Short Introduction to RcmdrPlugin.lfstat:

An R Commander plug-in for package lfstat to calculate low flow statistics for daily stream flow data[1]

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Summary:

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], comprehensive software was missing which enables a fast and standardized calculation of low flow statistics. We give here a short introduction to our software packages *lfstat* and *RcmdrPlugin.lfstat* which were compiled 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 offer a plug-in for the R-Commander, an easy to use graphical user interface (GUI) provided for R which is based on the tcl/tk package.

Reference:
[1] Gustard, A. & Demuth, S. (2009) (Eds) Manual on Low-flow Estimation and Prediction. Operational Hydrology Report No. 50, WMO-No. 1029, 136p.

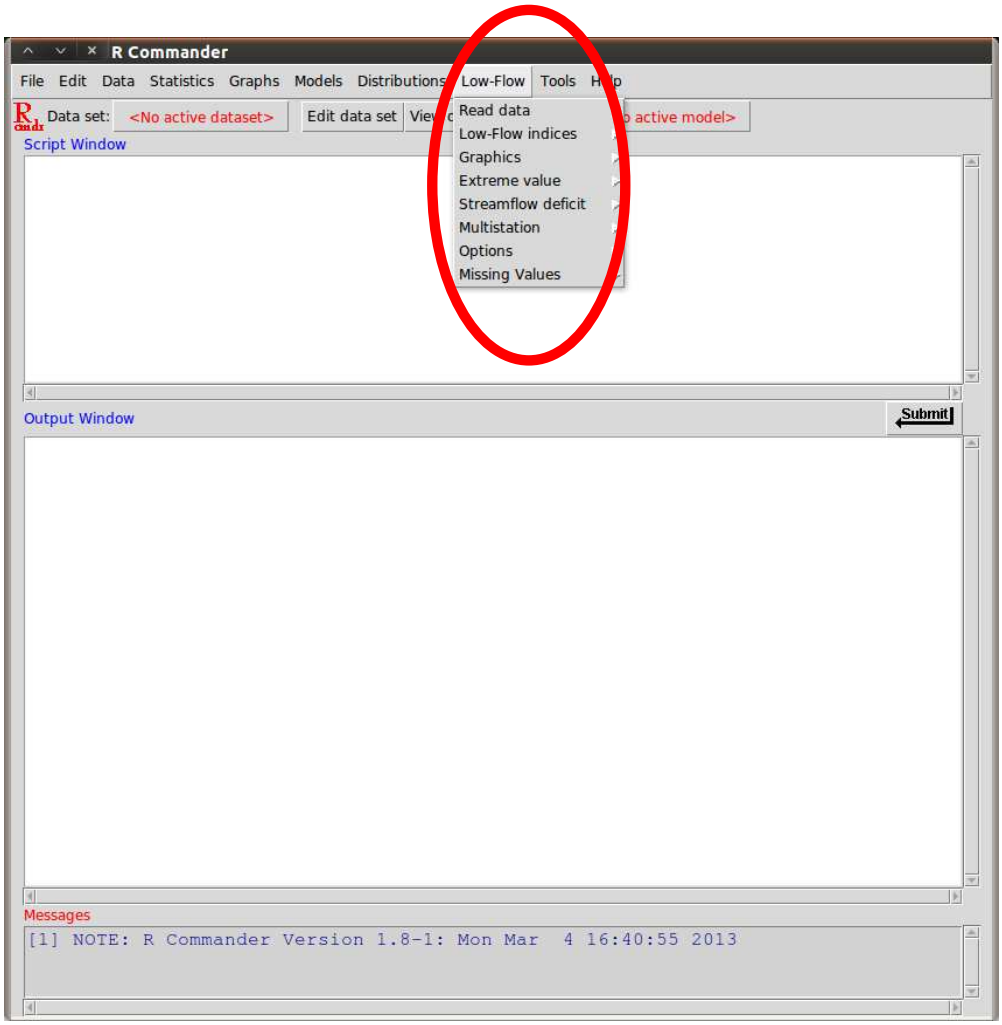
[1] The software packages are funded by the UNESCO and WMO funded project “Low flow and Drought software tool”. This short introduction is for version 0.1 (February/March 2013).

Introduction

The *RcmdrPlugin.lfstat* accesses the basic functionality of the low flow software package *lfstat* through a graphical user interface (GUI). The basic interface is John Fox's Rcmdr. The plug-in adds a „Low-flow“ menu where the functions of *lfstat* are implemented for easier application through menu control. After running a command the R syntax is displayed in the script window, what is a useful functionality for getting started with the powerful R programming language and/or the specific syntax of package *lfstat*.

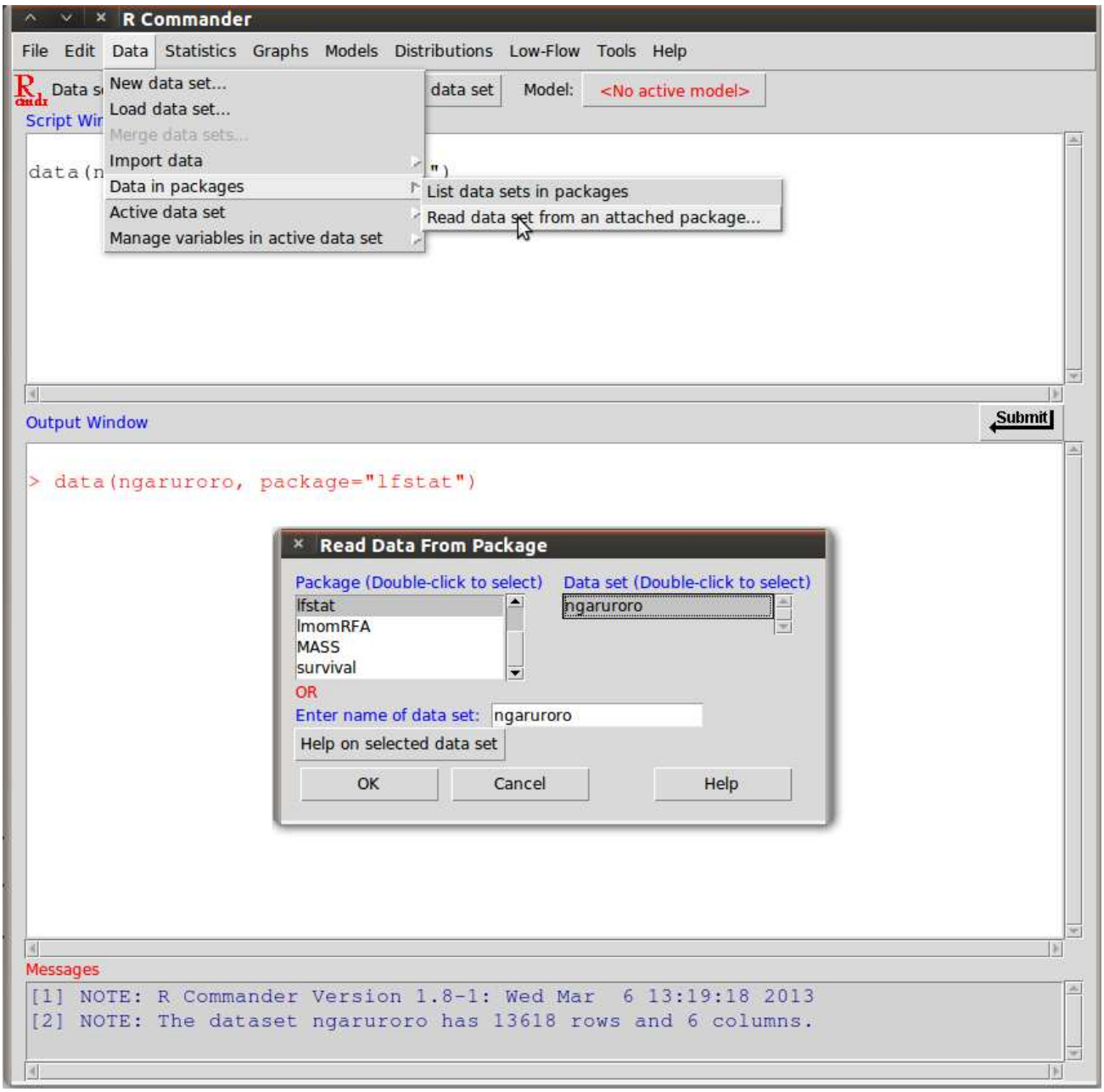
The *RcmdrPlugin.lfstat* can be installed from the CRAN web repository and started by entering the following commands in the R command line:

```
install.packages("lfstat")
install.packages("RcmdrPlugin.lfstat")
require(lfstat)
require(RcmdrPlugin.lfstat)
```



Example data set

For exploring lfstat and the R Commander plug-in we have added an example dataset of station Ngaruroro to the software package. The data set consists of a daily discharge series from 1963-2000 and the information is stored in the variables (columns) day, month, year, flow. The figure below illustrates how the data set can be loaded. Use button “View data set” from R Commander GUI for viewing the data.



Data import

R and the R-Commander offer various methods of reading data in different formats like Excel, SPSS, csv, etc. For most countries, the national hydrological service provides streamflow data in standardised ASCII-files similar to the following Global Runnoff Data Centre (GRDC) file format:

```
# Title: GRDC STATION DATA FILE
# Format: DOS-ASCII
# GRDC-No.: 9104020
# River: LABE
# Station: DECIN
# Country: CZ
YYYY-MM-DD;hh:mm; Original; Calculated; Flag
1887-11-01;--:--; 78.000; -999.000; -999
1887-11-02;--:--; 79.000; -999.000; -999
```

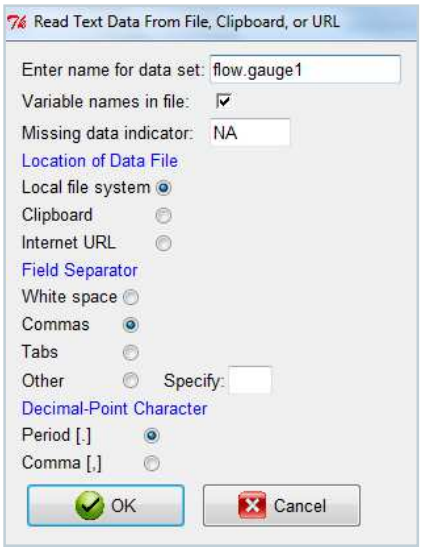
We aim to provide a direct reading method for as much of these standards as possible. At the moment the following three national formats are supported:

GRDC; HZB (Austria); LfU-Bayern (Germany)

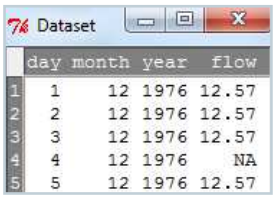
For all other cases, it is recommended to use flow data in csv format for import. The data need to have a matrix structure of at least 2 columns (common standard: row = day, column=variable), where the measured daily flows are stored in one column. Days without measurement need to be contained in the dataset, coded by a missing value code (standard: no value = NA, but this can be customized during the data import). On this basis, the csv data import consists of two steps:

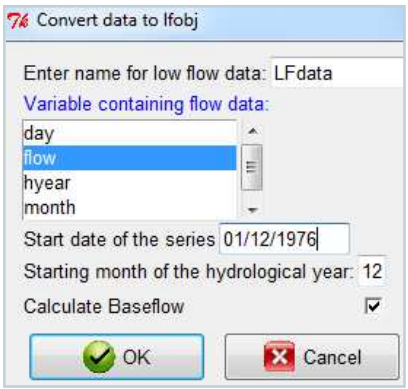
Step 1: Data -> Import data -> from text file

ii. Chose a name for the new dataset (no spaces)
iii. Specify the import format (field separator, decimal-point)
The figure (right) shows the settings for csv import.
iv. OK -> browse and select data file for import.
v. Message window: are there any errors?
vi. Do the number of rows and columns look as expected?
vii. View the data via View data set button.



Step 2: Low-Flow -> Read data -> Convert active data set to lfobj





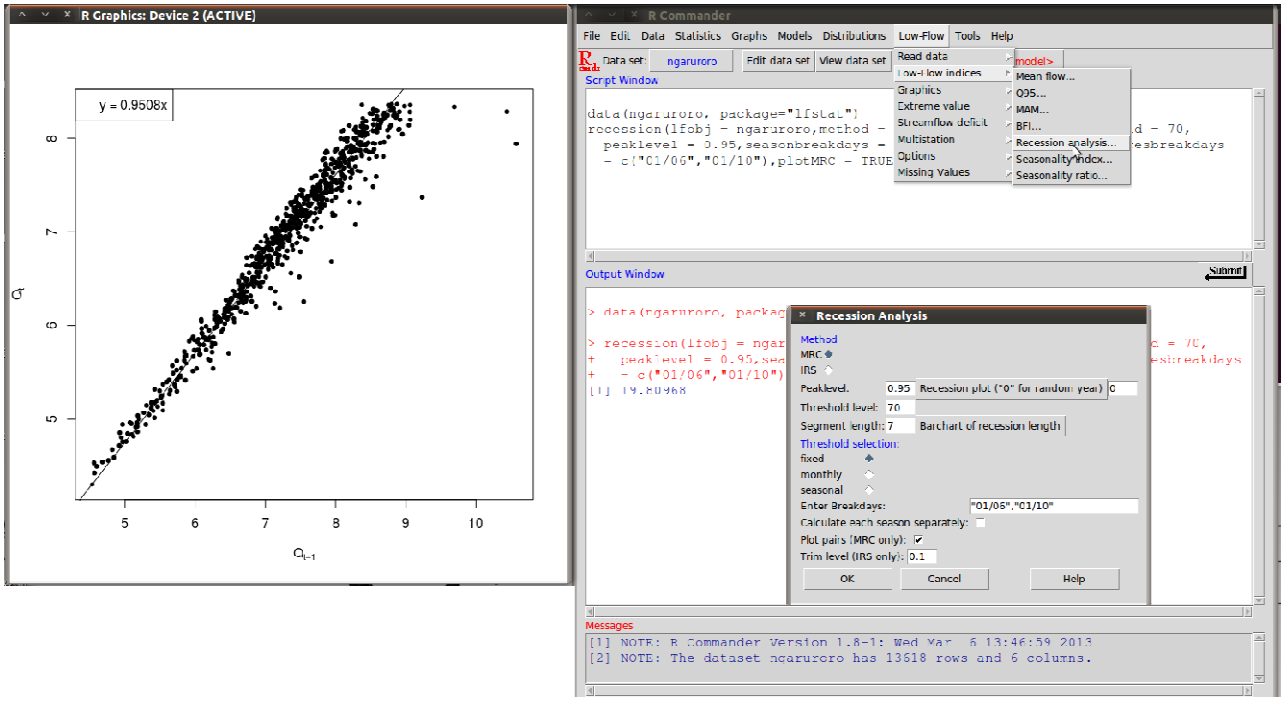
Low flow indices

For all analyses the data need to be stored as class *lfobj*. How to crate a data object of class lfobj is explained in section data import. 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.

The menu *Low flow indices* offers calculation routines of the following commonly used flow indices:

- Mean flow
- Q95
- MAM
- BFI
- recession constants

In addition the seasonality index and seasonality ratio can be computed. The figure below illustrates the estimation of the base flow recession constant through the menu item *Recession analysis…*

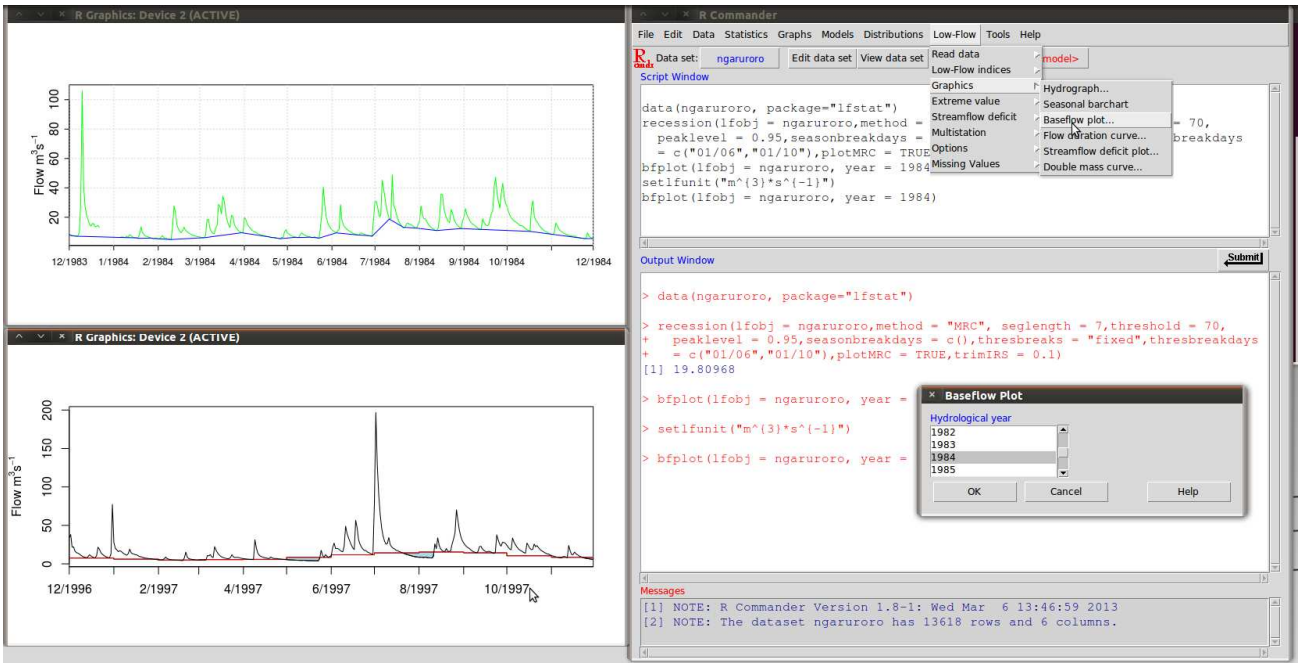


Graphics

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 diagnostics, flow duration curves as well as double mass curves. These functions can be accessed through the following menu items:

- Hydrograph
- Seasonal barchart
- Baseflow plot
- Flow duration curve
- Streamflow deficit plot
- Double mass curve

The figure below illustrates the computation of the *Baseflow plot* for station Ngaruroro.



Extreme value statistics

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 figure below shows the calculation of a T-year event (here return period T = 100 years) for station Ngaruroro.