

# Package ‘siland’

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**Type** Package

**Title** Spatial Influence of Landscape

**Version** 2.0

**Date** 2020-03-15

**Author** Carpentier F. and Martin O.

**Maintainer** Martin Olivier <olivier.martin@inra.fr>

**Description** Functions to analyze the effect of landscape features on spatial observations (described in a GIS shapefile format). It simultaneously estimates the spatial scales and intensities of landscape variable effects without any information about the scale of effect, Carpentier and Martin (2019) <doi:10.1101/692566>.

**License** GPL (>= 2.0)

**Depends** R (>= 3.5.0), base, graphics, stats, sf

**Imports** lme4, sp,raster, ggplot2, ggforce, fasterize, reshape2

**NeedsCompilation** no

**Suggests** knitr, rmarkdown

**VignetteBuilder** knitr

**Repository** CRAN

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## R topics documented:

siland-package	2
AIC.Bsiland	5
AIC.Fsiland	6
BIC.Bsiland	7
BIC.Fsiland	7
Bsiland	8
Bsiland.lik	10
bufferforsiland	12
dataCmoth	13
dataSiland	13

fitted.Bsiland . . . . .	14
fitted.Fsiland . . . . .	15
Fsiland . . . . .	15
Fsiland.lik . . . . .	18
Fsiland.quantile . . . . .	20
landCmoth . . . . .	21
landSiland . . . . .	21
landtoraster . . . . .	22
likresB1 . . . . .	23
plotBsiland.land . . . . .	23
plotFsiland . . . . .	24
plotFsiland.land . . . . .	25
plotFsiland.sif . . . . .	26
print.Bsiland . . . . .	27
print.Fsiland . . . . .	27
resB1 . . . . .	27
resB2 . . . . .	28
resB3 . . . . .	28
resF1 . . . . .	28
resF3 . . . . .	28
resF4 . . . . .	28
resF5.1 . . . . .	29
resF5.2 . . . . .	29
residuals.Bsiland . . . . .	29
residuals.Fsiland . . . . .	30
resY . . . . .	30
summary.Bsiland . . . . .	30
summary.Fsiland . . . . .	31
<b>Index</b>	<b>32</b>

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siland-package

*Spatial Influence of Landscape*


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## Description

Functions to analyze the effect of landscape features on spatial observations (described in a GIS shapefile format). It simultaneously estimates the spatial scales and intensities of landscape variable effects without any information about the scale of effect, Carpentier and Martin (2019) <doi:10.1101/692566>. This package allows for analyzing the effect of landscape features on georeferenced point observations (described in a Geographic Information System shapefile format). It simultaneously estimates the spatial scales and intensities of landscape variable effects. It does not require any information about the scale of effect. Two methods are available: one is based on focal sample site (Bsiland method, b for buffer) and one is distance weighted using Spatial Influence Function (Fsiland method, f for function). It allows for effects tests, effects maps and models comparison. \

**Details**

The DESCRIPTION file:

```

Package:      siland
Type:        Package
Title:       Spatial Influence of Landscape
Version:     2.0
Date:       2020-03-15
Author:      Carpentier F. and Martin O.
Maintainer:  Martin Olivier <olivier.martin@inra.fr>
Description: Functions to analyze the effect of landscape features on spatial observations (described in a GIS shapefile)
License:     GPL (>=2.0)
Depends:    R (>= 3.5.0), base, graphics, stats, sf
Imports:    lme4, sp,raster, ggplot2, ggforce, fasterize, reshape2
NeedsCompilation: no
Packaged:   2019-11-13 12:46:55 UTC; omartin
Suggests:   knitr, rmarkdown
VignetteBuilder: knitr

```

#### Index of help topics:

AIC.Bsiland	Akaike's An Information Criterion for siland package
AIC.Fsiland	Akaike's An Information Criterion for siland package
BIC.Bsiland	Bayesian Information criterion
BIC.Fsiland	Bayesian Information criterion
Bsiland	Estimation of landscape influence using Bsiland method (Buffers)
Bsiland.lik	-(Loglikelihood) as a function of buffer sizes.
Fsiland	Estimation of landscape influence using Fsiland method (Spatial Influence Function)
Fsiland.lik	-(Loglikelihood) as a function of SIF parameters.
Fsiland.quantile	Quantile of spatial influence function (SIF)
bufferforsiland	Percentage of landscape variable in buffers.
dataCmoth	Codling moth counts
dataSiland	Simulated data
fitted.Bsiland	Extract Bsiland model Fitted values
fitted.Fsiland	Extract Bsiland model Fitted values
landCmoth	Landscape of dataCmoth observations
landSiland	Simulated landscape.
landtoraster	Transformation of an sf object into raster
likresB1	Result for vignette of siland
plotBsiland.land	Map of Bsiland result
plotFsiland	Plot results from Fsiland function
plotFsiland.land	Map of Fsiland result
plotFsiland.sif	Plot the estimated spatial influence functions.
print.Bsiland	Bsiland print
print.Fsiland	Fsiland print

resB1	Result for vignette of siland
resB2	Result for vignette of siland
resB3	Result for vignette of siland
resF1	Result for vignette of siland
resF3	Result for vignette of siland
resF4	Result for vignette of siland
resF5.1	Result for vignette of siland
resF5.2	Result for vignette of siland
resY	Result for vignette of siland
residuals.Bsiland	Extract Bsiland Residuals
residuals.Fsiland	Extract Fsiland Residuals
siland-package	Spatial Influence of Landscape
summary.Bsiland	The function gives a summary of an object of class Bsiland
summary.Fsiland	The function gives a summary of an object of class Fsiland

**Author(s)**

Carpentier F. and Martin O. Maintainer: Martin Olivier <olivier.martin@inra.fr>

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AIC.Bsiland

*Akaike's An Information Criterion for siland package*


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**Description**

Function calculating thue usual Akaike's 'An Information Criterion' for an object of class Bsiland, according to the formula  $-2*\log\text{likelihood}+k*\text{npar}$ , with npar the number of parameters of the model and  $k = 2$ .

**Usage**

```
## S3 method for class 'Bsiland'
AIC(object,...,k=2)
```

**Arguments**

object	an object of class Bsiland
...	Dots are not take into account in this version
k	not used

**Value**

AIC value

**Author(s)**

O. Martin

**References**

Sakamoto, Y., Ishiguro, M., and Kitagawa G. (1986). Akaike Information Criterion Statistics. D. Reidel Publishing Company.

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AIC.Fsiland

*Akaike's An Information Criterion for siland package*


---

**Description**

Function calculating thue usual Akaike's 'An Information Criterion' for an object of class Fsiland, according to the formula  $-2*\log\text{likelihood}+k*\text{npar}$ , with npar the number of parameters of the model and  $k = 2$ .

**Usage**

```
## S3 method for class 'Fsiland'
AIC(object,...,k=2)
```

**Arguments**

object	an object of class Fsiland
...	Dots are not take into account in this version
k	not used

**Value**

AIC value

**Author(s)**

O. Martin

**References**

Sakamoto, Y., Ishiguro, M., and Kitagawa G. (1986). Akaike Information Criterion Statistics. D. Reidel Publishing Company.

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BIC.Bsiland	<i>Bayesian Information criterion</i>
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**Description**

Function computing the Bayesian Information Criterion for an object of class Bsiland, according to the formula  $-2*\log\text{likelihood}+k*\text{npar}$ , with npar the number of parameters of the model and  $k = \log(n)$  (n being the number of observations).

**Usage**

```
## S3 method for class 'Bsiland'  
BIC(object,...)
```

**Arguments**

object	an object of class Fsiland
...	Dots are not take into account in this version

**Value**

BIC value

**Author(s)**

O. Martin

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BIC.Fsiland	<i>Bayesian Information criterion</i>
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**Description**

Function computing the Bayesian Information Criterion for an object of class Fsiland, according to the formula  $-2*\log\text{likelihood}+k*\text{npar}$ , with npar the number of parameters of the model and  $k = \log(n)$  (n being the number of observations).

**Usage**

```
## S3 method for class 'Fsiland'  
BIC(object,...)
```

**Arguments**

object	an object of class Fsiland
...	Dots are not take into account in this version

**Value**

BIC value

**Author(s)**

O. Martin

Bsiland

*Estimation of landscape influence using Bsiland method (Buffers)***Description**

Function estimating landscape effect (and eventual local effects) using Bsiland method, i.e. estimating simultaneously : the buffer size (radius) and the effect of each landscape variable (and the effect of each local variable).

**Usage**

```
Bsiland(formula, land, data, family = "gaussian", init = 200, border = F)
```

**Arguments**

formula	a symbolic description (see lm() or glm()) of the model to be fitted. The details of model specification are given under 'Details'.
land	an object of class sf containing the landscape variables.
data	a dataframe containing the response variable and the local variables.
family	the distribution of response variable. family can be "gaussian", "poisson" or "binomial" and the associated link function are identity, log and logit respectively.
init	a vector indicating the starting values for buffer sizes in the estimation procedure. By default, starting values of buffer sizes of all landscape variable are equal to 200.
border	a logical indicating wether buffers are computed from the observation locations ( border=FALSE) or from the border of the polygon where observations are located ( border=TRUE))

**Details**

The Bsiland method is based on the model:

$$E(Y_i) = \mu + \sum_l \alpha_l x_{l,i} + \sum_k \beta_k p_{\delta_k,i}^k$$

with

- $Y_i$ , response variable,



- $x_{l,i}$ , local variable  $l$ ,
- $p_{\delta_k,i}^k$ , the percentage of the landscape variable  $k$  in a buffer of radius  $\delta_k$ , centered on site  $i$
- $\mu$ , the intercept
- $\alpha_l$  and  $\beta_k$ , the effects of local and landscape variables, respectively.

All parameters,  $\mu, \alpha_1, \dots, \alpha_L, \beta_1, \dots, \beta_K$  but also  $\delta_1, \dots, \delta_K$  radii of the buffers of the landscape variables are simultaneously estimated by likelihood maximization.

Models for *Bsiland* have the form `response ~ terms` where `response` is the columns name of the response variable in data and `terms` is a series of terms which specifies the names of landscape and local explanatory variables. The explanatory variables described in data are considered as local in the model, those described in the `sf` object `land` are considered as landscape variables.

For local variables, random effects can be considered using the syntax `(1|x)` similar to package `lme4` (see `lmer()` function in package `lme4`).

The explanatory variables are added using the symbol `"+"`. Interaction terms can be considered using the usual symbols `"*"` or `":"`. Notice that only interactions between local x local and local x landscape variables are considered.

## Value

`Bsiland` returns an object of type `Bsiland`, a list :

<code>coefficients</code>	a vector of the estimated coefficients
<code>parambuffer</code>	a vector of the estimated buffer radii
<code>formula</code>	an object of class <code>formula</code> that indicates the model
<code>buffer</code>	a dataframe indicating the percentages of landscape variables in buffer of estimated sizes centered on observations. The landscape variables are in columns, the observations in rows.
<code>loglik</code>	the estimated maximum loglikelihood
<code>loglik0</code>	the estimated maximum loglikelihood of the local model (no landscape variable)
<code>fitted</code>	the fitted values
<code>resoptim</code>	an object of class <code>optim</code> or <code>optimize</code> giving informations about the optimization procedure see <code>optim()</code> or <code>optimize()</code> for further details.
<code>result</code>	a <code>lm/glm/lmer</code> type object that corresponds to the model estimate knowing the estimated buffer sizes of landscape variables
<code>AIC</code>	the akaike information criterion of the model
<code>AIC0</code>	the akaike information criterion of the local model (no landscape variable)
<code>nparam</code>	the number of parameters
<code>pval0</code>	the p.value of the test of the landscape effect (the global effect of all spatial variables). Issued from the likelihood ratio test of the (complete) model vs the local model (complete model without landscape variables).
<code>family</code>	the family distribution of the model
<code>sd.error</code>	the estimated standard error for gaussian family, NA in other case

model.Type	the type of local model: GLM for generalised model, LMM for linear mixed model or GLMM for generalised linear mixed model
rand.StdDev	the estimated standard deviations of the random effects for LMM or GLMM
err	the estimated residuals
newdata	a dataframe containing the local variables and the percentages of the landscape variables in buffers of estimated buffer sizes for each observation (in rows).
border	a logical indicating the value used for estimation

**Author(s)**

O. Martin and F. Carpentier

**References**

Carpentier, F., & Martin, O. (2019). SILand: an R package for estimating the spatial influence of landscape. bioRxiv, 692566.

**Examples**

```
data(dataSiland)
data(landSiland)
data(resB1)
#resB1 has been pre-computed and is the result from the following command
#resB1=Bsiland(obs~x1+L1+L2,land=landSiland,data=dataSiland)
resB1
summary(resB1)
```

---

Bsiland.lik                      *-(Loglikelihood) as a function of buffer sizes.*

---

**Description**

Function investigating eventual optimization problems during numerical optimization of function Bsiland by plotting the *-(loglikelihood)* against buffer sizes of each landscape variable.

**Usage**

```
Bsiland.lik(res, land,data, varnames = NULL, seqd = seq(2, 2000, length = 10))
```

**Arguments**

res	an object resulting from Bsiland
land	the object of class sf describing the landscape variable, i.e. the land argument in the call to the Bsiland function that computed res.
data	the dataframe describing response variable and the local variables, i.e. the data argument in the call to the Bsiland function that computed res.
varnames	a vector containing the names (characters) of studied landscape variables. If varnames is NULL (by default), all landscape variables of the res model are considered.
seqd	a vector of buffer sizes (positive values) for which the -loglikelihood is computed.

**Details**

As with all numerical maximisation procedures, optimization problems may arise. The function `Bsiland.lik` allows to point out possible problems of optimization.

`Bsiland.lik` plots the -Loglikelihood against buffers sizes. During the Bsiland procedure, the estimation of buffer sizes is made by maximizing the likelihood i.e. by minimizing the -Loglikelihood. The orange horizontal line indicates the minimal value of -Loglikelihood obtained during the estimation (res result). The other continuous curves represent the -loglikelihood as a function of buffer sizes for each studied landscape variable (considering the other parameters of the model at their estimated value in res). The dotted lines indicate the values of buffer size estimated (res result).

When the minization correctly occurs, the minimal values of the -loglikelihoods for each landscape variable are equal to the value of the estimated minimal -Loglikelihood. This means that the value of each continuous curves is minimal at its intersection with the orange horizontal line. This also means that dotted lines intersect their associated continuous lines at their minimum.

If it is not the case, the minimizing procedure has failed and it is necessary to proceed again with an estimation with different initialisation values. This is possible with the argument `init` in function `Bsiland`.

**Value**

a ggplot of the -(loglikelihod) against buffer sizes of each landscape variables.

**Author(s)**

O. Martin and F. Carpentier

**Examples**

```
data(dataSiland)
data(landSiland)
data(resB1)
#resB1 has been pre-computed and is the result from the following command
#resB1=Bsiland(obs~x1+L1+L2,land=landSiland,data=dataSiland)
```

```

Bsiland.lik(resB1,dataSiland,land=landSiland,varnames=c("L1","L2"),seqd=seq(5,50,length=10))

# Illustration of failed estimation caused by wrong initial values.
# In a such case, the estimation should be done again ,
# by calling Bsiland with init=c(250,250) for instance.

#resB_fail=Bsiland(obs~x1+L1+L2,land=landSiland,data=dataSiland,init=c(2000,2000))
#Bsiland.lik(resB_fail,dataSiland,land=landSiland,varnames=c("L1","L2"),seqd=seq(5,3000,length=20))

```

---

bufferforsiland      *Percentage of landscape variable in buffers.*

---

## Description

Function computing the percentages of landscape variables in buffers of given sizes (i.e. radii).

## Usage

```
bufferforsiland(d, sfGIS, loc.sf, landnames, border = F)
```

## Arguments

d	a vector of the distances of the buffer sizes. The length of d has to be equal to that of landnames.
sfGIS	an object of class sf containing the landscape variables (land uses). Landscape variables are equal to 1 (presence) or 0 (absence).
loc.sf	an object of class sf or a dataframe containing locations of buffers centers. For dataframe, locations have to be given in columns "X" and "Y".
landnames	a vector of characters of the names of the landscape variables
border	a logical (FALSE by default). If border=FALSE buffers are computed from the locations points given in loc.sf If border=TRUE buffers are computed from the border of the polygon that contain the points in loc.sf.

## Value

a dataframe containing the percentages of the landscape variables named landnames (in columns) in buffers of sizes described in d and centered on locations described in loc.sf (in rows).

## Author(s)

Martin O.

**Examples**

```

data(dataSiland)
data(landSiland)
dataSiland[1:10,c("X","Y")]
landSiland$L1
landSiland$L2

bufferforsiland(c(100,200),sfGIS=landSiland, loc.sf=dataSiland, landnames=c("L1","L2"))

```

---

dataCmoth	<i>Codling moth counts</i>
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---

**Description**

This data set contains measurements of codling moth counts in 54 orchards. Anonymized data issued from Ricci et al. (2011) study.

**Usage**

```
data("dataCmoth")
```

**Format**

A data frame with 54 observations on 4 variables.

[,1]	X	numeric	locations (anonymized)
[,2]	Y	numeric	locations (anonymized)
[,3]	trait	numeric	number of treatments against codling moths in orchards
[,4]	Cmoth	numeric	average count of collected larvae in cardboard traps wrapped around tree trunks.

**References**

Ricci B., Franck P., Bouvier J.-C., Casado D. and Lavigne C. (2011). Effects of hedgerow characteristics on intra-orchard distribution of larval codling moth. *Agriculture, Ecosystems & Environment*. 140. 395-400. 10.1016/j.agee.2011.01.001.

---

dataSiland	<i>Simulated data</i>
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---

**Description**

Simulated data of response variable and local variables.

**Usage**

```
data("dataSiland")
```

**Format**

A data frame with 100 observations on 5 variables.

[,1]	X	numeric	location on X-axis
[,2]	Y	numeric	location on Y-axis
[,3]	x1	numeric	a continous local variable
[,4]	Id	numeric	identifier
[,5]	obs	numeric	response variable

**Examples**

```
data(dataSiland)
plot(dataSiland[,c("X", "Y")])
```

---

fitted.Bsiland

*Extract Bsiland model Fitted values*

---

**Description**

Function extracting fitted values of an object of class Bsiland.

**Usage**

```
## S3 method for class 'Bsiland'
fitted(object,...)
```

**Arguments**

object	an object of class Bsiland.
...	Dots are not take into account in this version

**Value**

Fitted values extracted from the object object.

**Author(s)**

O. Martin

---

fitted.Fsiland	<i>Extract Bsiland model Fitted values</i>
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---

**Description**

Function extracting fitted values of an object of class Fsiland.

**Usage**

```
## S3 method for class 'Fsiland'
fitted(object,...)
```

**Arguments**

object	an object of class Fsiland
...	Dots are not take into account in this version

**Value**

Fitted values extracted from the object object.

**Author(s)**

O. Martin

---

Fsiland	<i>Estimation of landscape influence using Fsiland method (Spatial Influence Function)</i>
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---

**Description**

Function estimating landscape effect (and eventual local effects) using Fsiland method, i.e. estimating simultaneously : the SIF parameter (i.e. mean distance of SIF) and the effect of each landscape variable (and the effect of each local variable).

**Usage**

```
Fsiland(formula,land,data,family ="gaussian",sif="exponential", init = 100,
border=F,wd=30)
```

**Arguments**

formula	a symbolic description (see <code>lm()</code> or <code>glm()</code> ) of the model to be fitted. The details of model specification are given under 'Details'.
land	an object of class <code>sf</code> containing the landscape variables.
data	a dataframe containing the response variable and the local variables.
family	the distribution of response variable. <code>family</code> can be "gaussian", "poisson" or "binomial" and the associated link function are identity, log and logit respectively.
sif	the family of the Spatial Influence Function. <code>sif</code> can be "exponential", "gaussian" or "uniform".
init	a vector indicating the starting values for SIF parameters in the estimation procedure. By default, starting values of SIF parameters of all landscape variable are equal to 100.
border	a logical indicating whether the spatial influence of the polygon where observations are located is taken into account. If <code>border=FALSE</code> , all pixels of a landscape variable have a spatial influence whether or not they belong to the polygon where the observation is located. If <code>border=TRUE</code> , only pixels outside the polygon of the observation, i.e. from the border of the polygon have an influence on this observation.
wd	a numeric, the size of pixels.

**Details**

The `Fsiland` method is based on the model:

$$E(Y_i) = \mu + \sum_l \alpha_l x_{l,i} + \sum_k \beta_k \left( \sum_r f_{\delta_k}(d_{r,i}) z_r^k \right)$$

with

- $Y_i$ , response variable,
- $x_{l,i}$ , local variable  $l$ ,
- $r$ , the discretization of study site in pixels  $r$
- $z^k_r$ , the value of the landscape variable  $k$  at the pixel  $r$ . If the landscape variable  $k$  is a presence/absence variable,  $z^k_r$  is equal to one or zero.
- $\mu$ , the intercept
- $\alpha_l$  and  $\beta_k$ , the effects of local and landscape variables, respectively.
- $f_{\delta_k}$ , the SIF associated with the landscape variable  $k$  with parameter  $\delta_k$  (the mean distance of the SIF, see detail further)
- $d_{r,i}$  the distance between the center of pixel  $r$  and the observation at site  $i$ .

All parameters,  $\mu, \alpha_1, \dots, \alpha_L, \beta_1, \dots, \beta_K$  but also  $\delta_1, \dots, \delta_K$  SIF parameters of the landscape variables are simultaneously estimated by likelihood maximization.

Models for `Fsiland` have the form `response ~ terms` where `response` is the columns name of the response variable in `data` and `terms` is a series of terms which specifies the names of landscape and



local explanatory variables. The explanatory variables described in data are considered as local in the model, those described in the `sf` object `land` are considered as landscape variables.

For local variables, random effects can be considered using the syntax `(1|x)` similar to package `lme4` (see `lmer()` function in package `lme4`). Interaction terms are not yet implemented in `Fsiland` contrary to `Bsiland`.

The explanatory variables are added using the symbol `"+"`. Interaction terms can be considered using the usual symbols `"*"` or `":"`. Notice that only interactions between local x local and local x landscape variables are considered.

Two families of SIF are currently implemented in the `siland` package, exponential and Gaussian families defined as  $f_{\delta}(d) = 2/(\pi\delta^2)\exp(-2d/\delta)$  and  $f_{\delta}(d) = 1/(2\delta\sqrt{\pi})\exp(-d\pi/(2\delta))^2$ , respectively. By definition,  $\delta$  represents the mean distance of these SIF.

The computation of the spatial influence of landscape variables is based on an approximation through the description of landscape variables distribution along a regular grid (modélisation of spatial influence of each pixel of landscape variable). The choice of `wd`, the size of pixels can have an impact on the estimation. The smaller the pixels, the more accurate the approximation, but also the longer the computation time. In our experience, we recommend using a pixel size at most three times smaller than the smallest estimated mean distance among the landscape variables SIF.

## Value

`Fsiland` returns an object of type `Fsiland`, a list :

<code>coefficients</code>	a vector of the estimated coefficients
<code>paramSIF</code>	a vector of the estimated parameters of SIF
<code>formula</code>	an object of class <code>formula</code> that indicates the model
<code>landcontri</code>	a dataframe of estimated cumulative influence of each landscape variable (in columns) on each observation (in rows).
<code>loglik</code>	the estimated maximum loglikelihood
<code>loglik0</code>	the estimated maximum loglikelihood of the local model (no landscape variable)
<code>result</code>	a <code>lm/glm/lmer</code> object that corresponds to the model estimate knowing the estimated SIF parameters of landscape variables.
<code>fitted</code>	the fitted values
<code>sif</code>	the family of the SIF
<code>resoptim</code>	an object of class <code>optim</code> or <code>optimize</code> giving informations about the optimization procedure see <code>optim()</code> or <code>optimize()</code> for further details.
<code>AIC</code>	the akaike information criterion of the model
<code>AIC0</code>	the akaike information criterion of the local model (no landscape variable)
<code>nparam</code>	the number of parameters
<code>pval0</code>	the p.value of the test of the landscape effect (the global effect of all spatial variables). Issued from the likelihood ratio test of the (complete) model vs the local model (complete model without landscape variables).
<code>family</code>	the family distribution for the model
<code>sd.error</code>	the estimated standard error for gaussian family, NA in other case

model.Type	the type of local model: GLM for generalised model, LMM for linear mixed model or GLMM for generalised linear mixed model
rand.StdDev	the estimated standard deviation of random effects for LMM or GLMM
err	the estimated residuals
border	a logical indicating the value used for estimation
wd	a number indicating the size of pixels

### Author(s)

Carpentier, F. and Martin, O.

### References

Carpentier, F., & Martin, O. (2019). SILand: an R package for estimating the spatial influence of landscape. bioRxiv, 692566.

### Examples

```
data(dataSiland)
data(landSiland)
data(resF1)
#resF1 has been pre-computed and is the result from the following command
#resF1=Fsiland(obs~x1+L1+L2,land=landSiland,data=dataSiland,sif="exponential")
resF1
resF1$AIC
```

---

Fsiland.lik

*-(Loglikelihood) as a function of SIF parameters.*

---

### Description

Function investigating eventual optimization problems during numerical optimization of function Fsiland by plotting the  $-(\log\text{likelihood})$  against parameters of Spatial Influence Functions (SIF) of each landscape variable. The parameter of a SIF is defined as the mean distance of SIF.

### Usage

```
Fsiland.lik(res, land,data, varnames = NULL, seqd = seq(2, 2000, length = 10))
```

**Arguments**

res	an object resulting from Fsiland
land	the object of class sf describing the landscape variable, i.e. the land" argument in the call to the Fsiland function that computed res.
data	the dataframe describing response variable and the local variables, i.e. the data argument in the call to the Fsiland function that computed res.
varnames	a vector containing the names (characters) of studied landscape variables. If varnames is NULL (by default), all landscape variables of the res model are considered.
seqd	a vector of SIF parameters (positive values) for which the -loglikelihood is computed.

**Details**

As with all numerical maximisation procedures, optimization problems may arise. The function `Fsiland.lik` allows to point out possible problems of optimization.

`Fsiland.lik` plots the -Loglikelihood against SIF parameters. During the `Fsiland` procedure, the estimation of SIF parameters is made by maximizing the likelihood i.e. by minimizing the -Loglikelihood. The orange horizontal line indicates the minimal value of -Loglikelihood obtained during the estimation (`res` result). The other continuous curves represent the -loglikelihood as a function of SIF parameters for each studied landscape variable (considering the other parameters of the model at their estimated value in `res`). The dotted lines indicate the values of SIF parameter estimated (`res` result).

When the minimization correctly occurs, the minimal values of the -loglikelihoods for each landscape variable are equal to the value of the estimated minimal -Loglikelihood. This means that the value of each continuous curves is minimal at its intersection with the orange horizontal line. This also means that dotted lines intersect their associated continuous lines at their minimum.

If it is not the case, the minimizing procedure has failed and it is necessary to proceed again with an estimation with different initialisation values. This is possible with the argument `init` in function `Fsiland`.

**Value**

a ggplot of the -(loglikelihood) against SIF parameters of each landscape variables.

**Author(s)**

O. Martin and F. Carpentier

**Examples**

```
data(dataSiland)
data(landSiland)
data(resF1)
#resF1 has been pre-computed and is the result from the following command
#resF1=Fsiland(obs~x1+L1+L2,land=landSiland,data=dataSiland,sif="exponential")
```

```

Fsiland.lik(resF1,dataSiland,land=landSiland,varnames=c("L1","L2"),seqd=seq(20,300,length=6))

# Illustration of failed estimation caused by wrong initial
# values (chosen initial values that are deliberately and obviously far too high)
# In a such case, the estimation should be done again ,
# by calling Fsiland with init=c(250,250) for instance.

#resF2=Fsiland(obs~x1+L1+L2,data=dataSiland,land=landSiland,init=c(20000,20000),wd=100)
#Fsiland.lik(resF2,dataSiland,land=landSiland,varnames=c("L1","L2"),seqd=seq(1e9,1e10,length=20))

```

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Fsiland.quantile	<i>Quantile of spatial influence function (SIF)</i>
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### Description

function computing quantiles of SIF, i.e. the radius of disk on which the integrated influence of the SIF is equal to given proportions,  $p$ . Calculations are performed for the estimated SIF of each landscape variable in  $x$ . The **area of medium influence and significant influence of a landscape variable**, that we defined as the disc containing 50% and 95% of the influence of the SIF (neglecting 50% and 5% of its broader effect) respectively can be computed using argument  $p = 0.5$  and  $p = 0.95$ , respectively.

### Usage

```
Fsiland.quantile(x, p = 0.95)
```

### Arguments

$x$	an object of class Fsiland resulting from function Fsiland
$p$	a vector of probabilities

### Value

A matrix of the radii of disks on which the integrated influences of the SIF estimated for each landscape variable of  $x$  (in columns) are equal to each probability of the vector  $p$  (in rows).

### Author(s)

O. Martin and F. Carpentier

**Examples**

```
data(dataSiland)
data(landSiland)
resF=Fsiland(obs~x1+L1+L2,land=landSiland,data=dataSiland,sif="exponential")
Fsiland.quantile(x=resF,p=c(0.5,0.95))
```

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landCmoth	<i>Landscape of dataCmoth observations</i>
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**Description**

This data set contains description of landscape associated to dataCmoth data. 3 Landscape variables are considered conventional orchards, organic orchards and vignards. Anonymized data issued from Ricci et al. (2011) study.

landCmoth is a sf object and gives the positions for three landscape variables: conv, org and vine.

**Usage**

```
data("landCmoth")
```

**Format**

A sf object with 11157 observations of 4 variables :

[,1]	conv	numeric	presence/absence of conventional orchard (0/1)
[,2]	org	numeric	presence/absence of organic orchard (0/1)
[,3]	vine	numeric	presence/absence of vignards (0/1)
[,4]	geometry	sfc_MULTIPOLYGON	location of polygons (anonymized)

**References**

Ricci B., Franck P., Bouvier J.-C., Casado D. and Lavigne C. (2011). Effects of hedgerow characteristics on intra-orchard distribution of larval codling moth. *Agriculture, Ecosystems & Environment*. 140. 395-400. 10.1016/j.agee.2011.01.001.

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landSiland	<i>Simulated landscape.</i>
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**Description**

Simulated landscape associated to dataSiland, containing two landscape variables, named L1 and L2.

**Usage**

```
data("landSiland")
```

**Format**

A sf object with 4884 observations on 3 variables.

[,1]	L1	numeric	presence/absence of L1 (0/1)
[,2]	L2	numeric	presence/absence of L2 (0/1)
[,3]	geometry	sfc_MULTIPOLYGON	polygon location

**Examples**

```
data(landSiland)
plot(landSiland$geometry)
plot(landSiland[landSiland$L1==1,]$geometry,col=2,add=TRUE)
plot(landSiland[landSiland$L2==1,]$geometry,col=3,add=TRUE)
```

---

 landtoraster

*Transformation of an sf object into raster*


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**Description**

Function transforming an object of class sf into raster (points grid) with wd, the pixel size of the raster. landname gives the variable names for which raster points have to be computed.

**Usage**

```
landtoraster(landgis, landname, wd, data = NULL)
```

**Arguments**

landgis	an object of class sf
landname	vector of names of landscape variable for which rasters are computed.
wd	numeric, pixels size of raster
data	a dataframe with X and Y columns, locations.

**Value**

a list of dataframes. The components of the list correspond to variables specified in argument landname. Each dataframe gives the X and Y locations of pixels in raster.

**Author(s)**

O. Martin

**Examples**

```
##---- Should be DIRECTLY executable !! ----
##-- ==> Define data, use random,
##--or do help(data=index) for the standard data sets.

data(dataSiland)
data(landSiland)
head(dataSiland)
head(landSiland)
u1=landtoraster(landSiland,c("L1","L2"),wd=100)
names(u1)
head(u1[[1]])
```

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likresB1	<i>Result for vignette of siland</i>
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**Description**

Precomputed result for vignette of siland

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plotBsiland.land	<i>Map of Bsiland result</i>
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**Description**

Function creating a map of Bsiland result, i.e. buffers estimations for each landscape variable.

**Usage**

```
plotBsiland.land(x, land, data, var = 1,landviz=F )
```

**Arguments**

x	an object resulting from Bsiland
land	the object of class sf describing the landscape variable, i.e. the land argument in the call to the Bsiland function that computed x
data	the dataframe describing response variable and the local variables, i.e. the data argument in the call to the Bsiland function that computed x.
var	a vector containing the numbers (numeric) of the mapped landscape variables.
landviz	If landviz=T (by default), polygons where the variable var is observed are colored in gray.

**Value**

a ggplot of class of the landscape effect estimated in the Bsiland object x i.e. a map of buffers.

**See Also**

Bsiland

**Examples**

```
data(dataSiland)
data(landSiland)
data(resB1)
#resB1 has been pre-computed and is the result from the following command
#resB1=Bsiland(obs~x1+L1+L2,land=landSiland,data=dataSiland)
plotBsiland.land(x=resB1,land=landSiland,data=dataSiland)
plotBsiland.land(x=resB1,land=landSiland,data=dataSiland,var=2)
```

---

plotFsiland

*Plot results from Fsiland function*

---

**Description**

Plot locations of observed data and locations of landscape variables. The black points correspond to the locations of observed data, and the size is proportional to numeric values. The locations of different landscape variables are displayed with small points of different colours. Estimated mean distance of spatial influence for each landscape variable is indicated beside the graphic with a continuous line. Dashed line indicates the radius that gives 95 percent of the total influence of each landscape variable.

**Usage**

```
plotFsiland(res, land, data)
```

**Arguments**

res	an object obtained from the function Fsiland
land	an object of class sf that gives the landscape variables
data	a dataframe with the response variable and the local variables

**Value**

an object of class ggplot



**Examples**

```

data(dataSiland)
data(landSiland)
data(resF1)
#resF1 has been pre-computed and is the result from the following command
#resF1=Fsiland(obs~x1+L1+L2,land=landSiland,data=dataSiland,sif="exponential")

plotFsiland(resF1,landSiland, dataSiland)

```

---

plotFsiland.land      *Map of Fsiland result*

---

**Description**

Function creating a map of Fsiland result, i.e. estimated spatial influence of each landscape variable or for the cumulative effect of all variables.

**Usage**

```
plotFsiland.land(x, land, data, var = 0, lw = 100, xlim=NULL, ylim=NULL,plot=T)
```

**Arguments**

x	an object resulting from Fsiland
land	the object of class sf describing the landscape variable, i.e. the land argument in the call to the Fsiland function that computed x
data	the dataframe describing response variable and the local variables, i.e. the data argument in the call to the Fsiland function that computed x.
var	a vector containing the numbers (numeric) of the mapped landscape variables. If var=0 (by default), the cumulative effect of all landscape variables is represented.
lw	the number of pixels on x-axis and y-axis for the graphical representation. A too high value can lead to memory allocation problems. By default lw=100.
xlim	a length-2 numeric vector, lower and upper limits of x-axis.
ylim	a length-2 numeric vector, lower and upper limits of y-axis.
plot	a logical (TRUE by default). If TRUE, the result is a graphic. If FALSE, the result is a dataframe of the cumulative spatial influence of the landscape variable(s) var.

**Value**

an object of class ggplot

**See Also**

Fsiland

**Examples**

```
data(dataSiland)
data(landSiland)
data(resF1)
#resF1 has been pre-computed and is the result from the following command
#resF1=Fsiland(obs~x1+L1+L2,land=landSiland,data=dataSiland,sif="exponential")
plotFsiland.land(x=resF1,land=landSiland,data=dataSiland,lw=20)
plotFsiland.land(x=resF1,land=landSiland,data=dataSiland,var=1,lw=20)
plotFsiland.land(x=resF1,land=landSiland,data=dataSiland,var=2,lw=20)
```

---

plotFsiland.sif      *Plot the estimated spatial influence functions.*

---

**Description**

Graphic representations for the different influence functions estimated with the function Fsiland().

**Usage**

```
plotFsiland.sif(x)
```

**Arguments**

x                      an object obtained with function Fsiland().

**Value**

no value is returned

**See Also**

Fsiland

**Examples**

```
data(dataSiland)
data(landSiland)
data(resF1)
#resF1 has been pre-computed and is the result for the following command
#resF1=Fsiland(obs~x1+L1+L2,land=landSiland,data=dataSiland,sif="exponential")
```

```
plotFsiland.sif(x=resF1)
```

---

```
print.Bsiland      Bsiland print
```

---

**Description**

function printing an object of class Bsiland. It returns the model used and the estimated parameters.

**Usage**

```
## S3 method for class 'Bsiland'
print(x,...)
```

**Arguments**

```
x          an object of class Bsiland.
...       not take into account in this version
```

---

```
print.Fsiland      Fsiland print
```

---

**Description**

function printing an object of class Bsiland. It returns the model used and the estimated parameters.

**Usage**

```
## S3 method for class 'Fsiland'
print(x,...)
```

**Arguments**

```
x          an object of class Fsiland
...       not take into account in this version
```

---

```
resB1          Result for vignette of siland
```

---

**Description**

Precomputed result for vignette of siland

---

resB2                      *Result for vignette of siland*

---

**Description**

Precomputed result for vignette of siland

---

resB3                      *Result for vignette of siland*

---

**Description**

Precomputed result for vignette of siland

---

resF1                      *Result for vignette of siland*

---

**Description**

Precomputed result for vignette of siland

---

resF3                      *Result for vignette of siland*

---

**Description**

Precomputed result for vignette of siland

---

resF4                      *Result for vignette of siland*

---

**Description**

Precomputed result for vignette of siland

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resF5.1	<i>Result for vignette of siland</i>
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**Description**

Precomputed result for vignette of siland

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resF5.2	<i>Result for vignette of siland</i>
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**Description**

Precomputed result for vignette of siland

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residuals.Bsiland	<i>Extract Bsiland Residuals</i>
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---

**Description**

Function extracting residuals for an estimated Bsiland model.

**Usage**

```
## S3 method for class 'Bsiland'
residuals(object,...)
```

**Arguments**

object	an object of class Bsiland
...	Dots are not take into account in this version

---

residuals.Fsiland	<i>Extract Fsiland Residuals</i>
-------------------	----------------------------------

---

**Description**

Function extracting residuals for an estimated Bsiland model.

**Usage**

```
## S3 method for class 'Fsiland'
residuals(object,...)
```

**Arguments**

object	an object of class Fsiland
...	Dots are not take into account in this version

---

resY	<i>Result for vignette of siland</i>
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---

**Description**

Precomputed result for vignette of siland

---

summary.Bsiland	<i>The function gives a summary of an object of class Bsiland</i>
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---

**Description**

The function gives a detailed summary of an object of class Fsiland. It gives results as the summary for an object of type glm or lm.

**Usage**

```
## S3 method for class 'Bsiland'
summary(object,...)
```

**Arguments**

object	an object of type Bsiland
...	Dots are not take into account in this version

---

summary.Fsiland	<i>The function gives a summary of an object of class Fsiland</i>
-----------------	---

---

**Description**

The function gives a detailed summary of an object of class Fsiland. It gives results as the summary for an object of type glm or lm.

**Usage**

```
## S3 method for class 'Fsiland'  
summary(object,...)
```

**Arguments**

object	an object of type Fsiland
...	Dots are not take into account in this version

# Index

## \*Topic **datasets**

- dataCmoth, [13](#)
- dataSiland, [13](#)
- landCmoth, [21](#)
- landSiland, [21](#)

## \*Topic **package**

- siland-package, [2](#)

AIC.Bsiland, [5](#)

AIC.Fsiland, [6](#)

BIC.Bsiland, [7](#)

BIC.Fsiland, [7](#)

Bsiland, [8](#)

Bsiland.lik, [10](#)

bufferforsiland, [12](#)

dataCmoth, [13](#)

dataSiland, [13](#)

fitted.Bsiland, [14](#)

fitted.Fsiland, [15](#)

Fsiland, [15](#)

Fsiland.lik, [18](#)

Fsiland.quantile, [20](#)

landCmoth, [21](#)

landSiland, [21](#)

landtoraster, [22](#)

likresB1, [23](#)

plotBsiland.land, [23](#)

plotFsiland, [24](#)

plotFsiland.land, [25](#)

plotFsiland.sif, [26](#)

print.Bsiland, [27](#)

print.Fsiland, [27](#)

resB1, [27](#)

resB2, [28](#)

resB3, [28](#)

resF1, [28](#)

resF3, [28](#)

resF4, [28](#)

resF5.1, [29](#)

resF5.2, [29](#)

residuals.Bsiland, [29](#)

residuals.Fsiland, [30](#)

resY, [30](#)

siland-package, [2](#)

summary.Bsiland, [30](#)

summary.Fsiland, [31](#)