Landscape perspectives in hydrological understanding and modelling for water management

Berit Arheimer
Swedish Meteorological and Hydrological Institute (SMHI), Norrköping, Sweden (berit.arheimer@smhi.se)

The Darcy medal acknowledges water-resources research, engineering and management. In my medal lecture I will embrace these aspects by telling the story of how my team merges numerical models and observations with landscape information to learn about hydrological processes and provide decision-support to society. We predict spatial and temporal variability of water fluxes and resources at local, regional and global scales to estimate hydrological variables in the past, present and future. We also explore “what if” scenarios for societal planning. Such predictions provide useful knowledge to maintain water resources at suitable quantities and qualities, despite on-going global warming, urbanization and environmental change. Water is the basis for all life and most societal sectors; hence, it must be managed properly for sustainable development. I will demonstrate how our scientific findings from the model applications have influenced water resources engineering and management policy.

Water management is always local but wider landscape information, such as knowledge about upstream/downstream conditions and residence-time, is needed when designing management measures. Water resources are normally shared by many stakeholders often with opposing objectives. Here, we found that models can have added value for science communication, participatory processes and conflict resolution to reach environmental goals.

It is well known that numerical models are more or less wrong and linked with uncertainties, but nevertheless, models combined with multiple sources of observations can be very helpful to aggregate information, quantify influence from various processes and describe outcome of complex phenomena. From modelling experiments, I will show how we reached deeper understanding of hydrological process when using the landscape perspective and large-sample empirical data across different physiographical conditions. Linking the model to landscape characteristics also gave us the possibility to make water predictions with some confidence even in data sparse regions and for ungauged catchments.

Large-scale modelling of water resources should be accompanied with site-specific data and local knowledge to be applicable for water resources engineering and management. Therefore, we share our model and I will exemplify how we reach a better understanding and make use of new science in collaborative efforts across the globe. Recently, the modelled data was also aggregated into societal-relevant indicators and provided through web-based climate and water services. During co-development of such on-line tools with practitioners, however, we encountered a large...
knowledge gap between data producers and data users, which calls for mutual engagement to reach understanding.

To sum up, my team uses and provides open data, open science and community building world-wide to accelerate water research by sharing local insights and collective intelligence in addressing multiple landscapes. Yet, scientific knowledge is always preliminary and needs to be challenged by peers and explored by users to be practically beneficial. I therefore advocate for science communication as an emerging field to engage more with. Hydrological scientists have a lot to contribute and learn in dialogues to find hope and solutions under global change, which will help in sustaining the water resources and the Planet as we know it.