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Groundwater-surface water interactions in fractured Mediterranean mountain environments

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Groundwater and surface-water systems interact in a variety of geological, morphological, and climatic settings. Vegetation also plays a key role in these interactions as it transfers water from the subsurface and groundwater table towards the surface, where it is redistributed by plants and trees in different soil depths. Cyprus is at the drier end of the precipitation spectrum of the Mediterranean region and has intense seasonal variations in precipitation with frequent droughts. In order to confront water scarcity issues and improve water management plans in the future, we need to obtain a better understanding of the groundwater and surface-water interactions and quantify the hydrological processes in this complex fractured Mediterranean mountain environment. The upstream and midstream of Peristerona watershed was selected as the study area (77 km^2). It is a forested mountain watershed with steep slopes (mean 22^o) and elevation varying from 417 to 1543 m. The main formations in the area are lower and upper pillow lavas, basalt, diabase and gabbro. From a hydrogeological point of view the upstream area consists mainly of heavily fractured intrusive formations that can hold groundwater inside the fractured zones and in some areas it consists of plutonic rocks with springs. The midstream area is dominated by volcanics with submarine pillow lavas.

To assess the surface and groundwater interactions a nested watershed approach will be followed with the synthesis and collation of hydrometric data through a dense monitoring network. Continuous measurements of rainfall, runoff and groundwater levels will be taken. Watershed characteristics will be processed in GIS environment. Also measurements of environmental stable isotopes ($O^{18}$and H^2) will be taken. In addition sap flow instruments will be installed in Pinus brutia species among with soil moisture sensors. Results will quantify the water uptake by trees (Pinus Brutia sp.) and the hydraulic redistribution back to the different soil depths. It will enable an assessment of the contribution of trees to the natural water cycle in situations similar to this environment.

Hydrometric analysis for each nested watershed will be applied and results are expected to show threshold values of rainfall for runoff generation and the contribution of groundwater (baseflow) to the river flow and vice versa. Relations between geology, morphology and climate will also be revealed. Rainfall and runoff data are currently available from two stations, Panagia bridge (438 m) and Platanistasa (780 m). Results show a linear relation between the daily runoff of the two stations. The relatively higher runoff in Platanistasa, as compared to Panagia bridge, is probably due to the steep slopes and the higher rainfall rates. Baseflow occurring at the end of the rain season indicate that the fractures in the geologic formations fill up during the rainy season and discharge during the end of the season. During the summer period, even when rainfall events occur, there is very little or no runoff generation.