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Modelling and Control of Floods

(Preface)

Jarosław J. NAPIÓRKOWSKI
Editor of the Issue

Institute of Geophysics, Polish Academy of Sciences
ul. Księcia Janusza 64, 01-452 Warszawa, Poland

The great floods that affected a number of regions in recent years have attracted a great deal of attention throughout the world. When looking at our Polish experience, it is obvious that flooding is responsible for a greater number of damaging events than most other types of natural disasters. Therefore, intensification of the studies of various aspects of flood problems is a must and is challenging not only for a scientific community but also for decision makers at both local and state levels.

This monograph reflects the results of the project supported by the Polish Committee for Scientific Research (that was registered as Grant No. 6 PO4D 032 19) and coordinated by the Institute of Geophysics, Polish Academy of Sciences. The objective of the project that covers a broad range of flood related research problems is to develop modules of Decision Support System for flood control. Particular modules were tested and verified for watersheds mostly jeopardized to severe flood events, mainly for Nysa Kłodzka River and a selected reach of Odra River. However, the obtained results are far more general and can be conveyed to any other area. In the monograph, we first discuss the current trends and needs in the modeling of flood related problems and flood control, numerical weather prediction, rainfall-runoff simulations and fluid motion in rivers. Further we present the precipitation forecast module that is based on a number of rainfall stations and with the help of General Circulation Model calculates hourly precipitation rates for an appropriate time horizon. Then two rainfall-runoff transformation models, namely the conceptual model and the semi-distributed HEC-HMS model, are discussed.

The next problem addressed in this monograph is the proper selection of flood routing models in channels. Solution of the flood operating problem in the system of reservoirs requires repeated solving of unsteady flow equations for successively generated operation scenarios. Thus, the solution algorithms applied in such a case should

be maximally efficient, not only in respect of the computer capabilities requirements, but – particularly important in this case – time of computations required to obtain the solution as well. Finally, computer-based analysis and control mechanisms for flood control in multireservoir systems are presented. The results of simulations of reservoir management in the case of the Nysa Kłodzka and the Upper Vistula catchments are described and discussed. The main task is to point out the role of computer simulation in the development of control mechanisms for large scale environmental systems.