ENVIRONMENTAL NOTE NO. 86

DCE File : 201/77

Reporting Officer : V. Paparo

NOTE ON THE DOCUMENT "THE PREDICTION OF LONG-TERM TRENDS IN AUSTRALIAN RAINFALL" BY E.G. BOWEN.

March, 1980

SUMMARY

The Bowen method of rainfall prediction uses past rainfall records to predict for a given site, the rainfall trend for a 5-10 year period. This prediction indicates whether rainfall will rise or fall for any particular year when compared to the previous year. The method is not used to predict the amount of rainfall or its distribution over the year.

An accuracy of about 80% is demonstrated for the method, but reliability is poor in areas where there is a mixture of predictions, some showing an upward trend and some a downward trend. In addition the spatial resolution of the method is not always good, being of the order of 500 km in some areas.

As a consequence of its nature and spatial resolution Bowen's method appears to be of no use to individual farmers on a year to year basis. Trends in rainfall will, in general, be of little help to a particular farmer who would like to know the amount and distribution of rainfall for the following year.

Bowen's method has its primary use in the area of broad-scale predictions of rainfall for statistical purposes. It has merit where one is to look at the annual rainfall trend of a large region over a number of years.

THE PREDICTION METHOD

The method of prediction is based on 60 to 80 years of rainfall records at any given station. It seeks to predict rainfall trends (rising or falling rainfall) on an annual basis.

Figure 1 shows the rainfall record for an 80 year period for the town of Walgett in New South Wales. If a spectral analysis of the record is carried out it may indicate (a typical result) three or four periods occurring in the range 5 to 30 years. Other peaks, with periods that are less than 5 years, also occur. (See Figure 2).

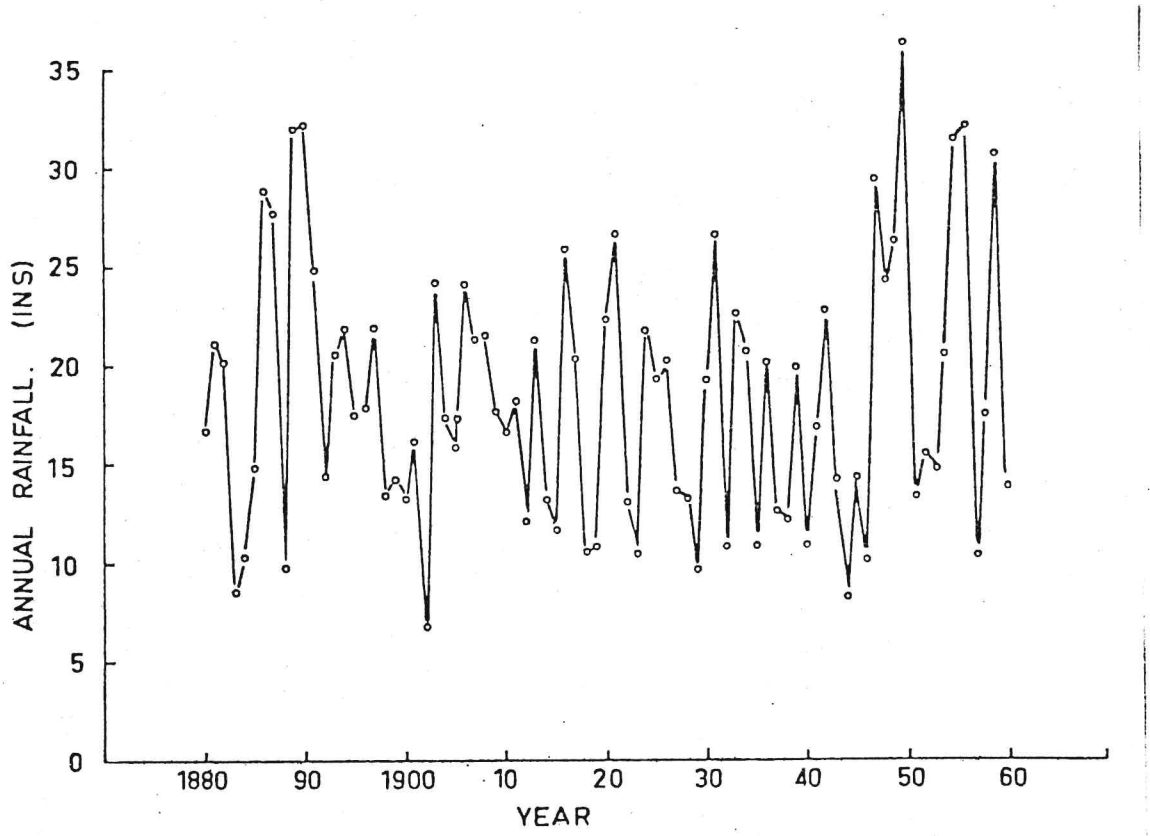

FIGURE 1

THE TOTAL ANNUAL RAINFALL FOR WALGETT N.S.W. FOR 1880-1960

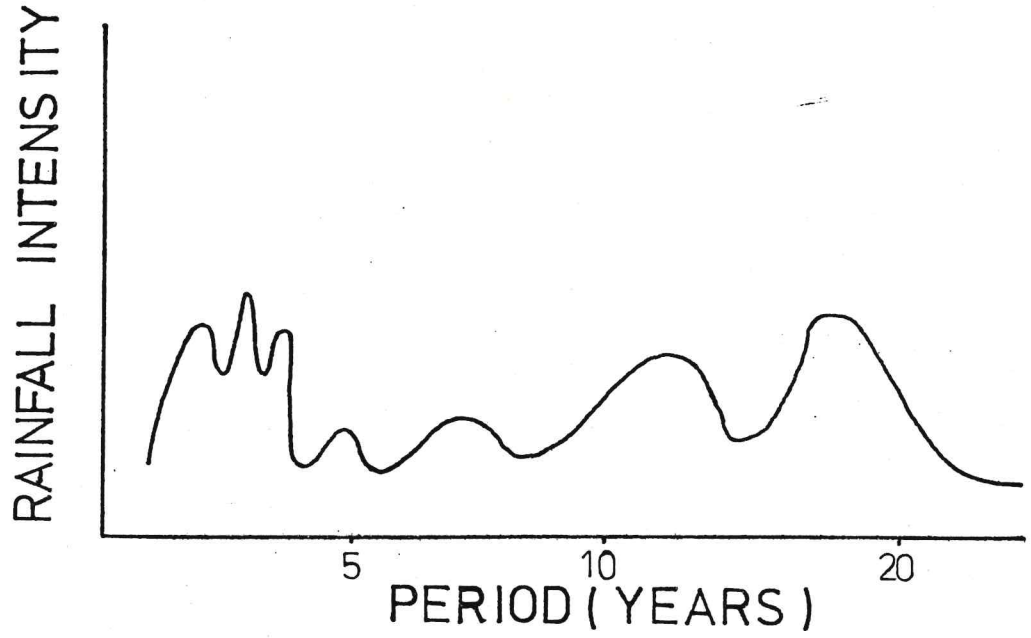

FIGURE 2

SPECTRAL ANALYSIS OF THE RAINFALL RECORD

A set of numerical filters is then used to "smooth" the rainfall record. These filters reject periodic components that are shorter than 5 years, where the greatest proportion of the "noise" fluctuations appear to exist. Thus, as shown in Figure 3, the rapidly varying (high frequency) components have been excluded from the original record.

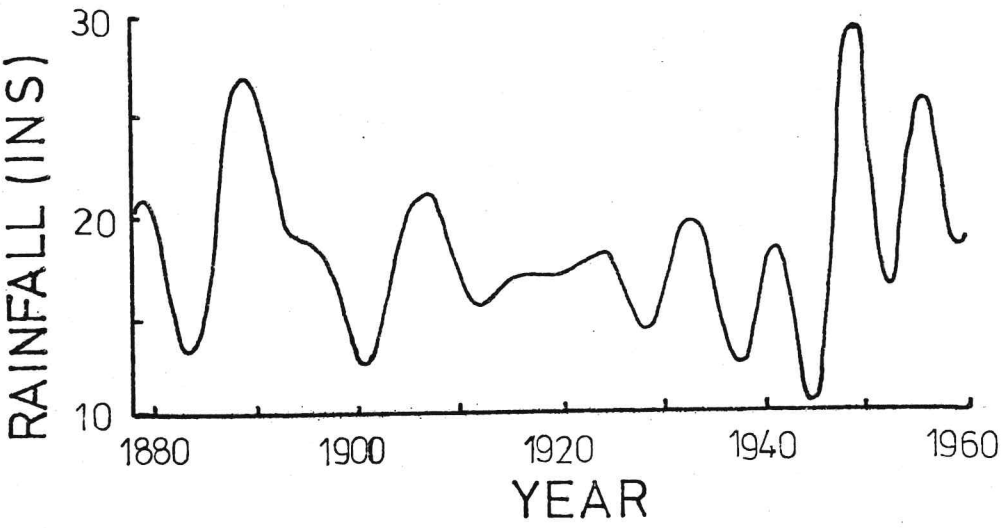

FIGURE 3

THE ANNUAL RAINFALL FOR WALGETT SMOOTHED TO ELIMINATE ALL COMPONENTS WITH A PERIOD SHORTER THAN 5 YEARS

It is apparent that the smoothed curve:

i) retains a large proportion of the variations of the actual rainfall record, and

ii) the curve appears to be much more cyclic in character than Figure 1.

The filtering process reduces the original data to a number of quasi-periodic oscillations as in Figure 4. As a result, the smoothed rainfall curve can be represented as the sum of these filtered outputs.

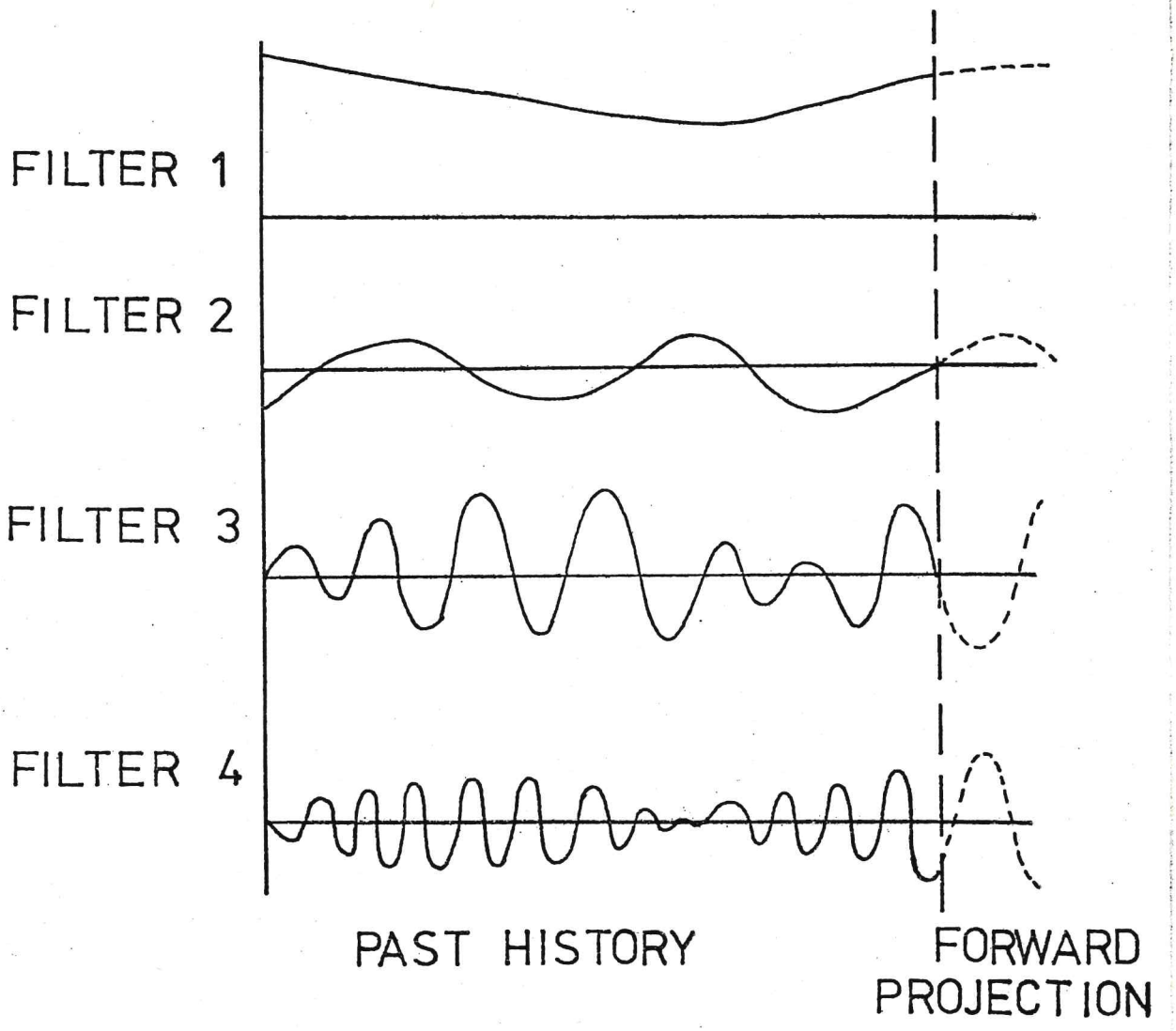

FIGURE 4

THE PRINCIPAL QUASI-PERIOD COMPONENTS OF THE SMOOTHED RAINFALL RECORD

For prediction purposes, each of the four filtered results is projected forward 5 to 10 years in time. The individual projected recrods are then summed to give a smoothed prediction and by its nature, this prediction contains less detail than the original data.

Bowen applies the above analysis to many rainfall stations throughout Australia. He has compiled five or six maps (representing successive years to be predicted) to show the rainfall trend for each year based on the preceeding year.

A station marked in red is predicted to undergo a downward trend and one marked in green, an upward trend.

The method appears to be most reliable in regions where the majority of stations show a trend in one direction. Thus, if there is a mixture of predictions, some showing an upward trend and others a downward trend, the accuracy is fairly poor.

Because the method indicates only trends, it cannot be used to make any year to year predictions on the amount and distribution of rainfall. As a consequence, Bowen's method has no apparent use for individual crop farmers.

One possible use of the method may be in the area of 5 to 10 year predictions. It may be indicated that a rainfall deficient period lasting for 4 years, for example, will occur over the next 7 years. Based on this information, the farmer may progressively reduce his stock numbers or increase his water supplies over the period. It must be recognised however that he has no way of knowing whether the rainfall "dip" is a mild one or whether a drought is expected. In addition, the spatial resolution of the method is poor, being of the order of 500 km in some areas. As a consequence, predictions are not accurate on an individual farm basis.

The primary use of Bowen's rainfall analysis method may lie in the area of broad-scale prediction. The best results are obtained where one looks at the rainfall trend of a large region (such as the northern wheat-belt of Western Australia). The annual rainfall trend of the area as a whole can be fairly confidently predicted, though the temporal distribution can not be determined. It is possible, however, that some general agricultural statistics based upon these predictions can be derived.

V. Paparo,
ENVIRONMENTAL OFFICER

27 March, 1980