

DELIVERABLE D.2.2.1

The Risk Mapping Tool for CNH Protection in CE river basin districts

Version 1

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A. Introduction

This deliverable is part of the Activities of the Work Package WP2 - Solutions for safeguarding CNH sites in river basin districts from climate change risks. This document focuses in particular on describing the workflow of the Activity A2.2 - Set up of tool for managing climate-induced risks and impact on CNH sensitive objectives in river basin districts - to upgrade and tailor the WebGIS platform “Risk Mapping Tool for Cultural Heritage Protection” developed in the previous funded projects ProteCHt2save and STRENCH. The upgraded platform is specifically addressed to actors in charge of heritage management, such as practitioners and technical experts of public bodies, by providing an easy-to-use tool for safeguarding sensitive CNH objectives in CE basin Districts, categorised as follows: A-SEA/RIVER SHORE, B-LAKE SHORE, C-INLAND.

The deliverable is structured into three different sections:

- Section B, which outlines the current state of the climate and air quality data implemented, describes in detail the dataset provided for the assessment of the present and future risks potentially affecting the INACO pilot sites.
- Section C details the major steps foreseen for the integration in the Risk Mapping Web GIS platform with the tools developed and described in deliverables D.2.1.1. “Decision Support Tool for the vulnerability report” and D.2.1.2 “App for self-vulnerability for assessment report”.
- Section D summarises how, through the testing at pilot sites, the Risk Mapping Tool will be categorised according to the 3 INACO groups through Activity 2.3 - Testing of tools in cultural and natural heritage sites in transitional seashore/rivershore environment, lakeshore environment and inland river basin. It also provides insights into the activities currently under development as part of Activity 2.2 that will be fully achieved during Activity 2.3, as they require specific actions to be undertaken at the pilot site level.

The Risk Mapping Tool for CNH protection in river basin districts, based on hazard mapping and vulnerability ranking, takes its roots from the works previously done in the framework of the Interreg Central EU projects ProteCHt2save and STRENCH. The current deliverable is strictly connected, being primarily a description of the improvements achieved with respect to the tool formerly developed, with STRENCH deliverables D.T1.3.2 Finalisation of the WebGIS Tool for decision making in the management of heritage at risk and D.T.2.2.1 Testing at pilot sites.

As for the previous Interreg CE Projects, the Risk Mapping tool (<https://www.protecht2save-wgt.eu/>) is designed to be open access after a process of user registration. Built upon the cooperative work done by the partnership, the ownership is of the INACO consortium, with potential future implementations under the coordination and responsibility of the LP (CNR-ISAC). The future maintenance after the project's life cycle is in charge of the LP which has committed to keep in operation the platform for at least 4 years after the project ends, hopefully by capitalizing the work done in the framework of EU and national funded actions and projects.

B. Hazard mapping upgrade and development

To support the WebGIS platform, a dedicated environmental data access service has been implemented to cover the climate-induced extreme hazards foreseen in the project (extreme precipitation, flood, wildfire, wind, drought, and landslides). The service includes a large number of datasets (62) identified as crucial for climate change risk assessment for natural and cultural heritage sites. Table 1 lists the available datasets with reference variable, spatial and temporal coverage, and time aggregation.

Table 1. Datasets provided to support the risk mapping tool. Datasets are grouped by type (model, satellite, indicators), reference variable, spatial coverage, temporal coverage, and temporal aggregation.

Name	Variable	Spatial Coverage	Temporal Coverage	time aggregation
Model-based climate variables and indicators				
Average temperature - daily	Temperature	Global	1950 - present	daily
Maximum temperature - daily	Temperature	Global		daily
Minimum temperature - daily	Temperature	Global		daily
Relative Humidity - daily	Relative Humidity	Global		daily
Consecutive Dry Days - monthly	Precipitation	Global		monthly
Consecutive Dry Days - yearly	Precipitation	Global		yearly
Consecutive wet days - monthly	Precipitation	Global		monthly
Consecutive wet days - yearly	Precipitation	Global		yearly
Days with precipitation > 95th percentile - monthly	Precipitation	Global		monthly
Days with precipitation > 95th percentile - yearly	Precipitation	Global		yearly
Extreme warm days - monthly	Temperature	Global		monthly
Extreme warm days - yearly	Temperature	Global		yearly
Heatwave Frequency - monthly	Temperature	Global		monthly
Heatwave Frequency - yearly	Temperature	Global		yearly
Heatwave number - monthly	Temperature	Global		monthly
Heatwave number - yearly	Temperature	Global		yearly
Intense precipitation days - monthly	Precipitation	Global		monthly
Intense precipitation days - yearly	Precipitation	Global		yearly
Maximum consecutive 5-day precipitation - monthly	Precipitation	Global		monthly
Maximum consecutive 5-day precipitation - yearly	Precipitation	Global		yearly
Summer days - monthly	Temperature	Global		monthly
Summer days - yearly	Temperature	Global		yearly
Satellite-based climate variables and indicators				
Average rainfall rate from satellite - monthly	Precipitation	Global	2000 - present	monthly
Average rainfall rate from satellite - quarterly	Precipitation	Global		quarterly
Average rainfall rate from satellite - yearly	Precipitation	Global		yearly

Name	Variable	Spatial Coverage	Temporal Coverage	time aggregation
Consecutive Dry Days from satellite - monthly	Precipitation	Global		monthly
Consecutive Dry Days from satellite - quarterly	Precipitation	Global		quarterly
Consecutive Dry Days from satellite - yearly	Precipitation	Global		yearly
Consecutive Wet Days from satellite - monthly	Precipitation	Global		monthly
Consecutive Wet Days from satellite - quarterly	Precipitation	Global		quarterly
Consecutive Wet Days from satellite - yearly	Precipitation	Global		yearly
Days with precipitation > 95th percentile from satellite - monthly	Precipitation	Global		monthly
Days with precipitation > 95th percentile from satellite - quarterly	Precipitation	Global		quarterly
Days with precipitation > 95th percentile from satellite - yearly	Precipitation	Global		yearly
Maximum consecutive 5-day precipitation from satellite - quarterly	Precipitation	Global		quarterly
Maximum consecutive 5-day precipitation from satellite- monthly	Precipitation	Global		monthly
Maximum consecutive 5-day precipitation from satellite- yearly	Precipitation	Global		yearly
Maximum consecutive 5-day without precipitation from satellite - quarterly	Precipitation	Global		quarterly
Maximum consecutive 5-day without precipitation from satellite - yearly	Precipitation	Global		yearly
Intense precipitation days from satellite - monthly	Precipitation	Global		monthly
Intense precipitation days from satellite - quarterly	Precipitation	Global		quarterly
Intense precipitation days from satellite - yearly	Precipitation	Global		yearly
Model-based air quality variables and indicators				
Surface NO2 concentration - Monthly	Air quality	Europe	2018 - present	monthly
Surface NO2 concentration - quarterly	Air quality	Europe		quarterly
Surface NO2 concentration - yearly	Air quality	Europe		yearly
Surface O3 concentration - monthly	Air quality	Europe		monthly
Surface O3 concentration - quarterly	Air quality	Europe		quarterly
Surface O3 concentration - yearly	Air quality	Europe		yearly
Surface PM10 concentration - monthly	Air quality	Europe		monthly
Surface PM10 concentration - quarterly	Air quality	Europe		quarterly
Surface PM10 concentration - yearly	Air quality	Europe		yearly
Surface PM2.5 concentration - monthly	Air quality	Europe		monthly
Surface PM2.5 concentration - quarterly	Air quality	Europe		quarterly
Surface PM2.5 concentration - yearly	Air quality	Europe		yearly
Surface SO2 concentration - monthly	Air quality	Europe		monthly
Surface SO2 concentration - quarterly	Air quality	Europe		quarterly
Surface SO2 concentration - yearly	Air quality	Europe		yearly

Name	Variable	Spatial Coverage	Temporal Coverage	time aggregation
Total Precipitation - daily	Precipitation	Global		daily
Tropical Nights - monthly	Temperature	Global		monthly
Tropical Nights - yearly	Temperature	Global		yearly
Climate impact indicators based on damage functions				
Biodeterioration	various	Global	1950 - present	yearly
Surface Recession	various	Europe	2018 - present	yearly

The Spatial domain

The spatial domain coverage varies depending on the data sources (see Figure 1): climate model and satellite-based dataset (Copernicus C3S ERA5-Land and NASA GPM IMERG) have a global coverage, while air quality indicators as well as derived climate impact indicators (Copernicus CAMS) have an European coverage. It was decided to load global data to enforce the webGIS tool scalability also outside Europe.

All datasets feature the same spatial resolution, namely 0.1 degrees for both latitude and longitude. This ensures smooth joint data exploitation for both visualization and processing purposes.

The temporal coverage

The temporal coverage varies depending on the datasets:

- Model-based climate data and indicators, being based on [Copernicus ERA5-land data](#), are available since 1950
- Satellite-based climate data and indicators, being based on the [NASA IMERG data](#), are available since 2000
- Air quality data and indicators, being based on the [Copernicus CAMS regional data](#), are available since 2018

All datasets are updated with a fixed frequency: being the monthly aggregation within the shortest time interval, all datasets and indicators are updated on the 10th day of each month, updating to the last available entire month.

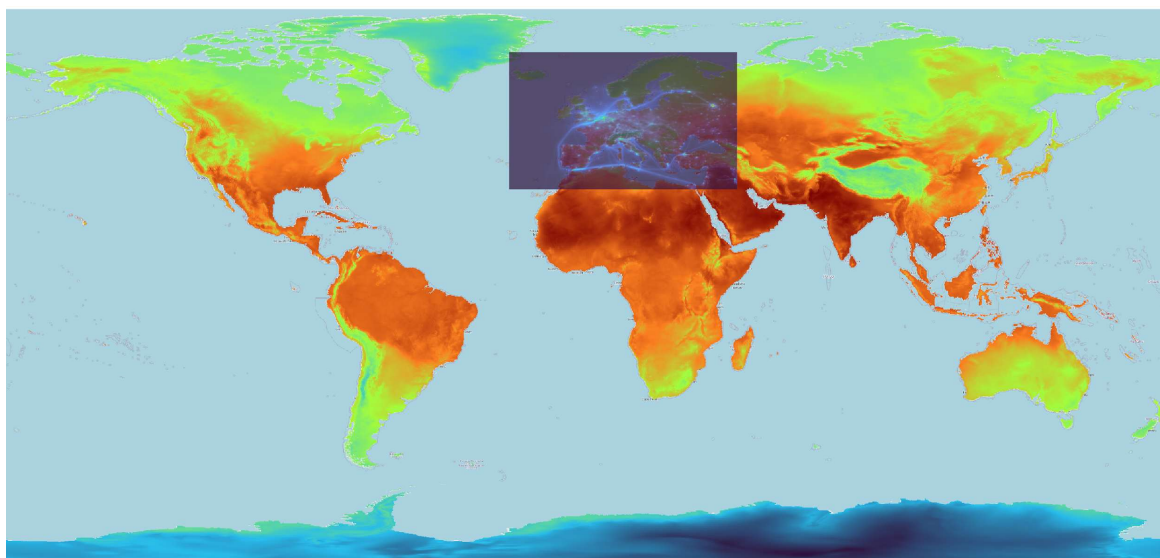
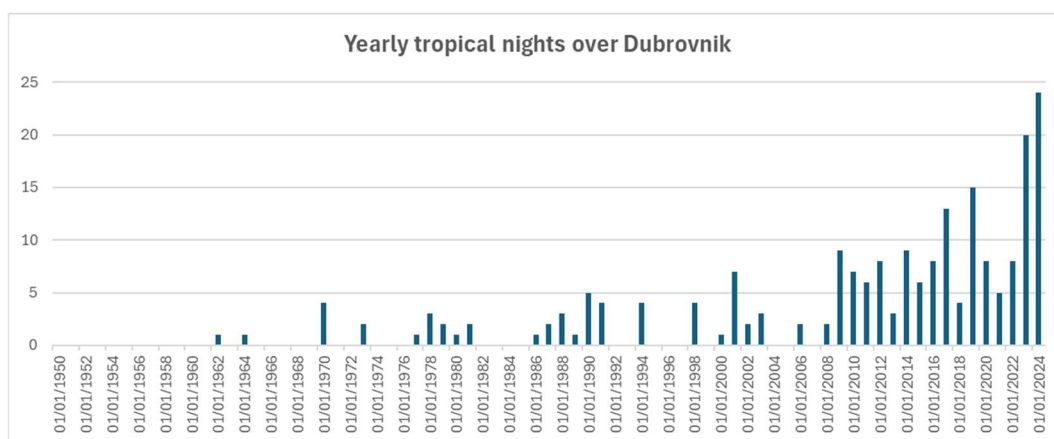
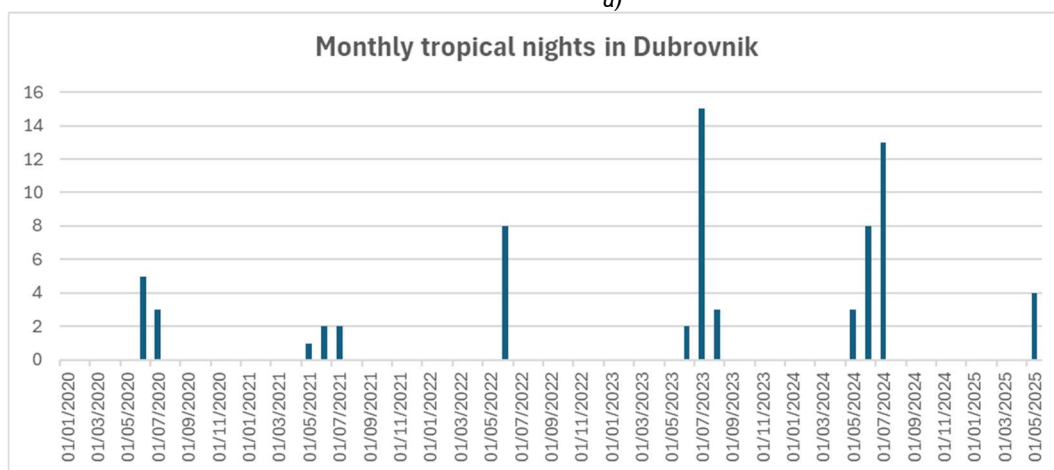


Figure 1. Spatial domain coverage for the different datasets. To represent the global coverage, the average daily temperature for 1st of June 2019 is provided; on top of the global data, the NO₂ daily average surface concentration of the same day is provided covering the European domain.



a)



b)

Figure 2. Time series of tropical nights over Dubrovnik (Croatia). a) shows the yearly-aggregated data from 1950 to 2024. b) shows the monthly tropical nights since January 2020. These figures demonstrate the capability of the data access API

to provide data with different temporal granularity (years (a) and months (b)) with different time ranges (from 1950 (a) and for the last few months (b)).

How to access the dataset

To facilitate access to data and indicators, three APIs (endpoint: <https://api.inaco.adamplatform.eu/docs>) have been implemented and made available to the Web-GIS tool:

- Collections (GET): it returns the list of datasets available to the client (at the time of writing this document, the list of datasets returned is described in Table 1).
- Area (POST). Once the dataset name, the bounding box (rectangle in GeoJSON format) and the date is provided, the API returns the raster file (in GeoTIFF format) representing the requested data (see e.g. Figure 1).
- timeseries (POST). Once the dataset name, the point (latitude and longitude coordinates) and the date range is provided, the API returns the time series (in JSON format) representing the requested time series (Figure 2 shows two time series extracted from the API).

C. Vulnerability tools integration

The tools for Vulnerability ranking developed in Activity A.2.1 and described in deliverables D.2.1.1. “Decision Support Tool for the vulnerability report” and D.2.1.2 “App for self-vulnerability for assessment report” will be accessible directly from the Risk Mapping Tool platform through the “Vulnerability” section. This integration is also driven by the requirement to provide a unique access point to users/stakeholders. All the feedback provided by the project partners during the testing of the tools at the INACO pilot sites (November 2025- May 2026) will function as input for revising the contents of the “Vulnerability” Section, providing a better, friendlier user solution for the end-users, also following the updated methodology for the assessment of the Vulnerability at the INACO pilot sites, which includes now the socio-economic aspects.

D. Next steps

In the upcoming months two main activity types are expected to be implemented for the data access facility:

- integration of new datasets
 - Fire risk assessment: [Fire Weather Index](#) from Copernicus C3S:
 - risk categorization using six classes
 - EU coverage product
 - Spatial resolution: 0.11 Degrees
 - Temporal coverage: 1970 - 2098 daily
- +-creation of a landslides susceptibility indicator: high resolution early warning prototype for one/two sites using the following datasets:
 - Digital Terrain model (Copernicus, 10 meters)
 - Land cover data (ESA, 10 meters)
 - High resolution weather forecast data (ECMWF, commercial product)

The work implemented as part of Activities A2.1 and A2.2, addressed to the development of tools for ranking vulnerability and managing climate-induced risks on CNH sensitive objectives in river basin districts, will allow INACO partnership to proceed with Activity A2.3 (closing date 31 May 2026). This activity focuses on the testing of the developed tools at the pilot sites in order to finalise them according to the 3 different groups. As foreseen in the Application Form, in fact, the testing will be proactively done by the partners according to the following groups:

- **GROUP A SEA/RIVER SHORE.** Natural reserve, historic villages and gardens in a transitional seashore /rivershore environment.
 - Valli di Comacchio, Po Delta River - IT
 - Dubrovnik River - HR

- **GROUP B LAKE SHORE.** Natural reserve, historic buildings and archaeological sites in a lakeshore environment.
 - Lake Neusiedl - AT
 - Fonyód town - HU

- **GROUP C INLAND.** Monumental complexes, historic parks and gardens in the inland river basin
 - Valley of Wiesent and Rednitz - DE (FO)
 - Jelenia Gorà Valley - PL (FOK)
 - Kosice Region - SK (TUKÉ)
 - Central Bohemia Vltava River Valley -CZ (ITAM CAS)