Appendix 24. Weighted Regressions on Time, Discharge, and Season Model Evaluation and Trend Analysis Graphical Output for Total Organic Carbon during January 1, 1999, through December 31, 2019

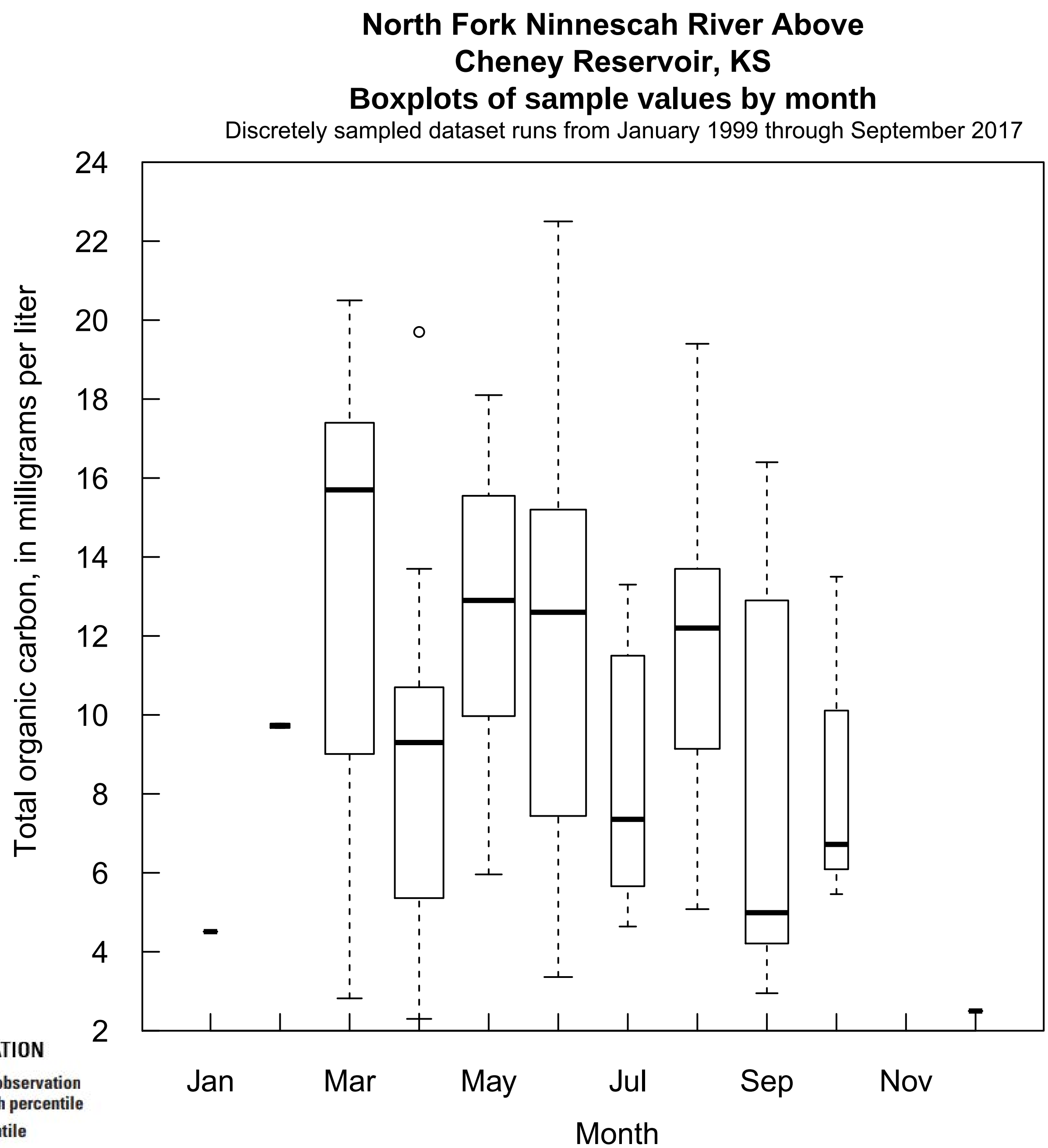
All graphics were produced using R programming language (R Core Team, 2019) and the Exploration and Graphics for RivEr Trends (EGRET) and EGRETci packages. More information on these packages and methods can be found in Hirsch and De Cicco (2015) and Hirsch and others (2015).

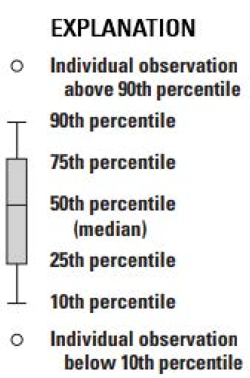
Functions used to produce the following outputs are included as text preceding the graphic.

Total Organic Carbon (00680)

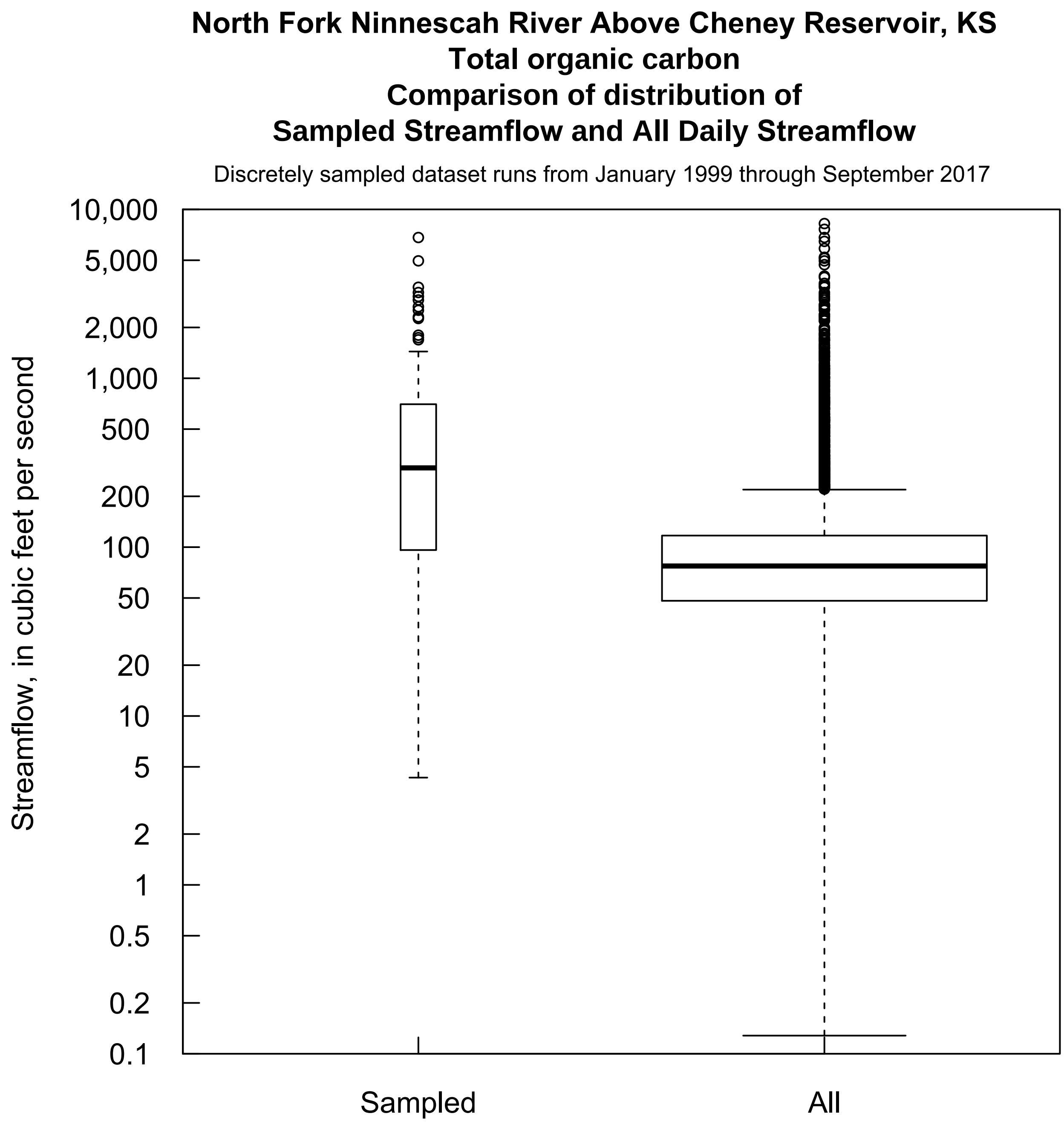
Sample Data

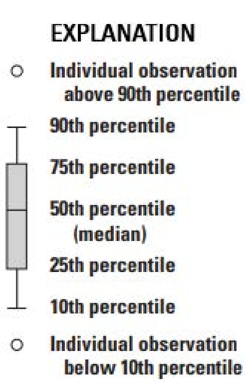
```
boxConcMonth(wrtds)
```



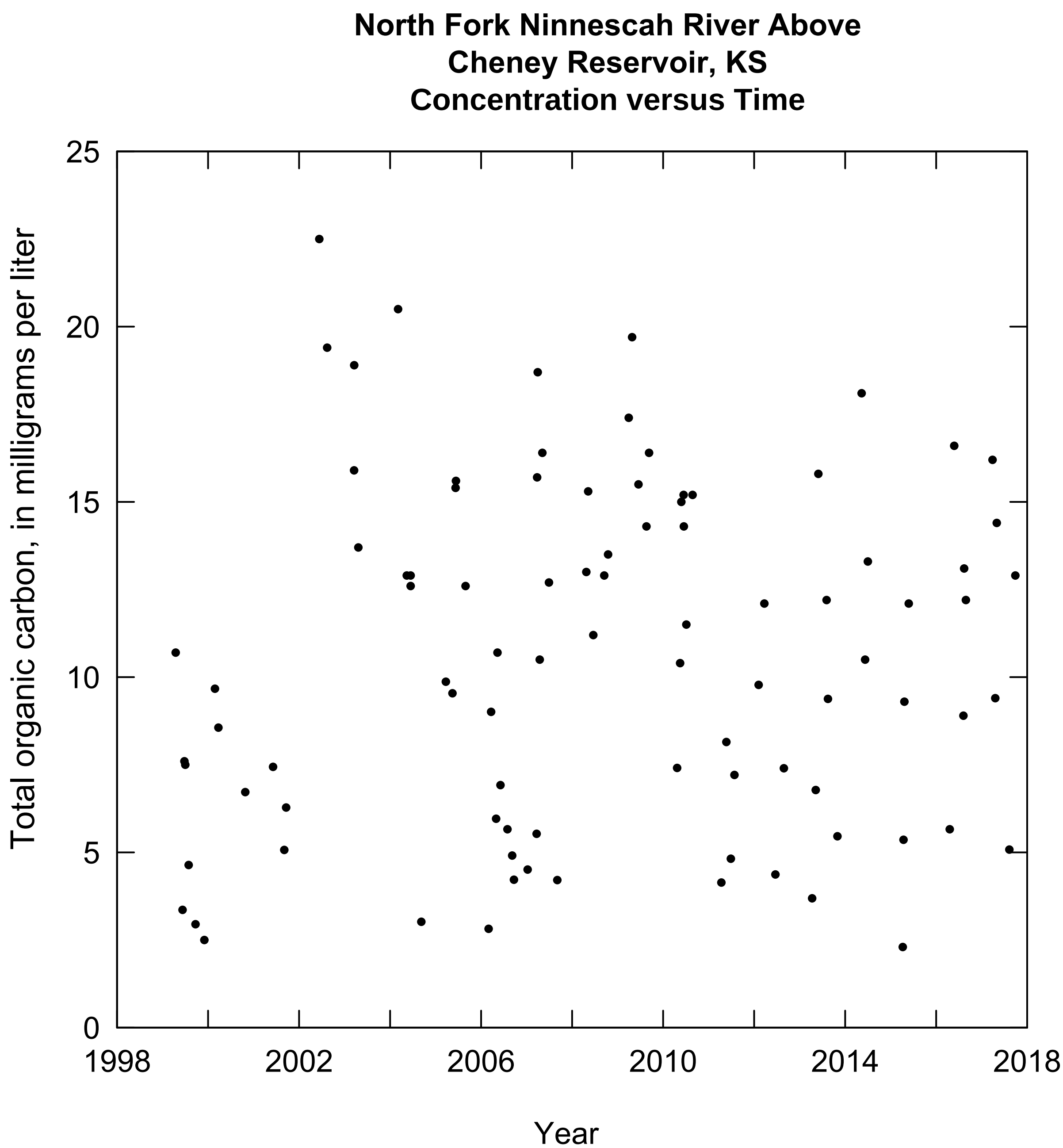


```
boxQTwice(wrtds, qUnit=1)
```

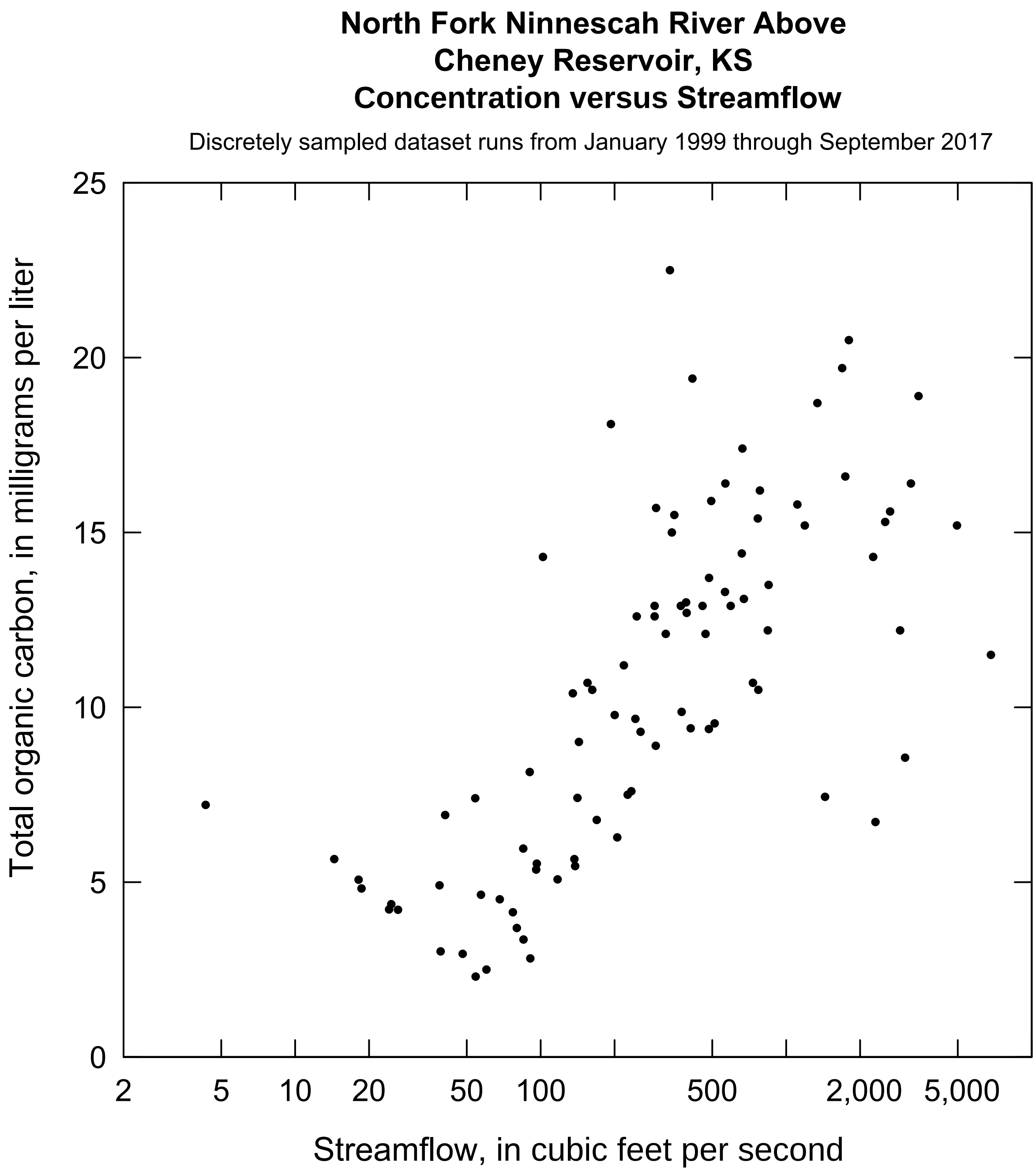




```
plotConcTime(wrtds)
```



```r
plotConcQ(wrtds, qUnit=1)
```



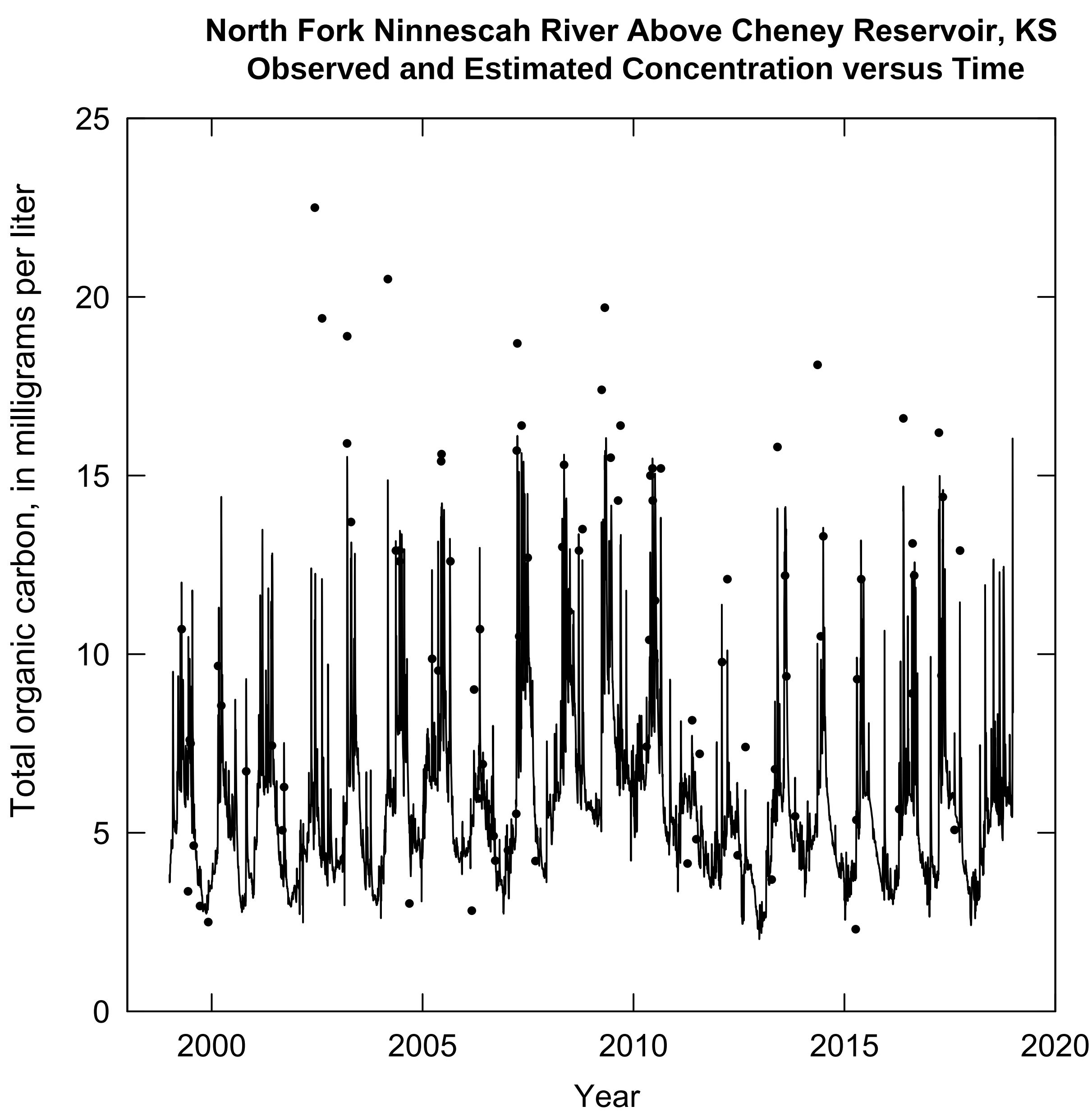
Weighted Regression on Time, Discharge, and Season Model Pesults

```
fluxBiasStat(wrtds$Sample)
```

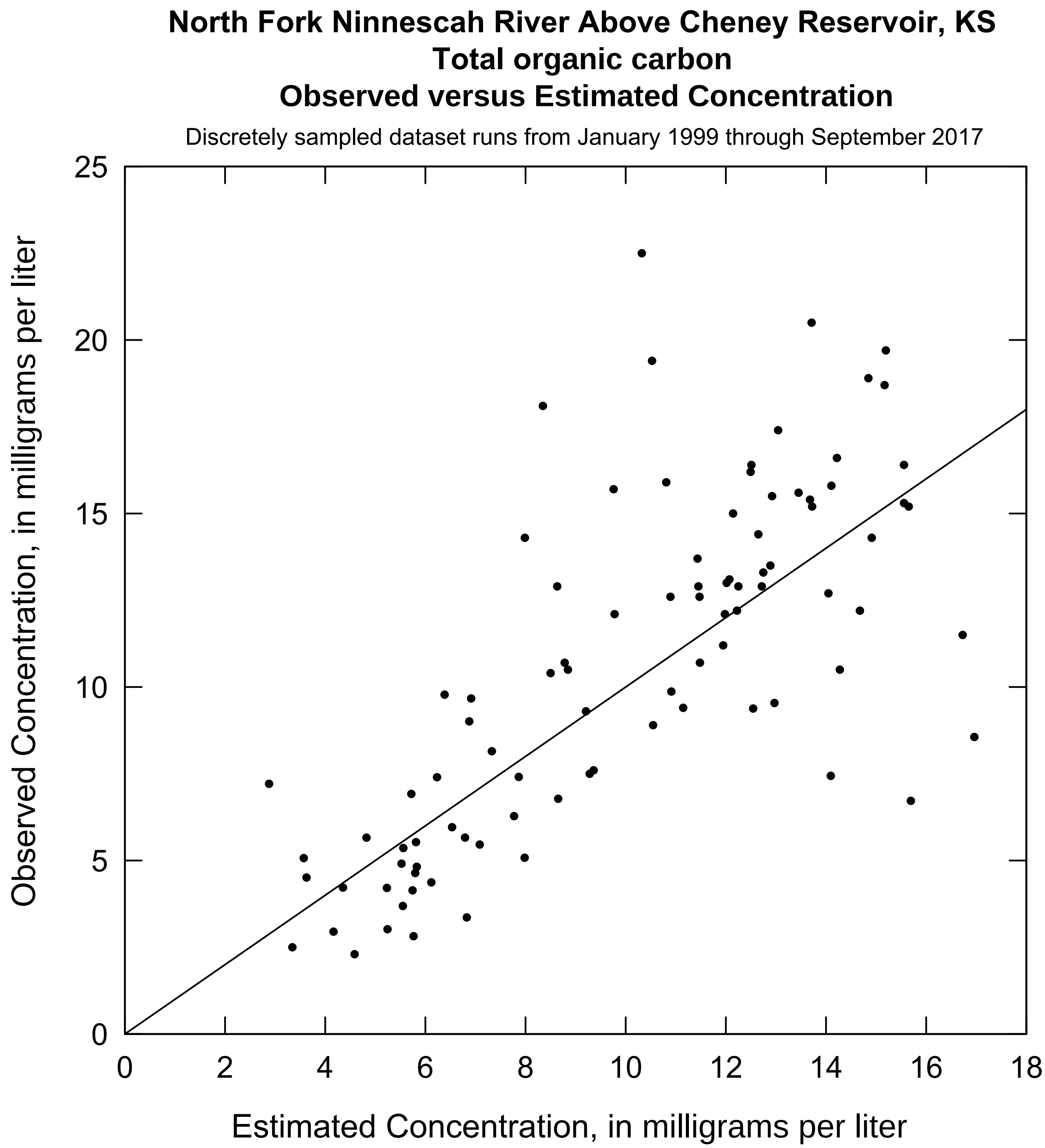
```
##             bias1
## 0.0262905130832568
```

The flux bias statistic is (Mean Of Estimated Flux - Mean Of Observed Flux) / Mean Of Observed Flux. The statistic assumes all the censored values are the mean. In Hickman and Hirsch (2017) they used -0.20 to 0.20 as guidance for acceptability of the flux bias statistic.

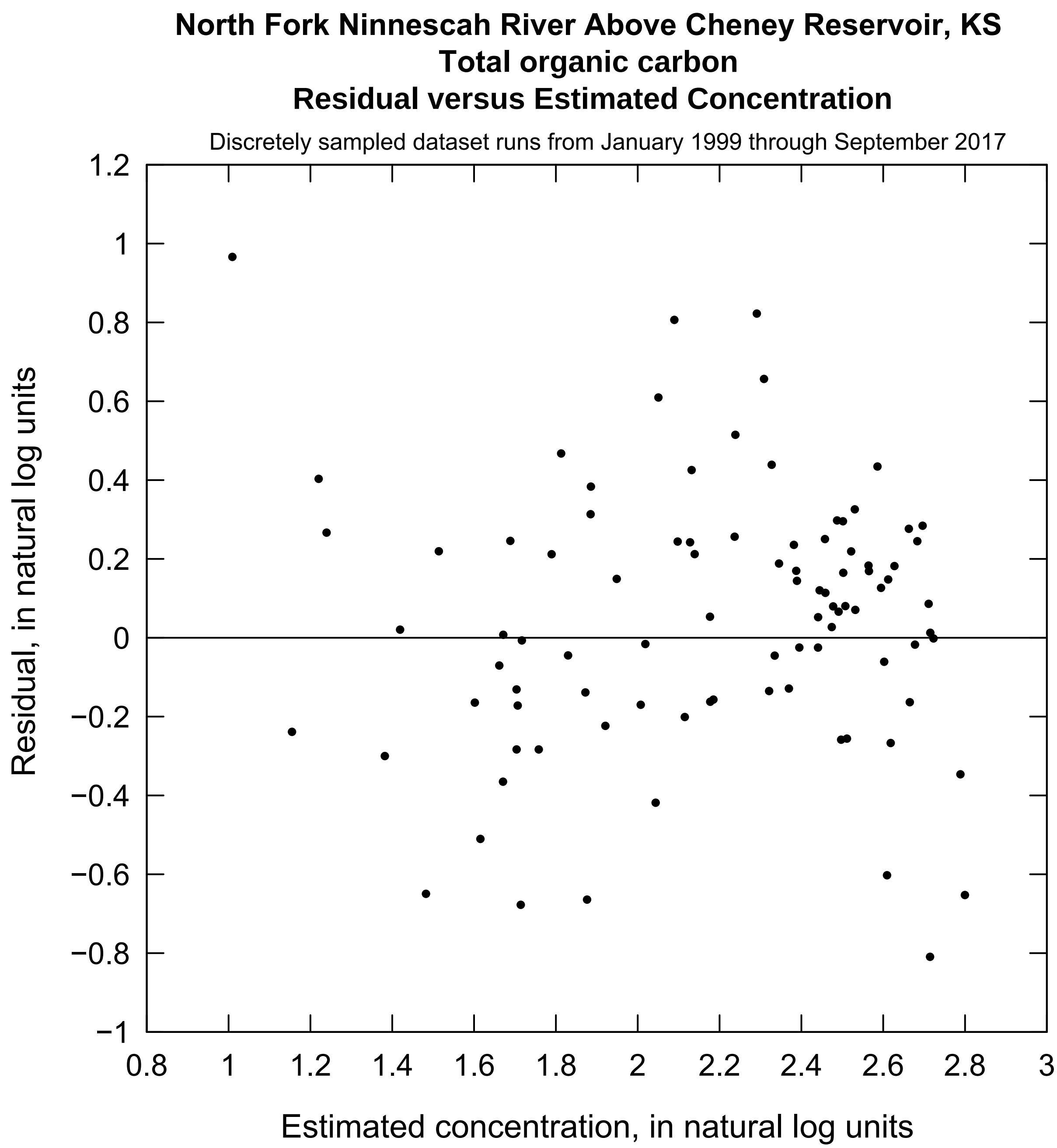
```
plotConcTimeDaily(wrtds)
```



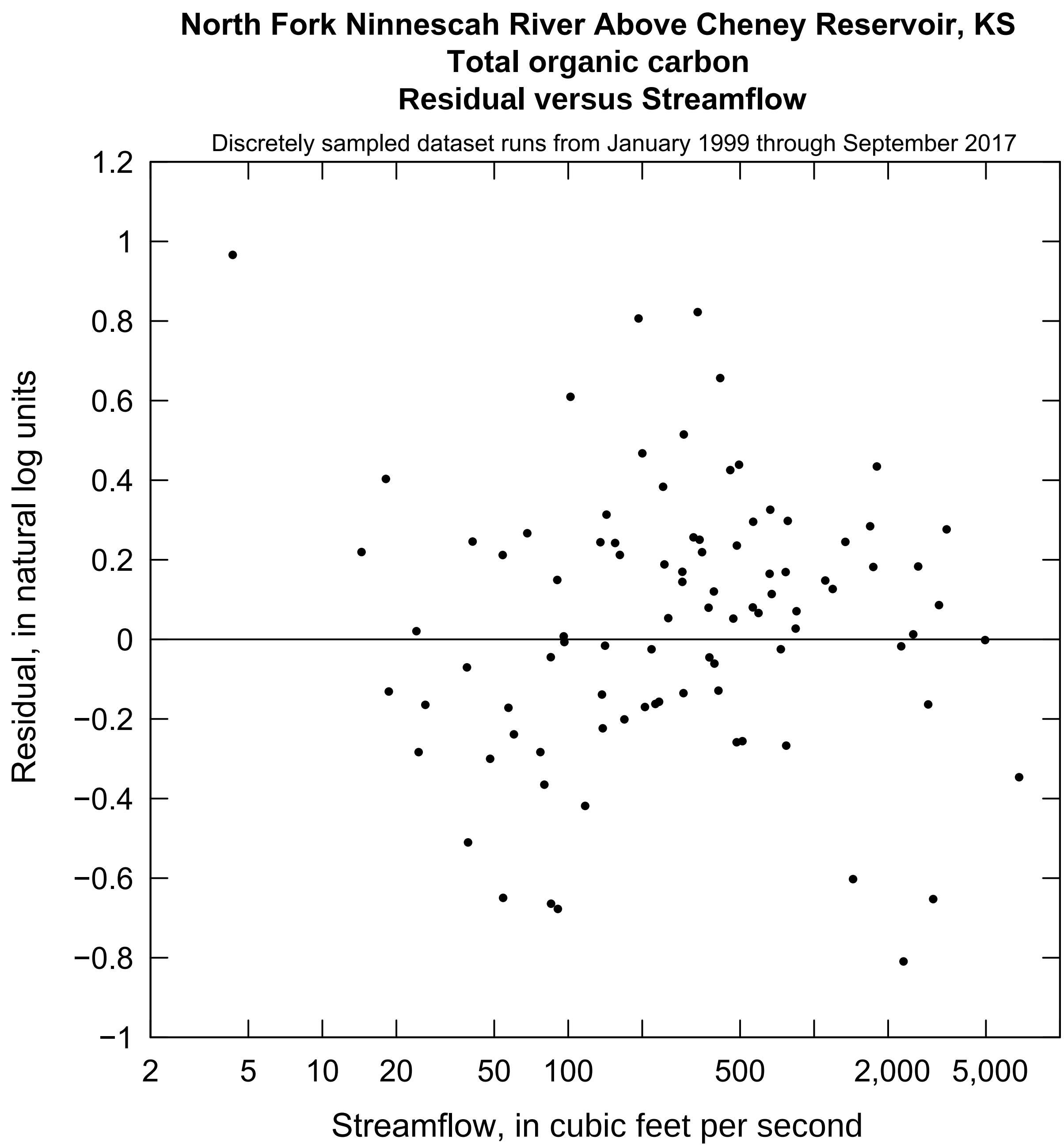
```r
plotConcPred(wrtds)
```



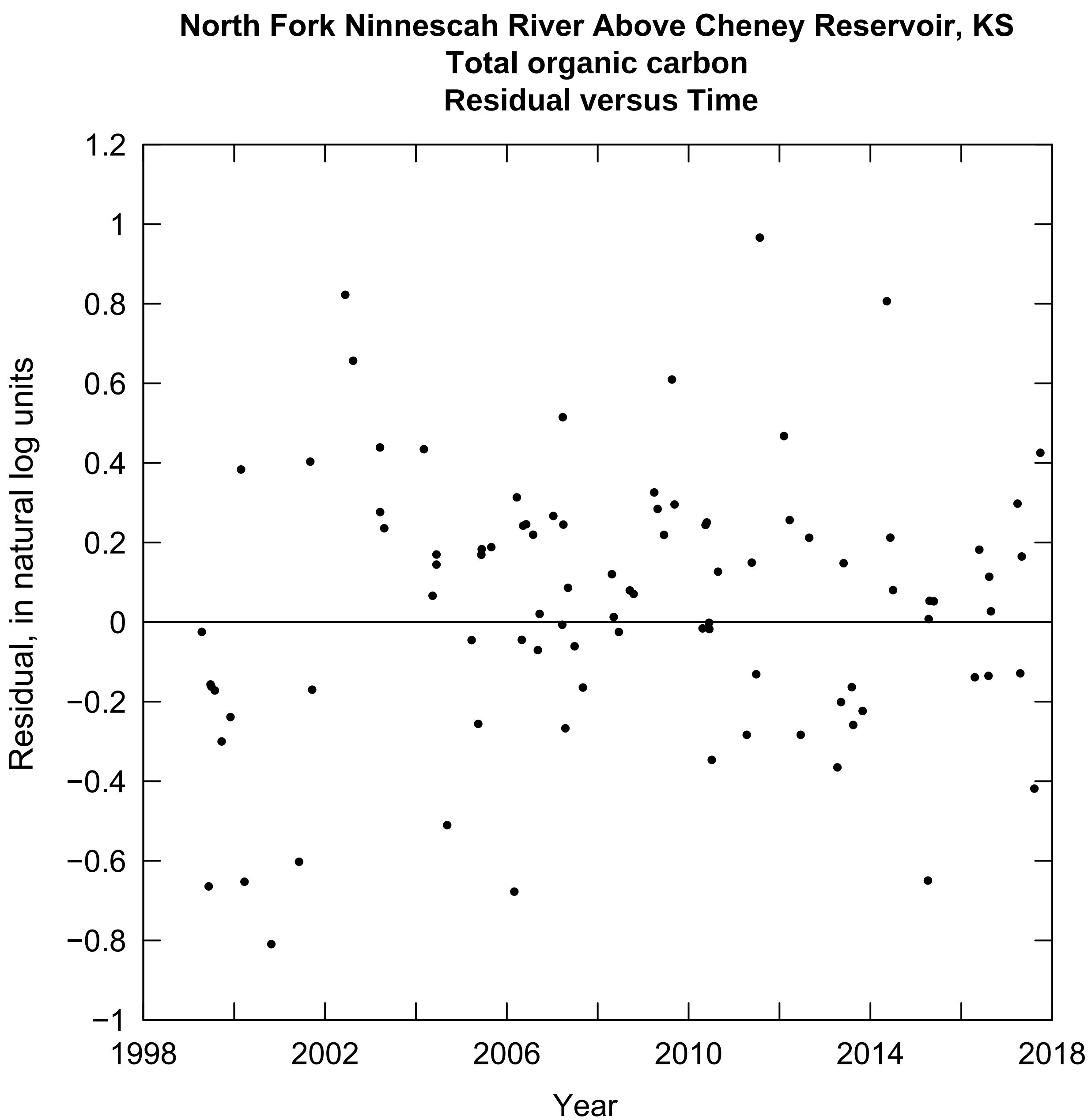
```r
plotResidPred(wzrtds)
```



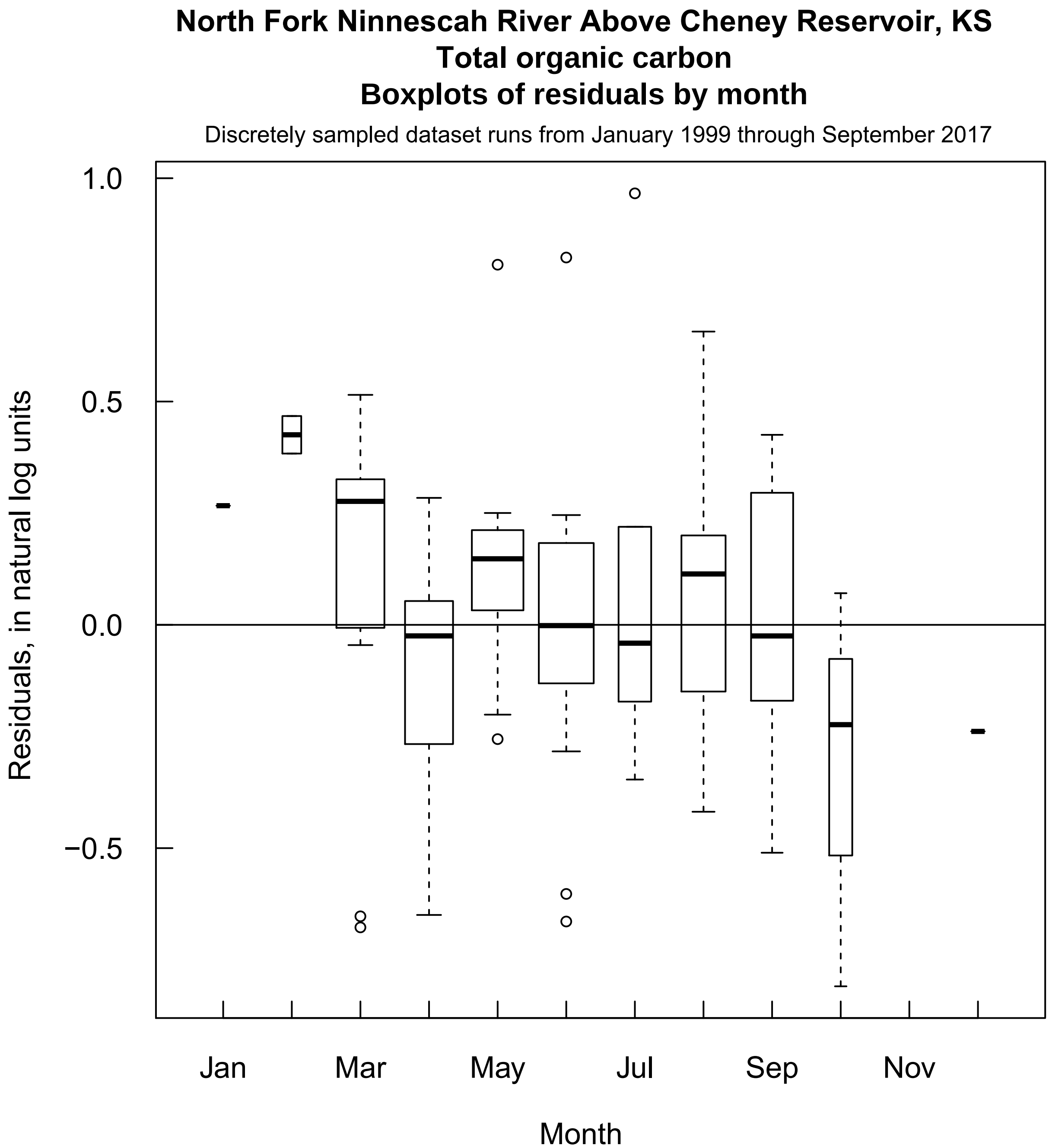
```r
plotResidQ(wrtds, qUnit=1)
```

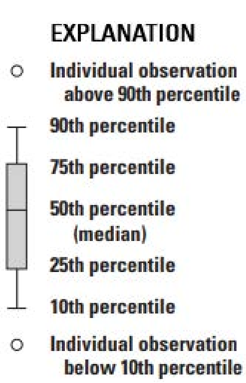


```r
plotResidTime(wrtds)
```

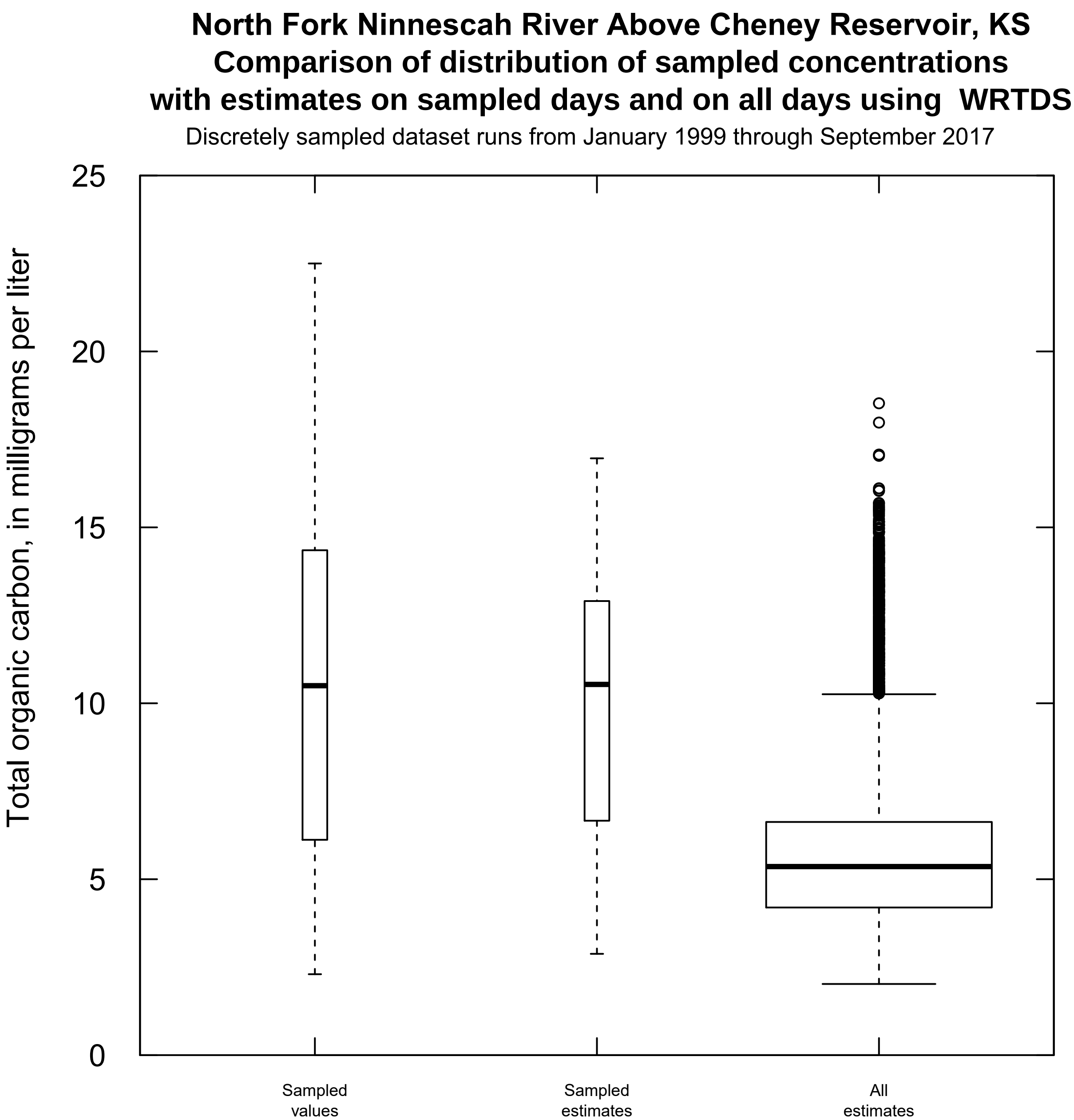


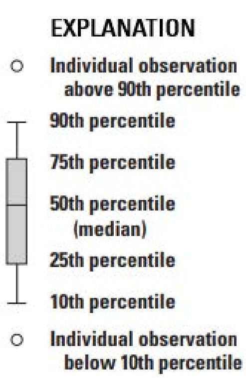
```r
boxResidMonth(wrtds)
```



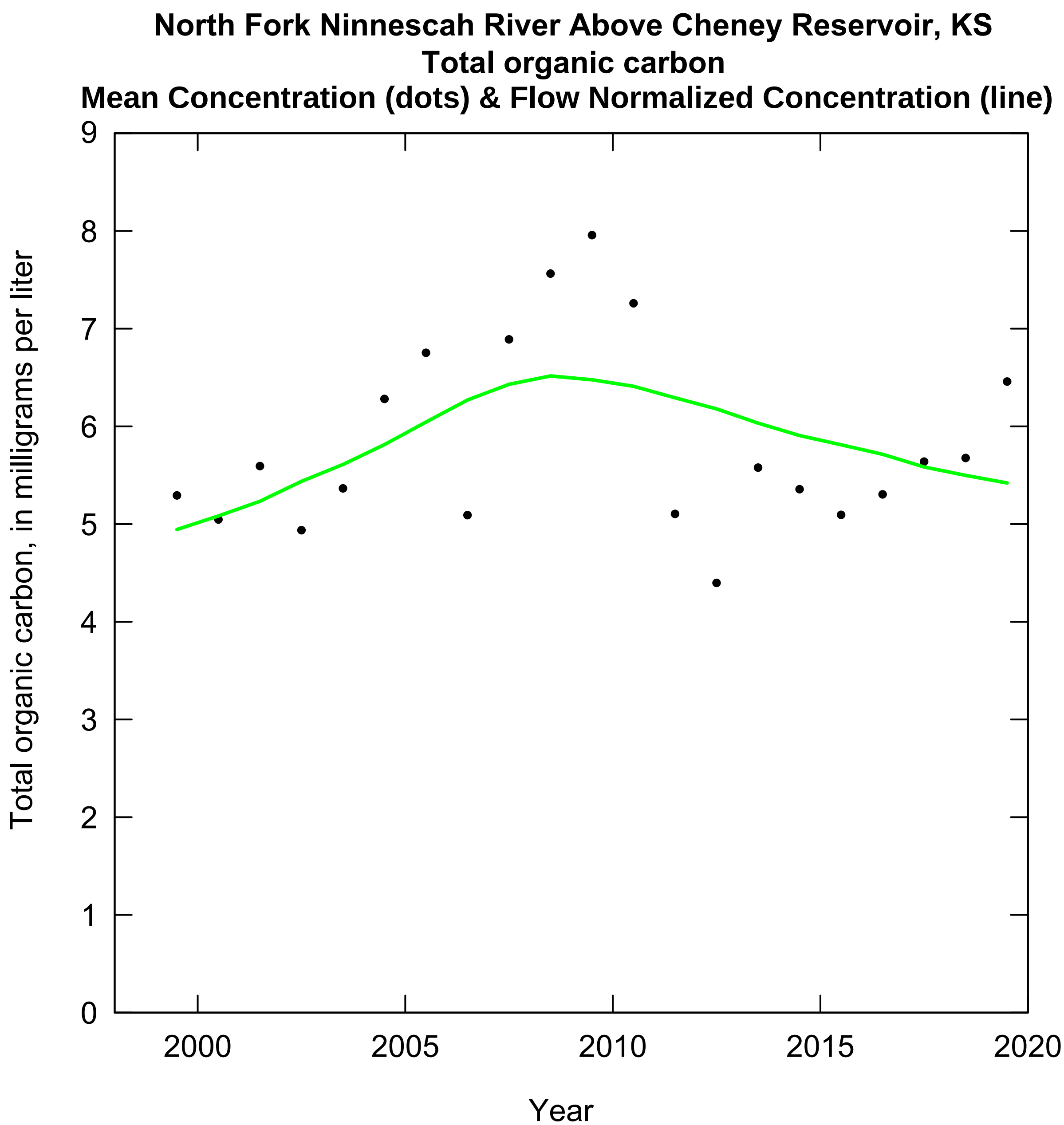


```
boxConcThree(wrtds)
```

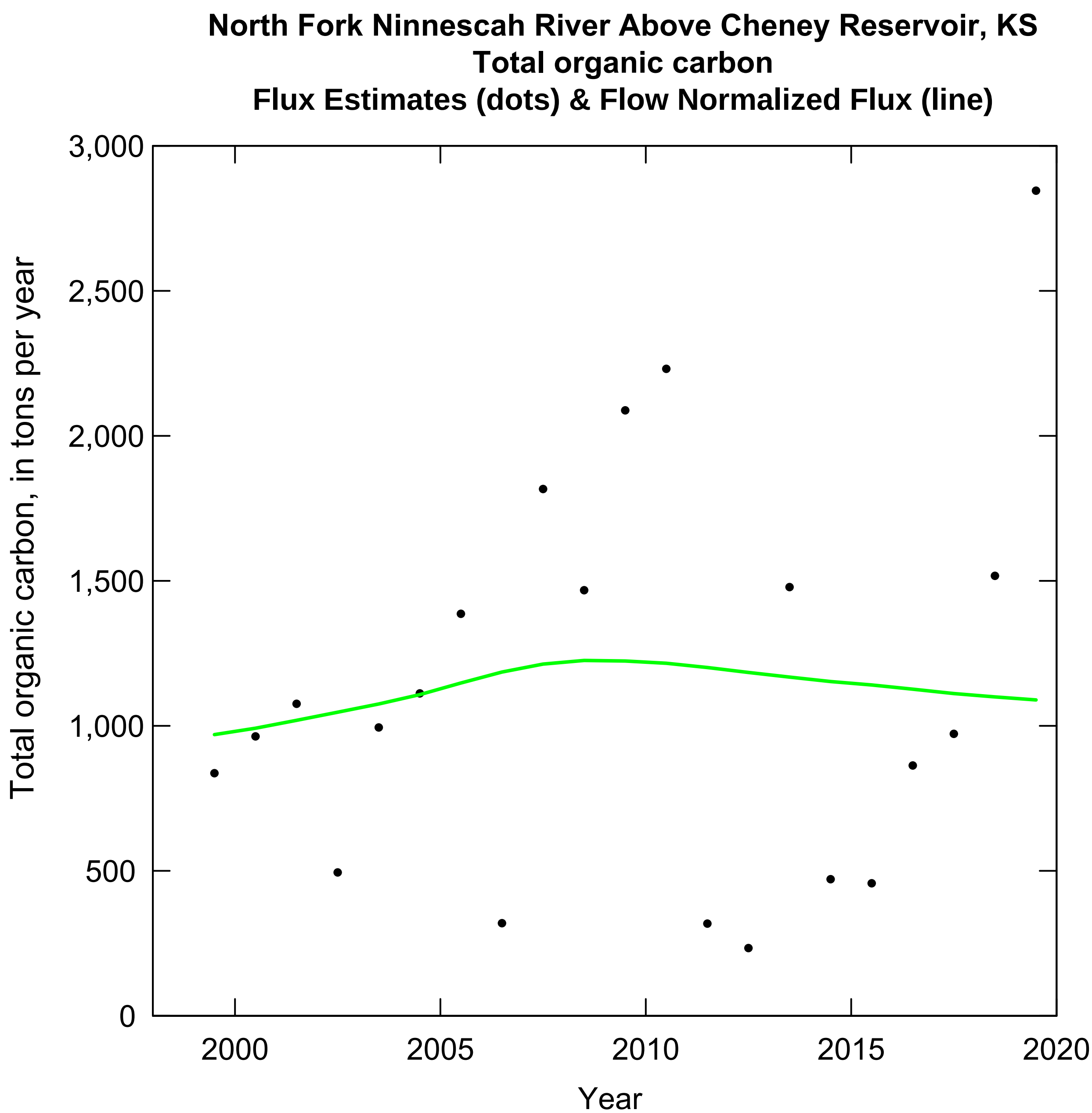




```r
plotConcHist(wrtds)
```



```
plotFluxHist(wrtds)
```



Trend (using EGRETci)

North Fork Ninnescah River Above Cheney Reservoir, KS   Total organic carbon

Calendar Year

Bootstrap process, for change from calendar year 1999 to 2017
dataset runs from September 1999 to January 2017
Bootstrap block length in days 200
bootBreak is 39 confStop is 0.7

Weighted Regressions on Time, Discharge, and Season (WRTDS) estimated
concentration change is   0.695 milligrams per liter (mg/L)

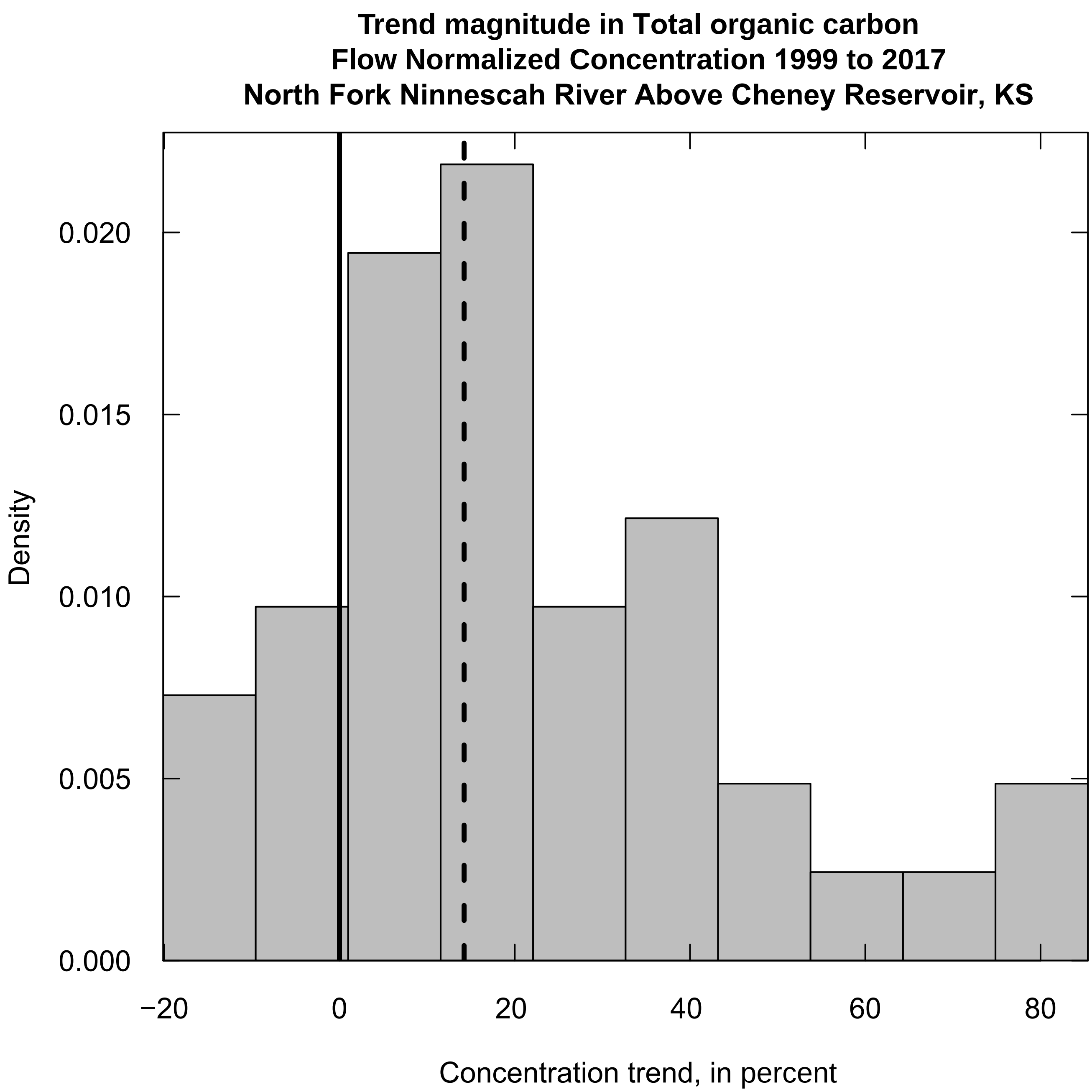
WRTDS estimated flux change is   0.1273 10^6 kilograms per year (kg/yr)

Should we reject Ho that Flow Normalized Concentration Trend = 0 ? Do Not Reject Ho
best estimate is   0.695 mg/L
Lower and Upper 90% CIs   -1.049   3.425
also 95% CIs   -1.387   3.828
and 50% CIs   0.170   1.547
approximate two-sided p-value for Conc   0.4
Likelihood that Flow Normalized Concentration is trending up =   0.787 is trending down =   0.213

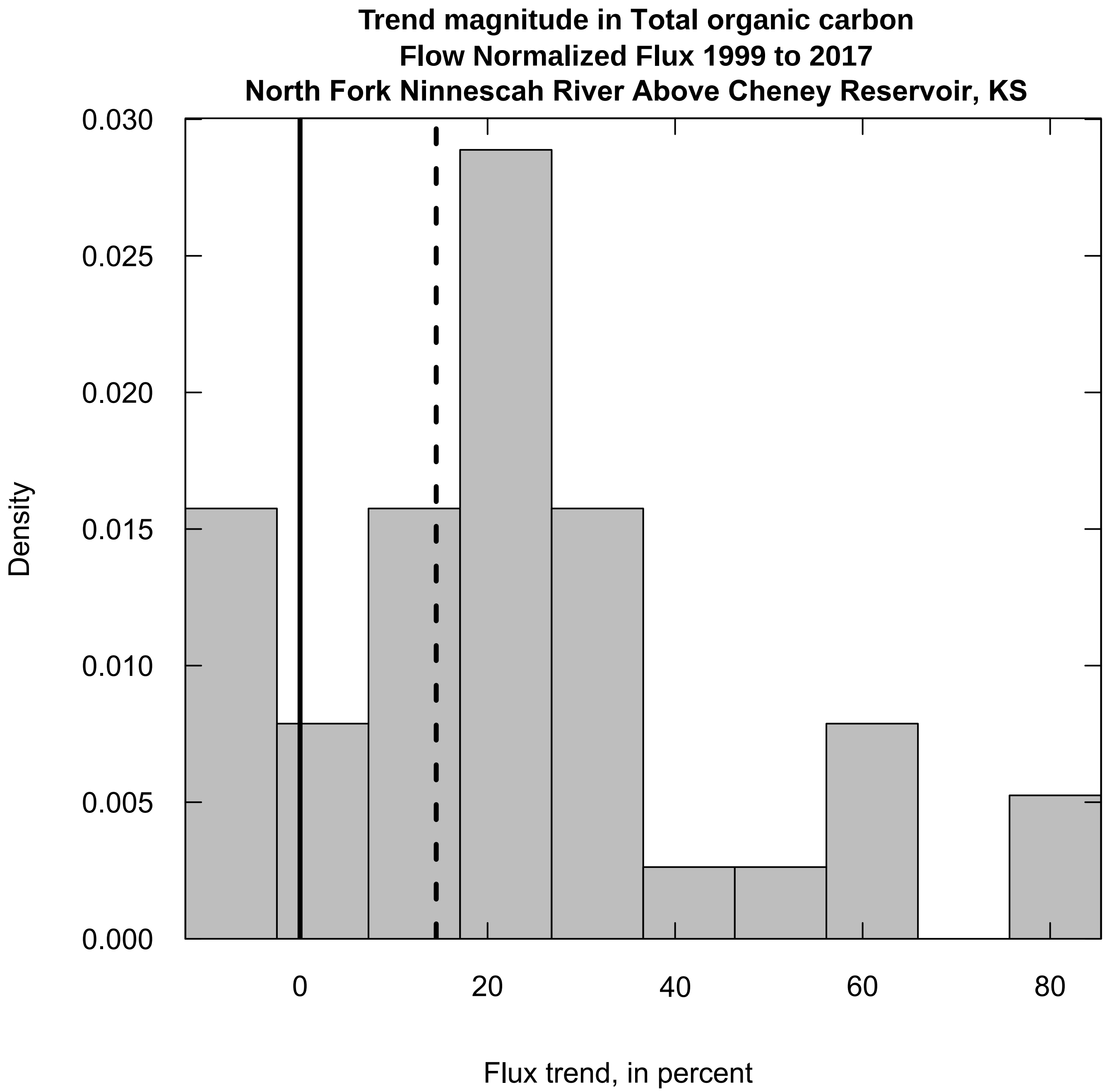
Should we reject Ho that Flow Normalized Flux Trend = 0 ? Do Not Reject Ho
best estimate is   0.1273 10^6 kg/year
Lower and Upper 90% CIs -0.0645   0.6300
also 95% CIs -0.1388   0.6318
and 50% CIs   0.0649   0.2649
approximate two-sided p-value for Flux   0.33
Likelihood that Flow Normalized Flux is trending up = 0.838 is trending down= 0.162

Upward trend in concentration is likely
Upward trend in flux is likely
Downward trend in concentration is unlikely
Downward trend in flux is unlikely

```
par(mar=c(5,6,5,0))
par(mfrow=c(2,1))
plotHistogramTrend(wrtds, eBoot, caseSetUp, flux=FALSE)
plotHistogramTrend(wrtds, eBoot, caseSetUp, flux=TRUE)
```

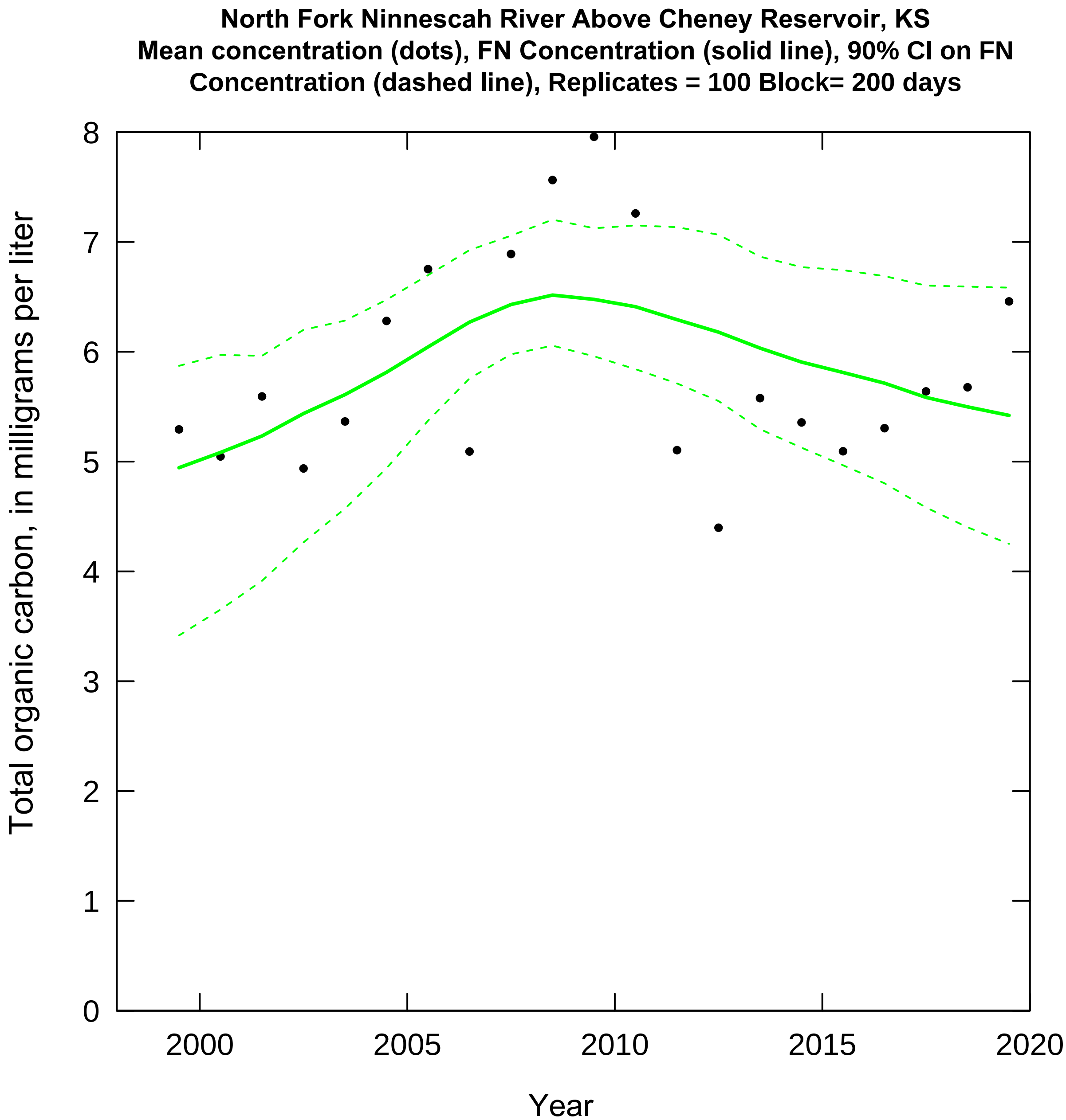


solid line = zero line (no trend)
dashed line = WRTDS trend estimate



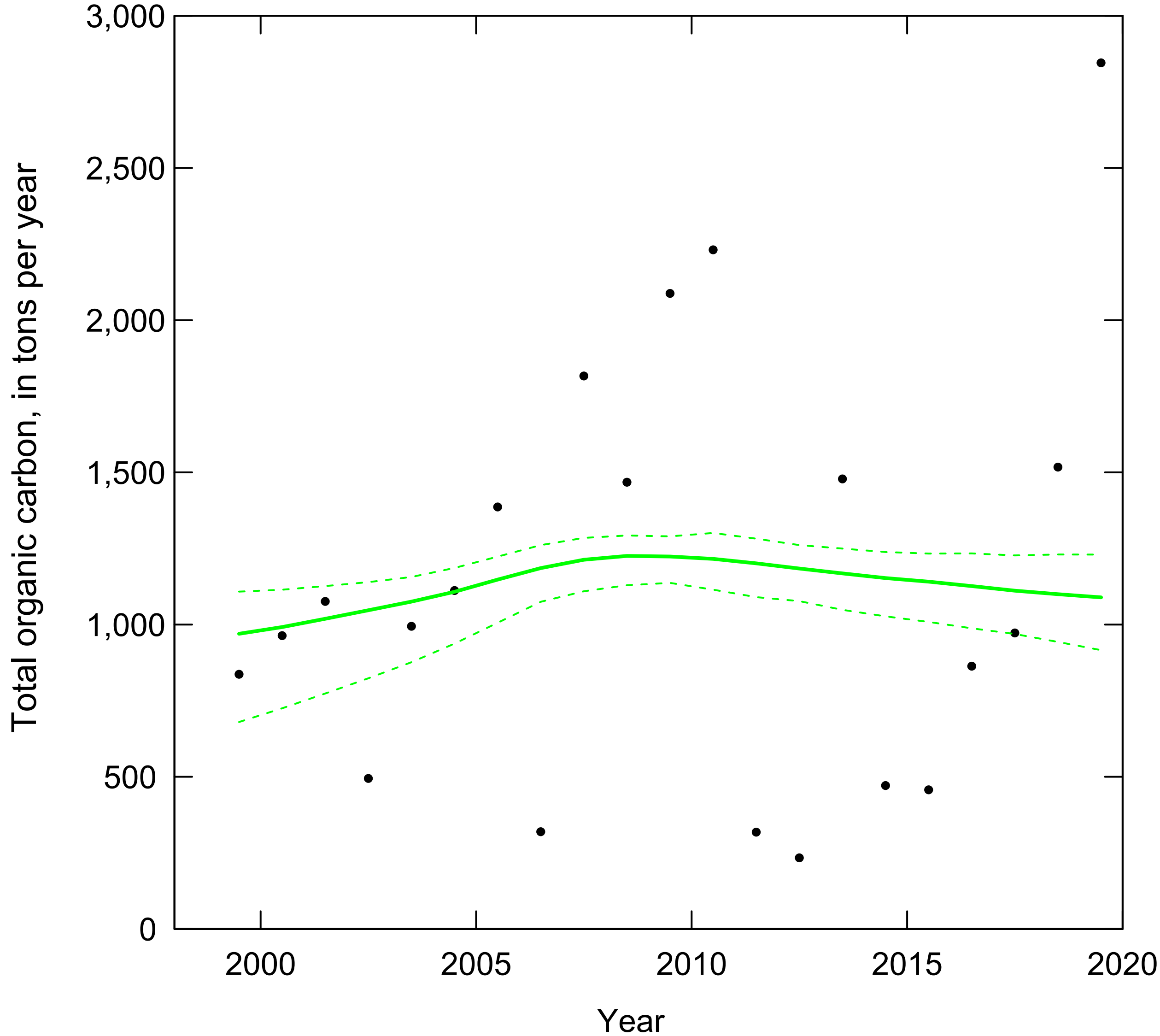
solid line = zero line (no trend)
dashed line = WRTDS trend estimate

```
par(mfrow=c(2,1))
plotConcHistBoot(wrtds, CIAnnualResults)
plotFluxHistBoot(wrtds, CIAnnualResults)
```



FN = Flow Normalized
CI = Confidence Interval

North Fork Ninnescah River Above Cheney Reservoir, KS
Mean Flux (dots), FN Flux (solid line), 90% CI on FN Flux (dashed line),
Replicates = 100 , Block= 200 days



FN = Flow Normalized
CI = Confidence Interval

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

References Cited

Hickman, R.E., and Hirsch, R.M., 2017, Trends in the quality of water in New Jersey streams, water years 1971–2011: U.S. Geological Survey Scientific Investigations Report 2016–5176, 58 p., accessed July 2020 at https://doi.org/10.3133/sir20165176.

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