

In September 2005 the Met Office issued their first seasonal forecast for Europe, predicting that temperatures would likely be cooler than normal over southern parts of the UK and mainland Europe for the upcoming winter. It was also predicted that precipitation would likely be lower than normal. Oil and gas prices thereafter rocketed – were these high prices a consequence of the winter seasonal forecast? How much weight should the markets and traders have given to this forecast given the current state of scientific knowledge? The Royal Meteorological Society was quick to seize the opportunity to convene a meeting on such an attractive topic. Interest was indeed high, as proven by the large number of people who attended this meeting on Wednesday 19 April 2006.

The talks fell into two sections. In the first section, presentations aimed to explain the scientific basis of the European winter forecast by investigating the main physical features which were thought to be relevant in the characterisation of the winter conditions. The second section covered issues related to the communication of the forecast by Met Office, particularly with regards to the communication of probabilistic information, and how this forecast impacted some users, especially in the energy sector. A panel discussion was also convened to discuss the issues raised across the whole spectrum of winter forecasting. A digest of the programme follows.

Dr Rowan Sutton (Centre Global Atmospheric Modelling, University of Reading), in his opening address to the meeting, emphasised the huge developments that have been made in long-range forecasting in the last decade, both in terms of scientific understanding but also in terms of technical capability. The main focus of long-range forecasting research has been based on using the slow-manifold of the oceans, especially in the Pacific, to forecast El Niño and its teleconnections. Rowan argued that the scientific community has now made significant advances on the understanding of the role of the North Atlantic Ocean and its influence on European climate and this is why European forecasting is now emerging as an area of keen research and public interest.

Some of the sources of European predictability were discussed by *Dr Adam Scaife* (Met Office), who had a three pronged message for the forum. The re-emergence of Atlantic sea surface temperature (SST) anomalies from spring to the following

autumn was the first. Then, the possible non-linear impacts of El Niño on European climate were analysed. It was noted that smaller events have a completely different impact on European climate compared to more major events. This would explain the relative difficulty in finding a coherent historical relationship and its apparent non-stationarity. Finally, Adam explored the impact of large-scale stratospheric waves on European tropospheric conditions – a process that allows potential European predictability of significant cold events up to a month in advance and appeared to have played a role in generating the cold winter conditions over Europe in 2005/06.

The North Atlantic Oscillation (NAO) played a large role in the formulation of the Met Office winter forecast. *Prof. Mark Saunders* (UCL) reminded the audience that the Arctic Oscillation (AO) is linked to UK winter climate and climate extremes as well as the NAO. Mark presented empirical statistical models which provide significant skill in predicting the winter seasonal and month-ahead AO. The AO hindcast skill derives solely from knowing prior zonal winds in the stratosphere and troposphere. Hindcasts for the period 1958/59 to 2005/06 show the model anticipates the anomaly sign of the winter AO in 68% of years from 1 December, and the anomaly sign of the month-ahead December, January and February AO in 71–79% of years. Mark further showed that the AO hindcast provides skill in predicting winter wind speed and temperature extremes over the UK.

Further discussion about physical mechanisms behind winter-predictability was undertaken by *Dr Warwick Norton* (University of Reading), by means of a range of modelling studies. Warwick contrasted the relative merits of empirical and dynamical methods. He showed that current dynamical models have a weak response to SST anomalies with a pattern of response that is displaced. Notably, the main feature of the Atlantic SST was a tripole pattern – the leading predictor, with positive anomalies in the tropics and at high latitude and a negative one at mid-latitudes, near the US coast. The 2005/06 winter was consistent with an empirical method with an atmospheric wave train emanating from the Caribbean, the location of the warm tropical SST anomaly. An interesting comment from the audience revealed that north Atlantic SSTs correlate with stratospheric anomalies more so than with the NAO, suggesting that stratospheric waves and Rossby wave prop-

agation in the north Atlantic might prove an interesting research topic for an industrious student!

Following on nicely from the previous discussion, *Dr Mark Rodwell* (ECMWF) discussed the deficiencies in the physical models' representation of tropical circulation and how these impact the extra-tropics. Initial model tendencies in ECMWF forecasts show that errors generating high level convergence over Amazonia create wave train responses in the extra-tropics that could project onto the NAO. Analysis of observations for the winter of 2005/06 showed that convection over Amazonia could have played a role in the observed anomalous NAO. Most coupled models also fail to represent the atmospheric NAO response to SSTs, although the Met Office's seasonal forecast system had a significant but reduced response through the 2005/06 winter. These two significant sources of error highlight the need for improvements in the representation of physical processes in coupled models. Mark also highlighted the continuing difficulty in presenting probabilistic forecasts to non-expert users. He emphasised the undesirable potential of forecast information to increase financial market volatility (as seen during last winter).

As mentioned before, the basis for the Met Office winter forecast was the empirical-statistical NAO forecast, and this was explained in more detail by *Dr Chris Gordon* (Met Office). However, this was shown to be only one source of forecast information that was analysed in the Met Office predicting "a two in three chance of a colder-than-average winter for much of Europe" last September (see Fig. 1). Aside from the interpretation of the forecasts from the coupled seasonal and decadal forecast model ensembles (and their historical skill assessments), the issue of identifying what is 'normal' under a changing climate was highlighted.

The autumn's dynamical forecasts were shown to have developed an NAO-like response to the canonical SST tripole pattern that was first observed in May 2005, and seen to be resurfacing in the Atlantic by November, but the amplitude of the signal was only 40%. Rather than looking for modelled near surface temperatures signals, the upper atmospheric response was shown to be a better indicator of the likely winter conditions. Answering to an audience question of "how cold is cold?", Chris highlighted that verification of probabilistic forecasts is clearly not possible for just one event.

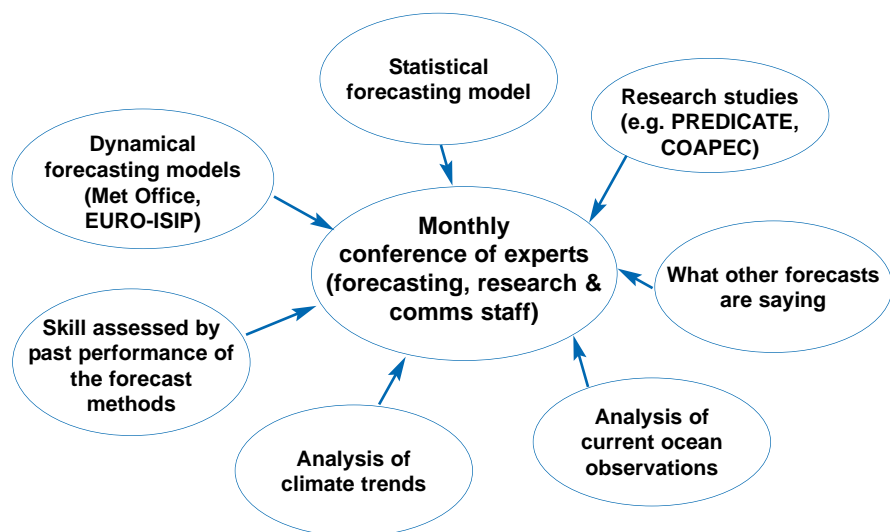


Fig. 1: The 2005/06 Met Office winter forecast was produced using a combination of statistical models, past climate information, and complex dynamical climate models with interpretation by operational forecasters.

A severe winter has arguably the largest possible impact of any weather event on UK Plc. Therefore, the communication of a cold winter forecast to the wide range of government, commercial and public bodies was the focus of the revealing talk by *Prof. Paul Hardaker* (Met Office, now RMetS). The focus of the communication was to enable the different groups to prepare for the winter – to enable the appropriate level of planning and response. Given the low level of skill in European winter forecasting, it was clearly a challenge to get the appropriate message across against the sensationalist media onslaught. Subsequent surveys have shown that 75% of the public knew of the prediction, and 13% took some action (occasionally somewhat inappropriate however eg. mending garden fences!). Effective communication also depends on the messenger – thankfully there is an apparent high level of trust of environment scientists by the public, as shown by published statistics. Overall, although the media response was mixed, the reports published by the ‘serious’ newspapers were quite balanced. The audience questions highlighted that the meteorological community were very interested in the basis of the forecast and would also benefit from more directed communication of the methods used.

To complete a review of the end-to-end process, *Dr Isla Gilmour* (Merrill Lynch Commodities) gave a fascinating talk on the use of weather information in the energy trading markets. Weather information, in the form of expert opinions and forecasts for a range of lead times, is used in a number of financial markets. In particular, weather is a key driver in the winter energy markets – the cost of an energy commodity depends on its supply and current or predicted demand. Medium-range forecasts in partic-

ular have an impact on the market and energy costs, and at this time, these have more impact than seasonal predictions as they are seen to be more reliable and skilful. The point was made that a better knowledge about forecast uncertainty is needed for seasonal forecasts to be used more widely in this industry. It is also true however that generally forecasts only have an impact on the markets if they are widely used and talked about. For the 2005/06 case, there was no impact on the markets at the time of the Met Office winter forecast press release in September. The markets did however react significantly when the first unseasonably cold weather hit London in mid-November (along with a number of high profile press stories), so it is possible that the winter forecast primed the markets and made them more sensitive. Further questions on this issue from the audience revealed that other significant factors were also at play including the fact that the UK was turning from a net exporter of gas to a net importer around that time as well as high gas demand in other areas of Europe.

The panel discussion that was convened included a valuable extra contributor – *Ms Jo Witters* from OFGEM (Office of Gas and Electricity Markets), along with *Paul Hardaker*, *Chris Gordon* and *Isla Gilmour*. *Jo* explained that the purpose of OFGEM is to regulate and monitor the energy markets. OFGEM also work to facilitate a more effective functioning of the market by working with market participants and energy users. For the energy suppliers, the forecast for the UK in 2005/06 was marginal as proper communication channels were not optimally activated. This may well change in the future, *Jo* added, as information regarding the likelihood of difficult winter conditions ahead can greatly assist in the ability of say

energy suppliers, especially for domestic use, to take commercial decisions.

Questions from the audience ranged over the entirety of the forecast and communication process to the user perspective. The issue of how to communicate low skill-high impact forecasts, and the potential damage that these may have on user confidence when the forecast is perceived to be wrong was raised (*Dr Mike Cullen*, *Met Office*). In answer, *Chris Gordon* emphasised the need for customer engagement so that risks and confidence are communicated appropriately in the correct language – each user has their own specific exposure and thresholds at which action must be taken. *Dr David Burridge* (*ThorpeX*) suggested that the winter seasonal forecast was the start of a new era in long-range forecasting, and encouraged forecast providers to continue to issue them in the future in a probabilistic manner, even when climatology must be used given the low signal in some seasons. To round off the discussion, *Paul Knightley* (*PA Weather Centre* – now *MeteoGroup UK*) raised the issue of the press over-inflating the message in forecasts and whether press releases, in trying to attract attention, are helping to distort the message. The *Met Office Press Officer* (*Wayne Elliot*) responded that it is indeed a delicate balance to engage the press whilst getting the scientific message across – often in very few words.

The general sense from the meeting was that in issuing the 2005/06 winter forecast, the scientific community has now been exposed to scrutiny on a topic which, although underpinned by good knowledge, continues to require further investigation. The organisers, *Alberto Troccoli* and *Matt Huddleston*, feel that the large attendance and the very positive feedback from the meeting are signs that there is a keen interest in this topic and an eagerness to advance the science of long-range forecasting. A sign of this is the number of events to foster understanding between industry and scientists that have flowed from this meeting – basic two-way communication is always of great benefit to all involved.

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