Scientific assessment of climate change notes that the world is indeed getting warmer. Taking to one side the reasons why, IAN BARRIE and DAVID HEMSTOCK consider the implications for the greenkeeper and the necessary changes for golf course irrigation

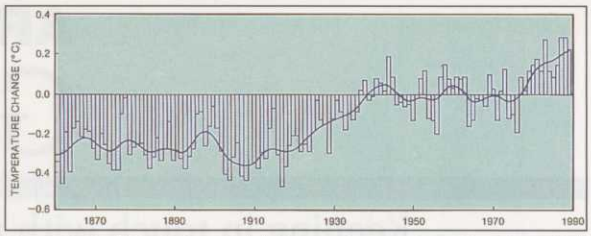

Fig. 1: Annual deviation of global mean temperatures for the period 1861-1989 (shown by bars), relative to the average for 1951-1980.
Source: United Nations Environment Programme Report 1990

Few of the world's climatologists would now disagree that our Earth is warmer than it was 150 years ago – and that the trend is still upwards (*see figure 1*). The 1980s set several world records for the warmest years over the past couple of centuries.

However, the cause of this global warming is still the subject of intense debate amongst scientists. Some consider that it is little more than a continuing recovery from the Little Ice Age, which affected Europe in the 16th and 17th Centuries, whilst others argue that it is principally the cause of mankind upsetting the natural chemical balance of the atmosphere by releasing vast quantities of carbon monoxide and other greenhouse gasses, such as CFCs and methane.

Rainfall records display a greater level of variability than those of temperature and accordingly it is harder to identify any trends, either by region or globally. At this stage it would be not be fair to say that just because the UK and large areas of mainland Europe have had three consecutive dry summers that this is due to global warming.

Whatever the outcome of the scientific debate, those among us who have to plan for the longer term must consider the implications for a warmer world in the future. One of the best ways to do this is to look back and assess the irrigation need for past years before going on to speculate on the consequences for the future.

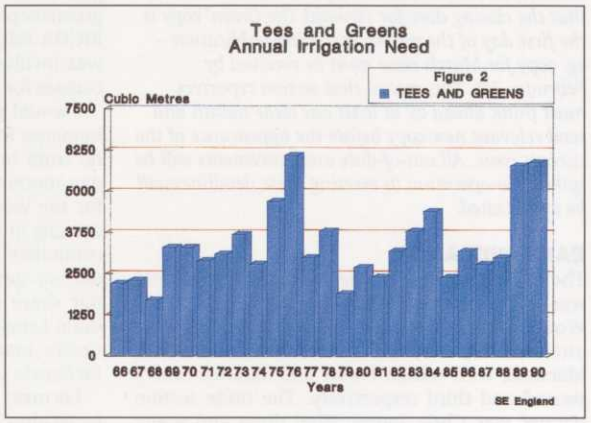

Fig. 2

Assessing irrigation need

Over the past few years a new method of assessing irrigation need has been developed. Put simply, it involves calculating (from weather records) the daily evaporation losses from a turfed surface, this loss then being balanced against daily records of local rainfall. As the 'soil' dries out there will come a point when irrigation is required.

An example of this would be to say that on successive dry days the evaporation losses were 2.5mm, so after three days this moisture deficit would be 7.5mm. Therefore the follow-

Too HOT to handle

ing day, when the deficit reached 10mm, would be a good time to apply, say, 5mm of irrigation. In short, 5mm of irrigation was applied when the moisture deficit reached 10mm. Now follow this plan day in day out for 25 years and you should have a pretty good idea of not only the average water use, but also the water need in hot dry months and seasons.

Luckily our computer does most of these calculations for us, as it is linked directly into the Met Office's computer.

A strategic irrigation plan

A plan similar to the one described above can be formulated for each area of the course, and indeed was formulated for a typical course in the South East of England. For example, applications of 5mm at a moisture deficit of 10mm may be suitable for most tees and greens, but with deeper rooting on surrounds a moisture deficit of 20mm would be reasonable, whilst if fairways have to be irrigated a moisture deficit of 40mm could be allowed before moisture stress became serious.

Esates of seasonal irrigation need

From year to year both evaporation and rainfall rates will vary, with the variation in rainfall being the greater. In SE England, summer rainfall (ie. April to September) has been as low as 185mm (1990) and as high as 500mm (1968).

The effect on the calculated irrigation need is dramatic Figure 2* shows the total seasonal need over the period from 1966 to 1990. For a long time 1976 stood out as a freak year, with irrigation near double the long term average. However, 1898 and 1990 have cast a new light on the chances of prolonged drought. Whereas not too many people would have planned to cope with such a dry period previously, there is now a more apparent need to cope with a situation which has risen three times in 25 years.

Using typical acreages for tees, greens and fairways, a similar calculation reveals that if fairways are also to be irrigated then the average irrigation need would have been 12,000 cubic metres against the 3,100 cubic metres needed for tees and greens alone. In a dry season the numbers increase to 42,000 and 6,100 cubic metres respectively. In other words, fairways would account for 80 to 90% of the total water need.

** An additional allowance has to be made for wastage due to uneven applications, overlapping and wind drift.*

Peak irrigation demand

A necessary planning value for the sizing of pumps, pipes and reservoirs is the maximum short period – or peak – irrigation demand. In the chosen example shown this occurred in July 1990, when tees, greens and fairways would have needed 15,200 cubic metres. Figure 3 illustrates the difference between this peak and the average monthly demand. Roughly speaking, peak rates are double the average.

A plan for the future?

Please accept that neither crystal balls nor seaweed will produce the information needed to form a sensible plan for the future! Scientifically, it is also clear that if temperatures continue to rise then evaporation rates will also increase. If this is accompanied by a reduction in summer rainfall then the need for irrigation will rise markedly. At our disposal is a range of options which will help redress the balance.

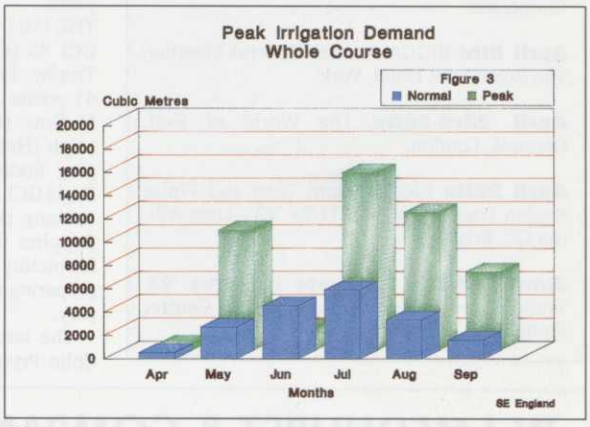

Fig. 3

Specific sowing of drought tolerant species is a sound first step. This would allow an increase in the moisture deficit at which irrigation is applied. If irrigation was applied at a deficit of 15mm, rather than the 10mm taken previously, in an average year a water saving of 15% would result. If a deficit of 20% could be allowed then the saving increases to 26%. Logically, in a wet year the savings would be larger.

More obviously, superior design and operation of an irrigation system reduces the amount of wastage due to overlap areas, uneven application and wind drift. The more novel forms of irrigation which have been the subject of much discussion would also have a role to play.

The wider picture

Realistically all the above has to be set in a global picture. It cannot be overstressed that we must consider ourselves an integral part of the world as a whole. If the gloomier forecasts are proved right – that the world warms by 2 degrees centigrade and sea levels rise by 50cms or more – then London and half the coastal cities in the world will be under sea water; drinking water will be in short supply and famine will be on an unprecedented scale.

This argues strongly for the type of actions which will hopefully be agreed at the Earth Summit Meeting in Brazil this year. They will call for large scale forest planting, reduction in greenhouse gas emissions and more efficient use of energy. Only the very brave – or the very foolish – would totally ignore the signals which have been evident over the past few years.

The managers of golf courses will have their part to play along with everyone else and a more efficient water use management policy will be as important as any.

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