

Contents

Part I Equations of Motion and Basic Ideas on Discretizations

- 1 Some Basic Dynamics Relevant to the Design of Atmospheric Model Dynamical Cores 3**
John Thuburn
- 2 Waves, Hyperbolicity and Characteristics 29**
Joseph Tribbia and Roger Temam
- 3 Horizontal Discretizations: Some Basic Ideas 43**
John Thuburn
- 4 Vertical Discretizations: Some Basic Ideas 59**
John Thuburn
- 5 Time Discretization: Some Basic Approaches 75**
Dale R. Durran
- 6 Stabilizing Fast Waves 105**
Dale R. Durran

Part II Conservation Laws, Finite-Volume Methods, Remapping Techniques and Spherical Grids

- 7 Momentum, Vorticity and Transport: Considerations in the Design of a Finite-Volume Dynamical Core 143**
Todd D. Ringler
- 8 Atmospheric Transport Schemes: Desirable Properties and a Semi-Lagrangian View on Finite-Volume Discretizations 185**
Peter H. Lauritzen, Paul A. Ullrich, and Ramachandran D. Nair

| | | |
|--|--|------------|
| 9 | Emerging Numerical Methods for Atmospheric Modeling | 251 |
| | Ramachandran D. Nair, Michael N. Levy, and Peter H. Lauritzen | |
| 10 | Voronoi Tessellations and Their Application to Climate and Global Modeling | 313 |
| | Lili Ju, Todd Ringler, and Max Gunzburger | |
| Part III Practical Considerations for Dynamical Cores in Weather and Climate Models | | |
| 11 | Conservation in Dynamical Cores: What, How and Why? | 345 |
| | John Thuburn | |
| 12 | Conservation of Mass and Energy for the Moist Atmospheric Primitive Equations on Unstructured Grids | 357 |
| | Mark A. Taylor | |
| 13 | The Pros and Cons of Diffusion, Filters and Fixers in Atmospheric General Circulation Models | 381 |
| | Christiane Jablonowski and David L. Williamson | |
| 14 | Kinetic Energy Spectra and Model Filters | 495 |
| | William C. Skamarock | |
| 15 | A Perspective on the Role of the Dynamical Core in the Development of Weather and Climate Models | 513 |
| | Richard B. Rood | |
| 16 | Refactoring Scientific Applications for Massive Parallelism | 539 |
| | John M. Dennis and Richard D. Loft | |