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Characterization of groundwater recharge in the Laurentides region

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At the watershed scales, groundwater recharge is one of the least understood components of the water cycle. This process is particularly difficult to quantify in the context where low-permeability fractured bedrock is predominant, as is the case in the Laurentides region (Quebec). The goals of this project are 1) to estimate the spatial and temporal variations of current recharge conditions using different approaches, and 2) to estimate recharge rates under climate change scenarios. In the study area (12 550 km²) the Canadian Shield geological formation is prevalent, but localized high yield granular aquifers are also frequent and exploited. Twenty-two long-term gauging stations provide flow rate data. In addition to these, three new gauging stations were installed in 2018 at the outlets of the Simon River (165.6 km²), the Saguay River (147.2 km²) and the Calumet River (50.1 km²) watersheds. These watersheds are scattered across the study site and span a wide range of land uses (forest, agricultural and resort). Groundwater level datasets are available at eight piezometers within the study area. The HydroBilan model (HB), a 1D spatially distributed water budget model using meteorological data and runoff curve numbers (RCN) adapted to the pedology of Quebec, is used to estimate recharge. This model requires very few parameters (eight), runs very rapidly and has been proven efficient in the southern part of the province. Meteorological data from the interpolated grid created by the Government of Quebec were used with data from local weather stations (1961-2017). The HB model is calibrated on four watersheds using total flows, base flows, and actual evapotranspiration (difference between annual flow rate and precipitation). Multiple cell sizes (100, 250, and 500 m) have been used within HB to determine the effects of spatial resolution on the calculated recharge. Recharge was also estimated with the commonly used baseflow separation filters on all the flow rate datasets. In addition, the water-table fluctuation method was applied on existing groundwater level time series to estimate recharge. The multiple recharge estimates are compared to create a range of possible spatially and temporally variable recharge values. The resulting maps of distributed recharge will be useful to plan future land development and water use in the study area and will be particularly valuable to some municipalities of the region, who are already suffering from severe low flow periods.