

Mass Soils - Composite Weeks Alteck 2016

PAZ

November 2016

Purpose

This file merges weekly composite concentrations and isotope data.

Imports:

- SoilCompConc_W1toW15.csv
- SoilCompIsotopes_W1toW15.csv

Generates:

- MassIso_CompositeSoils.csv

Required R-packages:

```
library("plyr")
library("dplyr")
```

Working directory

```
# setwd("D:/Documents/these_pablo/Alteckendorf2016/R")
# setwd("/Users/DayTightChunks/Documents/PhD/Routput/Alteck/R")
# setwd("D:/Documents/these_pablo/Alteckendorf2016/00_TransparencyFolder")
getwd()
```

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

Composite Concentrations & Isotope Data - Alteckendorf 2016

Isotopes selected where cleaned according to the following rules:

- a) The isotope shift was not largely beyond (2x) Streitwieser theoretical limits (i.e. > 10)
- b) Isotope shift was non-negative
- c) Nanograms of carbon > 5.0.

1. Import CSV files

```
weeklySoilConc = read.csv2("Data/SoilCompConc_W1toW15.csv", header = TRUE)
weeklySoilConc$Date.ti <- as.POSIXct(strptime(weeklySoilConc$Date.Soil, "%d/%m/%Y %H:%M", tz="EST")) #
sum(is.na(weeklySoilConc$Date.ti))
```

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

```
# View(weeklySoilConc)
weeklySoilConc <- weeklySoilConc[,c("Filename",
                                     "Transect",
                                     "Wnum",
```

```

        "Date.Soil",
        "Date.ti",
        "Conc.mug.g.dry.soil",
        "Conc.ComSoil.SD")]

colnames(weeklySoilConc)[colnames(weeklySoilConc) == "Filename"] <- "ID"
print("Soil Composites- Concentrations")

## [1] "Soil Composites- Concentrations"

str(weeklySoilConc)

## 'data.frame':    51 obs. of  7 variables:
##  $ ID          : Factor w/ 51 levels "AW-N-0","AW-N-0x",...: 2 36 19 1 35 18 3 10 11 12 ...
##  $ Transect     : Factor w/ 3 levels "N","S","T": 1 3 2 1 3 2 1 1 1 1 ...
##  $ Wnum         : int  -1 -1 -1 0 0 0 1 2 3 4 ...
##  $ Date.Soil    : Factor w/ 17 levels "03/05/2016 13:10",...: 13 13 13 16 16 16 3 7 10 14 ...
##  $ Date.ti      : POSIXct, format: "2016-03-25 00:04:00" "2016-03-25 00:04:00" ...
##  $ Conc.mug.g.dry.soil: num  0.0183 0.0205 0.0285 0.8893 0.8008 ...
##  $ Conc.ComSoil.SD   : num  NA NA NA 1.46 1.83 ...

# weeklySoilIso = read.csv2("Data/SoilCompIsotopes_W1toW15.csv", header = TRUE) # JESIUM data (before n
weeklySoilIso = read.csv2("Data/SoilCompIsotopes_W1toW15ng.csv", header = TRUE)

colnames(weeklySoilIso)[colnames(weeklySoilIso) == "DD13...31.21."] <- "DD13"
colnames(weeklySoilIso)[colnames(weeklySoilIso) == "ng..C."] <- "ngC"
colnames(weeklySoilIso)[colnames(weeklySoilIso) == "Filename"] <- "ID"

weeklySoilIso <- weeklySoilIso[, c("ID",
        "Repl",
        "d.13C.12C",
        "DD13",
        "ngC")]

weeklySoilIso <- subset(weeklySoilIso, DD13 > 0 & DD13 < 10 & ngC >= 5)

isoCompSummary = ddply(weeklySoilIso, c("ID"), summarise,
        N_compsoil = length(d.13C.12C),
        comp.d13C = mean(d.13C.12C),
        comp.d13C.SD = sd(d.13C.12C),
        comp.d13C.SE = comp.d13C.SD / sqrt(N_compsoil),
        N_ngC = length(ngC),
        ngC.mean = mean(ngC),
        ngC.SD = sd(ngC),
        ngC.SE = ngC.SD/sqrt(N_ngC))

print("Soil Composites - Isotopes All")

## [1] "Soil Composites - Isotopes All"

str(weeklySoilIso)

## 'data.frame':    103 obs. of  5 variables:
##  $ ID          : Factor w/ 42 levels "AW-N-1","AW-N-10",...: 2 2 3 3 7 7 7 8 8 8 ...

```

```
## $ Repl      : int  1 3 1 3 1 2 3 1 2 3 ...
## $ d.13C.12C: num -28.3 -26.7 -27.8 -28.1 -30.2 ...
## $ DD13      : num  2.9 4.46 3.38 3.09 1.04 ...
## $ ngC       : num  7.07 8.34 9.21 8.07 18.74 ...

print("Soil Composites - Isotopes Ave and St.Dev.")

## [1] "Soil Composites - Isotopes Ave and St.Dev."

str(isoCompSummary)

## 'data.frame':  38 obs. of  9 variables:
## $ ID          : Factor w/ 42 levels "AW-N-1","AW-N-10",...: 2 3 4 5 6 7 8 9 12 13 ...
## $ N_compsoil  : int   2 2 3 2 2 3 3 2 3 3 ...
## $ comp.d13C   : num  -27.5 -28 -23.7 -23.4 -26.9 ...
## $ comp.d13C.SD: num   1.107 0.206 0.389 0.364 1.802 ...
## $ comp.d13C.SE: num   0.783 0.146 0.224 0.258 1.274 ...
## $ N_ngC       : int   2 2 3 2 2 3 3 2 3 3 ...
## $ ngC.mean    : num   7.71 8.64 6.99 5.54 5.44 ...
## $ ngC.SD      : num   0.9027 0.806 0.4807 0.3214 0.0742 ...
## $ ngC.SE      : num   0.6383 0.5699 0.2775 0.2273 0.0524 ...
```

2. Merge lab concentrations and isotopes

```
comp.CoIs = merge(weeklySoilConc, isoCompSummary, by = "ID", all = T)
comp.CoIs$Wnum = as.numeric(comp.CoIs$Wnum)
comp.CoIs <- comp.CoIs[order(comp.CoIs$Wnum),]
print("Merged Soil Concentrations and Isotopes")
```

```
## [1] "Merged Soil Concentrations and Isotopes"

str(comp.CoIs)
```

```
## 'data.frame':  51 obs. of  15 variables:
## $ ID          : Factor w/ 51 levels "AW-N-0","AW-N-0x",...: 2 19 36 1 18 35 3 20 37 10 ...
## $ Transect     : Factor w/ 3 levels "N","S","T": 1 2 3 1 2 3 1 2 3 1 ...
## $ Wnum         : num  -1 -1 -1 0 0 0 1 1 1 2 ...
## $ Date.Soil    : Factor w/ 17 levels "03/05/2016 13:10",...: 13 13 13 16 16 16 3 3 3 7 ...
## $ Date.ti      : POSIXct, format: "2016-03-25 00:04:00" "2016-03-25 00:04:00" ...
## $ Conc.mug.g.dry.soil: num   0.0183 0.0285 0.0205 0.8893 3.204 ...
## $ Conc.ComSoil.SD : num   NA NA NA 1.46 2.77 ...
## $ N_compsoil    : int   NA NA NA NA NA NA NA 2 NA 3 ...
## $ comp.d13C     : num   NA NA NA NA NA ...
## $ comp.d13C.SD  : num   NA NA NA NA NA ...
## $ comp.d13C.SE  : num   NA NA NA NA NA ...
## $ N_ngC         : int   NA NA NA NA NA NA NA 2 NA 3 ...
## $ ngC.mean      : num   NA NA NA NA NA ...
## $ ngC.SD        : num   NA NA NA NA NA ...
## $ ngC.SE        : num   NA NA NA NA NA ...
```

3. Compute Degradation Extent and Delta-delta

```
# Pure and cuve isotope average
d13Co = -31.2144

# Lab enrichment:
# Alteck
epsilon_max = -1.5 # +/- 0.3 (@ 20C, 20% vwc)
```

```

epsilon_min = -2.0 # +/- 0.2 (@ 20C, 40% vwc)

epsilon_mean = -1.75

# Vine
# (@ 20C, 20% vwc) -0.8 +/- 0.1
# (@ 30C, 20% vwc) -1.4 +/- 0.2
# (@ 20C, 40% vwc) -1.7 +/- 0.2
# Average

# Remaining fraction
comp.CoIs$DD13C.comp <- (comp.CoIs$comp.d13C - (d13Co))

# Max epsilon (20C, 20%)
comp.CoIs$f.max.comp <-
  ((10^(-3)*comp.CoIs$comp.d13C + 1)/(10^(-3)*d13Co + 1))^(1000/(epsilon_max))

comp.CoIs$B.max.comp <-
  (1 - comp.CoIs$f.max.comp)*100

# Min epsilon (20C, 40%)
comp.CoIs$f.min.comp <-
  ((10^(-3)*comp.CoIs$comp.d13C + 1)/(10^(-3)*d13Co + 1))^(1000/(epsilon_min))

comp.CoIs$B.min.comp <-
  (1 - comp.CoIs$f.min.comp)*100

# Mean epsilon (# Alteck)
comp.CoIs$f.mean.comp <-
  ((10^(-3)*comp.CoIs$comp.d13C + 1)/(10^(-3)*d13Co + 1))^(1000/(epsilon_mean))

comp.CoIs$B.mean.comp <-
  (1 - comp.CoIs$f.mean.comp)*100

```

3. Compute Soil S-metolachlor Mass at time t across space

For non-measured plots, the soil concentration and isotope measured at the nearest transect is assumed. The total area for each transect at the end of the season is shown below. Corn fields in the catchment were known to have received S-metolachlor applications only during the last week of May, 2017. Given that two of these plots were not included within the transects, their area were not accounted for but until after the known application dates for corn plots.

The total pesticide mass for each transect at time t is then given by:

$$M(t)_{Ta} = C(t)_T \cdot \rho \cdot A_T \cdot D.$$

```

# S-metolachlor Mass [g]
# Conc. [ug/g dry soil] * [g/10^6 ug] * density [g/m3] * depth [m] * A [m2]
# Soil bulk density: 2200 or 0.99? -> Leaching experiments: 0.99 [g/cm3]
rho = 0.99*10^6 # soil density [g/m3]
depth = 0.005 # [m]

# Transect Areas pre-corn applications
Area_Na = 13.92663*10^4 # [m2]

```

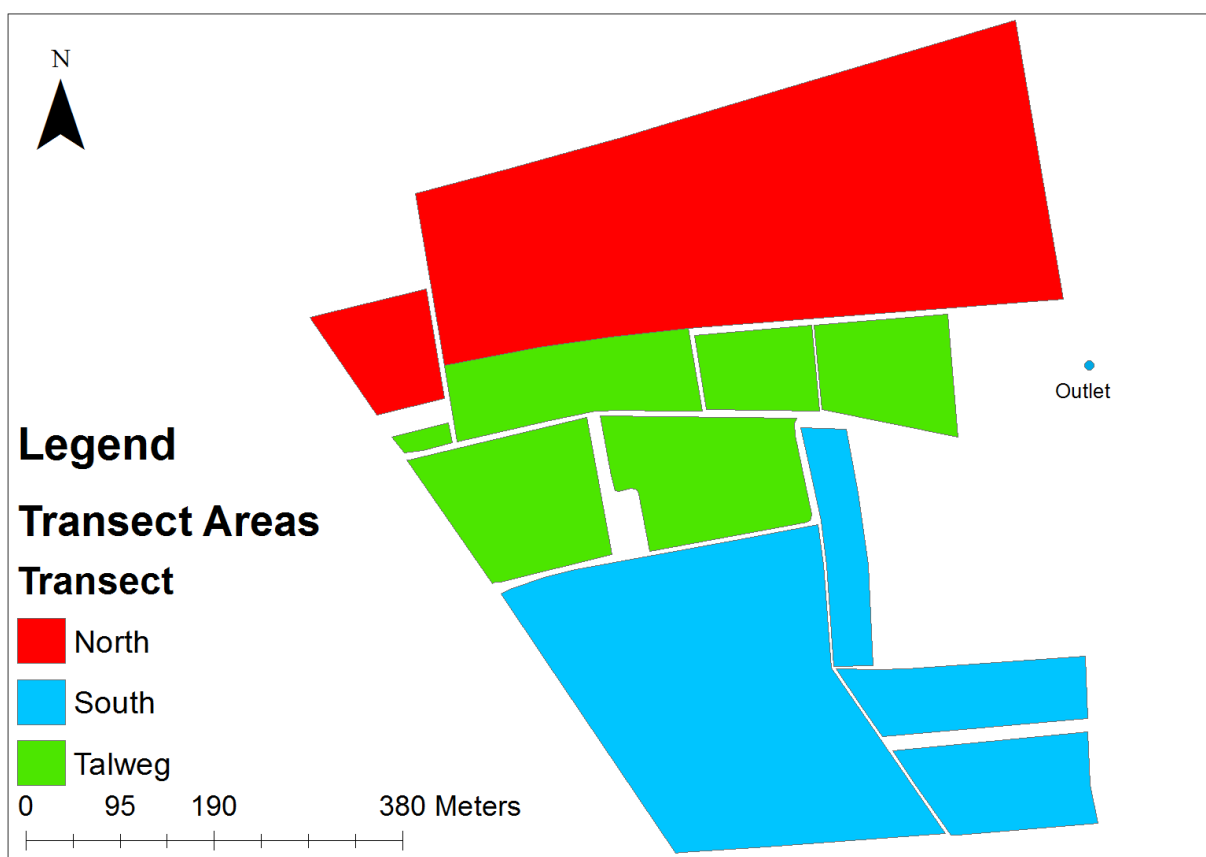


Figure 1: Transect Areas [Ha] (North: 14.995; Talweg: 8.774; South: 12.668)

```

# Corrections (old values):
#Area_Ta = 6.55813*10-4 # [m2] # South Burger's as Talweg
#Area_Sa = 11.05376*10-4 # [m2] # South Burger's as Talweg
Area_Ta = 4.37134*10-4 # [m2]
Area_Sa = 13.3175*10-4 # [m2] # South Burger's as South

# Transect Areas post Corn applications (not on transect)
Area_Nb = 14.9949*10-4 # [m2]

# Corrections (old values):
#Area_Tb = 6.55813*10-4 # [m2] # South Burger's as Talweg
#Area_Sb = 11.65202*10-4 # [m2] # South Burger's as Talweg
Area_Tb = 4.37134*10-4 # [m2]
Area_Sb = 13.91767*10-4 # [m2] # South Burger's as South

# Assign new column for S-metolachlor mass in grams
comp.CoIs$MassSoil.g <- NA

# Areas with S-metolachlor before week 9
comp.CoIs$MassSoil.g <-
  ifelse((comp.CoIs$Transect == "N" & comp.CoIs$Wnum < 6),
    comp.CoIs$Conc.mug.g.dry.soil*10-6*rho*depth*Area_Na,
  ifelse((comp.CoIs$Transect == "T" & comp.CoIs$Wnum < 6),
    comp.CoIs$Conc.mug.g.dry.soil*10-6*rho*depth*Area_Ta,
  ifelse((comp.CoIs$Transect == "S" & comp.CoIs$Wnum < 6),
    comp.CoIs$Conc.mug.g.dry.soil*10-6*rho*depth*Area_Sa, comp.CoIs$MassSoil.g)))

# Areas with S-metolachlor after week 9
comp.CoIs$MassSoil.g <-
  ifelse((comp.CoIs$Transect == "N" & comp.CoIs$Wnum >= 6),
    comp.CoIs$Conc.mug.g.dry.soil*10-6*rho*depth*Area_Nb,
  ifelse((comp.CoIs$Transect == "T" & comp.CoIs$Wnum >= 6),
    comp.CoIs$Conc.mug.g.dry.soil*10-6*rho*depth*Area_Tb,
  ifelse((comp.CoIs$Transect == "S" & comp.CoIs$Wnum >= 6),
    comp.CoIs$Conc.mug.g.dry.soil*10-6*rho*depth*Area_Sb, comp.CoIs$MassSoil.g)))

# Areas as variables (for later computation of bulk catchment mass)
comp.CoIs$Area.N <-
  ifelse((comp.CoIs$Wnum < 6), Area_Na, Area_Nb)

comp.CoIs$Area.T <-
  ifelse((comp.CoIs$Wnum < 6), Area_Ta, Area_Tb)

comp.CoIs$Area.S <-
  ifelse((comp.CoIs$Wnum < 6), Area_Sa, Area_Sb)

print("S-meto mass per transect at time-t")

## [1] "S-meto mass per transect at time-t"

```

```
str(comp.CoIs)
```

```
## 'data.frame': 51 obs. of 26 variables:
## $ ID : Factor w/ 51 levels "AW-N-0","AW-N-0x",...: 2 19 36 1 18 35 3 20 37 10 ...
## $ Transect : Factor w/ 3 levels "N","S","T": 1 2 3 1 2 3 1 2 3 1 ...
## $ Wnum : num -1 -1 -1 0 0 0 1 1 1 2 ...
## $ Date.Soil : Factor w/ 17 levels "03/05/2016 13:10",...: 13 13 13 16 16 16 3 3 3 7 ...
## $ Date.ti : POSIXct, format: "2016-03-25 00:04:00" "2016-03-25 00:04:00" ...
## $ Conc.mug.g.dry.soil: num 0.0183 0.0285 0.0205 0.8893 3.204 ...
## $ Conc.ComSoil.SD : num NA NA NA 1.46 2.77 ...
## $ N_compsoil : int NA NA NA NA NA NA NA 2 NA 3 ...
## $ comp.d13C : num NA NA NA NA NA ...
## $ comp.d13C.SD : num NA NA NA NA NA ...
## $ comp.d13C.SE : num NA NA NA NA NA ...
## $ N_ngC : int NA NA NA NA NA NA NA 2 NA 3 ...
## $ ngC.mean : num NA NA NA NA NA ...
## $ ngC.SD : num NA NA NA NA NA ...
## $ ngC.SE : num NA NA NA NA NA ...
## $ DD13C.comp : num NA NA NA NA NA ...
## $ f.max.comp : num NA NA NA NA NA ...
## $ B.max.comp : num NA NA NA NA NA ...
## $ f.min.comp : num NA NA NA NA NA ...
## $ B.min.comp : num NA NA NA NA NA ...
## $ f.mean.comp : num NA NA NA NA NA ...
## $ B.mean.comp : num NA NA NA NA NA ...
## $ MassSoil.g : num 12.61 18.8 4.44 613.08 2112.12 ...
## $ Area.N : num 139266 139266 139266 139266 139266 ...
## $ Area.T : num 43713 43713 43713 43713 43713 ...
## $ Area.S : num 133175 133175 133175 133175 133175 ...
```

```
tail(comp.CoIs)
```

```
##      ID Transect Wnum      Date.Soil      Date.ti
## 8  AW-N-14      N   14 04/07/2016 14:42 2016-07-04 14:42:00
## 25 AW-S-14      S   14 04/07/2016 14:42 2016-07-04 14:42:00
## 42 AW-T-14      T   14 04/07/2016 14:42 2016-07-04 14:42:00
## 9  AW-N-15      N   15 12/07/2016 01:00 2016-07-12 01:00:00
## 26 AW-S-15      S   15 12/07/2016 01:00 2016-07-12 01:00:00
## 43 AW-T-15      T   15 12/07/2016 01:00 2016-07-12 01:00:00
##      Conc.mug.g.dry.soil Conc.ComSoil.SD N_compsoil comp.d13C comp.d13C.SD
## 8      1.3336411      0.09490089      2 -26.92900      1.8017081
## 25      1.0220275      0.09490089      3 -27.83867      0.9586315
## 42      1.5868495      0.09490089      3 -26.08233      1.3480372
## 9      0.9564201      0.09490089      NA      NA      NA
## 26      1.1610022      0.09490089      NA      NA      NA
## 43      1.3119054      0.09490089      NA      NA      NA
##      comp.d13C.SE N_ngC ngC.mean      ngC.SD      ngC.SE DD13C.comp f.max.comp
## 8      1.2740000      2 5.437063 0.07417204 0.05244755      4.285400 0.05273474
## 25      0.5534661      3 5.734266 0.51506713 0.29737415      3.375733 0.09837564
## 42      0.7782896      3 5.489510 0.75721706 0.43717947      5.132067 0.02953162
## 9      NA      NA      NA      NA      NA      NA      NA
## 26      NA      NA      NA      NA      NA      NA      NA
## 43      NA      NA      NA      NA      NA      NA      NA
##      B.max.comp f.min.comp B.min.comp f.mean.comp B.mean.comp MassSoil.g
```

```
## 8      94.72653 0.11004558 88.99544 0.08028869 91.97113 989.8919
## 25     90.16244 0.17565709 82.43429 0.13701268 86.29873 704.0999
## 42     97.04684 0.07123861 92.87614 0.04884473 95.11553 343.3646
## 9              NA          NA          NA          NA          NA 709.9004
## 26              NA          NA          NA          NA          NA 799.8430
## 43              NA          NA          NA          NA          NA 283.8718
##      Area.N Area.T Area.S
## 8 149949 43713.4 139176.7
## 25 149949 43713.4 139176.7
## 42 149949 43713.4 139176.7
## 9 149949 43713.4 139176.7
## 26 149949 43713.4 139176.7
## 43 149949 43713.4 139176.7
```

```
write.csv2(comp.CoIs, 'Data/WeeklySoils_Rng.csv', row.names = F)
```