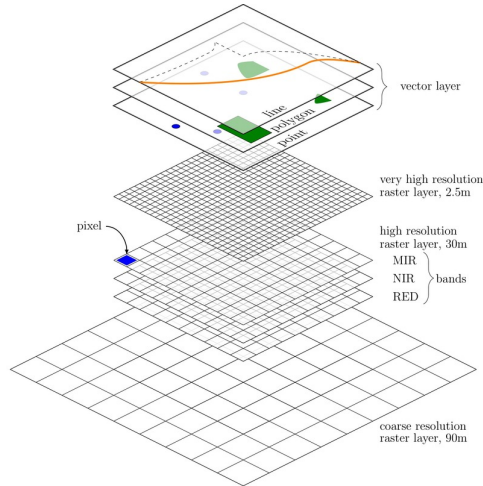


# Spatial R Cheat Sheet

## Remote Sensing and GIS functions



[book.ecosens.org](http://book.ecosens.org)

last updated: 3<sup>rd</sup> September, 2018

## Packages

A selection of packages that are used in the book is listed here, further relevant packages are available within R:

<b>RStoolbox</b>	various RS functions
<b>raster</b>	for raster data manipulation
<b>rgdal</b>	data import/export, projections
<b>sp</b>	vector data manipulation
<b>rgeos</b>	geometry commands
<b>wrspathrow</b>	Landsat WRS-2 information
<b>gfcanalysis</b>	Forest Cover Change product
<b>modis</b>	download and analyse MODIS
<b>bfast</b>	analyse time-series data
<b>rasterVis</b>	visualisation of time-series data
<b>glcm</b>	calculation of spatial metrics
<b>dismo</b>	species distribution modelling
<b>randomForest</b>	random forest modelling
<b>mgcv</b>	gam modelling
<b>move</b>	access and analyse movement data
<b>adehabitatHR</b>	home range analysis

further relevant packages:

<b>ggplot2</b>	for more fancy plots
<b>reshape2</b>	flexibly reshape data

More spatial R packages are listed here:

[cran.r-project.org/web/views/Spatial.html](http://cran.r-project.org/web/views/Spatial.html)

Relevant commands are listed below, actual syntax needs to be checked within the manual pages of each command.

## Raster

Raster data manipulation is similar to a spreadsheet or matrix manipulation but with coordinates and projections, hence various also not explicitly spatial commands can be applied. Here we mainly list commands designed for spatial data handling.

### Import and export

<b>raster()</b>	import (or generate) one raster layer
<b>brick()</b>	import raster with multiple layers
<b>writeRaster()</b>	export raster data to file
<b>writeFormats()</b>	list of supported raster file types
<b>getData()</b>	retrieves DEM and climate data directly from the web

### Information

<b>click()</b>	interactively query raster plot
<b>hist()</b>	histogram of raster values per layer
<b>cellStats()</b>	summary statistics of single layers
<b>summary()</b>	overall summary statistics
<b>extent()</b>	extent of raster data set
<b>ncell()</b>	number of cells (of one layer)
<b>nlayers()</b>	number of bands
<b>names()</b>	prints or sets layer names
<b>str()</b>	print the data structure
<b>NValue()</b>	get or set background values

### Visualisation

<b>ggR()</b> , <b>ggRGB()</b>	ggplot2 plotting commands implemented in RStoolbox
<b>plot()</b> , <b>plotRGB()</b>	raster plot and RGB plot. Useful arguments: <code>y=bandnumber</code> , <code>add=TRUE</code> (overlay multiple plots)
<b>image()</b> , <b>spplot()</b>	alternative plotting commands

### RasterVis package

<b>levelplot()</b>	fancy way to plot raster data information
<b>densityplot()</b>	raster value density plot
<b>bwplot()</b>	violin plot of raster data values
<b>hovmoller()</b>	spatio-temporal plotting options

### Projections

<b>projection()</b>	query or set projection (does NOT reproject)
<b>projectRaster()</b>	reprojects raster to new coordinate system

## Data manipulation

Most raster commands will output a file to a chosen location, if filename= is specified. Otherwise it will use temp files.

<b>stack()</b>	stack different raster layers together
<b>addLayer(); dropLayer()</b>	add/drop a raster layer
<b>crop()</b>	crop raster set to smaller extent
<b>drawExtent()</b>	draw extent on a plot for e.g. inclusion in <code>crop(raster,extent)</code>
<b>drawPolygon()</b>	create SpatialPolygon by drawing on a plot
<b>mask()</b>	masking of background values
<b>merge()</b>	combine raster tiles to a raster with larger extent (ignores NAs)
<b>mosaic()</b>	combine raster tiles and apply function to overlapping pixels, e.g. <code>mean</code>
<b>extract()</b>	extract values from Raster objects, using vector data
<b>buffer()</b>	buffer around cells that are not NA
<b>corLocal()</b>	local correlation based on moving window
<b>compareRaster()</b>	check if 2 raster have same extent, projection, resolution etc.
<b>cover()</b>	replace NA values with values of other layers

### Basic Operations

<b>raster*2/raster2</b>	any basic algebra operation
<b>calc()</b>	more efficient raster algebra, applies a function to raster data
<b>overlay()</b>	apply a function which uses specific bands, e.g. to calculate NDVI
<b>focal()</b>	moving window operations
<b>distance()</b>	calculate distance to closest feature, e.g. distance to water
<b>terrain()</b>	calculate terrain attributes from DEM, e.g. slope
<b>zonal()</b>	zonal statistics, for classified raster
<b>reclassify()</b>	reclassify raster values
<b>subs()</b>	substitutes values
<b>cut()</b>	reclassify values using ranges
<b>stackApply()</b>	computations on layer stack
<b>resample()</b>	resampling of raster to raster
<b>aggregate()</b>	aggregation of cells to coarser resolution
<b>disaggregate()</b>	disaggregation of cells to finer resolution
<b>rasterToPoints()</b>	converts a raster to vector points
<b>rasterToPolygons()</b>	converts a raster to polygons
<b>rasterToContour()</b>	converts raster values to contour
<b>[[ ]]</b>	address specific raster layer, e.g. <code>myRaster[[1]]</code> for first layer
<b>x &lt;- raster &gt; 50</b>	boolean operation, binary output
<b>raster[raster &lt;= 50] &lt;- 0</b>	replace all values < 50 with 0

## Remote Sensing Operations

### Image Analysis

superClass()	supervised classification
unsuperClass()	unsupervised classification
getValidation()	extract validation from superClass object
validateMap()	validation of existing classification
rasterEntropy()	class diversity across different classifications
spectralIndices()	computation of spectral indices
rasterCVA()	change vector analysis for change detection
rasterPCA()	principal component analysis
tasseledCap()	tasseled cap transformation
fCover()	analysis of fractional cover
sam()	spectral angle mapper
	extract band information

### Info & Preprocessing

getMeta()	
cloudMask()	cloud masking
cloudShadowMask()	cloud shadow masking
topCor()	topographic correction
panSharpen()	pan sharpening
histMatch()	image to image contrast matching
decodeQA()	quality flags to bit-words
normImage()	normalize raster image
pifMatch()	pseudo-invariant features
rescaleImage()	linear image rescaling
readEE()	import EarthExplorer files
readRSTBX()	save and read RStoolbox files
stackMeta()	import separate LSAT files to stack
lsat	Landsat example data (lsat)

## Vector

Vector data often come in shp format including a variety of auxiliary files. All of them are relevant and are needed for further analysis. Note that readShapePoly() etc. from package maptools do NOT automatically read projection information from shapefiles. It is recommended to use readOGR() instead.

### Import and Export

readOGR()	import vector file
writeOGR()	export vector file
ogrDrivers()	list supported file formats

### Information

plot()	vector plot. add=TRUE overlays multiple plots, e.g. combine with raster data
summary()	metadata and data summary
extent()	extent/bounding box of vector data
coordinates()	sets spatial coordinates to create spatial data, or retrieves spatial coordinates

### Projections

projection()	query or set projection (does NOT reproject)
spTransform()	reproject vector data to new coordinate system

### Data Manipulation

Check out the functions in the rgeos package, which provides most of the classical vector GIS operations such as buffers etc.

subset()	subset spatial data, based on a condition, e.g. keep only certain points
merge()	Merge a Spatial object having a data.frame (i.e. merging of non-spatial attributes)
over()	spatial overlay for points, grids and polygons
rasterize()	Rasterize points, lines, or polygons
distanceFromPoints()	computes the distance to points, output is a raster
extract()	extracts raster values behind points, lines or polygons
gIntersection()	intersection of vector data sets
gBuffer()	Buffer Geometry
name[name\$col_name > 10]	query and subset vector data

## Spatial Modeling

kfold()	partitioning of data set for training/validation purpose
evaluate()	cross-validation of models with presence/absence data
randomForest()	fits a randomForest model
maxent()	executes Maxent from R
gam()	fits a GAM
svm()	support vector machine
predict()	predicts statistical model into space (raster)

## Miscellaneous

Some useful commands which are related to spatial data analysis.

gmap() geocode()	get google maps for your plot geocoding in R
complete.cases()	returns only cases with no missing values
gridSample()	sample point from a grid e.g. just one point per pixel
function(...){...} return(...) if (...) {...} else{...} for (...) {...} while (...) { ...}	generates a defined functions returns the output of a function if else statement for loop while statement

### Further Packages

rNOMADS	data retrieval from NOAA, global/regional weather models
MODISTools	download and process MODIS data
modis	download and process MODIS data
bfastspatial	spatial temporal breakpoint detection
further spatial R packages: <a href="https://cran.r-project.org/web/views/Spatial.html">https://cran.r-project.org/web/views/Spatial.html</a>	

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2018

Compiled for the book "Remote and GIS for Ecologists - Using Open Source Software" [book.ecosens.org](http://book.ecosens.org)

