THE INTERACTION OF OCEAN WAVES AND WIND

The Interaction of Ocean Waves and Wind is the first book to describe in detail the two-way interaction between wind and ocean waves and shows how ocean waves affect weather forecasting on time scales of 5 to 90 days.

Winds generate ocean waves, but at the same time airflow is modified due to the loss of energy and momentum to the waves; thus, momentum loss from the atmosphere to the ocean depends on the state of the waves. This volume discusses ocean-wave evolution according to the energy balance equation, which describes the rate of wave-spectrum change by advection and by physical processes such as wind input, dissipation and nonlinear interactions. An extensive overview of nonlinear transfer is given, and as a by-product the role of four-wave interactions in the generation of extreme events, such as freak waves, is discussed. Effects on ocean circulation are described. Coupled ocean-wave–atmosphere modelling gives improved weather and wave forecasts.

This volume will interest ocean-wave modellers, physicists and applied mathematicians, and engineers interested in shipping and coastal protection.

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Preface

This is a book about ocean waves, their evolution and their interaction with the environment. It presents a summary and unification of my knowledge of wave growth, nonlinear interactions and dissipation of surface gravity waves, and this knowledge is applied to the problem of the two-way interaction of wind and waves, with consequences for atmosphere and ocean circulation.

The material of this book is, apart from my own contributions, based on a number of sources, ranging from the works of Whitham and Phillips to the most recent authoritative overview in the field of ocean waves, namely the work written by the WAM group, *Dynamics and Modelling of Ocean Waves*. Nevertheless, the present book is limited in its scope because it will hardly address interesting issues such as the assimilation of observations, the interpretation of satellite measurements from, for example, the radar altimeter, the scatterometer and the synthetic-aperture radar, nor will it address shallow-water effects. These are important issues but I felt that the reader would be served more adequately by concentrating on a limited number of subjects, emphasizing the role of ocean waves in practical applications such as wave forecasting and illuminating their role in the air–sea momentum exchange.

I started working on this book some 8 years ago. It would never have been finished had it not been for the continuous support of my wife Danielle Mérelle. Her confidence in my ability to complete this work far exceeded my own. I thank my parents, Aloysius Janssen and Rosa Burggrave, for supporting me to follow a university education. I am indebted to my Ph.D. advisor Martin Weenink and L. J. F. Broer for their introduction into the field of nonlinear physics. Also, it is a pleasure to acknowledge the contributions of P. G. Saffman and G. B. Whitham to my education in ocean waves. Things really started to happen when I joined the WAve Model (WAM) group. Most of the members of the WAM group thought that this was a unique opportunity for collaboration, and we had the time of our lives. I would like to thank Gerbrand Komen, Klaus and Susanne Hasselmann, Mark Donelan and Luigi Cavaleri for all the fruitful discussions and the collaborations. Furthermore, I would

like to thank Luciana Bertotti, Heinz Günther, Anne Guillaume, Piero Lionello and Liana Zambresky for sharing the burden of the development of a beautiful piece of software, and for all the fun we had.

Last, but not least, I would like to thank Pedro Viterbo and Jim Doyle for disentangling all the intricacies involved in the actual coupling of an atmospheric model and an ocean-wave prediction system. The former and present members of ECMWF's ocean-wave team, Jean Bidlot, Björn Hansen, Saleh Abdalla, Hans Hersbach and Øyvind Saetra are thanked for their dedicated efforts to further develop the WAM model software, while support by Lennart Bengtsson, David Burridge, Anthony Hollingsworth, Adrian Simmons and, in particular, Martin Miller is much appreciated.

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