

Interreg



CENTRAL EUROPE

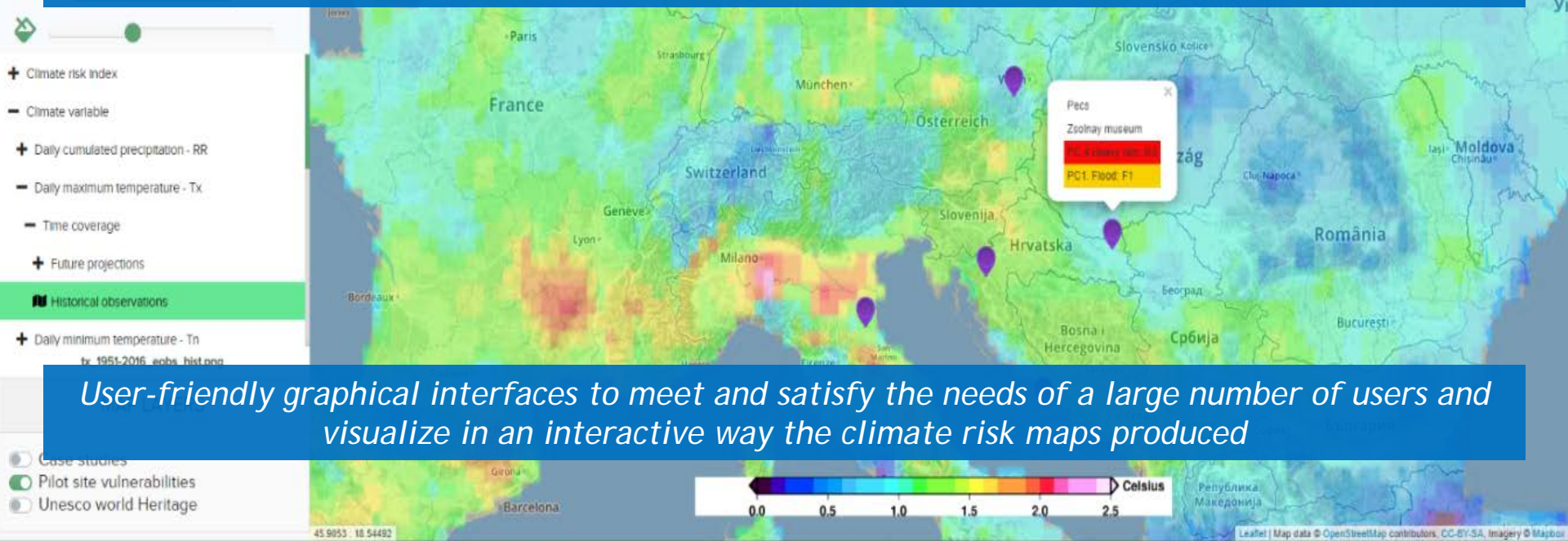
European Union
European Regional
Development Fund

ProteCHt2save

TAKING
COOPERATION
FORWARD

-  *INTERNATIONAL CONFERENCE - Cultural heritage challenges
Climate change, Interreg Central Europe Project ProteCHt2save*
-  Risk mapping for the protection of Cultural Heritage exposed to
climate extremes
-  Alessandro Sardella - ISAC-CNR Bologna (Italy)

For supporting policy and decision makers in the identification of risk areas and vulnerabilities for cultural heritage in Europe and in the Mediterranean Basin exposed to extreme events linked to climate change



User-friendly graphical interfaces to meet and satisfy the needs of a large number of users and visualize in an interactive way the climate risk maps produced

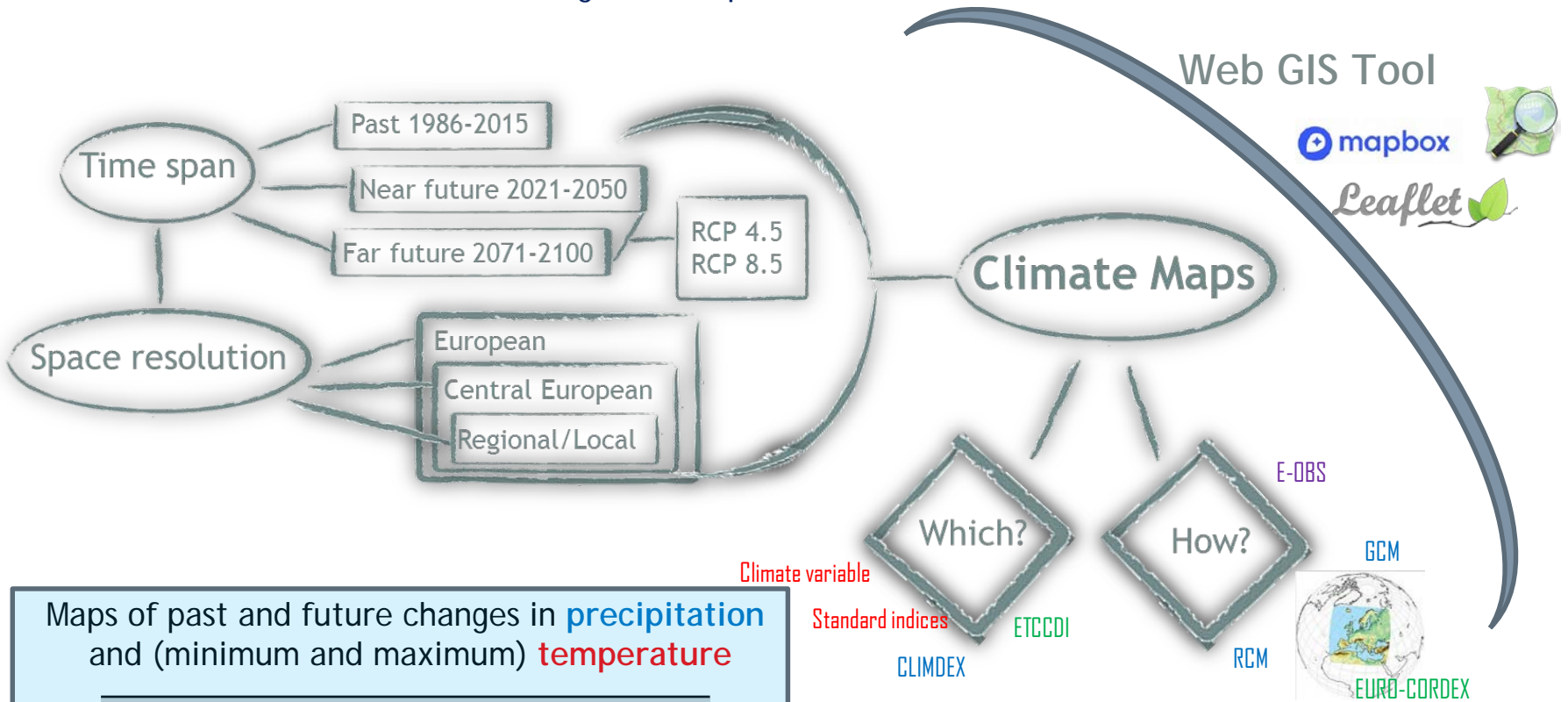
PRIORITY: NATURAL AND CULTURAL RESOURCES

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Elaboration of hazard maps referring to heavy rain, flooding, drought and extreme heat were elaborated covering the European and Mediterranean area



Maps of past and future changes in **precipitation** and (minimum and maximum) **temperature**

Code	Climate variables	Description
Tn	Tmin	daily minimum temperature
Tx	Tmax	daily maximum temperature
RR	Precipitation	daily cumulated precipitation

Maps of past and future changes related in **climate extreme indices**



Indices selection for extreme events analysis

Index	Definition and description	Related extreme event
R20mm	Very heavy precipitation days Number of days in a year with precipitation larger or equal 20 mm/day.	Heavy rain
R95pTOT	Precipitation due to extremely wet days The total precipitation in a year cumulated over all days when daily precipitation is larger than the 95th percentile of daily precipitation on wet days. A wet day is defined as having daily precipitation ≥ 1 mm/day. A threshold based on the 95th percentile selects only 5% of the most extreme wet days over a 30 year-long reference period.	Heavy rain
Rx5day	Highest 5-day precipitation amount Yearly maximum of cumulated precipitation over consecutive 5 day periods.	Flooding
CDD	Maximum number of consecutive dry days Maximum length of a dry spell in a year, that is the maximum number in a year of consecutive dry days with daily precipitation smaller than 1 mm/day.	Drought
Tx90p	Percentage of extremely warm days Percentage of days in a year when daily maximum temperature is greater than the 90th percentile. A threshold based on the 90th percentile selects only 10% of the warmest days over a 30 year-long reference period.	Extreme heating

www.climdex.org

Sardella et al. Atmosphere, under review

Standard indices defined by the CCI/WCRP/JCOMM Expert Team on Climate Change Detection Indices (ETCCDI)



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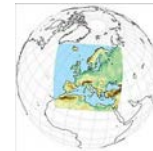
Elaboration of maps with hot spots of extreme potential impacts on Cultural Heritage

Numerical climate model simulations were analysed to study the possible future evolution of the climate system.

12 different combinations of 6 forcing global models (GCM), driving 5 regional models (RCM), have been taken into account for the elaboration of the maps related to the future projections

Multi-models ensembles of regional climate projection have been based on the **EURO-CORDEX*** initiative, which provides regional climate projections for Europe at two different spatial resolutions:

- "standard" resolution of 0.44 degrees (EUR-44, ~50 km)
- finer resolution of 0.11 degrees (EUR-11, ~12 km)



Future changes are calculated as the difference between:
2021-2050 and 1976-2005 (near future projection)
2071-2100 and 1976-2005 (far future projection)
under RCPs 4.5 and 8.5 scenarios (spatial resolution 12x12 Km).

Past changes are calculated as the difference between the period 1987-2016 and the period 1951-1980, using **E-OBS** (spatial resolution 25x25 Km)

GCM	RCM
CNRM-CM5	CCLM4-8-17
CNRM-CM5	RCA4
EC-EARTH	CCLM4-8-17
EC-EARTH	HIRHAM5
EC-EARTH	RACMO22E
EC-EARTH	RCA4
HadGEM2-ES	RACMO22E
HadGEM2-ES	RCA4
CM5A-MR	RCA4
MPI-ESM-LR	CCLM4-8-17
MPI-ESM-LR	REMO2009
NorESM1-M	HIRHAM5

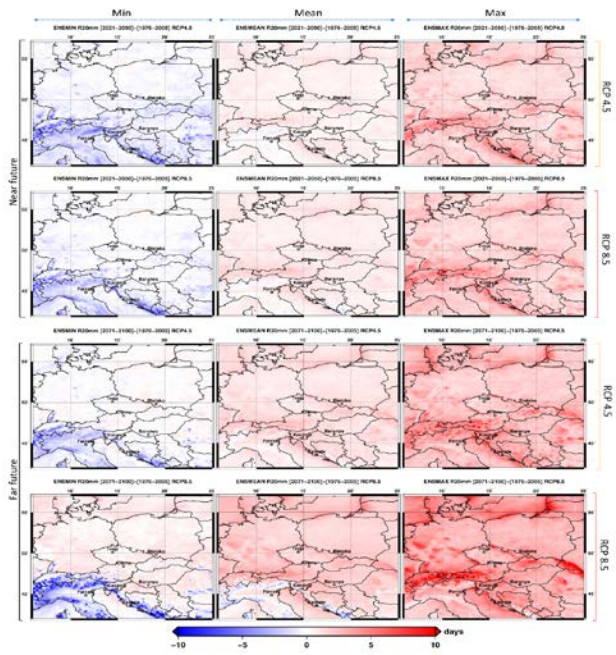
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Elaboration of maps with hot spots of extreme potential impacts on Cultural Heritage

Being aware that each individual GCM/RCM model has its own uncertainties, we kept the entire ensemble and considered all members and their statistics, in particular calculating the minimum, mean and maximum values of the model ensemble

- Time coverage:
- Historical [1987-2016] minus [1951-1980]
 - Near future [2021-2050] minus [1976-2005]
 - Far future [2071-2100] minus [1976-2005]

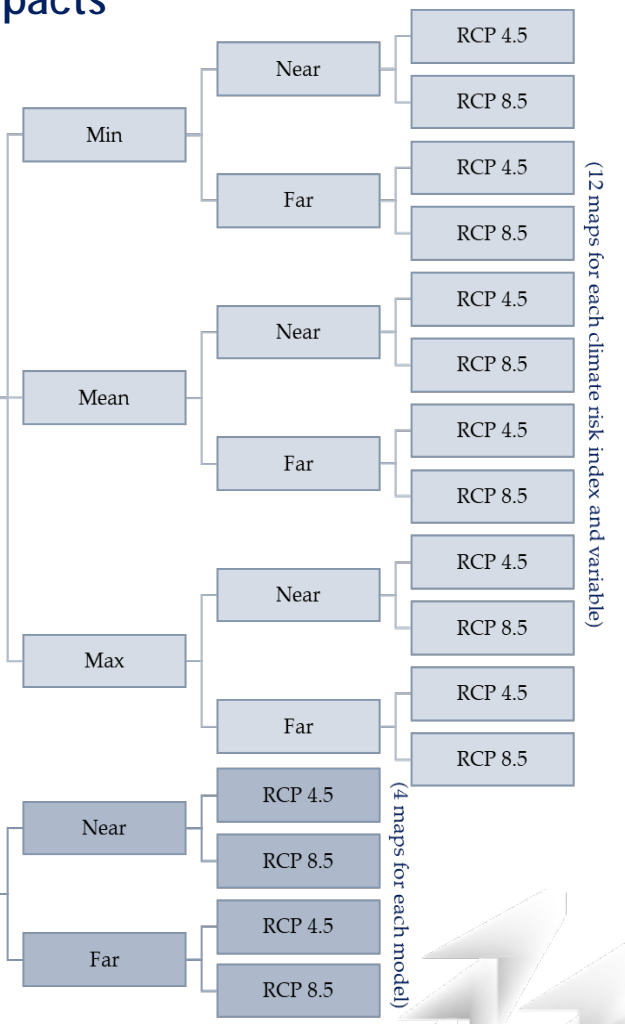


5 Climate risk index and 3 Variable (488 maps)

Historical (8 maps, ~25 km)
Future projections (480 maps, ~12 km)

8 Model ensemble (8x12=96 maps)

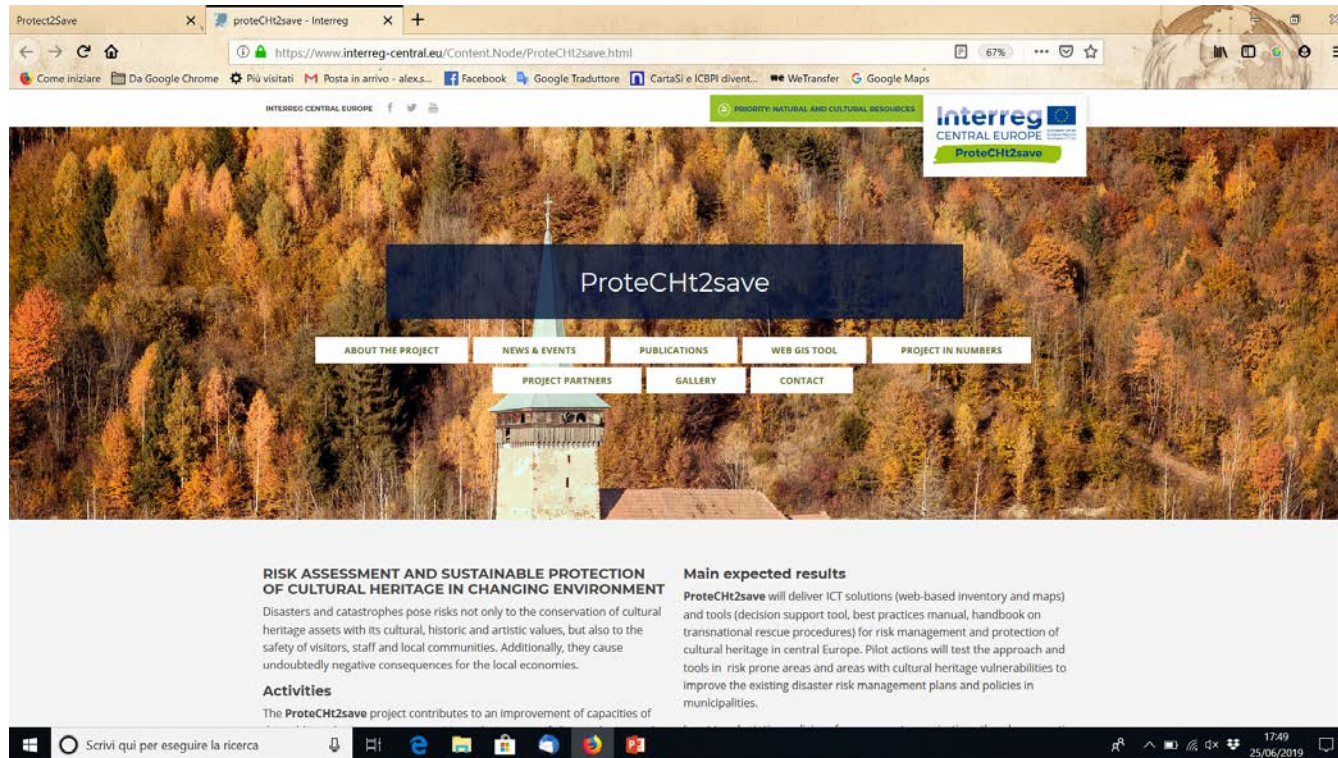
12 Individual models (8x12x4=384 maps)



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PROTECHT2SAVE WEB GIS TOOL FOR RISK MAPPING



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

