Data Analysis Prep

PAZ

8 août 2017

Files

Imports:

- **WeeklyHydroContam_R.csv** (water, Book 5)
- **MassBalance_R.csv** (soils, Book 7)

Generates (by merging above):

- **WaterSoils_R.csv**

Import packages

```
library("ggplot2")
library("ggrepel")
library("zoo")

# Melting data sets & changin axes
library("reshape2")

library("MASS")
```

Lab parameters

```
# Initial signature measured in tank
initialDelta = -32.253
```

References

Modified from: D. Borcard & F. Gillet Multivariate Analysis in Community Ecology: Constrained ordination and other analysis

Adapted from: Gwena?l Imfeld, LyGeS,2009

Import and merge water and soil data sets

```
# Check working directory
getwd()
```

```
## [1] "D:/Documents/these_pablo/Alteckendorf2016/HydrologicalMonitoring"
```

```r
# setwd("D:/Documents/these_pablo/Rscripts/Clustering")

waters = read.csv2("Data/WeeklyHydroContam_R.csv")



waters$ti <- as.POSIXct(strptime(waters$ti, "%Y-%m-%d %H:%M", tz="EST"))
colnames(waters)[colnames(waters) == "ti"] <- "Date.ti"
waters$Events <- factor(waters$Events, levels = unique(waters$Events))
waters$Event <- factor(waters$Event, levels = unique(waters$Event))

#colnames(waters)

# Integrate Catchment's Bulk signature for normalization of discharge signatures
# Soils
soils = read.csv2("Data/MassBalance_R.csv",
                        na.strings=c('#DIV/0!', '', 'NA'), header = TRUE)
colnames(soils)[colnames(soils) == "ti"] <- "Date.ti"
soils$Date.ti <- as.POSIXct(strptime(soils$Date.ti,
                                             "%Y-%m-%d %H:%M", tz="EST")) # csv typos, option 1
sum(is.na(soils$Date.ti)) == 0
```

```
## [1] TRUE
```

```r
#colnames(soils)

keepSoil <- c("WeekSubWeek", "Event",
              "comp.d13C.SE.North", "comp.d13C.SE.Talweg", "comp.d13C.SE.South",
              "f.max.comp", "f.mean.comp", "f.min.comp", "ngC.SD","ngC.SE", "N_compsoil", "N_ngC")
soils <- soils[ , !(names(soils) %in% keepSoil)]

names(soils)
```

```
##  [1] "Date.ti"               "Duration.Hrs"
##  [3] "timeSinceApp"          "timeSinceApp.NoSo"
##  [5] "timeSinceApp.N"        "timeSinceApp.T"
##  [7] "timeSinceApp.S"        "diss.d13C"
##  [9] "SD.d13C"               "CumOutDiss.g"
## [11] "CumOutFilt.g"          "TotSMout.g"
## [13] "TotSMout.g.SD"         "MELsm.g"
## [15] "MELsm.g.SD"            "Appl.Mass.g"
## [17] "Appl.Mass.g.OT"        "CumAppMass.g"
## [19] "CumAppMass.g.N"        "CumAppMass.g.T"
## [21] "CumAppMass.g.S"        "CumAppMass.g.OT"
## [23] "CumAppMass.g.N.OT"     "CumAppMass.g.T.OT"
## [25] "CumAppMass.g.S.OT"     "iniCo.ug.g.N"
## [27] "iniCo.ug.g.T"          "iniCo.ug.g.S"
## [29] "CumOutSmeto.g"         "CumOutMELsm.g"
## [31] "MassSoil.g.North"      "MassSoil.g.SD.North"
## [33] "Conc.mug.g.dry.soil.N" "comp.d13C.North"
## [35] "comp.d13C.SD.North"    "ID.N"
## [37] "Area.N"                "Area.T"
## [39] "Area.S"                "MassSoil.g.Talweg"
## [41] "MassSoil.g.SD.Talweg"  "Conc.mug.g.dry.soil.T"
## [43] "comp.d13C.Talweg"      "comp.d13C.SD.Talweg"
```

```
## [45] "ID.T"                   "MassSoil.g.South"
## [47] "MassSoil.g.SD.South"    "Conc.mug.g.dry.soil.S"
## [49] "comp.d13C.South"        "comp.d13C.SD.South"
## [51] "ID.S"                   "DD13C.North"
## [53] "DD13C.Talweg"           "DD13C.South"
## [55] "CatchMassSoil.g"        "CatchMassSoil.g.SD"
## [57] "BulkCatch.d13"          "BulkCatch.d13.SD"
## [59] "DD13.Bulk"              "Area.Catchment"
## [61] "BulkCatch.Conc"         "iniCo.Bulk"
```

```
repeatsInWater <- names(waters)[(names(waters) %in% names(soils))] # Not unique to waters
repeatsInWater <- repeatsInWater[2:length(repeatsInWater)]
waters <- waters[ , !(names(waters) %in% repeatsInWater)]

watSoilMerged <- merge(waters, soils, by = "Date.ti", all = T)

if (is.na(watSoilMerged$WeekSubWeek[nrow(watSoilMerged)])) {
  watSoilMerged <- watSoilMerged[1:nrow(watSoilMerged)-1, ]
}
# d13obs <- waters$SD.d13C
# totd13obs <- length(d13obs) - sum(is.na(d13obs))

watSoilMerged$DD13.Bulk <- watSoilMerged$BulkCatch.d13-initialDelta

colnames(watSoilMerged)
```

```
##   [1] "Date.ti"                 "WeekSubWeek"
##   [3] "tf"                      "iflux"
##   [5] "fflux"                   "changeflux"
##   [7] "maxQ"                    "minQ"
##   [9] "dryHrsIni"               "dryHrsMax"
##  [11] "dryHrsAve"               "noEventHrsIni"
##  [13] "noEventHrsMax"           "noEventHrsAve"
##  [15] "chExtreme"               "Peak"
##  [17] "Markers"                 "TimeDiff"
##  [19] "AveDischarge.m3.h"       "Volume.m3"
##  [21] "Sampled.Hrs"             "Sampled"
##  [23] "CumRain.mm"              "RainInt.mmhr"
##  [25] "Conc.mug.L"              "Conc.SD"
##  [27] "OXA_mean"                "OXA_SD"
##  [29] "ESA_mean"                "ESA_SD"
##  [31] "N.x"                     "N_d13C.diss"
##  [33] "MES.mg.L"                "MES.sd"
##  [35] "MO.mg.L"                 "Conc.Solids.mug.gMES"
##  [37] "Conc.Solids.ug.gMES.SD"  "N.y"
##  [39] "filt.d13C"               "filt.SD.d13C"
##  [41] "DD13C.diss"              "DD13C.filt"
##  [43] "NH4.mM"                  "TIC.ppm.filt"
##  [45] "Cl.mM"                   "NO3...mM"
##  [47] "PO4..mM"                 "NPOC.ppm"
##  [49] "TIC.ppm.unfilt"          "TOC.ppm.unfilt"
##  [51] "ExpMES.Kg"               "Appl.Mass.g.N"
##  [53] "Appl.Mass.g.T"           "Appl.Mass.g.S"
##  [55] "Appl.Mass.g.N.OT"        "Appl.Mass.g.T.OT"
##  [57] "Appl.Mass.g.S.OT"        "Appl.Mass.g.NoSo"
```

```
##  [59] "DissSmeto.mg"           "DissSmeto.mg.SD"
##  [61] "DissSmeto.g"            "DissSmeto.g.SD"
##  [63] "DissOXA.mg"             "DissOXA.mg.SD"
##  [65] "DissOXA.g"              "DissOXA.g.SD"
##  [67] "DissESA.mg"             "DissESA.mg.SD"
##  [69] "DissESA.g"              "DissESA.g.SD"
##  [71] "FiltSmeto.mg"           "FiltSmeto.mg.SD"
##  [73] "FiltSmeto.g"            "FiltSmeto.g.SD"
##  [75] "TotSMout.mg"            "TotSMout.mg.SD"
##  [77] "FracDiss"               "FracFilt"
##  [79] "BalMassDisch.g"         "prctMassOut"
##  [81] "FracDeltaOut"           "Events"
##  [83] "Weeks"                  "Event"
##  [85] "Duration.Hrs"           "timeSinceApp"
##  [87] "timeSinceApp.NoSo"      "timeSinceApp.N"
##  [89] "timeSinceApp.T"         "timeSinceApp.S"
##  [91] "diss.d13C"              "SD.d13C"
##  [93] "CumOutDiss.g"           "CumOutFilt.g"
##  [95] "TotSMout.g"             "TotSMout.g.SD"
##  [97] "MELsm.g"                "MELsm.g.SD"
##  [99] "Appl.Mass.g"            "Appl.Mass.g.OT"
## [101] "CumAppMass.g"           "CumAppMass.g.N"
## [103] "CumAppMass.g.T"         "CumAppMass.g.S"
## [105] "CumAppMass.g.OT"        "CumAppMass.g.N.OT"
## [107] "CumAppMass.g.T.OT"      "CumAppMass.g.S.OT"
## [109] "iniCo.ug.g.N"           "iniCo.ug.g.T"
## [111] "iniCo.ug.g.S"           "CumOutSmeto.g"
## [113] "CumOutMELsm.g"          "MassSoil.g.North"
## [115] "MassSoil.g.SD.North"    "Conc.mug.g.dry.soil.N"
## [117] "comp.d13C.North"        "comp.d13C.SD.North"
## [119] "ID.N"                   "Area.N"
## [121] "Area.T"                 "Area.S"
## [123] "MassSoil.g.Talweg"      "MassSoil.g.SD.Talweg"
## [125] "Conc.mug.g.dry.soil.T"  "comp.d13C.Talweg"
## [127] "comp.d13C.SD.Talweg"    "ID.T"
## [129] "MassSoil.g.South"       "MassSoil.g.SD.South"
## [131] "Conc.mug.g.dry.soil.S"  "comp.d13C.South"
## [133] "comp.d13C.SD.South"     "ID.S"
## [135] "DD13C.North"            "DD13C.Talweg"
## [137] "DD13C.South"            "CatchMassSoil.g"
## [139] "CatchMassSoil.g.SD"     "BulkCatch.d13"
## [141] "BulkCatch.d13.SD"       "DD13.Bulk"
## [143] "Area.Catchment"         "BulkCatch.Conc"
## [145] "iniCo.Bulk"
```

Reduce variable size

```
dropNoUse <- c("Markers" , "TimeDiff",
               "se.d13C", "MES.mg.L", "MES.sd", "MO.mg.L", "filt.se.d13C", "f.diss", "f.filt",
               "Appl.Mass.g",
               "FracDiss", "FracFilt",
               # Nanogram obs numbers.
```

```
                "N_ngC.diss", "N_ngC.fl",
                # Remove in mg units
                "DissSmeto.mg", "DissSmeto.mg.SD" ,
                "DissOXA.mg", "DissOXA.mg.SD",
               "DissESA.mg", "DissESA.mg.SD" ,
               "FiltSmeto.mg", "FiltSmeto.mg.SD" ,
               "TotSMout.mg","TotSMout.mg.SD",
               # Transect areas
               "ID.N", "ID.T", "ID.S", "Area.N", "Area.T", "Area.S",
               # Standard errors
               "se.d13C", "filt.se.d13C",
               # Degradation
               "B.diss.x", "B.filt.x",
               "B.mean.comp.North", "B.max.comp.North" , "B.min.comp.North",
               "B.mean.comp.Talweg", "B.max.comp.Talweg", "B.min.comp.Talweg",
               "B.mean.comp.South", "B.max.comp.South" , "B.min.comp.South",
               "FracDeltaOut" ,
               # Isotopes (DD already included)
                "comp.d13C.North","comp.d13C.SD.North",
               "comp.d13C.Talweg", "comp.d13C.SD.Talweg" #,
               # Masses on transects
               # "MassSoil.g.North", "MassSoil.g.Talweg", "MassSoil.g.South"
               )

watSoilMerged <- watSoilMerged[ , !(names(watSoilMerged) %in% dropNoUse)]


# Date conversion correct:
sum(is.na(watSoilMerged$Date.ti)) == 0
```

```
## [1] TRUE
```

```
colnames(watSoilMerged)
```

```
##   [1] "Date.ti"                "WeekSubWeek"
##   [3] "tf"                     "iflux"
##   [5] "fflux"                  "changeflux"
##   [7] "maxQ"                   "minQ"
##   [9] "dryHrsIni"              "dryHrsMax"
##  [11] "dryHrsAve"              "noEventHrsIni"
##  [13] "noEventHrsMax"          "noEventHrsAve"
##  [15] "chExtreme"              "Peak"
##  [17] "AveDischarge.m3.h"      "Volume.m3"
##  [19] "Sampled.Hrs"            "Sampled"
##  [21] "CumRain.mm"             "RainInt.mmhr"
##  [23] "Conc.mug.L"             "Conc.SD"
##  [25] "OXA_mean"               "OXA_SD"
##  [27] "ESA_mean"               "ESA_SD"
##  [29] "N.x"                    "N_d13C.diss"
##  [31] "Conc.Solids.mug.gMES"   "Conc.Solids.ug.gMES.SD"
##  [33] "N.y"                    "filt.d13C"
##  [35] "filt.SD.d13C"           "DD13C.diss"
##  [37] "DD13C.filt"             "NH4.mM"
##  [39] "TIC.ppm.filt"           "Cl.mM"
```

```
##  [41] "NO3...mM"               "PO4..mM"
##  [43] "NPOC.ppm"               "TIC.ppm.unfilt"
##  [45] "TOC.ppm.unfilt"         "ExpMES.Kg"
##  [47] "Appl.Mass.g.N"          "Appl.Mass.g.T"
##  [49] "Appl.Mass.g.S"          "Appl.Mass.g.N.OT"
##  [51] "Appl.Mass.g.T.OT"       "Appl.Mass.g.S.OT"
##  [53] "Appl.Mass.g.NoSo"       "DissSmeto.g"
##  [55] "DissSmeto.g.SD"         "DissOXA.g"
##  [57] "DissOXA.g.SD"           "DissESA.g"
##  [59] "DissESA.g.SD"           "FiltSmeto.g"
##  [61] "FiltSmeto.g.SD"         "BalMassDisch.g"
##  [63] "prctMassOut"            "Events"
##  [65] "Weeks"                  "Event"
##  [67] "Duration.Hrs"           "timeSinceApp"
##  [69] "timeSinceApp.NoSo"      "timeSinceApp.N"
##  [71] "timeSinceApp.T"         "timeSinceApp.S"
##  [73] "diss.d13C"              "SD.d13C"
##  [75] "CumOutDiss.g"           "CumOutFilt.g"
##  [77] "TotSMout.g"             "TotSMout.g.SD"
##  [79] "MELsm.g"                "MELsm.g.SD"
##  [81] "Appl.Mass.g.OT"         "CumAppMass.g"
##  [83] "CumAppMass.g.N"         "CumAppMass.g.T"
##  [85] "CumAppMass.g.S"         "CumAppMass.g.OT"
##  [87] "CumAppMass.g.N.OT"      "CumAppMass.g.T.OT"
##  [89] "CumAppMass.g.S.OT"      "iniCo.ug.g.N"
##  [91] "iniCo.ug.g.T"           "iniCo.ug.g.S"
##  [93] "CumOutSmeto.g"          "CumOutMELsm.g"
##  [95] "MassSoil.g.North"       "MassSoil.g.SD.North"
##  [97] "Conc.mug.g.dry.soil.N"  "MassSoil.g.Talweg"
##  [99] "MassSoil.g.SD.Talweg"   "Conc.mug.g.dry.soil.T"
## [101] "MassSoil.g.South"       "MassSoil.g.SD.South"
## [103] "Conc.mug.g.dry.soil.S"  "comp.d13C.South"
## [105] "comp.d13C.SD.South"     "DD13C.North"
## [107] "DD13C.Talweg"           "DD13C.South"
## [109] "CatchMassSoil.g"        "CatchMassSoil.g.SD"
## [111] "BulkCatch.d13"          "BulkCatch.d13.SD"
## [113] "DD13.Bulk"              "Area.Catchment"
## [115] "BulkCatch.Conc"         "iniCo.Bulk"
```

```
sum(is.na(watSoilMerged$maxQ))
```

```
## [1] 0
```

Variable generation

We would like to determine whether there are different clusters in the data.

Via response variables:

- Concentrations ($\mu g/L$)
- MEL-sm (g)
- Loads (SM g)
- Transformation products (OXA and ESA in $\mu g/L$ and in loads g)

Via hydrological characteristics:

- Event index:

$$\frac{I_{max} \cdot R_{tot}}{D}$$

- Event duration ($t_f - t_i$)
- Volume discharged ($\sum_{i=1}^{N} Q_i \cdot dt_i$, N: no. of measurements within the event)
- Average discharge ($\sum_{i=1}^{N} Q_i/N$)

Imax = max rainfall intensity mm/h ; Rtot = rainfall amount (mm); D = duration (min)

"A high EVI represents a short but intense rainfall event, whereas a low EVI indicates an event with a low intensity but long duration. The catchment response time is defined as the time between the gravity centre of the rain event and the peak outflow. (Baartman et al., 2013; in Lefrancq etal2017)"

The EVI has been adapted to reflect discharge index such that:

- Discharge index A [m3/h x m3/h]

$$DIa = \frac{Q_{max} \cdot V_{tot}}{D}$$

```
watSoilMerged$DIa <- watSoilMerged$maxQ*watSoilMerged$Volume.m3/watSoilMerged$Duration.Hrs
# watSoilMerged$DIb <- watSoilMerged$Volume.m3/watSoilMerged$Duration.Hrs * 1/watSoilMerged$maxQ
```

Normalization by remaining S-met mass and bulk ($\Delta\delta$)

This section normalizes outlet response variables (S-met and TPs loadings and $\Delta\delta$ values).

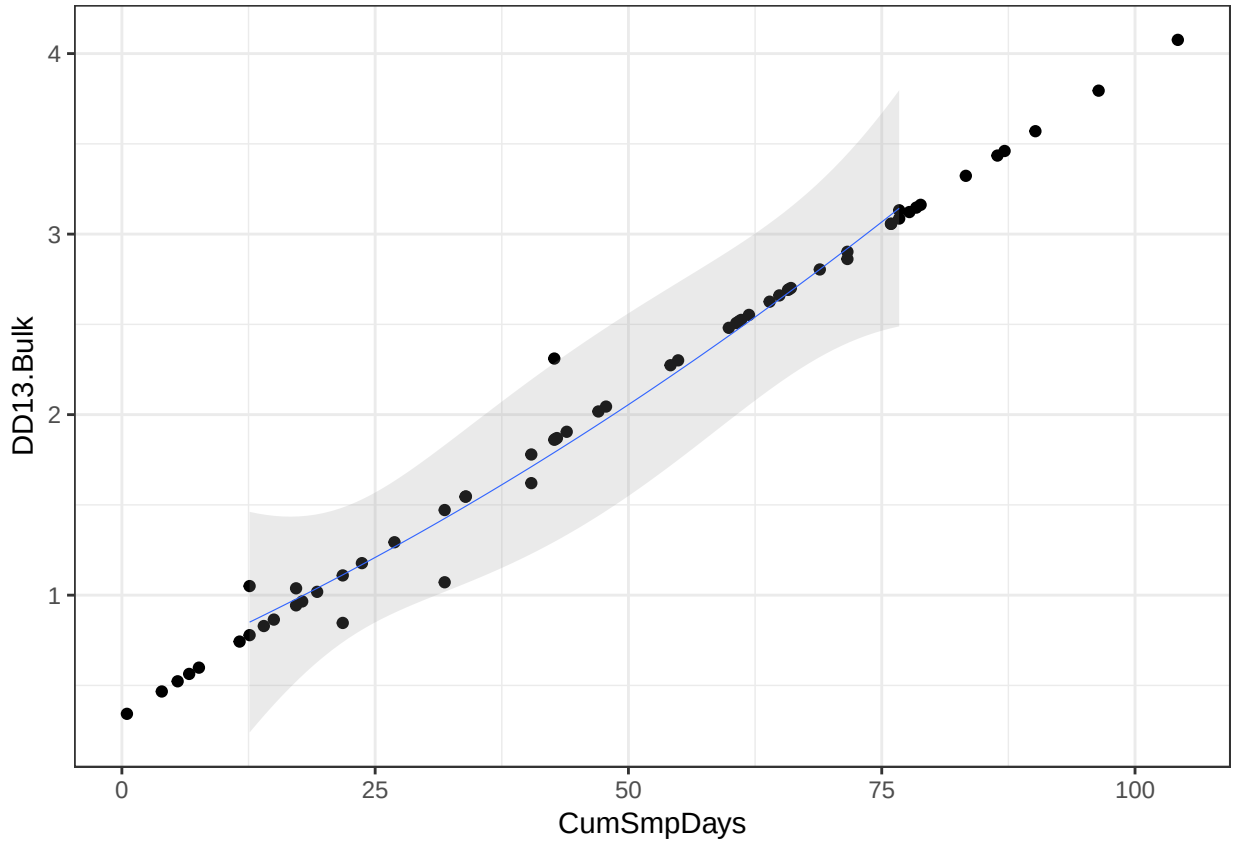
1. Convert date-time to cumuative days since first measurements (needed for step 2)
2. Compute linear models to predict bulk catchment soils $\Delta\delta$ and mass remaining.
3. Normalize outlet $\Delta\delta$ and S-met loadings by predicted values.

```
watSoilMerged$CumSmpDays <- cumsum(watSoilMerged$Sampled.Hrs)/24

DD.glm1 <- glm(watSoilMerged$DD13.Bulk ~ watSoilMerged$CumSmpDays)
DD.glm2 <- glm(watSoilMerged$DD13.Bulk ~ (watSoilMerged$CumSmpDays)^2, family = gaussian)

summary(DD.glm1) # Both models were identical
```

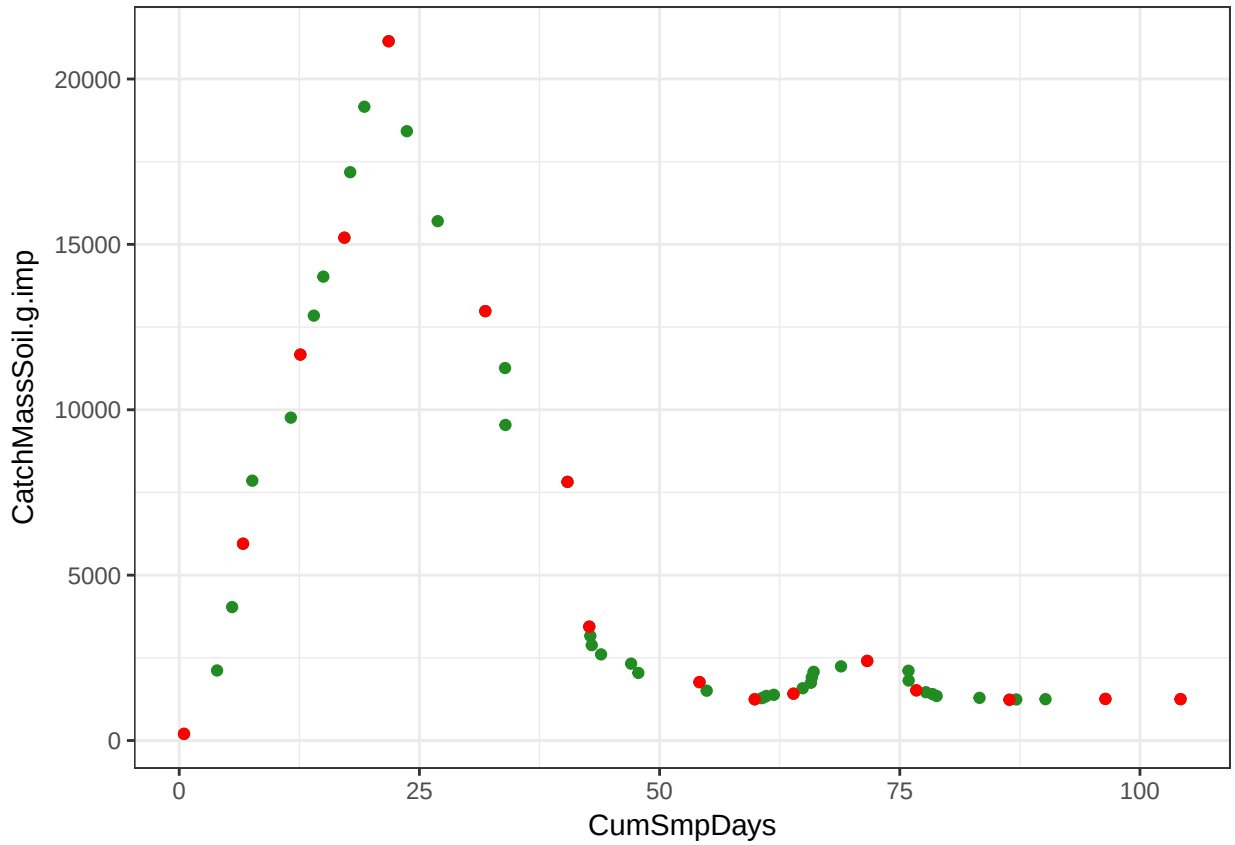
```
##
## Call:
## glm(formula = watSoilMerged$DD13.Bulk ~ watSoilMerged$CumSmpDays)
##
## Deviance Residuals:
##      Min        1Q    Median        3Q       Max
## -0.40001  -0.18485   0.00288   0.13880   0.44982
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                0.324711   0.214994   1.510 0.181704
## watSoilMerged$CumSmpDays 0.035992   0.004746   7.583 0.000273 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for gaussian family taken to be 0.09056214)
##
##     Null deviance: 5.75107  on 7  degrees of freedom
```

```
## Residual deviance: 0.54337  on 6  degrees of freedom
##   (43 observations deleted due to missingness)
## AIC: 7.1878
##
## Number of Fisher Scoring iterations: 2
```

```
# Input isotope predicted values
watSoilMerged$DD.Bulk.imp <- predict(DD.glm1, data.frame(watSoilMerged$CumSmpDays))
watSoilMerged$CatchMassSoil.g.imp <- na.approx(watSoilMerged$CatchMassSoil.g)

# Isotopes Bulk Soils
ggplot(data = watSoilMerged, aes(x = CumSmpDays))+
  geom_point(aes(y = DD13.Bulk)) +
  geom_point(aes(y = DD.Bulk.imp)) +
  stat_smooth(aes(x = CumSmpDays, y = DD13.Bulk ), method = "lm", formula = y ~ poly(x, 2), se = T, alp
  theme_bw()
```




```
ggplot(data = watSoilMerged, aes(x = CumSmpDays))+
  geom_point(aes(y = CatchMassSoil.g.imp), col = "forestgreen") +
  geom_point(aes(y = CatchMassSoil.g), col = "red") +
  theme_bw()
```




```
# View(watSoilMerged[, c(1:29, 47:60, 70, 102: ncol(watSoilMerged))])

# Option 1.
# Divide by estimated mass in catchment available # [-]
# watSoilMerged$SM.g.nrm <- watSoilMerged$TotSMout.g/watSoilMerged$BalMassDisch.g # [-]
# watSoilMerged$MEL.g.nrm <- watSoilMerged$MELsm.g/watSoilMerged$BalMassDisch.g # [-]

# Option 2
# Divide by estimated prct. mass in catchment available # [g]
# watSoilMerged$CumPrctMassOut <- cumsum(watSoilMerged$prctMassOut)
# watSoilMerged$SM.g.nrm.prc <- watSoilMerged$TotSMout.g/watSoilMerged$CumPrctMassOut # [-]
# watSoilMerged$MEL.g.nrm.prc <- watSoilMerged$MELsm.g/watSoilMerged$CumPrctMassOut # [-]


watSoilMerged$SM.g.nrm <- watSoilMerged$TotSMout.g/watSoilMerged$CatchMassSoil.g.imp # [-]
watSoilMerged$TP.g.nrm <- (watSoilMerged$MELsm.g-watSoilMerged$TotSMout.g)/watSoilMerged$CatchMassSoil.g
watSoilMerged$DD.diss.nrm <-  watSoilMerged$DD13C.diss/watSoilMerged$DD.Bulk.imp # Losses values where
watSoilMerged$DD.diss.nrmSD <- watSoilMerged$SD.d13C/watSoilMerged$DD.Bulk.imp
# watSoilMerged$DD.diff.prc <- ifelse( is.na(watSoilMerged$DD13C.diss) , NA,
#                                      ((watSoilMerged$DD13C.diss-watSoilMerged$DD.Bulk.imp)/watSoilMerge

names(watSoilMerged)
```

```
##    [1] "Date.ti"                "WeekSubWeek"
##    [3] "tf"                     "iflux"
##    [5] "fflux"                  "changeflux"
```

```
##   [7] "maxQ"                    "minQ"
##   [9] "dryHrsIni"               "dryHrsMax"
##  [11] "dryHrsAve"               "noEventHrsIni"
##  [13] "noEventHrsMax"           "noEventHrsAve"
##  [15] "chExtreme"               "Peak"
##  [17] "AveDischarge.m3.h"       "Volume.m3"
##  [19] "Sampled.Hrs"             "Sampled"
##  [21] "CumRain.mm"              "RainInt.mmhr"
##  [23] "Conc.mug.L"              "Conc.SD"
##  [25] "OXA_mean"                "OXA_SD"
##  [27] "ESA_mean"                "ESA_SD"
##  [29] "N.x"                     "N_d13C.diss"
##  [31] "Conc.Solids.mug.gMES"    "Conc.Solids.ug.gMES.SD"
##  [33] "N.y"                     "filt.d13C"
##  [35] "filt.SD.d13C"            "DD13C.diss"
##  [37] "DD13C.filt"              "NH4.mM"
##  [39] "TIC.ppm.filt"            "Cl.mM"
##  [41] "NO3...mM"                "PO4..mM"
##  [43] "NPOC.ppm"                "TIC.ppm.unfilt"
##  [45] "TOC.ppm.unfilt"          "ExpMES.Kg"
##  [47] "Appl.Mass.g.N"           "Appl.Mass.g.T"
##  [49] "Appl.Mass.g.S"           "Appl.Mass.g.N.OT"
##  [51] "Appl.Mass.g.T.OT"        "Appl.Mass.g.S.OT"
##  [53] "Appl.Mass.g.NoSo"        "DissSmeto.g"
##  [55] "DissSmeto.g.SD"          "DissOXA.g"
##  [57] "DissOXA.g.SD"            "DissESA.g"
##  [59] "DissESA.g.SD"            "FiltSmeto.g"
##  [61] "FiltSmeto.g.SD"          "BalMassDisch.g"
##  [63] "prctMassOut"             "Events"
##  [65] "Weeks"                   "Event"
##  [67] "Duration.Hrs"            "timeSinceApp"
##  [69] "timeSinceApp.NoSo"       "timeSinceApp.N"
##  [71] "timeSinceApp.T"          "timeSinceApp.S"
##  [73] "diss.d13C"               "SD.d13C"
##  [75] "CumOutDiss.g"            "CumOutFilt.g"
##  [77] "TotSMout.g"              "TotSMout.g.SD"
##  [79] "MELsm.g"                 "MELsm.g.SD"
##  [81] "Appl.Mass.g.OT"          "CumAppMass.g"
##  [83] "CumAppMass.g.N"          "CumAppMass.g.T"
##  [85] "CumAppMass.g.S"          "CumAppMass.g.OT"
##  [87] "CumAppMass.g.N.OT"       "CumAppMass.g.T.OT"
##  [89] "CumAppMass.g.S.OT"       "iniCo.ug.g.N"
##  [91] "iniCo.ug.g.T"            "iniCo.ug.g.S"
##  [93] "CumOutSmeto.g"           "CumOutMELsm.g"
##  [95] "MassSoil.g.North"        "MassSoil.g.SD.North"
##  [97] "Conc.mug.g.dry.soil.N"   "MassSoil.g.Talweg"
##  [99] "MassSoil.g.SD.Talweg"    "Conc.mug.g.dry.soil.T"
## [101] "MassSoil.g.South"        "MassSoil.g.SD.South"
## [103] "Conc.mug.g.dry.soil.S"   "comp.d13C.South"
## [105] "comp.d13C.SD.South"      "DD13C.North"
## [107] "DD13C.Talweg"            "DD13C.South"
## [109] "CatchMassSoil.g"         "CatchMassSoil.g.SD"
## [111] "BulkCatch.d13"           "BulkCatch.d13.SD"
## [113] "DD13.Bulk"               "Area.Catchment"
```

```
## [115] "BulkCatch.Conc"          "iniCo.Bulk"
## [117] "DIa"                     "CumSmpDays"
## [119] "DD.Bulk.imp"             "CatchMassSoil.g.imp"
## [121] "SM.g.nrm"                "TP.g.nrm"
## [123] "DD.diss.nrm"             "DD.diss.nrmSD"
```

```
#View(watSoilMerged[, c( 1, 32 , 73, 81:83 )])
```

Variable reduction for analysis

```
waterXY <- watSoilMerged

write.csv2(waterXY,
           'Data/WaterSoils_R.csv', row.names = F)
sum(is.na(watSoilMerged$maxQ))
```

```
## [1] 0
```

```
# waterXY <-  waterSmall[ , (names(waterSmall) %in% hydro)]
# waterXY.nona <- waterXY[complete.cases(waterXY), ]
```

Rainfall by period

Dry periods revised based on rainfall (not discharge)

```
# Merge different cummulative rains (ignore for now)
if (FALSE){
  rain30 <- read.csv2("Data/30minRain.csv")
  rain7 <- read.csv2("Data/7hrRain.csv")
  rain12 <- read.csv2("Data/12hrRain.csv")

  formTime <- function(x, newColName){
    x$Time <- as.POSIXct(strptime(x$Time, "%d/%m/%Y %H:%M", tz="EST"))
    colnames(x)[colnames(x) == "Cumm.mm"] <- newColName
    colnames(x)[colnames(x) == "Time"] <- "Date.ti"
    return(x)
  }

  rain30 <- formTime(rain30, "Cum30min")
  rain7 <- formTime(rain7, "Cum7hr")
  rain12 <- formTime(rain12, "Cum12hr")

  rain <- Reduce(function(...) merge(..., all=TRUE), list(rain30, rain7, rain12))

  watRain <- merge(watSoilMerged, rain12, by = "Date.ti", all = T)
  watRain <- Reduce(function(...) merge(..., all=TRUE), list(watSoilMerged, rain7, rain12))

  } else {
    watRain <- watSoilMerged
}
```

Reducing variables

```
names(watSoilMerged)
```

```
##   [1] "Date.ti"                "WeekSubWeek"
##   [3] "tf"                     "iflux"
##   [5] "fflux"                  "changeflux"
##   [7] "maxQ"                   "minQ"
##   [9] "dryHrsIni"              "dryHrsMax"
##  [11] "dryHrsAve"              "noEventHrsIni"
##  [13] "noEventHrsMax"          "noEventHrsAve"
##  [15] "chExtreme"              "Peak"
##  [17] "AveDischarge.m3.h"      "Volume.m3"
##  [19] "Sampled.Hrs"            "Sampled"
##  [21] "CumRain.mm"             "RainInt.mmhr"
##  [23] "Conc.mug.L"             "Conc.SD"
##  [25] "OXA_mean"               "OXA_SD"
##  [27] "ESA_mean"               "ESA_SD"
##  [29] "N.x"                    "N_d13C.diss"
##  [31] "Conc.Solids.mug.gMES"   "Conc.Solids.ug.gMES.SD"
##  [33] "N.y"                    "filt.d13C"
##  [35] "filt.SD.d13C"           "DD13C.diss"
##  [37] "DD13C.filt"             "NH4.mM"
##  [39] "TIC.ppm.filt"           "Cl.mM"
##  [41] "NO3...mM"               "PO4..mM"
##  [43] "NPOC.ppm"               "TIC.ppm.unfilt"
##  [45] "TOC.ppm.unfilt"         "ExpMES.Kg"
##  [47] "Appl.Mass.g.N"          "Appl.Mass.g.T"
##  [49] "Appl.Mass.g.S"          "Appl.Mass.g.N.OT"
##  [51] "Appl.Mass.g.T.OT"       "Appl.Mass.g.S.OT"
##  [53] "Appl.Mass.g.NoSo"       "DissSmeto.g"
##  [55] "DissSmeto.g.SD"         "DissOXA.g"
##  [57] "DissOXA.g.SD"           "DissESA.g"
##  [59] "DissESA.g.SD"           "FiltSmeto.g"
##  [61] "FiltSmeto.g.SD"         "BalMassDisch.g"
##  [63] "prctMassOut"            "Events"
##  [65] "Weeks"                  "Event"
##  [67] "Duration.Hrs"           "timeSinceApp"
##  [69] "timeSinceApp.NoSo"      "timeSinceApp.N"
##  [71] "timeSinceApp.T"         "timeSinceApp.S"
##  [73] "diss.d13C"              "SD.d13C"
##  [75] "CumOutDiss.g"           "CumOutFilt.g"
##  [77] "TotSMout.g"             "TotSMout.g.SD"
##  [79] "MELsm.g"                "MELsm.g.SD"
##  [81] "Appl.Mass.g.OT"         "CumAppMass.g"
##  [83] "CumAppMass.g.N"         "CumAppMass.g.T"
##  [85] "CumAppMass.g.S"         "CumAppMass.g.OT"
##  [87] "CumAppMass.g.N.OT"      "CumAppMass.g.T.OT"
##  [89] "CumAppMass.g.S.OT"      "iniCo.ug.g.N"
##  [91] "iniCo.ug.g.T"           "iniCo.ug.g.S"
##  [93] "CumOutSmeto.g"          "CumOutMELsm.g"
##  [95] "MassSoil.g.North"       "MassSoil.g.SD.North"
##  [97] "Conc.mug.g.dry.soil.N"  "MassSoil.g.Talweg"
##  [99] "MassSoil.g.SD.Talweg"   "Conc.mug.g.dry.soil.T"
```

```
## [101] "MassSoil.g.South"       "MassSoil.g.SD.South"
## [103] "Conc.mug.g.dry.soil.S"  "comp.d13C.South"
## [105] "comp.d13C.SD.South"     "DD13C.North"
## [107] "DD13C.Talweg"           "DD13C.South"
## [109] "CatchMassSoil.g"        "CatchMassSoil.g.SD"
## [111] "BulkCatch.d13"          "BulkCatch.d13.SD"
## [113] "DD13.Bulk"              "Area.Catchment"
## [115] "BulkCatch.Conc"         "iniCo.Bulk"
## [117] "DIa"                    "CumSmpDays"
## [119] "DD.Bulk.imp"            "CatchMassSoil.g.imp"
## [121] "SM.g.nrm"               "TP.g.nrm"
## [123] "DD.diss.nrm"            "DD.diss.nrmSD"
```