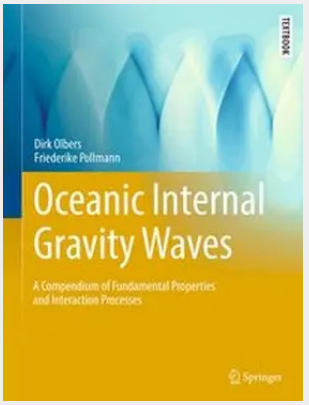
Olbers / Pollmann

# Oceanic Internal Gravity Waves

A Compendium of Fundamental Properties and Interaction Processes




Oceanic Internal Gravity Waves is a comprehensive introduction to the theory of a particular kind of wave motion: internal gravity waves, which occur in the interior of stratified fluids under the presence of rotation. In the ocean, internal gravity waves affect signal propagation and, through the mixing they create upon breaking, nutrient availability and even the energetics of the large-scale overturning circulation. To formulate an energetically consistent description of these scale-bridging connections and their role in ocean and climate dynamics, a thorough understanding of how internal wave energy is created, changed and dissipated is mandatory. To this end we present a concise mathematical framework of linear waves and their propagation and refraction properties. We go on to extensively discuss the statistical and dynamical description of a random ensemble of waves, their sources and interactions with larger-scale motions, and the interactions among the waves themselves. The book is structured in nine parts, each starting with elementary considerations and blending then classical topics with more advanced developments of fluid mechanics and theoretical oceanography. All concepts and equations are derived in detail and illustrated by numerous figures and applications. Two chapters summarize the theoretical considerations about the various interaction processes and give an overview of their role in the global wave climate. The final chapters describe recent scientific efforts to globally quantify internal wave generation, interactions, and dissipation and to develop, in combination with the theoretical foundations laid out in earlier chapters, an energy-constrained parameterization of wave-driven mixing for ocean general circulation models. An appendix provides short excursions into the mathematical background, such as vector analysis, differential equations, and the handling of random fields. The book is written on the physical and mathematical level of graduate students in programs of theoretical physical oceanography, meteorology and physics. Most of the problems discussed in this book are treated by analytical means. An extensive bibliography, detailed side notes and recommendations for further reference make this volume also a useful reading for researchers working in other fields of oceanography.

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**235,39 €**
219,99 € (zzgl. MwSt.)

*vorbestellbar, Erscheinungstermin ca. Februar 2027*

**Artikelnummer:** 9783032400680
**Medium:** Buch
**ISBN:** 978-3-032-40068-0
**Verlag:** Springer
**Erscheinungstermin:** 24.02.2027
**Sprache(n):** Englisch
**Auflage:** Erscheinungsjahr 2027
**Serie:** Springer Textbooks in Earth Sciences, Geography and Environment
**Produktform:** Gebunden
**Seiten:** 717
**Format (B x H):** 210 x 279 mm



**Kundenservice Verlag Dr. Otto Schmidt KG**
Neumannstraße 10, 40235 Düsseldorf | kundenservice@otto-schmidt.de | 0221-93738-997 (Inland)