

Athens Dengue Data

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This document contains the code for the analysis of microclimate data in ‘Carry-over effects of larval microclimate on the transmission potential of a mosquito-borne pathogen’ (Evans et al. 2017).

Paper Citation:

Evans MV, Shiau JC, Solano N, Brindley MA, Drake JM, Murdock, CC. 2017. Carry-over effects of larval microclimate on the transmission potential of a mosquito-borne pathogen.

Load Data

This data was cleaned in the RMarkdown file “EvansCode.Rmd”

```
climate <- read.csv(file='.././data/microclimate/clean/2016TrialsAdultCleaned.csv', stringsAsFactors = FALSE)

climate$Day <- as.Date(climate$Day, format="%Y-%m-%d")
climate$Site_ID <- as.factor(climate$Site_ID)
climate$Tray_ID <- as.factor(climate$Tray_ID)
climate$Class <- as.factor(climate$Class)

#drop R3T4 because it has wierd errors
climate <- filter(climate, Tray_ID!="R3T4")
```

Get mean, min, max

```
clim <- climate %>%
  dplyr::group_by(Tray_ID, Day, Site_ID, Class) %>%
  dplyr::summarise(meanT=mean(Temp), minT=min(Temp), maxT=max(Temp), meanRH=mean(RH), maxRH=max(RH), minRH=min(RH)) %>%
  ungroup() %>%
  group_by(Class, Day) %>% #get mean values per class
  dplyr::summarise(meanT=mean(meanT), minT=mean(minT), maxT=mean(maxT), meanRH=mean(meanRH), maxRH=mean(maxRH), minRH=min(minRH)) %>%
  ungroup()
```

Plots

Temperature Plot:

```
#pdf(file="../figures/forMS/temperature.pdf", width = 6, height=4, family="sans")

ggplot(data=clim, aes(x=Day, group=Class))+
  geom_line(aes(y=meanT, col=Class)) +
  geom_line(aes(y=minT, col=Class), linetype="dotted") +
  geom_line(aes(y=maxT, col=Class), linetype="dotted") +
  theme_fivethirtyeight() +
  scale_color_manual(values=c("dodgerblue", "gray20", "maroon")) +
  theme(axis.title = element_text(), axis.title.x = element_blank()) +
  ylab("Temperature (C)") +
  annotate("rect", xmin=as.Date("2016-08-01", format="%Y-%m-%d"), xmax=as.Date("2016-09-01", format="%Y-%m-%d"), ymin=15, ymax=25) +
  annotate("rect", xmin=as.Date("2016-09-26", format="%Y-%m-%d"), xmax=as.Date("2016-11-07", format="%Y-%m-%d"), ymin=15, ymax=25)
```

```

theme(panel.background = element_rect(fill = "transparent", colour = NA),
      plot.background = element_rect(fill = "transparent", colour = NA),
      legend.key = element_blank(),
      axis.line=element_line(color=ggthemes_data$fivethirtyeight["dkgray"], size=0.5),
      panel.grid = element_blank())+
theme(legend.background = element_rect(fill = "transparent", colour = NA))
#dev.off()

```

Relative Humidity

```
#pdf(file="../figures/forMS/supplement/relativeHumidity.pdf", width = 6, height=4, family="sans")
```

```

ggplot(data=clim, aes(x=Day, group=Class))+
  geom_line(aes(y=meanRH, col=Class)) +
  geom_line(aes(y=minRH, col=Class), linetype="dotted") +
  geom_line(aes(y=maxRH, col=Class), linetype="dotted") +
  theme_fivethirtyeight() +
  scale_color_manual(values=c("dodgerblue", "gray20", "maroon")) +
  theme(axis.title = element_text(), axis.title.x = element_blank()) +
  ylab("Relative Humidity (%)") +
  annotate("rect", xmin=as.Date("2016-08-01", format="%Y-%m-%d"), xmax=as.Date("2016-09-01", format="%Y-%m-%d"),
    ymin=0, ymax=100) +
  annotate("rect", xmin=as.Date("2016-09-26", format="%Y-%m-%d"), xmax=as.Date("2016-11-07", format="%Y-%m-%d"),
    ymin=0, ymax=100) +
  theme(panel.background = element_rect(fill = "transparent", colour = NA),
        plot.background = element_rect(fill = "transparent", colour = NA),
        legend.key = element_blank())+
  theme(legend.background = element_rect(fill = "transparent", colour = NA))
#dev.off()

```

Stats

By tray:

```

fall <- climate %>%
  filter(Day>"2016-09-26") %>%
  mutate(Block="Fall")

summer <- climate %>%
  filter(Day < "2016-09-01") %>%
  mutate(Block="Summer")

climBlocks <- rbind(summer, fall)
rm(summer,fall)

climTray <- climBlocks %>%
  group_by(Block, Tray_ID, Day, Site_ID, Class) %>%
  dplyr::summarise(meanT=mean(Temp), minT=min(Temp), maxT=max(Temp), meanRH=mean(RH), maxRH=max(RH), minRH=min(RH))

climTray$classxBLOCK <- interaction(climTray$Class, climTray$Block)

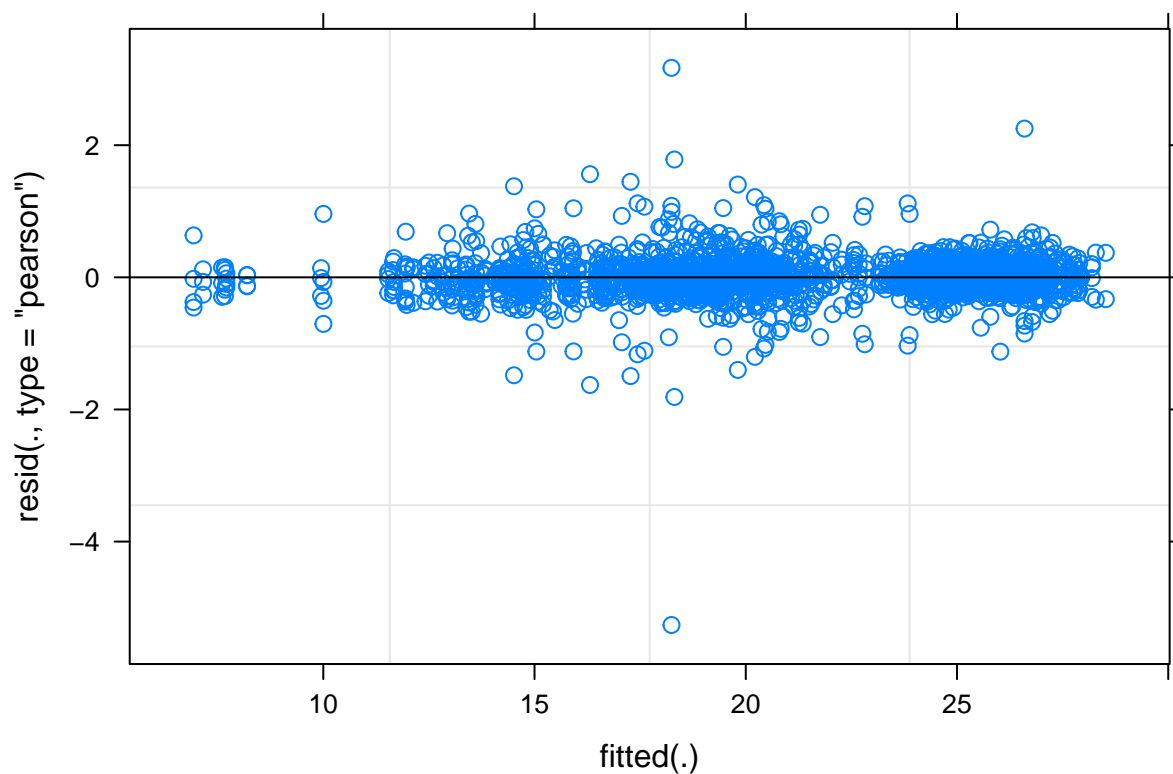
```

Temperature:

```

##----- Mean T
climModMean <- lmer(meanT~Class*Block + (1|Site_ID/Day), data=climTray)
plot(climModMean)

```



```
summary(climModMean)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: meanT ~ Class * Block + (1 | Site_ID/Day)
## Data: climTray
##
## REML criterion at convergence: 5262.8
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -14.5978  -0.3754  -0.0243   0.3471   8.7951
##
## Random effects:
## Groups      Name      Variance Std.Dev.
## Day:Site_ID (Intercept) 6.41441  2.5327
## Site_ID      (Intercept) 0.09433  0.3071
## Residual                    0.12998  0.3605
## Number of obs: 2347, groups: Day:Site_ID, 657; Site_ID, 9
##
## Fixed effects:
##              Estimate Std. Error t value
## (Intercept)    17.6920    0.2875  61.54
## ClassSuburban     0.4220    0.4065   1.04
## ClassUrban        1.6823    0.4066   4.14
## BlockSummer       7.7407    0.3472  22.29
## ClassSuburban:BlockSummer -0.4855    0.4910  -0.99
## ClassUrban:BlockSummer  -0.8797    0.4912  -1.79
##
```

```
## Correlation of Fixed Effects:
##          (Intr) ClssSb ClssUr BlckSm ClS:BS
## ClassSubrbrn -0.707
## ClassUrban   -0.707  0.500
## BlockSummer  -0.513  0.363  0.363
## ClssSbrb:BS   0.363 -0.513 -0.256 -0.707
## ClssUrbn:BS   0.363 -0.256 -0.513 -0.707  0.500

confint(climModMean)

##                2.5 %      97.5 %
## .sig01          2.3943928  2.67166520
## .sig02          0.0000000  0.52416447
## .sigma          0.3487024  0.37302719
## (Intercept)     17.1765902 18.20746062
## ClassSuburban   -0.3068903  1.15084617
## ClassUrban       0.9531466  2.41141753
## BlockSummer      7.0607762  8.42067552
## ClassSuburban:BlockSummer -1.4469675  0.47595211
## ClassUrban:BlockSummer   -1.8416811  0.08225865

car::Anova(climModMean)

## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: meanT
##              Chisq Df Pr(>Chisq)
## Class         16.1611  2  0.0003095 ***
## Block        1320.5517  1 < 2.2e-16 ***
## Class:Block     3.2186  2  0.2000309
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

#pairwise stats
summary(glht(climModMean, linfct = mcp(Class = "Tukey"), test = adjusted("holm"))))

##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
## Fit: lmer(formula = meanT ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Suburban - Rural == 0    0.4220    0.4065  1.038  0.55277
## Urban - Rural == 0      1.6823    0.4066  4.137 < 0.001 ***
## Urban - Suburban == 0   1.2603    0.4066  3.100  0.00543 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)

summary(glht(climModMean, linfct = mcp(Block = "Tukey"), test = adjusted("holm"))))

##
## Simultaneous Tests for General Linear Hypotheses
```

```
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = meanT ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Summer - Fall == 0    7.7407      0.3472   22.29  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)

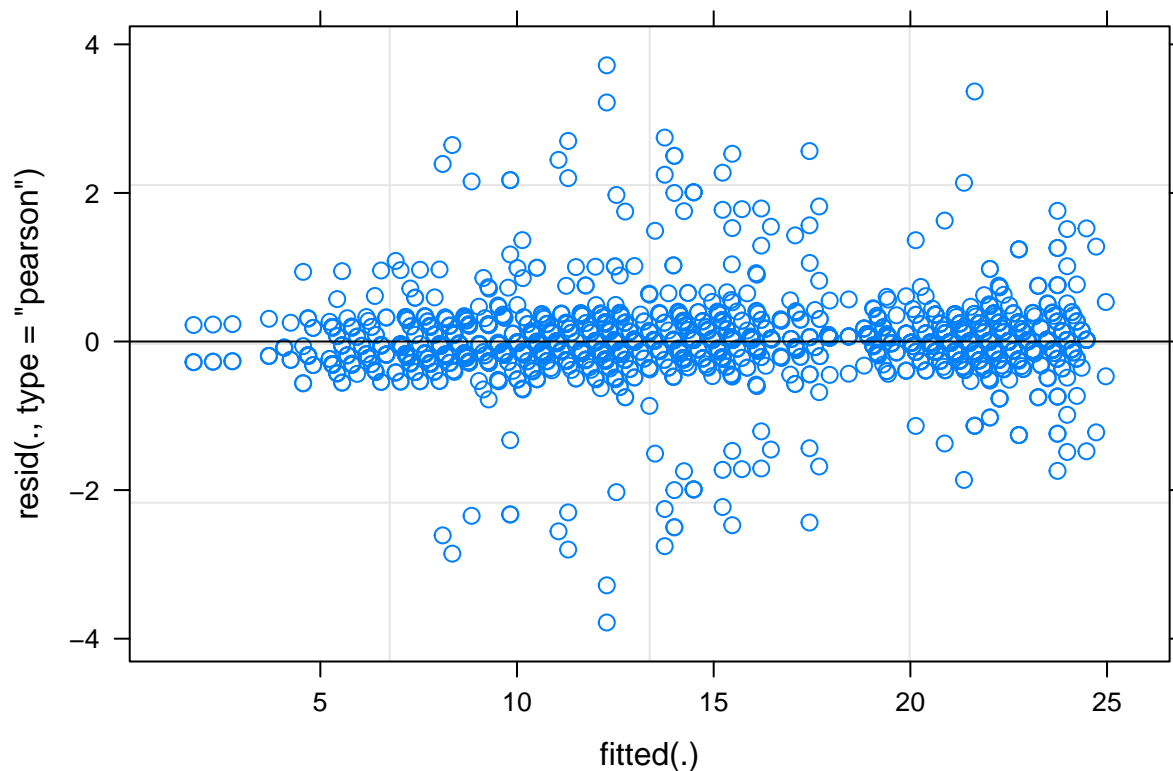
#pairwise stats-interaction
intMod <- lmer(meanT~classxBLOCK+ (1|Site_ID/Day), data=climTray)
summary(glht(intMod, linfct = mcp(classxBLOCK = "Tukey"), test = adjusted("holm")))
```

```
##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = meanT ~ classxBLOCK + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Suburban.Fall - Rural.Fall == 0    0.42199    0.40650    1.038  0.9015
## Urban.Fall - Rural.Fall == 0      1.68232    0.40664    4.137  <0.001
## Rural.Summer - Rural.Fall == 0     7.74073    0.34721   22.294  <0.001
## Suburban.Summer - Rural.Fall == 0   7.67720    0.42825   17.927  <0.001
## Urban.Summer - Rural.Fall == 0     8.54338    0.42842   19.942  <0.001
## Urban.Fall - Suburban.Fall == 0    1.26034    0.40661    3.100  0.0229
## Rural.Summer - Suburban.Fall == 0   7.31874    0.42827   17.089  <0.001
## Suburban.Summer - Suburban.Fall == 0 7.25522    0.34711   20.902  <0.001
## Urban.Summer - Suburban.Fall == 0   8.12140    0.42839   18.958  <0.001
## Rural.Summer - Urban.Fall == 0     6.05840    0.42840   14.142  <0.001
## Suburban.Summer - Urban.Fall == 0   5.99488    0.42835   13.995  <0.001
## Urban.Summer - Urban.Fall == 0     6.86106    0.34748   19.745  <0.001
## Suburban.Summer - Rural.Summer == 0 -0.06352    0.44896   -0.141  1.0000
## Urban.Summer - Rural.Summer == 0    0.80266    0.44912    1.787  0.4652
## Urban.Summer - Suburban.Summer == 0 0.86618    0.44908    1.929  0.3761
##
## Suburban.Fall - Rural.Fall == 0
## Urban.Fall - Rural.Fall == 0      ***
## Rural.Summer - Rural.Fall == 0    ***
## Suburban.Summer - Rural.Fall == 0  ***
## Urban.Summer - Rural.Fall == 0    ***
## Urban.Fall - Suburban.Fall == 0   *
## Rural.Summer - Suburban.Fall == 0  ***
## Suburban.Summer - Suburban.Fall == 0 ***
## Urban.Summer - Suburban.Fall == 0  ***
## Rural.Summer - Urban.Fall == 0    ***
## Suburban.Summer - Urban.Fall == 0  ***
## Urban.Summer - Urban.Fall == 0    ***
```

```
## Suburban.Summer - Rural.Summer == 0
## Urban.Summer - Rural.Summer == 0
## Urban.Summer - Suburban.Summer == 0
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)
anova(climModMean, intMod)

## Data: climTray
## Models:
## climModMean: meanT ~ Class * Block + (1 | Site_ID/Day)
## intMod: meanT ~ classxBlock + (1 | Site_ID/Day)
##           Df      AIC      BIC logLik deviance Chisq Chi Df Pr(>Chisq)
## climModMean  9 5276.4 5328.3 -2629.2  5258.4
## intMod       9 5276.4 5328.3 -2629.2  5258.4    0    0 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##----- Min T

climModMin <- lmer(minT~Class*Block + (1|Site_ID/Day), data=climTray)
plot(climModMin)
```



```
summary(climModMin)

## Linear mixed model fit by REML ['lmerMod']
## Formula: minT ~ Class * Block + (1 | Site_ID/Day)
## Data: climTray
##
## REML criterion at convergence: 6982.5
```

```
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -6.6857 -0.2415 -0.0001  0.1791  6.5718
##
## Random effects:
##      Groups      Name      Variance Std.Dev.
## Day:Site_ID (Intercept) 8.6046   2.9334
## Site_ID      (Intercept) 0.2506   0.5006
## Residual                0.3200   0.5657
## Number of obs: 2347, groups: Day:Site_ID, 657; Site_ID, 9
##
## Fixed effects:
##
##              Estimate Std. Error t value
## (Intercept)      11.0312     0.3906  28.244
## ClassSuburban      1.1999     0.5523   2.173
## ClassUrban         2.3612     0.5525   4.273
## BlockSummer       10.6943     0.4031  26.531
## ClassSuburban:BlockSummer -0.9281     0.5699  -1.629
## ClassUrban:BlockSummer  -1.4468     0.5704  -2.536
##
## Correlation of Fixed Effects:
##              (Intr) ClssSb ClssUr BlckSm Cls:BS
## ClassSubrbn -0.707
## ClassUrban  -0.707  0.500
## BlockSummer -0.438  0.310  0.310
## ClssSbrb:BS  0.310 -0.438 -0.219 -0.707
## ClssUrnb:BS  0.310 -0.219 -0.438 -0.707  0.500
```

```
confint(climModMin)
```

```
##              2.5 %      97.5 %
## .sig01        2.7723987  3.0951150
## .sig02        0.0000000  0.7844743
## .sigma        0.5471672  0.5853356
## (Intercept)   10.3326685 11.7298312
## ClassSuburban  0.2120769  2.1877250
## ClassUrban     1.3728696  3.3494647
## BlockSummer    9.9048933 11.4836185
## ClassSuburban:BlockSummer -2.0441377  0.1879479
## ClassUrban:BlockSummer  -2.5640654 -0.3298198
```

```
AIC(climModMin)
```

```
## [1] 7000.503
```

```
car::Anova(climModMin)
```

```
## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: minT
##              Chisq Df Pr(>Chisq)
## Class         12.3974  2  0.002032 **
## Block        1809.7702  1 < 2.2e-16 ***
## Class:Block     6.6062  2  0.036769 *
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

#pairwise stats
summary(glht(climModMin, linfct = mcp(Class = "Tukey"), test = adjusted("holm"))))

##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = minT ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Suburban - Rural == 0    1.1999     0.5523   2.173   0.0758 .
## Urban - Rural == 0      2.3612     0.5525   4.273  <1e-04 ***
## Urban - Suburban == 0    1.1613     0.5525   2.102   0.0894 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)

summary(glht(climModMin, linfct = mcp(Block = "Tukey"), test = adjusted("holm"))))

##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = minT ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Summer - Fall == 0  10.6943     0.4031  26.53  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)

#pairwise stats-interaction
intMod <- lmer(minT~classxBLOCK+ (1|Day) + (1|Site_ID), data=climTray)
summary(glht(intMod, linfct = mcp(classxBLOCK = "Tukey"), test = adjusted("holm"))))

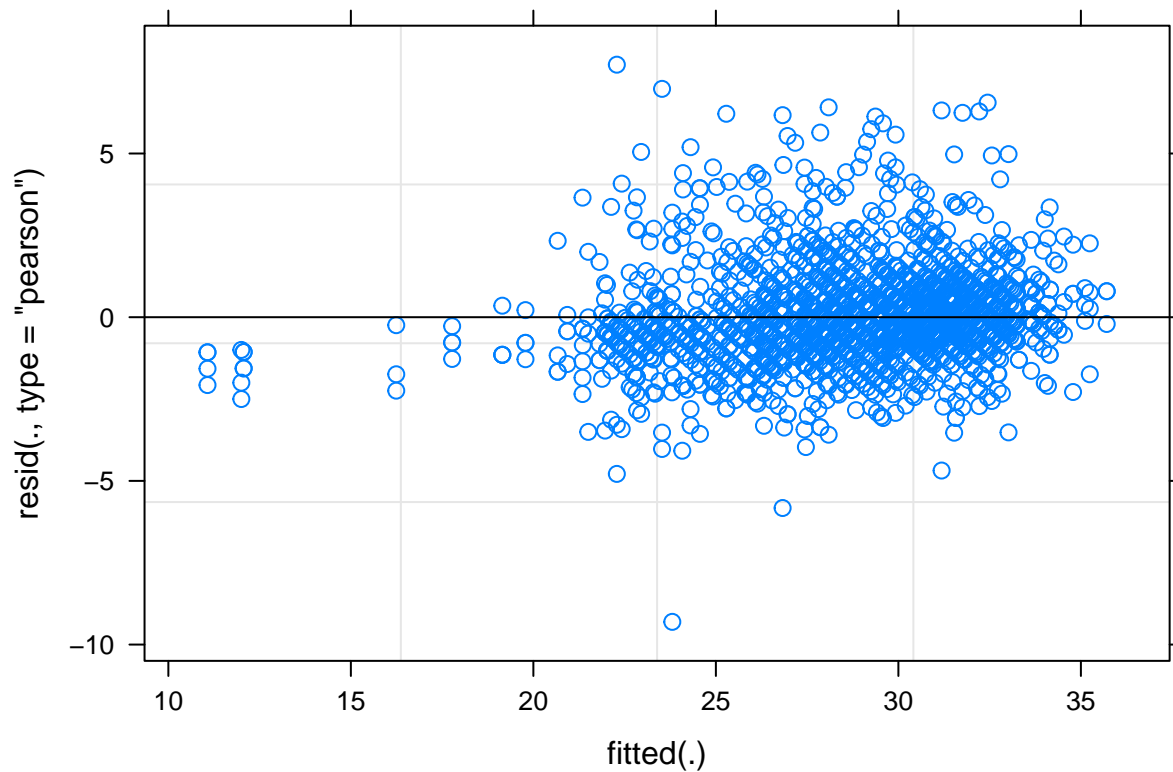
##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = minT ~ classxBLOCK + (1 | Day) + (1 | Site_ID),
##           data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Suburban.Fall - Rural.Fall == 0    1.1700     0.4893   2.391   0.096
## Urban.Fall - Rural.Fall == 0      2.3074     0.4897   4.712  <0.01
```



```

## Rural.Summer - Rural.Fall == 0      10.6241    0.6936   15.317   <0.01
## Suburban.Summer - Rural.Fall == 0    10.9362    0.8474   12.905   <0.01
## Urban.Summer - Rural.Fall == 0       11.6439    0.8477   13.736   <0.01
## Urban.Fall - Suburban.Fall == 0       1.1374    0.4896    2.323   0.114
## Rural.Summer - Suburban.Fall == 0      9.4541    0.8475   11.156   <0.01
## Suburban.Summer - Suburban.Fall == 0   9.7662    0.6934   14.084   <0.01
## Urban.Summer - Suburban.Fall == 0     10.4739    0.8477   12.356   <0.01
## Rural.Summer - Urban.Fall == 0         8.3167    0.8477    9.811   <0.01
## Suburban.Summer - Urban.Fall == 0      8.6288    0.8476   10.180   <0.01
## Urban.Summer - Urban.Fall == 0         9.3365    0.6940   13.453   <0.01
## Suburban.Summer - Rural.Summer == 0    0.3121    0.4901    0.637   0.938
## Urban.Summer - Rural.Summer == 0       1.0198    0.4906    2.079   0.191
## Urban.Summer - Suburban.Summer == 0    0.7078    0.4904    1.443   0.517
##
## Suburban.Fall - Rural.Fall == 0      .
## Urban.Fall - Rural.Fall == 0         ***
## Rural.Summer - Rural.Fall == 0         ***
## Suburban.Summer - Rural.Fall == 0      ***
## Urban.Summer - Rural.Fall == 0         ***
## Urban.Fall - Suburban.Fall == 0
## Rural.Summer - Suburban.Fall == 0      ***
## Suburban.Summer - Suburban.Fall == 0 ***
## Urban.Summer - Suburban.Fall == 0      ***
## Rural.Summer - Urban.Fall == 0         ***
## Suburban.Summer - Urban.Fall == 0      ***
## Urban.Summer - Urban.Fall == 0         ***
## Suburban.Summer - Rural.Summer == 0
## Urban.Summer - Rural.Summer == 0
## Urban.Summer - Suburban.Summer == 0
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)
##----- Max T
climModMax <- lmer(maxT~Class*Block + (1|Site_ID/Day), data=climTray)
plot(climModMax)

```



```
summary(climModMax)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: maxT ~ Class * Block + (1 | Site_ID/Day)
## Data: climTray
##
## REML criterion at convergence: 10495.2
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -5.7318 -0.4378 -0.1056  0.3470  4.7507
##
## Random effects:
##  Groups      Name      Variance Std.Dev.
## Day:Site_ID (Intercept) 7.2814   2.6984
## Site_ID      (Intercept) 0.1837   0.4286
## Residual                2.6362   1.6236
## Number of obs: 2347, groups: Day:Site_ID, 657; Site_ID, 9
##
## Fixed effects:
##              Estimate Std. Error t value
## (Intercept)    27.5646    0.3533   78.02
## ClassSuburban   -0.9842    0.4991   -1.97
## ClassUrban      -0.6990    0.5013   -1.39
## BlockSummer      3.9665    0.3870   10.25
## ClassSuburban:BlockSummer 0.3134    0.5460    0.57
## ClassUrban:BlockSummer  0.5852    0.5506    1.06
##
## Correlation of Fixed Effects:
```

```

##          (Intr) ClssSb ClssUr BlckSm ClS:BS
## ClassSubrbrn -0.708
## ClassUrban   -0.705  0.499
## BlockSummer  -0.465  0.329  0.328
## ClssSbrb:BS   0.330 -0.465 -0.232 -0.709
## ClssUrnb:BS   0.327 -0.231 -0.467 -0.703  0.498

confint(climModMax)

##                2.5 %      97.5 %
## .sig01          2.5357108  2.86094201
## .sig02          0.0000000  0.68836021
## .sigma          1.5703972  1.67991820
## (Intercept)     26.9317235  28.19712026
## ClassSuburban   -1.8777534 -0.09037949
## ClassUrban      -1.5967768  0.19911377
## BlockSummer      3.2086644  4.72427898
## ClassSuburban:BlockSummer -0.7559113  1.38268383
## ClassUrban:BlockSummer   -0.4918000  1.66475893

car::Anova(climModMax)

## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: maxT
##              Chisq Df Pr(>Chisq)
## Class          3.7127  2    0.1562
## Block        362.3897  1    <2e-16 ***
## Class:Block    1.1322  2    0.5677
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

#pairwise stats
summary(glht(climModMax, linfct = mcp(Class = "Tukey"), test = adjusted("holm")))

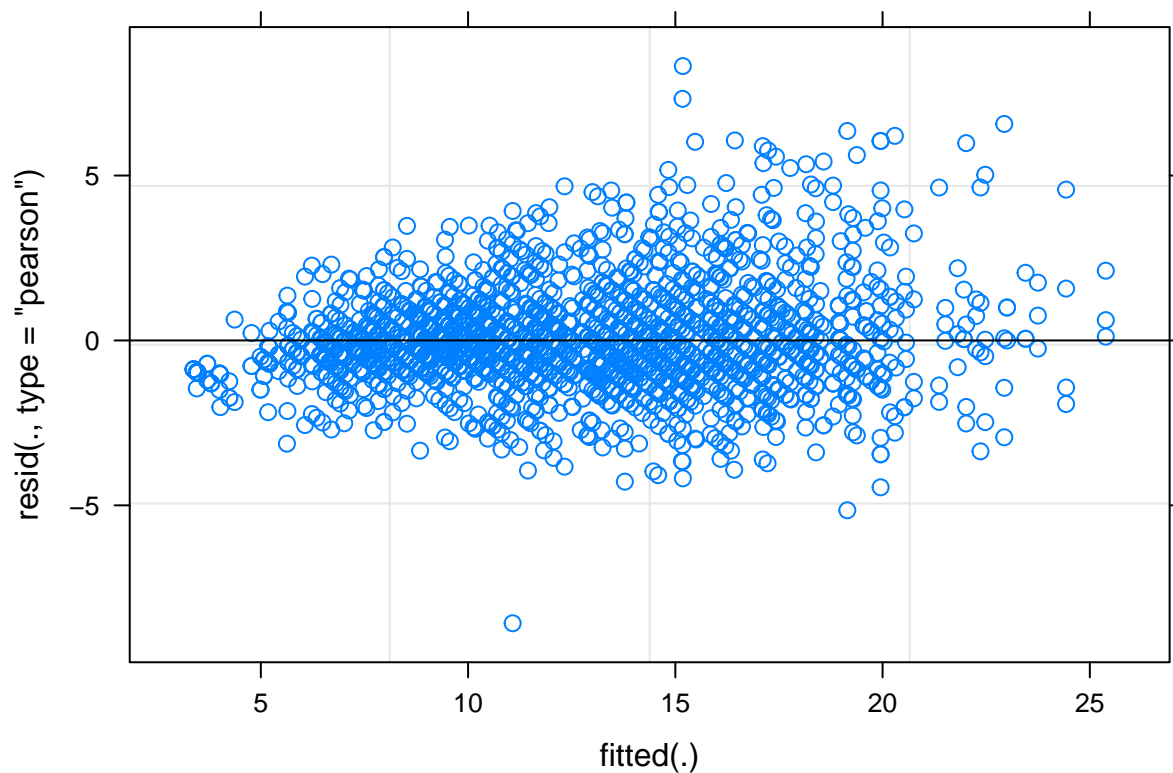
##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
## Fit: lmer(formula = maxT ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Suburban - Rural == 0  -0.9842    0.4991  -1.972    0.119
## Urban - Rural == 0    -0.6990    0.5013  -1.394    0.344
## Urban - Suburban == 0   0.2852    0.5008   0.570    0.836
## (Adjusted p values reported -- single-step method)

#pairwise stats
summary(glht(climModMax, linfct = mcp(Block = "Tukey"), test = adjusted("holm")))

##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts

```

```
##
##
## Fit: lmer(formula = maxT ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Summer - Fall == 0    3.966      0.387   10.25  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)
##----- DTR
climModDTR <- lmer(DTR~Class*Block + (1|Site_ID/Day), data=climTray)
plot(climModDTR)
```



```
summary(climModDTR)

## Linear mixed model fit by REML ['lmerMod']
## Formula: DTR ~ Class * Block + (1 | Site_ID/Day)
##   Data: climTray
##
## REML criterion at convergence: 10823.4
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -4.9380 -0.4872 -0.1015  0.3635  4.7903
##
## Random effects:
##   Groups      Name      Variance Std.Dev.
##   Day:Site_ID (Intercept) 8.4315   2.9037
```

```
## Site_ID      (Intercept) 0.8278    0.9098
## Residual                3.0155    1.7365
## Number of obs: 2347, groups: Day:Site_ID, 657; Site_ID, 9
##
## Fixed effects:
##              Estimate Std. Error t value
## (Intercept)      16.5316      0.5912  27.964
## ClassSuburban     -2.1824      0.8357  -2.612
## ClassUrban        -3.0535      0.8372  -3.647
## BlockSummer       -6.7216      0.4162 -16.151
## ClassSuburban:BlockSummer  1.2353      0.5873   2.103
## ClassUrban:BlockSummer   2.0139      0.5921   3.401
##
## Correlation of Fixed Effects:
##              (Intr) ClssSb ClssUr BlckSm Cls:BS
## ClassSubrbn -0.707
## ClassUrban  -0.706  0.500
## BlockSummer -0.299  0.211  0.211
## ClssSbrb:BS  0.212 -0.298 -0.150 -0.709
## ClssUrbn:BS  0.210 -0.149 -0.301 -0.703  0.498
```

```
confint(climModDTR)
```

```
##              2.5 %      97.5 %
## .sig01        2.72912092  3.0781503
## .sig02        0.39620399  1.3300970
## .sigma        1.67963700  1.7967155
## (Intercept)   15.47589100 17.5872384
## ClassSuburban -3.67459533 -0.6901218
## ClassUrban    -4.54851761 -1.5584246
## BlockSummer   -7.53661591 -5.9065912
## ClassSuburban:BlockSummer  0.08525682  2.3853445
## ClassUrban:BlockSummer    0.85526145  3.1744799
```

```
car::Anova(climModDTR)
```

```
## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: DTR
##              Chisq Df Pr(>Chisq)
## Class         8.2343  2  0.016291 *
## Block        549.2994  1 < 2.2e-16 ***
## Class:Block   11.7894  2  0.002754 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#pairwise stats
```

```
summary(glht(climModDTR, linfct = mcp(Class = "Tukey"), test = adjusted("holm")))
```

```
##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = DTR ~ Class * Block + (1 | Site_ID/Day), data = climTray)
```

```
##
## Linear Hypotheses:
##               Estimate Std. Error z value Pr(>|z|)
## Suburban - Rural == 0 -2.1824    0.8357 -2.612  0.0244 *
## Urban - Rural == 0    -3.0535    0.8372 -3.647  <0.001 ***
## Urban - Suburban == 0 -0.8712    0.8368 -1.041  0.5509
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)

#pairwise stats
summary(glht(climModDTR, linfct = mcp(Block = "Tukey"), test = adjusted("holm")))
```

```
##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = DTR ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##               Estimate Std. Error z value Pr(>|z|)
## Summer - Fall == 0 -6.7216    0.4162 -16.15  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)

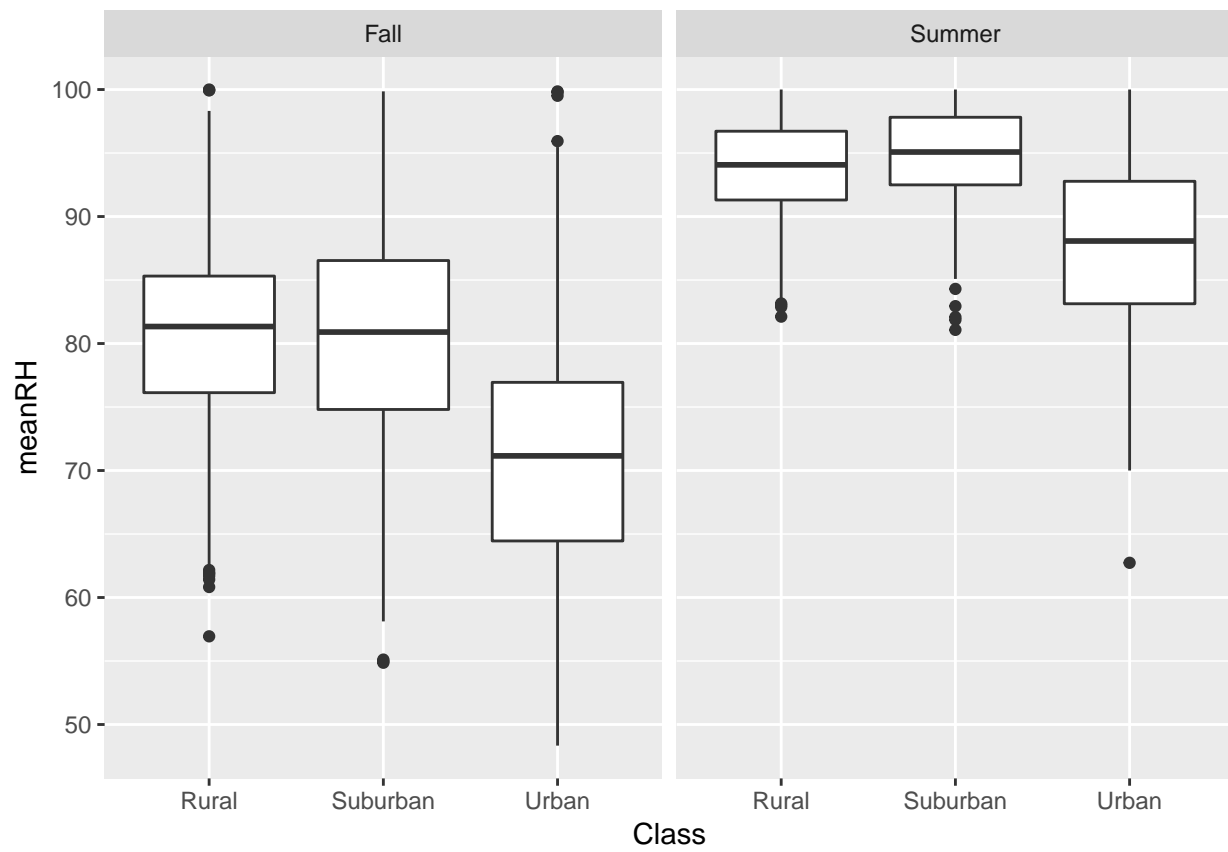
#pairwise stats-interaction
intMod <- lmer(DTR~classxBLOCK+ (1|Site_ID/Day), data=climTray)
summary(glht(intMod, linfct = mcp(classxBLOCK = "Tukey"), test = adjusted("holm")))
```

```
##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = DTR ~ classxBLOCK + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##               Estimate Std. Error z value Pr(>|z|)
## Suburban.Fall - Rural.Fall == 0 -2.18239    0.83566 -2.612  0.077947
## Urban.Fall - Rural.Fall == 0    -3.05354    0.83721 -3.647  0.002884
## Rural.Summer - Rural.Fall == 0   -6.72159    0.41618 -16.151  < 1e-04
## Suburban.Summer - Rural.Fall == 0 -7.66869    0.85099  -9.011  < 1e-04
## Urban.Summer - Rural.Fall == 0    -7.76128    0.85289  -9.100  < 1e-04
## Urban.Fall - Suburban.Fall == 0   -0.87115    0.83682  -1.041  0.884864
## Rural.Summer - Suburban.Fall == 0  -4.53921    0.85113  -5.333  < 1e-04
## Suburban.Summer - Suburban.Fall == 0 -5.48630    0.41433 -13.241  < 1e-04
## Urban.Summer - Suburban.Fall == 0   -5.57889    0.85250  -6.544  < 1e-04
## Rural.Summer - Urban.Fall == 0     -3.66806    0.85266  -4.302  0.000209
## Suburban.Summer - Urban.Fall == 0   -4.61515    0.85213  -5.416  < 1e-04
## Urban.Summer - Urban.Fall == 0     -4.70774    0.42123 -11.176  < 1e-04
## Suburban.Summer - Rural.Summer == 0 -0.94709    0.86619  -1.093  0.861933
## Urban.Summer - Rural.Summer == 0    -1.03968    0.86806  -1.198  0.809743
```

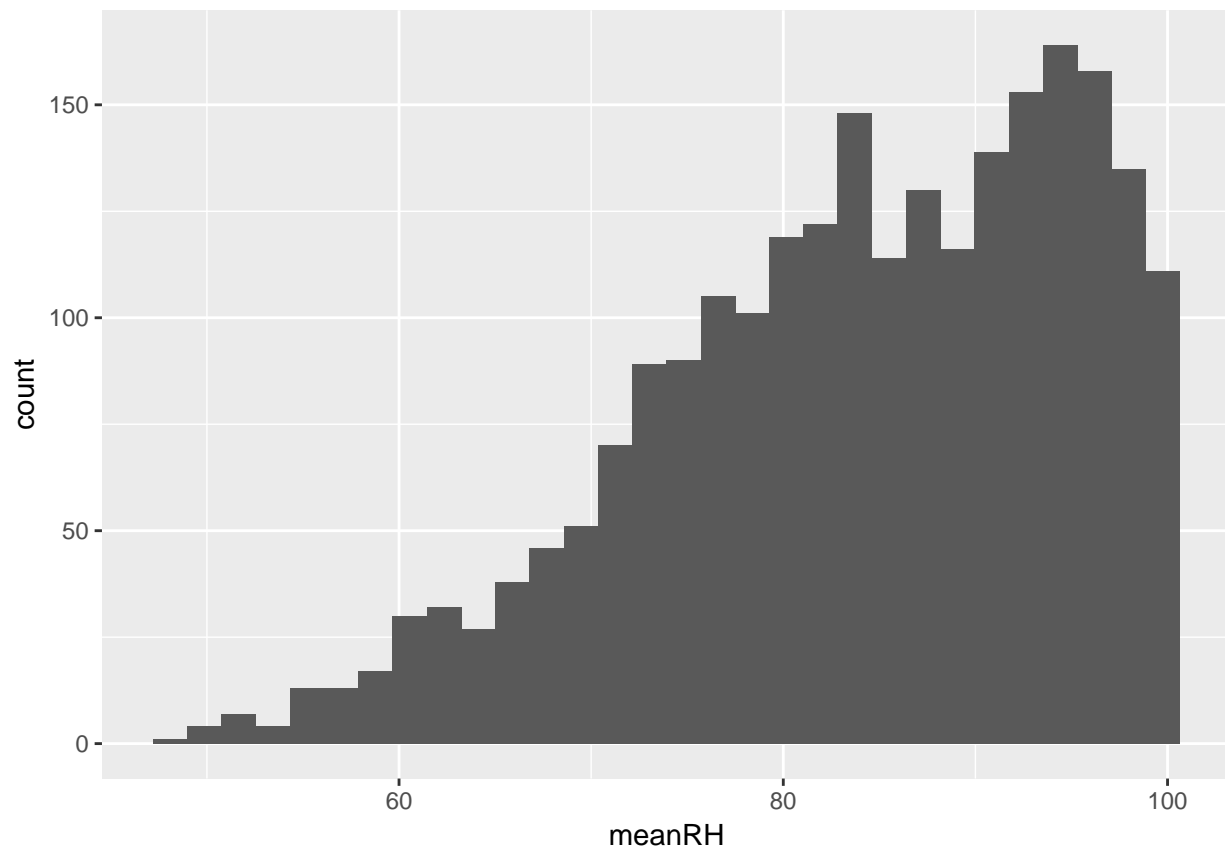
```
## Urban.Summer - Suburban.Summer == 0  -0.09259    0.86754  -0.107  0.999998
##
## Suburban.Fall - Rural.Fall == 0      .
## Urban.Fall - Rural.Fall == 0         **
## Rural.Summer - Rural.Fall == 0       ***
## Suburban.Summer - Rural.Fall == 0     ***
## Urban.Summer - Rural.Fall == 0       ***
## Urban.Fall - Suburban.Fall == 0
## Rural.Summer - Suburban.Fall == 0     ***
## Suburban.Summer - Suburban.Fall == 0 ***
## Urban.Summer - Suburban.Fall == 0     ***
## Rural.Summer - Urban.Fall == 0       ***
## Suburban.Summer - Urban.Fall == 0     ***
## Urban.Summer - Urban.Fall == 0       ***
## Suburban.Summer - Rural.Summer == 0
## Urban.Summer - Rural.Summer == 0
## Urban.Summer - Suburban.Summer == 0
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)
```

Relative Humidity:

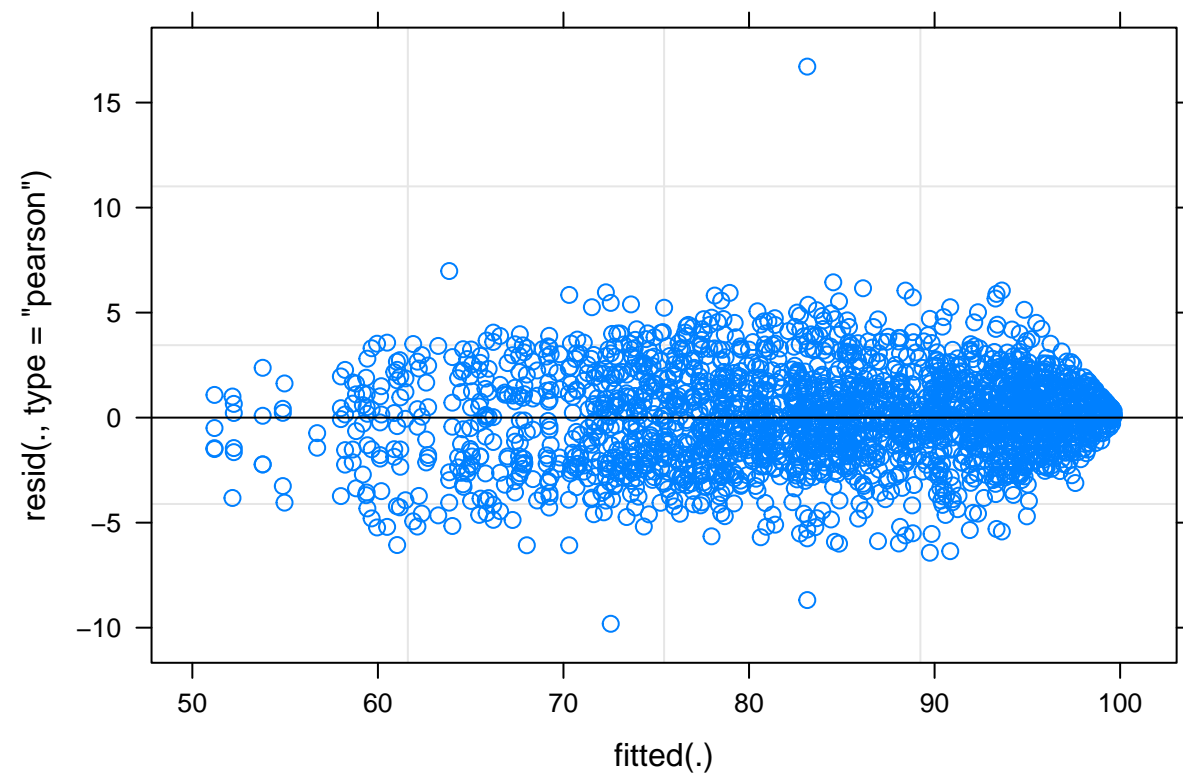
```
## ----- mean RH
ggplot(data=climTray, aes(x=Class, y=meanRH)) +
  geom_boxplot() +
  facet_wrap(~Block)
```



```
ggplot(data=climTray, aes(x=meanRH)) +  
  geom_histogram()
```

```
climModMeanRH <- lmer(meanRH~Class*Block + (1|Site_ID/Day), data=climTray)  
plot(climModMeanRH)
```



```
summary(climModMeanRH)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: meanRH ~ Class * Block + (1 | Site_ID/Day)
## Data: climTray
##
## REML criterion at convergence: 13168
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.8623 -0.5741  0.0102  0.5408  6.5764
##
## Random effects:
## Groups      Name      Variance Std.Dev.
## Day:Site_ID (Intercept) 45.329   6.733
## Site_ID      (Intercept)  5.130   2.265
## Residual                    6.458   2.541
## Number of obs: 2347, groups: Day:Site_ID, 657; Site_ID, 9
##
## Fixed effects:
##              Estimate Std. Error t value
## (Intercept)      80.8971     1.4436   56.04
## ClassSuburban     -0.4837     2.0412   -0.24
## ClassUrban        -9.9133     2.0425  -4.85
## BlockSummer       12.8614     0.9384  13.71
## ClassSuburban:BlockSummer  1.5000     1.3259   1.13
## ClassUrban:BlockSummer   4.3674     1.3306   3.28
##
## Correlation of Fixed Effects:
##              (Intr) ClssSb ClssUr BlckSm Cls:BS
## ClassSubrbn -0.707
## ClassUrban  -0.707  0.500
## BlockSummer -0.276  0.195  0.195
## ClssSbrb:BS  0.195 -0.276 -0.138 -0.708
## ClssUrnb:BS  0.195 -0.138 -0.277 -0.705  0.499
```

```
#confint(climModMeanRH)
```

```
car::Anova(climModMeanRH)
```

```
## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: meanRH
##              Chisq Df Pr(>Chisq)
## Class          22.905  2  1.062e-05 ***
## Block          745.353  1  < 2.2e-16 ***
## Class:Block    11.115  2   0.003858 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#pairwise stats
```

```
summary(glht(climModMeanRH, linfct = mcp(Class = "Tukey"), test = adjusted("holm")))
```

```
##
## Simultaneous Tests for General Linear Hypotheses
##
```

```
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = meanRH ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Suburban - Rural == 0  -0.4837    2.0412  -0.237    0.97
## Urban - Rural == 0    -9.9133    2.0425  -4.853 < 1e-05 ***
## Urban - Suburban == 0  -9.4296    2.0422  -4.617 1.14e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)
summary(glht(climModMeanRH, linfct = mcp(Block = "Tukey"), test = adjusted("holm"))))

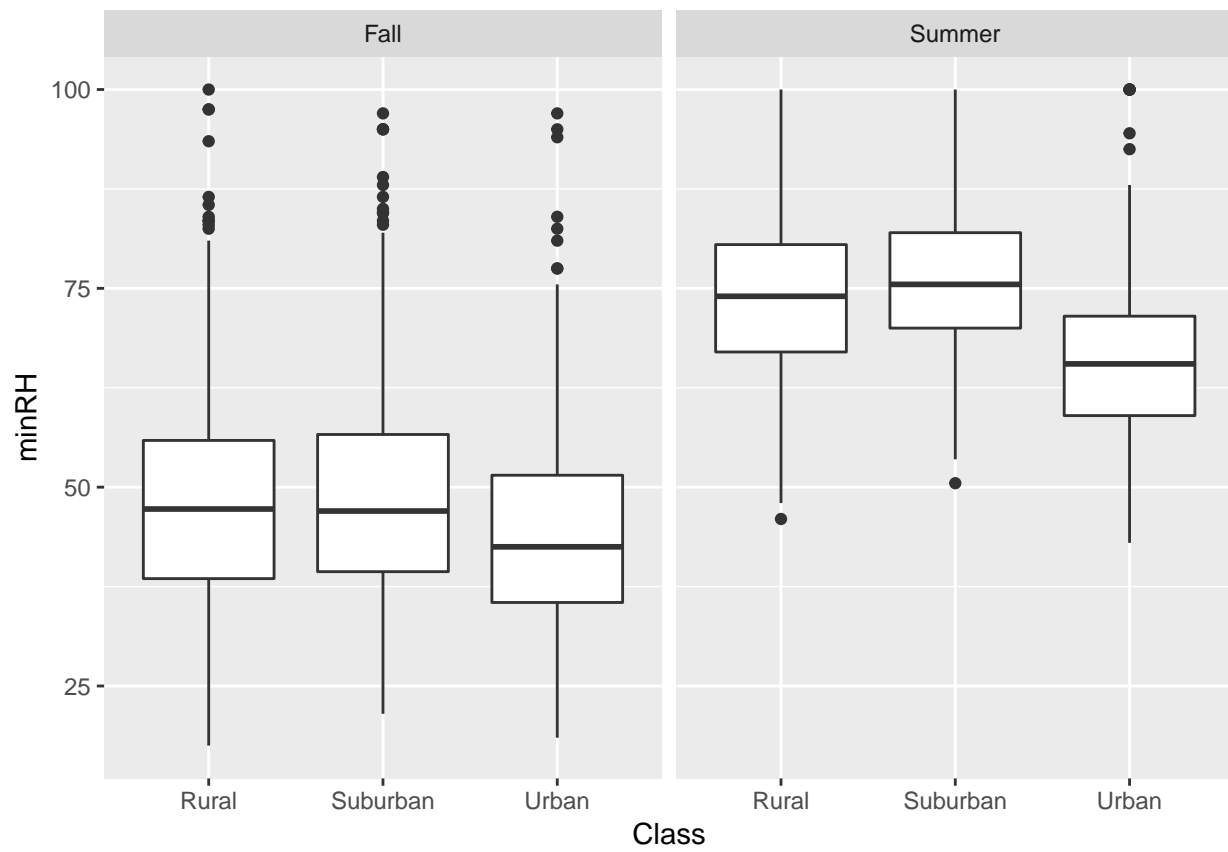
##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = meanRH ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Summer - Fall == 0  12.8614    0.9384   13.71 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)
#pairwise stats-interaction
intMod <- lmer(meanRH~classxBLOCK+ (1|Site_ID/Day), data=climTray)
summary(glht(intMod, linfct = mcp(classxBLOCK = "Tukey"), test = adjusted("holm"))))

##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = meanRH ~ classxBLOCK + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Suburban.Fall - Rural.Fall == 0  -0.4837    2.0412  -0.237 0.99987
## Urban.Fall - Rural.Fall == 0    -9.9133    2.0425  -4.853 < 1e-04
## Rural.Summer - Rural.Fall == 0   12.8614    0.9384   13.705 < 1e-04
## Suburban.Summer - Rural.Fall == 0  13.8777    2.0733   6.694 < 1e-04
## Urban.Summer - Rural.Fall == 0    7.3155    2.0750   3.526 0.00436
## Urban.Fall - Suburban.Fall == 0  -9.4296    2.0422  -4.617 < 1e-04
## Rural.Summer - Suburban.Fall == 0  13.3451    2.0734   6.436 < 1e-04
## Suburban.Summer - Suburban.Fall == 0 14.3614    0.9367   15.333 < 1e-04
## Urban.Summer - Suburban.Fall == 0    7.7992    2.0746   3.759 0.00185
## Rural.Summer - Urban.Fall == 0     22.7747    2.0748   10.977 < 1e-04
```

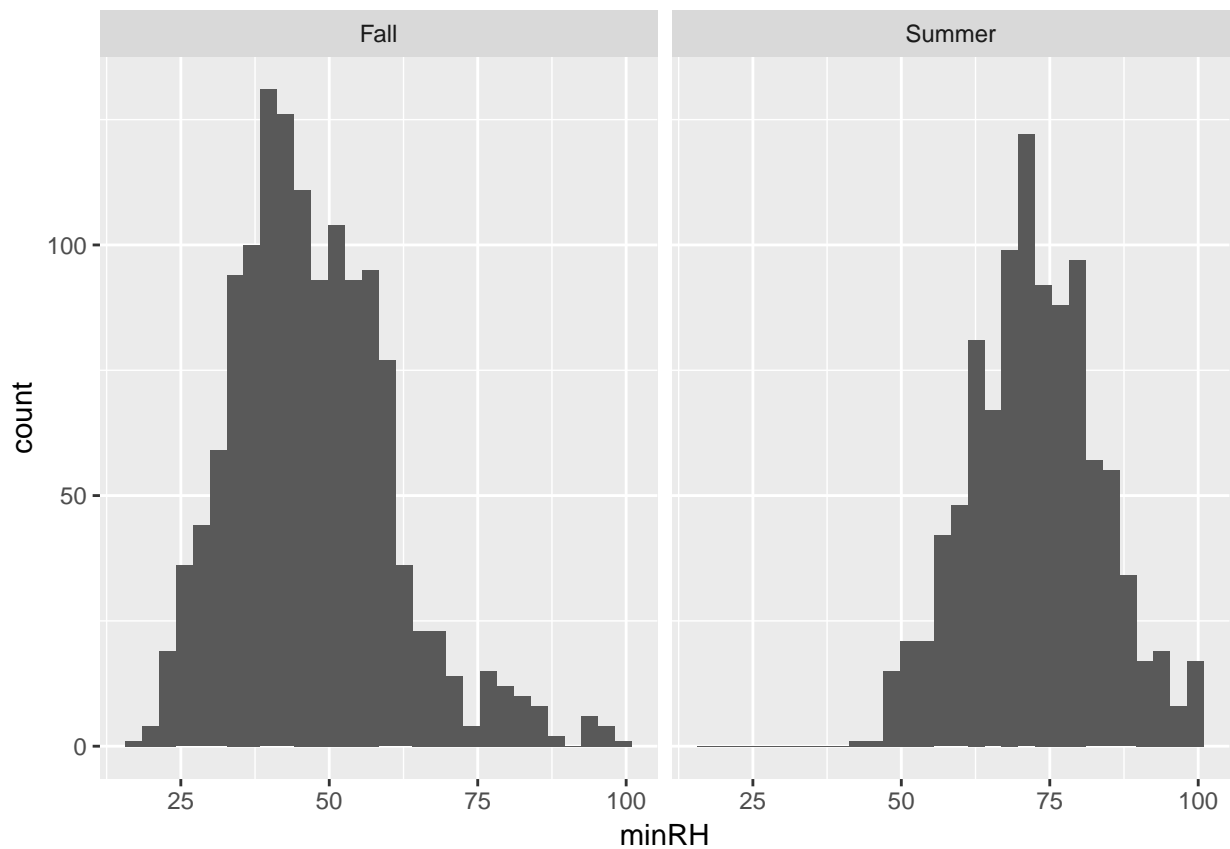
```
## Suburban.Summer - Urban.Fall == 0      23.7910      2.0743      11.469 < 1e-04
## Urban.Summer - Urban.Fall == 0          17.2288      0.9434      18.263 < 1e-04
## Suburban.Summer - Rural.Summer == 0      1.0164      2.1051      0.483 0.99577
## Urban.Summer - Rural.Summer == 0         -5.5459      2.1067     -2.632 0.07202
## Urban.Summer - Suburban.Summer == 0     -6.5622      2.1063     -3.116 0.01774
##
## Suburban.Fall - Rural.Fall == 0
## Urban.Fall - Rural.Fall == 0            ***
## Rural.Summer - Rural.Fall == 0          ***
## Suburban.Summer - Rural.Fall == 0       ***
## Urban.Summer - Rural.Fall == 0          **
## Urban.Fall - Suburban.Fall == 0         ***
## Rural.Summer - Suburban.Fall == 0       ***
## Suburban.Summer - Suburban.Fall == 0    ***
## Urban.Summer - Suburban.Fall == 0       **
## Rural.Summer - Urban.Fall == 0          ***
## Suburban.Summer - Urban.Fall == 0       ***
## Urban.Summer - Urban.Fall == 0          ***
## Suburban.Summer - Rural.Summer == 0
## Urban.Summer - Rural.Summer == 0        .
## Urban.Summer - Suburban.Summer == 0     *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)
```

```
anova(climModMeanRH, intMod)
```

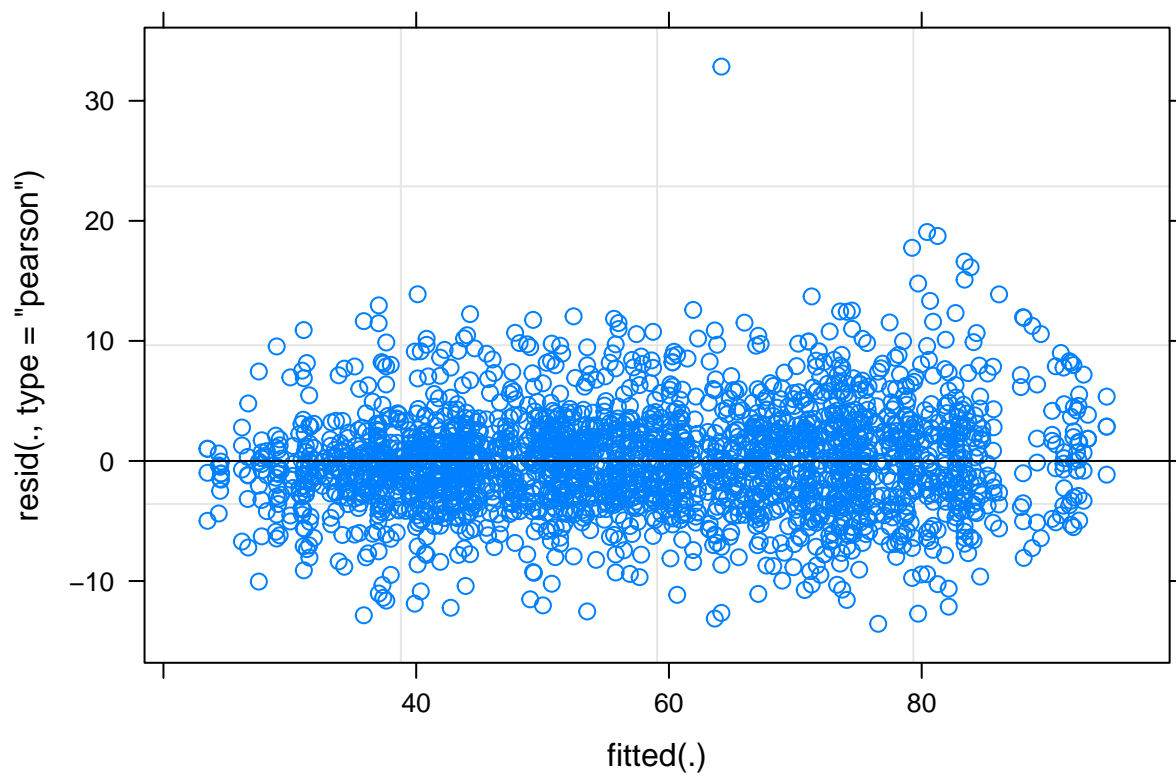
```
## Data: climTray
## Models:
## climModMeanRH: meanRH ~ Class * Block + (1 | Site_ID/Day)
## intMod: meanRH ~ classxBLOCK + (1 | Site_ID/Day)
##           Df    AIC    BIC logLik deviance Chisq Chi Df Pr(>Chisq)
## climModMeanRH  9 13198 13250  -6590    13180
## intMod         9 13198 13250  -6590    13180      0    0      1
## ----- min RH
ggplot(data=climTray, aes(x=Class, y=minRH)) +
  geom_boxplot() +
  facet_wrap(~Block)
```



```
ggplot(data=climTray, aes(x=minRH)) +
  geom_histogram() +
  facet_wrap(~Block)
```



```
climModMinRH <- lmer(minRH~Class*Block + (1|Site_ID/Day), data=climTray) #class not significant
plot(climModMinRH)
```



```
summary(climModMinRH)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: minRH ~ Class * Block + (1 | Site_ID/Day)
## Data: climTray
##
## REML criterion at convergence: 16093
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.7047 -0.5374 -0.0334  0.4450  6.5510
##
## Random effects:
## Groups      Name                Variance Std.Dev.
## Day:Site_ID (Intercept) 117.444  10.837
## Site_ID      (Intercept)   5.039   2.245
## Residual                        25.141   5.014
## Number of obs: 2347, groups: Day:Site_ID, 657; Site_ID, 9
##
## Fixed effects:
##              Estimate Std. Error t value
## (Intercept)      47.681      1.633  29.196
## ClassSuburban       1.154      2.308   0.500
## ClassUrban        -3.567      2.313  -1.542
## BlockSummer       25.812      1.525  16.927
## ClassSuburban:BlockSummer  1.643      2.154   0.763
## ClassUrban:BlockSummer -2.525      2.165  -1.166
##
## Correlation of Fixed Effects:
##              (Intr) ClssSb ClssUr BlckSm Cls:BS
## ClassSubrbn -0.707
## ClassUrban  -0.706  0.499
## BlockSummer -0.397  0.281  0.280
## ClssSbrb:BS  0.281 -0.396 -0.198 -0.708
## ClssUrnb:BS  0.279 -0.198 -0.398 -0.704  0.499
```

```
confint(climModMinRH)
```

```
##              2.5 %      97.5 %
## .sig01      10.2107286 11.4647016
## .sig02       0.5358557  3.4195201
## .sigma       4.8497477  5.1880132
## (Intercept)  44.7639746 50.5988092
## ClassSuburban -2.9697207  5.2775755
## ClassUrban    -7.7001488  0.5646331
## BlockSummer   22.8259517 28.7984227
## ClassSuburban:BlockSummer -2.5745004  5.8601362
## ClassUrban:BlockSummer  -6.7629457  1.7157679
```

```
AIC(climModMinRH)
```

```
## [1] 16111
```

```
car::Anova(climModMinRH)
```

```
## Analysis of Deviance Table (Type II Wald chisquare tests)
```

```
##
## Response: minRH
##           Chisq Df Pr(>Chisq)
## Class      9.9316  2  0.006972 **
## Block     838.4259  1 < 2.2e-16 ***
## Class:Block  3.7667  2  0.152080
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#pairwise stats
summary(glht(climModMinRH, linfct = mcp(Class = "Tukey"), test = adjusted("holm")))
```

```
##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = minRH ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##           Estimate Std. Error z value Pr(>|z|)
## Suburban - Rural == 0    1.154     2.308   0.500   0.871
## Urban - Rural == 0      -3.567     2.313  -1.542   0.271
## Urban - Suburban == 0   -4.721     2.312  -2.042   0.102
## (Adjusted p values reported -- single-step method)
```

```
summary(glht(climModMinRH, linfct = mcp(Block = "Tukey"), test = adjusted("holm")))
```

```
##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = minRH ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##           Estimate Std. Error z value Pr(>|z|)
## Summer - Fall == 0   25.812     1.525   16.93 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)
```

```
#pairwise stats-interaction
intMod <- lmer(minRH~classxBLOCK+ (1|Day) + (1|Site_ID), data=climTray)
summary(glht(intMod, linfct = mcp(classxBLOCK = "Tukey"), test = adjusted("holm")))
```

```
##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = minRH ~ classxBLOCK + (1 | Day) + (1 | Site_ID),
## data = climTray)
```

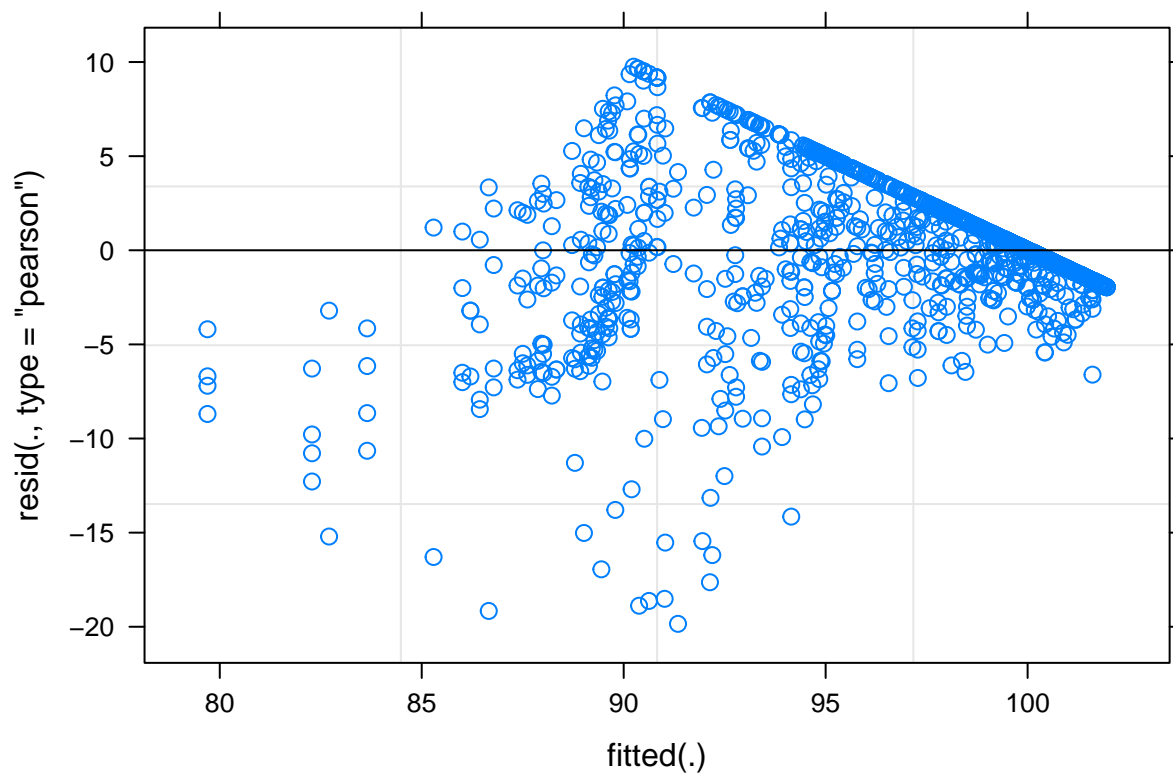


```
##
## Linear Hypotheses:
##
```

	Estimate	Std. Error	z value	Pr(> z)
## Suburban.Fall - Rural.Fall == 0	1.139	2.116	0.538	0.9730
## Urban.Fall - Rural.Fall == 0	-3.230	2.122	-1.522	0.4945
## Rural.Summer - Rural.Fall == 0	25.781	2.498	10.321	<0.001
## Suburban.Summer - Rural.Fall == 0	28.594	3.249	8.800	<0.001
## Urban.Summer - Rural.Fall == 0	19.254	3.254	5.917	<0.001
## Urban.Fall - Suburban.Fall == 0	-4.369	2.120	-2.060	0.2123
## Rural.Summer - Suburban.Fall == 0	24.642	3.250	7.583	<0.001
## Suburban.Summer - Suburban.Fall == 0	27.455	2.495	11.005	<0.001
## Urban.Summer - Suburban.Fall == 0	18.115	3.253	5.569	<0.001
## Rural.Summer - Urban.Fall == 0	29.011	3.254	8.916	<0.001
## Suburban.Summer - Urban.Fall == 0	31.824	3.252	9.785	<0.001
## Urban.Summer - Urban.Fall == 0	22.484	2.506	8.974	<0.001
## Suburban.Summer - Rural.Summer == 0	2.813	2.128	1.322	0.6205
## Urban.Summer - Rural.Summer == 0	-6.527	2.136	-3.056	0.0182
## Urban.Summer - Suburban.Summer == 0	-9.340	2.133	-4.378	<0.001

```
##
## Suburban.Fall - Rural.Fall == 0
## Urban.Fall - Rural.Fall == 0
## Rural.Summer - Rural.Fall == 0 ***
## Suburban.Summer - Rural.Fall == 0 ***
## Urban.Summer - Rural.Fall == 0 ***
## Urban.Fall - Suburban.Fall == 0
## Rural.Summer - Suburban.Fall == 0 ***
## Suburban.Summer - Suburban.Fall == 0 ***
## Urban.Summer - Suburban.Fall == 0 ***
## Rural.Summer - Urban.Fall == 0 ***
## Suburban.Summer - Urban.Fall == 0 ***
## Urban.Summer - Urban.Fall == 0 ***
## Suburban.Summer - Rural.Summer == 0
## Urban.Summer - Rural.Summer == 0 *
## Urban.Summer - Suburban.Summer == 0 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)
## ----- max RH

climModMaxRH <- lmer(maxRH~0+Class*Block + (1|Day)+ (1|Site_ID), data=climTray)
plot(climModMaxRH)
```



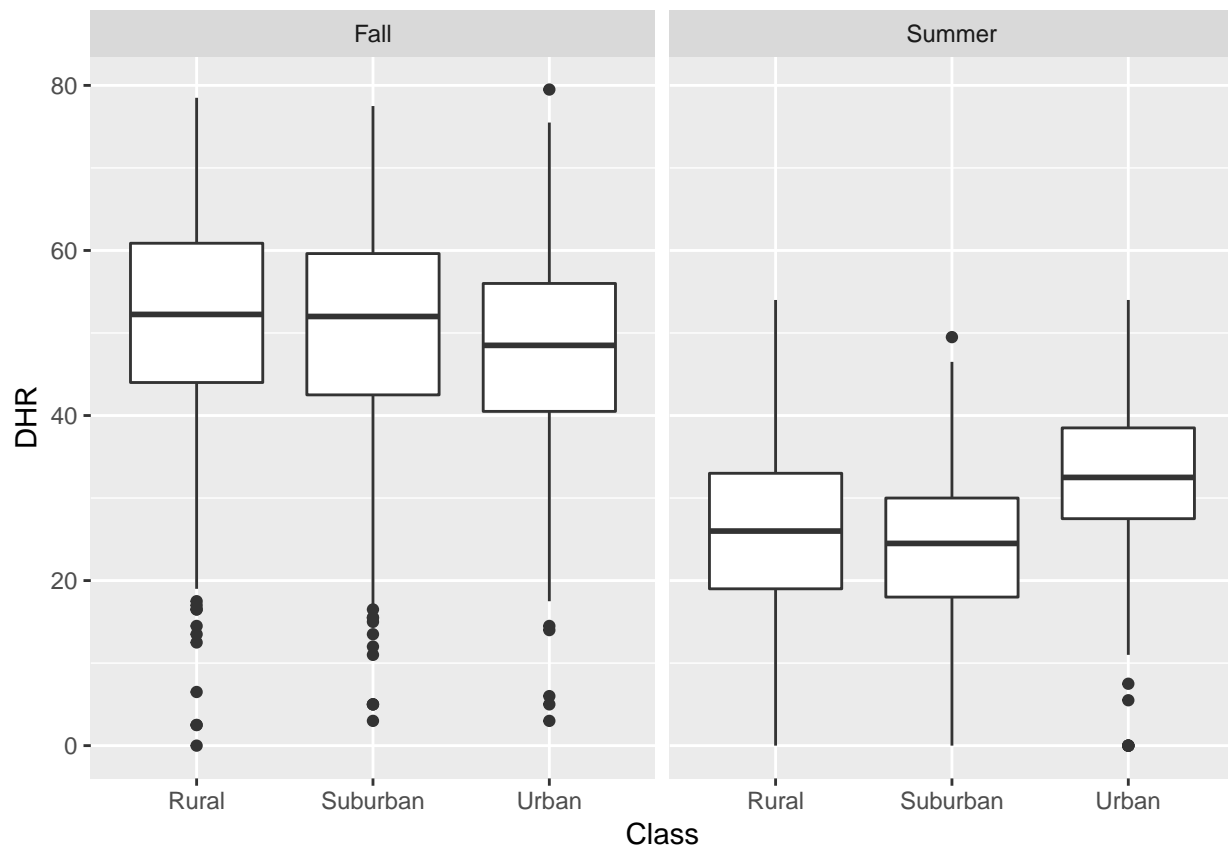
```
# summary(climModMaxRH)
# confint(climModMaxRH)
#
car::Anova(climModMaxRH)

## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: maxRH
##              Chisq Df Pr(>Chisq)
## Class      18854.651  3  < 2.2e-16 ***
## Block        29.934  1  4.471e-08 ***
## Class:Block   400.699  2  < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

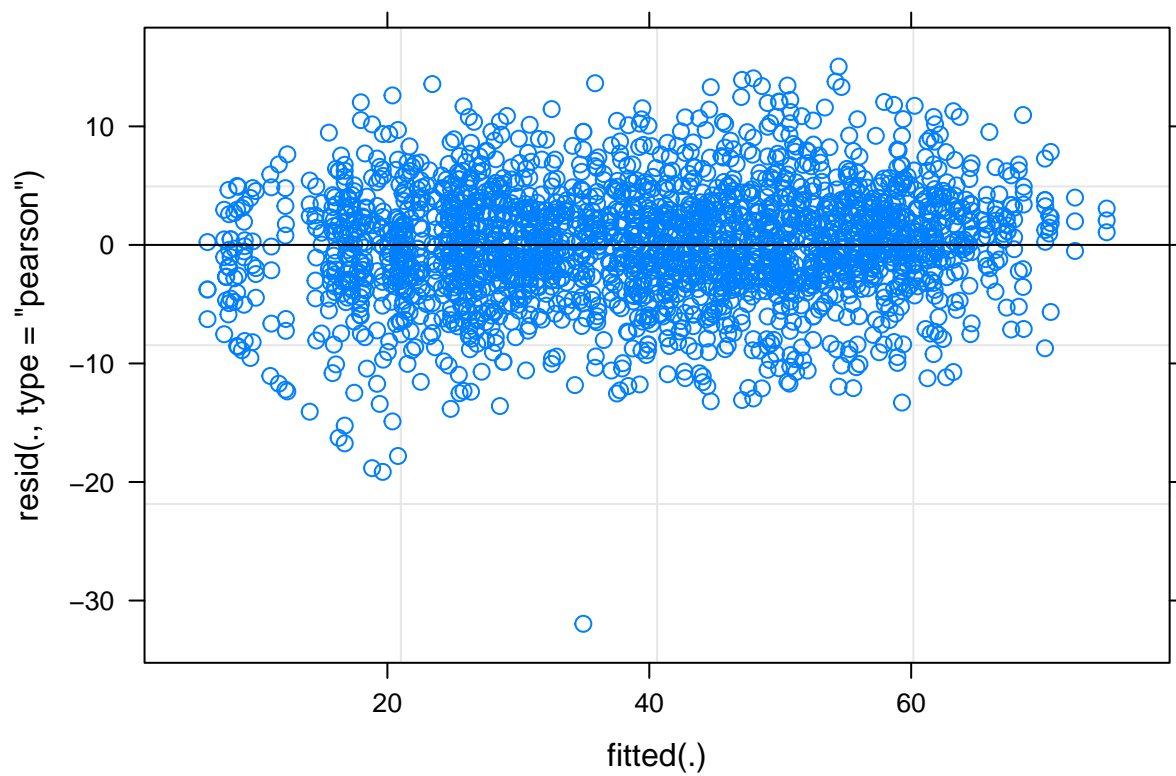
#
# #pairwise stats
# summary(glht(climModMaxRH, linfct = mcp(Class = "Tukey"), test = adjusted("holm")))
#
# #pairwise stats
# summary(glht(climModMaxRH, linfct = mcp(Block = "Tukey"), test = adjusted("holm")))

## ----- DHR

ggplot(data=climTray, aes(x=Class, y=DHR)) +
  geom_boxplot() +
  facet_wrap(~Block)
```



```
climModDHR <- lmer(DHR~Class*Block + (1|Site_ID/Day), data=climTray)
plot(climModDHR)
```



```
summary(climModDHR)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: DHR ~ Class * Block + (1 | Site_ID/Day)
## Data: climTray
##
## REML criterion at convergence: 16348.7
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -5.7706 -0.4919  0.0164  0.5348  2.7154
##
## Random effects:
## Groups      Name                Variance Std.Dev.
## Day:Site_ID (Intercept) 100.928  10.046
## Site_ID      (Intercept)   7.039   2.653
## Residual                    30.675   5.539
## Number of obs: 2347, groups: Day:Site_ID, 657; Site_ID, 9
##
## Fixed effects:
##              Estimate Std. Error t value
## (Intercept)      51.678      1.793  28.822
## ClassSuburban     -1.583      2.534  -0.625
## ClassUrban        -4.166      2.540  -1.640
## BlockSummer      -25.220      1.430 -17.635
## ClassSuburban:BlockSummer -1.185      2.019  -0.587
## ClassUrban:BlockSummer   8.770      2.033   4.314
##
## Correlation of Fixed Effects:
##              (Intr) ClssSb ClssUr BlckSm Cls:BS
## ClassSubrbn -0.707
## ClassUrban  -0.706  0.499
## BlockSummer -0.339  0.240  0.239
## ClssSbrb:BS  0.240 -0.338 -0.169 -0.708
## ClssUrnb:BS  0.238 -0.169 -0.340 -0.703  0.498
```

```
confint(climModDHR)
```

```
##              2.5 %      97.5 %
## .sig01         9.451518 10.6412827
## .sig02         1.014044  3.9319014
## .sigma         5.357105  5.7305033
## (Intercept)    48.476307 54.8788351
## ClassSuburban  -6.108188  2.9415353
## ClassUrban     -8.700055  0.3687241
## BlockSummer   -28.020483 -22.4191664
## ClassSuburban:BlockSummer -5.138046  2.7682353
## ClassUrban:BlockSummer   4.791649 12.7548122
```

```
car::Anova(climModDHR)
```

```
## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: DHR
##              Chisq Df Pr(>Chisq)
```

```

## Class          0.8513  2      0.6533
## Block          755.4904 1 < 2.2e-16 ***
## Class:Block    28.5709  2      6.25e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

#pairwise stats
summary(glht(climModDHR, linfct = mcp(Class = "Tukey"), test = adjusted("holm")))

##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = DHR ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Suburban - Rural == 0   -1.583      2.534  -0.625    0.807
## Urban - Rural == 0      -4.166      2.540  -1.640    0.229
## Urban - Suburban == 0   -2.582      2.538  -1.017    0.566
## (Adjusted p values reported -- single-step method)

#pairwise stats
summary(glht(climModDHR, linfct = mcp(Block = "Tukey"), test = adjusted("holm")))

##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = DHR ~ Class * Block + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)
## Summer - Fall == 0    -25.22      1.43  -17.64 <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)

#pairwise stats-interaction
intMod <- lmer(DHR~classxBLOCK+ (1|Site_ID/Day), data=climTray)
summary(glht(intMod, linfct = mcp(classxBLOCK = "Tukey"), test = adjusted("holm")))

##
## Simultaneous Tests for General Linear Hypotheses
##
## Multiple Comparisons of Means: Tukey Contrasts
##
##
## Fit: lmer(formula = DHR ~ classxBLOCK + (1 | Site_ID/Day), data = climTray)
##
## Linear Hypotheses:
##              Estimate Std. Error z value Pr(>|z|)

```

```

## Suburban.Fall - Rural.Fall == 0      -1.583      2.534  -0.625  0.9870
## Urban.Fall - Rural.Fall == 0         -4.166      2.540  -1.640  0.5341
## Rural.Summer - Rural.Fall == 0       -25.220      1.430 -17.635  <0.001
## Suburban.Summer - Rural.Fall == 0    -27.988      2.594 -10.790  <0.001
## Urban.Summer - Rural.Fall == 0       -20.615      2.600  -7.928  <0.001
## Urban.Fall - Suburban.Fall == 0      -2.582      2.538  -1.017  0.8979
## Rural.Summer - Suburban.Fall == 0    -23.636      2.594  -9.110  <0.001
## Suburban.Summer - Suburban.Fall == 0 -26.405      1.425 -18.534  <0.001
## Urban.Summer - Suburban.Fall == 0    -19.032      2.599  -7.323  <0.001
## Rural.Summer - Urban.Fall == 0       -21.054      2.600  -8.099  <0.001
## Suburban.Summer - Urban.Fall == 0    -23.822      2.598  -9.170  <0.001
## Urban.Summer - Urban.Fall == 0       -16.449      1.445 -11.382  <0.001
## Suburban.Summer - Rural.Summer == 0  -2.768      2.653  -1.044  0.8876
## Urban.Summer - Rural.Summer == 0      4.604      2.659   1.732  0.4729
## Urban.Summer - Suburban.Summer == 0   7.373      2.657   2.775  0.0525
##
## Suburban.Fall - Rural.Fall == 0
## Urban.Fall - Rural.Fall == 0
## Rural.Summer - Rural.Fall == 0      ***
## Suburban.Summer - Rural.Fall == 0    ***
## Urban.Summer - Rural.Fall == 0       ***
## Urban.Fall - Suburban.Fall == 0
## Rural.Summer - Suburban.Fall == 0    ***
## Suburban.Summer - Suburban.Fall == 0 ***
## Urban.Summer - Suburban.Fall == 0    ***
## Rural.Summer - Urban.Fall == 0       ***
## Suburban.Summer - Urban.Fall == 0    ***
## Urban.Summer - Urban.Fall == 0       ***
## Suburban.Summer - Rural.Summer == 0
## Urban.Summer - Rural.Summer == 0
## Urban.Summer - Suburban.Summer == 0 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Adjusted p values reported -- single-step method)

```