

Temp-Nut Plots

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1. ANCOVAs testing the effect of temperature on nutrient treatment (raw chlorophyll a) and nutrient LRRs

Lsmeans tests for significant differences among treatments, averaging over temperature

Lstrends tests for differences among the relationships between treatments and temperature

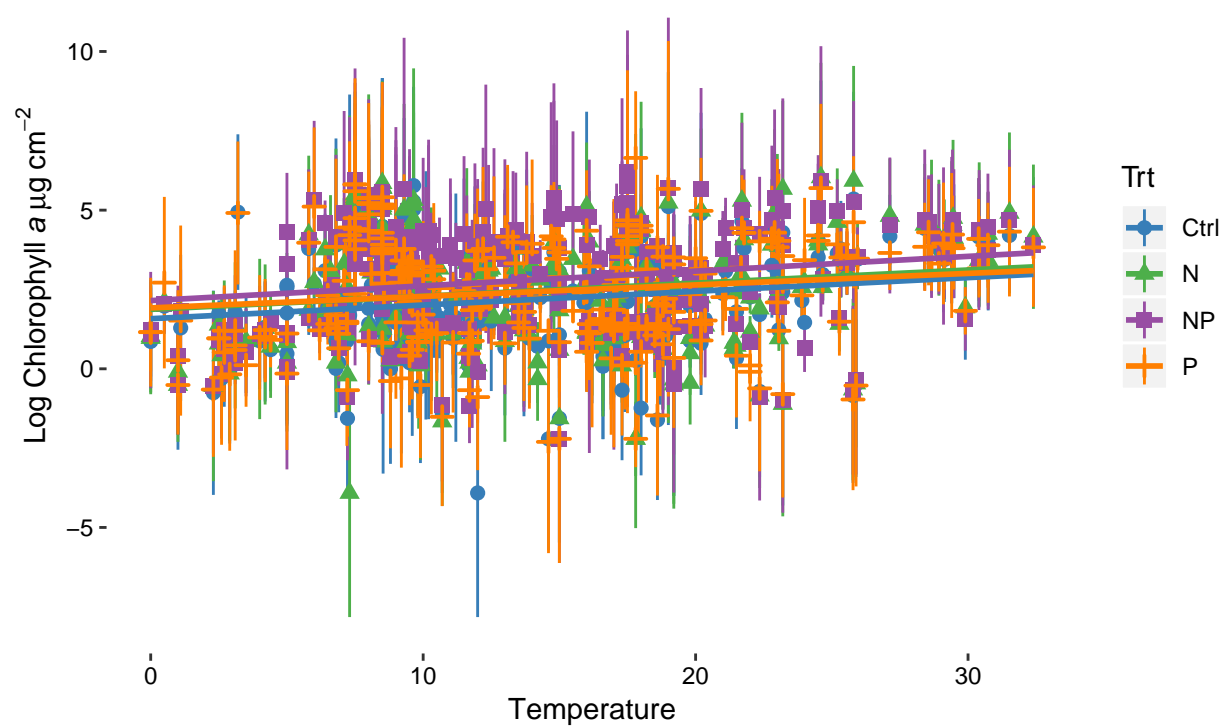
a. Temperature and raw Chl-a

#Chla vs. Temp

```
ggplot(Data, aes(x=Temp, y=log(Chla_Mean+.01), color=Trt)) +  
  geom_pointrange(aes(ymin=log(Chla_Mean+.01)-log(Chla_SE+.01), ymax=log(Chla_Mean+.01)+ log(Chla_SE+.01)),  
    geom_smooth(method=lm,  
      se=FALSE)+  
    #scale_colour_hue(l=50) +  
  theme(axis.text.x = element_text(colour="black"), panel.grid.minor = element_blank(), panel.grid.major = element_blank(),  
    ylab(bquote(Log~Chlorophyll~italic(a)~mu*g*~cm^-2))+  
    xlab(bquote(Temperature))+  
    scale_colour_manual(values=c("#377eb8", "#4daf4a", "#984ea3", "#ff7f00"))
```

```
## Warning: Removed 1320 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 1320 rows containing missing values (geom_pointrange).
```



```
#Chla vs. Temp ANCOVAs
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(log(Chla_Mean+.01)~Trt*Temp, data=Data)
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
##
## Response: log(Chla_Mean + 0.01)
##          Sum Sq   Df F value    Pr(>F)
## (Intercept)  891.1     1 337.7082 < 2.2e-16 ***
## Trt          11.0     3   1.3870   0.2451
## Temp        111.8     1  42.3562 1.093e-10 ***
## Trt:Temp       0.9     3   0.1079   0.9555
## Residuals   3345.7 1268
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#Log meets assumptions
```

```
#par(mfrow=c(2,2))
#plot(Model)
```

```
#Lsmeans (pairwise trt differences, averaging over temperature)
```

```
lsmeans(Model, pairwise~Trt)
```

```
## NOTE: Results may be misleading due to involvement in interactions

## $lsmeans
##   Trt      lsmean      SE    df lower.CL upper.CL
##   Ctrl 2.193055 0.08590997 1268 2.024514 2.361596
##   N    2.462183 0.09170713 1268 2.282268 2.642097
##   NP   2.810811 0.09211340 1268 2.630099 2.991522
##   P    2.435154 0.09492112 1268 2.248934 2.621373
##
## Results are given on the log (not the response) scale.
## Confidence level used: 0.95
##
## $contrasts
##   contrast      estimate      SE    df t.ratio p.value
##   Ctrl - N   -0.2691274 0.1256611 1268  -2.142  0.1406
##   Ctrl - NP  -0.6177554 0.1259579 1268  -4.904  <.0001
##   Ctrl - P   -0.2420986 0.1280255 1268  -1.891  0.2324
##   N - NP     -0.3486280 0.1299811 1268  -2.682  0.0372
##   N - P       0.0270288 0.1319857 1268   0.205  0.9970
##   NP - P      0.3756568 0.1322683 1268   2.840  0.0237
##
## Results are given on the log (not the response) scale.
## P value adjustment: tukey method for comparing a family of 4 estimates
#Lstrends (pairwise trt differences in the way chl-a responds to temperature)

comp=lstrends(Model, ~ Trt, var = "Temp")
cld(comp)

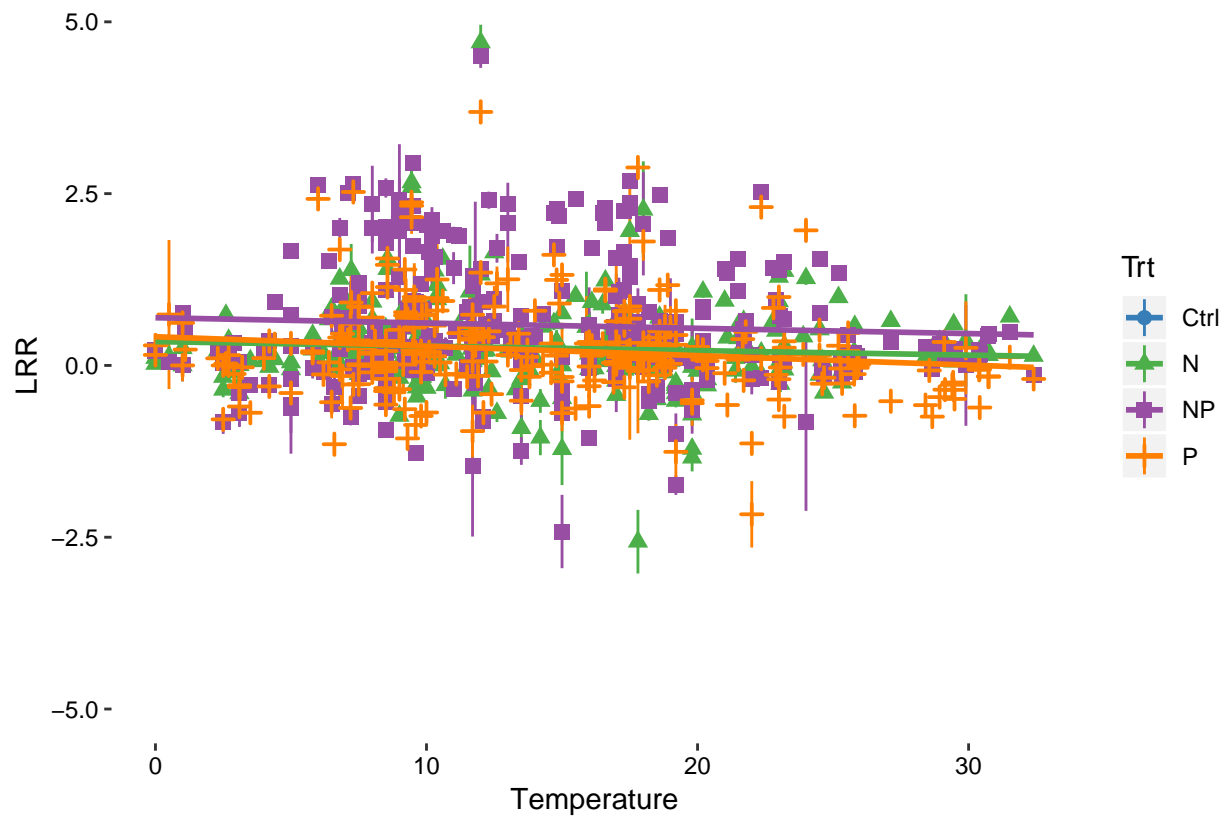
##   Trt Temp.trend      SE    df  lower.CL  upper.CL .group
##   P    0.03623894 0.01307773 1268 0.01058256 0.06189531 1
##   N    0.04131813 0.01289986 1268 0.01601072 0.06662555 1
##   Ctrl 0.04315815 0.01246543 1268 0.01870301 0.06761329 1
##   NP   0.04645512 0.01292140 1268 0.02110543 0.07180480 1
##
## Trends are based on the log (transformed) scale
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 4 estimates
## significance level used: alpha = 0.05
```

b.) Temperature and Nutrient LRRs

```
#LRRs vs. Temp

ggplot(Data, aes(x=Temp, y=LRR_Mean, color=Trt)) +
  geom_pointrange(aes(ymin=LRR_Mean-LRR_Var, ymax=LRR_Mean + LRR_Var, shape=Trt, color=Trt))+
  geom_smooth(method=lm,
              se=FALSE)+
  #scale_colour_hue(l=50) +
  theme(axis.text.x = element_text(colour="black"), panel.grid.minor = element_blank(), panel.grid.major = element_blank())+
  ylab(bquote(LRR))+
  xlab(bquote(Temperature))+
  ylim(-5,5) +
  scale_colour_manual(values=c("#377eb8", "#4daf4a", "#984ea3", "#ff7f00"))
```

```
## Warning: Removed 1679 rows containing non-finite values (stat_smooth).
## Warning: Removed 1681 rows containing missing values (geom_pointrange).
```



```
#Chla vs. Temp ANCOVAs
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(LRR_Mean~Trt*Temp, data=Data)
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
```

```
##
```

```
## Response: LRR_Mean
```

	Sum Sq	Df	F value	Pr(>F)
(Intercept)	39.58	1	63.8168	4.104e-15 ***
Trt	5.46	2	4.4005	0.01253 *
Temp	3.28	1	5.2837	0.02175 *
Trt:Temp	0.82	2	0.6584	0.51791
Residuals	565.63	912		

```
## ---
```

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

```
#Doesn't quite meet assumptions
```

```
#par(mfrow=c(2,2))
```

```
#plot(Model)
```

```
#Lsmeans (pairwise trt differences, averaging over temperature)
```

```
lsmeans(Model, pairwise~Trt)

## NOTE: Results may be misleading due to involvement in interactions

## $lsmeans
## Trt      lsmean      SE df lower.CL upper.CL
## N    0.2314538 0.04444813 912 0.1442213 0.3186863
## NP   0.5839468 0.04466983 912 0.4962792 0.6716144
## P    0.2204095 0.04601006 912 0.1301116 0.3107074
##
## Confidence level used: 0.95
##
## $contrasts
## contrast      estimate      SE df t.ratio p.value
## N - NP   -0.35249306 0.06301610 912  -5.594  <.0001
## N - P     0.01104426 0.06397313 912   0.173  0.9837
## NP - P     0.36353732 0.06412737 912   5.669  <.0001
##
## P value adjustment: tukey method for comparing a family of 3 estimates

#Lstrends (pairwise trt differences in the way chl-a responds to temperature)

comp=lstrends(Model, ~ Trt, var = "Temp")
cld(comp)

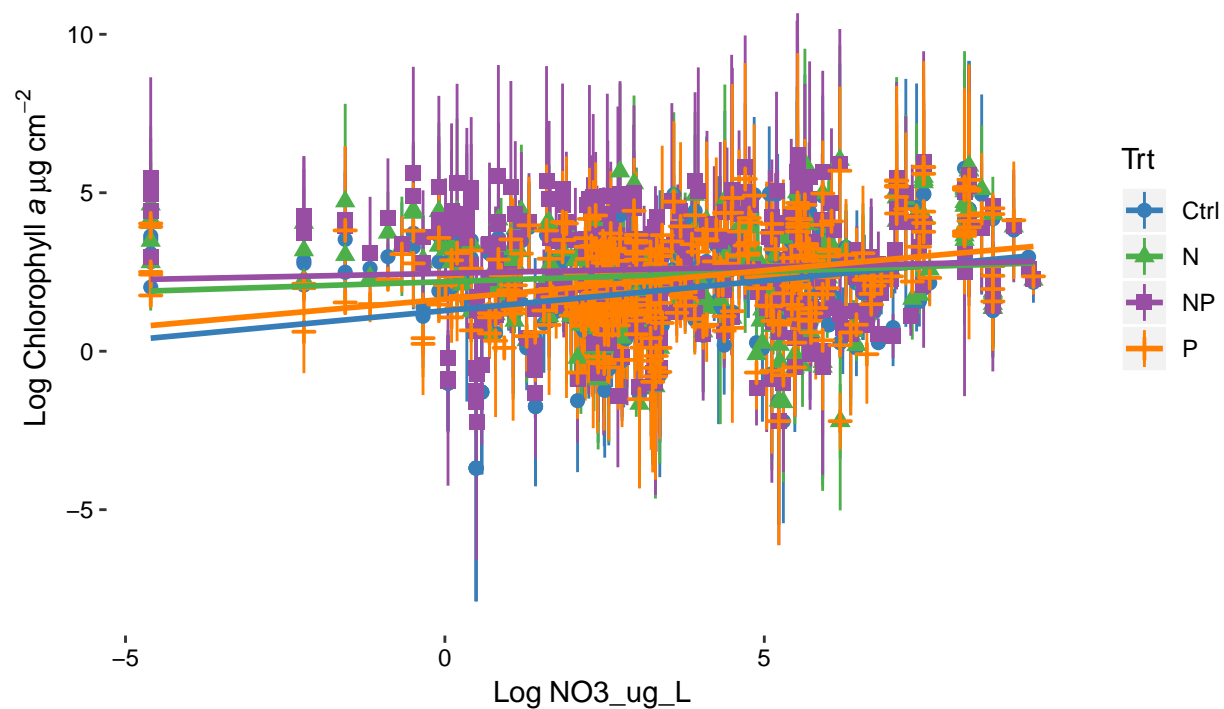
## Trt Temp.trend      SE df lower.CL upper.CL .group
## P   -0.013752727 0.006340441 912 -0.02619628 -0.001309176 1
## NP  -0.007688778 0.006264648 912 -0.01998358 0.004606024 1
## N   -0.003587448 0.006254203 912 -0.01586175 0.008686854 1
##
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 3 estimates
## significance level used: alpha = 0.05
```

c.) NO3_ug_L and raw Chl-a

```
#Chla vs. NO3_ug_L

ggplot(Data, aes(x=log(NO3_ug_L+.01), y=log(Chla_Mean+.01), color=Trt)) +
  geom_pointrange(aes(ymin=log(Chla_Mean+.01)-log(Chla_SE+.01), ymax=log(Chla_Mean+.01)+ log(Chla_SE+.01)),
  geom_smooth(method=lm,
              se=FALSE)+
  #scale_colour_hue(l=50) +
  theme(axis.text.x = element_text(colour="black"), panel.grid.minor = element_blank(), panel.grid.major = element_blank(),
  ylab(bquote(Log~Chlorophyll~italic(a)~mu*g*cm^-2))+
  xlab(bquote(Log~NO3_ug_L))+
  scale_colour_manual(values=c("#377eb8", "#4daf4a", "#984ea3", "#ff7f00"))

## Warning: Removed 1073 rows containing non-finite values (stat_smooth).
## Warning: Removed 1073 rows containing missing values (geom_pointrange).
```



```
#Chla vs. NO3_ug_L ANCOVAs
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(log(Chla_Mean+.01)~Trt*log(NO3_ug_L+.01), data=Data)
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
##
## Response: log(Chla_Mean + 0.01)
##              Sum Sq   Df F value    Pr(>F)
## (Intercept)   1714.7    1  684.3575 < 2.2e-16 ***
## Trt           108.5     3   14.4306 2.851e-09 ***
## log(NO3_ug_L + 0.01) 140.4    1   56.0216 1.210e-13 ***
## Trt:log(NO3_ug_L + 0.01) 45.6     3    6.0617 0.0004229 ***
## Residuals     3796.0 1515
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#Log meets assumptions pretty well
```

```
#par(mfrow=c(2,2))
#plot(Model)
```

```
#Lsmeans (pairwise trt differences, averaging over NO3_ug_Lerature)
```

```
lsmeans(Model, pairwise~Trt)
```

```
## NOTE: Results may be misleading due to involvement in interactions

## $lsmeans
##   Trt      lsmean      SE    df lower.CL upper.CL
##   Ctrl 2.452760 0.1045692 1515 2.247644 2.657876
##   N    2.589967 0.1098801 1515 2.374434 2.805500
##   NP   2.709230 0.1142756 1515 2.485075 2.933385
##   P    2.764117 0.1191243 1515 2.530451 2.997783
##
## Results are given on the log (not the response) scale.
## Confidence level used: 0.95
##
## $contrasts
##   contrast      estimate      SE    df t.ratio p.value
##   Ctrl - N    -0.13720730 0.1516850 1515  -0.905  0.8024
##   Ctrl - NP   -0.25646995 0.1548987 1515  -1.656  0.3478
##   Ctrl - P    -0.31135669 0.1585096 1515  -1.964  0.2021
##   N - NP      -0.11926266 0.1585324 1515  -0.752  0.8757
##   N - P       -0.17414940 0.1620624 1515  -1.075  0.7051
##   NP - P      -0.05488674 0.1650742 1515  -0.332  0.9873
##
## Results are given on the log (not the response) scale.
## P value adjustment: tukey method for comparing a family of 4 estimates
#Lstrends (pairwise trt differences in the way chl-a responds to NO3_ug_Lerature)

comp=lstrends(Model, ~ Trt, var = "NO3_ug_L")
cld(comp)

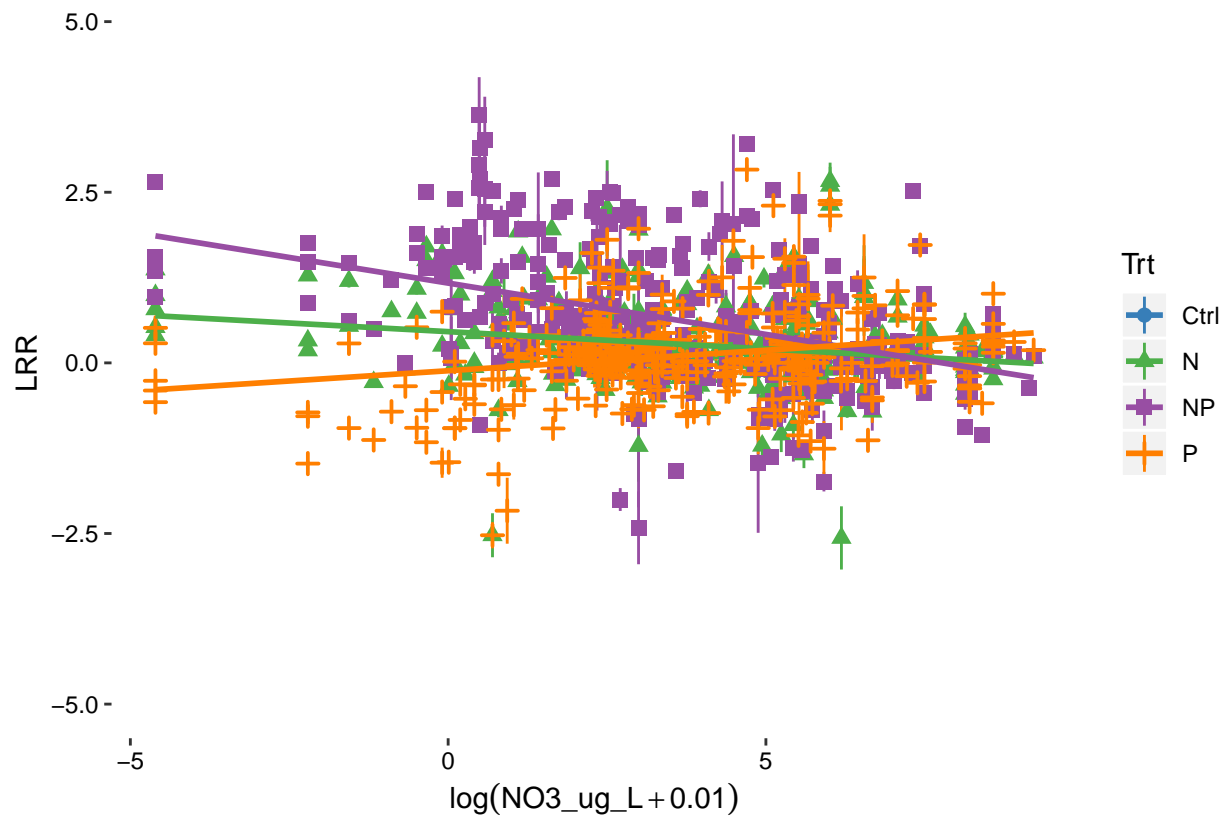
##   Trt NO3_ug_L.trend      SE    df      lower.CL      upper.CL .group
##   NP    7.409334e-05 5.651369e-05 1515 -3.676003e-05 0.0001849467    1
##   N     1.162822e-04 5.839608e-05 1515  1.736452e-06 0.0002308279    12
##   P     3.287566e-04 6.141273e-05 1515  2.082936e-04 0.0004492196    23
##   Ctrl  3.435698e-04 5.394183e-05 1515  2.377612e-04 0.0004493783    3
##
## Trends are based on the log (transformed) scale
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 4 estimates
## significance level used: alpha = 0.05
```

d.) NO3_ug_L and Nutrient LRRs

```
#LRRs vs. NO3_ug_L

ggplot(Data, aes(x=log(NO3_ug_L+.01), y=LRR_Mean, color=Trt)) +
  geom_pointrange(aes(ymin=LRR_Mean-LRR_Var, ymax=LRR_Mean + LRR_Var, shape=Trt, color=Trt))+
  geom_smooth(method=lm,
              se=FALSE)+
  #scale_colour_hue(l=50) +
  theme(axis.text.x = element_text(colour="black"), panel.grid.minor = element_blank(), panel.grid.major = element_blank())+
  ylab(bquote(LRR))+
  xlab(bquote(log(NO3_ug_L+.01)))+
  ylim(-5,5) +
  scale_colour_manual(values=c("#377eb8", "#4daf4a", "#984ea3", "#ff7f00"))
```

```
## Warning: Removed 1496 rows containing non-finite values (stat_smooth).
## Warning: Removed 1499 rows containing missing values (geom_pointrange).
```



```
#Chla vs. NO3_ug_L ANCOVAs
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(LRR_Mean~Trt*NO3_ug_L, data=Data)
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
```

```
##
```

```
## Response: LRR_Mean
```

	Sum Sq	Df	F value	Pr(>F)
(Intercept)	123.25	1	209.765	< 2.2e-16 ***
Trt	60.22	2	51.243	< 2.2e-16 ***
NO3_ug_L	5.61	1	9.555	0.002045 **
Trt:NO3_ug_L	8.12	2	6.914	0.001038 **
Residuals	642.78	1094		

```
## ---
```

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

```
#Doesn't really meet assumptions- outliers?
```

```
#par(mfrow=c(2,2))
```

```
#plot(Model)
```

```
#Lsmeans (pairwise trt differences, averaging over NO3_ug_Lerature)
```



```
lsmeans(Model, pairwise~Trt)
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

```
## $lsmeans
```

```
## Trt    lsmean      SE    df  lower.CL upper.CL
## N    0.2601297 0.03981684 1094 0.18200373 0.3382558
## NP   0.6246664 0.03916757 1094 0.54781432 0.7015184
## P    0.1107151 0.04123125 1094 0.02981387 0.1916164
##
```

```
## Confidence level used: 0.95
```

```
##
```

```
## $contrasts
```

```
## contrast estimate      SE    df t.ratio p.value
## N - NP   -0.3645366 0.05585230 1094  -6.527  <.0001
## N - P     0.1494146 0.05731838 1094   2.607  0.0251
## NP - P     0.5139512 0.05686927 1094   9.037  <.0001
##
```

```
## P value adjustment: tukey method for comparing a family of 3 estimates
```

```
#Lstrends (pairwise trt differences in the way chl-a responds to NO3_ug_Lerature)
```

```
comp=lstrends(Model, ~ Trt, var = "NO3_ug_L")
cld(comp)
```

```
## Trt NO3_ug_L.trend      SE    df  lower.CL  upper.CL .group
## NP  -1.472268e-04 3.046905e-05 1094 -2.070112e-04 -8.744246e-05 1
## N   -4.831936e-05 3.114293e-05 1094 -1.094260e-04 1.278726e-05 12
## P    2.269212e-05 3.505391e-05 1094 -4.608837e-05 9.147261e-05 2
##
```

```
## Confidence level used: 0.95
```

```
## P value adjustment: tukey method for comparing a family of 3 estimates
```

```
## significance level used: alpha = 0.05
```

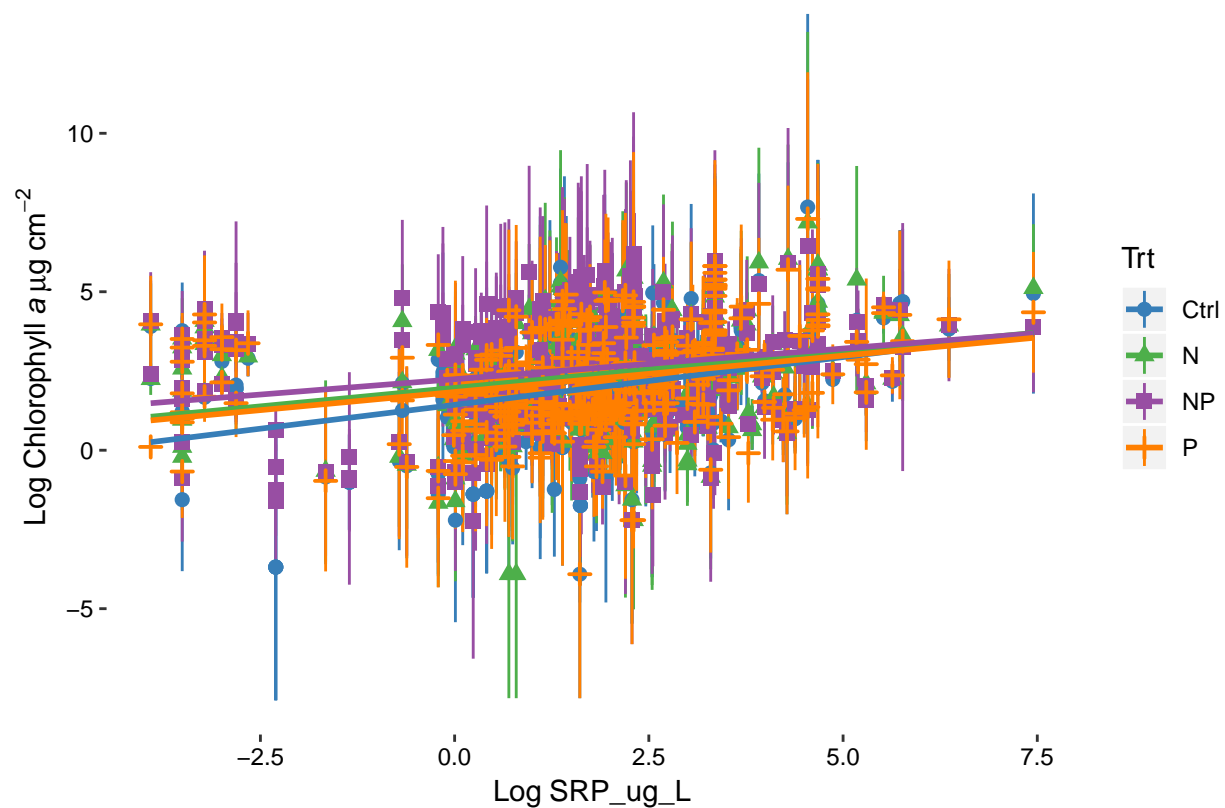
e.) SRP_ug_L and raw Chl-a

```
#Chla vs. SRP_ug_L
```

```
ggplot(Data, aes(x=log(SRP_ug_L+.01), y=log(Chla_Mean+.01), color=Trt)) +
  geom_pointrange(aes(ymin=log(Chla_Mean+.01)-log(Chla_SE+.01), ymax=log(Chla_Mean+.01)+ log(Chla_SE+.01))) +
  geom_smooth(method=lm,
              se=FALSE)+
  #scale_colour_hue(l=50) +
  theme(axis.text.x = element_text(colour="black"), panel.grid.minor = element_blank(), panel.grid.major = element_blank()) +
  ylab(bquote(Log~Chlorophyll~italic(a)~mu*g*~cm^-2))+
  xlab(bquote(Log~SRP_ug_L))+
  scale_colour_manual(values=c("#377eb8", "#4daf4a", "#984ea3", "#ff7f00"))
```

```
## Warning: Removed 1033 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 1033 rows containing missing values (geom_pointrange).
```



```
#Chla vs. SRP_ug_L ANCOVAs
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(log(Chla_Mean+.01)~Trt*log(SRP_ug_L+.01), data=Data)
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
##
## Response: log(Chla_Mean + 0.01)
##
```

	Sum Sq	Df	F value	Pr(>F)
(Intercept)	2889.0	1	1094.0171	< 2.2e-16 ***
Trt	78.1	3	9.8528	1.946e-06 ***
log(SRP_ug_L + 0.01)	309.8	1	117.3104	< 2.2e-16 ***
Trt:log(SRP_ug_L + 0.01)	8.8	3	1.1156	0.3415
Residuals	4106.3	1555		

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

```
#Log meets assumptions
```

```
#par(mfrow=c(2,2))
#plot(Model)
```

```
#Lsmeans (pairwise trt differences, averaging over SRP_ug_Lerature)
```

```
lsmeans(Model, pairwise~Trt)
```

```
## NOTE: Results may be misleading due to involvement in interactions

## $lsmeans
## Trt      lsmean      SE    df lower.CL upper.CL
## Ctrl 2.406370 0.1011331 1555 2.207998 2.604742
## N    2.718951 0.1046278 1555 2.513725 2.924178
## NP   2.867297 0.1072452 1555 2.656936 3.077658
## P    2.578531 0.1084938 1555 2.365722 2.791341
##
## Results are given on the log (not the response) scale.
## Confidence level used: 0.95
##
## $contrasts
## contrast      estimate      SE    df t.ratio p.value
## Ctrl - N    -0.3125813 0.1455159 1555  -2.148  0.1385
## Ctrl - NP   -0.4609269 0.1474091 1555  -3.127  0.0097
## Ctrl - P    -0.1721612 0.1483200 1555  -1.161  0.6518
## N - NP      -0.1483456 0.1498283 1555  -0.990  0.7551
## N - P        0.1404201 0.1507245 1555   0.932  0.7879
## NP - P       0.2887658 0.1525531 1555   1.893  0.2315
##
## Results are given on the log (not the response) scale.
## P value adjustment: tukey method for comparing a family of 4 estimates
#Lstrends (pairwise trt differences in the way chl-a responds to SRP_ug_Lerature)

comp=lstrends(Model, ~ Trt, var = "SRP_ug_L")
cld(comp)

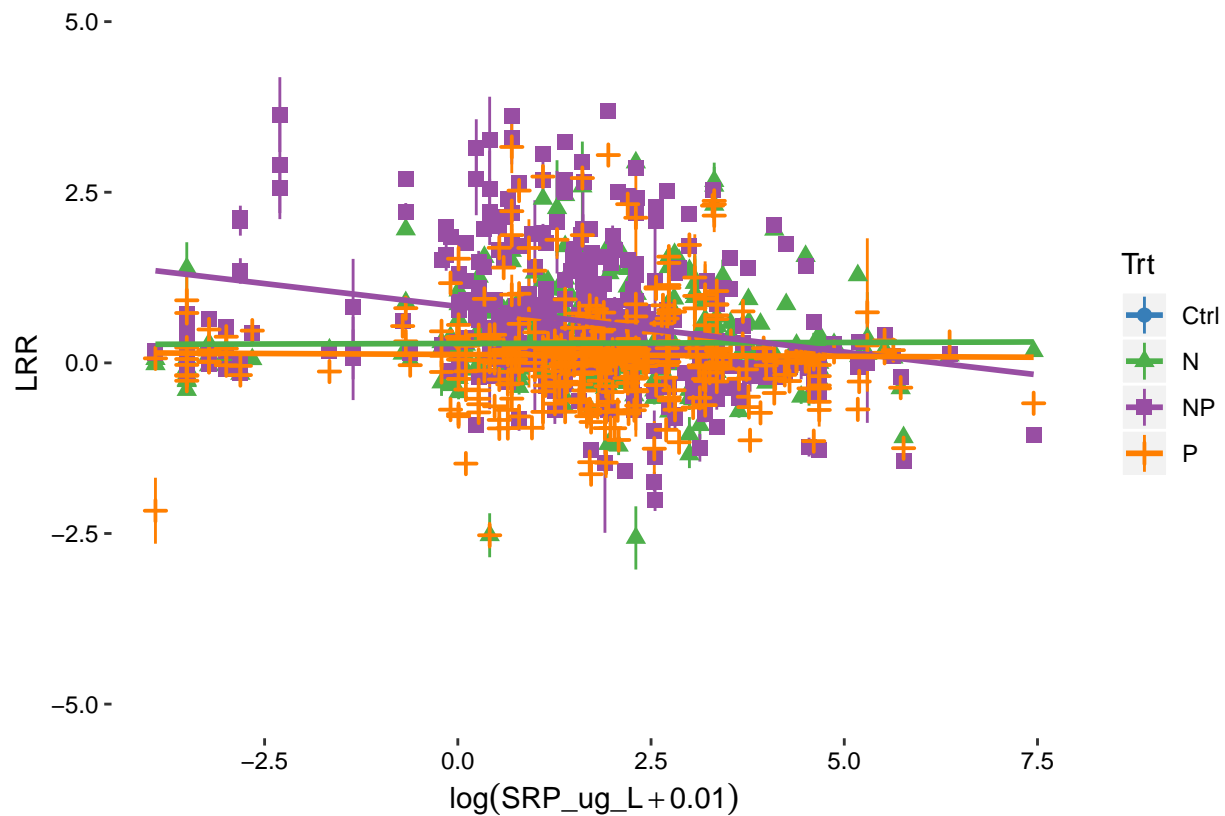
## Trt SRP_ug_L.trend      SE    df    lower.CL    upper.CL .group
## NP      0.005818832 0.001293512 1555  0.003281621 0.008356043 1
## P       0.006885602 0.001380123 1555  0.004178503 0.009592701 1
## N       0.006989942 0.001364861 1555  0.004312780 0.009667104 1
## Ctrl    0.009047831 0.001265452 1555  0.006565658 0.011530004 1
##
## Trends are based on the log (transformed) scale
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 4 estimates
## significance level used: alpha = 0.05
```

f.) SRP_ug_L and Nutrient LRRs

```
#LRRs vs. SRP_ug_L

ggplot(Data, aes(x=log(SRP_ug_L+.01), y=LRR_Mean, color=Trt)) +
  geom_pointrange(aes(ymin=LRR_Mean-LRR_Var, ymax=LRR_Mean + LRR_Var, shape=Trt, color=Trt))+
  geom_smooth(method=lm,
              se=FALSE)+
  #scale_colour_hue(l=50) +
  theme(axis.text.x = element_text(colour="black"), panel.grid.minor = element_blank(), panel.grid.major = element_blank())+
  ylab(bquote(LRR))+
  xlab(bquote(log(SRP_ug_L+.01)))+
  ylim(-5,5)+
  scale_colour_manual(values=c("#377eb8", "#4daf4a", "#984ea3", "#ff7f00"))
```

```
## Warning: Removed 1469 rows containing non-finite values (stat_smooth).
## Warning: Removed 1472 rows containing missing values (geom_pointrange).
```



```
#Chla vs. SRP_ug_L ANCOVAs
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(LRR_Mean~Trt*log(SRP_ug_L+.01), data=Data)
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
```

```
##
```

```
## Response: LRR_Mean
```

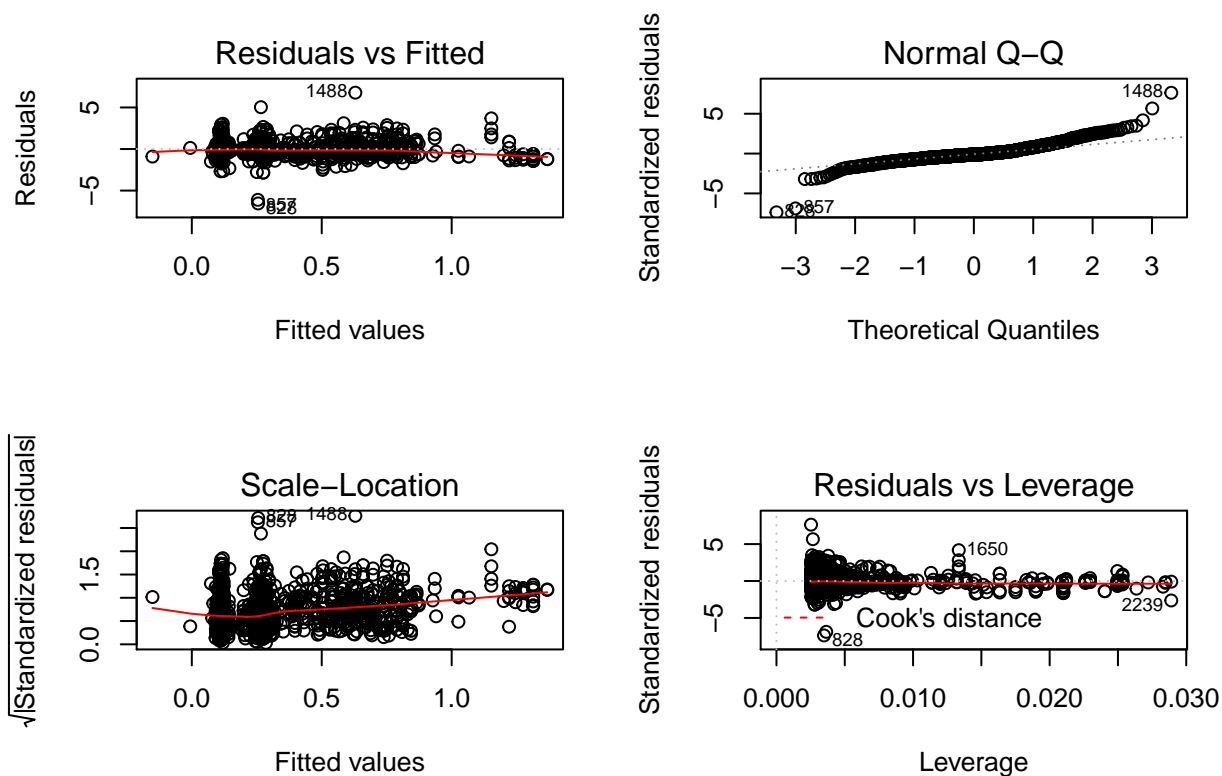
	Sum Sq	Df	F value	Pr(>F)
(Intercept)	97.71	1	123.4480	< 2.2e-16 ***
Trt	63.12	2	39.8689	< 2.2e-16 ***
log(SRP_ug_L + 0.01)	6.98	1	8.8183	0.003045 **
Trt:log(SRP_ug_L + 0.01)	17.47	2	11.0327	1.799e-05 ***
Residuals	890.48	1125		

```
## ---
```

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

```
#Doesn't really meet assumptions- outliers?
```

```
par(mfrow=c(2,2))
plot(Model)
```



```
#Lsmeans (pairwise trt differences, averaging over SRP_ug_Lerature)
```

```
lsmeans(Model, pairwise~Trt)
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

```
## $lsmeans
```

## Trt	lsmean	SE	df	lower.CL	upper.CL
## N	0.2873154	0.05758536	1125	0.17432857	0.4003021
## NP	0.4095170	0.05902190	1125	0.29371157	0.5253223
## P	0.1055423	0.05970582	1125	-0.01160496	0.2226896

```
##
```

```
## Confidence level used: 0.95
```

```
##
```

```
## $contrasts
```

## contrast	estimate	SE	df	t.ratio	p.value
## N - NP	-0.1222016	0.08246004	1125	-1.482	0.3000
## N - P	0.1817730	0.08295094	1125	2.191	0.0731
## NP - P	0.3039746	0.08395457	1125	3.621	0.0009

```
##
```

```
## P value adjustment: tukey method for comparing a family of 3 estimates
```

```
#Lstrends (pairwise trt differences in the way chl-a responds to SRP_ug_Lerature)
```

```
comp=lstrends(Model, ~ Trt, var = "SRP_ug_L")
cld(comp)
```

## Trt	SRP_ug_L.trend	SE	df	lower.CL	upper.CL	.group
--------	----------------	----	----	----------	----------	--------

```
## NP -0.0039550217 0.0006971827 1125 -0.005322946 -0.002587097 1
## P -0.0001617694 0.0007438650 1125 -0.001621288 0.001297749 2
## N 0.0003834353 0.0007356389 1125 -0.001059943 0.001826814 2
##
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 3 estimates
## significance level used: alpha = 0.05
```

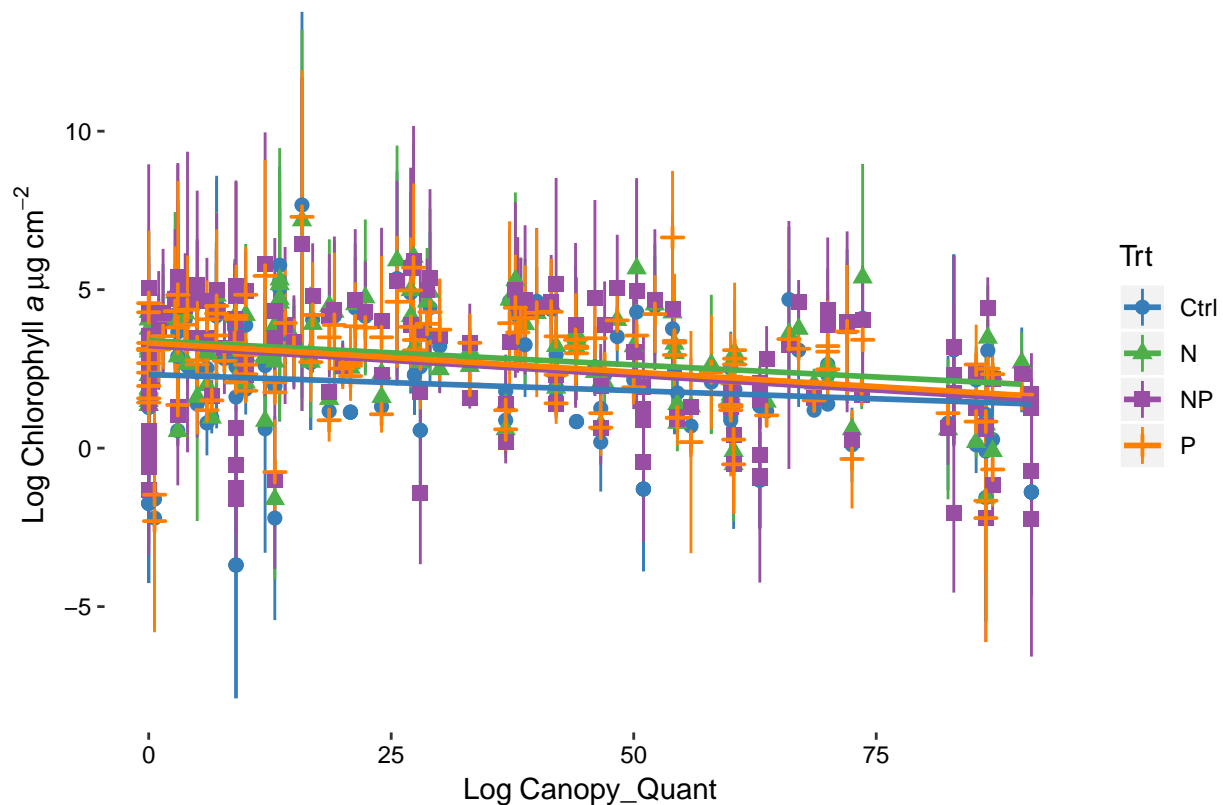
g.) Canopy_Quant and raw Chl-a

#Chla vs. Canopy_Quant

```
ggplot(Data, aes(x=Canopy_Quant, y=log(Chla_Mean+.01), color=Trt)) +
  geom_pointrange(aes(ymin=log(Chla_Mean+.01)-log(Chla_SE+.01), ymax=log(Chla_Mean+.01)+log(Chla_SE+.01))) +
  geom_smooth(method=lm,
    se=FALSE)+
  #scale_colour_hue(l=50) +
  theme(axis.text.x = element_text(colour="black"), panel.grid.minor = element_blank(), panel.grid.major = element_blank()) +
  ylab(bquote(Log~Chlorophyll~italic(a)~mu*g*~cm^-2)) +
  xlab(bquote(Log~Canopy_Quant)) +
  scale_colour_manual(values=c("#377eb8", "#4daf4a", "#984ea3", "#ff7f00"))
```

```
## Warning: Removed 1970 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 1970 rows containing missing values (geom_pointrange).
```



```
#Chla vs. Canopy_Quant ANCOVAs
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(log(Chla_Mean+.01)~Trt*Canopy_Quant, data=Data)
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
##
## Response: log(Chla_Mean + 0.01)
##              Sum Sq Df F value    Pr(>F)
## (Intercept)   2352.31  1 752.3427 < 2.2e-16 ***
## Trt           52.85   3   5.6347 0.0008183 ***
## Canopy_Quant  113.99   1  36.4578 2.693e-09 ***
## Trt:Canopy_Quant  6.28   3   0.6690 0.5712842
## Residuals    1932.27 618
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#Log meets assumptions
```

```
#par(mfrow=c(2,2))
#plot(Model)
```

```
#Lsmeans (pairwise trt differences, averaging over Canopy_Quanterature)
```

```
lsmeans(Model, pairwise~Trt)
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

```
## $lsmeans
##   Trt    lsmean      SE df lower.CL upper.CL
##   Ctrl 1.981605 0.1300118 618 1.726286 2.236924
##   N     2.879152 0.1456722 618 2.593080 3.165225
##   NP    2.608736 0.1430561 618 2.327801 2.889671
##   P     2.703810 0.1494472 618 2.410324 2.997296
##
```

```
## Results are given on the log (not the response) scale.
## Confidence level used: 0.95
```

```
## $contrasts
##   contrast      estimate      SE df t.ratio p.value
##   Ctrl - N   -0.89754729 0.1952523 618  -4.597  <.0001
##   Ctrl - NP  -0.62713088 0.1933084 618  -3.244  0.0068
##   Ctrl - P   -0.72220492 0.1980847 618  -3.646  0.0016
##   N - NP      0.27041641 0.2041701 618   1.324  0.5476
##   N - P       0.17534237 0.2086979 618   0.840  0.8353
##   NP - P     -0.09507404 0.2068804 618  -0.460  0.9677
##
```

```
## Results are given on the log (not the response) scale.
## P value adjustment: tukey method for comparing a family of 4 estimates
```

```
#Lstrends (pairwise trt differences in the way chl-a responds to Canopy_Quanterature)
```

```
comp=lstrends(Model, ~ Trt, var = "Canopy_Quant")
cld(comp)
```

```
## Trt Canopy_Quant.trend SE df lower.CL upper.CL .group
## NP -0.01871252 0.004836179 618 -0.02820985 -0.009215181 1
## P -0.01834459 0.005651818 618 -0.02944369 -0.007245496 1
## N -0.01526333 0.005542806 618 -0.02614835 -0.004378313 1
## Ctrl -0.01021516 0.004605659 618 -0.01925980 -0.001170521 1
##
## Trends are based on the log (transformed) scale
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 4 estimates
## significance level used: alpha = 0.05
```

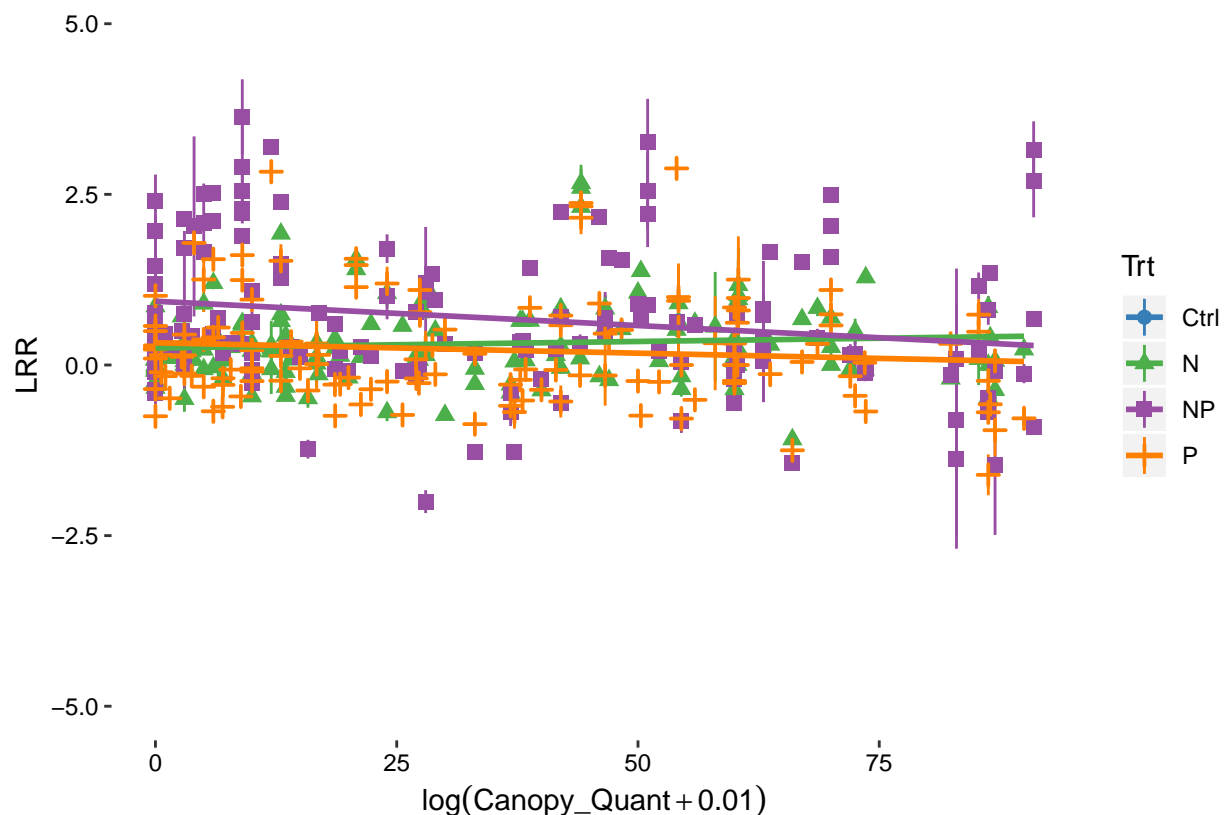
h.) Canopy_Quant and Nutrient LRRs

#LRRs vs. Canopy_Quant

```
ggplot(Data, aes(x=Canopy_Quant, y=LRR_Mean, color=Trt)) +
  geom_pointrange(aes(ymin=LRR_Mean-LRR_Var, ymax=LRR_Mean + LRR_Var, shape=Trt, color=Trt))+
  geom_smooth(method=lm,
              se=FALSE)+
  #scale_colour_hue(l=50) +
  theme(axis.text.x = element_text(colour="black"), panel.grid.minor = element_blank(), panel.grid.major = element_blank())+
  ylab(bquote(LRR))+
  xlab(bquote(log(Canopy_Quant+.01)))+
  ylim(-5,5)+
  scale_colour_manual(values=c("#377eb8", "#4daf4a", "#984ea3", "#ff7f00"))
```

```
## Warning: Removed 2156 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 2157 rows containing missing values (geom_pointrange).
```

#Chla vs. Canopy_Quant ANCOVAs

```
options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(LRR_Mean~Trt*Canopy_Quant, data=Data)
Anova(Model, type="III")
```

Anova Table (Type III tests)

##

Response: LRR_Mean

	Sum Sq	Df	F value	Pr(>F)
## (Intercept)	46.79	1	60.1694	6.247e-14 ***
## Trt	19.36	2	12.4507	5.519e-06 ***
## Canopy_Quant	3.85	1	4.9482	0.02663 *
## Trt:Canopy_Quant	7.20	2	4.6265	0.01028 *
## Residuals	338.27	435		

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

#Doesn't really meet assumptions- a few outliers

```
#par(mfrow=c(2,2))
```

```
#plot(Model)
```

#Lsmeans (pairwise trt differences, averaging over Canopy_Quanterature)

```
lsmeans(Model, pairwise~Trt)
```

```
## NOTE: Results may be misleading due to involvement in interactions

## $lsmeans
##   Trt      lsmean      SE    df  lower.CL  upper.CL
##   N    0.3123903  0.07262424 435  0.16965230 0.4551284
##   NP   0.6627047  0.07135712 435  0.52245710 0.8029523
##   P    0.2239399  0.07453497 435  0.07744648 0.3704334
##
## Confidence level used: 0.95
##
## $contrasts
##   contrast      estimate      SE    df t.ratio p.value
##   N - NP    -0.3503144  0.1018141 435   -3.441  0.0018
##   N - P      0.0884504  0.1040660 435    0.850  0.6721
##   NP - P      0.4387648  0.1031858 435    4.252  0.0001
##
## P value adjustment: tukey method for comparing a family of 3 estimates
#Lstrends (pairwise trt differences in the way chl-a responds to Canopy_Quanterture)

comp=lstrends(Model, ~ Trt, var = "Canopy_Quant")
cld(comp)

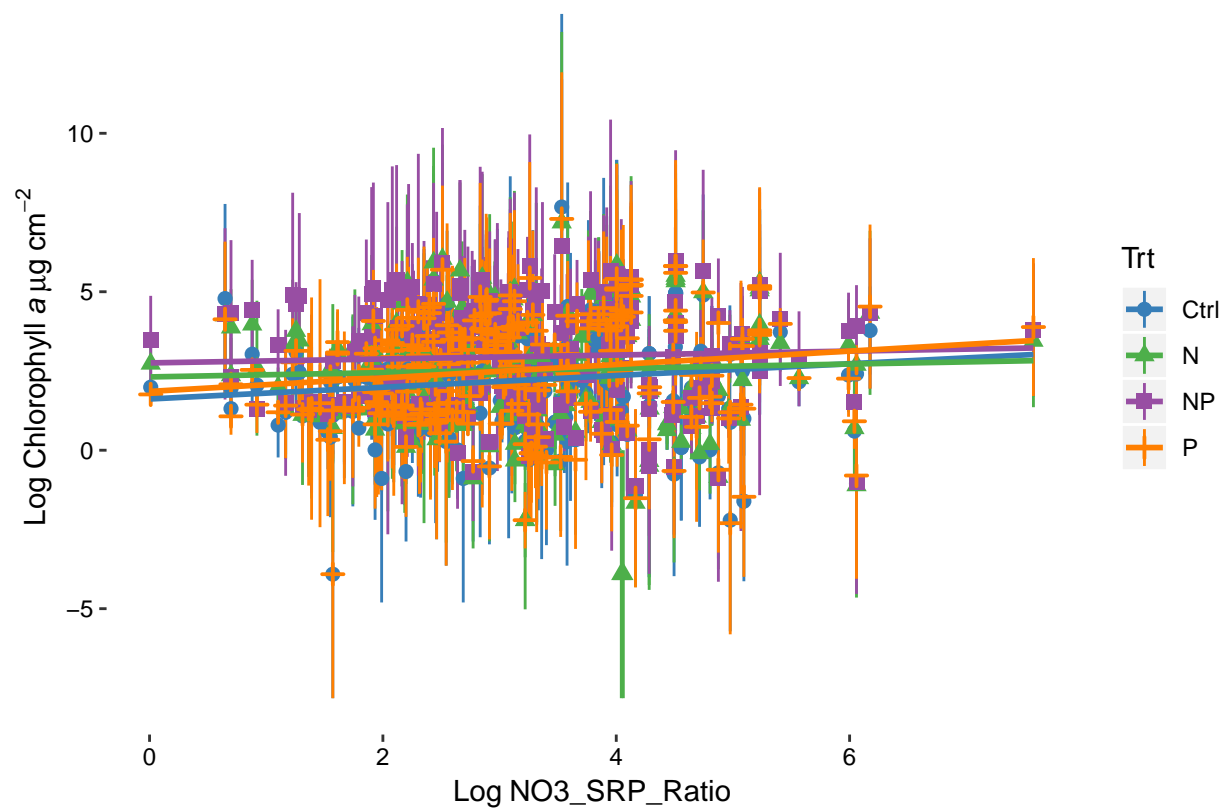
##   Trt Canopy_Quant.trend      SE    df  lower.CL  upper.CL .group
##   NP      -0.009151509  0.002411861 435  -0.013891859 -0.004411158    1
##   P      -0.003054353  0.002818630 435  -0.008594180  0.002485475    12
##   N       0.001914844  0.002764265 435  -0.003518132  0.007347820     2
##
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 3 estimates
## significance level used: alpha = 0.05
```

i.) NO3_SRP_Ratio and raw Chl-a

```
#Chla vs. NO3_SRP_Ratio

ggplot(Data, aes(x=log(NO3_SRP_Ratio+.01), y=log(Chla_Mean+.01), color=Trt)) +
  geom_pointrange(aes(ymin=log(Chla_Mean+.01)-log(Chla_SE+.01), ymax=log(Chla_Mean+.01)+ log(Chla_SE+.01))) +
  geom_smooth(method=lm,
              se=FALSE)+
  #scale_colour_hue(l=50) +
  theme(axis.text.x = element_text(colour="black"), panel.grid.minor = element_blank(), panel.grid.major = element_blank()) +
  ylab(bquote(Log~Chlorophyll~italic(a)~mu*g*~cm^-2))+
  xlab(bquote(Log~NO3_SRP_Ratio))+
  scale_colour_manual(values=c("#377eb8", "#4daf4a", "#984ea3", "#ff7f00"))

## Warning: Removed 1457 rows containing non-finite values (stat_smooth).
## Warning: Removed 1457 rows containing missing values (geom_pointrange).
```



```
#Chla vs. NO3_SRP_Ratio ANCOVAs
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(log(Chla_Mean+.01)~Trt*log(NO3_SRP_Ratio+.01), data=Data)
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
##
## Response: log(Chla_Mean + 0.01)
##
```

	Sum Sq	Df	F value	Pr(>F)
(Intercept)	614.7	1	219.6110	< 2.2e-16 ***
Trt	25.2	3	3.0025	0.029615 *
log(NO3_SRP_Ratio + 0.01)	26.6	1	9.4934	0.002112 **
Trt:log(NO3_SRP_Ratio + 0.01)	7.0	3	0.8278	0.478614
Residuals	3165.6	1131		

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

```
#Log generally meets assumptions
```

```
#par(mfrow=c(2,2))
#plot(Model)
```

```
#Lsmeans (pairwise trt differences, averaging over NO3_SRP_Ratioerature)
```

```
lsmeans(Model, pairwise~Trt)
```

```
## NOTE: Results may be misleading due to involvement in interactions

## $lsmeans
## Trt      lsmean      SE    df lower.CL upper.CL
## Ctrl 2.348707 0.1153741 1131 2.122336 2.575078
## N    2.580036 0.1196325 1131 2.345309 2.814762
## NP   3.000282 0.1225740 1131 2.759784 3.240780
## P    2.693609 0.1232886 1131 2.451709 2.935509
##
## Results are given on the log (not the response) scale.
## Confidence level used: 0.95
##
## $contrasts
## contrast      estimate      SE    df t.ratio p.value
## Ctrl - N    -0.2313289 0.1662020 1131  -1.392  0.5047
## Ctrl - NP   -0.6515750 0.1683317 1131  -3.871  0.0007
## Ctrl - P    -0.3449024 0.1688528 1131  -2.043  0.1731
## N - NP      -0.4202461 0.1712785 1131  -2.454  0.0680
## N - P       -0.1135735 0.1717906 1131  -0.661  0.9116
## NP - P       0.3066726 0.1738518 1131   1.764  0.2914
##
## Results are given on the log (not the response) scale.
## P value adjustment: tukey method for comparing a family of 4 estimates
#Lstrends (pairwise trt differences in the way chl-a responds to NO3_SRP_Ratioerature)

comp=lstrends(Model, ~ Trt, var = "NO3_SRP_Ratio")
cld(comp)

## Trt NO3_SRP_Ratio.trend      SE    df      lower.CL      upper.CL
## NP      0.001011100 0.001433474 1131 -0.0018014670 0.003823667
## N      0.001102023 0.001386252 1131 -0.0016178914 0.003821937
## Ctrl    0.003015823 0.001355612 1131  0.0003560250 0.005675621
## P      0.003453043 0.001394233 1131  0.0007174696 0.006188616
##
## .group
## 1
## 1
## 1
## 1
##
## Trends are based on the log (transformed) scale
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 4 estimates
## significance level used: alpha = 0.05
```

j.) NO3_SRP_Ratio and Nutrient LRRs

```
#LRRs vs. NO3_SRP_Ratio

ggplot(Data, aes(x=log(NO3_SRP_Ratio+.01), y=LRR_Mean, color=Trt)) +
  geom_pointrange(aes(ymin=LRR_Mean-LRR_Var, ymax=LRR_Mean + LRR_Var, shape=Trt, color=Trt))+
  geom_smooth(method=lm,
              se=FALSE)+
#scale_colour_hue(l=50) +
```

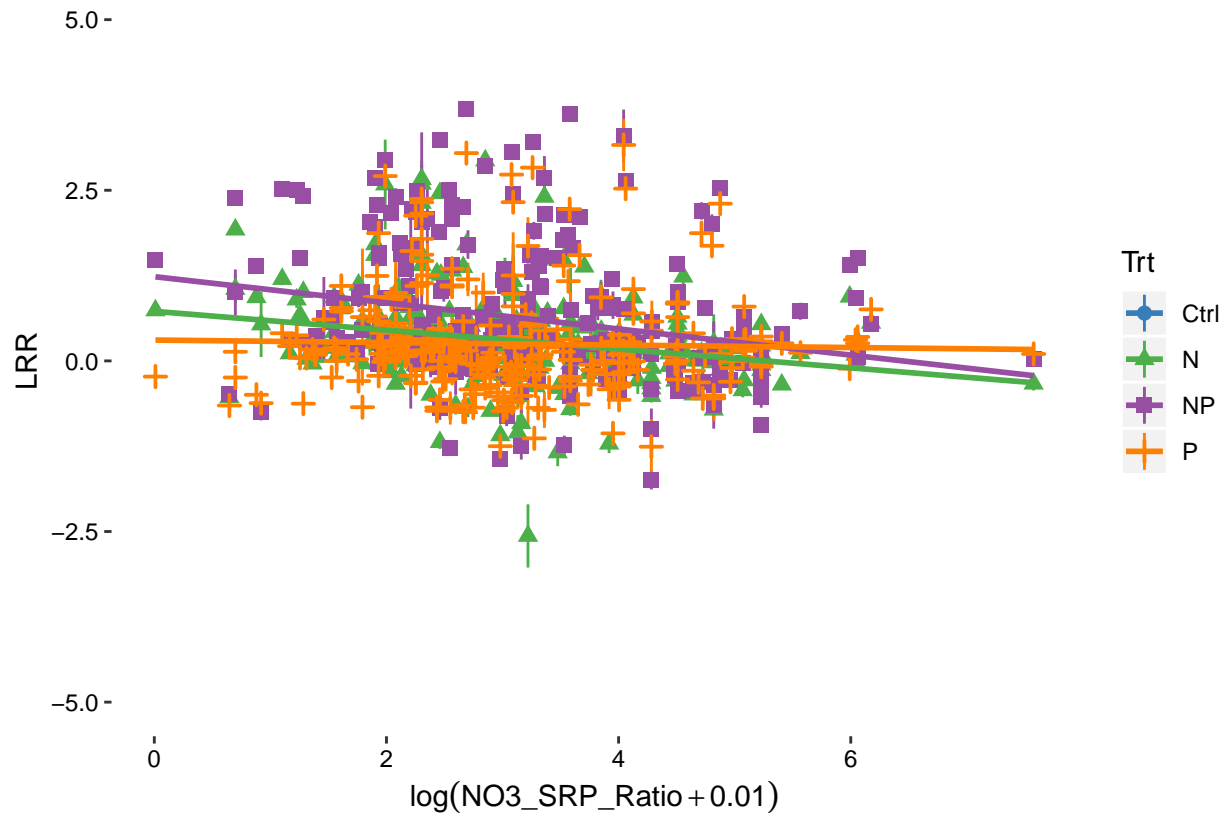
```

theme(axis.text.x = element_text(colour="black"), panel.grid.minor = element_blank(), panel.grid.major = element_blank(),
ylab(bquote(LRR))+
xlab(bquote(log(NO3_SRP_Ratio+.01)))+
ylim(-5,5)+
scale_colour_manual(values=c("#377eb8", "#4daf4a", "#984ea3", "#ff7f00"))

```

```
## Warning: Removed 1765 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 1767 rows containing missing values (geom_pointrange).
```



```
#Chla vs. NO3_SRP_Ratio ANCOVAs
```

```

options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(LRR_Mean~Trt*log(NO3_SRP_Ratio+.01), data=Data)
Anova(Model, type="III")

```

```
## Anova Table (Type III tests)
```

```
##
```

```
## Response: LRR_Mean
```

```
##
```

	Sum Sq	Df	F value	Pr(>F)
(Intercept)	69.81	1	87.6179	< 2.2e-16 ***
Trt	17.95	2	11.2624	1.493e-05 ***
log(NO3_SRP_Ratio + 0.01)	22.70	1	28.4878	1.218e-07 ***
Trt:log(NO3_SRP_Ratio + 0.01)	8.84	2	5.5505	0.004031 **
Residuals	660.51	829		

```
## ---
```

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

```

#Doesn't quite meet assumptions- outliers?

#par(mfrow=c(2,2))
#plot(Model)

#Lsmeans (pairwise trt differences, averaging over NO3_SRP_Ratioerature)
lsmeans(Model, pairwise~Trt)

## NOTE: Results may be misleading due to involvement in interactions

## $lsmeans
##      Trt      lsmean      SE    df    lower.CL    upper.CL
##  N      0.1144148  0.06383318  829  -0.01087883  0.2397085
##  NP     0.4787643  0.06540251  829   0.35039030  0.6071383
##  P      0.2329824  0.06578390  829   0.10385984  0.3621050
##
## Confidence level used: 0.95
##
## $contrasts
##      contrast      estimate      SE    df t.ratio p.value
##  N - NP      -0.3643495  0.09139017  829   -3.987  0.0002
##  N - P       -0.1185676  0.09166349  829   -1.294  0.3992
##  NP - P       0.2457819  0.09276319  829    2.650  0.0223
##
## P value adjustment: tukey method for comparing a family of 3 estimates
#Lstrends (pairwise trt differences in the way chl-a responds to NO3_SRP_Ratioerature)

comp=lstrends(Model, ~ Trt, var = "NO3_SRP_Ratio")
cld(comp)

##      Trt NO3_SRP_Ratio.trend      SE    df    lower.CL    upper.CL .group
##  NP      -0.0035894779  0.0007647009  829  -0.005090455  -0.002088500   1
##  N       -0.0030415544  0.0007395097  829  -0.004493086  -0.001590023   1
##  P       -0.0002969651  0.0007437672  829  -0.001756854   0.001162923   2
##
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 3 estimates
## significance level used: alpha = 0.05

```

k.) NO3_ug_L and Nutrient LRRs

```

#LRRs vs. NO3_ug_L

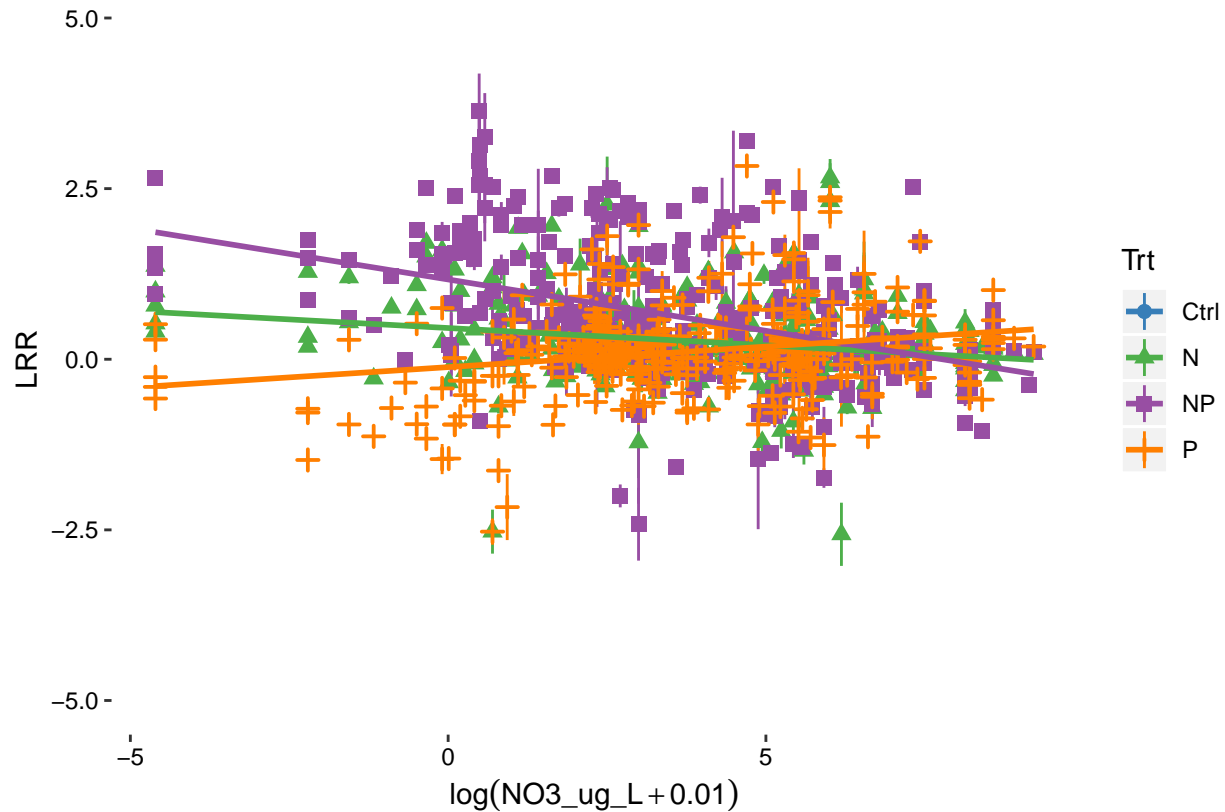
ggplot(Data, aes(x=log(NO3_ug_L+.01), y=LRR_Mean, color=Trt)) +
  geom_pointrange(aes(ymin=LRR_Mean-LRR_Var, ymax=LRR_Mean + LRR_Var, shape=Trt, color=Trt))+
  geom_smooth(method=lm,
              se=FALSE)+
  #scale_colour_hue(l=50) +
  theme(axis.text.x = element_text(colour="black"), panel.grid.minor = element_blank(), panel.grid.major = element_blank())+
  ylab(bquote(LRR))+
  xlab(bquote(log(NO3_ug_L+.01)))+

```

```
ylim(-5,5)+
scale_colour_manual(values=c("#377eb8", "#4daf4a", "#984ea3", "#ff7f00"))
```

```
## Warning: Removed 1496 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 1499 rows containing missing values (geom_pointrange).
```



```
#Chla vs. NO3_ug_L ANCOVAs
```

```
options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(LRR_Mean~Trt*log(NO3_ug_L+.01), data=Data)
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
```

```
##
```

```
## Response: LRR_Mean
```

	Sum Sq	Df	F value	Pr(>F)
(Intercept)	87.96	1	164.454	< 2.2e-16 ***
Trt	99.01	2	92.563	< 2.2e-16 ***
log(NO3_ug_L + 0.01)	15.87	1	29.665	6.34e-08 ***
Trt:log(NO3_ug_L + 0.01)	52.92	2	49.471	< 2.2e-16 ***
Residuals	585.11	1094		

```
## ---
```

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

```
#Meets assumptions
```

```
#par(mfrow=c(2,2))
```

```

#plot(Model)

#Lsmeans (pairwise trt differences, averaging over NO3_ug_Lerature)

lsmeans(Model, pairwise~Trt)

## NOTE: Results may be misleading due to involvement in interactions

## $lsmeans
## Trt      lsmean      SE    df  lower.CL upper.CL
## N    0.1437495 0.05062901 1094 0.04440851 0.2430904
## NP   0.2363295 0.05265564 1094 0.13301208 0.3396470
## P    0.2578174 0.05488503 1094 0.15012552 0.3655092
##
## Confidence level used: 0.95
##
## $contrasts
## contrast      estimate      SE    df t.ratio p.value
## N - NP   -0.09258008 0.07304733 1094  -1.267  0.4140
## N - P    -0.11406790 0.07467037 1094  -1.528  0.2783
## NP - P   -0.02148782 0.07605907 1094  -0.283  0.9570
##
## P value adjustment: tukey method for comparing a family of 3 estimates
#Lstrends (pairwise trt differences in the way chl-a responds to NO3_ug_Lerature)

comp=lstrends(Model, ~ Trt, var = "NO3_ug_L")
cld(comp)

## Trt NO3_ug_L.trend      SE    df  lower.CL  upper.CL .group
## NP  -2.773393e-04 2.644408e-05 1094 -3.292262e-04 -2.254524e-04  1
## N   -9.330772e-05 2.732490e-05 1094 -1.469229e-04 -3.969259e-05  2
## P    1.110495e-04 2.873646e-05 1094  5.466467e-05  1.674343e-04  3
##
## Confidence level used: 0.95
## P value adjustment: tukey method for comparing a family of 3 estimates
## significance level used: alpha = 0.05

```

2.) Three-way interaction models examine the effects of in-stream NO₃, SRP, and temp on chlorophyll a (broken out by treatment) and LRRs (broken out by treatment)

a.) Temp-Nut Interactions and raw Chl-a

```

##Controls

Ctrl=subset(Data, Trt=="Ctrl")

#Chla vs. NO3_ug_L, SRP, Temp ANCOVAs

options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(log(Chla_Mean+.01)~log(NO3_ug_L+.01)*log(SRP_ug_L)*Temp, data=Ctrl)
Anova(Model, type="III")

```



```
## Anova Table (Type III tests)
##
## Response: log(Chla_Mean + 0.01)
##
## Sum Sq Df F value Pr(>F)
## (Intercept) 4.51 1 2.8220 0.094237 .
## log(NO3_ug_L + 0.01) 11.63 1 7.2796 0.007451 **
## log(SRP_ug_L) 4.31 1 2.6983 0.101720
## Temp 38.07 1 23.8244 1.887e-06 ***
## log(NO3_ug_L + 0.01):log(SRP_ug_L) 12.45 1 7.7914 0.005656 **
## log(NO3_ug_L + 0.01):Temp 10.74 1 6.7196 0.010099 *
## log(SRP_ug_L):Temp 0.55 1 0.3445 0.557791
## log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp 1.71 1 1.0678 0.302438
## Residuals 397.94 249
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

#Log meets assumptions

#par(mfrow=c(2,2))
#plot(Model)

##Nitrogens

Nitrogen=subset(Data, Trt=="N")

#Chla vs. NO3_ug_L, SRP, Temp ANCOVAs

options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(log(Chla_Mean+.01)~log(NO3_ug_L+.01)*log(SRP_ug_L)*Temp, data=Nitrogen)
Anova(Model, type="III")

## Anova Table (Type III tests)
##
## Response: log(Chla_Mean + 0.01)
##
## Sum Sq Df F value Pr(>F)
## (Intercept) 2.66 1 1.3706 0.24291
## log(NO3_ug_L + 0.01) 9.65 1 4.9617 0.02688 *
## log(SRP_ug_L) 2.33 1 1.1979 0.27488
## Temp 35.02 1 18.0125 3.175e-05 ***
## log(NO3_ug_L + 0.01):log(SRP_ug_L) 9.93 1 5.1058 0.02477 *
## log(NO3_ug_L + 0.01):Temp 11.31 1 5.8161 0.01666 *
## log(SRP_ug_L):Temp 0.62 1 0.3168 0.57409
## log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp 2.34 1 1.2028 0.27390
## Residuals 451.08 232
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

#Log meets assumptions

#par(mfrow=c(2,2))
#plot(Model)

##Phosphorus
```

```
Phosphorus=subset(Data, Trt=="P")

#Chla vs. NO3_ug_L, SRP, Temp ANCOVAs

options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(log(Chla_Mean+.01)~log(NO3_ug_L+.01)*log(SRP_ug_L)*Temp, data=Phosphorus)
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
##
## Response: log(Chla_Mean + 0.01)
##
```

	Sum Sq	Df	F value	Pr(>F)
(Intercept)	1.44	1	0.8350	0.361880
log(NO3_ug_L + 0.01)	3.61	1	2.0916	0.149601
log(SRP_ug_L)	1.09	1	0.6291	0.428580
Temp	23.83	1	13.8130	0.000259 ***
log(NO3_ug_L + 0.01):log(SRP_ug_L)	9.76	1	5.6578	0.018275 *
log(NO3_ug_L + 0.01):Temp	3.46	1	2.0043	0.158340
log(SRP_ug_L):Temp	0.30	1	0.1741	0.676947
log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp	3.10	1	1.7996	0.181214
Residuals	362.24	210		

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

#Log meets assumptions

```
#par(mfrow=c(2,2))
#plot(Model)
```

##Nitrogen + Phosphorus

```
NP=subset(Data, Trt=="NP")

#Chla vs. NO3_ug_L, SRP, Temp ANCOVAs

options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(log(Chla_Mean+.01)~log(NO3_ug_L+.01)*log(SRP_ug_L)*Temp, data=NP)
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
##
## Response: log(Chla_Mean + 0.01)
##
```

	Sum Sq	Df	F value	Pr(>F)
(Intercept)	7.44	1	3.2953	0.070891 .
log(NO3_ug_L + 0.01)	1.30	1	0.5743	0.449405
log(SRP_ug_L)	19.74	1	8.7405	0.003465 **
Temp	12.43	1	5.5014	0.019925 *
log(NO3_ug_L + 0.01):log(SRP_ug_L)	44.11	1	19.5296	1.58e-05 ***
log(NO3_ug_L + 0.01):Temp	0.07	1	0.0321	0.857982
log(SRP_ug_L):Temp	11.55	1	5.1126	0.024767 *
log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp	18.19	1	8.0547	0.004979 **
Residuals	478.80	212		

```
## ---
```

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

```
#Log meets assumptions
```

```
#par(mfrow=c(2,2))
```

```
#plot(Model)
```

b.) Temp-Nut interactions on LRRs

```
##Nitrogens
```

```
Nitrogen=subset(Data, Trt=="N")
```

```
#LRR vs. NO3_ug_L, SRP, Temp ANCOVAs
```

```
options(contrasts=c("contr.sum", "contr.poly"))
```

```
Model=aov(LRR_Mean~log(NO3_ug_L+.01)*log(SRP_ug_L)*Temp, data=Nitrogen)
```

```
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
```

```
##
```

```
## Response: LRR_Mean
```

	Sum Sq	Df	F value	Pr(>F)	
## (Intercept)	2.987	1	8.4863	0.003928	**
## log(NO3_ug_L + 0.01)	1.220	1	3.4674	0.063853	.
## log(SRP_ug_L)	0.800	1	2.2730	0.133009	
## Temp	0.745	1	2.1169	0.147029	
## log(NO3_ug_L + 0.01):log(SRP_ug_L)	1.595	1	4.5314	0.034332	*
## log(NO3_ug_L + 0.01):Temp	0.307	1	0.8717	0.351453	
## log(SRP_ug_L):Temp	1.014	1	2.8815	0.090945	.
## log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp	1.299	1	3.6924	0.055885	.
## Residuals	81.647	232			

```
## ---
```

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

```
#Log mostly meets assumptions
```

```
#par(mfrow=c(2,2))
```

```
#plot(Model)
```

```
##Phosphorus
```

```
Phosphorus=subset(Data, Trt=="P")
```

```
#Chla vs. NO3_ug_L, SRP, Temp ANCOVAs
```

```
options(contrasts=c("contr.sum", "contr.poly"))
```

```
Model=aov(LRR_Mean~log(NO3_ug_L+.01)*log(SRP_ug_L)*Temp, data=Phosphorus)
```

```
Anova(Model, type="III")
```

```
## Anova Table (Type III tests)
```

```
##
```

```
## Response: LRR_Mean
```

```
##                               Sum Sq Df F value Pr(>F)
## (Intercept)                   0.648  1  1.6525 0.20003
## log(NO3_ug_L + 0.01)          0.328  1  0.8363 0.36152
## log(SRP_ug_L)                  0.255  1  0.6492 0.42131
## Temp                          0.506  1  1.2906 0.25724
## log(NO3_ug_L + 0.01):log(SRP_ug_L) 0.745  1  1.8995 0.16961
## log(NO3_ug_L + 0.01):Temp       0.603  1  1.5368 0.21648
## log(SRP_ug_L):Temp              0.785  1  2.0012 0.15866
## log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp 1.507  1  3.8402 0.05136 .
## Residuals                     82.394 210
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

#Log mostly meets assumptions

#par(mfrow=c(2,2))
#plot(Model)

##Nitrogen + Phosphorus

NP=subset(Data, Trt=="NP")

#Chla vs. NO3_ug_L, SRP, Temp ANCOVAs

options(contrasts=c("contr.sum", "contr.poly"))
Model=aov(LRR_Mean~log(NO3_ug_L+.01)*log(SRP_ug_L)*Temp, data=NP)
Anova(Model, type="III")

## Anova Table (Type III tests)
##
## Response: LRR_Mean
##                               Sum Sq Df F value    Pr(>F)
## (Intercept)                   11.557  1 23.6165 2.285e-06 ***
## log(NO3_ug_L + 0.01)           5.454  1 11.1453 0.0009951 ***
## log(SRP_ug_L)                   7.226  1 14.7664 0.0001608 ***
## Temp                           1.931  1  3.9467 0.0482525 *
## log(NO3_ug_L + 0.01):log(SRP_ug_L) 5.656  1 11.5575 0.0008061 ***
## log(NO3_ug_L + 0.01):Temp       3.282  1  6.7061 0.0102745 *
## log(SRP_ug_L):Temp              8.244  1 16.8472 5.780e-05 ***
## log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp 6.503  1 13.2888 0.0003359 ***
## Residuals                     103.745 212
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

#Log meets assumptions

#par(mfrow=c(2,2))
#plot(Model)
```