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Topographic controls upon soil macropore flow

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Macropores are important components of soil hydrology. This study assessed whether hillslope-scale controls could be shown to influence patterns of macropore flow and whether macropore flow could be shown to influence hillslope-scale runoff generation. The spatial distribution of macropore flow as a proportion of saturated hydraulic conductivity was tested on six humid-temperate slopes using transects of tension infiltrometer measurements. Automated water table and overland flow monitoring allowed the timing of, and differentiation between, saturation-excess overland flow and infiltration-excess overland flow occurrence on the slopes to be determined and related to tension-infiltrometer measurements. Two slopes were covered with blanket peat, two with stagnohumic gleys and two with brown earth soils. All slopes had not been disturbed by agricultural activity within the last 20 years. This controlled the potential for tillage impacts on macropores. The proportion of near-surface macropore flow to saturated hydraulic conductivity was found to vary according to slope position. The spatial patterns were not the same for all hillslopes. On the four non-peat slopes there was a relationship between locations of overland flow occurrence and reduced macroporosity. This relationship did not exist for the peat slopes investigated because they experienced overland flow across their whole slope surfaces. Nevertheless, they still had a distinctive spatial pattern of macropore flow according to slope position. For the other soils tested, parts of slopes which were susceptible to saturation-excess overland flow (e.g. hilltoes or flat hilltops) tended to have least macropore flow. To a lesser extent, for the parts of slopes susceptible to infiltration-excess overland flow, the proportion of macropore flow as a component of infiltration was also smaller compared to the rest of the slope. The roles of macropore creation and macropore infilling by sheet wash are discussed, and it is noted that the combination of these may result in distinctive topographically controlled spatial patterns of macropore flow.