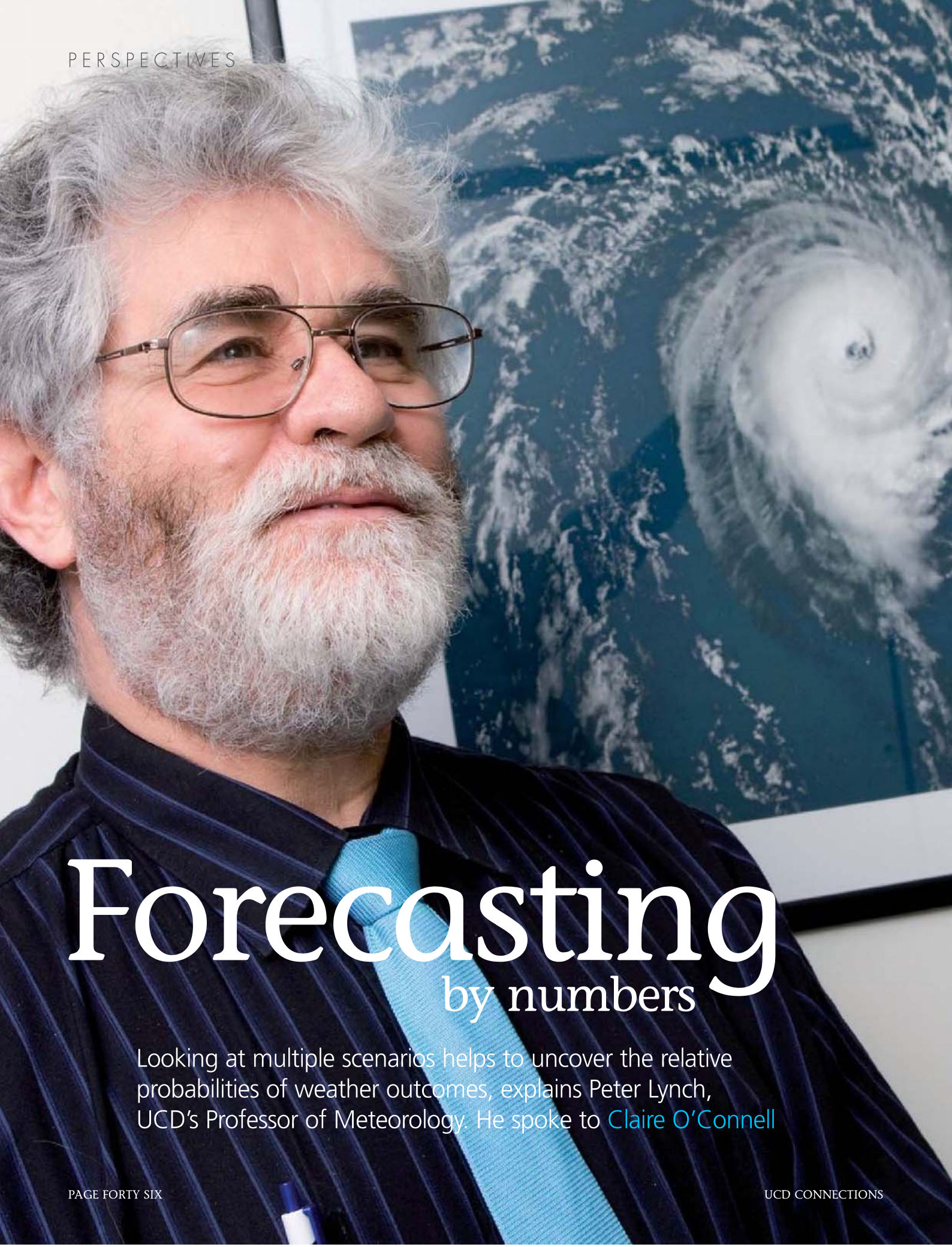

Forecasting by numbers

Looking at multiple scenarios helps to uncover the relative probabilities of weather outcomes, explains Peter Lynch, UCD's Professor of Meteorology. He spoke to Claire O'Connell

IF YOU have ever listened to the weather forecast and wondered how they work out whether it's going to rain or shine, then Professor Peter Lynch is the man to ask. We meet on a suitably blustery day at his office in UCD's Meteorology and Climate Centre, in the School of Mathematical Sciences. Storm and flood warnings saturate the weekend's news bulletins, providing a good example of how socially important weather forecasting is, according to Lynch, UCD Professor of Meteorology.

"The fact that people can be warned a couple of days in advance so they can get the sandbags out and take precautions, this has enormous benefit for society," he says. "The increased skill of forecasts and their reliability has huge social benefits: for agriculture, transport, fisheries and forestry. In fact, just about everything is affected by the weather."

The complexity of the atmosphere means a huge amount of number-crunching is involved in forecasting, and this is where Lynch sees the beauty of it. A maths graduate from UCD, he discovered an affinity for numbers thanks in part to one of his lecturers, Dr David Judge. "His lectures in mechanics had an electrifying effect, I thought they were terrific. He really instilled a great love of the subject and I have been passionate about mathematics ever since."

Lynch completed a master's degree at UCD and then joined Met Éireann where he spent three decades as a forecaster, including a few years at Shannon Airport. "I'm happy to say no planes crashed while I was doing that," he laughs.

He did a PhD at Trinity College Dublin, then became head of research and eventually deputy director at Met Éireann. It was in this position that he had responsibility for training meteorologists. It was an area where the organisation saw a glaring gap in home-grown education, so Met Éireann and UCD set up a memorandum of understanding for education and research. Lynch was appointed the first Chair of Meteorology in UCD in 2004 and he now oversees undergraduate and taught master's programmes, as well as postgraduate research in the university.

That research includes modelling wind variability in Ireland – an important area for developing alternative energy sources – looking at atmospheric turbulence and figuring out how to deal with mathematical noise in weather forecast models.

Lynch also has a deep interest in the history of numerical forecasting, and wrote a book on the early 20th-century pioneer Lewis Fry Richardson, who challenged the traditional approach of basing weather predictions on what had gone before. Richardson's attempts at a trial forecast were hampered by a lack of understanding about the atmosphere, but he helped pave the way for modern forecasting and dreamt of a day when we could handle the scale of computing required.

That dream came true in the form of ENIAC (Electronic Numerical Integrator And Computer), a supercomputer in the US that in the 1950s ground through the numbers needed to predict changes in the weather. Since then, our increased understanding of the atmosphere combined with better data and computing power has added a day per decade to the range of reliable short-term forecasts, according to Lynch.

We can now predict weather events like storms within three to four days with reasonable confidence, he says. But it requires some clever thinking. The atmosphere is chaotic or non-linear, which in practice means that even tiny changes in the system can quickly grow into big differences. So the best approach to forecasting is to do an 'ensemble' of 50 to 100 predictions, each one looking at a plausible set of initial conditions.

Looking at multiple scenarios helps to uncover the relative probabilities of weather outcomes, explains Lynch. "They tend to cluster into groups, some saying it will be windy next week, with others saying it will be calm. We can group them and then depending on the relative number of forecasts in each cluster, we have an idea of the likelihood of the outcome."

However, there are limitations. "You can't predict the details beyond, say, a couple of weeks," he says. "So if you plan on getting married in three months' time and you want to know if the particular Saturday is going to be fine, we can't tell. It's the fundamental nature of the system that it is extremely sensitive to little variations."

For fun, Lynch reprocessed the original ENIAC forecast data on a laptop. The procedure that took a full day in the 1950s was sewn up in less than a second. He then teamed up with his son Owen, a software engineer, to put the forecasting function onto his mobile phone.

To demonstrate, Lynch grabs his phone, selects the function and within three quarters of a second we have a weather forecast for North America. "It's not a telephone any more, it's a portable, hand-operated numerical integrator and computer, which gives you Phoniac," he smiles.

So could we all have forecasts on our mobiles in years to come? "Why not?" says Lynch, outlining his own dream of the future. "You could imagine a yachtsman modelling large eddies as he sailed around Dún Laoghaire. Perhaps Phoniac will be the forerunner of such microscale forecasting systems, just as ENIAC foreshadowed global and regional weather predictions."

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