Preface

This is a graduate-level introductory overview of the global circulation of the atmosphere, a subject closely tied to atmospheric dynamics. A course on dynamics tends to focus on basic physical concepts and methods for their analysis, however, while *a course on the global circulation must focus on what the atmosphere actually does, and why*.

Graduate-level studies in atmospheric dynamics are an essential prerequisite for reading this book. It is assumed that the reader is familiar with basic concepts of atmospheric dynamics such as the equation of motion, the approximate hydrostatic and geostrophic balances, potential temperature, vorticity, pressure coordinates, and planetary waves. More advanced dynamical concepts are introduced as needed. Chapter 4, in particular, gives a brief but fairly detailed overview of the concepts used throughout the book. Some instructors may choose to refer to chapter 4 only as needed to explain concepts used in the later chapters.

It is difficult to draw a line between the global circulation and climate. The two subjects are growing closer together as the roles of heating and dissipation in the global circulation emerge as key issues. Such topics as monsoons, the hydrologic cycle, and the planetary energy budget can be included under either "climate" or "global circulation," although perhaps with different slants. Climate is the bigger subject. This book skirts the edges of physical climatology.

Our understanding of the global circulation has advanced enormously in recent decades, and the subject is rapidly becoming both broader and deeper. There is far too much to cover in one book, so I have had to make choices. Several parts of the book stress the role of cloud systems and other small-scale processes in the global circulation. Isentropic coordinates are used extensively, and energetics are discussed in some detail. There is a chapter on the global circulation as turbulence, including an extended discussion of predictability.

I have chosen to discuss many of the topics in terms of their original sources, rather than the latest papers. This quasi-historical approach gives credit to the pioneers of our field and highlights the human aspects of the research.

Some of the end-of-chapter problems involve working with observations. The Internet has made it unnecessary to include the data with the book. Many of the figures in this book utilized the Interim Reanalysis of the European Centre for Medium Range Weather Forecasts, which is one suitable source of global atmospheric data for use with the problems, although there are many others.

This book is based on classes I have taught at Colorado State University over the past 26 years. Mike Kelly, Cara-Lyn Lappen, Katherine Harris, Stefan Tulich, Anning Cheng, Mike Toy, Kyle Wiens, Cristiana Stan, Jason Furtado, Maike Ahlgrim, Luke Van Roekel, Levi Silvers, and Matt Masarik performed superbly as teaching assistants for the course, and both the students and I learned as a result of their efforts. Mick Christi, Kate Musgrave, and Kevin Mallen pointed out numerous typos and other errors in the text. The many students who have taken the course over the years asked questions and made suggestions that taught me a lot.

Thomas Birner, Charlotte DeMott, Scott Denning, Celal Konor, and Wayne Schubert of Colorado State University commented on drafts of various chapters and helped me decide what to keep in and what to leave out. George Kiladis of NOAA's Earth System Research Laboratory and Richard Somerville of the Scripps Institution for Oceanography also made valuable suggestions. Any and all errors are my responsibility.

Mark Branson and Don Dazlich ably produced many of the figures. I could not have finished without their help. Mark in particular endured a multiweek crunch as the book neared completion.

Michelle Beckman and Valerie Hisam helped with early versions of the manuscript. Connie Hale helped to obtain permission to use various figures taken from the literature.

Princeton University Press (PUP) has been a pleasure to work with. I am especially grateful to Ingrid Gnerlich for her encouragement, patience, and advice. She recruited four readers who contributed valuable reviews of a preliminary draft of the book. One of them, in particular, wrote a lengthy and detailed set of extremely helpful comments. Karen Fortgang and Karen Carter of PUP efficiently managed production of the book. Barbara Liguori improved the manuscript through an impressive job of copyediting.

Finally, I thank my wife, Mary Kay, for patiently cheering me on as I wrestled this project to the ground. She read several of the chapters, asked thoughtful questions, and enjoyed finding some of my mistakes.