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Five reasons not to use numerical models in water resource management (Arne Richter Award Lecture for OYS)

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Sustainable water resource management in a quickly changing world poses new challenges to hydrology and decision sciences. Systems analysis can contribute to promote sustainable practices by providing the theoretical background and the operational tools for an objective and transparent appraisal of policy options for water resource systems (WRS) management.
Traditionally, limited availability of data and computing resources imposed to use oversimplified WRS models, with little consideration of modeling uncertainties and of the non-stationarity and feedbacks between WRS drivers, and a priori aggregation of costs and benefits.
Nowadays we increasingly recognize the inadequacy of these simplifications, and consider them among the reasons for the limited use of model-generated information in actual decision-making processes. On the other hand, fast-growing availability of data and computing resources are opening up unprecedented possibilities in the way we build and apply numerical models.
In this talk I will discuss my experiences and ideas on how we can exploit this potential to improve model-informed decision-making while facing the challenges of uncertainty, non-stationarity, feedbacks and conflicting objectives. In particular, through practical examples of WRS design and operation problems, my talk will aim at stimulating discussion about the impact of uncertainty on decisions: can inaccurate and imprecise predictions still carry valuable information for decision-making? Does uncertainty in predictions necessarily limit our ability to make 'good' decisions? Or can uncertainty even be of help for decision-making, for instance by reducing the projected conflict between competing water use?
Finally, I will also discuss how the traditionally separate disciplines of numerical modelling, optimization, and uncertainty and sensitivity analysis have in my experience been just different facets of the same 'systems approach'.