

**Praise for the Second Edition**

"The Great Book of the field, and it will remain so for a generation or longer. ... the reader is privileged to receive a unified presentation from a master scientific writer whose pedagogy is unmatched in the discipline. This book is a truly grand achievement. It will be well used by fluid dynamicists, oceanographers, atmospheric scientists, applied mathematicians, and physicists for decades to come."

*Stephen M. Griffies, Geophysical Fluid Dynamics Laboratory and Princeton University*

"... the book I use for my class, the book I recommend to incoming graduate students (no matter their background), and the book I go to first when I need clarity on GFD topics. The first edition has been my go-to text since it was first published, and there is no doubt that the second edition will become as dog-eared."

*Elizabeth A. Barnes, Colorado State University*

"... an exceptionally valuable introduction to the dynamical theory of the large-scale circulation of the atmosphere and ocean ... This second edition is a further major achievement by the author ... an exceptionally valuable resource for those designing advanced-level courses, for the students taking those courses and for researchers."

*Peter Haynes, University of Cambridge*

"For good reason, the first edition is now the standard text for courses in oceanography, and it will clearly continue with this edition, helping all of us, not just students, to clarify our understanding of this field."

*Trevor J. McDougall, University of New South Wales*

"Vallis writes explanations as clear as tropical ocean waters, bringing fresh new light to complex concepts. This expanded text will be immediately useful both for graduate students and seasoned researchers in the field."

*Dargan M. W. Frierson, University of Washington*

 **Online Resources**  
[www.cambridge.org/vallis2](http://www.cambridge.org/vallis2)

 All figures from the book

 Link to the author's website, with student exercises and solutions

**From reviews of the First Edition**

"... extremely helpful to introduce the issues of fluid dynamics to students ... I would be happy to see this wonderful textbook on as many desks of our community as possible."

*Meteorologische Zeitschrift*

"... sure to grace the shelves of libraries and ... individuals for many years to come, both as a reference and a tutorial text."

*Quarterly Journal of the Royal Meteorological Society*

"... highly recommended textbook."

*Physik Journal*

The atmosphere and ocean are two of the most important components of the climate system, and fluid dynamics is central to our understanding of both. This book provides a unified and comprehensive treatment of the field that blends classical results with modern interpretations. Suitable for advanced undergraduate and graduate students, as well as established scientists, the book takes the reader seamlessly from the basics to the frontiers of knowledge, from the equations of motion to modern theories of the general circulation of the atmosphere and ocean. These concepts are illustrated throughout the book with observations and numerical examples. As well as updating and revising existing chapters, this second edition includes new chapters on tropical dynamics, El Niño, the stratosphere and gravity waves. It is now also illustrated with colour figures throughout. Supplementary resources are provided online, including figures from the book and problem sets, making this new edition an ideal resource for students in the atmospheric, oceanic and climate sciences. It will also be of interest to students in applied mathematics and engineering.

# Atmospheric and Oceanic Fluid Dynamics

VALLIS

Second Edition

# Atmospheric and Oceanic Fluid Dynamics

Fundamentals and Large-Scale Circulation

Second Edition

GEOFFREY K. VALLIS

Cover illustration: To the southeast of the Rio de la Plata – flanked by the grayish human population centers of Buenos Aires and Montevideo – float much larger populations of phytoplankton borne along by the currents and eddies of this dynamic region of the southwestern Atlantic Ocean. Image courtesy of Norman Kuring, NASA Ocean Biology Processing Group.

Cover designed by Hart McLeod Ltd

CAMBRIDGE  
UNIVERSITY PRESS  
[www.cambridge.org](http://www.cambridge.org)

ISBN 978-1-107-06550-5



CAMBRIDGE