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What more do we know, twenty years later? Updating the potential impacts of future climate change on soil erosion by water on the English South Downs

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Among the first simulations of the effects of climate change on soil erosion by water were those carried out by Favis-Mortlock and Boardman and colleagues, published from 1990 onwards. These simulations focused on agricultural hillslopes on the English South Downs. Erosion by water had become a problem here during the 1980s, due in large part to agricultural intensification: in particular, the adoption of autumn-planted cereals. Assuming modest (c. 10%) increases in winter rainfall by the 2050s, results suggested slightly larger increases (c. 10-20%) in average annual erosion rates. Erosion rates for individual years showed much greater increases, however.

Whilst novel, this was — by present-day standards — rather crude work. The site-specific future daily weather required by the erosion models EPIC and WEPP was created using a range of techniques, now appearing somewhat naive, for downscaling the results from then-contemporary Global Climate Models. There was no consideration of changes in sub-daily rainfall characteristics i.e. of changes in future rainfall intensity; and assumptions regarding future land use were simplistic.

Much more robust and physically-plausible representations of site-specific future climate are now possible. These result both from continual and incremental improvement in the numerical modelling of global climate, and from the development of tools (now usable by non-specialists) for the statistical downscaling of future climates. An example of such a tool is SDSM, the Statistical Down Scaling Model. However, information regarding future sub-daily rainfall has not improved greatly in over twenty years. Information on future land use is also little better than was the case in the early 1990s. And there has been no great improvement in the tools available to model water erosion: as demonstrated by the GCTE model evaluations of the late 1990s, models such as EPIC and WEPP possess notable shortcomings.

Recent work by Mullan and Favis-Mortlock (EGU 2010) made use of SDSM and WEPP, as the best currently available tools, to represent future erosion by water for agricultural sites in Northern Ireland (NI). SDSM-derived future daily weather data, with unchanged rainfall intensity and land use, was input to WEPP: the results indicated decreases in future average annual erosion rates, compared with the present. Next, WEPP was run using this future weather data together with increased future rainfall intensities: results then changed to modest increases in future average annual erosion rates, compared with the present. Finally, future land use was also changed, assuming agricultural intensification: WEPP indicated very large increases in average annual erosion compared to the present.

The relative complexity of results from this NI study contrasts with the simplicity of those from the South Downs: particularly interesting is the potential role of future rainfall intensity. Thus the study described in this paper adopts a similar strategy to the NI work to update the original South Downs work of Favis-Mortlock and Boardman, and so to answer the question: what more do we know, twenty years later?