Geophysical Research Abstracts
Vol. 15, EGU2013-477-3, 2013
EGU General Assembly 2013

Can soil surface sealing be a natural compensation mechanism for soil water loss under future dry conditions?

Shai Sela (1), Tal Svoray (1), and Shmuel Assouline (2)

(1) Ben Gurion University, Geography and Environmental Development, Beer-Sheva, Israel (selas@bgu.ac.il), (2) Environmental Physics and Irrigation, A.R.O - Volcani Center, Bet Dagan, Israel.

Physical sealing of the soil is a widespread natural process in bare soil patches between shrubs, occurring frequently in dry environments. The seal layer has significantly lower hydraulic conductivity than the underlying undisturbed soil and thus it affects significantly hydrological fluxes. The presence of seal layer has been shown previously to be a negative feedback for vegetation water availability by reducing infiltration which leads to runoff initiation and consequently, propagation of desertification processes. The seal layer, however, has also shown a positive feedback, disregarded previously, resulting from suppressed evaporation fluxes from the soil which can have a much broader impact and affect water budget of dry areas at the regional scale. This positive feedback is studied in this research with model-based analysis of both measured local climatic records and synthetic climate change scenarios. The hillslope site (0.05 KM2) is located at the LTER Lehavim site, in the Negev desert at the south of Israel (31020' N, 34045' E). Annual rainfall is 290 mm and the soils are brown lithosols and arid brown loess, prone to surface sealing. The vegetation is characterized by scattered dwarf shrubs with dominant species Sarcopoterium spinosum. A previously published, high resolution physically-based model (aggregated Hydrus 1D runs) was used. The model (3X3 m2, 8240 cells) accounts explicitly for topographic and soil hydraulic parameters. Hydraulic properties of the seal layer at the soil surface were modeled following Mualem and Assouline (1989). Simulation of measured climate records reveals the seal layer to be a positive feedback for root zone water availability during dry and averaged rainfall seasons, while being a negative feedback during higher than average rainfall amounts (increasing the mean water content in the root zone, relatively to an unsealed profile, by 39%, 19% and -11% respectively). To study the seal layer role in future drier conditions, as projected by climate models for the Mediterranean region, the hydrological model was forced with a series of synthetic rainfall storms, systematically varying the drying intervals, evaporation intensity and soil initial water content conditions. Compared to an unsealed system, the presence of a seal layer was found to be an efficient water conservation mechanism, "buffering" the effect of climatic scenarios. For the drying intervals duration of 7 and 10 days (corresponding for the averages drying intervals during an average and dry seasons), water content at the root zone under the seal was found to be 17% and 20% higher, respectively. Furthermore, the seal layer effect on root zone water storage was found to be spatially heterogeneous, as the seal layer interacts differently with local topographic parameters.