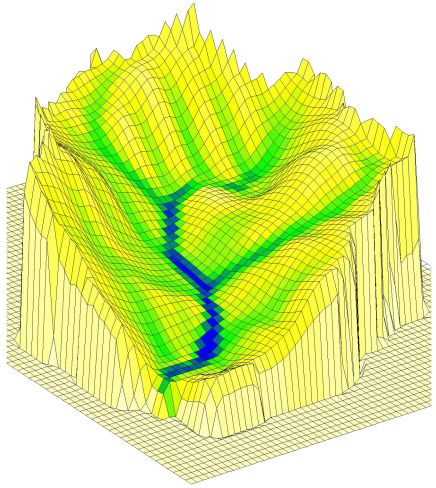
Analyses spatiales sous R



Analyses spatiales sous R

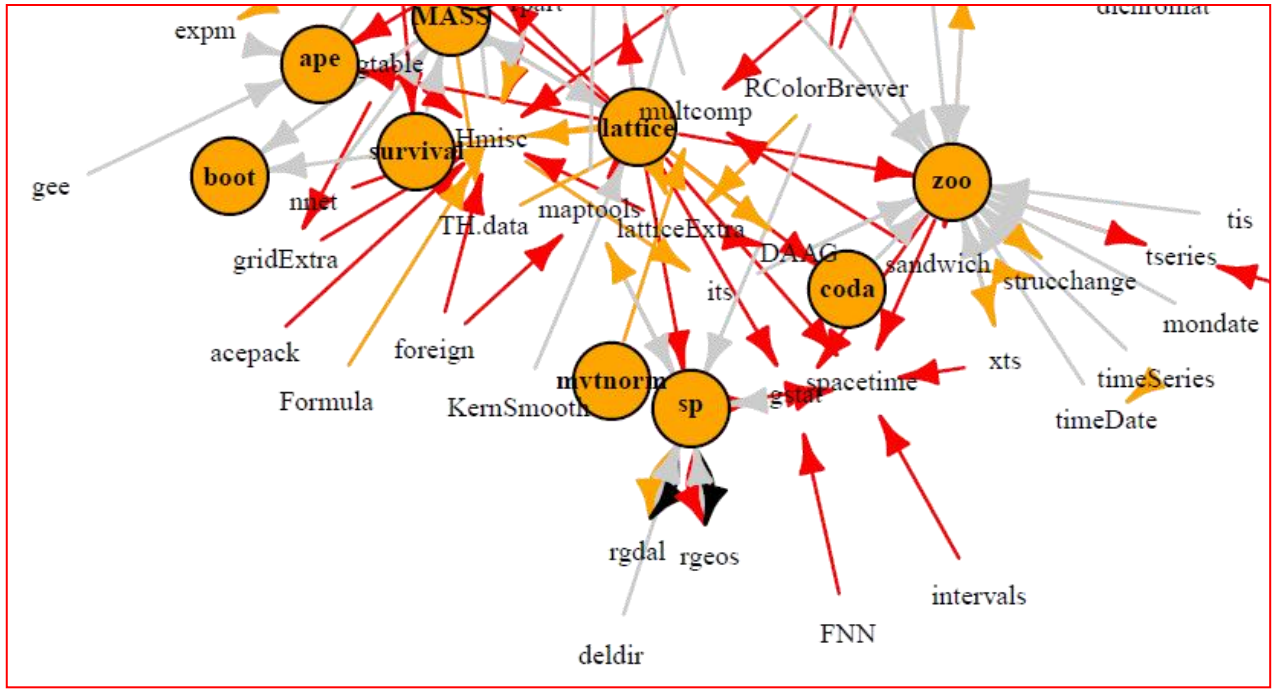
Quels sont les packages R les plus populaires?

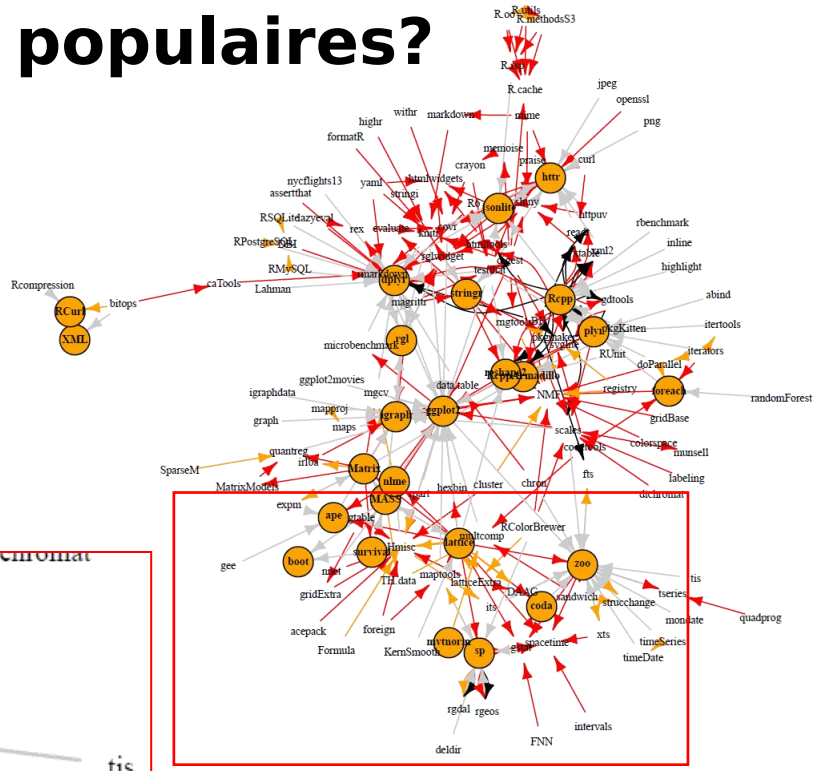
```
> head(stat, 25)
                page.rank
Rcpp          0.023746405
MASS          0.018444947
ggplot2       0.009815878
Matrix        0.009280136
mvtnorm       0.007771195
survival      0.007666329
lattice       0.007366396
plyr          0.006744613
sp            0.004728809
igraph        0.004590097
stringr       0.004310797
httr          0.004197378
XML           0.004177170
RcppArmadillo 0.004118777
reshape2      0.003584849
coda          0.003574366
RCurl         0.003500386
dplyr         0.003485314
jsonlite      0.003423806
foreach       0.003417097
```

Analyses spatiales sous R

Quels sont les packages R les plus populaires?

Le package sp l'un des 10 packages
les plus utilisés





Analyses spatiales sous R

Packages pour les analyses spatiales sous R

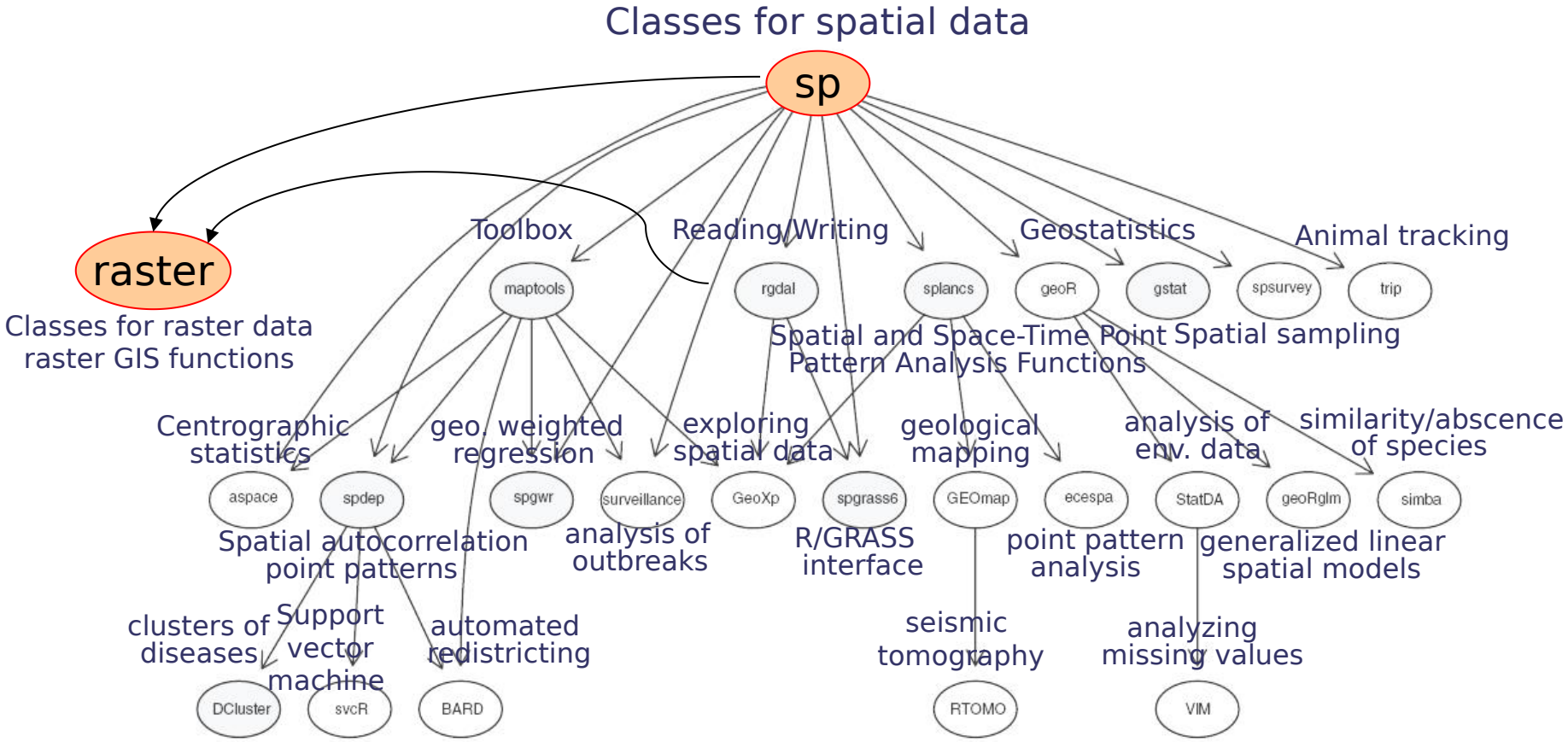
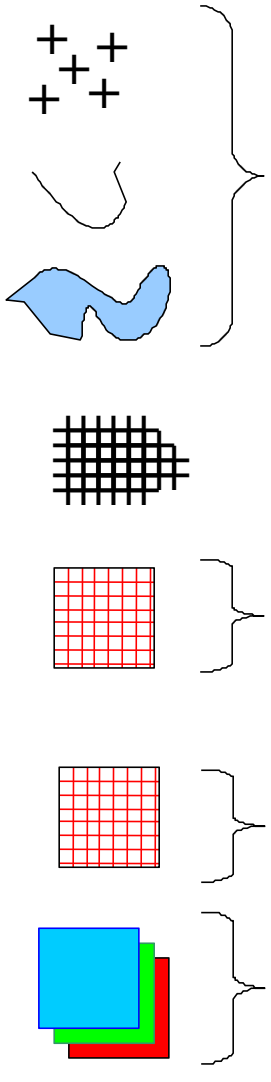


Fig. 1.1. Tree of R contributed packages on CRAN depending on or importing **sp** directly or indirectly; others suggest **sp** or use it without declaration in their package descriptions (status as of 2008-04-06)

Analyses spatiales sous R

Type de données	Importer/exporter	Classes du **package sp**
Vector data	readOGR() writeOGR()	SpatialPoints SpatialPointsDataFrame
		SpatialLines SpatialLinesDataFrame
		SpatialPolygons SpatialPolygonsDataFrame
Raster data		SpatialPixels SpatialPixelsDataFrame
	readGDAL() writeGDAL()	SpatialGrid SpatialGridDataFrame
	raster()	**Classes du package raster:** RasterLayer
	stack() brick()	RasterStack – multiple files RasterBrick – multiple files



Analyses spatiales sous R

Formats de fichiers supportés : package sp

Données raster : readGDAL(), writeGDAL()

```
> x <- gdalDrivers()
> subset(x, (x$create==TRUE))
       name                                long_name create  copy
2      ADRG        ARC Digitized Raster Graphics   TRUE FALSE
7       BMP MS Windows Device Independent Bitmap   TRUE FALSE
9        BT  VTP .bt (Binary Terrain) 1.3 Format   TRUE FALSE
19     EHdr                    ESRI .hdr Labelled   TRUE  TRUE
21     ELAS                                ELAS   TRUE FALSE
22     ENVI                    ENVI .hdr Labelled   TRUE FALSE
23      ERS                 ERMapper .ers Labelled   TRUE FALSE
34     GSBG   Golden Software Binary Grid (.grd)   TRUE  TRUE
36    GTiff                               GeoTIFF   TRUE  TRUE
38      HFA          Erdas Imagine Images (.img)   TRUE  TRUE
39      IDA              Image Data and Analysis   TRUE FALSE
40    ILWIS                   ILWIS Raster Map   TRUE  TRUE
41     INGR                  Intergraph Raster   TRUE  TRUE
50 Leveller                Leveller heightfield   TRUE FALSE
51      MEM                    In Memory Raster   TRUE FALSE
52      MFF                  Vexcel MFF Raster   TRUE  TRUE
53     MFF2              Vexcel MFF2 (HKV) Raster   TRUE  TRUE
56     NITF National Imagery Transmission Format   TRUE  TRUE
57     PAux                    PCI .aux Labelled   TRUE FALSE
58   PCIDSK                 PCIDSK Database File   TRUE  TRUE
62      PNM      Portable Pixmap Format (netpbm)   TRUE FALSE
64      RMF                  Raster Matrix Format   TRUE FALSE
67      RST                     Idrisi Raster A.1   TRUE  TRUE
70      SGI            SGI Image File Format 1.0   TRUE FALSE
72 Terragen                 Terragen heightfield   TRUE FALSE
75      VRT                       Virtual Raster   TRUE  TRUE
```

Données vectorielles : readOGR(), writeOGR()

```
> ogrDrivers()
             name write
1          AVCBin FALSE
2          AVCE00 FALSE
3             BNA  TRUE
4             CSV  TRUE
5             DGN  TRUE
6  ESRI Shapefile  TRUE
7      Geoconcept  TRUE
8         GeoJSON  TRUE
9             GML  TRUE
10            GMT  TRUE
11            GPX  TRUE
12            KML  TRUE
13   MapInfo File  TRUE
14         Memory  TRUE
15            REC FALSE
16            S57  TRUE
17           SDTS FALSE
18          TIGER  TRUE
19        UK .NTF FALSE
20            VRT FALSE
21         XPlane FALSE
```

Analyses spatiales sous R

Classes pour les données vectorielles : (package sp)

Lire un shapefile des frontières nationales

```
> country<-readOGR(dsn="Module Initiation R (CST07)/Données_découpage_administratif",layer="Political_Map")
OGR data source with driver: ESRI Shapefile
Source: "Module Initiation R (CST07)/Données_découpage_administratif", layer: "Political_Map"
with 209 features
It has 3 fields
```

Structure de l'objet country

```
> str(country)
Formal class 'SpatialPolygonsDataFrame' [package "sp"] with 5 slots
  ..@ data       :'data.frame': 209 obs. of  3 variables:
  .. ..$ NAME     : Factor w/ 209 levels "Afghanistan",..: 1 2 3 4 5 6 7 8 9 10 ...
  .. ..$ GMI_CNTRY: Factor w/ 203 levels "AFG","AGO","ALB",..: 1 3 51 4 2 8 9 6 7 10 ...
  .. ..$ REGION   : Factor w/ 10 levels "Antarctica","Asia",..: 2 5 8 5 10 1 4 6 2 3 ...
  ..@ polygons   :List of 209
  .. ..$ :Formal class 'Polygons' [package "sp"] with 5 slots
  .. .. .. ..@ Polygons :List of 1
  .. .. .. .. ..$ :Formal class 'Polygon' [package "sp"] with 5 slots
  .. .. .. .. .. .. ..@ labpt  : num [1:2] 66 33.8
  .. .. .. .. .. .. ..@ area   : num 62.6
  .. .. .. .. .. .. ..@ hole   : logi FALSE
  .. .. .. .. .. .. ..@ ringDir: int 1
  .. .. .. .. .. .. ..@ coords : num [1:291, 1:2] 65.6 65.6 65.7 65.8 65.8 ...
  .. .. .. ..@ plotOrder: int 1
  .. .. .. ..@ labpt    : num [1:2] 66 33.8
  .. .. .. ..@ ID       : chr "0"
  .. .. .. ..@ area     : num 62.6
```

Analyses spatiales sous R

Classes pour les données vectorielles : (package sp)

Lire un shapefile des frontières nationales

```
> country<-readOGR(dsn="Module Initiation R (CST07)/Données_découpage_administratif",layer="Political_Map")
OGR data source with driver: ESRI Shapefile
Source: "Module Initiation R (CST07)/Données_découpage_administratif", layer: "Political_Map"
with 209 features
It has 3 fields
```

Structure de l'objet country

```
  .. ..$ :Formal class 'Polygons' [package "sp"] with 5 slots
  .. .. .. ..@ Polygons :List of 1
  .. .. .. .. ..$ :Formal class 'Polygon' [package "sp"] with 5 slots
  .. .. .. .. .. .. ..@ labpt  : num [1:2] 37.855 0.531
  .. .. .. .. .. .. ..@ area   : num 47.3
  .. .. .. .. .. .. ..@ hole   : logi FALSE
  .. .. .. .. .. .. ..@ ringDir: int 1
  .. .. .. .. .. .. ..@ coords : num [1:158, 1:2] 34.1 34 34 33.9 33.9 ...
  .. .. .. ..@ plotOrder: int 1
  .. .. .. ..@ labpt    : num [1:2] 37.855 0.531
  .. .. .. ..@ ID       : chr "98"
  .. .. .. ..@ area     : num 47.3
  .. .. [list output truncated]
  ..@ plotOrder  : int [1:209] 6 156 33 197 38 25 10 72 98 84 ...
  ..@ bbox       : num [1:2, 1:2] -180 -90 180 83.6
  .. ..- attr(*, "dimnames")=List of 2
  .. .. ..$ : chr [1:2] "x" "y"
  .. .. ..$ : chr [1:2] "min" "max"
  ..@ proj4string:Formal class 'CRS' [package "sp"] with 1 slot
  .. .. ..@ projargs: chr "+proj=longlat +datum=WGS84 +no_defs +ellps=WGS84 +towgs84=0,0,0"
> |
```

Analyses spatiales sous R

Classes pour les données vectorielles : (package sp)

Lire un shapefile des frontières nationales

```
> country<-readOGR(dsn="Module Initiation R (CST07)/Données_découpage_administratif",layer="Political_Map")
OGR data source with driver: ESRI Shapefile
Source: "Module Initiation R (CST07)/Données_découpage_administratif", layer: "Political_Map"
with 209 features
It has 3 fields
```

Structure de l'objet country

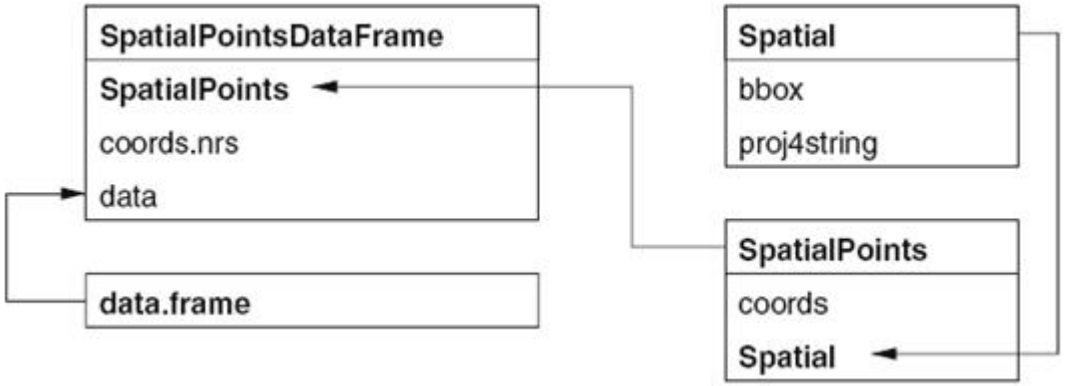
```
> bbox(country)
        min       max
x -180.0002 180.00000
y  -90.0000  83.62303
> proj4string(country)
[1] "+proj=longlat +datum=WGS84 +no_defs +ellps=WGS84 +towgs84=0,0,0"

> coordinates(country)
             [,1]        [,2]
0      66.0269456  33.8395896
1      20.0646597  41.1434974
2       2.6316692  28.1625806
3       1.5872973  42.5414671
4      17.5732076 -12.3339554
5      14.9355722 -80.2707305
6     -61.7883184  17.0716242
7     -65.1491697 -35.1847743

> x<-country@data
> is.data.frame(x)
[1] TRUE
```

Analyses spatiales sous R

Classes pour les données vectorielles : (package sp)




```
> str(Abies.spatiale)
Formal class 'SpatialPointsDataFrame' [package "sp"] with 5 slots
  ..@ data       :'data.frame': 3618 obs. of  5 variables:
  .. ..$ alti     : int [1:3618] 500 380 270 401 579 500 500 579 401 500 ...
  .. ..$ periode  : int [1:3618] 2 1 1 1 1 1 1 1 1 1 ...
  .. ..$ massif   : Factor w/ 6 levels "alpes","corse",..: 6 6 6 6 6 6 6 6 6 6 ...
  .. ..$ abondance: int [1:3618] 3 5 6 1 4 2 4 3 6 4 ...
  .. ..$ flore    : Factor w/ 2 levels "AD","PA": 1 1 1 1 1 1 1 1 1 1 ...
  ..@ coords.nrs : num(0)
  ..@ coords     : num [1:3618, 1:2] 940598 968992 967159 947976 943371 ...
  .. ..- attr(*, "dimnames")=List of 2
  .. .. ..$ : chr [1:3618] "00A8" "00F27" "00F28" "0101" ...
  .. .. ..$ : chr [1:2] "xLamb2" "yLamb2"
  ..@ bbox       : num [1:2, 1:2] 359000 1643772 1174243 2460648
  .. ..- attr(*, "dimnames")=List of 2
  .. .. ..$ : chr [1:2] "xLamb2" "yLamb2"
  .. .. ..$ : chr [1:2] "min" "max"
  ..@ proj4string:Formal class 'CRS' [package "sp"] with 1 slot
  .. .. ..@ projargs: chr "+proj=lcc +lat_1=49 +lat_2=44 +lat_0=46.5 +lon_0=3 +x_0=700000 +y_0=6600000 +ellps=GRS80 +towgs84=0,0,0,0,0,
```

Analyses spatiales sous R

Classes pour les données vectorielles :
(package sp)

Le format "proj4" pour se référencer spatialement
(http://www.spatialreference.org/)

```
# liste des systèmes de projection disponibles
EPSG <- make_EPSG()
str(EPSG)
head(EPSG)
```

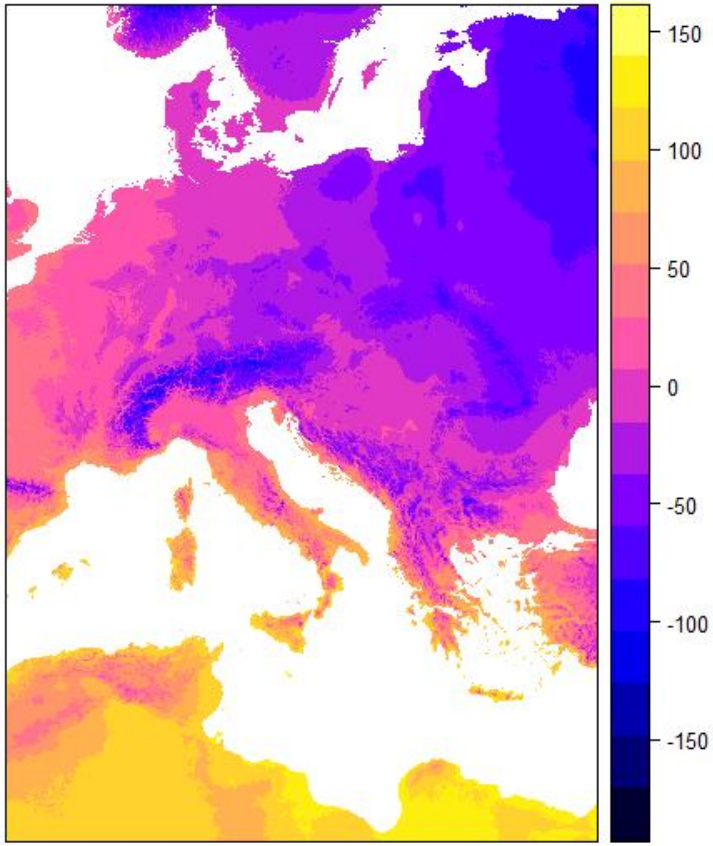
```
> head(EPSG)
  code                                          note                                                                                      prj4
1 3819                                     # HD1909 +proj=longlat +ellps=bessel +towgs84=595.48,121.69,515.35,4.115,-2.9383,0.853,-3.408 +no_defs
2 3821                                      # TWD67                                                  +proj=longlat +ellps=aust_SA +no_defs
3 3824                                      # TWD97                                     +proj=longlat +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +no_defs
4 3889                                       # IGRS                                     +proj=longlat +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +no_defs
5 3906                                   # MGI 1901                           +proj=longlat +ellps=bessel +towgs84=682,-203,480,0,0,0,0 +no_defs
6 4001 # Unknown datum based upon the Airy 1830 ellipsoid                                                   +proj=longlat +ellps=airy +no_defs
```

Analyses spatiales sous R

Classes pour données raster: :
(package sp)

Importer/exporter: readGDAL, writeGDAL

```
spplot(Janv)
```



Analyses spatiales sous R

Classes pour données raster: : (package raster)

```
> tmean_16<-raster("tmean1_16.tif")
> tmean_16
class       : RasterLayer
dimensions  : 3600, 3600, 12960000  (nrow, ncol, ncell)
resolution  : 0.008333333, 0.008333333  (x, y)
extent      : 0, 30, 30, 60  (xmin, xmax, ymin, ymax)
coord. ref. : +proj=longlat +datum=WGS84 +no_defs +ellps=WGS84 +towgs84=0,0,0
data source : C:\Users\tarek\Desktop\thèse\COURS\Module Initiation R\tmean_16_tif\tmean1_16.tif
names       : tmean1_16
values      : -171, 140  (min, max)
```

RasterLayer
- raster()
- Uniquement une couche

```
>
> # création d'un objet de classe RasterStack
> files<-c("tmean2_16.tif","tmean3_16.tif","tmean4_16.tif","tmean5_16.tif",
+ "tmean6_16.tif","tmean7_16.tif","tmean8_16.tif","tmean9_16.tif","tmean10_16.tif"
+ ,"tmean11_16.tif","tmean12_16.tif")
> for (i in 1:11){
+ tmp<-raster(files[i])
+ tmean_16<-stack(tmean_16,tmp)
+               }
> tmean_16
class       : RasterStack
dimensions  : 3600, 3600, 12960000, 12  (nrow, ncol, ncell, nlayers)
resolution  : 0.008333333, 0.008333333  (x, y)
extent      : 0, 30, 30, 60  (xmin, xmax, ymin, ymax)
coord. ref. : +proj=longlat +datum=WGS84 +no_defs +ellps=WGS84 +towgs84=0,0,0
names       : tmean1_16, tmean2_16, tmean3_16, tmean4_16, tmean5_16, tmean6_16, tmean7_16, tmean8_16, tmean9_16, tmean10_16, tmean11_16, tmean12_16
min values  :      -171,      -177,      -172,      -154,      -108,       -74,       -46,       -47,       -64,        -94,       -137,       -157
max values  :       140,       146,       179,       228,       279,       332,       355,       346,       308,        244,        201,        160
```

RasterStack
- stack()
- Plusieurs couches