Geophysical Research Abstracts
Vol. 20, EGU2018-3395-1, 2018
EGU General Assembly 2018

Simulating the effects of agricultural change on flow and sediment generation using SHETRAN

Veronica Escobar Ruiz (1), Hugh Smith (1), and William Blake (2)

(1) School of Environmental Science, Geography and Planning, University of Liverpool, Liverpool, UK (v.escobar-ruiz@liverpool.ac.uk), (2) School of Geography, Earth and Environmental Science, Plymouth University, Plymouth, UK

Agricultural intensification can affect catchment flow and sediment responses through increased cultivation, soil compaction, changes in land cover arrangement, and modifications to landscape structure, including changes to roads, hedges or farm dams. These changes in agricultural landscapes have been associated with increases in field-scale runoff and soil erosion, but the link to catchment-scale impacts has received less attention. This contribution aims to examine flow and sediment generation under different agricultural catchment conditions. To this end, a physically-based, spatially-distributed model, SHETRAN, was applied to two small agricultural catchments located in southeast England. Model calibration was conducted on the Blackwater catchment (18 km^2) with validation on the adjacent Kit Brook (22 km^2) catchment using 15-minute flow and turbidity measurements to compute suspended sediment fluxes for the period from September 2010 to October 2014. Calibration simulations were performed at a 50x50 m grid resolution using a 2010 land cover map where winter barley is the dominant arable crop. The effects of land cover change on flow and sediment exports were examined using eight historic land cover maps spanning 1990-2015 and for different crop types, while the potential effect of arable soil compaction were evaluated by applying permanent grassland and woodland soil hydraulic properties to arable land. Model sensitivity to changes in DEM grid resolution (200x200m, 100x100m, 50x50m and 25x25m) was also evaluated.

Model performance was accurate in terms of event timing, whereas flow and sediment event peaks, as well as flow volumes and sediment yield, were generally under predicted. Sensitivity analysis showed that an increase in grid size (50 to 200 m) led to a 40% and 10% decrease in flow peaks and volume, respectively, though more complex behaviour was observed for sediments. The comparison of simulations for past land covers showed only small variations in peak and total streamflow. In contrast, comparing the map with the highest percentage of arable land cover (38% Blackwater and 41% Kit Brook, 2007) with the lowest (13% Blackwater and 18% Kit Brook, 1990) revealed an increase of 23% and 144% in total sediment flux for the Blackwater and Kit Brook, respectively. Spring cereal and potato crops produced increases in flow and sediment events peaks with only small changes in flow volume. Removing the soil compaction effect from arable land showed reductions of up to 13% in flow and 35% in sediment export over the four year simulation period. Further analysis of flow and sediment generation as well as the effect of landscape modifications will be presented.