

## SHORTER CONTRIBUTIONS

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SECULAR TRENDS IN TARGET/CONTROL AREA RATIOS, 1925-66, USED  
IN ANALYSIS OF CLOUD-SEEDING IN VICTORIA, 1966

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## 1. INTRODUCTION

This paper presents a third assessment of the cloud seeding operation carried out by the Victorian Department of Agriculture in Wimmera and Mallee districts of Western Victoria in August, September, October 1966. Previous assessments have been carried out by G. O'Mahony, Bureau of Meteorology and E.E. Adderley, Division of Radio-Physics, C.S.I.R.O. in the Vol. 15, No. 3, September 1967, and Vol. 16, No. 2, June 1968, issues of the Australian Meteorological Magazine.

## 2. ANALYSIS

Adderley's analysis was based on a table of the ordered ratios of target area rainfall to control area rainfall for the period 1925 to 1965 and showed that the 1966 ratio had only been exceeded twice in 41 years. Thus, the evidence indicates that rainfall in the target area was unusually high compared to the control area and the results appear consistent with a probable increase in precipitation from silver iodide seeding.

However, the ranking of the ratios assumes implicitly that the average ratio is stable with time. Analysis of the data shows that this is not the case. For example, excluding 1966, three of the highest five ratios are 1961, 1964 and 1963.

Regression analysis of the ratio against time for the period 1925 to 1966 produced a highly significant correlation, the least squares equation being:

$$A = 0.549 + 0.00617 Y$$

$$r^2 = 0.256^{**}$$

$$n = 42$$

where A = Target to Control Area Ratio

Y = Year - 1900

$r^2$  = Coefficient of Determination

n = Number of years

\*\* = Significant at 0.01 level.

No meteorological rationale is offered for the relationship which indicates a relative increase over time of rainfall in a central area compared to neighbouring areas. The relationship could be due to chance, but this appears highly improbable. It is suggested tentatively that the observed trend may be the upward sector of a long-term cycle. Alternatively, land use differences may be a factor.

Based on the above upward trend, the expected value for 1966 is 0.956 with 95% symmetrical confidence limits of 0.680 to 1.232. The actual 1966-value of 1.045 lies well within this range, indicating that the 1966 ratio was not unusual.

The above calculation of confidence limits assumes that errors are approximately normally distributed and this is, in fact, the case. Ranking of the errors provides a further non-parametric test, independent of the form of the distribution of errors. There are 11 years with higher positive deviations from expected values than the 1966 deviation, indicating that such a value could easily have occurred by chance.

### 3. CONCLUSIONS

Acceptance of the above secular trend in the target to control area ratio invalidates Adderley's conclusion of a probable increase in precipitation in the target area from silver-iodide seeding.

Because of rainfall spatial variability, it is obvious that such operations should be conducted over several years if statistical conclusions are to be drawn. It may be desirable in future to analyse beforehand the probability of an operation statistically validating a range of possible conclusions for varying durations of operation.