Institute for Mathematical Innovation

Improving Met Office weather forecasting

UNIVERSITY OF BATH

The Met Office plays a vital role in the UK economy by providing accurate weather forecasts, but a major limitation of forecast accuracy is the ability to blend computational modelling with observational data. In collaboration with the Met Office, University of Bath mathematicians have developed adaptive numerical methods that allow computational models to make better use of data. As a result of implementing these methods into operational models, the Met Office forecasting accuracy of temperatures near the ground has demonstrably improved, helping local councils, airports and the travelling public.

IMI

Improving Met Office weather forecasting

Weather affects all of us and we take a close interest in it; national and regional television news reports typically finish with a weather forecast watched by millions. Accurate weather forecasting has become essential in the transport, agricultural and energy sectors, and for managing the day-to-day operations of the emergency services.

The challenge

The Met Office plays a vital role in providing five-day weather forecasts for use across the UK. The Met Office relies on a range of advanced computer models, and combines the outputs of these models with observational data from a wide variety of sources in order to strike the optimal balance between different sources of error. A key limitation on the accuracy of the overall forecasts is the accuracy of the computer model and its ability consistently to represent the kinds of real weather feature that are captured by the observational data.

The solution

In collaboration with the Met Office, University of Bath mathematicians have developed more efficient numerical methods, known as adaptive meshes, which when incorporated into data assimilation algorithms are better able to capture rapid changes in temperature, pressure, or wind speed, and therefore these adaptive meshes can make better use of the available observational data. Over a period of ten years, the collaborative research project developed approaches that were demonstrably more accurate than existing techniques, and could be readily inserted into existing software at the Met Office.

The benefits

A direct consequence of this research is a demonstrable improvement in the Met Office forecasting skill, as measured by comparing predictions with subsequent weather observations. This has far-reaching economic and societal impact, for example the Met Office is now able to better predict fog hazards at airports, and road surface temperatures in winter, ensuring that preventative measures such as gritting roads with salt are used appropriately and in ways that minimise their environmental side-effects.

"The new method of adapting computational grids to the expected solution is now being exploited in the high resolution analyses used to drive the short-range forecasts for the UK. Particular benefit has been found in predicting low-level temperatures, which is very important for maintaining the road network in a safe condition and for predicting fog."

Prof Mike Cullen,
Senior Research Fellow, Met Office