

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

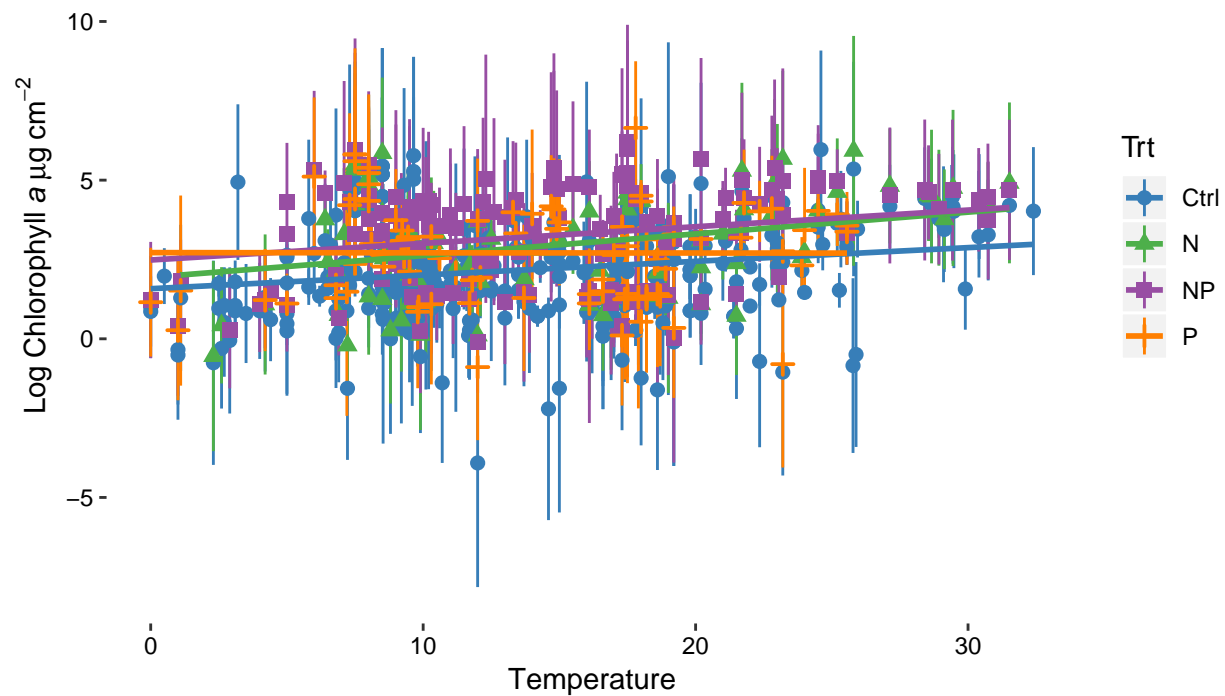
a. Temperature and raw Chl-a

#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 556 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 556 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) 449.19  1 193.7091 < 2.2e-16 ***
## Trt          26.10  3   3.7519  0.01082 *
## Temp         38.90  1  16.7768 4.696e-05 ***
## Trt:Temp     10.40  3   1.4954  0.21453
## Residuals   1623.22 700
## ---
## 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  2.190645 0.08051639 700 2.032562 2.348727
## N      2.907072 0.15261647 700 2.607431 3.206713
## NP     3.227157 0.12174516 700 2.988127 3.466186
## P      2.707094 0.15826899 700 2.396355 3.017833
##
## 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    -0.7164270 0.1725534 700  -4.152  0.0002
## Ctrl - NP   -1.0365117 0.1459616 700  -7.101  <.0001
## Ctrl - P    -0.5164492 0.1775724 700  -2.908  0.0196
## N - NP      -0.3200846 0.1952272 700  -1.640  0.3571
## N - P        0.1999779 0.2198655 700   0.910  0.7998
## NP - P       0.5200625 0.1996771 700   2.605  0.0463
##
## 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)

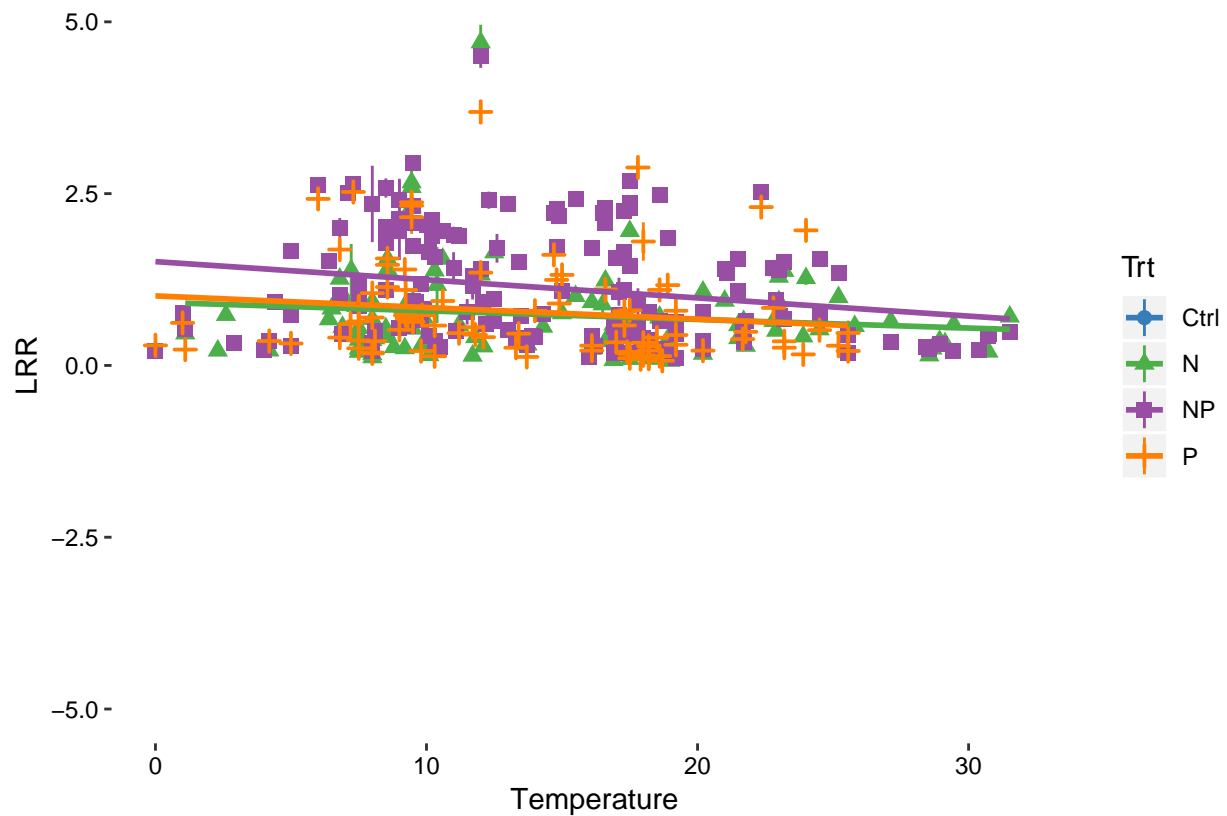
## Trt      Temp.trend      SE    df    lower.CL    upper.CL .group
## P      -0.0005966077 0.02617721 700 -0.05199186 0.05079864 1
## Ctrl   0.0431581478 0.01168599 700  0.02021436 0.06610193 1
## NP     0.0524759991 0.01826102 700  0.01662306 0.08832894 1
## N      0.0685480396 0.02097145 700  0.02737357 0.10972251 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 914 rows containing non-finite values (stat_smooth).
## Warning: Removed 914 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)	76.597	1	138.7054	< 2.2e-16 ***
Trt	4.697	2	4.2525	0.014983 *
Temp	4.953	1	8.9687	0.002945 **
Trt:Temp	0.614	2	0.5561	0.573974
Residuals	189.966	344		

```
## ---
```

```
## 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    0.7389219 0.07436612 344 0.5926523 0.8851914
## NP   1.1303873 0.05933107 344 1.0136900 1.2470846
## P    0.7687583 0.07745849 344 0.6164064 0.9211101
##
```

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

```
##
```

```
## $contrasts
```

```
## contrast      estimate      SE df t.ratio p.value
## N - NP   -0.39146542 0.09513409 344  -4.115  0.0001
## N - P    -0.02983642 0.10737847 344  -0.278  0.9583
## NP - P     0.36162900 0.09757045 344   3.706  0.0007
##
```

```
## 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
## NP  -0.02641861 0.008911366 344 -0.04394624 -0.008890989 1
## P   -0.01690078 0.012774458 344 -0.04202666  0.008225095 1
## N   -0.01249417 0.010234051 344 -0.03262336  0.007635018 1
##
```

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

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

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

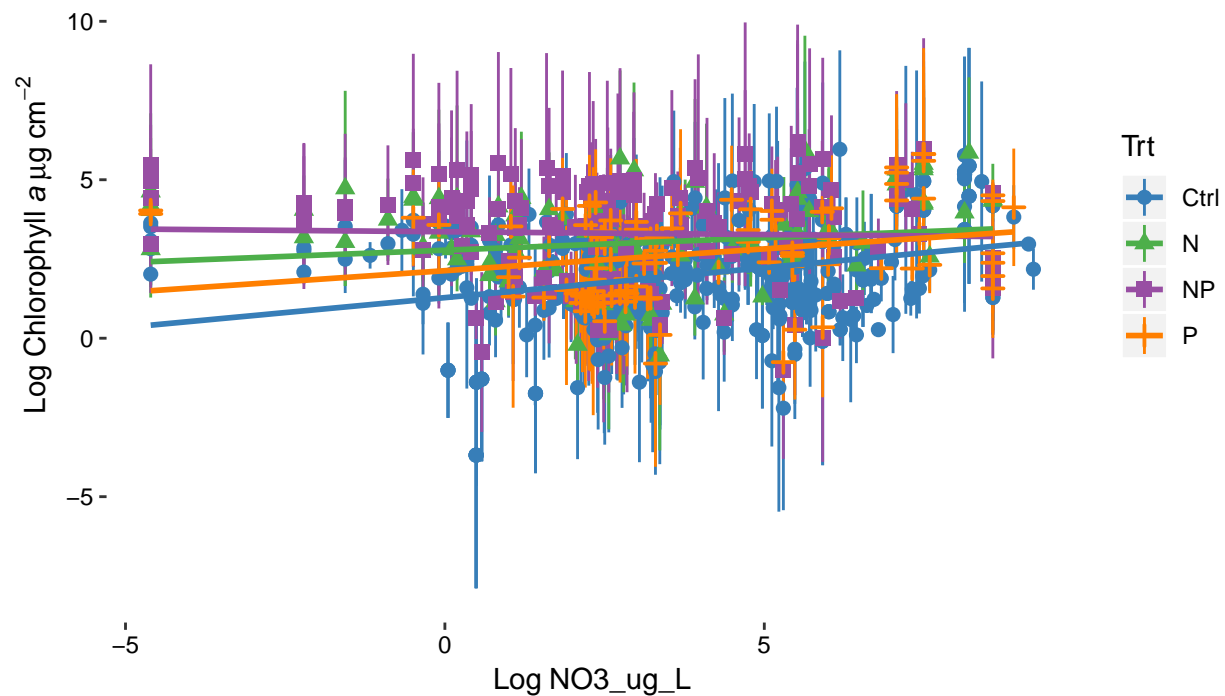
c.) NO3_ug_L and raw Chl-a

```
#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 443 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 443 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)	1274.42	1	547.823	< 2.2e-16 ***
Trt	241.74	3	34.638	< 2.2e-16 ***
log(NO3_ug_L + 0.01)	40.57	1	17.440	3.285e-05 ***
Trt:log(NO3_ug_L + 0.01)	39.77	3	5.699	0.0007305 ***
Residuals	1891.31	813		

```
## ---
## 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  2.440884  0.09955109  813  2.245477  2.636292
## N      3.258676  0.20588527  813  2.854547  3.662805
## NP     3.251149  0.17893846  813  2.899913  3.602385
## P      2.976425  0.20153330  813  2.580838  3.372012
##
## 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    -0.817791937  0.2286901  813   -3.576  0.0021
## Ctrl - NP   -0.810264889  0.2047667  813   -3.957  0.0005
## Ctrl - P    -0.535541310  0.2247801  813   -2.383  0.0812
## N - NP       0.007527048  0.2727778  813    0.028  1.0000
## N - P        0.282250628  0.2881049  813    0.980  0.7611
## NP - P        0.274723580  0.2695081  813    1.019  0.7382
##
## 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)

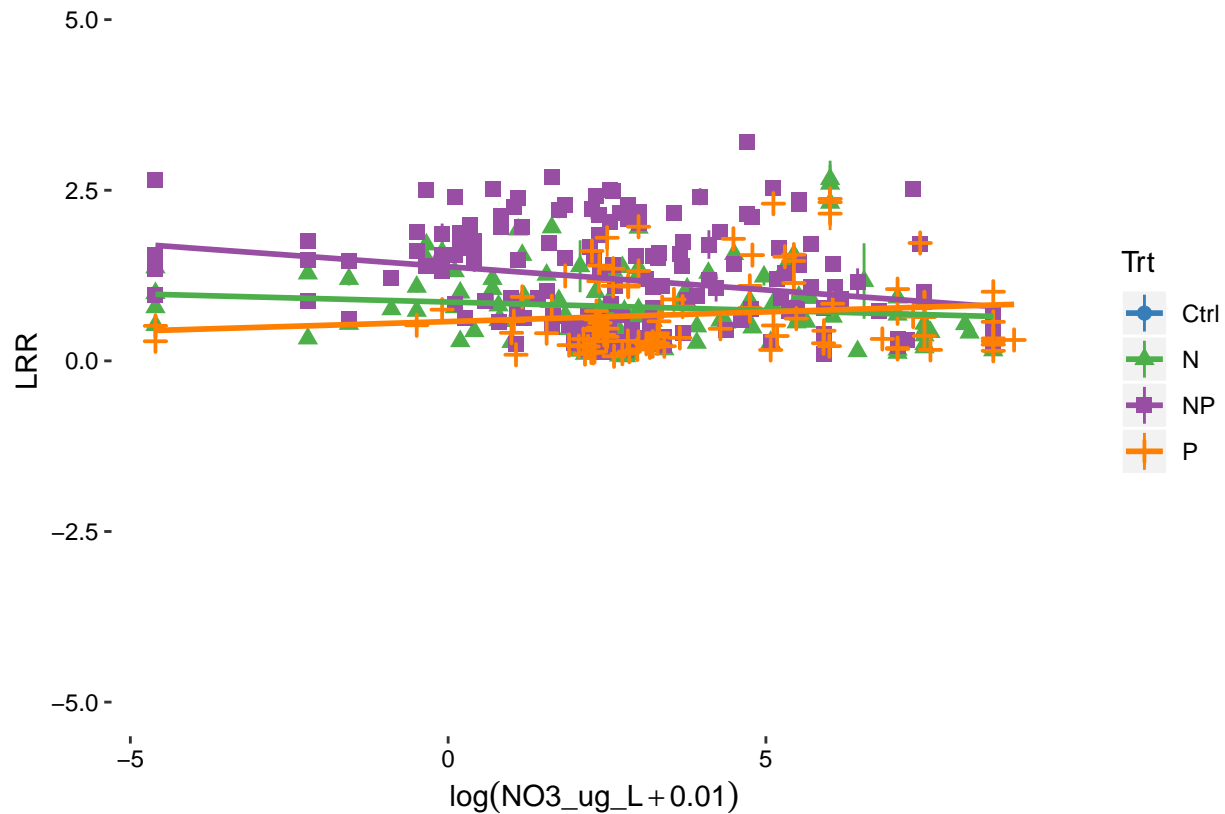
## Trt  NO3_ug_L.trend      SE    df      lower.CL      upper.CL .group
## NP   -3.375578e-05  8.180243e-05  813  -1.943246e-04  0.0001268131   1
## N     1.511512e-04  9.443989e-05  813  -3.422353e-05  0.0003365260  12
## P     2.651905e-04  1.153585e-04  813   3.875493e-05  0.0004916262  12
## Ctrl  3.638642e-04  5.504633e-05  813   2.558145e-04  0.0004719138   2
##
## 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 866 rows containing non-finite values (stat_smooth).
## Warning: Removed 867 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)	279.550	1	642.8127	< 2.2e-16 ***
Trt	18.429	2	21.1878	1.83e-09 ***
NO3_ug_L	5.028	1	11.5615	0.0007425 ***
Trt:NO3_ug_L	1.216	2	1.3976	0.2484117
Residuals	170.475	392		

```
## ---
```

```
## 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    0.7767926 0.06019105 392 0.6584549 0.8951302
## NP   1.1714382 0.04966521 392 1.0737947 1.2690817
## P    0.6967082 0.06665349 392 0.5656652 0.8277512
##
```

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

```
##
```

```
## $contrasts
```

```
## contrast      estimate      SE df t.ratio p.value
## N - NP   -0.39464563 0.07803586 392  -5.057  <.0001
## N - P     0.08008437 0.08980897 392   0.892  0.6459
## NP - P     0.47473000 0.08312232 392   5.711  <.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  -1.455899e-04 4.649224e-05 392 -0.0002369953 -5.418462e-05 1
## N   -1.301904e-04 6.747370e-05 392 -0.0002628460  2.465163e-06 1
## P   -4.230766e-05 4.513564e-05 392 -0.0001310459  4.643055e-05 1
##
```

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

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

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

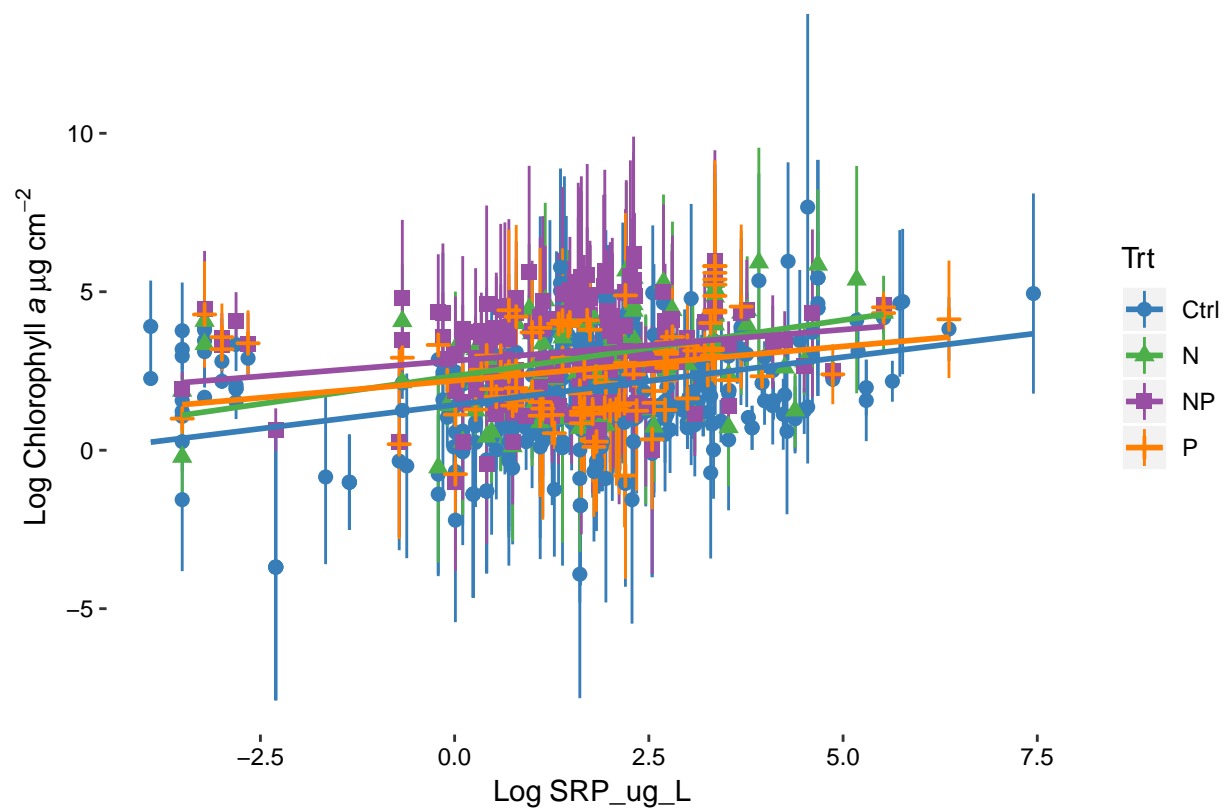
e.) SRP_ug_L and raw Chl-a

```
#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 421 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 421 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)	1419.27	1	582.8538	< 2.2e-16 ***
Trt	139.42	3	19.0853	5.610e-12 ***
log(SRP_ug_L + 0.01)	114.88	1	47.1774	1.267e-11 ***
Trt:log(SRP_ug_L + 0.01)	6.08	3	0.8325	0.4761
Residuals	2033.26	835		

```
## ---
## 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 2.337342 0.09151571 835 2.157715 2.516970
##   N    3.401943 0.16910997 835 3.070012 3.733873
##   NP   3.413292 0.17219052 835 3.075315 3.751269
##   P    2.844303 0.19081731 835 2.469765 3.218841
##
## 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   -1.06460025 0.1922844 835  -5.537  <.0001
##   Ctrl - NP  -1.07594948 0.1949992 835  -5.518  <.0001
##   Ctrl - P   -0.50696019 0.2116279 835  -2.396  0.0787
##   N - NP     -0.01134923 0.2413457 835  -0.047  1.0000
##   N - P       0.55764006 0.2549695 835   2.187  0.1276
##   NP - P      0.56898930 0.2570230 835   2.214  0.1203
##
## 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)

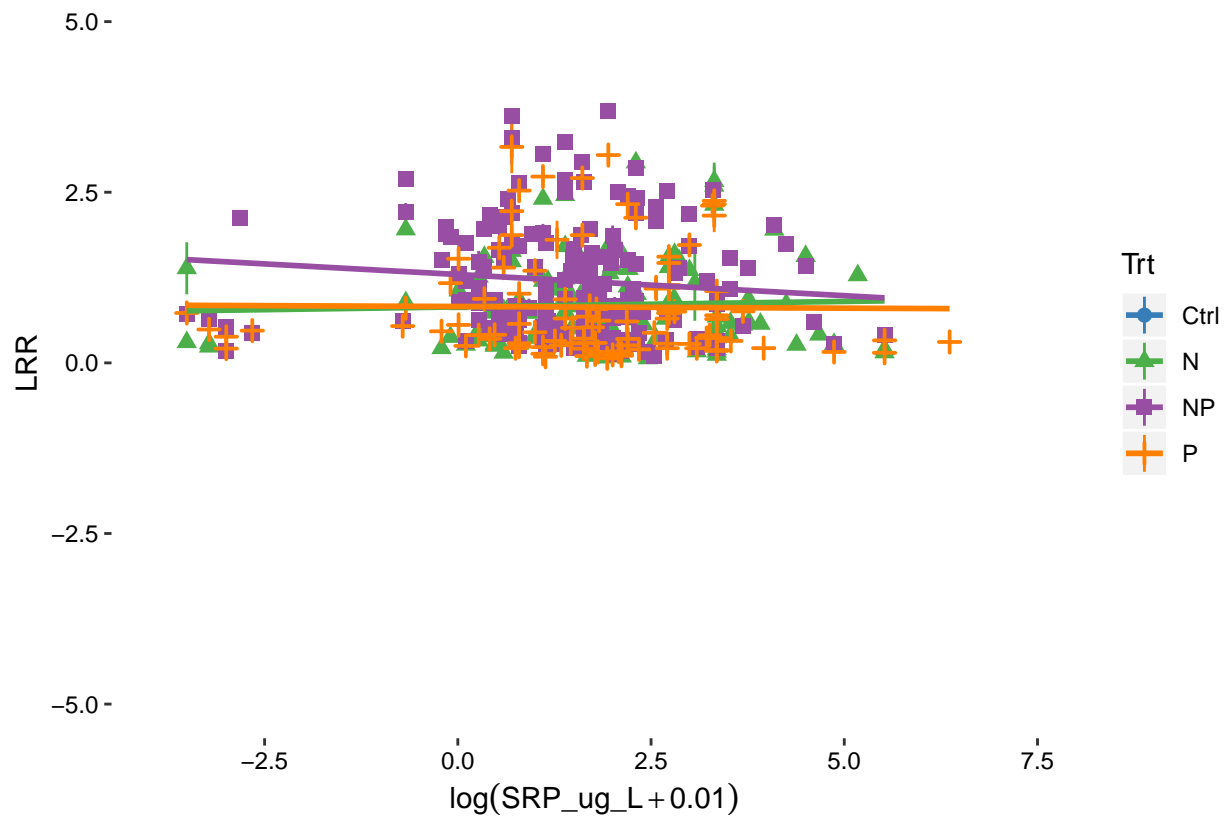
##   Trt   SRP_ug_L.trend      SE    df   lower.CL   upper.CL .group
##   NP      0.007035297 0.002946108 835 0.001252649 0.01281794 1
##   P      0.007739924 0.003267081 835 0.001327266 0.01415258 1
##   Ctrl   0.010779502 0.001447751 835 0.007937844 0.01362116 1
##   N      0.012622325 0.003073171 835 0.006590277 0.01865437 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 855 rows containing non-finite values (stat_smooth).
## Warning: Removed 856 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)	180.877	1	249.6849	< 2.2e-16 ***
Trt	10.990	2	7.5853	0.0005834 ***
log(SRP_ug_L + 0.01)	0.290	1	0.4003	0.5272902
Trt:log(SRP_ug_L + 0.01)	0.982	2	0.6781	0.5081671
Residuals	293.390	405		

```
## ---
```

```
## 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    0.8957124 0.08653870 405 0.7255913 1.065834
##   NP   1.1603460 0.08678302 405 0.9897446 1.330947
##   P    0.8123530 0.09788279 405 0.6199312 1.004775
##
## Confidence level used: 0.95
##
## $contrasts
##   contrast      estimate      SE df t.ratio p.value
##   N - NP   -0.26463361 0.1225571 405  -2.159  0.0796
##   N - P     0.08335938 0.1306522 405   0.638  0.7992
##   NP - P     0.34799299 0.1308141 405   2.660  0.0221
##
## 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)

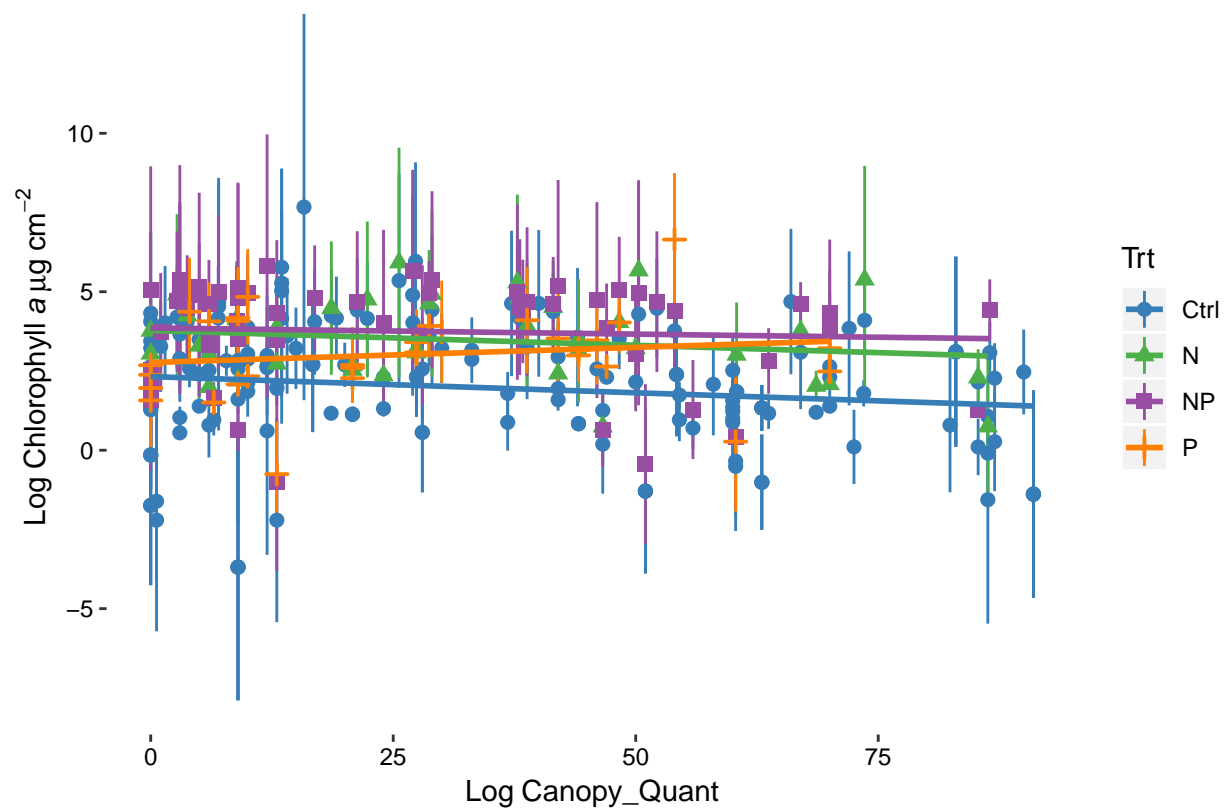
##   Trt SRP_ug_L.trend      SE df lower.CL upper.CL .group
##   NP  -0.0031507109 0.002374742 405 -0.007819071 0.001517649 1
##   P   -0.0002610640 0.002633466 405 -0.005438034 0.004915906 1
##   N    0.0006749867 0.002477163 405 -0.004194716 0.005544689 1
##
## Confidence level used: 0.95
## P value 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.x = 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 944 rows containing non-finite values (stat_smooth).
## Warning: Removed 944 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)    791.80  1 246.8310 < 2.2e-16 ***
## Trt           60.44  3   6.2805 0.0003772 ***
## Canopy_Quant    1.29  1   0.4022 0.5264201
## Trt:Canopy_Quant  5.75  3   0.5978 0.6168920
## Residuals    1000.85 312
## ---
## 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 1.998297 0.1319976 312 1.738579 2.258015
## N     3.480799 0.2769059 312 2.935960 4.025638
## NP    3.734079 0.2347833 312 3.272120 4.196038
## P     3.070523 0.3203330 312 2.440237 3.700809
##
## 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    -1.4825024 0.3067576 312  -4.833  <.0001
## Ctrl - NP   -1.7357820 0.2693447 312  -6.444  <.0001
## Ctrl - P    -1.0722257 0.3464630 312  -3.095  0.0115
## N - NP      -0.2532796 0.3630428 312  -0.698  0.8979
## N - P        0.4102767 0.4234266 312   0.969  0.7672
## NP - P       0.6635563 0.3971605 312   1.671  0.3409
##
## 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)

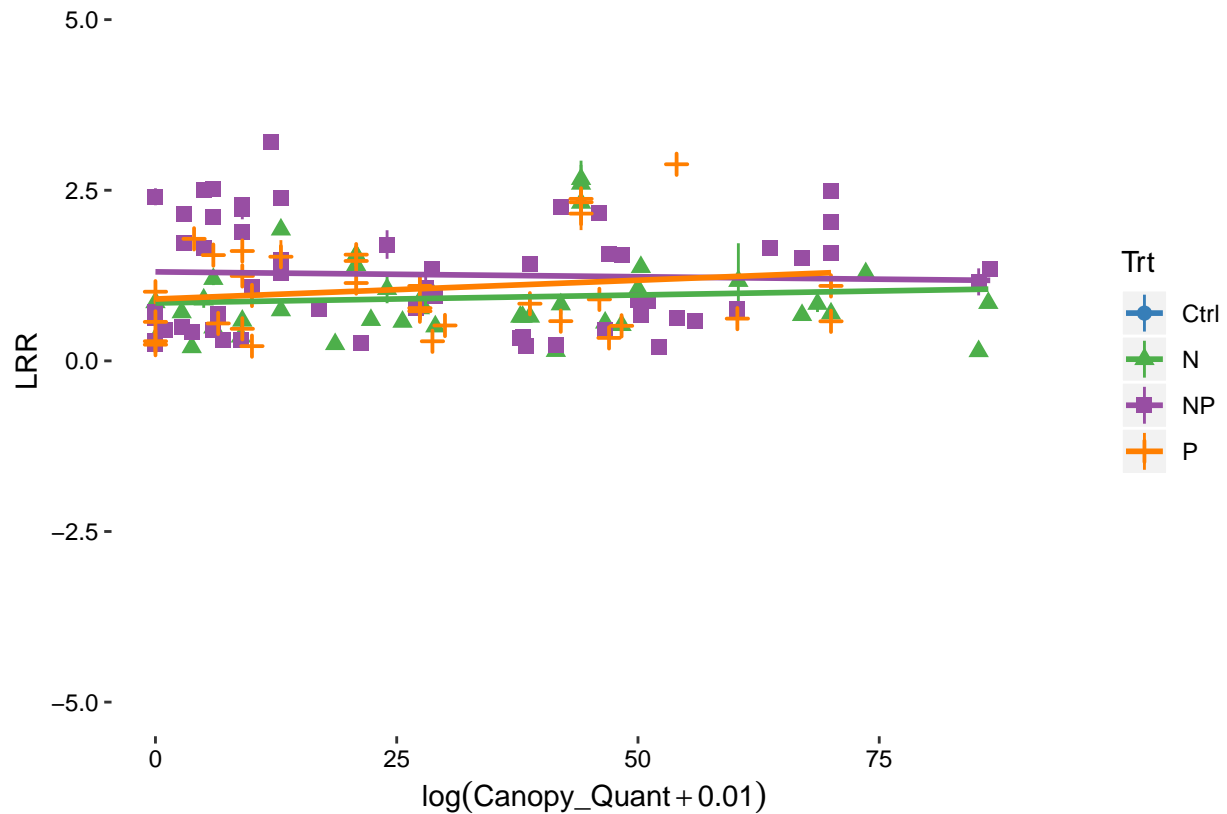
## Trt Canopy_Quant.trend      SE    df    lower.CL    upper.CL .group
## Ctrl      -0.010215161 0.004665081 312 -0.01939416 -0.001036163 1
## N          -0.009310378 0.011924572 312 -0.03277312  0.014152367 1
## NP         -0.003907969 0.009315450 312 -0.02223702  0.014421078 1
## P           0.009581223 0.015045086 312 -0.02002144  0.039183883 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 1129 rows containing non-finite values (stat_smooth).
## Warning: Removed 1130 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)	48.874	1	81.5275	2.12e-15 ***
Trt	2.459	2	2.0511	0.1328
Canopy_Quant	0.291	1	0.4853	0.4873
Trt:Canopy_Quant	0.548	2	0.4572	0.6341
Residuals	77.333	129		

```
## ---
```

```
## 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    0.9163666 0.1213602 129 0.6762525 1.156481
##   NP   1.2624673 0.1001872 129 1.0642445 1.460690
##   P    1.0663704 0.1355395 129 0.7982022 1.334539
##
## Confidence level used: 0.95
##
## $contrasts
##   contrast      estimate      SE df t.ratio p.value
##   N - NP   -0.3461008 0.1573714 129  -2.199  0.0751
##   N - P    -0.1500038 0.1819320 129  -0.825  0.6885
##   NP - P     0.1960969 0.1685480 129   1.163  0.4772
##
## P value adjustment: tukey method for comparing a family of 3 estimates
#Lstrends (pairwise trt differences in the way chl-a responds to Canopy_Quantature)

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

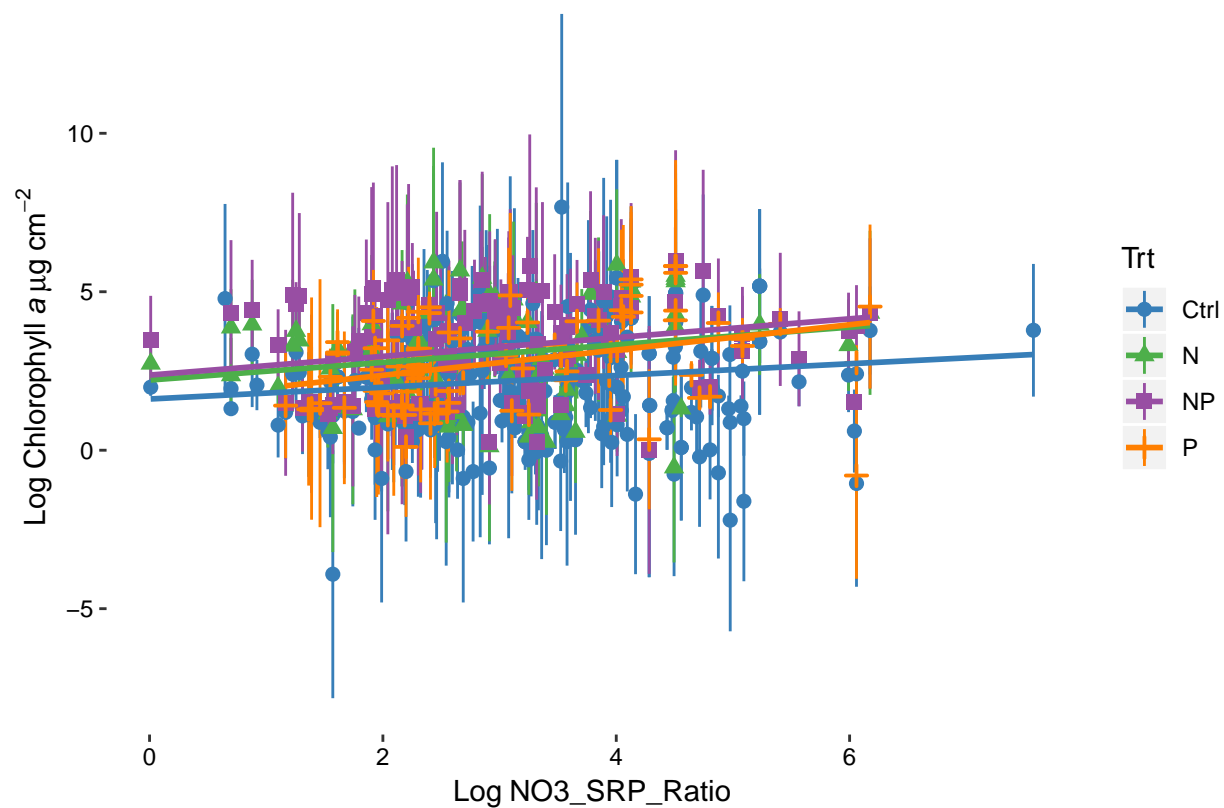
##   Trt Canopy_Quant.trend      SE df      lower.CL      upper.CL .group
##   NP      -0.001434254 0.004027030 129 -0.009401832 0.006533324    1
##   N         0.002350881 0.005154942 129 -0.007848299 0.012550061    1
##   P         0.005509649 0.006503928 129 -0.007358531 0.018377830    1
##
## Confidence 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 621 rows containing non-finite values (stat_smooth).
## Warning: Removed 621 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)	258.85	1	106.3428	< 2.2e-16 ***
Trt	9.85	3	1.3493	0.2574
log(NO3_SRP_Ratio + 0.01)	57.63	1	23.6746	1.441e-06 ***
Trt:log(NO3_SRP_Ratio + 0.01)	5.07	3	0.6942	0.5558
Residuals	1545.67	635		

```
## ---
## 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 2.325592 0.1025302 635 2.124253 2.526932
##   N    3.278474 0.2057745 635 2.874393 3.682555
##   NP   3.503343 0.1660907 635 3.177189 3.829496
##   P    3.093732 0.1981893 635 2.704547 3.482918
##
## 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   -0.9528813 0.2299034 635  -4.145  0.0002
##   Ctrl - NP  -1.1777503 0.1951886 635  -6.034  <.0001
##   Ctrl - P   -0.7681399 0.2231399 635  -3.442  0.0034
##   N - NP     -0.2248690 0.2644414 635  -0.850  0.8302
##   N - P       0.1847414 0.2856959 635   0.647  0.9167
##   NP - P      0.4096104 0.2585829 635   1.584  0.3885
##
## 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)

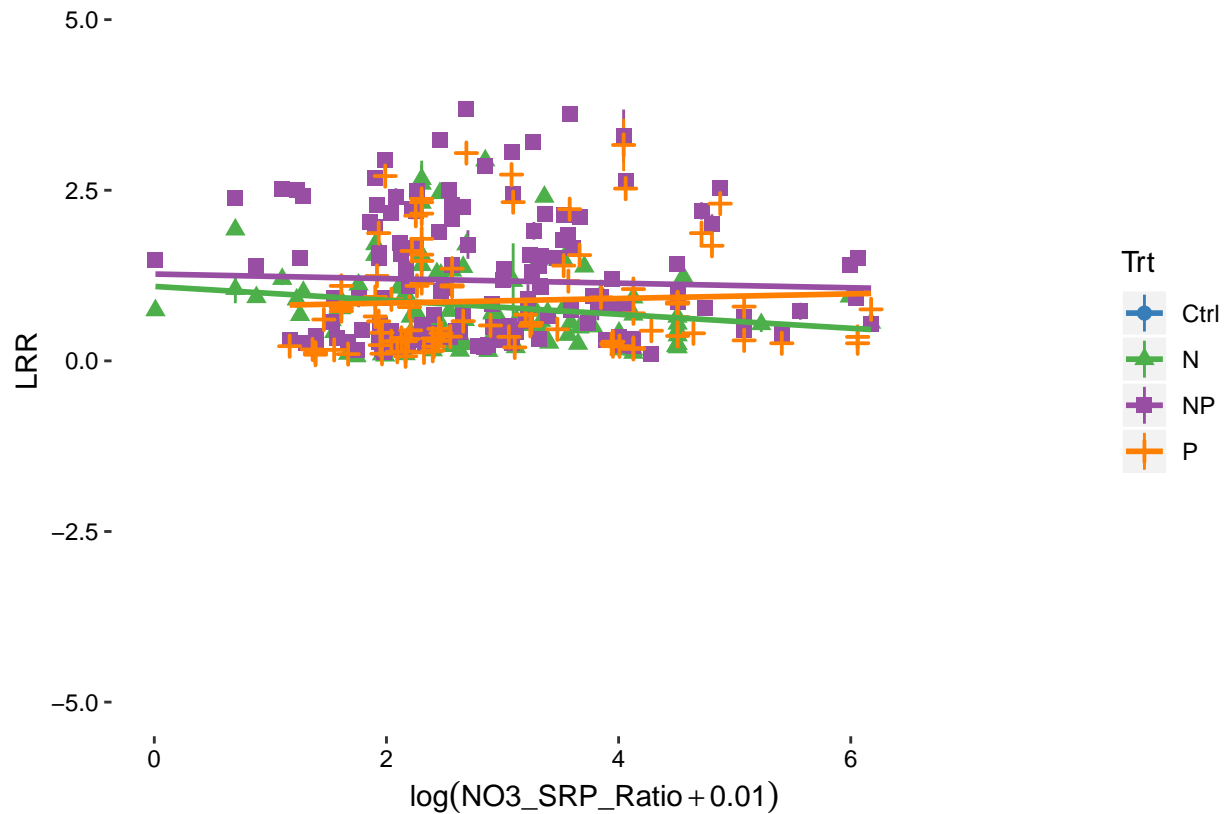
##   Trt NO3_SRP_Ratio.trend      SE    df      lower.CL      upper.CL .group
##   Ctrl      0.003353242 0.001405632 635 5.929938e-04 0.006113491 1
##   N          0.005035482 0.002519954 635 8.703013e-05 0.009983934 1
##   NP         0.005355182 0.002042649 635 1.344017e-03 0.009366346 1
##   P          0.007219915 0.002462726 635 2.383843e-03 0.012055987 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 927 rows containing non-finite values (stat_smooth).
## Warning: Removed 927 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+0.01), data=Data)
Anova(Model, type="III")
```

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

```
##
```

```
## Response: LRR_Mean
```

	Sum Sq	Df	F value	Pr(>F)
## (Intercept)	59.204	1	74.2606	2.802e-16 ***
## Trt	3.426	2	2.1484	0.1183
## log(NO3_SRP_Ratio + 0.01)	1.733	1	2.1735	0.1414
## Trt:log(NO3_SRP_Ratio + 0.01)	2.143	2	1.3439	0.2622
## Residuals	265.481	333		

```
## ---
```

```
## 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    0.7162073 0.11128448 333 0.4972981 0.9351165
## NP   1.1571047 0.09023207 333 0.9796080 1.3346014
## P    0.9040719 0.10810498 333 0.6914171 1.1167266
##
## Confidence level used: 0.95
##
## $contrasts
## contrast      estimate      SE df t.ratio p.value
## N - NP   -0.4408975 0.1432692 333  -3.077  0.0064
## N - P    -0.1878646 0.1551481 333  -1.211  0.4476
## NP - P     0.2530328 0.1408138 333   1.797  0.1722
##
## 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)

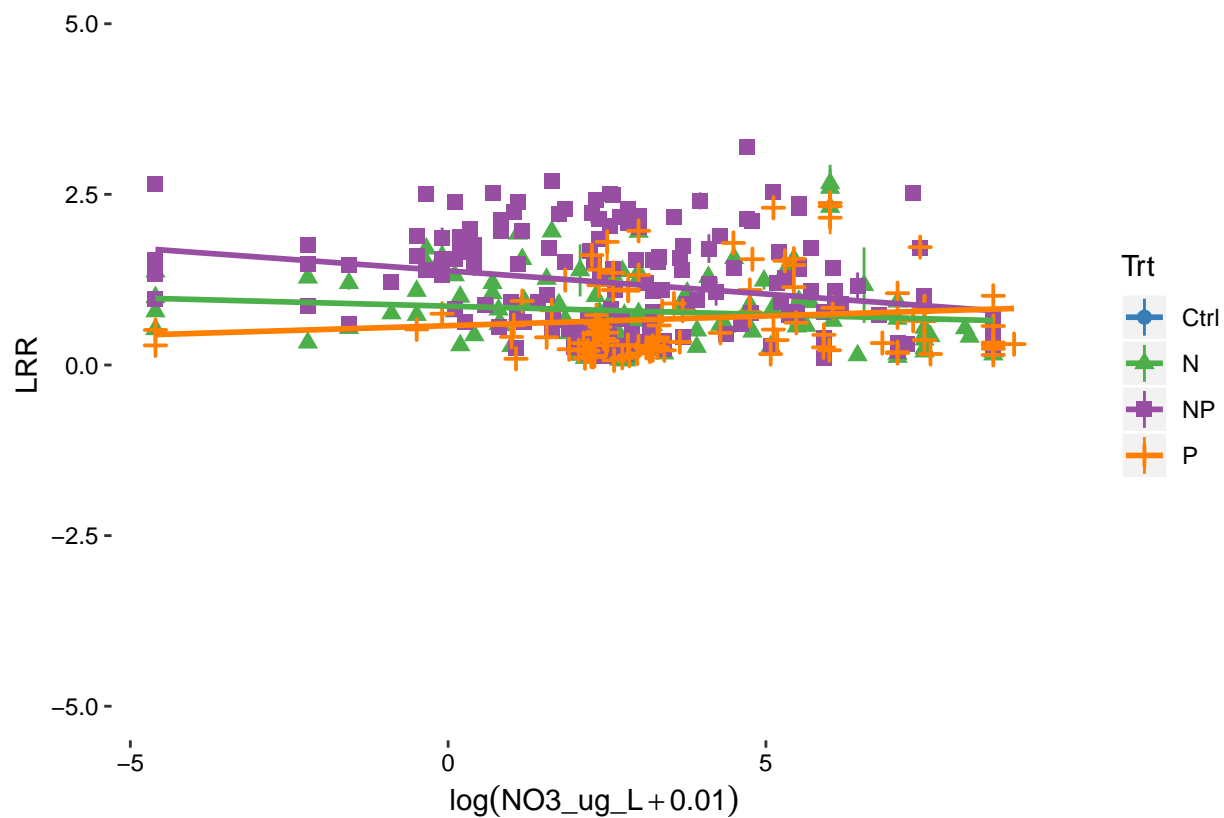
## Trt NO3_SRP_Ratio.trend      SE df      lower.CL      upper.CL .group
## N      -0.0034091951 0.001854773 333 -0.007057744 0.0002393541  1
## NP     -0.0017956850 0.001503460 333 -0.004753162 0.0011617917  1
## P       0.0007854361 0.001812651 333 -0.002780254 0.0043511263  1
##
## Confidence level 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 866 rows containing non-finite values (stat_smooth).
## Warning: Removed 867 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) 123.947  1 286.3828 < 2.2e-16 ***
## Trt         17.441  2  20.1493 4.682e-09 ***
## log(NO3_ug_L + 0.01)  1.234  1  2.8513  0.092095 .
## Trt:log(NO3_ug_L + 0.01)  4.094  2  4.7301  0.009336 **
## Residuals    169.658 392
## ---
## 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    0.7136920 0.08700477 392  0.5426377  0.8847464
##   NP   0.9688516 0.07556051 392  0.8202971  1.1174062
##   P    0.7467103 0.08499691 392  0.5796035  0.9138171
##
## Confidence level used: 0.95
##
## $contrasts
##   contrast      estimate      SE    df t.ratio p.value
##   N - NP    -0.2551596 0.1152355 392   -2.214  0.0700
##   N - P     -0.0330183 0.1216318 392   -0.271  0.9602
##   NP - P      0.2221413 0.1137271 392    1.953  0.1254
##
## 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   -1.496627e-04 4.027377e-05 392 -2.288423e-04 -7.048307e-05   1
##   N    -5.405734e-05 4.649557e-05 392 -1.454692e-04  3.735454e-05  12
##   P     6.234816e-05 5.679443e-05 392 -4.931163e-05  1.740079e-04   2
##
## 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)      0.119  1  0.0898  0.765270
## log(NO3_ug_L + 0.01)      0.054  1  0.0404  0.841300
## log(SRP_ug_L)          0.228  1  0.1720  0.679623
## Temp                10.556  1  7.9559  0.006231 **
## log(NO3_ug_L + 0.01):log(SRP_ug_L)      3.591  1  2.7062  0.104440
## log(NO3_ug_L + 0.01):Temp        0.094  1  0.0710  0.790706
## log(SRP_ug_L):Temp          0.004  1  0.0030  0.956816
## log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp  1.408  1  1.0610  0.306536
## Residuals          92.873 70
## ---
## 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) 2.210 1 2.1127 0.15104
## log(NO3_ug_L + 0.01) 0.479 1 0.4580 0.50103
## log(SRP_ug_L) 4.290 1 4.1016 0.04708 *
## Temp 0.726 1 0.6940 0.40794
## log(NO3_ug_L + 0.01):log(SRP_ug_L) 6.732 1 6.4365 0.01367 *
## log(NO3_ug_L + 0.01):Temp 0.110 1 0.1051 0.74685
## log(SRP_ug_L):Temp 1.201 1 1.1486 0.28793
## log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp 3.296 1 3.1510 0.08071 .
## Residuals 65.895 63
## ---
## 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) 12.769 1 7.5159 0.007308 **
## log(NO3_ug_L + 0.01) 2.282 1 1.3433 0.249355
## log(SRP_ug_L) 35.479 1 20.8834 1.467e-05 ***
## Temp 1.132 1 0.6664 0.416369
## log(NO3_ug_L + 0.01):log(SRP_ug_L) 40.047 1 23.5720 4.720e-06 ***
## log(NO3_ug_L + 0.01):Temp 2.812 1 1.6549 0.201420
## log(SRP_ug_L):Temp 28.105 1 16.5432 9.815e-05 ***
## log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp 25.954 1 15.2769 0.000174 ***
## Residuals 161.396 95
## ---
## 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)      0.4393  1  1.2828 0.2612
## log(NO3_ug_L + 0.01) 0.0070  1  0.0203 0.8871
## log(SRP_ug_L)      0.0299  1  0.0873 0.7685
## Temp              0.0037  1  0.0109 0.9173
## log(NO3_ug_L + 0.01):log(SRP_ug_L) 0.0027  1  0.0078 0.9297
## log(NO3_ug_L + 0.01):Temp      0.0010  1  0.0029 0.9568
## log(SRP_ug_L):Temp            0.0074  1  0.0216 0.8836
## log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp 0.0032  1  0.0094 0.9231
## Residuals              23.9695 70

#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)      0.0580  1  0.1759 0.6763
## log(NO3_ug_L + 0.01) 0.0579  1  0.1754 0.6768
## log(SRP_ug_L)      0.0034  1  0.0104 0.9191
## Temp              0.0020  1  0.0061 0.9380
## log(NO3_ug_L + 0.01):log(SRP_ug_L) 0.0001  1  0.0004 0.9838
## log(NO3_ug_L + 0.01):Temp      0.0122  1  0.0371 0.8479
## log(SRP_ug_L):Temp            0.0016  1  0.0047 0.9454
## log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp 0.0062  1  0.0188 0.8915
```

```
## Residuals                                20.7854 63
#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)	4.733	1	12.3177	0.0006878 ***
log(NO3_ug_L + 0.01)	0.015	1	0.0380	0.8458286
log(SRP_ug_L)	5.753	1	14.9697	0.0002002 ***
Temp	0.298	1	0.7750	0.3809054
log(NO3_ug_L + 0.01):log(SRP_ug_L)	1.084	1	2.8210	0.0963264 .
log(NO3_ug_L + 0.01):Temp	0.015	1	0.0395	0.8428611
log(SRP_ug_L):Temp	4.519	1	11.7601	0.0008967 ***
log(NO3_ug_L + 0.01):log(SRP_ug_L):Temp	0.646	1	1.6824	0.1977531
Residuals	36.507	95		

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

#Log meets assumptions

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