Desert Meteorology

Aridity prevails over more than one third of the land area of Earth, and over a significant fraction of the oceans as well. Yet to date there has been no comprehensive reference volume or textbook dealing with the weather processes that define the character of desert areas.

Desert Meteorology fills this gap by treating all aspects of desert weather, such as large-scale and local-scale causes of aridity, precipitation characteristics in deserts, dust storms, floods, climate change in deserts, precipitation processes, desertification, the land-surface physics of deserts, numerical modeling of desert atmospheres, and the effect of desert weather on humans. A summary is provided of the climates and surface properties of the desert areas of the world. The book is written with the assumption that the reader has only a basic knowledge of meteorology, physics, and calculus, making it useful to those in a wide range of disciplines. It includes review questions and problems for the student.

This comprehensive volume will satisfy all who need to know more about the weather and climate of arid lands. It will appeal especially to advanced students and researchers in environmental science, meteorology, physical geography, hydrology, and engineering.

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To my mother and father,
Dorothy and Tom,
who never lost faith,
and
to my wife Susan

"Water, thou hast no taste, no color, no odor; canst not be defined, art relished while ever mysterious. Not necessary to life, but rather life itself, thou fillest us with a gratification that exceeds the delight of the senses."

Antoine de Saint-Exupéry, *Wind, Sand and Stars* (1939)

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Preface

This book is intended as a text and as a reference book for students from a range of disciplines, not just the atmospheric sciences. However, it is expected that students will have had at least an introductory, undergraduate, non-technical course in weather. The equations will have to be interpreted by an instructor for those without preparation in physical sciences and mathematics with calculus. And the short refresher tutorials on various topics at the beginning of some chapters will likely be skipped by those with more rigorous backgrounds in atmospheric sciences. At the end of each chapter are lists of suggested general references for further reading, questions for review, and problems and exercises. The references represent a spectrum of difficulty levels; some are qualitative whereas others may be quite technically oriented. Students without a technical background will need to choose from the qualitative references, of which there are many. The review questions are provided as study aids. The technical discipline of each student, which has served as the motivation for studying this subject, will ultimately determine what material is most germane. Thus, the student and the instructor should add their own study questions to those provided. The problems and exercises are sometimes sufficiently challenging that background reading in other texts in atmospheric sciences may be required. A number of the problems require some mathematics, and these are most appropriate for students with such a background. Hints to solutions of some of the problems can be found at the back of the book.

Metric units will be used throughout the book. Exceptions are limited to providing near-surface temperatures in degrees Fahrenheit as well as Celsius. Technical words will often be printed in **bold** the first time that they are used in the text in order to emphasize that they are important and that their meaning should be remembered. If the bold words are not defined in the text or in a footnote, a brief definition will be found in the glossary in Appendix A. Also provided are lists of symbols employed and their meaning, abbreviations, and conversion factors

and physical constants (Appendixes B–D). Maps with national boundaries and country names are included in Appendix E to serve as a temporary substitute for a good world atlas, which should be available and consulted frequently. Most city names used in the text are located on the maps.

The fact that this is one of the only books exclusively devoted to desert meteorology has served as motivation for trying to make it useful to a broad audience, with both technical and non-technical backgrounds. It has also been the aim to provide as even a treatment as possible for all of the world's deserts, to make it uniformly useful to students and researchers worldwide. This aim has been occasionally compromised because many good studies of desert meteorology are not readily accessible to a Western author, especially when they are available in report form only. It is nevertheless hoped that subject-area omissions that have resulted from the unavailability of some literature are minor.

Throughout the book are inset boxes containing short informal presentations of special topics that generally relate in some way to the subjects treated in the text. The material is primarily of human interest, and is intended to provide the reader with light treatments of some subjects related to arid-land meteorology that do not fit within the more formal text presentations.

Even though it has been the primary aim to provide a complete technical treatment of the various aspects of desert meteorology, it is hoped that the reader also develops a subjective impression of the desert environment in terms of its spiritual effects on people, the importance of protecting it from further degradation, and the excitement associated with exploring and appreciating one of the few remaining frontiers on the planet.

To facilitate using this book as a text in desert meteorology, course materials are provided free of charge on the author's web site, which can be accessed through http://publishing.cambridge.org/resources/0521817986/. Included are Microsoft PowerPoint ® files that are used by the author in a desert meteorology course at the University of Colorado, Boulder.

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