

BOOK REVIEWS

Stochastic Modelling in Physical Oceanography. Edited by R. J. ADLER, P. MÜLLER & B. L. ROZOVSKII. BIRKHÄUSER, 1996. 470 pp. ISBN 3-7643-3798-2. DM148.

This is a collection of papers which – in the words of the editors – can roughly be characterized into three groups: mathematical analysis of models that arise from, or are somehow related to, physical oceanography; expositions by oceanographers of phenomena and models that they are working with today or would like to see developed in the future; and the true interdisciplinary papers, where the borders between the two disciplines and approaches become blurred. However, the editors leave it to the reader to make his own classification.

Following in part the above classification the first group contains the following papers: 1. Particle displacements in inhomogeneous turbulence, by Andrew F. Bennet, pp. 1–45; 2. Massively parallel simulations of motions in a Gaussian velocity field, by René Carmona, Stanislav A. Grishin, & Stanislav A. Molchanov, pp. 47–68; 3. Stochastic modelling of turbulent flows, by J. R. Herring, pp. 185–205; 4. Short-time correlation approximations for diffusing tracers in random velocity fields: a functional approach, by V. I. Klyatskin, W. A. Woyczynski & D. Gurarie, pp. 221–269; 5. Particles, vortex dynamics and stochastic partial differential equations, by Peter Kotelenez, pp. 271–294.

The above papers deal mostly with basic aspects of fluid particle kinematics and conserved scalars in some prescribed random velocity fields (both Gaussian and non-Gaussian), some including the influence of the mean flow. Some dynamical aspects are discussed in the paper by Herring, in which the nonlinear terms are modelled as a random stirring and eddy viscosity, and in the paper by Kotelenez, in which special emphasis is given to the vorticity distribution in two-dimensional fluid flows. An important feature is that considerable attention is given to non-Gaussian aspects, though still too much ‘Gaussianity’ remains in use in spite of the fact that turbulent flows are strongly non-Gaussian with some Gaussian-like features: turbulence is such a rich phenomenon that it can ‘afford’ many near-Gaussian manifestations being essentially non-Gaussian.

The following four papers dealing with similar issues are also of a distinctly basic nature, with the emphasis on Lagrangian chaos in inhomogeneous flows in the papers by Samelson and Yang and a review of some recent results on the relation between Lagrangian and Eulerian statistics in the paper by Molchanov: 6. Maximum likelihood estimators in the equations of physical oceanography, by L. Piterbarg & B. Rozovskii, pp. 397–421; 7. Chaotic transport by mesoscale motions, by R. M. Samelson, pp. 423–438; 8. Chaotic transport and mixing by ocean gyre circulation, by Huijun Yang, pp. 440–466; 9. Topics in statistical oceanography, by S. Molchanov, pp. 342–380.

The third group is oriented more specifically to oceanographic issues: 10. A statistical approach to ocean model testing and tuning, by Claude Frankignoul, pp. 89–112; 11. Applications of stochastic particle models to oceanographic problems, by Annalisa Griffa, pp. 113–140; 12. Sound through the internal wave field, by Frank S. Henyey & Charles Macaskill, pp. 141–184; 13. Neptune effect: statistical-mechanical forcing of ocean circulation, by Greg Holloway, pp. 207–219; 14. Feature and contour based data analysis and assimilation in physical oceanography, by Arthur J. Mariano &

Toshio M. Chin, pp. 311–342; 15. Stochastic forcing of quasi-geostrophic eddies, by Peter Müller, pp. 381–395.

Finally, two papers are of more technical nature: 16. Comparison tests for the spectra of dependent multivariate time series, by René Carmona & Andrea Wang, pp. 69–88; 17. Non-Gaussian autoregressive sequences and random fields, by Keh-Shin Lii & Murray Rosenblatt, pp. 295–309.

Most of the papers in this collection present very useful up-to-date reviews of their subjects, e.g. those by Bennet, Henyey & Macaskill, Herring, Klyatskin Molchanov, Yang, thereby making this oceanographically oriented collection useful for a much broader audience.

A. TSINOBER

Level Set Methods. By J. A. SETHIAN. Cambridge University Press, 1996. 218 pp. ISBN 052187202 9. £27.95

At first sight, the idea of representing an interface as a level set of a function looks a retrograde step, because it is a vastly redundant description. Nevertheless, the author makes a convincing case that the level set representation has many advantages. In particular, it avoids the problem of self-intersection and allows for change in topology. Also it can be implemented with relatively little redundancy by concentrating around the desired level set the resolution with which the function is represented.

The book is principally about how to compute the evolution of interfaces numerically, using representation as level sets. There is a lot of freedom in how to evolve a function consistently with given motion of its zero set, but two choices are described here. The first is the ‘level set equation’ in which the law governing the normal velocity of the interface is extended to all level sets of the function by an advective equation. The second, for the special case of monotonically moving fronts, is to determine a single function such that the interface at time t is the level set with value t . Various pitfalls and clever tricks are described.

A wide range of applications is presented, ranging from generation of grids for the exterior of unusually shaped bodies and character recognition to flame dynamics and simulation of etching in microchip fabrication.

I enjoyed reading the book and recommend it to anyone interested in propagating interfaces numerically.

R. S. MACKAY