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Which factors, processes and storages influence low flow (Q347)?

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In Switzerland, estimation of residual water is based on Q347 (flow exceeded during 347 days per year). In ungauged catchments Q347 has to be determined with some simplified approaches. However, these statistical models often provide inaccurate results.

The runoff reaction of a river depends on the spatial distribution of the Dominant Runoff Processes (DRP) like Hortonian Overland Flow (HOF), Saturated Overland Flow (SOF), Sub-Surface Flow (SSF) or Deep Percolation (DP) within its catchment area. Low flow is fed by slowly reacting groundwater or deep hillslope storages. These storages are supposed to be located mainly beneath permeable soils in highly permeable bedrock like talus, deposits of debris flows or rock fall, gravel of river deposits, lateral moraines or karst systems, represented in DRP-maps by slowly reacting SOF3-, SSF3- or DP- areas. To better understand these mechanisms, the relation between areas of slowly reacting SOF3, SSF3, DP and the form of the recession curves was analysed in 27 catchments of Swiss Plateau and Jura. Results show, that drainage characteristics and percentage of SOF3-, SSF3- and DP- areas in catchments relate well. The more extended the recharge areas, the smoother and longer the recession curves. For example the recession to Q347 in the Eulach River (Area of SOF3, SSF3, DP = 54%) takes 95 days, in the Töss River only 10 days (Area of SOF3, SSF3, DP = 9%).

However, the differences in Q347 cannot be explained with these percentages. The runoff volume from Q347 to Q365 in 14 investigated catchments is only between 0.2 and 14 mm, about 1.5% of the annual precipitation volume. It seems that the storages mentioned above do not contribute significantly any more, when the discharge falls below Q347.

It was found that catchments with high Q347 consist mainly of sandstone, conglomerate or large scaled wetlands. It seems that mainly porous and fissured solid rocks contribute to Q347. Very small Q347 are usually caused by seepage loss of water in the riverbed.