Climate Change

Professor Peter Lynch talks to Sean Duke (BSc 1987) about the unpredictability of Climate Change and future measures for predicting Climate Change both in Ireland and globally.

Professor Peter Lynch, the first Chair of Meteorology at UCD took up his post in September 2004 from Met Éireann, where he was Deputy Director. The position at UCD presented an opportunity to combine education and research. Professor Lynch had previously taught third-level courses in Meteorology and Atmospheric Physics at TCD. He also has a passion for mathematics and its application in particular, the Mathematics of Atmosphere Dynamics. Since 2004, he has been steadily working to build up the various teaching and research programmes at UCD.

Professor Lynch's primary research interest area is that of abrupt climate change. For example, the idea that something could happen that would trigger very rapid climate change. Or, more interestingly, but more dangerously, something could happen that could trigger a new climate phenomenon, one that is totally unexpected, and has never been seen before. "The possibility of sudden climate changes is not just speculation" says Professor Lynch, "the historical climate record has shown that the temperature has changed dramatically, by five degrees Celsius or more, over a period as short as a decade. This has been revealed in ice cores, which contain pockets of trapped gases from ancient periods in the Earth's history. The mixture of the gases can indicate what temperatures were like."

Unanticipated climate events, which Professor Lynch refers to as 'unanticipated emergent phenomena', are scary, as they don't exist now, but if the right climate conditions arise, they could exist and prove devastating. An example he gives is that of the Ozone Hole appearing in the Ozone Layer. The Ozone Layer is the protective layer around the Earth that protects us from damaging solar radiation. The Ozone Hole, which appeared in the Antarctic stratosphere, was totally unforeseen, and the reaction of scientists was to believe their measuring instruments must be wrong.

"It was only afterwards that chemists and atmospheric scientists managed to determine what was going on - complicated chemical interactions involving Chlorofluorocarbons (CFCs)," explains Professor Lynch.

Professor Lynch also uses hurricanes as another example of Climate Change. Hurricanes would not happen if the ocean temperature did not reach 260 Celsius. If we lived on a planet where the temperature of our oceans never reached this level, then we would be unaware of the existence of hurricanes. "The point is," says Professor Lynch, "as our climate changes, there may be other phenomena that could appear. They might be triggered into life - perhaps devastatingly - given changes in certain parameters."

Serious flooding has become a regular feature of Ireland's climate in the past decade. This has become a major issue for government, Professor Lynch and his colleagues are looking at developing ways of predicting floods in advance.

A computer model was developed of the River Suir Basin, it was found that the system was quite sensitive to even small changes in rainfall. If an effective model could be developed for the River Suir, then one could be developed for other areas.

He says that the indications are that in future, flooding events in Ireland will be more severe and more frequent. Wind is also likely to increase by about 15 per cent in winter and decrease in summer. At the moment, however, these are just 'indications', and Peter would like to see an expansion of this work so that 'probabilities' can be developed for certain scenarios occurring in the future.

One way to try and turn indications into more reliable probabilities is to use the method of 'Ensemble Prediction'. This is where a large number of computer simulations of possible climate scenarios are developed into a collection known as an ensemble. The next step is to look at the statistical behaviour of the ensemble, as everything that is measurable in science has some 'error' component built in - for example, even the speed of light is not known exactly! This approach means that when you give a prediction of future climate, there is a measure of confidence. The prediction may be drawn up from, an ensemble of 100 simulations. The more scenarios that are looked at and analysed in terms of computer simulations, the better the chances are of accurate predictions.

"We want to know what is the probability, or likelihood of different things happening?" explains Professor Lynch. "In that context we might find that in our ensemble, most of the predictions cluster in a certain region, with maybe one or two wildcats. These could give an indication of extreme unanticipated events. For example the possibility of abrupt climate change and this is an area where we don't know enough, so far. Ireland and the rest of the world could benefit from this approach, as unexpected events may become more predictable."

At a national level, there is a collaborative project between UCD and Met Éireann are working on a collaborative project, the Community Climate Change Consortium for Ireland (the C4I Project), the aim of which is to model and predict climate change in Ireland. This involves running regional climate models, through a computational method called nesting. The idea is to 'nest' a regional model for Ireland and the North Atlantic inside the massive global models that are available.

"The regional model gives a much higher resolution and a more precise description of the climate in the region that we are interested in," says Professor Lynch. "We are concerned specifically with how climate change will impact on Ireland. Almost anything that you think of is going to be affected by climate change; agriculture transport, tourism, health, recreation, industry, construction, and energy."

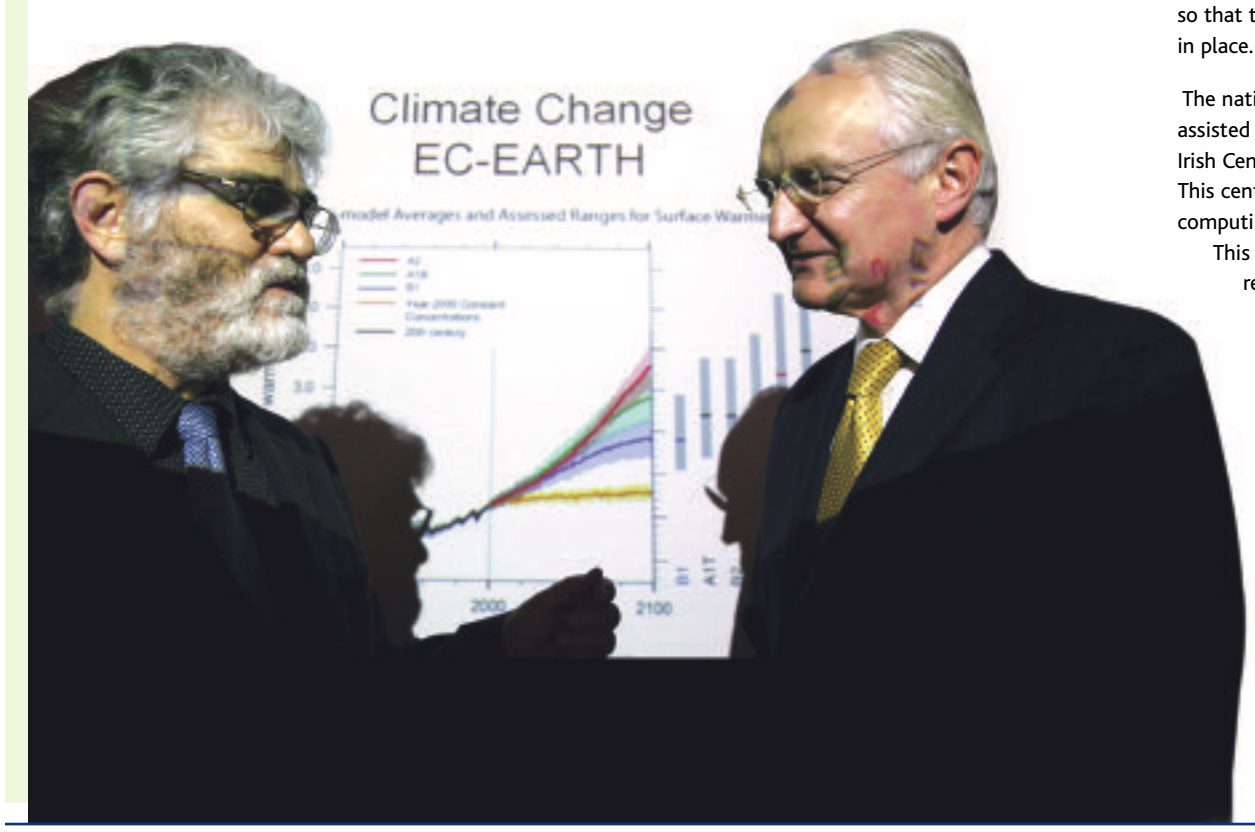
Professor Lynch feels that information about the likely impact of climate change in all these areas will provide decision makers in government and the private sector with the solid data they require to make plans for the future. The C4I Project aims to fill gaps in the knowledge that exists today. For example, if the temperature rises significantly, then the east of Ireland might experience pressure for water supplies in future years. It is important that planners know what is likely to happen here, so that they can put appropriate strategies in place.

The national climate research efforts were assisted greatly by the establishment of the Irish Centre for High-End Computing (ICHEC). This centre recently acquired a powerful computing platform, called an IBM Blue Gene/P. This will help to improve the precision of regional weather forecasting. Making improvements in forecasting is difficult because, for many technical reasons, the computational requirements climb very quickly in order to make better predictions.

European climate-prediction experts met recently at UCD, to discuss the development of a computer system to examine future weather patterns. The Minister for the Environment, John Gormley, TD opened the meeting which was part of the EC-Earth Programme, an international collaborative project aiming to simulate and predict the entire global climate system. UCD is a partner in EC-Earth. The group plans to develop a computer model that will improve predictions of global climate for the rest of this century.

Speaking at the opening, Minister Gormley said that projects such as EC-Earth are "absolutely essential if we are to predict the global climate conditions with accuracy. Climate change threatens our very existence and we must tackle it now. We also want to expand the links to international research to ensure that Ireland has an advanced capability for predicting future climate conditions".

Sean Duke is a UCD graduate and joint editor of Science Spin



For some time, many had felt that the training in meteorology in Ireland was not at the level it should be nor was there enough research happening in the field here. Irish students had to go to universities abroad for training. Met Éireann approached a number of universities about setting up a training and research programme, and reached an agreement with UCD. Following on from this, a Chair of Meteorology post was established in UCD, and Professor Lynch was appointed to the role, in September 2004.

Professor Lynch recognised the importance of establishing a teaching programme as soon as possible. The first course was the MSc in Meteorology, covering all the main areas of the field. The MSc has been operating successfully and is now in its fourth year.

A new undergraduate programme Climate and Earth System Science was set up in collaboration with the School of Geological Sciences. "Because climate change issues are in the news almost every day, there is always a high level of interest from undergraduates," explained Professor Lynch, "but it is vitally important that students are well grounded in mathematics. This is a basic requirement for climate modelling and means that undergraduates are typically coming from engineering or physics."

This year there are in the region of 20 undergraduate students taking meteorology modules, as part of their engineering, physics, or other degrees. A further seven undergraduate students are registered in the full Climate and Earth System Science degree, which Professor Lynch hopes to develop further.

Professor Lynch would like to continue to build on the undergraduate degree, and to link it in a stronger way with the MSc. He regards the study of climate change as interesting academically, but also as a field with good career prospects.

In terms of where his students might end up working he cites the Marine Institute, the Office of Public Works, the Environmental Protection Agency, and Sustainable Energy Ireland as some examples. But, he also notes that in future major companies may have "a climate change guy" as it will become economically worth their while to do so.