Relating the diversity in our models to the uncertainty in our future

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Today's state-of-the-art climate models consist of complicated computer simulation models of the Earth's climate system. In some respects, the simulations produced using these models bear a striking similarity to the observed climate system; in other respects, simulations produced by various state-of-the-art models differ significantly both from one another and the target system. How then does diversity in our models relate to uncertainty in our future? In particular, how might we interpret multi-model, multi-parameter, multi-initial condition model simulations under a given scenario, like doubling the level of CO2 in the atmosphere? Current state-of-the-art models lend support, often quantitative, to the results derived from previous state-of-the-art models, results which now extend back for over a century. The aim of probability forecasts is considered within the hierarchy of model complexity suggested by past and future state-of-the-art models; this is considered in the context of long-term resource allocation following Thompson (1957). The importance of distinguishing strategic aims (model improvement) from tactical aims (policy and decision support), as well as the impact this distinction should have on the design of model experiments, is clarified. "Climate-like" questions also arise in other areas of applied science, including oil exploration, the design of untestable nuclear devices, and the dynamics of influenza epidemics, and there too important questions remain concerning how to translate the output our models into support for our decision making.

The concept of Probabilistic Similarity is introduced with the aim of illustrating how our models might provide decision-support-relevant probability forecasts, meaning probability forecasts that would be quantitatively used as such. Necessary conditions for making credible claims for (decision-support-relevant) probability forecasts are discussed, and it is argued that no decision-support-relevant probability forecast can be obtained today. The results of Bayesian analyses are considered explicitly. It is

argued that the inconvenient truth we see in the observations of the recent past must be faced within an inconvenient ignorance of the future. (With this comes no suggestion that current models overstate the risks.)The additional risk that (literally) over-selling the current "best available information" holds for the credibility of science is noted, with examples. In order to see through our models, we must respect their limitations, even as these limitations decrease in the coming decades.

Thompson (1957) Tellus 9:275-295