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A direct time series comparison between the La Jolla and Belfast radiocarbon records.

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For many years it has been widely assumed that the variations in the level of atmospheric carbon-14 were due to statistical fluctuations arising from experimental error. This is understandable since the signal/noise ratio is very low and the time sequences representing the variations are strongly stochastic. Interlaboratory comparisons show that baseline variations in the absolute value of the carbon-14 concentration do exist. However, assuming linearity, the $\Delta^{14}C$ values are independent of these. The importance of assessing the quantitive reality of the $\Delta^{14}C$ values is based upon their expression of the interplanetary cosmic ray source function, because in the range of 100-1000 year periods, there appears to be no evidence that the Earth's magnetic field is the source modulating function. Therefore the modulation is either due to changes in the solar atmosphere propogated out into the solar wind, or extra-heliospheric pressure effects, but these appear to be unlikely for the periods noted here. Periods in the range of 100-1000 years are so far entirely unexplained by solar physics (cf. Boyer) but are broadly consistent with the sunspot index and the sparse data on long term variations of the solar radius, e.g. Gilliland [1981]. The recent availability of the new high quality Belfast time sequence of $\Delta^{14}C$ now permits a simple mutual assessment of the several sequences which are available. Since the La Jolla record has been a standard for many years (and also subject to criticism), we chose these two for a simple comparison. The basic "lumped" statistics are as follows:

TABLE 1.

	La Jolla+	Belfast
Time interval	3985BC-1832AD	3982BC-1840AD
No. data pts.	502	282
$\Delta^{14}C$ minimum	-32	-28
Maximum	88	86
Mean	15.1	13.1
St. dev.	30.0	29.4
3rd moment	0.6	0.7
4th moment	-0.8	-0.6

+La Jolla data trunctated to approximately match Belfast sequence length. Fourth moment (kurtosis) is referenced to the value of three for a normal distribution. The negative value signifies lesser peakedness than normal. All statistics are based on per mil. It is clear from Table 1 that the two sequences are in close accord, that the internal spread (sigmas) are very similar, that only a small baseline (mean) difference exists, and that both sequences closely follow a symmetrical normal distribution.

Although Table 1. gives a statistical summary, it contains no information linking data points, e.g. autocorrelations. Some of these have recently been reported on [Sonett, 1984], and the reader is referred to these for details.

Here we make the simplest of comparisons, but because of the simplicity, it is especially direct and straightforward. The two sequences are first tructated to the same interval. No corrections for the large scale trend is made, nor is the data splined and interpolated. Thus both sequences are pristine. We have, however filtered them with a low pass Martin filter set to reduce the bandwidth by about a factor of ten at the 3 db point (Fig. 1 insert). The uncertainty arises from the definition of filtering of a series of unequally spaced points for which a Nyquist period cannot be exactly defined.

Although close similarities are apparent in the unfiltered data, the periods in the range of 100-1000 years are of most interest and least corrupted by the unequal spacing. The filter operation removes these higher frequencies and brings out the obvious longer period correlations. Fig 1. shows the two sequences superimposed on a common time scale. Although differences exist, the close agreement between these two sequences, one determined over a period of years beginning about 1955 and carried out on White mountain Bristlecone pines, and the other done later in Belfast using Irish peat bog wood, is striking. Fig. 1 confirms the validity of the two dendrochronologically established annual tree ring sequences and shows that, as expected on geochemical grounds, a close global relation exists, and that these two laboratories have obtained data in which the similarities outweigh differences. This correlation between the two strongly reinforces the statistical view that the $\Delta^{14}C$ record is that of real interplanetary modulation of the cosmic ray source leading to the generation of atmospheric ^{14}C.

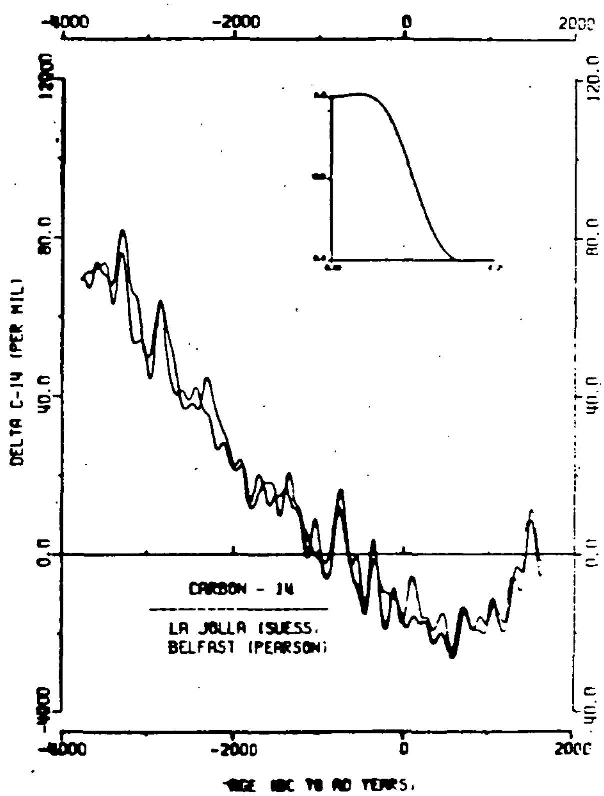

Fig. 1. La Jolla (heavy line) vs. Belfast $\Delta^{14}C$ for the interval 3980 BC - 1840 AD. Data is unsplined and long period "sine wave" is not removed.

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