Introduction to the EGRETci package

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March 4, 2015

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```
library(EGRET)
library(EGRETci)
eList <- Choptank_eList
#Interactive function to set up trend analysis:
caseSetUp <- trendSetUp(eList)
eList <- setPA(eList)
eList <- setForBoot(eList)

eBoot <- wBT(eList,caseSetUp,
             saveOutput = TRUE, fileName = "outputText.txt")

#Save output
saveEGRETci(eList, eBoot)
```

The output in output.txt is:

```
 Choptank River    Inorganic nitrogen (nitrate and nitrite)

  Bootstrap process, for change from Water Year 1985 to Water Year 2005
                  data set runs from WaterYear 1980 to Water Year 2011
  Bootstrap block length in days 200
  bootBreak is 9  confStop is 0.7

 WRTDS estimated concentration change is   0.328  mg/L
 WRTDS estimated flux change is          0.03148  10^6 kg/yr
 value is bootstrap replicate result (deltack or deltafk in paper)
 nPos is cumulative number of positive trends
 post_p is posterior mean estimate of probability of a positive trend
 Lower and Upper are estimates of the 90\% CI values for magnitude of trend
```

rep	Concentration					Flux				
	value	nPos	post_p	Lower	Upper	value	nPos	post_p	Lower	Upper
1	0.267	1	0.75	0.267	0.267	0.02585	1	0.75	0.02585	0.02585
2	0.295	2	0.833	0.267	0.295	0.02635	2	0.833	0.02585	0.02635
3	0.318	3	0.875	0.267	0.318	0.03256	3	0.875	0.02585	0.03256
4	0.233	4	0.9	0.233	0.318	0.02718	4	0.9	0.02585	0.03256
5	0.373	5	0.917	0.233	0.373	0.03897	5	0.917	0.02585	0.03897
6	0.309	6	0.929	0.233	0.373	0.03404	6	0.929	0.02585	0.03897
7	0.354	7	0.938	0.233	0.373	0.03824	7	0.938	0.02585	0.03897
8	0.293	8	0.944	0.233	0.373	0.02632	8	0.944	0.02585	0.03897
9	0.415	9	0.95	0.233	0.415	0.04439	9	0.95	0.02585	0.04439
10	0.421	10	0.955	0.233	0.421	0.04115	10	0.955	0.02585	0.04439
11	0.374	11	0.958	0.233	0.421	0.03796	11	0.958	0.02585	0.04439
12	0.362	12	0.962	0.233	0.421	0.03708	12	0.962	0.02585	0.04439
13	0.309	13	0.964	0.233	0.421	0.03073	13	0.964	0.02585	0.04439
14	0.353	14	0.967	0.233	0.421	0.03364	14	0.967	0.02585	0.04439
15	0.18	15	0.969	0.18	0.421	0.01796	15	0.969	0.01796	0.04439
16	0.312	16	0.971	0.18	0.421	0.02388	16	0.971	0.01796	0.04439
17	0.401	17	0.972	0.18	0.421	0.04159	17	0.972	0.01796	0.04439
18	0.34	18	0.974	0.18	0.421	0.03359	18	0.974	0.01796	0.04439

```
      19   0.285    19   0.975    0.18   0.421   |    0.03073    19   0.975  0.01796  0.04439
      20   0.291    20   0.976   0.183   0.421   |    0.02888    20   0.976  0.01826  0.04425

Should we reject Ho that Flow Normalized Concentration Trend = 0 ? Reject Ho
 best estimate is   0.328 mg/L
  Lower and Upper 90\% CIs    0.183    0.421
 also 95\% CIs    0.180    0.421
 and 50\% CIs    0.292    0.370
 approximate two-sided p-value for Conc     0.048
* Note p-value should be considered to be < stated value
 Likelihood that Flow Normalized Concentration is trending up =      0.976  is trending down =

Should we reject Ho that Flow Normalized Flux Trend = 0 ? Reject Ho
 best estimate is  0.03148 10^6 kg/year
  Lower and Upper 90\% CIs   0.0183   0.0442
 also 95\% CIs   0.0180   0.0444
 and 50\% CIs   0.0266   0.0382
 approximate two-sided p-value for Flux     0.048
* Note p-value should be considered to be < stated value
 Likelihood that Flow Normalized Flux is trending up =      0.976  is trending down=     0.0238

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

3 Confidence Bands

Base-R workflow for confidence bands on model results:

```
eList <- Choptank_eList

nBoot <- 100
blockLength <- 200

widthCI <- 90
ciLower <- (50-(widthCI/2))/100
ciUpper <- (50+(widthCI/2))/100
probs <- c(ciLower,ciUpper)

repAnnualResults <- vector(mode = "list", length = nBoot)
for(n in 1:nBoot){
    repAnnualResults[[n]] <- bootAnnual(eList, blockLength)
}

CIAnnualResults <- ciBands(eList, repAnnualResults, probs)
```

Taking advantage of the foreach package to do parallel computing:

```
library(foreach)
library(doParallel)
library(iterators)
```

```
nBoot <- 100
blockLength <- 200

widthCI <- 90
ciLower <- (50-(widthCI/2))/100
ciUpper <- (50+(widthCI/2))/100
probs <- c(ciLower,ciUpper)

nCores <- detectCores() - coreOut
cl <- makeCluster(nCores)
registerDoParallel(cl)
repAnnualResults <- foreach(n = 1:nBoot,.packages=c('EGRETci')) %dopar% {
   annualResults <- bootAnnual(eList, blockLength)
}
stopCluster(cl)

CIAnnualResults <- ciBands(eList, repAnnualResults, probs)
```