



Time-variable Travel Time Distributions and StorAge Selection functions of three lowland catchments

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A large fraction of stream water derives from groundwater of which the contribution is variable in time and space. This groundwater contribution consists of different flow paths with distinctive travel times which form a catchment's Travel Time Distribution (TTD). Using a high-resolution spatially distributed groundwater flow model, we calculated dynamic TTDs of three lowland catchments in the Netherlands and used these to construct StorAge Selection (SAS) functions to describe the variable mixing of flow paths in the catchment storage. The interplay between the activation of shallow flow paths and the intensification of flow paths with rising groundwater levels was found to control the dynamic TTDs. The catchments showed a preference for the discharge of the younger water, which appeared to be controlled by the drainage density. The shape of the SAS functions was shown to be influenced by geology and topography, while the temporal variation in the SAS functions was controlled by the activation of shallow flow paths. We also found spatial differences in the catchment mixing between up- and downstream sections. We computed realistic values for the dynamics in SAS functions of lowland catchments, which is needed for construction of dynamic TTDs. These dynamic TTDs are important for understanding the heterogeneous behaviour of streams, their water quality and their ecological functioning.