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Groundwater Recharge Estimation using Low-Cost Observation Techniques and Potential Applications

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Sustainable groundwater management requests groundwater recharge estimation as a critical quantity. We used physical-based modelling using data from a low-cost weather station and tested the feasibility and robustness of recharge estimation. The method was tested on two locations in British Columbia (B.C.), Canada. The main study was conducted in Southern Abbotsford, B.C. and applications related to water management in future climates and to water usage optimization were conducted in Okanagan Valley, B.C. Recharge was determined using HYDRUS-1D. The meteorological data were recorded by a HOBO weather station for a short observation period (about 1 year) and an existing weather station (Abbotsford A) for long-term study purpose (27 years). The derived soil hydraulic parameters of two undisturbed soil cores were used to characterize the soil. Model performance was evaluated by using observed soil moisture and soil temperature data. A rigorous sensitivity analysis was used to test the robustness of the model. Recharge during the short observation period was estimated at 863 mm and 816 mm. The mean annual recharge was estimated at 848 mm/year, and 859 mm/year based on a time series of 27 years. 80% of precipitation contributed to recharge in hydrologic winter period. The comparison of the recharge estimates with other studies indicates a good agreement. Being able to predict transient recharge estimates, this method can provide a tool for estimates on nutrient leaching which is often controlled by strong precipitation events and rapid infiltration of water and nitrate into the soil. Modeling supports that recharge estimates at high temporal resolution also increase the prediction quality of nitrate leaching. The application for water resources related problems in the Okanagan Valley showed that linking groundwater and surface water using regional groundwater estimates improved calibration of existing groundwater model strongly and that our method is capable to use upscaled (soil) data for reliable and regional water management conceptualization. It builds a robust and inexpensive tool in climate change studies.