Planul Național de Redresare și Reziliență
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DTEclimate
INFP

THE RESEARCH CENTER FOR CLIMATE CHANGE DUE TO NATURAL DISASTERS AND EXTREME WEATHER EVENTS (REACTIVE PROJECT)

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Abstract

Some of the most well-known climate-change are the irreversible increase of global temperature, the reconfiguration of ocean chemistry and circulation, or the increase in the frequency of extreme weather events. These phenomena mostly involve the atmosphere, hydrosphere, and cryosphere domains. However, only a few studies have evaluated the impact of climate change on the structure and dynamics of the lithosphere and how these strongly coupled Earth systems react to each other. Such examples refer to the redistribution of stresses within the lithosphere as a result of melting glaciers, which cause earthquake swarms (1), increased volcanic activity, increased microseismic intensity (2), either due to post-flood stress discharge or changes in groundwater levels. Climate change can also affect local site conditions. Land stability, subsidence, soil liquefaction, resonance frequency changes that do not correspond to the existing building codes, and ground motion amplification can be an indirect result of near-surface structural changes due to extreme weather events and the strong alternation between drought and flood conditions. These have an immediate impact on local seismic risk assessment and directly affect existing civil and industrial infrastructures situated in areas already prone to strong ground motion, such as South-East Romania.

Scope

The aim of the **REACTIVE project** is to **develop a complex and coupled atmosphere-hydrosphere-lithosphere data monitoring service** which will provide for the first time an integrated view of how climate-change-stimulated phenomena can impact ground structure and motion properties in seismically vulnerable locations. In this purpose a multiple data variables will be used to build a time-dependent multi-hazard map, where output parameters can be used directly by civil and industrial users for hazard protection.

The REACTIVE project is part of the complex project "**Competence Center for Climate Change Digital Twin Earth for forecasts and societal redressement**: **DTEClimate**", in the frame of Romania National Recovery and Resilience Plan.

Methods

For the identification of extreme events, we propose a continuous monitoring using the existing seismic networks to record the noise variations identified on the vertical lines of broadband sensors, the use of GNSS stations to identify changes in the atmosphere (water vapor), sudden variations in atmospheric pressure based on observations of infrasound waves, satellite-based meteorological information, as well as identification of extreme atmospheric phenomena in the Black Sea through the use of dedicated sensors and systems.

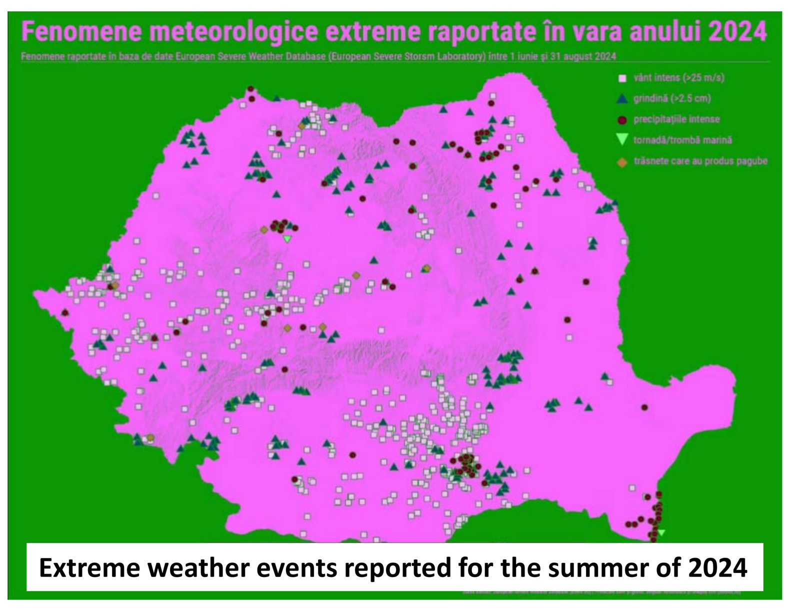
Dissemination and Communication

REACTIVE website: https://reactive.infp.ro/
Social networks: Youtube (https://youtu.be/jl5pcHbIFcs), Facebook, Instagram
Symposium, Articles and Newsletter: 3S, 7A, and 2N

Objectives

- Proposes upgrading monitoring networks and monitoring performance of several types of networks operated by INCDFP;
- Apply the latest available processing techniques and software packages to extract information from each type of data and analyze possible correlation and causality;
- Generating time-dependent multi-hazard maps for urban and local-scale strong earthquake scenarios with an additional effect of climate change variables and integrating them into the existing early warning system (REWS);
- The project integrates with the EU Horizon Europe Mission "Adaptation to Climate Change" and will serve as a starting point for several research directions, with the ultimate goal of reducing seismic risk and increasing the resilience and adaptation of economically vulnerable communities to changing local seismic conditions.

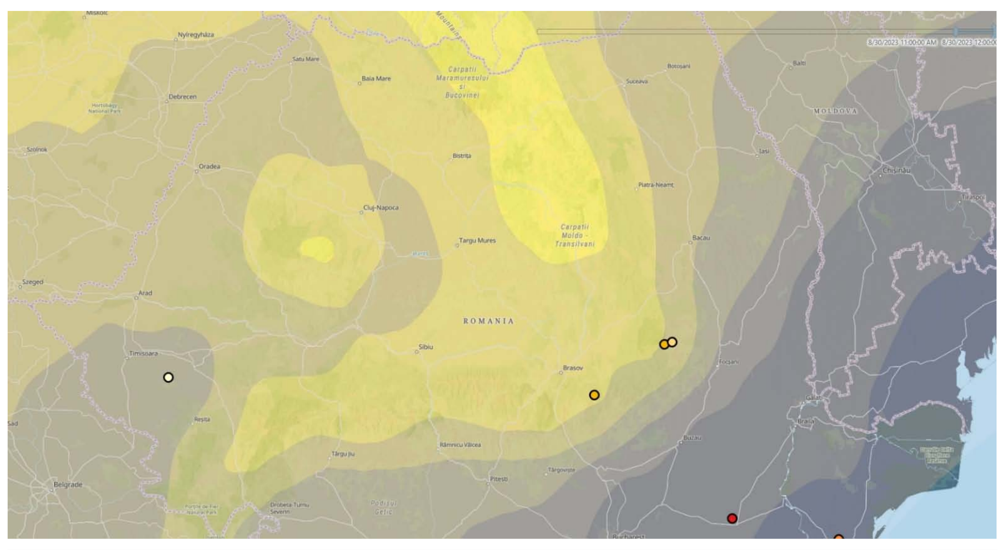
Extreme Events



Extreme weather events reported for the summer of 2024

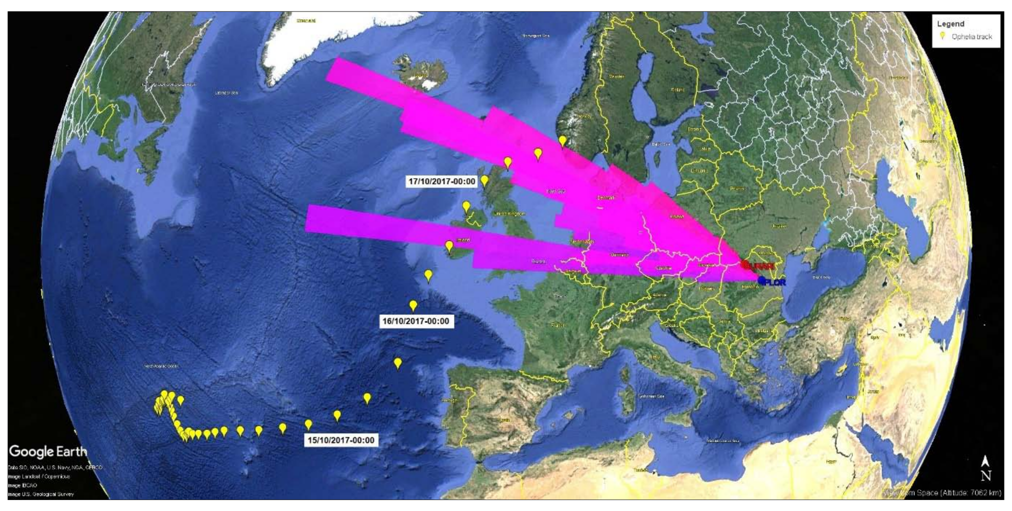
Seismic Results

- Upgrade of 5 seismic station with broadband seismic sensors;
- The intermediate results regarding the daily variation of the PSD values and the spectrogram obtained for the seismic stations equipped with broadband sensors during the storms Frederico and Bettina using the infrastructure of the National Seismic Network


Thee variations of seismic noise in a certain range of periods and atmospheric pressure from the storm of August 30-31, 2023

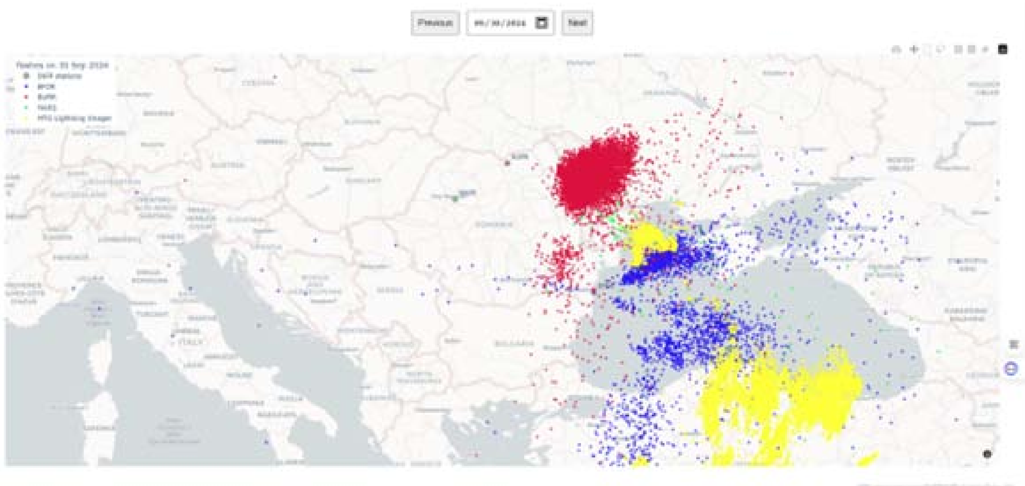
Infrasonic Results

- Installation of 1 infrasound monitoring system at Agigea;
- Infrasonic signal analysis methods have been developed and collected in a library called "InfraPy". Their features are: Beamforming and Detection, Event Identification, Localization, Yield Estimation, InfraView GUI, Command Line Interface (CLI) and Python Notebook


Polar histograms of the detections of the infrasonic stations BURARI and for the time interval October 15-17, 2017. The complete track of the storm Ophelia (October 6-17, 2017) is represented by the yellow dots

GNSS Results

- Installation of 2 GNSS stations, 4 sea level and atmospheric ionization equipment's;
- Development of a software for data analysis from the atmospheric ionization network (electrical discharges);
- Development of an application for the analysis of GNSS data regarding the amount of water vapor in the atmosphere.


The lightning data from 3 Boltek stations (shown in red, blue and green colors) as well as from EUMETSAT

Conclusions

The **REACTIVE (DTE-EE)** project, will develop an atmosphere-hydrosphere-lithosphere data monitoring service that will provide for the first time an integrated view of how climate-driven phenomena can affect soil structure and movement.

Acknowledgements

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References

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(2) Aster, R.C., McNamara, D.E. and Bromirski, P.D., 2008. Multidecadal climate-induced variability in microseisms. Seismological Research Letters, 79(2), pp.194-202.