Earth Syst. Dynam. Discuss., https://doi.org/10.5194/esd-2018-36
Manuscript under review for journal Earth Syst. Dynam.
Discussion started: 11 June 2018

Earth System Dynamics Discussions

Ideas: a simple proposal to improve the contribution of IPCC WG1 to the assessment and communication of climate change risks

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In late June 2018 the authors of the Working Group I (WGI) contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR6) will meet for the first time in Guangzhou, China to begin the process of designing the report, building on the outline developed at the AR6 Scoping Meeting held in Addis Ababa last year. An issue which merits greater attention than in previous WGI reports is the assessment and communication of risk. It is now widely accepted that it is appropriate - and necessary for decision making - to frame climate change as a problem in risk assessment and risk management (King et al, 2015; Weaver et al 2017). In the AR5 greater use was made than in previous Assessment Reports of a formal risk assessment framework which spans the dimensions of hazard, exposure and vulnerability (IPCC, 2014). However, risk framing had little influence on the WGI report, and this needs to be addressed in AR6.

A common measure of risk is likelihood x impact (Fig 1). It is standard practice in risk assessment to highlight both the most likely impacts *and* low likelihood high impact scenarios. Such scenarios merit specific attention because the associated costs can be extremely high, so decision makers need to know about them. It follows that WGI has a responsibility to assess and communicate explicitly the scientific evidence concerning potential high impact scenarios, even when the likelihood of occurrence is assessed to be small. In past reports the assessment of key parameters by WG1 has focussed overwhelmingly on likely ranges only. When information has been provided about the tails of distributions only likelihoods have been communicated using terms - following the IPCC's uncertainty guidance (Mastrandrea et al, 2010) - such as "very unlikely" or "extremely unlikely": a clear steer that policy makers should largely ignore such possibilities. But this is wrong. Policy makers care about risk not likelihood alone. The IPCC's uncertainty guidance ignores impact and is symmetric with respect to high or low impact scenarios; this is inappropriate for the communication of risk (Fig 1).

I suggest the WGI authors should agree a modest number of key parameters for which an assessed ***physically plausible high impact scenario or storyline*** (e.g. Zappa and Shepherd, 2017) can be provided. This should be done for core parameters such as climate sensitivity and TCRE (the Transient Climate Response to cumulative carbon Emissions: Allen et al, 2009; Matthews et al, 2009), and could also be done for some large-scale impact-relevant metrics (informed by WGII), such as the magnitude of increases in extreme rainfall. There will be a need to agree consistent procedures for the definition,

description, and use of such storylines, for example they could be associated with a specific assessed likelihood (e.g. <=5%), and their characterisation should emphasise physical constraints and evidence, not model results alone. This will be helped by a growing literature on which to draw (e.g. Hazeleger et al, 2015; Zappa and Shepherd, 2017). Physically based high impact storylines are distinct from socioeconomic scenarios, but the WG1 report could usefully provide information on outcomes that could arise from a combination of, e.g., high climate sensitivity and a high emissions scenario.

Some will argue that the WGII report is needed to provide information on impacts. For detailed information this is certainly the case, but the general shape of the damage function for a large basket of impacts (Fig 1) is insensitive to such details, and is all that is needed to justify WGI providing a much more thorough assessment of relevant scenarios. Other critics will suggest that for WGI to identify high impact scenarios explicitly would constitute scaremongering; this concern is no doubt one reason why previous WGI reports have focused so much on the likely range. But it is misguided. Policy makers need to know about high impact scenarios and WGI has a responsibility to contribute its considerable expertise to making the appropriate assessments.

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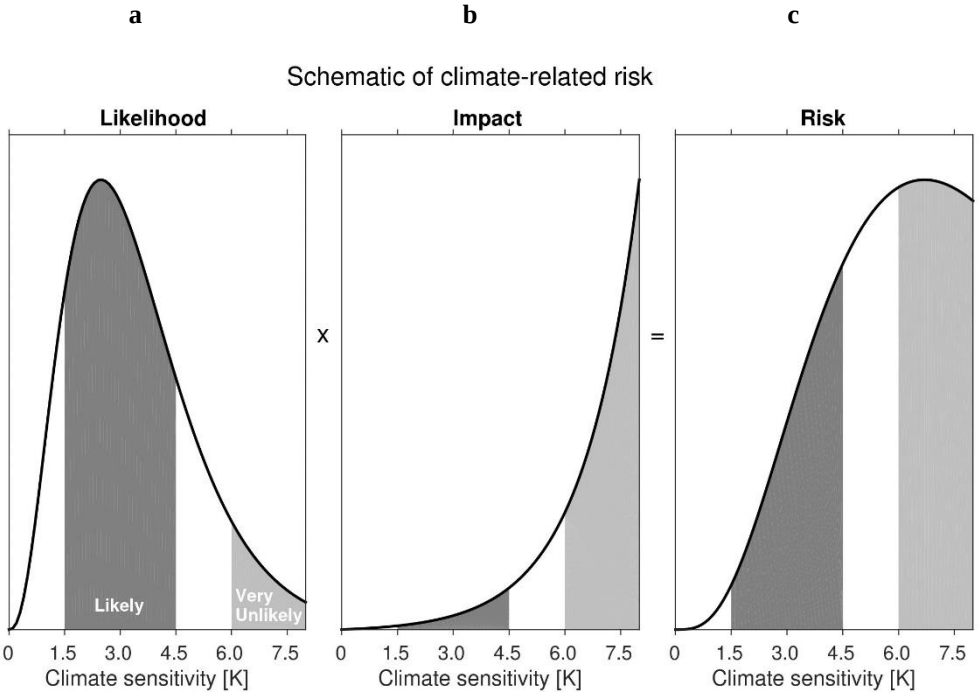

Figure 1: A *schematic* representation of how climate change risk depends on equilibrium climate sensitivity (ECS). Panel a shows a possible likelihood distribution consistent with the IPCC AR5 assessment that "Equilibrium climate sensitivity is likely in the range 1.5 C to 4.5 C (high confidence), extremely unlikely less than 1 C (high confidence) and very unlikely greater than 6 C (medium confidence)." Panel b illustrates schematically the fact that the cost of impacts and adaptation rises very rapidly (shown here as an exponential damage function) with ECS. Panel c shows that, in this example, the resultant risk (quantified here as likelihood x impact) is highest for high ECS values. The precise shape of the risk curve is dependent on assumptions about the shape of the likelihood and damage functions at high sensitivity (Weitzman et al, 2011). (Figure by Ed Hawkins.)

Acknowledgments

I thank Professor Ed Hawkins for making the figure, and for valuable discussions.