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Modelling the impacts of climate change on future rates of soil erosion: a case study from the north of Ireland

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Soil erosion by water is not currently a major issue in Ireland, owing to the predominance of permanent grassland and hence year-round protection of the soil from rainfall and runoff. When the land cover is removed following tillage, however, the soil becomes exposed to the forces of rainfall and flowing water, and 'a window of opportunity' is presented for soil erosion to occur. Past evidence suggests tillage was once more important than pasture in Irish agriculture, with a shift from livestock husbandry towards intensive arable farming prompting soil erosion. Insufficient protection of the soil following tillage is therefore a key ingredient in the development of soil erosion on agricultural land, as is a sufficient supply of rainfall to exploit the exposed soil. Any changes to the frequency of tillage or the amount/intensity of rainfall may therefore be expected to increase future soil erosion rates.

The potential exists for such changes to increase Irish soil erosion rates under future climate change. Increased rainfall intensity and greater winter rainfall amounts are projected for Ireland, which may result in increased runoff from agricultural land. In addition, projected increases in annual temperatures may cause a shift in land use to accommodate a possible introduction of crops suited to the warmer conditions. Therefore any changes from the current predominance of permanent grassland to arable farming will increase tillage and therefore reduce protection of the soil from erosion.

This study examines the impacts of future climate change on soil erosion by modelling future erosion rates using the Water Erosion Prediction Project (WEPP) model (Flanagan and Nearing, 1995) for a site in the north of Ireland. Most previous studies of soil erosion under future climate change (eg. Favis-Mortlock and Boardman, 1995; Pruski and Nearing, 2002; Kim et al, 2009) use raw General Circulation Model (GCM) output to perturb the erosion model to represent changed climate conditions. Due to the coarse spatial resolution of GCMs and the much finer scale nature of soil erosion, however, some method of generating higher resolution climate change projections is desirable to more robustly model future erosion rates for individual sites. In this study, the Statistical DownScaling Model (SDSM) (Wilby and Dawson, 2007) is used to 'downscale' coarse GCM output to the point-scale. This makes possible the assessment of site-specific future rainfall and temperature changes upon future soil erosion rates. Despite the crucial importance of land use, and hence vegetation cover, most previous climate change- soil erosion studies assume that land use will continue unchanged into the future (Favis-Mortlock and Guerra, 1999). Here, potential future land use scenarios for the modelled site are considered, to examine how both direct and indirect impacts of climate change may impact future soil erosion rates in Ireland.