

Atmospheric and Oceanic Fluid Dynamics

Fundamentals and Large-Scale Circulation

Second Edition

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. It 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 existing chapters, this second, full-colour edition includes new chapters on tropical dynamics, El Niño, the stratosphere and gravity waves. Supplementary resources are provided online, including figures from the book and problem sets, making this new edition an ideal resource for students and scientists in the atmospheric, oceanic and climate sciences, as well as in applied mathematics and engineering.

Geoffrey K. Vallis is a professor of applied mathematics at the University of Exeter, UK. Prior to taking up his position there, he taught for many years at Princeton University in the USA. He has carried out research in the atmospheric sciences, oceanography and the planetary sciences, and has published over 100 peer-reviewed journal articles. He is the recipient of various prizes and awards, including the Adrian Gill Prize (Royal Meteorological Society) in 2014, and the Stanislaw M. Ulam Distinguished Scholar award (Los Alamos National Laboratory) in 2013.

“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*

“In 2006, Vallis’ first edition of AOFD offered the atmospheric and oceanic sciences community a truly great book, marking a milestone in our discipline. Well, Vallis has done it again! This second edition of AOFD represents the pinnacle of a maturing discipline. It is **The Great Book** of the field, and it will remain so for a generation or longer. AOFD-2 dives deep into atmospheric and oceanic fluid dynamics, spanning a wealth of topics while offering the reader lucid, pedagogical, and thorough presentations across a universe of knowledge. There are really three books here: one focused on geophysical fluid dynamic fundamentals; a second on atmospheric dynamics; and a third on oceanic dynamics. Each part offers new material relative to the first edition, as well as the reworking of earlier presentations to enhance pedagogy and update understanding based on recent research. . . . 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. Each sentence, paragraph, section, chapter, and figure, are thoughtful and erudite, providing the reader with insights and rigor needed to truly capture the physical and mathematical essence of each topic.”

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

“Vallis speaks my language. He successfully weaves together fundamental theory, physical intuition, and observed phenomena to tell the story of geophysical fluid behavior at local and global scales. This multi-pronged approach makes this an ideal text for both beginners and experts alike - there is something for everyone. This is why it is 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 of this book has been my go-to text since it was first published . . . With the new edition, we now get an even more comprehensive view of how the fundamental processes that dictate the evolution of our atmosphere and oceans drive the complex phenomena we observe.”

Elizabeth A. Barnes, *Colorado State University*

“The first edition . . . provided 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 . . . It includes significant new material on the atmosphere and on the ocean, presented in two separate later sections of the book, but building carefully and clearly on the ‘unified’ material in the first part of the book . . . The second edition will be an exceptionally valuable resource for those designing advanced-level courses, for the students taking those courses and for researchers, many of whom will surely be stimulated by the clear presentation of existing theory to identify what such theory does not explain and where progress is needed.”

Peter Haynes, *University of Cambridge*

“This second edition is even more comprehensive than the first. It now covers subjects such as the derivation of the first law of thermodynamics, the fundamental physics involved in the meridional overturning of the ocean, and equatorial oceanography. The book concentrates on the fundamentals of each subject, with sufficient motivation to make the exposition clear. For good reason, the first edition is now the standard text for courses in oceanography, and this will clearly continue with this second edition, helping all of us, not just students, to clarify our understanding of this field.”

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

“Researchers looking for an informative and coherent treatment of the dynamics of the atmosphere and ocean, starting at a fundamental level, and proceeding to advanced topics, will find that this book is a truly superb resource. The book is particularly notable for its even-handed treatment of the ocean and the atmosphere and its synthetic discussion of observations, numerics and analytic methods.”

William R. Young, *Scripps Institution of Oceanography*

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