

# CRONOS PROJECT: MAIN FEATURES OF SEISMICITY ANALYSIS FOR THE CENTRAL AND SOUTHERN CROATIAN COASTAL AREA

Iva Lončar <sup>(1)</sup>, Snježana Markušić <sup>(2)</sup>, Ines Ivančić <sup>(3)</sup>

<sup>(1)</sup> Project associate - seismologist, Andrija Mohorovičić Geophysical Institute, Department of Geophysics, Faculty of Science, University of Zagreb, [iva.loncar@gfz.hr](mailto:iva.loncar@gfz.hr)

<sup>(2)</sup> Associate Professor, Andrija Mohorovičić Geophysical Institute, Department of Geophysics, Faculty of Science, University of Zagreb, [snjezana.markusic@gfz.hr](mailto:snjezana.markusic@gfz.hr)

<sup>(3)</sup> Seismologist, Croatian Seismological Survey, Department of Geophysics, Faculty of Science, University of Zagreb, [ines.ivancic@gfz.hr](mailto:ines.ivancic@gfz.hr)

*Keywords:* CRONOS project, seismicity, earthquake catalogue, catalogue completeness

## 1. About CRONOS project

The overall objective of the project “Investigation of seismically vulnerable areas in Croatia and seismic ground motion assessment” – CRONOS – is to make Croatian society more resilient to the impact of destructive earthquakes. The aim of the CRONOS project, funded by Norwegian Financial Mechanism, is to facilitate this through the development and modernization of seismic hazard assessment in Croatia and stimulate the development of seismic risk reduction policies through scientific infrastructure and capacity building, knowledge transfer, and international research cooperation.

## 2. Seismicity analysis of the central and southern Croatian coastal area

Croatia is characterized by a moderate-to-high seismicity in its coastal and moderate seismicity with the rare occurrence of strong earthquakes in its continental parts. More than 145.000 earthquakes from the period before Christ till the end of 2020 are contained in the Croatian Earthquake Catalogue (CEC) – an updated and continuously supplemented version first described in [1]. There were more than 100 stronger earthquakes, whose computed or estimated magnitudes were more than 5. Most of the earthquakes on Croatian territory are the result of the strain accumulation caused by the rotation of the Adria microplate towards the Eurasian tectonic plate [2]. Central Croatia is in a contact zone of three big geological units: The Alps, the Dinarides (or The Dinaric Alps), and the Pannonian Basin.

### 2.1 General observations and statistical analysis

The main area of focus of this research is central and southern Croatian coastal areas – the targeted region of the CRONOS project. The first step towards the presented goal is to analyse and understand the past seismicity of the given area. Therefore, for the chosen area (42.5 – 44.5 °N, 14.75 – 17.75 °E) an earthquake catalogue CEC-Cronos has been prepared. The given revised catalogue contains 44049 earthquakes which occurred between the years 306 and 2020 (Fig. 1). Those earthquakes, magnitudes up to 6.7 and intensities in the epicentre up to IX °MSK, have been statistically processed and will be further presented.

Within 44049 earthquakes contained in CEC-Cronos, making the area of interest significantly seismically dense, around 400 of them are of magnitude M4+. Most of these earthquakes occurred at depths between 10 and 15 km. Although the most significant seismicity noted in the catalogue occurred before instrumental recording began, the last century was seismically turbulent as well. It is worth mentioning Imotski (29 Dec 1942) M6.2 and Makarska (11 Jan 1962) M6.1 (preceded by the M5.9 foreshock four days before) earthquakes, all causing great human casualties and severe damage.

The completeness of the declustered CEC-Cronos has been tested for three different years representing the milestones in the technology development, and therefore the quality of the seismic

recordings, over the years. Along with magnitudes of completeness for given years, Table 1 shows the corresponding Gutenberg-Richter coefficients from the given year until 2020.

Analysis of the seismicity of an area, spatial and statistical, and the characterization of the same, is a necessary preliminary work and prerequisite for the seismic hazard assessment. Proper understanding of the seismicity of the area is crucial for further seismic hazard assessment and therefore the preparedness for future stronger events for which it is not a question of if but when they will happen. Moreover, significant historical events have drawn attention to the importance of the proper single-event critical reanalysis which is the next step for thorough seismicity research of the given area.

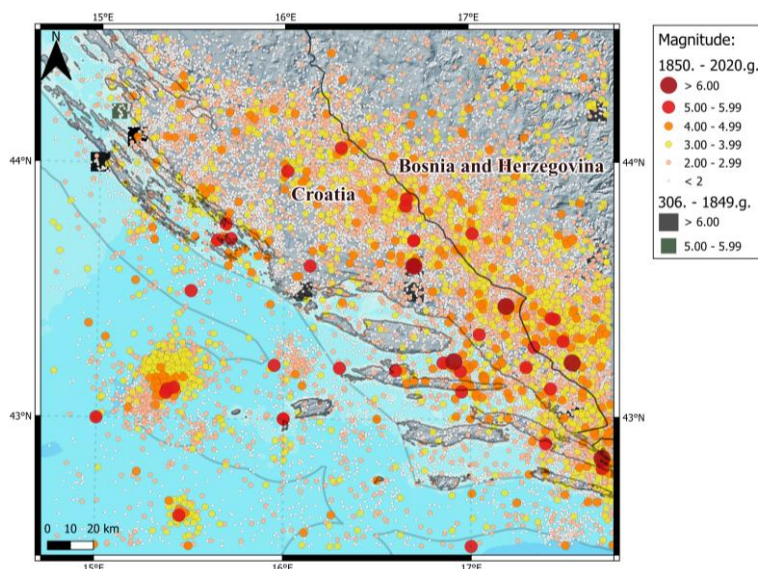


Figure 1. Spatial distribution of earthquakes contained in CEC-Cronos.

Table 1 – CEC-Cronos magnitudes of completeness

$t_0$	$M_c$	$a$	$b$
1908.	3.9	4.23	0.98
1982.	3.1	4.43	1.02
2000.	2.9	4.38	1.01

## Acknowledgements

This work has been supported by the Norwegian Financial Mechanism 2014-2021 under the project “Investigation of seismically vulnerable areas in Croatia and seismic ground motion assessment - CRONOS”, 04-UBS-U-0002/22-90. We would like to thank Croatian Seismological Survey for providing us with the seismicity data within the Croatian Earthquake Catalogue and our colleague mag. phys.-geophys. Lada Dvornik for additional catalogue analysis.

## References

- [1] Herak, M., Herak, D., Markušić, S. (1996): Revision of the earthquake catalogue and seismicity of Croatia, 1908–1992. *Terra Nova*, 8, 86–94, doi: <https://doi.org/10.1111/j.1365-3121.1996.tb00728.x>
- [2] Weber, J., Vrabec, M., Pavlovčić-Prešeren, P., Dixon, T., Jiang, Y., Stopar, B. (2010): GPS-derived motion of the Adriatic microplate from Istria Peninsula and Po Plain sites, and geodynamic implications. *Tectonophysics*, 483 (3-4), 214-222, doi: <https://doi.org/10.1016/j.tecto.2009.09.001>