Climate Change and Geohazards: Projected Changes in Precipitation and Runoff

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EXTENDED ABSTRACT

According to the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report, it is *extremely likely* that human influence has been the dominant cause of the observed warming of the climate system since the mid-20th century (IPCC 2013). Further, climate change trends will persist with continued emissions of greenhouse gases, such that we can expect changes in global, regional and local temperature and precipitation patterns. Continued warming and changing precipitation patterns will have a large effect on the hydrology of western North America, with significant implications for water resources, the economy, infrastructure, and ecosystems (e.g. Milly et al. 2008; Schindler and Donahue 2006). Throughout most of British Columbia (BC), seasonal runoff is either snow-dominated (nival regimes), or snow influenced (hybrid nival-pluvial or nival-glacial regimes). Within such regimes, projected changes in hydrology under a number of plausible emissions scenarios include less snowpack, earlier onset of spring melt, and decreased summer flow (Schnorbus et al. 2014; Werner et al. 2013; Shrestha et al. 2012).

A more pertinent concern, however, is the anticipated intensification of the global water cycle due to climate change and its effect on hydrologic extremes (Huntington 2006; Collins et al. 2013). As certain geohazards, such as debris floods, debris flows and other types of landslides, can be triggered by intense and/or prolonged rainfall, snowmelt, rain-on-snow or runoff, the non-stationarity of these extremes may drive changes in the magnitude and frequency of geohazard events. This, in turn, may require adjustments of risk management strategies. Although there is mounting and compelling evidence that the magnitude of extreme precipitation events will increase with continued global warming, much less information, or consensus, is available on the potential effect of climate change on extreme runoff.

This presentation will discuss and present results from an ongoing hydrologic modelling study to quantify the potential changes in hydrologic extremes in a case study region of the Columbia and Rocky Mountains in southeastern BC. The study employed an ensemble modelling approach, whereby the hydrology model was forced with meteorological data statistically downscaled from climate experiments generated using a range of different global climate models (GCMs) forced by two emissions scenarios. The current study used climate data produced as part of the World Climate Research Programme (WCRP) Coupled Model Intercomparison Project Phase 5 (CMIP5) (Taylor et al. 2012). The CMIP5 experiments are based on emissions specified by Representative Concentration Pathway (RCP) scenarios (van Vuuren et al. 2011), and we have utilized climate projections from two such scenarios, RCP 8.5 and RCP 4.5. The RCP 8.5 scenario represents no policy changes to reduce future emissions, leading to emissions in 2100 that are three times those that we see today. The RCP 4.5 scenario represents an intermediate emissions trajectory whereby radiative forcing stabilizes shortly after 2100 and includes somewhat ambitious greenhouse gas reductions over time.

Extreme value theory, which provides a basis for modelling the maxima of a time series using one of several distributions of the extreme value family (Coles 2001; Ouarda et al. 2008), was used to quantify future changes in magnitude and frequency of annual maximum rainfall and runoff. As this study remains a work-in-progress, this presentation will provide preliminary results concerning projected changes. The intent is to examine and discuss the changes in extreme events in a spatially distributed fashion. An ultimate goal for this work would be to expand the results to all of BC and distill the information into suitable guidance material for geohazard design and risk management.

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