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The evolution of recent seismicity in the Ionian Islands (W. Greece) with implications on seismic hazard assessment

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Research Highlights

- An overview of the recent seismicity in the Ionian Islands is presented, focusing on the period of 2014-2018.
- Probabilistic Seismic Hazard Assessment indicates PGA values that surpass the provisions of EAK2003.

The Ionian Sea, in western Greece, is undoubtedly one of the most seismically active areas in Greece. From north to south, the dominant structures include the Apulian collision zone, near Corfu Island, the dextral Cephalonia-Lefkada Transform Fault Zone (CLTFZ) and the north-western end of the Hellenic subduction zone, near Zakynthos Island. Herein, we present the past seismicity in the Ionian Sea area, with emphasis on the last decade; particularly during the period between 2014 and 2018, which was marked by strong earthquakes striking the islands of Cephalonia, Lefkada and Zakynthos. To this purpose, we employed a catalogue of ~62,000 earthquakes for the period between February 2011 and November 2021 (Sakkas *et al.*, 2022), with data collected from the databases of the Geodynamics Institute of the National Observatory of Athens (GI-NOA) and the Seismological Laboratory of the National and Kapodistrian University of Athens (SL-NKUA), as well as relocated seismicity catalogues for the major aftershock sequences (Papadimitriou *et al.*, 2021; Kapetanidis, 2017). The spatiotemporal evolution of seismicity projected along a south-north axis (A-B) is presented in **Fig. 1**. Low seismicity is observed in the north, where the collision between the Apulian platform and the Hellenic foreland is taking place. At the Central Ionian Sea, where CTLFZ is the prevailing structure generating intense seismic activity, the 2014 Mw6.1 and Mw5.9 Cephalonia earthquakes occurred on an adjacent local faulting zone, with the aftershock sequence expanding in the vicinity of the activated area along the Paliki peninsula, and offshore northwards (group #1/red in **Fig. 1**). Few months later, on 17 November 2015, another strong earthquake (Mw6.4) occurred on or parallel to the Lefkada segment of the CLTFZ (group #2/green in **Fig. 1**). The post-seismic activity expanded along the CLTFZ and southwards, in the same area as the 2014 sequence. Its temporal evolution shows a long relaxation period, reaching its background levels (0.1–0.2 events/day) between late 2016 and mid-2017. The two seismic sequences are linked in space and time, with the 2014 activity likely accelerating the 2015 event. The October 2018 Mw6.7 Zakynthos earthquake occurred close to the northwestern tip of the Hellenic Arc, with aftershocks expanding in the vicinity of the epicentral area, but mainly offshore south and west of Zakynthos Island (group #3/blue in **Fig. 1**). The seismicity rate has remained at higher values than the background (0.2 events/day) for more than three years.

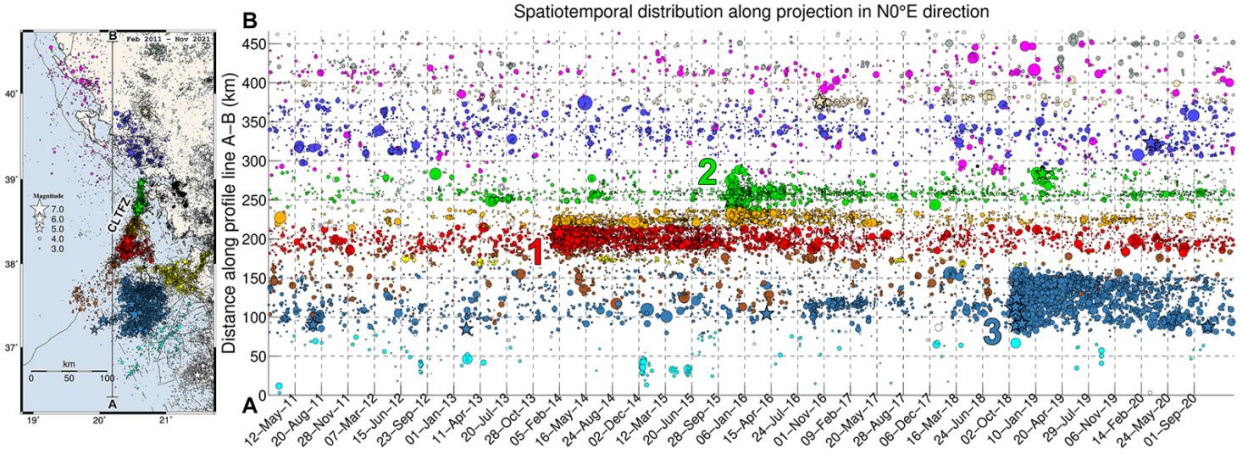

Figure 1. Left: Map of seismicity in the Ionian Sea, from the compiled catalogue of this study. Right: spatiotemporal projection along the south-north oriented profile A-B (see map). Colours correspond to different spatial groups.

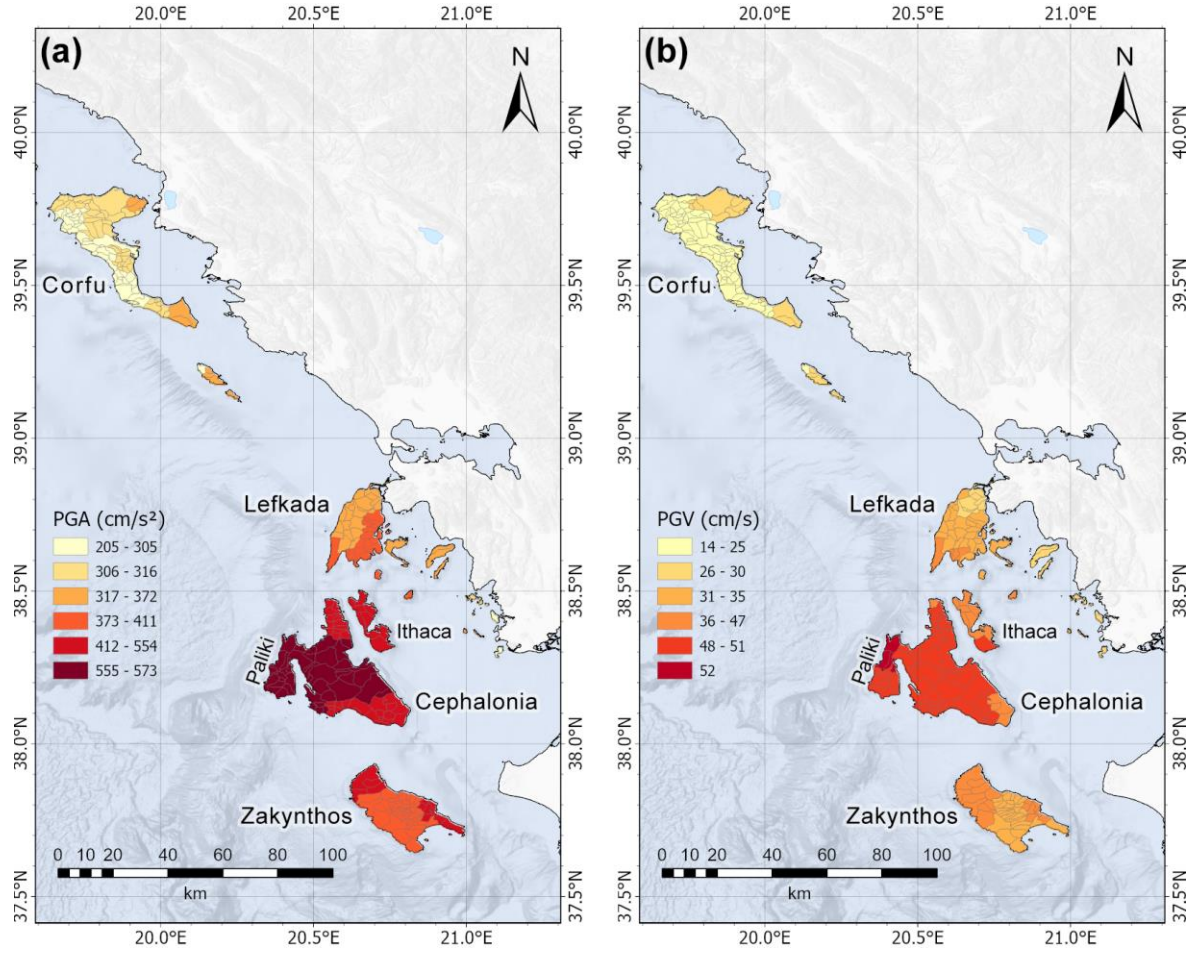

Figure 2. Spatial distribution of (a) PGA and (b) PGV values, for a return period of 475 years.

In the framework of this study, the seismic hazard of the Ionian Islands was evaluated using a probabilistic seismic hazard assessment (PSHA) method, including earthquake data since 1900 (Makropoulos *et al.*, 2012), whereas the Area-Source zones of the Euro-Mediterranean Seismic Hazard Model (ESHM13; Giardini *et al.*, 2014) were selected as the seismotectonic model. The PSHA revealed high PGA and PGV expected values in the central Ionian and lower values on Corfu Island (**Fig. 2**). The largest values are observed in Cephalonia and Ithaca islands, with PGA surpassing 412 cm/s^2 for a return period of 475 years. These values are higher than those proposed by the current Greek Building Code (EAK, 2003), which makes provision for an estimate PGA of 353 cm/s^2 (0.36 g) for the same return period.

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References

EAK, 2003. Greek Seismic Code edited by: Earthquake Planning & Protection Organization. Athens Greece, 72, 7. (In Greek)

Giardini, D., Wossner, J., Danciu, L., 2014. Mapping Europe's Seismic Hazard. Eos, Transactions, AGU, 95, 261–262.

Makropoulos, K., Kaviris, G., Kouskouna, V., 2012. An updated and extended earthquake catalogue for Greece and adjacent areas since 1900. Nat. Hazards Earth Syst. Sci. 12, 1425–1430. https://doi.org/10.5194/nhess-12-1425-2012

Papadimitriou, P., Kapetanidis, V., Karakonstantis, A., Spingos, I., Pavlou, K., Kaviris, G., Kassaras, I., Sakkas, V., Voulgaris, N., 2021. The 25 October, 2018 Zakynthos (Greece) earthquake: seismic activity at the transition between a transform fault and a subduction zone. Geophys. J. Int., 225, 15–36. doi:10.1093/gji/ggaa575

Kapetanidis, V. Spatiotemporal Patterns of Microseismicity for the Identification of Active Fault Structures Using Seismic Waveform Cross-Correlation and Double-Difference Relocation. Ph.D. Thesis, Department of Geophysics-Geothermics, Faculty of Geology and Geoenvironment, University of Athens, Athens, Greece, 2017.

Sakkas, V., Kapetanidis, V., Kaviris, G., Spingos, I., Mavroulis, S., Diakakis, M., Alexopoulos, J.D., Kazantzidou-firtinidou, D., Kassaras, I., Dilalos, S., Vassilakis, E., Kotsi, E., Tselentis, G., Lekkas, E., Voulgaris, N., 2022. Seismological and Ground Deformation Study of the Ionian Islands (W. Greece) during 2014–2018, a Period of Intense Seismic Activity. Applied Sciences, 12 (5), art. no. 2331.