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What do models tell us about water and sediment connectivity?

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Recently, connectivity has emerged as a promising concept to understand the transfer of water and sediment in a catchment. Both structural connectivity – i.e. representing the connectivity of system properties such as the (micro)topography, and functional connectivity – i.e. representing connections that may change and evolve over time such as soil moisture, are important to consider. As discussed by Nunes et al. (in press), good models should be effectively connected models, i.e. represent properly the fluxes of water and sediment both within and between its fundamental spatial units. However, there is no clear framework to guide how this should be assessed. In this study we analysed changes in landscape connectivity using six well-known erosion models: Erosion3D, Fullswof, Landsoil, LISEM, MAHLERAN and Watersed. Our objective was to determine if, and how simulated connectivity is linked with model structure. The models all simulated the same, semi-virtual 124 ha watershed, loosely based on the Giser experimental agricultural watershed in Belgium. A total of 53 connectivity scenarios with differences in spatial complexity and presence of connectivity features were simulated using two rainfall events (10- and 50-year return periods). The spatial complexity was varied in terms of field size (5, 10 or 20 ha) and five different land-use patterns with tillage orientation following the axis of the fields. Finally, for mid-sized fields (10 ha) and for each of the five land-use patterns, the following connectivity features were tested: conservation tillage (i.e. orientation of fields along the contour), and presence of grass strips and a grassed waterway. We will discuss the impacts of these scenarios on overland flow and sediment connectivity for each model, in relation with its structure. In the future, these results will be used to investigate the possibility to derive more generic results using model ensembles.

Reference:
Nunes JP, Wainwright J, Bielders CL, Darboux F, Fiener P, Finger D, Turnbull L. In Press. Better models are more effectively connected models. Earth Surface Processes and Landforms doi: 10.1002/esp.4323.