The Tipping Point

Climate science may be in the dock but, undeterred, UCD is pushing on with efforts to identify the likely impact of global warming on Ireland. **PROFESSOR PETER LYNCH** tells *Kevin O'Sullivan* how even minute changes - in terms of temperature or other factors - can make a big difference on a local level.

By early 2009, climate change, "the greatest global challenge facing humankind in the 21st century" – was edging its tortuous way up the global agenda. Obama was attempting to make the US face up to global warming. Other major CO_2 generators, notably India and China, were beginning to move in the right direction. Hope for a deal to cut greenhouse gases in Copenhagen was taking hold.

By year's end, somehow, there was a side-on collision. Key players baulked at a deal as the UN's Intergovernmental Panel on Climate Change (which is overseeing global negotiations) was thrown into chaos. The debate was also infected by "Climategate" and the claims of sceptics who seized on the contents of hacked emails from the University of East Anglia's Climate Research Unit. This was supposedly the 'smoking gun' that confirmed some climatologists colluded in manipulating data to support the view that human-induced climate change is real. A storm was further fuelled by the admission by the IPCC that its prediction in a landmark 2007 assessment on the scale of meltdown in Himalayan glaciers was based on an unscientific World Wildlife Fund report.

Back home we were having the coldest winter in a generation, prompting *The Irish Times* to remark: "So much for all of that guff about global warming! Are world leaders having the wrong debate?" Said in jest, it prompted another round of 'denier' letters. Some contend that recession has further sidetracked the debate and there is a collapse in public confidence in the science of climate.

In the face of that maelstrom, it's reassuring to know that Met Éireann Professor of Meteorology Peter Lynch remains an optimist. Based at the UCD School of Mathematical Sciences, he is director of its Meteorology & Climate Centre – a small but critical component in the university's frontier-linking research into the smart/green economy; alternative energy sources, earth sciences and the environment.

Professor Lynch doesn't shirk from comment on the skewed debate but his judgment on climate remains rooted in scientific evidence: CO_2 is going up and up; the Earth is getting warmer. There are too many uncertainties which prevent accurate prediction of future impacts of climate change. We could see a dramatic change in climate which happens quite suddenly. There remains a risk of a catastrophic change.

He has no doubt that irreversible damage has resulted from human-induced global warming. The loss of a species equates to irreparable damage. On the possibility of catastrophic change he points to "ice-albedo feedback"; the more ice melts the less white polar regions are, the more energy they absorb, the warmer it gets. This is a self-sustaining, even a self-accelerating, process. He thought we were seeing it in recent years but last winter it was less pronounced.

A significant baseline in the Irish context was achieved with the 2008 C4I study 'Ireland in a Warmer World'. Indications are firming up since.

The UCD team runs a range of models (developed in different parts of the world) and applies them to Ireland and its surrounds. "You really want to telescope down to more detail with regional models nested within the global model. It gives more precision and detail ... mountains and coastline are more accurately incorporated in the mix," he says.

The initial impetus came from Met Éireann's concern that there was and inadequate level of 'climate modelling' in Ireland. "You really need to know not just what's happening but the level of certainty you can bring to it. To say Ireland is going to experience a three-degree increase in temperature is not really good enough on its own ... You need a measure of the uncertainty of the spreads," he says. So they run ensembles (five or ten simulations) together. If they are cohesive and consistent, they have confidence in them.

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It's a massive computational task. Atmospheric pressure, temperature and wind are represented at various points covering Ireland which make up a grid. The finer the grid of points, the better the resolution. Typical models have ten million different numbers specifying the state of the system. "It indicates what the climate is doing right now; one moment in time. Then you compute the climate changes in all of those, step by step into the future," he explains.

Global temperatures have increased by about 0.7 degrees in the past century, and by more in Ireland – but there could be a variety of reasons for that. "We have to be really careful with changes; not to attribute them to some cause because we feel like doing it."

He is afraid there is a great deal of misinformation on climate, "most of it due to ignorance or carelessness; some due to malice aforethought, because vested interests are trying to rubbish the message." On misinformation, he doesn't claim to have direct knowledge but knows what happened with the tobacco industry in the past. "The oil industry is a similar example; there is a major reluctance to face up to the consequences of burning fossil fuels."

'Evidence-based' indications suggest Irish winters are likely to be warmer and summers drier. We may be facing an increase of two or three degrees in temperature over the next 50 years. "We are confident about the temperature, not so confident about rainfall. We all know the vagaries of the Irish weather ... confirmed by three atrocious summers on the trot."

Increasing accuracy is being achieved by refining the physics and resolution of models with the help of computer power provided by the Irish Centre for High-End Computing in UCD, "an excellent resource nationally", Professor Lynch notes.

There are reports that in Ireland things are happening that never happened before. He adds: "It's not at all that clear that things are dramatically different than they were before. But they do have a large impact because of the way we live, because of the way we build, and we have a growing population."

Rainfall might decrease in summer but the pattern of change is such that although the overall monthly rainfall is similar, there are more extreme events leading to perhaps a more defined pattern of change. There are consequences of a month's rainfall falling in a day. The ground and water ducts can only absorb so much. The Irish climate is notoriously fickle, which has to be factored into

EFFECT: more frequent flooding, more severe flooding, likelihood of flooding in areas previously not at risk.

EFFECT: intense storms, extreme weather and, with 60 per cent of the Irish population living within 10km of the coast, coastal erosion may become a significant problem.

deliberations. Globally, Professor Lynch believes there is a major problem for humanity and things are changing quite rapidly. Frequent flooding events are hard to explain on the basis of natural variability. Ireland is "not especially" vulnerable in the broad climate sense, yet biological processes are a delicate balance and temperature sensitive. With just a small change, pests can occur that threaten animals and plants causing unanticipated bad effects. "We do not have the ability to predict what's going to happen."

The ozone hole in the atmosphere was not anticipated. With CFCs increasing, a slight decrease was expected in the tropics rather than a catastrophic decrease in the Antarctic. "We are doing the same with CO_2. We think we know the major consequences but I don't believe we do." Most life processes are very sensitive to temperature change. "I'm afraid that something could go seriously awry and cause a shift in climate to a different regime. Any change causes great hardship."

'Positive feedbacks' in the atmosphere pose a threat of runaway changes or a move suddenly to a different regime - his colleague Prof Ray Bates is working in this area. "It does worry me. I believe if we keep on allowing CO_2 to increase indefinitely, I wouldn't be surprised if the climate regime changed suddenly and unexpectedly." Within a century? "You take a stick and you bend it and you bend it, suddenly it will snap. How can you predict when? It's a bit like that volcano. It has stopped - will it stay stopped?"

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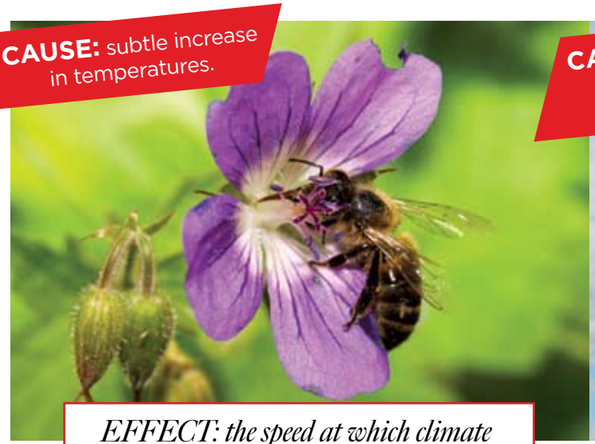
Our ability to explain things after the event is good; we haven't got that much ability to anticipate the unforeseen. "If you think of something like a rainbow, you can explain the colours in great detail, the intensity and spectrum ... But who would actually predict a rainbow? You would never imagine such a thing. It's the same with most natural phenomena; we have to experience them before we can explain them," he says.

Greater certainty is emerging. Notable success has come with weather forecasting models over the past 50 years. "We have gained one day in predictability every decade. So the six-day forecast is a good as a five-day forecast ten years ago. These weather models are similar to those being used to model climate."

The models are coupling oceans, atmosphere, ice, land and vegetative processes, which is helping to create an 'Earth systems model'. This complements plans to establish an Earth Systems Institute in UCD. The multidisciplinary facility is in the formative stage and awaiting a Government decision on funding. Already that blend of climate expertise is contributing to an international collaboration which has created EC-Earth; an earth system model.

Where is it all leading to? "My own opinion as an optimist is that we will find technological solutions," declares Professor Lynch. He recalls phenomenal developments in automation and transport in the 1900-1930 period. "We are working like mad to find solutions. I would be hopeful we will find clean energy sources. Certainly, it will be very much a multifactorial solution."



EFFECT: the speed at which climate change is occurring does not allow species enough time to adapt, so populations and distributions will be affected.

EFFECT: landscape change due to investment in biofuel crops and alternative sources of energy.

Wind energy will be a small but significant element. A lot of work is being done on wave energy. "If we do elementary calculations, we have more than enough wave energy along the west coast to keep us going but we don't know how to get it. It's just a massively difficult task in engineering terms. The environment is so hostile."

He is sure there will be advances in capturing solar energy, energy storage and in carbon capture/sequestration. As the problem becomes clearer and more urgent, greater effort and resources will be applied. It may require the scale - in terms of money and resources - of the Manhattan Project (codename for a Second World War project for the development of the first nuclear bombs). "If we did the same with nuclear fusion we might see progress." It requires a massive injection in clean energy. Nuclear fusion, he feels, ought to be a lot cleaner than nuclear fission, which is central to current modes of nuclear power.

Ultimately, he believes there should be a political solution too, but he accepts the big difficulty - that people have to take measures that hurt their own economy and it is not obvious they will see benefit from that. "Things may have to get worse before we see real political moves to stabilise the climate ... But you can't stop burning oil if you don't have an alternative."

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He was disappointed rather than despondent after Copenhagen. He believes the UN's IPCC is the right platform for negotiations. "It's quite unique in giving a forum where scientists and politicians, at least, try to communicate. It has been a great success in enabling world leaders to get access to the very best information."

On the Irish Government's response, he says it has been fairly minimalist. Part of that is buying carbon credits which he regards as not convincing: "It doesn't show a serious commitment". A Carbon Tax is window dressing, in his view, but on balance it's better to have it than not. "We have to do lots of things; no single one is going to solve the problem." We are somewhere in the peleton of Europe, possibly dragging dangerously behind.

The information void remains, so resources are critical to fund relevant research. "My last word would tend to be one of optimism, not for a political resolution but for a technical breakthrough. Because of our geographical location, we should be working very hard to develop wave energy. It's enormously difficult and it may take a long time. It's the sensible thing to do." ■

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