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Knowing the Future: parallels between weather and financial forecasting

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Rosmarie De Witt, ZAMG

Google 'forecasting future', and over 28 million hits appear. Clearly, knowing what will happen before it happens is big business: from financial markets to the weather, and anything in between, says Rosmarie de Wit, Austrian center for meteorology (ZAMG).

In many cases this is more than just curiosity, as this knowledge can be used to optimize decisions and reduce risks by taking precautions. Defensive driving and gritting by highway operators, for example, could prevent accidents in case of predicted frost. To discover parallels between the fields of weather and financial forecasting, a short overview of past and current weather forecasting practices is outlined here.

The wish to predict the weather resulted in all kinds of interesting approaches. A very creative one is the method in which a frog is put in a jar with a little ladder, predicting nice weather if the frog climbs up. Needless to say, an accurate forecast is not guaranteed!

Things improved after the invention of the telegraph in the mid-1800s. Data exchange over large distances became much faster, and the first weather maps with information about the large-scale atmospheric conditions could be drawn.

The realization that the state of the atmosphere can be described using a set of mathematical equations was the next major leap, as it allowed the calculation of future conditions based on the current state of the system. However, it was not until the invention of the first computer in the 1940s that the *numerical weather prediction* as we know it took off.

Computer simulations

Weather models consist of a system of coupled non-linear partial differential equations, which have to be solved in three spatial dimensions.

These equations can only be solved numerically using computer simulations, and as a result the equations have to be discretized so the calculations can be performed for discrete points in space (on the model grid) and for advancing time.

After initializing the model using observations provided by the global observational network (consisting of e.g. weather stations, satellites, ship and airplane measurements), the situation at future times is determined by calculating the changes occurring during each time step.

In order to account for uncertainties in the initial conditions and approximations in the model physics, several model runs are performed, each with small tweaks.

Smaller deviations, better forecast

Looking at the spread in this *model ensemble* gives valuable information about the sensitivity of the atmosphere to the initial conditions, and the certainty of the prediction. The smaller the deviations, the more certain one can be that the predicted events will happen. The whole forecasting process is computationally expensive, hence supercomputers operate around the clock.

Naturally, forecasts are most reliable for the next few days, but ever increasing computational power and model developments result in continuously improving forecast: today's 5-day forecast is as accurate as the 3-day forecast was in 2007. So in terms of weather, 'forecasting the future' is definitely possible!

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Knowing the weather

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