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More accurate in decision making than in science?

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MODELLING IN APPLIED HYDRAULICS: MORE ACCURATE IN DECISION MAKING THAN IN SCIENCE?

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ABSTRACT

Marked differences occur between modelling in scientific hydraulic research, in hydraulic engineering and in public decision making. This study reviews differences in the required accuracy of model results and differences in the choice between physical and numerical modelling. Physical models are used for studying elementary processes and their interactions under controlled conditions in scientific research; for the planning and design of interventions in hydraulic engineering; and for explanation and demonstration in public decision making. Numerical models are powerful tools in scientific research, but field applications cannot be verified or validated according to rigorous scientific standards. Hydraulic engineers use numerical models for various purposes, some requiring a high accuracy and some not. They are used to uncertainty and deal with this by means of sensitivity analyses or probabilistic approaches. Numerical models are also used for decision making on interventions that affect stakeholders, sometimes even having the last word in corresponding protocols or legislation. The suggested or perceived accuracy of model results is in this context much higher than the real accuracy. This leads to the paradoxical situation that decision makers and stakeholders put higher demands on accuracy than scientists do.

1. INTRODUCTION

Hydrodynamic and morphodynamic models have become indispensable and inevitable tools in applied hydraulics. Generally models can be divided into physical models, or models that can be touched, and abstract models. Physical models can be divided further into scale models, representing aspects of reality at a reduced scale, and analogue models, based on analogy between different physical systems, for instance between currents in an electrical circuit and currents in a river network. Abstract models can be divided into conceptual models, such as word models and graphical representations, and mathematical models, based on mathematical formulas or equations. The equations of mathematical models can be solved in two ways. Simplifying the equations to a form amenable for analysis leads to analytical models; translating them into a form that can be solved by a computer leads to numerical models. Scale models have become the dominant type of physical model in applied hydraulics, reaching high levels of craftsmanship [1]. Numerical models have become the dominant type of abstract model, benefitting from great advances in computer science and technology.

The choice of an appropriate model and the required accuracy depend on the context of application. There are marked differences between modelling in scientific hydraulic research, in hydraulic engineering and in public decision making. This study reviews the accuracy of model results and the choice between physical and numerical modelling in the realms of science, engineering and decision making.

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