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Nota di contenuto	Introduction.- Introduction to Mapping and Neural Networks -- Mapping Examples -- Some Generic Properties of Mappings -- MLP NN – A Generic Tool for Modeling Nonlinear Mappings -- Advantages and Limitations of the NN TechniqueNN Emulations -- Final remarks -- Atmospheric and Oceanic Remote Sensing Applications -- Deriving Geophysical Parameters from Satellite Measurements: Conventional Retrievals and Variational Retrievals -- NNs for Emulating Forward Models -- NNs for Solving Inverse Problems: NNs Emulating Retrieval Algorithms.-Controlling the NN Generalization and Quality Control of Retrievals -- Neural Network Emulations for SSM/I Data -- Using NNs to Go Beyond the Standard Retrieval Paradigm -- Discussion.- Applications of NNs to Developing Hybrid Earth System Numerical Models for Climate and Weather -- Numerical Modeling Background -- Hybrid Model Component and a Hybrid Model -- Atmospheric NN Applications -- An Ocean Application of the Hybrid Model Approach: Neural Network Emulation of Nonlinear Interactions in Wind Wave Models -- Discussion -- NN Ensembles and their applications -- Using NN Emulations of Dependencies between Model Variables in DAS -- NN nonlinear multi-model ensembles -- Perturbed physics and ensembles with perturbed physics -- Conclusions -- Comments about NN Technique -- Comments about other Statistical Learning Techniques.

Sommario/riassunto

This book brings together a representative set of Earth System Science (ESS) applications of the neural network (NN) technique. It examines a progression of atmospheric and oceanic problems, which, from the mathematical point of view, can be formulated as complex, multidimensional, and nonlinear mappings. It is shown that these problems can be solved utilizing a particular type of NN – the multilayer perceptron (MLP). This type of NN applications covers the majority of NN applications developed in ESS such as meteorology, oceanography, atmospheric and oceanic satellite remote sensing, numerical weather prediction, and climate studies. The major properties of the mappings and MLP NNs are formulated and discussed. Also, the book presents basic background for each introduced application and provides an extensive set of references. Dr. Vladimir Krasnopolsky holds a MSc and a PhD in Physics obtained from the Moscow State University. After graduating, he has worked there as a Senior Research Scientist at the Institute of Nuclear Physics, before becoming a Physical Scientist at the NCEP/NWS/NOAA as well as an Adjunct Professor at the Earth System Science Interdisciplinary Center of the University of Maryland. Dr. Krasnopolsky is a member (former Chair) of American Meteorological Society Committee on Artificial Intelligence Applications to Environmental Science and a member of IEEE/CSI/INNS Working Group (Task Force) on Computational Intelligence in Earth and Environmental Sciences. Dr. Krasnopolsky has published over a hundred papers in scientific journals and a book on quantum mechanics. “This is an excellent book to learn how to apply artificial neural network methods to earth system sciences. The author, Dr Vladimir Krasnopolsky, is a universally recognized master in this field. With his vast knowledge and experience, he carefully guides the reader through a broad variety of problems found in the earth system sciences where neural network methods can be applied fruitfully. (...) The broad range of topics covered in this book ensures that researchers/graduate students from many fields (...) will find it an invaluable guide to neural network methods.” (Prof. William W. Hsieh, University of British Columbia, Vancouver, Canada) “Vladimir Krasnopolsky has been the “founding father” of applying computation intelligence methods to environmental science; (...) Dr. Krasnopolsky has created a masterful exposition of a young, yet maturing field that promises to advance a deeper understanding of best modeling practices in environmental science.” (Dr. Sue Ellen Haupt, National Center for Atmospheric Research, Boulder, USA) “Vladimir Krasnopolsky has written an important and wonderful book on applications of neural networks to replace complex and expensive computational algorithms within Earth System Science models. He is uniquely qualified to write this book, since he has been a true pioneer with regard to many of these applications. (...) Many other examples of creative emulations will inspire not just readers interested in the Earth Sciences, but any other modeling practitioner (...) to address both theoretical and practical complex problems that may (or will!) arise in a complex system." ” (Prof. Eugenia Kalnay, University of Maryland, USA) .