Forecasting climate – the odds on getting it right

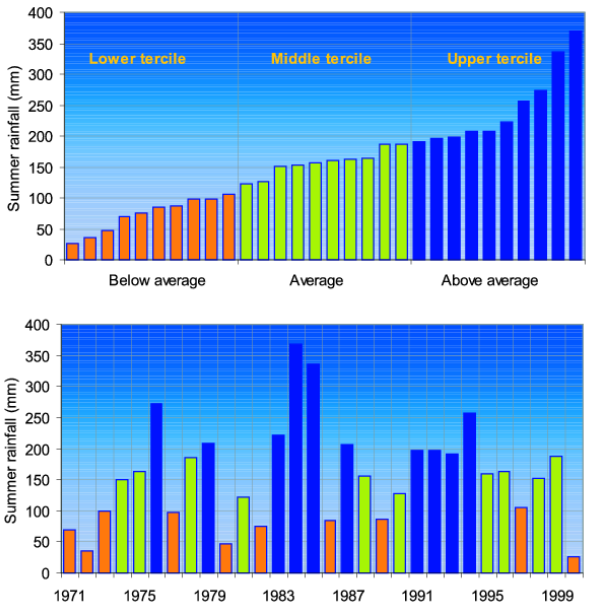
Forecasting climate is a process of looking at climate variables and weighing up the value and reliability of each piece of information. There's no smart menu of procedures or clever software that can do the job for you.

A good indicator of climate for the next few months is found in the historical climate patterns of the past 20 or more years. This tells us the likely mean state of the climate for any season or month, and the degree and frequency of climate variations on those time scales.

For example, rainfall measurements might show that receiving less than 40% (let's call it 65 mm) of summer rainfall in Marlborough is quite common – that it happens on average say 2 years in every 10. So if we had no other information than the historical rainfall data on which to base a summer forecast for Marlborough, we could say that there was a 20% chance of rainfall being 65 mm or less.

ENSO

But every now and then there is a systematic change in weather patterns – a tweak if you like in the normal circulation, rainfall, or temperatures that might last for a few months or longer. The El Niño-Southern Oscillation (ENSO) is a Pacific wide phenomenon that affects New Zealand climate like that. When we examine past El Niño summers in Marlborough for example, we find that some are wet and some are dry, but on the whole they are more likely to be drier than the average over all summers. So, following our earlier example, how would El Niño affect our prediction of whether Marlborough summer rainfall was likely to be 65 mm or less? It would make a dry summer more likely, and increase the chance from 20% to say 30% that the rainfall would be 65 mm or less.



The natural distribution

Like many natural phenomena, aspects of climate, such as rainfall amounts or mean temperatures, occur in a range of 'sizes' – there are high, medium, and low values. In the figure above, 30 years of summer rainfall at Sevenoaks climate site in Marlborough is rearranged in order of amount (upper figure), and shown divided into three categories (terciles) with a third of the rainfalls in each category. The actual sequence of summer rainfall totals from 1971–72 to 2000–01 are given in the lower figure, highlighting the dramatic difference between the wettest years in the mid 1980s and the 2000–01 total of 27 mm, which was the lowest summer rainfall in the 30 years.

Terciles

The data are arranged into terciles simply as a way to characterise three types of summers —'dry', 'average', and 'wet'— that are different from each other in practical terms. So from the Sevenoaks data we can define a dry, average, or wet summer as one having less than 110 mm, 111 to 190 mm, or more than 190 mm of rain respectively.

For any summer, over the long term, there is a one in three chance of rainfall being in each tercile, until other factors, such as ENSO as mentioned earlier, tip the odds in favour of one tercile or another.

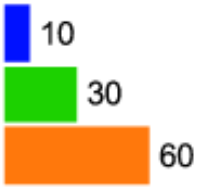
Forecast models

Just as we need to know how ENSO changes the chances of drier or wetter summers, we have also to look at a range of other climate models and climate factors. We have to determine what physical differences in the climate they indicate are likely, and the significance of those changes. Sometimes the models can be counter-suggestive, so we must assess how much credibility or 'weight' to give each one.

In the end, each model or climate factor offers information on how the typical distribution of climate patterns might shift, on time scales of a month or two, or a season, or longer. Climate forecasting aims to achieve a consensus that draws together all these bits of information to tell a coherent story.

Outlook assessment

In NIWA climate outlooks, the weight or likelihood of each forecast condition is given using bar graphs like the one shown here. The bars and numbers represent the consensus we have reached on the likelihood that seasonal rainfalls, temperatures, soil moisture levels and river flows will occur in each tercile. Increased likelihood is represented by longer bars with higher numbers. With each forecast, the most likely outcome, in our assessment, is highlighted by the caption under the graph. In this example, the caption is likely to read 'Below average'.



Call these numbers a ranking of expectations or our percent weighting of likely outcomes, we hope you find them useful.