PNAS Figures

PAZ

22 novembre 2016

Required R-packages:

```
# Data wrangling
library("plyr")
library("dplyr")

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

# Plotting:
library("ggplot2")
library("cowplot")
library("gridExtra")
library("Cairo")
library("GGally")
library("scales")
```

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"
```

Soils

```
weeklySoil = read.csv2("Data/WeeklySoils_Rng.csv", na.strings=c('#DIV/0!', '', 'NA'), header = TRUE)
weeklySoil$Date.ti <- as.POSIXct(strptime(weeklySoil$Date.ti, "%Y-%m-%d %H:%M", tz="EST")) # csv typos,
#weeklySoil$Date.ti <- as.POSIXct(strptime(weeklySoil$Date.ti, "%d/%m/%Y %H:%M", tz="EST"))
sum(is.na(weeklySoil$Date.ti))
```

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

```
#weeklySoil$Conc.ComSoil.SD <-
#  ifelse(weeklySoil$Conc.ComSoil.SD == as.character("#DIV/0!"), NA, as.numeric(as.character(weeklySoil

str(weeklySoil)
```

```
## 'data.frame':    51 obs. of  19 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              : int  -1 -1 -1 0 0 0 1 1 1 2 ...
```

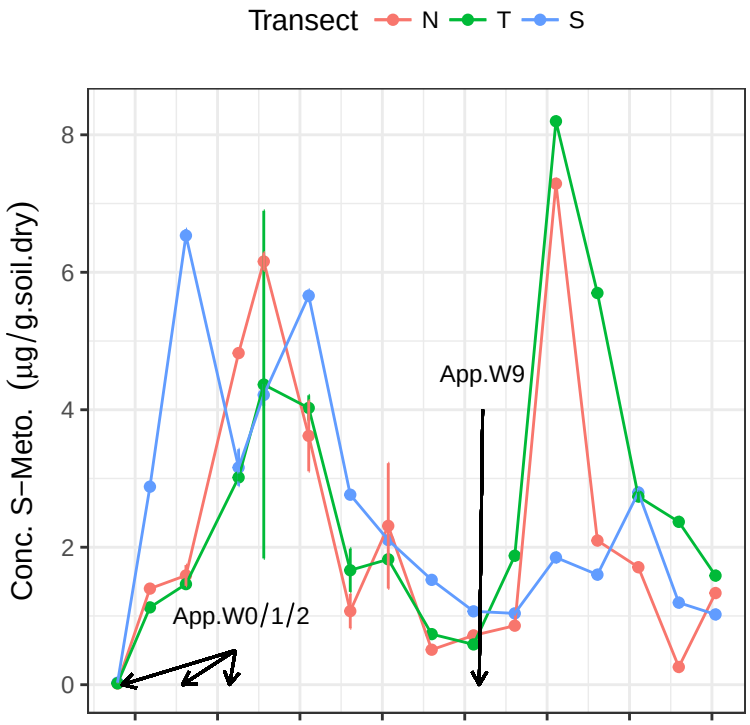
```
##  $ Date.Soil          : Factor w/ 17 levels "03/05/2016 13:10",..: 13 13 13 16 16 16 3 3 3 7 ...
##  $ Date.ti            : POSIXct, format: "2016-03-25 00:04:00" "2016-03-25 00:04:00" ...
##  $ Conc.mug.g.dry.soil: num  0.018 0.029 0.02 1.398 2.881 ...
##  $ Conc.ComSoil.SD    : num  NA NA NA NA NA ...
##  $ N_compsoil         : int  NA NA NA NA NA NA 2 2 3 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 ...
##  $ DD13C.comp         : num  NA NA NA NA NA ...
##  $ f.comp             : num  NA NA NA NA NA ...
##  $ B.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.com         : num  NA NA NA NA NA ...
##  $ MassSoil.g         : num  12.41 15.87 6.49 963.74 1576.37 ...
```

```
# weeklySoil = weeklySoil %>%
#  group_by(Transect) %>%
#  arrange(Transect, Wnum)

weeklySoil$Transect <- factor(weeklySoil$Transect, levels = c("N", "T", "S"))
```

Soil Concentrations

```
################################
# Concentrations
################################
################################
################################
#weeklySoil$ti[3] <- as.POSIXct("2016-04-14 08:25:00")
#weeklySoil$ti[14] <- as.POSIXct("2016-04-14 08:25:00")
#weeklySoil$ti[24] <- as.POSIXct("2016-04-14 08:25:00")
#lb1a2 <- paste("App.")
lbW012 <- paste("App.W0/1/2")
lbW9 <- paste("App.W9")

limits_conc_soil <- aes(ymin=Conc.mug.g.dry.soil-Conc.ComSoil.SD,  ymax=Conc.mug.g.dry.soil+Conc.ComSoi
#limits_conc_soil <- aes(ymin=mean-0.5, ymax=mean+0.5)

pd <- position_dodge(0.5) # move them .05 to the left and right

co = ggplot(weeklySoil[1:48, ],
            aes(x=Date.ti, y=Conc.mug.g.dry.soil, colour=Transect, group = Transect)) +

  geom_point() +
  geom_line() +

  # Error bars
  geom_errorbar(limits_conc_soil, width=.1, position=pd) +
  # scale_y_continuous(limits=c(0,10),oob = rescale_none) +

  # Themes and axes
```

```
  theme_bw() +
  theme(legend.position = "top",
        axis.text.x=element_blank(),
        axis.title.x=element_blank()
        ) +

  scale_x_datetime(breaks = date_breaks("2 weeks"), labels = date_format("%b %d")) +
  ylab(expression(paste("Conc. S-Meto.  ", {({mu}*g / g.soil.dry)}))) +
  # facet_wrap(~Transect, nrow = 3) +
  # xlab("Date") +
  # theme(axis.text.x=element_text(angle = 45, hjust = 1)) +
  # scale_x_datetime(breaks = date_breaks("2 weeks"), labels = date_format("%b %d")) +

  # Smooth linear models
  # stat_smooth(method = "lm", formula = y ~ poly(x, 2)) +
  # stat_smooth(method = "lm") +

  # Text
  # W0 Application
  # annotate("text", x = as.POSIXct('2016-03-25 08:04:00'), y = 4, label = lb1a2, parse = T, size = 3.0
  geom_segment(aes(x = as.POSIXct('2016-04-14 08:04:00'), y = 0.5, xend = as.POSIXct('2016-03-26 01:04:
               arrow = arrow(length = unit(0.2, "cm"))) +

  # W1 Application
  geom_segment(aes(x = as.POSIXct('2016-04-14 08:04:00'), y = 0.5,
                   xend = as.POSIXct('2016-04-05 08:04:00'), yend = 0), color = "black",
               arrow = arrow(length = unit(0.2, "cm"))) +
  # W2 Application
  annotate("text", x = as.POSIXct('2016-04-15 08:04:00'), y = 1, label = lbW012, parse = T, size = 3.0)
  geom_segment(aes(x = as.POSIXct('2016-04-14 08:04:00'), y = 0.5,
                   xend = as.POSIXct('2016-04-13 08:04:00'), yend = 0), color = "black",
               arrow = arrow(length = unit(0.2, "cm"))) +
  # W9 Application
  annotate("text", x = as.POSIXct('2016-05-26 08:04:00'), y = 4.5, label = lbW9, parse = T, size = 3.0)
  geom_segment(aes(x = as.POSIXct('2016-05-26 08:04:00'), y = 4,
                   xend = as.POSIXct('2016-05-25 18:04:00'), yend = 0), color = "black",
               arrow = arrow(length = unit(0.2, "cm")))


  #geom_text_repel(aes(label=Wnum),
   #                size = 3,
    #               arrow = arrow(length = unit(0.005, 'npc'), type = "closed"),
     #              force = 0.5,
      #             point.padding = unit(0.5, 'lines'),
       #            max.iter = 2e3,
        #           nudge_x = .05)

co
```




```
# Linear model
# ggsave(co, filename = "CompositeConcLM.png", width = 7, height = 5, units = "in", scale = 1)

ggsave(co, filename = "CompositeConcLM.tiff", height = 10, width = 8.7, units = 'cm')

# No linear model
# ggsave(co, filename = "CompositeConc.png", width = 7, height = 5, units = "in", scale = 1)
```

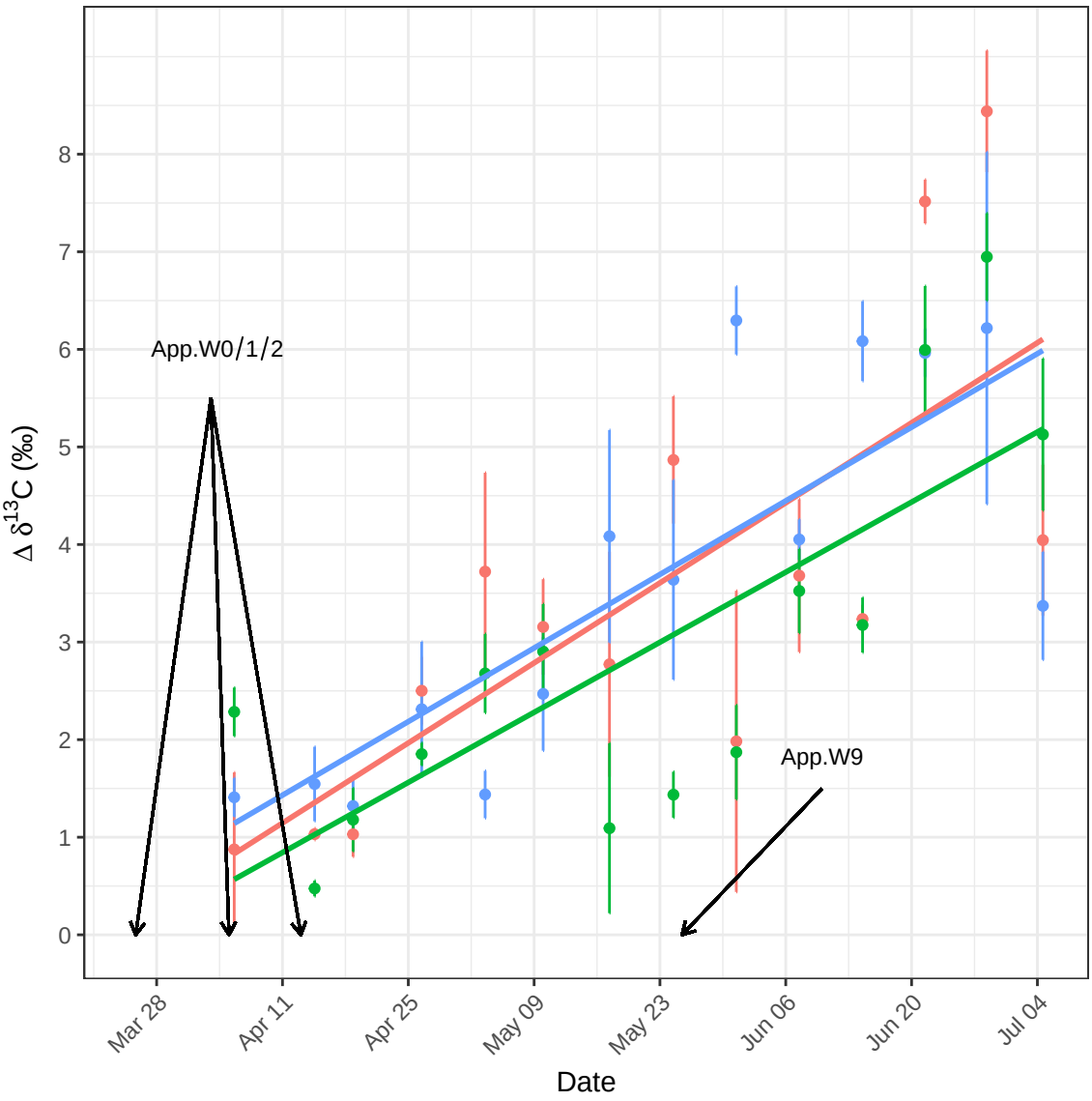
Soil isotope signatures

```
initialDelta = -31.21
weeklySoil$DD13C.comp <- (weeklySoil$comp.d13C - (initialDelta))

limits_dCsoil <- aes(ymin=comp.d13C-comp.d13C.SD, ymax=comp.d13C+comp.d13C.SD)
#limits_dCsoil <- aes(ymin=comp.d13C-0.5, ymax=comp.d13C+0.5)
lb1a <- paste("App.~S-meto.")
lb1ab <- paste("delta^{13}~C:-31.21")
lb1a2 <- paste("App. ")

lbW012 <- paste("App.W0/1/2")
lbW9 <- paste("App.W9")

isCo =ggplot(weeklySoil, aes(x=Date.ti, y=comp.d13C, colour=Transect, group = Transect)) +
  geom_errorbar(limits_dCsoil, width=.05) +
  geom_point() +
  theme_bw() +
  #stat_smooth(method = "lm", formula = y ~ poly(x, 2)) +
```

```
  stat_smooth(method = "lm") +
  facet_wrap(~Transect, nrow = 3) +
  xlab("Date") +
  theme(axis.text.x=element_text(angle = 45, hjust = 1)) +
  #ylab(expression(paste({delta}^"13","C", ' \211'))) +
  ylab(expression(paste({delta}^"13","C", ' (\u2030)'))) +
  scale_y_continuous(breaks=seq(-34,-21,2)) +
  geom_hline(yintercept = -31.21, color = "dodgerblue4", linetype = "dotted") +
  geom_hline(yintercept = -30.71, color = "dodgerblue3", linetype = "dotted") +
  geom_hline(yintercept = -31.71, color = "dodgerblue3", linetype = "dotted") +
  annotate("text", x = as.POSIXct('2016-04-05 22:04:00'), y = -22.5, label = lb1a, parse = T, size = 3.
  annotate("text", x = as.POSIXct('2016-04-05 22:04:00'), y = -23.5, label = lb1ab, parse = T, size = 3

  annotate("text", x = as.POSIXct('2016-03-25 08:04:00'), y = -29, label = lb1a2, parse = T, size = 3.0
  geom_segment(aes(x = as.POSIXct('2016-03-25 08:04:00'), y = -29.8,
                   xend = as.POSIXct('2016-03-25 08:04:00'), yend = -31.0),
               arrow = arrow(length = unit(0.2, "cm"))) +
  annotate("text", x = as.POSIXct('2016-04-03 00:04:00'), y = -29, label = lb1a2, parse = T, size = 3.0
  geom_segment(aes(x = as.POSIXct('2016-04-03 00:04:00'), y = -29.8,
                   xend = as.POSIXct('2016-04-05 08:04:00'), yend = -31.0),
               arrow = arrow(length = unit(0.2, "cm"))) +
  annotate("text", x = as.POSIXct('2016-04-13 08:04:00'), y = -25, label = lb1a2, parse = T, size = 3.0
  geom_segment(aes(x = as.POSIXct('2016-04-13 08:04:00'), y = -26,
                   xend = as.POSIXct('2016-04-13 08:04:00'), yend = -31.0),
               arrow = arrow(length = unit(0.2, "cm"))) +
  annotate("text", x = as.POSIXct('2016-05-26 08:04:00'), y = -29, label = lb1a2, parse = T, size = 3.0
  geom_segment(aes(x = as.POSIXct('2016-05-26 08:04:00'), y = -29.8,
                   xend = as.POSIXct('2016-05-25 08:04:00'), yend = -31.0),
               arrow = arrow(length = unit(0.2, "cm"))) +
  #scale_x_continuous(breaks=seq(0,11,1)) +
  scale_x_datetime(breaks = date_breaks("2 weeks"), labels = date_format("%b %d")) +

  #annotate("text", x = as.POSIXct('2016-05-30 20:04:00'), y = -30.5, label = lb1a, parse = T, size = 2
  theme(legend.position = "top")

# isCo

# Linear model (LM)
# ggsave(isCo, filename = "CompositeIsotopesLM.png", width = 7, height = 5, units = "in", scale = 1)
# No linear model
# ggsave(isCo, filename = "CompositeIsotopes.png", width = 7, height = 5, units = "in", scale = 1)


# View(weeklySoil)

# Ommitted, graph is tautological.
### Delta vs. f (Soils)
soilf = ggplot(weeklySoil, aes(x=f.comp, y=DD13C.comp, colour=Transect, group = Transect)) +
  #geom_errorbar(limits_dCsoil, width=.05) +
  geom_point() +
  theme_bw() +
  stat_smooth(method = "lm", formula = y ~ poly(x, 2)) +
  #stat_smooth(method = "lm") +
```

```
  facet_wrap(~Transect, nrow = 3) +
  scale_x_reverse() +
  xlab("Fraction remaining (f)") +
  theme(axis.text.x=element_text(angle = 45, hjust = 1)) +
  #ylab(expression(paste({delta}^"13","C", ' \211'))) +
  ylab(expression(paste({Delta~delta}^"13","C", ' (\u2030)'))) +
  #scale_y_continuous(breaks=seq(-34,-21,2)) +
  theme(legend.position = "top") +
  #geom_text_repel(aes(label=WeekNo, color = factor(Transect)),
                  #arrow = arrow(length = unit(0.005, 'npc'), type = "closed"),
                  #force = 1,
                  #point.padding = unit(1.0, 'lines'),
                  #max.iter = 2e3,
                  #nudge_x = .2) +
  geom_point()

# soilf

################################
################################
################################
### DeltaDelta vs time
################################
# View(weeklySoil)
# limits_DdCsoil <- aes(ymin=comp.d13C-comp.d13C.SD-initialDelta, ymax=comp.d13C+comp.d13C.SD-initialDe
limits_DdCsoil <- aes(ymin=comp.d13C-comp.d13C.SE-initialDelta, ymax=comp.d13C+comp.d13C.SE-initialDelta
# pd <- position_dodge(0.5)
# AOdf[1:27,]
deltaTime = ggplot(weeklySoil[1:48, ], aes(x=Date.ti, y=DD13C.comp, colour=Transect, group = Transect))
  geom_errorbar(limits_DdCsoil, width=.5) +
  geom_point() +

  # Themes and axes
  theme_bw() +
  theme(legend.position="none",
        # axis.title.x = element_blank(),
        axis.text.x=element_text(angle = 45, hjust = 1)
        ) +
  xlab("Date") +
  scale_x_datetime(breaks = date_breaks("2 weeks"), labels = date_format("%b %d")) +


  ylab(expression(paste({Delta~delta}^"13","C", ' (\u2030)'))) +
  scale_y_continuous(breaks=seq(0, 8, 1)) +
  # ylab(expression(paste({delta}^"13","C", ' \211'))) +
  # ylab(expression(paste({delta}^"13","C", ' (\u2030)'))) +
  # facet_wrap(~Transect, nrow = 3) +

  # Smooth linear models
  stat_smooth(method = "lm", se=FALSE) +
  # stat_smooth(method = "lm", formula = y ~ poly(x, 2)) +
  # stat_smooth(data=subset(weeklySoil[4:27, ]), method = "lm", formula = y~x, se=F) +
  # stat_smooth(data=subset(weeklySoil[18:36, ]), method = "lm", formula = y~x, se=F) +
```

```
  # Text
  # Application W0
  annotate("text",
           x = as.POSIXct('2016-04-04 01:04:00'), y = 6, label = lbW012, parse = T, size = 3.0) +
  geom_segment(aes(x = as.POSIXct('2016-04-03 08:04:00'), y = 5.5,
                   xend = as.POSIXct('2016-03-25 22:04:00'), yend = -0), color = "black",
                arrow = arrow(length = unit(0.2, "cm"))) +
  #annotate("text",
  #         x = as.POSIXct('2016-04-03 00:04:00'), y = 2, label = lb1a2, parse = T, size = 3.0) +

  # Application W1
  geom_segment(aes(x = as.POSIXct('2016-04-03 08:04:00'), y = 5.5,
                   xend = as.POSIXct('2016-04-05 08:04:00'), yend = 0), color = "black",
                arrow = arrow(length = unit(0.2, "cm"))) +
  # annotate("text", x = as.POSIXct('2016-04-15 08:04:00'), y = 1, label = lb1a2, parse = T, size = 3.0

  # Application W2
  geom_segment(aes(x = as.POSIXct('2016-04-03 08:04:00'), y = 5.5,
                   xend = as.POSIXct('2016-04-13 08:04:00'), yend = 0), color = "black",
                arrow = arrow(length = unit(0.2, "cm"))) +

  # Application W9
  annotate("text",
           x = as.POSIXct('2016-06-10 08:04:00'), y = 1.8, label = lbW9, parse = T, size = 3.0) +
  geom_segment(aes(x = as.POSIXct('2016-06-10 08:04:00'), y = 1.5,
                   xend = as.POSIXct('2016-05-25 18:04:00'), yend = 0), color = "black",
                arrow = arrow(length = unit(0.2, "cm"))) # +

  #geom_text_repel(aes(label=Wnum, color = factor(Transect)),
   #                arrow = arrow(length = unit(0.005, 'npc'), type = "closed"),
    #               force = 1,
     #              point.padding = unit(1.0, 'lines'),
      #             max.iter = 2e3,
       #            nudge_x = .2)


deltaTime
```

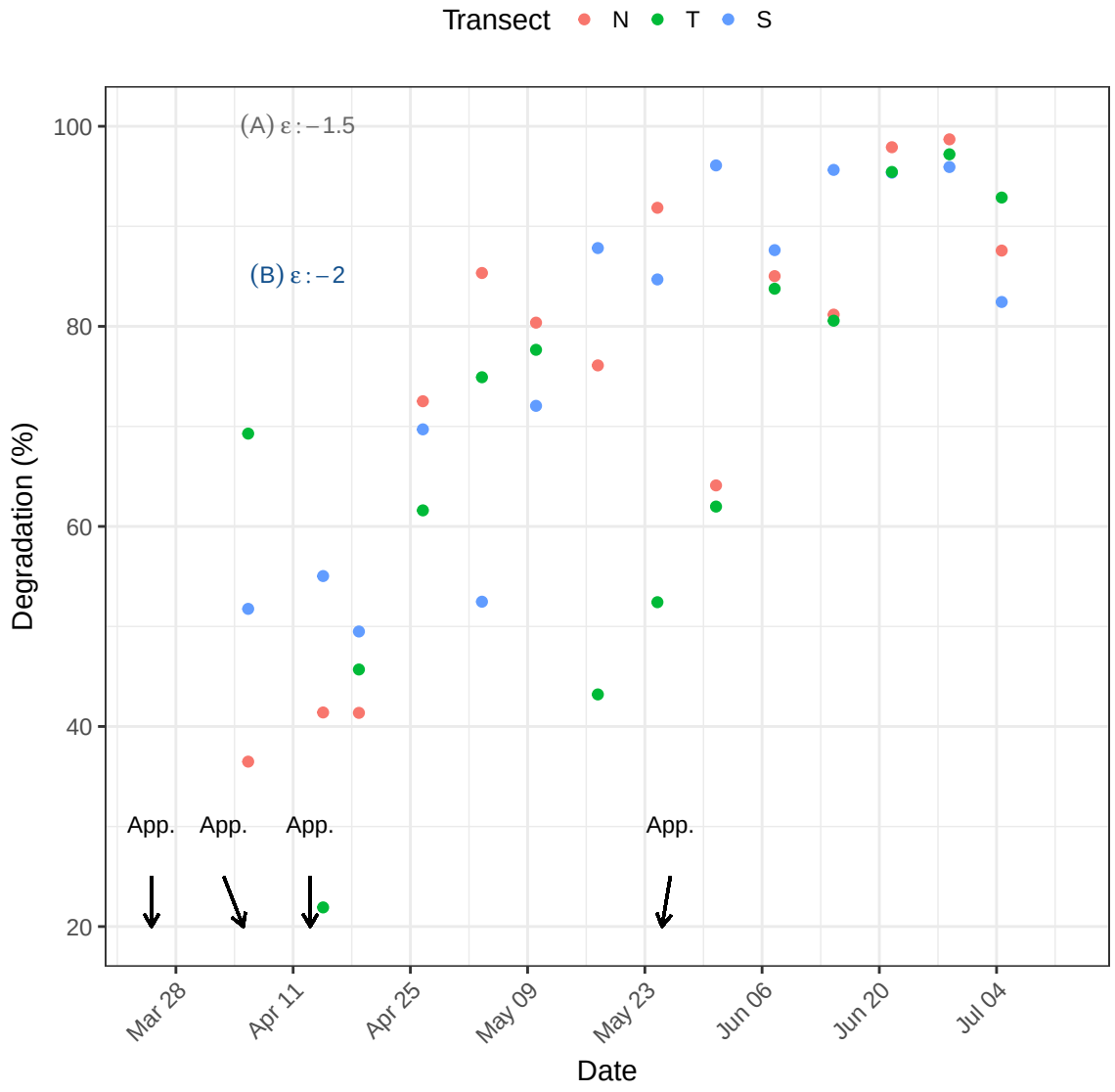



```
#soils = plot_grid(co, deltaTime, ncol = 1, nrow = 2, align = "v")
#soils
```

Degradation

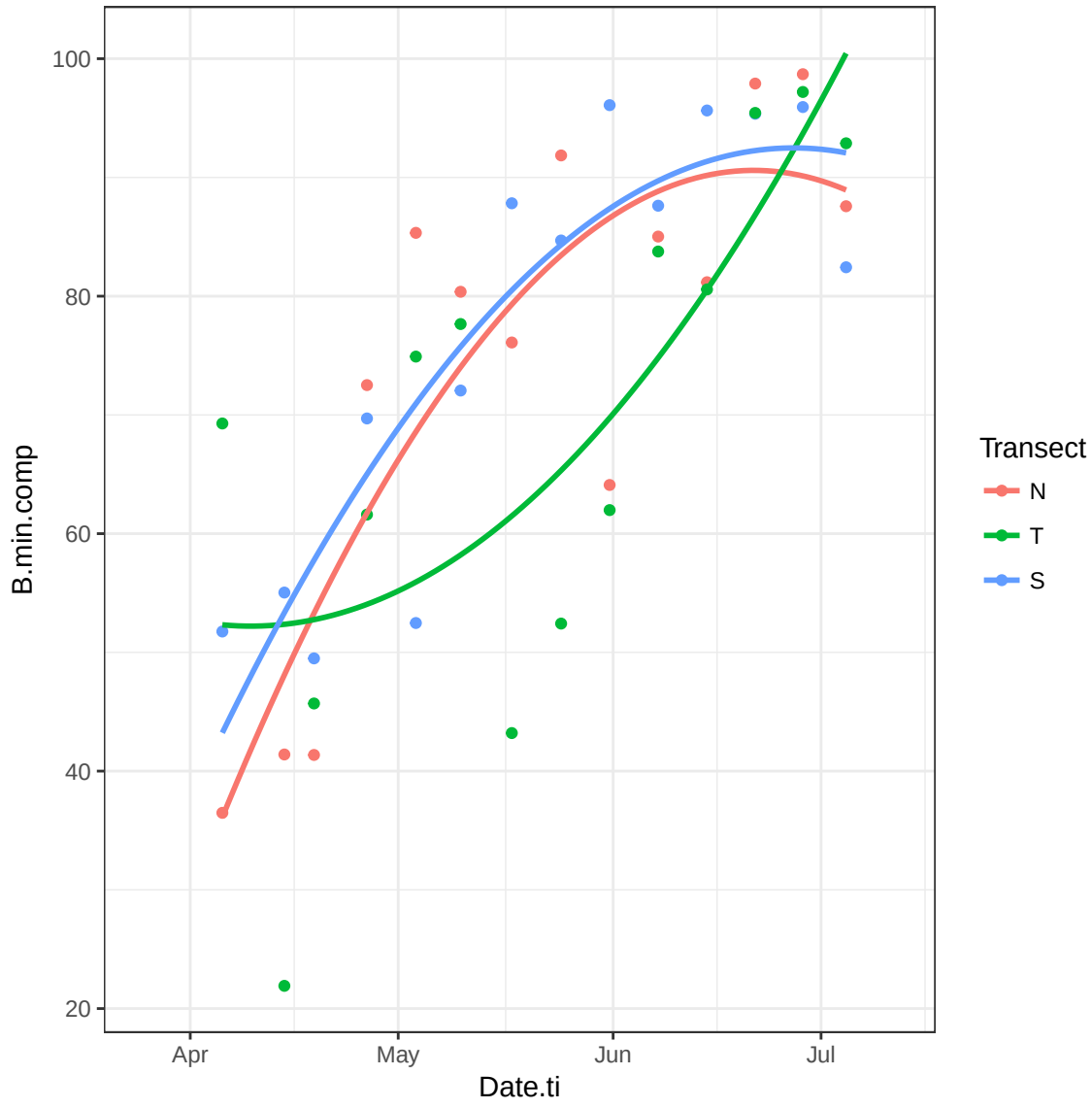
```
lb1a2 <- paste("App.")

lb1b <- paste("(A)~epsilon:-1.5")
lb1b2 <- paste("(B)~epsilon:-2.0")



Bsoil =ggplot(weeklySoil)+
  #geom_errorbar(limits_dCsoil, width=.05) +
  #geom_point(aes(x=Date.ti, y=B.comp, colour=Transect, group = Transect)) +
  geom_point(aes(x=Date.ti, y=B.min.comp, colour=Transect, group = Transect)) + #, color = "dodgerblue4
```

```
  theme_bw() +
  # stat_smooth(method = "lm", formula = y ~ poly(x, 2)) +
  #stat_smooth(aes(x=Date.ti, y=B.min.comp), method = "lm", se = F, color = "dodgerblue4") +
  #stat_smooth(aes(x=Date.ti, y=B.comp), method = "lm", se = F, color = "grey40") +

  # Individual / broken lines
  #geom_smooth(data=subset(weeklySoil[10:27, ]), aes(x=Date.ti, y=B.min.comp), method = "lm", se = F, c
  #geom_smooth(data=subset(weeklySoil[31:45, ]), aes(x=Date.ti, y=B.min.comp), method = "lm", se = F, c
  #geom_smooth(data=subset(weeklySoil[10:27, ]), aes(x=Date.ti, y=B.comp), method = "lm", se = F, color
  #geom_smooth(data=subset(weeklySoil[31:45, ]), aes(x=Date.ti, y=B.comp), method = "lm", se = F, color

  # Continous lines
  # geom_smooth(data=subset(weeklySoil[1:45, ]), aes(x=Date.ti, y=B.min.comp), method = "lm", formula =
  # geom_smooth(y=B.min.comp, method = "lm", formula = y ~ poly(x, 2)) +
  # facet_wrap(~Transect, nrow = 3) +
  xlab("Date") +
  theme(axis.text.x=element_text(angle = 45, hjust = 1)) +
  #ylab(expression(paste({delta}^"13","C", ' \211'))) +
  ylab("Degradation (%)") +
  scale_y_continuous(breaks=seq(0, 100, 20)) +
  #geom_hline(yintercept = -31.47, color = "dodgerblue4", linetype = "dotted") +
  #geom_hline(yintercept = -30.97, color = "dodgerblue3", linetype = "dotted") +
  #geom_hline(yintercept = -31.97, color = "dodgerblue3", linetype = "dotted") +
  annotate("text", x = as.POSIXct('2016-04-11 20:04:00'), y = 100, label = lb1b, parse = T, size = 3.0,
  annotate("text", x = as.POSIXct('2016-04-11 20:04:00'), y = 85, label = lb1b2, parse = T, size = 3.0,

  annotate("text", x = as.POSIXct('2016-03-25 08:04:00'), y = 30, label = lb1a2, parse = T, size = 3.0)
  geom_segment(aes(x = as.POSIXct('2016-03-25 08:04:00'), y = 25,
                   xend = as.POSIXct('2016-03-25 08:04:00'), yend = 20),
               arrow = arrow(length = unit(0.2, "cm"))) +
  annotate("text", x = as.POSIXct('2016-04-03 00:04:00'), y = 30, label = lb1a2, parse = T, size = 3.0)
  geom_segment(aes(x = as.POSIXct('2016-04-03 00:04:00'), y = 25,
                   xend = as.POSIXct('2016-04-05 08:04:00'), yend = 20),
               arrow = arrow(length = unit(0.2, "cm"))) +
  annotate("text", x = as.POSIXct('2016-04-13 08:04:00'), y = 30, label = lb1a2, parse = T, size = 3.0)
  geom_segment(aes(x = as.POSIXct('2016-04-13 08:04:00'), y = 25,
                   xend = as.POSIXct('2016-04-13 08:04:00'), yend = 20),
               arrow = arrow(length = unit(0.2, "cm"))) +
  annotate("text", x = as.POSIXct('2016-05-26 08:04:00'), y = 30, label = lb1a2, parse = T, size = 3.0)
  geom_segment(aes(x = as.POSIXct('2016-05-26 08:04:00'), y = 25,
                   xend = as.POSIXct('2016-05-25 08:04:00'), yend = 20),
               arrow = arrow(length = unit(0.2, "cm"))) +
  scale_x_datetime(breaks = date_breaks("2 weeks"), labels = date_format("%b %d")) +
  #scale_x_continuous(breaks=seq(0,11,1)) +
  theme(legend.position = "top")

Bsoil
```




```
# Linear model
ggsave(Bsoil, filename = "CompositeDegradationLM.png", width = 7, height = 5, units = "in", scale = 1)

#deltaCo = plot_grid(co, isCo, ncol = 2, nrow = 1, align = "h")
# deltaCoBio = plot_grid(co, isCo, Bsoil, ncol = 3, nrow = 1, align = "h")
# deltaCoBio


# Linear model
#ggsave(deltaCo, filename = "CompositeConcLM.png", width = 6, height = 7, units = "in", scale = 1)
# ggsave(deltaCoBio, filename = "SoilConcDeltBio_LM.png", width = 11.69, height = 8.27, units = "in", s

# No linear model
#ggsave(deltaCo, filename = "CompositeConc.png", width = 6, height = 7, units = "in", scale = 1)

# weeklySoil2 = weeklySoil[1:45, ]
# View(weeklySoil2)
```

```
Bsoil2 = ggplot(weeklySoil, aes(x=Date.ti, y=B.min.comp, colour=Transect, group = Transect)) +
  geom_point() +
  # geom_point(aes(x=Date.ti, y=B.comp, colour=Transect, group = Transect)) +
  theme_bw() +
  stat_smooth(method = "lm", formula = y ~ poly(x, 2), se=FALSE)

Bsoil2
```



Water

```
AOdf = read.csv2("Data/WeeklyHydroContam_R.csv")
str(AOdf)
```

```
## 'data.frame':    51 obs. of  59 variables:
##  $ ti                  : Factor w/ 51 levels "2016-03-25 00:04:00",..: 1 2 3 4 5 6 7 8 9 10 ...
```

```
##  $ WeekSubWeek         : Factor w/ 51 levels "W0-0x","W0-1",..: 1 2 3 4 5 6 26 27 28 29 ...
##  $ tf                  : Factor w/ 51 levels "2016-03-25 12:02:00",..: 1 2 3 4 5 6 7 8 9 10 ...
##  $ iflux               : num  1.25 1.12 1.31 1.46 16.33 ...
##  $ fflux               : num  1.13 1.31 1.46 16.45 15.18 ...
##  $ changeflux          : num  -0.119 0.189 0.148 14.989 -1.15 ...
##  $ peak                : num  1.25 1.38 1.64 38.4 18.67 ...
##  $ valley              : num  1.118 1.082 0.929 1.449 13.201 ...
##  $ tdiff               : num  12 82.5 37.6 27.3 23.1 ...
##  $ chExtreme           : num  -0.13 0.256 0.33 36.944 -3.133 ...
##  $ AveDischarge.m3.h   : num  1.2 1.21 1.28 14.32 15.53 ...
##  $ Volume.m3           : num  14.4 100.2 48.3 390.4 359.2 ...
##  $ Sampled.Hrs         : num  12 82.5 37.6 27.3 23.1 ...
##  $ Sampled             : Factor w/ 2 levels "Not Sampled",..: 1 2 1 2 2 1 2 2 1 2 ...
##  $ Conc.mug.L          : num  NA 0.246 NA 6.788 6.561 ...
##  $ Conc.SD             : num  NA 0.0193 NA 0.2894 0.1906 ...
##  $ N.x                 : int  NA 3 NA 3 3 NA 3 3 NA 3 ...
##  $ diss.d13C           : num  NA -26.7 NA -30.5 -30.6 ...
##  $ SD.d13C             : num  NA 0.936 NA 0.106 0.151 ...
##  $ se.d13C             : num  NA 0.5403 NA 0.0612 0.0874 ...
##  $ MES.mg.L            : num  NA 53.4 NA 62.5 22.5 ...
##  $ MES.sd              : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ MO.mg.L             : num  NA 0 NA 0.001 0.0001 NA 0.0001 0.0001 NA 0.0058 ...
##  $ Conc.Solids.mug.gMES: num  NA 0.645 NA 0.126 0.436 ...
##  $ N.y                 : int  NA NA NA NA NA NA 3 3 NA NA ...
##  $ filt.d13C           : num  NA NA NA NA NA ...
##  $ filt.SD.d13C        : num  NA NA NA NA NA ...
##  $ filt.se.d13C        : num  NA NA NA NA NA ...
##  $ DD13C.diss          : num  NA 4.545 NA 0.741 0.59 ...
##  $ DD13C.filt          : num  NA NA NA NA NA ...
##  $ f.diss              : num  NA 0.0689 NA 0.6459 0.706 ...
##  $ f.filt              : num  NA NA NA NA NA ...
##  $ B.diss              : num  NA 93.1 NA 35.4 29.4 ...
##  $ B.filt              : num  NA NA NA NA NA ...
##  $ NH4.mM              : num  NA NA NA 0.05 NA NA NA NA NA NA ...
##  $ TIC.ppm.filt        : num  NA NA NA 51.8 44.8 NA 66.7 52.1 NA 69.4 ...
##  $ Cl.mM               : num  NA NA NA 1.48 1574 ...
##  $ NO3...mM            : num  NA NA NA 616 778 ...
##  $ PO4..mM             : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ NPOC.ppm            : num  NA NA NA 4 4.4 NA 5.8 3.4 NA 9.1 ...
##  $ TIC.ppm.unfilt      : num  NA NA NA 44.8 26.4 NA 39 32.3 NA 54.8 ...
##  $ TOC.ppm.unfilt      : num  NA NA NA 4.7 5.4 NA 2.7 3.8 NA 3.9 ...
##  $ ExpMES.Kg           : num  NA 5.35 NA 24.4 8.08 ...
##  $ DissSmeto.mg        : num  NA 24.6 NA 2649.9 2357 ...
##  $ FiltSmeto.mg        : num  NA 3.45 NA 3.07 3.52 ...
##  $ TotMassOut.mg       : num  NA 28.1 NA 2653 2360.5 ...
##  $ FracDiss            : num  NA 0.877 NA 0.999 0.999 ...
##  $ FracFilt            : num  NA 0.12301 NA 0.00116 0.00149 ...
##  $ Appl.Mass.g         : num  6369 0 0 0 0 ...
##  $ CumAppMass.g        : num  6369 6369 6369 6369 6369 ...
##  $ SimOutDiss.g        : num  0 0.0246 0 2.6499 2.357 ...
##  $ SimOutFilt.g        : num  0 0.00345 0 0.00307 0.00352 ...
##  $ SimOutSmeto.g       : num  0 0.0281 0 2.653 2.3605 ...
##  $ CumOutDiss.g        : num  0 0.0246 0.0246 2.6745 5.0315 ...
##  $ CumOutFilt.g        : num  0 0.00345 0.00345 0.00652 0.01004 ...
```

```
##  $ CumOutSmeto.g       : num  0 0.0281 0.0281 2.681 5.0416 ...
##  $ BalMassDisch.g      : num  6369 6369 6369 6367 6364 ...
##  $ FracMassOut         : num  0 0.000308 0 0.029119 0.025909 ...
##  $ FracDeltaOut        : num  0 -0.00821 0 -0.88723 -0.79334 ...
```

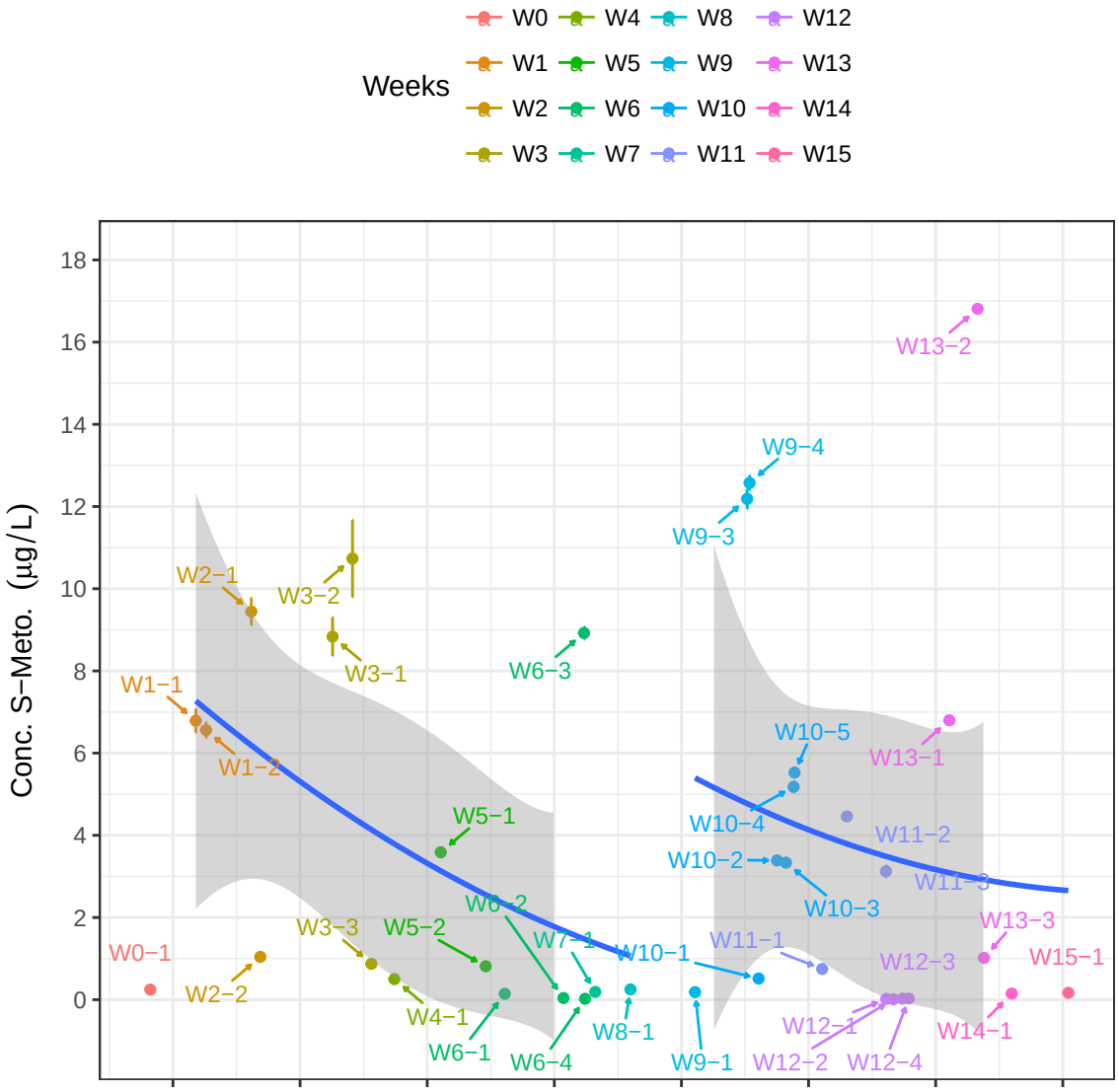
```
# Adding a Weeks column for labelling
AOdf$WeekSubWeek <- as.character(AOdf$WeekSubWeek)
Split <- strsplit(AOdf$WeekSubWeek, "-", fixed = TRUE)
AOdf$Weeks <- sapply(Split, "[", 1)

AOdf$WeekSubWeek <- factor(AOdf$WeekSubWeek, levels = unique(AOdf$WeekSubWeek))
AOdf$Weeks <- factor(AOdf$Weeks, levels = unique(AOdf$Weeks))
AOdf$ti <- as.POSIXct(strptime(AOdf$ti, "%Y-%m-%d %H:%M", tz="EST"))
sum(is.na(AOdf$ti))
```

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

Outlet - Concentrations

```
# View(AOdf)

limits_conc <- aes(ymin=Conc.mug.L-Conc.SD, ymax=Conc.mug.L+Conc.SD, color = Weeks, group = Weeks)



conc1 <- ggplot(AOdf, aes(x=ti, y=Conc.mug.L)) +
  geom_point( aes(color = Weeks, group = Weeks)) +

  # Error bars
  geom_errorbar(limits_conc, width=1) +

  # Themes and axes
  theme_bw() +
  theme(# axis.text.x=element_text(angle = 45, hjust = 1),
        axis.text.x=element_blank(),
        axis.title.x=element_blank(),
        legend.position="top"
        )+
  guides(col = guide_legend(nrows = 2)) +  # Sets legend parameters
  xlab("Date") +
  scale_x_datetime(breaks = date_breaks("2 weeks"), labels = date_format("%b %d")) +
  ylab(expression(paste("Conc. S-Meto.  ", {({mu}*g / L)}))) +
  scale_y_continuous(breaks = c(18,16,14,12,10, 8, 6, 4, 2, 0), limits = c(-1, 18) ) +

  # Smooth linear models
  geom_smooth(data=subset(AOdf[4:27, ]), method = "lm", formula = y ~ poly(x, 2)) +
  geom_smooth(data=subset(AOdf[27:length(AOdf), ]), method = "lm", formula = y ~ poly(x, 2)) +

  # Text
  # Application W9
  # annotate("text",
  #         x = as.POSIXct('2016-06-10 08:04:00'), y = -1, label = lbW9, parse = T, size = 3.0) +
  # geom_segment(aes(x = as.POSIXct('2016-06-05 08:04:00'), y = -1,
```

```
  #                 xend = as.POSIXct('2016-05-25 18:04:00'), yend = -0.9), color = "black",
  #             arrow = arrow(length = unit(0.2, "cm"))) +
  geom_text_repel(aes(label=WeekSubWeek, color = factor(Weeks)), # WeekSubWeek or Weeks
                  size = 3,
                  arrow = arrow(length = unit(0.005, 'npc'), type = "closed"),
                  force = 0.5,
                  point.padding = unit(0.5, 'lines'),
                  max.iter = 2e3,
                  nudge_x = .05)
conc1
```




```
conc2 <- ggplot(AOdf[28:length(AOdf),], aes(x=ti, y=Conc.mug.L)) +
  geom_point( aes(color = Weeks, group = Weeks)) +
```

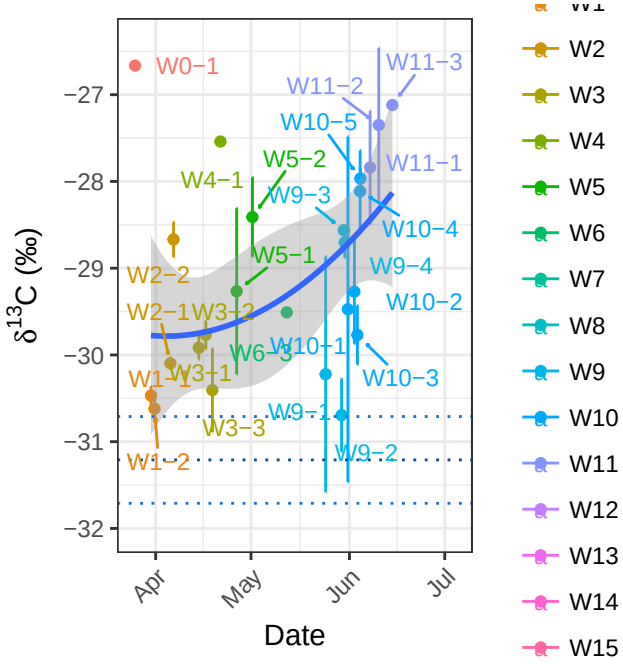
```
  # Error bars
  # geom_errorbar(aes(ymin=mean.d13C-SD.d13C, ymax=mean.d13C+SD.d13C), width=.1) +
  geom_errorbar(limits_conc, width=1) +

  # Themes & axes
  # theme_gray() +
  theme_bw() +
  theme(legend.position = "none") +
  theme(axis.text.x=element_text(angle = 45, hjust = 1),
        axis.text.y = element_blank(),
        legend.title = element_blank(),
        plot.margin = unit(c(0,3.5,0,0), "lines")) +
  #scale_x_datetime(breaks = date_breaks("week"), labels = date_format("%m/%d")) +
  scale_y_continuous(breaks = c(20,15,10,5,0), limits = c(-5, 20) ) +
  xlab("Date") +
  ylab("") +

  # Smooth linear models
  stat_smooth(method = "lm", formula = y ~ poly(x, 2)) +
  #geom_hline(yintercept = -31.21, color = "dodgerblue4", linetype = "dotted") +
  #geom_hline(yintercept = -30.71, color = "dodgerblue3", linetype = "dotted") +
  #geom_hline(yintercept = -31.71, color = "dodgerblue3", linetype = "dotted") +

  # Text
  #annotate("text", x = as.POSIXct('2016-06-25 00:04:00'), y = -31.2, label = lb1, parse = T) +
  annotate("text", x = as.POSIXct('2016-05-27 08:04:00'), y = -3, label = "App.4", parse = T) +
  geom_segment(aes(x = as.POSIXct('2016-05-26 08:04:00'), y = -4,
                   xend = as.POSIXct('2016-05-26 08:04:00'), yend = -5.0),
               arrow = arrow(length = unit(0.2, "cm"))) +
  geom_text_repel(aes(label=Weeks, color = factor(Weeks)),
                  size = 3,
                  arrow = arrow(length = unit(0.005, 'npc'), type = "closed"),
                  force = 0.5,
                  point.padding = unit(0.5, 'lines'),
                  max.iter = 2e3,
                  nudge_x = .05)


#concs = plot_grid(conc1, conc2, ncol = 2, nrow = 1, align = "h")
#concs
```

Outlet Isotopes - Continous

```
AOdf$SD.d13C.err  <- ifelse(is.na(AOdf$SD.d13C), 0.5, AOdf$SD.d13C)
# limits_dC <- aes(ymin=diss.d13C-SD.d13C.err, ymax=diss.d13C+SD.d13C.err, color = Weeks, group = Weeks
limits_dC <- aes(ymin=diss.d13C-SD.d13C, ymax=diss.d13C+SD.d13C, color = Weeks, group = Weeks)
# View(AOdf)

iso <- ggplot(AOdf, aes(x=ti, y=diss.d13C)) +
  #geom_errorbar(aes(ymin=mean.d13C-SD.d13C, ymax=mean.d13C+SD.d13C), width=.1) +
  geom_errorbar(limits_dC, width=1) +
  #theme_gray() +
```

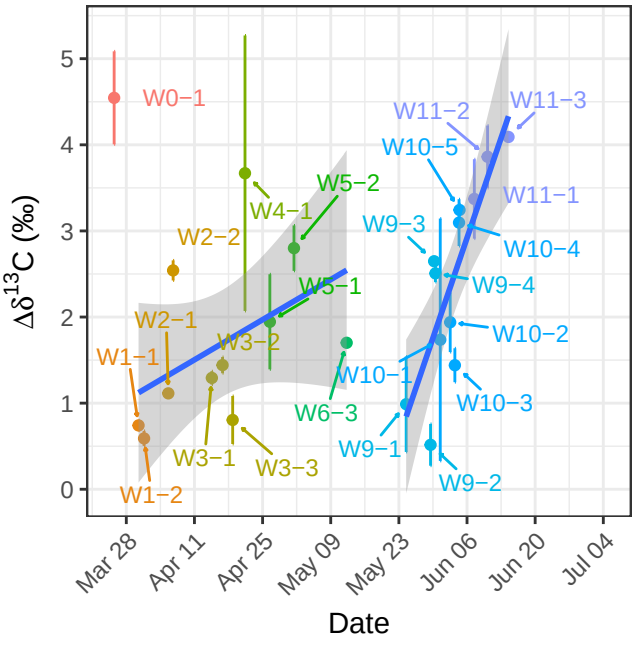
```
  theme_bw() +
  theme(axis.text.x=element_text(angle = 45, hjust = 1)) +
  #scale_x_datetime(breaks = date_breaks("week"), labels = date_format("%m/%d")) +
  geom_point( aes(color = Weeks, group = Weeks)) +
  #stat_smooth(method = "lm", formula = y ~ x) +
  geom_smooth(data=subset(AOdf[4:length(AOdf), ]), method = "lm", formula = y ~ poly(x, 2)) +
  #stat_smooth(method = "lm", formula = y ~ poly(x, 2)) +
  #theme(axis.text.x = element_blank()) +
  #theme(plot.margin = unit(c(1,1,1,1), "lines")) +
  geom_hline(yintercept = -31.21, color = "dodgerblue4", linetype = "dotted") +
  geom_hline(yintercept = -30.71, color = "dodgerblue3", linetype = "dotted") +
  geom_hline(yintercept = -31.71, color = "dodgerblue3", linetype = "dotted") +
  #annotate("text", x = as.POSIXct('2016-06-25 00:04:00'), y = -31.2, label = lb1, parse = T) +
  xlab("Date") +
  #theme(legend.position="top") +
  scale_y_continuous(breaks = c(-32,-31,-30,-29, -28, -27), limits = c(-32, -26.4) ) +
  ylab(expression(paste({delta}^"13","C", ' (\u2030)'))) +
  geom_text_repel(aes(label=WeekSubWeek, color = factor(Weeks)),
                  size = 3,
                  arrow = arrow(length = unit(0.005, 'npc'), type = "closed"),
                  force = 0.5,
                  point.padding = unit(0.5, 'lines'),
                  max.iter = 2e3,
                  nudge_x = .05)
  #ylab(expression(paste({delta}^"13","C", ' \211')))
  #ylab(expression(paste({delta}^"13","C")))
```

```
iso
```

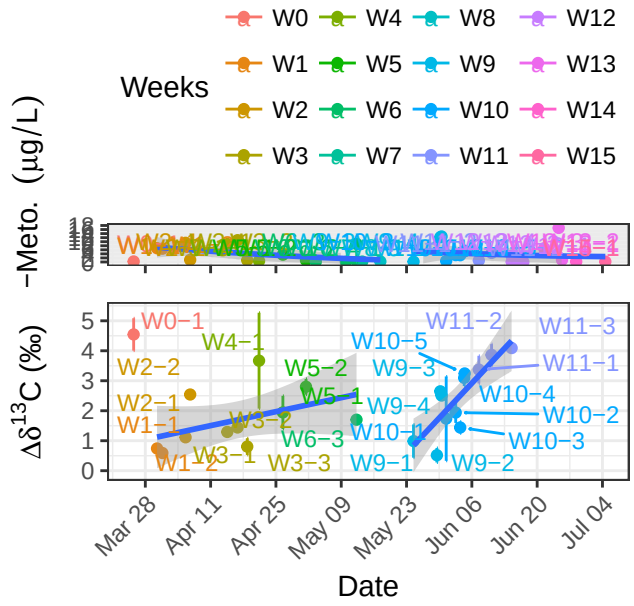



```
ggsave(iso, filename = "Outlet_Delta_ti_cont.png", width = 8, height = 5, units = "in", scale = 1)


# DeltaDelta Water
```

```
#limits_DdCwater <- aes(ymin=diss.d13C-SD.d13C-initialDelta, ymax=diss.d13C+SD.d13C-initialDelta, color
limits_DdCwater <- aes(ymin=diss.d13C-se.d13C-initialDelta, ymax=diss.d13C+se.d13C-initialDelta, color =

iso2 <- ggplot(AOdf, aes(x=ti, y=DD13C.diss)) +
  # Error bars
  # geom_errorbar(aes(ymin=mean.d13C-SD.d13C, ymax=mean.d13C+SD.d13C), width=.1) +
  geom_errorbar(limits_DdCwater, width=1) +

  # Themes and Axes
  # theme_gray() +
  # theme(axis.text.x = element_blank()) +
  # theme(plot.margin = unit(c(1,1,1,1), "lines")) +
  theme_bw() +
  theme(legend.position="none",
        # legend.title = element_blank(),
        axis.text.x=element_text(angle = 45, hjust = 1)) +
  guides(col = guide_legend(nrow = 2)) +  # Sets legend parameters
  xlab("Date") +
  scale_x_datetime(breaks = date_breaks("2 weeks"), labels = date_format("%b %d")) +

  # scale_y_continuous(breaks = c(-32,-31,-30,-29, -28, -27), limits = c(-32, -26.4) ) +
  # scale_y_continuous(breaks = c(6, 4, 2, 0), limits = c(-1, 6) ) +
  scale_y_continuous(breaks=seq(0, 6, 1)) +
  ylab(expression(paste({Delta}, {delta}^"13","C", ' (\u2030)'))) +

  #scale_x_datetime(breaks = date_breaks("week"), labels = date_format("%m/%d")) +
  geom_point( aes(color = Weeks, group = Weeks)) +

  # Smooth linear models
  # stat_smooth(method = "lm", formula = y ~ x) +
  # geom_smooth(data=subset(AOdf[4:length(AOdf), ]), method = "lm", formula = y ~ poly(x, 2)) +
  geom_smooth(data=subset(AOdf[4:27, ]), method = "lm", formula = y~x) +
  geom_smooth(data=subset(AOdf[28:length(AOdf), ]), method = "lm", formula = y ~ x) +

  # Text
  # annotate("text",
  #         x = as.POSIXct('2016-06-10 08:04:00'), y = 0.3, label = lbW9, parse = T, size = 3.0) +
  # geom_segment(aes(x = as.POSIXct('2016-06-05 08:04:00'), y = 0.2,
  #                  xend = as.POSIXct('2016-05-25 18:04:00'), yend = 0), color = "black",
  #              arrow = arrow(length = unit(0.2, "cm"))) +
  # annotate("text", x = as.POSIXct('2016-06-25 00:04:00'), y = -31.2, label = lb1, parse = T) +
  geom_text_repel(aes(label=WeekSubWeek, color = factor(Weeks)),
                  size = 3,
                  arrow = arrow(length = unit(0.005, 'npc'), type = "closed"),
                  force = 0.5,
                  point.padding = unit(0.5, 'lines'),
                  max.iter = 2e3,
                  nudge_x = .05)
  #ylab(expression(paste({delta}^"13","C", ' \211')))
  #ylab(expression(paste({delta}^"13","C")))

iso2
```




```
concIsoWater = plot_grid(conc1, iso2, ncol = 1, nrow = 2, align = "v")
concIsoWater
```

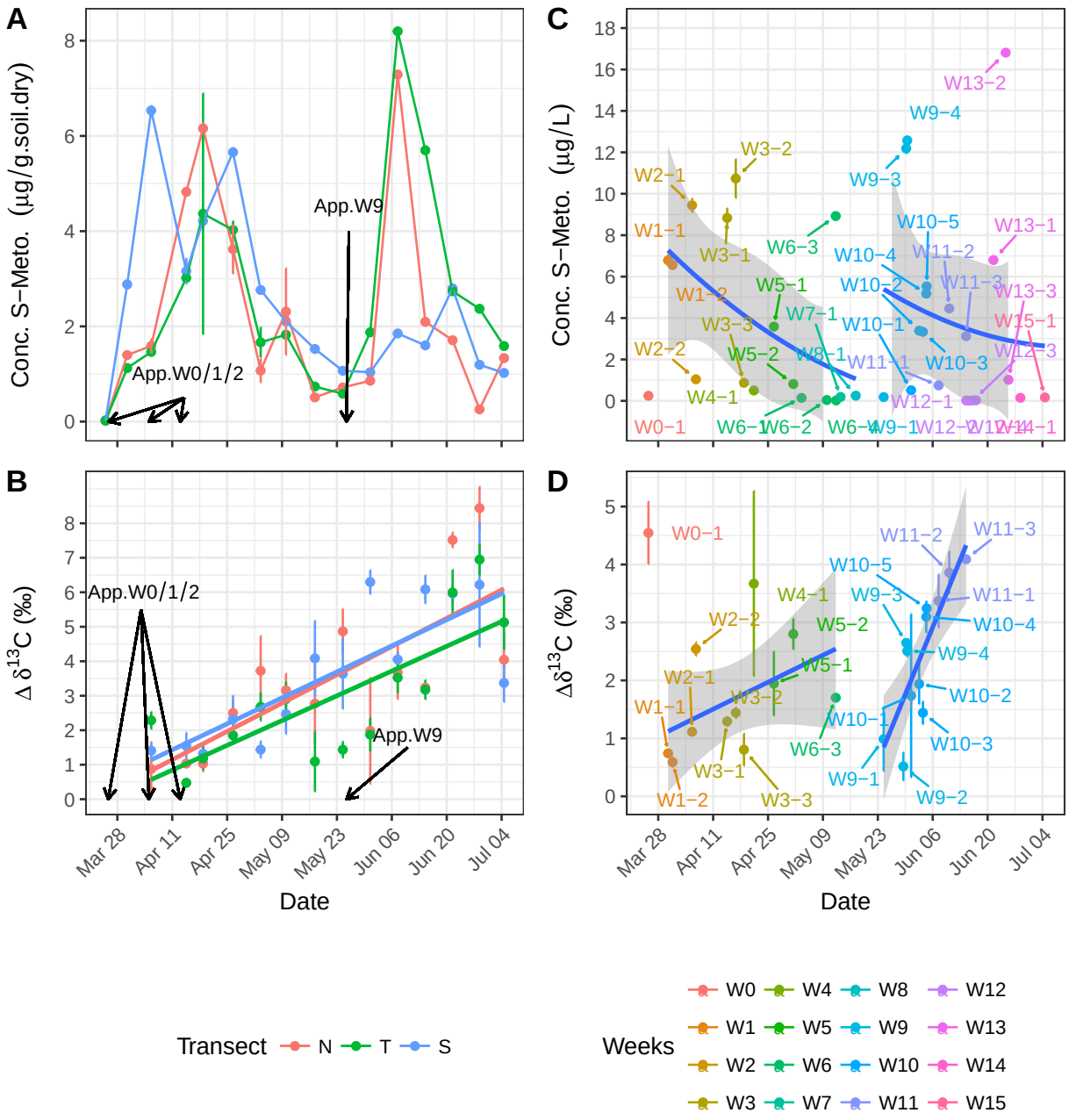



```
# plot_grid(co, deltaTime, ncol = 1, nrow = 2, align = "v")
```

All plots

```
concSoils <- co + theme(legend.position='none')
concWater <- conc1 + theme(legend.position='none')
```

```
legend_soils = get_legend(co)
legend_water = get_legend(conc1)

grid4 <- plot_grid(concSoils, concWater, deltaTime, iso2,
                   ncol =2, nrow = 2, align ="v",
                   labels = c("A", "C", "B", "D"))
fig1 <- ggdraw() +
  draw_plot(grid4, x=0, y=.2, width =  1, height = .8) +
  draw_plot(legend_water, x=0.5, y = 0, width = 0.5, height = 0.2) +
  draw_plot(legend_soils, x=0, y=0, width = 0.6, height = 0.2)

fig1
```




```
ggsave(fig1, filename = "SoilsAndOutlet.tiff", height = 18, width = 17.8, units = 'cm')
```

Mass balance approach

```
library("ggplot2")
library("scales")
library("reshape2")
library("zoo")

soilsOut = read.csv2("Data/MassBalance_R.csv", header = T)
```

```r
soilsOut$ti <- as.POSIXct(soilsOut$ti, "%Y-%m-%d %H:%M", tz = "EST")
sum(is.na(soilsOut$ti))
```

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

```r
print("Mass Balance Soils")
```

```
## [1] "Mass Balance Soils"
```

```r
str(soilsOut)
```

```
## 'data.frame':    52 obs. of  27 variables:
##  $ ti                 : POSIXct, format: "2016-03-25 00:04:00" "2016-03-25 12:04:00" ...
##  $ WeekSubWeek        : Factor w/ 51 levels "W0-0x","W0-1",..: 1 2 3 4 5 6 26 27 28 29 ...
##  $ B.diss             : num  NA 93.1 NA 35.4 29.4 ...
##  $ B.filt             : num  NA NA NA NA NA ...
##  $ CumOutDiss.g       : num  0 0.0246 0.0246 2.6745 5.0315 ...
##  $ CumOutFilt.g       : num  0 0.00345 0.00345 0.00652 0.01004 ...
##  $ CumAppMass.g       : num  6369 6369 6369 6369 6369 ...
##  $ B.comp.North       : num  NA NA NA NA NA ...
##  $ MassSoil.g.North   : num  12.4 NA NA 963.7 NA ...
##  $ comp.d13C.North    : num  NA NA NA NA NA ...
##  $ comp.d13C.SD.North : num  NA NA NA NA NA ...
##  $ comp.d13C.SE.North : num  NA NA NA NA NA ...
##  $ ID.N               : Factor w/ 17 levels "AW-N-0","AW-N-0x",..: 2 NA NA 1 NA NA 3 NA NA 10 ...
##  $ B.comp.Talweg      : num  NA NA NA NA NA ...
##  $ MassSoil.g.Talweg  : num  6.49 NA NA 365.21 NA ...
##  $ comp.d13C.Talweg   : num  NA NA NA NA NA ...
##  $ comp.d13C.SD.Talweg: num  NA NA NA NA NA ...
##  $ comp.d13C.SE.Talweg: num  NA NA NA NA NA ...
##  $ ID.T               : Factor w/ 17 levels "AW-T-0","AW-T-0x",..: 2 NA NA 1 NA NA 3 NA NA 10 ...
##  $ B.comp.South       : num  NA NA NA NA NA ...
##  $ MassSoil.g.South   : num  15.9 NA NA 1576.4 NA ...
##  $ comp.d13C.South    : num  NA NA NA NA NA ...
##  $ comp.d13C.SD.South : num  NA NA NA NA NA ...
##  $ comp.d13C.SE.South : num  NA NA NA NA NA ...
##  $ ID.S               : Factor w/ 17 levels "AW-S-0","AW-S-0x",..: 2 NA NA 1 NA NA 3 NA NA 10 ...
##  $ CatchMassSoil.g    : num  34.8 NA NA 2905.3 NA ...
##  $ BulkCatch.d13      : num  NA NA NA NA NA ...
```

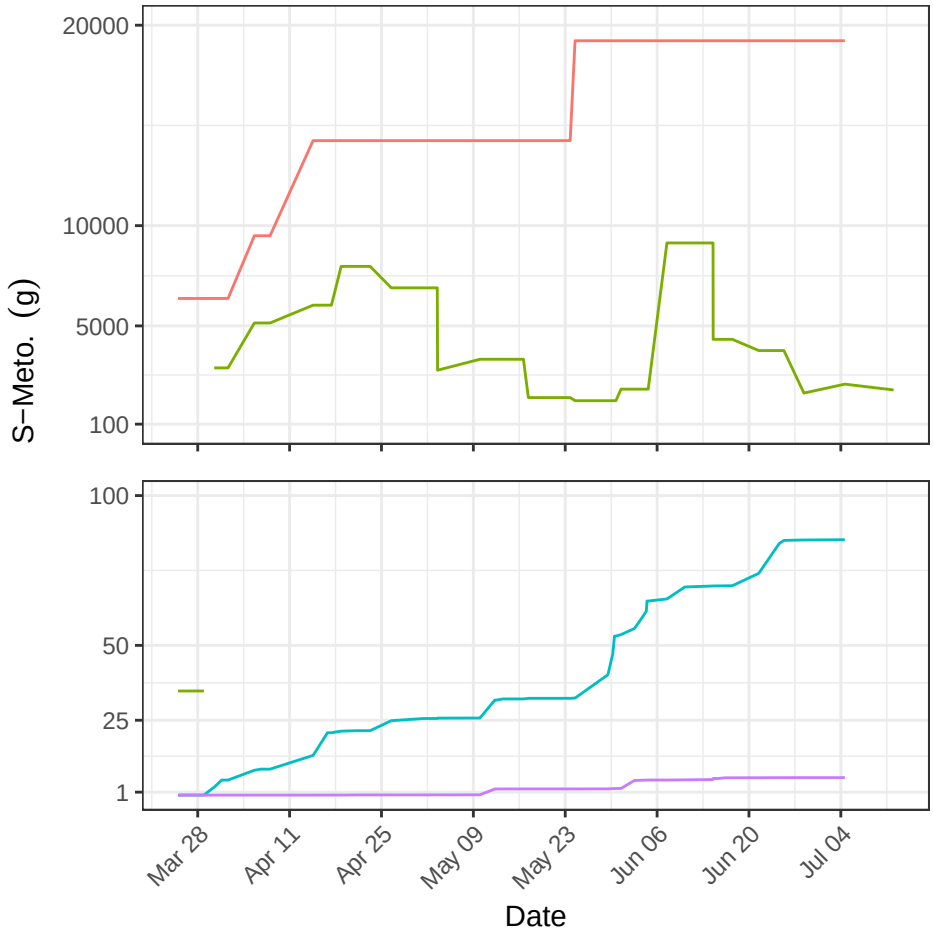
```r
# Melt data set

##Subset the necessary columns
soilsRemainMass <- soilsOut[, c("ti" ,"CumAppMass.g", "CumOutDiss.g", "CumOutFilt.g", "CatchMassSoil.g")

# Replace each NA with the most recent non-NA prior to it.
# Purpose: To match continuous outlet time array
soilsRemainMass$CatchMassSoil.g <- na.locf(soilsRemainMass$CatchMassSoil.g)
# View(soilsRemainMass)

##Then rearrange your data frame
remainMassMolten = melt(soilsRemainMass, id=c("ti"))
# View(remainMassMolten)

pg <- remainMassMolten
# Change variable names:
```

```r
levels(pg$variable)[levels(pg$variable)=="CumAppMass.g"] <- "Applied Cum. (Survey)"
levels(pg$variable)[levels(pg$variable)=="CumOutDiss.g"] <- "Dissolved Cum. (Outlet)"
levels(pg$variable)[levels(pg$variable)=="CumOutFilt.g"] <- "Sediment Cum. (Outlet)"
levels(pg$variable)[levels(pg$variable)=="CatchMassSoil.g"] <- "Catch. Mass (0.5cm Soil)"

# Change the order:
levels(pg$variable)
```

```
## [1] "Applied Cum. (Survey)"    "Dissolved Cum. (Outlet)"
## [3] "Sediment Cum. (Outlet)"   "Catch. Mass (0.5cm Soil)"
```

```r
pg$variable <- factor(pg$variable, levels = c("Applied Cum. (Survey)", "Catch. Mass (0.5cm Soil)", "Dis
# names(pg)[names(pg)=="variable"]  <- "Estimated Mass"

massBalTop <- ggplot(pg) +
  geom_line(aes(x=ti, y=value, group = variable, color=variable)) +

  # Themes and axes
  theme_bw() +
  theme(# axis.text.x=element_text(angle = 45, hjust = 1),
        axis.text.x=element_blank(),
        axis.title.x=element_blank(),
        axis.title.y = element_text(hjust = 0.0),
        legend.position="none"

        )+
  labs(color = "Estimated Mass") +
  guides(col = guide_legend(ncol = 2)) +  # Sets legend parameters

  # xlab("Date") +
  scale_x_datetime(breaks = date_breaks("2 weeks"), labels = date_format("%b %d")) +
  ylab(expression(paste("S-Meto.  ", {(g)}))) +
  scale_y_continuous(breaks = c(100, 5000, 10000, 20000), limits = c(100, 20000) )
  # scale_y_continuous(trans=log_trans(), breaks=c(1,5,10,50,100,500,1000,2000,3000,4000,5000))


massBalBottom <- ggplot(pg) +
  geom_line(aes(x=ti, y=value, color=variable)) +

  # Themes and axes
  theme_bw() +
  theme(axis.text.x=element_text(angle = 45, hjust = 1),
        #axis.text.x=element_blank(),
        #axis.title.x=element_blank(),
        axis.title.y = element_blank(),
        legend.position="none"
        )+
  # guides(col = guide_legend(nrows = 2)) +  # Sets legend parameters
  xlab("Date") +
  scale_x_datetime(breaks = date_breaks("2 weeks"), labels = date_format("%b %d")) +
  ylab(expression(paste("Mass. S-Meto.  ", {(g)}))) +

  scale_y_continuous(breaks = c(1, 25, 50, 100), limits = c(0, 100) )
```

```
massBalLegend <- ggplot(pg) +
  geom_line(aes(x=ti, y=value, color=variable)) +

  # Themes and axes
  theme_bw() +
  theme(axis.text.x=element_text(angle = 45, hjust = 1),
        #axis.text.x=element_blank(),
        #axis.title.x=element_blank(),
        legend.position="top"
        )+
  guides(color = guide_legend(title = "Mass Distribution",  title.position = "top"))+
  # guides(col = guide_legend(nrows = 2)) +  # Sets legend parameters
  xlab("Date") +
  scale_x_datetime(breaks = date_breaks("2 weeks"), labels = date_format("%b %d")) +
  ylab(expression(paste("Mass. S-Meto.  ", {(g)}))) +
  scale_y_continuous(breaks = c(1, 25, 50, 100), limits = c(0, 100) )



massBal = plot_grid(massBalTop, massBalBottom, ncol = 1, nrow = 2, align = "v")
massBal
```

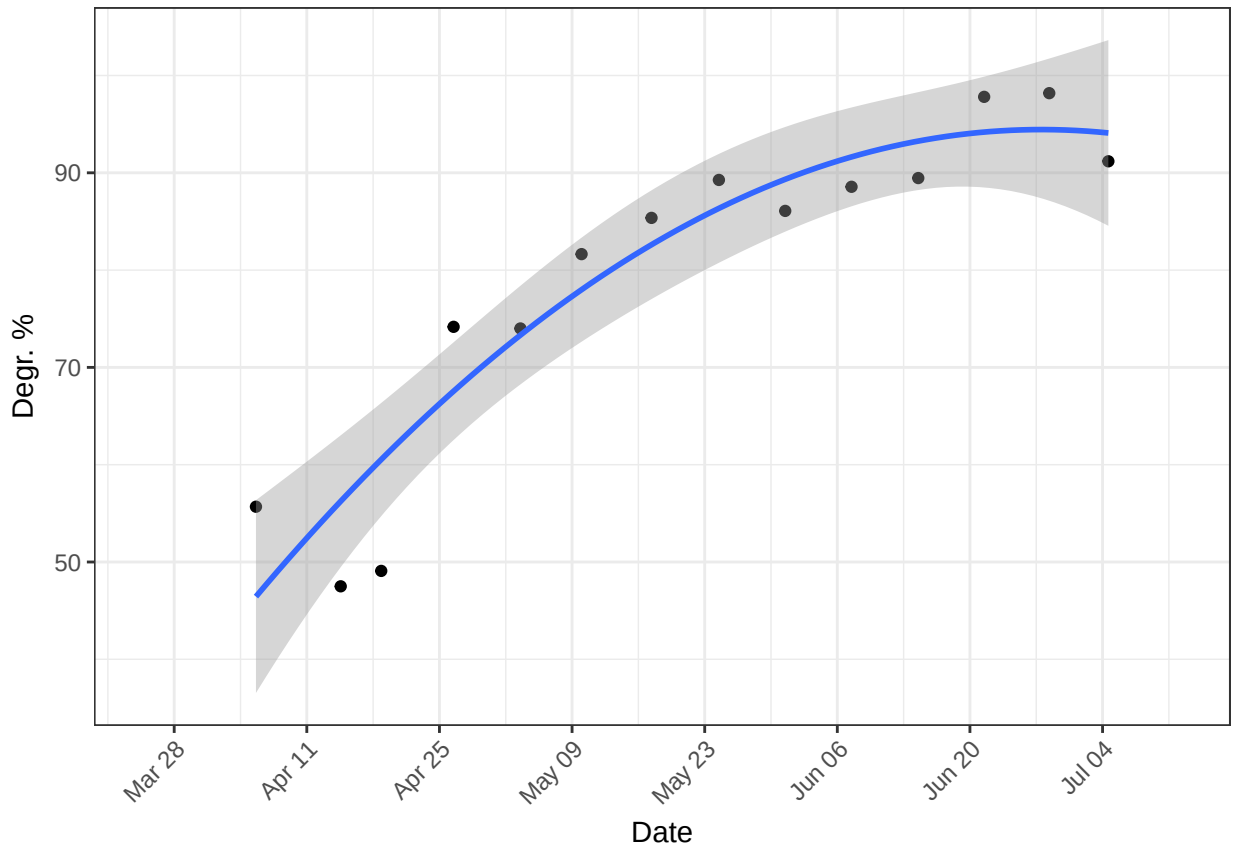


Catchment degradation based on bulk signatures

```
# 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
soilsOut$DD13C.bulk <- (soilsOut$BulkCatch.d13 - (d13Co))

# Max epsilon (30C, 20%)
soilsOut$f.bulk <-
  ((10^(-3)*soilsOut$BulkCatch.d13 + 1)/(10^(-3)*d13Co + 1))^(1000/(epsilon_max))

soilsOut$B.bulk <-
  (1 - soilsOut$f.bulk)*100

# Min epsilon (20C, 40%)
soilsOut$f.min.bulk <-
  ((10^(-3)*soilsOut$BulkCatch.d13 + 1)/(10^(-3)*d13Co + 1))^(1000/(epsilon_min))

soilsOut$B.min.bulk <-
  (1 - soilsOut$f.min.bulk)*100

# Mean epsilon (# Alteck)
soilsOut$f.mean.bulk <-
  ((10^(-3)*soilsOut$BulkCatch.d13 + 1)/(10^(-3)*d13Co + 1))^(1000/(epsilon_mean))

soilsOut$B.mean.bulk <-
  (1 - soilsOut$f.mean.bulk)*100



bulkB <- ggplot(soilsOut, aes(x=ti, y=B.mean.bulk)) +
  geom_point() +
  # geom_point(aes(x=Date.ti, y=B.comp, colour=Transect, group = Transect)) +

  # Theme and axes
  theme_bw() +
  ylab("Degr. %") +
```

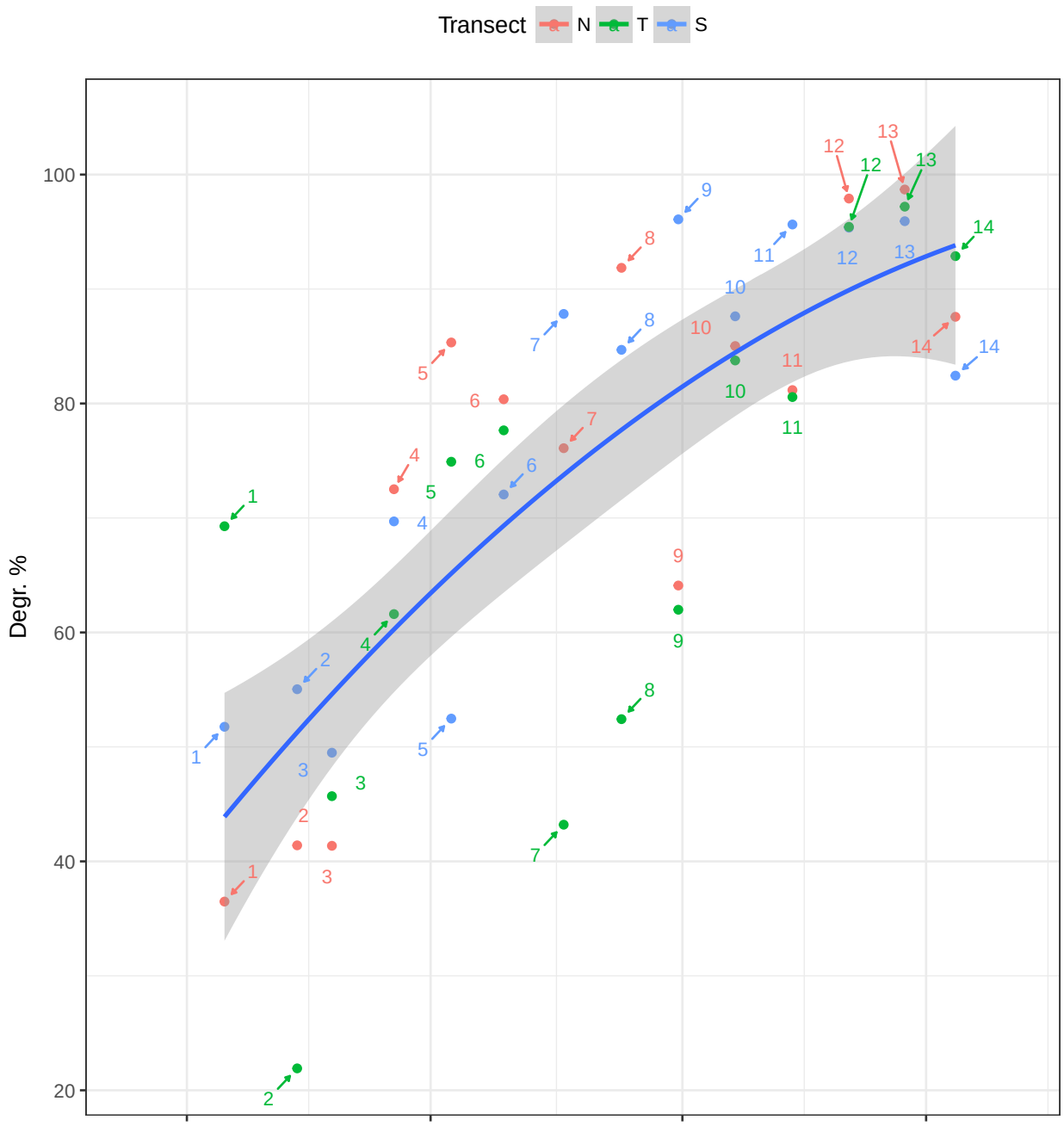
```
  theme(legend.position = "top",
        #axis.title = element_blank(),
        #axis.title.x = element_blank(),
        #axis.text.x = element_blank()
        axis.text.x=element_text(angle = 45, hjust = 1)
        ) +
  xlab("Date") +
  scale_x_datetime(breaks = date_breaks("2 weeks"), labels = date_format("%b %d")) +

  # scale_y_continuous(breaks = c(25, 50, 75, 100), limits = c(0, 100) ) +
  # stat_smooth(method = "lm", formula = y ~ poly(x, 2), se=FALSE)
  # geom_smooth(data=subset(weeklySoil[14:28, ]), method = "lm", formula = y ~ poly(x, 2), se = F) +
  geom_smooth(aes(group = 1), method = "lm", formula = y ~ poly(x, 2))
  # stat_smooth(data=subset(weeklySoil[4:39, ]), method = "lm", formula = y ~ poly(x, 2), se = F)
  # stat_smooth(method = "lm", formula = y ~ x, se=FALSE)
  #geom_text_repel(aes(label=Wnum, color = factor(Transect)),
   #                size = 3,
    #               arrow = arrow(length = unit(0.005, 'npc'), type = "closed"),
     #              force = 0.5,
      #             point.padding = unit(0.5, 'lines'),
       #            max.iter = 2e3,
        #           nudge_x = .05)
```

```
bulkB
```



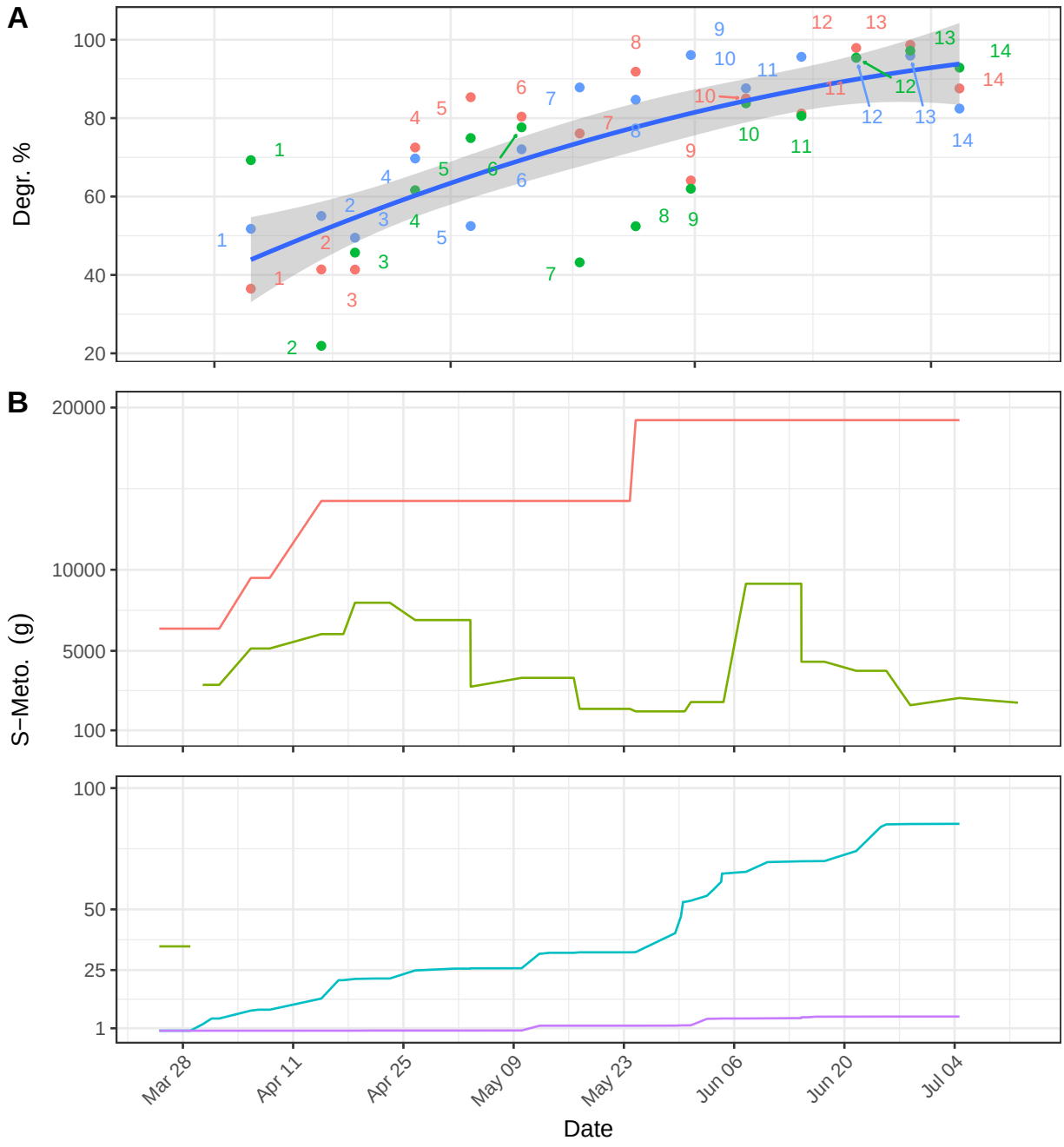
Degradation based on transect signatures

```
# View(weeklySoil)
Bsoil2 = ggplot(weeklySoil, aes(x=Date.ti, y=B.min.comp, colour=Transect, group = Transect)) +
  geom_point() +
  # geom_point(aes(x=Date.ti, y=B.comp, colour=Transect, group = Transect)) +

  # Theme and axes
  theme_bw() +
  ylab("Degr. %") +
  theme(legend.position = "top",
        #axis.title = element_blank(),
        axis.title.x = element_blank(),
        axis.text.x = element_blank()
        #axis.text.x=element_text(angle = 45, hjust = 1)
        ) +
  # xlab("Date") +
  # scale_x_datetime(breaks = date_breaks("2 weeks"), labels = date_format("%b %d")) +
  # ylab(expression(paste("Degradation %"))) +

  # scale_y_continuous(breaks = c(25, 50, 75, 100), limits = c(0, 100) ) +
  # stat_smooth(method = "lm", formula = y ~ poly(x, 2), se=FALSE)
  # geom_smooth(data=subset(weeklySoil[14:28, ]), method = "lm", formula = y ~ poly(x, 2), se = F) +
  geom_smooth(aes(group = 1), method = "lm", formula = y ~ poly(x, 2)) +
  # stat_smooth(data=subset(weeklySoil[4:39, ]), method = "lm", formula = y ~ poly(x, 2), se = F)
  # stat_smooth(method = "lm", formula = y ~ x, se=FALSE)
  geom_text_repel(aes(label=Wnum, color = factor(Transect)),
                  size = 3,
                  arrow = arrow(length = unit(0.005, 'npc'), type = "closed"),
                  force = 0.5,
                  point.padding = unit(0.5, 'lines'),
                  max.iter = 2e3,
                  nudge_x = .05)

Bsoil2
```

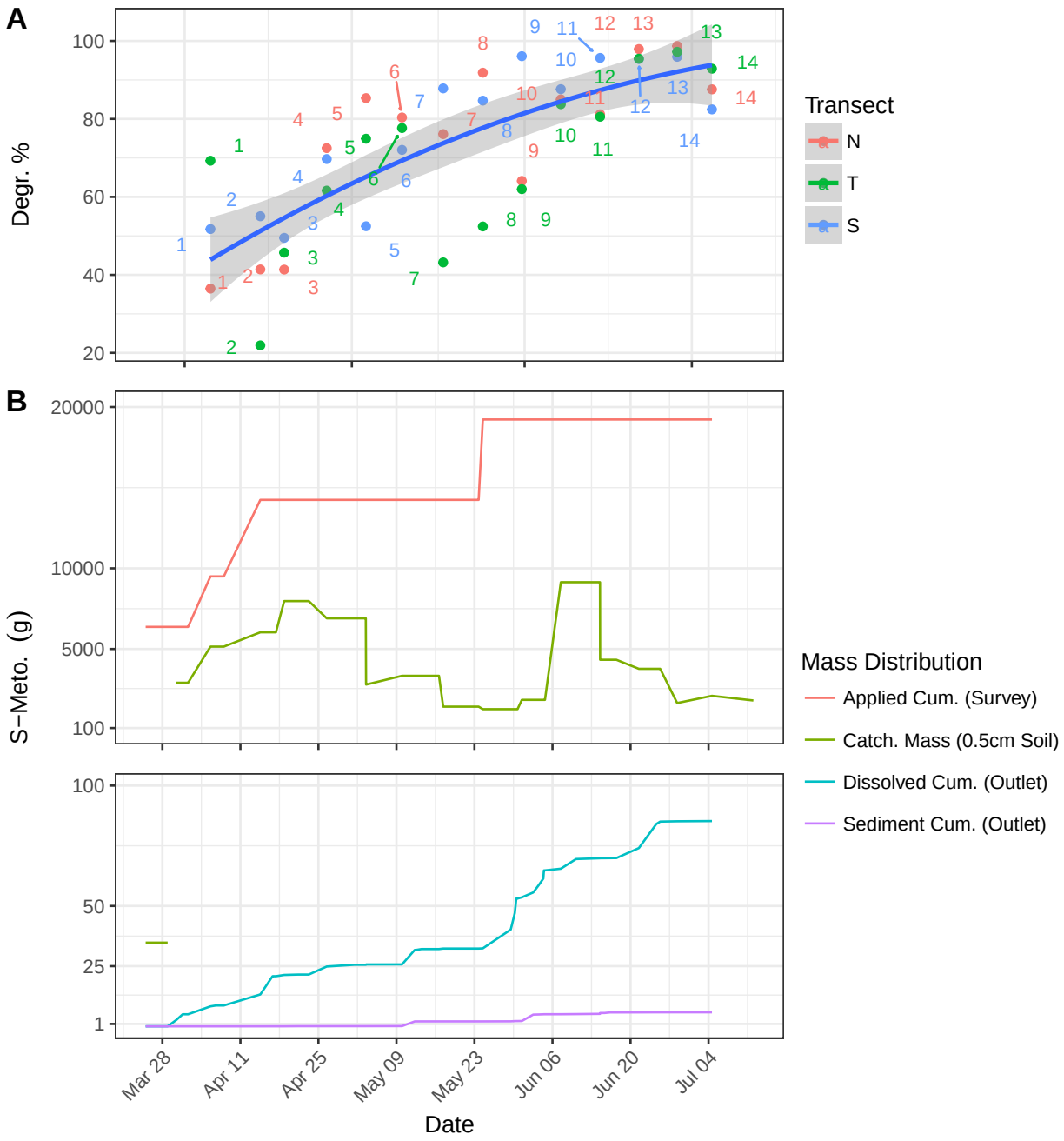



```
## Merging both figures

# massBalNoL <- massBal + theme(legend.position='none')
BsoilNoL <- Bsoil2 + theme(legend.position='none')

legend_mass = get_legend(massBalLegend + guides(colour = guide_legend(title = "Mass Distribution",  titl
legend_deg = get_legend(Bsoil2 + guides(colour = guide_legend(title.position = "top", nrow = 3, byrow =


gridPartB <- plot_grid(BsoilNoL, massBalTop, massBalBottom,
                    ncol =1, nrow = 3, align ="v",
```

```
                    labels = c("A", "B"))
gridPartB
```




```
fig2 <- ggdraw() +
  draw_plot(gridPartB, x=0, y=0, width =  0.75, height = 1) +
  draw_plot(legend_deg, x=0.5, y =0.7, width = 0.6, height = 0.3) +
  draw_plot(legend_mass, x=0.5, y=0.2, width = 0.75, height = 0.3)

fig2
```



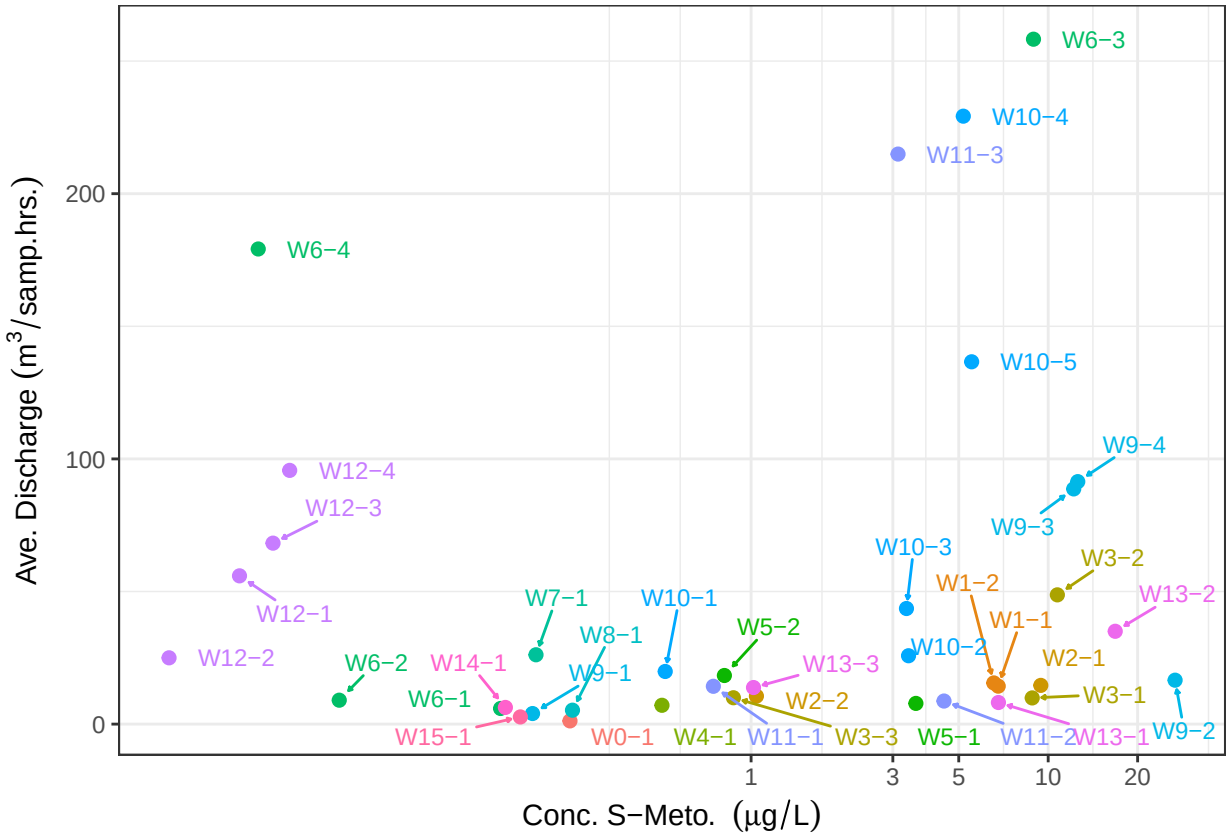

```
ggsave(fig2, filename = "BvsMassBal.tiff", height = 10, width = 17.8, units = 'cm')
```

XY-Plots

```
QC <- ggplot(AOdf, aes(y=AveDischarge.m3.h, x=Conc.mug.L, group = WeekSubWeek, color = Weeks)) +
  geom_point(size = 2) +
  theme_bw() +
  theme(axis.text.y = element_blank()) +
  theme(legend.title=element_blank()) +
  theme(plot.margin = unit(c(0,0.5,0,0), "lines")) +
```

```
  #stat_smooth(method = "lm", formula = y ~ poly(x, 2)) +
  theme_bw() +
  theme(legend.position="none") +
  #scale_y_continuous(trans=log_trans(), breaks=c(1, 5, 10, 50, 100, 200)) +
  scale_x_continuous(trans=log_trans(), breaks=c(1, 3, 5, 10, 20)) +
  ylab(expression(paste("Ave. Discharge ", {(m^{3} / samp.hrs. )}))) +
  xlab(expression(paste("Conc. S-Meto.  ", {({mu}*g / L)}))) +
  geom_text_repel(aes(label=WeekSubWeek, color = factor(Weeks)),
                  size = 3,
                  arrow = arrow(length = unit(0.005, 'npc'), type = "closed"),
                  force = 0.5,
                  point.padding = unit(0.5, 'lines'),
                  max.iter = 2e3,
                  nudge_x = .05)
```

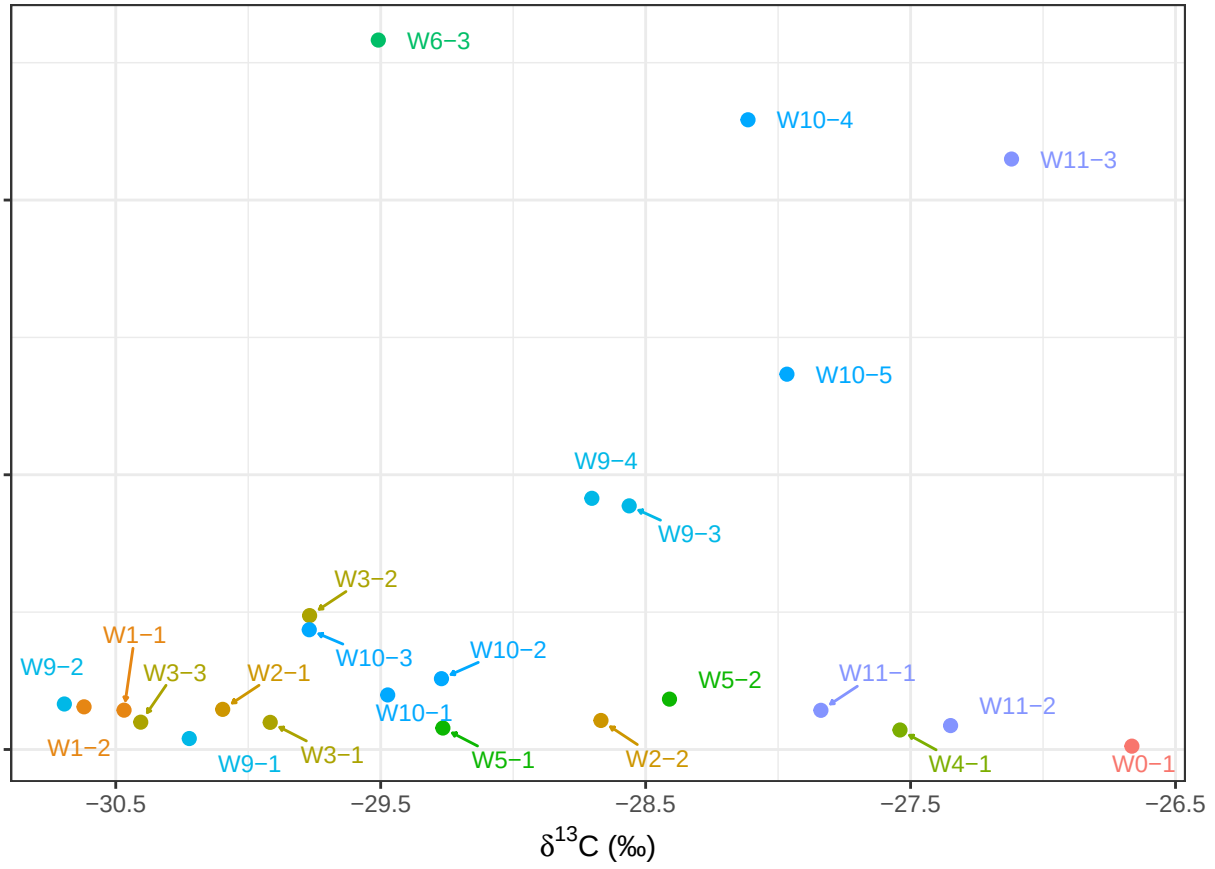
```
QC
```



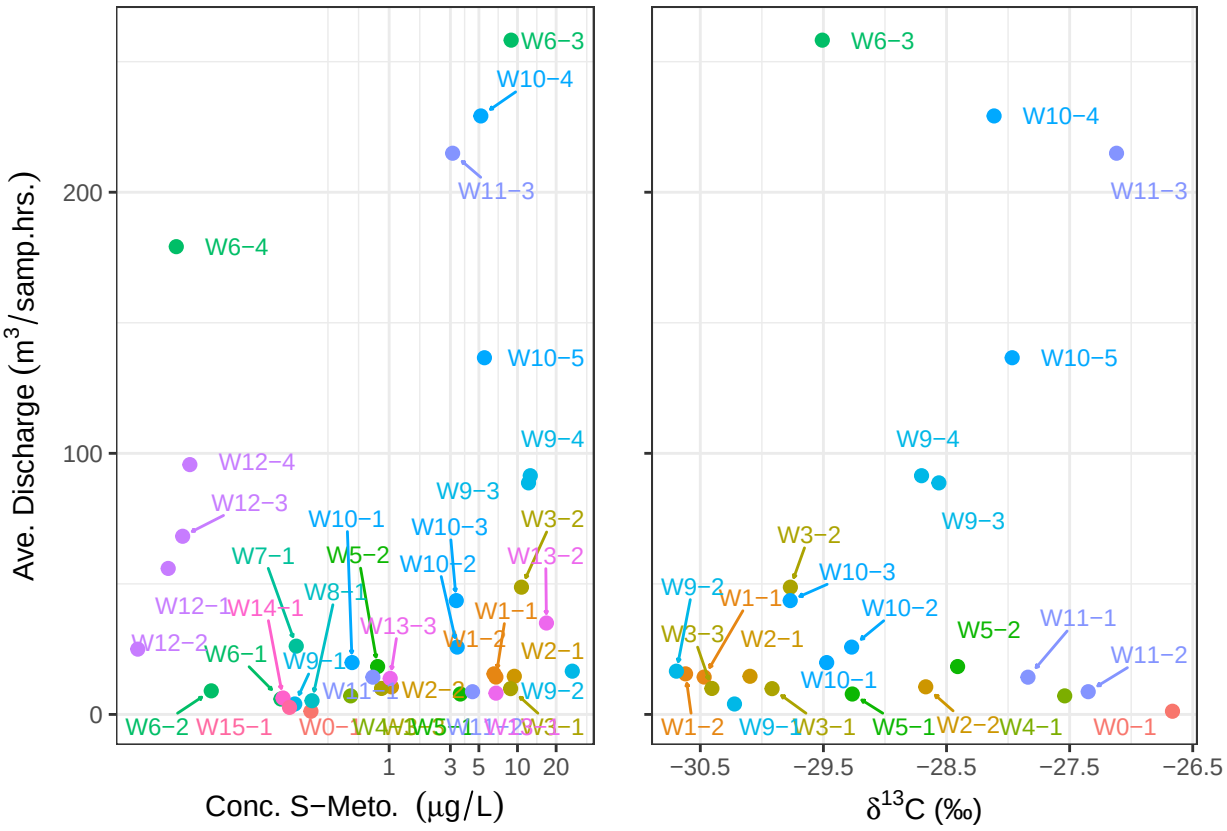

```
QD <- ggplot(AOdf, aes(y=AveDischarge.m3.h, x=diss.d13C, group = WeekSubWeek, color = Weeks)) +
  geom_point(size = 2) +
  theme_bw() +
  theme(axis.text.y = element_blank()) +
  theme(plot.margin = unit(c(0,0.8,0,0), "lines")) +
  #theme(legend.title=element_blank()) +
  #theme(legend.text = element_text(size = 10)) +
  theme(legend.position="none") +
  #stat_smooth(method = "lm", formula = y ~ poly(x, 2)) +
```

```
  #scale_y_continuous(trans=log_trans(), breaks=c(1, 3, 5, 8, 10, 30, 50, 80, 100, 300)) +
  ylab(expression(paste("Ave. Discharge ", {(m^{3} / sample)}))) +
  ylab("") +
  scale_x_continuous(breaks=seq(-31.5, -26.5, 1)) +
  xlab(expression(paste({delta}^"13","C", ' (\u2030)'))) +
  geom_text_repel(aes(label=WeekSubWeek, color = factor(Weeks)),
                  size = 3,
                  arrow = arrow(length = unit(0.005, 'npc'), type = "closed"),
                  force = 0.5,
                  point.padding = unit(0.5, 'lines'),
                  max.iter = 2e3,
                  nudge_x = .05)
```

```
QD
```




```
acd = plot_grid(QC, QD, ncol = 2, nrow = 1, align = "h")
acd
```




```
ggsave(acd, filename = "Disch_Conc_Delta_XYlabs.png", width = 8, height = 5, units = "in", scale = 1)
#ggsave(acd, filename = "Disch_Conc_Delta_XY.png", width = 8, height = 5, units = "in", scale = 1)
#ggsave(acd, filename = "Disch_Conc_Delta_W.pdf", width = 8, height = 4.6, units = "in", scale = 1)
```