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Characterization of groundwater and surface water interactions along Kirmir Stream using field measurements and thermal remote sensing

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The exchange processes between surface water and groundwater have recently received attention due to the important implications on the basin-scale water management as well as biogeochemical and ecological status of watersheds. We investigated the exchange processes between Kirmir Stream – a controlled stream nearby the city of Ankara, Turkey - and groundwater using a hierarchical multi-scale approach incorporating catchment physical characteristics (geology, geomorphology, DEM etc.), water quality field parameters as well as in-situ and remotely sensed measurements. Geological and geomorphological information pinpointed potential stream reaches where the interaction could occur. The identified reach was then investigated through in-situ measurements including differential discharge measurements, temperature measurements at different depths (temperature sticks), as well as remotely-sensed thermal images to identify discharge variations and temperature anomalies. Nested piezometers were then installed at possible discharge locations to investigate the variation in the vertical hydraulic gradient over time. Temperature probes (i-buttons) installed at various depths into the streambed for a period of time and helped to quantify temporal variations in vertical flow components. Basic water quality field parameters (temperature, electrical conductivity, total dissolved solid amount, salinity and dissolved oxygen) collected along the Kirmir Stream and nearby springs were investigated through Cluster Analysis to identify potential source areas. This hierarchical, multi-scale methodology provided an efficient and effective way to determine the locations and the direction of groundwater and surface water exchange processes. It was found that geology and channel modification exerted strong controls on the exchange processes.