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 7.3

D7.3 Release of the software suite and integration into IDSIP

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Summary

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1. Overview

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 inthe 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. But 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.

The objective of deliverable D7.3 is to make available a set of sotftware packages for users compresing a wide range of stakeholders in order to faciltate them the creation of self-made climate services from the data available from the results of WP2 and the complete set of indices available from the WP4 work.

2.- INDECIS Software suite

INDECIS has created or supports different software suites for climate data quality control and homogenisation, indices calculation, datasets inter-comparison and climate indices visualization. The ten developed packages are hereafter described.

2.1 INDECIS QC software (INQC)

This software was created by the C3/URV team. INQC is designed to perform the quality control of European Climate Assessment and Dataset (ECA&D) daily data of maximum, minimum and average temperature, precipitation, sea level pressure, relative humidity, wind speed, snow depth, cloud coverage and sunshine duration. Also, INQC's functions can be used to deal with quality control problems in any other climatological data set with the daily time resolution. INQC is in beta version (inqc_beta.R) available from GitHub.

INQC software link is: https://github.com/INDECIS-Project/INQC

2.2 QC software for tall towers wind data (QCSS4TT), created by BSC

This software was created by the BSC team. A tall tower or met mast consists of a high vertical structure (often reaching heights up to 100 meters above ground) with several booms distributed along the vertical mast. Those booms are instrumented with meteorological sensors

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that record wind speed, wind direction and other parameters at multiple heights above ground level. The special nature of these observational sites allows performing some non-standard quality control techniques.

QCSS4TT software link is https://earth.bsc.es/gitlab/jramon/INDECIS-QCSS4TT/

2.3 MetQC software

This software was created by the Global Change Research Institute of the Czech Academy of Sciences (GCRI) team. Original QC functions converted from ProClimDB into R software (called MetQC) form the basis of the presented software in order to be better usable by various users and applicable stand-alone. The main script (MetQC_frame.R) uses three main steps of the data processing, and is divided into functions accordingly: getting information about data, finding neighbours for subsequent data quality control, and data quality control itself. MetQC software link is http://www.climahom.eu/software/SW_2/MetQC_INDECIS_distrib. zip

2.4 INDECIS Software Suite for Indices Calculation

This software was created by the Instituto Pirenaico de Ecologia / Consejo Superior de Investigaciones Cientificas (CSIC) team. Open-source software, stand-alone and designed in R with capabilities to compute the 136 indices defined in the INDECIS project. Each index corresponds to a single function with options to be calculated on different time scales: annual, monthly and seasonal. Some of the indices only show an annual functionality, but most of them can be calculated at the three different time scales. The functions can be adapted to any format of data inputs and they can be adapted to calculate iteratively the climate indices from large datasets (e.g. gridded netcdf files). The software has been tested by using gridded climate data from ECA&D and ERA5.

The Software Suite for Indices Calculation can be found in https://cran.r-project.org/web/packages/ClimInd/index.html

2.5 INDECIS Software Suite of Atmospheric Circulation Indices Calculation

This software was designed by Santander Meteorology Group (UC-CSIC) team. With this Open-source software, standard large-scale circulation indices can be computed in a stand-alone way. It has been designed in R language. This package is integrated in the *climate4R* suite of climate analysis.

climate4R is a set of R packages for transparent climate data access, post processing (including bias correction and downscaling) and visualization. For more information and references, visit the *climate4R* page: https://github.com/SantanderMetGroup/climate4R.

climate4R.indices is the package to compute several indices within the *climate4R* framework, therefore is seamlessly integrated with the *climate4R* data structures, and provides support for parallel computing. The software is accessible from https://github.com/SantanderMetGroup/climate4R.indices

2.6 INDECIS software for intercomparison of reanalysis datasets (INTERDECIS)

INTERDECIS is an open-source software, stand-alone and designed in R with capabilities to analyse the various climatic datasets performance using as reference E-OBS gridded dataset and ERA5 reanalysis product. The functions can be applied to any NetCDF files, as long as they are regularly spaced in the lat/lon grid format. Accuracy measures can be computed from the values extracted from the cells (grids) of the reference (E-OBS/ERA5) and analysed datasets, in which a given coordinates (points) fall. The development version of the interdecis can be installed in R environment from the GitHub repository, with sample data available on interdecisdata R package.

INTERDECIS software was designed by National Meteorological Administration (MeteoRo) and can be found in https://github.com/alexdum/interdecis

2.7 fireDanger: R package for calculation of fire danger indices

This software was designed by Santander Meteorology Group (UC-CSIC) team. FireDanger is a R package for the calculation of fire danger indices, including INDECIS set of forest fire indices: Fire Weather Index, Finnish Forest Fire Danger Index, Keetch-Byram Drought Index, McArthur Forest Fire Danger Index and Modified Nesterov Index. Firedanger was designed can be found in https://github.com/SantanderMetGroup/fireDanger

2.8.- INDECIS Suite for Homogenization of ECA&D Daily Series

The functions used for the homogenization of the daily ECA&D series have been developed by AEMET team and can be found in http://indecis.eu/software.php.

2.9 Cut-netCDF Suite for trimming huge netCDF files

The 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 have been developed by AEMET team and can be found in http://indecis.eu/software.php.

2.10.- INDECIS Sun and Beach Index Calculator

This R package allows you to download the data and calculate the INDECIS Sun and Beach Index (INSBIN) for specific coordinates. It has been realized within the INDECIS project and WP7 works. From the workshops held with local agents of sun and beach tourism, the variables and their values have been defined, allowing to calculate the index.

The package have been developed by C3/URV team and can be found in http://indecis.eu/software.php.

Annex 1. List of software suites.

Software name	Purpose	Institution	Contact
INQC	Quality Control of ECA&D	C3/URV	enric.aguilar@urv.cat
QCSS4TT	Quality Control for tall towers wind data	BSC	jaume.ramon@bsc.es
MetQC software	Generic Quality Control functions	GCRI	stepanek.p@czechglobe.cz
Climate Indices	Indices calculation suite	IPE/CSIC	svicen@ipe.csic.es
Large-scale circulation indices	Large-scale circulation indices calculation suite	UC-CSIC	ana.casanueva@unican.es
INTERDECIS	Intercomparison of reanalysis datasets	MeteoRo	dumitrescu@meteoromania.ro
fireDanger	Calculation of fire danger indices	UC-CSIC	joaquin.bedia@unican.es
Homogenization	Homogenization suite for ECA&D	AEMET	jguijarrop@aemet.es
Cut-netCDF	R scripts that trim the netCDF files in smaller ones.	AEMET	mnunezc@aemet.es
INSBIN Calculator	R script for download data and calculate INDECIS Beach Tourism	UC3/URV	jonxavier.olano@urv.cat

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