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Groundwater recharge in the discharge area of a semi-arid catchment

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The definition of discharge area is an area where the flow of groundwater is directed upward with respect to the water table. However, such a definition is subjected to criticism because it is usually accepted that rainfall can infiltrate into the subsurface and recharge the aquifer. Rise in water table is usually a direct result of groundwater recharge. In this study, we examine the contribution of water table rise caused by infiltration of rainfall and upward flux of groundwater discharge from the deep part of a catchment in northwestern China with a semi-arid climate.

The water table and soil moisture in the discharge area the catchment were monitored for one year since May, 2014. The water table is recorded using Diver, while soil moistures at four different depths are recorded using 5TM. The hourly rainfall data is also available in a nearby meteorological station. Both groundwater and soil water are found to have responses to rainfalls. Soil moisture in the shallow part (5 cm, 20 cm and 50 cm below surface) increases due to the infiltration of rainfall, and the magnitude of increase in soil moisture is dependent on the amount of rainfall, and decreases with depth. Soil moisture in the deep part (100 cm below surface) also has responses to rainfalls, however, the pattern differs in different seasons. From May until middle September, the increase in soil moisture at 100 cm associated with rainfalls was caused by the increase in water table, while after middle September, the increase in soil moisture at 100 cm associated with rainfalls was caused by direct infiltration of rainfall. Based on the variations in soil moisture, we conclude that the rise in water table from May to middle September is not caused by the in situ infiltration of rainfall, and the infiltrated rainfall got evaporated before arriving at the water table, and the rainfalls after middle September could reach the water table and constitute recharge of groundwater.

In short periods without rainfall, there is a trend of water table decreases during May and early August, and a trend of water table rise during late September and late November. The former is due to high evaporation of groundwater in the summer exceeds the upward flux of groundwater discharge from the

deep part of the basin, and the latter is due to the upward flux of groundwater discharge exceeds the low groundwater evaporation in the fall. By assuming that the upward flux of groundwater discharge and the ratio of groundwater evaporation to potential evaporation are basically stable within a year, the two terms are successfully estimated. The amount of vertical flux of groundwater discharge from the deep of the basin is found to be of significance importance in the water balance of discharge area.