

Low flow in Switzerland: analyses by the Federal Office for the Environment

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The general definition of drought is “a sustained and regional extensive occurrence of below average natural water availability” (Tallaksen & Lanen, 2004). If, as part of this, a streamflow deficit develops we speak of a hydrological drought. Summer 2003 and winter 2005/06 have shown recently that hydrological drought can also become a problem in a country like Switzerland, where normally the availability of water is no topic.

Depending on whether the hydrological drought is occurring in summer or winter, the causes but also the effects are different. While in summer, in catchment basins without snow- or glaciermelt, the consequences of a precipitation deficit are aggravated by high temperature, low flows in winter can be the result of cold temperatures, when all precipitation falls as snow. The same hydrological drought can have serious effects on agriculture in summer but be of no importance in winter. This is also true for other socio-economic or ecological consequences of a drought situation. In addition, the threshold at which a streamflow deficit gets critical is highly depending on the problem which is analysed. These are the reasons why no single drought characteristic is suitable to describe droughts for any type of studies in any region. Consequently, a lot of different methods exist.

Due to the fact that it is used in legislation on water protection, the best known low flow characteristic in Switzerland is Q_{347} , the 95-percentile flow from the flow duration curve. Several studies made by FOEN concentrated on this value (e.g. Aschwanden & Kan, 1999). To calculate estimates of T-year events, other parameters are more suitable. In recent years, FOEN has calculated a low flow statistic based on time series of annual minimum values according to DVWK recommendations (DVWK, 1983). The annual values of the lowest mean of runoff over a given number of days x (1, 7, 14 and 30), the so called NM_xQ , are saved for the time series of over 300 runoff-measuring stations in a special database (NQStat-DB) which also allows the calculation of T-year-events. The values are updated every year.

The NQStat-DB was used as basis for a table in the Hydrological Atlas of Switzerland (Kan et. al, in prep.). On three maps, different aspects of $NM7Q$ are shown for the period 1984-2003. Apart from the mean of $NM7Q$ over this period, the $NM7Q$ of each non-influenced gauging station set in comparison to the Mean Flow (MQ) is displayed. The third map shows the seasonality of $NM7Q$. Additionally, some time series diagrams of $NM7Q$ demonstrate long and short term fluctuations.

Following the drought event in summer 2003 the NQStat-DB was used to calculate the return period of the observed runoff-values in all non-influenced catchment basins

(BUWAL et. al, 2004). The mainly touched basins are situated in the north-eastern part of Switzerland and in Jura. In detail, the spatial variability is very high. Due to local predisposition (exposure, relief, soil storage capacity, snow storage etc.) even neighbouring catchments can react very differently to the same meteorological drought event observed over a wide area. A comparison with other dry years shows that, from the hydrological point of view, 2003 was not that exceptional. Since the beginning of systematic runoff measurements around 1900, some other years were more affected, e.g. 1947. Nevertheless, the hydrological drought 2003 was rather pronounced and the consequences on different ecological and socio-economic questions were – at least locally – of very high importance.

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