Supplement of Biogeosciences, 12, 2207–2226, 2015
http://www.biogeosciences.net/12/2207/2015/
doi:10.5194/bg-12-2207-2015-supplement

Biogeosciences Open Access

Supplement of

Global analysis of seasonality in the shell flux of extant planktonic Foraminifera

L. Jonkers and M. Kučera

Correspondence to: L. Jonkers (jonkersl@cardiff.ac.uk)

Figure captions

Fig. S1 (page 2-3): Seasonality maps showing the proportion of mean annual flux per season for all species investigated. The size of the pie charts is scaled to the log of the mean annual flux.

Fig. S2 (page 4-42): periodic regression results for all sites. Black dots indicate observations, red line modelled flux. Sites are numbered according to Table 1.

Fig. S3 (page 43): observed vs. modelled peak timing for individual species. Legend as in Fig. 3A.

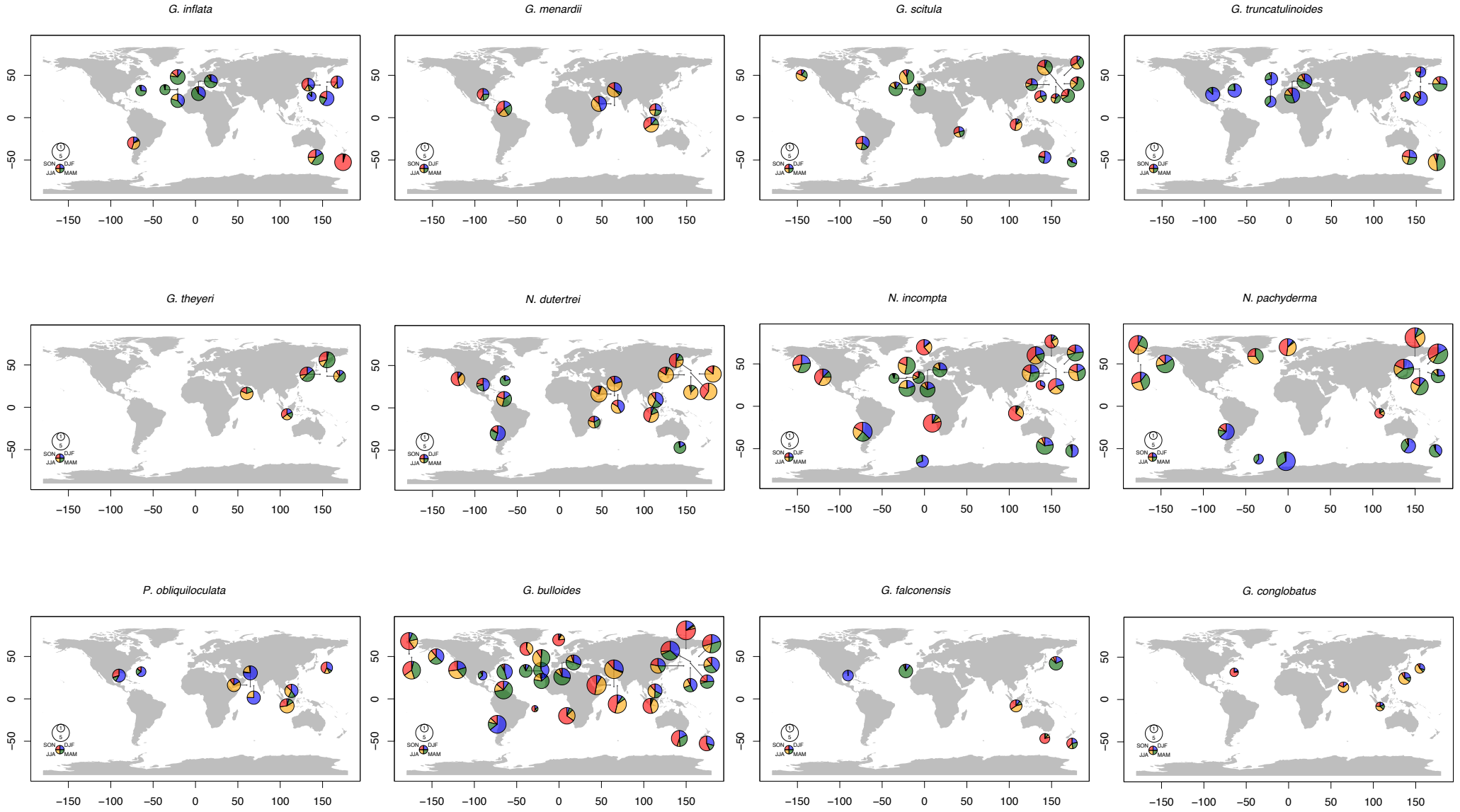
Fig. S4 (page 44): residual of observed-modelled peak timing for all species. Legend as in Fig. 3B.

Fig. S5 (page 45-47): Maps showing presence or absence of a cyclic component in the individual time series.

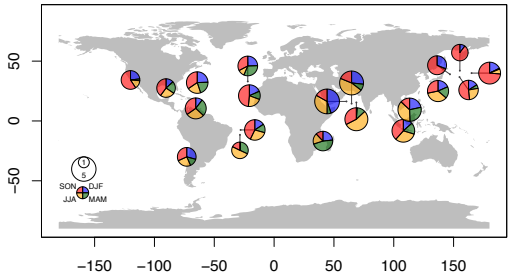
Fig. S6 (page 48-49): seasonality patterns of all species. Species with a green dot bear symbionts.

Fig. S7 (page 50): proportion of time series with single and double cycles. As Fig. 4B, but for individual species grouped by seasonality mode.

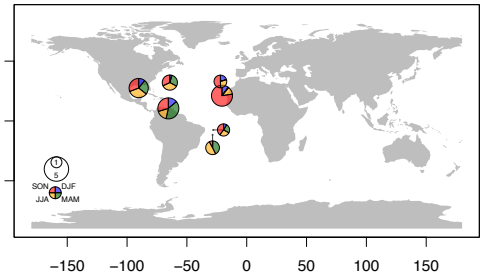
Fig. S8 (page 51-52): patterns in peak timing (cf. Fig. 7) compared to the seasonal pattern of upper ocean temperature.


G. inflata
G. menardii
G. scitula
G. truncatulinoides
G. theyeri
N. dutertrei
N. incompta
N. pachyderma
P. obliquiloculata
G. bulloides
G. falconensis
G. conglobatus
SON DJF JJA MAM
5
−150 −100 −50 0 50 100 150
−50 0 50

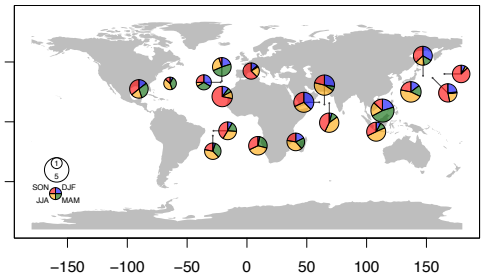
G. ruber (white)



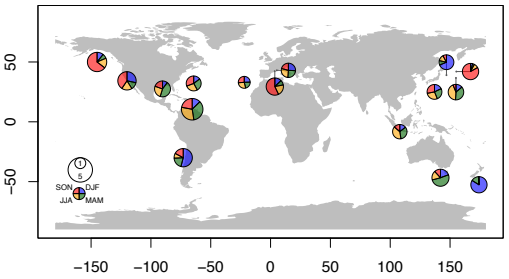
G. ruber (pink)



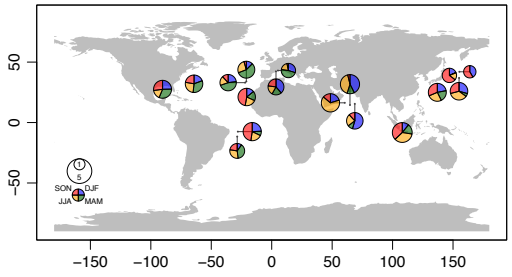
G. sacculifer



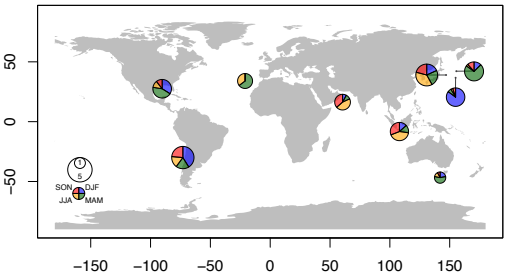
O. universa



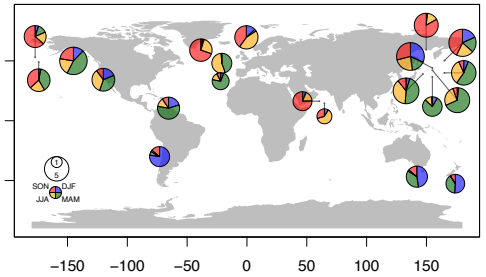
G. siphonifera



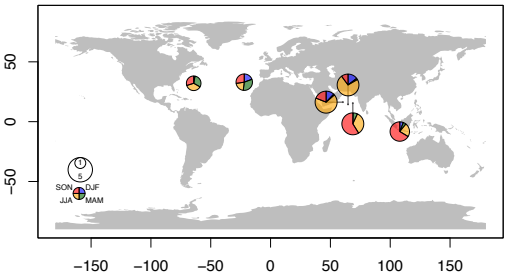
G. calida



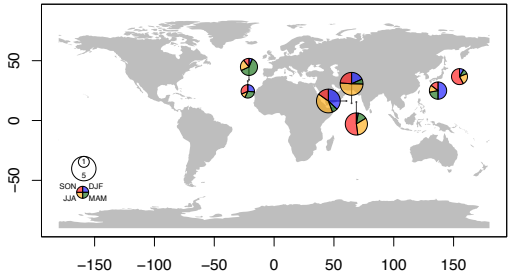
T. quinqueloba



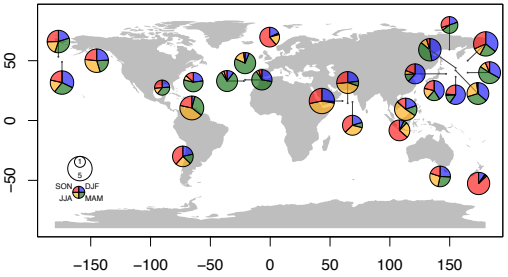
G. rubescens



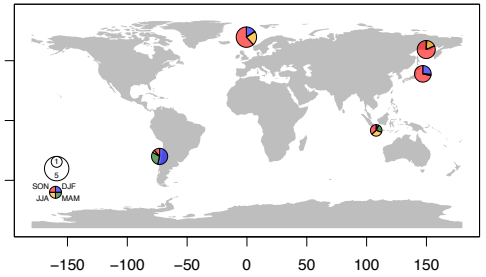
G. tenella



G. glutinata

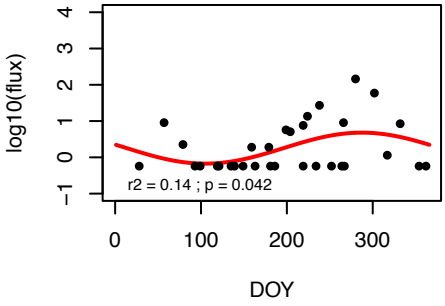


G. uvula

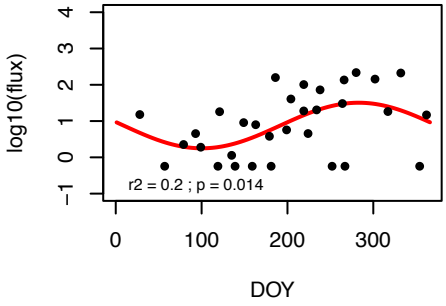


Site 1

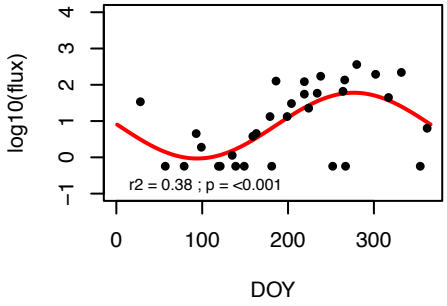
G_bul



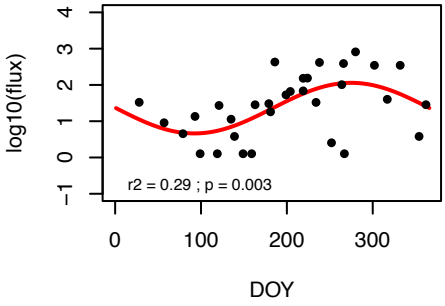
G_glu



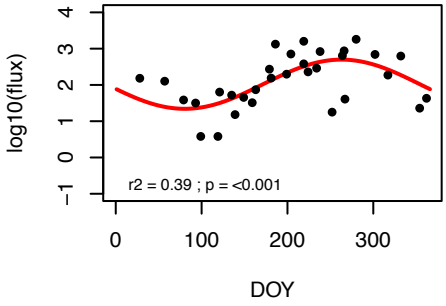
G_uvu



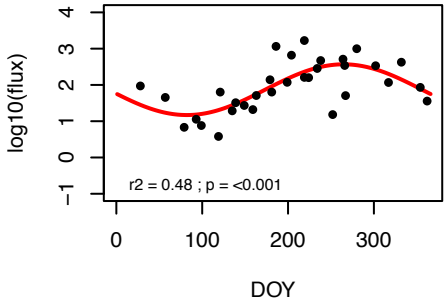
N_inc



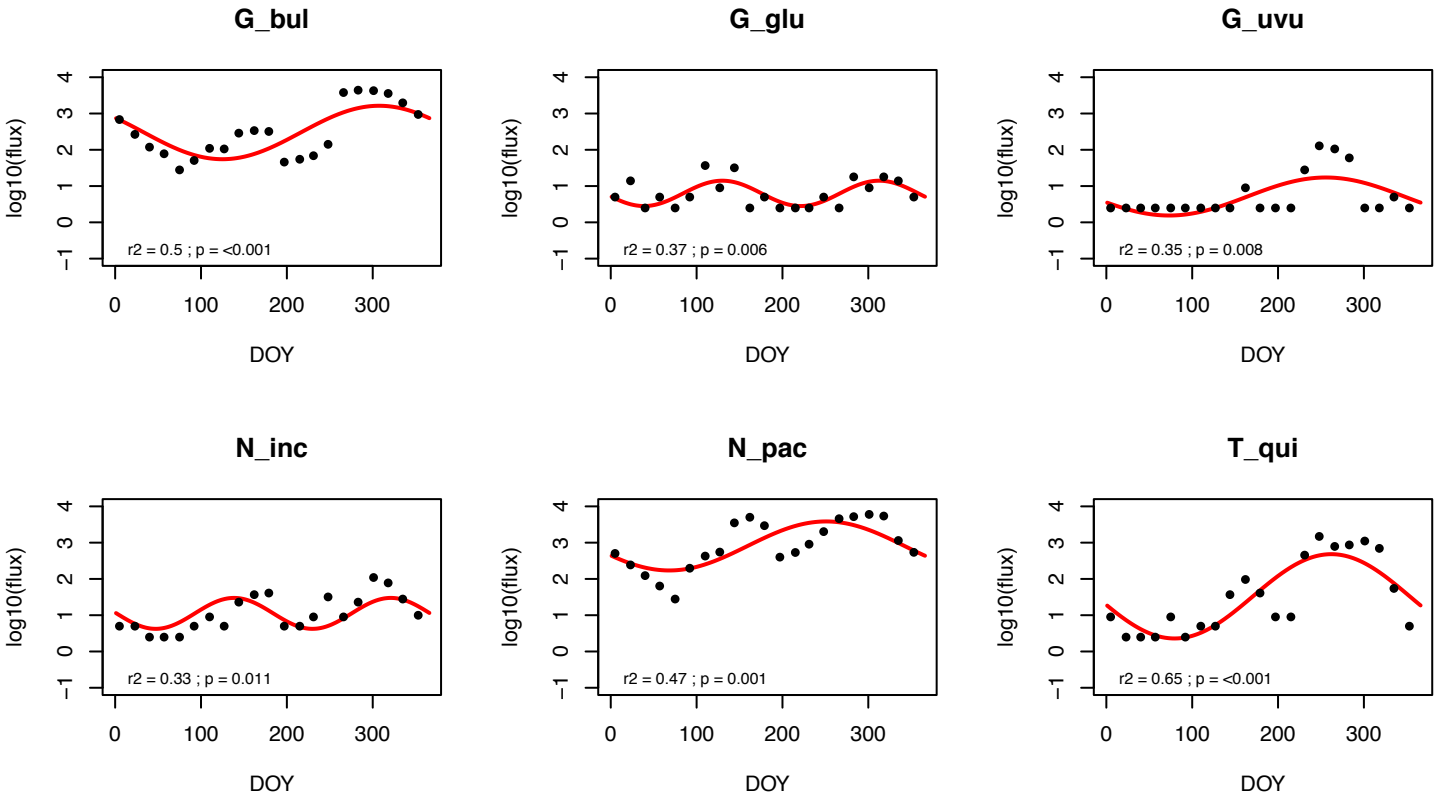
N_pac



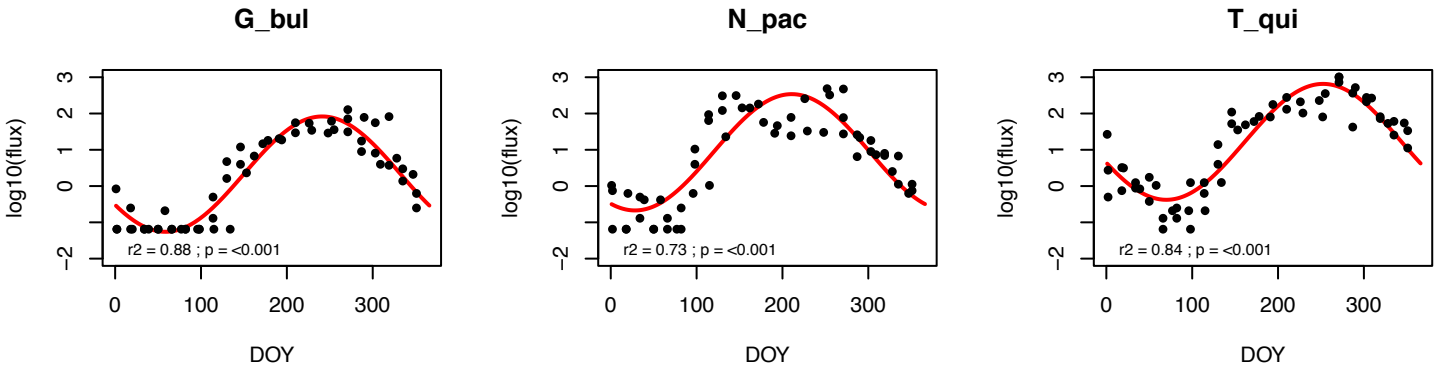
T_qui



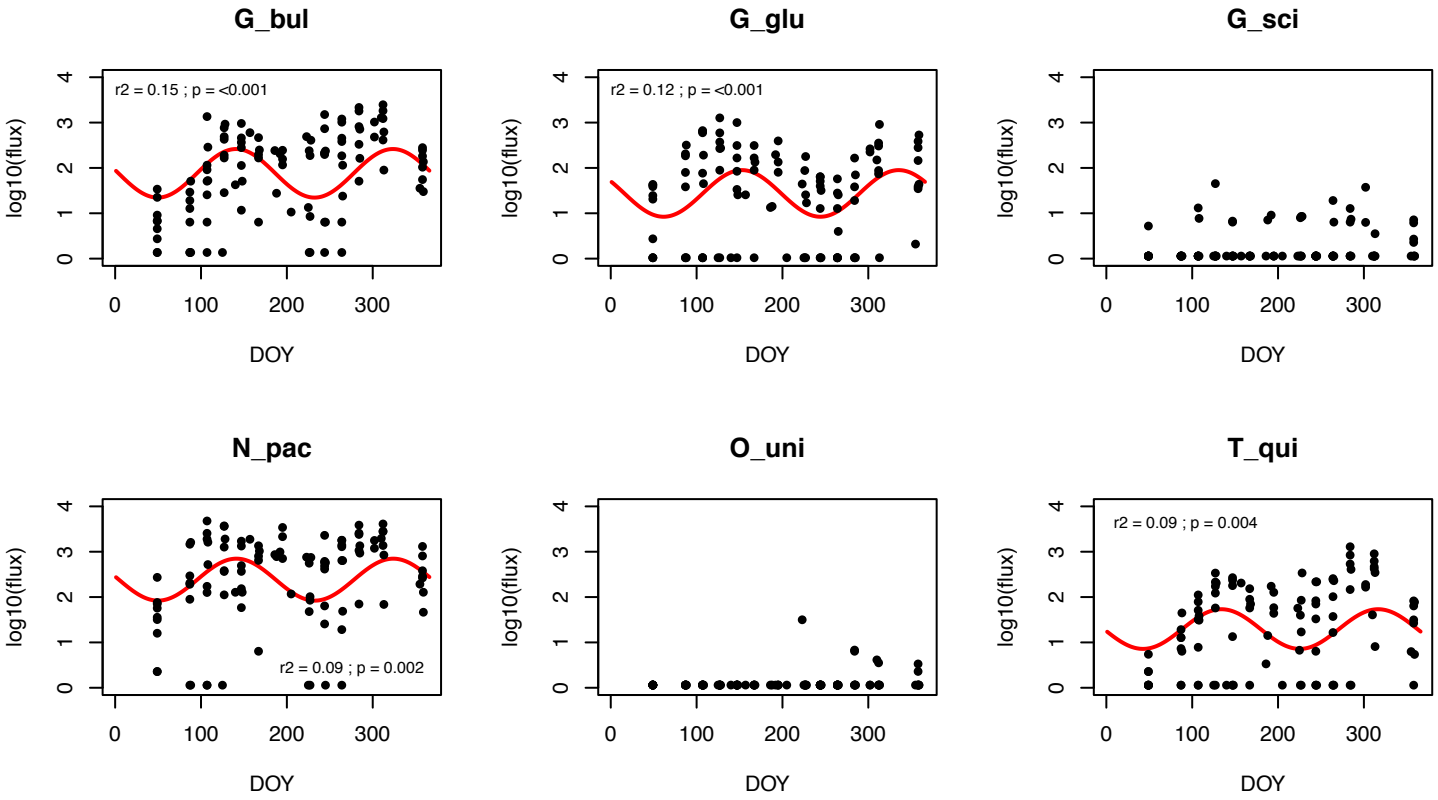
Site 2


G_bul
log10(flux)
DOY
r2 = 0.5 ; p = <0.001
G_glu
log10(flux)
DOY
r2 = 0.37 ; p = 0.006
G_uvu
log10(flux)
DOY
r2 = 0.35 ; p = 0.008
N_inc
log10(flux)
DOY
r2 = 0.33 ; p = 0.011
N_pac
log10(flux)
DOY
r2 = 0.47 ; p = 0.001
T_qui
log10(flux)
DOY
r2 = 0.65 ; p = <0.001

Site 3

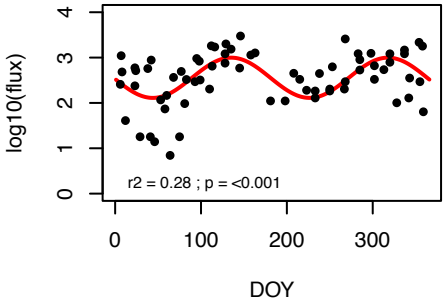

G_bul
log10(flux)
DOY
r2 = 0.88 ; p = <0.001
N_pac
log10(flux)
DOY
r2 = 0.73 ; p = <0.001
T_qui
log10(flux)
DOY
r2 = 0.84 ; p = <0.001

Site 4

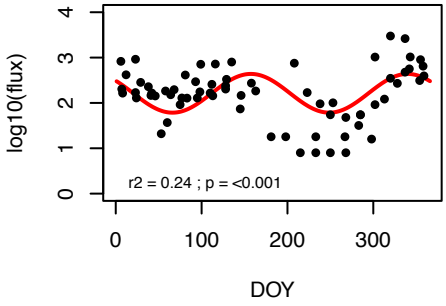

G_bul
r2 = 0.15 ; p = <0.001
G_glu
r2 = 0.12 ; p = <0.001
G_sci
N_pac
r2 = 0.09 ; p = 0.002
O_uni
T_qui
r2 = 0.09 ; p = 0.004
log10(flux)
DOY
0
100
200
300
1
2
3
4

Site 5

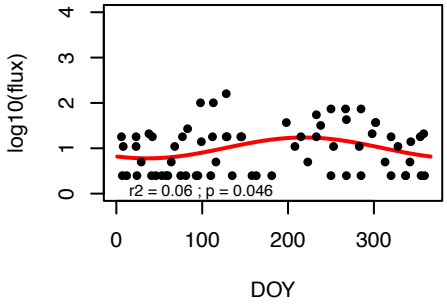
G_bul



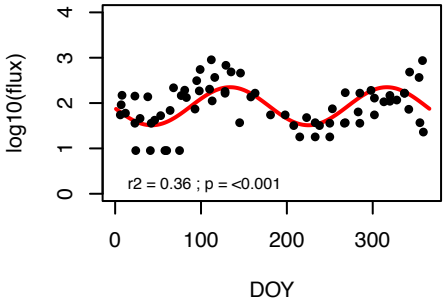
G_glu



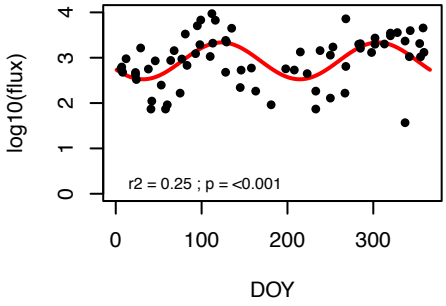
G_sci



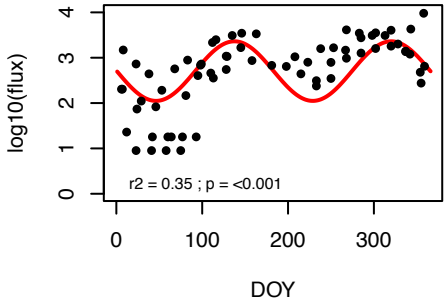
N_inc



N_pac

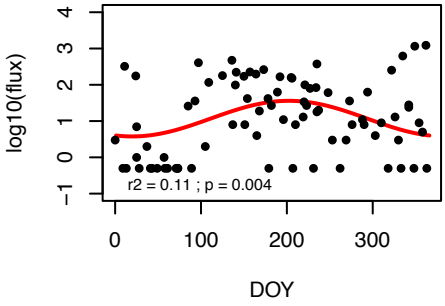


T_qui

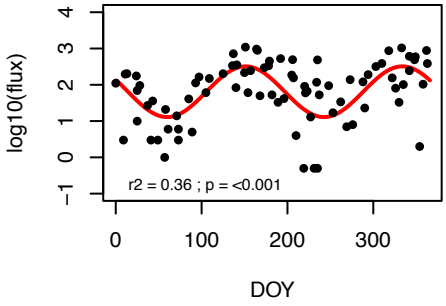


Site 6

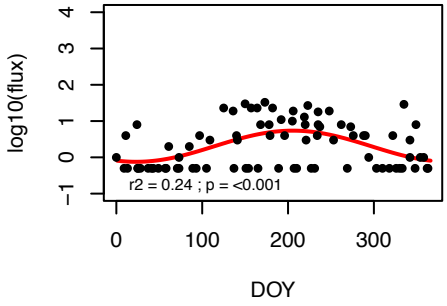
G_bul



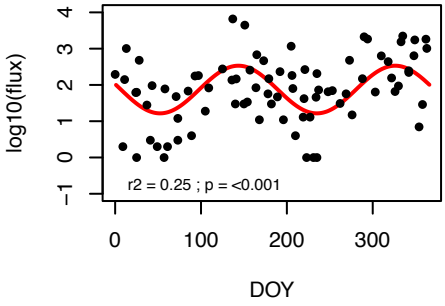
G_glu



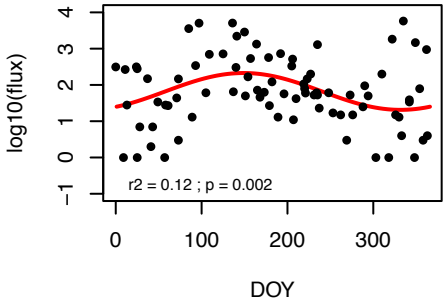
G_sci



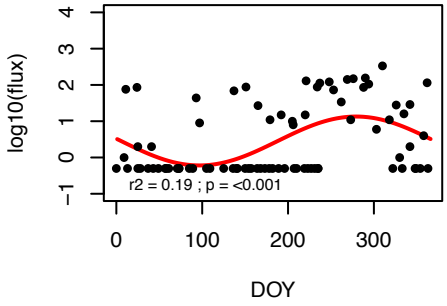
N_inc



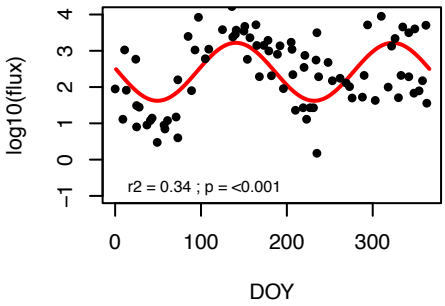
N_pac



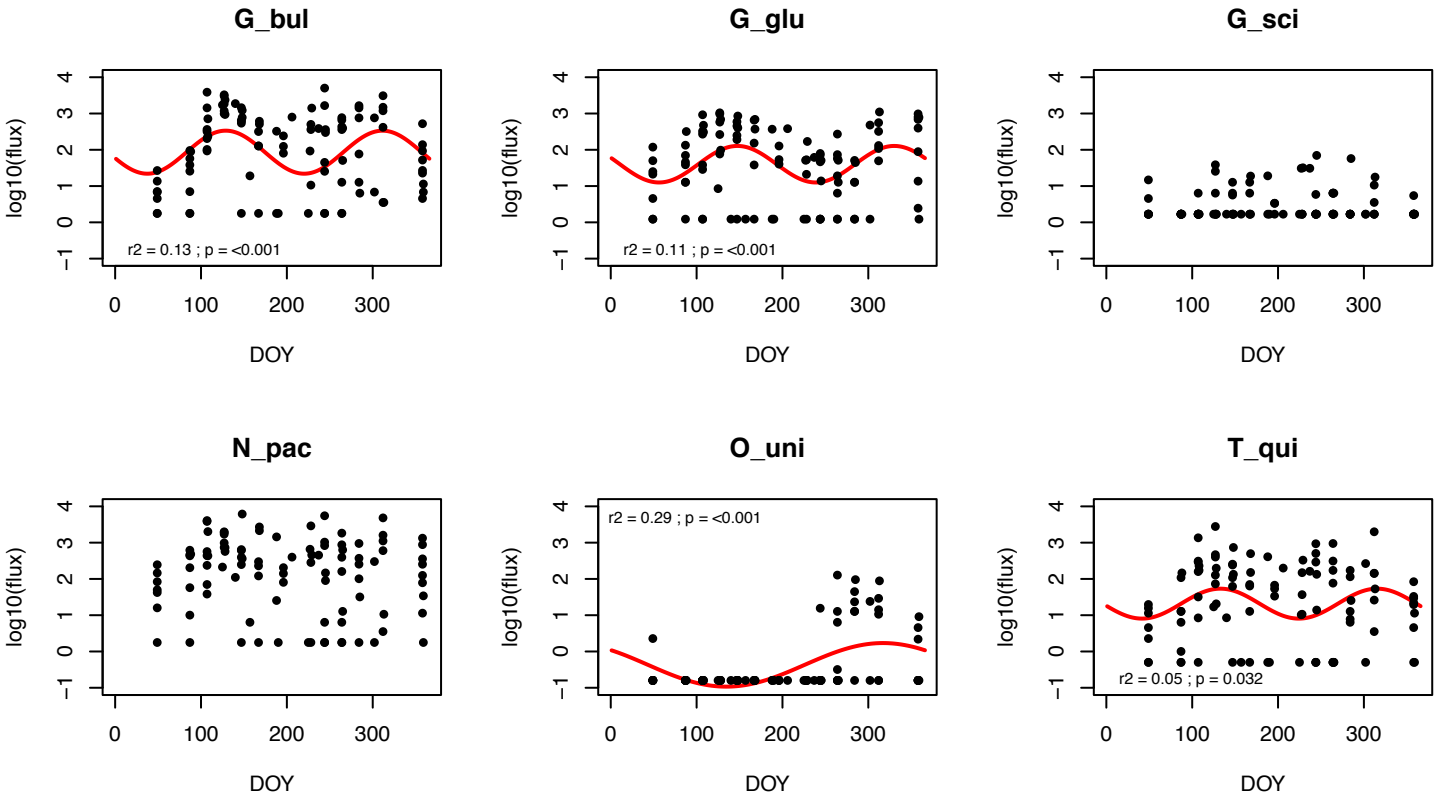
O_uni



T_qui

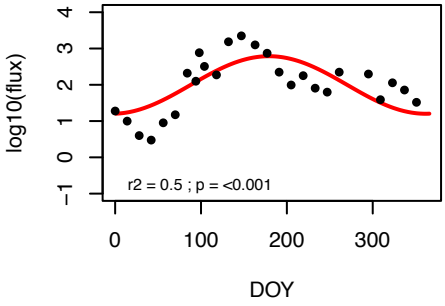


Site 7

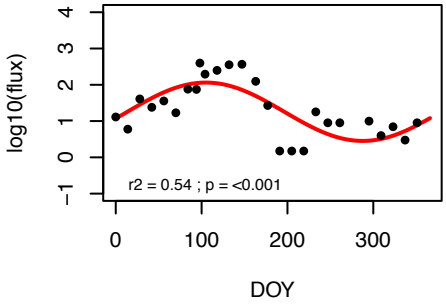

G_bul
log10(flux)
DOY
r2 = 0.13 ; p = <0.001
G_glu
log10(flux)
DOY
r2 = 0.11 ; p = <0.001
G_sci
log10(flux)
DOY
N_pac
log10(flux)
DOY
O_uni
log10(flux)
DOY
r2 = 0.29 ; p = <0.001
T_qui
log10(flux)
DOY
r2 = 0.05 ; p = 0.032

Site 8

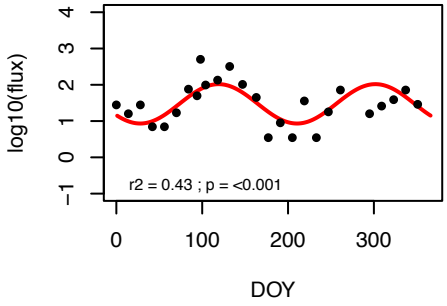
G_bul



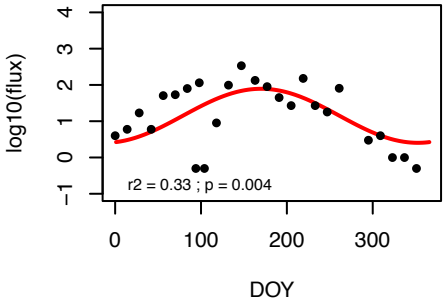
G_glu



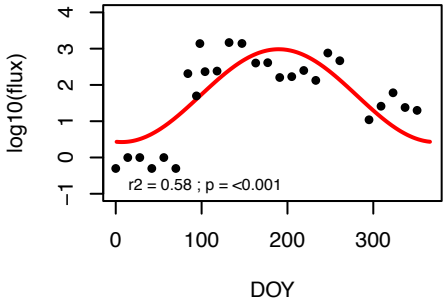
G_inf



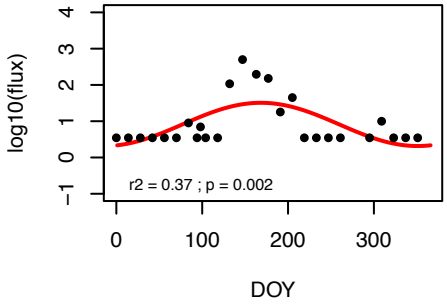
G_sci



N_inc

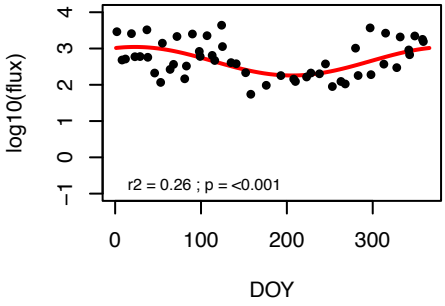


T_qui

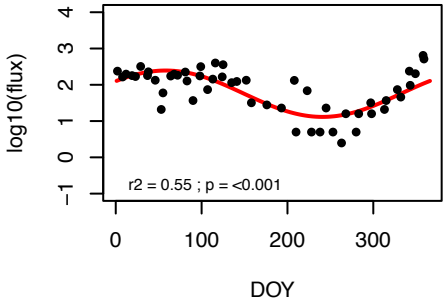


Site 9

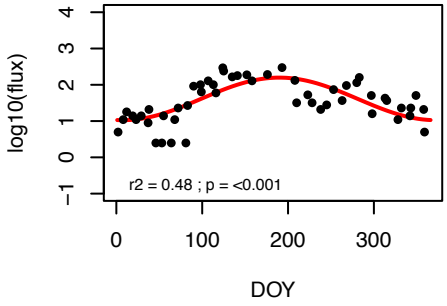
G_bul



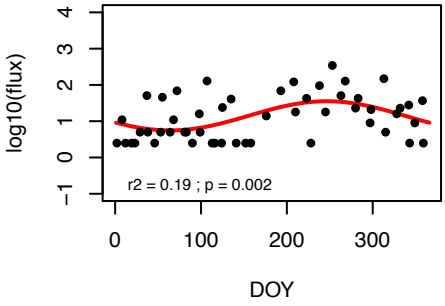
G_glu



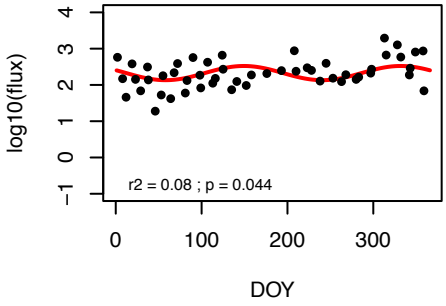
G_sci



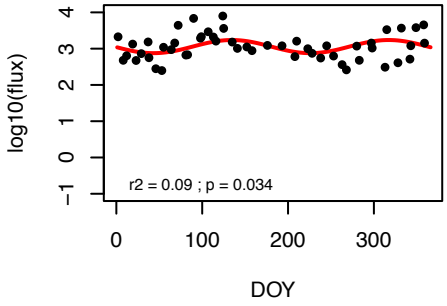
N_dut



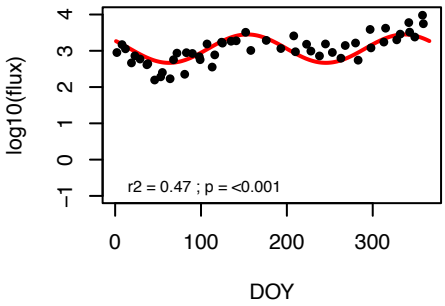
N_inc



N_pac

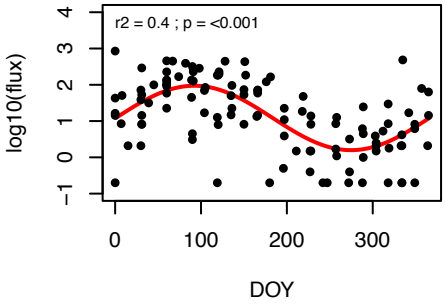


T_qui

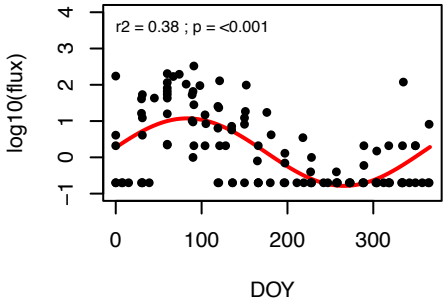


Site 10

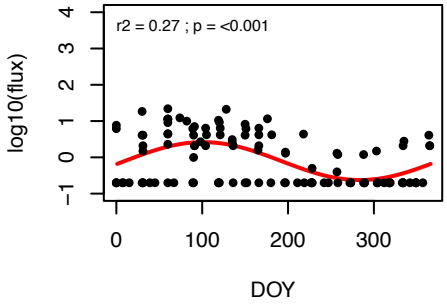
G_bul



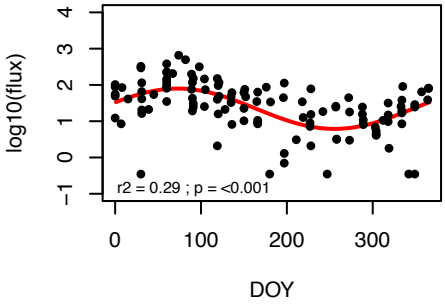
G_inf



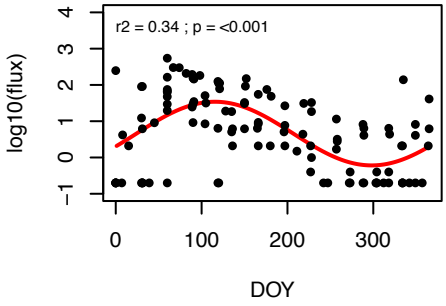
G_sip



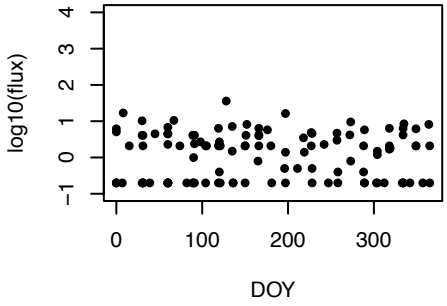
G_tru



N_inc

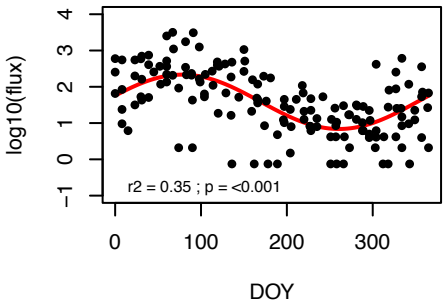


O_uni

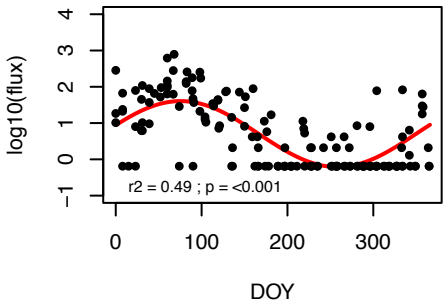


Site 11

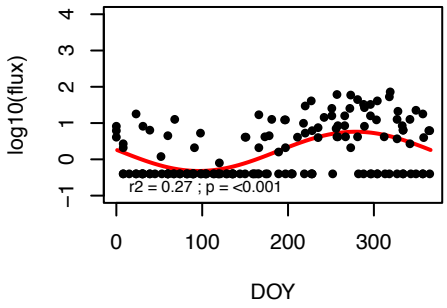
G_bul



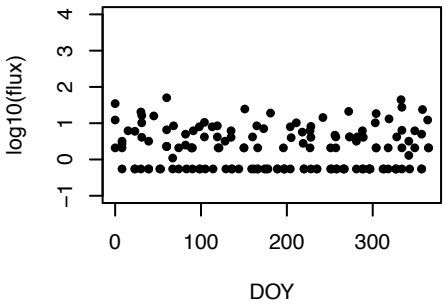
G_inf



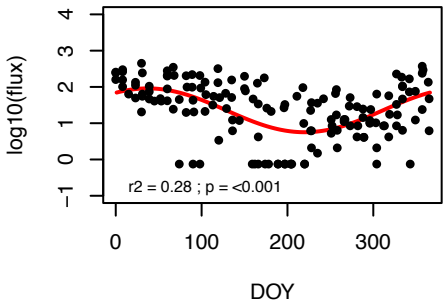
G_sac



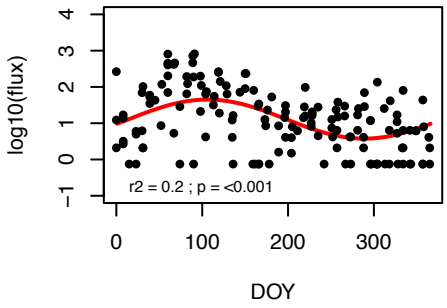
G_sip



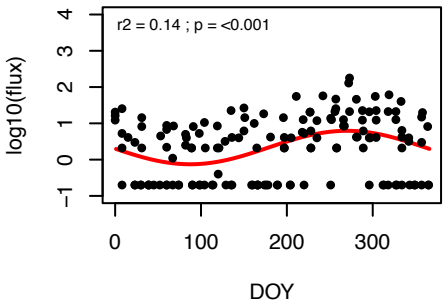
G_tru



N_inc

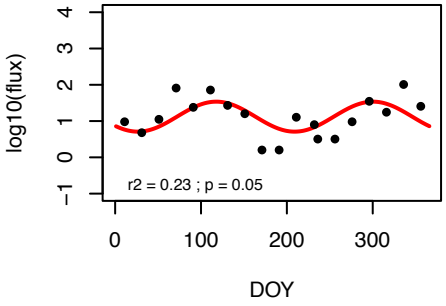


O_uni

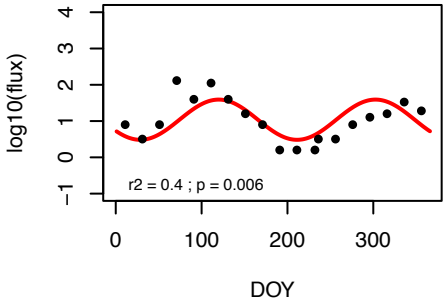


Site 12

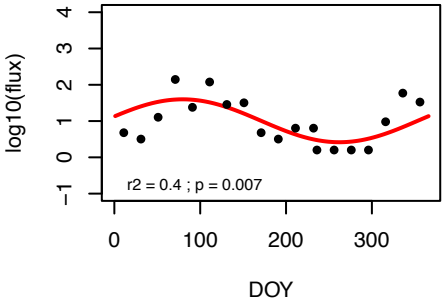
G_bul



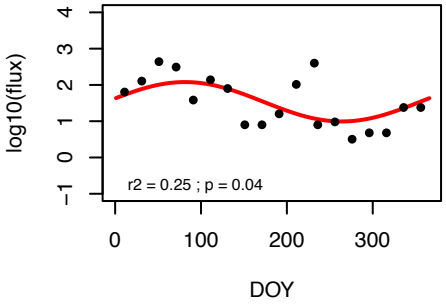
G_cal



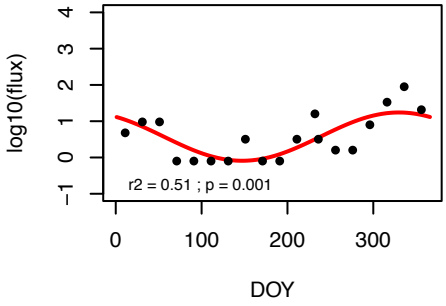
G_fal



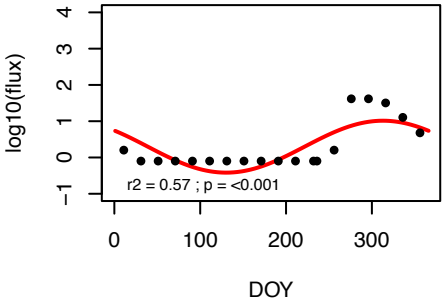
G_glu



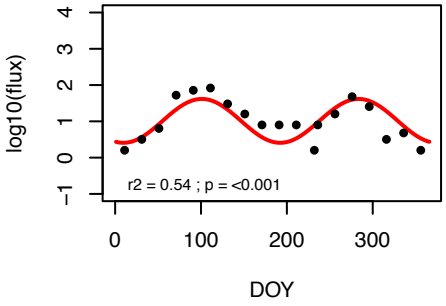
G_inf



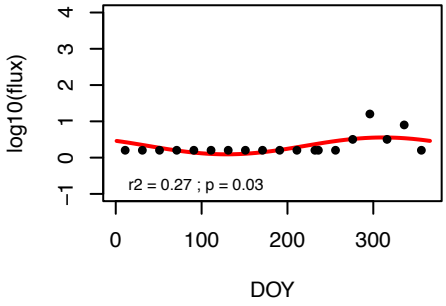
G_rubw



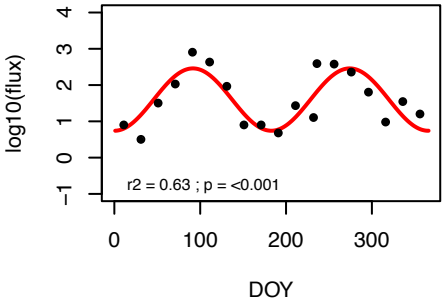
G_sci



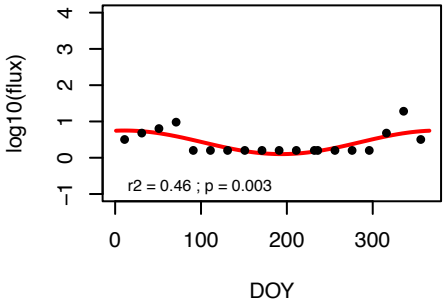
G_sip



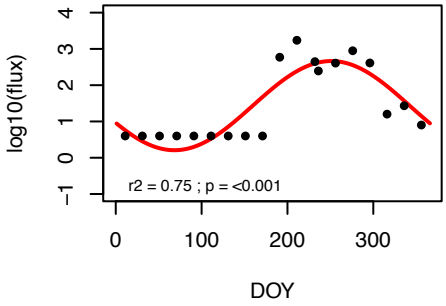
G_the



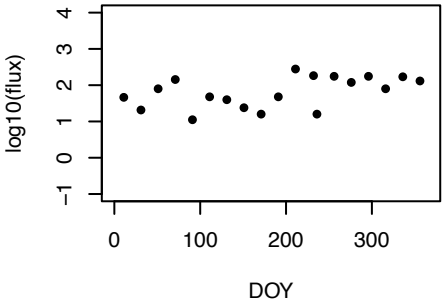
G_tru



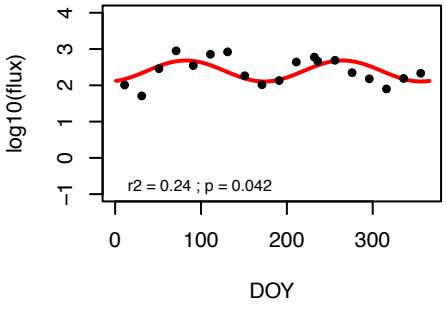
N_dut



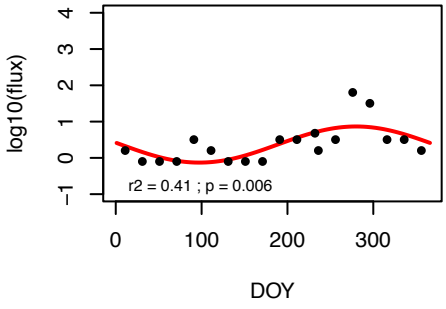
N_inc



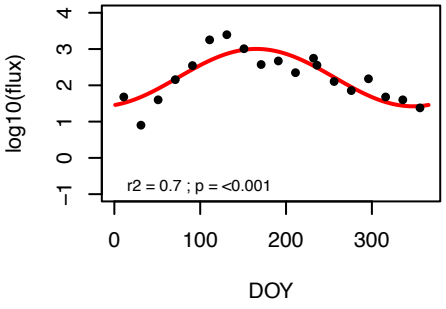
N_pac



O_uni

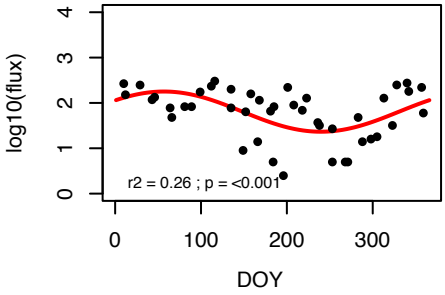


T_qui

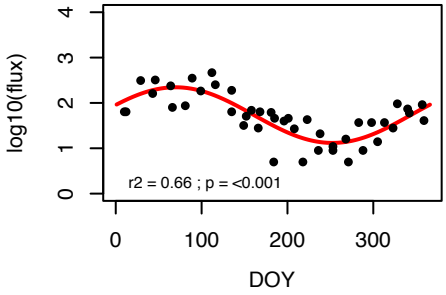


Site 13

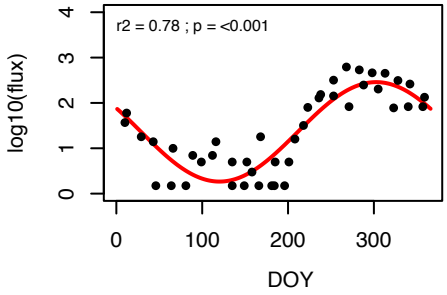
G_bul



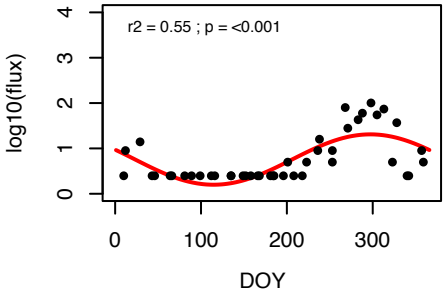
G_glu



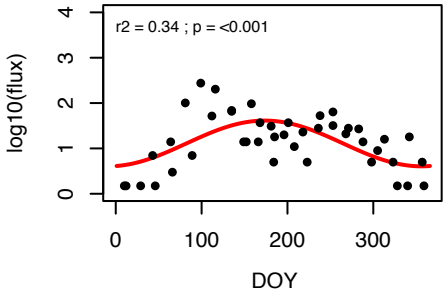
G_rubw



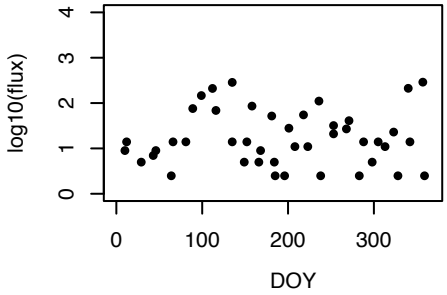
G_sac



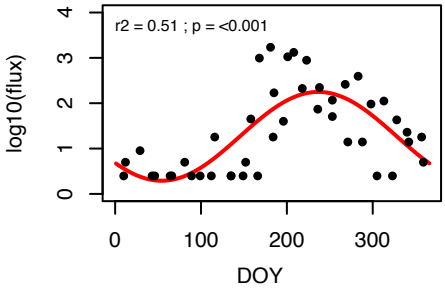
G_sci



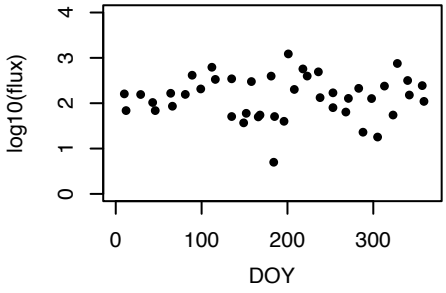
G_tru



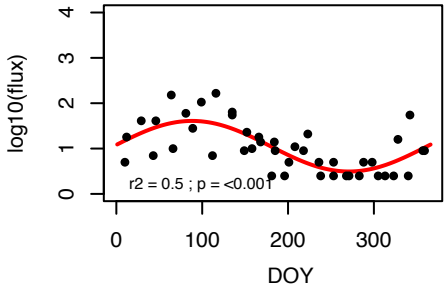
N_dut



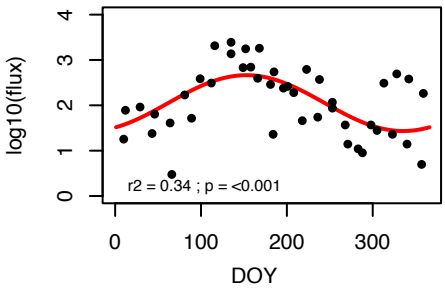
N_inc



N_pac

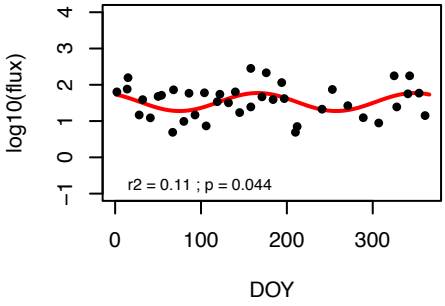


T_qui

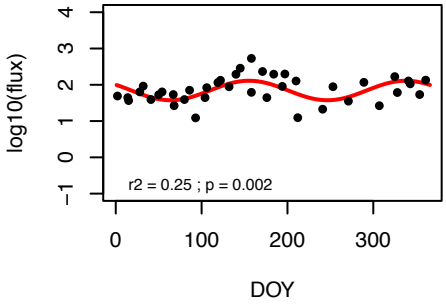


Site 14

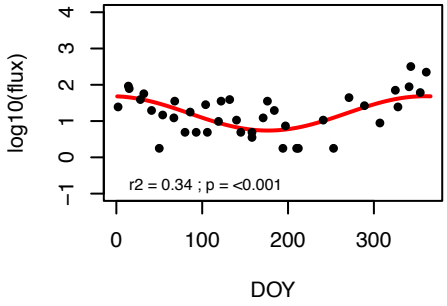
G_bul



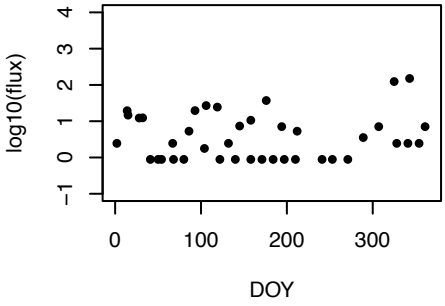
G_cal



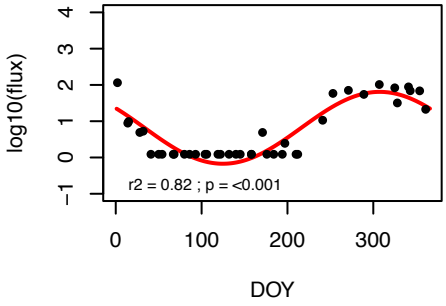
G_glu



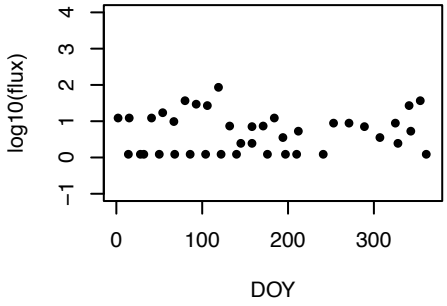
G_inf



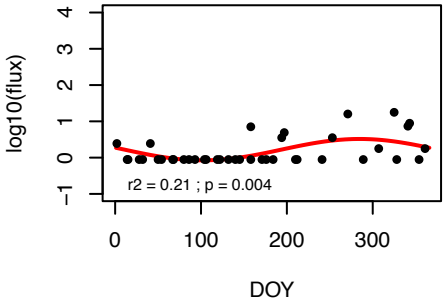
G_rubw



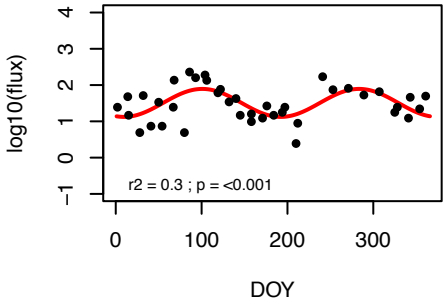
G_sci



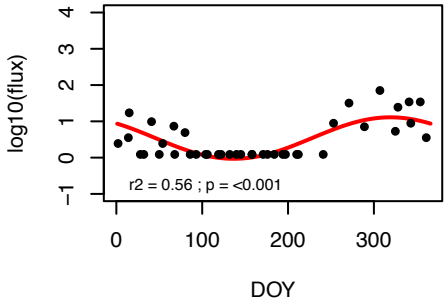
G_sip



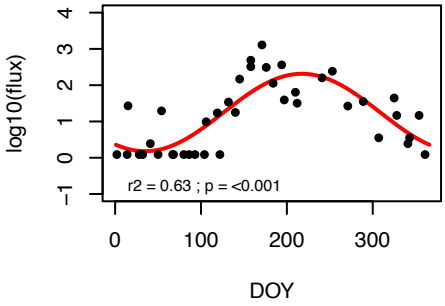
G_the



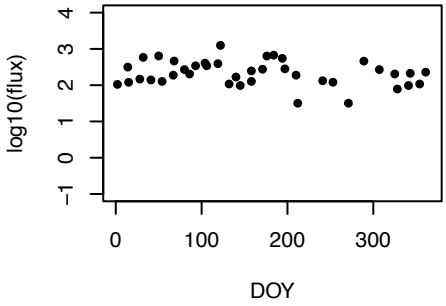
G_uvu



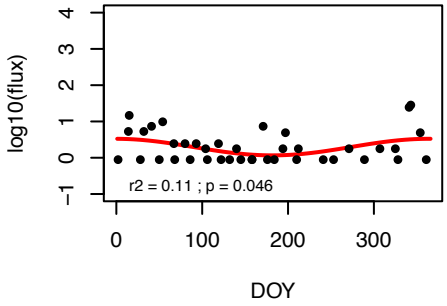
N_dut



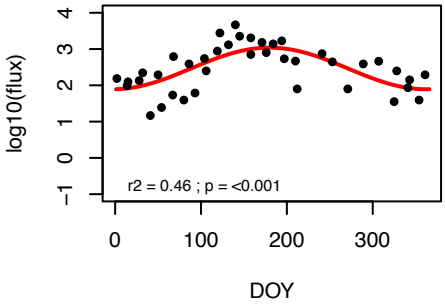
N_inc



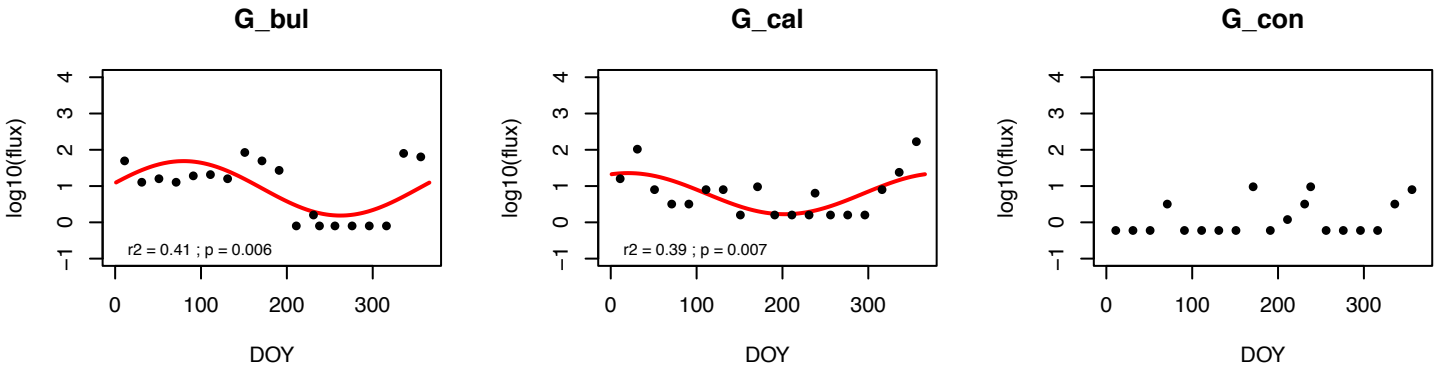
O_uni



T_qui

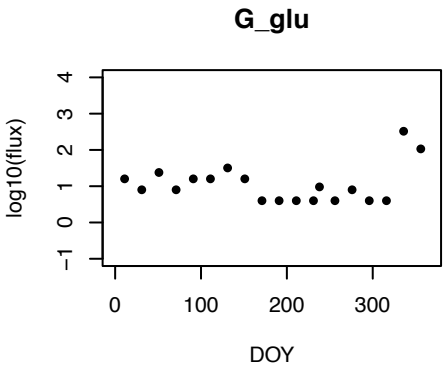


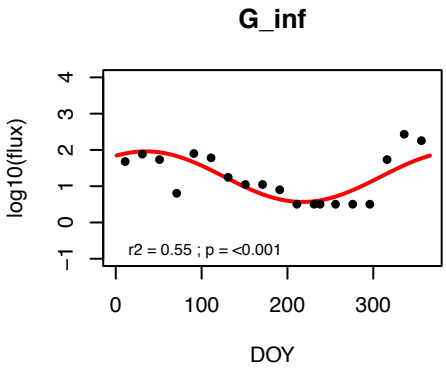
Site 15

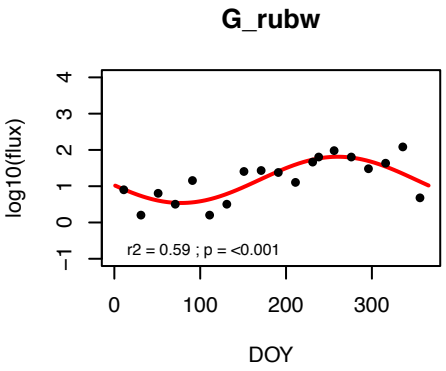

G_bul
log10(flux)
DOY
r2 = 0.41 ; p = 0.006

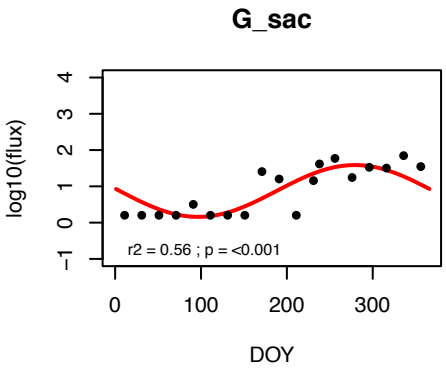
G_cal
log10(flux)
DOY
r2 = 0.39 ; p = 0.007

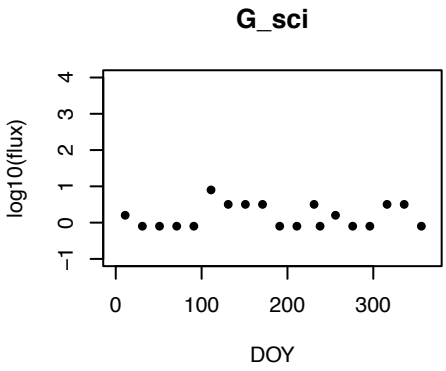
G_con
log10(flux)
DOY

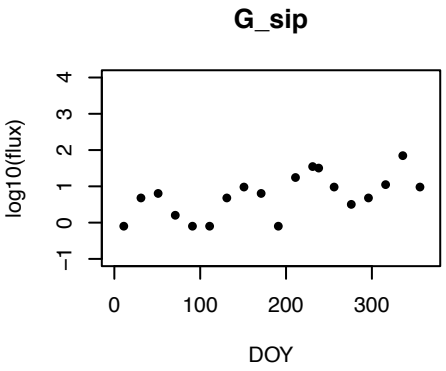

G_glu
log10(flux)
DOY

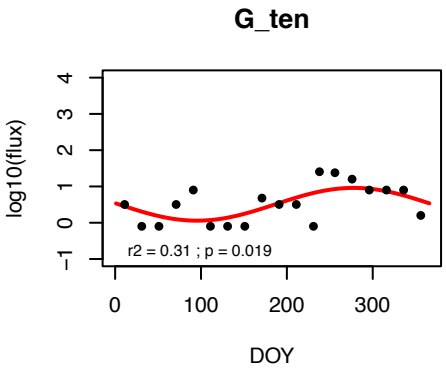

G_inf
log10(flux)
DOY
r2 = 0.55 ; p = <0.001

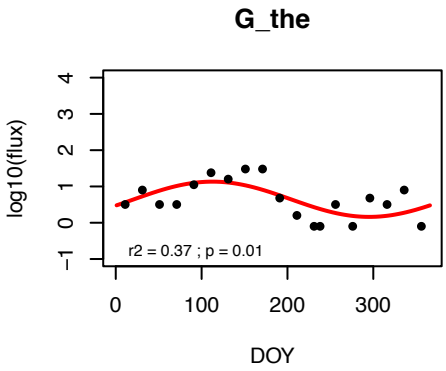

G_rubw
log10(flux)
DOY
r2 = 0.59 ; p = <0.001

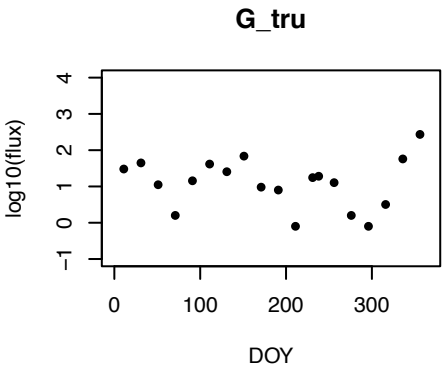

G_sac
log10(flux)
DOY
r2 = 0.56 ; p = <0.001

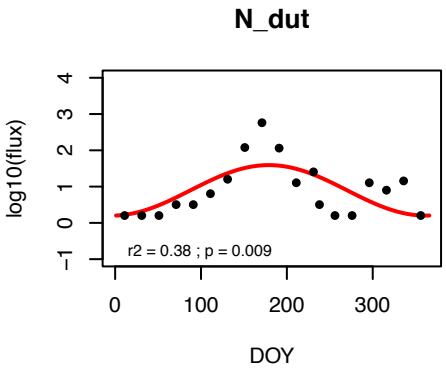

G_sci
log10(flux)
DOY

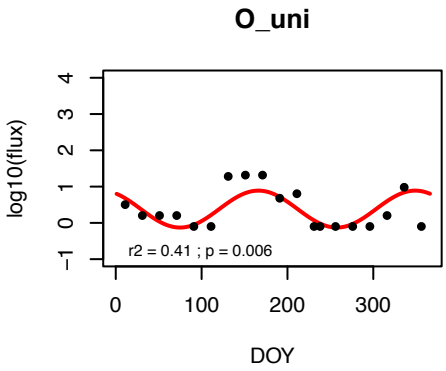

G_sip
log10(flux)
DOY

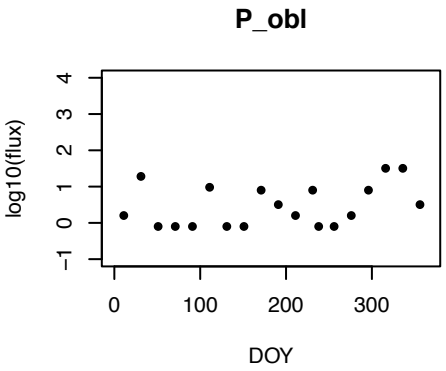

G_ten
log10(flux)
DOY
r2 = 0.31 ; p = 0.019


G_the
log10(flux)
DOY
r2 = 0.37 ; p = 0.01

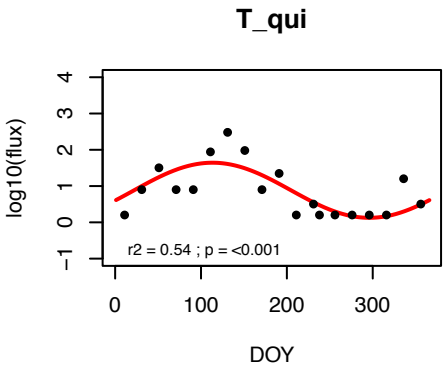

G_tru
log10(flux)
DOY


N_dut
log10(flux)
DOY
r2 = 0.38 ; p = 0.009


O_uni
log10(flux)
DOY
r2 = 0.41 ; p = 0.006

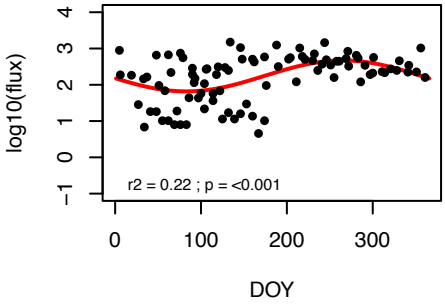

P_obl
log10(flux)
DOY

Site 15 cont.

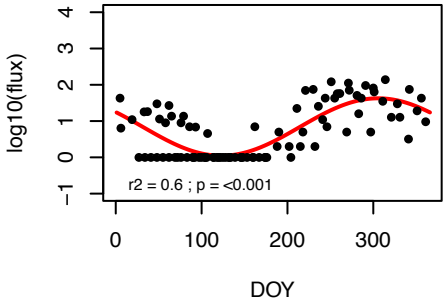


Site 16

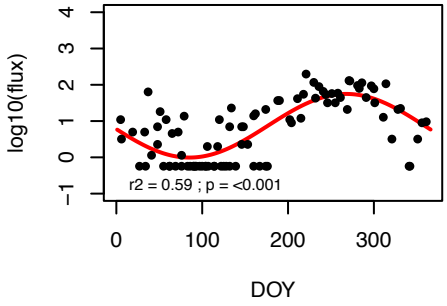
G_bul



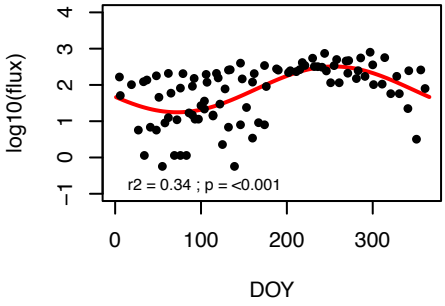
G_rubw



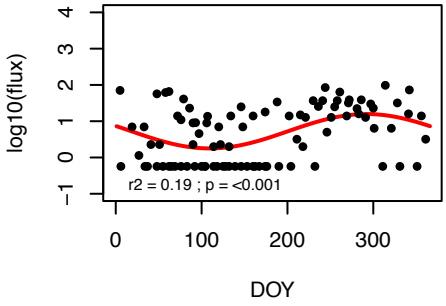
N_dut



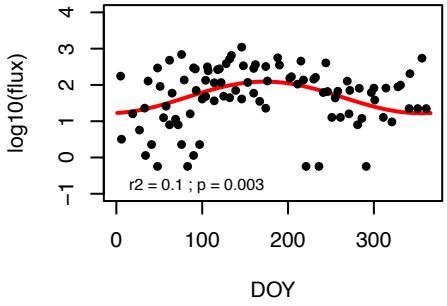
N_inc



O_uni

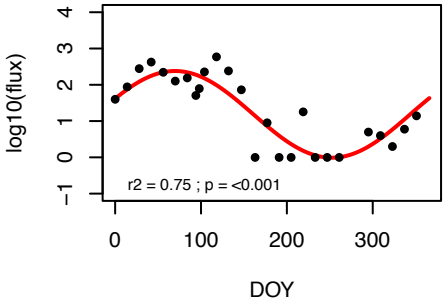


T_qui

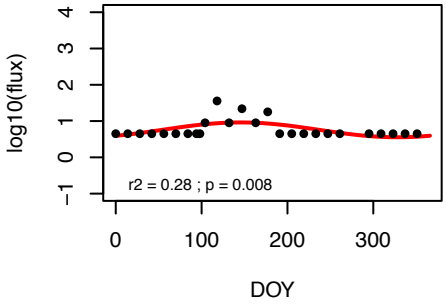


Site 17

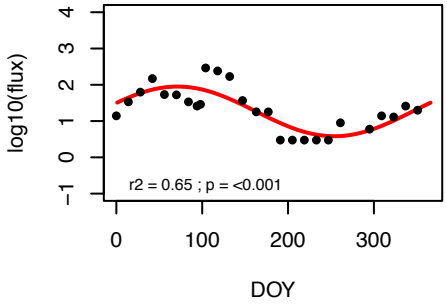
G_bul



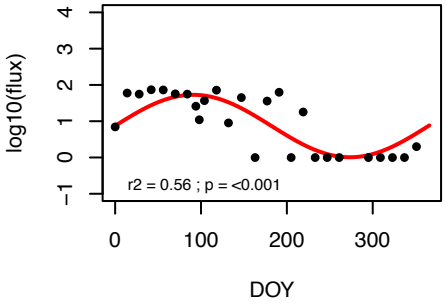
G_cal



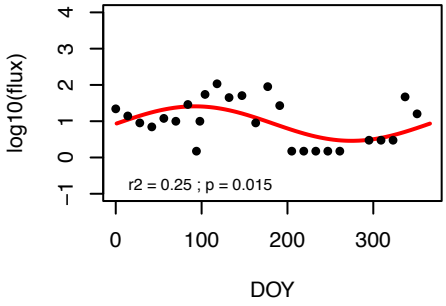
G_glu



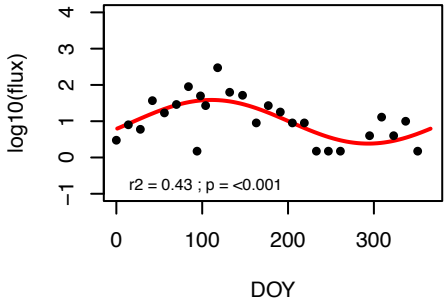
G_inf



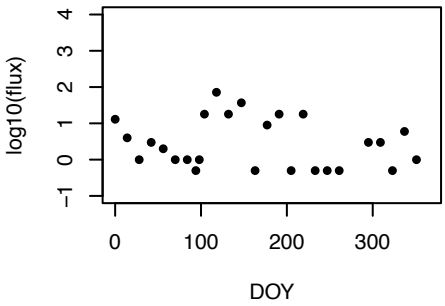
G_sac



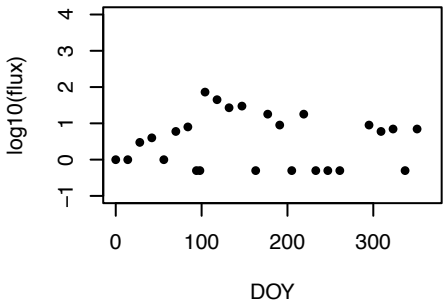
G_sci



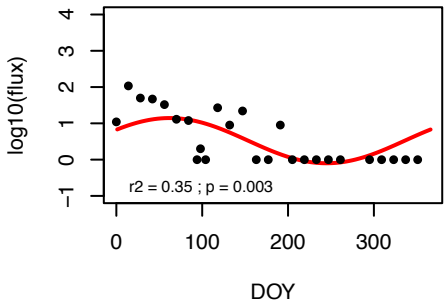
G_sip



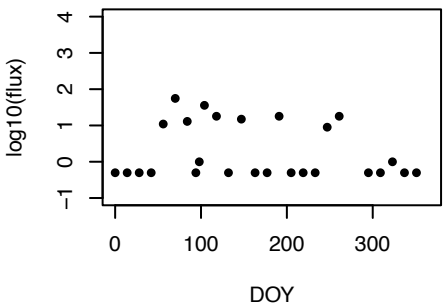
G_ten



G_tru

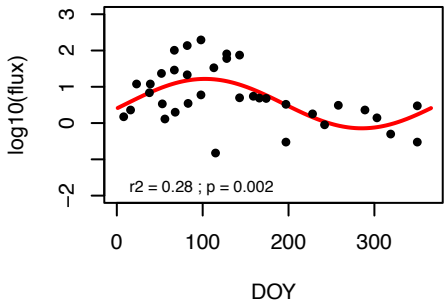


N_inc

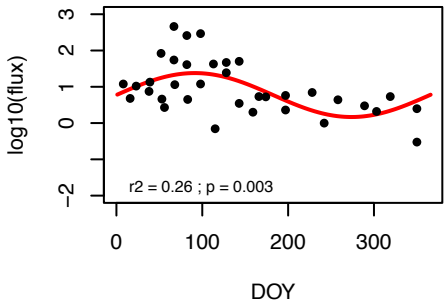


Site 18

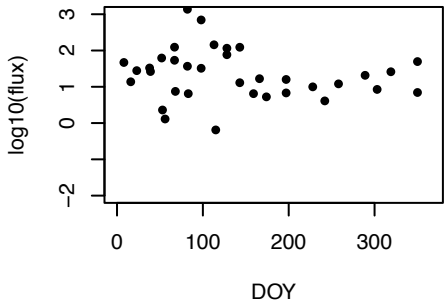
G_bul



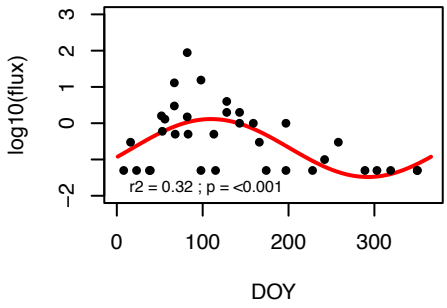
G_fal



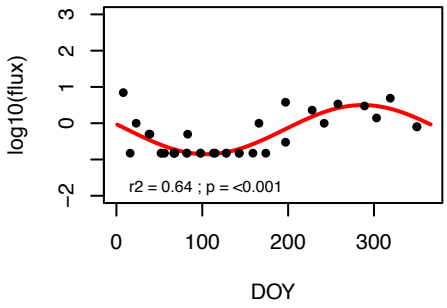
G_glu



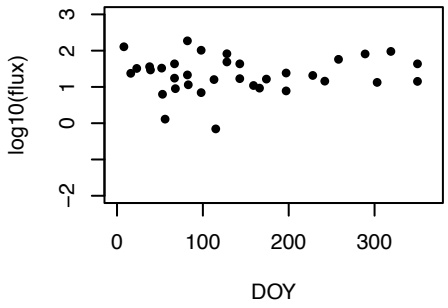
G_inf



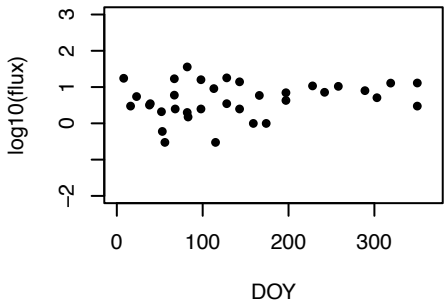
G_rubp



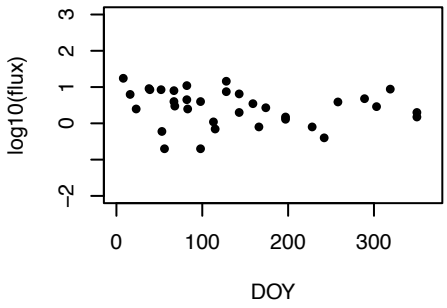
G_rubw



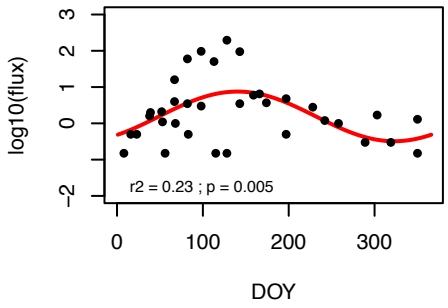
G_rus



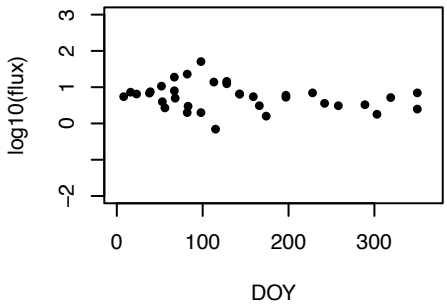
G_sac



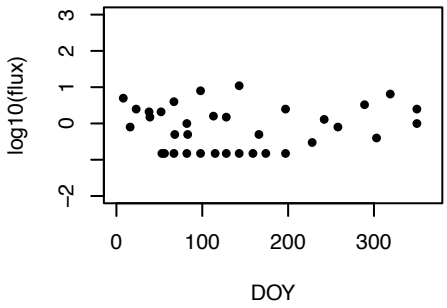
G_sci



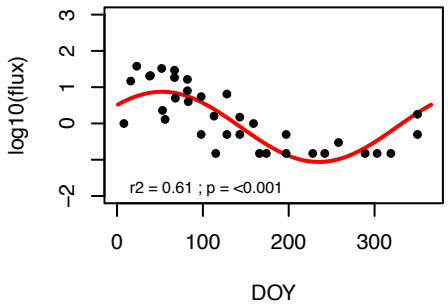
G_sip



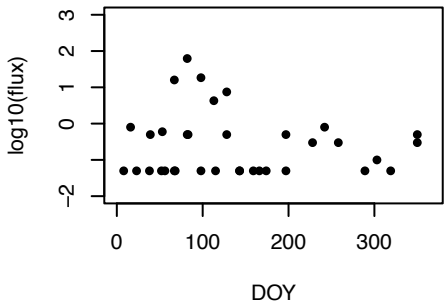
G_ten



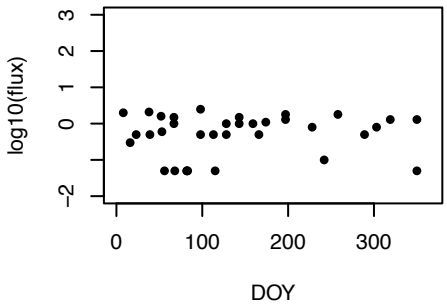
G_tru



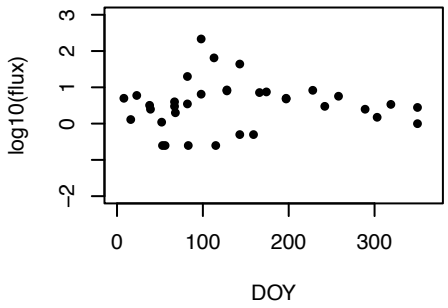
N_inc



O_uni

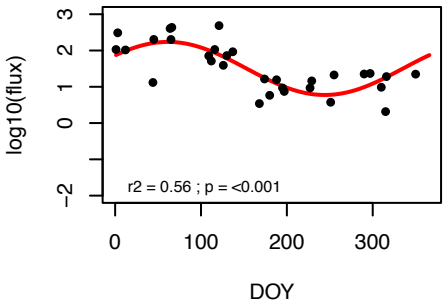


T_qui

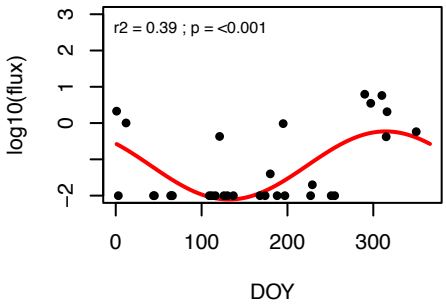


Site 19

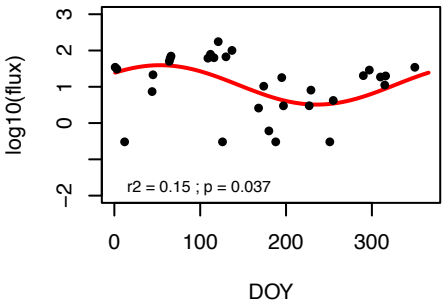
G_bul



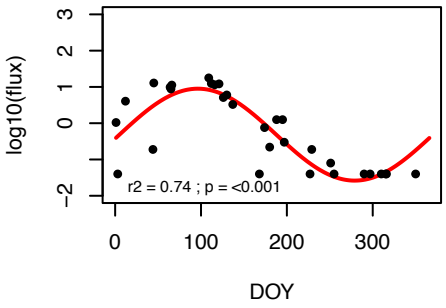
G_con



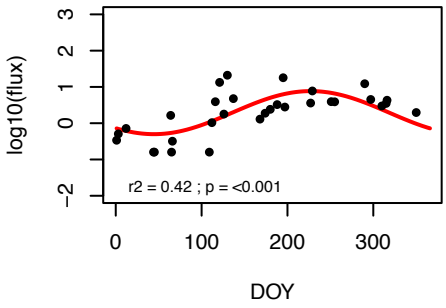
G_glu



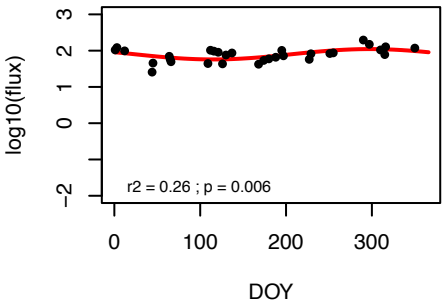
G_inf



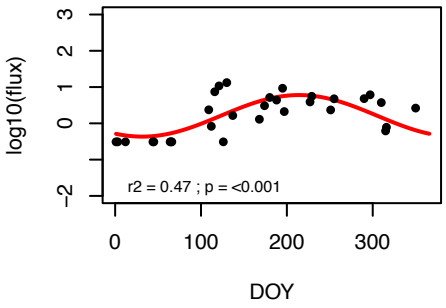
G_rubp



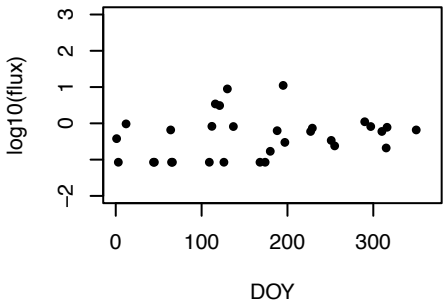
G_rubw



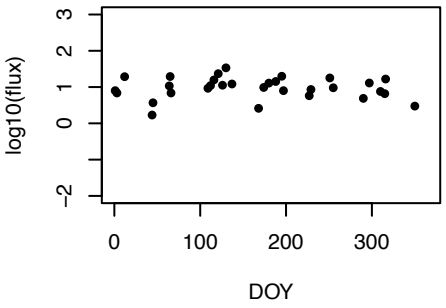
G_rus



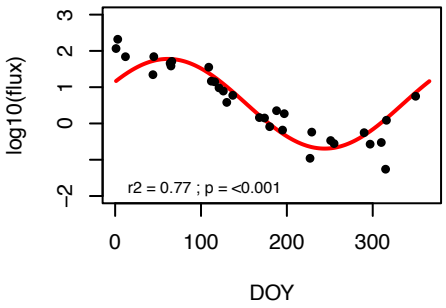
G_sac



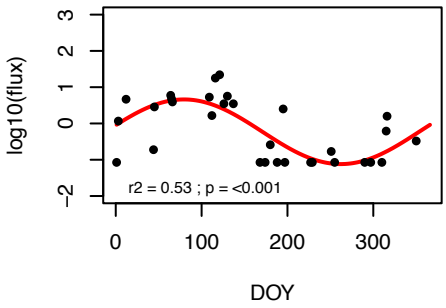
G_sip



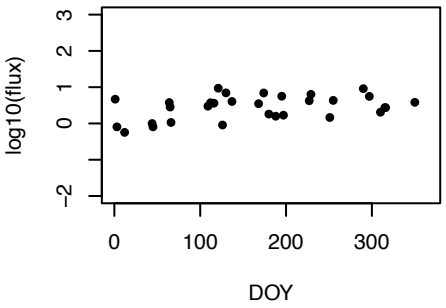
G_tru



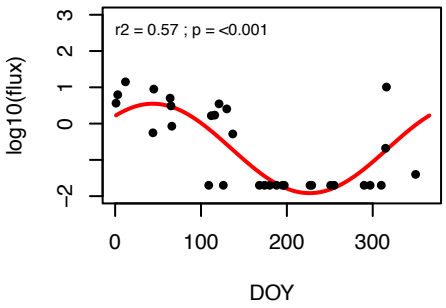
N_dut



O_uni

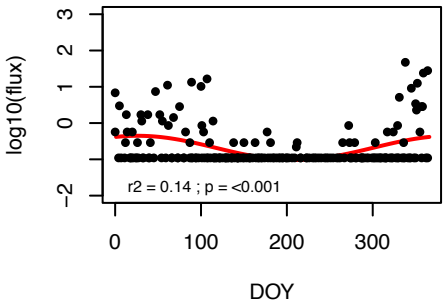


P_obl

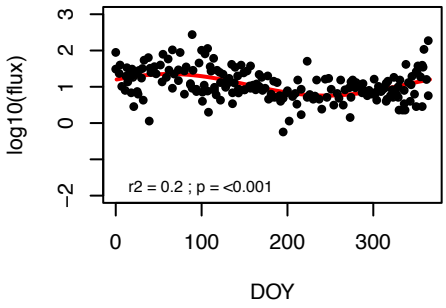


Site 20

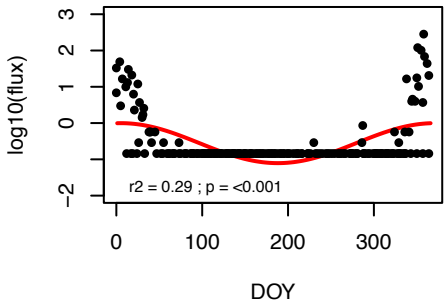
G_bul



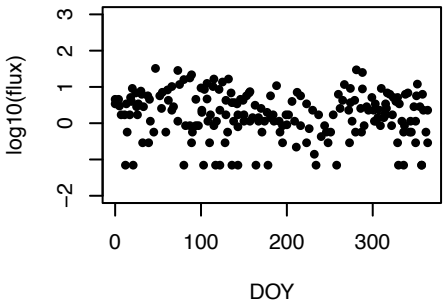
G_cal



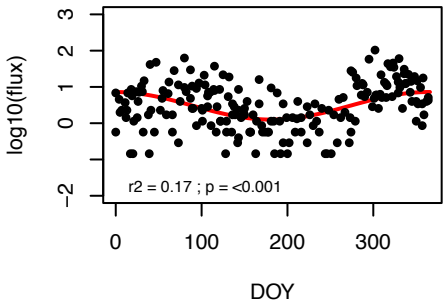
G_fal



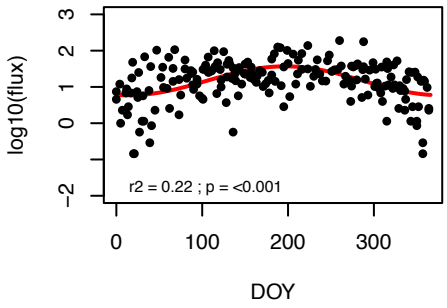
G_glu



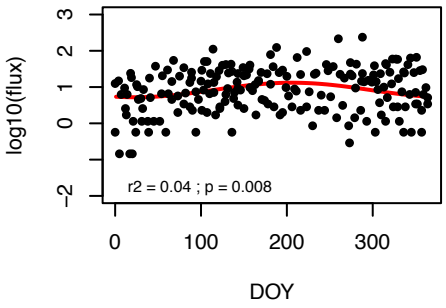
G_men



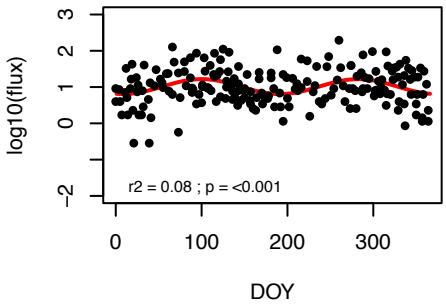
G_rubp



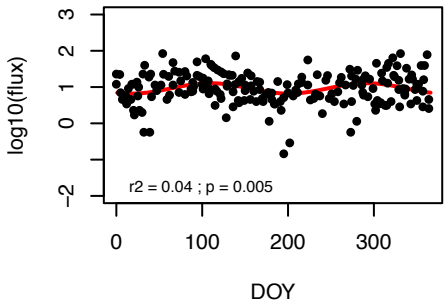
G_rubw



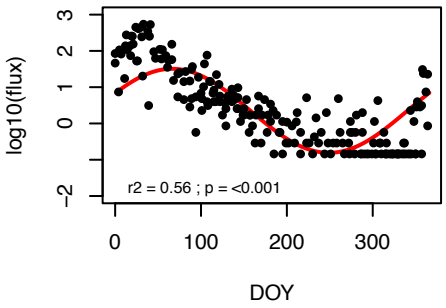
G_sac



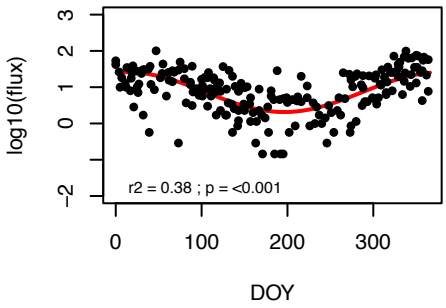
G_sip



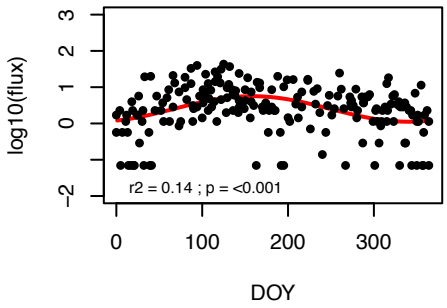
G_tru



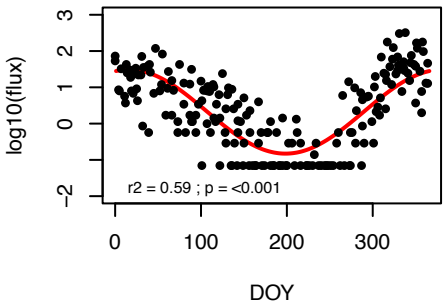
N_dut



O_uni

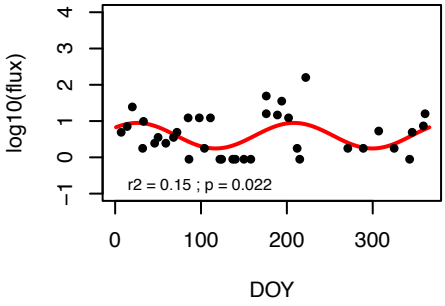


P_obl

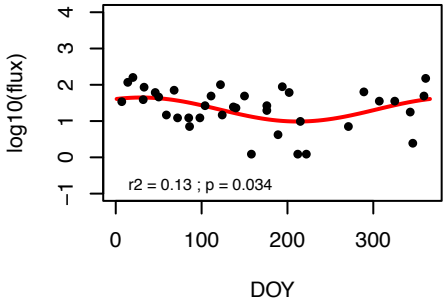


Site 21

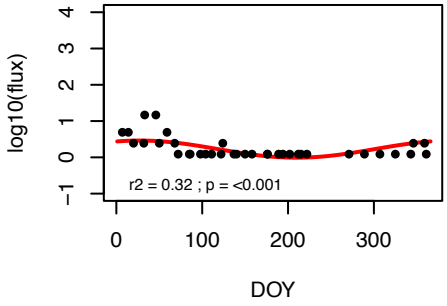
G_con



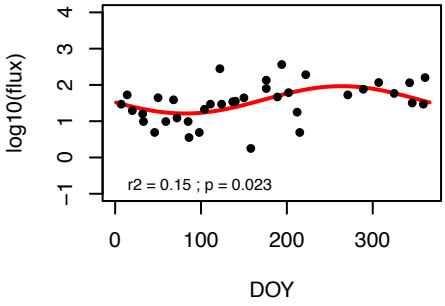
G_glu



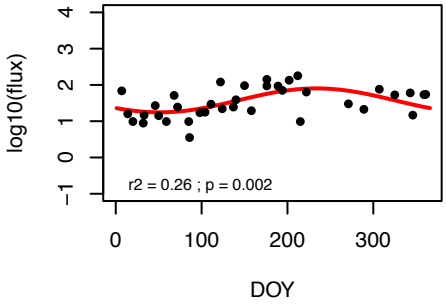
G_inf



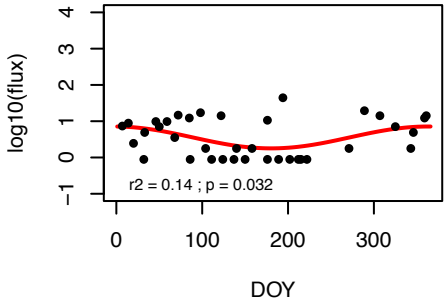
G_rubw



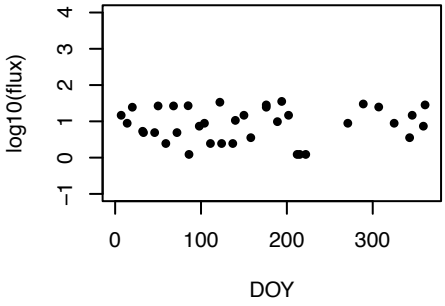
G_sac



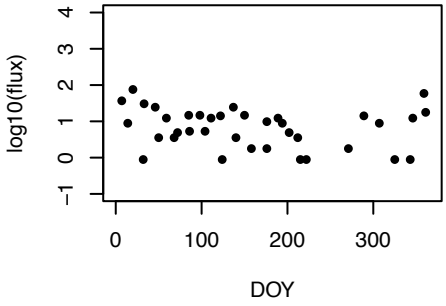
G_sci



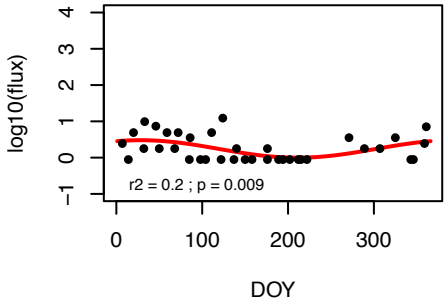
G_sip



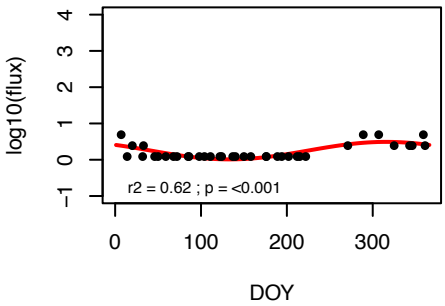
G_ten



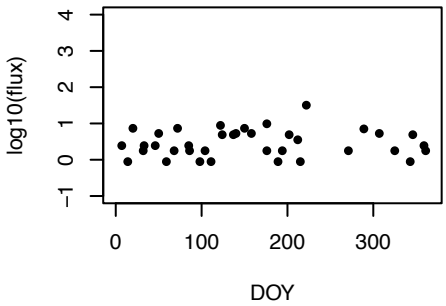
G_tru



N_inc

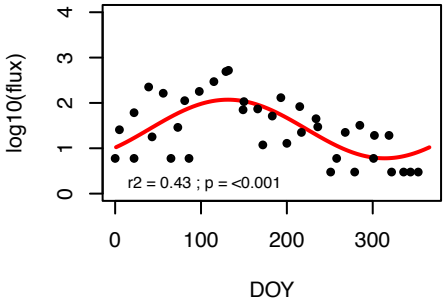


O_uni

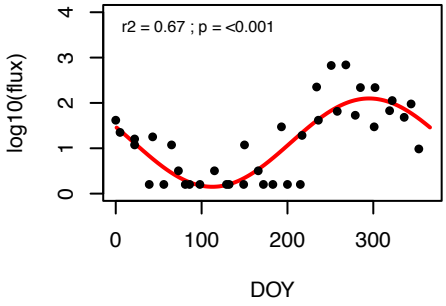


Site 22

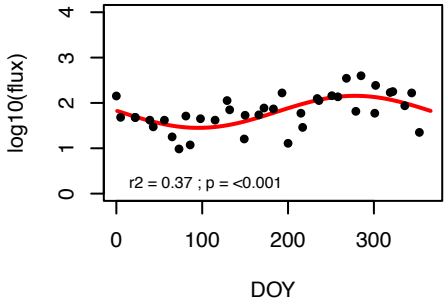
G_bul



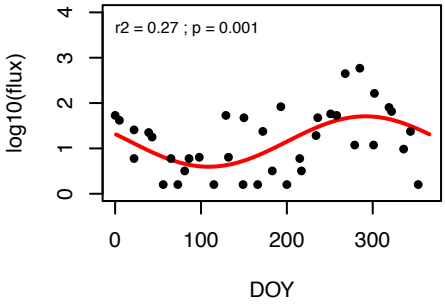
G_rubp



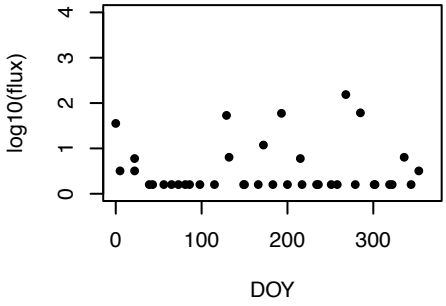
G_rubw



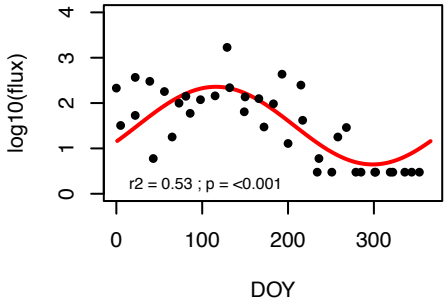
G_sac



G_sip

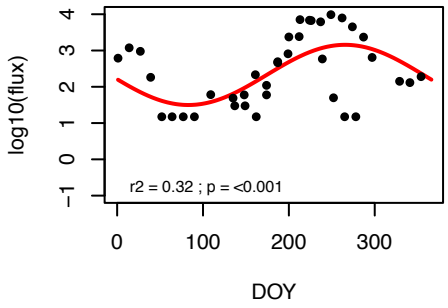


N_inc

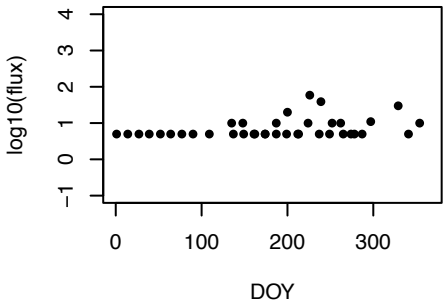


Site 23

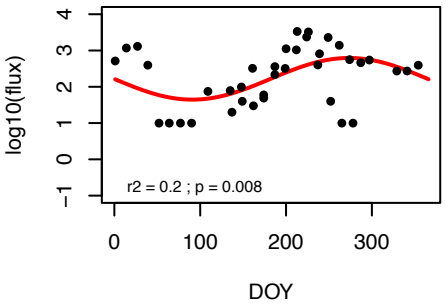
G_bul



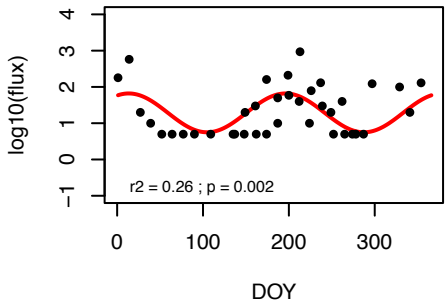
G_cal



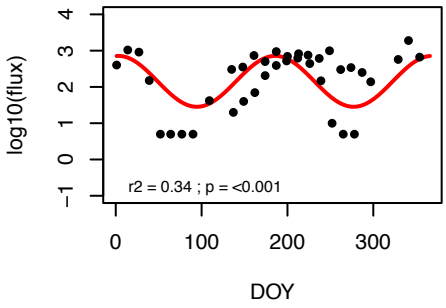
G_glu



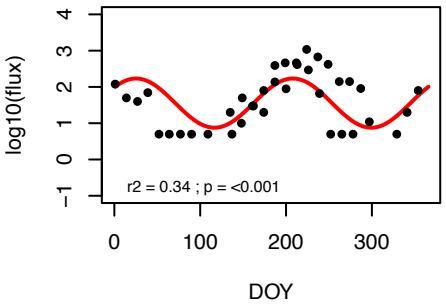
G_men



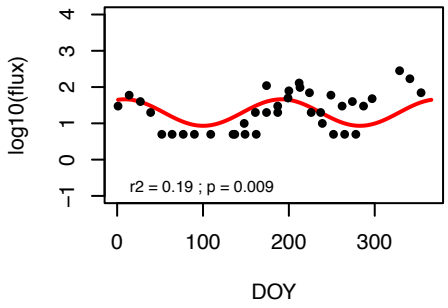
G_rubw



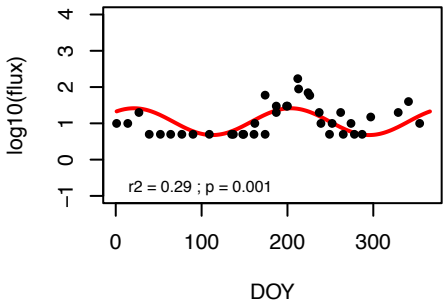
G_rus



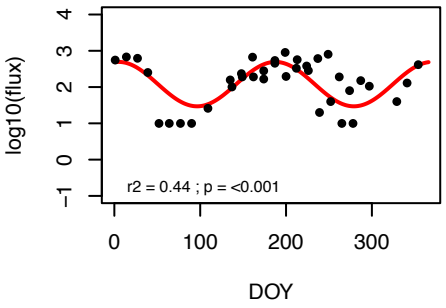
G_sac



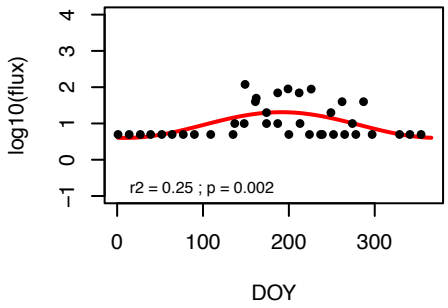
G_sip



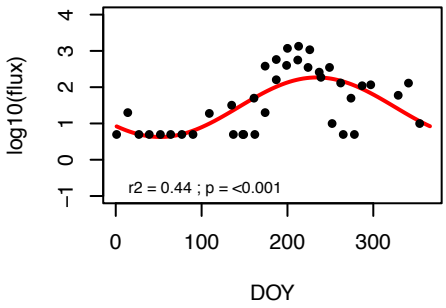
G_ten



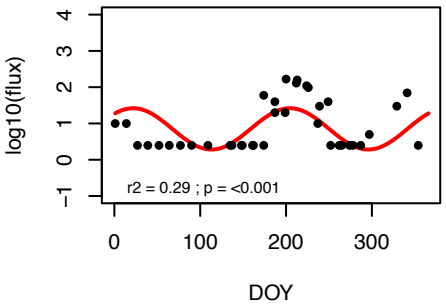
G_the



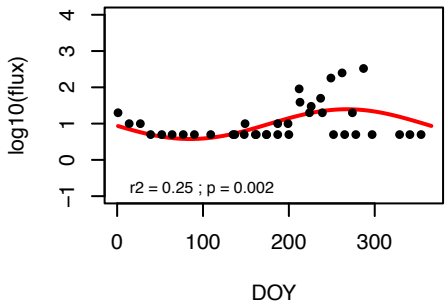
N_dut



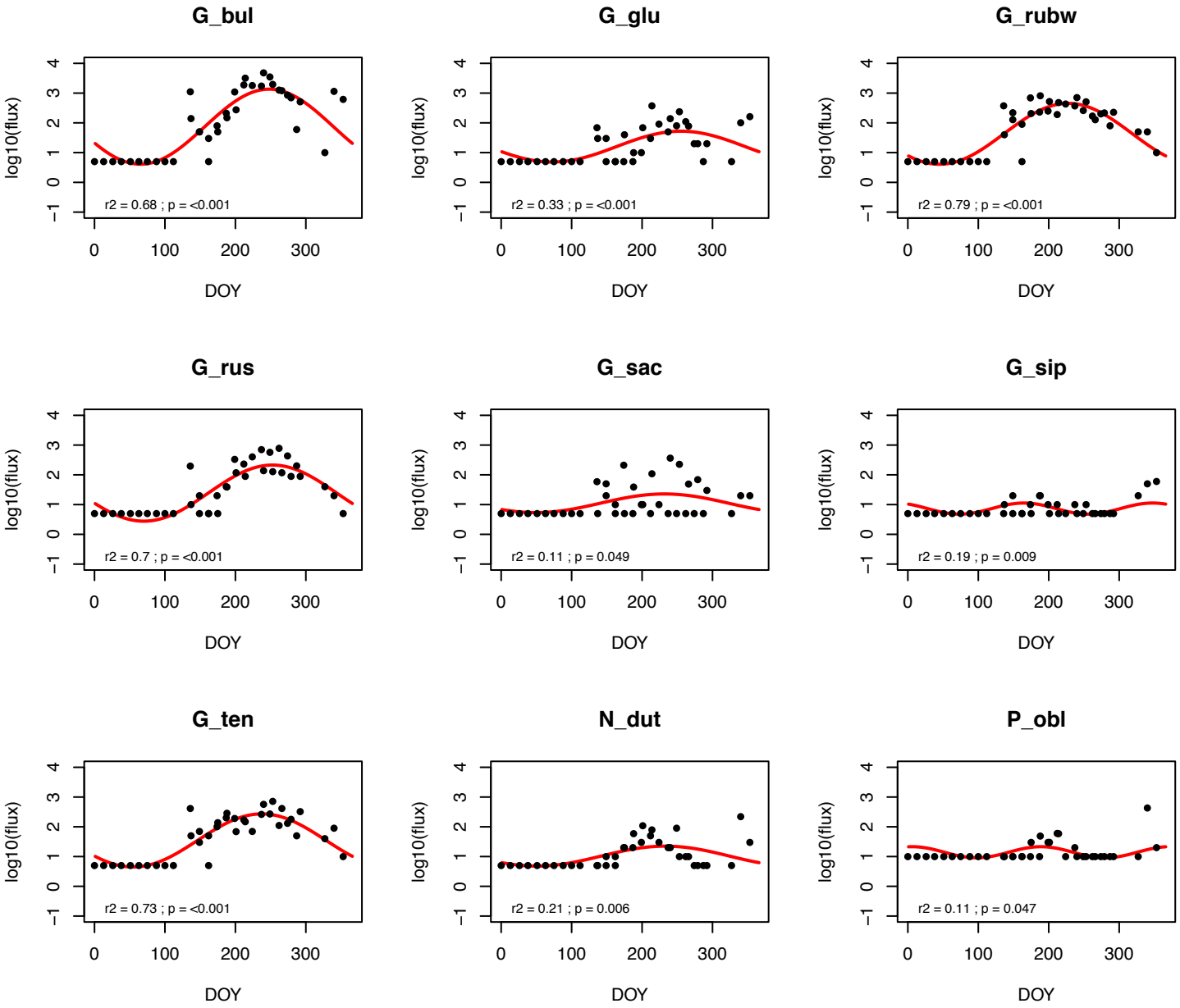
P_obl



T_qui

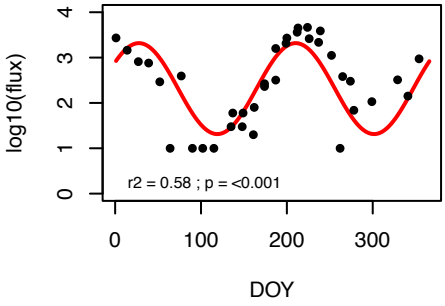


Site 24

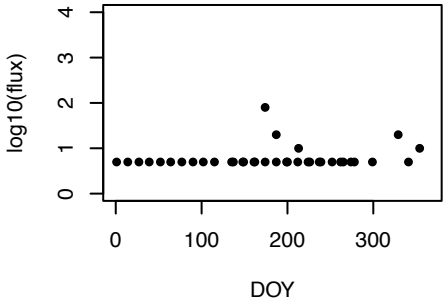

G_bul
r2 = 0.68 ; p = <0.001
G_glu
r2 = 0.33 ; p = <0.001
G_rubw
r2 = 0.79 ; p = <0.001
G_rus
r2 = 0.7 ; p = <0.001
G_sac
r2 = 0.11 ; p = 0.049
G_sip
r2 = 0.19 ; p = 0.009
G_ten
r2 = 0.73 ; p = <0.001
N_dut
r2 = 0.21 ; p = 0.006
P_obl
r2 = 0.11 ; p = 0.047
log10(flux)
DOY
−1 0 1 2 3 4
0 100 200 300

Site 25

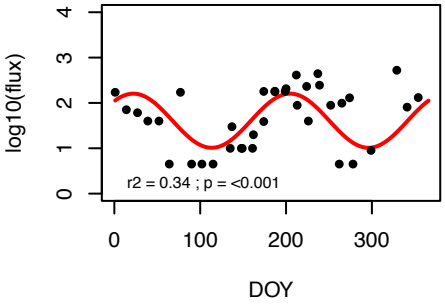
G_bul



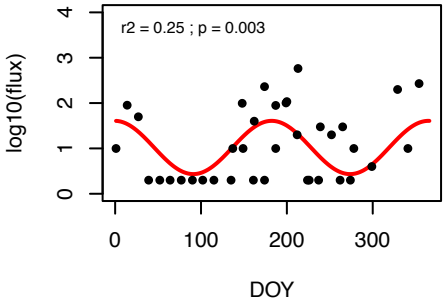
G_con



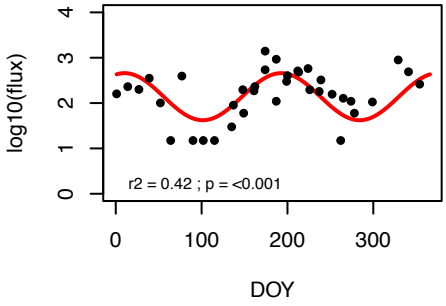
G_glu



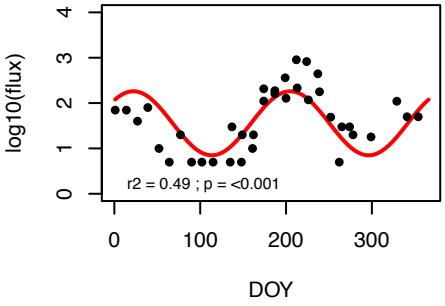
G_men



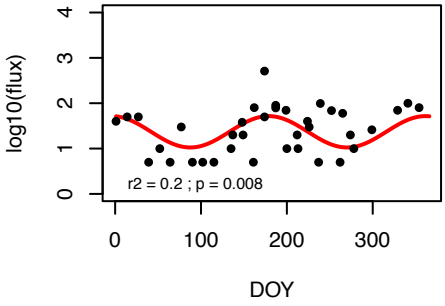
G_rubw



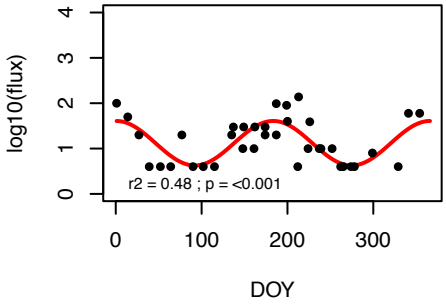
G_rus



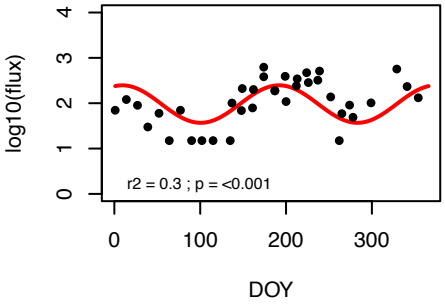
G_sac



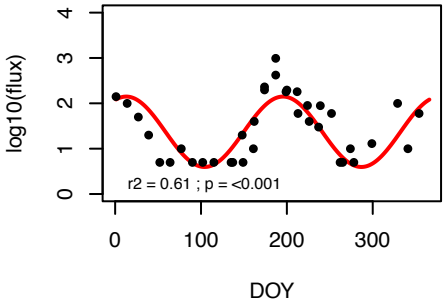
G_sip



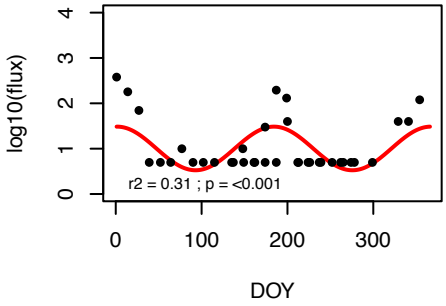
G_ten



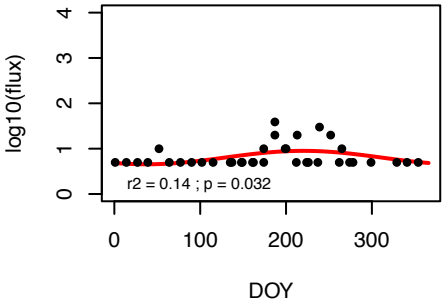
N_dut



P_obl

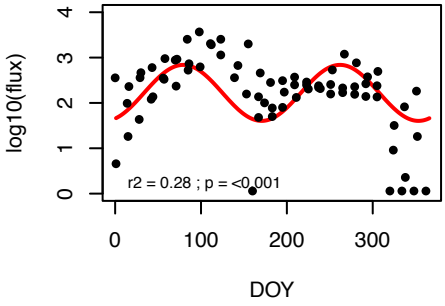


T_qui

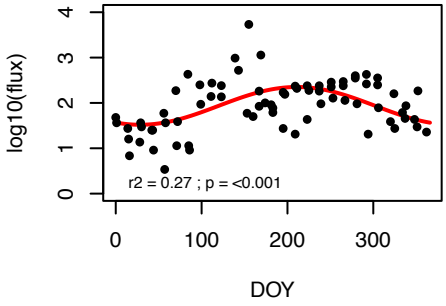


Site 26

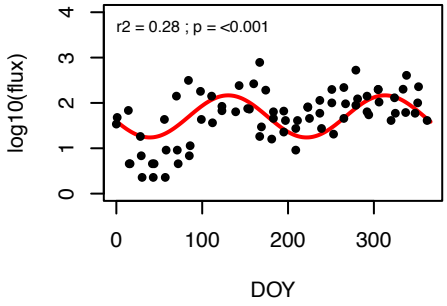
G_bul



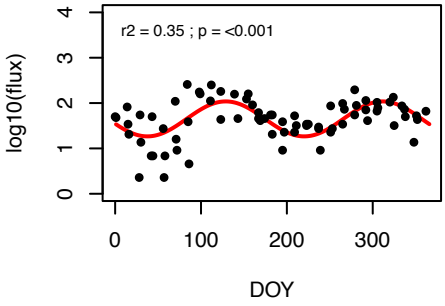
G_glu



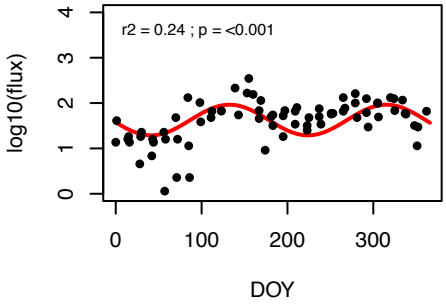
G_men



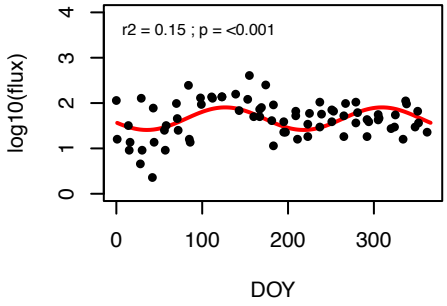
G_rubp



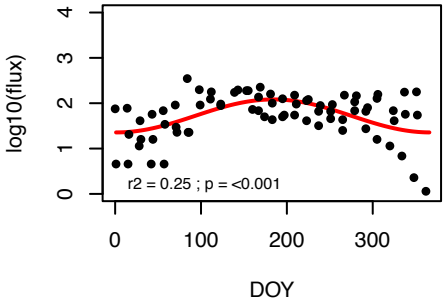
G_rubw



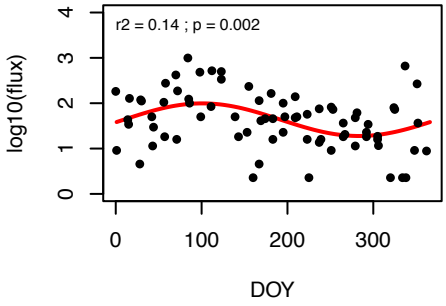
N_dut



O_uni

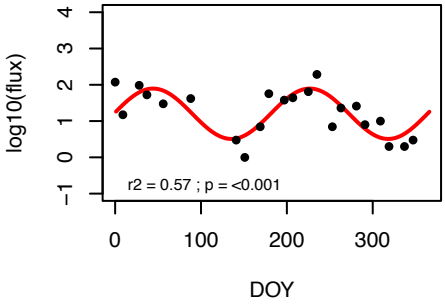


T_qui

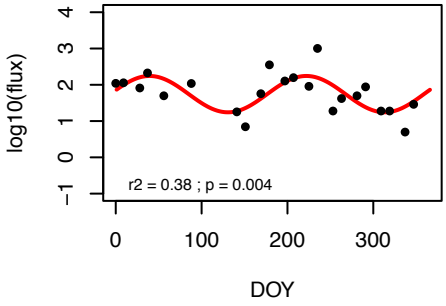


Site 27

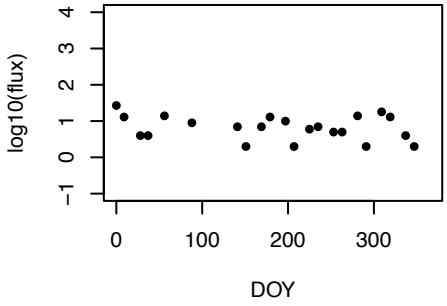
G_bul



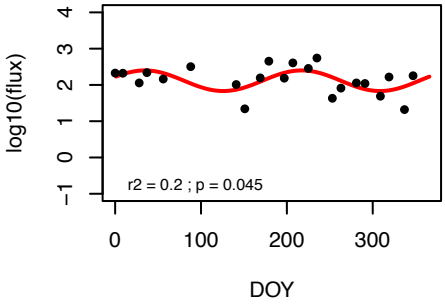
G_glu



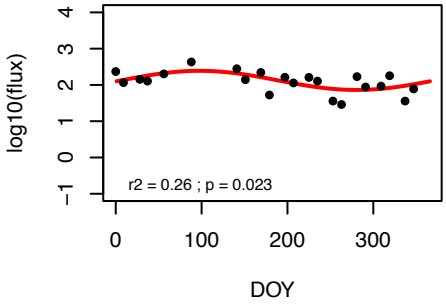
G_men



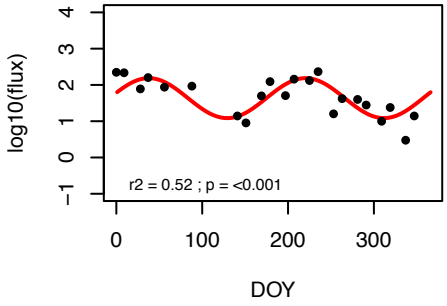
G_rubw



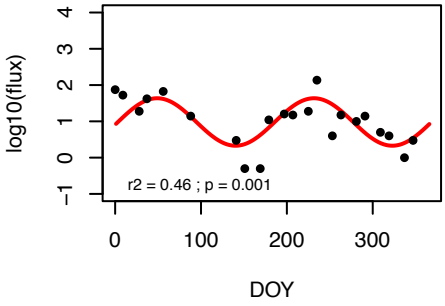
G_sac



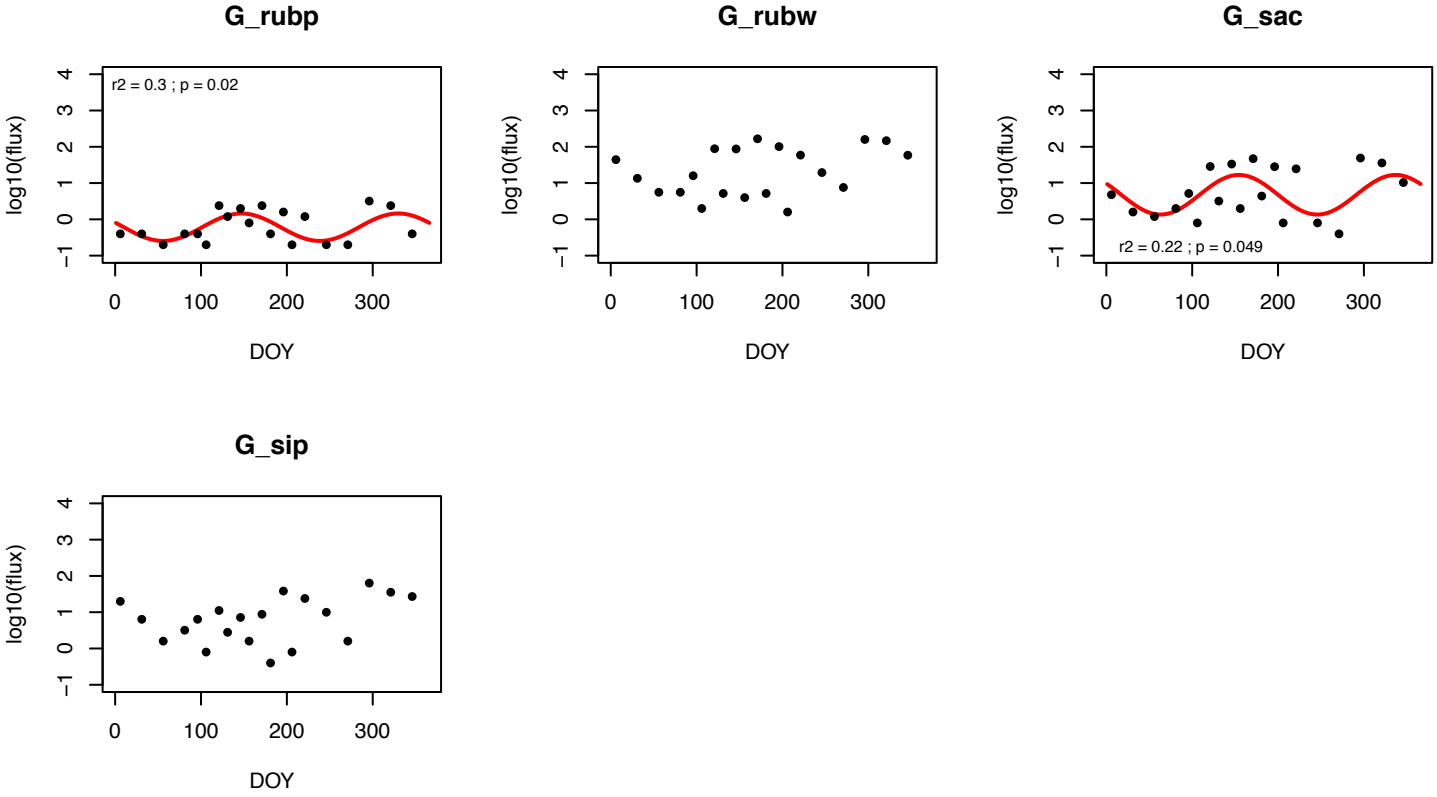
N_dut



P_obl



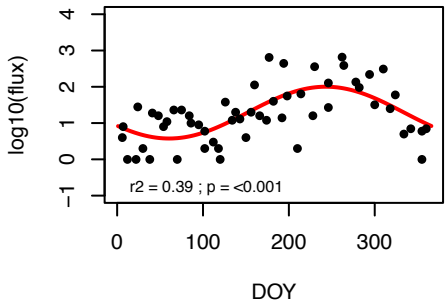
Site 28


G_rubp
r2 = 0.3 ; p = 0.02
log10(flux)
DOY
G_rubw
log10(flux)
DOY
G_sac
r2 = 0.22 ; p = 0.049
log10(flux)
DOY

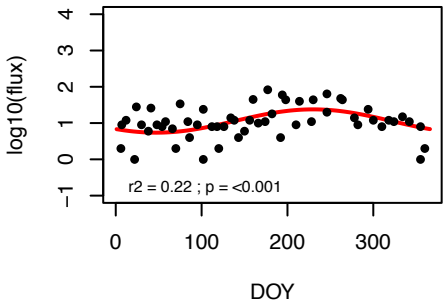
G_sip
log10(flux)
DOY

Site 29

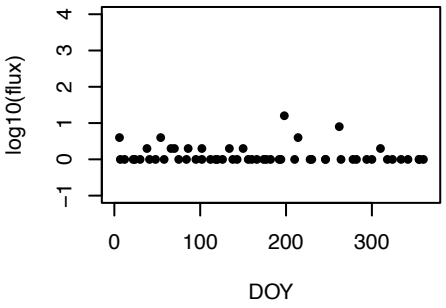
G_bul



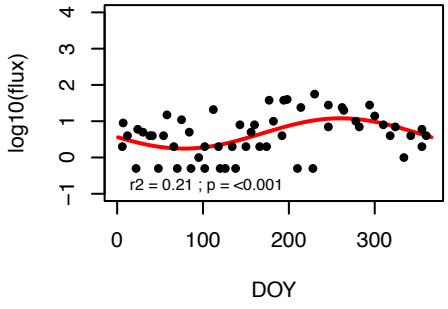
G_cal



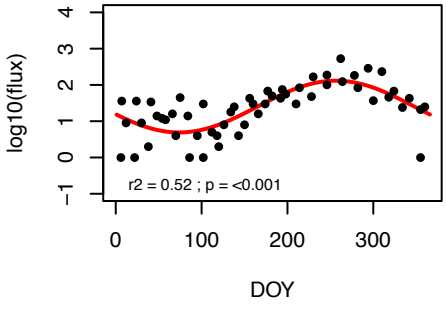
G_con



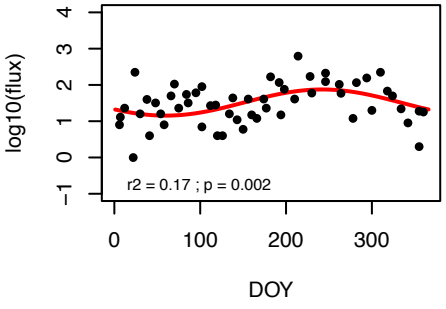
G_fal



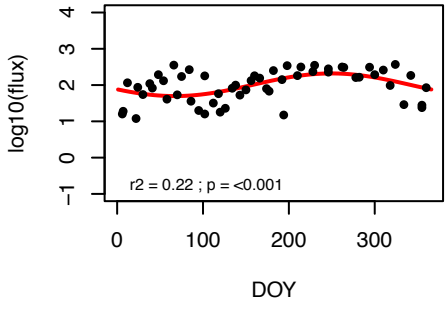
G_glu



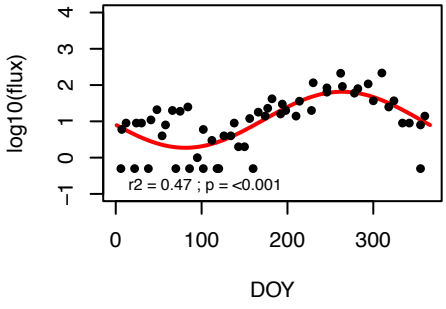
G_men



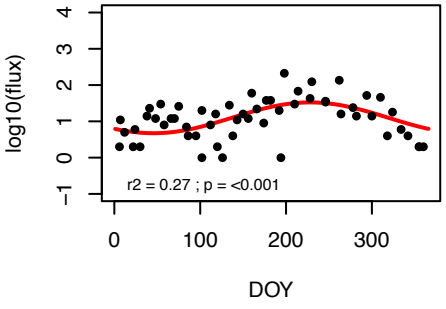
G_rubw



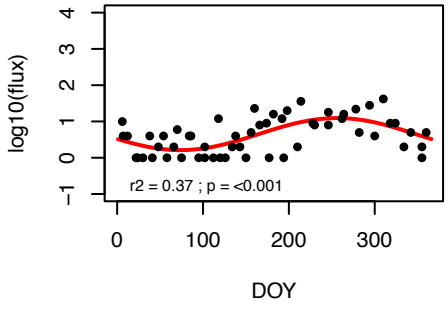
G_rus



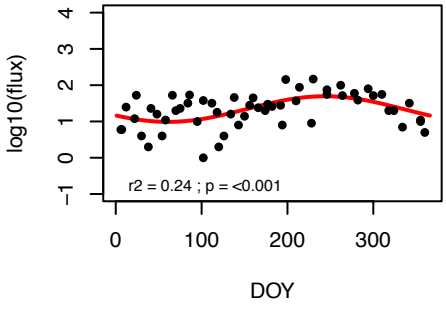
G_sac



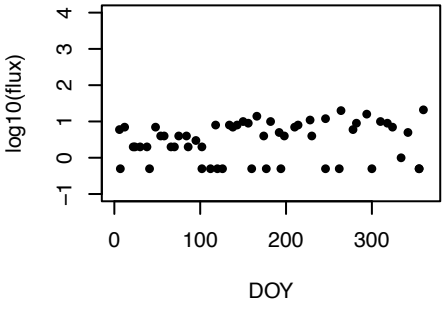
G_sci



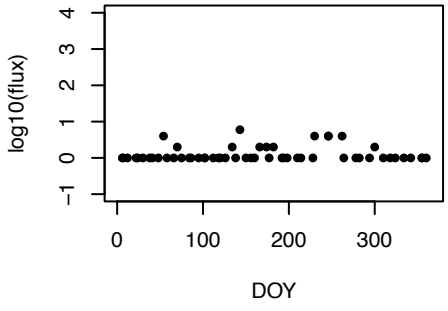
G_sip



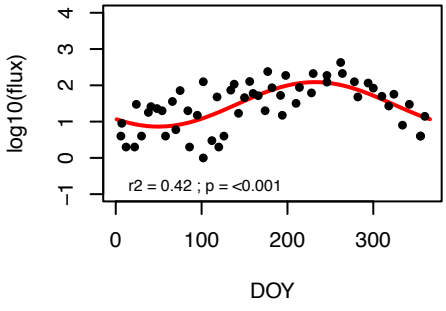
G_the



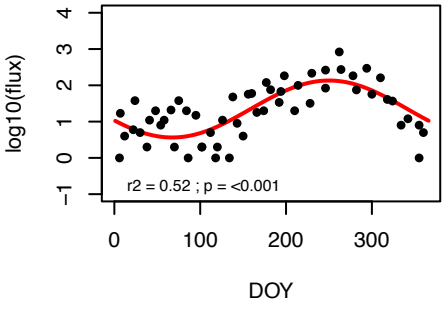
G_uvu



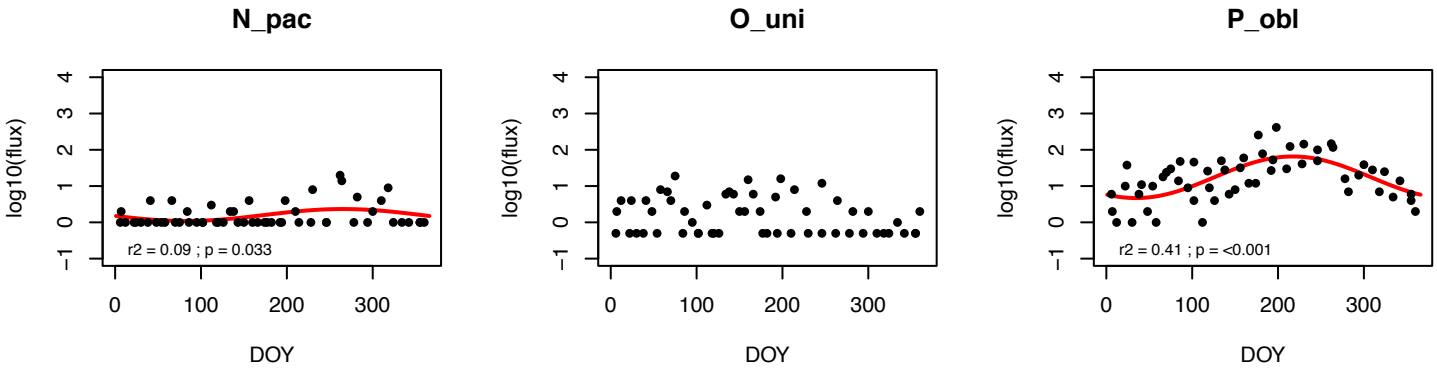
N_dut



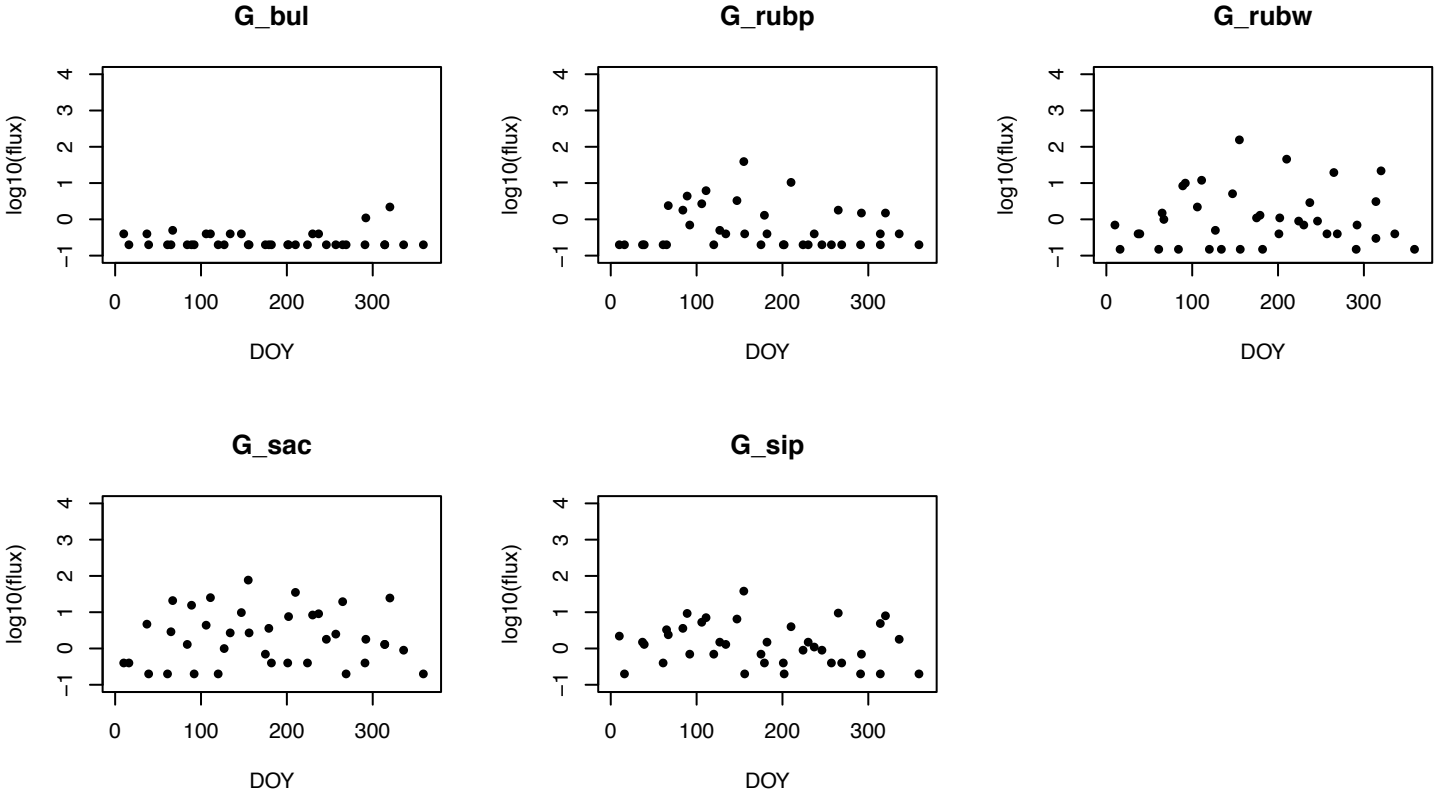
N_inc



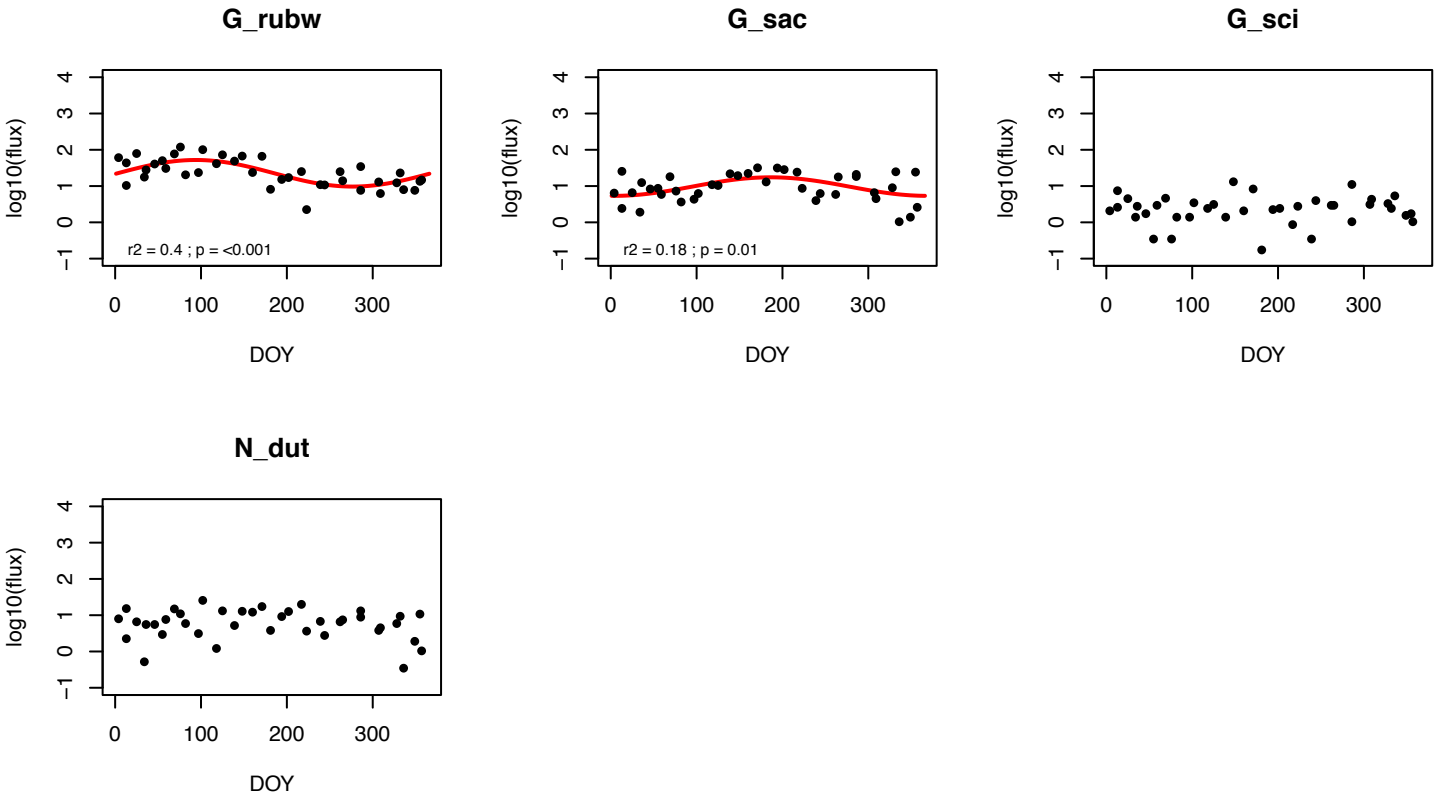
Site 29 cont.


N_pac
log10(flux)
−1 0 1 2 3 4
r2 = 0.09 ; p = 0.033
0 100 200 300
DOY
O_uni
log10(flux)
−1 0 1 2 3 4
0 100 200 300
DOY
P_obl
log10(flux)
−1 0 1 2 3 4
r2 = 0.41 ; p = <0.001
0 100 200 300
DOY

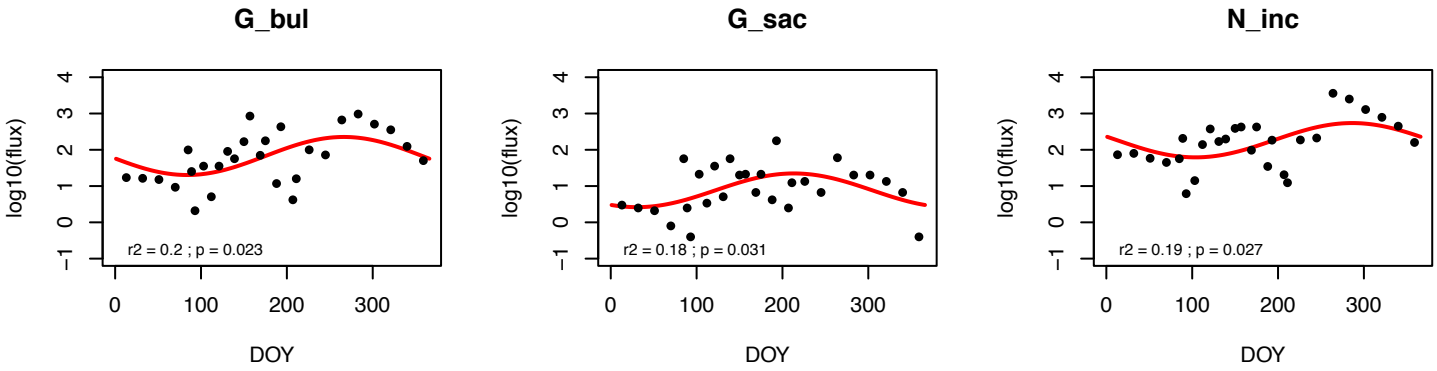
Site 30


G_bul
G_rubp
G_rubw
G_sac
G_sip
log10(flux)
DOY
−1 0 1 2 3 4
0 100 200 300

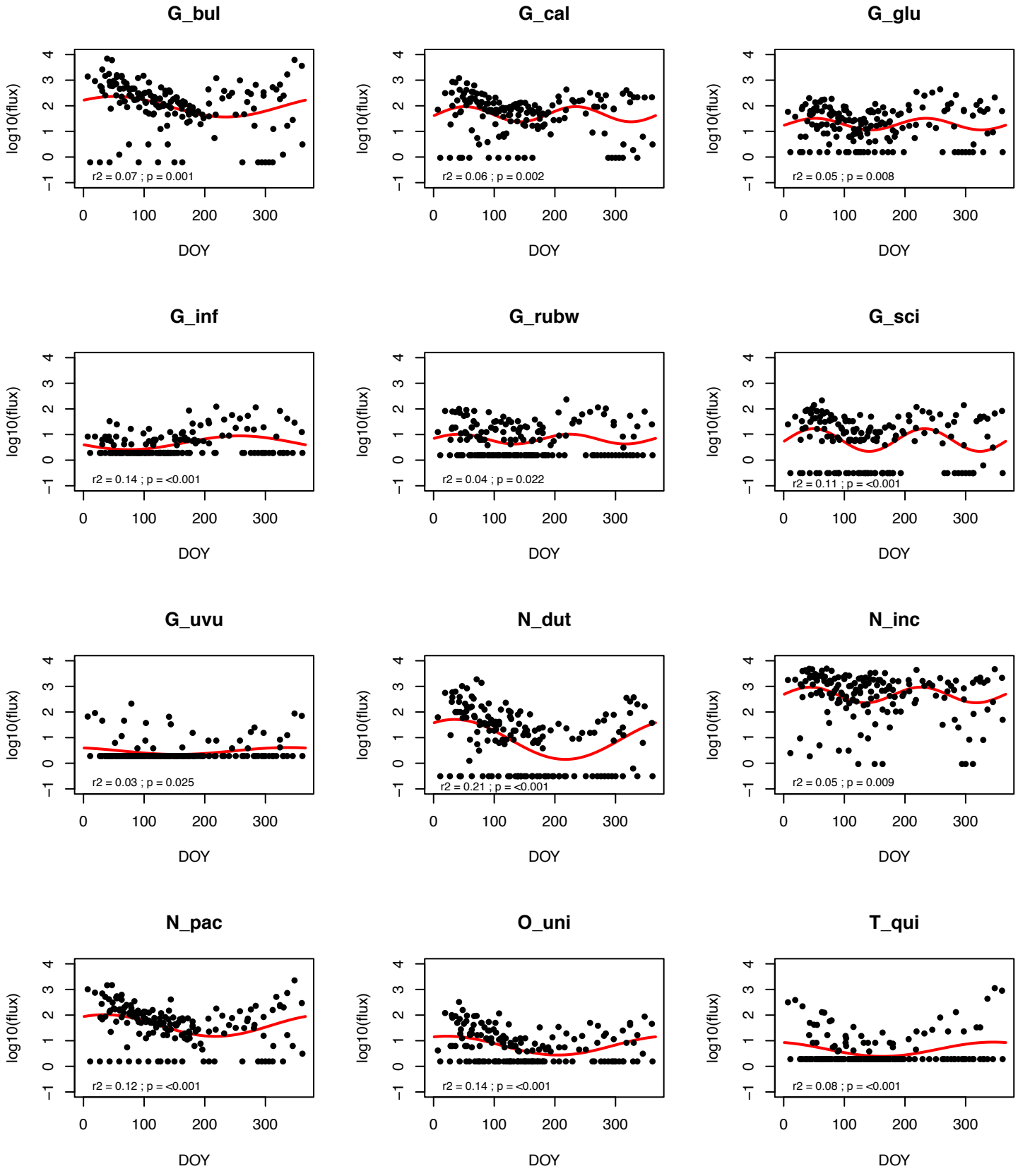
Site 31


G_rubw
log10(flux)
DOY
r2 = 0.4 ; p = <0.001
G_sac
log10(flux)
DOY
r2 = 0.18 ; p = 0.01
G_sci
log10(flux)
DOY
N_dut
log10(flux)
DOY

Site 32

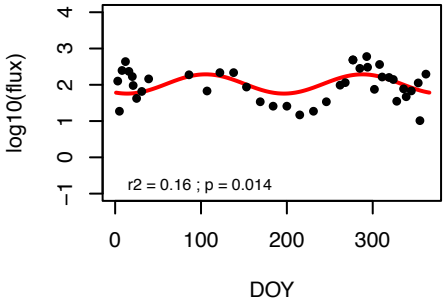

G_bul
log10(flux)
DOY
r2 = 0.2 ; p = 0.023
G_sac
log10(flux)
DOY
r2 = 0.18 ; p = 0.031
N_inc
log10(flux)
DOY
r2 = 0.19 ; p = 0.027

Site 33

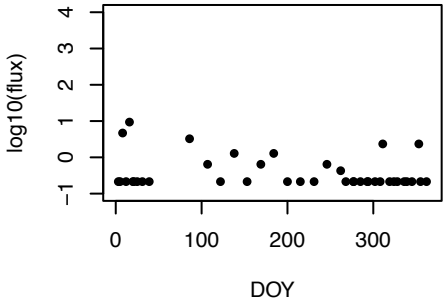

G_bul
r2 = 0.07 ; p = 0.001
G_cal
r2 = 0.06 ; p = 0.002
G_glu
r2 = 0.05 ; p = 0.008
G_inf
r2 = 0.14 ; p = <0.001
G_rubw
r2 = 0.04 ; p = 0.022
G_sci
r2 = 0.11 ; p = <0.001
G_uvu
r2 = 0.03 ; p = 0.025
N_dut
r2 = 0.21 ; p = <0.001
N_inc
r2 = 0.05 ; p = 0.009
N_pac
r2 = 0.12 ; p = <0.001
O_uni
r2 = 0.14 ; p = <0.001
T_qui
r2 = 0.08 ; p = <0.001
log10(flux)
DOY

Site 34

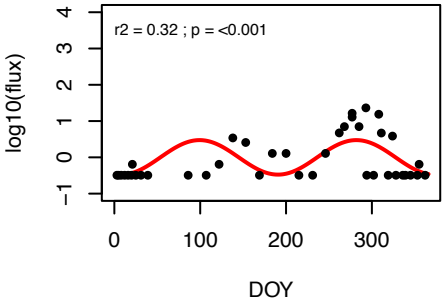
G_bul



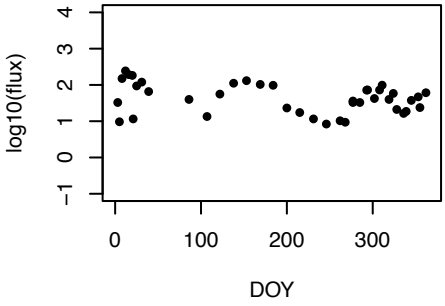
G_cal



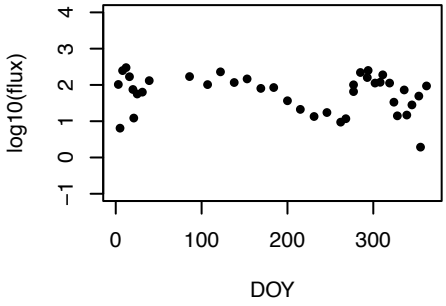
G_fal



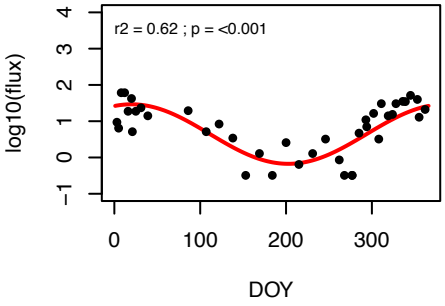
G_glu



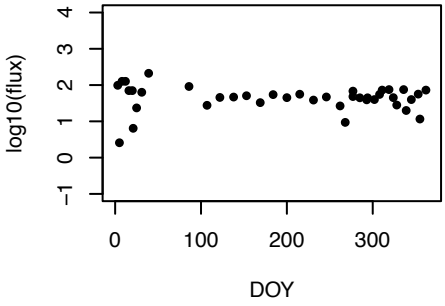
G_inf



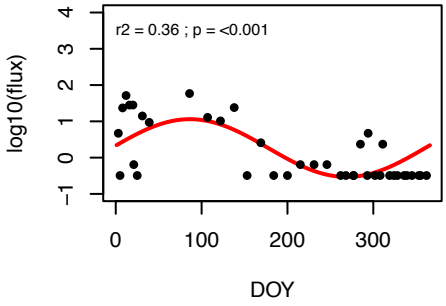
G_sci



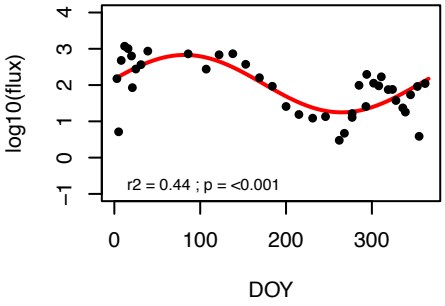
G_tru



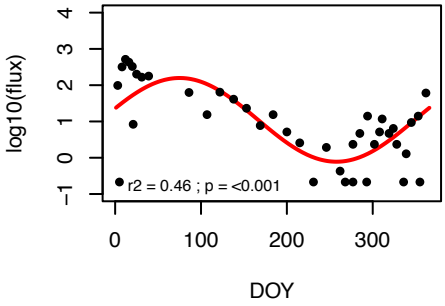
N_dut



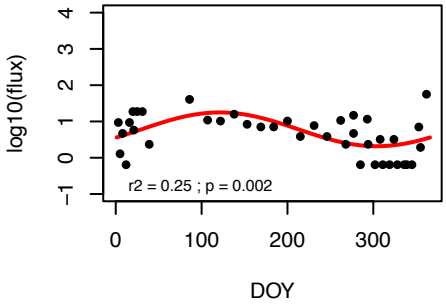
N_inc



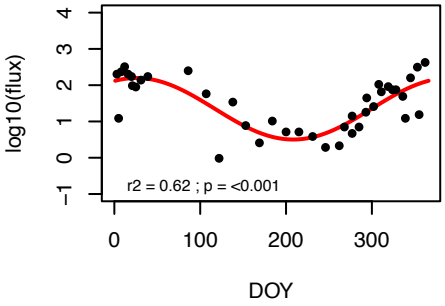
N_pac



O_uni

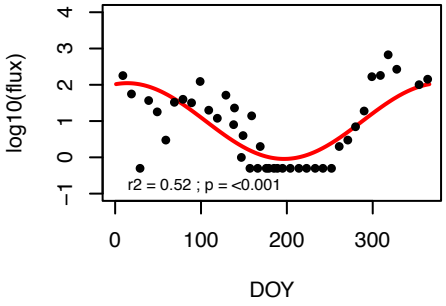


T_qui

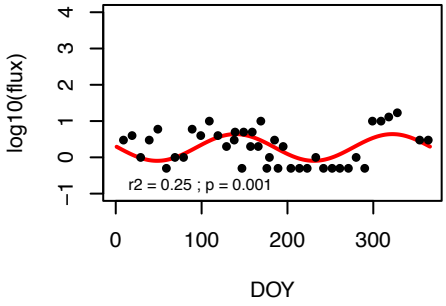


Site 35

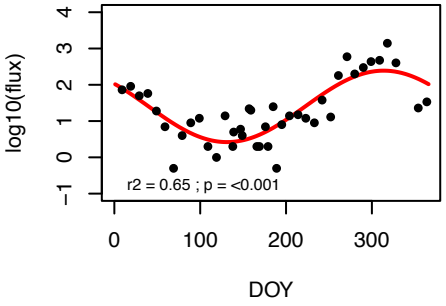
G_bul



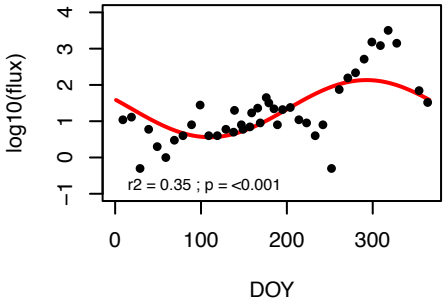
G_fal



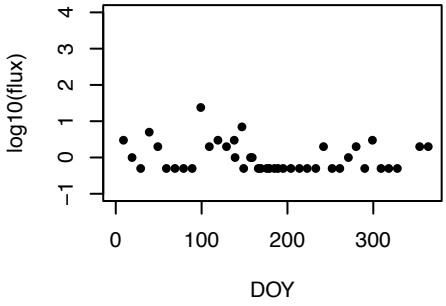
G_glu



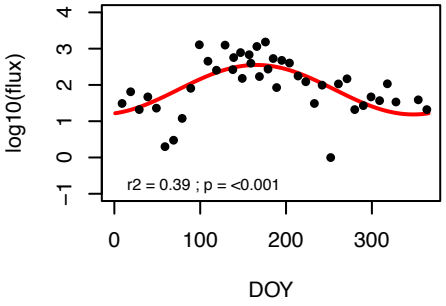
G_inf



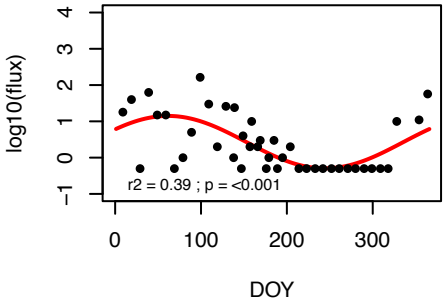
G_sci



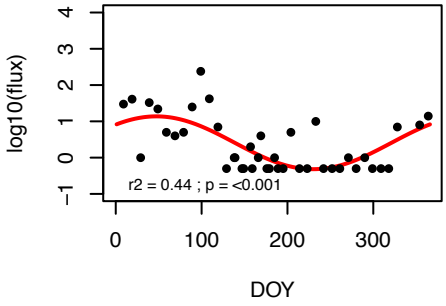
G_tru



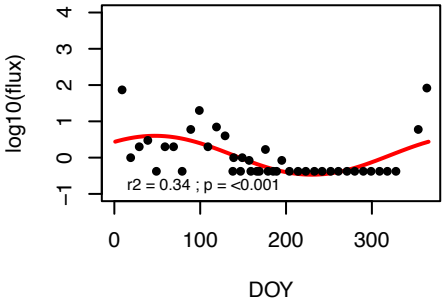
N_inc



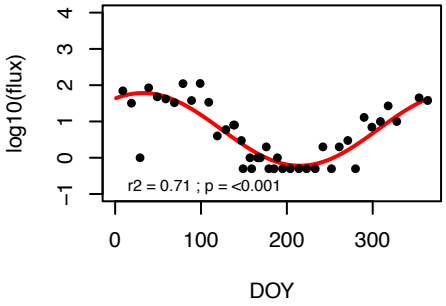
N_pac



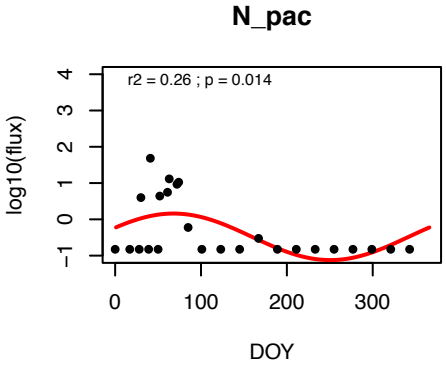
O_uni



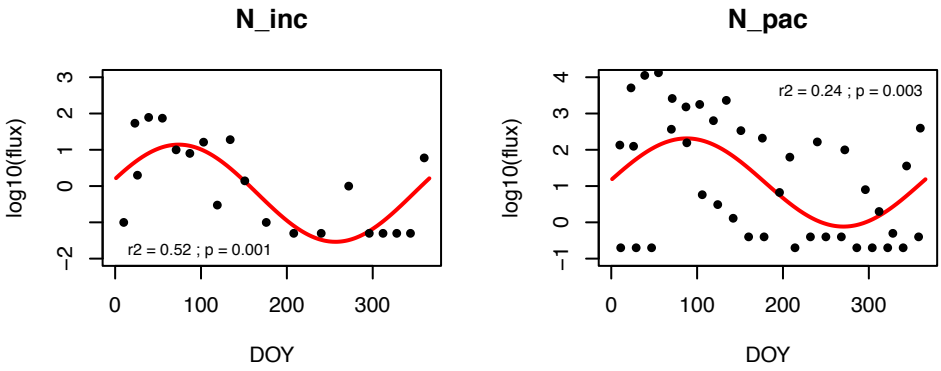
T_qui

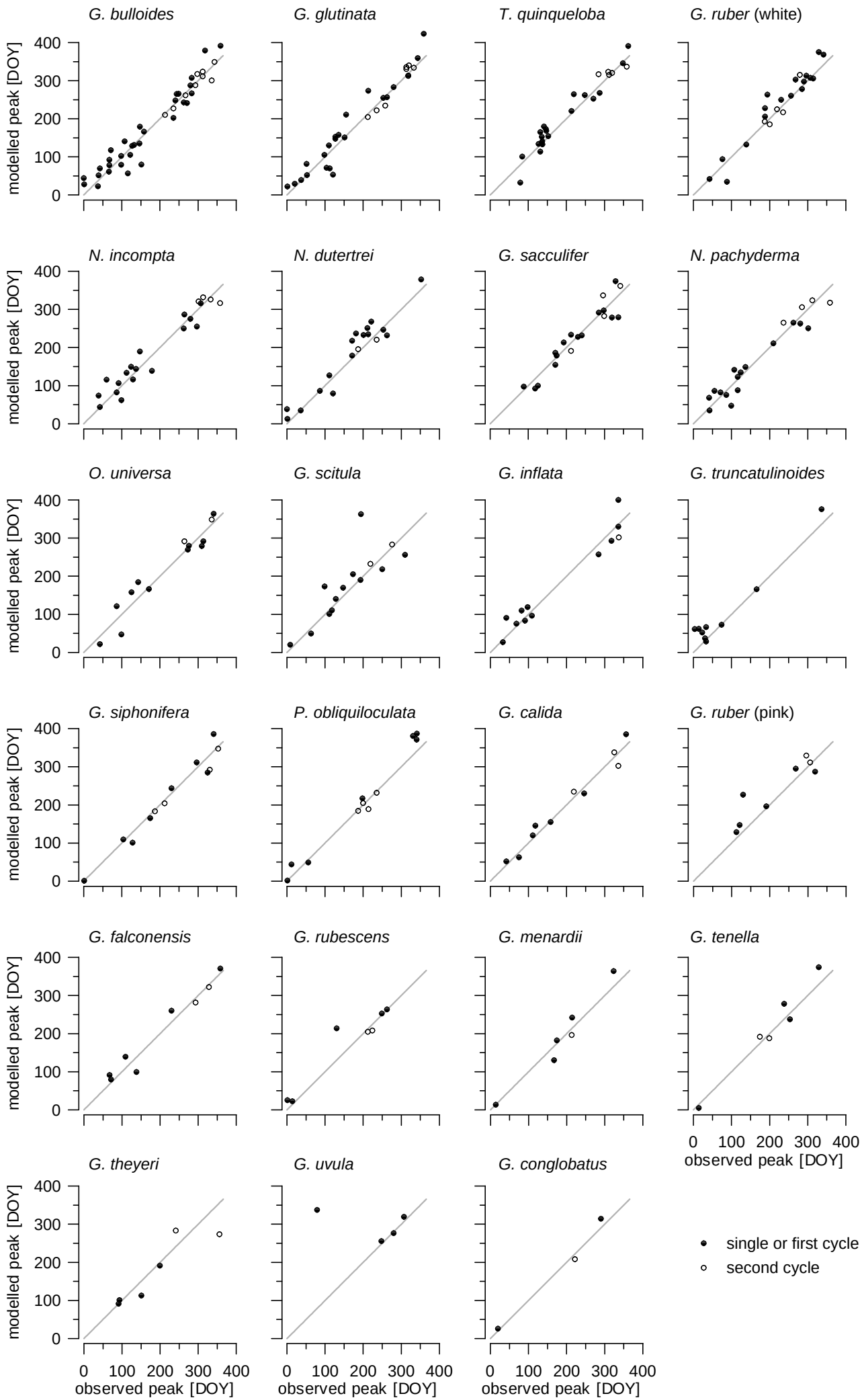


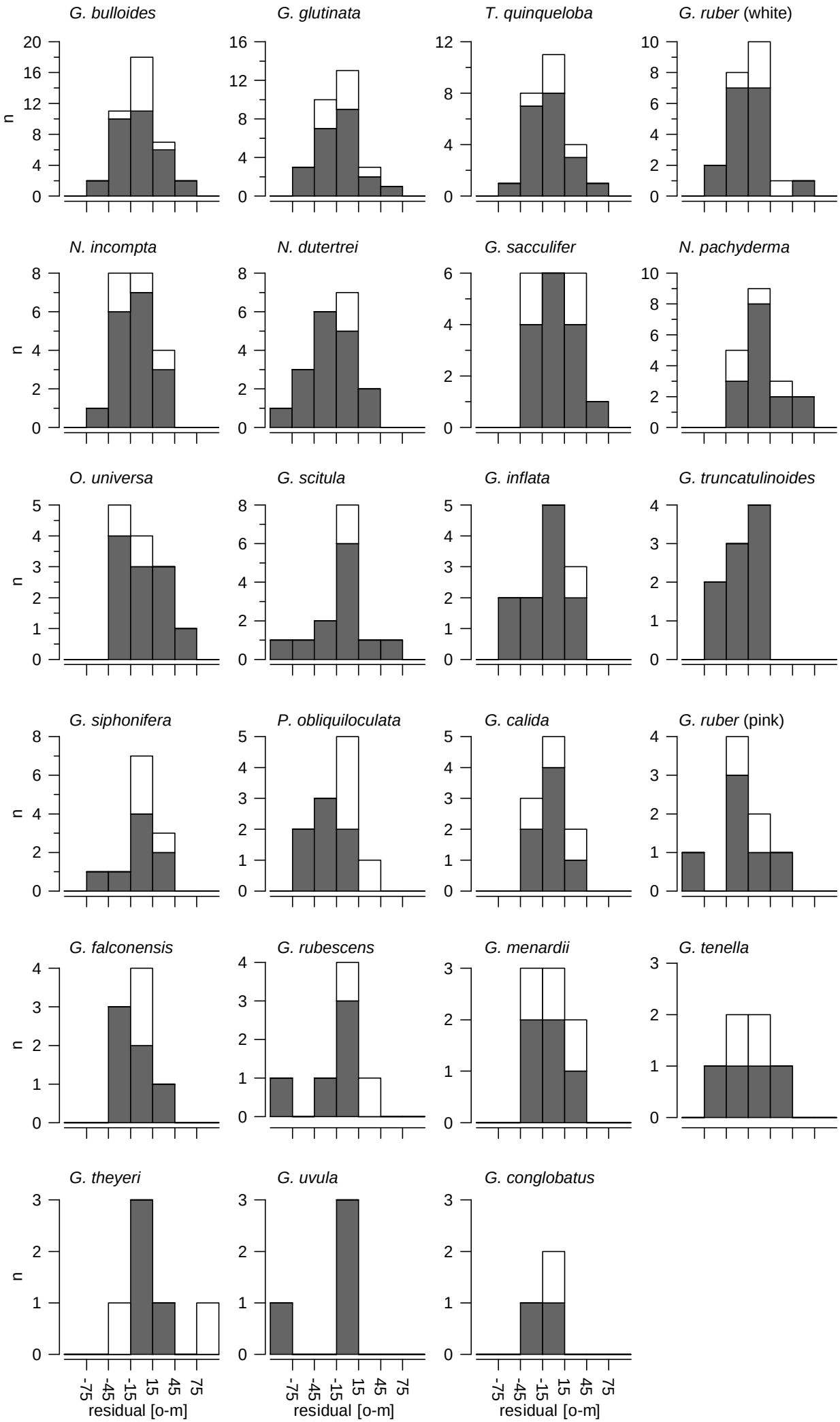
Site 36



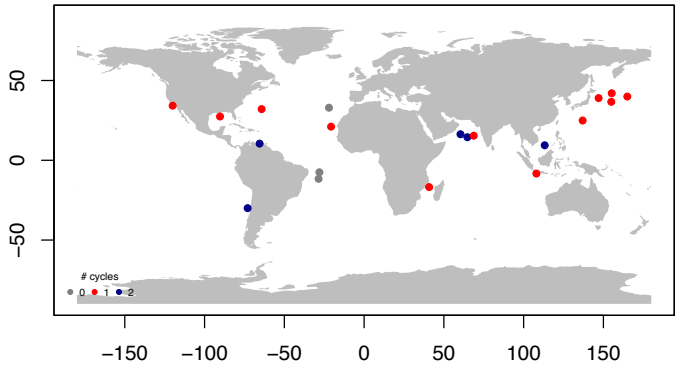
Site 37


N_inc
log10(flux)
−2
0
1
2
3
r2 = 0.52 ; p = 0.001
0
100
200
300
DOY
N_pac
log10(flux)
−1
0
1
2
3
4
r2 = 0.24 ; p = 0.003
0
100
200
300
DOY

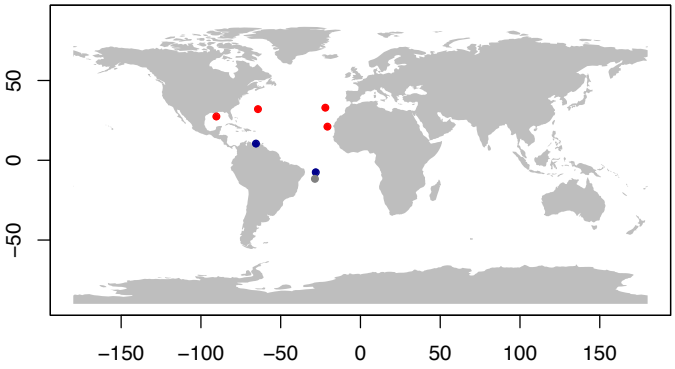

G. bulloides
G. glutinata
T. quinqueloba
G. ruber (white)
N. incompta
N. dutertrei
G. sacculifer
N. pachyderma
O. universa
G. scitula
G. inflata
G. truncatulinoides
G. siphonifera
P. obliquiloculata
G. calida
G. ruber (pink)
G. falconensis
G. rubescens
G. menardii
G. tenella
G. theyeri
G. uvula
G. conglobatus
modelled peak [DOY]
observed peak [DOY]
0
100
200
300
400
single or first cycle
second cycle


G. bulloides
G. glutinata
T. quinqueloba
G. ruber (white)
N. incompta
N. dutertrei
G. sacculifer
N. pachyderma
O. universa
G. scitula
G. inflata
G. truncatulinoides
G. siphonifera
P. obliquiloculata
G. calida
G. ruber (pink)
G. falconensis
G. rubescens
G. menardii
G. tenella
G. theyeri
G. uvula
G. conglobatus
n
-75 -45 -15 15 45 75
residual [o-m]

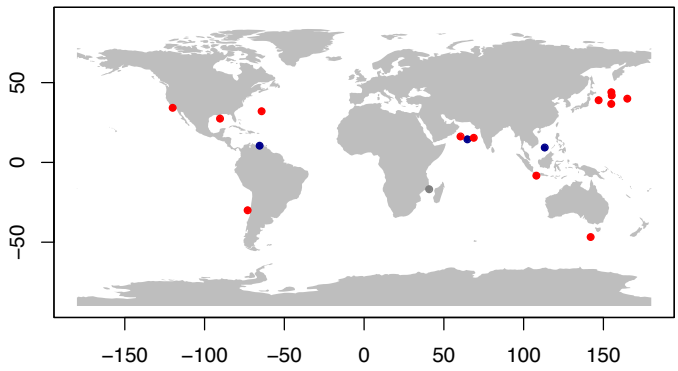
G. ruber (white)



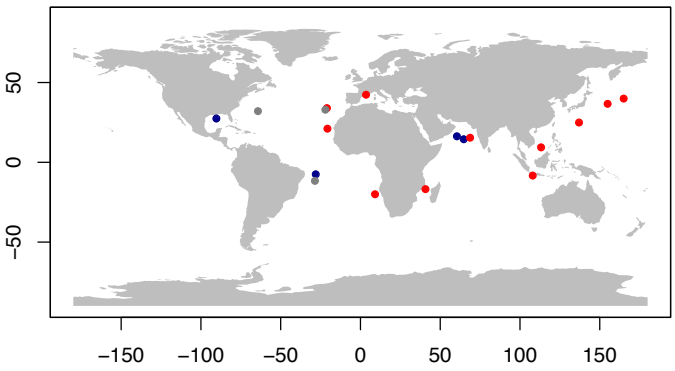
G. ruber (pink)



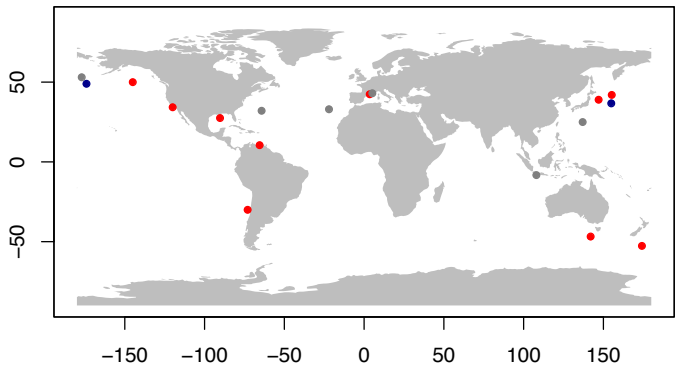
N. dutertrei



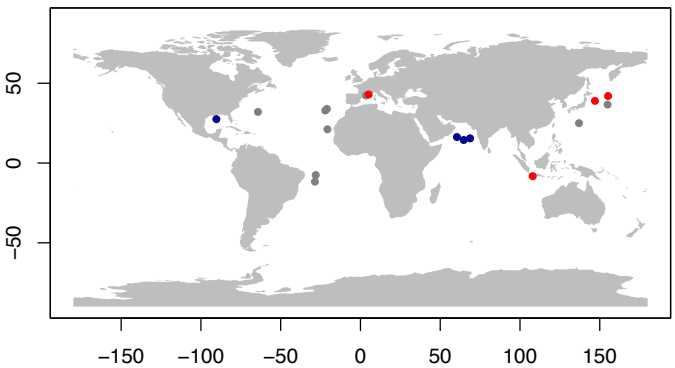
G. sacculifer



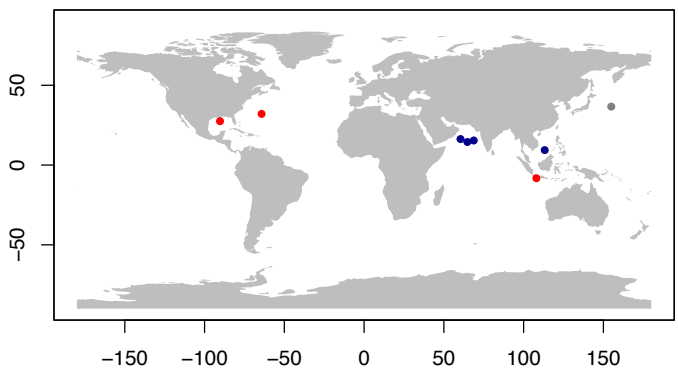
O. universa



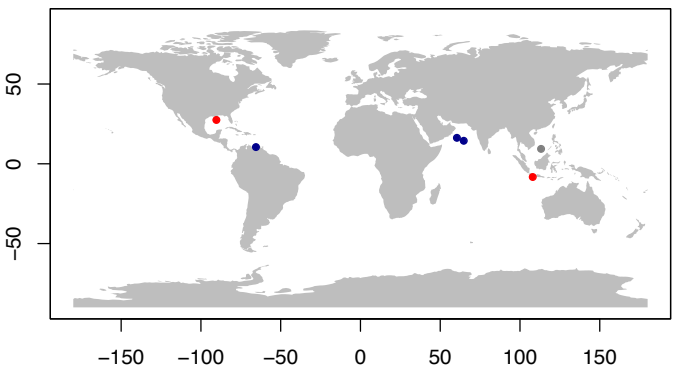
G. siphonifera



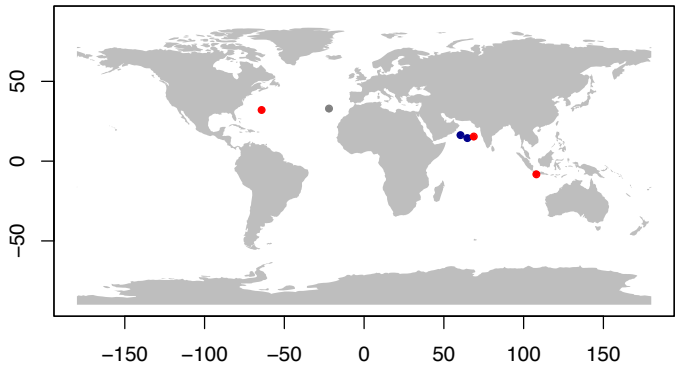
P. obliquiloculata



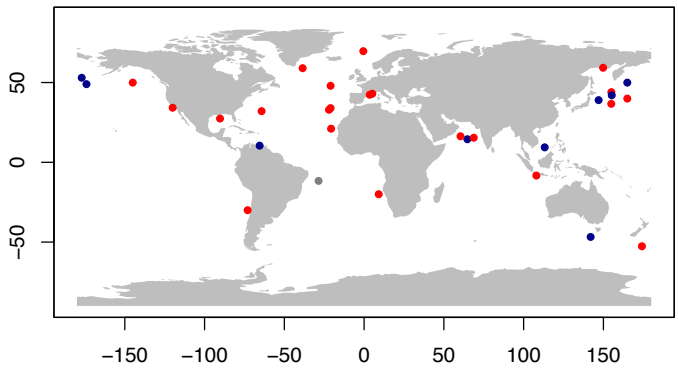
G. menardii



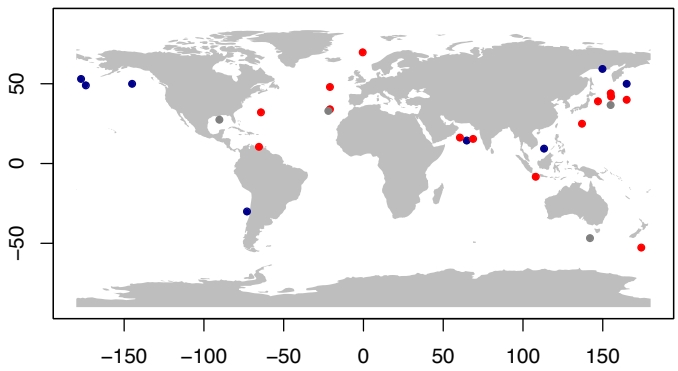
G. rubescens



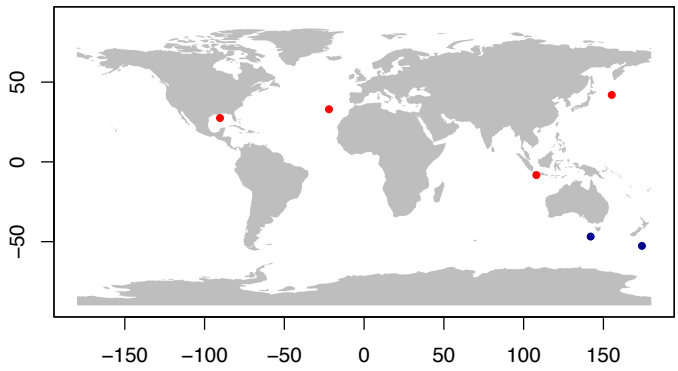
G. bulloides



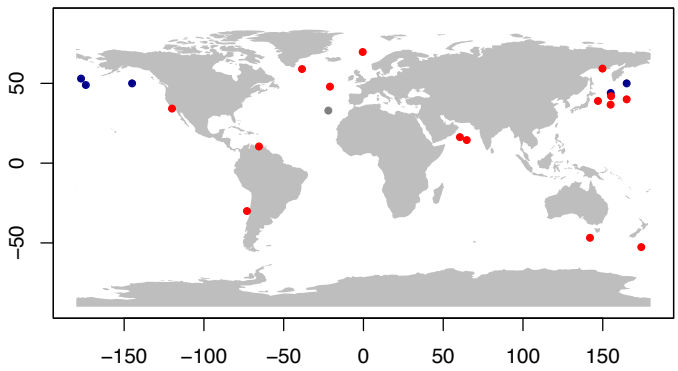
G. glutinata



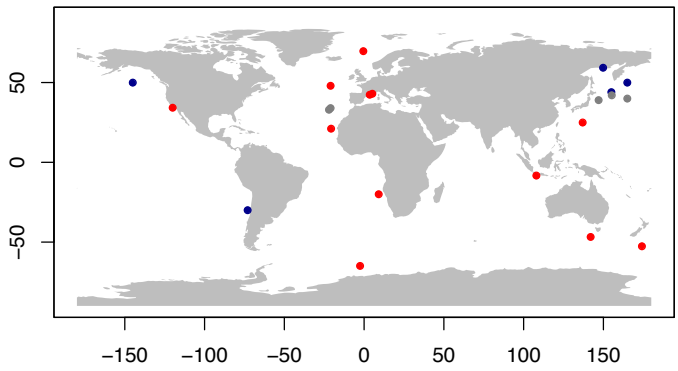
G. falconensis



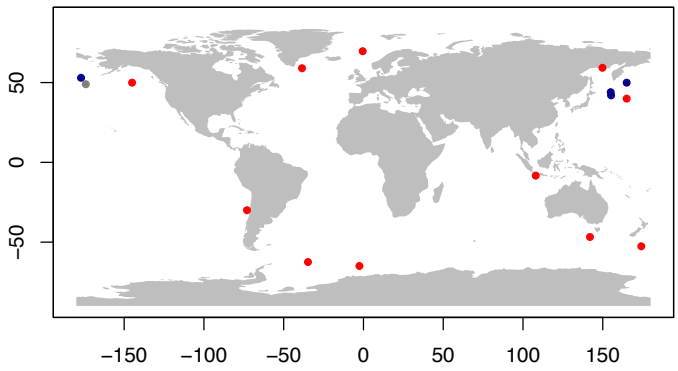
T. quinqueloba



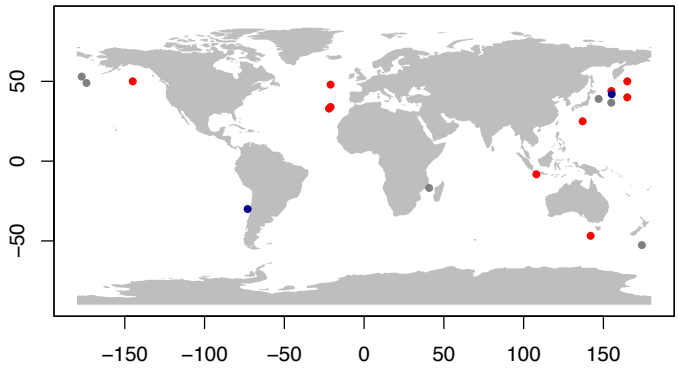
N. incompta



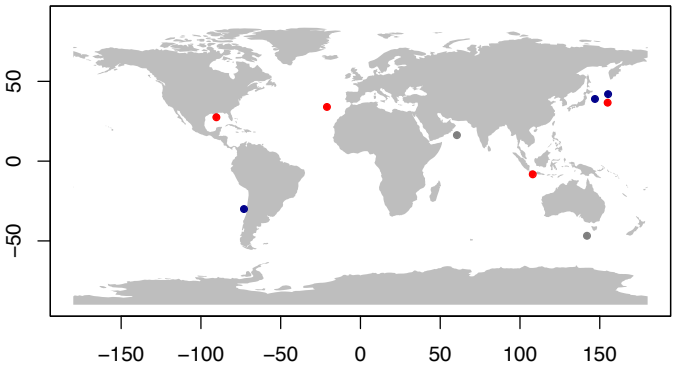
N. pachyderma



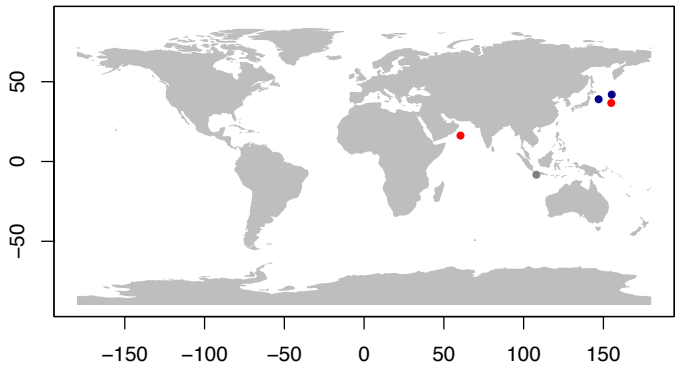
G. scitula



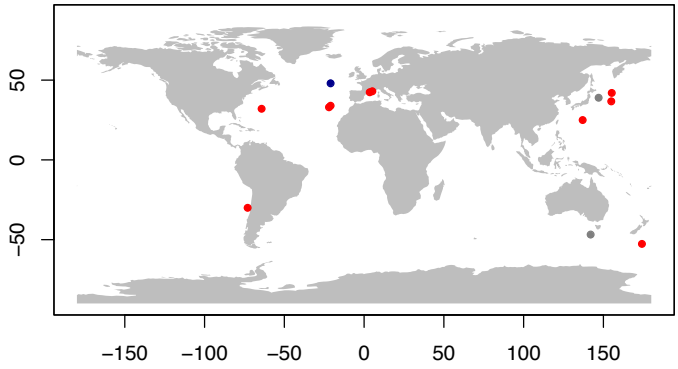
G. calida



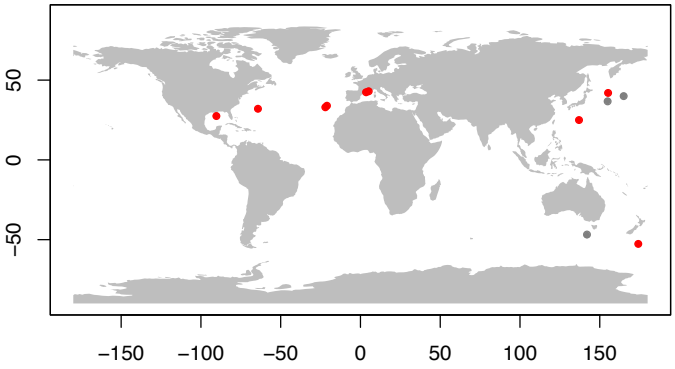
G. theyeri



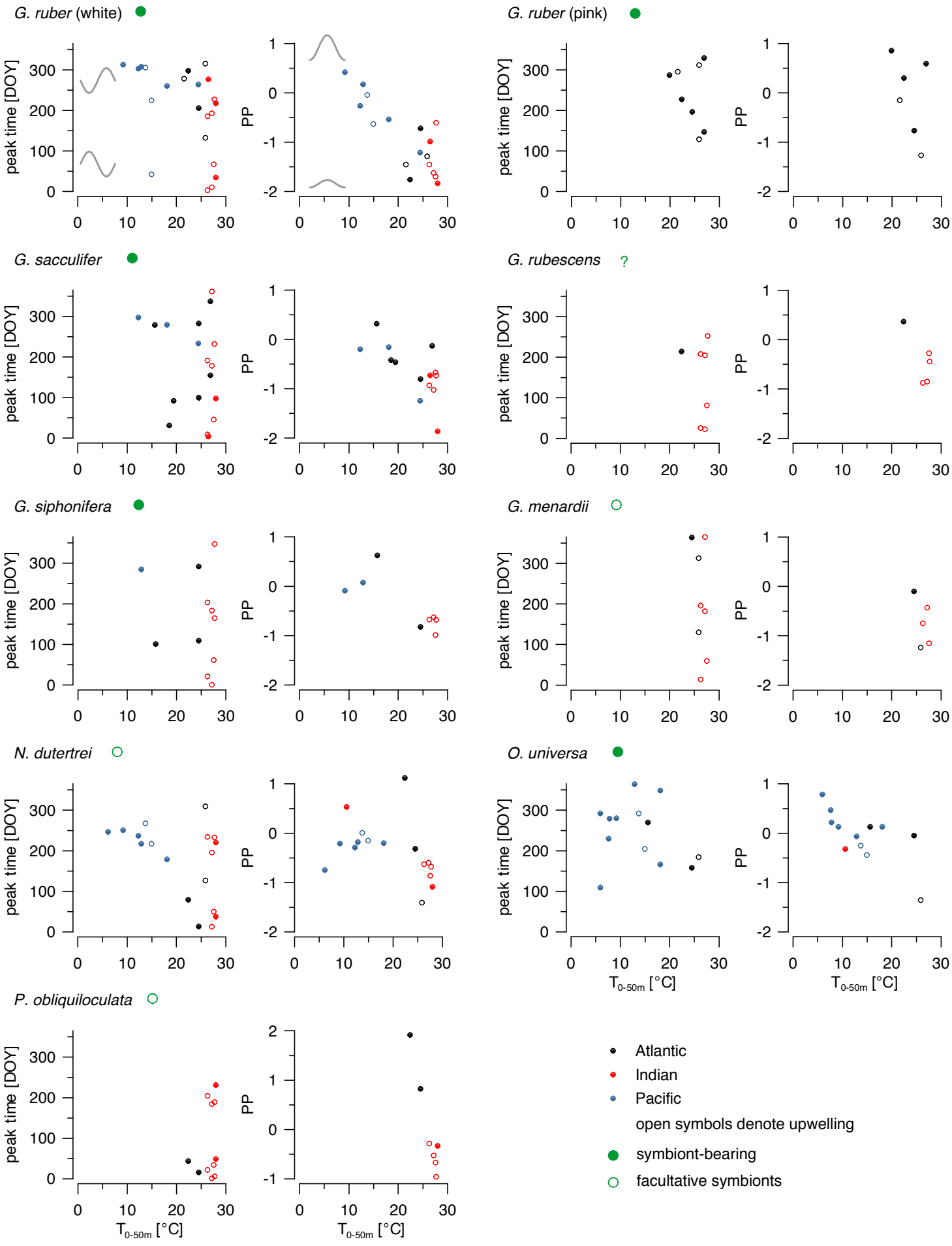
G. inflata



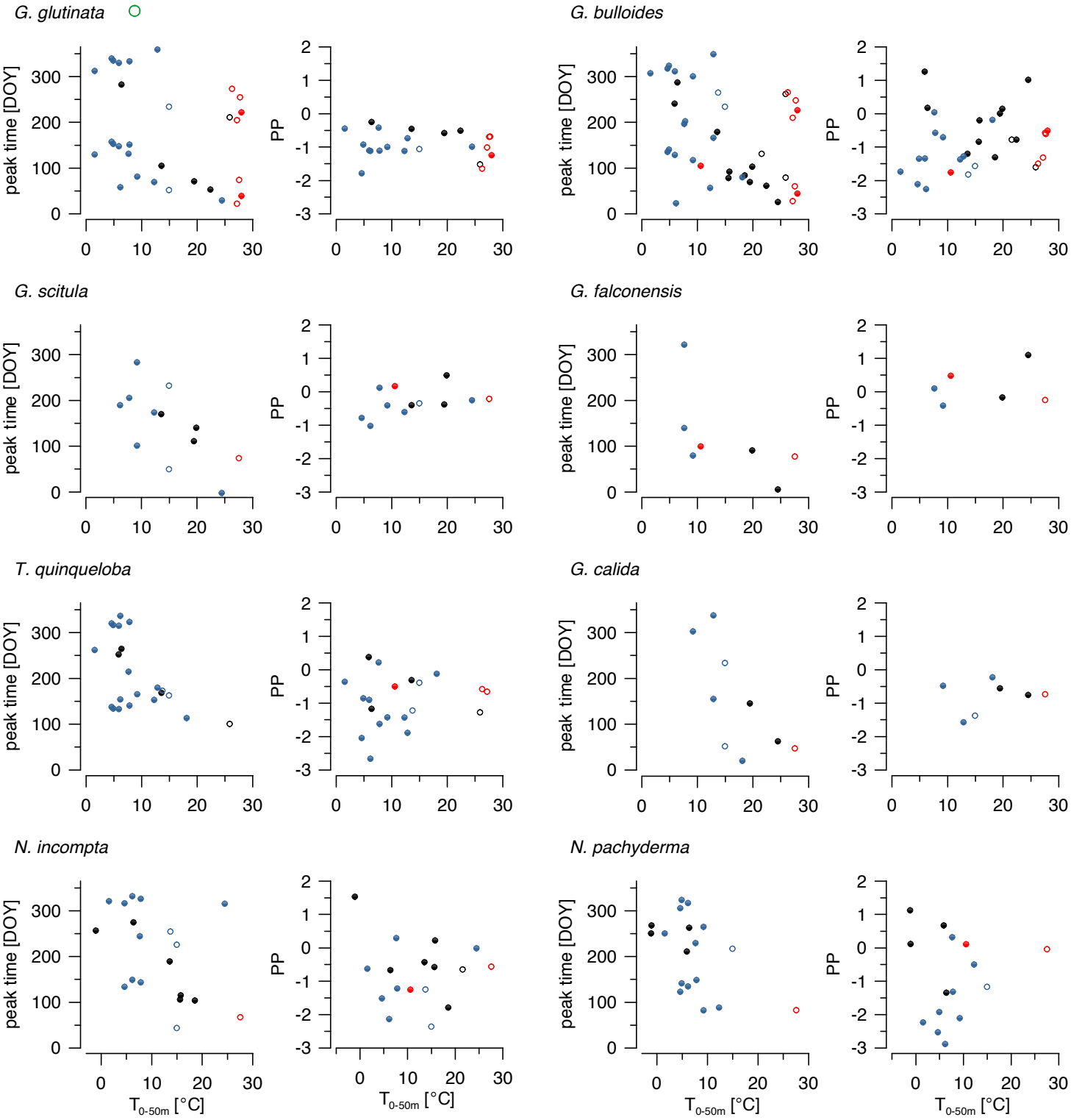
G. truncatulinoides



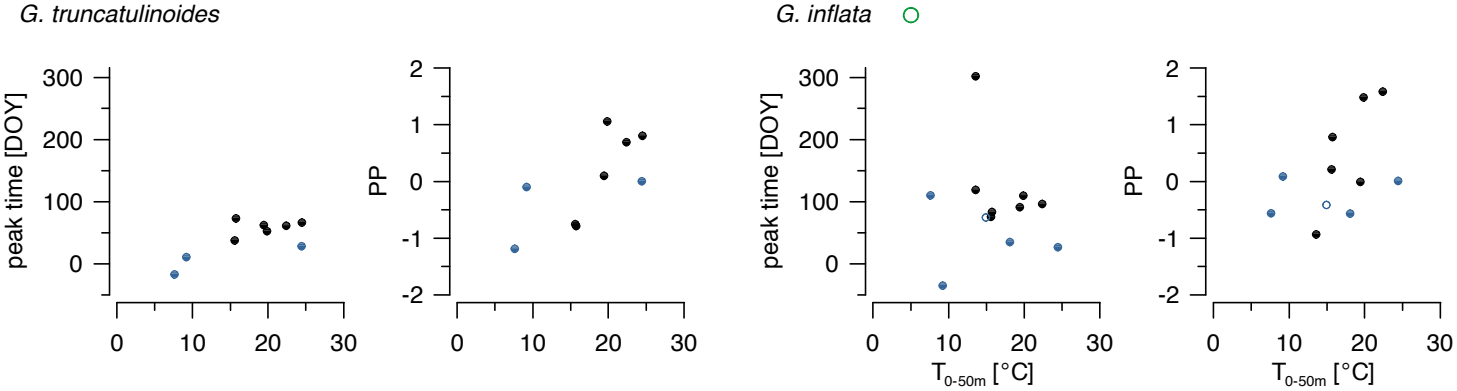
Group A


G. ruber (white)
G. ruber (pink)
G. sacculifer
G. rubescens ?
G. siphonifera
G. menardii
N. dutertrei
O. universa
P. obliquiloculata
peak time [DOY]
PP
T0-50m [°C]
Atlantic
Indian
Pacific
open symbols denote upwelling
symbiont-bearing
facultative symbionts

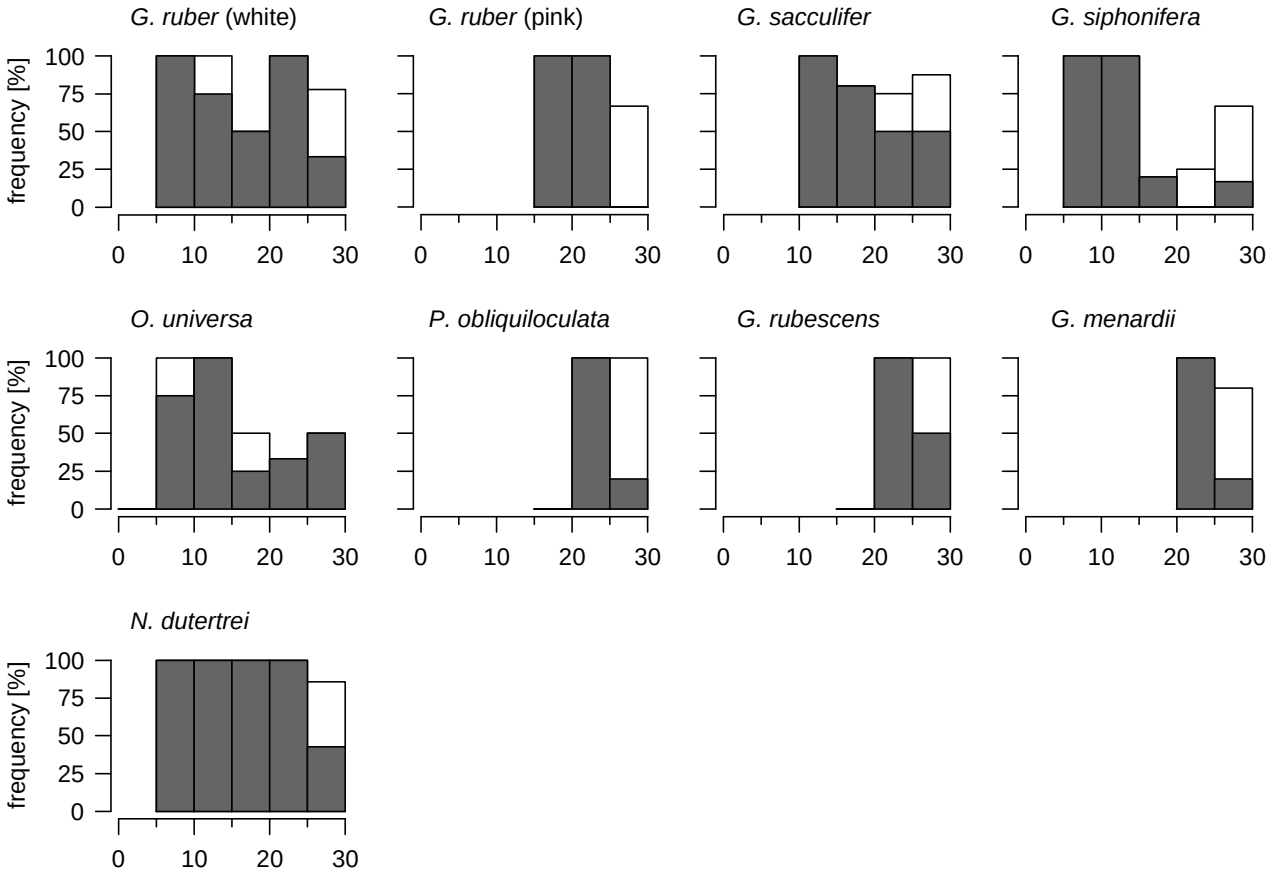
Group B



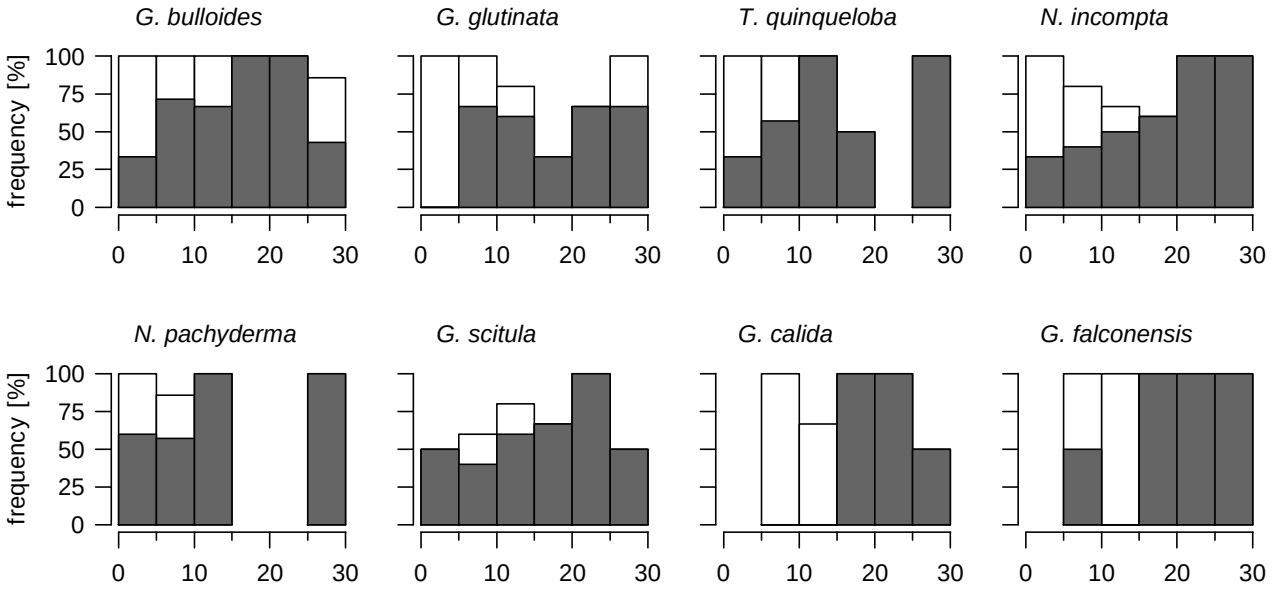
Group C



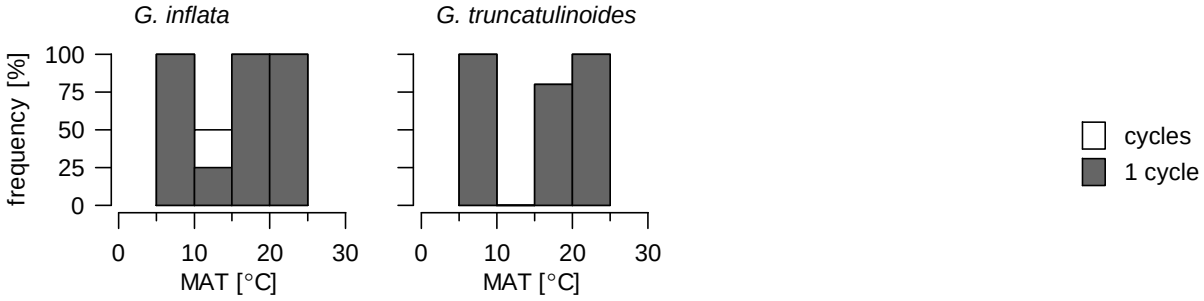
Group A

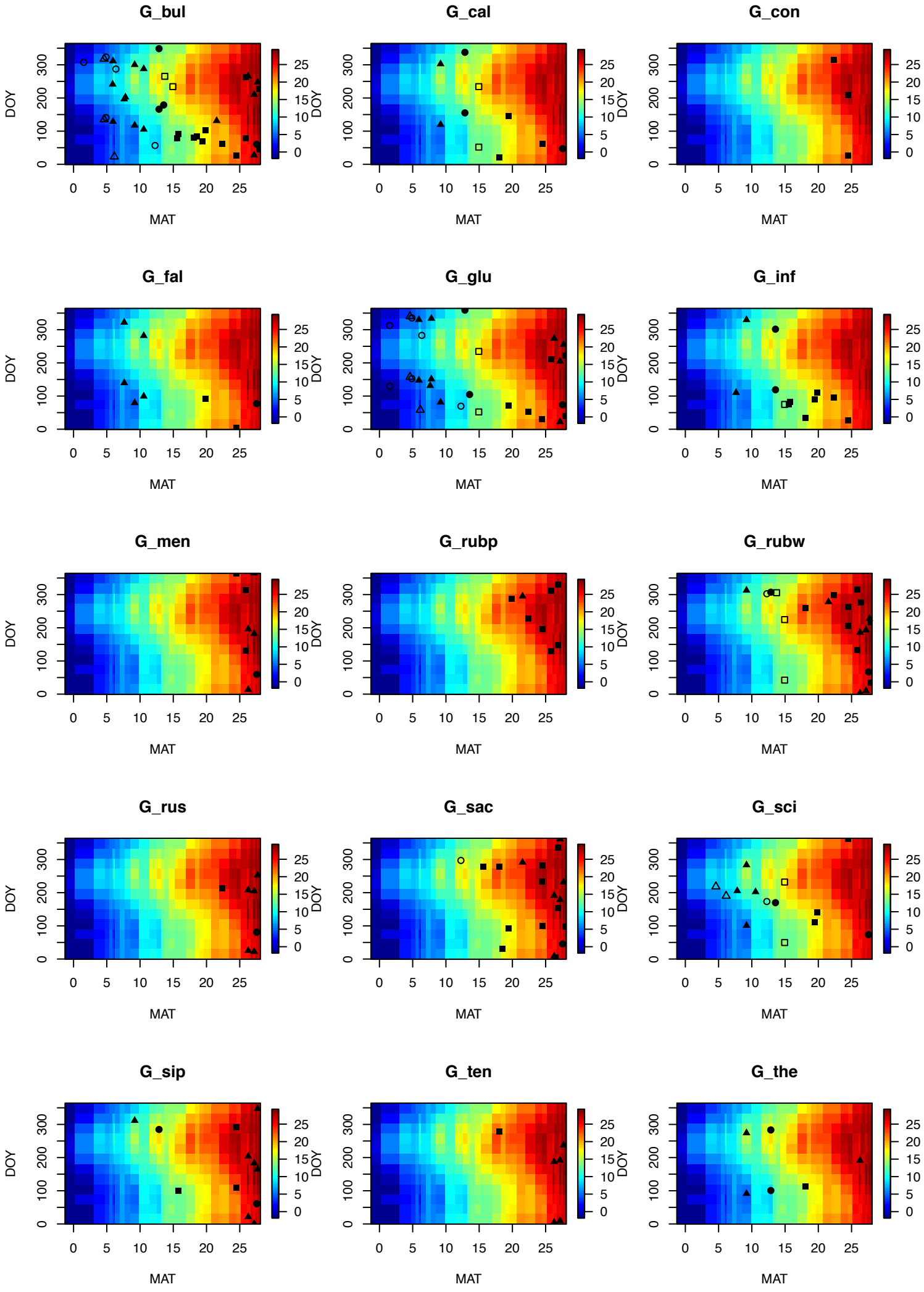


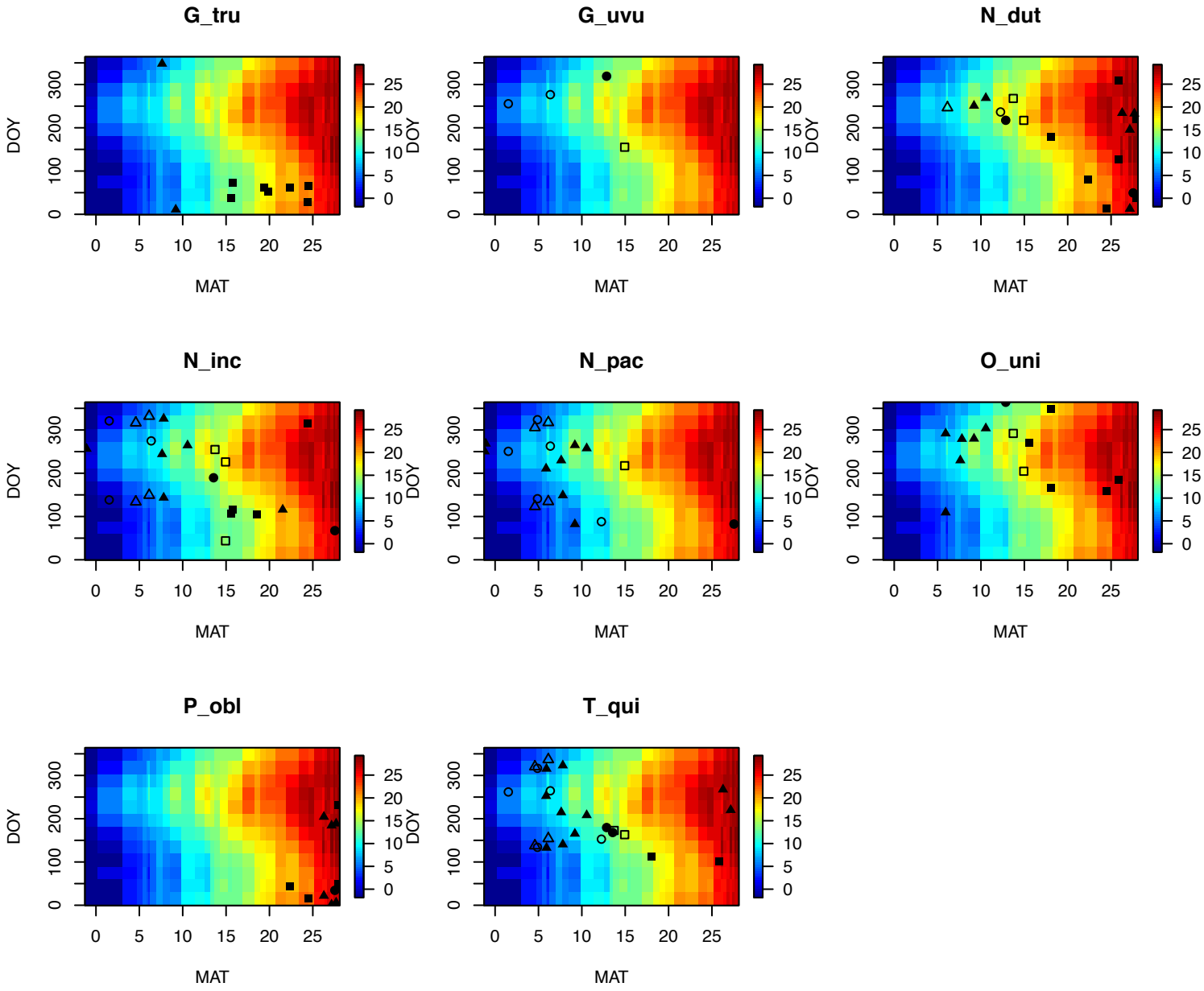
Group B



Group C




G_bul
G_cal
G_con
G_fal
G_glu
G_inf
G_men
G_rubp
G_rubw
G_rus
G_sac
G_sci
G_sip
G_ten
G_the
DOY
MAT
0
100
200
300
0
5
10
15
20
25


G_tru
G_uvu
N_dut
N_inc
N_pac
O_uni
P_obl
T_qui
DOY
MAT
0
100
200
300
0
5
10
15
20
25