The CRIT-MEET from CRISI-ADAPT II Project: an adaptation planning tool according to near and seasonal range forecast of climate-related natural hazards

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Introduction

The CRISI-ADAPT II Project, namely "Climate Risk Information for SupportIng ADAptation Planning and operation" is built around an 11 Partner Consortium in July 2019 which joins 4 demonstration cases and 8 Receiving Regions for scaling methods and results as a test of replicability across 5 Mediterranean Countries (Italy, Spain, Portugal, Malta and Cyprus) (Figure 1). It is focused on 4 strategic sectors: flooding/emergency response, water management for agriculture, energy planning and port infrastructures/operations. This 36-months project has been partially funded by the EIT Climate KIC, on behalf of the European Union, however a considerable budget reduction happened during the third year due to external causes. This cut reduced considerably the development of 3 of the 4 case studies and focusing all the progress mostly on the Maltese pilot case. The CRISI-ADAPT II intends to provide to the involved Stakeholders a Web-based GIS tool to cope with local natural hazards according to near and seasonal range forecast of climate risks. The core of the project is essentially the co-design of climate services and to propose such solutions as an adaptation to business and infrastructure long-term planning and crisis management.

Goal and Objectives

CRISI-ADAPT II aims to monitor and improve the adaptation planning through a real time implementation and validation according to near and seasonal range forecast of climate risks. The project runs along a specific path concerning the analysis and monitoring of climate impacts through a continuous-time approach (Figure 2): Climate Risk Information Tool (CRIT) and Early Warning System Monitoring Extreme Events Tool (MEET). Among other functionalities, CRIT integrates vulnerable elements and hazards estimated according to CMIP6 climate model outputs, while MEET uses seasonal forecasts from two approaches: The European Copernicus service named ECMWF-SEAS5 and a teleconnection-based method developed in the RESCCUE project (Redolat et al. 2019, 2020). Short term daily forecast is calculated on daily basis from the high-resolution model of the European center (IFS -ECMWF-) and for a time span of 7 days while mid-term seasonal forecast proceeds from the ECMWF-SEAS5 model, collected from the Copernicus C3S platform, and combined with Model Output Statistics (MOS) on monthly basis.

The Malta Case Study

Most of the project effort has put into developing the Maltese Case Study, which is characterized by a considerable fragility for flash floods and storm surges consequences in urbanized areas. Considering not just the actual scenarios but mostly future climate trends (IPCC 2022), it is expected to see a considerable increase of the risk associated with heavy rainfall and sea level rise under business-as-usual condition in the most populated part of the island (Figure 3). Despite a reasonable number of studies have been conducted (EWA 2015; EWA 2021), Malta's flood problems persist (Flood 2019). Deeper investigations were requested by local Stakeholders by employing innovative modelling techniques and adopting detailed field data and measures to fulfil EU Flood Directive 2007/60/EC (EU 2007) as a whole. Heretofore, Malta's central hydrological basin relied mostly on the surface drainage systems and natural ponds, however recent years developments (MTIC 2013) led to the construction of the very first underground drainage system, targeting flood problems up to 5 years return period in the worst-hit areas. This system upgrade helped to reduce considerably those damages related to higher frequency rainfall events and set the basis for Malta's urban resilience potential advances. Although the implementation of this extensive network of underground tunnels, canals and water storages for agricultural purposes, flooding issues persist for higher return periods, arguing its viability also for expected climate change predictions. To perform a comprehensive flood risk assessment, a wide set of hazard maps (Figure 4 at the top) coming from the elaboration of 1D-2D hydrological simulations involving surface and underground drainage network were completed. 5, 10 and 20 years of return period were considered, and tailored climate projection factors were applied to rainfall patterns to simulate the expected total amount and intensity future variations. Open data were treated with established GIS processes to obtain vulnerability maps (Figure 4 in the middle) for pedestrians and vehicles. Finally, the matrix combination between hazard and vulnerability maps led to the generation of risk maps, which express tangible (direct and indirect) and intangible impacts such as flood resilience (expressed as the continuity of urban services) (Figure 4 at the end).

The CRIT-MEET Platform

A free version of the platform with just C3S Seasonal Prediction is available for the areas surrounding the Case Studies and it can be found at the link https://tool.crisi-adapt2.eu/ (Figure 5). Available variables involve maximum and minimum temperature, total precipitation, wind gusts and relative humidity. Concerning climate projections, Shared Socioeconomic Pathways (SSP2-4.5, SSP3-7.0, and SSP5-8.5) scenarios of CMIP6 were considered and the ERA5-Land reanalysis was selected as a reference baseline for all the cases. Variables are provided by 30-years span period, from historical, up to the end of the Century. Climate data are available for all the case studies, while tailored menu and options are displayed as function of the case study characteristics.

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Figure 1. CRISI-ADAPT II case Studies (Valencia, Andalucia Region, Malta and Cyprus) and Receiving Regions (Ypsonas, Badalona, Castelledefels, Lisbon, Madrid and Conselice)

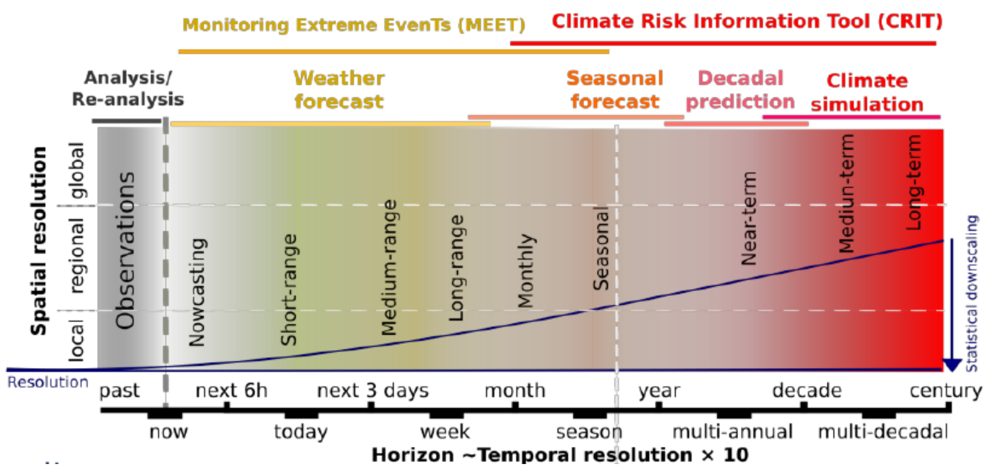

Figure 2. CRISI-ADAPT EWS (Early Warning System) based on MEET (Monitoring Extreme EvenTs) and Climate Risk Information Tool (CRIT) tools.

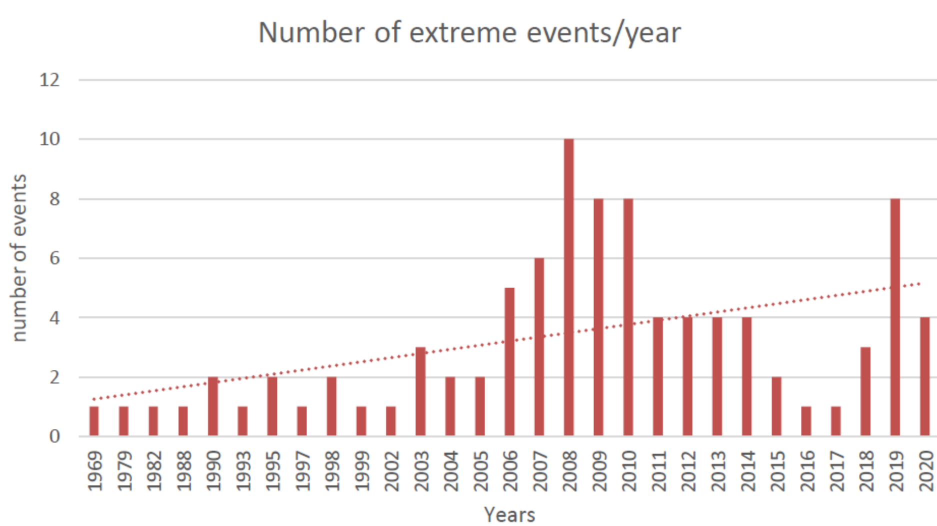

Figure 3. Malta extreme meteorological events by year

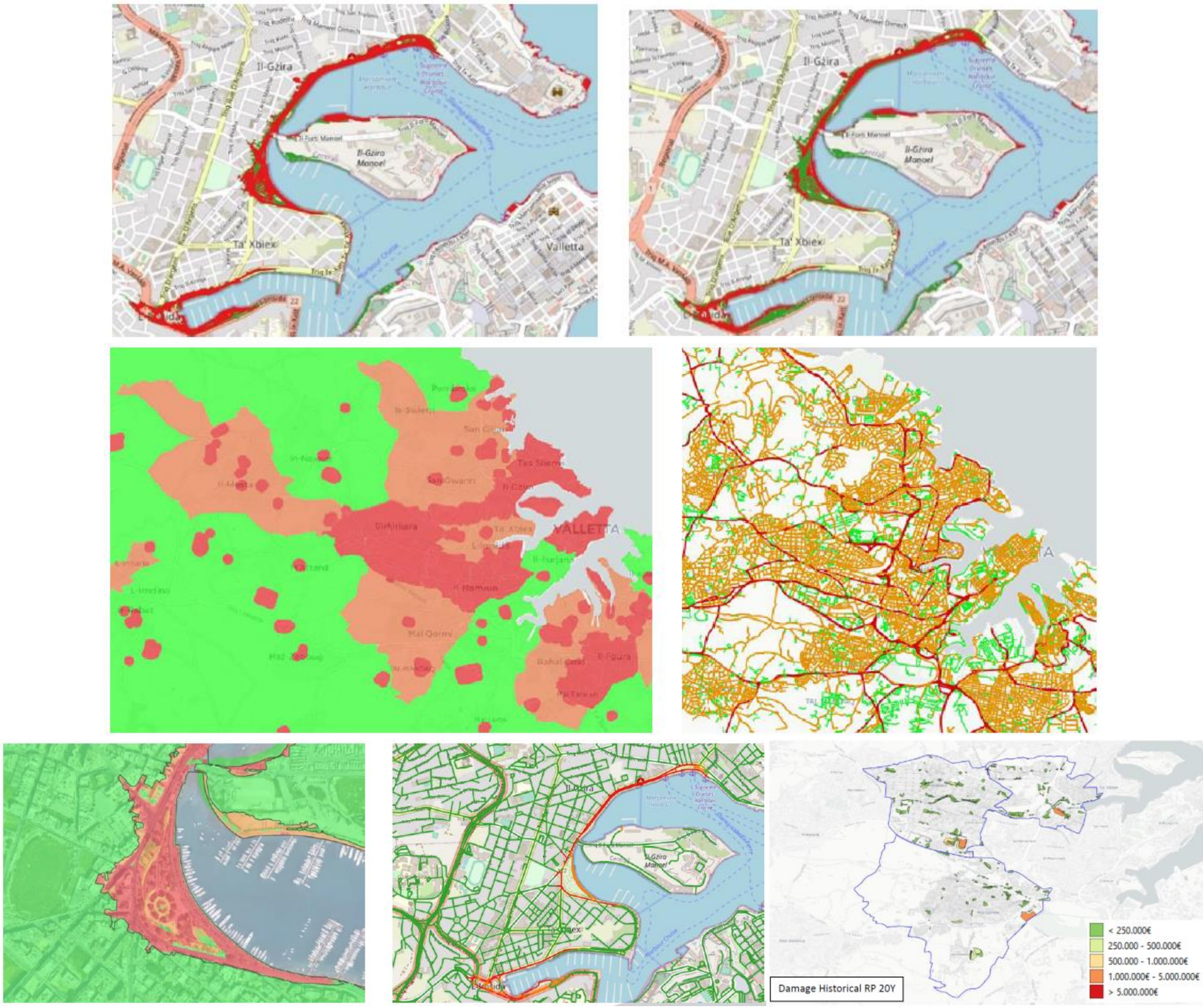

Figure 4. from the top: Coastal hazard maps for pedestrian (left) and vehicles (right), Vulnerability maps, Coastal Intangible risk maps (1st and 2nd from the left) and Pluvial Tangible Risk maps for the case study area (right)

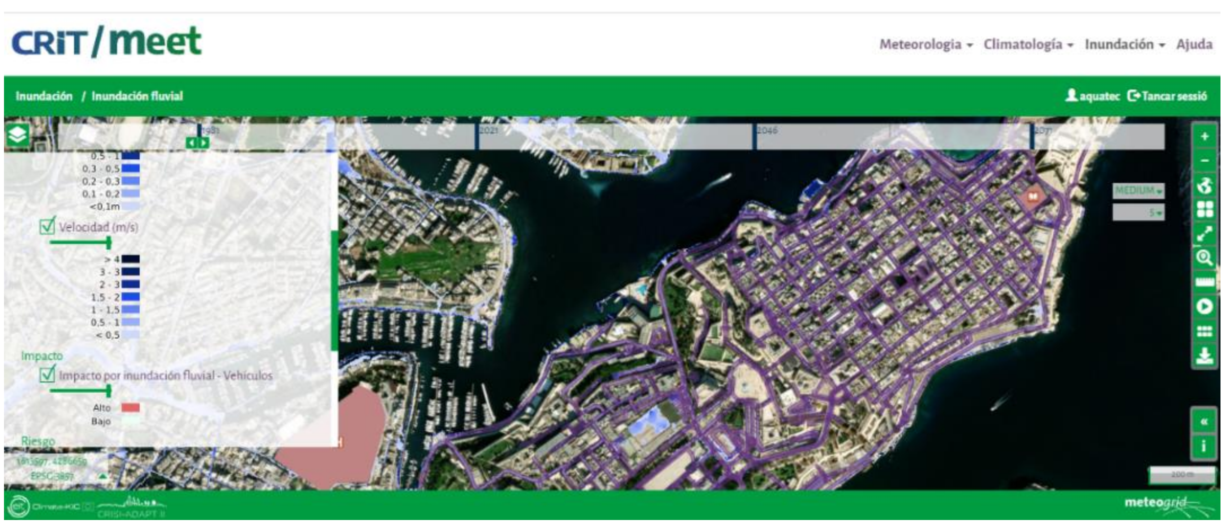

Figure 5. A screenshot of the CRIT-MEET platform