HIGH-RESOLUTION MEASUREMENTS OF RAINFALL

JOHN GORDON HOSKING

Submitted in fulfilment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

University of Auckland December 1984

PLATE 1 Maritime Cumulonimbus, Abel Tasman National Park, New Zealand, February 1982.

ABSTRACT

A field system capable of making high-resolution measurements of rainfall is described. The system incorporates a disdrometer, an array of high-resolution raingauges, a general-purpose data acquisition system and ancillary equipment. In an evaluation of the disdrometer, a theory allowing calculation of the effects of windspeed on detection efficiency is presented which has wide applicability. The raingauges are an improved design allowing 10-s temporal resolution of rainfall intensity and 100 m spatial resolution of rain-patch size when used in the array.

An extensive data base of measurements made using the field system is described. Duration of rainfall is shown to be approximately log-normal and is consistent with a log-normal distribution of precipitation region size. The fractional duration of rainfall above a threshold intensity varies considerably between rain periods, a result which may be important for electromagnetic attenuation models. Estimation of the shapes of rain patches using the raingauge array is demonstrated and shows considerable promise.

Raindrop fallspeeds, measured using the disdrometer, generally show much less deviation from stagnant air terminal velocities than indicated by previously reported results. Much of the spread in the results is shown to be consistent with instrumentation errors although significant residual deviations are still apparent; the fallspeeds are generally slower than stagnant air values would suggest. Measurements of the arrival rate of raindrops at the disdrometer indicate clustering of drops rather than the often assumed Poisson distribution. The clustering is associated with small drops and has reasonable correlation with rainfall intensity. Examination of the cross-correlation of arrival rates of different sized drops show results in contradiction to previous results; small drops are found to lead other sized drops. Using a normalisation method, the shapes of raindrop size distributions measured are shown to be depressed in the mid-radius region.

DEDICATION

This thesis is dedicated to my father

LESLIE HOWARD HOSKING

(1917 - 1977)

"In framing an ideal we may assume what we wish, but should avoid impossibilities"

Aristotle.

ACKNOWLEDGEMENTS

There are many people who deserve thanks for their contributions to this thesis and I would particularly like to thank: my parents, for early encouragement of my academic pursuits; the Departments of Computer Science and Physics for financial assistance; the staff of the Physics Workshops for advice and assistance in hardware implementation; the New Zealand Meteorological Service, for supplementary data; Murray Johns, Gary Bold and Dave Ash, for the plotting subroutines and cross-assembler used; David Schwartz, Warren Gray and Kevin Paulson, for assistance with the field installation; Stuart Bradley, for much practical and theoretical advice.

Special thanks must be given to my supervisor, Dave Stow, for his vital encouragement throughout the duration of this project.

Finally I would like to thank my wife, Janne, for her continual patience and for the excellent job she has made of typing this thesis.

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