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PREFACE

Forest cover change, climate variability, and hydrological responses

1 | THE NATURE AND SCOPE OF THE SPECIAL ISSUE

Understanding ecohydrological response to environmental change is critical for protecting watershed functions, sustaining clean water supply, and other ecosystem services, safeguarding public safety, floods mitigation, and drought response. Understanding ecohyhdrological processes and their implications to forest and water management has become increasingly important in the Anthropocene (Li et al., 2017; Sun & Vose, 2016). In forested watersheds or landscapes, the complex relationships between climate and forest cover are commonly viewed as two key drivers of ecohydrological processes. Quantifying these relationships and the ecohydrological response to change is key to improved land-use planning and management in forested watersheds.

This special issue includes 11 selected papers presented at the 4th IUFRO (International Union of Forest Research Organization) Conference on Forests and Water in a Changing Environment held from July 6–9, 2015, in Kelowna, British Columbia, Canada. This collection represents the most recent studies on forest ecohydrological processes under a wide range of geographic regions and environmental settings.

The first four papers in this special issue examine the relationships between climate and ecohydrological processes. Liu (2017) investigated the response of dead forest fuel moisture to climate change in the continental United States, an area of frequent wildfires and where controlled burning is used to reduce fire hazards. Using the empirical fuel moisture model of the US National Fire Danger Rating System, the study predicted an overwhelming decrease in fuel moisture across the United States, mainly due to an increase in air temperature, further suggesting future increases in frequency, size, and intensity of wildfires. Liu, Harper, Dell, Liu, and Yu (2017) examined vegetation responses to a long drought period (2002–2010) on the Australian continent and found a dramatic decline in both normalized difference vegetation and leaf area indices particularly in places where rainfall decreased the most. Using the FORECAST-Climate model, de Andrés et al. (2017) simulated the responses of a mixed Scots pine and European beech forest to climate change. They found improved water use efficiency in the mixed species as compared to monoculture beech or pine stands and suggest that plantings of pine and beech mixed forest could be an effective climate change adaptation strategy on drought-prone sites in northern Spain. Zhang, Hickel and Shao (2017a) clearly demonstrated the critical role of climate in changing moisture regime, vegetation dynamics, water use efficiency and, consequently, hydrological response to forest disturbance in six large watersheds located in the interior of British Columbia, Canada.

The five subsequent papers focus on the relationships between ecohydrological processes and forest changes caused by environmental disturbance, logging, and reforestation. Hallema et al. (2017) found that forest cover loss through wildfire greatly enhanced streamflow in their three case watersheds in the conterminous United States. Winkler, Spittlehouse, and Sarah (2017) demonstrated that logging (47%) only caused 5% increase of annual water yield but greatly shifted seasonal flow patterns (e.g., increasing April–May total yield but decreasing June–July water yield). Tschaplinski and Pike (2017) demonstrate that logging-related changes in annual water yield and the seasonal distribution of flow can have important implications for other ecohydrological processes and significant downstream consequences such as increased sedimentation and deterioration of fish habitat. Based on the paired-basin experiments, Perry and Jones (2017) found that Douglas-fir regeneration in the U.S. Pacific Northwest significantly reduced summer flows. Similarly, Zhang, Wei and Li (2017b) showed reductions in monthly streamflow with afforestation in four Australian catchments based on the simulations using a dynamic water balance model.

The importance of understanding the combined effects of changes in both climate and land (or forest) cover on ecohydrologic processes is illustrated in the final two papers. Chen et al. (2017) assessed soil moisture changes in response to both regional climate and land cover changes across China. Their study was able to quantify relative roles of climatic variability and land cover changes in surface soil moisture dynamics. They concluded that climatic factors were the main contributors to the declining trends of cool-season soil moisture in central and south China, and land cover changes were a more dominant control in soil moisture in northwest China. Schüler et al. (2017) assessed hydrological processes and water resources under future climate and forest cover changes in two forested headwater catchments in South-West Germany using the physical based hydrological model ArcAPEX. Their results suggest usefulness of considering “spread the risk” management options and “no-regret” decisions in dealing with the uncertain future. Those two case studies clearly demonstrate importance of including both climate and forest changes in assessing hydrological response. This rather holistic approach is also highlighted in several other studies in this special issue (e.g., Zhang, et al., 2017a; Hallema et al., 2017).

The case studies reported in this special issue clearly demonstrate the critical and individual role of climate and forests in ecohydrological processes. More importantly, this special issue also shows the significance of, and need for, considering the combined effects of both climate variability and forest cover change when assessing hydrological variations in forested watersheds and in future ecohydrological studies.

Xiaohua Wei[1]*
Rita Winkler[2]
Ge Sun[3]
[1]*University of British Columbia (Okanagan Campus), 1177 Research Road, Kelowna, BC V1V1V7, Canada*
[2]*Ministry of Forests, Lands and Natural Resource Operations, Kamloops, BC, Canada*
[3]*USDA Forest Service Southern Research Station, Eastern Forest Environmental Threat Assessment Center, Raleigh, NC 27606, USA*

Correspondence
Xiaohua (Adam) Wei, University of British Columbia (Okanagan Campus), 1177 Research Road, Kelowna, BC V1V1V7, Canada.
Email: adam.wei@ubc.ca

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