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LFSTAT - Low-Flow Analysis in R

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The calculation of characteristic stream flow during dry conditions is a basic requirement for many problems in hydrology, ecohydrology and water resources management. As opposed to floods, a number of different indices are used to characterise low flows and streamflow droughts. Although these indices and methods of calculation have been well documented in the WMO Manual on Low-flow Estimation and Prediction [1], a comprehensive software was missing which enables a fast and standardized calculation of low flow statistics. We present the new software package lfstat to fill in this obvious gap. Our software package is based on the statistical open source software R, and expands it to analyse daily stream flow data records focusing on low-flows. As command-line based programs are not everyone's preference, we also offer a plug-in for the R-Commander, an easy to use graphical user interface (GUI) provided for R which is based on tcl/tk.

The functionality of lfstat includes estimation methods for low-flow indices, extreme value statistics, deficit characteristics, and additional graphical methods to control the computation of complex indices and to illustrate the data. Beside the basic low flow indices, the baseflow index and recession constants can be computed. For extreme value statistics, state-of-the-art methods for L-moment based local and regional frequency analysis (RFA) are available. The tools for deficit characteristics include various pooling and threshold selection methods to support the calculation of drought duration and deficit indices. The most common graphics for low flow analysis are available, and the plots can be modified according to the user preferences. Graphics include hydrographs for different periods, flexible streamflow deficit plots, baseflow visualisation, recession diagnostic, flow duration curves as well as double mass curves, and many more.

From a technical point of view, the package uses a S3-class called lfobj (low-flow objects). This objects are usual R-data-frames including date, flow, hydrological year and possibly baseflow information. Once these objects are created, analysis can be performed by mouse-click and a script can be saved to make the analysis easily reproducible. At the moment we are offering implementation of all major methods proposed in the WMO manual on Low-flow Estimation and Predictions [1]. Future plans include a dynamic low flow report in odt-file format using odf-weave which allows automatic updates if data or analysis change. We hope to offer a tool to ease and structure the analysis of stream flow data focusing on low-flows and to make analysis transparent and communicable. The package can also be used in teaching students the first steps in low-flow hydrology. The software packages can be installed from CRAN (latest stable) and R-Forge: http://r-forge.r-project.org (development version).

References:

[1] Gustard, Alan; Demuth, Siegfried, (eds.) Manual on Low-flow Estimation and Prediction. Geneva, Switzerland, World Meteorological Organization, (Operational Hydrology Report No. 50, WMO-No. 1029).