Day 3: SoilR Exercises

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SoilR and RothC model

1. Get familiar with the RothC model using the RothC guide (./Materials).

How many pools are used in RothC and what is the assumption on splitting organic inputs into decomposable and resistant plant material? The four active compartments are Decomposable Plant Material (DPM), Resistant Plant Material (RPM), Microbial Biomass (BIO) and Humified Organic Matter (HUM). The Assumption for splitting the organic input into DPM and RPM represents an influence of the landuse and vegetation type.

In how far is this assumption different from the assumption on the split between microbial biomass and humified substances? BIO and HUM split depends on the clay content of the soil, that gives input to the pore size and water capacity of the soil, which is an indicator for microbial activity. the influence is stronger and direct, instead of a generalization of many factors that are put into the ratio of DPM and RPM.

Ex 2

```
refdata <- read.table("materials/reference_2000-2100.txt", header=T)
scenariodata <- read.table("materials/rcp8.5_2000-2100.txt", header=T)
```

Add evaporation:

```
Evp=data.frame(Month=1:12, Evp=c(12, 18, 35, 58, 82, 90, 97, 84, 54, 31, 14, 10))
Evp2 <- Evp

for (i in 1:100) {
  Evp <- rbind(Evp, Evp2)
}

refdata <- cbind(refdata, Evp$Evp)
scenariodata <- cbind(scenariodata, Evp$Evp)
```

Initial IOM:

```
FallIOM=0.049* 69.7^(1.139) # 69.7 is the SOM
```

Calculation of the moisture effect with the function fW.RothC

```
#?fW.RothC
# pE is evaporation coefficient and here set to 1

# for the reference data
moisture_ref <- fW.RothC(refdata$Precip, refdata$`Evp$Evp`, S.Thick = 25,
```

```
                          pClay = 48, pE = 1, bare = FALSE)

# for the scenario data
moisture_sc <- fW.RothC(scenariodata$Precip, scenariodata$`Evp$Evp`, S.Thick = 25,
                        pClay = 48, pE = 1, bare = FALSE)
```

Calculation of the temperature effect with the function fT.RothC

```
#?fT.RothC

# reference temp effect
tempeff_ref <- fT.RothC(refdata$Temp)

# scenario temp effect
tempeff_sc <- fT.RothC(scenariodata$Temp)
```

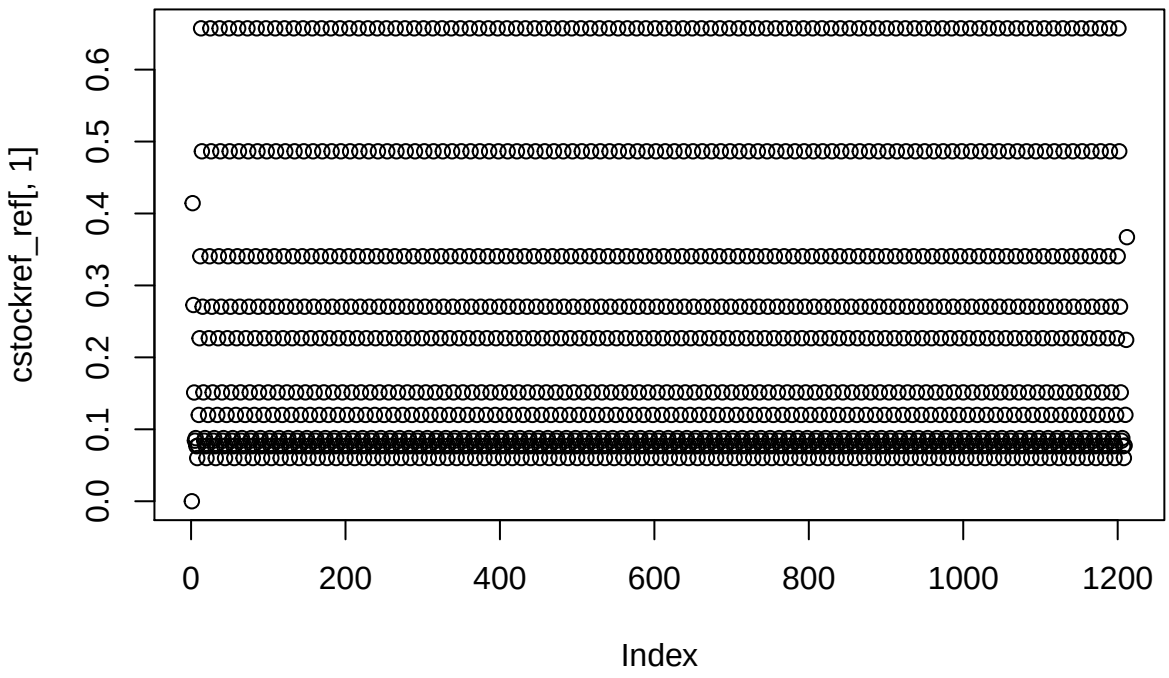
Xi is the product of the moisture effect and the temperature effect

```
# reference
xi_ref = data.frame("month"=1:1212 , "xi"=moisture_ref$b*tempeff_ref)

#scenario
xi_sc = data.frame("month"=1:1212 , "xi"=moisture_sc$b*tempeff_sc)


#?RothCModel
# DPM, RPM, BIO and HUM initial 0
```

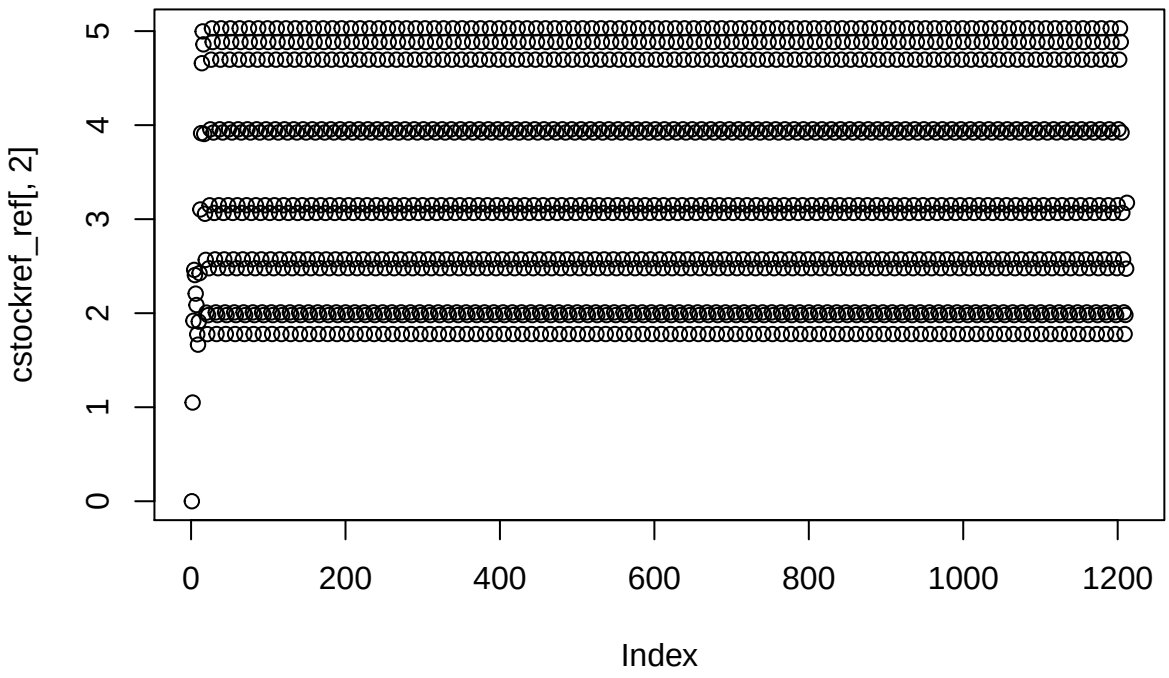
Model for the reference data:

```
refmodel <- RothCModel(xi_ref$month, ks = c(k.DPM = 10, k.RPM = 0.3,
            k.BIO = 0.66, k.HUM = 0.02, k.IOM = 0), C0 = c(0, 0, 0, 0, FallIOM),
            In = 2.7, DR = 1.44, clay = 48, xi = xi_ref, solver = deSolve.lsoda.wrapper, pass = FALSE)

cstockref_ref <- getC(refmodel) # get the pools
#head(cstockref_ref) # in the beginning
#tail(cstockref_ref) # in the end
```

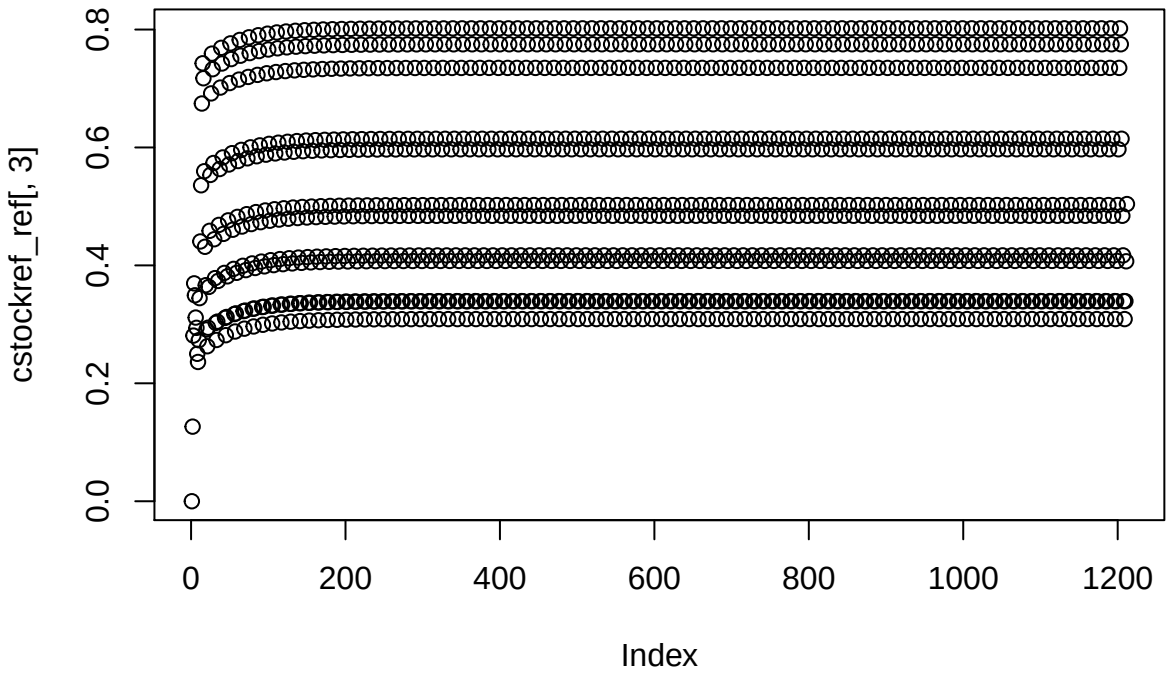
```
# Reference data: Stock changes
plot(cstockref_ref[,1]) # DPM
```



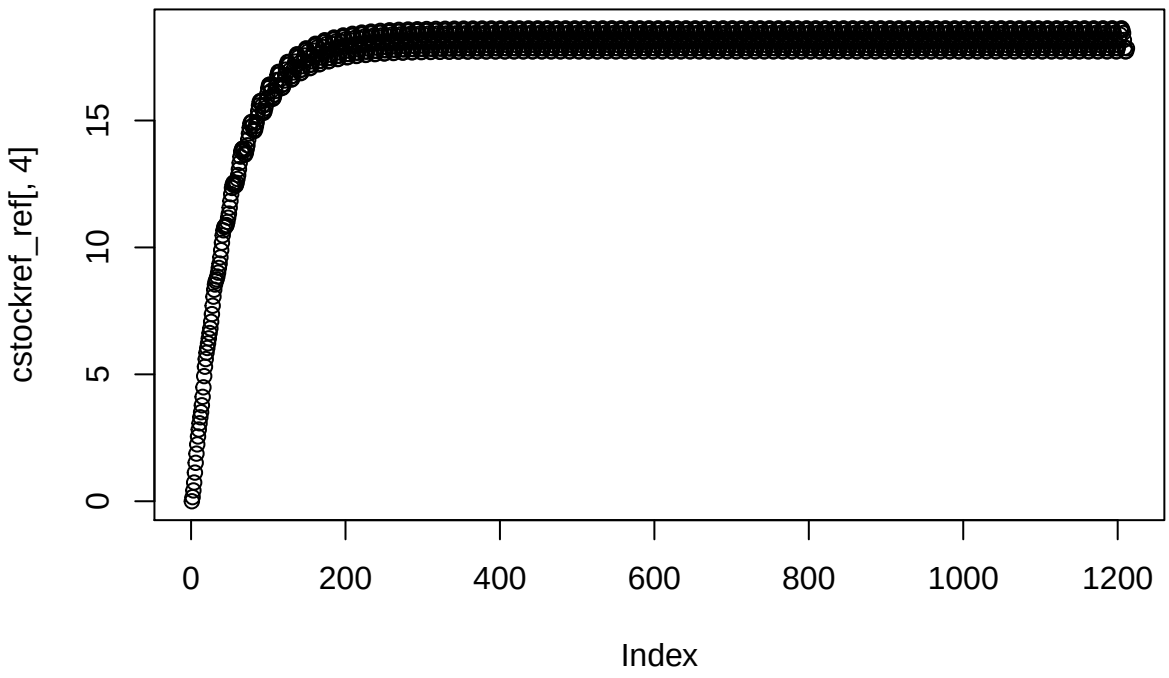

```
plot(cstockref_ref[,2]) # RPM
```



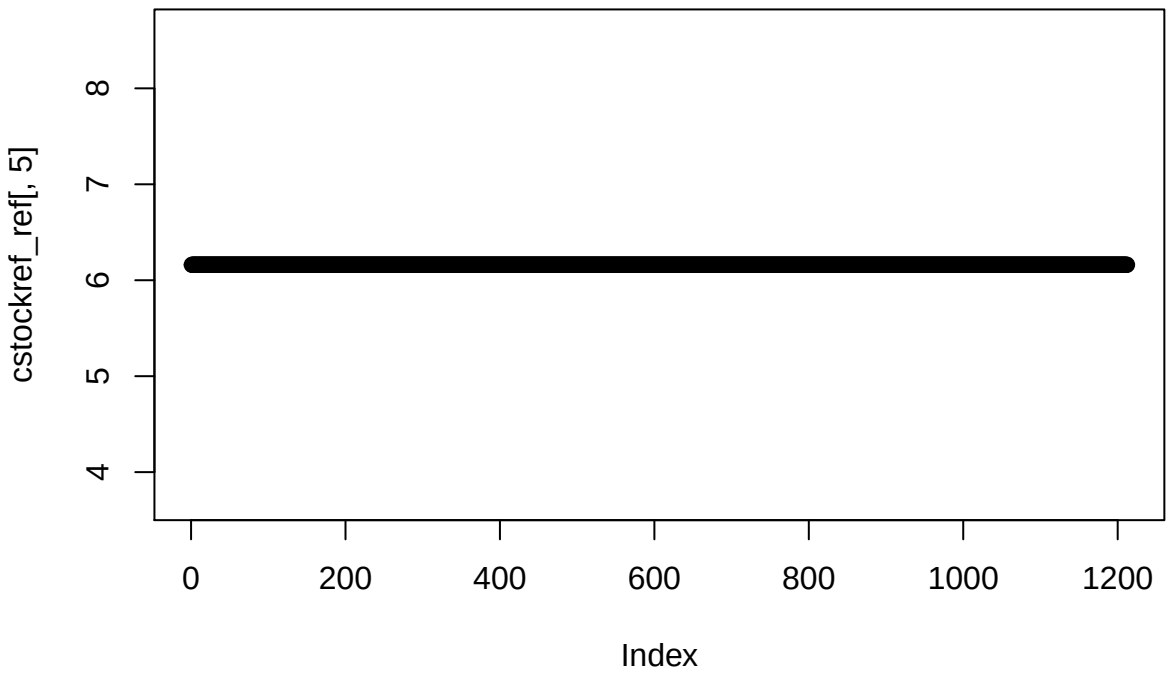

```
plot(cstockref_ref[,3]) # BIO
```




```
plot(cstockref_ref[,4]) # HUM, needs ~ 360 month = 30 years
```



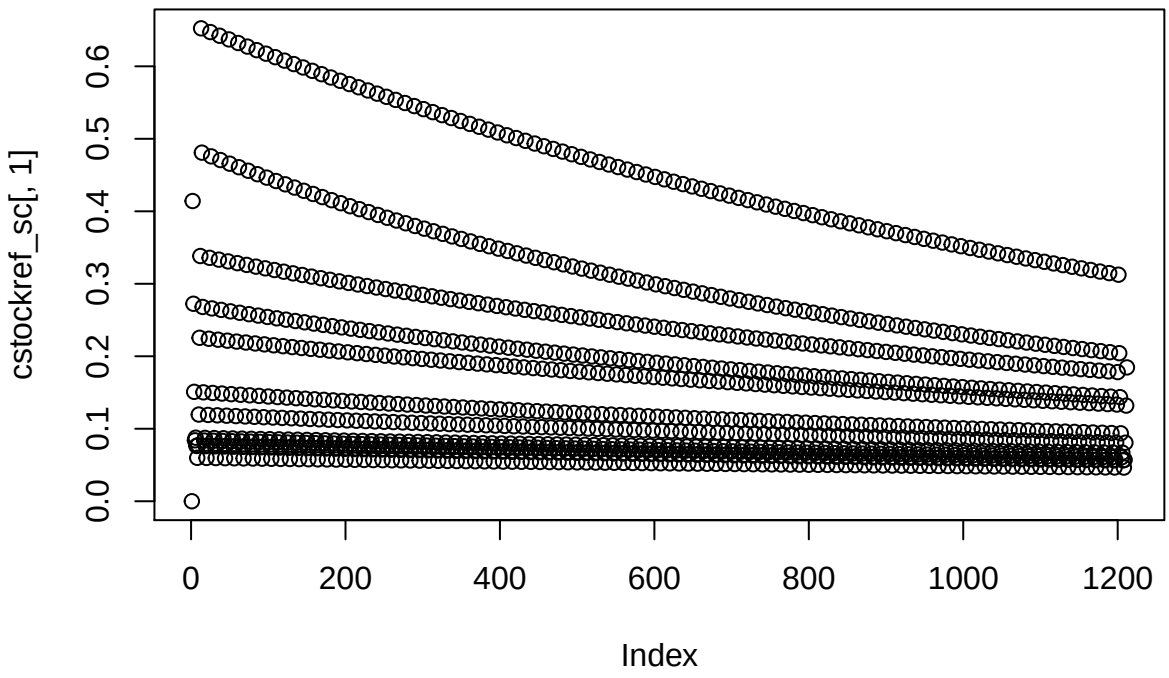

```
plot(cstockref_ref[,5]) # IoM # does not change at all
```



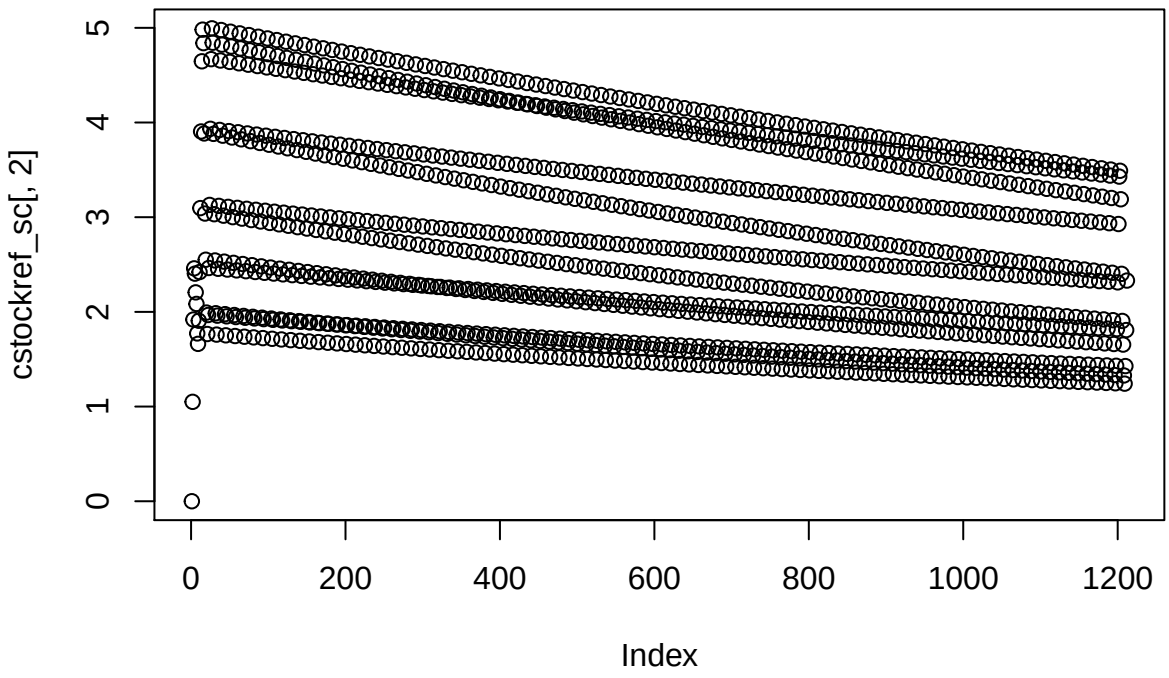
Model for the scenario data:

```
# scenario data

scmodel <- RothCModel(xi_sc$month, ks = c(k.DPM = 10, k.RPM = 0.3,
           k.BIO = 0.66, k.HUM = 0.02, k.IOM = 0), C0 = c(0, 0, 0, 0, FallIOM),
           In = 2.7, DR = 1.44, clay = 48, xi = xi_sc, solver = deSolve.lsoda.wrapper, pass = FALSE)

cstockref_sc <- getC(scmodel)
#head(cstockref_sc)
#tail(cstockref_sc)
```

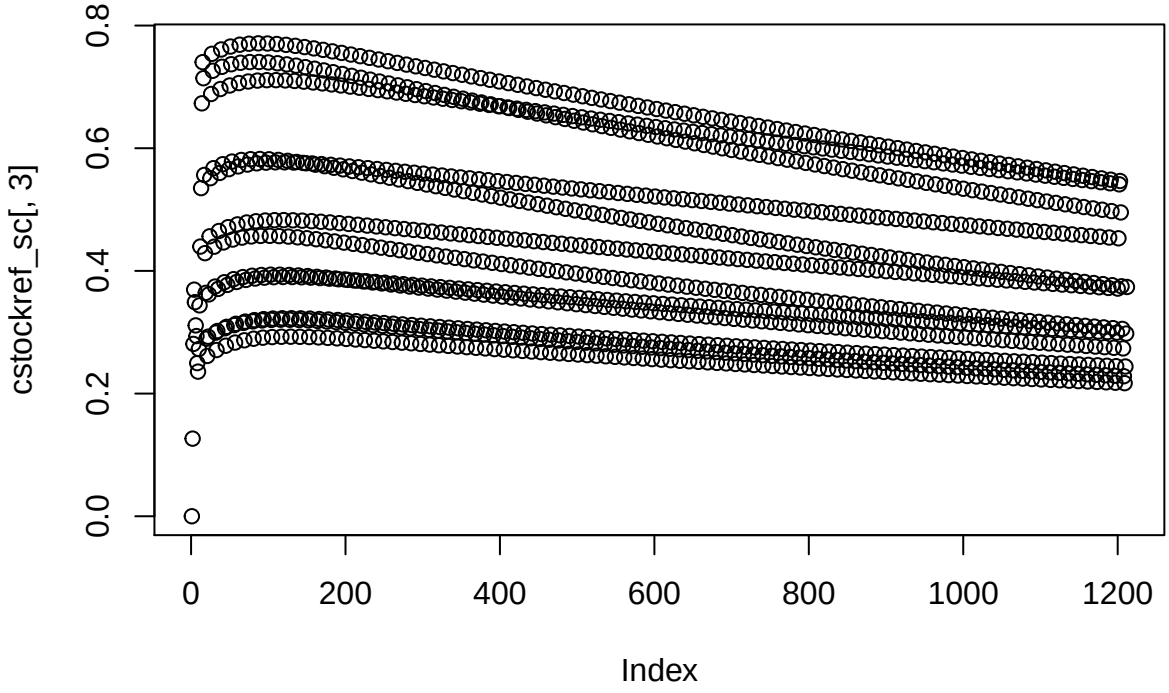
```
# Scenario data: Stock changes
plot(cstockref_sc[,1])
```



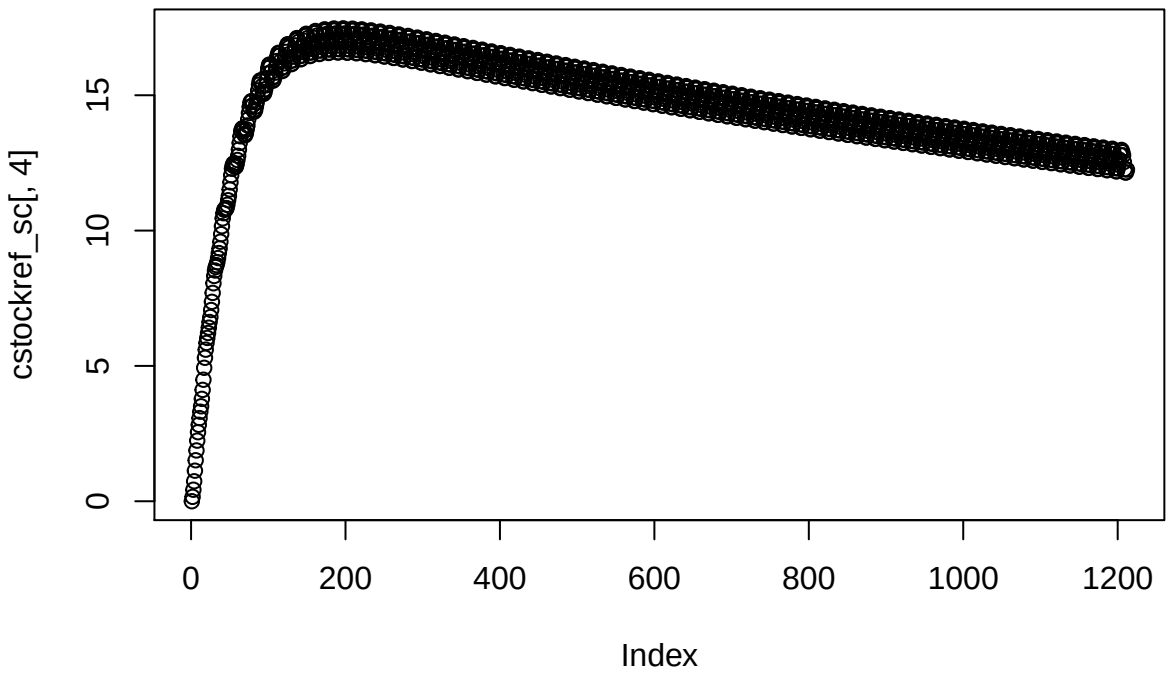

```
plot(cstockref_sc[,2])
```




```
plot(cstockref_sc[,3])
```




```
plot(cstockref_sc[,4])
```




```
#plot(cstockref_sc[,5])
```

Spin up

- 30 years of reference data (360 months)

```
# Reference data
spinned_up_refdata <- rbind(refdata[1:360,], refdata)

# Scenariodata
spinned_up_scenariodata <- rbind(refdata[1:360,], scenariodata)
```

Moisture effect for spinned up data

```
# for the reference data
spinned_moisture_ref <- fW.RothC(spinned_up_refdata$Precip, spinned_up_refdata$`Evp$Evp`,
                                 S.Thick = 25, pClay = 48, pE = 1, bare = FALSE)


# for the scenario data
spinned_moisture_sc <- fW.RothC(spinned_up_scenariodata$Precip, spinned_up_scenariodata$`Evp$Evp`,
                                S.Thick = 25, pClay = 48, pE = 1, bare = FALSE)
```

Temperature effect for spinned up data

```
#?fT.RothC

# reference temp effect
```

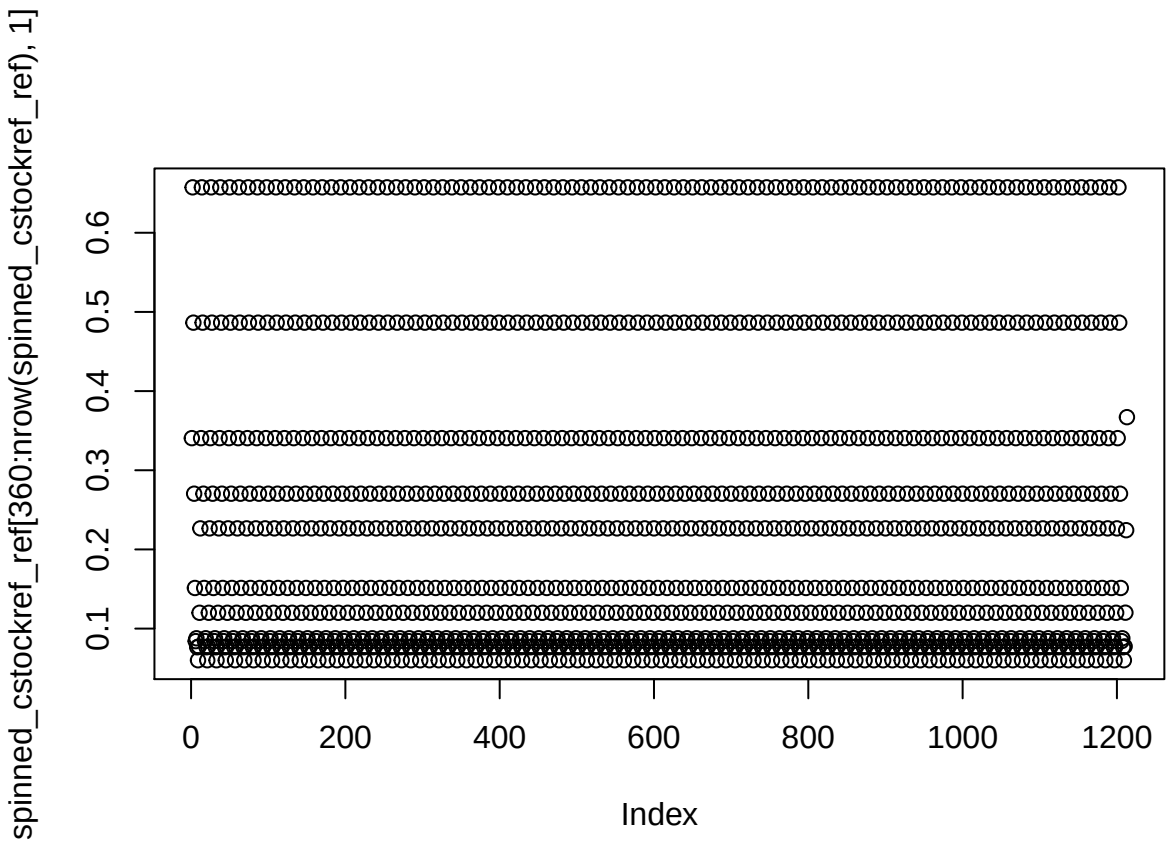
```r
spinned_tempeff_ref <- fT.RothC(spinned_up_refdata$Temp)

# scenario temp effect
spinned_tempeff_sc <- fT.RothC(spinned_up_scenariodata$Temp)
```

xi for spinned up data

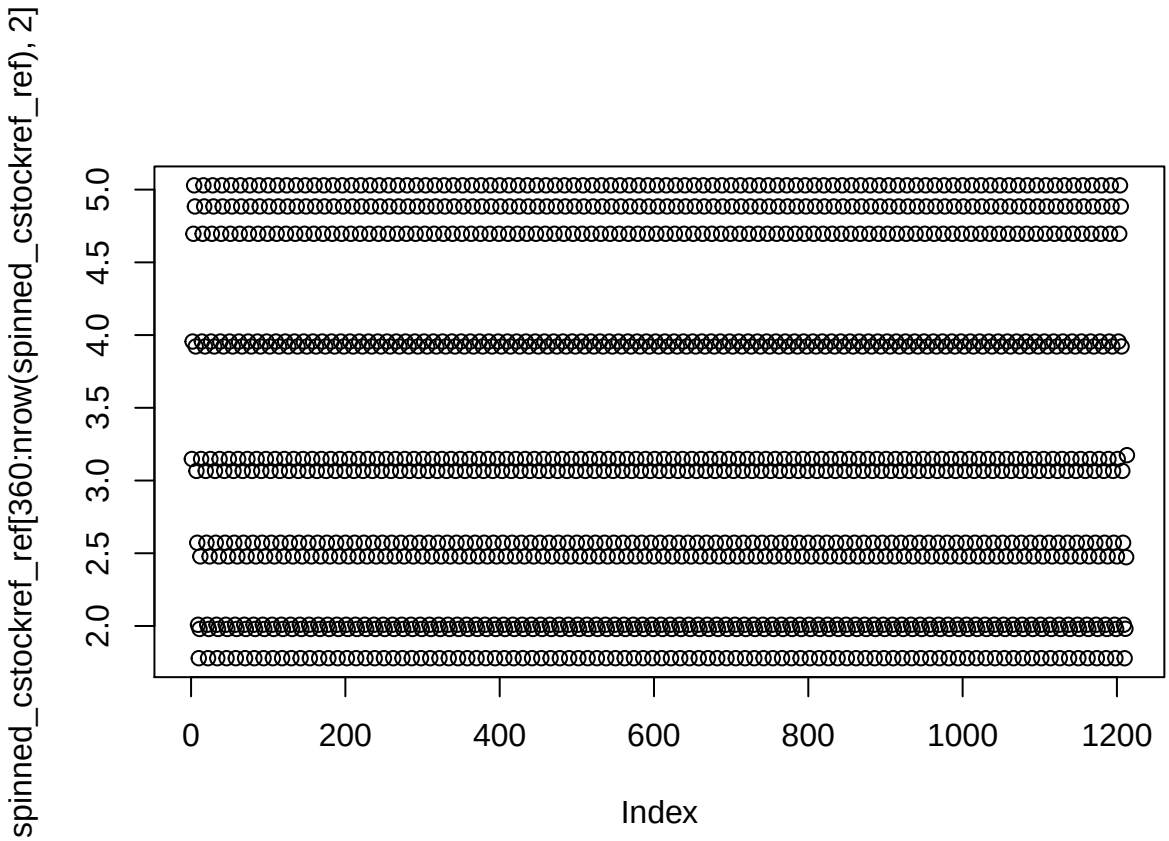
```r
xi_ref_spinned = data.frame("month"=1:1572 , "xi"=spinned_moisture_ref$b*spinned_tempeff_ref)

xi_sc_spinned = data.frame("month"=1:1572 , "xi"=spinned_moisture_sc$b*spinned_tempeff_sc)


#?RothCModel

# spinned up reference model

spinned_refmodel <- RothCModel(xi_ref_spinned$month, ks = c(k.DPM = 10, k.RPM = 0.3,
                    k.BIO = 0.66, k.HUM = 0.02, k.IOM = 0), C0 = c(0, 0, 0, 0, FallIOM),
                    In = 2.7, DR = 1.44, clay = 48, xi = xi_ref_spinned,
                    solver = deSolve.lsoda.wrapper, pass = FALSE)

spinned_cstockref_ref <- getC(spinned_refmodel)
#head(spinned_cstockref_ref)
#tail(spinned_cstockref_ref)


# spinned up scenario data

spinned_scmodel <- RothCModel(xi_sc_spinned$month, ks = c(k.DPM = 10, k.RPM = 0.3,
                   k.BIO = 0.66, k.HUM = 0.02, k.IOM = 0), C0 = c(0, 0, 0, 0, FallIOM),
                   In = 2.7, DR = 1.44, clay = 48, xi = xi_sc_spinned,
                   solver = deSolve.lsoda.wrapper, pass = FALSE)

spinned_cstockref_sc <- getC(scmodel)
#head(spinned_cstockref_sc)
#tail(spinned_cstockref_sc)
```

Now, there should be no changes in time for the different stocks in the reference data if we begin at the end of the spin up.

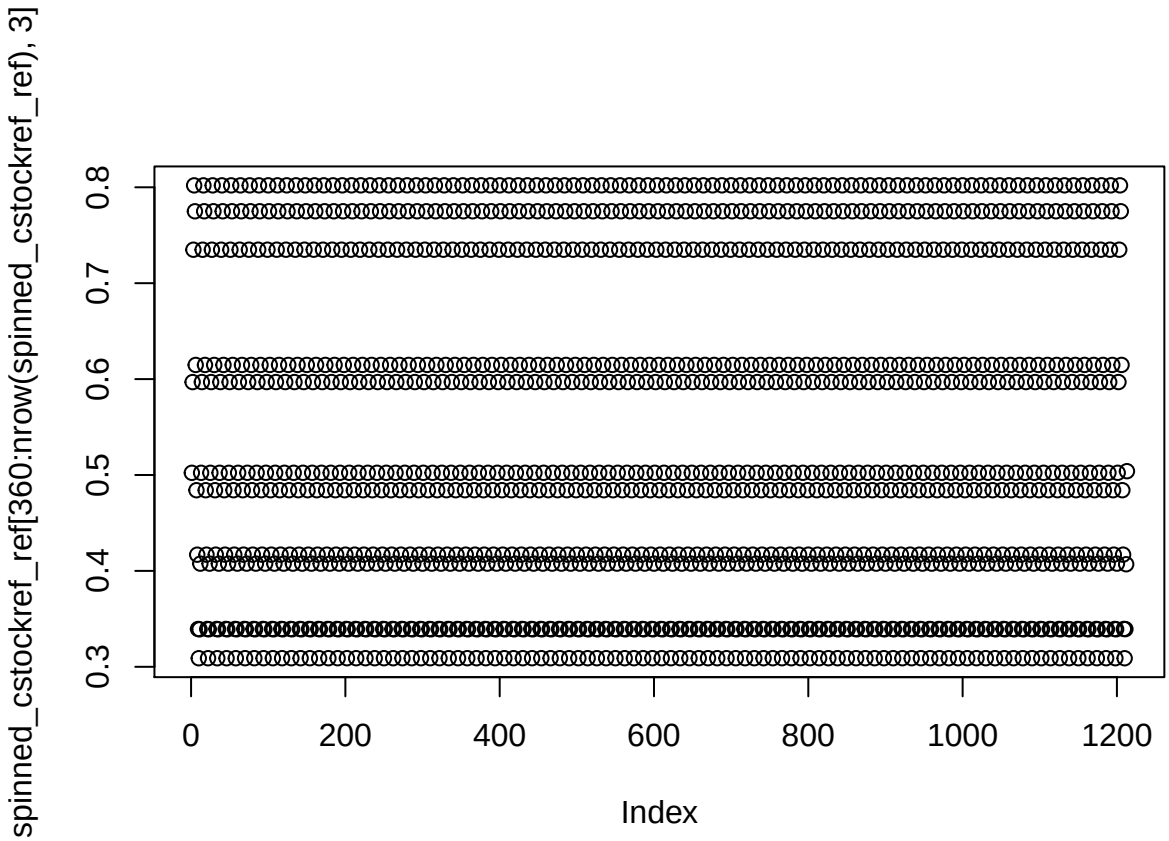
```r
plot(spinned_cstockref_ref[360:nrow(spinned_cstockref_ref),1]) # DPM
```



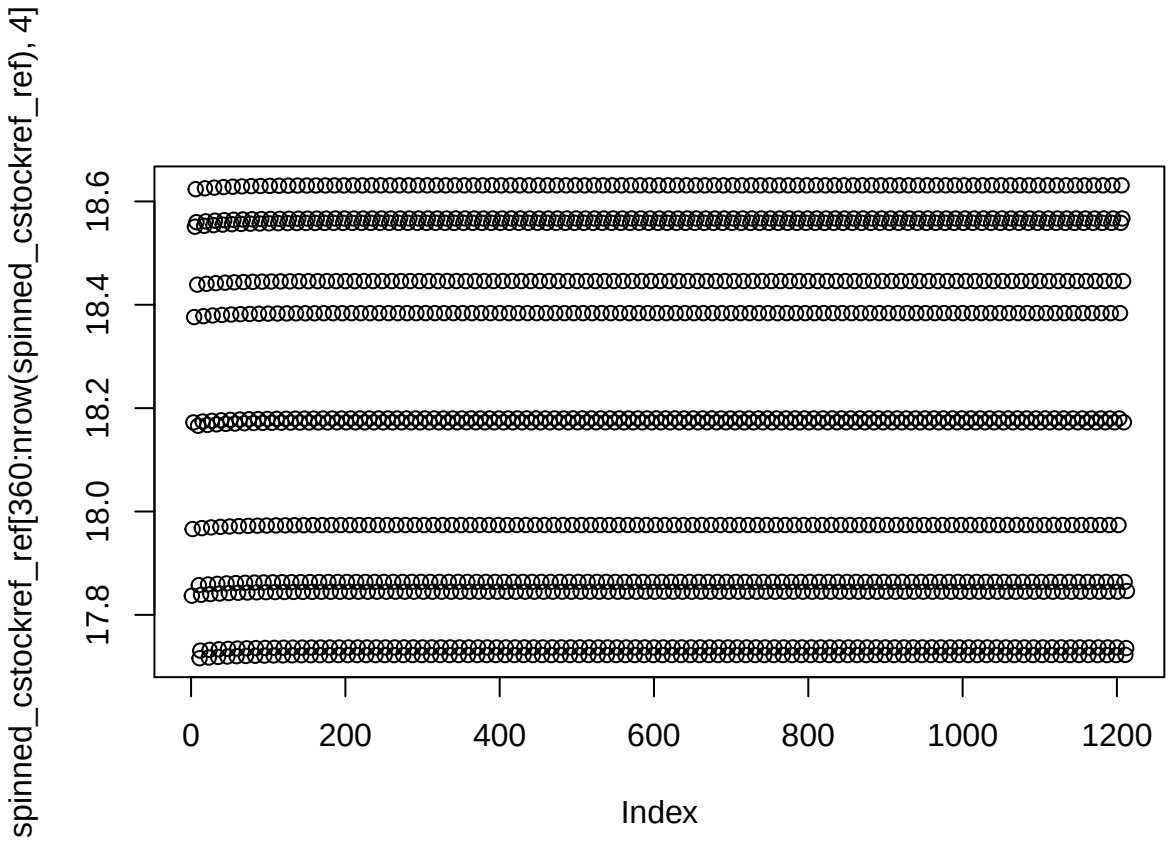

```
plot(spinned_cstockref_ref[360:nrow(spinned_cstockref_ref),2]) # RPM
```




```
plot(spinned_cstockref_ref[360:nrow(spinned_cstockref_ref),3]) # BIO
```



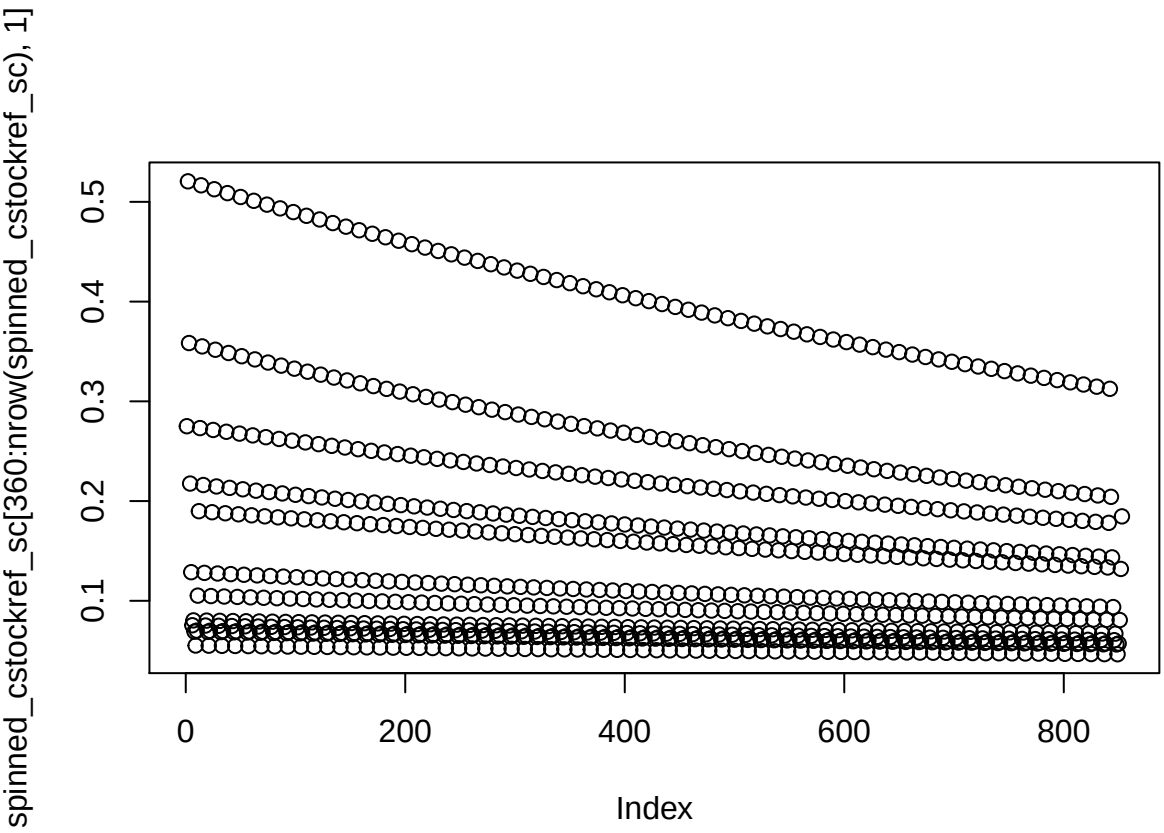

```
plot(spinned_cstockref_ref[360:nrow(spinned_cstockref_ref),4]) # HUM, only very small changes seen now
```



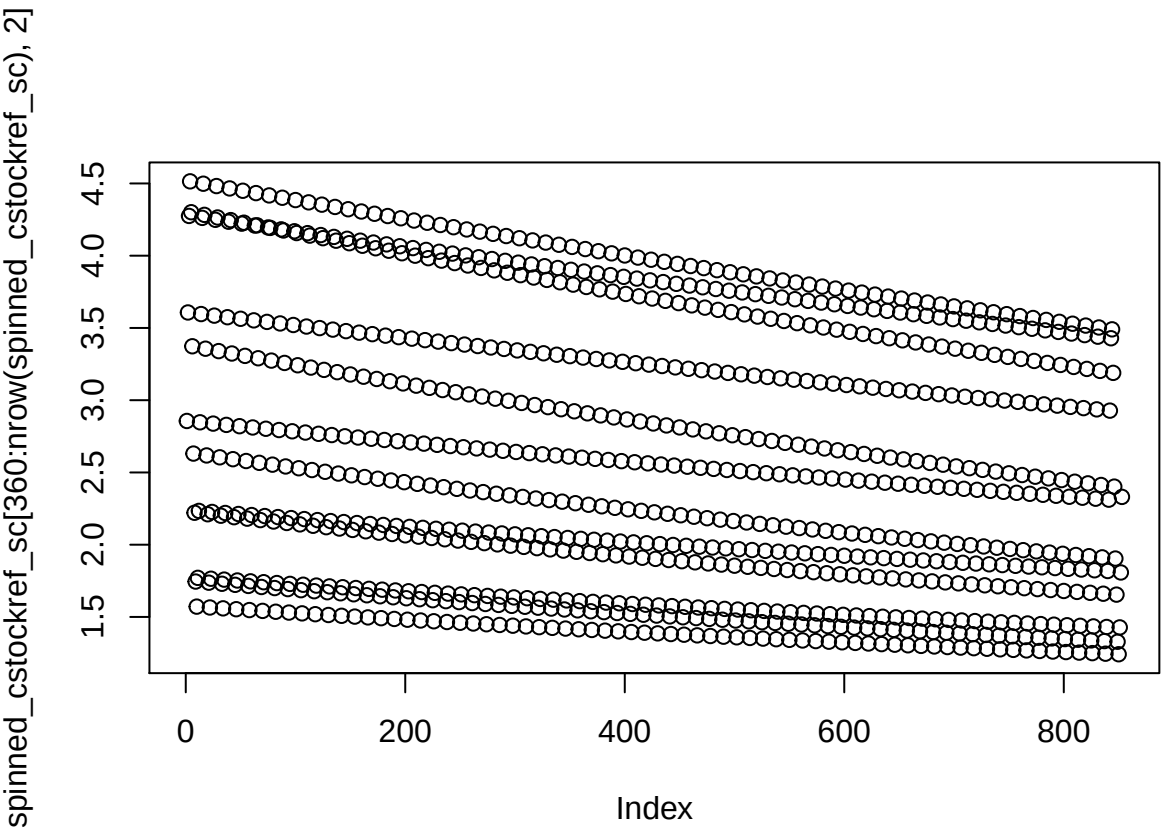

```
#plot(spinned_cstockref_ref[360:nrow(spinned_cstockref_ref),5]) # IoM
```

Let's look at the scenario data.

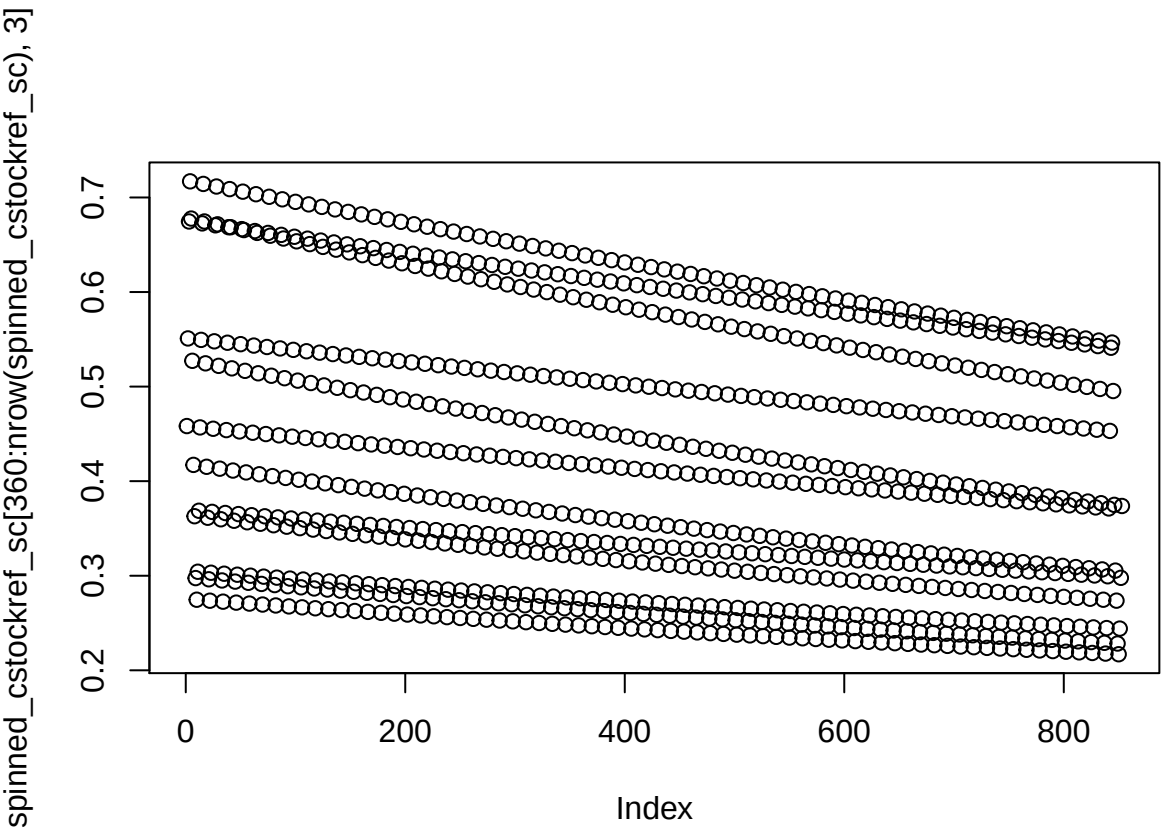
```
plot(spinned_cstockref_sc[360:nrow(spinned_cstockref_sc),1]) # DPM
```



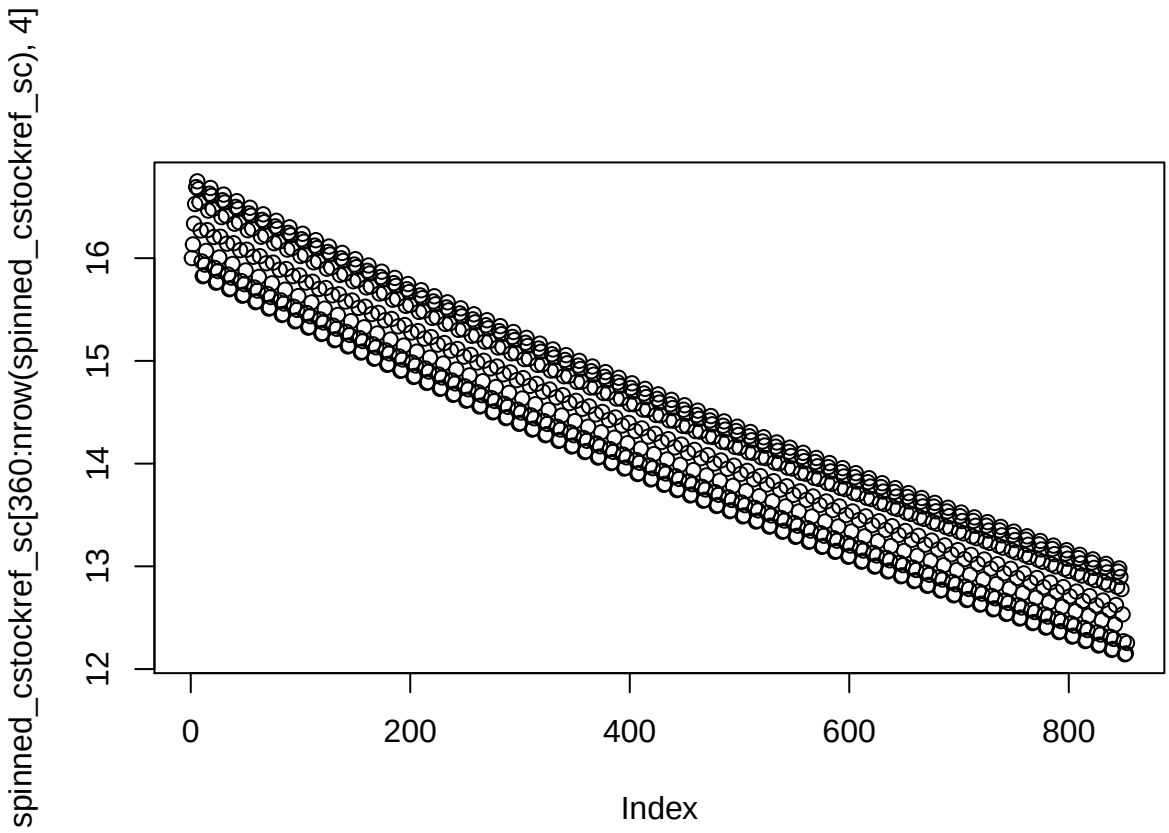

```
plot(spinned_cstockref_sc[360:nrow(spinned_cstockref_sc),2]) # RPM
```




```
plot(spinned_cstockref_sc[360:nrow(spinned_cstockref_sc),3]) # BIO
```




```
plot(spinned_cstockref_sc[360:nrow(spinned_cstockref_sc),4]) # HUM
```




```
#plot(spinned_cstockref_sc[360:nrow(spinned_cstockref_sc),5]) # IoM
```

Changes in climate change scenario also after the spin up!

Ex 3

```
exp_data <- read.delim("00_experimentalData.txt")

### doesnt run, just a sketch overview, due to not enough time
pool_model <- function(parameter, onepool = TRUE){
  if(onepool == TRUE){
    model <- OnepModel(t, k, C0, In, xi = 1, solver = deSolve.lsoda.wrapper, pass = FALSE)
  } else {
    model <- TwopFeedbackModel(t = , ks = c(pool1, pool2), a21, a12, C0 = c(0, 0, 0, 0, FallIOM), In = 
  }
  return(getAccumulatedRelease(model))
}

costf <- function(parameter, onepool = TRUE){
  model <- pool_model(parameter, onepool = onepool)
  mincost <- modCost(model, obs)
  return(mincost)
}


opt_CO2 <- modFit(costf, p, ..., lower = exp_data$cummCO2[1], upper = exp_data$cummCO2[21], method = c(
```

```
t <- exp_data$time
k <- exp_data$cummCO2
```