Comprehensive analysis and separation of river hydrograph using the **grwat** R package

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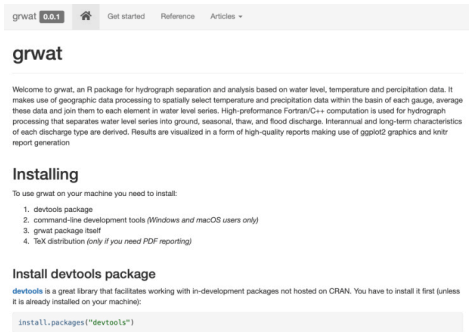
grwat is a comprehensive set of programming tools aimed at analysis of river hydrograph



What's inside

More than 25 functions to automate hydrograph separation, analyze and visualize inter-annual and long-term changes

gr_animate()	Animate discharge through years
gr_baseflow()	Extracts baseflow for discharge
gr_fill_gaps()	Fill missing water discharge data using linear interpolation
gr_get_params()	Get default separation parameters for selected region
gr_help_vars()	Get hydrograph parameters list
gr_join_interim()	Join ERA-INTERIM data to hydrological level series
gr_kable_tests()	Kable p-values table by coloring it using green-yellow-red palette
gr_map()	Map reanalysis and basin data
gr_plot_minmonth()	Plot histogram of minimum discharge month for two periods
gr_plot_periods()	Plot long-term changes of hydrograph variables for two periods
gr_plot_separation()	Plot hydrograph separation
gr_plot_ss()	Plot scale-space tree of hydrograph
gr_plot_tests()	Plot change year density
gr_plot_vars()	Plot interannual parameters
gr_proc_basins()	Join reanalysis data based on geographic location and time
gr_proc_gauge()	Process gauge directory
gr_read_interim()	Read ERA-INTERIM reanalysis NetCDF files with temperature and precipitation
gr_read_sep()	Read file with hydrograph separation
gr_read_vars()	Read file with hydrograph variables
gr_report_basins()	Generate reports with detailed hydrograph analysis
gr_report_gauge()	Generate report for the specified gauge folder
gr_separate()	Separates river hydrograph
gr_set_params()	Change separation parameters through graphical interface
gr_ss()	Perform scale-space transform of hydrograph
gr_ss_tree()	Get scale-space tree data frame from Scale4C object
gr_summarize()	Calculate various summary stats for separated hydrograph
gr_test_vars()	Run various tests on interannual characteristics. Required number of observations for various tests: Pettitt > 0, Mann.Kendall > 2, Theil-Sen slope > 1, Student > 1,
st_buffer_geo()	Buffer sf objects in geographic coordinates through conic projection

http://tsamsonov.github.io/grwat

The study was supported by the Russian Science Foundation grant No. 19-77-10032

gr_fill_gaps()

Fills gaps in observations based on threshold autocorrelation value

29	29	1	1946	13.5	-13.25	0.033	29	29	1	1946	13.5	-13.2	0.0
30	30	1	1946	13.3	-11.03	0.095	30	30	1	1946	13.3	-11.0	0.1
31	31	1	1946	13.3	-15.40	0.155	31	31	1	1946	13.3	-15.4	0.2
32	1	2	1946	NA	-15.30	0.326	32	1	2	1946	13.2	-15.3	0.3
33	2	2	1946	NA	-13.26	0.425	33	2	2	1946	13.1	-13.3	0.4
34	3	2	1946	NA	-7.10	1.243	34	3	2	1946	13.1	-7.1	1.2
35	4	2	1946	NA	-2.42	1.246	35	4	2	1946	13.0	-2.4	1.2
36	5	2	1946	NA	-1.93	1.159	36	5	2	1946	12.9	-1.9	1.2
37	6	2	1946	12.8	-5.13	0.956	37	6	2	1946	12.8	-5.1	1.0
38	7	2	1946	13.0	-27.26	0.405	38	7	2	1946	13.0	-27.3	0.4
39	8	2	1946	13.0	-37.62	0.153	39	8	2	1946	13.0	-37.6	0.2

gr_summarize()

Aggregates hydrograph data by each water-resources year resulting in more than 50 useful variables

	Year	Year1	Year2	datestart	datepolend	polprod	Qy	Qmax	datemax	Qygr	Qmmsummer	monmmsummer	Qmmwin	nommwin
1	1946	1946	1947	1946-04-11	1946-05-20	39 days	68.99302	1250	1946-04-30	19.881982	7.8	7	8.6	8
2	1947	1947	1948	1947-04-04	1947-05-24	50 days	83.35204	1610	1947-04-28	20.239717	7.4	8	8.3	6
3	1948	1948	1949	1948-04-05	1948-05-14	39 days	55.68692	943	1948-04-13	18.070650	11.0	8	8.0	8
4	1949	1949	1950	1949-04-07	1949-05-23	46 days	49.44258	1100	1949-05-01	9.927366	6.2	7	4.8	6
5	1950	1950	1951	1950-04-06	1950-05-08	32 days	47.37718	436	1950-04-22	16.549616	6.8	5	7.3	8
6	1951	1951	1952	1951-03-27	1951-05-07	41 days	49.36477	694	1951-04-07	16.536378	6.9	8	7.9	4
7	1952	1952	1953	1952-04-16	1952-06-02	47 days	116.15257	991	1952-04-30	28.440327	16.8	5	15.0	8
8	1953	1953	1954	1953-04-01	1953-05-06	35 days	97.55805	1070	1953-04-22	26.575056	15.8	7	11.2	7
9	1954	1954	1955	1954-04-15	1954-05-14	29 days	62.12916	520	1954-04-22	21.605693	11.6	8	12.2	6
10	1955	1955	1956	1955-04-17	1955-06-09	53 days	95.38169	1240	1955-05-01	25.812738	13.5	9	8.5	7
11	1956	1956	1957	1956-04-17	1956-06-04	48 days	84.59313	1040	1956-05-04	22.591212	18.3	8	15.4	8
12	1957	1957	1958	1957-04-16	1957-05-15	29 days	103.96213	1430	1957-05-02	31.511612	15.8	7	16.7	8

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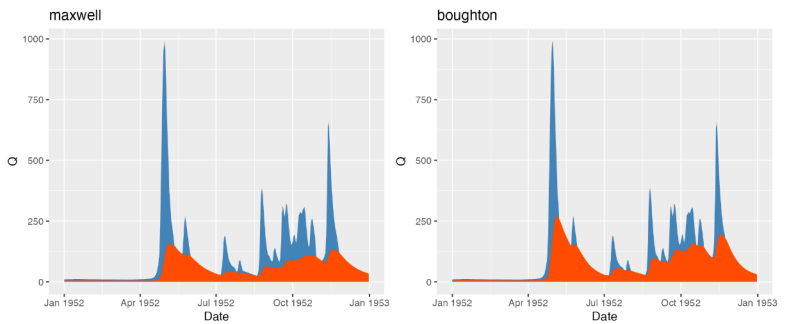
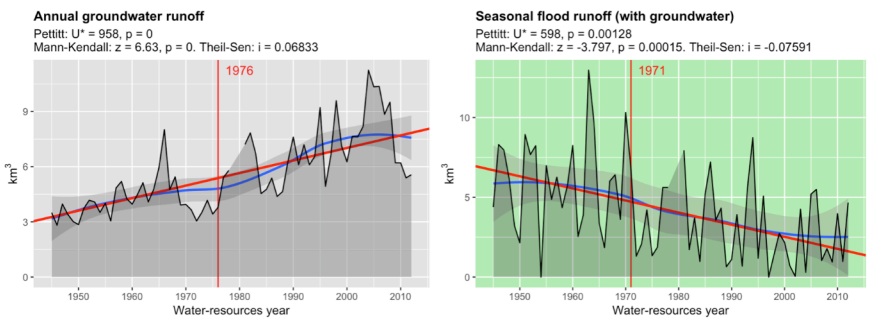
gr_baseflow()

Separates hydrograph into baseflow and quickflow using numerous parameterized methods



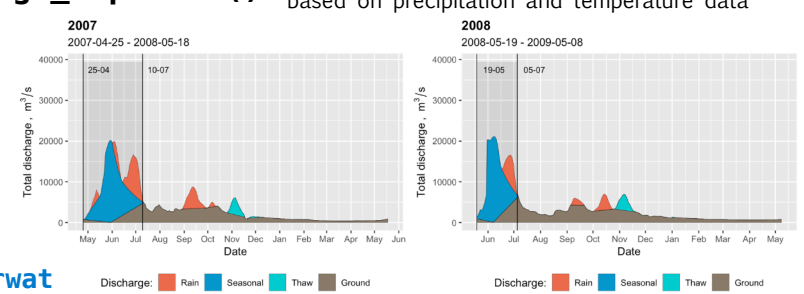
gr_plot_vars()

Visualizes interannual variable changes with Mann-Kendall, Pettitt and Theil-Sen tests



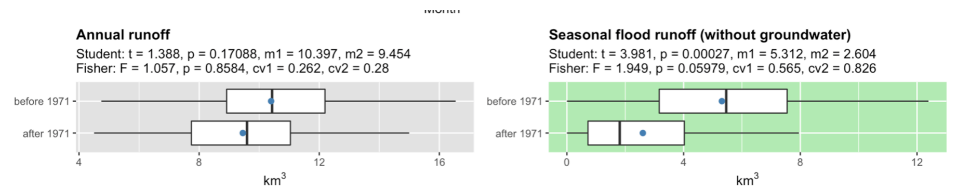
gr_separate()

Separates discharge using the original method based on precipitation and temperature data



gr_plot_periods()

Visualizes long-term changes of variables separated into two periods calculated by Pettitt test



gr_kable_tests()

Fancy tabular reports on long-term changes

p-values of statistical criteria

N	Variable	Change.Year	Trend	Mann.Kendall	Pettitt	Student	Fisher
1	Annual runoff	1971	-0.0079	0.68216	0.7195	0.17088	0.8584
2	Seasonal flood runoff (without groundwater)	1971	-0.07467	0.00012	0.00189	0.00027	0.05979
3	Annual groundwater runoff	1976	0.06833	0	0	0	0.00211