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Impacts of climate change on soil erosion in Portuguese sub-humid and semi-arid watersheds

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Desertification is a critical issue for Mediterranean drylands, and is often associated with soil degradation. Climate change could increase soil erosion and degradation rates in this region due to the expected increase in climatic aridity, with negative consequences for vegetation cover and soil protection; an increase in rainfall intensity could also contribute to this increase. However, lower overall rainfall rates could negate this trend.

The main objective of this work was to estimate the impacts of climate change on soil erosion in Mediterranean watersheds by explicitly addressing these issues. A two-scale modelling framework was developed for this purpose, coupling a continuous erosion model (SWAT), capable also of simulating vegetation growth, with a single-storm erosion model (MEFIDIS). The framework was applied to two contrasting study areas: the Guadiana and the Tejo, which currently present a semi-arid and humid climate. Eight synthetic climate change scenarios were created using a stochastic weather generator, comprising temperature increases between 1.6 and 6.4 ºC and rainfall decreases between -2.5% and -40%, creating an envelope which includes a large number of the climate change scenarios predicted for these regions for 2071-2100.

Model results indicate that:
1) For the most important landcovers, vegetation biomass growth is expected to decrease by as much as 25% in the most extreme scenarios (for pine and eucalypt forests, winter wheat, and vineyards), but expected to increase for drought-adapted vegetation (sclerophyllous trees and shrubs).
2) Soil erosion is expected to decrease in all landcovers except for winter wheat.
3) In winter wheat, soil erosion is expected to decrease in climate change scenarios with the lowest rainfall, increasing by as much as 150% in scenarios with the highest rainfall.
4) An increase in storm intensity is expected to lead to higher soil erosion in the Tejo basin but not in the Guadiana basin since, in the latter case, the highest growth of sclerophyllous vegetation would be sufficient to negate the impacts of stronger storms.