

Exceptional Weather Events

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The Dry Period October 1974 to August 1976

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Summary

The dry period which lasted from October 1974 to August 1976 is described, using data from the Irish rainfall station network. Maps, showing the distribution of rainfall during the most notable drought episodes, are presented and data on evapotranspiration and soil moisture deficit are also given.

In southeast Ulster, the period April to August 1975 was the driest such period for nearly 150 years. In large areas of the East, Midlands and South the April to August period of 1975 and 1976 were among the half dozen driest such periods in the last 150 years. However, the north and West of the country were much less severely affected.

In 1975 the driest was in early summer whereas, in 1976, it was in late summer. This, combined with the fact that the total April to August rainfall was slightly higher in 1976 in most areas, meant that the effect of the drought on agriculture was more severe in 1975 than in 1976.

Introduction

During the period October 1974 to August 1976 inclusive, rainfall was well below normal and the summers of 1975 and 1976 were notably dry and sunny. The deficit of rainfall had serious consequences for both the growth of agricultural crops and for the supply of water for industrial and domestic use.

Before describing the period in detail, it is useful to consider what is meant by the term “drought”. There is no generally accepted definition of the word and different definitions are employed by meteorologists, agriculturists and hydrologists. These definitions reflect the varying interest of the different specialists in the effects of a prolonged period of rainfall deficiency on such things as soil moisture, stream flow and the level of water in wells and reservoirs.

Meteorological definitions of drought involve only meteorological parameters. Thus, for example, a drought may be defined as a period of at least a certain number of days to none of which is credited more than a certain amount of rain (British meteorological office, 1939). With this definition, the length of the period is a measure of the intensity of the drought. However, where comparisons are to be made between areas in different average rainfalls, a more useful measure is simply the rainfall for the period or its difference from normal expressed as a percentage of normal (Tabony, 1977). This measure may be refined by the inclusion of potential evapotranspiration (P. E.) which is the evaporation under conditions of unrestricted water supply and depends only on

meteorological conditions. However, this has disadvantages since P.E. is generally measured at a smaller number of stations than rainfall and has a strong seasonal dependence.

Agriculturalists are interested in drought because of their effect on the growth of crops. The prime water requirements of crops is for an adequate supply of moist soil moisture during the growing season. Thus in Ireland a large rainfall deficit in winter would have little or no adverse effect on agriculture whereas the same deficit in summer could have serious consequences. One measure of agricultural drought is known as "soil moisture deficit" S. M. D. which is defined as the amount of rainfall needed to bring supply the soil to 'field capacity'. Field capacity is the moisture content of the soil when it is holding all the water it can against the force of gravity. SMD may be calculated from rainfall and actual evapotranspiration using an accounting procedure. A.E. is a function of P. E. soil moisture and other factors such as crop, type of soil etc., so it follows that SMD is not a purely meteorological parameter. In Irish practice, in the calculation of SMD, AE is obtained using a procedure due to Aslying (1965) which was derived for the case of a grass covered surface. In Ireland, SMD is 0 or close to 0 during the winter months (October to March approximately) while it may vary considerably during the summer, depending on weather conditions. Agricultural drought is characterized by a large difference between AE and PE and by a large values of SMD according to Fitzgerald (1976), grass growth is noticeably affected when SMG exceeds 50mm. A more detailed discussion of evapotranspiration and SMD is given by Connaughton (1969).

Hydrologists are interested in that part of the rainfall which is not used in evapotranspiration by crops and other vegetation but which percolates through the soil and eventually goes to fill reservoirs and raise groundwater levels. This fraction is greatest in winter and at least in summer and it is common to divide the year into two six month periods for hydrological purposes: October to March inclusive, when reservoirs are normally filling, and April to September, when their levels are falling due to excess of consumption over input. A deficiency in winter rainfall is of most concern to the hydrologists dealing with water supply, since it results in reservoirs inadequately filled to meet the period of summer demand. However, lack of rainfall during the summer may also be of concern, since it leads directly indirectly to an increase in water consumption by the public. This paper concentrates mainly on meteorological droughts using as a measure of drought intensity the rainfall amount expressed as a percentage of average. However, some references are also made to agricultural and hydrological drought.

Rainfall during the period October 1974 to August 1976

In Figure 1, the rainfall for each month from October 1974 to August 1976, expressed as a percent of average, is shown for a station situated in the southeast of the country (Johnstown castle county Wexford), or a station as situated in the northwest (Glenamoy

County Mayo) and for the country as a whole. The data for “the country as a whole” are taken from the Monthly Weather Report and were obtained by taking the simple mean of the percentage of average values for all stations maintained by the Irish meteorological Service. The Northern Ireland stations were not included. The averages used were the 1931 to 1960 averages which were current at the time. However, for the individual stations Johnstown Castle and Glenamoy, the more recent 1941 to 1970 averages have been used. The use of the two different sets of averages as a negligible effect on the results since the difference between them are small compared to the difference from average of the individual monthly value.

Following a wet September, the months October to December 1974 were drier than normal for the country as a whole. However, there was a large difference between the South and east of the country, where rainfall was well below average, and the north and West, where it was near average. For example, in December, Johnstown Castle recorded only 53.4mm (49% of average) while Glenamoy recorded 154.2mm (97% of average). Figure 1. January 1975 was wet, particularly in the west and Midlands, but some areas in the east and southeast had below average rainfall. Thus, thus in the South and E the beginning of the dry period may be placed in late 1974 while, in the north and West there was no sign of any rainfall deficiency until after January 1975.

Rainfall at below average in almost all areas in February and March 1975. April was generally somewhat wetter than average although large areas of the in the east and South were below average. During the early part of May there was some rain, particularly in the Midlands and east where Dublin (Phoenix Park) received 53 millimeters between 8th and 14th.

However, about the middle of the month a dry period commenced which continues throughout June and for the first week of July. In figure 2 the distribution of rainfall for this period is shown. It may be seen that the only extensive areas receiving more than 25mm of rain were along the western seaboard. At Carnew (vocational school), County Wicklow only 4.3mm of precipitation was recorded between 15th may and 7th July inclusive.

In the second week of July outbreaks of thundery rain which were particularly heavy in parts of Munster brought some relief from the drought. During the second-half of the month the West and northwest received normal quantities of rain. However the east of the country continued to suffer a deficit of precipitation and for example Dublin (Phoenix Park) received a monthly total of only 33.4mm (47% of average). August was another dry month although the drought was not as severe as in May and June and a small area in the extreme Southeast received more than the normal fall.

The dry summer was followed by a wet September and by an October which was on the whole slightly wetter than average. However November was again below average and

December was very dry (less than 20% of average in the Cork area). For the year 1975 as a whole rainfall was 53% of average. In January 1976 above average rainfall in the northwest combined with below average in the southeast to give 100% of average for the country as a whole figure 1. A rather dry February was balanced by a rather wet March but this was followed by a very dry April when most eastern and southern areas had less than half the normal fall.

In May rainfall was well above normal in the north northwest and parts of the Midlands and South north Donegal had over 200% of average. However a coastal strip stretching from Drogheda to Waterford had less than the average fall. June was dry particularly in Midland and southeastern areas. The last few days of June and the first few of July at extremely warm dry and sunny weather. From about 5th to 15th July there were outbreaks of rain mostly of a thundery nature giving substantial falls in parts of the east South and southwest northwest. However the second-half of the month was very dry in almost all areas and this dry spell continued through August and the first week of September. In figure 3 the distribution of rainfall for the period 16th July to 7th September is shown. During this period Drogheda (Killineer) recorded only 2.5mm of precipitation and a number of other stations in different parts of the country recorded less than 5mm.

The heavy rains of September and October which affected particularly the east of the country may be said to mark the end of the dry period. There was no lack of rainfall during the winter of 1976/1977 and although the summer of 1977 was drier than average there was no prolonged dry spells such as occurred in 1975 and 1976.

Considering the period October 1974 to August 1976 as a whole it is clear that the southeast was much drier compared to normal than the northwest. At Johnstown castle the total rainfall for the period was 1324.5mm or 67% of normal. At Glenamoy it was 2331.1mm or 90% of normal. In only five of the 23 months was the percentage of average at Johnstown greater than that at Glenamoy Figure 1. These months were February May and August 1975 and July and August 1976.

Agricultural aspects

The effect of the dry period on growing conditions in the southeast and northwest of the country is illustrated in Figure 4 which shows thrice monthly values of potential evapotranspiration actual evapotranspiration and soil moisture deficit for Johnstown castle and Glenamoy.

It may be seen that a reduction in soil moisture deficits to affect grass growths (indicated by MD's exceeding 50mm) began to be felt at both Johnstown castle and Glenemoy in late May 1975. At Johnstown SMD reached a maximum of 105 millimeters in early July and remained above 50mm until mid-september despite the effect of rain in July and August. At Glenamoy SMD reached 86mm at the end of June but the July rains

for sufficient to bring it well below 50mm and gross conditions were reasonably satisfactory for the rest of the summer.

In 1976 SMD at Johnstown increased rather slowly at 1st and did not pass the 50mm mark until late June, However it continued to increase as the summer progressed despite a temporary fall due to rain in mid-july and by the end of August had reached a maximum of 131 mm. Heavy rain in late September brought it back almost to 0 by the end of that month. At Glenamoy rainfall during may June and July was more than adequate to maintain growth. During August however soil moisture became depleted and for a period in late August and early September grass growth was seriously retarded.

Effect on water supply

Rainfall during the winter half years 1974/1975 and 1975/1976 was below normal in most areas though not extraordinarily so. For example at Roundwood (valve tower) situations near 1 of the principal reservoirs supplying Dublin city the October March rainfall was 590.1 millimeters 82% of average in 1974/1975 and 545.7 millimeters 76% of average in 1975/1976. There have been three years since 1941 when the October to March rainfall was less than 75% of average at Roundwood.

However the lack of rainfall during the summer of 1975 and 1976 led to a very heavy demand for water. The situation was worse in 1976 because the demands of the previous summer had reduced the water storage in reservoirs and aquifers below the normal levels and the winter rainfall of 1975/1976 was inadequate to restore them sufficiently to meet the 1976 demand. Restrictions on the use of water were introduced in both summers.

Comparison between the summers of 1975 and 1976

Figure 5 and figure 6 show the rainfall for the periods April to August expressed as a percentage of average for 1975 and 1976 respectively. This enables the spatial distribution of the summer drought in the two years to be seen and a comparison to be made between them.

The distributions for the two years are not dissimilar. In both years the West and northwest suffered least parts of these regions having over 80% of normal in 1975 and over 90% of normal in 1976. Most severely affected in 1975 were parts of counties arma and down which had less than 40% of normal and rather large areas in the northeast E SE and Midlands which had less than 50%. In 1976 significant areas were less than 50% were confined to the east and southeast. The most notable difference between the patterns for the two years is that April to August 1975 was much drier then April to August 1976 over most of Ulster and north Leinster. However some areas mostly in the southern half of the country were drier for these months in 1976 than in 1975.

For the country as a whole the drought was more severe in 1975 than in 1976. The overall percentage of average rainfall for the period April to August was 62% in 1975 and 66% in 1976. If data for the Northern Ireland stations had been included in the calculation of the overall percentage the difference would be greater as the contrast between the two summers was most marked in Ulster. Thus the situation in Ireland contrasted with that in southern Britain northern France and adjacent areas where the major drought was in 1976.

Another significant difference between the two summers was that in 1975 the driest period occurred early in the summer whereas in 1976 it occurred later. In 1975 the most notable dry period was from 15th May to 6th July inclusive; in 1976 the driest period was from 16th July to 7th September. Incidentally these two periods were exactly the same length (54 days). The timing of these drought episodes is important from the agricultural point of view. Most crops are more sensitive to drought in the early rather than the late summer and for some for example cereal crops a warm dry August may actually be an advantage. For this reason the effect on agriculture of the dry summer of 1975 was more severe than that of 1976.

Comparison with previous dry periods

Armagh observatory is situated in the area most severely affected by the drought in the summer of 1975. From April to August inclusive of that year only 151.2mm of rainfall was recorded there. This was by far the lowest April to August total ever recorded in our map which has a record extending back to 1836. The next lowest totals are 7.18 inches (182.4mm) in 1870 and 7.69 inches (195.3mm) in 1876. In 1976 the April to August total was 239.7mm. This was the 10th lowest such total since 1836.

At Dublin (Phoenix Park) the rainfall total of 208.8mm recorded between April and August 1975 was not extraordinarily low compared with previous years. One reason for this was the spell of heavy rain experienced there in early May which made it the only station in the country with above average rainfall for that month. In 1976 the April to August total was 176.8mm making it the 4th driest such period since the station opened in 1837. The driest April to August periods were in 1887 when only 125.2mm were recorded, 1870 (138.2mm) and 1864 (161.1 mm). After 1976 the driest April to August periods in the present century were in 1933 (182.1mm) and 1911 (189.4mm).

During the 23 month period from October 1974 to August 1976, 1092.3mm of precipitation were recorded at the phoenix park. Considering 23 month periods (starting in any month), 7 can be found since 1837 with rainfall lower than this. Most notable of these was the period from December 1857 to October 1859 when 1014.1mm were recorded. In the 20th century the period commencing in September 1903 had 1083.8mm and that's commencing in March 1933 1085.6mm. Also worthy of mention

are the 25 months from October 1942 to August 1944 the total rainfall for which was 1095.5mm.

Acknowledgement

Acknowledgment is made to the meteorological office Belfast for data used in drawing the northern parts of figures 5 and 6 and particularly for rainfall data for arma observatory for the periods 1836 to date.

References

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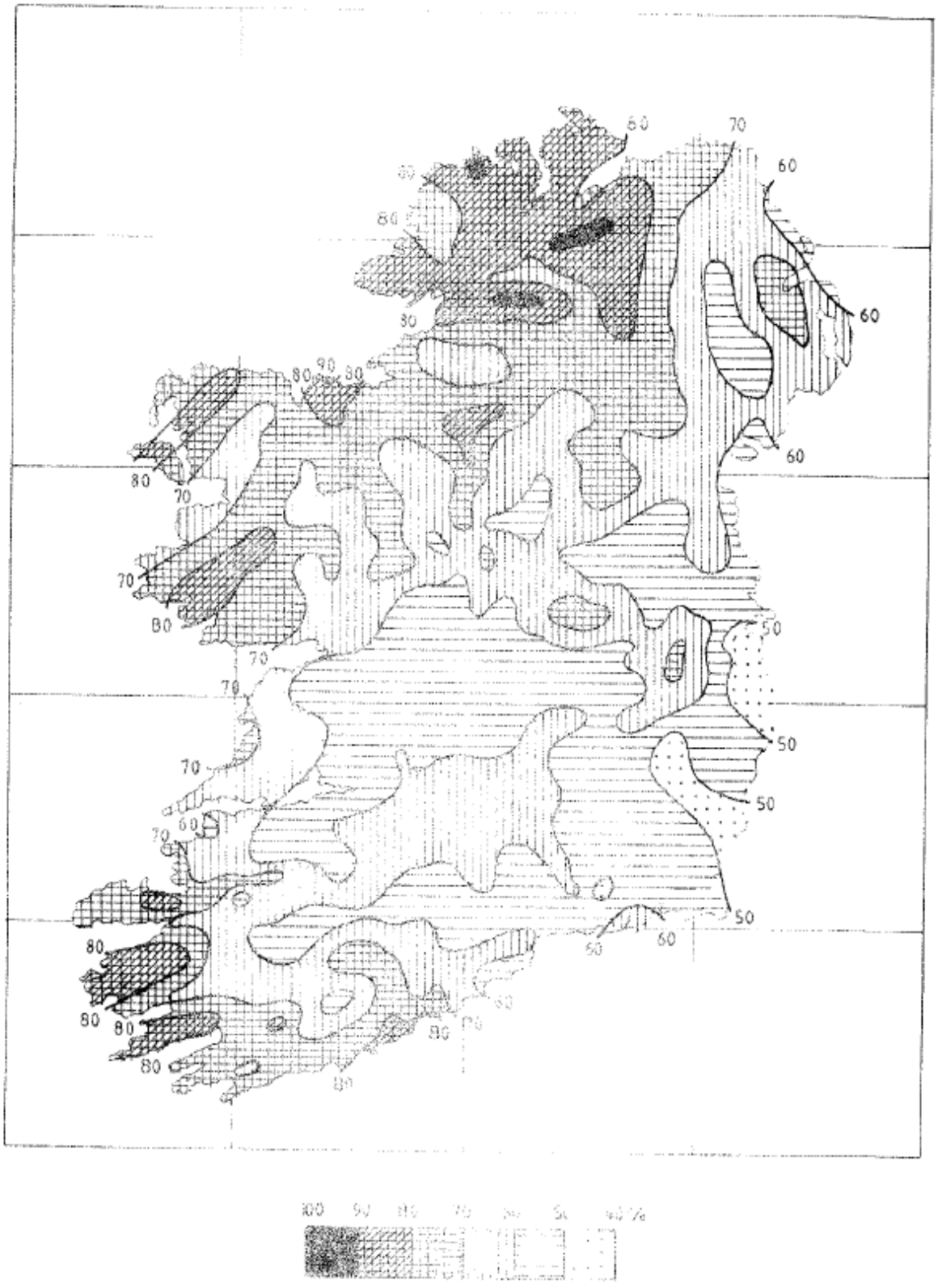


Figure 1 Monthly rainfall percentage of average from October 1974 to August 1976.

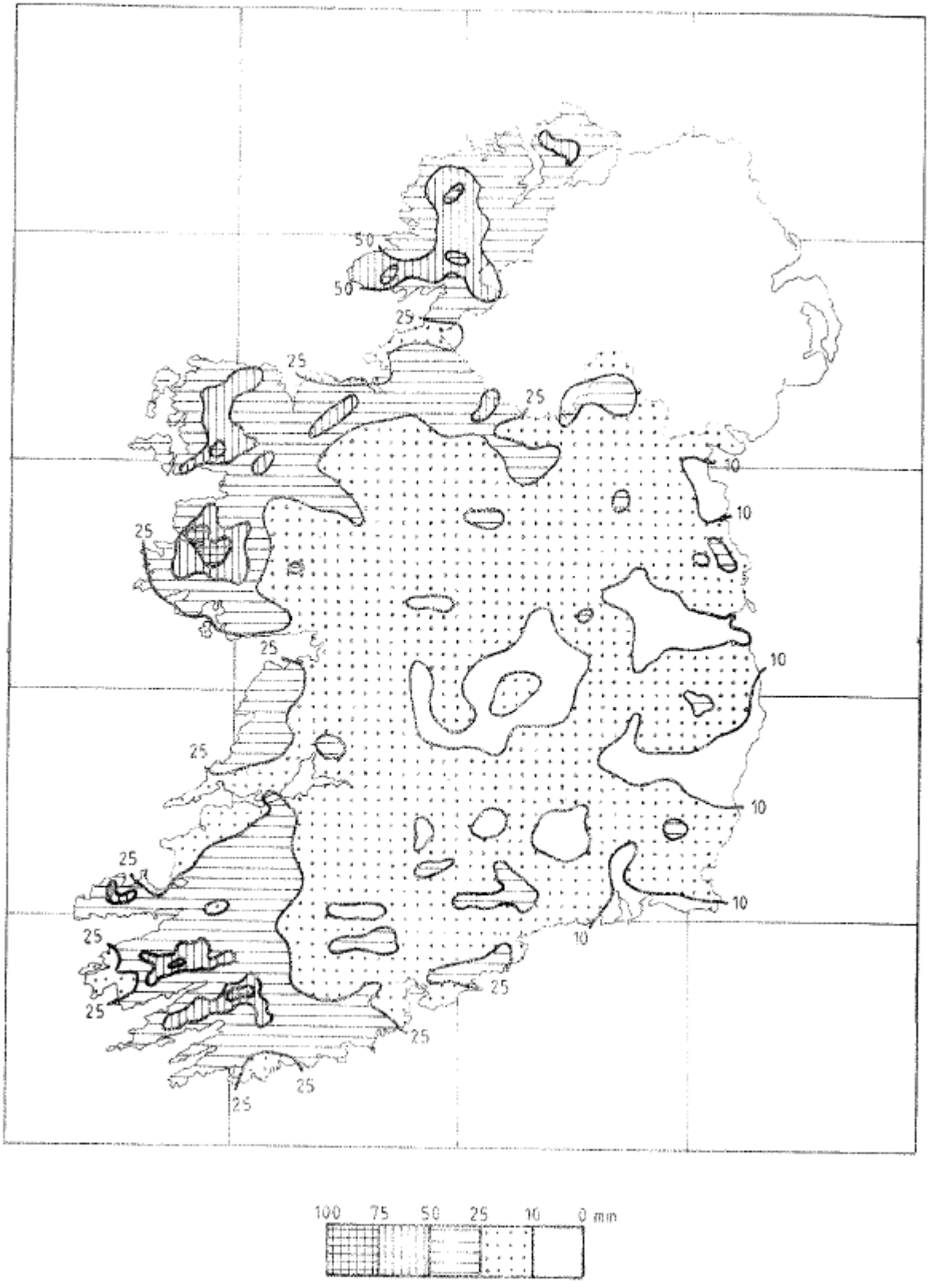


Figure 2 Rainfall millimeters for the period 15th of may 1975 to 6 July 1975 inclusive.

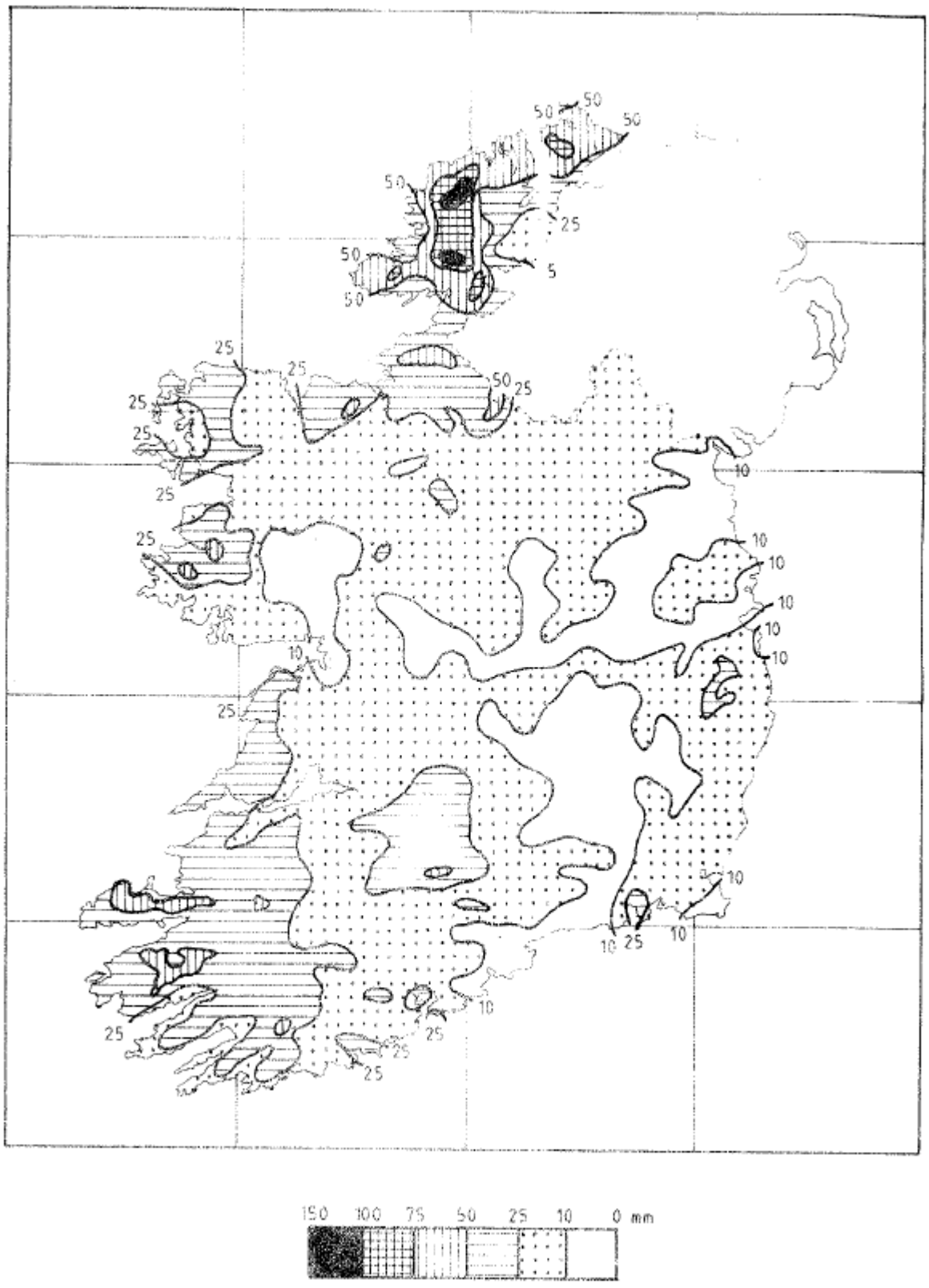


Figure 3 Rainfall millimeter for the period 16th July 1976 to 7th September 1976 inclusive.

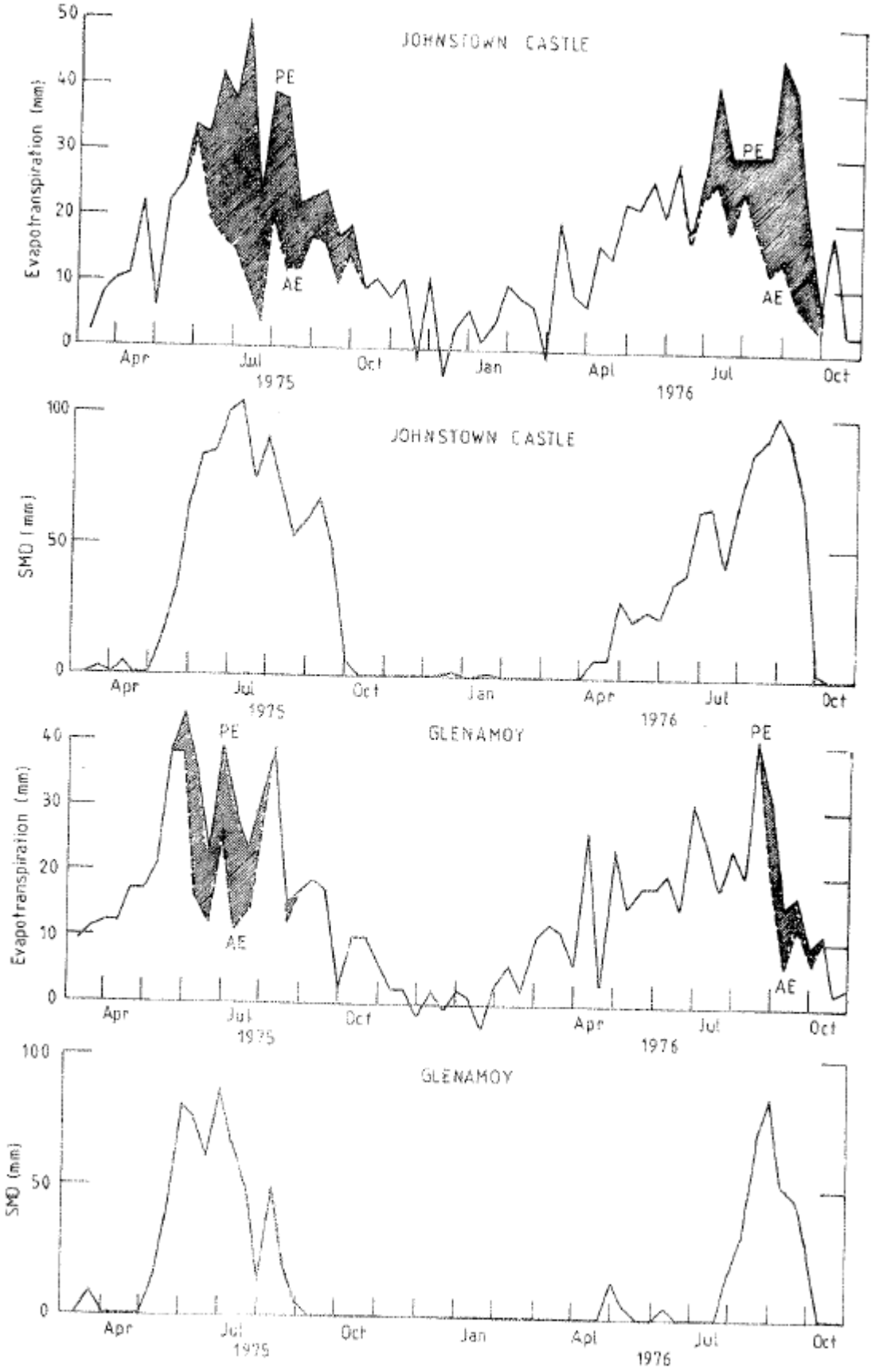


Figure 4 Potential evapotranspiration (PE), Actual evapotranspiration (AE) and soil moisture deficit (all in mm) from March 1975 to October 1976.

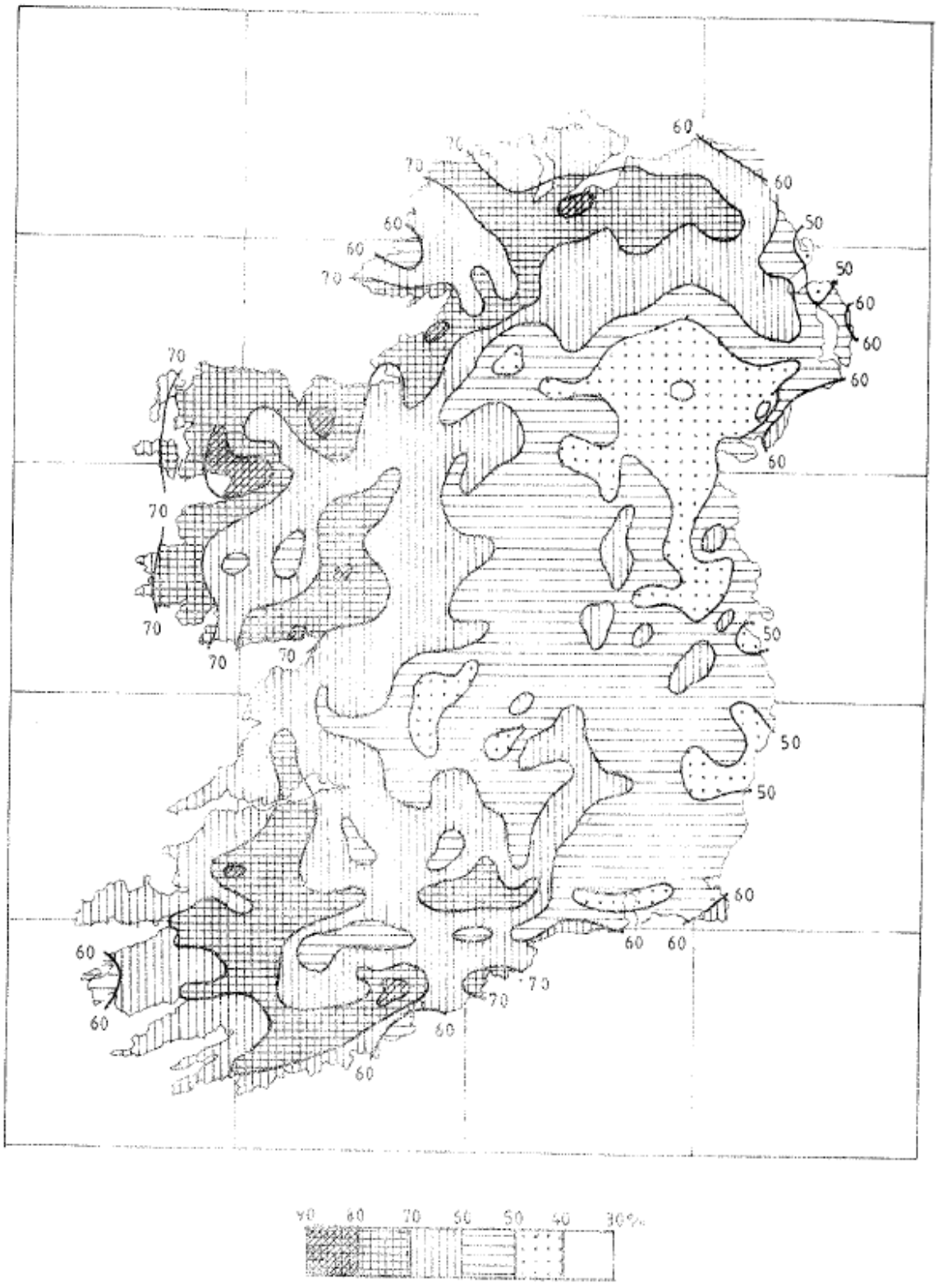


Figure 5. Rainfall for the period April to August 1975 expressed as a percentage of average (1941 to 1970)

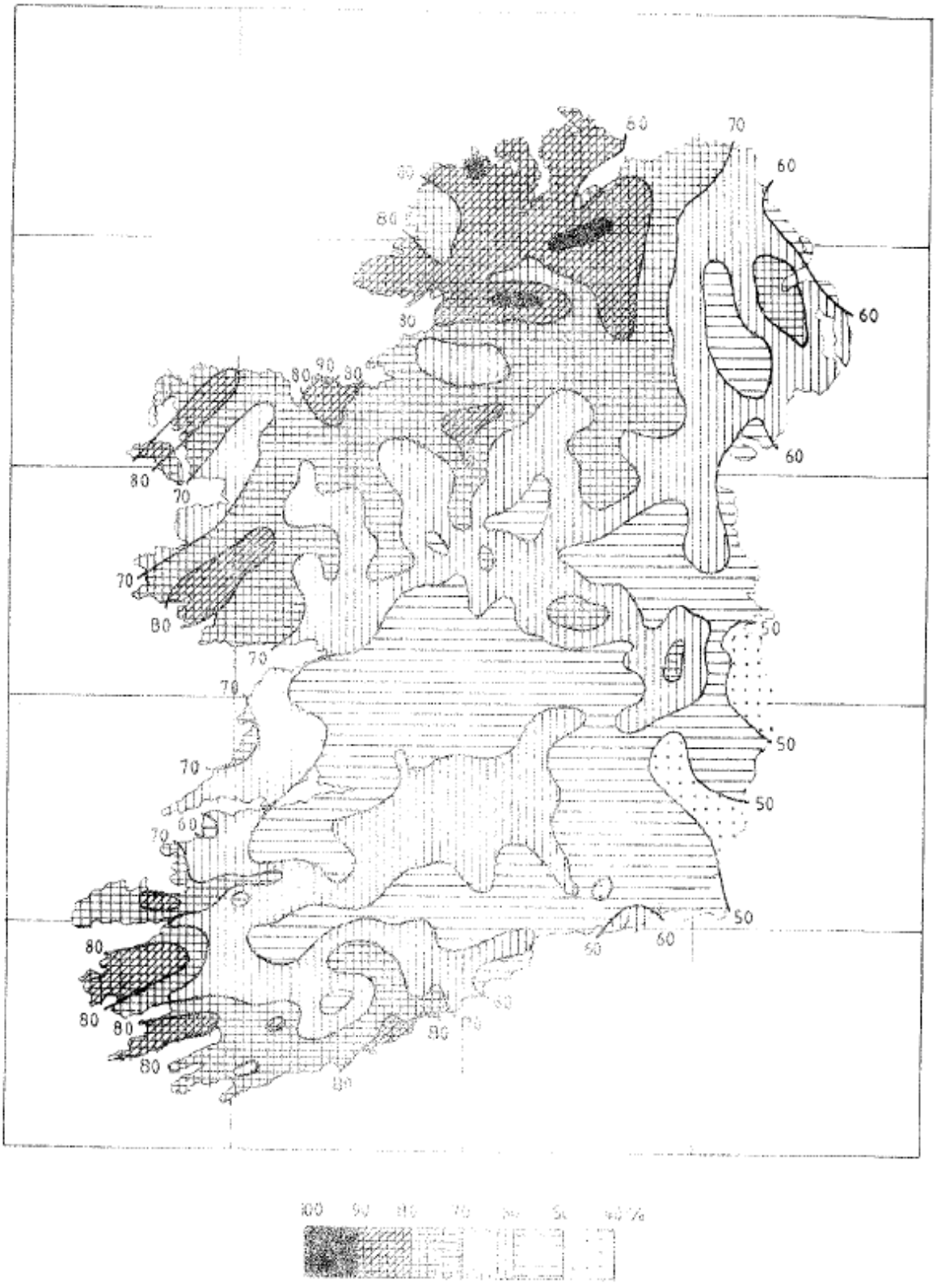


Figure 6 Rainfall for the period April to August 1976 expressed as a period of average percentage of average (1941 to 1970)