The role of irrigation in depression-focused groundwater recharge in the Canadian Prairies

Alexandra Hughes, Edwin Cey, & Masaki Hayashi
Department of Geoscience, University of Calgary, Calgary, Alberta, Canada

ABSTRACT
Groundwater recharge in the Canadian Prairies is known to be affected by topography, geology, and meteorological conditions, which often give rise to depression-focused recharge (DFR). This natural recharge regime can be altered by anthropogenic changes in land use (e.g., wetland drainage, agriculture, etc.). The extensive coverage of irrigated cropland in southern Alberta makes it an important land-use type; however, its effects on groundwater recharge have scarcely been studied. The goal of this study was to investigate the role of irrigation in groundwater recharge in the Canadian Prairies, where DFR is common. The main study site was located at the Alberta Irrigation Technology Centre (AITC) in Lethbridge, Alberta. Two cropped fields, one irrigated and one dryland, were instrumented with soil moisture and temperature sensors, monitoring wells and meteorological stations. A second irrigated field was instrumented within a topographic depression. Spatial and temporal differences in measured parameters (e.g., soil moisture distribution at depth, hydraulic response of probes to irrigation and precipitation events, surface radiation fluxes) between irrigated and dryland crops, as well as between upland and depression regions, were observed. Porewater extract samples were obtained from boreholes drilled at the main site, as well as four additional boreholes taken from a depression and upland of both an irrigated and dryland crop at a second site near Coaldale, Alberta. Chloride and stable isotope (^{2}H and ^{18}O) analyses of these samples were compared to precipitation, irrigation, surface water, and groundwater samples, enabling identification of the source (i.e., irrigation water, mid-winter melts, spring runoff, summer rains) and rate of groundwater recharge for various irrigated-dryland and depression-upland combinations. This research provides important insights to aid in quantifying the spatial and temporal variability of groundwater recharge for different land uses and topography found in the Canadian Prairies.