

## Confidence, uncertainty and decision-support relevance in climate predictions

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### Abstract

Over the last 20 years, climate models have been developed to an impressive level of complexity. They are core tools in the study of the interactions of many climatic processes and justifiably provide an additional strand in the argument that anthropogenic climate change is a critical global problem. Over a similar period, there has been growing interest in the interpretation and probabilistic analysis of the output of computer models; particularly, models of natural systems. The results of these areas of research are being sought and utilized in the development of policy, in other academic disciplines, and more generally in societal decision making. Here, our focus is solely on complex climate models as predictive tools on decadal and longer time scales. We argue for a reassessment of the role of such models when used for this purpose and a reconsideration of strategies for model development and experimental design. Building on more generic work, we categorize sources of uncertainty as they relate to this specific problem and discuss experimental strategies available for their quantification. Complex climate models, as predictive tools for many variables and scales, cannot be meaningfully calibrated because they are simulating a never before experienced state of the system; the problem is one of extrapolation. It is therefore inappropriate to apply any of the currently available generic techniques which utilize observations to calibrate or weight models to produce forecast probabilities for the real world. To do so is misleading to the users of climate science in wider society. In this context, we discuss where we derive confidence in climate forecasts and present some concepts to aid discussion and communicate the state-of-the-art. Effective communication of the underlying assumptions and sources of forecast uncertainty is critical in the interaction between climate science, the impacts communities and society in general.

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