

Goodness-of-fit Measures to Compare Observed and Simulated Values with hydroGOF

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1 Installation

Installing hydroGOF:

```
> install.packages("hydroGOF")
```

2 Setting Up the Environment

1. Loading the *hydroGOF* library, which contains data and functions used in this analysis.

```
> library(hydroGOF)
```

2. Loading observed streamflows of the Ega River (Spain), with daily data from 1961-Jan-01 up to 1970-Dec-31

```
> require(zoo)
> data(EgaEnEstellaQts)
> obs <- EgaEnEstellaQts
```

3. Generating a simulated daily time series, initially equal to the observed values (simulated values are usually read from the output files of the hydrological model)

```
> sim <- obs
```

4. Computing the numeric goodness-of-fit measures for the "best" (unattainable) case

```
> gof(sim=sim, obs=obs)
```

```
      [,1]
ME      0
MAE     0
MSE     0
RMSE    0
NRMSE % 0
PBIAS % 0
```

```

RSR      0
rSD      1
NSE      1
mNSE     1
rNSE     1
d        1
md       1
rd       1
cp       1
r        1
R2       1
bR2      1
KGE      1
VE       1

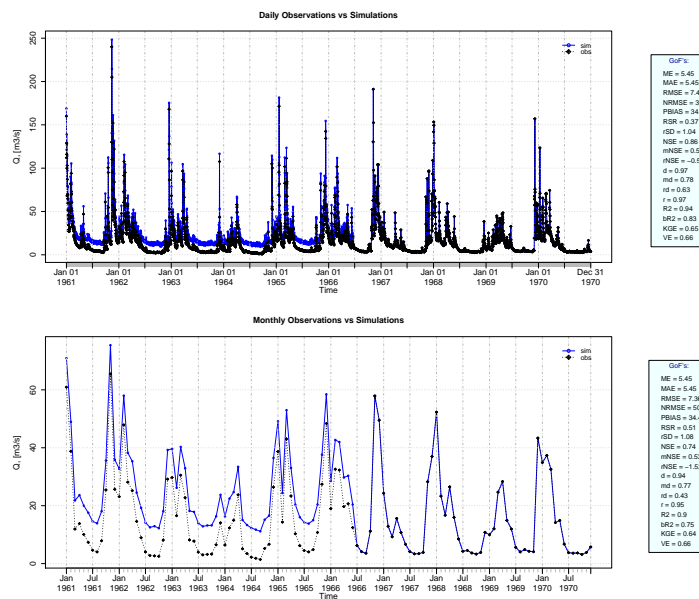
```

- Randomly changing the first 2000 elements of 'sim', by using a normal distribution with mean 10 and standard deviation equal to 1 (default of 'rnorm').

```
> sim[1:2000] <- obs[1:2000] + rnorm(2000, mean=10)
```

- Plotting the graphical comparison of 'obs' against 'sim', along with the numeric goodness-of-fit measures for the daily and monthly time series

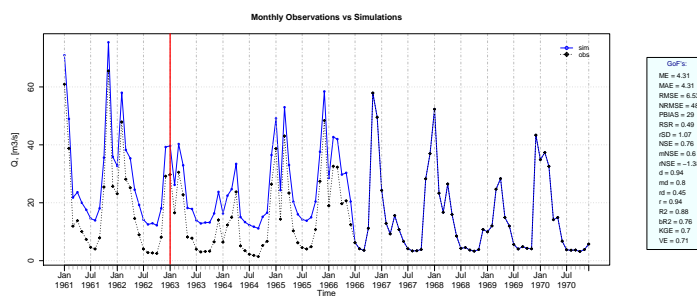
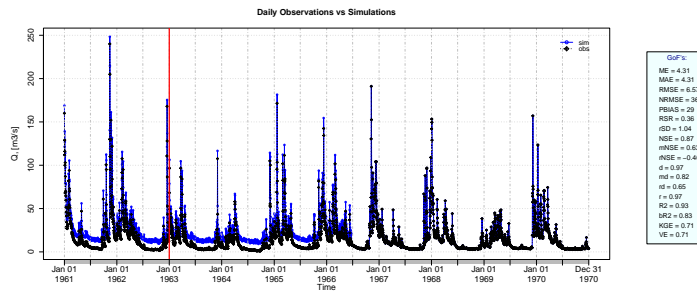
```
> ggof(sim=sim, obs=obs, ftype="dm", FUN=mean)
```



3 Removing Warm-up Period

- Using the first two years (1961-1962) as warm-up period, and removing the corresponding observed and simulated values from the computation of the goodness-of-fit measures:

```
> ggof(sim=sim, obs=obs, ftype="dm", FUN=mean, cal.ini="1963-01-01")
```



2. Verification of the goodness-of-fit measures for the daily values after removing the warm-up period:

```
> sim <- window(sim, start=as.Date("1963-01-01"))
> obs <- window(obs, start=as.Date("1963-01-01"))
> gof(sim, obs)
```

```

      [,1]
ME      4.31
MAE     4.31
MSE    43.15
RMSE    6.57
NRMSE % 36.10
PBIAS % 29.00
RSR     0.36
rSD     1.04
NSE     0.87
mNSE    0.63
rNSE    -0.46
d       0.97
md      0.82
rd      0.65
cp      0.45
r       0.97
R2      0.93
bR2     0.83
KGE     0.71
VE      0.71
```

4 Analysis of the Residuals

1. Computing the daily residuals (even if this is a dummy example, it is enough for illustrating the capability)

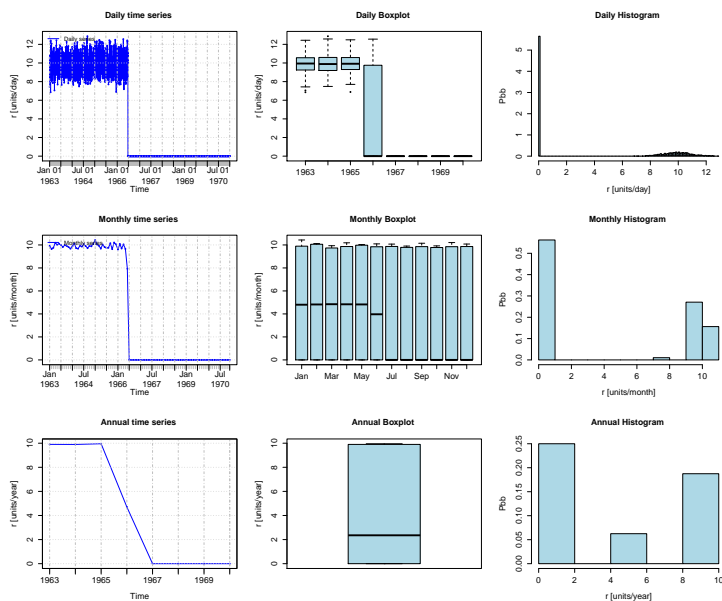
```
> r <- sim-obs
```

2. Summarizing and plotting the residuals (it requires the hydroTSM package):

```
> library(hydroTSM)
> smry(r)
```

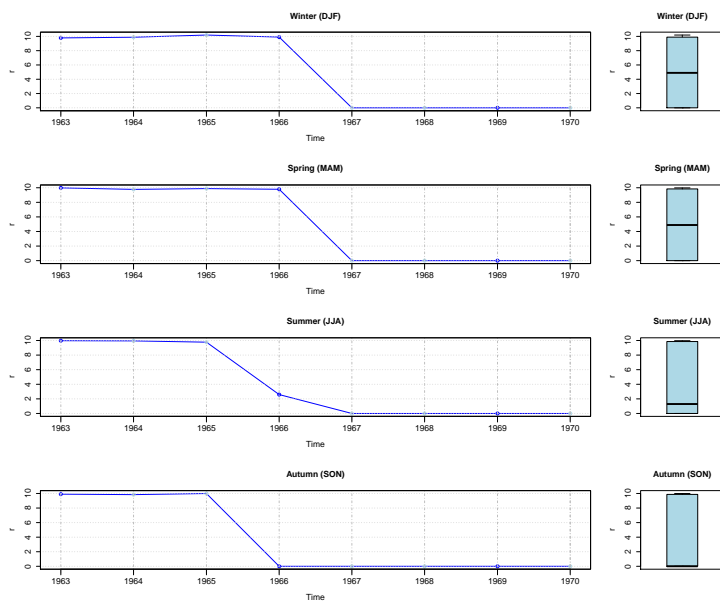
	Index	r
Min.	1963-01-01	0.0000
1st Qu.	1964-12-31	0.0000
Median	1966-12-31	0.0000
Mean	1966-12-31	4.3080
3rd Qu.	1968-12-30	9.7320
Max.	1970-12-31	12.8700
IQR	<NA>	9.7316
sd	<NA>	4.9595
cv	<NA>	1.1512
Skewness	<NA>	0.3179
Kurtosis	<NA>	-1.8283
NA's	<NA>	2.0000
n	<NA>	2922.0000

```
> # daily, monthly and annual plots, boxplots and histograms
> hydroplot(r, FUN=mean)
```



3. Seasonal plots and boxplots

```
> # daily, monthly and annual plots, boxplots and histograms  
> hydroplot(r, FUN=mean, pfreq="seasonal")
```



This tutorial was built under:

- [1] "x86_64-pc-linux-gnu (64-bit)"
- [1] "R version 3.0.2 (2013-09-25)"
- [1] "hydroGOF 0.3-8"