
CLIMADA-App Documentation

Release latest

EIOPA

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GENERAL DESCRIPTION

Data and models on climate-related risks are crucial to improve the accuracy of climate risk assessment for the ultimate benefit of policyholders as well as of industry, the supervisory community and the public sector in general.

For example, in its application guidance on running climate change materiality assessment and using climate change scenarios in the ORSA¹, EIOPA clearly depicted the availability of tools to be one major challenge SMEs will face when doing such exercise. While more and more tools and data are available/developed, it is still challenging to get access to the right tools/data. For example, some tools might be user-friendly but very expensive to use and vice versa some tools are available as open source but may not be user friendly.

EIOPA aims to support the modelling and management of climate change risks, by promoting the development of open-source models (see EIOPA's sustainable finance key areas of activities²). This should reduce the costs of running climate change analyses, increase innovation, democratise the use of cat models, raise awareness of the risks...

¹ EIOPA publishes application guidance on how to reflect climate change in ORSA | Eiopa (europa.eu)

² Sustainable finance | Eiopa (europa.eu)

THE CLIMADA-APP

The CLIMADA-App developed by EIOPA is a case study to encourage further developments, help stakeholders to start doing cat modelling in an easy way to understand their risks... This is in line with EIOPA's efforts to build a bridge between the latest development in climate science and the insurance industry/supervisors.

The CLIMADA-App is a user interface interface which should facilitate the use of the open-source cat model **CLIMADA**³. The user interface is a free software. You can redistribute and/or modify it. The installation and use of the user interface is done at the user's discretion and risk. The user agrees to be solely responsibility for any damage to the computer system, loss of data or any other damage resulting from installation or use of the software. EIOPA shall not be responsible or liable for any damages arising in connection with downloading, installation, modifying or any other use of the software. EIOPA shall assume no responsibility for the underlying model, hazard data, vulnerability data, exposure data, any errors or other mistakes or inaccuracies in the software, in the results produced by the software or in the related documentation. EIOPA can not guarantee compatibility with future versions of CLIMADA.

License for CLIMADA:

Copyright (C) 2017 ETH Zurich, **CLIMADA contributors listed in AUTHORS**. CLIMADA is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License Version 3, 29 June 2007 as published by the Free Software Foundation, <https://www.gnu.org/licenses/gpl-3.0.html>. CLIMADA is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details: <https://www.gnu.org/licenses/gpl-3.0.html>.

To enhance usability and provide users with a comprehensive understanding of the scenarios, the CLIMADA-App's graphical user interface has been tailored to users' needs. The App generates responsive exposure, hazard, and risk maps with detailed information, offering valuable visual insights into the spatial distribution and intensity of various climate-related factors.

In addition to these informative maps, the CLIMADA-App also produces two types of comprehensive reports: A PDF report that provides a concise summary of the executed scenario, featuring visuals such as images, diagrams, and essential summaries of the findings. This format makes it easy for users to grasp the key takeaways and share them with relevant stakeholders.

An XLSX report that delivers a more detailed data-driven output, presenting results produced by CLIMADA at various levels, including country, NUTS2, and aggregated levels. This comprehensive dataset allows users to delve deeper into the analysis, extract specific information, and perform further investigations as needed.

By generating responsive maps, PDF summaries, and XLSX data reports, the CLIMADA-App caters to different user requirements, offering a holistic view of climate-related risks and enabling in-depth analysis.

³ CLIMADA has not been developed to do detailed pricing analyses. The model can provide aggregated views of nat cat risks.

INSTALLATION

Installation guidelines for users

The following installation guidelines are designed to help users quickly set up the CLIMADA-App and start generating maps and reports.

As a desktop application, CLIMADA-App does not require a direct installation process. Instead, users will receive a compressed folder containing the necessary executable files. To set up the application, follow these steps:

1. Download the zipped folder containing the CLIMADA-App package.
2. Unzip the folder within the chosen directory. Keep in mind that this could take a reasonable amount of time, depending on the environment, due to the large amount of files.
3. Run the application by double-clicking the CLIMADA-APP.exe file.

By following these steps, users can easily start working with the CLIMADA App to create maps, analyze scenarios, and generate comprehensive reports.

Installation guidelines for developers

These installation guidelines are primarily aimed at developers who want to maintain or extend the current codebase and need to assess how the implemented software changes impact the design and functionality of the application.

The CLIMADA App package already includes a frozen conda environment under the `climada_env` folder. The `climada_env` offers everything needed to run the application. If developers want to replicate the environment for local development, add or delete modules, a conda environment should be created using the `environment.yml` file.

Follow these steps to set up the development environment:

Inside the base folder of the cloned project, run the following command to create the `climada-app` conda environment:

INSTALLATION GUIDELINES FOR DEVELOPER

1. Download the zipped folder containing the CLIMADA-App package.
2. Unzip the folder within the chosen directory. Keep in mind that this could take a reasonable amount of time, depending on the environment, due to the large amount of files.
3. Run the application by double-clicking the CLIMADA-APP.exe file.

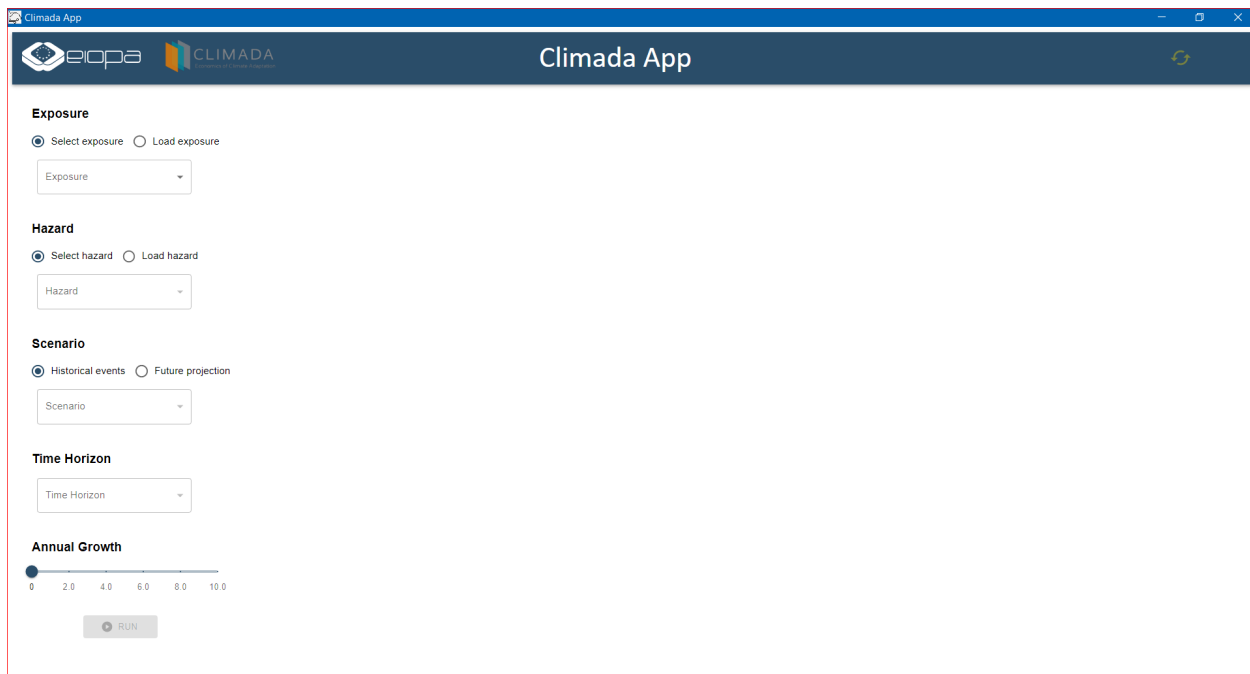
By following these steps, users can easily start working with the CLIMADA-App to create maps, analyze scenarios, and generate comprehensive reports. Inside the base folder of the cloned project run the following command to create the climada-app conda environment. =====

```
conda env create -f environment.yml
```

To start the client CLIMADA user interface, execute the two commands below:

```
npm install  
npm start
```

After executing the above commands, a CLIMADA-App window will open, displaying the interface as shown in the image below.



4.1 Basic Definitions

Table 1: Table of Basic Definitions (Part 1)

Vocabulary	Definitions
CLIMADA	CLIMate ADAptation
Python	An interpreted high-level general-purpose programming language.
Anaconda	A Python distribution to simplify package management/deployment.
Engine	The CLIMADA Engine contains the Impact and Cost-Benefit classes, which are where the main model calculations are done, combining Hazard and Entity objects.
Sphinx	A tool to create documentation.
Makefile	A special file containing shell commands to be executed.
Hazard	A class that stores sets of geographic hazard footprints.
Entity	This is a container that groups CLIMADA's socio-economic models.
Exposures	The geolocated exposures. Each exposure is associated with a value, which can be a dollar value, population, crop yield, etc, information to associate it with impact functions for the relevant hazard(s) (in the Entity's ImpactFuncSet), a geometry, and other optional properties such as deductables and cover.
Impact	A class that stores CLIMADA's modelled impacts and the methods to calculate them from Exposure, Impact Function and Hazard classes.
CostBenefit	A class to appraise adaptation options. It uses an Entity's MeasureSet to calculate new Impacts based on their adjustments to hazard, exposure, and impact functions, and returns statistics and plotting routines to express cost-benefit comparisons.
Storm tracks	Storm tracks are created and stored in a separate class, TCTracks. We use its method from_ibtracs_netcdf to create the tracks from the IBTRaCS storm tracks archive.
Centroids	A hazard's centroids can be any set of locations where we want the hazard to be evaluated.
Impact functions	Impact functions describe a relationship between a hazard's intensity and your exposure in terms of a percentage loss.

Table 2: Table of Basic Definitions (Part 2)

Vocabulary	Definitions
Adaptation measures	CLIMADA's adaptation measures describe possible interventions that would change event hazards and impacts, and the cost of these interventions. They are stored as Measure objects within a MeasureSet container class.
Discount rates	The disc_rates attribute is of type DiscRates. This class contains the discount rates for the following years and computes the net present value for given values.
OpenStreetMap	OpenStreetMap methods to create exposures from data available through the OpenStreetMap API.
LitPop	Regional economic model using nightlight and population maps together with several economic indicators.
BlackMarble	Regional economic model from nightlight intensities and economic indicators (GDP, income group). Largely succeeded by LitPop.
climada.util.client.Client	For programmatical access to the CLIMADA data API, this is the REST call wrapper class.
Server	The CLIMADA data file server is hosted on https://data.iac.ethz.ch that can be accessed via a REST API at https://climada.ethz.ch
Client	Python wrapper around REST calls to the CLIMADA data API server.
Unique Identifiers	Any dataset can be identified with data_type, name and version. The combination of the three is unique in the API servers' underlying database. However, sometimes the name is already enough for identification. All datasets have a UUID, a universally unique identifier, which is part of their individual url. E.g., the uuid of the dataset https://climada.ethz.ch/rest/dataset/b1c76120-4e60-4d8f-99c0-7e1e7b7860ec is "b1c76120-4e60-4d8f-99c0-7e1e7b7860ec".

Table 3: Table of Basic Definitions (Part 3)

Vocabulary	Definitions
Data Set Status	The datasets of climada.ethz.ch may have the following statuses a) active: the default for real life data, b) preliminary: when the dataset is already uploaded but some information or file is still missing, c) expired: when a dataset is inactivated again and d) test_dataset: data sets that are used in unit or integration tests have this status in order to be taken seriously by accident.
TropCylcone	Hazard-derived class for tropical cyclones
River flooding	A global water depth hazard for flood, including methods to work with ISIMIP simulations.
European windstorms	A Hazard extension which includes methods to read and plot footprints from the Copernicus WISC dataset and for DWD and ICON forecasts.
ImpactFuncSet	Functions to describe the impacts that hazards have on exposures, expressed in terms of e.g. the % dollar value of a building lost as a function of water depth, or the mortality rate for over-70s as a function of temperature.
CostBenefit	A class to appraise adaptation options.

FUNCTIONALITY

Table of Contents for Functionality

- *Functionality*
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 - *CLIMADA-App Overview*
 - *Generic example: All data is fetched from CLIMADA's API*
 - * *Load Exposure example: User loads an Exposure xlsx dataset and all other data is fetched from CLIMADA's API*
 - * *Load Hazard example: User loads a Hazard .hdf5 file and all other data is fetched from CLIMADA's API*
 - * *Load Exposure and Hazard example: User loads an Exposure xlsx dataset and a Hazard .hdf5 file.*
 - * *Offline Capability of CLIMADA-App.*

5.1 Explanation of Input parameters

An explanation of the CLIMADA-App UI parameters is provided in the lines below.

- **Exposure** represents assets, people, livelihoods, infrastructures, and other elements within an area of interest that are potentially exposed to hazards. In the CLIMADA-App, users can:
 - (1) select an Exposure from the drop-down menu which uses the LitPop-module, a component of the probabilistic natural catastrophe damage model CLIMADA. The LitPop-module downscales national asset value estimates proportionally to a combination of nightlight intensity (“Lit”) and population data (“Pop”)
 - (2) load an Exposure(at country or NUTS2 or latitude/longitude level) in Excel format from the ‘data/exposures’ directory (examples of excel input files can be found in the data/exposure directory).
- **Hazard** refers to weather events like storms, floods, droughts, or heat waves, characterized by both their probability of occurrence and physical intensity. Hazard classes collect historical data or model simulations, transforming them as necessary to create a coherent event database. Users can load a Hazard file in hdf5 format from the ‘data/hazards’ directory.
- **Climate Scenario** denotes a climatological event set, often represented by codes such as RCP 2.6 (Representative Concentration Pathway)

- **Time Horizon** specifies a suitable time frame for socioeconomic scenarios driving climate change models. Time horizons can be historical (past) or future projections.
 - **Annual Growth** refers to the projected economic growth.
-

5.2 CLIMADA-App Overview

The CLIMADA-App enables users to conduct various model experiments by choosing different combinations of input parameters. For Exposure and Hazard, users can select values from a dropdown list or import a file (Excel for Exposure, hdf5 for Hazard).

The available hazard types within the CLIMADA-App are Storm Europe and River flood. When selecting a Hazard, users can choose a Historical scenario or a future projection scenario (RCP 2.6, RCP 4.5d, RCP 6.0, RCP 8.5). Currently, no future projection scenarios are available for the Storm Europe hazard type. The User would then also need to select the time horizon and the annual growth (if needed).

5.3 Generic example: All data is fetched from CLIMADA's API

Quick Description: *The following section outlines CLIMADA-App's functionality by detailing the use case where the User selects all available input options and all data is fetched from CLIMADA's API. For this an internet connection is needed.*

Note: The functionality demonstrated in the workflow below requires the CLIMADA-App interface application to be installed on the user's computer.

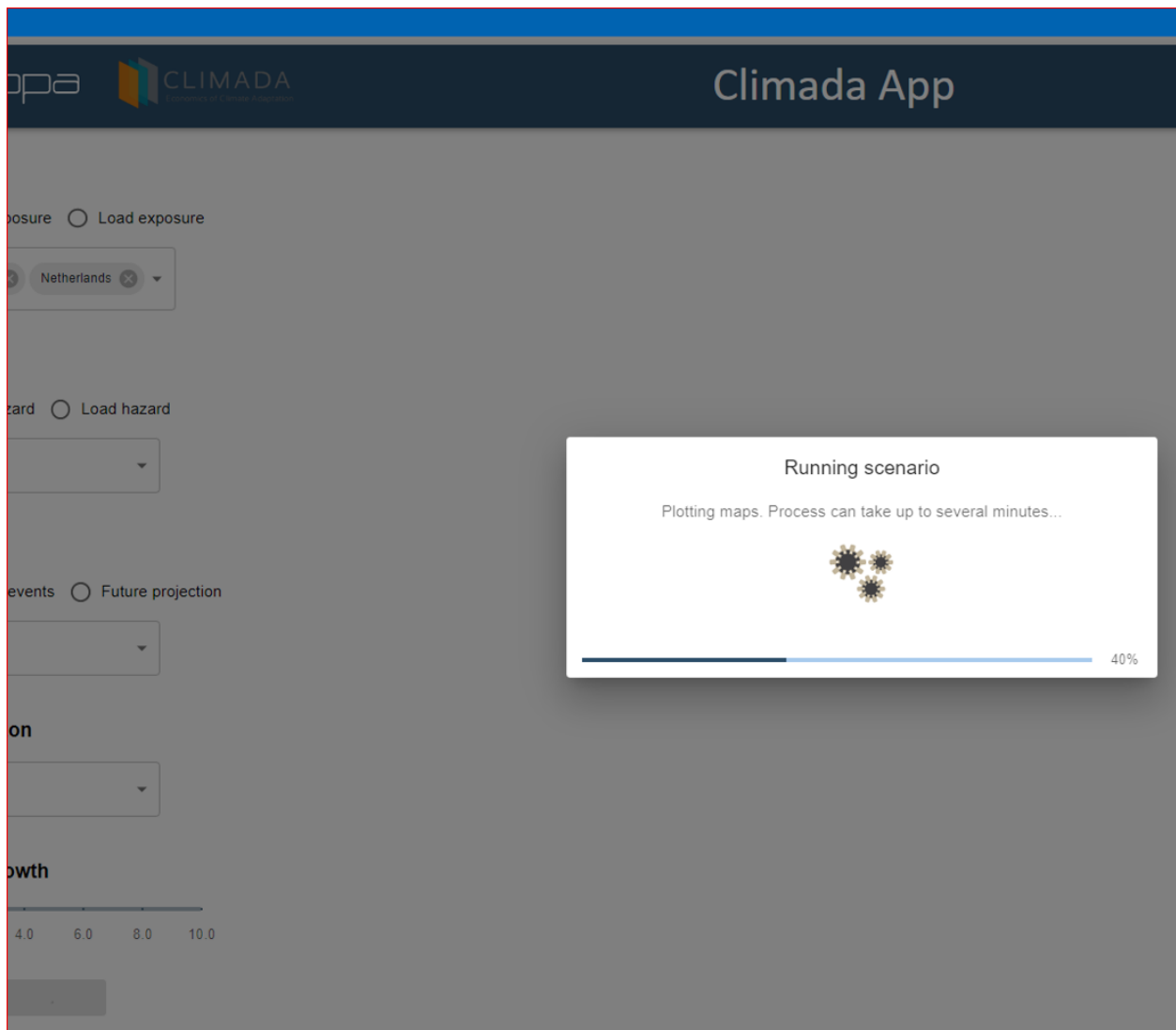
The user of the current CLIMADA-App UI application can select preferred values from the input fields in sequential order. In the following image, an example is displayed showing how the user can select options from the input fields.

The screenshot displays the Climada App interface with the following configuration options:

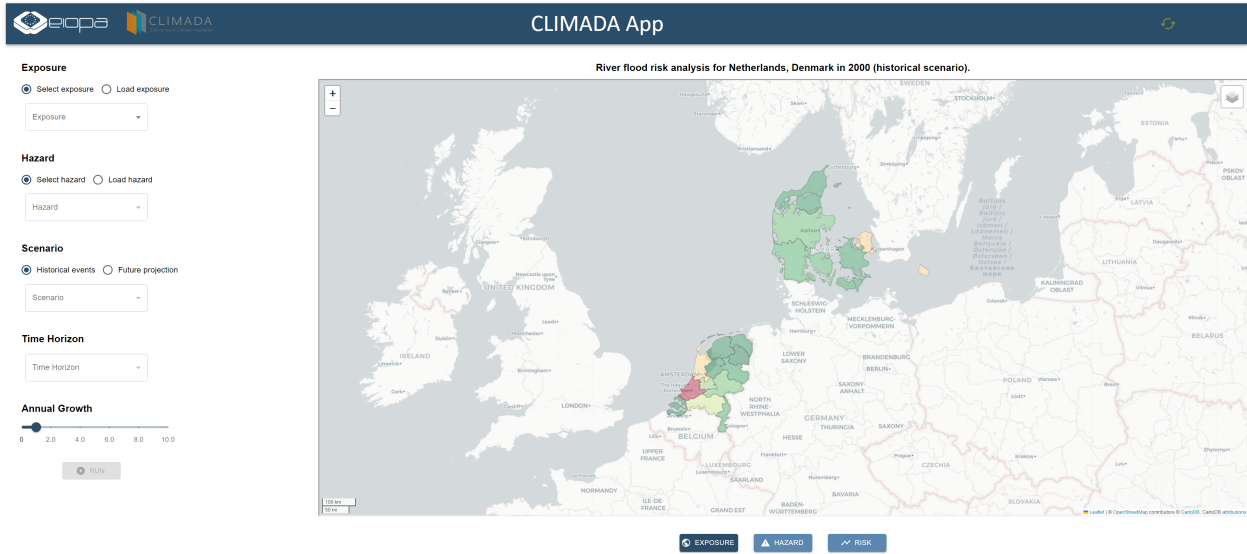
- Exposure:** Radio buttons for "Select exposure" (selected) and "Load exposure". A multi-select dropdown menu shows "Denmark" and "Netherlands" selected.
- Hazard:** Radio buttons for "Select hazard" (selected) and "Load hazard". A dropdown menu shows "River flood" selected.
- Scenario:** Radio buttons for "Historical events" (selected) and "Future projection". A dropdown menu shows "Historical" selected.
- Time Horizon:** A dropdown menu shows "2000" selected.
- Annual Growth:** A slider control ranging from 0 to 10.0, with the value set at approximately 1.0.

A "RUN" button is located at the bottom of the configuration area.

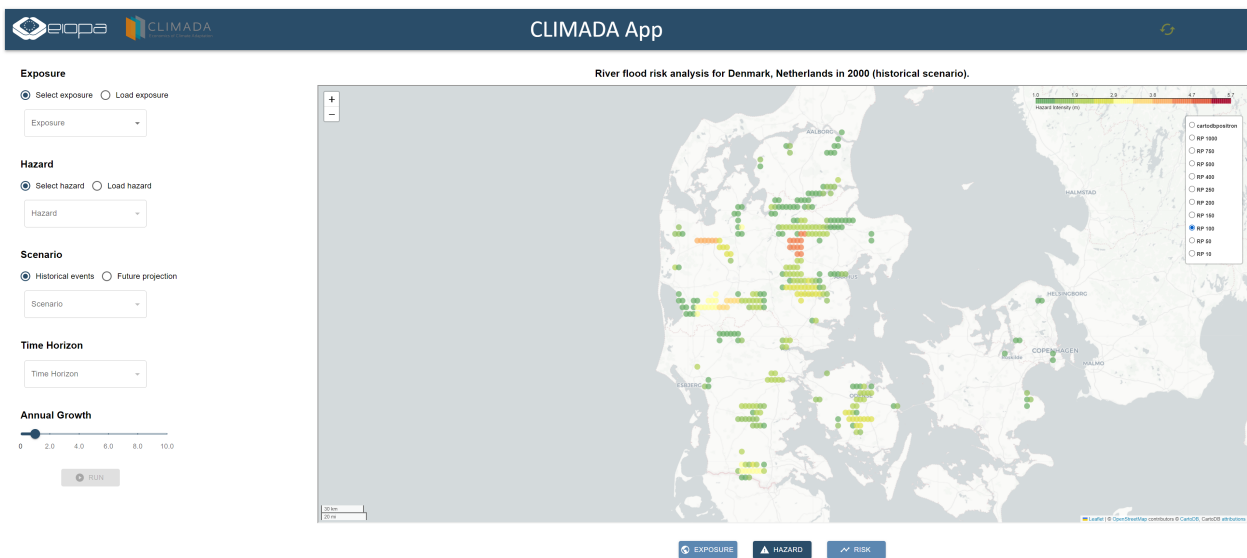
After the user has selected the appropriate and valid options from the filtering fields, the program can be executed by clicking on the RUN button.



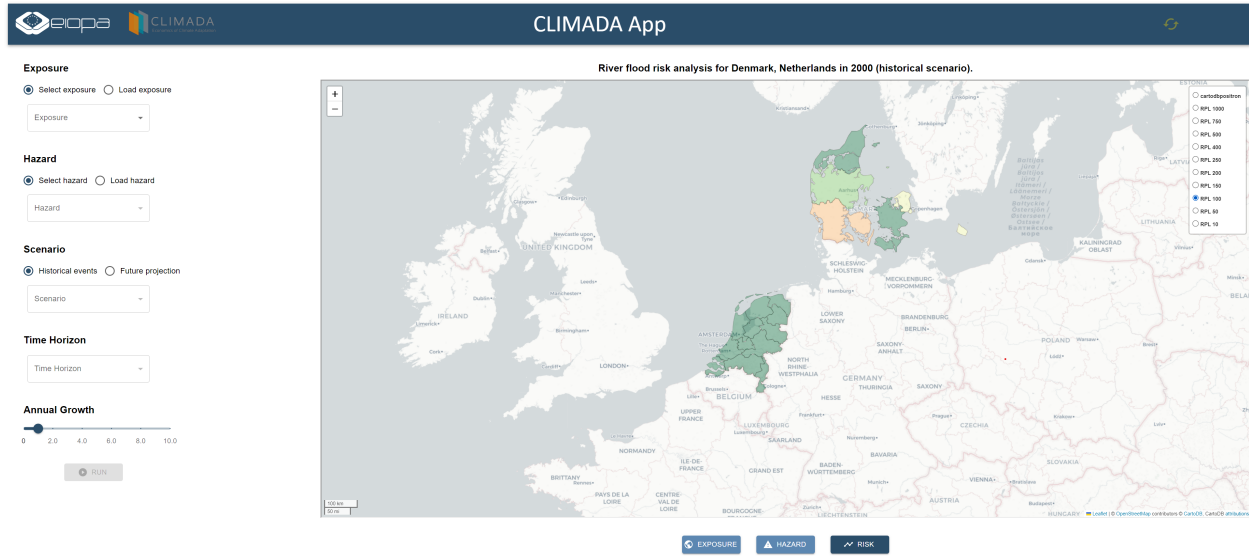
In the screen below you can see the maps generated by CLIMADA-App visible to the user.
The map generated from the exposure perspective.



The map generated from the hazard perspective with a return period of 100 years.



Also, the map generated from the risk perspective with a return period of 100 years.



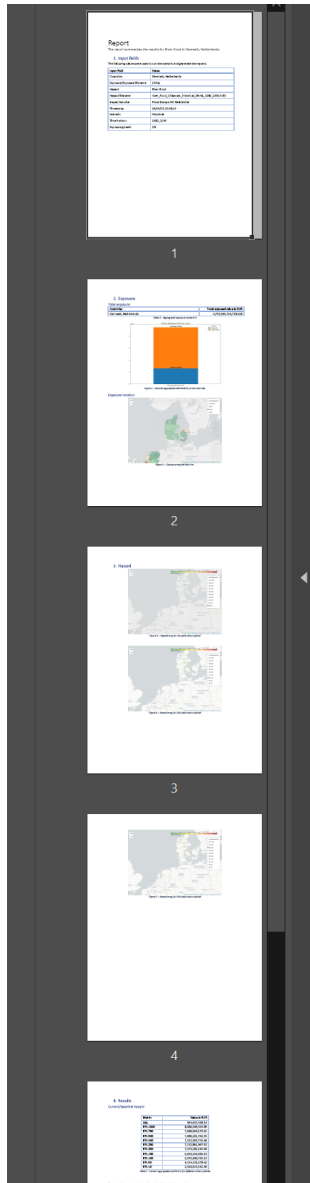
Finally, an excel and a pdf report is generated according to the report_template.docx format in the data/reports/ project directory.

An example of a generated excel report can be seen in the image below.

Country results			
1. Exposure			
Country	Total exposed value in EUR		
Denmark	1,306,677,104,152.16€		
Netherlands	3,429,013,610,566.14€		
2. Results in EUR			
Peril	Country	Metric	Value
River flood	Denmark	AAL	964,633,059.29€
River flood	Denmark	RPL 1000	8,486,096,616.86€
River flood	Denmark	RPL 750	7,984,694,179.91€
River flood	Denmark	RPL 500	7,483,291,742.95€
River flood	Denmark	RPL 400	7,313,565,705.40€
River flood	Denmark	RPL 250	7,132,891,967.92€
River flood	Denmark	RPL 200	7,103,181,160.64€
River flood	Denmark	RPL 150	6,959,354,999.19€
River flood	Denmark	RPL 100	6,575,949,730.20€
River flood	Denmark	RPL 50	4,154,136,278.42€
River flood	Denmark	RPL 10	2,399,613,162.50€
River flood	Netherlands	AAL	308.86€
River flood	Netherlands	RPL 1000	96,830.48€
River flood	Netherlands	RPL 750	78,684.18€
River flood	Netherlands	RPL 500	60,537.88€
River flood	Netherlands	RPL 400	56,199.52€
River flood	Netherlands	RPL 250	34,988.13€
River flood	Netherlands	RPL 200	21,635.20€
River flood	Netherlands	RPL 150	17,597.75€
River flood	Netherlands	RPL 100	0.00€

Navigation bar: General information | Aggregated results | **Country results** | NUTS2 results | List of NUTS | +

An example of a generated pdf report can be seen in the following image.



Report

The report summarizes the results for River flood in Denmark, Netherlands.

1. Input fields

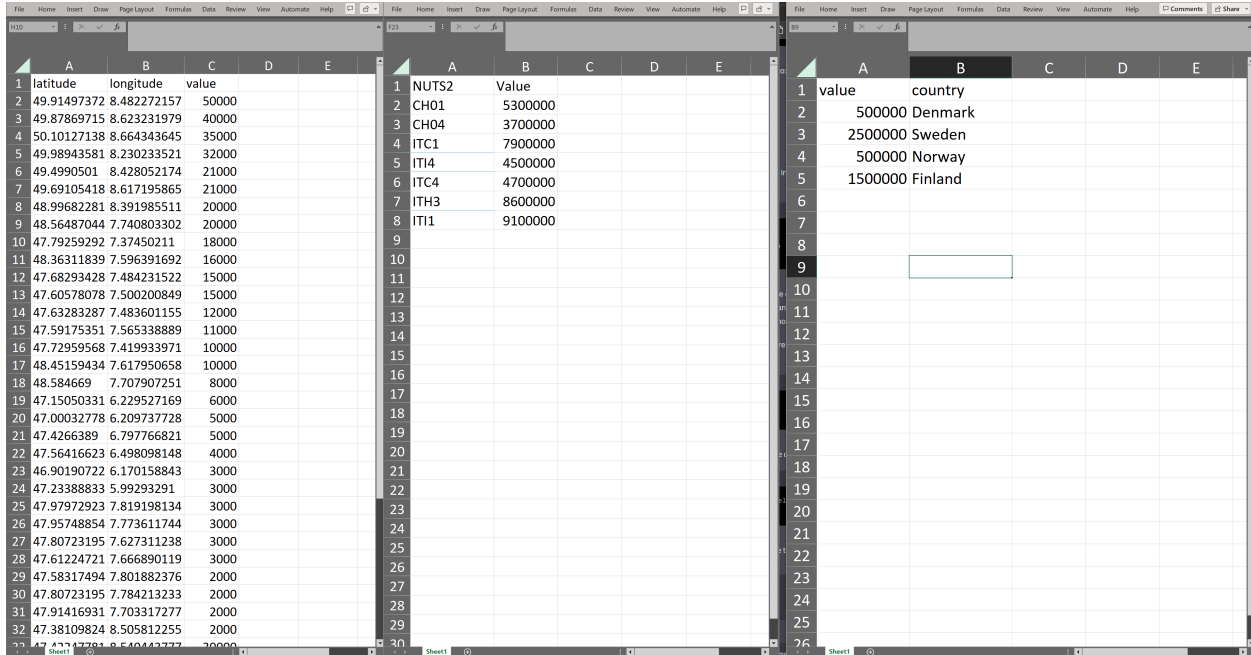
The following values were used to run the scenario and generate the reports:

Input field	Value
Countries	Denmark, Netherlands
Exposure/Exposure filename	LitPop
Hazard	River flood
Hazard filename	river_flood_150arcsec_historical_DK-NL_1980_2000.hdf5
Impact function	Flood Europe JRC Residential
Timestamp	26/04/23 23:58:15
Scenario	historical
Time horizon	1980_2000
Exposure growth	1%

5.3.1 Load Exposure example: User loads an Exposure xlsx dataset and all other data is fetched from CLIMADA's API

CLIMADA-App offers the option to run a scenario with customized user input data, instead of fetching the data from CLIMADA's API. The user can load a custom Exposure dataset in xlsx format by clicking on the Load exposure radio button in the Exposure input section. Examples of .xlsx Exposure templates can be found in the application's resources/data/exposures directory. The .xlsx Exposure templates are available in three different formats:

- Lat/long granularity
- NUTS2 administration level granularity
- Country level granularity



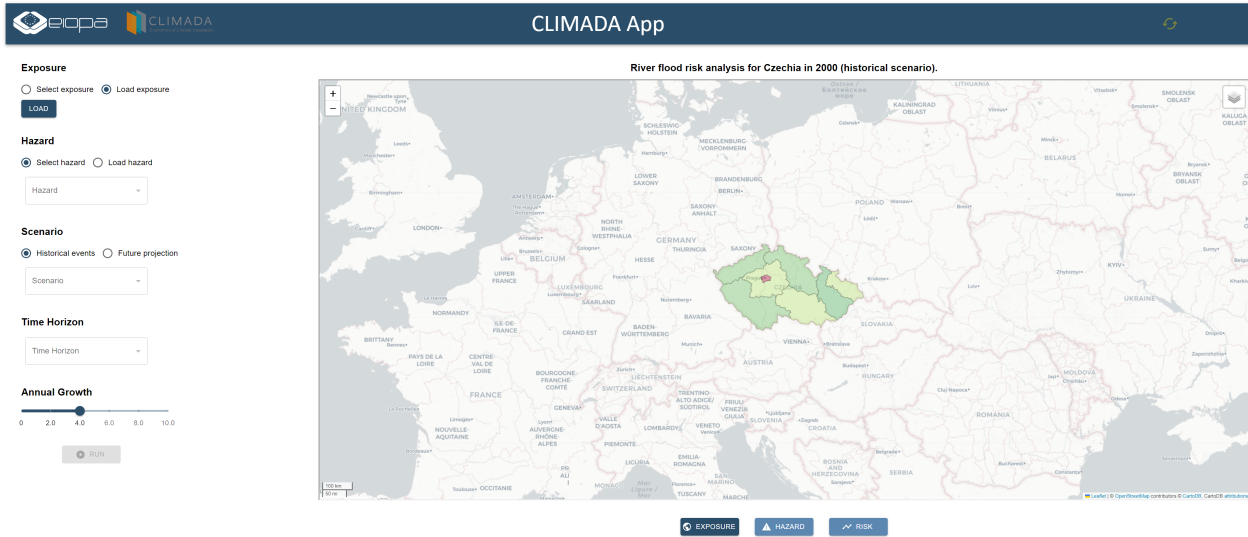
The User selects the rest of the input fields to fetch the additional datasets (Hazard, scenario, time horizon) from CLIMADA's API.

The screenshot displays the CLIMADA App interface with the following sections:

- Exposure:** Radio buttons for "Select exposure" and "Load exposure" (selected). A "LOAD" button is present.
- Hazard:** Radio buttons for "Select hazard" (selected) and "Load hazard". A dropdown menu is set to "Hazard".
- Scenario:** Radio buttons for "Historical events" (selected) and "Future projection". A dropdown menu is set to "Scenario".
- Time Horizon:** A dropdown menu set to "Time Horizon".
- Annual Growth:** A slider ranging from 0 to 10.0, with the marker positioned at 0.

A "RUN" button is located below the Annual Growth slider. A green notification box at the bottom right states: "Hazard params set successfully. X".

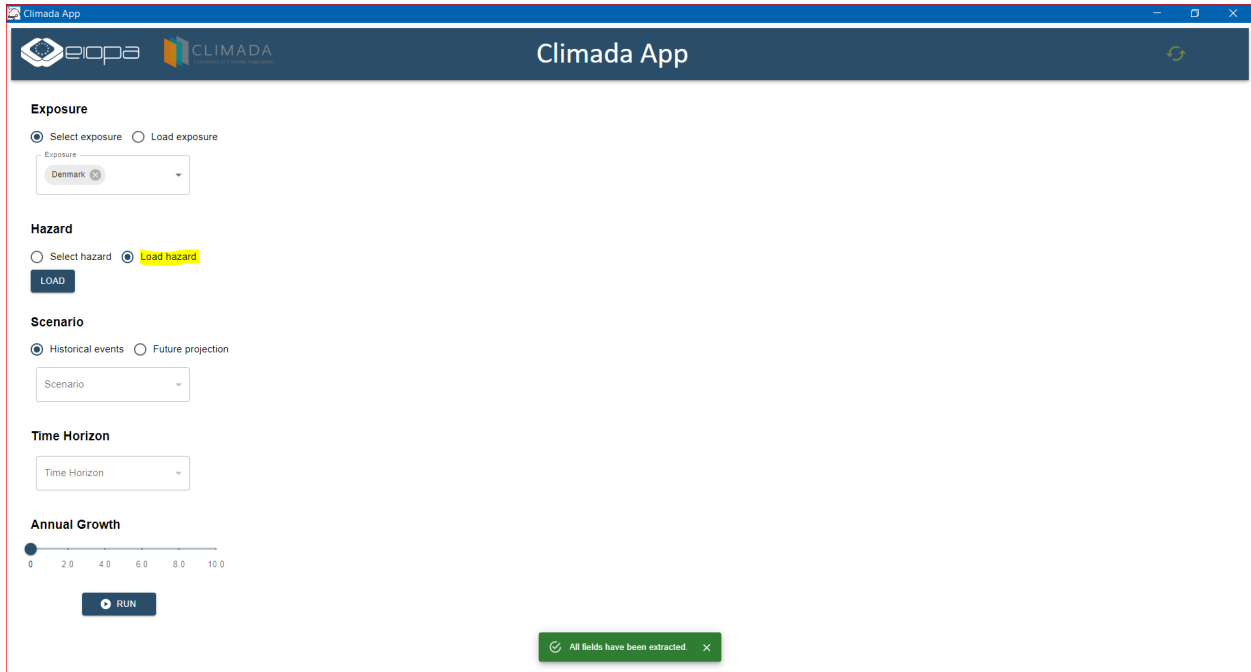
Then, once the “RUN” has been selected the maps (Exposure, Hazard and Risk) are generated.



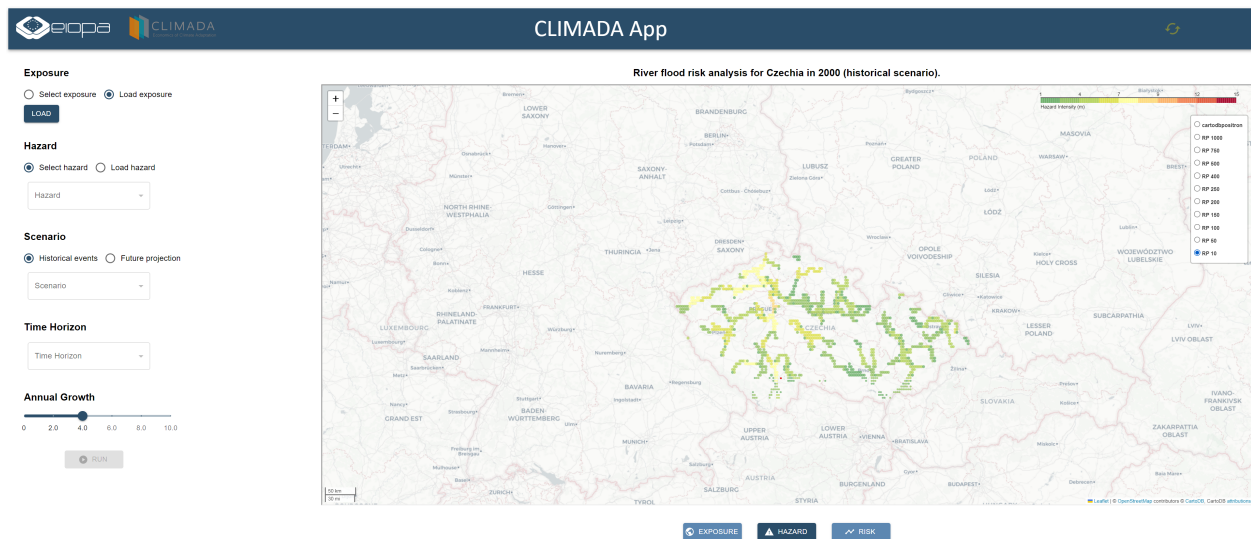
Note: Custom .xlsx Exposure datasets need to be added in resources/data/exposures to be recognised by CLIMADA-App

5.3.2 Load Hazard example: User loads a Hazard .hdf5 file and all other data is fetched from CLIMADA's API

CLIMADA-App offers the option to run a scenario with customized user input data, instead of fetching the data from CLIMADA's API. The user can load a Hazard .hdf5 file by clicking on the Load hazard radio button in the Hazard input section. Previously downloaded hazard .hdf5 files from CLIMADA's API can be used again as Hazard input data.



Then, once the remaining input options have been selected the output is generated similarly to other use cases.



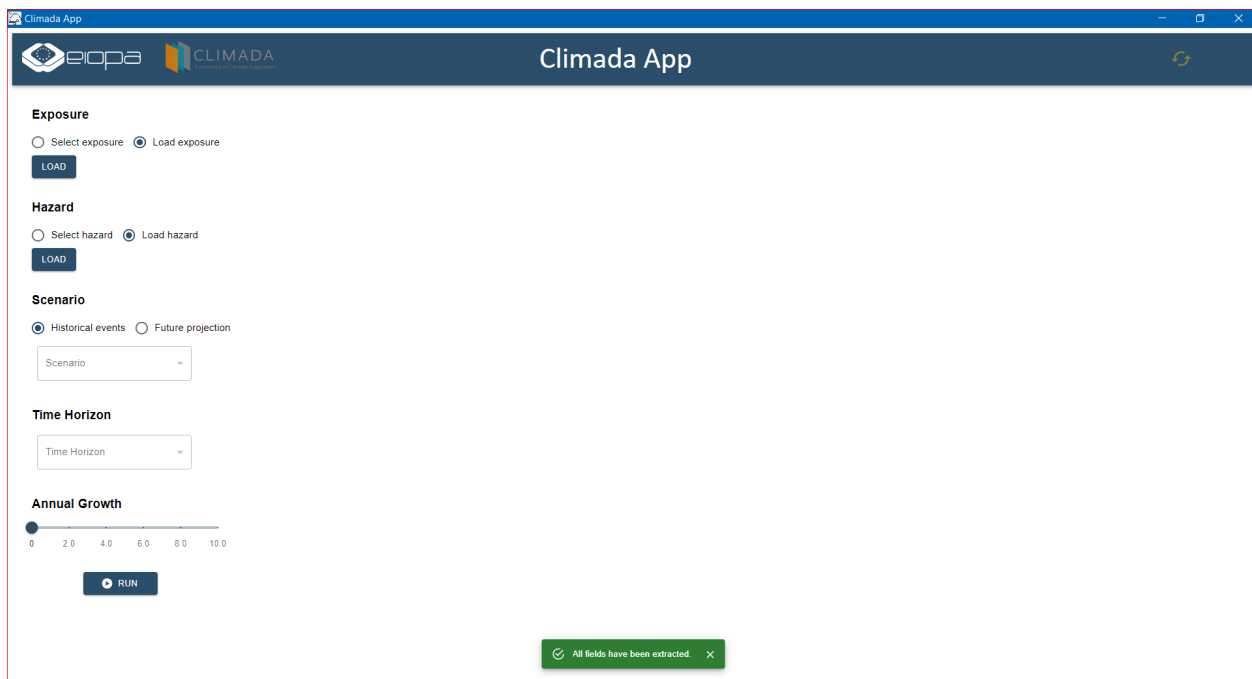
Note: Custom .hdf5 Hazard datasets need to be added in resources/data/hazards to be recognised by CLIMADA-App

5.3.3 Load Exposure and Hazard example: User loads an Exposure xlsx dataset and a Hazard .hdf5 file.

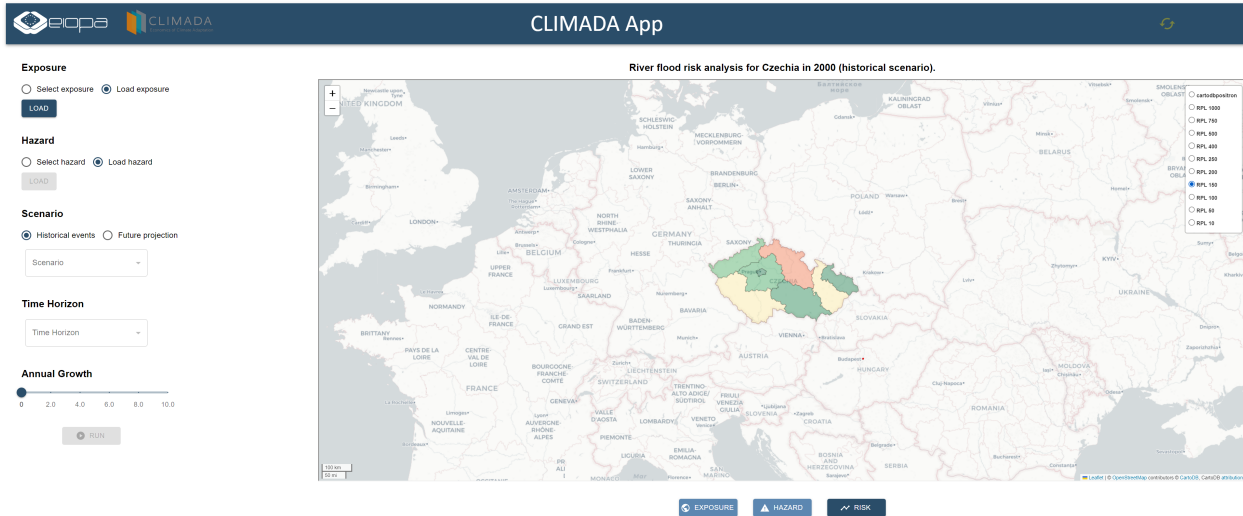
CLIMADA-App offers the option to run a scenario with customized user input data, instead of fetching the data from CLIMADA's API. The user can load a custom Exposure dataset in xlsx format by clicking on the Load exposure radio button in the Exposure input section and load a Hazard .hdf5 file by clicking on the Load hazard radio button in the Hazard input section. Previously downloaded hazard .hdf5 files from CLIMADA's API can be used again as Hazard input data. Examples of .xlsx Exposure templates can be found in the application's resources/data/exposures directory. The .xlsx Exposure templates are available in three different formats:

- Lat/long granularity
- NUTS2 administration level granularity
- Country level granularity

Note: When the user chooses to import the exposure file and to import the hazard file then there is no need to complete the remaining input options.



Then the maps are generated as shown in the screen below. Also, the excel and pdf report are created and stored in the data/reports/ project directory.

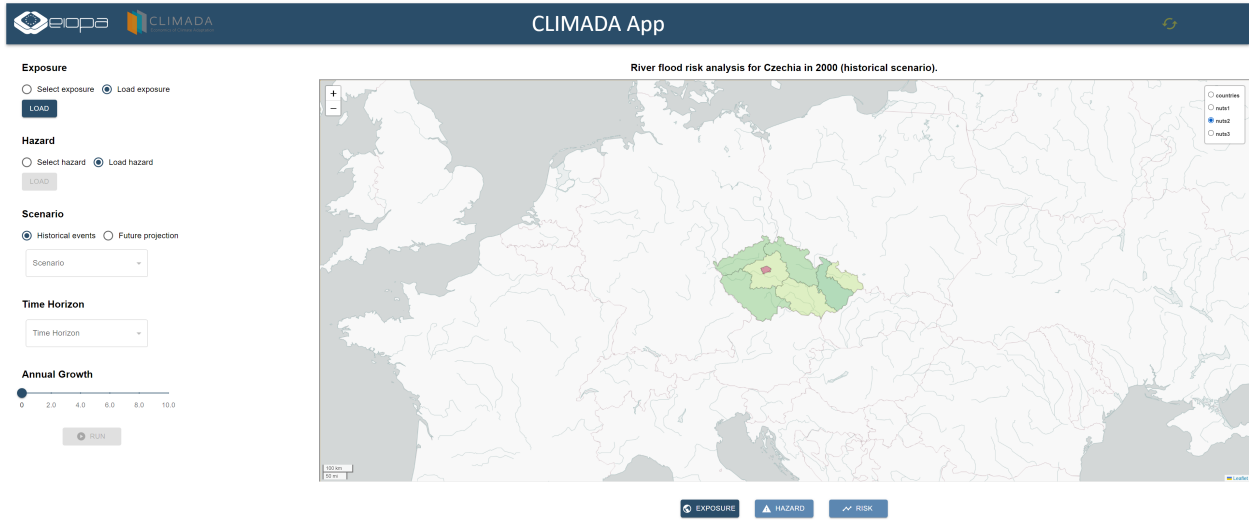


5.3.4 Offline Capability of CLIMADA-App.

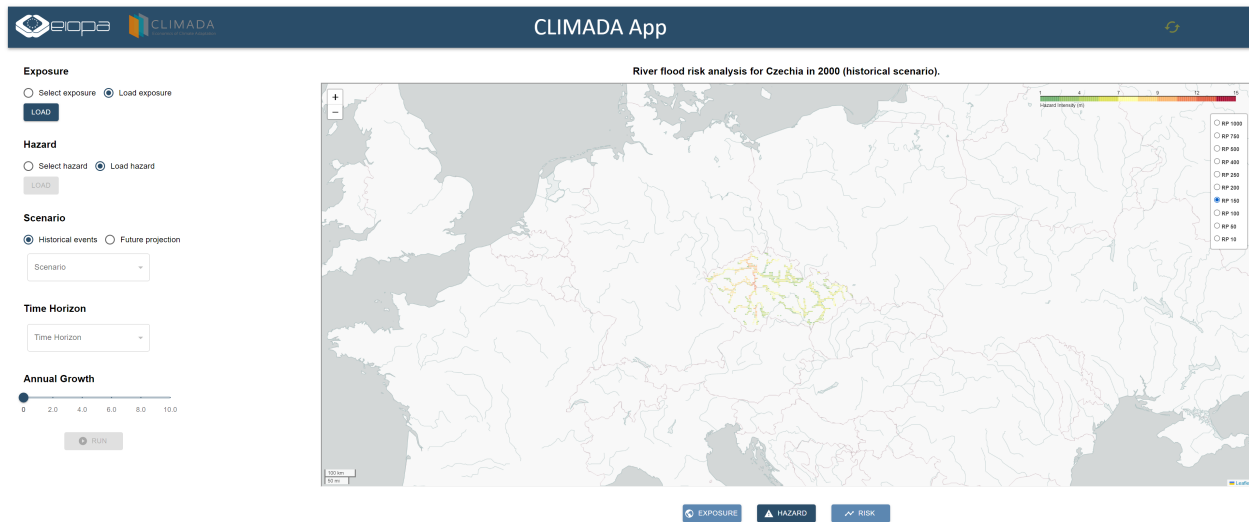
CLIMADA-App is designed work seamlessly even without an internet connection. The offline capability of the CLIMADA-App includes visualizing and interacting with maps, analyzing data, and generating reports. This feature offers flexibility and ensures that data remains secure and within control. Note that while working offline, certain functionalities that depend on live data updates or external web services might be limited or unavailable.

In offline mode, the user is able to load predefined exposure and hazard datasets (xlsx and hdf5 files respectively) and run the application following the same procedures as in the online version, eith the same process as in the ‘Load Exposure and Hazard’ section of the User Guide. It’s important to note that while the offline mode provides exposure, hazard, and risk basemaps, these maps offer limited administrative information. For instance, details such as country names and cities might not be as comprehensive compared to the online mode. Despite this limitation, the offline capability ensures that essential functionality remains available, allowing for continuity in risk analysis.

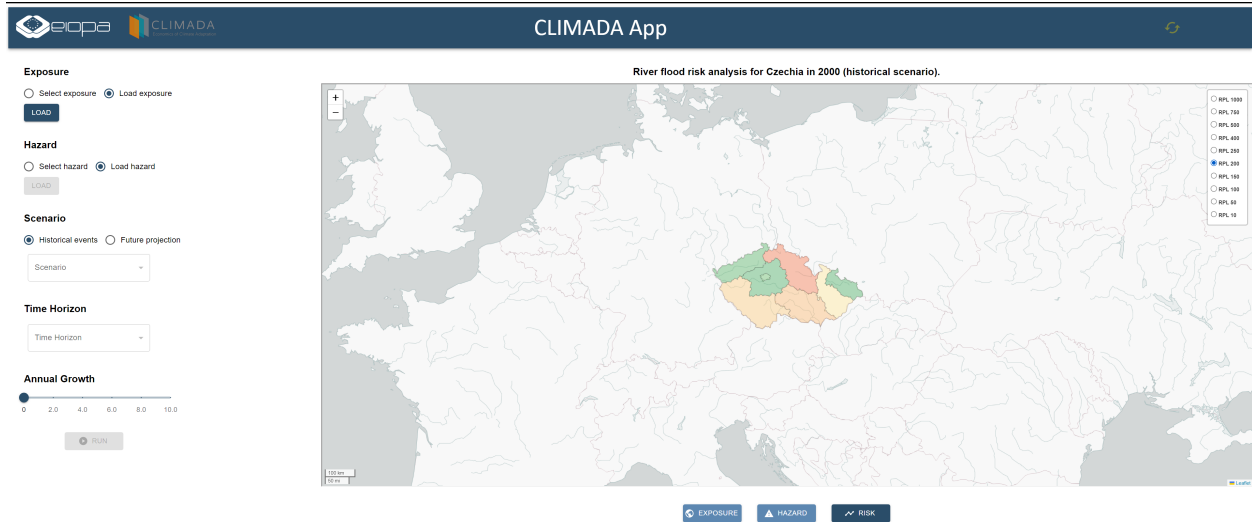
The map generated from the exposure perspective.



The map generated from the hazard perspective with a return period of 100 years.



Also, the map generated from the risk perspective with a return period of 100 years.



Note: Custom .xlsx Exposure datasets need to be added in resources/data/exposures to be recognised by CLIMADA-App

Note: Custom .hdf5 Hazard datasets need to be added in resources/data/hazards to be recognised by CLIMADA-App

Note: Please note, that on the upper right side of the screen there is a refresh button which lets the user reset the input options on the left side of the screen to run a new experiment.

DEVELOPER GUIDE

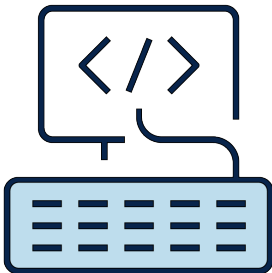


Table of Contents for Developer Guide

- *Developer Guide*
 - *Implemented features and components*
 - * *util package*
 - * *requirements folder data*

6.1 Implemented features and components

The backend consists of a) the **util** package which includes ten modules and b) some supplementary files (i.e. CLIMADA metadata, currency rates, etc.) in the **requirements** folder of the project which have been fetched and are needed so that the CLIMADA-App runs correctly.

6.1.1 util package

Specifically, the util package includes the following modules:

- constants
- handlers
- pdf
- xlsx
- app
- plots
- run_scenario
- set_hazards_metadata
- set_horizons_metadata
- set_scenarios_metadata

In the **constants** module all the relative project directory paths used by the backend implementation of the project are defined. Moreover, all the constant and frequently used path variables and data structures (e.g. NUTS data, list of RCPs, EEA countries, etc.) are declared in this module.

The **handlers** module consists most of the heavy functionality within the application. More specifically these functions are listed with an overview description for each one:

- The **__assign_country_weights_to_eea_countries__** method: Assign weight to EEA countries and store GeoDataFrame data to feather file.
- The **__assign_nuts2_weights_to_eea_countries__** method: Assign weight to EEA nuts2 administrations and store GeoDataFrame data to feather file.
- The **assign_coords_and_weights** method: Reads the feather files to get the exposure geodataframe data.
- The **beautify_hazard_type** method: Get a beautified version of the hazard type to use in UI and reports.
- The **beautify_scenario** method: Get a beautified version of the scenario to use in UI and reports.
- The **beautify_time_horizon** method: Get a beautified version of the time horizon to use in UI and reports.
- The **calculate_impact** method: Create an climada.entity.Impact object from the specified Exposures and Hazard objects.
- The **calculate_impact_output** method: Create an 1-D table containing all the impact data needed to generate the reports.
- The **calculate_impact_output_per_country** method: Get the impact result calculations in country level.
- The **calculate_impact_output_per_nuts2** method: No documentation available.
- The **clear_map_images** method: Clear all map image files from the assets directory.
- The **clear_temp_dir** method: Clear all helper temp files from the temp directory.
- The **compare_values** method: Helper method to compare present and future values and return
- The **convert_exposure_to_gdf** method: Convert exposure datasets to a GeoDataFrame.

- The **convert_iso2_to_iso3** method: No documentation available.
- The **deepcopy** method: Deep copy operation on arbitrary Python objects.
- The **filter_impact_coords** method: Filters out non-european continent coordinates.
- The **generate_hazard_gdf** method: Generate a pandas DataFrame containing latitude, longitude, and local exceedance intensity values for the specified return periods.
- The **get_aggregated_exposure** method: Get the aggregated exposure from a `climada.entity.exposures.Exposures` object.
- The **get_alpha2_country_codes_from_countries** method: Get a list with countries iso2 code from a list of country names.
- The **get_countries_from_exposure_xlsx** method: Read the selected .xlsx input file and get the distinct countries from the coordinates,
- The **get_country_country_codes_from_country_names** method: No documentation available.
- The **get_country_from_country_code** method: Get the country name from the country's iso2 code.
- The **get_country_name_from_country_code** method: Returns the name of the country associated with the given country code.
- The **get_currency_rates** method: Get the currency rates of EUR compared to USD.
- The **get_eea_country_codes** method: Returns a list of two-letter ISO country codes for the countries that are members of the European
- The **get_exposure** method: Query the data api for exposures datasets of the given type, download associated
- The **get_exposure_data_from_xlsx** method: Read the selected .xlsx input file and build the necessary exposure data to
- The **get_exposure_dataset_infos** method: Find all datasets matching the given parameters.
- The **get_exposure_from_xlsx** method: Read the selected .xlsx input file and create a `climada.entity.exposures.Exposures` object.
- The **get_exposure_per_country** method: Get the exposure per country pandas.DataFrame from a `climada.entity.exposures.Exposures` object.
- The **get_exposure_xlsx_category** method: Get the category of the input .xlsx file. Options are:
- The **get_fields_from_h5** method: Return a dictionary object holding the data, result and message information which will be the
- The **get_fields_from_hazard_file** method: Extract scenario and time_horizon from hazard filename
- The **get_hazard** method: Queries the data api for hazard datasets of the given type, downloads associated
- The **get_hazard_dataset_infos** method: Find all datasets matching the given parameters.
- The **get_hazard_from_hdf5** method: Read the selected .hdf5 input file and build the necessary hazard data to
- The **get_hazard_scenario_from_Hazard** method: Determine the hazard scenario from the given Hazard object.
- The **get_hazard_time_horizon_from_Hazard** method: Determine the hazard time horizon from the given Hazard object.
- The **get_hazard_type_from_Hazard** method: Read a Hazard object and return the hazard type.

- The **get_hazard_type_from_impact** method: Read an Impact object and return the hazard type.
- The **get_impact_function_from_impact** method: Get the impact function of an climada.entity.Impact object.
- The **get_interp1d_value** method: Get the interpolated value for different return periods.
- The **get_list_of_datasetInfo_objects** method: A helpful method to return the initialisation of a DatasetInfo object given the data provided
- The **get_nearest_value** method: Get the nearest value in an array of numbers.
- The **get_polygons** method: Sanitize the Eurostat shapefiles to include only relevant countries and nuts2
- The **get_ref_year** method: No documentation available.
- The **get_valid_hazards** method: A method to help populate the climate scenario drop down list in the Climada-App UI based
- The **get_valid_horizons** method: A method to help populate the time horizon slide bar in the Climada-App UI based
- The **get_valid_scenarios** method: A method to help populate the climate scenario drop down list in the Climada-App UI
- The **read_dtst_infos** method: A method that reads and loads the four list_dataset_infos for the four CLIMADA hazards.
- The **sanitize_exposure_xlsx** method: Normalize the structure of the exposure .xlsx input file.
- The **set_map_title** method: Generate the map title to present in the UI for the user specified scenario.

The **pdf** module consists of the functionality that supports the generation of the pdf report. More specifically these functions are listed with an overview description for each one:

- The **beautify_hazard_type** method: Get a beautified version of the hazard type to use in UI and reports.
- The **beautify_scenario** method: Get a beautified version of the scenario to use in UI and reports.
- The **convert** method: No documentation available.
- The **create_pdf_report** method: Create new pdf report base on user input.
- The **get_alpha2_country_codes_from_countries** method: Get a list with countries iso2 code from a list of country names.
- The **save_map_as_image** method: Saves screenshots of a map rendered by a HTML file with Leaflet library for different map types and RP levels.

The **xlsx** module consists of the functionality that supports the generation of the xlsx report. More specifically these functions are listed with an overview description for each one:

- The **_get_aggregated_exposure** method: Get the aggregated exposure from a climada.entity.exposures.Exposures object.
- The **_get_aggregated_results_in_euro_table** method: Get the aggregated results to fill the aggregated_results_in_euro_table in the report.
- The **_get_country_results_in_euro_table** method: Get the country results to fill the country_results_in_euro_table in the report.
- The **_get_expected_aggregated_results_in_euro_table** method: Get the expected results to fill the expected_results_in_euro_table in the report.

- The `_get_expected_country_results_in_euro_table` method: Get the expected country results to fill the `expected_country_results_in_euro_table` in the report.
- The `_get_expected_nuts2_results_in_euro_table` method: Get the expected nuts2 results to fill the `expected_nuts2_results_in_euro_table` in the report.
- The `_get_exposure_per_country` method: Get the exposure per country pandas.DataFrame from a `climada.entity.exposures.Exposures` object.
- The `_get_exposure_per_nuts2` method: Get the exposure per nuts2 pandas.DataFrame from a `climada.entity.exposures.Exposures` object.
- The `_get_nuts2_results_in_euro_table` method: Get the nuts2 results to fill the `nuts2_results_in_euro_table` in the report.
- The `create_NUTS2_results_worksheet` method: Generate the nuts2 results worksheet.
- The `create_NUTS_worksheet` method: Generate the nuts2 info worksheet.
- The `create_aggregated_results_worksheet` method: Generate the aggregated results worksheet.
- The `create_country_results_worksheet` method: Generate the country results worksheet.
- The `create_general_information_worksheet` method: Generate the General information worksheet.
- The `create_xlsx_report` method: Create new xlsx report base on user input.
- The `makedirs` method: `makedirs(name [, mode=0o777][, exist_ok=False])`
- The `write_rich_string` method: Helper method to write part of strings in Excel, in different format

The **plots** module consists of the functionality that supports the generation of the maps. More specifically these functions are listed with an overview description for each one:

- The `calculate_impact_output_per_nuts2` method: No documentation available.
- The `cmap_map` method: Applies function (which should operate on vectors of shape 3: [r, g, b]),
- The `generate_exposure_choropleth` method: Generate a `folium.Choropleth` object for a given administrative level, with the ability to filter by country.
- The `generate_exposure_geojsonpopup` method: Generate a `GeoJsonPopup` object with specified fields and aliases.
- The `generate_hazard_gdf` method: Generate a pandas DataFrame containing latitude, longitude, and local exceedance intensity values for the specified return periods.
- The `get_cmap` method: Helper method to generate the colormap for the maps.
- The `get_country_country_codes_from_country_names` method: No documentation available.
- The `get_polygons` method: Sanitize the Eurostat shapefiles to include only relevant countries and nuts2
- The `plot_exceedance_freq_curve` method: Compute and plot the exceedance frequency curve. The impact data is based on
- The `plot_exposure` method: Plots the exposure for the given countries.
- The `plot_hazard` method: Generates a `folium` map to visualize hazard intensity by NUTS2 region for different return periods using circles.
- The `plot_impact` method: Compute and plot exceedance impact maps in nuts2 level for different return periods.

- The **plot_stacked_aggregated_exposure** method: Compute and plot the stacked aggregated exposure.
- The **save_map_as_image** method: Saves screenshots of a map rendered by a HTML file with Leaflet library for different map types and RP levels.
- The **update_html_links** method: No documentation available.

The **data** module consists of the functionality that supports the generation of the data persistent files. More specifically these functions are listed with an overview description for each one:

- The **generate_countries_gdf** method: Generate a geopandas GeoDataFrame that contains information about each European country, including population
- The **generate_eea_values_gdf** method: No documentation available.
- The **generate_nuts1_gdf** method: Generates a GeoDataFrame of the NUTS1-level regions in the European Union with added population data.
- The **generate_nuts2_gdf** method: Generates a GeoDataFrame of the NUTS2-level regions in the European Union with added population data.
- The **generate_nuts3_gdf** method: Generates a GeoDataFrame of the NUTS3-level regions in the European Union with added population data.
- The **list_dataset_infos** method: Retrieve the dataset information from the server or from a local feather file.

6.1.2 requirements folder data

The **requirements** folder contains a variety of necessary files that are needed for the application to run. In more details:

- **featherfiles:**
 - **eea_exposures_countries_gdf.feather:** Exposure GeoDataFrame data for Economic European Area countries on country level.
 - **eea_exposures_nuts2_gdf.feather:** Exposure GeoDataFrame data for Economic European Area countries on nuts2 administration level.
 - **EEA_RG_01M_2021_values.feather:** Eurostat data for Economic European Area countries on 01M analysis.
 - **list_dataset_infos.feather:** CLIMADA's API list of dataset_infos for all data types.
 - **NUTS_list.feather:** NUTS2 list data information.
- **resources:**
 - **cartodb_positron:** Folder containing all the CartonDB positron maps for offline use.
 - **leaflet.css:** Leaflet is the leading open-source JavaScript library for user-friendly interactive maps. Available for offline use.
 - **leaflet.js:** Leaflet is the leading open-source JavaScript library for user-friendly interactive maps. Available for offline use.
- **shapefiles:** Folder containing EUROSTAT's shapefiles with all the administration levels in Europe.
- **temp:** Folder containing temp files during execution time. Temp folder clears automatically.
- **templates:** Templates used to generate reports.

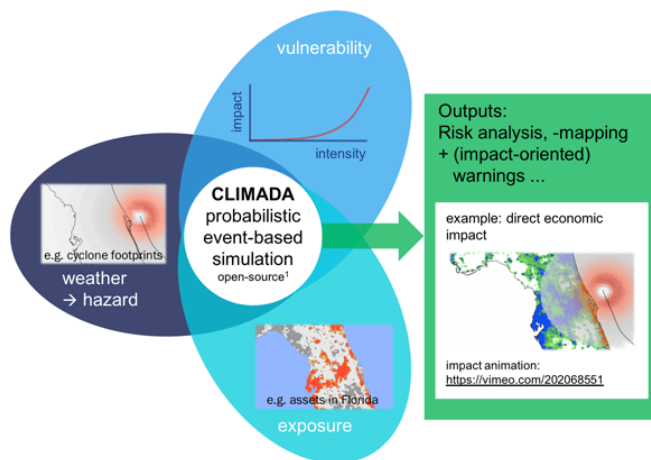
- **chromedriver.exe**: chromedriver.exe is used to generate maps and screenshots with selenium during offline mode.
- **currency_rates.json**: currency_rates.json contains the USD - EUR rates

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The **CLIMADA App User Interface** is a desktop application based on the open-source natural catastrophe model tool, **CLIMADA** .

The CLIMADA App User Interface provides an enhanced user experience for working with the CLIMADA software, enabling users to analyze major climate-related extreme-weather hazards such as river floods and European storms at high resolution. The app supports both historical and future projection scenarios, calculating the impact of hazards for a specified exposure. Data inputs required to run these scenarios can either be fetched from the CLIMADA API or loaded from user-defined .xlsx and .hdf5 files.



Note: It is advisable to read the documentation sections in the order presented in the **Table of Contents**.
