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Modeling the Hydrological System – Balancing of Complexity and Uncertainty

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Complex water resources management problems require predictive tools for modeling of water- and solute fluxes on different spatial and temporal scales. Central problems comprise e.g. climate change impact on water availability and flooding risks, water allocation under scarce water conditions and water quality deterioration from intensive agriculture or mining activities.

Traditionally, both complex physically based hydrological modeling systems and lumped conceptual model systems are applied to serve and support decision making in water management. While lumped hydrological model systems usually focus on streamflow reproduction and are computationally efficient and have parameters that can be identified by calibration, they suffer from a lack of physical relevance and physical parameter interpretability. This implies e.g. that their predictability for new climate or environmental boundary conditions might be rather restricted. Physically based hydrological models, on the other hand, have reached highly increased complexity by integrating and coupling to adjacent compartments like the atmosphere or by including detailed additional process descriptions e.g. for energy fluxes. This may allow the enhanced consideration of feedback processes over compartments and different spatial and temporal scales. While hydrological predictability might increase here, data demands have increased in parallel. Because of these information constraints that result in high parameter uncertainties, non-validity of process equations at different scales, non-uniqueness of field data for model representations, etc., complex hydrological models also show limitations to provide reliable hydrological predictions.

The session therefore would like to address the following topics:

- **Recent developments in both complex and lumped hydrological model development**
- **Limitations and potentials of complex physical models vs. ensembles of lumped models**
- **Predictability of hydrological model systems under transient forcing conditions (climate, land use, consumption, …)**