

TAKING
COOPERATION
FORWARD

2° Local Focus Group

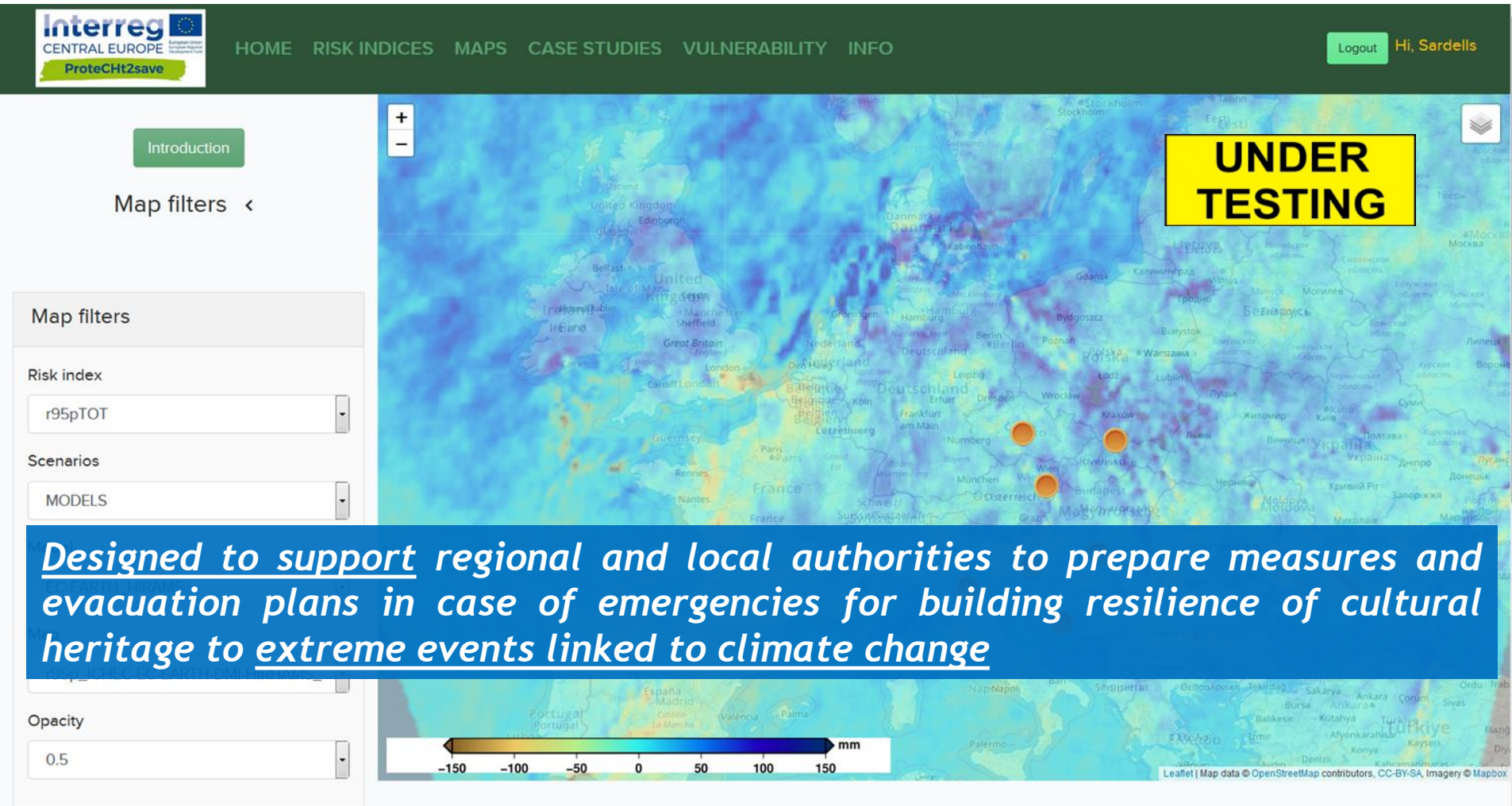
*L'analisi della vulnerabilità del Patrimonio Culturale nell'ambito del
Progetto Interreg Central Europe ProteCHt2save*

📍 *Salone Internazionale del Restauro dei Musei e delle Imprese Culturali XXVI
Edizione, Ferrara Fiere, Ferrara*

💬 **Mappe di rischio per la protezione del Patrimonio
Culturale esposto ad eventi climatici estremi**

👤 Alessandro Sardella, ISAC-CNR Bologna

PROTECHT2SAVE WEB GIS TOOL FOR RISK MAPPING



Designed to support regional and local authorities to prepare measures and evacuation plans in case of emergencies for building resilience of cultural heritage to extreme events linked to climate change



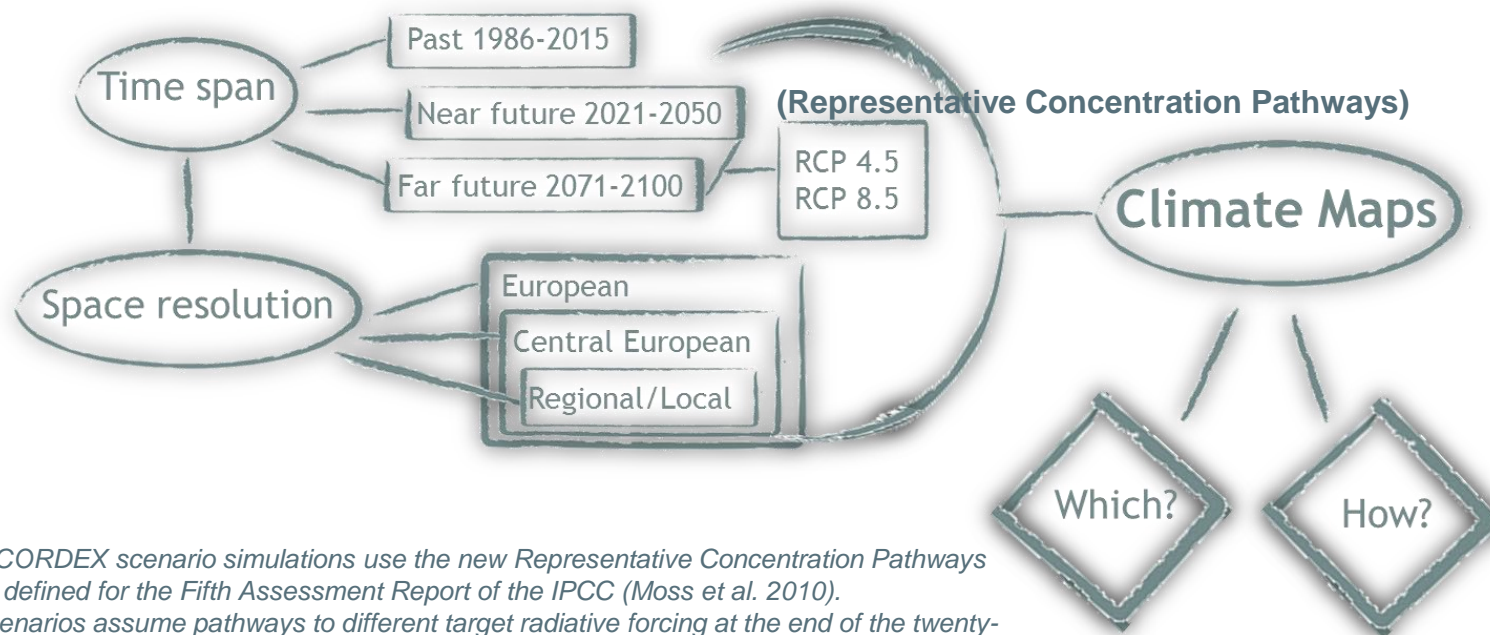
WP T1 Identification of risk areas and priorities

WP T1 OUTPUTS

O.T1.1	Inventory of existing archives, maps, databases, model outputs for risk evaluation (state of art)	Data harmonization and management. Information from existing CC simulations/scenarios/NatCatSERVICE database on loss events due to natural hazards/existing national emergency plans for natural disaster response
O.T1.2	Development of local maps for risk management and protection of cultural heritage	Production of a map creator ICT tool aiming at assessing risk prone areas and “hot spots” where multiple concurrent hazards lead to potential impacts on CH.
O.T1.3	Compilation of a comprehensive set of Manual for mitigation and adaptation	The Manual will offer adaptation strategies for CH management in the face of climate change, with the main aim of assisting heritage stakeholders, policy and decision makers.



CLIMATE DATA, DOWNSCALING AND ANALYSIS TOOLS



EURO-CORDEX scenario simulations use the new Representative Concentration Pathways (RCPs) defined for the Fifth Assessment Report of the IPCC (Moss et al. 2010). RCP scenarios assume pathways to different target radiative forcing at the end of the twenty-first century. For instance, scenario RCP8.5 assumes an increase in radiative forcing of 8.5 W/m² by the end of the century relative to pre-industrial conditions.

D.T1.2.2
D.T1.2.3

Elaboration of maps with hot spots of extreme potential impacts on CH

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CLIMATE DATA, DOWNSCALING AND ANALYSIS TOOLS

General Framework

Regional Climate Models (RCMs)

10-50 km

Downscaling

Bias correction

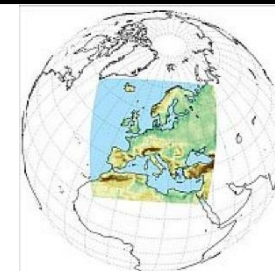
Statistic/Stochastic Downscaling

1 km

ProteCht2save

Euro-CORDEX (Coordinated Downscaling Experiment - European Domain) RCMs

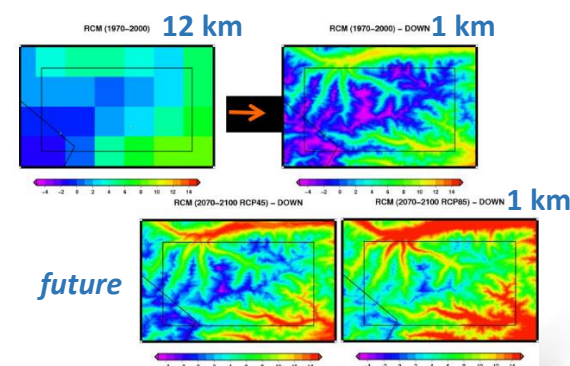
- **0.11° lat-lon resolution (~12 km)**
- **Historical and future simulations**
- **Two future scenarios (RCP4.5 and RCP8.5)**



Station based reference dataset E-OBS (25 km), used for correcting the temperature and precipitation provided by the RCMs.

Use of the **RainFARM** downscaling technique: **temperature and precipitation downscaling with orographic correction**

historical



future

D.T1.2.2
D.T1.2.3

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CLIMATE EXTREMES AND METRICS

The analyses of **changes in climate extremes**, such as dry spells or intense precipitation, exploits software tools developed by ISAC-CNR providing **indices** to evaluate statistics of **extreme events** for **temperature** and **precipitation** and to compare them with observed extremes. They implement standard indices defined by the **Expert Team on Climate Change Detection Indices (ETCCDI)**, whose definition can be found at the **Climdex project** web site and other indices measuring hydroclimatic intensity.

<http://etccdi.pacificclimate.org/indices.shtml>



D.T1.2.2
D.T1.2.3

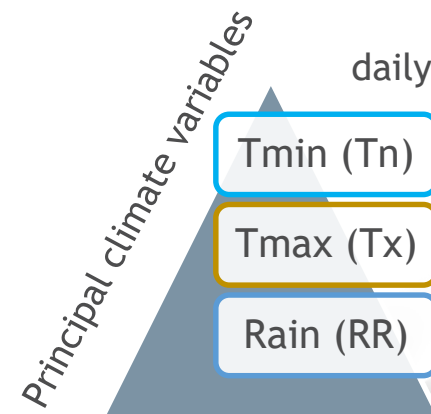
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CLIMATE EXTREMES AND METRICS

Indexes selected to evaluate statistics of extreme events for temperature and precipitation and to compare with observed extremes



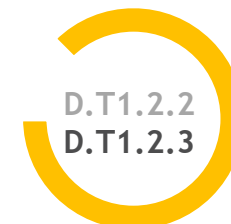
<https://www.climdex.org/learn/indices>



ELABORATION OF MAPS WITH HOT SPOTS OF EXTREME POTENTIAL IMPACTS ON CH

Data from models has been used for the production of :

- i) maps of changes of principal climate variables (**temperature** and **precipitation**)
- ii) maps related to **climate extremes**



Summary

8 maps	Past (1987-2016) wrt (1951-1980)
>8 maps	Near future (2021-2050) wrt (1975-2005) RCP4.5
>8 maps	Near future RCP8.5
>8 maps	Far future (2071-2100) wrt (1975-2005) RCP4.5
>8 maps	Far future RCP8.5

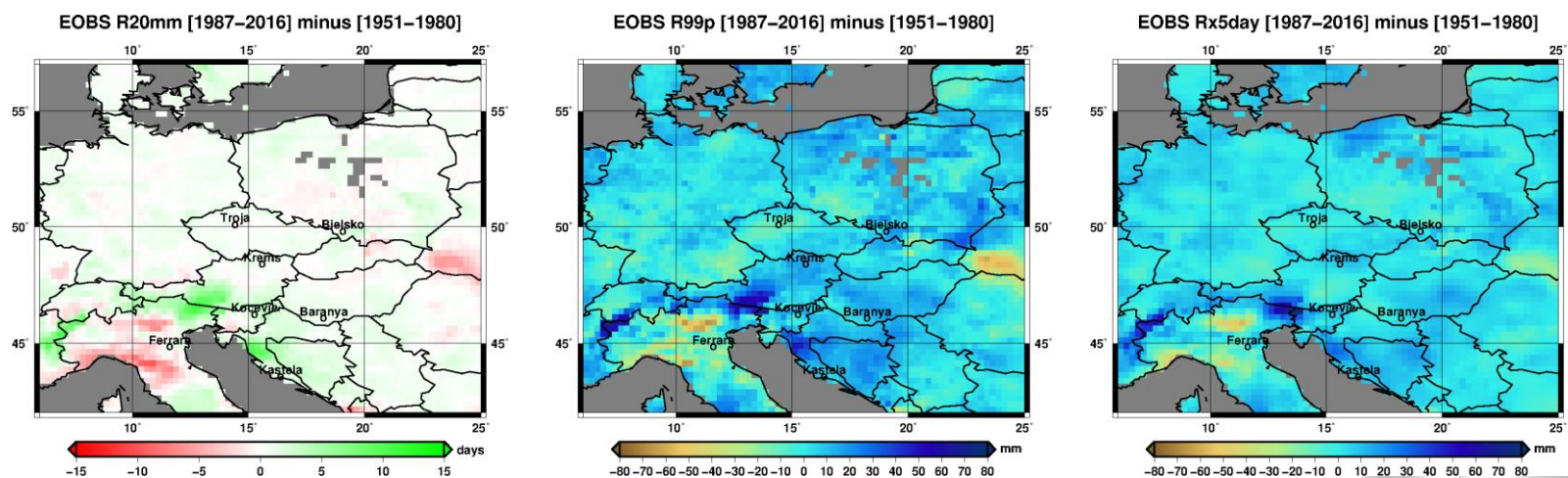
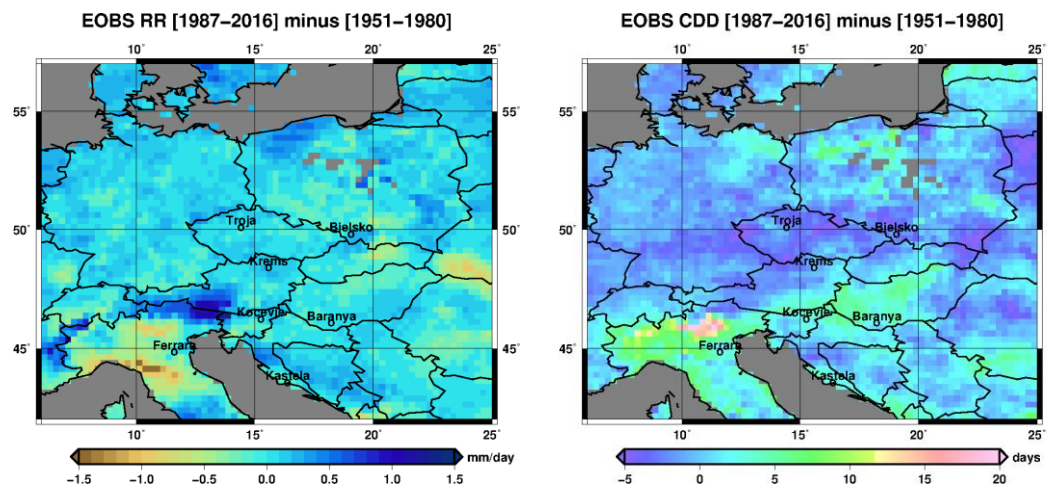
Number of maps produced: > 40



ELABORATION OF MAPS WITH HOT SPOTS OF EXTREME POTENTIAL IMPACTS ON CH

Changes in (1987-2016) wrt (1951-1980) of precipitation and precipitation-related extremes (CDD, R20mm, R99pTOT, Rx5day) in Central Europe

Data source: E-OBS



D.T1.2.2
D.T1.2.3

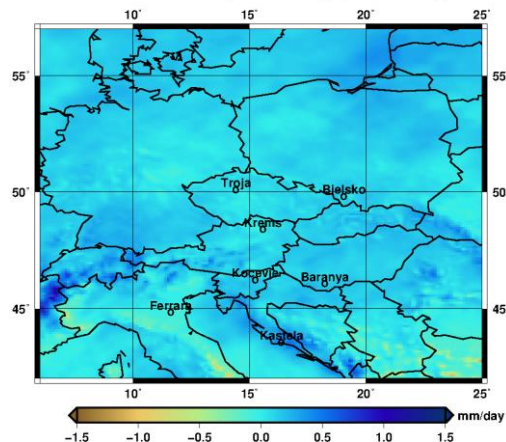


ELABORATION OF MAPS WITH HOT SPOTS OF EXTREME POTENTIAL IMPACTS ON CH

in (2021-2050) wrt (1976-2005)

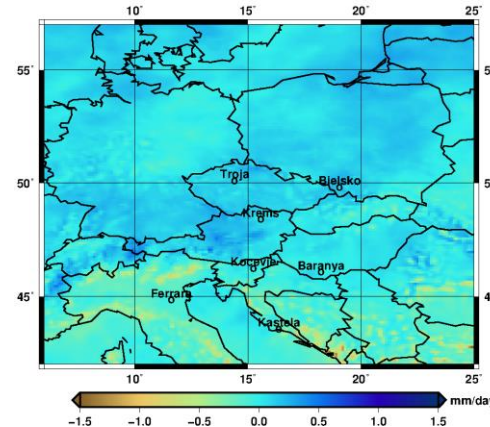
in (2071-2100) wrt (1976-2005)

MPI-ESM-LR-RCA4 RR [2021-2050]-[1976-2005] RCP4.5

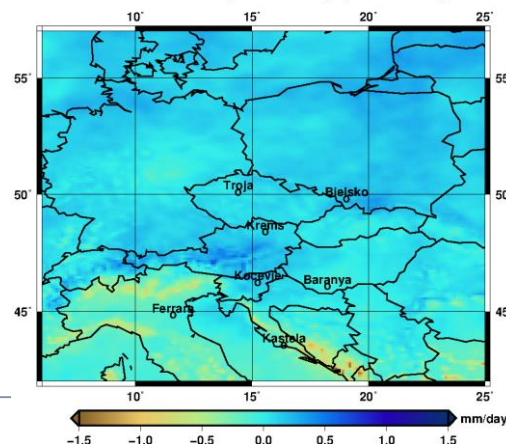


RCP 4.5

MPI-ESM-LR-RCA4 RR [2071-2100]-[1976-2005] RCP4.5

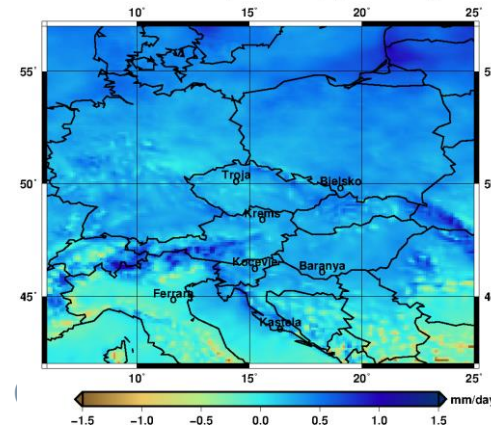


MPI-ESM-LR-RCA4 RR [2021-2050]-[1976-2005] RCP8.5



RCP 8.5

MPI-ESM-LR-RCA4 RR [2071-2100]-[1976-2005] RCP8.5



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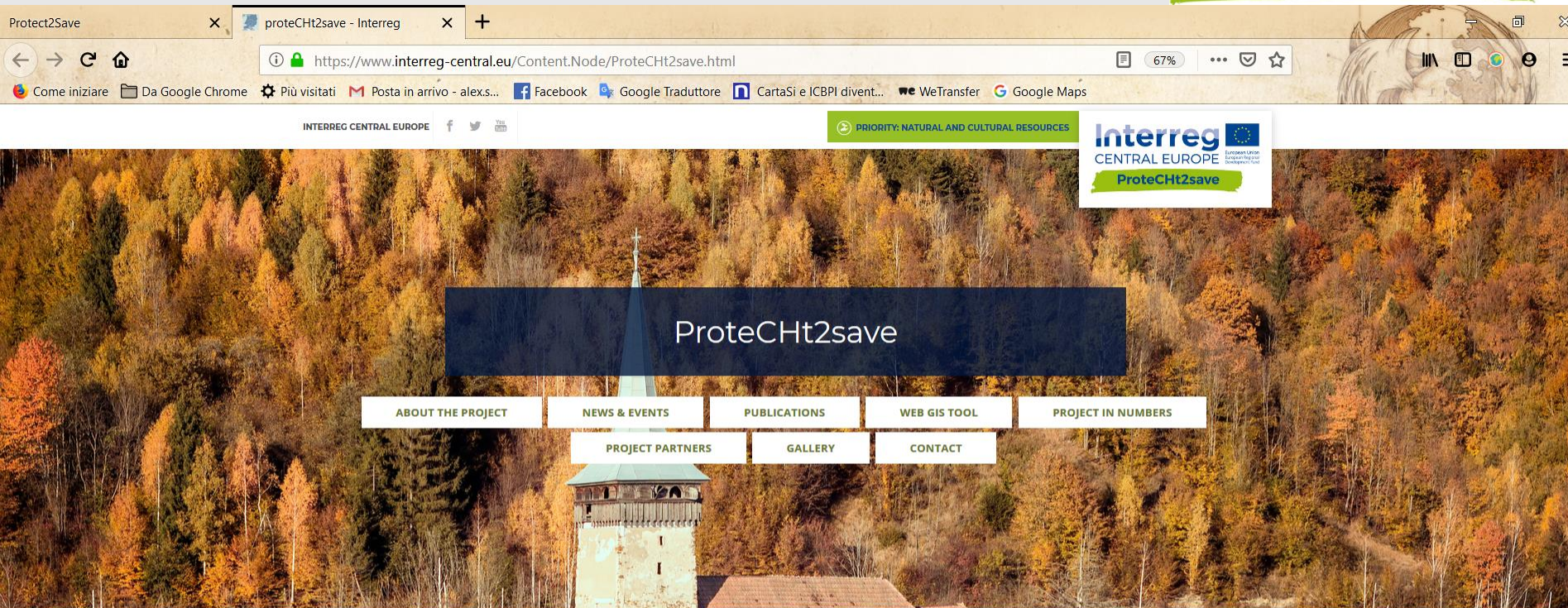
Data source: RCA4 RCM (Euro-CORDEX)

**Changes in
precipitation
in Central
Europe:**

D.T1.2.2
D.T1.2.3



PROTECHT2SAVE WEB GIS TOOL FOR RISK MAPPING



RISK ASSESSMENT AND SUSTAINABLE PROTECTION OF CULTURAL HERITAGE IN CHANGING ENVIRONMENT

Disasters and catastrophes pose risks not only to the conservation of cultural heritage assets with its cultural, historic and artistic values, but also to the safety of visitors, staff and local communities. Additionally, they cause undoubtedly negative consequences for the local economies.

Activities

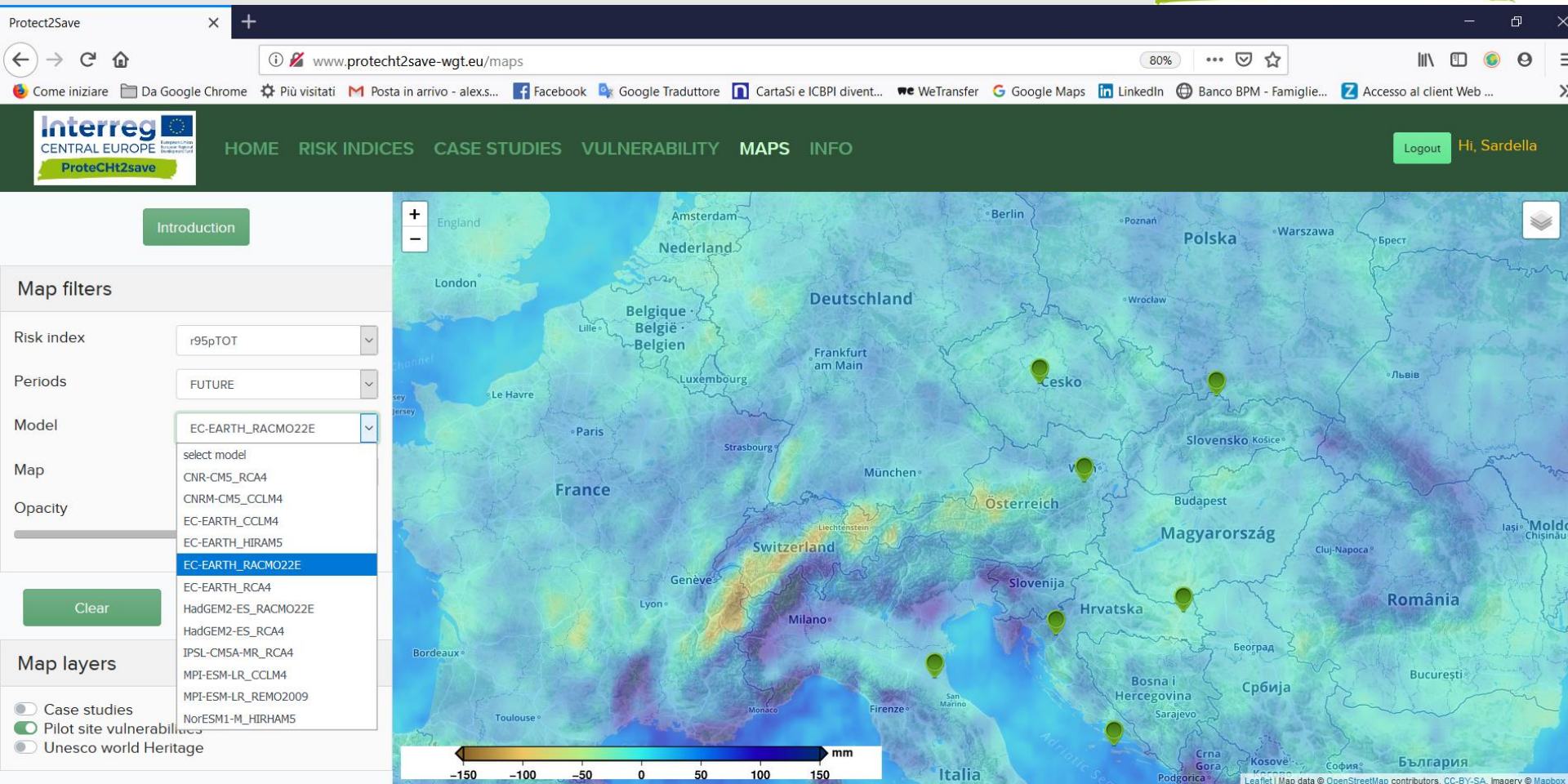
The **ProteCHt2save** project contributes to an improvement of capacities of

Main expected results

ProteCHt2save will deliver ICT solutions (web-based inventory and maps) and tools (decision support tool, best practices manual, handbook on transnational rescue procedures) for risk management and protection of cultural heritage in central Europe. Pilot actions will test the approach and tools in risk prone areas and areas with cultural heritage vulnerabilities to improve the existing disaster risk management plans and policies in municipalities.



PROTECHT2SAVE WEB GIS TOOL FOR RISK MAPPING



Contacts
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PROTECHT2SAVE WEB GIS TOOL FOR RISK MAPPING

Protect2Save

www.protect2save-wgt.eu/maps

HOME RISK INDICES CASE STUDIES VULNERABILITY MAPS INFO

Logout Hi, Sardella

Introduction

Map filters

Risk index: r95pTOT

Periods: FUTURE

Model: EC-EARTH_RACMO22E

Map: r95p_ICHEC-EC-EARTH-KNMI-R

Opacity: [slider]

Clear Load

Map layers

- ☐ Case studies
- ☒ Pilot site vulnerabilities
- ☐ Unesco world Heritage

Map showing risk indices across Central Europe, with a color scale from -150 to 150 mm. The map displays various countries including England, Nederland, België, Deutschland, France, Switzerland, Italia, Polska, Czechia, Slovakia, Hungary, Romania, and Bulgaria. Major cities like London, Paris, Frankfurt, Munich, Vienna, Budapest, and Rome are marked. A scale bar at the bottom indicates distances in mm.

Contacts

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PROTCHT2SAVE

PROTECHT2SAVE WEB GIS TOOL FOR RISK MAPPING


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Ferrara

ACTION	EVENT	ICON
<u>Pilot action 3:</u> Preparation strategies for the historic centre in Italy	Heavy rain	

SITE LOCATION

Lat: 44.835297° Long: 11.619895°





Cathedral, Piazza Trento Trieste

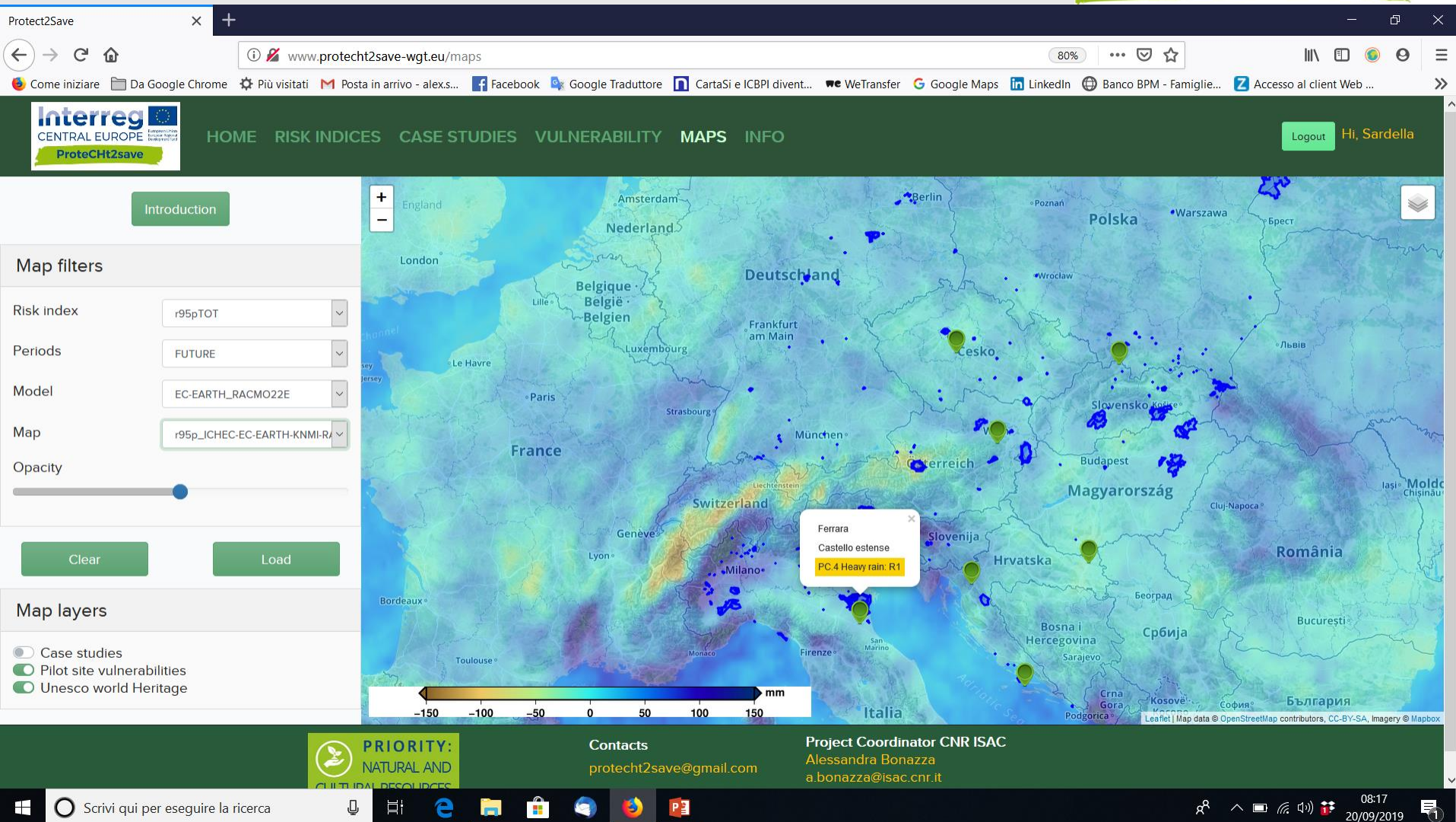
Plan:

A – Cathedral, Piazza Trento Trieste

B – Piazza Municipale



PROTECHT2SAVE WEB GIS TOOL FOR RISK MAPPING



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PROTECHT2SAVE WEB GIS TOOL FOR RISK MAPPING

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www.protecht2save-wgt.eu/Vulnerability

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Vulnerability

Identification of the critical elements in the resilience and risk management of cultural heritage and critical analysis of local vulnerability and measures in emergency situations for cultural heritage.

Managerial criticalities

Managerial critical elements relate to those aspects of a CH system which are not connected to the physicality of the asset but rather to its operation, administration and care. Managerial critical elements therefore include how CH environments are used and protected involving social and economic as well as policy and regulation issues.

- MC1. Information concerning CH object
- MC2. Funding availability and accessibility
- MC3. Knowledge and awareness
- MC4. CH protection planning
- MC5. Policy and regulation

Physical criticalities

Physical critical elements relate to the aspects of a CH system involving its actual material composition and structural conditions. The sensitivity of historic structures and structural elements to weather and disasters is influenced by material and structural capability to resist exceptional loads and environments during disastrous situation.

- PC1. Flood
- PC2. Fire due to drought
- PC3. Wind
- PC4. Heavy rain

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HOME RISK INDICES

MC4

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Rank	Type	Vulnerability	Examples	Preventive measures and priorities
PP0	Resilience and risk management plan is enforced and up-to-date	No major vulnerability issues. Adequate protection and resilience of CH assets is provided	Risk management plan exists together with resilience building measures, maintenance schemes and emergency procedures	Regular inspection and maintenance
PP1	No maintenance schemes for CH at risk	Minor damage might be experienced due to long-term effects of malfunctioning building control systems (drainage, electrical, ventilation) and protection systems (alarms, early-warning)	Proper maintenance is missing inducing in some cases bad functioning of protection systems, drainage systems, fittings etc.	Regular inspection and maintenance; Awareness and knowledge raising and sharing; Early warning systems
PP2	Lack of specific emergency measures	Damage expected in particular to moveable heritage either immediately after the disaster or due to lack of knowledge, mishandling and improper storage during rescue	No evacuation plan. No rescue plan for valuable objects inside buildings (e.g. galleries, museums). No emergency plan for coordination of efforts after the disaster	Emergency plans; Early warning systems; Awareness and knowledge raising and sharing
PP3	No resilience and risk management plan	Heavy damage is expected. Loss of moveable heritage. Complex, at times impossible recovery.	No resilience and risk management plan is enforced	Town planning which includes risk management, Risk assessment including vulnerability and hazard maps, Design and implementation of structural measures for CH assets at risk, Emergency plans, Early warning systems

Managerial criticalities

Managerial critical elements relate to the operation, administration and care of CH environments which are not connected to the physical conditions. The sensitivity of CH environments to weather and disasters is related to the ability to resist exceptional loads and to recover after a disaster.

- MC1. Information concerning
- MC2. Funding availability and
- MC3. Knowledge and aware
- MC4. CH protection planning
- MC5. Policy and regulation

Aspects of a CH system involving cultural conditions. The sensitivity of CH environments to weather and disasters is related to the ability to resist exceptional loads and to recover after a disaster.

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PC4

Rank	Type	Heavy rain Vulnerability	Examples	Preventive measures and priorities
R0	Weather resistant structures and elements sheltered from rain	No detectable damage after heavy rain.	Elements and structures made of sound materials whose shapes minimise rain exposure	Regular inspection and maintenance to evaluate the good conditions of the structure and its elements
R1	Structures and elements partly exposed to rain and/or moderate rainwater runoff	Occurrence of occasional and localised moisture areas (moist stains). Depending on moisture storage and transport capacities of the materials moisture can be lowered to natural content without damage. Monitoring is required to assess such case.	Vertical surfaces moderately exposed to winds	Prevent water penetrating or soaking into material
R2	Structures and elements exposed to rain and/or heavy rainwater runoff	Material degradation. Occasional high moisture in porous materials leads to a series of durability problems such as disintegration, crumbling, biological colonisation, unhealthy conditions for occupants.	typically i) roofs, ii) inclined surfaces of sculptures, iii) vertical surfaces exposed to prevailing and strong winds	Prevent water penetrating or soaking into material; Carry out long-term monitoring of structural health
R3	Complex shape structures and elements with horizontal surfaces	Almost permanent high moisture in building materials which might lead to significant durability problems. The prolonged presence of rainwater in the material could affect the mechanical properties of the materials and lead to structural damage	typically i) cornices, ii) balconies, iii) Decorative architectural elements and edges, corners, protuberances or subtle elements fixed to massive parts	Ensure that water is carried away rapidly and effectively (outlets, adequate unblocked gutters, etc.); Provide protection against rain penetration
R4	Complex shape structures and elements with water traps	Extended damage to porous building materials due to permanent high moisture content. Structure or its parts not possible to be used by occupants due to unhealthy environment. Structural damage is expected due to long-term degradation of material properties	typically roof and façade details made of sensitive material, foundations and lower portions of vertical elements built in lower level areas prone to water pooling	Ensure that water is carried away rapidly and effectively (outlets, adequate unblocked gutters, etc.); Carry out architectural improvements (details, cornices, etc.); Replace originals by replicas; Provide protection against rain penetration

Managerial criticalities

Managerial critical elements relate to those aspects connected to the physicality of the asset but rather than Managerial critical elements therefore include how the asset is protected involving social and economic as well as physical aspects of a CH system involving its actual material and the sensitivity of historic structures and structural elements influenced by material and structural capability to resist during disastrous situation.

- MC1. Information concerning CH object
- MC2. Funding availability and accessibility
- MC3. Knowledge and awareness
- MC4. CH protection planning
- MC5. Policy and regulation

Project Coordinator CNR ISAC

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We can visualize the ProteCHt2save Web GIS Tool starting from the official web site of the Project clicking on the Web GIS Tool button.

<https://www.interreg-central.eu/Content.Node/ProteCHt2save.html>

