Watershed-scale parameter identification through river discharge and groundwater level recession analysis

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Résumé

In regions with cold and temperate climates, river and groundwater hydrographs are usually characterized by two distinct periods of declining water levels: a summer and a winter recession period. Each of these periods can last several weeks and is minimally influenced by water inflows. These recessions, therefore, provide an opportunity to study the natural response of river-aquifer systems during low-flow periods. In this study, a calibration approach is proposed for identifying hydraulic properties of aquifers at the basin scale based on the analysis of river discharge and groundwater level recession curves. The proposed framework is applied to the Yamaska River watershed (Quebec, Canada), which covers an area of 5000 km2 and is characterized by a complex geology that affects river and aquifer interactions. For this study, daily records from 19 observation wells and 10 river monitoring stations distributed throughout the basin were analyzed for the period from 2000 to 2020. More than 40 recession events were identified and extracted, ranging in length from 20 to 60 days. All recession events associated with an observation point (well or river station) were combined into a master recession curve. Preliminary analysis of each master curve shows that the recession rate is similar for all events. The recessions also show a dependence on elevation, with rates varying depending on the elevation of the water table in the aquifer. In addition, these recession rates vary throughout the watershed or are similar to rates at other observation points. Future work will use a 3D groundwater flow model (HydroGeoSphere) of the study area to evaluate how model parameters such as conductivity and storativity can be derived from the information contained in the recession curves (trial-and-error and automatic inversion). By providing recession-derived hydraulic properties for the river-aquifer system at the watershed scale, a comprehensive understanding of the low-flow dynamics of the system is expected. This enhanced understanding is critical for accurately predicting and managing water resources in the study area.

Mots-Clés: recession curves, low flows, model calibration, hydrogeological characterization

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