

**Anticipating Anticipation: Improving Decision Support Today and Tomorrow
by Reconsidering the Aims and Limits of Weather Prediction**

Leonard Smith

ECMWF, 21 February 2018

Abstract

LSE's Centre for the Analysis of Time Series (CATS) is moving its primary focus back into applied weather forecasting for decision support. We have several funded projects starting this month and expect more. I aim to provide a wide ranging survey of the opportunities open to weather prediction in the near future, an exciting glimpse of some of recent scientific developments at CATS, and one horror story based on a fictional, but not unrealistic, challenge facing the Global Weather Enterprise (GWE). My aim is to ignite half a dozen follow-on discussions on technical issues, including harsh mathematical realities (that suggest moving our aim from probability forecasts to early warning), the provisions of user-relevant measures of skill (IGN still in the lead here), and improved uncertainty guidance for using the simulations, forecasts, products and tweets available today.

Mathematically sophisticated users have used ensemble weather forecasts to improve their decision making for some time now [1]. Under the NERC funded IRIS project and Erica Thompson's NERC fellowship, CATS will be working with somewhat more normal users including START, the Red Cross and other NGO's to better understand and exploit simulations models and probabilistic weather forecasts. The aim may be as simple as guidance regarding how many reindeer hunting licences to issue (ECOPOTENTIAL) or guidance on using weather forecasts for anticipatory action on the ground before a disaster strike (START disperses significant funds that **must** be spent on a very short time scale). Timescales of interest fall from the medium range (drought, for instance) to annual range (el Nino, for instance); anywhere that there is evidence of useful decision-relevant anticipatory skill.

Numerate users (including energy, insurance, logistics and finance sectors) aim to better use existing forecasts, and perhaps develop better forecast information in-house if it is not available in the market. Some people worry this is a major challenge for the Global Weather Enterprise (GWE); I do not aim to discuss solutions to political challenges but instead discuss the kind of scientific challenges in play. The insurance sector, for instance, has co-funded the CATS' EPSIS project, which aims at establishing a set of skill measures the industry will expect to be produces for all probabilistic forecasts[2], with supporting guidance on the user relevance of various measures. Refining the targets being forecast are also of significant interest to the sector: some common targets may be irrelevant, while real increases in skill of relevant targets may not prove of value.

As CATS is moving to an applications oriented posture, many topics which are often separated in a research framework are inseparably mixed in real-world application. Another challenge to the GWE is the speed with which promising, high-risk/high-reward ideas are evaluated. CATS' examples include evaluation of ensemble size [3] and true multi-model forecasting (via cross pollination in time [4]) will be touched on as examples. The primary focus of the talk will be on uncertainty guidance: what we might do if the provision of probability forecasts is unobtainable, and the aims are numerical weather forecasting require retargeting, again [5].

- [1] Smith, L.A. (2016) '[Integrating Information, Misinformation and Desire: Improved Weather-Risk Management for the Energy Sector](#)', in Aston, P.J. et al (ed.) *UK Success Stories in Industrial Mathematics*, 289-296. Springer. DOI: 10.1007/978-3-319-25454-8_37.
- [2] Smith, L.A., Suckling, E.B., Thompson, E.L., Maynard, T. and Du, H. (2015) '[Towards improving the framework for probabilistic forecast evaluation](#)', *Climatic Change*. DOI: 10.1007/s10584-015-1430-2.
- [3] Machete, R.L. and Smith, L.A. (2016) '[Demonstrating the value of larger ensembles in forecasting physical systems](#)', *Tellus A*, 68, 28393. DOI: 10.3402/tellusa.v68.28393.
- [4] Du, H. and Smith, L.A. (2017) '[Multimodel cross pollination in time](#)', *Physica D: Nonlinear Phenomena*, Vol. 353-4, pp.31-38. DOI: 10.1016/j.physd.2017.06.001.
- [5] Smith L.A. (2018) 'Revising the Aims of Weather Forecasts, Again' *N Proc Geophysics*, in review.

