IAHS2017-63
IAHS Scientific Assembly 2017

Understanding groundwater/surface-water interactions through hydropedological interpretations of soil distribution patterns

Johan van Tol
University of the Free State, Soil, Crop and Climate Sciences, South Africa (vantoljj@ufs.ac.za)

Implementation of the water policies and management of water resources require the understanding, characterisation and quantification of groundwater/surface water interactions. Accurate characterisation of the groundwater contribution to surface resources are complicated by the heterogeneity of aquifers and the fact that flow through fractured rock are often the dominant pathway in many catchments. Characterisation of groundwater/surface water interactions typically involves the geomorphic description of the catchment, hydrograph separation and geochemistry. These are absent in ungauged basins. Soils, a first order control in partitioning of hydrological flowpaths, are often ignored in these studies. In this paper it is argued that hydropedological interpretation of soil information can contribute to the characterization of groundwater/surface water interactions and since soil information is readily available can contribute to predictions in ungauged basins. To test this argument, long term streamflow records were used to determine the contribution of groundwater to streamflow in 21 catchments by Ebrahim et al (2016). The catchments are diverse in terms of area (22 – 696 km¬2), climate (rainfall between 640 – 1048 mm.y-1) and spatial distribution. The Baseflow Index (BFI) and Coefficient of Variation in Baseflow (CBV) were selected as hydrological variables in this study. Soils and soil distribution patterns within the catchments were obtained from the Land Type database of South Africa. The soil types were related to their dominant hydropedological response and re-grouped into four hydropedological classes: recharge (freely drained – vertical flow dominant); interflow (lateral flow dominant); wet responsive (overland flow due to saturation excess dominant) and shallow responsive (overland flow due to infiltration excess dominant). A total of 188 land type inventories were interpreted. The dominant hydropedological soil distribution pattern for each catchment were determined by average weighing. Significant ($p < 0.05$) positive correlations exists between the coverage of recharge soils, average soil depth and average clay content, implying that recharge soils do indeed recharge groundwater stores and thereby contribute to baseflow. These variables were negatively correlated with CVB. Significant negative correlations exists between the coverage of interflow soils as well as shallow responsive soils and BFI. These variables significantly increased the CVB as well. Subsurface lateral flow is therefore associated with stormflow in these catchments and not baseflow. Interestingly there were no significant correlations between rainfall or catchment area and BFI or CVB. The results proof that hydropedological interpretation of soils and their spatial distribution can contribute to the understanding and characterization of groundwater/surface water interactions and might especially be useful for predictions in ungauged basins.