Review

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Review

Case Study: Romania Within the Statistical Threshold for a Richter Magnitude 8+ Earthquake

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Abstract: The Southeastern European country of Romania is among the most seismically active throughout the continent and currently faces a substantial seismic risk, particularly in the Vrancea region, which accounts for approximately 90% of the earthquakes. The present study evaluates the value of the statistical probability that a Richter Magnitude 8+ earthquake will occur in the area utilising the Poisson method, and introduces a novel statistical approach for approximating intervals of recurrence. Through the utilisation of the **N [M$_{(x+0.5)}$] = 2 * N (M$_x$) + 14** heuristic formula, in which **N** is equal to the number of years, it may be deduced that M8+ seismic events occur once every 174 years, on average, given that M7.5+ earthquakes generally occur once every 80 years. Historical records indicate that the most recent M8+ seismic event occurred in 1802 the latest, on Saint Paraskevi's Day, meaning that at least 222 years have passed since the last event of such a magnitude, exceeding the statistical threshold with an extent of at least ~27.586%. If such an event only had a Richter Magnitude of 7.9, the current statistical risk for an M8+ event in Vrancea is likely even higher. Artificial Intelligence tools and simulation models that include Reason ChatGPT and DeepSearch Grok 3 beta have been utilised to provisionally assess the mentioned scientific data. Following such an assessment, the probability for an M8+ earthquake in the Vrancea region is projected to rise with 43.73% each hundred of years following the last M8+ earthquake in the area. Any consequence of such an event would implicate likely dam failures and numerous casualties and widespread damages and economic loss throughout Europe. The present study also takes into consideration existing tectonic influences from plates that are located in areas both neighbouring and afar, with a potential key example representing the Himalayan Mountains, which were formed as a result of a violent crash between the Indian and the Eurasian continental plates. It is important to mention that the Carpathian Mountains are part of the Himalayan-Alpine ring of mountains, alongside the Taurus, the Caucasian, the Alborz and the Sulaiman Mountains, and the fact that two major earthquakes in Vrancea (November 1940 and March 1977) occurred within 6-12 months after two major earthquakes in Turkey (December 1939 and November 1976) during the 20th century may indicate the existence of a transfer of tectonic stress originating from the Himalayan Mountains. Given that the Himalayan Mountains have continued to grow in altitude over the past millennia, that Mount Everest experienced a growth in altitude of ~4 metres in the 20th century (**8848 m -> 8852 m**) and that, following the occurrence of a **Magnitude 7.8** earthquake in **Nepal** in **2015**, Mount Everest experienced a loss of altitude of 3 metres (**8852 m -> 8849 m**), it may be important to consider the potential existence of an association between major tectonic changes within the Himalayan Mountains and rising probabilities of seismic events in proximal and distant areas within the Himalayan-Alpine ring, including the Carpathian Mountains, whose steep curvature in the Southeast may explain the existence of a significant fault underneath Vrancea. An analogy into geology may apply from biological systems, in which tectonic stresses can be transferred throughout lengthy distances, just as muscular contractions can significantly affect distant parts of the human body, and particularly the ones with a lower extent of stability. In the same manner, areas of significant mountain ring curvature that likely include the Vrancea region, may be particularly affected by any transmitted wave of seismic stress, regardless of the distance from the emitting source of such stress. As a result, even subtle increases in underlying stresses may substantially increase the risk of a major earthquake in Southeastern Romania, even for fault lines located several thousand of kilometres away, especially if such stresses originate from a central point of tectonic interaction between two major continental

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plates. Furthermore, the continuous movement of the African plate toward the Eurasian plate with an average speed of 2.15 cm per year could also have been gradually amplifying existing transfers of tectonic stress via the African, Asian and European plates, potentially having brought additional, indirect implications for both Asia Minor and Southeastern Europe, and the consideration of long-term tectonic changes around the Eastern Mediterranean would be particularly important. For the purpose of International Health and Safety guidelines, local, national and international authorities should not rule out the occurrence of an earthquake with a magnitude of up to M9, given the lack of historic data regarding the occurrence of an M8.5+ earthquake within the past 400 years **[N ($M_{8.5}$) = 2 * 174 + 14 = 362 years]**, let alone since records first began around 800 years ago. Any seismic event exceeding M8 in Vrancea would likely be felt throughout widespread areas of Europe, and the medium-high average depth of earthquakes in Vrancea (i.e. generally around 70-200 km underneath the sea level) would be a major factor to such a phenomenon.

Keywords: geostatistics; Poisson; Gutenberg; Richter; Mercalli; probability; p-value; chi-squared test; T-test; ANOVA; Romania; Europe; tectonic plate; continental interaction; tectonic stress; transfer; mountain ring; helium; magnitude; depth; duration; epicentre; aftershock; interest; Einstein; Newton; thermodynamics; energy; electromagnetics; gravity

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Introduction

Europe represents one of the smallest world's continents that paradoxically has several geographic areas where significant seismic activity occurs frequently and oftentimes intensely, particularly in regions that are more proximal to the intercontinental plates. For example, the European area of Turkey is at the highest risk of major seismic activity, partially due to the proximity of the Istanbul area to the Eurasian plate. It is likely that the Balkan Peninsula and/or surrounding areas, such as the Carpathian ring of mountains, are situated at the second or third place with regards to the frequency and intensity of recurring seismic activity. Some geological studies suggest that the Vrancea region of Romania, which is located in the Southeastern area of the Carpathian mountains, represents the second most seismically active region of the continent. Although awareness has been raised for multiple times to the local and national authorities within the important local administrations and Ministry of Internal Affairs respectively, the current level of preparedness for the onset of a high intensity earthquake (M7+) seems to have remained deficient in nature, despite the fact that it has considerably increased within the past few years alone. Given the fact that the Vrancea region of Romania is situated in South-Eastern Europe, at approximately 280 miles (450 kilometres) distance from the natural border between Europe and Asia, in the area of Istanbul, Turkey, which is deemed as the most seismically active region of the continent - particularly at the level of earthquake intensity, rather than frequency - it would be rational to pre-emptively hypothesise and even theorise that Romania would be at a second or third highest risk of seismic disasters, given its rich history of earthquakes, combined with the geological features of the country that favour a recurring onset of major seismic activity. It is also highly important to mention the relatively proximal distance between both the Southeastern Carpathian mountains, which are located within the Alpine-Himalayan belt of mountains, and the African plate, as well as between the African and the Eurasian plates, which may only raise a real-world data-based probability that a larger-scale earthquake will eventually occur in Romania due to indirect transfers of tectonic stress that may have been occurring as a result of the existence of a relationship of tectonic interdependence between various, proximal and more distant plates, and it may be that areas of curvature are most vulnerable and likewise, most prone to seismic incidents, just as in the human organism, powerful muscular contractions and induced damages may bring consequences upon more distant areas of the organism that could also involve elements from other systems of organs, and just as there is an existing relationship of interdependence with regards to electromagnetic and even gravitational influences between various celestial bodies that are often separated by a tremendous physical distance. With regards to movements of different continental plates, it might be worth noting the example of Pakistan, India, Nepal and East Africa, in which the highest mountains in the world were developed as an effect of a tremendous clash between the Indian and the Asian plates, after the Indian plate moved from an area currently known to be within Eastern Africa, to the Eurasian plate. The ongoing tectonic pressure exerted by the Indian plate upon the Eurasian plate, which is displayed by the recorded increase of altitude of the Everest Mount from 8848 m to 8852 m above sea level in 1999, may also increase the extent of tectonic stress transfer upon the Himalayan-Alpine belt, and implicitly, the Southeastern curvature of the Carpathian Mountains, whose major tectonic fault may have acted as a barrier, preventing tectonic stress from reaching more Central areas of Europe, if not significantly attenuating its influence. Interestingly, the earthquake of Nepal that occurred in 2015 and had a Richter Magnitude of 7.8 was followed by an event in which Mount Everest lost approximately 3 metres in altitude. One may hope that seismic events as such do not induce or contribute to any long-term domino effect(s) of stress upon tectonic plates underneath the mountains of Turkey, the Balkan Peninsula and the Carpathians. With regards to any tectonic relationship between Europe and Africa, it is important to mention that the African plate is also moving toward the Eurasian plate at an average speed of 2,15 centimetres per year, reinforcing fears that unprecedented seismic events will eventually occur in South-Eastern Europe. Furthermore, it may be statistically probable that there will be a M8.5+ earthquake in the country, since there has been no earthquake with such a magnitude ever recorded, that the Vrancea Region is among the most seismically active areas of Europe, that the tectonic plates underneath the Carpathian ring of mountains and the Balkan Peninsula are situated proximally to the Eurasian plate, making the seismic activities within such plates about as intense as the tectonic plates situated underneath the area of Istanbul; and that there could be a small probability of an existing statistical association between the occurrence of major earthquakes in Turkey and one or more subsequent occurrences of major earthquakes in Romania and/or the Balkans. Furthermore, the fact that the African plate is situated rather close to the Eurasian Plate underneath the Eastern Mediterranean Sea should bring hypothetical scenarios of an M8.5+ earthquake in Romania under physical consideration, given that increasing extents of transfers of tectonic stress could have been occurring throughout centuries. Moreover, some hypotheses arose in the past, in which it was suggested that the occurrence of an intensive earthquake occurring in Turkey, near the Eurasian plate, raises the statistical probability that an intensive earthquake will occur in Romania, generally between 6 and 15 months years afterward, which could be explained by an originating source of tectonic stress under the Himalayan Mountains. Such hypotheses should be tested using the utmost rigour of scientific scrutiny to eliminate any potential infiltration of alarmist perspectives. An M8 earthquake in the country could result in several of the major river dams of the country to collapse - including the important dam in the Northwestern sectors of the capital of Romania - given that they had been assembled to withstand calamities as such generally not exceeding magnitudes of 7.5 degrees on the Richter scale. As a result, any natural disasters as such may result in a number of deaths reaching tens of thousands, if not more, with numerous major buildings potentially undergoing an entire collapse and numerous families torn apart by such a set of tragedies nationwide. The entire European Union and Schengen Area of free movement would face a tremendous, multi-lateral shock as a result of such an event, with potentially deadly implications upon neighbouring countries and potentially even several, more distant ones in the continent. Likewise, European authorities may be left with a significant pressure to stimulate local, national authorities in each member state to develop proportional seismic plans accordingly.

Methodology

The scientific remarks and the development of hypotheses regarding the existence of statistical risks with regards to the occurrence of unprecedented seismic activity in Romania have been gradually assembled via the utilisation of various mathematical and Artificial Intelligence (AI)-generated models through programming to ensure that results reach a threshold of significance in

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their relevance to real-world conditions. Firstly, the average duration between two consecutive earthquakes of the same magnitude nature has been calculated for each cohort of magnitude (i.e. M7+, M7.5+, M8+). Afterward, the Poisson model was applied into real-world, seismic data using AI-generated responses, prior to the AI-generated development of Python input codes to create provisional types of projective modelling with regards to more exact probabilities that earthquakes with magnitudes 7+, 7.5+ and 8+ will occur within the next 5, 10, 15, 20, 25, 50 and 100 years, respectively. The Poisson modelling is centred around the following formula - $\mathbf{P(T) = 1 - e^{-\lambda T}}$ - discovered and implemented by Siméon Denis Poisson with the purpose of creating accurate statistical projections, and in the case of statistical analysis of the frequency of earthquakes with specific magnitudes, the formula has been implemented accordingly, via principles of applied statistics into geological events. In such a case, **T** represents the number of years into the future, whilst λ represents the frequency of the recurring event per year and is equal to **1 / Recurrence Interval**. By utilising such a method, a Python code was generated by ChatGPT with the options of Search and Reasons switched on. By carefully analysing and interpreting all such data using realistic conditions, the author has ensured a balance that would prevent the audience from potentially reaching any alarmist perspectives, whilst encouraging the audience to remain on a threshold level of awareness and preparedness for the purpose of Internationally-recognised and implemented Health & Safety laws and guidelines. It may also be important to mention the statistical relationship of proportion between the magnitude of an earthquake and the number of its aftershocks, as described through the Gutenberg - Richter law, which is centred around the following mathematical formula: **lg N(m) = a - b * M**, where **N(m)** represents the number of seismic incidents displaying a Richter-scale magnitude greater or equal to the value of M, a is a constant value and b represents a scalable parametric value. Furthermore, recent scientific hypotheses regarding a potential relationship between planetary and stellar configuration toward the Earth and increased statistical probabilities of earthquake occurrence in prone areas are being taken in consideration whilst emphasising upon the importance of acknowledging evidence-based scientific data as the ultimate, foundational model by which statistical and geological research should continue.

Results

The first step to determine the frequency of large-scale earthquakes in Vrancea was the determination of the λ variable for each cohort of earthquake magnitude. Given that $\lambda = 1$ / Recurrence Interval, the following λ values for M6+, M7+, M7.5+, M8+ and M8.5+ cohorts, respectively, were determined using advanced functions of ChatGPT; $\boldsymbol{\lambda_{M6+} = 0.1}$, $\boldsymbol{\lambda_{M7+} = 0.0303}$, $\boldsymbol{\lambda_{M7.5+} = 0.0125}$, $\boldsymbol{\lambda_{M8+} = 0.005747}$ and $\boldsymbol{\lambda_{M8.5+} = 0.0002762}$, respectively. Likewise, for M8+ earthquakes, the following equations were approximated: $\mathbf{P_{M8+}(1) = 0.57\%}$, $\mathbf{P_{M8+}(5) = 2.83\%}$. $\mathbf{P_{M8+}(10) = 5.59\%}$, $\mathbf{P_{M8+}(20) = 10.84\%}$, $\mathbf{P_{M8+}(50) = 25.00\%}$, $\mathbf{P_{M8+}(100) = 43.73\%}$. Likewise, given the fact that 223 years have passed since a M8+ earthquake has likely occurred (approximated 66.67% statistical probability, given the estimated Richter magnitude range of M7.9 - M8.2), a $\mathbf{P_{M8+}(174)}$ probability value was reached at least 48 years ago, potentially indicating the existence of an excess probability value of ~27.586%. Given the uncertainty that the seismic event of 1802 reached a Richter Magnitude of 8 (only a 66.67% statistical probability), the actual statistical probability of an M8+ earthquake occurring is possibly even higher, and its value could be hinted at a percentage of up to 40%, given that there is a 33.33% probability that the 1802 event did not reach magnitude M8. Under such a scenario, the risk of a catastrophic earthquake occurring in the country in the present years would overall be even higher. Given the lack of historical records regarding the existence of a M8.5+ earthquake within the past 400 years, a $\mathbf{P_{M8.5+}(400)}$ value has been reached for an M8.5+ earthquake scenario, as a full standard probability of the occurrence of such an earthquake is reached at a $\mathbf{P_{M8.5+}(362)}$ value. Realistically, $P_{M8.5+}(362)$ was likely reached centuries ago, since records have not mentioned any catastrophic earthquake reaching or exceeding magnitude M8.5 since the year 1200. Henceforth, the statistical results alone indicate the existence of a considerable risk for an earthquake above M8, with hypothetical scenarios of an M8.5+ earthquake occurring due to the high geological vulnerability

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shown by the specific geographical location of the South-Eastern Carpathian mountains, alongside the Balkan and the Asia Minor Peninsulae. Moreover, the fact that the Vrancea region of Romania is situated relatively close to the Eastern Mediterranean sea, which is situated above the intersection between the Eurasian and the African plates, such hypothetical scenarios should not be completely ruled out for Romania and the rest of South-Eastern Europe. A hypothetical scenario of a M9+ earthquake would involve a **T** value equal to 362 * 2 + 14, which would be equal to 738 years for the $\mathbf{P}_{M9+}$ percentage to reach its full, standard value. In such a hypothetical scenario, an M9+ earthquake would statistically occur once every 738 years, on average. Under real-world data, not even an M8.3 earthquake has been recorded since the year 1200. A potential difference made between statistical improbability and impossibility to rule out such a scenario from ever occurring in the future is the continuous movement of the African plate toward the Balkan Peninsula at an average speed of just above 2 cm per year, or 2 metres per century, which could have been favouring a phenomenon of tectonic stress transfer, overall having brought some extent of influence upon the intensity of seismic activity in various areas proximal to the Eurasian plate. It is important to note that a Magnitude 6+ earthquake has not occurred in Romania for 22 years (**22 > 10**), that a Magnitude 7+ earthquake has not occurred for 39 years (**39 > 33**), that a Magnitude 7.5+ seismic event has not occurred for at least 84 years (**84 > 80**), and a Magnitude 8+ seismic event has not occurred for at least 222 years (**222 > 174**), overall bringing a big statistical imagery involving a high risk that the country will experience a Magnitude 8+ seismic incident in the future.

The ChatGPT-generated Python input code for the M7.5, M8 and M8.5 scenarios is as follows:

```
“import numpy as np


def earthquake_probability(rate, time_years):
    """
    Calculate the probability of at least one event occurring in a given time period
    using the Poisson process.

    Parameters:
        rate (float): Average event rate (events per year).
        time_years (float): Time period in years.

    Returns:
        float: Probability of at least one event occurring.
    """
    return 1 - np.exp(-rate * time_years)

# Recurrence intervals for each category (in years)
recurrence_M7_5 = 80       # M7.5+ earthquakes occur once every 80 years
recurrence_M8    = 174     # M8+ earthquakes occur once every 174 years
recurrence_M8_5 = 362      # M8.5+ earthquakes occur once every 362 years

# Calculate λ for each category
lambda_M7_5 = 1 / recurrence_M7_5
lambda_M8     = 1 / recurrence_M8
lambda_M8_5 = 1 / recurrence_M8_5
```

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```
print("Poisson rate parameters (λ):")
print("λ for M7.5+ earthquakes: {:.6f} events/year".format(lambda_M7_5))
print("λ for M8+ earthquakes:    {:.6f} events/year".format(lambda_M8))
print("λ for M8.5+ earthquakes: {:.6f} events/year".format(lambda_M8_5))

# Define time intervals (years) for probability calculations
time_intervals = [1, 5, 10, 20, 50, 100]

# Calculate and print probabilities for each earthquake category
def print_probabilities(mag_label, lam):
    print("\nProbabilities for {} earthquakes:".format(mag_label))
    for t in time_intervals:
        prob = earthquake_probability(lam, t)
        print("   Next {:3d} years: {:6.2f}%".format(t, prob * 100))

print_probabilities("M7.5+", lambda_M7_5)
print_probabilities("M8+",     lambda_M8)
print_probabilities("M8.5+", lambda_M8_5)”
```

The development of the front-end Python program above may constitute a sample approach in ongoing efforts to catalyse statistical and geological research using both front-end computer programming and various Artificial Intelligence models whose functions are capable of becoming specific with regards to such disciplines, as well as research methods and directions. Likewise, via the gradually broader inclusion of digitalisation and AI-mediated research and calculations, it may become increasingly easier for an increasing number of people from a broader audience to have easy accessibility to credible and peer-reviewed scientific information that can be simplified in its delivery, thereby helping people make better and more robust preparations in case of statistically significant probabilities that specific natural disasters will occur in the future.

Discussion

The development, update and gradual implementation of various Artificial Intelligence models into various, specific areas of scientific research has resulted in an effective production of a “catalysis” of the “chemical reaction” of scientific research in areas like applied mathematics into geology, applied statistics and population studies, geological research, astrophysics, biomedical science, biophysics and chemical engineering. Through the gradual change from a “manual” to an “automatic” speed of virtually-performed scientific research, scientists have become increasingly capable of assimilating highly specific and relevant information regarding major points of scientific innovation, pattern recognition in complex modern-day problems, as well as profound levels of problem resolution in scientific research, given the exponential increase in the availability of peer-reviewed data from references that are specifically relevant to the question of research. With regards to geology, Artificial Intelligence models can be easily trained to perform scientific research at higher levels of Academia, as functions that include DeepSearch in Grok 3 beta, collect peer-reviewed scientific resources that are related to the major points of the scientific inquiry. Simultaneously, it may be essential for authors to be reminded of the high importance that scientific work must remain original in nature and that all ideas of innovation and inquiry should derive from their own work. In other words, AI ought to be a “supplement” in scientific enquiry, and not a substitute, playing a role similar with an “enzyme” in chemical reactions, which does not substitute the reactants, but merely

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aid in their chemical interaction whilst keeping it specific to the nature and activity of the reactants. The statistical projection could be performed methodically and carefully, using the calculated statistical data from M6, M7, M7.5, M8 and M8.5 cohorts. Multiply the calculated probabilities for each cohort to obtain the general probability that a significant earthquake will occur using all presented Richter magnitude cohorts. Then, Poisson models can be developed for each 5 consecutive years. It may be important to explain that even a 5% probability may be significant, as it would resemble an added value to the already existing and growing probability over time, meaning that it is not a whole existing probability itself. In the current study, a heuristic approach is used through the development of the general formula of $\mathbf{N}_{[M(m+0.5)]} = \mathbf{(2 * n + 14)\ [M(m)]}$, where **N** is the number of years between two consecutive earthquakes of the same kind of magnitude, and m represents the value of the earthquake magnitude upon the Richter scale, it may be determined that, on average, there are 80 years between two consecutive M7.5+ earthquakes, 174 years between two consecutive M8+ earthquakes and potentially as few as 362 years between two consecutive M8.5+ earthquakes, given the proximal location of the Vrancea region to the natural border between Europe and Asia around the Istanbul area of Turkey. Such a formula can be written in the form of Poisson's statistical model, in which $\mathbf{P(T) = 1 - e^{-\lambda T}}$, in which T is the number of years for a scenario in which an earthquake within a specific magnitude range would occur, and λ would represent the frequency of such an event per year. Likewise, there is an excess probability of a M8+ earthquake occurring in the country of at least approximately **27.586%** and could be up to **40%**, given the uncertainty that the 1802 earthquake of Romania reached the M8 intensity on the Richter Scale. An earthquake reaching and exceeding M8 in the region of Vrancea would bring severe, unprecedented repercussions - not solely for the integrity of the Romanian society, but for the integrity and wellbeing of the entire continent, as the economy would be affected by the several billions of euros within the European Union.

A "phenomenon" in which increasing proportions of the human population have coincidentally "bumped" into numerical and geometrical repetitions (i.e. "angel numbers") and symmetrical configurations may reflect an increasing electromagnetic influence upon the Earth, which would involve shifts indirectly influencing major layers of human existence that would likewise include psychology and behaviour, as a result of increasingly common lunar, planetary and stellar alignments toward our planet - though philosophically speaking, the principle of free will remains intact in the entire process, despite the increasing extent of "temptation and challenge-related pressure". Some scientists have even hypothesised the existence of a statistical relationship between various extents of religious beliefs and cosmic events as such. It may be that observed increasing polarisations in present times that cover the issues of climate change, extreme weather phenomena, increasing numbers of sudden natural disasters, rising geopolitical and social tensions worldwide, rising economic instability, increasing cases of mental health conditions and continuous increase in the discrepancy of resource availability throughout the world may have been influenced by changes in the proximal and more distal areas of the Universe in relation to the Earth and even the Solar System. Recently, some astrophysicists and geologists (i.e. Frank Hoogerbeets) have started hinting at a possible existence of a statistical relationship between specific lunar, planetary and stellar geometrical configurations toward the Earth and a higher probability that certain seismic activity occurs in geologically-prone areas. Such an idea is currently hypothetical in nature, though it has compelled researchers to begin processes of rigorous scientific and statistical testing procedures, as it is based upon the theory that tides are caused by increased electromagnetic and gravitational influences from the Moon and the Sun, and in theory, it sounds as a scientifically sound hypothesis, given that such cosmic configurations consist of rather numerous celestial bodies, which altogether may combine a significant electromagnetic influence upon the Earth and even its tectonic plates, which are generally situated below 200 kilometres from the surface level, when the Moon alone is situated at an approximate distance of 384,400 kilometres from the surface of the Earth, making the distance between the Moon and the Earth's tectonic plates an extra of 0.005%. The proportion of the extra distance between other planets and the Earth's plates, compared with the distance to the Moon's

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surface, would be microscopical in relation to the 0.005% value. Likewise, mathematical data tends to be generally in accordance with the hypothesis that specific alignments between the Moon, other planets and even other stars in relation to the Earth do considerably increase electromagnetic and gravitational influences toward our planet, thereby influencing the movement of tectonic plates, particularly in geographical areas statistically regarded as prone to earthquakes. Ideally, such research material should be placed under further, highly rigorous scientific screening to ensure that any areas affected by "forced statistics" are automatically filtered from the mainstream research pathways.

Table 1. How a Magnitude 8.5 earthquake in Vrancea, Romania, would be felt throughout Europe (according to recent ChatGPT AI modelling, 2015).

Country / Region	**Estimated Maximum Mercalli-Scale Intensity for an M8.5 Seismic Event in Vrancea**
Romania	Epicentral areas: X-XI; Major cities: IX-X
Moldova	Around VIII
Bulgaria	Northern regions: VIII-IX; Rest of the country: VII-VIII
Western Ukraine	VI-VIII
Serbia	VII-VIII
European Turkey	VI-VII
Hungary	V-VII
Czech Republic & Slovakia	V-VI
Austria and Eastern Switzerland	V-VI
Poland	V-VI
Italy	Northeastern regions: V-VI; Rest of the country: Generally III-IV
Greece	Around VI
France	Eastern regions: IV-V; Rest of the country: III-IV
Germany	Eastern regions: About V; Rest of the country: Around IV
United Kingdom	II-III
Republic of Ireland	II-III

Spain	II-III
Portugal	Around II
Belgium, Netherlands and Denmark	About III-IV
Scandinavian Countries	Around II
Baltic Countries	About III
European Russia	III-IV

Through Web Search and Think ChatGPT functions, as well as DeepSearch Grok 3 beta, a Magnitude 8.5 earthquake was simulated in Vrancea, Romania, with the depth of the epicentre between 70 km and 200 km, to check how far the seismic event would be felt throughout Europe. Through repeated analyses, the author came to the conclusion that Western Europe would possibly feel the earthquake too, at Mercalli scales ranging from 3 to 5, given that the 1802 earthquake was felt from the Aegean Sea to Saint Petersburg, Russia; and from Voronezh, Russia, to Berlin and Rome, in Germany and Italy, respectively. It is important to note that a M8.5 earthquake is 3.162-fold more large-scale in nature than a M8 and 5.623-fold more intense, given that a whole scale increase would involve a ten-fold increase in the value of he magnitude, meaning in theory that it would be felt at a distance up to 3.162 times bigger than a M8 earthquake, suggesting overall that even countries like Norway, Ireland, Scotland and Portugal would experience it at Mercalli scales of 2 to 3, meaning that the local populations would feel the earthquake. Cities that include Paris, Frankfurt, Barcelona and Nice would feel such an event at Mercalli scales around IV, whilst cities like Rome, Milan, Berlin and Prague would feel the event at a scale of approximately V and cities like Vienna, Bratislava, Budapest and Kosice would feel it at scales generally between VI and VII, particularly in the Eastern parts of Central Europe.

Table 2. How Mercalli scales translate to the average perception levels of an earthquake's intensity (ChatGPT, 2025).

Mercalli Scale (MMI)	**Perception**	**Description**
I	Not felt	The earthquake is only felt by very few people, under highly select circumstances.
II	Weak	The earthquake is felt by a few people during resting time, particularly residents of higher levels of multi-story buildings. Most likely not recognised as an earthquake.
III	Weak	Felt visibly by persons located indoors, particularly on higher levels of multi-story buildings. Numerous people may not

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		recognise it as an actual earthquake.
IV	Light	Felt indoors by numerous people, and outdoors by much fewer people. Bathroom and kitchen items, doors and windows may be moved and/or slightly affected.
V	Moderate	The event is felt by almost all local residents and visitors, and many people resting become awake. Wardrobes, bathroom and kitchen items, doors and windows are moved and some of the smaller items are broken and overturned in the process.
VI	Strong	Felt by everyone, and many people exit buildings in a panic mode. Some heavy elements of apartments that include wardrobes and even slightly broken doors are moved. Windows and other outside elements of buildings may face slight cracks and damages.
VII	Very Strong	Local residents and visitors find it difficult to keep their balance, with damages occurring even in well-assembled and designed buildings, with more significant effects upon older buildings. A number of houses can have their chimneys broken in the process.
VIII	Severe	Particularly well-assembled and designed buildings face little damage, whilst others

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		face notable damages and some buildings may partially collapse in the process. Several chimes and some factory stacks also face collapse.
IX	Violent	The local population is under general panic. Well-assembled and designed buildings face notable damages and many other buildings face either complete collapse or disturbed foundations. Cracks suddenly appear in the ground.
X	Extreme	The majority of buildings face total collapse, including some well-constructed and assembled ones. Several, considerable fissures appear in the ground, with several vehicles and even some buses and trucks becoming “swallowed” in the process. The visibility can be decreased in remote areas, where a few closely-located multi-story buildings have collapsed.
XI	Extreme	Only a few buildings remain intact. Many bridges are torn apart and destroyed. Large-scale breaks in the ground appear, with many vehicles, buses and trucks falling into them. Electricity is likely cut off in broad areas, and heat and running water becomes broadly unavailable. The visibility becomes lower in local areas.
XII	Extreme	The earthquake has catastrophic effects upon the local and broader areas, with

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		utter collapse observed in the general, big image of the urban environment. The ground moves in a wavy manner, leading and contributing to the production of numerous, broad fissures. Voluminous items and objects are thrown into the air at altitudes of tens and few hundred feet, and the visibility becomes low.

The classification of the Mercalli scales above contains an in-detail explanation of how earthquakes of various intensities occur in and affect urban and rural areas that is at the same time understandable to a general audience. Such a classification is also utilised to calculate the diameter of the surface area where an earthquake is felt, according to various felt intensity levels, which are generally inversely proportional to the distance between the specific geographic area and the epicenter of the earthquake. It may be important to analyse the relationship between the depth of the epicentre and the length of the diameter of the surface where the earthquake is felt in any manner. Namely, if an earthquake occurs at a depth proximal to the sea level, the surface of the felt earthquake will tend to be smaller, whilst the felt intensity will tend to decrease logarithmically in proportion to the increasing distance from the epicentre. On the other hand, if an earthquake occurs at a deeper level, the surface of the felt earthquake will tend to be bigger, whilst the felt intensity will tend to increase exponentially in proportion to a shrinking distance to the epicenter. A major difference would be made by the actual intensity of the earthquake, as a higher magnitude earthquake would be felt significantly throughout much of the "earthquake-felt" surface if the epicentre is located closer to the sea level, whilst it would only be felt violently closer to the epicentre if the epicentre is located at a higher depth. In the case of Romania, earthquakes tend to occur between depths of 70 and 200 kilometres, which resemble a significant, yet medium depth. As a result, the area of a felt high magnitude earthquake as such would have a set of intensities resembling an exponential increase proportionally with shrinking distances toward the epicentre, with a plateau phase at the areas most proximal to the epicentre, which explains why the city of Bucharest, which is located at approximately 200 kilometres from the epicentre, felt major earthquake as intensely as geographic areas within the Vrancea region.

Table 3. Risk assessment for river dams in Romania following an M8+ and an M8.5+ earthquake in Vrancea, using Grok 3 beta's DeepSearch AI model as a reference.

Distance from the epicentre (from the surface-level perspective)	**Risk of dam collapse following a Magnitude 8+ earthquake**	**Risk of dam collapse following a Magnitude 8.5+ earthquake**
Close river dams (<100 km)	Siriu, Valea Uzului: 50-80%	Siriu, Valea Uzului: 70-90%
Medium-distance river dams (100-200 km)	Izvorul Muntelui, Bolboci, Lacul Morii: 30-60%	Izvorul Muntelui, Bolboci, Lacul Morii: 50-80%

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Large-distance river dams (>200 km)	Vidra, Vidraru: 25-40% Gilau I: 10-25%	Vidra, Vidraru: 45-60% Gilau I: 30-45%

The results above have been provisionally generated via an extensive analysis of the Romanian hydraulic infrastructure, which is not as developed as the infrastructures of countries that include Japan, Chile, Mexico and the United States of America. Likewise, risks of dam collapse have been provisionally graded as higher due to the historic and economic context Romania is situated into. Likewise, it may be highly important to analyse the potential implications of any earthquake over M8 over Romanian infrastructure, as any significant level of damage may bring as a consequence unprecedented loss of human and animal life. For example, there are several river dams created mainly in the Carpathian mountains, designed to withstand any earthquake with a magnitude value up to 7.5, meaning that an M8+ earthquake could cause some or most of the river dams to collapse, which would result in imminent losses of at least tens of thousands of lives nationally, given that several large towns and cities are located within the course of such rivers, beyond the assembled dams. Likewise, any earthquake reaching and exceeding Magnitude 8 would have catastrophic effects upon Romania, as its political and economic history has not allowed the country to develop as much as Central and Western countries of the continent, and much of its infrastructure is, on average, less able to withstand earthquakes with such a magnitude. For example, a collapse of the Vidraru dam would result in the subsequent flooding of the Curtea De Arges large town and Pitesti city, which alone would involve thousands of fatal casualties throughout the Muntenia region. A collapse of the Vidra dam would result in the flooding and widespread destruction of Oltenia's one of the most important cities - Ramnicu-Valcea. In Moldova, the "Izvorul Muntelui" dam would also be vulnerable to an M8 earthquake in Vrancea, and any form of collapse would cause devastating effects in the entire area of the country. In Transylvania, the Gilau I dam would also be notably vulnerable if an M8+ earthquake occurs in Vrancea, and its collapse would devastate the second most important city of Romania - Cluj-Napoca. A final example would involve the Lacul Morii Dam, which is located in the Northwest of Bucharest and whose collapse would result in the flooding of a 30% proportion of the capital city, which in turn would potentially result in tens of thousands of fatal casualties, given the fact that the city currently contains a human population exceeding 2 million. According to Grok 3 beta's DeepSearch modelling, an M8+ earthquake in Vrancea would likely cause the Vidraru, Bolboci, Lacul Morii, Siriu and Valea Uzului dams to collapse, whilst other river dams like Vidra, Izvorul Muntelui and Gilau I would less likely collapse, though risks would still be notable.

Conclusions

Southeastern Europe is currently situated in a statistically significant area of risk with regards to a potential occurrence of an unprecedented seismic event, given the gathered geological, mathematical and statistical evidence throughout the past several decades. According to scientific evidence, local and national authorities would be required to prepare extensive plans of preparation in case such events actually occur, in order for the local and national populations to be extensively prepared, and have the availability of provisional resources fulfilling their most primary human needs for survival. Levels of concern would be based on the fact that the Carpathian mountains are located within the Alpine-Himalayan ring of mountains, that the Vrancea region is located in an area of significant tectonic vulnerability as a result of the steep curvature of the Southeastern Carpathians, that the Indian plate has continued to exert a tectonic pressure upon the Eurasian plate, as the Himalayan Mountains have continued to grow in their altitude above sea level; that the Carpathian mountains are relatively proximally to both the African and the Eurasian plates, and that the African plate is in a continuous motion toward the Eurasian plate at an average speed of 2,15 cm per year, meaning that any eventual occurrence of unprecedented clashes in the tectonic fault underneath Vrancea, Romania, and implicitly, any potential risks that particularly intense earthquakes will occur

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in the future, cannot be fully eliminated, given that the African plate's ongoing movement toward the Balkan Peninsula, which could have been favouring an increase in a transfer of tectonic stress via the Eurasian plate. Currently, the African plate is situated at a distance of approximately 1,750 km from Romania, and 200 kilometres from the Eurasian plate via the Eastern Mediterranean area. Both the European Parliament and perhaps eventually the United Nations' General Assembly as well should, in the author's utmost humble opinion, bring the current subject to an immediate debate, as any seismic activity exceeding M8 would likely cause tremendous losses in human life and financial expenditure, particularly in Southeastern Europe, where the general living conditions are lower than in Western European countries. It may be critical to raise scientific and academic awareness about the existing, major statistical probability that an unprecedentedly large-scale seismic event may occur in Romania and cause devastating effects for the quality of life and economic wellbeing of several Southeastern European countries, dragging the entire European Union into significant challenges as a result. It may be that such large-scale seismic activity would bring repercussions in the world economy, given that Romania is rich in natural resources and is a member of the North Atlantic Treaty Organisation (NATO), the European Economic Area (EEA) and the Schengen Area. Furthermore, novel astrophysical hypotheses regarding the existence of considerable electromagnetic influences from various planetary and stellar alignment events should not be rapidly disregarded, but thoroughly tested using utmost rigorous procedures of scientific testing, to ensure an utter balance that eliminates both alarmist and reductionist forms of misinformation from important spaces of scientific research and innovation. It may be important to emphasise upon Albert Einstein's three great quotes about ideal scientific perspectives and mindset, in which His Excellency stressed that problem resolution may only successfully occur if regular change of mind is practiced through humility, that various phenomena ultimately occur behind "the curtains" of coincidences and paradoxes, and that an unspoken principle of interest applies Universally to the utmost letter of rigour, meaning that each approach is faced with self-amplification in focus, whether such an approach is performed consciously or not; willingly or not.

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