A NEW MAP OF THE RAINFALL PATTERNS BELOW 1600 mm FOR THE CANTERBURY HIGH COUNTRY

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INTRODUCTION

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New Zealand is a land of great rainfall contrasts. Nowhere is this more evident than around the Southern Alps. Recent studies by hydrologists (Griffiths & McSaveney, 1983) report that peak average annual rainfalls on the west coast reach 11,000 mm, which is a very high figure by world standards. Such rainfalls occur in areas where the rainfall gradients are extremely large, as is illustrated by the fact that only 30 kilometres away from the area of peak rainfall on the west coast there are inland valleys on the eastern side of the Southern Alps where the average annual rainfall is less than 1000 mm.

These huge rainfall gradients cause major interpolation problems and although the gradient just mentioned is an extreme case, there are many places around the Southern Alps where they are still very large. Over the years there have been a few intensive studies of average rainfall that have accurately located the patterns and gradients involved. Principal amongst them are the Griffiths & McSaveney study mentioned above and a study of the Clutha River catchment by power division, MWD in 1977. The study reported here by Belton & Ledgard represents another substantial step in the process of accurately defining the average rainfall distribution over a large area. It should be realised that the following short note belies the large amount of work that the authors have conducted in painstakingly collecting and checking a very substantial amount of rainfall data.

During the summer of 1982-83 the Forest Research Institute surveyed the growth of exotic trees throughout the Canterbury high country. Edaphic, physiographic and climatic site factors were also recorded so that relationships between tree growth and site characteristics could be examined.

Because of the presence of a strong rainfall gradient in the area, we anticipated that rainfall would be the key variable influencing tree growth. Consequently, any inaccuracies in rainfall estimates could obscure the more subtle influences of other site factors. When we started the field work, the Meteorological Service Isohyetal map (N.Z. Meteorological Service 1978) based on 1941-1970 rain station normals was the only means for estimating rainfall for most plots. After finding inaccuracies in the isohyet map we decided to make further investigations in an attempt to improve the accuracy of rainfall estimates.

Information from rain stations additional to those on which the original map was based was available from Ministry of Works, catchment boards, and the New Zealand Meteorological Service. In addition, we sent a questionnaire on rainfall records to runholders in the Waitaki catchment. Two categories of runholders' rain-gauge records were accepted: those spanning six or more years, for which the average value was used; and records ranging from 2-5 years, for which average estimates were obtained after using the nearest long-term rain station records to scale for periodic fluctuations. Records from gauges not located in a clear area distant at least twice the height of the nearest obstruction such as a tree or building were also excluded.

For the Waitaki, 18 additional estimates of rainfall were obtained from runholders' rain-gauge records and 10 from unpublished data from the Ministry of Work's rain station transects in the Ahururi, Jollie and Maryburn catchments. Updated Meteorological Service rainfall observations provided four additional stations (New Zealand Meteorological Service 1979, 1980, 1981). These new records increased the number of point estimates of mean annual rainfall for the Waitaki Catchment below the 1600 mm isohyet from 18 (N.Z. Meteorological Service 1978 map) to 50.

For catchments north of the Waitaki, 18 new stations below the 1600 mm isohyet were added to the 28 Meteorological Service 1941-70 stations. The majority of these new stations, and the most instructive, form part of the Rakaia transect of a Water and Soil Division (Ministry of Works) climatological study (Griffiths and McSaveney, 1983).

An axiom of isohyet mapping in New Zealand is that rainfall increases with altitude, and a strong relationship between altitude and rainfall was assumed in the construction of the Meteorological Service Isohyet Map (1978). The nature of this relationship was difficult to define in major rain-shadow areas (Tomlinson, A. I., pers. comm.). However, Griffiths and McSaveney (1983) compared the topographic profile with the spatial distribution of rainfall along a transect in the upper Rakaia catchment and showed that leeward distance from the crest of the Southern Alps, the zone of principal interception of the predominant rain-bearing wind, was more important than altitude in determining precipitation. The isohyet patterns mapped in Figure 1 take account of this 'altitude-leeward distance' interaction.

The major effect of this interaction and of the new point estimates of rainfall on the isohyet patterns is that more extensive areas of lower rainfall can be defined, particularly in the eastern section of the Waitaki basin. Here, zones below the 500 and 600 mm isohyets are considerably enlarged from those shown on the 1978 map. Also the steep increase in rainfall gradient occurs further westward than defined on the Meteorological Service Isohyet Map (1978), and starts beyond the 1000 mm isohyet rather than from c. 800 mm.

REFERENCES

Griffiths, G. A. and McSaveney, M. J., 1983: Distribution of mean annual precipitation across some steepland regions of New Zealand. *New Zealand Journal of Science*, 26: 197-209.

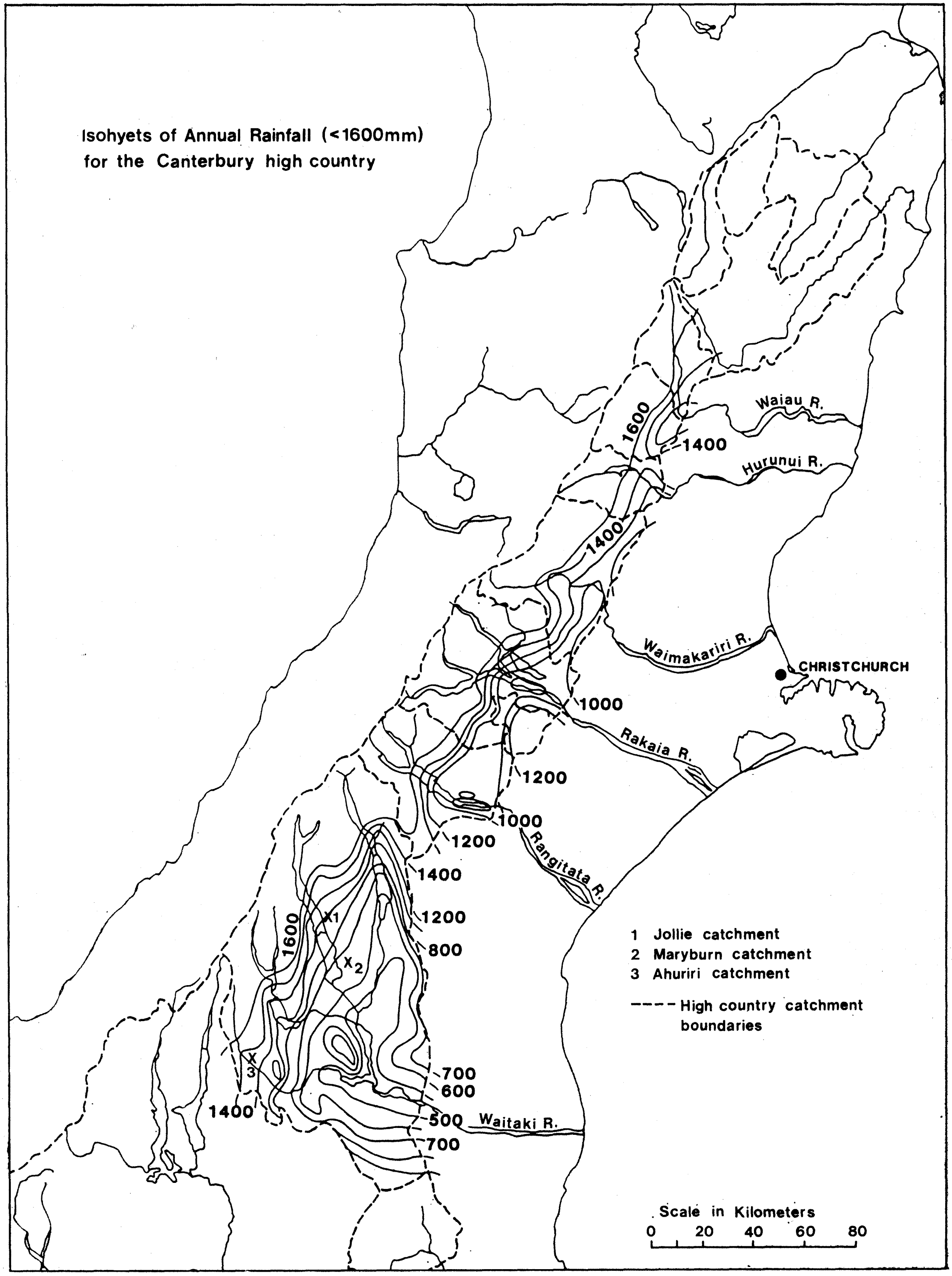
New Zealand Meteorological Service, 1983: Rainfall normals for New Zealand 1941-70. *N.Z. Meteorological Service Miscellaneous Publication*, No. 145, 34 p.

——— 1978: Isohyetal map of New Zealand, 1941-70 normals, Scale 1:500,000. Wellington, New Zealand.

——— 1979: Rainfall observations for 1979, *New Zealand Meteorological Service Miscellaneous Publication*, No. 110, 69 p.

——— 1980: Rainfall observations for 1980, *New Zealand Meteorological Service Miscellaneous Publication*, No. 110, 68 p.

——— 1981: Rainfall observations for 1981, *New Zealand Meteorological Service Miscellaneous Publication*, No. 110, 61 p.


Isohyets of Annual Rainfall (<1600mm)
for the Canterbury high country
Waiau R.
Hurunui R.
Waimakariri R.
CHRISTCHURCH
Rakaia R.
Rangitata R.
Waitaki R.
1600
1400
1400
1000
1200
1000
1200
1400
1200
800
1600
700
600
500
700
1400
X1
X2
X3
1 Jollie catchment
2 Maryburn catchment
3 Ahuriri catchment
High country catchment boundaries
Scale in Kilometers
0 20 40 60 80