Preface

INTAS has been an international association for the promotion of collaboration between scientists from the European Union, Island, Norway, and Switzerland (INTAS countries) and scientists from the new independent countries of the former Soviet Union (NUS countries). The program was founded in 1993, existed until 31 December 2006 and is since 01 January 2007 in liquidation. Its goal was the furthering of multilateral partnerships between research units, universities, and industries in the NUS and the INTAS member countries. In the year 2003, on the suggestion of Dr. V. Vlasenko, the writer initiated a research project on "Strongly nonlinear internal waves in lakes: generation, transformation and meromixis" (Ref. Nr. INTAS 033-51-3728) with the following partners:

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Prof. Dr. E. Pelinovsky, Institute of Applied Physics, Laboratory of Hydrophysics, Russia, Academy of Sciences, Nizhni Novgorod, Russia

Prof. Dr. N. Filatov, Northern Water Problems Institute, Karelian Scientific Centre, Russian Academy of Sciences, Petrozavodsk, Russia

Prof. Dr. V. Maderich, Institute of Mathematical Machines and System Modeling, Ukrainian Academy of Sciences, Kiev, Ukraine

Prof. Dr. V. Nikishov, Institute of Hydrodynamics, Department of Vortex Motion, Ukrainian Academy of Sciences, Kiev, Ukraine

The joint proposal was granted with commencement on 01 March 2004 and it lasted until 28 February 2007. The writer was research and management coordinator; annual reports were submitted.

The final report, listing the administrative and scientific activities, submitted to the INTAS authorities quickly passed their scrutiny; however, it was nevertheless decided to collect the achieved results in a book and to extend and complement the

results obtained at that time with additional findings obtained during the 4 years after termination of the INTAS project. Publication in the Springer Verlag series "Advances in Geophysical and Environmental Mechanics and Mathematics" was arranged. The writer served as Editor of the book, now entitled "Nonlinear Internal Waves in Lakes" for brevity. The contributions of the six partners mentioned above were collected into four chapters. Unfortunately, even though a full chapter on the theories of weakly nonlinear waves was planned, Professor E. Pelinovsky, a world-renowned expert in this topic, withdrew his early participation. The remaining chapters contain elements of it, and the referenced literature makes an attempt of partial compensation. Strongly nonlinear waves are adequately covered in Chap.4. Writing of the individual chapters was primarily done by the four remaining groups; all chapters were thoroughly reviewed and criticized professionally and linguistically, sometimes with several iterations. We hope the text is now acceptable.

Internal waves and oscillations (seiches) in lakes are important ingredients of lake hydrodynamics. A large and detailed treatise on "Physics of Lakes" has recently been published by Hutter et al. [1, 2]. Its second volume with the subtitle "Lakes as Oscillators" deals with *linear* wave motions in homogeneous and stratified waters, but only little regarding *nonlinear* waves is treated in these books. The present book on "Nonlinear Internal Waves in Lakes" can well serve as a complementary book of this treatise on topics which were put aside in [1, 2].

Indeed, internal wave dynamics in lakes (and oceans) is an important physical component of geophysical fluid mechanics of 'quiescent' water bodies of the globe. The formation of internal waves requires seasonal stratification of the water bodies and *generation* by (primarily) wind forces. Because they propagate in basins of variable depth, a generated wave field often experiences *transformation* from large basin-wide scales to smaller scales. As long as this fission is hydrodynamically stable, nothing dramatic will happen. However, if vertical density gradients and shearing of the horizontal currents in the metalimnion combine to a Richardson number sufficiently small ($< ¼$), the light epilimnion water mixes with the water of the hypolimnion, giving rise to vertical diffusion of substances into lower depths. This *meromixis* is chiefly responsible for the ventilation of the deeper waters and the homogenization of the water through the lake depth. These processes are mainly formed because of the physical conditions, but they play biologically an important role in the trophicational state of the lake.

- Chapter 1 on *Internal waves in lakes: Generation, transformation, meromixis – an attempt of a historical perspective* gives a brief overview of the subjects treated in Chaps.2–4. Since brief abstracts are provided at the beginning of each chapter, we restrict ourselves here to state only slightly more than the headings.
- Chapter 2 is an almanac of *Field studies of nonlinear internal waves in lakes on the Globe*. An up-to-date collection of nonlinear internal dynamics is given from a viewpoint of field observation.
- Chapter 3 presents exclusively *Laboratory modeling of transformation of large-amplitude internal waves by topographic obstructions*. Clearly defined driving mechanisms are used as input so that responses are well identifiable.

- Chapter 4 presents *Numerical simulations of the non-hydrostatic transformation of basin-scale internal gravity waves and wave-enhanced meromixis in lakes*. It rounds off the process from generation over transformation to meromixis and provides an explanation of the latter.

As coordinating author and editor of this volume of AGEM^2, the writer thanks all authors of the individual chapters for their patience in co-operating in the process of various iterations of the drafted manuscript. He believes that a respectable book has been generated; let us hope that sales will corroborate this.

It is our wish to thank Springer Verlag in general and Dr. Chris Bendall and Mrs. Agata Oelschläger, in particular, for their efforts to cope with us and to do everything possible in the production stage of this book, which made this last iteration easy.

Finally, the authors acknowledge the support of their home institutions and extend their thanks to the INTAS authorities during the 3 years (2004–2007) of support through INTAS Grant 3-51-3728.

For all authors,
Zurich, Switzerland K. Hutter

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