

# Package ‘spacetime’

April 5, 2023

**Version** 1.3-0

**Title** Classes and Methods for Spatio-Temporal Data

**Depends** R (>= 3.0.0)

**Imports** graphics, utils, stats, methods, lattice, sp (>= 1.1-0), zoo (>= 1.7-9), xts (>= 0.8-8), intervals

**Suggests** adehabitatLT, cshapes (>= 2.0), foreign, gstat (>= 1.0-16), maps, mapdata, plm, raster, RColorBrewer, rmarkdown, RPostgreSQL, knitr, googleVis, ISOcodes, markdown, sf, sftime

**LazyData** no

**Description** Classes and methods for spatio-temporal data, including space-time regular lattices, sparse lattices, irregular data, and trajectories; utility functions for plotting data as map sequences (lattice or animation) or multiple time series; methods for spatial and temporal selection and subsetting, as well as for spatial/temporal/spatio-temporal matching or aggregation, retrieving coordinates, print, summary, etc.

**License** GPL (>= 2)

**URL** <https://github.com/edzer/spacetime>

**BugReports** <https://github.com/edzer/spacetime/issues>

**Encoding** UTF-8

**VignetteBuilder** knitr

**Collate** Class-xts.R Class-ST.R Class-STFDF.R Class-STSDF.R  
Class-STIDF.R Class-STTDF.R interval.R endtime.R ST-methods.R  
STFDF-methods.R STSDF-methods.R STIDF-methods.R STTDF-methods.R  
apply.R coerce.R stconstruct.R plot.R stplot.R timematch.R  
over.R aggregate.R eof.R mnf.R bind.R na.R raster.R tgrass.R  
stinteraction.R

**NeedsCompilation** no

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---

air	<i>Air quality data, rural background PM10 in Germany, daily averages 1998-2009</i>
-----	---

---

### Description

Air quality data obtained from the airBase European air quality data base. Daily averages for rural background stations in Germany, 1998-2009. In addition, NUTS1 regions (states, or Bundeslaender) for Germany to illustrate spatial aggregation over irregular regions.

### Usage

```
data(air)
```

### Note

see vignette on overlay and spatio-temporal aggregation in this package; the vignette on using google charts shows where the ISO\_3166\_2\_DE table comes from.

**Author(s)**

air quality data compiled for R by Benedict Graeler; NUTS1 level data obtained from <https://www.gadm.org/>

**References**

<https://www.eionet.europa.eu/etcs/etc-acm/databases/airbase>

**Examples**

```
data(air)
rural = STFDF(stations, dates, data.frame(PM10 = as.vector(air)))
# how DE was created from DE_NUTS1:
#if (require(rgeos))
# DE = gUnionCascaded(DE_NUTS1)
#
```

---

delta

*find default time interval end points when intervals are regular*

---

**Description**

find default time interval end points when intervals are regular

**Usage**

```
delta(x)
```

**Arguments**

x                    object of class `xts`, or of another class that can be coerced into `POSIXct`;

**Details**

to find the interval size for the last observation (which has no next observation), `x` needs to be at least of length 2.

**Value**

sequence of `POSIXct` time stamps, indicating the end of the time interval, given by the next observation in `x`. The last interval gets the same width of the one-but-last interval.

**Author(s)**

Edzer Pebesma

## References

<https://www.jstatsoft.org/v51/i07/>

## Examples

```
x = as.POSIXct("2000-01-01") + (0:9) * 3600
delta(x)
```

---

EOF

*Compute spatial or temporal empirical orthogonal function (EOF)*

---

## Description

Compute spatial or temporal empirical orthogonal function (EOF)

## Usage

```
eof(x, how = c("spatial", "temporal"), returnEOFs = TRUE, ...)
EOF(x, how = c("spatial", "temporal"), returnPredictions = TRUE, ...)
```

## Arguments

<code>x</code>	object of class STDFD
<code>how</code>	character; choose "spatial" or "temporal" mode
<code>returnEOFs</code>	logical; if TRUE, the eigenvectors (EOFs) are returned in the form of a <a href="#">Spatial</a> or <a href="#">xts</a> object; if FALSE, the object returned by <a href="#">prcomp</a> is returned, which can be printed, or from which a summary can be computed; see examples.
<code>returnPredictions</code>	logical; if TRUE, the functions are returned (i.e., predicted principle components, or PC scores); if FALSE, the object returned by <a href="#">prcomp</a> is returned, which can be printed, or from which a summary can be computed; see examples (deprecated, see below).
<code>...</code>	arguments passed on to function <a href="#">prcomp</a> ; note that <code>scale.=TRUE</code> needs to be specified to obtain EOFs based on correlation (default: covariance)

## Value

In spatial mode, the appropriate `Spatial*` object. In temporal mode, an object of class `xts`.

## Note

EOF is deprecated: it mixes up spatial and temporal EOFs, and returns projections (PC scores) instead of EOFs (eigenvectors); to compute EOFs, use `eof`.

**Examples**

```

if (require(gstat)) {
  data(wind)
  library(sp)
  wind.loc$y = as.numeric(char2dms(as.character(wind.loc[["Latitude"]])))
  wind.loc$x = as.numeric(char2dms(as.character(wind.loc[["Longitude"]])))
  coordinates(wind.loc) = ~x+y
  proj4string(wind.loc) = "+proj=longlat +datum=WGS84"

  # match station order to names in wide table:
  stations = 4:15
  wind.loc = wind.loc[match(names(wind[stations]), wind.loc$Code),]
  row.names(wind.loc) = wind.loc$Station
  wind$time = ISOdate(wind$year+1900, wind$month, wind$day, 0)
  space = list(values = names(wind)[stations])
  wind.st = stConstruct(wind[stations], space, wind$time, SpatialObj = wind.loc)
  # select first 500 time steps, to limit run time:
  wind.st = wind.st[,1:500]
  wind.eof.1 = eof(wind.st)
  wind.eof.2 = eof(wind.st, "temporal")
  wind.eof.1.PCs = eof(wind.st, returnEOFs = FALSE)
  eof(wind.st, "temporal", returnEOFs = FALSE)
  summary(eof(wind.st, returnEOFs = FALSE))
  summary(eof(wind.st, "temporal", returnEOFs = FALSE))
  plot(eof(wind.st, "temporal", returnEOFs = FALSE))
}

```

---

 fires

*Northern Los Angeles County Fires*


---

**Description**

Wildfire occurrences in Northern Los Angeles County, California between 1976 and 2000. The spatial units are in scaled feet, taken from the NAD 83 state-plane coordinate system. One unit is equivalent to 100,000 feet or 18.9 miles. The times for the points were produced by the date package and represent the number of days since January 1, 1960.

**Usage**

```
data(fires)
```

**Format**

A data frame with 313 observations with day of occurrence, x and y coordinates.

**Author(s)**

Roger Peng, taken from (non-CRAN) package ptproc,  
<https://www.biostat.jhsph.edu/~rpeng/software/index.html>;  
 example code by Roger Bivand.

**Examples**

```
data(fires)
fires$X <- fires$X*100000
fires$Y <- fires$Y*100000
library(sp)
coordinates(fires) <- c("X", "Y")
proj4string(fires) <- CRS("+init=epsg:2229 +ellps=GRS80")
dates <- as.Date("1960-01-01")+(fires$Time-1)
Fires <- STIDF(as(fires, "SpatialPoints"), dates, data.frame(time=fires$Time))
library(mapdata)
if (require(sf)) {
  m <- map("county", "california", xlim=c(-119.1, -117.5),
          ylim=c(33.7, 35.0), plot=FALSE, fill=TRUE)
  m.sf <- st_transform(st_as_sf(m), "EPSG:2229")
  cc <- as(m.sf, "Spatial")
  plot(cc, xlim=c(6300000, 6670000), ylim=c(1740000, 2120000))
  plot(slot(Fires, "sp"), pch=3, add=TRUE)
  stplot(Fires, sp.layout=list("sp.lines", cc))
}
```

mnf

*Generic mnf method***Description**

Compute mnf from spatial, temporal, or spatio-temporal data

**Usage**

```
mnf(x, ...)
## S3 method for class 'matrix'
mnf(x, ..., Sigma.Noise, use = "complete.obs")
## S3 method for class 'mts'
mnf(x, ..., use = "complete.obs")
## S3 method for class 'zoo'
mnf(x, ..., use = "complete.obs")
## S3 method for class 'SpatialPixelsDataFrame'
mnf(x, ..., use = "complete.obs")
## S3 method for class 'SpatialGridDataFrame'
mnf(x, ..., Sigma.Noise, use = "complete.obs")
## S3 method for class 'RasterStack'
```

```

mnf(x, ..., use = "complete.obs")
## S3 method for class 'RasterBrick'
mnf(x, ..., use = "complete.obs")
## S3 method for class 'STSDf'
mnf(x, ..., use = "complete.obs", mode = "temporal")
## S3 method for class 'STFDF'
mnf(x, ..., use = "complete.obs", mode = "temporal")

```

### Arguments

x	object for which an mnf method is available
...	ignored
Sigma.Noise	Noise covariance matrix; when missing, estimated from the data by using the covariance of lag-one spatial or temporal differences (MAF)
use	method to deal with missing values when computing covariances; see <a href="#">cov</a>
mode	for ST objects: if "temporal", compute covariances in time dimension, if "spatial", compute them in spatial dimension.

### Details

Uses MAF (Min/max Autocorrelation Factors) to estimate the noise covariance. This implementation estimates the noise covariance by  $0.5\text{Cov}(Z(s) - Z(s + \Delta))$ , so that eigenvalues can be directly interpreted as approximate estimates of the noise covariance.

### Value

object of class `(c("mnf", "prcomp"))`; see [prcomp](#). Additional elements are values, containing the eigenvalues.

### See Also

<https://r-spatial.org/r/2016/03/09/MNF-PCA-EOF.html>

### Examples

```

# temporal data:
set.seed(13531) # make reproducible
s1 = arima.sim(list(ma = rep(1,20)), 500)
s2 = arima.sim(list(ma = rep(1,20)), 500)
s3 = arima.sim(list(ma = rep(1,20)), 500)
s3 = s3 + rnorm(500, sd = 10)
d = cbind(s1,s2,s3)
plot(d)
m = mnf(d)
m
summary(m)
plot(predict(m))

# spatial example:
## Not run:

```

```

library(sp)
grd = SpatialPoints(expand.grid(x=1:100, y=1:100))
gridded(grd) = TRUE
fullgrid(grd) = TRUE
pts = spsample(grd, 50, "random")
pts$z = rnorm(50)
library(gstat)
v = vgm(1, "Sph", 90)
out = krige(z~1, pts, grd, v, nmax = 20, nsim = 4)
out[[3]] = 0.5 * out[[3]] + 0.5 * rnorm(1e4)
out[[4]] = rnorm(1e4)
splot(out, as.table = TRUE)
m = mnf(out)
m
summary(m)

## End(Not run)
if (require(gstat)) {
  data(wind)
  library(sp)
  wind.loc$y = as.numeric(char2dms(as.character(wind.loc[["Latitude"]])))
  wind.loc$x = as.numeric(char2dms(as.character(wind.loc[["Longitude"]])))
  coordinates(wind.loc) = ~x+y
  proj4string(wind.loc) = "+proj=longlat +datum=WGS84"

  # match station order to names in wide table:
  stations = 4:15
  wind.loc = wind.loc[match(names(wind[stations]), wind.loc$Code),]
  row.names(wind.loc) = wind.loc$Station
  wind$time = ISOdate(wind$year+1900, wind$month, wind$day, 0)
  space = list(values = names(wind)[stations])
  wind.st = stConstruct(wind[stations], space, wind$time, SpatialObj = wind.loc, interval = TRUE)
  m = mnf(wind.st)
  m
  plot(m)
  stplot(predict(m), mode = "tp")
}

```

---

na.locf

*replace NA attribute values; disaggregation time series*


---

### Description

replace NA attribute values in time series, using last or next observation, or using (temporal) interpolation, and disaggregation

### Usage



```
## S3 method for class 'STFDF'
na.locf(object, na.rm = FALSE, ...)
## S3 method for class 'STFDF'
na.approx(object, x = time(object), xout, ..., na.rm = TRUE)
## S3 method for class 'STFDF'
na.spline(object, x = time(object), xout, ..., na.rm = TRUE)
```

## Arguments

object	object of class STFDF, with potentially NA values
na.rm	logical; need non-replaced NA values be removed?
x	times at which observations are taken; should not be modified
xout	if present, new times at which the time series should be approximated (disaggregated)
...	passed on to underlying zoo functions; see details

## Details

details are found in [na.locf](#), [na.approx](#), [na.spline](#).

## Value

object of class STFDF, with NA values replaced.

## Author(s)

Edzer Pebesma

## References

<https://www.jstatsoft.org/v51/i07/>

## Examples

```
# toy example:
library(sp)
pts = SpatialPoints(cbind(c(0,1),c(0,1)))
Sys.setenv(TZ="GMT")
tm = seq(as.POSIXct("2012-11-25"), as.POSIXct("2012-11-30"), "1 day")
df = data.frame(a = c(NA,NA,2,3,NA,NA,NA,2,NA,NA,4,NA), b = c(NA,2,3,4,5,1,2,NA,NA,NA,NA,3))
x = STFDF(pts, tm, df)
as(x, "xts")
as(na.locf(x), "xts")
as(na.locf(x, fromLast = TRUE), "xts")
as(na.locf(na.locf(x), fromLast = TRUE), "xts")
# drops first record:
as(na.approx(x[,1]), "xts")
# keep it:
cbind(as(na.approx(x[,1], na.rm=FALSE), "xts"),
as(na.approx(x[,2]), "xts"))
```

```

cbind(as(na.spline(x[,1]), "xts"),
as(na.spline(x[,2]), "xts"))
#disaggregate:
xout = seq(start(x), end(x), "6 hours")
as(na.approx(x[,1], xout = xout), "xts")
as(na.spline(x[,1], xout = xout), "xts")
as(na.spline(x[,2], xout = xout), "xts")

# larger/real data:
data(air)
rural = STFDF(stations, dates, data.frame(PM10 = as.vector(air)))
# fill NA's with last non-NA
r = na.locf(rural)
# sample (NOT aggregate) to monthly:
m = seq(start(rural), end(rural), "1 month")
stplot(na.approx(rural[1:20,"2003::2005"], xout = m), mode = 'ts')

```

---

nbMult

*convert a spatial nb object to a matching STF object*


---

## Description

convert a spatial nb object to a matching STF object

## Usage

```
nbMult(nb, st, addT = TRUE, addST = FALSE)
```

## Arguments

nb	object of class nb (see package spdep), which is valid for the spatial slot of object st: length(nb) should equal length(st@sp)
st	object of class STF
addT	logical; should temporal neighbours be added?
addST	logical; should spatio-temporal neighbours be added?

## Details

if both addT and addST are false, only spatial neighbours are added for each time replicate.

details are found in

Giovana M. de Espindola, Edzer Pebesma, Gilberto Câmara, 2011. Spatio-temporal regression models for deforestation in the Brazilian Amazon. STDM 2011, The International Symposium on Spatial-Temporal Analysis and Data Mining, University College London - 18th-20th July 2011.

## Value

object of class nb

**Author(s)**

Edzer Pebesma

over-methods

*consistent spatio-temporal overlay for objects inheriting from ST***Description**

consistent spatio-temporal overlay for STF, STS and STI objects, as well as their \*DF counterpart: retrieves the indexes or attributes from one geometry at the spatio-temporal points of another

**Usage**

```
## S4 method for signature 'STF,STF'
over(x, y, returnList = FALSE, fn = NULL, ...)
## S4 method for signature 'xts,xts'
over(x, y, returnList = FALSE, fn = NULL, ...)
## S4 method for signature 'ST'
aggregate(x, by, FUN, ..., simplify = TRUE)
```

**Arguments**

x	geometry (S/T locations) of the queries
y	layer from which the geometries or attributes are queried
returnList	logical; determines whether a list is returned, or an index vector
fn	(optional) a function; see value
by	geometry over which attributes in x are aggregated (this can be a Spatial* geometry, or a ST* geometry), or temporal aggregation, such as "month", "10 minutes", or a function such as <a href="#">as.yearmon</a> ; see <a href="#">aggregate.zoo</a> . In case x is of class <a href="#">STFDF</a> , argument by may be "time" or "space", in which cases aggregation over all time or all space is carried out.
FUN	aggregation function
simplify	boolean; if TRUE, and space or time dimensions can be dropped, the simpler (Spatial or xts) object will be returned
...	arguments passed on to function fn or FUN

**Value**

an object of length `length(x)`, or a data.frame with number of rows equal to `length(x)`. If `returnList` is FALSE, a vector with indices of y for each geometry (point, grid cell centre, polygon or lines x time point) in x. if `returnList` is TRUE, a list of length `length(x)`, with list element i the vector of indices of the geometries in y that correspond to the *i*-th geometry in x.

The aggregate method for ST objects aggregates the attribute values of x over the geometry (space, time, or space-time) of by, using aggregation function FUN.

For the matching of time intervals, see [timeMatch](#).

For setting, or retrieving whether time represents intervals, see [timeIsInterval](#).

**Methods**

`x = "STF", y = "STF"`

`x = "xts", y = "xts"` finds the row index of the instance or interval of time instances of `x` matching to `y`. Only if `timeIsInterval(x) == TRUE`, intervals are sought. In that case, time intervals start at the time instance of a record, and end at the next. The last time interval length is set to the interval length of the one-but-last (non-zero) interval. In case of a single time instance for `y`, its interval is right-open.

**Note**

See also [over](#); methods intersecting `SpatialLines` with anything else, or `SpatialPolygons` with `SpatialPolygons`, need `rgeos` to be loaded first.

**Author(s)**

Edzer Pebesma, <edzer.pebesma@uni-muenster.de>

**References**

<https://www.jstatsoft.org/article/view/v051i07>

**See Also**

[over](#); [vignette\('sto'\)](#), [vignette\('over'\)](#), [timeMatch](#), [timeIsInterval](#)

---

read.tgrass

*read or write tgrass (time-enabled grass) files*

---

**Description**

read or write tgrass (time-enabled grass) files

**Usage**

```
read.tgrass(fname, localName = TRUE, useTempDir = TRUE, isGeoTiff = TRUE)
write.tgrass(obj, fname, ...)
```

**Arguments**

<code>fname</code>	file name to read from, or write to
<code>localName</code>	logical; if TRUE, <code>fname</code> is a local file, else it is the full path name to the file
<code>useTempDir</code>	logical: use a temporary directory for extraction?
<code>isGeoTiff</code>	logical: are the files in the tar.gz file GeoTIFFs?
<code>obj</code>	object to export, of class <code>STFDF</code> or <code>RasterStack</code>
<code>...</code>	arguments passed on to <a href="#">writeRaster</a>

**Details**

The tgrass format is a gzip'ed tar file (.tar.gz) that has geotiff files (with suffix .tif), and three files (list.txt, proj.txt and init.txt) describing the file names and time slices, coordinate reference system, and dimensions

**Value**

read.tgrass returns an object of class RasterStack, writetgrass returns nothing

**Author(s)**

Edzer Pebesma; time-enabled grass by Soeren Gebbert

**References**

<https://dx.doi.org/10.1016/j.envsoft.2013.11.001>

**Examples**

```
## Not run:
library(spacetime)
r = read.tgrass("precipitation_1950_2011_yearly.tar.gz", useTempDir = FALSE)
write.tgrass(r, "myfile.tar.gz")

## End(Not run)
```

---

ST-class

*Class "ST"*

---

**Description**

An abstract class from which useful spatio-temporal classes are derived

**Usage**

```
ST(sp, time, endTime)
```

**Arguments**

sp	an object deriving from class <a href="#">Spatial</a> , such as a <a href="#">SpatialPoints</a> or <a href="#">SpatialPolygons</a>
time	an object of class xts, or a time vector (currently: Date, POSIXct, timeDate, yearmon and yearqtr; are supported; see <a href="#">xts</a> ); in the latter case, it should be in time order
endTime	vector of class POSIXct holding end points of time intervals

**Objects from the Class**

Objects of this class are not meant to be useful; only derived classes can be meaningful

**Slots**

sp: Object deriving from class "Spatial"

time: Object of class "xts"

**Methods**

`[[ signature(obj = "ST")`: retrieves the attribute element

`$ signature(obj = "ST")`: retrieves the attribute element

`[[<- signature(obj = "ST")`: sets or replaces the attribute element

`$<- signature(obj = "ST")`: sets or replaces the attribute element

**Note**

argument (and object slot) sp can be pure geometry, or geometry with attributes. In the latter case, the geometries are kept with the sp slot, and only replicated (when needed) on coercion to the long format, with `as.data.frame`.

Slot time needs to be of class xts; if a time or date vector is passed as argument to SP, it will be converted into an xts object.

When endTime is missing, an error is thrown.

ST is meant as a super-class, and is not to be used for representing data, similar to Spatial in the sp package.

**Author(s)**

Edzer Pebesma, <edzer.pebesma@uni-muenster.de>

**References**

<https://www.jstatsoft.org/v51/i07/>

**Examples**

```
time = as.Date('2008-01-01')+1:2
library(sp)
sp = SpatialPoints(cbind(c(0,1),c(0,1)))
ST(sp, time, delta(time))
```

---

stbox	<i>obtain ranges of space and time coordinates</i>
-------	--

---

**Description**

obtain ranges of space and time coordinates

**Usage**

```
stbox(obj)
bbox(obj)
```

**Arguments**

obj                    object of a class deriving from ST

**Value**

stbox returns a `data.frame`, with three columns representing x-, y- and time-coordinates, and two rows containing min and max values. `bbox` gives a matrix with coordinate min/max values, compatible to [bbox](#)

**Methods**

**stbox** signature(x = "ST"): obtain st range from object

---

stConstruct	<i>create ST* objects from long or wide tables</i>
-------------	--

---

**Description**

create ST\* objects from long or wide tables

**Usage**

```
stConstruct(x, space, time, SpatialObj = NULL, TimeObj = NULL,
  crs = CRS(as.character(NA)), interval, endTime)
```

**Arguments**

x	object of class <code>matrix</code> or <code>data.frame</code> , holding the long, space-wide or time-wide table; see details.
space	in case x is a long table, character or integer holding the column index in x where the spatial coordinates are (if <code>length(space)==2</code> ) or where the ID of the spatial location is (if <code>length(space)==1</code> ). If x is a space-wide table, a list with each (named) list element a set of columns that together form a variable
time	in case x is a long table, character or integer indicating the column in x with times;
SpatialObj	object of class <a href="#">Spatial-class</a> , containing the locations of a time-wide table, or the locations of a long table
TimeObj	in case of space-wide table, object of class <code>xts</code> , containing the times for each of the columns in a list element of space
crs	object of class <a href="#">CRS-class</a> ; only used when coordinates are in x and no CRS can be taken from <code>SpatialObj</code>
interval	logical; specifies whether time should reflect time instance ( <code>FALSE</code> ) or time intervals ( <code>TRUE</code> ). If omitted, defaults values depend on the class
endTime	vector of <code>POSIXct</code> , specifying (if present) the end points of observation time intervals

**Details**

For examples, see below.

A long table is a `data.frame` with each row holding a single observation in space-time, and particular columns in this table indicate the space (location or location ID) and time.

A space-wide table is a table in which different columns refer to different locations, and each row reflects a particular observation time.

A time-wide table is a table where different times of a particular characteristic are represented as different columns; rows in the table represent particular locations or location IDs.

**Value**

Depending on the arguments, an object of class `STIDF` or `STDFD`.

**References**

<https://www.jstatsoft.org/v51/i07/>

**Examples**

```
# stConstruct multivariable, time-wide
if (require(maps) && require(plm) && require(sf)) {
  library(sp)

  states.m <- map('state', plot=FALSE, fill=TRUE)
  IDs <- sapply(strsplit(states.m$names, ":"), function(x) x[1])
}
```



```

sf = st_as_sf(states.m, IDs=IDs)
row.names(sf) = sf$ID # not needed if sf >= 1.0-13
states <- as(sf, "Spatial")
states=geometry(states)

yrs = 1970:1986
time = as.POSIXct(paste(yrs, "-01-01", sep=""), tz = "GMT")
data("Produc")
# deselect District of Columbia, polygon 8, which is not present in Produc:
Produc.st <- STDF(states[-8], time, Produc[order(Produc[,2], Produc[,1]),])
# stplot(Produc.st[,,"unemp"], yrs, col.regions = brewer.pal(9, "YlOrRd"),cuts=9)

# example 1: st from long table, with states as Spatial object:
# use Date format for time:
Produc$time = as.Date(paste(yrs, "01", "01", sep = "-"))
# take centroids of states:
xy = coordinates(states[-8])
Produc$x = xy[,1]
Produc$y = xy[,2]
#using stConstruct, use polygon centroids for location:
x = stConstruct(Produc, c("x", "y"), "time", interval = TRUE)
class(x)
stplot(x[,,"unemp"])

# alternatively, pass states as SpatialObj:
Produc$state = gsub("TENNESSE", "TENNESSEE", Produc$state)
Produc$State = gsub("_", " ", tolower(Produc$state))
x = stConstruct(Produc, "State", "time", states)
class(x)
all.equal(x, Produc.st, check.attributes = FALSE)
}

if (require(sf)) {
fname = system.file("shape/nc.shp", package="sf")[1]
nc = as(st_read(fname), "Spatial")
timesList = list(
BIR=c("BIR74", "BIR79"), # sets of variables that belong together
NWBIR=c("NWBIR74", "NWBIR79"), # only separated by space
SID=c("SID74", "SID79")
)
t = as.Date(c("1974-01-01", "1979-01-01"))
nc.st = stConstruct(as(nc, "data.frame"), geometry(nc), timesList,
TimeObj = t, interval = TRUE)
}
# stConstruct multivariable, space-wide
if (require(gstat)) {
data(wind)
wind.loc$y = as.numeric(char2dms(as.character(wind.loc[["Latitude"]]))))
wind.loc$x = as.numeric(char2dms(as.character(wind.loc[["Longitude"]]))))
coordinates(wind.loc) = ~x+y
proj4string(wind.loc) = "+proj=longlat +datum=WGS84"
}

```

```

# match station order to names in wide table:
stations = 4:15
wind.loc = wind.loc[match(names(wind[stations]), wind.loc$Code),]
row.names(wind.loc) = wind.loc$Station
# convert to utm zone 29, to be able to do interpolation in
# proper Euclidian (projected) space:

# create time variable
wind$time = ISOdate(wind$year+1900, wind$month, wind$day, 0)

w = STFDF(wind.loc, wind$time,
data.frame(values = as.vector(t(wind[stations]))))
space = list(values = names(wind)[stations])
wind.st = stConstruct(wind[stations], space, wind$time, SpatialObj = wind.loc, interval = TRUE)
all.equal(w, wind.st)
class(wind.st)
}

```

---

STFDF-class

*Class "STFDF"*


---

### Description

A class for spatio-temporal data with full space-time grid; for  $n$  spatial locations and  $m$  times,  $n \times m$  observations are available

### Usage

```

STF(sp, time, endTime = delta(time))
STFDF(sp, time, data, endTime = delta(time))
## S4 method for signature 'STFDF'
x[i, j, ..., drop = is(x, "STFDF")]
## S4 method for signature 'STFDF,xts'
coerce(from, to, strict=TRUE)
## S4 method for signature 'STFDF,Spatial'
coerce(from, to)

```

### Arguments

sp	object of class <a href="#">Spatial</a> , having $n$ elements
time	object holding time information, of length $m$ ; see <a href="#">ST</a> for details
endTime	vector of class <code>POSIXct</code> , holding end points of time intervals; by default, time intervals equal the time step width, see <a href="#">delta</a>
data	data frame with $n \times m$ rows corresponding to the observations (spatial index moving fastest)
x	an object of class <code>STFDF</code>
i	selection of spatial entities

<code>j</code>	selection of temporal entities (see syntax in package <code>xts</code> )
<code>...</code>	selection of attribute(s)
<code>drop</code>	if TRUE and a single spatial entity is selected, an object of class <code>xts</code> is returned; if TRUE and a single temporal entity is selected, and object of the appropriate <code>Spatial</code> class is returned; if FALSE, no coercion to reduced classes takes place
<code>from</code>	object of class STFDF
<code>to</code>	target class
<code>strict</code>	ignored

**Value**

the `as.data.frame` coercion returns the full long table, with purely spatial attributes and purely time attributes replicated appropriately.

**Objects from the Class**

Objects of this class represent full space/time data with a full grid (or lattice) layout

**Slots**

`sp`: spatial object; see [ST-class](#)

`time`: temporal object; see [ST-class](#)

`data`: Object of class `data.frame`, which holds the measured values; space index cycling first, time order preserved

**Methods**

[ `signature(x = "STFDF")`]: selects spatial entities, temporal entities, and attributes

**coerce** STFDF,xts

**coerce** STFDF,Spatial(from) coerces to (wide form) `SpatialXxDataFrame`, where `SpatialXx` is the spatial class of `from@sp`

**plot** `signature(x = "STF", y = "missing")`: plots space-time layout

**plot** `signature(x = "STFDF", y = "missing")`: plots space-time layout, indicating full missing valued records

**Author(s)**

Edzer Pebesma, <edzer.pebesma@uni-muenster.de>

**References**

<https://www.jstatsoft.org/v51/i07/>

**Examples**

```

sp = cbind(x = c(0,0,1), y = c(0,1,1))
row.names(sp) = paste("point", 1:nrow(sp), sep="")
library(sp)
sp = SpatialPoints(sp)
time = as.POSIXct("2010-08-05")+3600*(10:13)
m = c(10,20,30) # means for each of the 3 point locations
mydata = rnorm(length(sp)*length(time),mean=rep(m, 4))
IDs = paste("ID",1:length(mydata))
mydata = data.frame(values = signif(mydata,3), ID=IDs)
stfdf = STIDF(sp, time, mydata)
stfdf
stfdf[1:2,]
stfdf[,1:2]
stfdf[,2]
stfdf[,,"values"]
stfdf[1,]
stfdf[,2]
as(stfdf[,1], "xts")
as(stfdf[,2], "xts")
# examples for [[, [[<-, $ and $<-
stfdf[[1]]
stfdf[["values"]]
stfdf[["newVal"]] <- rnorm(12)
stfdf$ID
stfdf$ID = paste("OldIDs", 1:12, sep="")
stfdf$NewID = paste("NewIDs", 12:1, sep="")
stfdf
x = stfdf[stfdf[1:2,],]
all.equal(x, stfdf[1:2,])
all.equal(stfdf, stfdf[stfdf,]) # converts character to factor...

```

---

STIDF-class

*Class "STIDF"*


---

**Description**

A class for unstructured spatio-temporal data; for  $n$  spatial locations and times,  $n$  observations are available

**Usage**

```

STI(sp, time, endTime)
STIDF(sp, time, data, endTime)
## S4 method for signature 'STIDF'
x[i, j, ..., drop = FALSE]
## S4 method for signature 'STIDF,STSDF'
coerce(from, to, strict=TRUE)

```

**Arguments**

sp	object of class <a href="#">Spatial</a>
time	object holding time information; when STIDF is called, a non-ordered vector with times, e.g. <a href="#">POSIXct</a> will also work, and rearrange the sp and data slots according to the ordering of time; for this to work no ties should exist.
endTime	vector of class <a href="#">POSIXct</a> , indicating the end points of time intervals for the observations. By default, for STI objects time is taken, indicating that time intervals have zero width (time instances)
data	data frame with appropriate number of rows
x	an object of class <a href="#">STFDF</a>
i	selection of record index (spatial/temporal/spatio-temporal entities)
j	or character string with temporal selection
...	first element is taken as column (variable) selector
drop	if TRUE and a single spatial entity is selected, an object of class <a href="#">xts</a> is returned (NOT yet implemented); if TRUE and a single temporal entity is selected, and object of the appropriate <a href="#">Spatial</a> class is returned; if FALSE, no coercion to reduced classes takes place
from	object of class <a href="#">STFDF</a>
to	target class
strict	ignored

**Objects from the Class**

Objects of this class carry full space/time grid data

**Slots**

sp: Object of class "Spatial"  
time: Object holding time information, see [ST-class](#)  
data: Object of class `data.frame`, which holds the measured values

**Methods**

[ `signature(x = "STIDF")`]: selects spatial-temporal entities, and attributes

**Note**

arguments sp, time and data need to have the same number of records, and regardless of the class of time ([xts](#) or [POSIXct](#)) have to be in corresponding order: the triple `sp[i]`, `time[i]` and `data[i, ]` refer to the same observation

**Author(s)**

Edzer Pebesma, <edzer.pebesma@uni-muenster.de>

## References

<https://www.jstatsoft.org/v51/i07/>

## Examples

```
sp = cbind(x = c(0,0,1), y = c(0,1,1))
row.names(sp) = paste("point", 1:nrow(sp), sep="")
library(sp)
sp = SpatialPoints(sp)
time = as.POSIXct("2010-08-05")+3600*(10:13)
m = c(10,20,30) # means for each of the 3 point locations
mydata = rnorm(length(sp)*length(time),mean=rep(m, 4))
IDs = paste("ID", 1:length(mydata))
mydata = data.frame(values = signif(mydata,3), ID=IDs)
stidf = as(STFDF(sp, time, mydata), "STIDF")
stidf[1:2,]
all.equal(stidf, stidf[stidf,])
```

---

stInteraction

*subtract marginal (spatial and temporal) means from observations*

---

## Description

subtract marginal (spatial and temporal) means from observations

## Usage

```
stInteraction(x, ...)
```

## Arguments

x                    object of class STFDF  
 ...                   arguments passed to [rowMeans](#), [colMeans](#) and [mean](#), such as `na.rm=TRUE`

## Value

object of class [STFDF](#) with each attribute replaced by its residual, computed by  $y_{ij} - x_{ij} - m_{.jmi} / m_{.j}$  with  $m_{.j}$  the grand mean,  $m_{.j}$  the temporal mean,  $m_{.i}$  the spatial mean and  $m_{.}$  the grand mean.

## Examples

```
if (require(gstat)) {
  library(sp)
  data(wind)
  wind.loc$y = as.numeric(char2dms(as.character(wind.loc[["Latitude"]])))
```

```

wind.loc$x = as.numeric(char2dms(as.character(wind.loc[["Longitude"]]))))
coordinates(wind.loc) = ~x+y
proj4string(wind.loc) = "+proj=longlat +datum=WGS84"
# match station order to names in wide table:
stations = 4:15
wind.loc = wind.loc[match(names(wind[stations]), wind.loc$Code),]
row.names(wind.loc) = wind.loc$Station
wind$time = ISOdate(wind$year+1900, wind$month, wind$day, 0)
space = list(values = names(wind)[stations])
wind.st = stConstruct(wind[stations], space, wind$time, SpatialObj = wind.loc)

wind.sti = stInteraction(wind.st)
# temporal means for any station should be zero:
c(mean(wind.sti[3,]),
# spatial mean for each time step should be zero:
mean(wind.sti[,5][[1]]))
}

```

---

stplot

*produce trellis plot for STxDF object*


---

## Description

create trellis plot for ST objects

## Usage

```

stplot(obj, ...)
stplot.STFDF(obj, names.attr = trimDates(obj), ...,
as.table = TRUE, at, cuts = 15, scales = list(draw = FALSE),
animate = 0, mode = "xy", scaleX = 0, auto.key = list(space = key.space),
main, key.space = "right", type = "l", do.repeat = TRUE, range.expand = 0.001)
stplot.STIDF(obj, ..., names.attr = NULL, as.table = TRUE,
scales = list(draw = FALSE), xlab = NULL, ylab = NULL,
type = "p", number = 6, tcuts, sp.layout = NULL, xlim =
bbox(obj)[1, ], ylim = bbox(obj)[2, ])

```

## Arguments

obj	object of a class deriving from ST
names.attr	names that will be used in the strip; trimDates(obj) trims "-01" ending(s) from printed Dates
as.table	logical; if TRUE, time will increase from top to bottom; if FALSE, time will increase from bottom to top
at	values at which colours will change; see <a href="#">levelplot</a>

cuts	number of levels the range of the attribute would be divided into
animate	numeric; if larger than 0, the number of seconds between subsequent animated time steps (loop; press ctrl-C or Esc to stop)
mode	plotting mode; if "xy", maps for time steps are plotted; if "xt", a space-time plot is constructed (see argument <code>scaleX</code> , but read details below); if "ts", multiple-locations time series are plotted in a single plot, or in a separate panel for each attribute; if "tp" single- or multi-attribute time series are plotted in multiple panels, one panel per location.
scaleX	integer: 0, 1 or 2; when mode is "xt", used to determine whether the index of the spatial location is shown (0), the x coordinate (1) or the y coordinate (2).
auto.key	see the <code>auto.key</code> argument in <a href="#">xyplot</a>
main	character; plot title, use NULL to omit title
key.space	character; see <a href="#">xyplot</a>
scales	scales drawing; see <code>scales</code> argument of <a href="#">xyplot</a>
xlab	x-axis label
ylab	y-axis label
type	character; use 'l' for lines, 'p' for symbols, 'b' for both lines and symbols
do.repeat	logical; repeat the animation in an infinite loop?
range.expand	numeric; if <code>at</code> is not specified, expand the data range with this factor to cover all values
number	number of time intervals, equally spaced
tcuts	time cuts in units of <code>index(obj)</code> ; this overrides <code>number</code>
sp.layout	list or NULL; see <a href="#">splot</a>
...	arguments passed on to <a href="#">splot</a> in case of plotting objects of class STFDF or STIDF, or to <a href="#">xyplot</a> in case of <code>stplot.STIDF</code>
xlim	numeric, x range
ylim	numeric, y range

### Value

In non-animation and "xy" mode, `stplot` is a wrapper around [splot](#), that automatically plots each time stamp in a panel. The returned value is a lattice plot.

In "xt" mode, a space-time plot with space on the x-axis and time on the y-axis is plotted. By default, the space ID is plotted on the x-axis, as space can be anything (points, polygons, grid cells etc). When `scaleX` is set to 1 or 2, the x- resp. y-coordinates of the spatial locations, obtained by [coordinates](#), is used instead. Beware: when the x-coordinate is plotted, and for each (x,t) element multiple y-coordinates are sent to the plot, it is not clear which (x,y,t) value becomes the plotted value, so slicing single y values is advised – no checking is done. The returned value is a lattice plot.

In animation mode (`animate > 0`), single maps are animated in an endless loop, with `animate` seconds between each. No proper value is returned: the loop needs to be interrupted by the user.



**Methods**

**stplot** signature(x = "STFDF"): plots object of class [STFDF](#)

**stplot** signature(x = "STSDf"): plots object of class [STSDf](#)

**stplot** signature(x = "STI"): plots object of class [STI](#)

**stplot** signature(x = "STIDF"): plots object of class [STIDF](#)

**stplot** signature(x = "STT"): plots object of class [STT](#)

**stplot** signature(x = "STTDF"): plots object of class [STTDF](#)

**Note**

vignette("spacetime") contains several examples

**References**

<https://www.jstatsoft.org/v51/i07/>

---

STSDf-class

Class "STSDf"

---

**Description**

A class for spatio-temporal data with partial space-time grids; for n spatial locations and m times, an index table is kept for which nodes observations are available

**Usage**

```

STS(sp, time, index, endTime = delta(time))
STSDf(sp, time, data, index, endTime = delta(time))
## S4 method for signature 'STSDf'
x[i, j, ..., drop = is(x, "STSDf")]
## S4 method for signature 'STSDf,STFDF'
coerce(from, to, strict=TRUE)
## S4 method for signature 'STSDf,STIDF'
coerce(from, to, strict=TRUE)

```

**Arguments**

sp	object of class <a href="#">Spatial</a>
time	object holding time information; see <a href="#">ST-class</a>
data	data frame with rows corresponding to the observations (spatial index moving faster than temporal)
index	two-column matrix: rows corresponding to the nodes for which observations are available, first column giving spatial index, second column giving temporal index

endTime	vector of class POSIXct with end points of time intervals for the observations
x	an object of class STFDF
i	selection of spatial entities
j	selection of temporal entities (see syntax in package xts)
...	selection of attribute(s)
drop	if TRUE and a single spatial entity is selected, an object of class xts is returned; if TRUE and a single temporal entity is selected, and object of the appropriate Spatial class is returned; if FALSE, no coercion to reduced classes takes place
from	object of class STFDF
to	target class
strict	ignored

### Objects from the Class

Objects of this class carry sparse space/time grid data

### Slots

sp: Object of class "Spatial"

time: Object holding time information; see [ST-class](#) for permitted types

index: matrix of dimension  $n \times 2$ , where  $n$  matches the number of rows in slot data

data: Object of class data.frame, which holds the measured values

### Methods

[ signature(x = "STSDF"): selects spatial entities, temporal entities, and attributes

**plot** signature(x = "STS", y = "missing"): plots space-time layout

**plot** signature(x = "STSDF", y = "missing"): plots space-time layout, indicating records partially NA

### Author(s)

Edzer Pebesma, <edzer.pebesma@uni-muenster.de>

### References

<https://www.jstatsoft.org/v51/i07/>

### See Also

[delta](#)

**Examples**

```

sp = cbind(x = c(0,0,1), y = c(0,1,1))
row.names(sp) = paste("point", 1:nrow(sp), sep="")
library(sp)
sp = SpatialPoints(sp)
library(xts)
time = xts(1:4, as.POSIXct("2010-08-05")+3600*(10:13))
m = c(10,20,30) # means for each of the 3 point locations
mydata = rnorm(length(sp)*length(time),mean=rep(m, 4))
IDs = paste("ID",1:length(mydata))
mydata = data.frame(values = signif(mydata,3), ID=IDs)
stfdf = STTDF(sp, time, mydata)
stfdf
stfdf = as(stfdf, "STTDF")
stfdf[1:2,]
stfdf[,1:2]
stfdf[,2]
stfdf[,,"values"]
stfdf[1,]
stfdf[,2]
# examples for [[, [[<-, $ and $<-
stfdf[[1]]
stfdf[["values"]]
stfdf[["newVal"]] <- rnorm(12)
stfdf$ID
stfdf$ID = paste("OldIDs", 1:12, sep="")
stfdf$NewID = paste("NewIDs", 12:1, sep="")
stfdf
x = stfdf[stfdf,]
x = stfdf[stfdf[1:2,],]
all.equal(x, stfdf[1:2,])

```

---

STTDF-class

*Class "STTDF"*


---

**Description**

A class for spatio-temporal trajectory data

**Usage**

```

## S4 method for signature 'STTDF,ltraj'
coerce(from, to, strict=TRUE)
## S4 method for signature 'ltraj,STTDF'
coerce(from, to, strict=TRUE)

```

**Arguments**

from                    from object

to                   target class  
strict               ignored

### Objects from the Class

Objects of this class carry sparse (irregular) space/time data

### Slots

sp: Object of class "Spatial", containing the bounding box of all trajectories  
time: Object of class "xts", containing the temporal bounding box of all trajectories  
traj: Object of class list, each element holding an **STI** object reflecting a single trajectory;  
data: Object of class data.frame, which holds the data values for each feature in each trajectory

### Methods

[ signature(x = "STTDF"): select trajectories, based on index, or spatial and/or temporal predicates

### Note

The data.frame needs to have a column called burst which is a factor (or character) and contains the grouping of observations that come from a continuous sequence of observations. In addition, a column id is used to identify individual items.

### Author(s)

Edzer Pebesma, <edzer.pebesma@uni-muenster.de>

### References

<https://www.jstatsoft.org/v51/i07/>

### Examples

```
library(sp)
m = 3# nr of trajectories
n = 100 # length of each
l = vector("list", m)
t0 = as.POSIXct("2013-05-05", tz="GMT")
set.seed(1331) # fix randomness
for (i in 1:m) {
  x = cumsum(rnorm(n))
  y = cumsum(rnorm(n))
  sp = SpatialPoints(cbind(x,y))
  #t = t0 + (0:(n-1) + (i-1)*n) * 60
  t = t0 + (0:(n-1) + (i-1)*n/2) * 60
  l[[i]] = STI(sp, t)
}
stt= STT(l)
```

```

stddf = STTDF(stt, data.frame(attr = rnorm(n*m), id = paste("ID", rep(1:m, each=n))))
x = as(stt, "STI")
stplot(stddf, col=1:m, scales=list(draw=TRUE))
stplot(stddf, by = "id")
stplot(stddf[1])
stplot(stddf[1])

# select a trajectory that intersect with a polygon
p = Polygon(cbind(x=c(-20,-15,-15,-20,-20),y=c(10,10,15,15,10)))
pol=SpatialPolygons(list(Polygons(list(p), "ID")))
#if (require(rgeos)) {
# stplot(stddf[pol])
# names(stddf[pol]@traj)
# stplot(stddf[1:2],col=1:2)
# stplot(stddf[,t0])
# stplot(stddf[, "2013"])
# stplot(stddf[pol, "2013"])
# is.null(stddf[pol,t0])
#}

```

---

timeIsInterval	<i>retrieve, or set, information whether time reflects instance (FALSE) or intervals (TRUE)</i>
----------------	---

---

### Description

retrieve, or set, information whether time reflects instance (FALSE) or intervals (TRUE)

### Usage

```

timeIsInterval(x, ...)
timeIsInterval(x) <- value

```

### Arguments

x	object, of any class
...	ignored
value	logical; sets the timeIsInterval value

### Value

logical; this function sets or retrieves the attribute `timeIsInterval` of `x`, UNLESS `x` is of class `ST`, in which case it sets or retrieves this attribute for the `time` slot of the object, i.e. `timeIsInterval(x@time) <- value`

**Note**

From spacetime 0.8-0 on, timeIsInterval is dropped in favour of a more generic time intervals by specifying endTime of each observation

**See Also**

[over](#), [timeIsInterval](#)

---

timeMatch	<i>match two (time) sequences</i>
-----------	-----------------------------------

---

**Description**

match two (time) sequences, where each can be intervals or instances.

**Usage**

```
timeMatch(x, y, returnList = FALSE, ...)
```

**Arguments**

x	ordered sequence, e.g. of time stamps
y	ordered sequence, e.g. of time stamps
returnList	boolean; should a list be returned with all matches (TRUE), or a vector with single matches (FALSE)?
...	end.x and end.y can be specified for xts and POSIXct methods

**Details**

When x and y are of class xts or POSIXct, end.x and end.y need to specify endpoint of intervals.

In case x and y are both not intervals, matching is done on equality of values, using [match](#).

If x represents intervals, then the first interval is from x[1] to x[2], with x[1] included but x[2] not (left-closed, right-open). In case of zero-width intervals (e.g. x[1]==x[2]), nothing will match and a warning is raised. Package intervals is used to check overlap of intervals, using, [interval\\_overlap](#).

**Value**

if returnList = FALSE: integer vector of length length(x) with indexes of y matching to each of the elements of x, or NA if there is no match. See section details for definition of match.

if returnList = TRUE: list of length length(x), with each list element an integer vector with all the indexes of y matching to that element of x.

**Author(s)**

Edzer Pebesma

**References**<https://www.jstatsoft.org/v51/i07/>**See Also**[over](#), [timeIsInterval](#), [interval\\_overlap](#)**Examples**

```

t0 = as.POSIXct("1999-10-10")
x = t0 + c(0.5+c(2,2.1,4),5)*3600
y = t0 + 1:5 * 3600
x
y
#timeIsInterval(x) = FALSE
#timeIsInterval(y) = FALSE
timeMatch(x,y, returnList = FALSE)
timeMatch(x,y, returnList = TRUE)
#timeIsInterval(y) = TRUE
timeMatch(x,y, returnList = FALSE, end.y = delta(y))
timeMatch(x,y, returnList = TRUE, end.y = delta(y))
#timeIsInterval(x) = TRUE
timeMatch(x,y, returnList = FALSE, end.x = delta(x), end.y = delta(y))
timeMatch(x,y, returnList = TRUE, end.x = delta(x), end.y = delta(y))
#timeIsInterval(y) = FALSE
timeMatch(x,y, returnList = FALSE, end.x = delta(x))
timeMatch(x,y, returnList = TRUE, end.x = delta(x))

x = as.POSIXct("2000-01-01") + (0:9) * 3600
y = x + 1
y[1] = y[2]
x
y
TI = function(x, ti) {
  timeIsInterval(x) = ti
  x
}
#timeMatch(TI(y,FALSE),TI(y,FALSE))
#timeMatch(TI(y,TRUE), TI(y,TRUE))
#
#timeMatch(TI(x,FALSE),TI(y,FALSE))
#timeMatch(TI(x,FALSE),TI(y,TRUE))
#timeMatch(TI(x,TRUE), TI(y,FALSE))
#timeMatch(TI(x,TRUE), TI(y,TRUE))
#
#timeMatch(TI(x,FALSE),TI(y,FALSE), returnList = TRUE)
#timeMatch(TI(x,FALSE),TI(y,TRUE), returnList = TRUE)
#timeMatch(TI(x,TRUE), TI(y,FALSE), returnList = TRUE)

```

```
#timeMatch(TI(x,TRUE), TI(y,TRUE), returnList = TRUE)
```

---

unstack	<i>write STFDF to table forms</i>
---------	-----------------------------------

---

## Description

create table forms of STFDF objects

## Usage

```
## S3 method for class 'STFDF'
unstack(x, form, which = 1, ...)
## S3 method for class 'STFDF'
as.data.frame(x, row.names, ...)
```

## Arguments

x	object of class STFDF
form	formula; can be omitted
which	column name or number to have unstacked
row.names	row.names for the data.frame returned
...	arguments passed on to the functions <a href="#">unstack</a> or <a href="#">as.data.frame</a>

## Value

unstack returns the data in wide format, with each row representing a spatial entity and each column a time; see [unstack](#) for details and default behaviour.

as.data.frame returns the data.frame in long format, where the coordinates of the spatial locations (or line starting coordinates, or polygon center points) and time stamps are recycled accordingly.

## Examples

```
sp = cbind(x = c(0,0,1), y = c(0,1,1))
row.names(sp) = paste("point", 1:nrow(sp), sep="")
library(sp)
sp = SpatialPoints(sp)
library(xts)
time = xts(1:4, as.POSIXct("2010-08-05")+3600*(10:13))
m = c(10,20,30) # means for each of the 3 point locations
mydata = rnorm(length(sp)*length(time),mean=rep(m, 4))
IDs = paste("ID",1:length(mydata))
mydata = data.frame(values = signif(mydata,3), ID=IDs)
stfdf = STFDF(sp, time, mydata)
as.data.frame(stfdf, row.names = IDs)
```



```
unstack(stfdf)  
t(unstack(stfdf))  
unstack(stfdf, which = 2)
```

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