Geophysical Research Abstracts
Vol. 18, EGU2016-8365, 2016
EGU General Assembly 2016

Representing spatial and temporal complexity in ecohydrological models: a meta-analysis focusing on groundwater – surface water interactions

Karlie McDonald (1), Sarah Mika (2), Tamara Kolbe (3), Ben Abbott (3), Francesco Ciocca (4), Amaia Marruedo (5), David Hannah (1), Christian Schmidt (6), Jan Fleckenstein (6), and Stefan Karuse (1)

(1) University of Birmingham, United Kingdom, (2) University of New England, Armidale, Australia, (3) Le Centre National de la Recherche Scientifique, Rennes, France, (4) Silixa, United Kingdom, (5) Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany, (6) Helmholtz Centre for Environmental Research, Leipzig, Germany

Sub-surface hydrologic processes are highly dynamic, varying spatially and temporally with strong links to the geomorphology and hydrogeologic properties of an area. This spatial and temporal complexity is a critical regulator of biogeochemical and ecological processes within the interface groundwater – surface water (GW-SW) ecohydrological interface and adjacent ecosystems. Many GW-SW models have attempted to capture this spatial and temporal complexity with varying degrees of success. The incorporation of spatial and temporal complexity within GW-SW model configuration is important to investigate interactions with transient storage and subsurface geology, infiltration and recharge, and mass balance of exchange fluxes at the GW-SW ecohydrological interface. Additionally, characterising spatial and temporal complexity in GW-SW models is essential to derive predictions using realistic environmental conditions.

In this paper we conduct a systematic Web of Science meta-analysis of conceptual, hydrodynamic, and reactive and heat transport models of the GW-SW ecohydrological interface since 2004 to explore how these models handled spatial and temporal complexity. The freshwater – groundwater ecohydrological interface was the most commonly represented in publications between 2004 and 2014 with 91% of papers followed by marine 6% and estuarine systems with 3% of papers. Of the GW-SW models published since 2004, the 52% have focused on hydrodynamic processes and <15% covered more than one process (e.g. heat and reactive transport). Within the hydrodynamic subset, 25% of models focused on a vertical depth of <5m. The primary scientific and technological limitations of incorporating spatial and temporal variability into GW-SW models are identified as the inclusion of woody debris, carbon sources, subsurface geological structures and bioclogging into model parameterization. The technological limitations influence the types of models applied, such as hydrostatic coupled models and fully intrinsic saturated and unsaturated models, and the assumptions or simplifications scientists apply to investigate the GW-SW ecohydrological interface.

We investigated the type of modelling approaches applied across different scales (site, reach, catchment, nested catchments) and assessed the simplifications in environmental conditions and complexity that are commonly made in model configuration. Understanding the theoretical concepts that underpin these current modelling approaches is critical for scientists to develop measures to derive predictions from realistic environmental conditions at management relevant scales and establish best-practice modelling approaches for improving the scientific understanding and management of the GW-SW interface. Additionally, the assessment of current modelling approaches informs our proposed framework for the progress of GW-SW models in the future. The framework presented aims to increase future scientific, technological and management integration and the identification of research priorities to allow spatial and temporal complexity to be better incorporated into GW-SW models.