Event runoff calibration with LISEM in a recently burned Mediterranean forest catchment.

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Wildfires are known to change post-fire hydrological response as a consequence of fire-induced changes such as soil water repellence (SWR). SWR has also been identified as a key factor determining runoff generation at plot and slope scale studies, in which soil moisture content (SMC) has been presented as dependent variable. However, these relationships have not been established at catchment scale yet, mainly due to the inherent difficulties in monitoring post-fire hydrological responses at this scale and in finding relationships between these events with SWR point (time and space) measurements. To fulfill these knowledge gaps, the present study aims to advance the knowledge on post-fire hydrological response by simulating quick flows from a small burned catchment using a physical event-based soil erosion model (OpenLISEM).

OpenLISEM was applied to simulate sixteen events with two distinct initial soil moisture conditions (dry and wet), in which the model calibration was performed by adjusting Manning's n and saturated soil moisture content (theta_s). Considering that manual calibration resulted in distinct Manning's n for wet and dry conditions, while thetas required an individual calibration for each event, an alternative parameterization of theta_s was created by means of linear regressions, for all the events together (“overall”), and for wet and dry events separately (“wet” and “dry”). Model performance was evaluated at the outlet, while hillslope predictions were compared with runoff data from micro-plots that were installed at 3 of the hillslopes (Vieira et al., 2018).

The validation of field data at micro-plot scale revealed several comparability limitations attributed to the time-step of the field data (1- to 2-weekly) in comparison to the duration of the events (170-940 min). Nevertheless, the most striking result from our simulations is the fact that OpenLISEM did not predict overland flow generation at two out of the three locations where it was observed. Our simulations also showed that the forest roads are a source of the runoff generation and their configuration affects catchment connectivity.

At the outlet level, OpenLISEM achieved a satisfactory (0.50 < NSE ≤ 0.70) and very good (NSE > 0.80) model performance according to Moriasi, et al. (2015), in predicting total discharge (NSE=0.95), peak discharge (NSE=0.68), and the time of the peak (NSE=1.00), for the entire set of
events under manual calibration. In addition, simulations in wet conditions achieved higher accuracy in comparison to the dry ones.

When using the parameterization based on the linear regression calibration, OpenLISEM simulation efficiency dropped, but still to satisfactory and very good ($\text{NSE}_{\text{overall}} = 0.58$, $\text{NSE}_{\text{combined}} = 0.86$) accuracy levels for total discharge.

Overall, we conclude that calibrating post-fire hydrological response at catchment scale with the OpenLISEM model, can result in reliable simulations for total flow, peak discharge and timing of the peaks. When considering the parameterization of theta, as proxy for repellent and wettable soils, more information than the initial soil moisture is required.