Swamp forest dataset

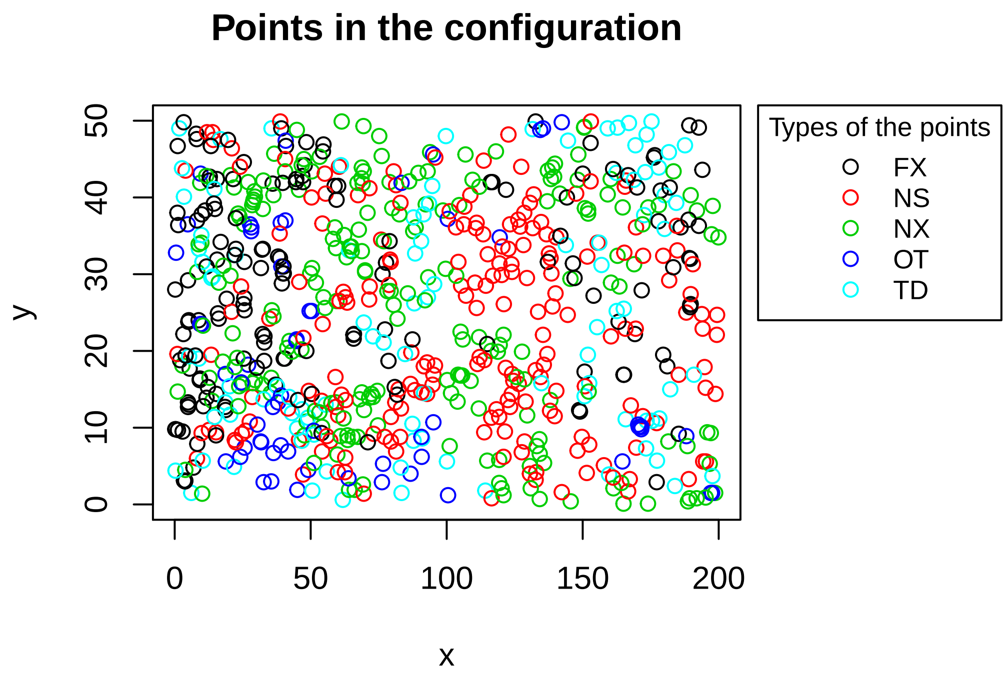
```r
library(ppjsdm)
#> Registered S3 method overwritten by 'spatstat':
#>   method     from
#>   print.boxx cli
library(ecespa)
#> Loading required package: spatstat
#> Loading required package: spatstat.data
#> Loading required package: nlme
#> Loading required package: rpart
#>
#> spatstat 1.64-0       (nickname: 'Susana Distancia')
#> For an introduction to spatstat, type 'beginner'
library(plot.matrix)
remove(list = ls())

set.seed(1)
```

This vignette explains how to use the `ppjsdm` package with the `swamp` dataset from `ecespa`. Locations and botanical classification of trees in a plot in the Savannah River. Locations are given in metres, rounded to the nearest 0.1 metre. The data come from a 1-ha (200 m x 50 m) plot in the Savannah River Site, South Carolina, USA. The 734 mapped stems included 156 Carolina ash (Fraxinus caroliniana), 215 Water tupelo (Nyssa aquatica), 205 Swamp tupelo (Nyssa sylvatica), 98 Bald cypress (Taxodium distichum) and 60 stems of 8 additional species. We begin by loading the data with all species.

```r
configuration <- Configuration(swamp$y, swamp$x, swamp$sp)
window <- Rectangle_window(c(0, 200), c(0, 50))
```

The point configuration is plotted below.

```r
par(mar = c(5, 4, 4, 13) + 0.1)
plot(configuration, window = window)
```



We provide a series of ranges for the interaction radii, and let the fitting function calibrate the model.

```
short_range <- c(0, 20)
medium_range <- c(0, 20)
long_range <- c(0, 20)
model <- "square_exponential"
medium_range_model <- "square_exponential"
max_points <- 1000
saturation <- 2
steps <- 100000
```

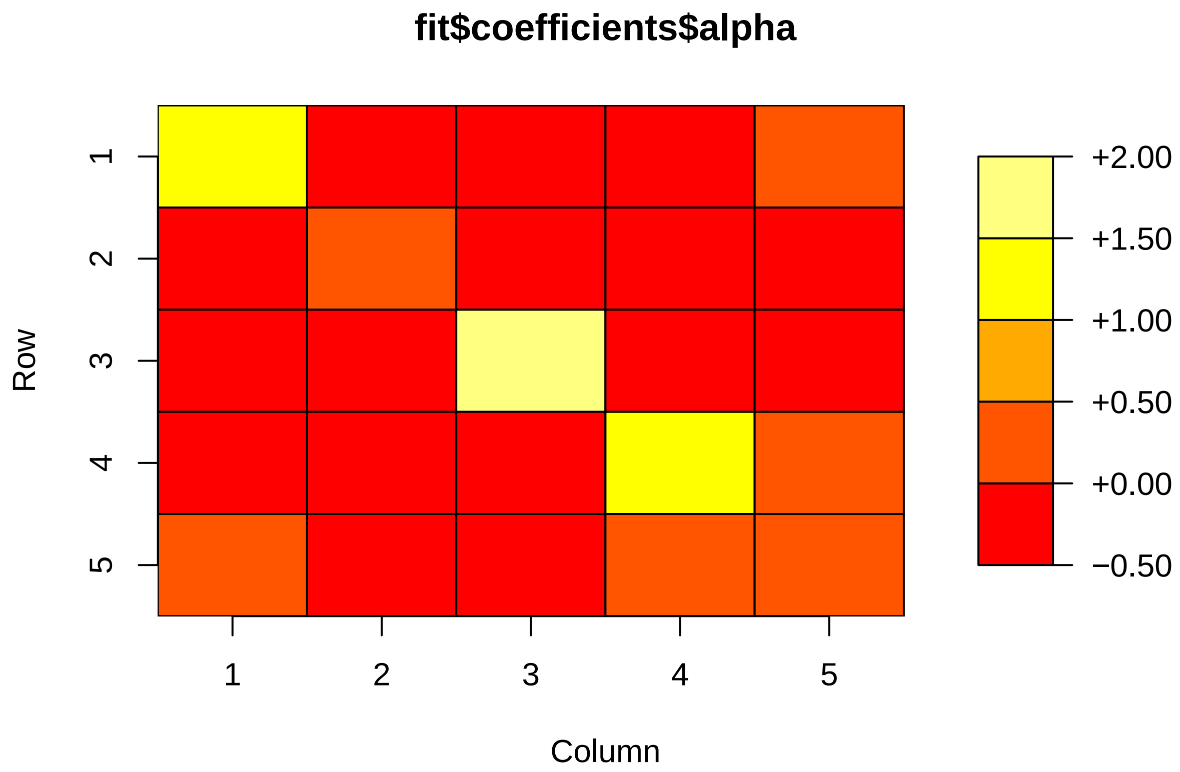
We can now call the fitting function.

```
fit <- ppjsdm::gibbsm(configuration,
                      window = window,
                      model = model,
                      medium_range_model = medium_range_model,
                      short_range = short_range,
                      medium_range = medium_range,
                      long_range = long_range,
                      use_glmnet = FALSE)
#> $beta0
#> [1] -3.891146 -3.915768 -5.944859 -5.846535 -3.048352
#>
#> $alpha
#>             [,1]       [,2]        [,3]        [,4]        [,5]
#> [1,]  1.16859440 -0.1410701 -0.06813122 -0.25672395  0.07894446
#> [2,] -0.14107005  0.4138691 -0.20445148 -0.10966303 -0.16902152
#> [3,] -0.06813122 -0.2044515  1.80995285 -0.05257573 -0.20400237
#> [4,] -0.25672395 -0.1096630 -0.05257573  1.01785162  0.03695092
```

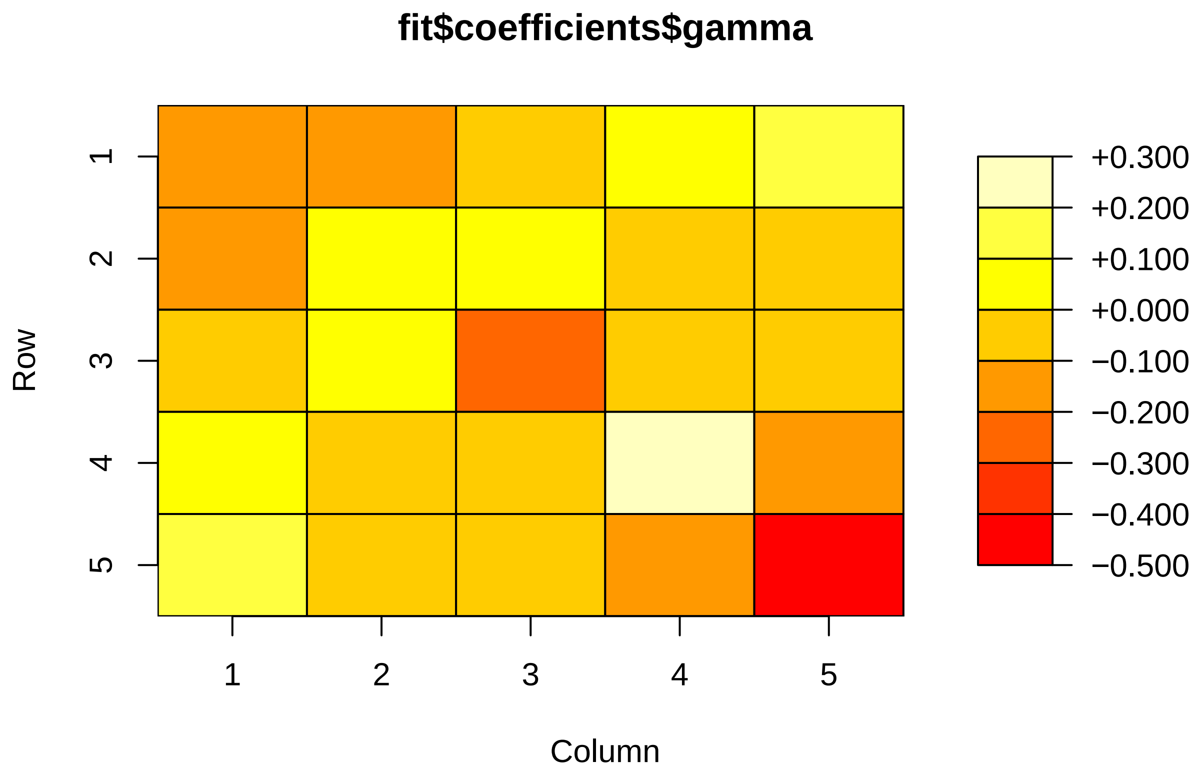
```
#> [5,]  0.07894446 -0.1690215 -0.20400237  0.03695092  0.12958700
#>
#> $gamma
#>             [,1]        [,2]        [,3]        [,4]        [,5]
#> [1,] -0.10623189 -0.10718143 -0.08944907  0.03371259  0.13398898
#> [2,] -0.10718143  0.08022038  0.03001064 -0.08164895 -0.06021949
#> [3,] -0.08944907  0.03001064 -0.28273572 -0.04534980 -0.07397309
#> [4,]  0.03371259 -0.08164895 -0.04534980  0.21342043 -0.11379872
#> [5,]  0.13398898 -0.06021949 -0.07397309 -0.11379872 -0.47220695
#>
#> $beta
#>
#> [1,]
#> [2,]
#> [3,]
#> [4,]
#> [5,]
print(summary(fit))
#>             coefficients         se     CI95_lo      CI95_hi Ztest         Pval
#> log_lambda1  -3.89114585 0.66759173 -5.19960159 -2.582690110   *** 5.588391e-09
#> log_lambda2  -3.91576783 1.22797070 -6.32254619 -1.508989478    ** 1.428587e-03
#> log_lambda3  -5.94485938 0.99671664 -7.89838809 -3.991330668   *** 2.454702e-09
#> log_lambda4  -5.84653486 1.06756176 -7.93891745 -3.754152270   *** 4.337452e-08
#> log_lambda5  -3.04835220 0.75741426 -4.53285687 -1.563847534   *** 5.705214e-05
#> alpha_1_1     1.16859440 0.16843974  0.83845859  1.498730221   *** 3.983667e-12
#> alpha_1_2    -0.14107005 0.06934860 -0.27699081 -0.005149294     * 4.192979e-02
#> alpha_1_3    -0.06813122 0.06210065 -0.18984625  0.053583807       2.725934e-01
#> alpha_1_4    -0.25672395 0.11838411 -0.48875254 -0.024695367     * 3.011552e-02
#> alpha_1_5     0.07894446 0.09002812 -0.09750741  0.255396324       3.805482e-01
#> alpha_2_2     0.41386911 0.17326028  0.07428521  0.753453014     * 1.690749e-02
#> alpha_2_3    -0.20445148 0.05375549 -0.30981031 -0.099092663   *** 1.427466e-04
#> alpha_2_4    -0.10966303 0.09939427 -0.30447222  0.085146156       2.698911e-01
#> alpha_2_5    -0.16902152 0.08331724 -0.33232031 -0.005722732     * 4.249395e-02
#> alpha_3_3     1.80995285 0.33617078  1.15107022  2.468835471   *** 7.283723e-08
#> alpha_3_4    -0.05257573 0.08922326 -0.22745011  0.122298647       5.556866e-01
#> alpha_3_5    -0.20400237 0.07698397 -0.35488818 -0.053116558    ** 8.050772e-03
#> alpha_4_4     1.01785162 0.35253550  0.32689473  1.708808506    ** 3.886481e-03
#> alpha_4_5     0.03695092 0.13074590 -0.21930633  0.293208175       7.774710e-01
#> alpha_5_5     0.12958700 0.24593477 -0.35243630  0.611610299       5.982518e-01
#> gamma_1_1    -0.10623189 0.29910785 -0.69247251  0.480008718       7.224679e-01
#> gamma_1_2    -0.10718143 0.05575689 -0.21646293  0.002100060       5.456809e-02
#> gamma_1_3    -0.08944907 0.07106243 -0.22872887  0.049830726       2.081245e-01
#> gamma_1_4     0.03371259 0.08504797 -0.13297837  0.200403550       6.918136e-01
#> gamma_1_5     0.13398898 0.09786777 -0.05782831  0.325806283       1.709737e-01
#> gamma_2_2     0.08022038 0.56736586 -1.03179627  1.192237021       8.875611e-01
#> gamma_2_3     0.03001064 0.10630516 -0.17834364  0.238364925       7.777085e-01
#> gamma_2_4    -0.08164895 0.06897935 -0.21684600  0.053548092       2.365428e-01
#> gamma_2_5    -0.06021949 0.07535160 -0.20790591  0.087466934       4.241861e-01
#> gamma_3_3    -0.28273572 0.24499212 -0.76291145  0.197440005       2.484754e-01
#> gamma_3_4    -0.04534980 0.06300204 -0.16883153  0.078131925       4.716390e-01
#> gamma_3_5    -0.07397309 0.08107246 -0.23287220  0.084926013       3.615415e-01
#> gamma_4_4     0.21342043 0.18057499 -0.14050005  0.567340908       2.372479e-01
#> gamma_4_5    -0.11379872 0.10292123 -0.31552064  0.087923188       2.688618e-01
```

```
#> gamma_5_5    -0.47220695 0.15328735 -0.77264463 -0.171769274    ** 2.066294e-03
#>                    Zval
#> log_lambda1 -5.8286310
#> log_lambda2 -3.1888121
#> log_lambda3 -5.9644428
#> log_lambda4 -5.4765308
#> log_lambda5 -4.0246829
#> alpha_1_1    6.9377597
#> alpha_1_2   -2.0342163
#> alpha_1_3   -1.0971097
#> alpha_1_4   -2.1685677
#> alpha_1_5    0.8768867
#> alpha_2_2    2.3887132
#> alpha_2_3   -3.8033602
#> alpha_2_4   -1.1033134
#> alpha_2_5   -2.0286500
#> alpha_3_3    5.3840279
#> alpha_3_4   -0.5892604
#> alpha_3_5   -2.6499331
#> alpha_4_4    2.8872315
#> alpha_4_5    0.2826163
#> alpha_5_5    0.5269161
#> gamma_1_1   -0.3551625
#> gamma_1_2   -1.9222994
#> gamma_1_3   -1.2587393
#> gamma_1_4    0.3963950
#> gamma_1_5    1.3690819
#> gamma_2_2    0.1413909
#> gamma_2_3    0.2823065
#> gamma_2_4   -1.1836724
#> gamma_2_5   -0.7991800
#> gamma_3_3   -1.1540605
#> gamma_3_4   -0.7198148
#> gamma_3_5   -0.9124318
#> gamma_4_4    1.1818936
#> gamma_4_5   -1.1056875
#> gamma_5_5   -3.0805344
print(fit$coefficients)
#> $beta0
#> [1] -3.891146 -3.915768 -5.944859 -5.846535 -3.048352
#>
#> $alpha
#>             [,1]       [,2]        [,3]        [,4]        [,5]
#> [1,]  1.16859440 -0.1410701 -0.06813122 -0.25672395  0.07894446
#> [2,] -0.14107005  0.4138691 -0.20445148 -0.10966303 -0.16902152
#> [3,] -0.06813122 -0.2044515  1.80995285 -0.05257573 -0.20400237
#> [4,] -0.25672395 -0.1096630 -0.05257573  1.01785162  0.03695092
#> [5,]  0.07894446 -0.1690215 -0.20400237  0.03695092  0.12958700
#>
#> $gamma
#>             [,1]        [,2]        [,3]        [,4]        [,5]
#> [1,] -0.10623189 -0.10718143 -0.08944907  0.03371259  0.13398898
#> [2,] -0.10718143  0.08022038  0.03001064 -0.08164895 -0.06021949
```

```
#> [3,] -0.08944907  0.03001064 -0.28273572 -0.04534980 -0.07397309
#> [4,]  0.03371259 -0.08164895 -0.04534980  0.21342043 -0.11379872
#> [5,]  0.13398898 -0.06021949 -0.07397309 -0.11379872 -0.47220695
#>
#> $beta
#>
#> [1,]
#> [2,]
#> [3,]
#> [4,]
#> [5,]
#>
#> $short_range
#>          [,1]     [,2]      [,3]     [,4]     [,5]
#> [1,] 1.321006 4.020319  4.020319 4.020319 4.020319
#> [2,] 4.020319 6.027380  4.020319 4.020319 4.020319
#> [3,] 4.020319 4.020319 10.217037 4.020319 4.020319
#> [4,] 4.020319 4.020319  4.020319 8.531621 4.020319
#> [5,] 4.020319 4.020319  4.020319 4.020319 5.646177
#>
#> $medium_range
#>          [,1]     [,2]     [,3]     [,4]     [,5]
#> [1,] 14.53570 11.42453 11.42453 11.42453 11.42453
#> [2,] 11.42453 14.49334 11.42453 11.42453 11.42453
#> [3,] 11.42453 11.42453 18.76176 11.42453 11.42453
#> [4,] 11.42453 11.42453 11.42453 24.07697 11.42453
#> [5,] 11.42453 11.42453 11.42453 11.42453 17.31168
#>
#> $long_range
#>          [,1]     [,2]     [,3]     [,4]     [,5]
#> [1,] 20.15012 14.97125 14.97125 14.97125 14.97125
#> [2,] 14.97125 24.36686 14.97125 14.97125 14.97125
#> [3,] 14.97125 14.97125 25.64857 14.97125 14.97125
#> [4,] 14.97125 14.97125 14.97125 30.73331 14.97125
#> [5,] 14.97125 14.97125 14.97125 14.97125 22.77481
par(mar=c(5.1, 5.1, 4.1, 4.1))
plot(fit$coefficients$alpha)
```




```
plot(fit$coefficients$gamma)
```




```r
print(fit$aic)
#> [1] 3413.65
print(fit$bic)
#> [1] 3634.273
```

We may then plot the corresponding Papangelou conditional intensity.

```r
# parameters <- fit$coefficients
# plot_papangelou(window = window,
#                 configuration = configuration,
#                 type = 1,
#                 model = model,
#                 medium_range_model = medium_range_model,
#                 alpha = parameters$alpha,
#                 lambda = parameters$lambda,
#                 beta = matrix(0, 6, 0),
#                 gamma = parameters$gamma,
#                 covariates = list(),
#                 short_range = parameters$short_range,
#                 medium_range = parameters$medium_range,
#                 long_range = parameters$long_range,
#                 saturation = saturation,
#                 max_points = max_points)
```