The Climate Archive of Armagh Observatory

Figure 1. The Robinson Cup Anemometer at Armagh Observatory: the cup anemometer was invented by T.R. Robinson, the third Director.

Of the problems facing the human race today, none is more pressing in the medium term than change in the global climate. Global warming, if it continues at the current rate for a century or more, is expected to cause increasing desertification of some parts of the world simultaneously with rising sea levels. No country is immune from the effects of global warming, but those with extensive coastlines, such as Ireland and Britain, have particular cause for concern. Although it can be argued that climate has never been stable, we cannot plan for the industrial and social requirements of the future unless we understand the causes of climate change – i.e. are they natural or anthropogenic in origin, to what degree do the various factors contribute, and what will the consequences be?

To answer questions such as these, we require accurate knowledge of how the world's climate has varied in the past. Information can come from various indicators of climatic conditions, such as tree-ring widths and ice core composition.

Figure 2. An example page from the Armagh meteorological record for April 1866: note the comments: 'aurora' on 17th and 'corncrakes & cuckoo' on 27th.

However, all such 'proxy' indicators require calibration with instrumental data gathered over recent centuries. Unfortunately, prior to 1860, very few stations existed where meteorological observations were made on a regular long-term basis and, of those that did, many are now in heavily built-up areas which have their own micro-climate. Armagh Observatory is unusual in this respect in that it is situated in a small city which has seen relatively little change in its population over the past two centuries. However, what makes the Armagh data series exceptional is its length, for, starting in 1796, it now has the longest series from a single site in Ireland or the UK.

Recently, a project to place the Armagh Observatory meteorological archive on the world wide web has received funding from the UK Heritage Lottery Fund and the Irish Soldiers and Sailors Land Trust. The project will allow access to over 7,000 pages of daily meteorological data stretching back to 1796 when observations commenced (*http://climate.arm.ac.uk*). In addition, the project will provide calibrated and standardised meteorological series for scientific and educational use, as well as high time resolution data from a new automatic weather station. To bridge a gap in the Armagh data from 1825–1833, when either observations were not made or have been subsequently lost, further data from Dunsink Observatory covering the period 1804–1850 will be employed.

Though, strictly speaking, the Armagh data only tells us how climate has varied in one part of Northern Ireland, in fact the proximity of the Atlantic Ocean and the direction of the prevailing wind mean that the temperature in Ireland generally follows that of the Atlantic. It is the great oceans of the world, the Pacific and Atlantic, that provide the principal heat reservoirs on which climate stability depends and which moderate the changes in the world's weather.

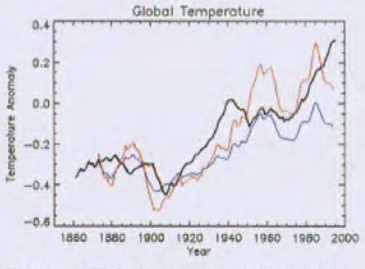

Figure 3. Global temperature anomalies – black (observed); blue – contribution from low clouds predicted from changes in the cosmic ray flux (solar activity); red – combined total solar activity contribution to temperature – this includes the effect of solar activity (via cosmic rays) on low clouds and the change in the Sun's brightness (courtesy of E. Palle Bago).

Recent research at Armagh by E. Palle Bago and the author on satellite cloud data has shown that not only temperature, but also cloud factors over Ireland, are well correlated with those over the Atlantic. This work indicates further that, if one looks at specifically low cloud (altitude 1–3 km) over the period for which data is available (1983–1994), there is a strong correlation with the cosmic ray flux. As the cosmic ray flux is heavily influenced by the degree of solar activity, this may be one link *via* which changes in solar activity can affect the Earth's climate. Whilst all clouds to some extent cool the Earth by reflecting sunlight, they also warm by absorbing and re-emitting the long wavelength radiation from the ground. The balance between these two opposing contributions determines whether clouds at a particular level warm or cool the climate and, by summing the effects over the whole Earth, one can derive the net effect.

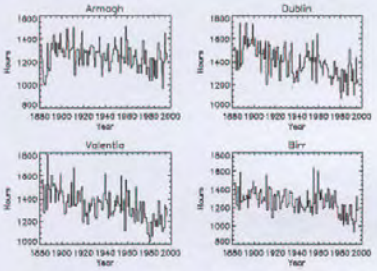

Figure 4. Total annual sunshine hours for four sites in Ireland 1881–1998. Note the general downward trend in sunshine which is believed to be associated with a world-wide increase in cloudiness (courtesy of E. Palle Bago).

The results suggest that much of the global warming that has occurred over the last century could in principal have derived from the known changes in solar activity levels and their predicted effects on low clouds. However, when we look at the actual observed cloud data from various parts of the world, including Ireland, since the beginning of the 20th century, we find that the picture is more complicated and that changes in cloud at all levels must be taken into account before we can reliably predict the full contribution of clouds to global warming.

Thus we see how mundane and often tedious meteorological observations, if gathered over a sufficient time, can give us important clues about the real causes of global warming.

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