situation first and building up to difficult ones later, I know there is a case to be made for presenting a fuller picture from the beginning.

Chapter 1 starts with some very basic material but also includes some sophisticated ideas about fluids and the stress tensor. I think it is confusing to introduce the dyadic notation as well as tensor notation – dyadic notation is not now in common use and is only referred to again fleetingly in Chapter 3. The problems at the end of the chapter are demanding, requiring both physical insight and good manipulative skills.

The Navier–Stokes equations are then derived in three stages. First, the principles of conservation of mass and momentum are introduced and the idea of vorticity is explored thoroughly. Examples and problems at this stage involve global balances and a thorough knowledge of engineering principles is assumed. Then the partial differential equations of fluid flow are derived and, after a digression into fluid in static equilibrium, the constitutive equations are introduced and the Navier–Stokes equation derived.

There is a tendency throughout the early part of the book to produce long lists of definitions and models (e.g. special fluids in Chapter 2, constitutive relations in Chapter 5), but nowhere is it *explained* what the essential assumptions are that lead to the Navier–Stokes equations. One is left with a sense of endless possibilities without being given either physical or mathematical reasons for the course pursued.

The second half of the book (Chapters 6–10) concentrates on applications. These are divided into exact solutions of the Navier–Stokes equations, boundary layers, nearly unidirectional flow (including lubrication) and creeping flows. While each chapter is clear and self-contained, there is a certain disconnectedness and unevenness in presentation which is unfortunate. This is most marked in the boundary layer theory in Chapter 8 which is extremely old-fashioned (note the dates of the references in this chapter) and does not properly exploit the perturbation theory which has been presented in Chapter 7.

The book is clearly written and will probably be most useful as a reference book for both students and teachers. Throughout the book there are summaries and tables of useful formulae and fluid properties, and there are a plethora of worked examples. For a teacher of a practically-oriented course on fluid dynamics, it will provide a rich source of problems and useful references.

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Numerical Methods for Wave Equations in Geophysical Fluid Dynamics by Dale R. Durran (Springer-Verlag Inc., New York, 1999, 465 pp.) DM 98; US$ 49.95 hardcover ISBN 0-387-98376-7

It rarely happens that an urgently required book appears at the right moment. In our group, we were discussing the design of a numerical model for atmospheric boundary layer flow. The main point was to decide what set of approximated equations should be solved and what schemes are to be used. Discussing these issues, Dale Durran's book helped us not only to clarify definitions and terminology but it provided excellent tools for illustrating the properties of different numerical approaches. It is the attraction of this book that it gives easy access to standard and advanced numerical techniques and illustrates all these by numerous examples and exercises. Dale Durran has achieved this by an exact and concise presentation of his material and by dropping lengthy mathematical proofs. For this reason, the anticipated readership of scientists working in atmospheric and oceanic dynamics certainly extends to all modellers in computational fluid dynamics.

The book is divided into eight chapters. The *Introduction* starts with rather dry basics about classification of partial differential equations (PDEs). Advanced readers may recognize that they have read this in better form somewhere else, but a consistent terminology is necessary as a starting point. Conducted by the interest in applying numerical methods, the reader will find the following sections about PDEs that frequently occur in geophysical fluid dynamics, about their filtering and strategies for numerical approximation more advantageous. The second chapter comprehends *Basic Finite-Difference Methods* starting with accuracy, consistency, stability and convergence issues and summarizes standards of time and space differencing. Here, Durran's strategy is to introduce and to discuss the mentioned topics by means of the one-dimensional advection equation. In *Beyond the One-Way Wave Equation*, he turns to systems of equations with three or more independent variables and discusses numerical properties including non-linear instability of various discretisations of classical problems as Burger's equation and the barotrapic vorticity equation. The following two chapters (*Series-Expansion Methods* and *Finite Volume Methods*) deal with spectral, pseudospectral, finite-element and finite volume methods often applied in geophysical computational dynamics. These chapters give a brilliant overview and incorporate recent publications. *Semi-Lagrangian Methods* are an attractive alternative to classical Eulerian methods. The sixth chapter provides orientation under which circumstances the respective scheme becomes superior. Chapter 7, *Physically Insignificant Fast Waves* deals with the problems that atmospheric modellers are rarely interested in: sound waves. The different methods (including solving the Poisson or Helmholtz equations) how to filter these fast waves out of the equations are described. As the solution of elliptic boundary value problems is not the topic of this book, the interested reader will find a concise overview, useful references and web sites with numerical libraries. The chapter *Nonreflecting Boundary Conditions* is especially important for atmospheric physicists as they only have one solid boundary, the surface ground for numerical schemes. For example, simulating the flow over a mountain ridge or the development of a daytime boundary layer one must prescribe the physics at the lateral and upper boundaries. It is obvious that there is no straightforward answer which method gives the best results in terms of non-reflecting information back into the numerical domain, but the standard techniques are described.

Most of the chapters conclude in a short summary of the respective material. Problems and exercises that stimulate to improve one's skill in applying truncation error analysis or writing simple codes testing numerical schemes and methods complete each chapter. The internet site http://www.atmos.washington.edu/methods.for.waves/ provides an overview about the detailed content of this book and updates errata. Furthermore, it contains a link to Springer; thus, you can order this book immediately!

Altogether, I profited a lot from this book and it was great pleasure to study this text, to solve the exercises and to write some test FORTRAN programmes. I recommend to every modeller who wants to know a little more about the operation of the 'engine' in their numerical vehicles that he puts this book as close as possible to his working desk.

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