

Learning from other sectors: The Met Office



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Introduction

The Met Office is a world leader in providing weather and climate services, employing more than 1,700 people at 60 locations throughout the world. The Met Office is recognised as one of the world's most accurate forecasters, using more than 10 million weather observations each day, an advanced atmospheric model and a high performance supercomputer to create 3,000 tailored forecasts and briefings daily. These are delivered to a huge range of customers from the government, to businesses, the general public, armed forces, and other organisations. The Met Office's work goes beyond forecasting weather and climate; it also extends to assessing the impact of the weather on UK society and business.

There are 540 scientists in the Met Office, out of nearly 2,000 people, focused on improving the accuracy of the numerical models.

Approach

The basis of the numerical prediction models is a multilayer spherical grid, with about two million grid points in the Earth's atmosphere. The models rely on the meteorologists' wisdom and knowledge of the atmosphere, combined with observations. To start the model running, information about the current state of the Earth's atmosphere is needed at each of the two million grid points, based on observational data. Once the model has run, the huge grid of data needs to be turned into something usable.

Understanding uncertainty in the model output is key, and confidence levels are needed. These depend on the outcomes

of 100 runs of the model; if outcomes are dispersed, confidence is lower, whereas if they converge, confidence is higher.

In advance of the St Jude storm in October 2013, meteorologists looked at the probability of the storm following various paths, and combined this with the time of year, time of day, and the likelihood of large numbers of high-sided vehicles on motorways to determine its impact. They provided an 'amber' warning of winds along the south coast, which turned out to be accurate. Very large amounts of data were turned into something easily interpretable by the public.

The scale of data handling and processing is very large. Each day, 106 million observations are processed and stored; 20 quadrillion calculations are done; 40 terabytes of data are archived; four million forecasts are produced. The UK high-resolution model produces 380 gigabytes of data in one run; in comparison the human genome contains 250 gigabytes of data and does not change. The UK model is run four times a day.

Global observational data is taken from a multitude of sources, including synoptic weather sites, radiosondes carried by weather balloons, weather radar, buoys on the oceans, ships making observations, off-shore oil rigs, aircraft and satellites. Amateur observers also input their data. The data comes in at different times, and needs to be aggregated and interpolated on the grids. Quality is key - if it is not sufficient, the models will crash when run. The data needs to go through a quality control process before being put into the model, and weights are ascribed according to the age of the data.

Data sharing between national meteorological services is made possible

by an international agreement; a massive World Meteorological Organisation (WMO) global telecommunications system enables observations to be circulated. Data is stored for the WMO, and also for Datapoint, a service which provides weather data to the public.

Providing the weather forecast for specific sites requires the addition of information about local topography and water sources, for example. The Met Office aim to provide this for one million sites globally.

Combining forecast data with other types of data

Forecast data may be combined with other data sets for various purposes. For example, if Network Rail wants to know when there are going to be leaves on the line, ADAS provides data on when the trees are susceptible to dropping their leaves, and this information is combined with forecasts on when the wind is going to pick up and there will be extra leaf fall. This can be turned into an 'adhesion forecast'. As another example, British Geological Survey provides information on source strengths of ash from certain volcanoes, and the Met Office uses that data to model dispersion and work out concentrations at certain locations, which is useful for the aviation industry.

Weather data is useful throughout the lifecycle of a wind farm, from deciding where to locate it, to determining how safe it will be for people working on it, especially if it is offshore, to providing wind forecasts for predicting power production. It also is useful to predict weather windows for shipping people out for maintenance.