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# Hydrologic and Soil Science in a Mediterranean Critical Zone Observatory: Koiliaris River Basin

Nikolaos Nikolaidis (1), Fotini Stamati (1), Jerald Schnoor (2), Daniel Moraetis (1), and Manolis Kotronakis (1)

(1) Technical University of Crete, Department of Environmental Engineering, University Campus, 73100 Chania, Greece (nikolaos.nikolaidis@enveng.tuc.gr), (2) Department of Civil and Environmental Engineering, University of Iowa, USA

The Koiliaris River watershed is situated 25km east from the city of Chania, Crete, Greece. The total watershed area is 145km2 and the main supply of water originates in the White Mountains. At high elevations (altitude 2014 m), the maximum slope is 43% while at the lower elevations the slope measures 1-2%. Land use includes heterogeneous agricultural areas (25.4%), olive and orange groves (15.6%), and scrub and/or herbaceous vegetation associations (57.6%). The geology of the Basin consists of 23.8% Plattenkalk (dolomites, marbles, limestone and re-crystallized limestone with cherts); 31% of Trypali units (re-crystallized calcaric breccias); 9.4% limestones with marls in Neogene formations; 13% marls in Neogene formations; 12.8% schists, and 10% quaternary alluvial deposits. Intensive hydrologic and geochemical monitoring has been conducted since 2004 while the site has historical data since the '60s. In addition, a telemetric high-frequency hydrologic and water quality monitoring station has been deployed to obtain data for the characterization of the hydrologic and biogeochemical processes with varying process response-times. Hydrologic and geochemical modeling confirms the estimation of characteristic times of these processes. The main type of soil degradation in the basin as well as in other arid and semi-arid regions is water erosion, which is due to the clearing of forests and natural vegetation for cropping and livestock grazing. De-vegetation and inappropriate cultivation practices induces soil organic matter (SOM) losses making soils susceptible to erosion and desertification with global consequences for food security, climate change, biodiversity, water quality, and agricultural economy. Cropland plowing breaks-up water stable aggregates making the bio-available pool bio-accessible; which could be microbially attacked and oxidized resulting in SOM decline. Chronosequence data analysis suggested first-order kinetic rate of decline of the bio-available carbon and nitrogen pools, where as much as half of the total OM loss could take place during the first year after the conversion of grassland to cropland. We have shown by physical fractionation and spectroscopic techniques in croplands and set-aside fields that most of the SOM decline in croplands has been attributed to the breakup of macroaggregates and the oxidation of particulate organic matter despite the climatic or textural conditions. However, lower decomposition rates and higher silt-clay content of Greek soil create more stable aggregates and facilitate OM stabilization. Studies on Koiliaris River highland de-vegetated grazing lands suggested decline of soil biochemical quality compared to native vegetated lands. The size of soluble mineral nitrogen and organic carbon pools have also decreased. The composition of the soluble OM pool had significantly lower DOC aromaticity and was nitrogen enriched compared with the naturally vegetated lands. The DON Aromaticity Index was shown to be a promising sensitive indicator of de-vegetation effect on the soluble pool of OM. The partitioning coefficients of the potential soluble organic nitrogen increased with increasing DON aromaticity for the de-vegetated lands, indicating that the lower the aromaticity, the more prone soils are to leaching DON and potentially affect water quality. The land-use load apportionment analysis revealed that the river export load of dissolved organic nitrogen (DON) is linearly correlated with the normalized, livestock derived, DON load input from pasture suggesting that increasing livestock grazing in a watershed would result in higher DON export in river. DON aromaticity could serve as a simple indicator of soil biochemical quality and aggregate disturbance in soils and therefore SOM stability. We have conducted a stratified soil sampling intending to validate the utility of the examined indices for the quantification of the effects of agricultural pressures to soil quality and the detection of potential effects on water quality. The watershed is one of the Critical Zone Observatories in the FP7 funded project SoilTrEC.