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# Integrating uncertainties for climate change mitigation

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The target of keeping global average temperature increase to below 2°C has emerged in the international climate debate more than a decade ago. In response, the scientific community has tried to estimate the costs of reaching such a target through modelling and scenario analysis. Producing such estimates remains a challenge, particularly because of relatively well-known, but ill-quantified uncertainties, and owing to limited integration of scientific knowledge across disciplines. The integrated assessment community, on one side, has extensively assessed the influence of technological and socio-economic uncertainties on low-carbon scenarios and associated costs. The climate modelling community, on the other side, has worked on achieving an increasingly better understanding of the geophysical response of the Earth system to emissions of greenhouse gases (GHG). This geophysical response remains a key uncertainty for the cost of mitigation scenarios but has only been integrated with assessments of other uncertainties in a rudimentary manner, i.e. for equilibrium conditions. To bridge this gap between the two research communities, we generate distributions of the costs associated with limiting transient global temperature increase to below specific temperature limits, taking into account uncertainties in multiple dimensions: geophysical, technological, social and political. In other words, uncertainties resulting from our incomplete knowledge about how the climate system precisely reacts to GHG emissions (geophysical uncertainties), about how society will develop (social uncertainties and choices), which technologies will be available (technological uncertainty and choices), when we choose to start acting globally on climate change (political choices), and how much money we are or are not willing to spend to achieve climate change mitigation. We find that political choices that delay mitigation have the largest effect on the cost-risk distribution, followed by geophysical, future energy demand, and mitigation technology uncertainties. This information provides central information for policy making, since it helps to understand the relationship between mitigation costs and their potential to reduce the risk of exceeding 2°C, or other temperature limits like 3°C or 1.5°C, under a wide range of scenarios.