Supplementary material I-S3

Contents

Figure 2

Fig. 2.A Decomposition C loss (%)

Model output

```
##
## Call:
## lm(formula = "C.loss_Ma1 ~ log(neigh.sp.rich)", data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -50.755 -10.573  -1.088  10.112  38.701
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)          59.175      2.236  26.461   <2e-16 ***
## log(neigh.sp.rich)    1.532      1.927   0.795    0.428
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.32 on 151 degrees of freedom
## Multiple R-squared:  0.00417,    Adjusted R-squared:  -0.002425
## F-statistic: 0.6322 on 1 and 151 DF,  p-value: 0.4278
```

Model quality

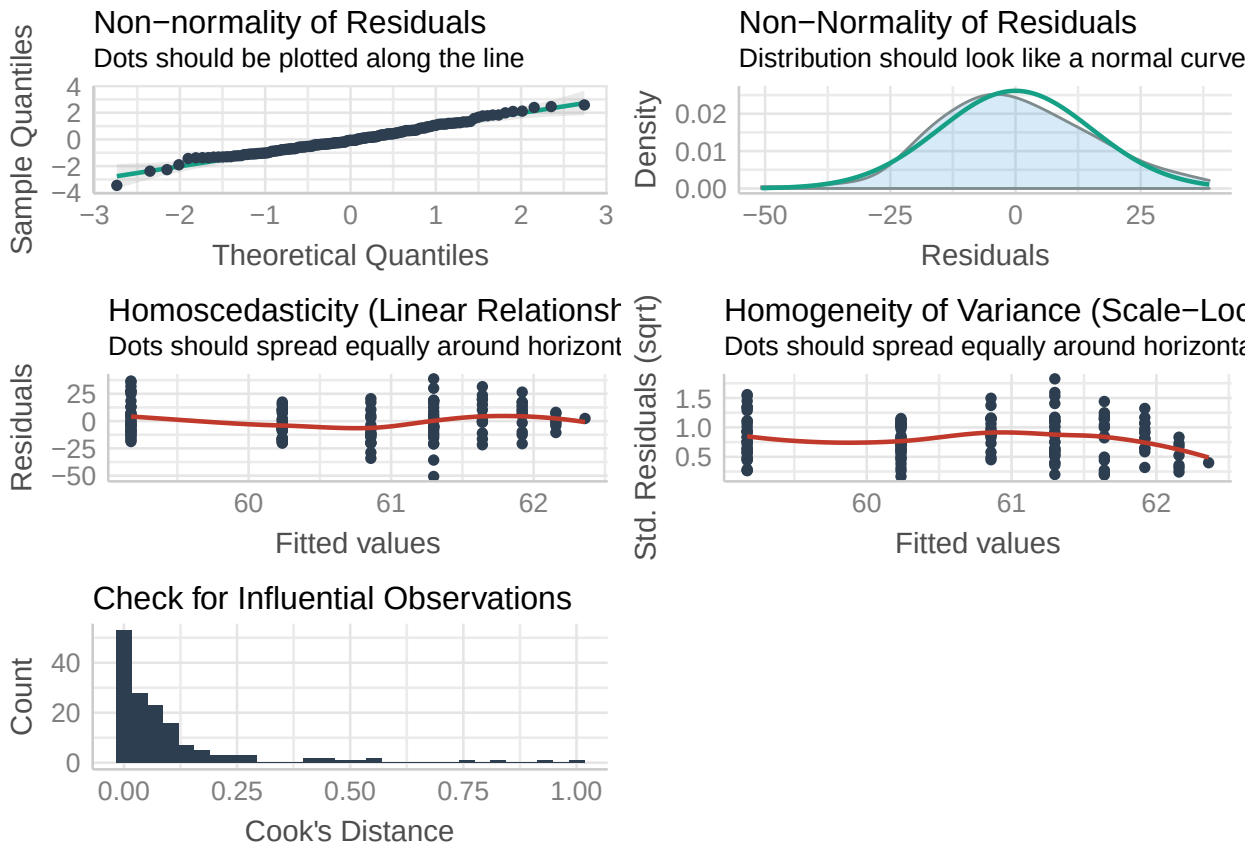


Fig. 2.B Decomposition N loss (%)

Model output

```
##
## Call:
## lm(formula = "N.loss_Ma1 ~ log(neigh.sp.rich)", data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -41.429 -12.969   1.371  11.548  34.494
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)          65.506      2.418  27.094   <2e-16 ***
## log(neigh.sp.rich)    4.989      2.083   2.395   0.0179 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 16.56 on 151 degrees of freedom
## Multiple R-squared:  0.03659,    Adjusted R-squared:  0.03021
## F-statistic: 5.735 on 1 and 151 DF,  p-value: 0.01785
```

Model quality

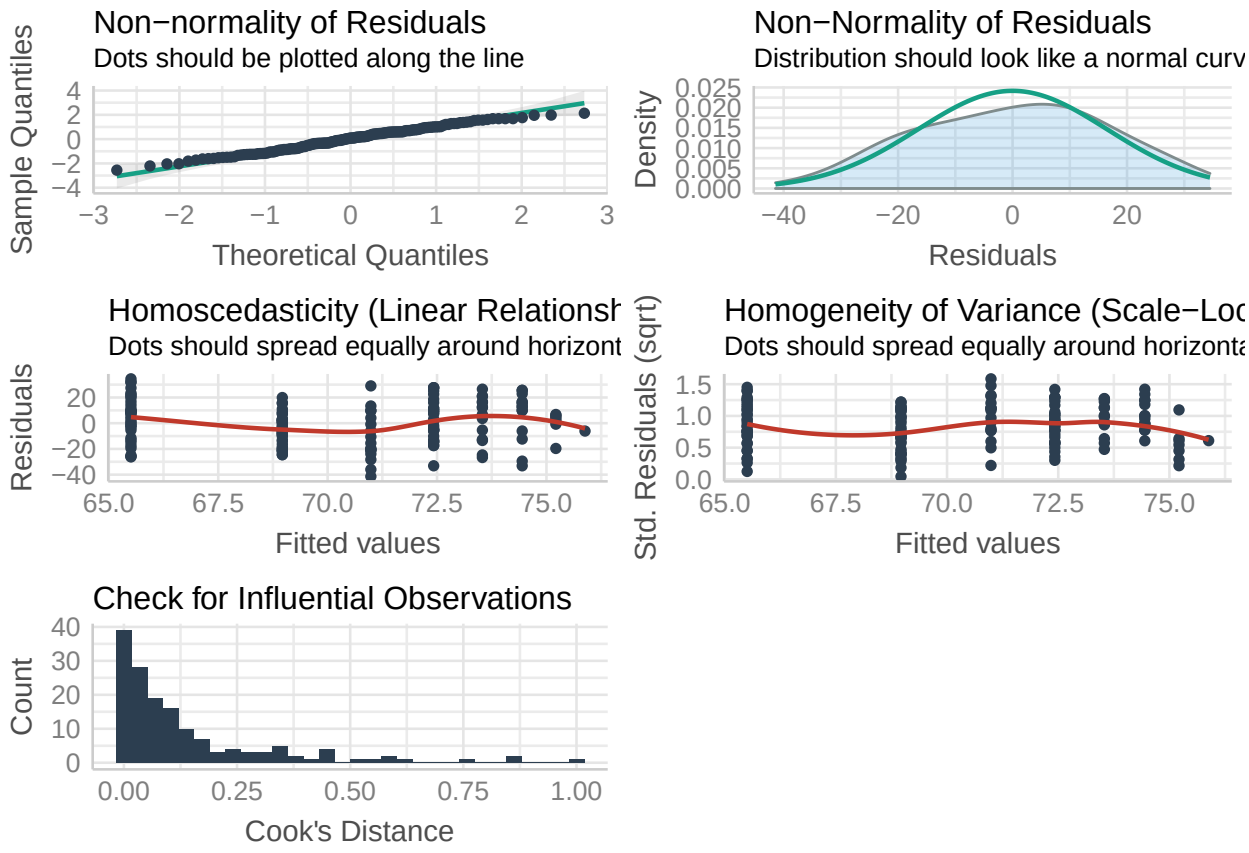


Fig. 2.C Microbial decomposition C loss (%)

Model output

```
##
## Call:
## lm(formula = "C.loss_Mi1 ~ log(neigh.sp.rich)", data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -25.889  -7.769  -0.531   6.920  36.553
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)          49.521      1.720  28.783   <2e-16 ***
## log(neigh.sp.rich)   -1.826      1.482  -1.231     0.22
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 11.79 on 151 degrees of freedom
## Multiple R-squared:  0.009943,   Adjusted R-squared:  0.003386
## F-statistic: 1.516 on 1 and 151 DF,  p-value: 0.2201
```

Model quality

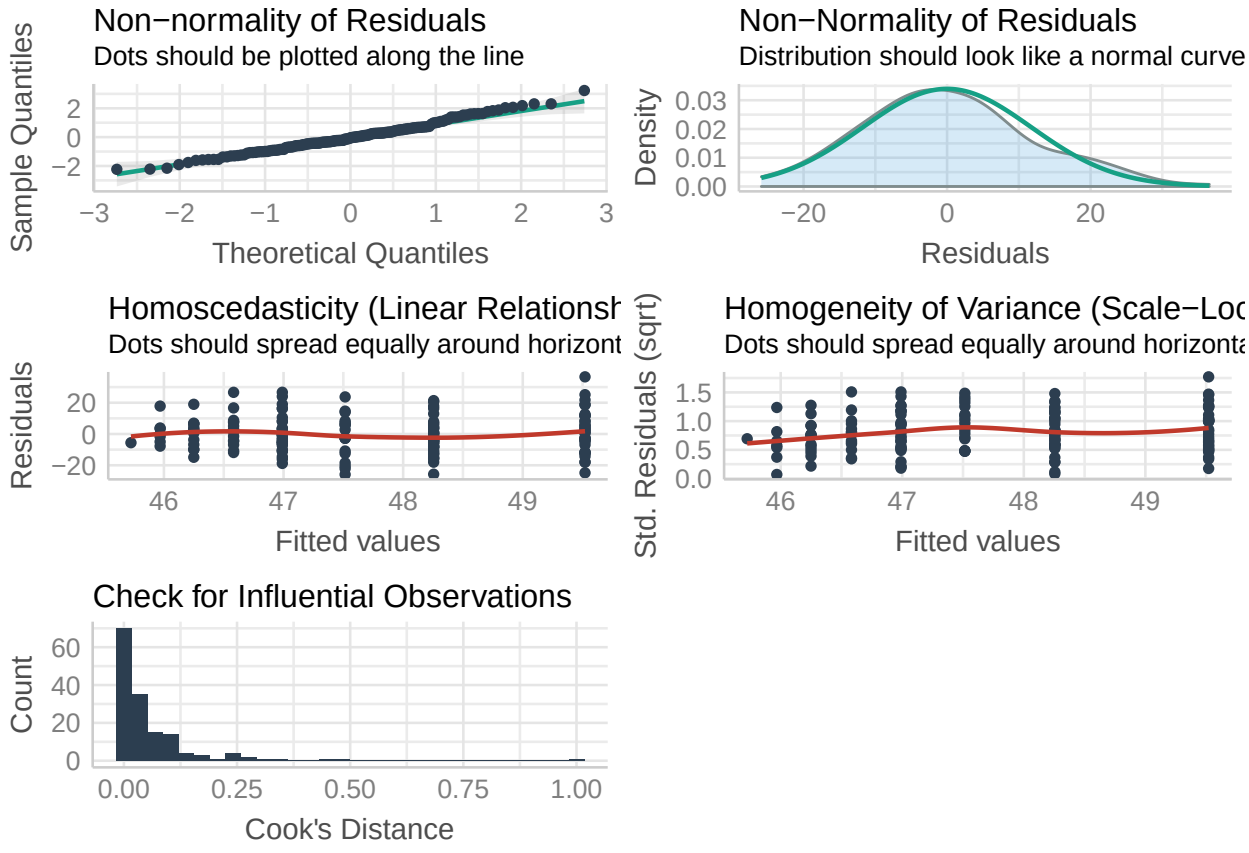


Fig. 2.D Microbial decomposition N loss (%)

Model output

```
##
## Call:
## lm(formula = "N.loss_Mi1 ~ log(neigh.sp.rich)", data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -36.379 -10.818  -1.621   7.900  43.181
##
## Coefficients:
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)          56.819      2.308  24.616   <2e-16 ***
## log(neigh.sp.rich)    2.885      1.989   1.451    0.149
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 15.81 on 151 degrees of freedom
## Multiple R-squared:  0.01374,    Adjusted R-squared:  0.007213
## F-statistic: 2.104 on 1 and 151 DF,  p-value: 0.149
```

Model quality

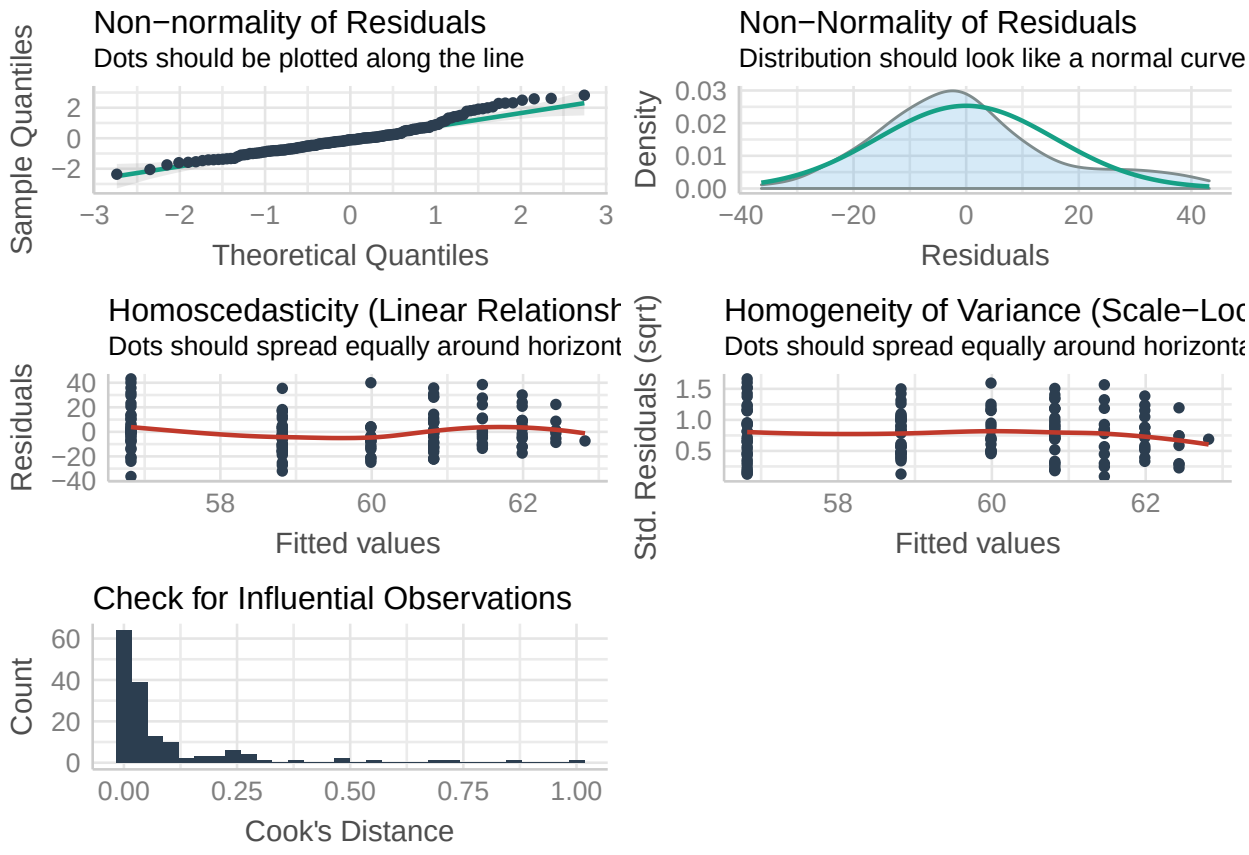


Fig. 2.E Decomposability C loss (%)

Model output

```
##
## Call:
## lm(formula = "C.loss_CG ~ log(lit.rich)", data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -21.659  -5.099  -0.132   5.716  20.047
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    43.7478     0.9935  44.032   <2e-16 ***
## log(lit.rich)  -1.2590     0.8716  -1.445    0.151
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.124 on 151 degrees of freedom
## Multiple R-squared:  0.01363,    Adjusted R-squared:  0.007099
## F-statistic: 2.087 on 1 and 151 DF,  p-value: 0.1507
```

Model quality

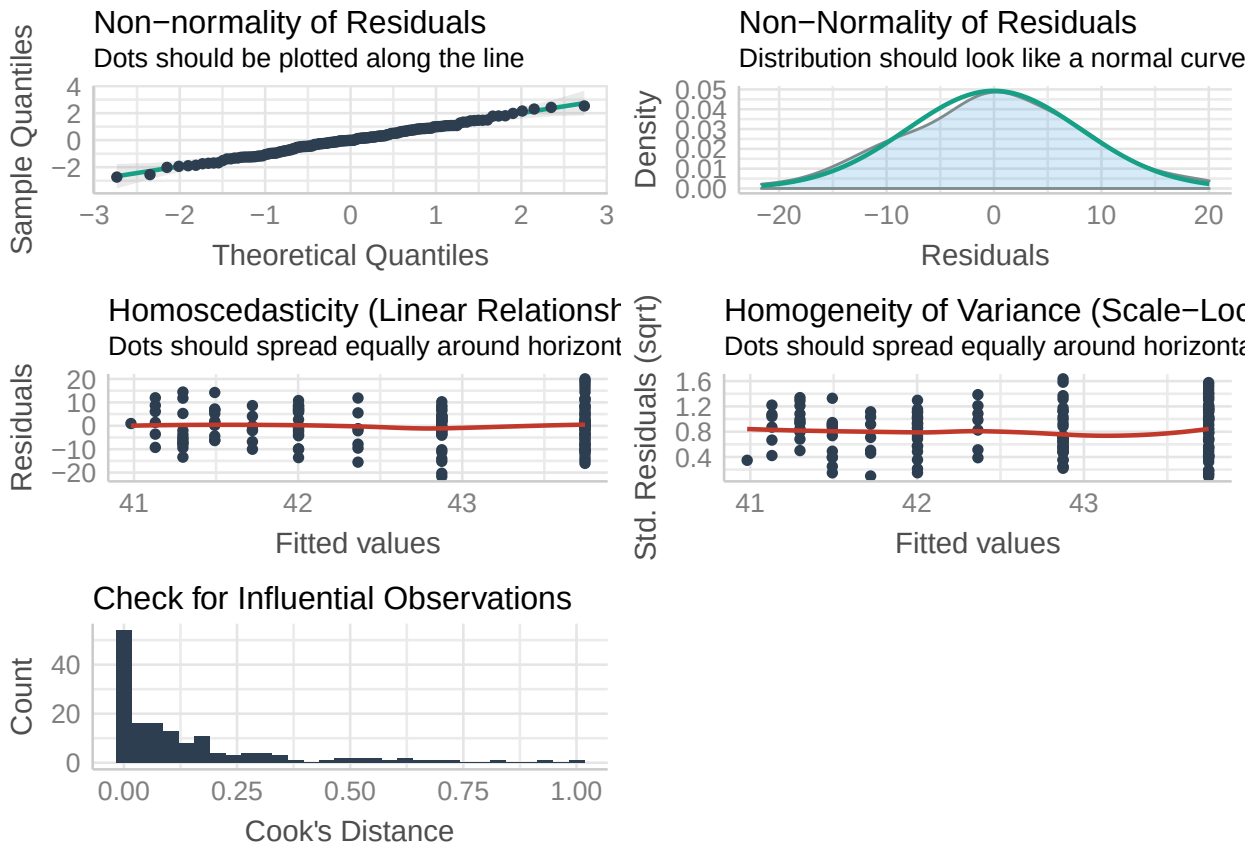


Fig. 2.F Decomposability N loss (%)

Model output

```
##
## Call:
## lm(formula = "N.loss_CG ~ log(lit.rich)", data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -24.5090  -4.9002   0.0964   4.6015  24.6910
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    42.2580     0.9720  43.476  < 2e-16 ***
## log(lit.rich)   3.1526     0.8527   3.697 0.000304 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7.947 on 151 degrees of freedom
## Multiple R-squared:  0.08302,    Adjusted R-squared:  0.07694
## F-statistic: 13.67 on 1 and 151 DF,  p-value: 0.0003043
```

Model quality

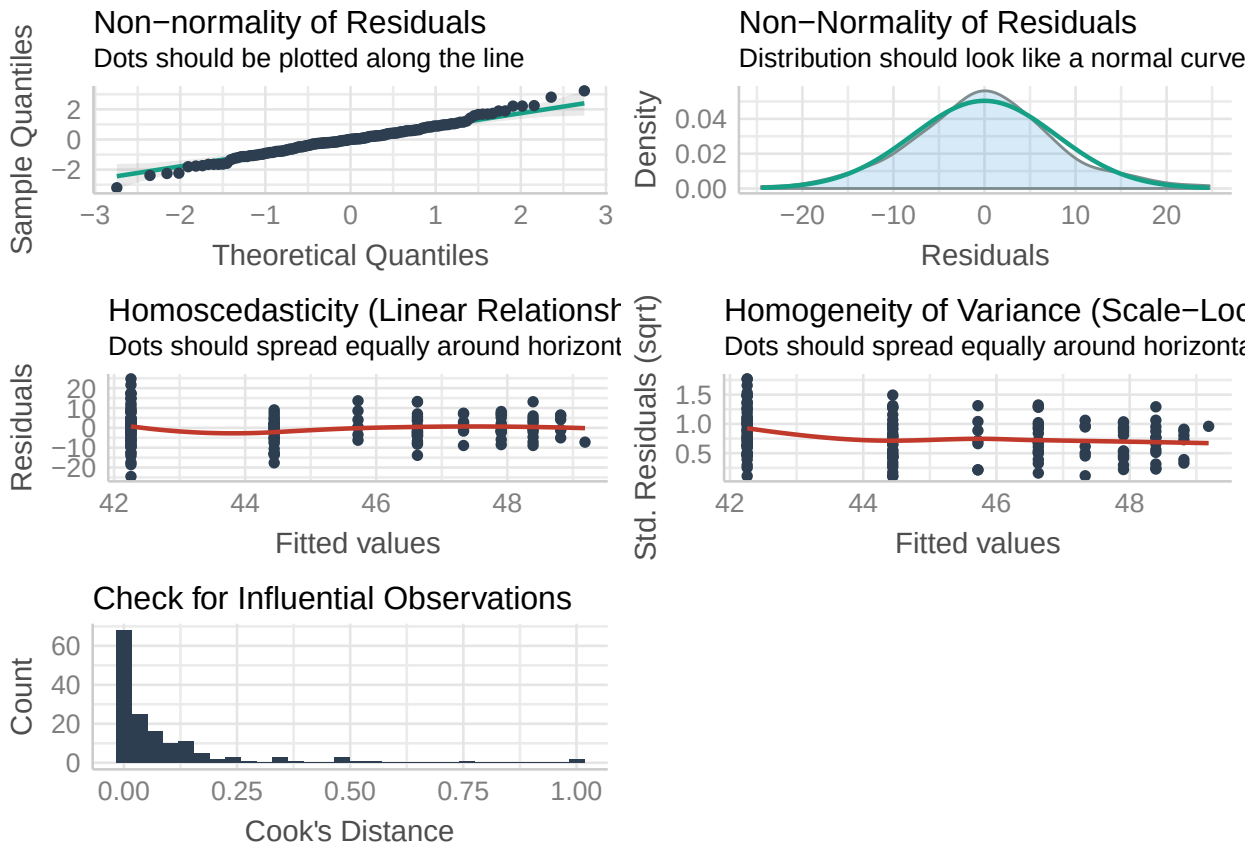


Figure 3

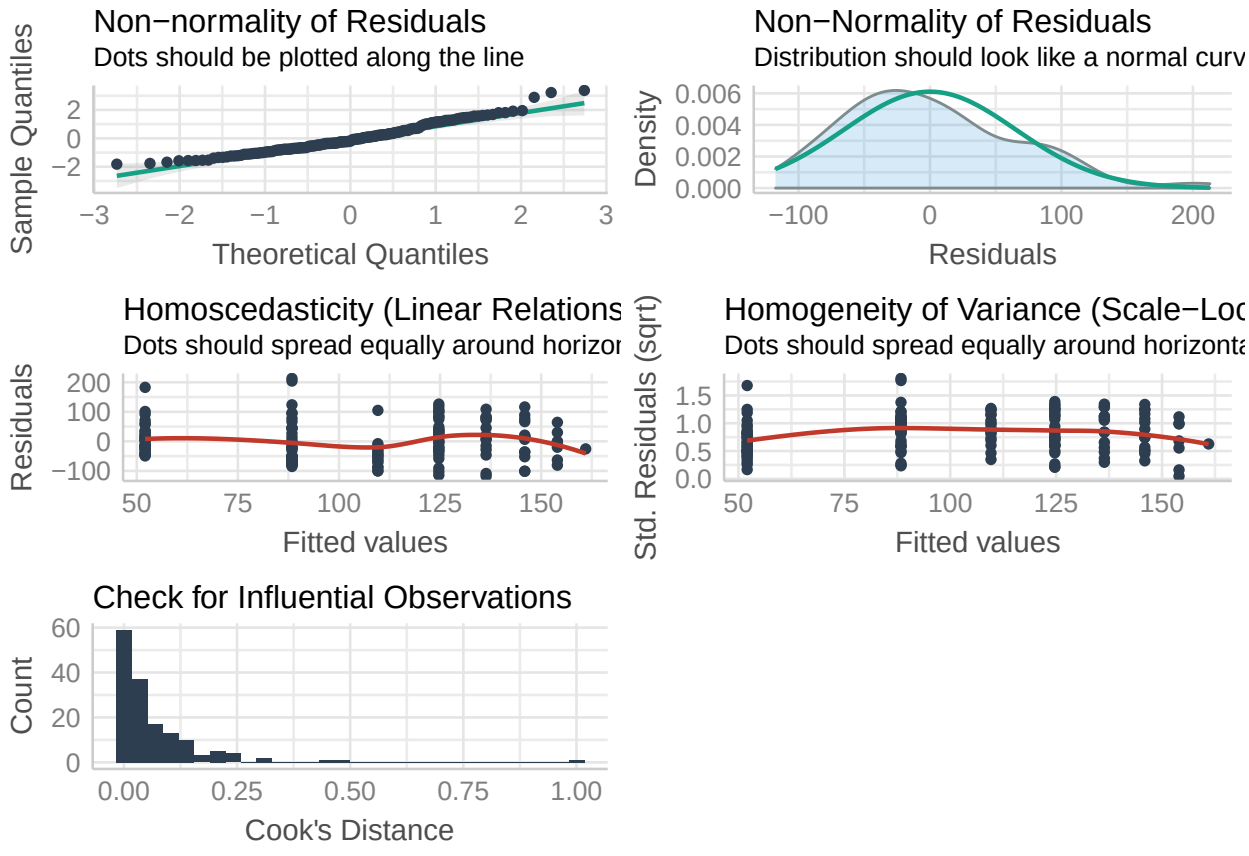
Fig. 3.A Tree diversity effect on the amount of litterfall and litter species richness

Amount of litterfall

Model

```
##
## Call:
## lm(formula = "fall ~ log(neigh.sp.rich)", data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -117.50  -46.43  -12.57   36.28  212.99
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)         52.061      9.570   5.440 2.10e-07 ***
## log(neigh.sp.rich)  52.387      8.246   6.353 2.36e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 65.56 on 151 degrees of freedom
## Multiple R-squared:  0.2109, Adjusted R-squared:  0.2057
## F-statistic: 40.36 on 1 and 151 DF,  p-value: 2.359e-09
```

Model quality .



Litter species richness

Model

```
##
## Call:
## lm(formula = "lit.rich ~ log(neigh.sp.rich)", data = df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.4450 -1.2606 -0.2954  0.6351  4.6699
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)         0.3649     0.1996   1.828   0.0695 .
## log(neigh.sp.rich)  2.8353     0.1720  16.488   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.367 on 151 degrees of freedom
## Multiple R-squared:  0.6429, Adjusted R-squared:  0.6405
## F-statistic: 271.9 on 1 and 151 DF,  p-value: < 2.2e-16
```

Model quality .

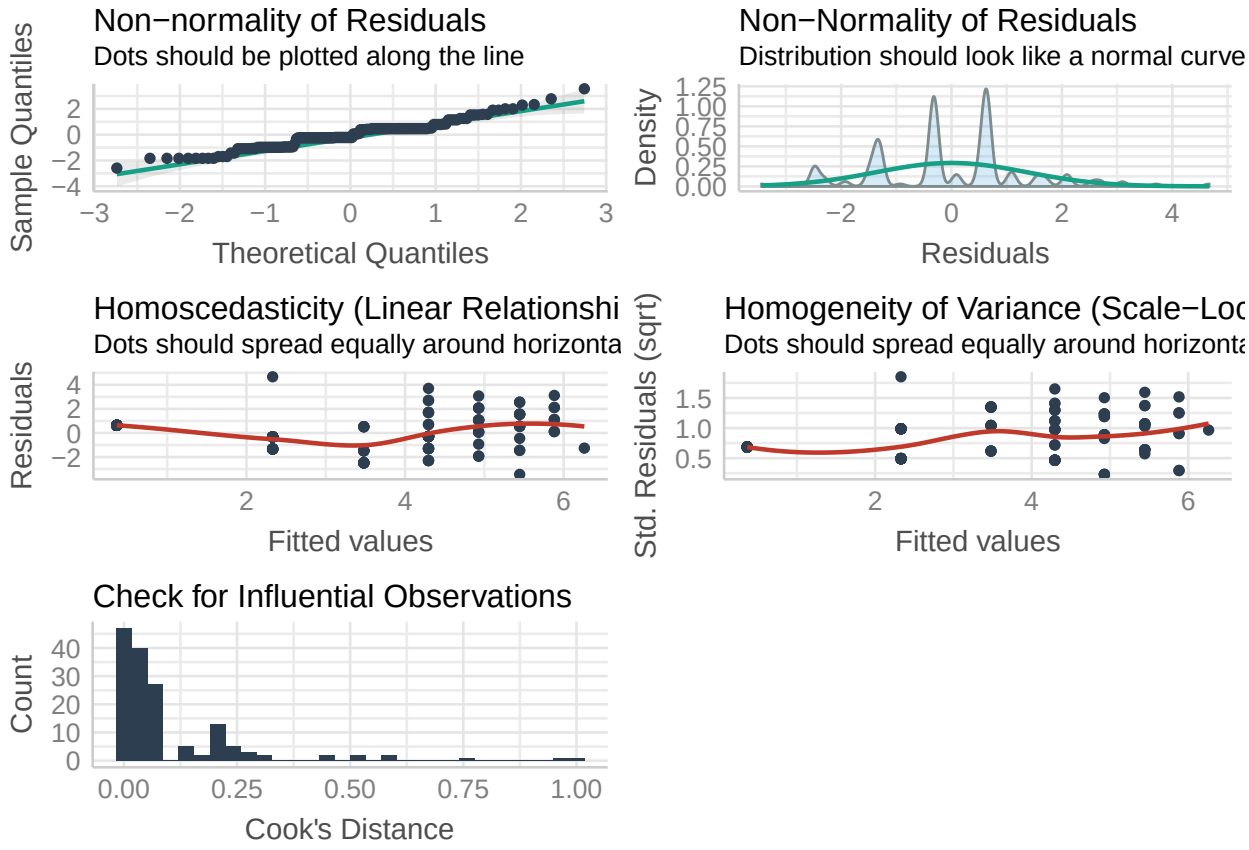


Fig. 3.B: Part of microbial decomposition in litter decomposition

Part of microbial decomposition in total C loss

$$\text{microbial contribution to } C_{loss} = \frac{C.loss_{microbial}}{C.loss_{total}}$$

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   30.32   64.30   80.55   84.42   97.41  476.48
```

Part of microbial decomposition in total N loss

$$\text{microbial contribution to } N_{loss} = \frac{N.loss_{microbial}}{N.loss_{total}}$$

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   27.31   74.62   86.59   87.16  100.62  190.34
```

Fig. 3.C: Structural equation model

SEM structure

Labels: "Ma" = total decomposition, "Mi" = microbial decomposition, "CG" = Common Garden (i.e., decomposability), "fall" = amount of litterfall, "lit.rich" = litter species richness, "neigh.sp.rch" = neighborhood tree species richness

```
form.sem =
  '
  C.loss_Ma1 ~ C.loss_Mi1 + fall + log.lit.rich + log.neigh.sp.rich
  N.loss_Ma1 ~ N.loss_Mi1 + fall + log.lit.rich + log.neigh.sp.rich
  C.loss_Ma1 ~~ N.loss_Ma1

  C.loss_Mi1 ~ C.loss_CG + fall + log.lit.rich + log.neigh.sp.rich
  N.loss_Mi1 ~ N.loss_CG + fall + log.lit.rich + log.neigh.sp.rich
  C.loss_Mi1 ~~ N.loss_Mi1

  C.loss_CG ~ log.lit.rich
  N.loss_CG ~ log.lit.rich
  C.loss_CG ~~ N.loss_CG

  fall ~ log.neigh.sp.rich
  log.lit.rich ~ log.neigh.sp.rich
  fall ~~ log.lit.rich
'
```

Hypotheses .

Causal relations

Response variable	Explanatory variable	Hypothesis
C.loss_Ma1	C.loss_Mi1	We expect total litter decomposition to be carried out by the microbial community
C.loss_Ma1	fall	We expect litter decomposition rate to increase with the amount of litterfall due to the addatation of the decomposer community to the higher amount of nutrients
C.loss_Ma1	log.lit.rich	We expect litter decomposition rate to increase with litter species richness due to the increase of litter complementarity
N.loss_Ma1	N.loss_Mi1	We expect total litter decomposition to be carried out by the microbial community
N.loss_Ma1	fall	We expect litter decomposition rate to increase with the amount of litterfall due to the addatation of the decomposer community to the higher amount of nutrients
N.loss_Ma1	log.lit.rich	We expect litter decomposition rate to increase with litter species richness due to the increase of litter complementarity
C.loss_Mi1	C.loss_CG	We expect microbial decomposition to increase with litter decomposability
C.loss_Mi1	fall	We expect litter decomposition rate to increase with the amount of litterfall due to the addatation of the decomposer community to the higher amount of nutrients

(continued)

Response variable	Explanatory variable	Hypothesis
C.loss_Mi1	log.lit.rich	We expect litter decomposition rate to increase with litter species richness due to the increase of litter complementarity
N.loss_Mi1	N.loss_CG	We expect microbial decomposition to increase with litter decomposability
N.loss_Mi1	fall	We expect litter decomposition rate to increase with the amount of litterfall due to the addatation of the decomposer community to the higher amount of nutrients
N.loss_Mi1	log.lit.rich	We expect litter decomposition rate to increase with litter species richness due to the increase of litter complementarity
C.loss_CG	log.lit.rich	We expect litter decomposition rate to increase with litter species richness due to the increase of litter complementarity
N.loss_CG	log.lit.rich	We expect litter decomposition rate to increase with litter species richness due to the increase of litter complementarity
fall	log.neigh.sp.r	We expect tree litterfall to increase with tree species richness
log.lit.rich	log.neigh.sp.ric	We expect litter species richness to increase with tree species richness

Correlations

Covariate 1	Covariate 2	Hypothesis
C.loss_Ma1	N.loss_Ma1	We expect carbon and nitrogen decomposition to be positively correlated
C.loss_Mi1	N.loss_Mi1	We expect carbon and nitrogen decomposition to be positively correlated
C.loss_CG	N.loss_CG	We expect carbon and nitrogen decomposition to be positively correlated
fall	log.lit.rich	We expect the amount of litterfall and litter species richness to be positively correlated as both positively affected by tree species richness

Model outputs

Summary .

Labels: "Ma" = total decomposition, "Mi" = microbial decomposition, "CG" = Common Garden (i.e., decomposability), "fall" = amount of litterfall, "lit.rich" = litter species richness, "ngh.sp.rch" = neighborhood tree species richness

```
## lavaan 0.6-7 ended normally after 42 iterations
##
##   Estimator                                         ML
##   Optimization method                           NLMINB
##   Number of free parameters                         32
##
##   Number of observations                           153
##
## Model Test User Model:
##
##   Test statistic                                10.994
##   Degrees of freedom                                12
##   P-value (Chi-square)                           0.529
##
## Parameter Estimates:
##
##   Standard errors                             Standard
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##
## Regressions:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   C.loss_Ma1 ~
##     C.loss_Mi1        0.264    0.052    5.069    0.000    0.264    0.261
##     fall              0.319    0.092    3.468    0.001    0.319    0.314
##     log.lit.rich      0.185    0.158    1.168    0.243    0.185    0.181
##     log.ngh.sp.rch   -0.214    0.144   -1.486    0.137   -0.214   -0.210
##   N.loss_Ma1 ~
##     N.loss_Mi1        0.507    0.048   10.511    0.000    0.507    0.492
##     fall              0.235    0.081    2.904    0.004    0.235    0.232
##     log.lit.rich      0.090    0.139    0.649    0.516    0.090    0.089
##     log.ngh.sp.rch   -0.053    0.126   -0.423    0.672   -0.053   -0.053
##   C.loss_Mi1 ~
##     C.loss_CG         0.433    0.055    7.881    0.000    0.433    0.430
##     fall              0.046    0.091    0.502    0.616    0.046    0.045
##     log.lit.rich      0.196    0.156    1.255    0.210    0.196    0.195
##     log.ngh.sp.rch   -0.217    0.142   -1.532    0.125   -0.217   -0.216
##   N.loss_Mi1 ~
##     N.loss_CG         0.350    0.056    6.271    0.000    0.350    0.356
##     fall              0.110    0.089    1.229    0.219    0.110    0.111
##     log.lit.rich      0.235    0.154    1.530    0.126    0.235    0.239
##     log.ngh.sp.rch   -0.198    0.139   -1.429    0.153   -0.198   -0.202
##   C.loss_CG ~
##     log.lit.rich     -0.117    0.080   -1.454    0.146   -0.117   -0.117
##   N.loss_CG ~
##     log.lit.rich      0.288    0.077    3.722    0.000    0.288    0.288
```

```
##   fall ~
##     log.ngh.sp.rch    0.459    0.072    6.395    0.000    0.459    0.459
##   log.lit.rich ~
##     log.ngh.sp.rch    0.856    0.042   20.445    0.000    0.856    0.856
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##  .C.loss_Ma1 ~~
##    .N.loss_Ma1        0.579    0.075    7.716    0.000    0.579    0.798
##  .C.loss_Mi1 ~~
##    .N.loss_Mi1        0.550    0.078    7.062    0.000    0.550    0.695
##  .C.loss_CG ~~
##    .N.loss_CG         0.379    0.082    4.604    0.000    0.379    0.401
##  .fall ~~
##    .log.lit.rich      0.197    0.040    4.901    0.000    0.197    0.432
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .C.loss_Ma1        0.827    0.095    8.746    0.000    0.827    0.803
##    .N.loss_Ma1        0.636    0.073    8.746    0.000    0.636    0.624
##    .C.loss_Mi1        0.807    0.092    8.746    0.000    0.807    0.803
##    .N.loss_Mi1        0.776    0.089    8.746    0.000    0.776    0.807
##    .C.loss_CG         0.980    0.112    8.746    0.000    0.980    0.986
##    .N.loss_CG         0.911    0.104    8.746    0.000    0.911    0.917
##    .fall              0.784    0.090    8.746    0.000    0.784    0.789
##    .log.lit.rich      0.266    0.030    8.746    0.000    0.266    0.268
```

R squared

```
##   C.loss_Ma1   N.loss_Ma1   C.loss_Mi1   N.loss_Mi1    C.loss_CG    N.loss_CG
##        0.197        0.376        0.197        0.193        0.014        0.083
##         fall log.lit.rich
##        0.211        0.732
```

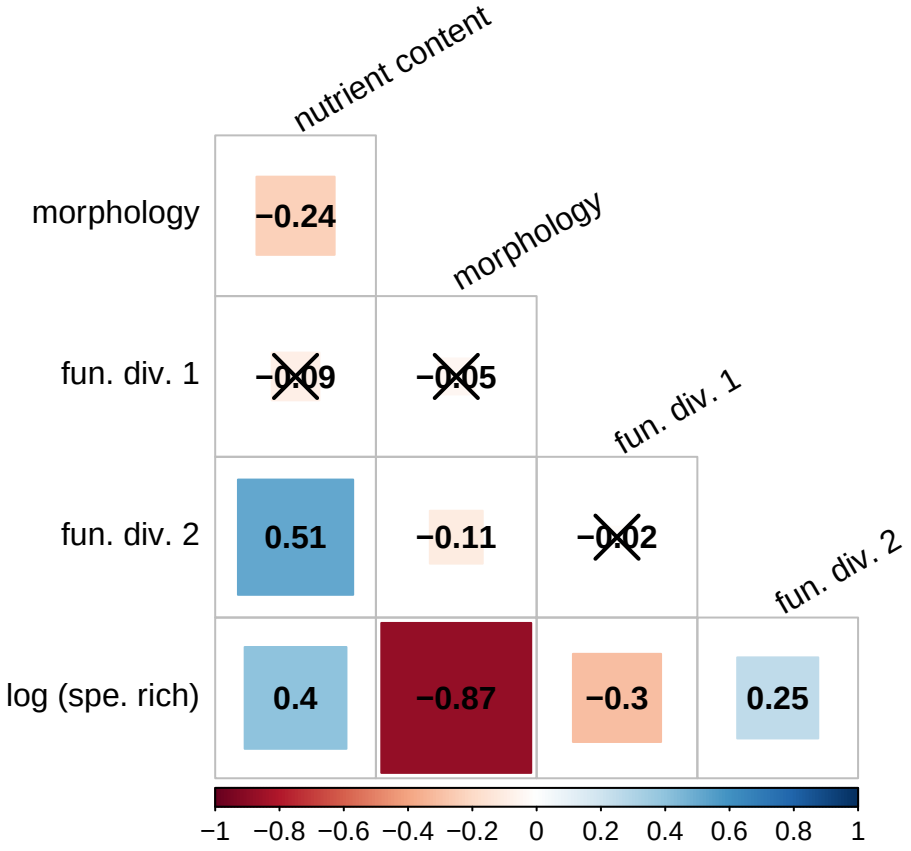
Model quality

```
##     DF    CFI  RMSEA   SRMR
## 12.000  1.000  0.000  0.031
```

Figure 4

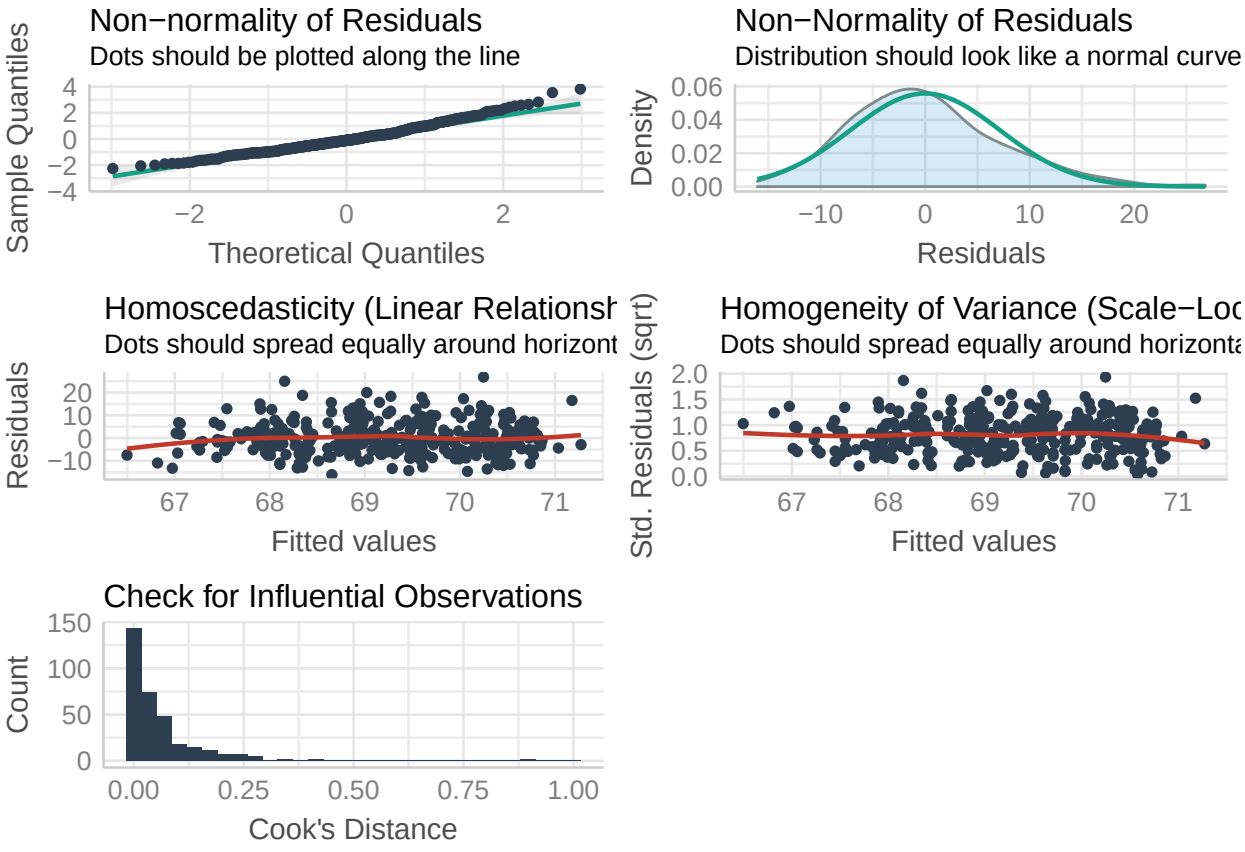
Fig. 4.A: Decomposability drivers

Correlation between explanatory variables



Decomposability C loss

```
##
## Call:
## lm(formula = C.loss ~ compo.pca.1, data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -16.0580  -5.0609  -0.6945   3.9496  26.8027
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  69.2268     0.3891 177.915  < 2e-16 ***
## compo.pca.1   1.0215     0.3897   2.621  0.00915 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7.164 on 337 degrees of freedom
## Multiple R-squared:  0.01998,    Adjusted R-squared:  0.01707
## F-statistic: 6.872 on 1 and 337 DF,  p-value: 0.009155
```



Decomposability N loss

```
##
## Call:
## lm(formula = N.loss ~ div.pca.1 + compo.pca.1 + log(lit.rich),
##     data = df)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -25.5671  -4.8384  -0.5727   5.3752  29.4864
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    69.7242     0.7842  88.909  < 2e-16 ***
## div.pca.1       0.4594     0.1909   2.406 0.016667 *
## compo.pca.1     2.0861     0.5152   4.049 6.38e-05 ***
## log(lit.rich)   2.5523     0.7333   3.481 0.000566 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.67 on 335 degrees of freedom
## Multiple R-squared:  0.1249, Adjusted R-squared:  0.1171
## F-statistic: 15.94 on 3 and 335 DF,  p-value: 1.041e-09
```

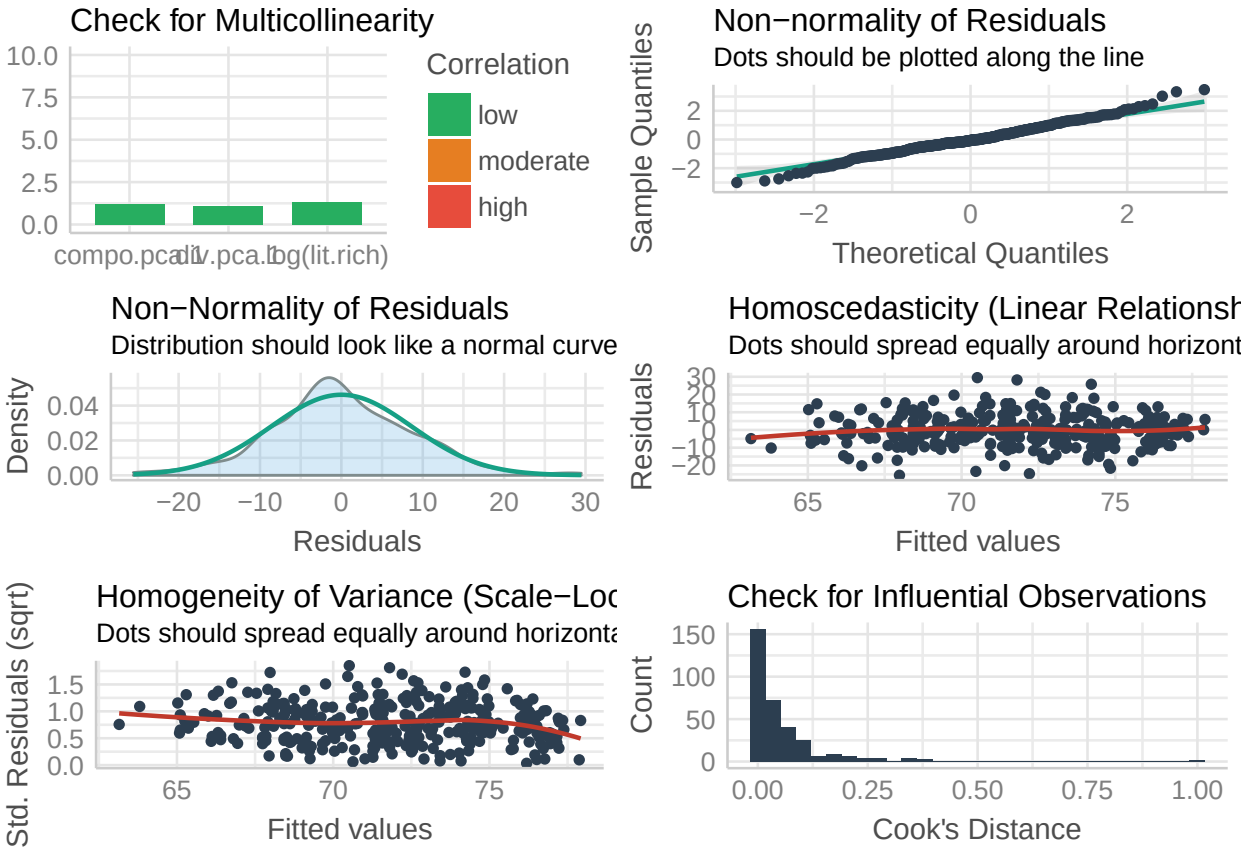
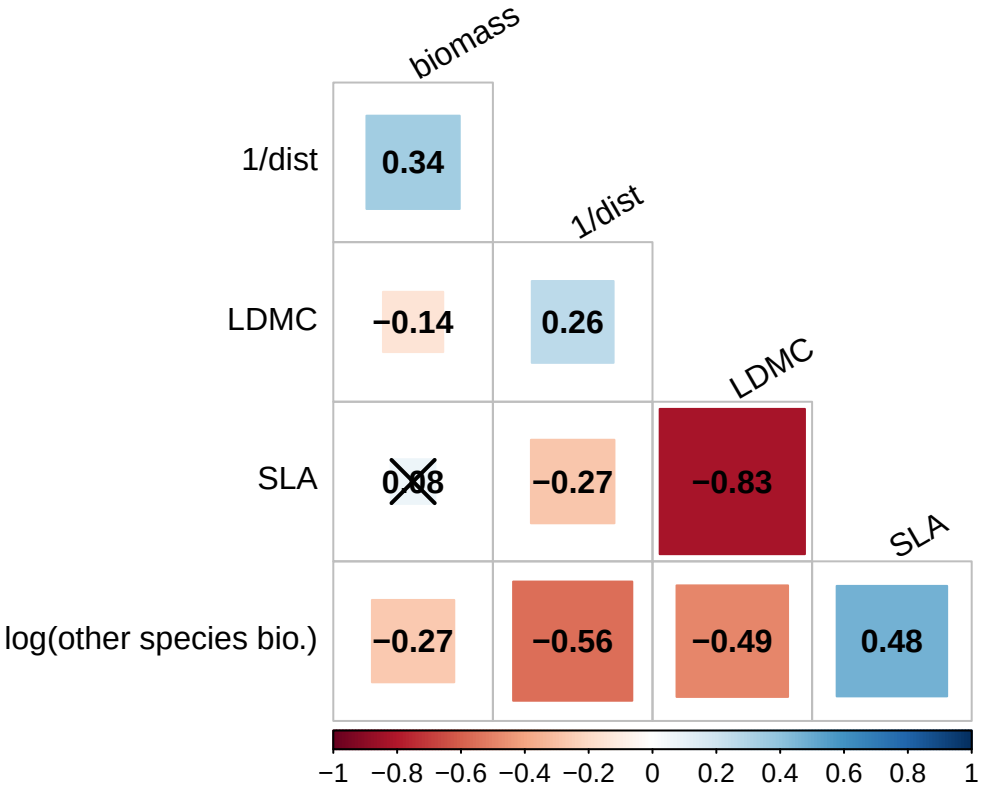
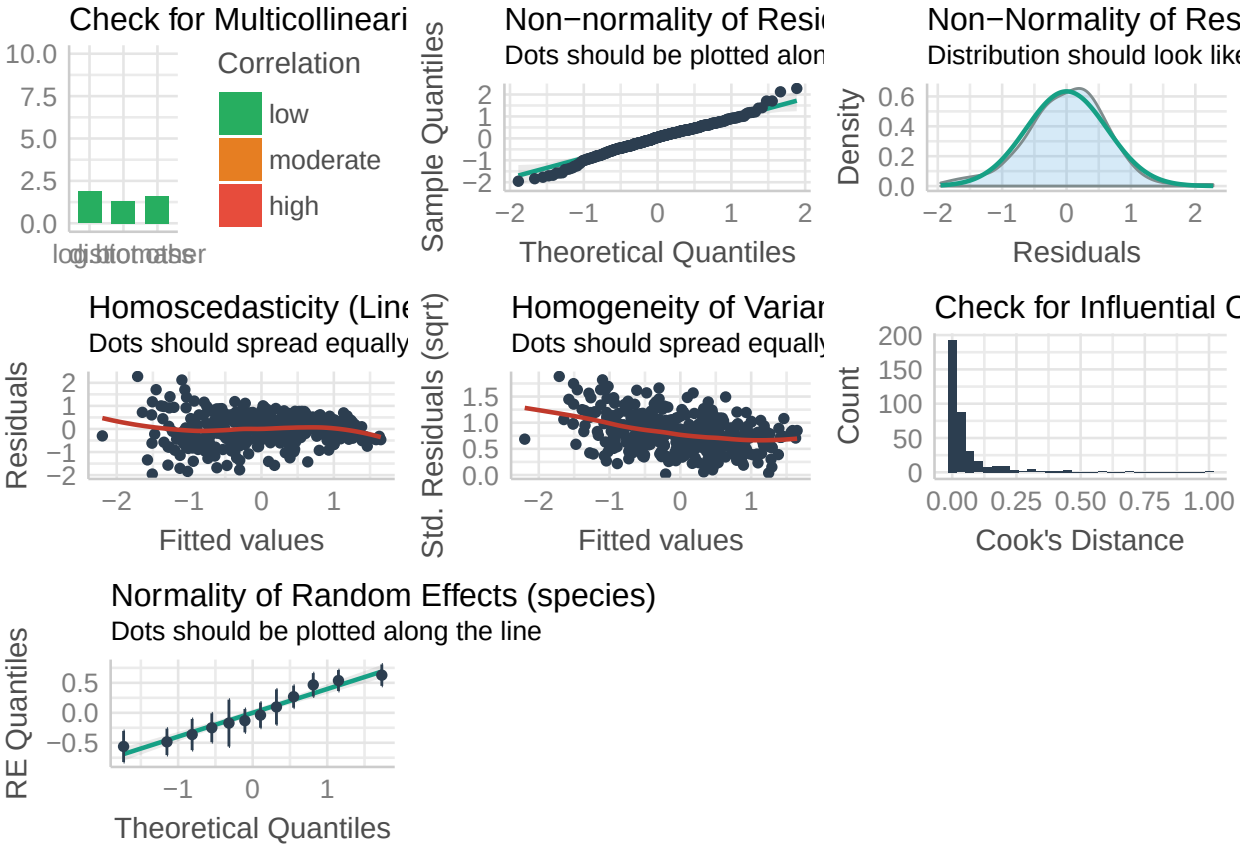


Fig. 4.B: Litterfall drivers

Correlation between explanatory variables



```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: log.litter.biomass.area ~ log.biomass + dist + tot.other + (1 |
##     species)
##    Data: df.stat
##
## REML criterion at convergence: 767.2
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.0497 -0.5819  0.0695  0.6145  3.5516
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  species  (Intercept) 0.1785   0.4225
##  Residual             0.4107   0.6408
## Number of obs: 372, groups:  species, 12
##
## Fixed effects:
##              Estimate Std. Error        df t value Pr(>|t|)
## (Intercept)  -0.10092    0.12795  10.89923  -0.789  0.44707
## log.biomass   0.43985    0.04755 354.96121   9.251  < 2e-16 ***
## dist          0.14263    0.04644 367.58871   3.072  0.00229 **
## tot.other    -0.10310    0.04953 363.68207  -2.082  0.03809 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) lg.bms dist
## log.biomass  0.066
## dist        -0.014 -0.390
## tot.other    0.050  0.047  0.542
```


Check for Multicollinearity
Correlation
low
moderate
high
Non−normality of Residuals
Dots should be plotted along the line
Sample Quantiles
Theoretical Quantiles
Non−Normality of Residuals
Distribution should look like the curve
Density
Residuals
Homoscedasticity (Linearity)
Dots should spread equally
Residuals
Fitted values
Homogeneity of Variance
Dots should spread equally
Std. Residuals (sqrt)
Fitted values
Check for Influential Cases
Count
Cook's Distance
Normality of Random Effects (species)
Dots should be plotted along the line
RE Quantiles
Theoretical Quantiles