

Storyline approaches to regional climate change

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Scientific statements about climate change are usually constructed as hypotheses, and issued with a certain level of confidence attached. As is normal in science, the confidence levels are designed to guard against Type 1 statistical errors (false positives). This approach has served climate science well for the global, thermodynamic aspects of climate change, including, notably, their detection and attribution. However, at the regional scale this confidence-based approach becomes something of a straightjacket, because the desired levels of confidence are usually not obtainable. This reflects the important role of atmospheric circulation at the regional scale, where the forced changes are not yet detectable, there is no accepted underlying theory for any such changes, and models can disagree on the sign of the changes. A symptom of this straightjacket is that there is not a single statement involving the effects of atmospheric circulation in the Summary for Policymakers of IPCC WGI AR5. Thus, the focus on avoiding Type 1 errors raises the serious prospect of committing Type 2 errors (false negatives) (Lloyd and Oreskes 2018), and thereby has ethical implications.

Ways must therefore be found to construct useful scientific statements on the regional scale, and even on the local scale, that reflect this level of uncertainty yet retain the relevant information about climate risk. Storylines — physically self-consistent unfoldings of past events, or of plausible future events or pathways (Shepherd et al. 2018) — provide a potential way forward, both for the interpretation of the observed record and for the description of plausible futures. Storylines avoid the blurring of climate information that accompanies more probabilistic approaches, which are anyway not justifiable in the face of correlated, systematic uncertainties. For circulation changes, which are feature-based changes, a multi-model mean can lead to a washed-out response, even though any particular model may predict a strong change somewhere. For example, and of relevance to SPARC, NH stratospheric polar vortex changes — which remain uncertain in their sign — are small in the CMIP5 multi-model mean but play a crucial role in the severity of European wintertime climate impacts such as windstorms and Mediterranean drying (Zappa and Shepherd 2017).

This paper will discuss some of the benefits of storyline approaches for understanding and representing regional aspects of climate change, and how they can be reconciled with more probabilistic approaches. It will also discuss how they can thereby act as a bridge between the “two cultures” of IPCC WGI and WGII and help facilitate the risk-based perspective that is being sought within IPCC as a whole.

Key words: regional climate change, atmospheric circulation, uncertainty, storylines, risk

References

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