10.1071_ISSN0311-4546EC110p6

Waiting for El Niño

A coupled atmosphere-ocean model with the ability to predict the likely onset of El Niño and La Niña events up to nine months in advance is being developed by Dr Ian Smith of CSIRO Atmospheric Research in Melbourne. This will give farmers, natural disaster organisations, water catchment managers and other agencies more time to prepare for the impact of the El Niño–La Niña cycle, which dominates the climate of northern and eastern Australia.

El Niño events are heralded by a change in the strength of easterly trade winds in the tropics. This shift in wind strength, through its influence on ocean currents, cools sea-surface temperatures across the tropical western Pacific and around Australia's north, stifling rainfall across eastern Australia.

El Niño droughts typically are broken by autumn rains, as trade winds resume their normal easterly pattern, increasing sea-surface temperatures and evaporation. If the trade winds become stronger than usual, and sea-surface temperatures to the north are cooler than average, a La Niña event develops: the reverse of an El Niño.

La Niña is notorious for causing major floods and storm damage in south-east Queensland, inland New South Wales and eastern Victoria. La Niña storms can also cause heavy inflows into catchments, threatening dams.

The ocean-atmosphere model simulates climatic processes at a horizontal grid spacing of two degrees and divides the atmosphere into nine layers.

The model being used by Smith to predict El Niño events evolved from a climate change model developed by CSIRO Atmospheric Research. 'Instead of using the model to study changes in the climate system over several decades or centuries, we are applying it to a different problem: that of changes over several months,' Smith says.

'We try to predict how an El Niño event will develop: whether it's likely to be warm (El Niño), cool (La Niña), or neutral. Once we've made a prediction, we use records of previous events to estimate regional rainfall.

'For example, for the "neutral" 2001–02 summer, we reviewed rainfall, temperature and other meteorological data from neutral phases in the past to determine whether a particular region is likely to receive rainfall and temperatures above or below average.'

Smith says predicting climate with numerical models is at a similar stage of development to numerical weather prediction more than a decade ago.

Today's models are reproducing the physics of the ocean-atmosphere system more realistically, and data density has improved enormously, but climate prediction is inherently more difficult, and it could take decades to achieve significant improvements.

Climatologists once relied mainly on sparse data from ships at sea. Now, they have access to huge data sets from orbiting satellites and arrays of buoys moored across the Pacific, 30 degrees south and north of the Equator, the nursery latitudes for El Niño and La Niña events.

A method called 'hindcasting is used to verify the model's accuracy. This involves testing its ability to predict events of the past. For example, given the conditions prevailing at the time, would it have successfully predicted the 1982–83 or 1991–84 El Niños?

'At this stage, our skill at getting it right six months ahead matches that of other models, such as those developed by the European Centre for Medium Range Forecasting, or NOAA's National Centre for Environmental Prediction,' Smith says.

Despite the progress in monitoring and modelling, there are still many unanswered questions about ENSO.

'We're not sure why the 1991-94 warm event or the 1998-2001 cool event were so persistent,' Smith says. 'And we're still a long way short of fully understanding what triggers these events, what influences their evolution, and why they end.

'We just don't have enough detailed historical data, nor enough measurements of what is happening in the Pacific Ocean.

'It's the ocean that ultimately determines what happens, and there has been a concerted effort in recent decades to enhance measurements of temperatures, surface winds, and currents.

'We also still don't know all we need to know about the physics of the oceans and atmosphere, and their interactions.

'Finally, there's the chaos factor: at times the system becomes sensitive to small perturbations, making it difficult to predict what will happen.'

'With weather forecasting, you can test your theories and predictions every day. With climate forecasting, you might get an ENSO event only once every four or five years. And because the system is inherently chaotic, we may never be able to predict ENSO events with great confidence.

'But people are beginning to understand that if we make a prediction far enough ahead to affect their decision making, and they understand that it is better than tossing the proverbial coin, then the probabilities can be tipped in their favour.

'Many farmers understand this and pay close attention to both the current and predicted state of ENSO. We do not advise farmers to plant early, late, or more, but we do provide them with information to feed into their risk-management decisions.'

Smith says it is too early to confidently predict that there will be an El Niño event in 2002–03, even though the Southern Oscillation Index, the most widely used measure of El Niño and La Niña events, was heading ominously towards negative values late in 2001.

The research has been federally funded through Agriculture, Forestry and Fisheries Australia's Climate Variability in Agriculture Program. Details of the project are available on the web at: http://www.dar.csiro.au/res/regmod/cc.htm.

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