Preface

The purpose of this book is to provide a foundation in the physical understanding of the earth's climate system. It is based on more than 20 years' experience teaching climate dynamics at Cornell University and, more recently, The University of Texas at Austin.

Most universities and colleges do not have a Department of Atmospheric Science, in which a technical course on climate dynamics would most likely be found. However, there is a pressing need to increase and promote an understanding of the climate system. Climate change will affect all fields of study and all professions in the coming decades, including the medical and engineering professions, and it will increasingly involve global political systems and economic planning. I wrote this book to support and broaden the teaching of climate dynamics.

The book assumes no background in atmospheric or ocean sciences and is written to be accessible for teaching by faculty in any field of science, mathematics, or engineering. The material is appropriate for any science or engineering undergraduate student who has completed two semesters of calculus and one semester of calculus-based physics. In combination with selected readings from the most recent Assessment Report of the Intergovernmental Panel on Climate Change, this book can be used to develop a course on contemporary climate change that emphasizes the physical understanding of the climate system.

The first section of the book (chapters 1–3) provides a description of the climate system based on observations of the mean climate state and its variability. It introduces the vocabulary of the field, the dependent variables that describe the climate system, and the typical approaches taken in displaying these variables. Taken together, chapters 2 and 3 form an atlas of the climate system, and figures from these chapters are referenced throughout the book.

The second section of the book (chapters 4–6) is aimed at developing a quantitative understanding of the processes that determine the climate

state—radiation, heat balances, and the basics of geophysical fluid dynamics. The fluid dynamics application is developed on the premise that the student is familiar with Newton's laws of motion and basic thermodynamics from a first course in college physics. With an understanding of the basic processes, applications for the atmosphere, ocean, and hydrologic cycle are developed in chapters 7–9. The last three chapters of the book, chapters 10–12, are more directly related to contemporary climate change.

Many people contributed to this book, directly and indirectly. My daughter, Hilary, and my son, Jeffrey, always keep life interesting, and I appreciate their love and support. I also thank my father, Robert Harrison, for many years of encouragement. Professor Peter Gierasch taught the class with me for a number of years at Cornell, and his clear-sighted treatment of the material is reflected especially in the chapters on radiation and ocean dynamics. Major contributions to creating and improving figures came from Dr. Edward Vizy, Zachary Launer, and I especially thank Meredith Brown, who also helped with technical editing. I am also grateful to Ingrid Gnerlich and her colleagues at Princeton University Press for their patience and persistence. The hundreds of students in my climate classes over the years inspired this book and influenced its contents through their insightful questions, eagerness to *really* understand, and their genuine concern for the future of the planet. I am grateful to them all.