Geophysical Research Abstracts
Vol. 18, EGU2016-10362-1, 2016
EGU General Assembly 2016


# Quantifying depression-focused recharge in a seasonally frozen, semi-arid landscape

Edwin Cey, Saskia Noorduijn, Aaron Mohammed, Igor Pavlovskii, Laurence Bentley, and Masaki Hayashi
Department of Geoscience, University of Calgary, Canada (ecey@ucalgary.ca)

Groundwater recharge in the northern prairie region is influenced by seasonal accumulation of snowmelt runoff in numerous closed topographic depressions (tens to 100's of meters in size) that dot the landscape. Estimating recharge is difficult due to the number and complexity of processes at play, including snow redistribution, runoff, infiltration, evapotranspiration, lateral water redistribution, and recharge, which take place on clay-rich, macroporous sediments that are seasonally frozen. A multi-faceted study, referred to as the Groundwater Recharge in the Prairies (GRIP) project, was undertaken on the Canadian prairies in order to better understand the key hydrologic processes and to generate reliable basin-scale estimates of groundwater recharge that are necessary for sustainable groundwater management. Detailed monitoring of hydrological fluxes across individual depression-midslope-upland complexes was undertaken at three field sites located in different ecoregions, yielding valuable insights into the hydrologic processes and feedbacks within these individual micro-catchments. This process understanding was incorporated into a relatively simple one-dimensional (1D) water budget model, to which a new upscaling scheme was applied to estimate recharge over a watershed or multiple watersheds. The 1D model links upland and depression processes for an individual micro-catchment, and then upscales to a larger model grid cell based on a categorization of depressions based on their surface area and density within the grid cell. This approach enables explicit incorporation of relevant recharge processes, thus producing realistic recharge estimates, while limiting computational demand. The model has been calibrated and tested against a long-term data set from one of the field sites. Results demonstrate complex relationships between upland-depression water transfers and catchment geometry, resulting in maximal groundwater recharge in catchments with intermediate ratios of depression to catchment area. Preliminary modeling results and field data also suggest that recharge is highly sensitive to local land use and climatic conditions, and thus the model represents a useful tool for evaluation of spatial and temporal variability of recharge in the face of changing land use and climatic conditions.