Indecis

Sectorial Climate Services

Integrated approach for the **d**evelopment across **E**urope of user oriented **c**limate **i**ndicators for GFCS high-priority **s**ectors: agriculture, disaster risk reduction, energy, health, water, and tourism

Work Package 7

Deliverable 7.4

Basic semi-automated Climate Services and protocol for requesting advanced climate services launched at IDISP

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Index

1. Introduction

INDECIS has been dedicated to the creation of new methods and tools for climate data quality control and homogenization, indices calculation, visualization and communication to produce integrated sector oriented climate indices and services across Europe and their communication to stakeholders. The project has integrated a chain of processes: from compiling observations and the creation of climatic datasets to the production of sectorial indices and climate services – tailored to specific sectors – and the evaluation and comparison with alternative dataset like reanalysis and model data activities. INDECIS has intended to offer to European countries a start-to-end approach for climate services provision as well as an evaluation of the benefit of other sources of information. Inside the whole project, the work package 7 (WP7) entitled "Generation and Communication of Climate Services" was dedicated to transform INDECIS' climate datasets and indices into climate services, targeting a wide range of stakeholders. It has coordinated its delivery and effective communication, linking the outputs of WPs 3, 4, 5 and 6 to turn them into user-friendly products. The first step in WP7 was identified a strategy for the communication of climate services that was materialised in the deliverable 7.1. Furthermore, WP7 continued this work by developing, as a case study, a business model for the exploitation of climate service in the touristic sector that it was decribed in the deliverable 7.2. This work has been packaged into a software suite based in free open source language (e.g. R for calculations and graphics and SAGA for GIS) and front-ended with IDISP that it was presented in the deliverable 7.3.

WP7 also have the objective of definition of semi-automated basic climate services and the creation of semi-automated basic climate services. In that sense, the objective of deliverable D7.4a we present a new tool to visualization and download the 136 climate indices defined in WP4 in a customized way that can facilitate their exploitation for the ending users.

2. Visualization and download of climate indices

The Work Package 4, Indices Catalog, Definition and Implementation, offers to users the possibility of download 136 climate indices in NETCDF format (link https://indecis.csic.es/).

These NETCDF files cover a spatial domain of the whole Europe and 68 years of temporal record (from 1951 to 2018). Depending on the index, the temporal scale of the values is monthly, seasonal or annual scale.
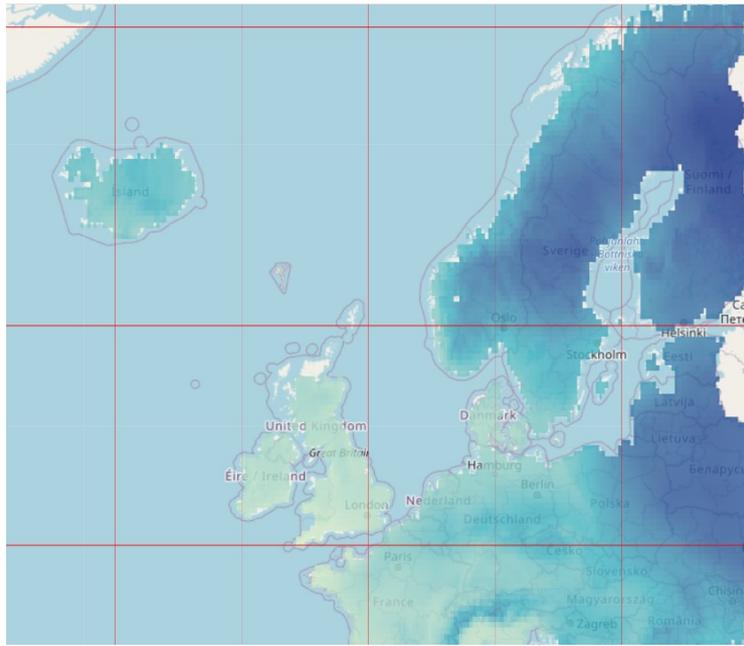
Figure 1. European spatial domain covered by INDECIS project

The files sizes are very huge due to the great spatial and temporal coverage. Therefore, in order to facilitate the handling of indices to the users, in Work Package 7 the Cut-netCDF software has been developed for cutting the NETCDF files choosing the spatial area and the temporal coverage.

This software consists of three R scripts that cut the netCDF files containing the climate indices defined in WP4, from all over Europe, and from the entire time period into smaller files for each of the European regions (NUTS) and for each of the indices, years and accumulations that are chosen. Thus, the resulting files are easier to manage and user-friendly due to their greater specificity and their smaller size. The package can be found in the web page of the project (http://indecis.eu/software.php) and in the web page developed for this purpose (http://indecis.aemet.es/indices/index.html).

Using this tool, users can obtain smaller downloaded files and, consequently, easy to handle. The resultant files are also more specific to the necessities of the users.

The resulting files can be also saved in the original NETCDF format or in four different formats: PNG, PDF, GeoTIFF, and SHP) that covers diverse user's necessities. Depending of the chosen browser, some files are directly visible.

Here below, several examples obtained from Cut-netCDF software are shown for:

a) France

b) Spain

c) Portugal

d) Region of Extremadura (Spain)
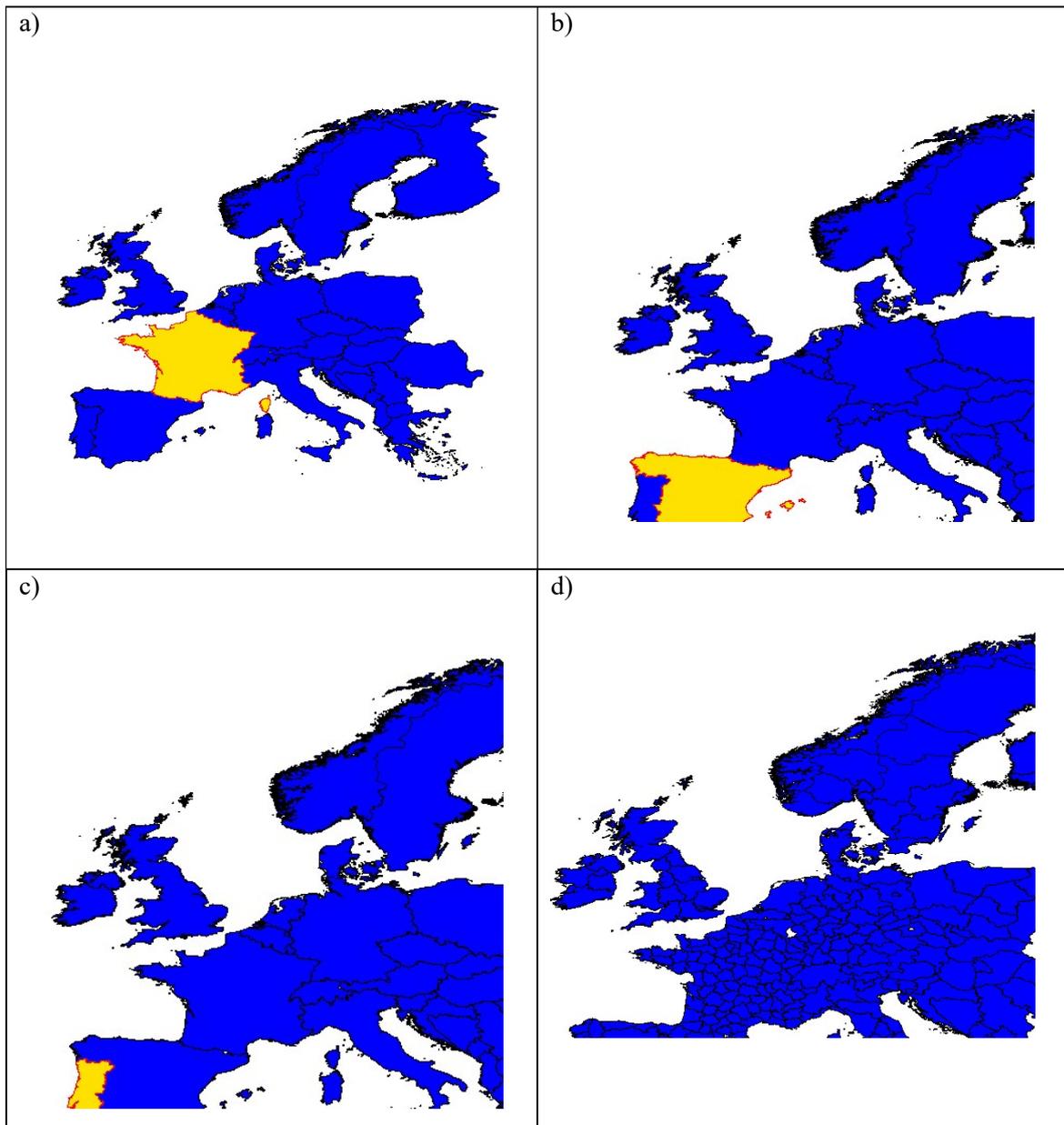
Figure 2: Four examples of spatial coverages that can be obtained from Cut-netCDF software

As examples, the monitor page allows to download several indices:

- FWI (Canadian Fire Weather Index)

- GTX (Monthly mean of daily maximum air temperature)

- R10mm (Number of days with precipitation greater than 10 mm)

- SPI12 (Standardized precipitation index for 12 months)

For FWI, GTX and R10mm indices the available values are:

- Annual mean

- Seasonal mean (spring, summer, autumn and winter)

- Monthly mean

For SPI12 index, monthly values are available.

Possible format for the download files are:

- NetCDF

- PDF

- PNG

- SHP

- GeoTIFF
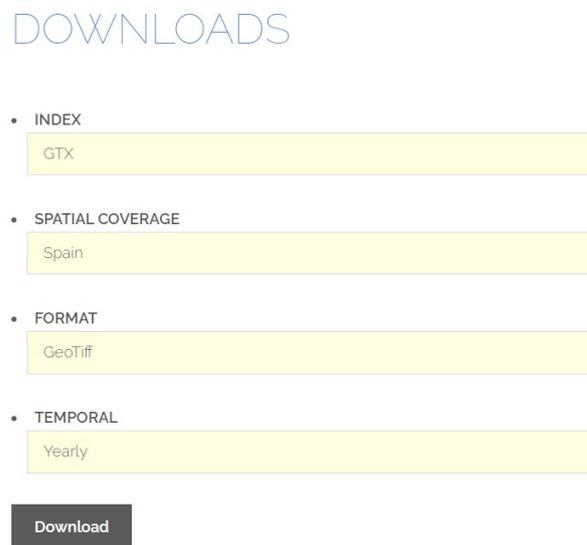
Figure 3. Image of the download tool available in http://indecis.aemet.es/indices/index.html

3. Description and download of Cut-netCDF software package

In the web page http://indecis.aemet.es/indices/codes.html there are a complete description of the software developed for cutting the netCDF files. The software has been developed in R language V3.6.2 (2019-12-12) -- "Dark and Stormy Night", Copyright (C) 2019 The R Foundation for Statistical Computing, Platform: x86_64-w64-mingw32/x64 (64-bit)

Three scripts have been generated that can be downloaded from:

- Cutting monthly mean values for NUTS

- Cutting seasonal mean values for NUTS

Indecis
Sectorial Climate Services

- [Cutting annual mean values for countries](#)

The scripts have a similar structure, comprehending the following steps:

- The R libraries that are needed for run are loaded into memory (these libraries must have been previously installed in the R package).

- The file paths are defined, it must be modified for each computer.

- The indices loop have annual, monthly and seasonal values begins, it is different in each case.

- The NetCDF orientation files is corrected if necessary.

- A loop is started for every nuts in which you want to calculate the values of the indices.

- A loop is started for every year in which the values of the indices are to be calculated.

- For every steps of this triple nested loop, the following files are calculated:

  - A GeoTIFF file with the chosen information about index, NUTS, year, season or month

  - A NetCDF file with the chosen information about index, NUTS, year, season or month

  - A SHAPE file with the chosen information about index, NUTS, year, season or month

  - A PDF file with the chosen information about index, NUTS, year, season or month

  - A PNG file with the chosen information about index, NUTS, year, season or month