Modeling the impact of clear-cut, mountain pine beetle and wildfire on the hydrology of the Upper Columbia and Okanagan river basins

Zelalem Tesemma, University of Saskatchewan; John Pomeroy, Centre for Hydrology, University of Saskatchewan, Saskatoon, Canada ; Alain Pietroniro, University of Calgary, Schulich School of Engineering, Calgary, Canada

The Upper Columbia and Okanagan River basins play a significant role as the source of biodiversity and ecosystem services and provide water that is necessary for irrigation, communities and the functioning of hydropower dams and reservoirs in British Colombia and the northwest United States. However, the effects of logging, disease and forest fires, and the subsequent regeneration and forest disturbance on the hydrology of the basins have not been thoroughly studied. This study aims to simulate basin runoff with and without forest disturbance using an enhanced version of MESH (Modélisation Environnementale communautaire – Surface Hydrology) that incorporates mountain hydrology and vector base routing. MESH was setup over a total of 2122 model sub-basins: 1770 for the Upper Columbia and 352 for the Okanagan and Similkameen River basins. Sub-basin areas range from 1.01 to 366.4 km2. Meteorological variables from the European Union Integrated Project Water and Global Change ERA-Interim (WATCH-WFDEI), bias corrected by the Global Environmental Multiscale and Canadian Precipitation Analysis (GEM-CaPA) at 10 km by 10 km were used to force the model. Forests were segregated into four species classes: Spruce, Pine, Fir, and Hemlock. In addition, forest harvesting, mountain pine beetle impact on pine, regrowth and wildfire were parameterised separately. The forest harvesting, mountain pine beetle, and regrowth were further segregated into three groups by age as Fresh Clear-cut and/or Mountain Pine Beetle impacted, Clear-cut and/or Mountain Pine Beetle regrowth up to 5 years old, and Clear-cut and/or Mountain Pine Beetle regrowth aged more than 5 years and parametrized based on 20 years of high resolution MODIS LAI data. The wildfire areas were variable from year to year but parameterized in a similar way as barren land. The methodology developed to model forest disturbance and regrowth is innovative in a continental scale hydrological model. The model run that considered forest disturbance and regrowth showed a better model performance. The model simulation results of the forest disturbance and regrowth model in MESH will be demonstrated.