Questions on the Table:

Stating Plainly Our Aims in Light of our Acknowledged Ignorance and Training

Big data, data assimilation and uncertainty quantification workshop

Institut Henry Poincaré, Paris, 14 November 2019

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Abstract

Actually supporting real world decisions suggests a rather different approach to modelling and the presentation of forecast systems than the more straightforward scientific goal of learning something interesting about the physical system, or even just learning about the model. When there is little resemblance between forecast and outcome, making the model better (for everyone) may not need to consider specific detailed aspects of model performance. Expert opinion will play a very significant role in interpreting model output for decision making. As models and forecast systems improve, however, the role of the model-based forecast system in quantitative support for policy and decision making increases tremendously. Certainly in weather forecasting, and internal operational forecasting in other sectors, probabilistic forecasts provide useful, decision-relevant information. "The Question" then becomes critical. What question is being asked? What decision is being supported? What aspect of the world is being forecast? Answering "what question(s) will best inform that decision maker?" is a critical part of the design process. The "best available" model is irrelevant if it is not adequate for this purpose, answering with sufficient precision the particular question on the table.

These issues are discussed in the context of a particular application of weather forecasts by Électricité de France and anticipative disaster risk reduction (DRR) in Pakistan. The limits of traditional UQ, in particular the limited relevance of common approaches to UQ in model-land, are discussed. Other Buzz words in the meeting's description are touched upon, in terms of altering the experimental design to yield decision relevant results. Results from Model Intercomparison Projects (MIPs) are significantly less relevant than those of Reality Intercomparison Projects (RIPs). The very aim of Data Assimilation (DA) is unclear outside model land. Similarly, studies expected to improve forecast skill in the perfect model scenario may simply make things worse in actual application; evaluating pre-forecast sub-systems of the model-based forecast systems cannot be sure to improve the real-world forecast.

In short, the importance of experimental design for decision making is stressed along with the relevance of the forecast target. The critical aspects of "adequate for purpose" are contrasted with the potentially irrelevant "best available." And the importance of expert judgement in quantifying the probability of a big surprise and other critical statistics is noted.

The role of "The Question" in quantitative decision and policy support ties these components of model-based forecasting together. Without understanding of the question on the table, scientists and decision makers are unlikely to improve decision making, and can make it much worse. (Apologies to Karl Pearson.)

Berger, J.O. and Smith, L.A. (2019) 'On the statistical formalism of uncertainty quantification,' *Annual Review of Statistics and its Application,* 6. 3.1-3.28.

Smith, L.A. (2016) 'Integrating information, misinformation and desire: improved weather-risk management for the energy sector', in Aston, P.J., Mulholland, A.J. and Tant, K.M.M. (ed.) *UK Success Stories in Industrial Mathematics*, 289-296. Springer

Roulston, M.S. and Smith, L.A. (2004) 'The boy who cried wolf revisited: the impact of false alarm intolerance on cost-loss scenarios', *Weather and Forecasting,* 19 (2): 391-397.