CARE-RoPutna - Climate change floods risk assessment for enhanced preparedness and resilience of vulnerable Putna river basin local communities in Romania

First Phase results
River flood workflow
Flood building damage and population exposed workflow

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CLIMAAX
climate ready regions

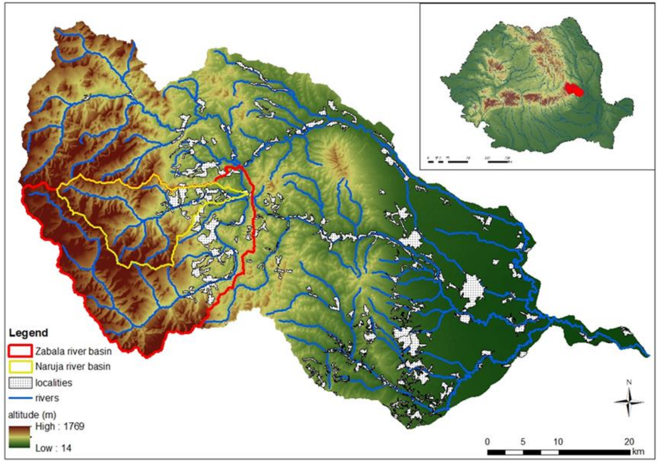
Putna river basin

Vrancea County RO226

Population: 335.000

70/km^2

70% rural areas



Putna river: tributary of Siret river

Basin area 2500 km^2

Mountains and hills

Major climate related hazards

- River flooding
- Heavy rainfall - as a major risk factor for flash floods

Recent severe flood events

2005, 2012, 2016, 2021, 2022

- Loss of life
- Major damage

Vulnerable communities

- Limited resources
- High exposure to natural hazards
- Large number of vulnerable people

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Workflows and scenarios selection

River flooding

Flood damages

Heavy rainfall

Main exposed areas/vulnerable groups:

- Local communities living in flood-prone areas
- Transport infrastructure
- Agricultural land
- Water/sewage networks

➢ National Strategy for Adaptation to Climate Change - **RCP 4.5 and RCP 8.5 -** a good level of confidence for the results of future climate projections

➢ National Strategy for the Management of Flood Risk - standard protection values, expressed by probabilities of exceedance of maximum flows – **1% (100-years RP), 10% (10-years RP)**

➢ National methodology adopted for the implementation of the Floods Directive 2007/60/CE - requires flood hazard mapping for 3 annual probabilities of exceedance (low **500-years RP**, medium **100-years RP** and high **10-years RP**)

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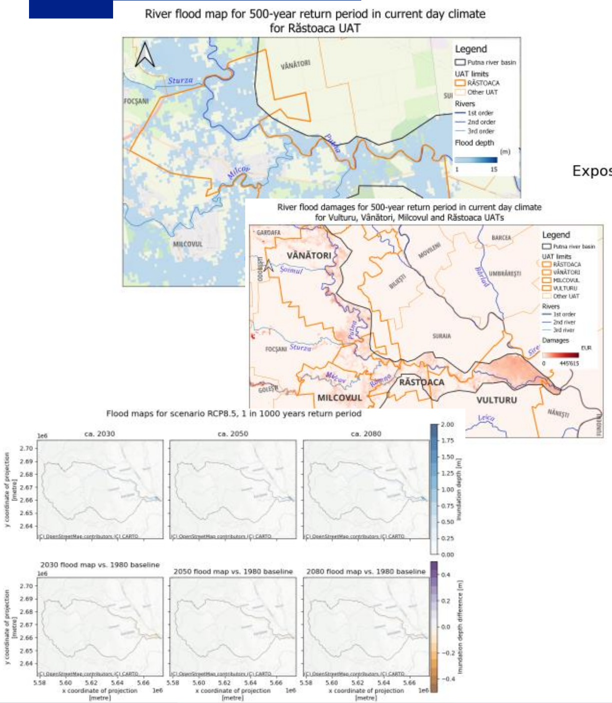
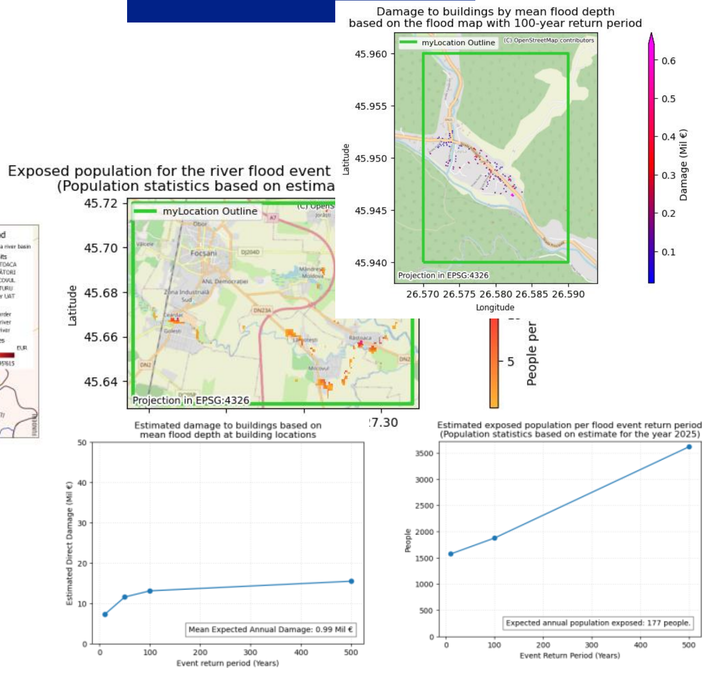
Workflows – first results, basis for detailed analysis in Phase 2

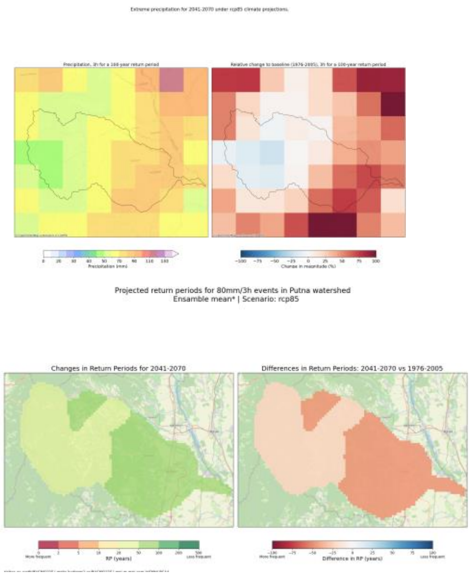
River flooding



Flood damages



Heavy rainfall



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Workflow: River flood

Method – tailor and run workflow notebook in CLIMAAX JupyterHub
Data overview:

Hazard data	Vulnerability data	Exposure data	Risk output
River flood hazard maps for Europe and the Mediterranean Basin region –(depths over return periods 10, 100 and 500), JRC	LUISA depth-damage curves for land use - JRC	Europe LUISA Land Cover 2018 (100m resolution) - JRC	River flood hazard maps for 10, 100, 500 years RP for preset day scenario Flood damage maps, expressed in economic value, for extreme events with different return periods based on available flood maps for the historical climate
Aqueduct Floods Hazard Maps (for RCP4.5, RCP8.5, 2030, 2050, 2080) – Aqueduct Floods data portal			Comparison plot of flood depth maps between the future and historical climates under two climate scenarios (RCP4.5 and RCP8.5) for the selected return periods

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Workflow: River flood

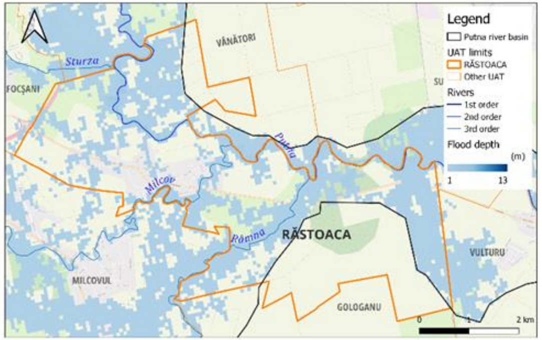
Step 1 – Hazard assessment – present day scenario

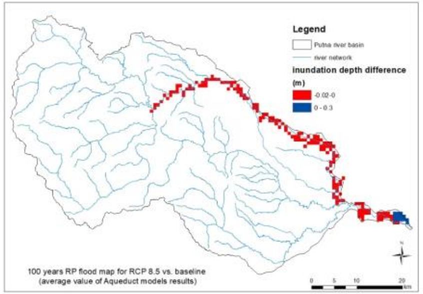
- Defining coordinates of Putna river basin - .shp
- Downloading dataset JRC river flood hazard maps
- Selecting relevant exceedance probabilities – 10, 100, 500 years RP
- Obtaining JRC flood hazard map for present day scenario for the selected RP – custom GIS analysis on Territorial Administrative Units

Step 2 – estimating the effect of climate change scenarios

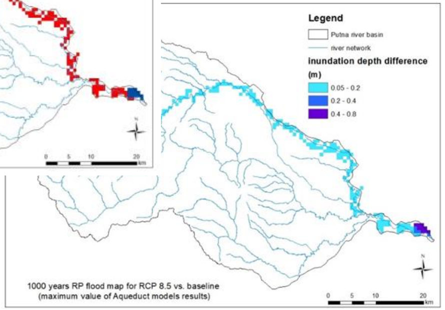
- Downloading Aqueduct Floods (RCP4.5, RCP8.5 for years 2030, 2050, 2080) – coarse resolution
- Analysing the average of the results of different models vs. baseline scenario – slight decreasing trend in flood depth
- Custom GIS analysis on the worst case vs. baseline scenario – adjusting the code to take into account the maximum value of the results of the Aqueduct models for RCP8.5, 1000 years RP - increasing trend in flood depth

River flood map for 100-year return period in current day climate for Răstoaca UAT





100 years RP flood map for RCP 8.5 vs. baseline (average value of Aqueduct models results)



1000 years RP flood map for RCP 8.5 vs. baseline (maximum value of Aqueduct models results)

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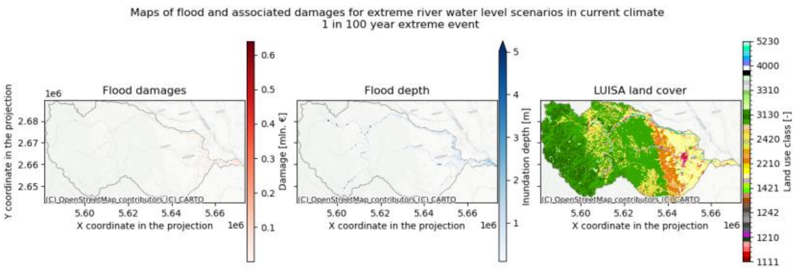
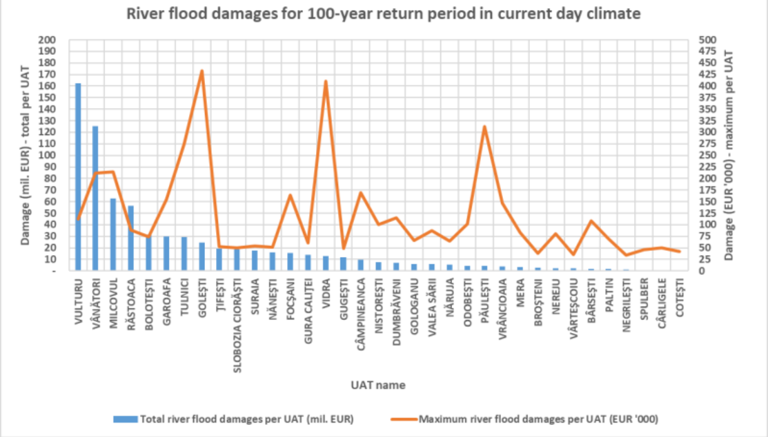
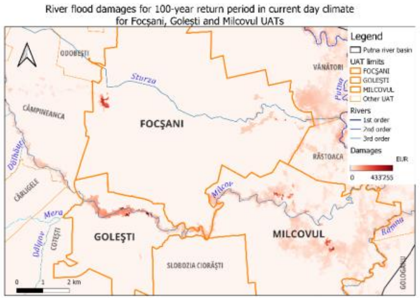
Workflow: River flood

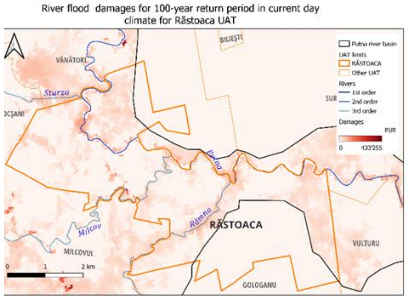


Step 3 – risk assessment

- Loading river flood hazard maps
- Download and clip the land use dataset (JRC Luisa land cover)
- Loading Luisa damage curves
- Adjusting the potential damage values based on Romania's GDP
- Processing flood damage maps in current day climate (economic damage)
- External custom GIS Analysis on the main TAUs affected







The economic damage was mapped based on the hazard maps combined with land use maps, damage curves, and country-specific economic parameters that approximate the economic value of different land use types.

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Workflow: Flood damage and population exposed

Method – tailor and run workflow notebook in CLIMAAX Jupyterhub
Data overview:

Hazard data	Vulnerability data	Exposure data	Risk output
River flood hazard maps for Europe and the Mediterranean Basin region - JRC	Inundation depth thresholds for population exposure/displacement	GHS-POP R2023A - GHS population grid multitemporal (1975-2030) Population density estimated for 2025 - JRC	Maps of exposed population Estimated annual exposed population graph Maps of displaced population Estimated annual displaced population graph
River flood hazard maps for Europe and the Mediterranean Basin region –JRC	Damage curves for buildings- JRC	Building data - OpenStreetMap	Building damage maps Estimated annual building damage graph

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Workflow: Flood damage

Step 1 – Hazard assessment

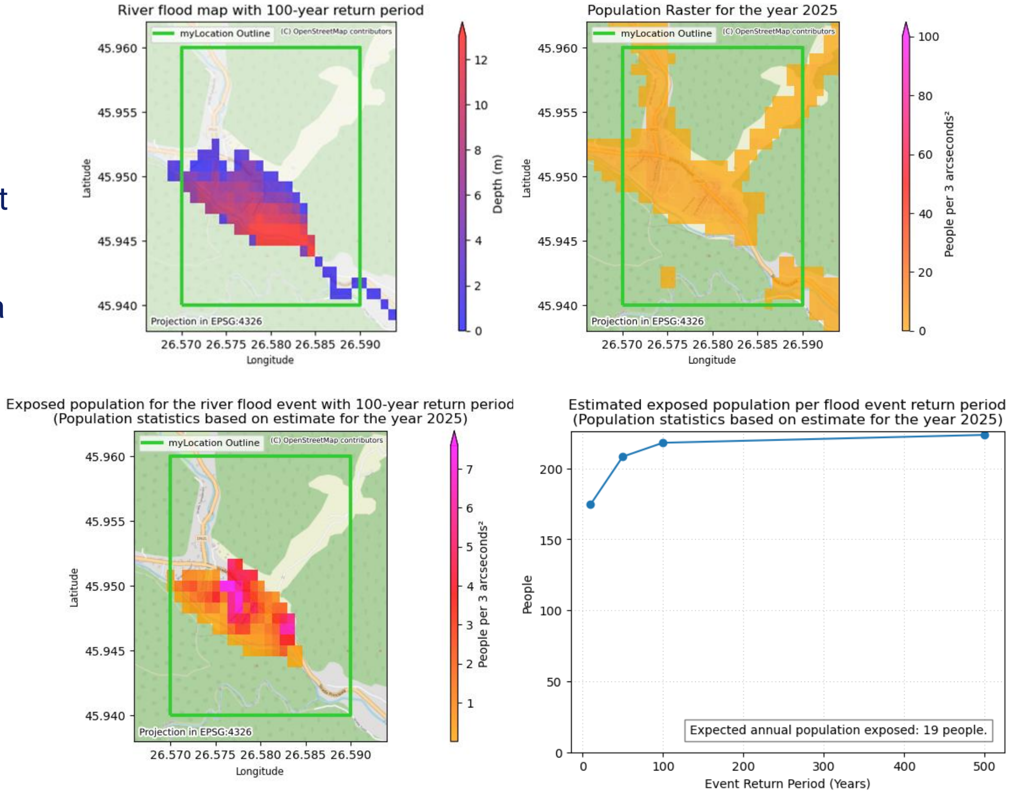
- retrieving the hazard maps from the regional dataset

Step 2 – Risk assessment

- Detailed analysis on the limitations of exposure data available in the workflow
- Selecting relevant areas
- Downloading population density and building footprint data for selected area

Population exposure

- Intersect the flood depth raster with the population density
- Computing population exposure maps and plots for the selected RP



Relevant area: Lepsa localty – Vrancei Mountains, low lying area

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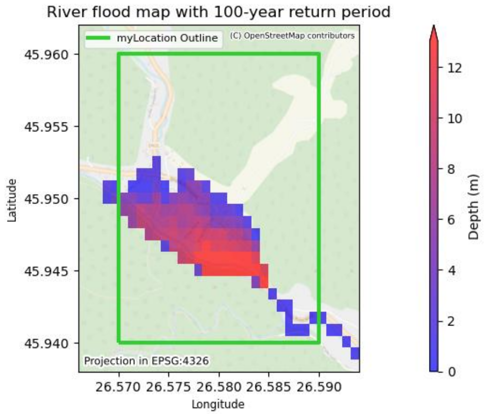
Workflow: Flood damage

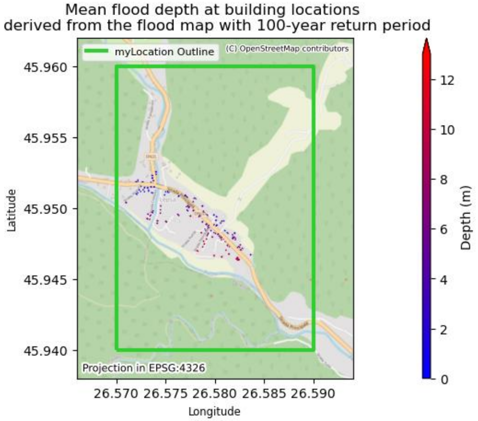
Step 2 – Risk assessment

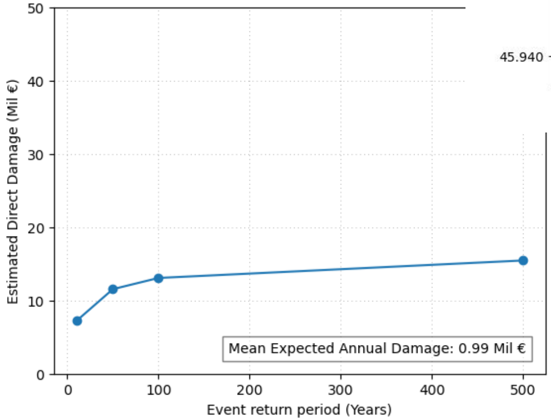
Building damage

- Processing flood depths at building locations
- Calculating the economic damage to buildings (reconstruction costs)
- Computing building damage maps and costs for the selected RP

Based on the flood depth at the building locations, the economic damage to buildings, as reconstruction costs were calculated , applying the JRC damage function for Universal class multiplied with the maximum damage value per square meter and the building footprint area.







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Limitations

Most limitations of the CRA in phase 1 are related to the availability and resolution of the default available datasets in the provided workflows for Putna river basin. The lack of the following data for the study area was the main constraint of the CRA analysis in the first phase:

- buildings footprint and types;
- transport infrastructure layer;
- socio-economic development future scenarios;
- maximum discharges values and percent change in maximum discharges values for the present day and future scenarios;
- high resolution river flood maps for future climate scenarios;

Other limitations of the datasets used would include the unknown deviations of the flows used for deriving the JRC hazard maps comparing to the available national maximum flows for different RP.

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Phase 1 conclusions

- The main outputs indicate high values of the selected hazards and risks for most of the selected return periods s and generally increasing trends for future scenarios.

- The workflows are well designed, proved to be quite stable, and they really support the general assessment of different hazard and risk, facilitating the integration and processing of relevant global and/or regional data.

- There is a need to improve the assessment of potential climate change impact on fluvial floods, as the use of Aqueduct datasets allow to perform only a qualitative one and mainly for large rivers.

- The results of this phase need to be considered as preliminary assessment, taking into account the limitations of the datasets used in the workflows, but they provide a basis for further refining the analysis in the next phase, by using the Toolbox as expert users, in order to create a fully customized risk assessment for selected areas, by integrating local high-resolution datasets, alternative methodologies and hydraulic and hydrological models.

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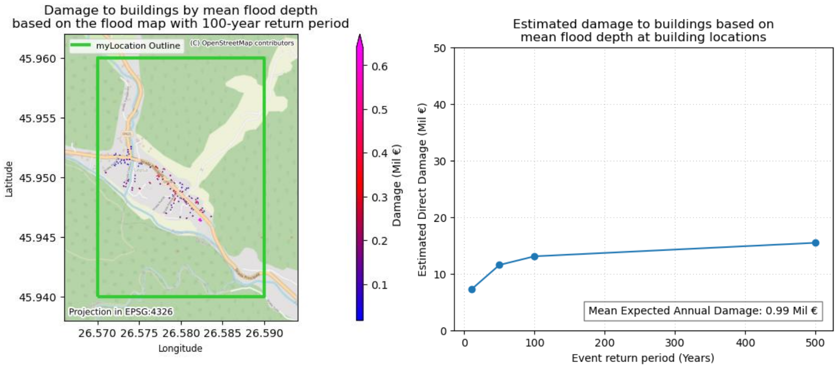
Phase 2 – ongoing work
Workflow: Flood damage – buildings

Step 2 – Risk assessment

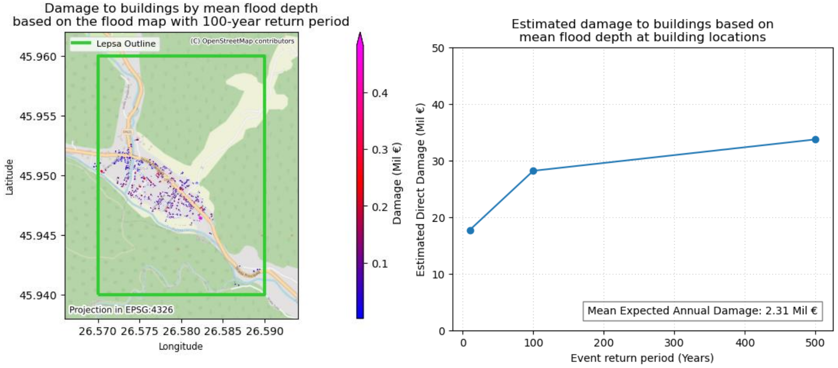
- Adapting and integrating the .shp with local data on building footprint in the workflow notebook
- Calculating the economic damage to buildings (reconstruction costs)

using the parameters values for Romania (Consumer Price Index value, Maximum Damage)

- Computing local building damage maps and costs for the selected RP



Phase 1 – analysis with default data



Phase 2 – analysis with local data

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