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Influence of Water Storage in Aquifers on the Character of Baseflow Recessions

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The dQ/dt vs. Q function based on data points plotted on a double-log plot has been applied in hydrologic dynamic analysis broadly. However, the recession flows used in the analysis are affected by the initial water storage conditions, and the processes of evapotranspiration and precipitation/groundwater recharge. Thus, plotted data points never collapse along a single line, making it more difficult to identify a unique relation. Based on this point, we applied a calibrated groundwater flow model for the Sagehen Creek watershed located in California to evaluate the influence of antecedent storage and hydrologic fluxes such as evapotranspiration and precipitation/recharge to provide individual discharge recession time series for detailed scrutiny. We found the sloping topography is a key control leading to a concave recession curve in the examined catchment. Moreover, the influence of evapotranspiration is not instantaneous, and the influence of precipitation/recharge is not permanent. We found the distribution of storage at the beginning of a recession event to influence the characteristics of the event. The antecedent storage in upland (far from stream) controls the low flow in late time, while the valley area (near to stream) may dominate the quick flow in early time. In wet condition, the higher storage in upland leads to a bigger transit to valley and then the rate of recession decreasing fast. The low flow has a positive relationship with past streamflow. Then it would be an appropriate indicator to antecedent storage distribution. Based on this point, a zero-dimension hydrological model was developed to simulate the discharge from catchment subsurface storage. The model was applied in Sagehen Creek, as well as in Nangao catchment of China. The results show that the model has a good performance to simulate the discharge dynamic encompassing a wide range of water storage.