An R package for computing a synoptic classification and spatial regionalization of precipitation data

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What does the `synoptReg` package do?

synoptReg is an open source package that contains a set of functions used to:

1. perform a **PCA-based synoptic classification** using an atmospheric variable;
2. create maps showing the **spatial distribution of the precipitation** amounts based on the weather types of the synoptic classification;
3. develop a **spatial precipitation regionalization** based on the previous maps.

Step-by-step tutorial for using synoptReg

1. Reading and formatting NetCDF data

synoptReg has two functions related to read and format data:

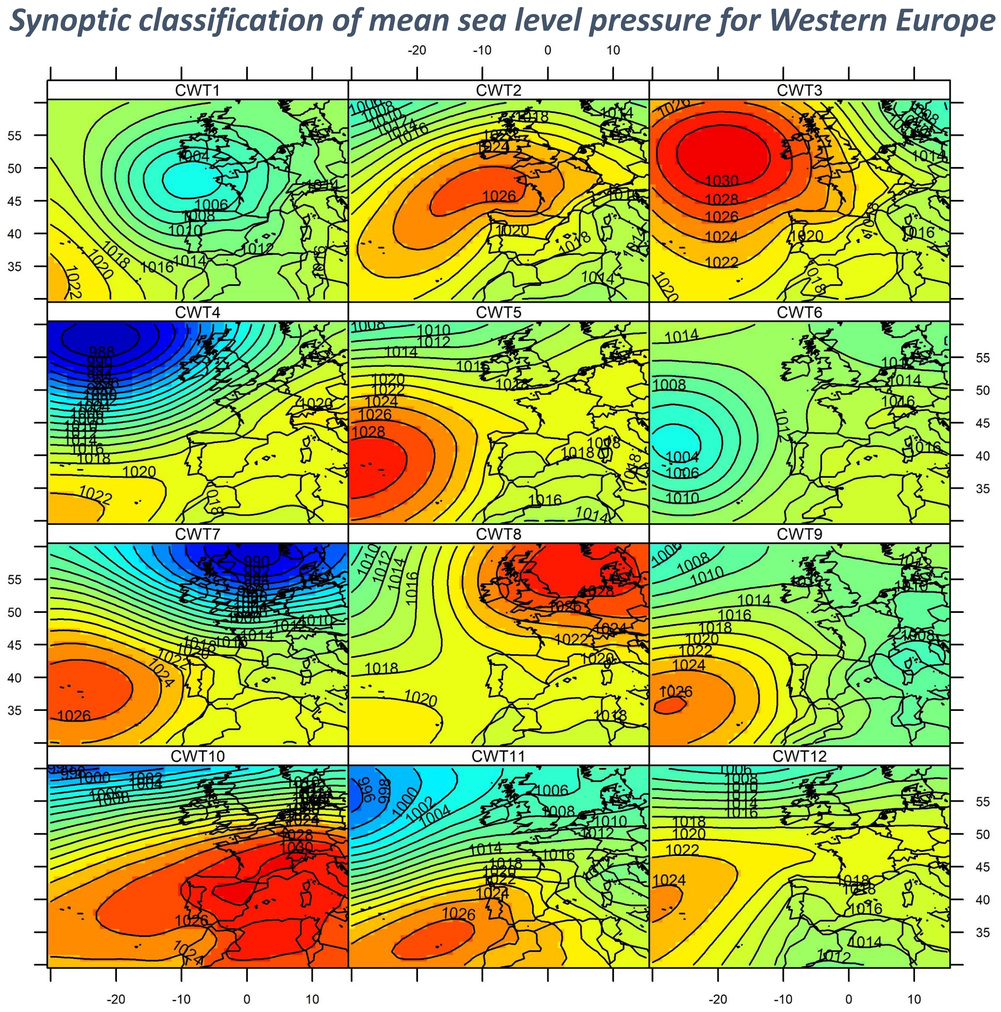
- **`read_nc`** reads a NetCDF file to extract the atmospheric or environmental variable, longitudes, latitudes and dates. A continuous NetCDF without date gaps is required.
- **`tidy_cuttime_nc`** formats the 3D-array output from `read_nc` function to an S-mode dataframe.

2. PCA-based synoptic classification

synoptReg also has 3 functions to perform the PCA-based synoptic classification approach:

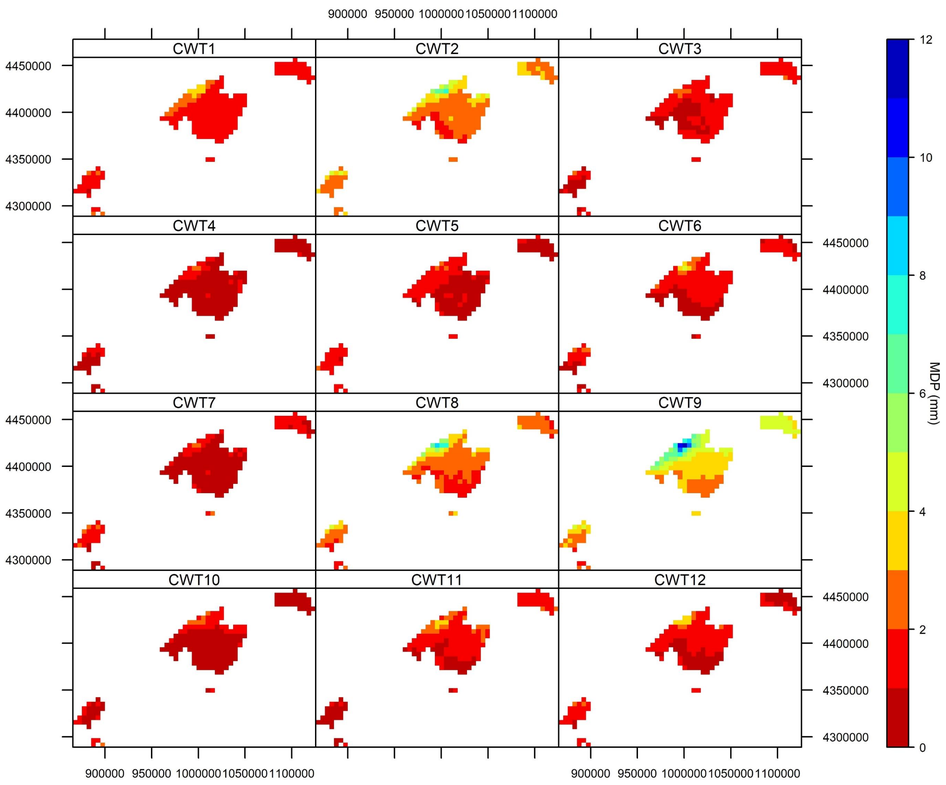
- **`pca_decision`** plots the explained variance against the number of the principal component.
- **`synoptclas`** establishes a daily synoptic classification based on any atmospheric variable.
- **`raster_clas`** converts the `dataframe` of the synoptic classification into a `RasterStack` object (see figure below).

Synoptic classification of mean sea level pressure for Western Europe



3. Spatial distribution of precipitation amounts

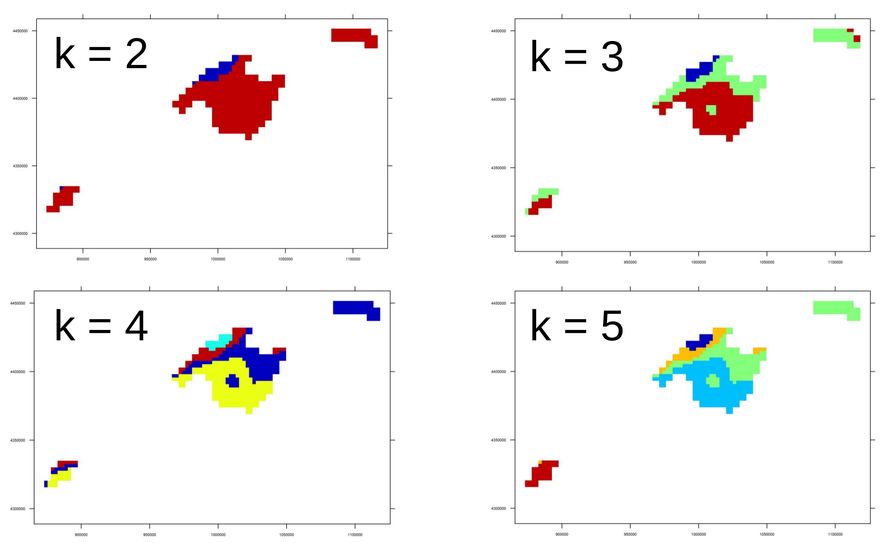
- Similar to `raster_clas`, **`raster_ct2env`** allows to average daily precipitation amounts by each circulation type and converting to RasterStack object. (See example for Balearic Islands)



- In addition, the **`raster_pca`** function can be used to apply a PCA on the RasterStack object of daily precipitation amounts to explore the main precipitation spatial patterns.

4. Regionalization based on the previous results

- **`regionalization`** performs an unsupervised clustering of the RasterStack object. (See the following proposals of daily precipitation regionalization for Balearic Islands)



5. Future developments

- New function to **automatically download reanalysis data** from NCEP/NCAR and ECMWF.
- Include **Jenkinson and Collison** classification method.
- **Insert 2 atmospheric variables** in the PCA-based synoptic classification approach.

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