.

As outlined in the Commentary, it is clear that short-term measures for climate change relief other than reductions in CO_2 emissions, such as limiting the release of short-lived greenhouse gases, need to be evaluated against their long-term contribution to reductions in cumulative emissions: flash-in-the-pan actions to cool the planet in the next few years will not necessarily buy time, but catch up with us later. If they take this message on board, the negotiators must consider a timeframe extending many decades into the past and future, which complicates the attribution of responsibility and the allocation of allowances.

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Mountain of coal. Cumulative emissions of CO_2, for example from fossil fuel burning, determine global mean warming.

Time is of the essence. A Review Article in the Focus (http://dx.doi.org/10.1038/ngeo2248) concludes that our cumulative carbon emissions so far have already sent us two thirds of the way towards the threshold of 2 °C of warming over pre-industrial levels that has served as a focus point for policy. The countdown has started, not only on the negotiations, but also the emissions clock.

In addition, although global mean temperature rise may be the best-understood response to greenhouse emissions, it is not the only one. Indeed, perhaps it is not even the most important one. As outlined in a Perspective in the Focus (http://dx.doi.org/10.1038/ngeo2253), aspects of climate change that are related to atmospheric circulation, such as changes in regional weather events (including extremes) and to some degree rain- and snowfall, are significantly more uncertain than global mean temperature. For these aspects — often the most important for human societies — climate model projections show significantly less agreement than for the more straightforward warming response. It is therefore less clear at which point in the cumulative emissions curve substantial changes in atmospheric circulation may occur. These uncertainties are unlikely to be resolvable in the near future.

For the negotiations, it will be important to keep in mind that additional climate change impacts may come from changes in atmospheric circulation — some might call these the 'known unknowns'. One example is the risk that the frequency or pattern of extreme weather events in the North American and Eurasian mid-latitudes could change in response to Arctic sea ice loss[6]: a risk that is not well quantified, but that would severely affect many people. Given the potential for substantial damage from such circulation-related aspects of the climate system, we need to avoid the risk of altering weather patterns too much, even if we do not know precisely what 'too much' is.

The case that the Earth is warming, largely in response to human action, has been documented in the fifth assessment report of the Intergovernmental Panel on Climate Change, published in 2013. Impacts, adaptation and mitigation options have also been synthesized in depth in the report, and the literature is constantly being updated by the scientific community. We know that, with the cumulative emissions so far, we have already committed ourselves to substantial warming; it is time for negotiators to commit themselves to a binding long-term plan.

Perhaps a stronger involvement from the political sciences (*Nature Clim. Change* http://dx.doi.org/10.1038/nclimate2396; 2014). could help pave the way to less confrontation and more collaboration among countries; this avenue needs to be explored in earnest. Most importantly, climate change mitigation must acquire positive connotations of future well-being, economic opportunity and positive intellectual challenge. Once this is achieved, the field and the negotiations will gain momentum for change too. ❐

References

1. http://www.un.org/climatechange/summit/
2. Allen, M. R. *et al. Nature* **458,** 1163–1166 (2009).
3. Meinshausen, M. *et al. Nature* **458,** 1158–1162 (2009).
4. Matthews, H. D. *et al. Nature* **459,** 829–832 (2009).
5. *Nature Geosci.* **7,** 157 (2014).
6. Cohen, J. *et al. Nature Geosci.* **7,** 627–637 (2014).

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