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### **Mathematical modelling of water circulation in the Baltic Sea, (Matematyczne modelowanie pola przepływów w Morzu Bałtyckim),**

"Prace habilitacyjne", Ossolineum, Wrocław, 1988, 1 - 281, (in Polish)

#### **Summary**

This work is an attempt to synthesize all problems of mathematical considerations in general, and hydrodynamical-numerical modelling in specific, for the theoretical reproduction of water circulation in the Baltic Sea. It summarizes, in a concise form, all the results of investigations carried out by different authors in the last fifteen years. The main interest in the work is paid in a construction of hydrodynamical - numerical models where specific characteristics of hydrological and meteorological regimes in a chosen water basin is taken into account. In this work quite a number of additional information and remarks are included, and all, as to the author's opinion are given sometimes in details due to its importance and moreover for the sake to facilitate the understanding of studying all various aspects of mathematical modelling. A detailed description of numerical methods applied already in models where efforts were given to solve specific cases in chosen water basins, is here omitted, for the reader can find enough excellent monographs and handbooks in this field of research.

The presented work is divided into five chapters. The first one describes the basic characteristics of hydrological and meteorological regimes and analyzes the water dynamics of the Baltic Sea. In the second chapter the theoretical basis of the mathematical modelling of water circulation are discussed. Governing equations, initial and boundary conditions are here derived, and the measures and assumptions applied to simplify the complex 3-D problem are presented in this chapter.

The third chapter contains a review of the rules and methods used for estimation of physical parameters of the models, e.g. momentum exchange coefficients, heat and mass exchange coefficients, as well as surface and bottom stresses. The characteristics of the field of generating forces, i.e. atmospheric pressure, wind velocity and water density completes the third chapter. The next, fourth chapter, presents the results of calculations obtained by different investigators who applied in their research work the hydrodynamical - numerical models receiving finally currents at chosen depths and integral circulation characteristics, i.e. sea level, mass transport or stream function for mass transport. Critical comments and comparisons of different models with respect to their physical and mathematical compactness/connectivity/ and their correctness in the description of water circulation in the Baltic Sea are given here.

The last chapter gives the-state-of-the-art of the hydrodynamical - numerical modelling of water circulation in the Baltic Sea, showing the existing efforts and running needs of the further improvements of all the models applied and indicating the growing call for closer international cooperation in this field of marine research.