ThermalBuffer\_Script

#Hourly Data ###Data Wrangling

#Read in data  
quarterHour\_condensed <- readRDS('quarterHour\_condensed.RDS')  
quarterHour\_condensed <- as.data.frame(t(quarterHour\_condensed))  
quarterHour\_condensed <- quarterHour\_condensed %>% mutate\_all(~ifelse(is.nan(.), NA, .))  
  
#Create 15 min sequence  
quarterHour <- seq(mdy\_h('7/1/2020 00'),mdy\_h('7/13/2021 00'),by = "15 mins")  
quarterHour <- as.data.frame(quarterHour)  
  
#Attach to data frame  
quarterHour\_condensed <- cbind(quarterHour\_condensed,quarterHour)  
  
#Format data long  
quarterHour\_long <- gather(quarterHour\_condensed, site, value, -quarterHour)

#Seasonal buffering ##Summer ###Data wrangling

#Read in data  
daily\_maxs\_condensed <- readRDS('daily\_maxs\_condensed.RDS')  
daily\_maxs\_condensed <- as.data.frame(t(daily\_maxs\_condensed))  
daily\_maxs\_condensed <- daily\_maxs\_condensed %>% mutate\_all(~ifelse(is.nan(.), NA, .))  
  
#Create "day" sequence   
day <- seq(mdy('7/1/2020'),mdy('7/13/2021'),by = "day")   
day <- as.data.frame(day) #convert "day" to data frame  
  
#Attach day to data frame  
daily\_maxs\_condensed <- cbind(daily\_maxs\_condensed,day)  
  
#Format data long  
daily\_max\_long <- gather(daily\_maxs\_condensed, site, value, -day)  
data\_summer <- daily\_max\_long %>%filter(day>'2020-07-15'& day < '2020-09-15')

###Seiad Creek

#Boxplot  
b1 <- ggplot(subset(data\_summer, site %in% c("AP","SP","Durazo","LS","May","SC")))+  
 geom\_boxplot(aes(x = site, value, col = day))+  
 labs(title = "(a) Seiad Creek, 15 July - 15 September")+  
 theme\_classic()+  
 theme(text=element\_text(size=16), axis.title.x=element\_blank())+  
 scale\_x\_discrete(name ="Site",   
 limits = c("AP","SP","Durazo","LS","May","SC"),  
 labels=c("AP" = "Alexander","SP"= "Stender","Durazo"=  
 "Durazo","LS" = "LowerSeiad","May"="May","SC" = "SeiadCreek"))+  
 scale\_y\_continuous(name="Daily Maximum Temp (C)",limits=c(12.5, 22.5))  
  
  
#ANOVA  
data\_summer\_SC <- subset(data\_summer, site %in% c("AP","SP","Durazo","LS","May","SC"))  
shapiro.test(data\_summer\_SC$value) #check for normality

##   
## Shapiro-Wilk normality test  
##   
## data: data\_summer\_SC$value  
## W = 0.97156, p-value = 1.378e-06

leveneTest(value ~ site, data = data\_summer\_SC) #check for equal variances

## Warning in leveneTest.default(y = y, group = group, ...): group coerced to  
## factor.

## Levene's Test for Homogeneity of Variance (center = median)  
## Df F value Pr(>F)   
## group 5 12.513 3.266e-11 \*\*\*  
## 360   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

anova\_SC <- aov(value ~ site, data = data\_summer\_SC) #run one way anova  
summary.aov(anova\_SC)

## Df Sum Sq Mean Sq F value Pr(>F)   
## site 5 1653.6 330.7 146.6 <2e-16 \*\*\*  
## Residuals 360 812.4 2.3   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

TukeyHSD(anova\_SC) #posthoc analysis

## Tukey multiple comparisons of means  
## 95% family-wise confidence level  
##   
## Fit: aov(formula = value ~ site, data = data\_summer\_SC)  
##   
## $site  
## diff lwr upr p adj  
## Durazo-AP -4.0572131 -4.8365556 -3.2778706 0.0000000  
## LS-AP -1.4045902 -2.1839326 -0.6252477 0.0000059  
## May-AP -6.3854098 -7.1647523 -5.6060674 0.0000000  
## SC-AP -1.0391803 -1.8185228 -0.2598379 0.0021580  
## SP-AP -2.7762295 -3.5555720 -1.9968870 0.0000000  
## LS-Durazo 2.6526230 1.8732805 3.4319654 0.0000000  
## May-Durazo -2.3281967 -3.1075392 -1.5488543 0.0000000  
## SC-Durazo 3.0180328 2.2386903 3.7973753 0.0000000  
## SP-Durazo 1.2809836 0.5016411 2.0603261 0.0000520  
## May-LS -4.9808197 -5.7601621 -4.2014772 0.0000000  
## SC-LS 0.3654098 -0.4139326 1.1447523 0.7605330  
## SP-LS -1.3716393 -2.1509818 -0.5922969 0.0000108  
## SC-May 5.3462295 4.5668870 6.1255720 0.0000000  
## SP-May 3.6091803 2.8298379 4.3885228 0.0000000  
## SP-SC -1.7370492 -2.5163917 -0.9577067 0.0000000

report(anova\_SC)

## For one-way between subjects designs, partial eta squared is equivalent to eta squared.  
## Returning eta squared.

## The ANOVA (formula: value ~ site) suggests that:  
##   
## - The main effect of site is statistically significant and large (F(5, 360) =  
## 146.55, p < .001; Eta2 = 0.67, 95% CI [0.63, 1.00])  
##   
## Effect sizes were labelled following Field's (2013) recommendations.

###Horse Creek

#Boxplot  
b2 <- ggplot(subset(data\_summer, site %in% c("FG","UL","LL","GP","HC")))+  
 geom\_boxplot(aes(x = site, value, col = day))+  
 labs(title = "(b) Horse Creek, 15 July - 15 September")+  
 theme\_classic()+  
 theme(text=element\_text(size=16), axis.title.x=element\_blank())+  
 scale\_x\_discrete(name ="Site",   
 limits = c("FG","UL","LL","GP","HC"),  
 labels=c("FG" = "FishGulch","UL"= "UpperLaw","LL"=  
 "LowerLaw","GP" = "Goodman","HC"="HorseCreek"))+  
 scale\_y\_continuous(name="Daily Maximum Temp (C)",limits=c(12.5, 22.5))  
  
#ANOVA  
data\_summer\_HC <- subset(data\_summer, site %in% c("FG","UL","LL","GP","HC"))  
shapiro.test(data\_summer\_HC$value) #check for normality

##   
## Shapiro-Wilk normality test  
##   
## data: data\_summer\_HC$value  
## W = 0.96968, p-value = 5.183e-06

leveneTest(value ~ site, data = data\_summer\_HC) #check for equal variances

## Warning in leveneTest.default(y = y, group = group, ...): group coerced to  
## factor.

## Levene's Test for Homogeneity of Variance (center = median)  
## Df F value Pr(>F)   
## group 4 21.089 2.481e-15 \*\*\*  
## 299   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

anova\_HC <- aov(value ~ site, data = data\_summer\_HC) #run one way anova  
summary.aov(anova\_HC)

## Df Sum Sq Mean Sq F value Pr(>F)   
## site 4 834.0 208.51 300.9 <2e-16 \*\*\*  
## Residuals 299 207.2 0.69   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
## 1 observation deleted due to missingness

TukeyHSD(anova\_HC) #posthoc analysis

## Tukey multiple comparisons of means  
## 95% family-wise confidence level  
##   
## Fit: aov(formula = value ~ site, data = data\_summer\_HC)  
##   
## $site  
## diff lwr upr p adj  
## GP-FG -2.6355984 -3.0510175 -2.220179202 0.0000000  
## HC-FG 2.4490738 2.0336546 2.864492929 0.0000000  
## LL-FG -0.4217459 -0.8371651 -0.006326743 0.0446373  
## UL-FG 0.7445656 0.3291464 1.159984733 0.0000142  
## HC-GP 5.0846721 4.6709731 5.498371121 0.0000000  
## LL-GP 2.2138525 1.8001535 2.627551448 0.0000000  
## UL-GP 3.3801639 2.9664649 3.793862924 0.0000000  
## LL-HC -2.8708197 -3.2845187 -2.457120683 0.0000000  
## UL-HC -1.7045082 -2.1182072 -1.290809207 0.0000000  
## UL-LL 1.1663115 0.7526125 1.580010465 0.0000000

report(anova\_HC)

## For one-way between subjects designs, partial eta squared is equivalent to eta squared.  
## Returning eta squared.

## The ANOVA (formula: value ~ site) suggests that:  
##   
## - The main effect of site is statistically significant and large (F(4, 299) =  
## 300.88, p < .001; Eta2 = 0.80, 95% CI [0.77, 1.00])  
##   
## Effect sizes were labelled following Field's (2013) recommendations.

##Winter ###Data wrangling

#Read in data  
daily\_mins\_condensed <- readRDS('daily\_mins\_condensed.RDS')  
daily\_mins\_condensed <- as.data.frame(t(daily\_mins\_condensed))  
daily\_mins\_condensed <- daily\_mins\_condensed %>% mutate\_all(~ifelse(is.nan(.), NA, .))  
  
#Create "day" sequence   
day <- seq(mdy('7/1/2020'),mdy('7/13/2021'),by = "day")   
day <- as.data.frame(day) #convert "day" to data frame  
  
#Attach day to data frame  
daily\_mins\_condensed <- cbind(daily\_mins\_condensed,day)  
  
#Format data long  
daily\_min\_long <- gather(daily\_mins\_condensed, site, value, -day)  
data\_winter <- daily\_min\_long %>%filter(day>'2020-12-15'& day < '2021-02-15')

###Seiad Creek

#Boxplot  
b3 <- ggplot(subset(data\_winter, site %in% c("AP","SP","Durazo","LS","May","SC")))+  
 geom\_boxplot(aes(x = site, value, col = day))+  
 labs(title = "(c) Seiad Creek, 15 December - 15 February")+  
 theme\_classic()+  
 theme(text=element\_text(size=16))+  
 scale\_x\_discrete(name ="Site",   
 limits = c("AP","SP","Durazo","LS","May","SC"),  
 labels=c("AP" = "Alexander","SP"= "Stender","Durazo"=  
 "Durazo","LS" = "LowerSeiad","May"="May","SC" = "SeiadCreek"))+  
 scale\_y\_continuous(name="Daily Minimum Temp (C)",limits=c(4, 12))  
  
#ANOVA  
data\_winter\_SC <- subset(data\_winter, site %in% c("AP","SP","Durazo","LS","May","SC"))  
shapiro.test(data\_winter\_SC$value) #check for normality

##   
## Shapiro-Wilk normality test  
##   
## data: data\_winter\_SC$value  
## W = 0.97899, p-value = 3.577e-05

leveneTest(value ~ site, data = data\_winter\_SC) #check for equal variances

## Warning in leveneTest.default(y = y, group = group, ...): group coerced to  
## factor.

## Levene's Test for Homogeneity of Variance (center = median)  
## Df F value Pr(>F)   
## group 5 2.0719 0.06831 .  
## 360   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#variances not equal, need to transform  
data\_winter\_SC$trans <- log(data\_winter\_SC$value)  
leveneTest(trans ~ site, data = data\_winter\_SC)

## Warning in leveneTest.default(y = y, group = group, ...): group coerced to  
## factor.

## Levene's Test for Homogeneity of Variance (center = median)  
## Df F value Pr(>F)   
## group 5 6.4079 1.017e-05 \*\*\*  
## 360   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#variances equal with log transformation  
  
anova\_SC2 <- aov(trans ~ site, data = data\_winter\_SC) #run one way anova  
summary.aov(anova\_SC2)

## Df Sum Sq Mean Sq F value Pr(>F)   
## site 5 11.625 2.3250 131.1 <2e-16 \*\*\*  
## Residuals 360 6.383 0.0177   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

TukeyHSD(anova\_SC2) #posthoc analysis

## Tukey multiple comparisons of means  
## 95% family-wise confidence level  
##   
## Fit: aov(formula = trans ~ site, data = data\_winter\_SC)  
##   
## $site  
## diff lwr upr p adj  
## Durazo-AP 0.241037424 0.17195420 0.31012065 0.0000000  
## LS-AP -0.102090413 -0.17117364 -0.03300719 0.0004165  
## May-AP 0.373473971 0.30439074 0.44255720 0.0000000  
## SC-AP -0.110127715 -0.17921094 -0.04104449 0.0000988  
## SP-AP 0.022372196 -0.04671103 0.09145542 0.9391630  
## LS-Durazo -0.343127837 -0.41221106 -0.27404461 0.0000000  
## May-Durazo 0.132436547 0.06335332 0.20151977 0.0000011  
## SC-Durazo -0.351165138 -0.42024837 -0.28208191 0.0000000  
## SP-Durazo -0.218665228 -0.28774845 -0.14958200 0.0000000  
## May-LS 0.475564383 0.40648116 0.54464761 0.0000000  
## SC-LS -0.008037302 -0.07712053 0.06104593 0.9994529  
## SP-LS 0.124462609 0.05537938 0.19354584 0.0000060  
## SC-May -0.483601685 -0.55268491 -0.41451846 0.0000000  
## SP-May -0.351101775 -0.42018500 -0.28201855 0.0000000  
## SP-SC 0.132499910 0.06341668 0.20158314 0.0000011

report(anova\_SC2)

## For one-way between subjects designs, partial eta squared is equivalent to eta squared.  
## Returning eta squared.

## The ANOVA (formula: trans ~ site) suggests that:  
##   
## - The main effect of site is statistically significant and large (F(5, 360) =  
## 131.12, p < .001; Eta2 = 0.65, 95% CI [0.60, 1.00])  
##   
## Effect sizes were labelled following Field's (2013) recommendations.

###Horse Creek

#Boxplot  
b4 <- ggplot(subset(data\_winter, site %in% c("FG","UL","LL","GP","HC")))+  
 geom\_boxplot(aes(x = site, value, col = day))+  
 labs(title = "(d) Horse Creek, 15 December - 15 February")+  
 theme\_classic()+  
 theme(text=element\_text(size=16))+  
 scale\_x\_discrete(name ="Site",   
 limits = c("FG","UL","LL","GP","HC"),  
 labels=c("FG" = "FishGulch","UL"= "UpperLaw","LL"=  
 "LowerLaw","GP" = "Goodman","HC"="HorseCreek"))+  
 scale\_y\_continuous(name="Daily Minimum Temp (C)",limits=c(4, 12))  
  
#ANOVA  
data\_winter\_HC <- subset(data\_winter, site %in% c("FG","UL","LL","GP","HC"))  
shapiro.test(data\_winter\_HC$value) #check for normality

##   
## Shapiro-Wilk normality test  
##   
## data: data\_winter\_HC$value  
## W = 0.97587, p-value = 5.203e-05

leveneTest(value ~ site, data = data\_winter\_HC) #check for equal variances

## Warning in leveneTest.default(y = y, group = group, ...): group coerced to  
## factor.

## Levene's Test for Homogeneity of Variance (center = median)  
## Df F value Pr(>F)   
## group 4 6.604 4.179e-05 \*\*\*  
## 300   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

anova\_HC2 <- aov(value ~ site, data = data\_winter\_HC) #run one way anova  
summary.aov(anova\_HC2)

## Df Sum Sq Mean Sq F value Pr(>F)   
## site 4 461.0 115.24 170 <2e-16 \*\*\*  
## Residuals 300 203.4 0.68   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

TukeyHSD(anova\_HC2) #posthoc analysis

## Tukey multiple comparisons of means  
## 95% family-wise confidence level  
##   
## Fit: aov(formula = value ~ site, data = data\_winter\_HC)  
##   
## $site  
## diff lwr upr p adj  
## GP-FG 2.05360656 1.6444688 2.46274436 0.0000000  
## HC-FG -1.12196721 -1.5311050 -0.71282941 0.0000000  
## LL-FG 1.69054645 1.2814086 2.09968425 0.0000000  
## UL-FG 1.74040984 1.3312720 2.14954764 0.0000000  
## HC-GP -3.17557377 -3.5847116 -2.76643597 0.0000000  
## LL-GP -0.36306011 -0.7721979 0.04607769 0.1088229  
## UL-GP -0.31319672 -0.7223345 0.09594108 0.2223688  
## LL-HC 2.81251366 2.4033759 3.22165146 0.0000000  
## UL-HC 2.86237705 2.4532392 3.27151485 0.0000000  
## UL-LL 0.04986339 -0.3592744 0.45900119 0.9972919

report(anova\_HC2)

## For one-way between subjects designs, partial eta squared is equivalent to eta squared.  
## Returning eta squared.

## The ANOVA (formula: value ~ site) suggests that:  
##   
## - The main effect of site is statistically significant and large (F(4, 300) =  
## 170.01, p < .001; Eta2 = 0.69, 95% CI [0.65, 1.00])  
##   
## Effect sizes were labelled following Field's (2013) recommendations.

##Boxplot Figure

png("Fig\_Boxplots.png",width = 1000, height = 600)  
(b1 + b2) / (b3 + b4)

## Warning: Removed 12 rows containing non-finite values (stat\_boxplot).

## Warning: Removed 1 rows containing non-finite values (stat\_boxplot).

## Warning: Removed 2 rows containing non-finite values (stat\_boxplot).

## Warning: Removed 21 rows containing non-finite values (stat\_boxplot).

dev.off()

## png   
## 2

#Daily Buffering ##Data wrangling

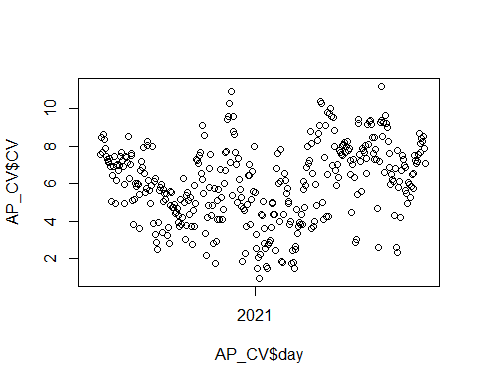
quarterHour\_condensed$day <- lubridate::floor\_date(quarterHour\_condensed$quarterHour, unit="day") #Bin by day  
  
#Create a function for coefficient of variance (CV)  
CV <- function(x){  
 (sd(x)/mean(x))\*100  
}

##Individual CVs

#Alexander Pond   
AP\_CV <- quarterHour\_condensed %>% #15 min data  
 group\_by(day) %>% #Group by day  
 dplyr::select(AP) %>% #Select site  
 summarize(CV = CV(AP)) #Calculate CV per day for one site

## Adding missing grouping variables: `day`

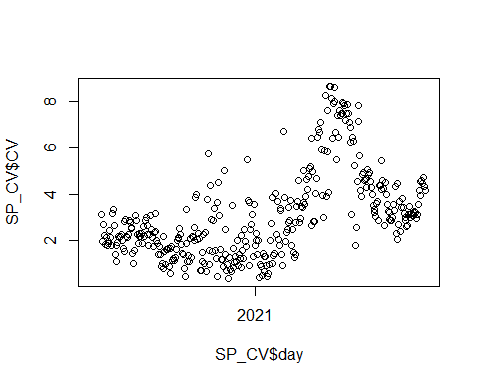
AP\_CV\_mean <- mean(AP\_CV$CV,na.rm=T) #Take all days as mean over entire year  
plot(AP\_CV$day,AP\_CV$CV) #Plot a time series of CV



#Stender Pond  
SP\_CV <- quarterHour\_condensed %>%   
 group\_by(day) %>%   
 dplyr::select(SP) %>%  
 summarize(CV = CV(SP))

## Adding missing grouping variables: `day`

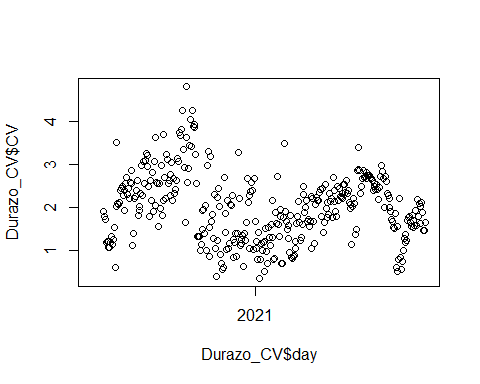
SP\_CV\_mean <- mean(SP\_CV$CV,na.rm=T)  
plot(SP\_CV$day,SP\_CV$CV)



#Durazo Pond  
Durazo\_CV <- quarterHour\_condensed %>%   
 group\_by(day) %>%   
 dplyr::select(Durazo) %>%  
 summarize(CV = CV(Durazo))

## Adding missing grouping variables: `day`

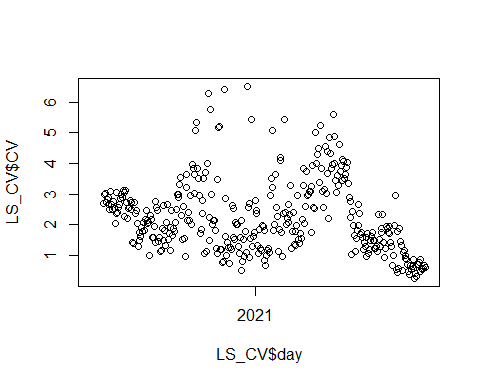
Durazo\_CV\_mean <- mean(Durazo\_CV$CV,na.rm=T)  
plot(Durazo\_CV$day,Durazo\_CV$CV)



#Lower Seiad   
LS\_CV <- quarterHour\_condensed %>%   
 group\_by(day) %>%   
 dplyr::select(LS) %>%  
 summarize(CV = CV(LS))

## Adding missing grouping variables: `day`

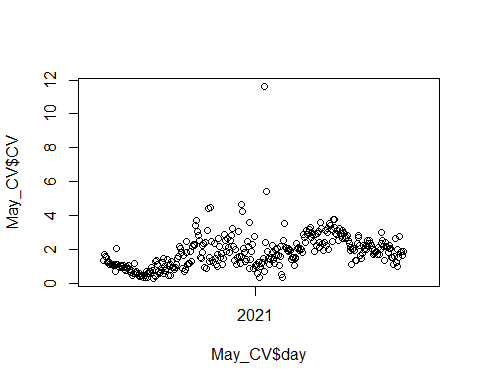
LS\_CV\_mean <- mean(LS\_CV$CV,na.rm=T)  
plot(LS\_CV$day,LS\_CV$CV)



#May Pond  
May\_CV <- quarterHour\_condensed %>%   
 group\_by(day) %>%   
 dplyr::select(May) %>%  
 summarize(CV = CV(May))

## Adding missing grouping variables: `day`

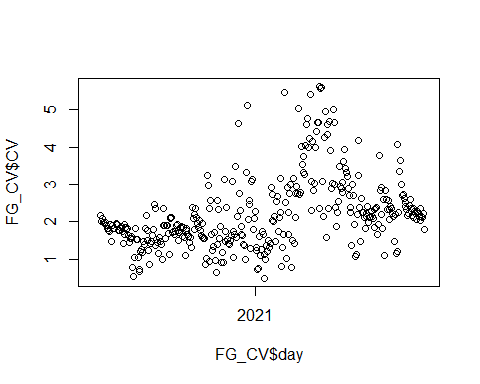
May\_CV\_mean <- mean(May\_CV$CV,na.rm=T)  
plot(May\_CV$day,May\_CV$CV)



#Fish Gulch  
FG\_CV <- quarterHour\_condensed %>%   
 group\_by(day) %>%   
 dplyr::select(FG) %>%  
 summarize(CV = CV(FG))

## Adding missing grouping variables: `day`

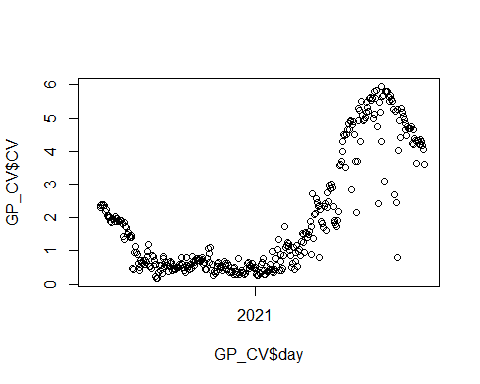
FG\_CV\_mean <- mean(FG\_CV$CV,na.rm=T)  
plot(FG\_CV$day,FG\_CV$CV)



#Goodman Pond  
GP\_CV <- quarterHour\_condensed %>%   
 group\_by(day) %>%   
 dplyr::select(GP) %>%  
 summarize(CV = CV(GP))

## Adding missing grouping variables: `day`

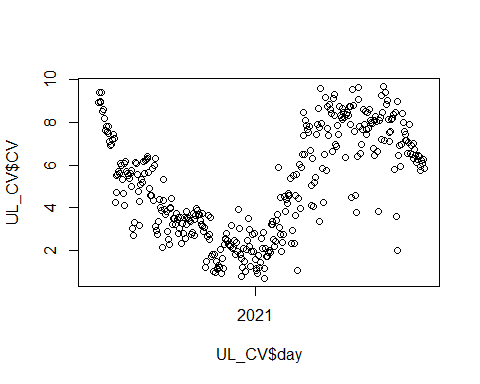
GP\_CV\_mean <- mean(GP\_CV$CV,na.rm=T)  
plot(GP\_CV$day,GP\_CV$CV)



#Upper Lawrence  
UL\_CV <- quarterHour\_condensed %>%   
 group\_by(day) %>%   
 dplyr::select(UL) %>%  
 summarize(CV = CV(UL))

## Adding missing grouping variables: `day`

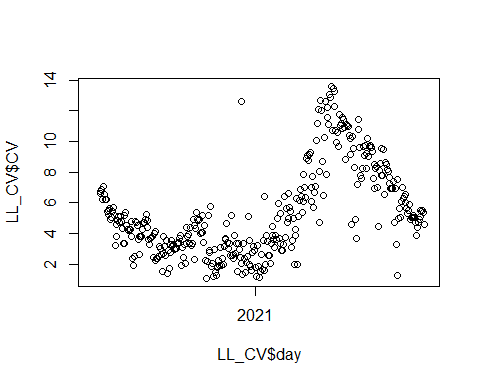
UL\_CV\_mean <- mean(UL\_CV$CV,na.rm=T)  
plot(UL\_CV$day,UL\_CV$CV)



#Lower Lawrence  
LL\_CV <- quarterHour\_condensed %>%   
 group\_by(day) %>%   
 dplyr::select(LL) %>%  
 summarize(CV = CV(LL))

## Adding missing grouping variables: `day`

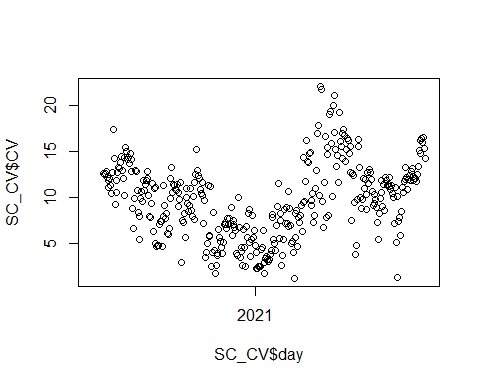
LL\_CV\_mean <- mean(LL\_CV$CV,na.rm=T)  
plot(LL\_CV$day,LL\_CV$CV)



#Seiad Creek  
SC\_CV <- quarterHour\_condensed %>%   
 group\_by(day) %>%   
 dplyr::select(SC) %>%  
 summarize(CV = CV(SC))

## Adding missing grouping variables: `day`

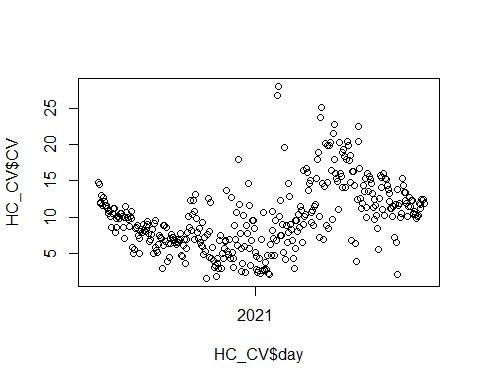
SC\_CV\_mean <- mean(SC\_CV$CV,na.rm=T)  
plot(SC\_CV$day,SC\_CV$CV)



#Horse Creek  
HC\_CV <- quarterHour\_condensed %>%   
 group\_by(day) %>%   
 dplyr::select(HC) %>%  
 summarize(CV = CV(HC))

## Adding missing grouping variables: `day`

HC\_CV\_mean <- mean(HC\_CV$CV,na.rm=T)  
plot(HC\_CV$day,HC\_CV$CV)



##CV Ratios

#CV Ratios are Creeks/Ponds  
#No Buffering = <1  
#Buffering = >1  
  
#Alexander Pond   
SC\_AP <- SC\_CV\_mean/AP\_CV\_mean  
  
#Stender Pond  
SC\_SP <- SC\_CV\_mean/SP\_CV\_mean  
  
#Durazo Pond  
SC\_Durazo <- SC\_CV\_mean/Durazo\_CV\_mean  
  
#Lower Seiad   
SC\_LS <- SC\_CV\_mean/LS\_CV\_mean  
  
#May Pond  
SC\_May <- SC\_CV\_mean/May\_CV\_mean  
  
#Fish Gulch  
HC\_FG <- HC\_CV\_mean/FG\_CV\_mean  
  
#Goodman Pond  
HC\_GP <- HC\_CV\_mean/GP\_CV\_mean  
  
#Upper Lawrence  
HC\_UL <- HC\_CV\_mean/UL\_CV\_mean  
  
#Lower Lawrence  
HC\_LL <- HC\_CV\_mean/LL\_CV\_mean

##CV Data Table

data.frame(Creek=c("Seiad Creek","Seiad Creek","Seiad Creek","Seiad Creek","Seiad Creek","Horse Creek","Horse Creek","Horse Creek","Horse Creek"),  
 CreekCV=round(c(SC\_CV\_mean,SC\_CV\_mean,SC\_CV\_mean,SC\_CV\_mean,SC\_CV\_mean,HC\_CV\_mean,HC\_CV\_mean,HC\_CV\_mean,HC\_CV\_mean),2),  
 Pond=c("Alexander","Stender","Durazo","Lower Seiad","May","Fish Gulch","Goodman","Upper Lawrence","Lower Lawrence"),  
 PondCV=round(c(AP\_CV\_mean,SP\_CV\_mean,Durazo\_CV\_mean,LS\_CV\_mean,May\_CV\_mean,FG\_CV\_mean,GP\_CV\_mean,UL\_CV\_mean,LL\_CV\_mean),2),  
 CV\_Ratio=(round(c(SC\_AP,   
 SC\_SP,  
 SC\_Durazo,  
 SC\_LS,  
 SC\_May,  
 HC\_FG,  
 HC\_GP,  
 HC\_UL,  
 HC\_LL),2)))

## Creek CreekCV Pond PondCV CV\_Ratio  
## 1 Seiad Creek 9.68 Alexander 6.02 1.61  
## 2 Seiad Creek 9.68 Stender 3.08 3.14  
## 3 Seiad Creek 9.68 Durazo 2.02 4.80  
## 4 Seiad Creek 9.68 Lower Seiad 2.25 4.31  
## 5 Seiad Creek 9.68 May 1.83 5.30  
## 6 Horse Creek 9.94 Fish Gulch 2.21 4.49  
## 7 Horse Creek 9.94 Goodman 1.97 5.06  
## 8 Horse Creek 9.94 Upper Lawrence 5.09 1.95  
## 9 Horse Creek 9.94 Lower Lawrence 5.35 1.86

#Figure 3: Time Series Examples Figure

daily\_means\_condensed <- readRDS('daily\_means\_condensed.RDS')  
daily\_means\_condensed <- as.data.frame(t(daily\_means\_condensed))  
daily\_means\_condensed <- daily\_means\_condensed %>% mutate\_all(~ifelse(is.nan(.), NA, .))  
day <- seq(mdy('7/1/2020'),mdy('7/13/2021'),by = "day")   
day <- as.data.frame(day) #convert "day" to data frame  
  
#Attach day to data frame  
daily\_means\_condensed <- cbind(daily\_means\_condensed,day)  
daily\_means\_condensed$day <- as.POSIXct(daily\_means\_condensed$day)  
  
mycolors <- met.brewer(name="Archambault",n=4,type="discrete")  
  
p1 <- ggplot()+  
 geom\_line(data = quarterHour\_condensed, aes(x = quarterHour, y = AP), color ="#D3D3D3", size = 1) +  
 geom\_line(data = daily\_means\_condensed, aes(x = day, y = AP), color ="#88a0dc", size = 1) +  
 labs(title = "(a) Alexander Pond", x = "Date", y = "Temperature (C)")+  
 scale\_y\_continuous(name="Daily Mean Temp (C)",limits=c(0, 25))+  
 theme\_classic()+  
 theme(text=element\_text(size=16),legend.position = "none",axis.title.x=element\_blank())  
p2 <- ggplot()+  
 geom\_line(data = quarterHour\_condensed, aes(x = quarterHour, y = UL), color ="#D3D3D3", size = 1) +  
 geom\_line(data = daily\_means\_condensed, aes(x = day, y = UL), color = "#ed968c", size = 1) +  
 labs(title = "(c) Upper Lawrence Pond", x = "Date", y = "Temperature (C)")+  
 scale\_y\_continuous(name="Daily Mean Temp (C)",limits=c(0, 25))+  
 theme\_classic()+  
 theme(text=element\_text(size=16),legend.position = "none")  
p3 <- ggplot()+  
 geom\_line(data = quarterHour\_condensed, aes(x = quarterHour, y = SC), color ="#D3D3D3", size = 1) +  
 geom\_line(data = daily\_means\_condensed, aes(x = day, y = SC), color = "#e78429", size = 1) +  
 labs(title = "(b) Seiad Creek", x = "Date", y = "Temperature (C)")+  
 scale\_y\_continuous(name="Daily Mean Temp (C)",limits=c(0, 25))+  
 theme\_classic()+  
 theme(text=element\_text(size=16),legend.position = "none", axis.title.x=element\_blank())  
p4 <- ggplot()+  
 geom\_line(data = quarterHour\_condensed, aes(x = quarterHour, y = HC), color ="#D3D3D3", size = 1) +  
 geom\_line(data = daily\_means\_condensed, aes(x = day, y = HC), color = "#f9d14a", size = 1) +  
 labs(title = "(d) Horse Creek", x = "Date", y = "Temperature (C)")+  
 scale\_y\_continuous(name="Daily Mean Temp (C)",limits=c(0, 25))+  
 theme\_classic()+  
 theme(text=element\_text(size=16),legend.position = "none")  
  
png("Fig\_TempTimeSeries.png",width = 1000, height = 600)  
(p1 + p3) / (p2 + p4)

## Warning: Removed 931 row(s) containing missing values (geom\_path).

## Warning: Removed 10 row(s) containing missing values (geom\_path).

## Warning: Removed 1202 row(s) containing missing values (geom\_path).

## Warning: Removed 13 row(s) containing missing values (geom\_path).

## Warning: Removed 694 row(s) containing missing values (geom\_path).

## Warning: Removed 9 row(s) containing missing values (geom\_path).

## Warning: Removed 688 row(s) containing missing values (geom\_path).

## Warning: Removed 9 row(s) containing missing values (geom\_path).

dev.off()

## png   
## 2

#May Pond Example

May <- readRDS("May.rds")  
MayCk <- readRDS("MayCk.rds")  
  
May\_August <-May %>%filter(day>'2020-08-01'& day < '2020-08-31')  
May\_August <- May\_August[,c("Temp","date")]   
MayCk\_August <-MayCk %>%filter(day>'2020-08-01'& day < '2020-08-31')  
MayCk\_August <- MayCk\_August[,c("Temp","date")]   
  
png("Fig\_MayPond.png", width = 700, height = 400)  
ggplot()+  
 geom\_line(data = May\_August, aes(x = date, y = Temp, color = "May Pond"))+  
 geom\_line(data = MayCk\_August, aes(x = date, y = Temp, color = "Seiad Creek"))+  
 labs(x = "Date",  
 y = "Hourly Temperature (C)",  
 title = "May Pond and Seiad Creek, August 2020")+  
 theme\_classic()+  
 theme(text=element\_text(size=16), legend.position = "bottom")+  
 scale\_colour\_manual("", values = c("May Pond"="#88a0dc", "Seiad Creek"="#ed968c")) +  
 scale\_y\_continuous("Hourly Temperature (C)")   
dev.off()

## png   
## 2