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Abstract

SCIENTIFIC MODELLING IN SUPPORT OF DECISION MAKING:

SKILL AND VALUE, NONLINEARITY AND CREDIBILITY

Science and scientific modelling can aid both decision making and the advancement of science itself. They can also hamper each. The proliferation of nonlinear models and the abuse of statistical "post" processing has led to the oversell of scientific results which may threaten the credibility of science in the long run. And climate science is an empirical science only in the long run.

After an intuitive introduction to the strengths and limitations of mathematical modelling in the context of simple physical systems and their nonlinear mathematical counterparts, we will contrast the roles of simulation forecasting in decision support for weather-like tasks and climate-like tasks. The roles of "uncertainty" in observations, in model parameters, in model structure and in external impacts differ significantly in these two situations.

Weather-like tasks occur frequently, perhaps daily, providing the chance to learn from our mistakes (and those of our models); probabilistic forecasts are of proven value (if not, perhaps, probability forecasts per se!). In this case proper scores reflect skill and case studies can determine if skilful forecasts add value. Climate-like tasks are much more challenging as they tend to resemble a series of one-off extrapolations on time scales over which our models themselves evolve significantly.
Limitations of current climate models are noted explicitly and it is argued that failing to embrace and communicate these limitations risks the credibility of science-based policy.

Scientists tend to focus on forecast skill, while those who use forecasts desire forecast value; the failure to clearly distinguish these two features of a probabilistic forecast results in honest miscommunication between the modelling community and both policy makers and industry. This is particularly common when the "best available" model is not "fit for purpose". It is argued that this is the case for zip-code level "probability" forecasts of climate change in the 2080.s; a product is now available online for the UK with government (and implicit Met Office) approval. Using the insights of climate science to limit the miscommunication of these so-called Bayesian approaches by introducing an expert based "Probability of a Big Surprise" is discussed, and an intuitive example where use of Newton's Laws leads to poor decision support is provided. Finally, challenges facing the maintenance of long-term parallel research streams in science and in modelling are noted.

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