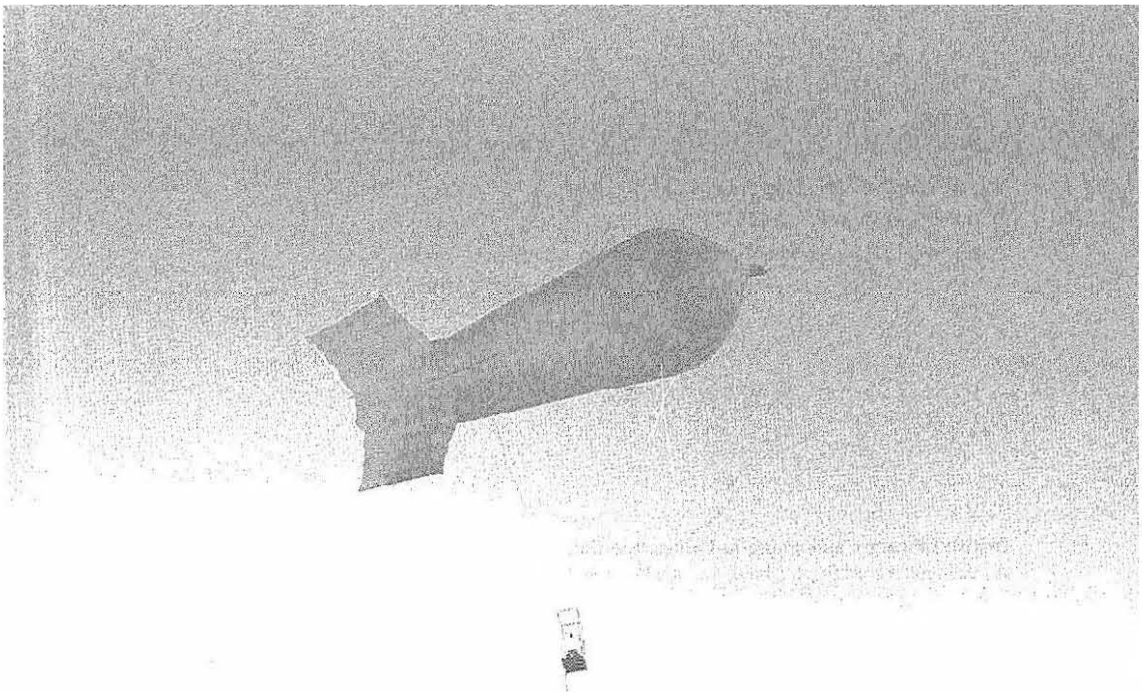

Physical Principles of Meteorology and Environmental Physics

Global, Synoptic and Micro Scales

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For Josephine and Robert John Robson

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Preface

Meteorology is generally regarded as a discipline in its own right and is normally taught at universities (if at all) separately from mainstream physics. In general the research literature is divided along similar lines, with some outstanding exceptions to this rule, e.g., Lorenz's 1963 paper in the Journal of the Atmospheric Sciences, which has provided a springboard for the burgeoning field of chaos and nonlinear dynamics. One of the goals of our book is to bring the two fields a little closer, for there has never been a better time to do so.

At the time of writing, the public debate over the global climate has reached a frenzied pitch with the release of the 4th Report of the Intergovernmental Panel on Climate Change (http://www.ipcc.ch/). Moreover, a widespread perception is that water, rather than oil or even terrorism, will be the other main global political issue of the century. Never has it been more important for the scientific community to provide the decision makers with objective and accurate information. Unfortunately the global climate models upon which the IPCC, economists, politicians and others rely to make their decisions, are by their very nature complex and opaque to all but the specialist few. This provides fertile ground for the global warming skeptics, and there is by no means general acceptance of anthropogenic warming, even among meteorologists and climatologists.

This book provides both theoretical and practical grounding in meteorology, with an emphasis on phenomena in the boundary layer, and aims at furnishing either a stand alone course or a firm platform for the reader to proceed with further study in one of the specialist areas, including global climate modeling. The theory component derives from a course of about 40 lectures given at the senior undergraduate and graduate level, and is of a standard comparable with the Australian Bureau of Meteorology's graduate training course for weather forecasters.

The main practical component concerns a research project measuring CO_2 exchange between the atmosphere and (a) native tropical rainforest and (b) introduced sugar cane in tropical north-eastern Australia. The aim here is to introduce the reader to experimental techniques and procedures, but there is a particularly important lesson to be learned from the results: during the peak growth phase, it is observed that sugar cane sequestrates more than three times as much carbon dioxide as does rainforest on an average daily basis! This result seems to contradict the widespread belief that clearing rainforest and replacing it with crops is self-evidently a bad thing, but of course one has to take many other factors into account. Whatever its implications for climate modeling might be, it only serves to reinforce our belief that unsubstantiated assumption is never a substitute for hard physics. That, in a nutshell spells out what this book is all about.

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