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Consequences of climate change for runoff and soil erosion: coupled simulation at the seasonal and extreme event scales

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The consequences of climate change for runoff and soil erosion were evaluated for the Alenquer basin, in Portugal, at both the seasonal and extreme event scales. The evaluation was done by coupling two runoff and erosion models, one working at the seasonal and annual scale (SWAT) and the other working at the extreme event scale (MEFIDIS).

The models were applied using the results from the regional circulation model PROMES for 2070-2100, assuming the SRES emission scenario A2, for daily rainfall and temperature. Annual and seasonal changes to surface and sub-surface runoff, soil erosion and vegetation biomass production were estimated directly by running the SWAT model with the PROMES results.

Changes at the extreme event scale were estimated by assuming that: 1) Changes in daily winter rainfall patterns, as predicted by the PROMES model, will be reflected in storm intensities and durations for a given return period; 2) Changes in total rainfall and temperature will mostly affect vegetation cover and pre-storm soil moisture.

The MEFIDIS model was applied to estimate the consequences of changes to rainfall intensity and duration to three measured storms, under the first assumption. Under the second assumption, the SWAT model results for biomass production were used to adjust vegetation cover parameters in MEFIDIS, such as canopy cover, interception storage capacity, and flow resistance. SWAT results for ground flow were also used to adjust soil moisture before the storm, particularly the spatial distribution of saturated areas where saturation runoff is likely to occur.

MEFIDIS was able to estimate changes to runoff, peak runoff, erosion rates and ero-

sion patterns for the selected climate change scenario, for a given storm return period. These results showed the usefulness of the methodology to look at the complex consequences of climate change at several scales, especially if used to analyze a greater range of possible scenarios.