https://doi.org/10.1016/j.enggeo.2019.105403 - *Supplementary material*

Supplementary material for "NDSHA: A new paradigm for reliable seismic hazard assessment"

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[b] *Institute of Geophysics, China Earthquake Administration, Beijing, China*
[c] *Accademia Nazionale delle Scienze detta dei XL, Rome, Italy*
[d] *International Seismic Safety Organization, ISSO, Arsita, Italy*
[e] *Beijing University of Civil Engineering and Architecture (BUCEA), China*
[f] *Oregon Earthquake Awareness, Portland, Oregon, USA*

"Tell me you kept the box and receipt."

*"The **conundrum**, though, is that, once serious questions are raised, it's hard—and perhaps even wrong—not to debate them."*

https://www.youtube.com/watch?v=CDJPaSKVTXE

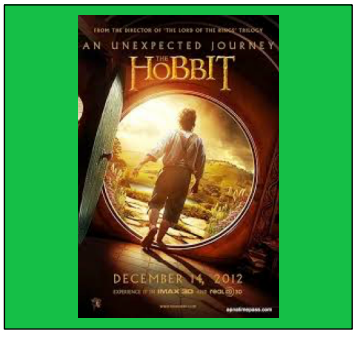
PSHA: You've been sitting quietly for far too long.

NDSHA: I'm going on an adventure!

I WANT YOU FOR AN ADVENTURE !

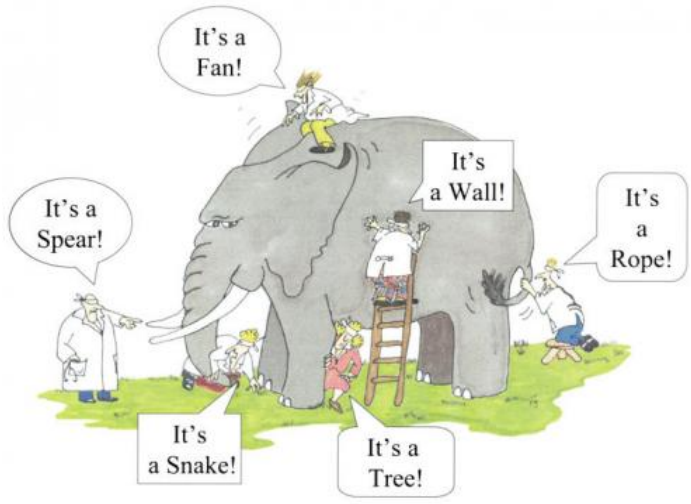
To A NEW PARADIGM . . .

ENTER HERE:



BIBLIOGRAPHIC JOURNEY to a *NEW PARADIGM !*

Jurassic PSHA (Probabilistic Stoney Hazardous Asteroids)
https://www.youtube.com/watch?v=zHalXjs0cDA

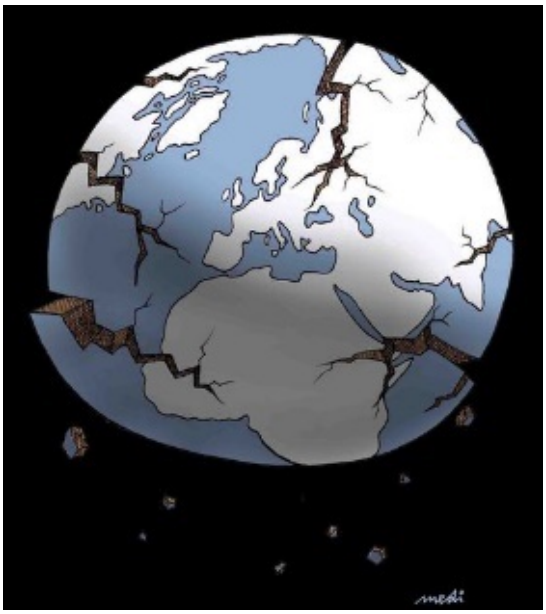


Saxe, J.S. (1873) "The Blind Men and the Elephant", a re-telling of an Indian parable that deals with perception and the subjective nature of truth: featuring six blind men who wish to observe an elephant. https://www.commonlit.org/en/texts/the-blind-men-and-the-elephant?search_id=3423435

Cancani, A. (1904) "Sur l'emploi d'une double échelle sismique des intensités, empirique et absolue", *Gerlands Beitr. Geophys.*, 2, pp. 281–283.

Gilbert, G.K. (1909) "Forecasting Earthquakes", v. 29, no. 734, pp.121-136. https://doi.org/10.1126/science.29.734.121

Reid, H.F. (1911) "The elastic-rebound theory of earthquakes", *University of California Publications, Bulletin of the Department of Geological Sciences,* v. 6, pp. 413–444.



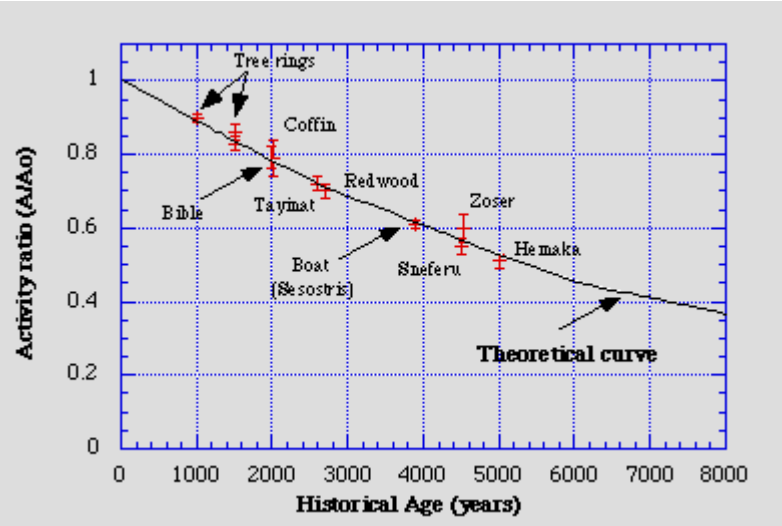
1912 Alfred Wegener comes up with idea of Continental Drift

Wegener, A. (1924) "The Origin of Continents and Oceans", (The first English edition, a translation of the 1922 third German edition: *Die Entstehung der Kontinente und Ozeane*), *Dutton*, pp. 212.

"Continental Drift" Alfred Wegener Song by The Amoeba People
https://www.bing.com/videos/search?q=alfred+wegener+amoeba+people&view=detail&mid=39AD324C8139E8A39CCC39AD324C8139E8A39CCC&FORM=VIRE

─ 1946 - 1960 ─

Radiocarbon Dating Revolution



The "Curve of Knowns" after Libby and Arnold (1949). The first acid test of the new radiocarbon dating method was based upon radiocarbon dating of known age samples primarily from Egypt (the dates are shown in the diagram by the red lines, each with a 1 standard deviation included). The Egyptian King's name is given next to the date obtained. The theoretical curve was constructed using the half-life of 5568 years. http://www.c14dating.com/int.html

Radiocarbon age dating method is developed by a team of scientists
led by late Prof. Willard F Libby of Univ. Chicago in immediate post WW II years
http://www.c14dating.com/int.html

─ 1948 ─

Professor George W. Housner Founds EERI

Kawasumi, H. (**1951**) "Measures of earthquake danger and expectancy of maximum intensity throughout Japan as inferred from the seismic activity in historical times", *Bull. Earthquake Res. Inst*. 29.
Infeld, L. (**1953**) "Leonardo Da Vinci and the Fundamental Laws of Science", *Science & Society*, Vol. 17, No. 1 (Winter, 1953), pp. 26-41.

─ 29 June 1954 ─

R. Buckminster Fuller, who invented and popularized the *Geodesic Dome* in 1940s, receives U.S. Patent

─ 1956 ─

First Commercial Nuclear Power Plant: England

─ 1957 ─

Second Commercial Nuclear Power Plant: USA

Gumbel E.J. (**1958**) "Extreme Value Statistics", *Columbia Univ. Press*, New York ─ (2004) "Extreme Value Statistics", *Dover Publications*, Mineola, NY: unabridged re-publication of 1958 edition, pp. 400. ISBN 0-486-43604-7

─ 22 May 1960 ─

The Giant M 9.5 Valdivia, Chile Megathrust Earthquake and Tsunami
https://www.ngdc.noaa.gov/hazard/22may1960.html

Tsunami Animation: Valdivia, Chile, 1960 (rotating globe)
https://www.youtube.com/watch?v=RHYbprZAIWo

1960 Nobel Prize in Chemistry 1960
awarded to Willard Frank Libby

"for his method to use carbon-14 for age determination in archaeology, geology, geophysics, and other branches of science."

Nobel Lecture, December 12, 1960
https://www.nobelprize.org/prizes/chemistry/1960/libby/lecture/
http://www.c14dating.com/int.html

1960 ─ American geophysicist Harry H. Hess developed the idea that oceanic crust forms along mid-ocean ridges and spreads out laterally away from the ridges. The following year, *

─ 1961 ─

1961 ─ geophysicist Robert S. Dietz named the phenomenon seafloor spreading. Hess and Dietz's work played a pivotal role in the development of the modern theory of plate tectonics. *

─ 25 May 1961 ─

President John F. Kennedy announces his goal of putting a man on the moon by the end of the decade.
https://www.space.com/11772-president-kennedy-historic-speech-moon-space.html

1963 ─ British geologists Frederick J. Vine and Drummond H. Matthews - as well as Canadian geophysicist Laurence W. Morley, who worked independently of the others - postulated that new crust would have a magnetization aligned with Earth's geomagnetic field. They noted that this would appear over geologic time as bands of crust that exhibit alternating patterns of magnetic polarity. The later identification of such patterns of magnetic striping provided additional evidence that Earth's plates

separate at mid-ocean ridges. * In this same year, Canadian geophysicist J. Tuzo Wilson proposed that the bend in the Hawaiian Islands chain was created as the result of a large Pacific Ocean plate shifting to the NW over a fixed *hotspot*, "spawning a long series of volcanoes" in its wake, evidence for rigid plate motions on a mobile earth.**

1965 ─Canadian geophysicist J. Tuzo Wilson introduced concept of a "transform fault" (horizontal motion between plates), which provided "a wonderful geometric test for the existence of continental drift and plate tectonics." **

Mid 1960s ─ A global network of sensors designed to detect hydro-acoustic signals was installed to monitor compliance with the Nuclear Test- Ban Treaty of 1963. The sensors also recorded earthquake activity. Scientists later found that earthquakes and volcanic activity occur almost exclusively at the edges of tectonic plates. National Geographic published bathymetric maps of the world's oceans, familiarizing millions with the wonders of the newly imaged seafloor. *

Wilson, J.T. (1963) "A possible origin of the Hawaiian Islands", *Canadian Journal of Physics*, v. 41, pp. 863–870.

Housner, G.W. (1963) "An engineering report on the Chilean earthquakes of May 1960: Preface [in Special Volume on the Chilean earthquakes of May 1960]", *Bull. Seismol. Soc. Am.*, 53, 2, pp. 219-223.

─ 23 Nov. 1963 ─

First Episode: 'Doctor Who'

'Doctor Who' is a classic BBC science-fiction programme with a cult following. The Doctor is called a 'Time Lord', a time-travelling scientist from a far off planet, who travels through time and space (various *recurrence intervals* and *return periods*) in a shop known by the acronym TARDIS. A TARDIS is a machine that is larger on the inside than the outside… (Google) https://www.youtube.com/watch?v=_a3YAEhWU6k
https://www.youtube.com/watch?v=5VRBGRJ9PLM

It's about time . . . https://www.youtube.com/watch?v=HHSCsKg7fPE

─ 1964 ─

The Beatles Invasion Arrives in America: Friday, 07 Feb. 1964

Try and See It My Way . . .
https://www.youtube.com/watch?v=Qyclqo_AV2M&list=PLmo4pBukfRoN8SB5RKvfiY9CTl9pI_IFc

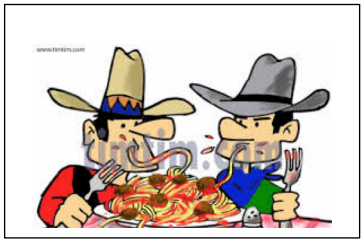
─ 27 March 1964 ─

The Giant M 9.2 Alaska Megathrust Earthquake and Tsunami ─ 1964 ─

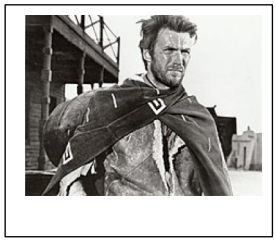
https://www.youtube.com/watch?v=4pptCGR9N4g

Star Trek's first pilot episode lays groundwork for introducing:
"Flip Communicator" (Cell Phone), "Beaming Up," and "Warp Drive"

─ Mid 1960s ─



"If you think about the form, it's a stranger from out of town."



Clint Eastwood as the Man with No Name in *A Fistful of Dollars*.

Ennio Morricone - The Spaghetti Westerns Music - Greatest Western Themes of all Time
https://www.youtube.com/watch?v=Q7tIqEgRwJY

PASTA IS PROLOGUE

"World, I know you! From now on there are no more surprises!"
- Once Upon a time in the West (1968)
https://www.youtube.com/watch?v=RKuJ9CGMA18

"A broad subgenre of Western Films emerges in the wake of *Sergio Leone's* film-making style and box office success. The term was used by American critics and those in other countries because most of these westerns were produced and directed by Italians . . . The best-known *Spaghetti Westerns* were directed by Sergio Leone and scored *by Ennio Morricone*, notably the three films of **The Dollars Trilogy** (starring Clint Eastwood as the main character) ─ ***A Fistful of Dollars*** (1964), ***For A Few Dollars More*** (1965) and ***The Good, the Bad and the Ugly*** (1966) https://www.youtube.com/watch?v=pw8mOUEaY-k ─ as well as ***Once Upon a Time in the West*** (1968) ─ all consistently listed among the best Westerns of any variety." https://en.wikipedia.org/wiki/Spaghetti_Western

Rosenblueth, E. (**1964**) "Probabilistic design to resist earthquakes", *Proc. ASCE*, 90, pp. 189-219.

─ 1965 ─

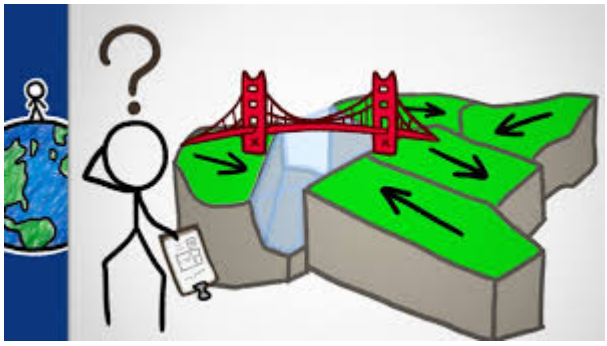
─ 14 July 1965 ─
Mars Flyby captures first close-up images of the red planet

─ 11 Dec. 1965 ─
Richard P. Feynman Nobel Prize Lecture

"The faults will become apparent later."

Feynman, R.P. (**1965)** "The Development of the Space-Time View of Quantum Electrodynamics", *Richard P. Feynman Nobel Lecture*, December 11, 1965, Stockholm, Sweden, pp.25.
https://www.nobelprize.org/prizes/physics/1965/feynman/lecture/

> That was the beginning, and the *idea* seemed so obvious to me and so elegant that *I fell deeply in love* with it. And, like falling in love with a woman, it is only possible if you do not know much about her, so you *cannot see her faults*. The faults will become apparent *later*, but after the love is strong enough to hold you to her. So*, I was held to this theory, in spite of all difficulties, by my youthful enthusiasm.*



(Ad Hoc Panel on Earthquake Prediction: Press, Frank, chair (**1965**) "Earthquake Prediction: A Proposal for a Ten-Year Program of Research", *Administrative Report to the Office of Science and Technology*, Washington, D. C., September, 1965.)

Housner, G.W. (1965) "Intensity of earthquake ground shaking near the causative fault", *Proc. Third World Conf. on Earthquake Engr.*, pp. 94-11.

Ipek, M. et al (1965) "Earthquake zones of Turkey according to seismological data", *Prof Conf. Earthquake Resistant Construction Regulations*, (in *Turkish*) Ankara, turkey.

Wilson, J.T. (1965) "A new class of 'transform' faults and their bearing on Continental Drift", *Nature*, 207, pp. 343-347 (Published 24 July 1965).

─ 1966 ─

─ 08 Sept. 1966 ─
Star Trek TV Series Begins
https://www.youtube.com/watch?v=zI9YYe-jgHI

─ 10 Oct. 1966 ─
Beach Boys: Good Vibrations
https://www.youtube.com/watch?v=mdt0SOqPJcg

Lomnitz, C. (1966) "Statistical prediction of earthquakes", *Reviews of Geophys.* v. 4 (3), 01 Aug. 1966, pp. 337-393. https://doi.org/10.1029/RG004i003p00377

Wegener, A. (1966) "The Origin of Continents and Oceans", (English translation from the 4th Revised German Ed. of *Die Entstehung der Kontinente und Ozeane,* first published 1915), Dover.

─ 1967 ─

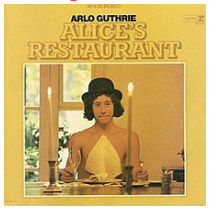
GIULIANO F. PANZA *
Laurea in Fisica { Physics Degree } University of Bologna (Italy) 1967

* A complete Curriculum Vitae follows the Bibliographic Journey

"Advent of The New Plate Tectonic Paradigm"
from "~~fixed continents~~" to *plate tectonics*

─ 25 July 1967 ─
Construction of Fukushima Daiichi Nuclear Power Plants Begins

─ Sept. 1967 ─



"You can get anything you want at Alice's Restaurant"
https://www.youtube.com/watch?v=m57gzA2JCcM

Alice's Restaurant is the debut album by Arlo Guthrie released in September 1967 by Reprise Records. It features one of his most famous songs, "Alice's Restaurant Massacree". A steady seller, the album peaked at #29 on the Billboard 200 album chart on the week of March 2, 1968. Wikipedia See also Guthrie, A. (2015) "Alice's Restaurant 50th Anniversary Concert - Thanksgiving Day 2015", on *PBS*.

1967 ─Dan McKenzie and Robert Parker publish the first complete description of how crustal plates move around on the surface of the sphere (D. McKenzie and R. L. Parker, *Nature* 216, 1276–1280; 1967), the paper that the Geological Society in London celebrated as the 50th Anniversary of Plate Tectonics.

A Commemoration of the "Advent of the Paradigm" — The Arrival of the Model of the *Theory*
https://www.bl.uk/voices-of-science/interviewees/dan-mckenzie/audio/dan-mckenzie-the-first-scientific-paper-on-plate-tectonics

McKenzie, D.P. and Parker, R.L. (1967) "The North Pacific: an Example of Tectonics on a Sphere", Nature 216, pp. 1276-1280 (Received 14 Nov 1967 - Published 30 Dec. 1967).
https://doi.org/10.1038/2161276a0

Cox, A., Dalrymple, G.B. and Doell, R. R. (1967) "Reversals of the earth's magnetic field", *Scientific American*, v. 216 (2), pp. 44-54.

Sykes, L. R. (1967) "Mechanisms of Earthquakes and Nature of Faulting on the Mid-Oceanic Ridges", *Journal of Geophysical Research,* v. 72, pp. 2131-2153. In this paper Lynn Sykes of Lamont Geological Observatory verified that Wilson's postulated transform fault motions were correct; and "the announcement went a long way in convincing people that continental drift had not only occurred in past 200 m.y., but was going on under our feet today, at the rate at which our toenails are growing." **

Takeuchi, H., Ueda, S. and Kanamori, H. (1967) "Debate about the Earth: Approach to geophysics through analysis of Continental Drift", Freeman, Cooper, pp. 253.
Wilson, J.T. (1967) "Advice for the establishment", *Saturday Review*, 1967-09-02, 50-57.

Ferraes, S.G. (1967) "Test of Poisson process for earthquakes in Mexico City", *J. Geophys Res*., 72 (14) 15 July 1967, pp. 3741-3742. https://doi.org/10.1029/JZ072i014p03741 06 Dec. 2012 online

Newmark, N.M. (1967) "Design Criteria for Nuclear Reactors Subjected to Earthquake Hazards", Urbana, Ill.

— 1968 —

GIULIANO F. PANZA
***Ettore Cardani* Award, Università di Torino 1968**

— 04 April 1968 —
Civil Rights Leader Dr. Martin Luther King, Jr. Assassinated in Memphis, TN

— April 1968 —
***2001: A Space Odyssey* - Epic Science Fiction Film**
https://www.youtube.com/watch?v=osuD6Kpw2AA

https://www.youtube.com/watch?v=p3WoaOIKXwk

Dr. Who here . . .

"I want to report a 2500 yr. earthquake."

Earthquake Magnitude Power Comparison
https://www.youtube.com/watch?v=DWFxIgv3Jc0

— 01 Oct. 1968 —

PSHA IMPERIAL MARCH **BEGINS:**

https://www.youtube.com/watch?v=4wvpdBnfiZo

C. Allin Cornell 1938 – 2007

"Father of Modern Earthquake Risk Analysis"

Cornell, C.A. (**1968**) "Engineering seismic risk analysis", *Bull. Seismol. Soc. Am.*, 58 (5) , pp. 1583–1606. (Received 2 Jan. 1967 – Published 1 Oct. 1968)
https://pubs.geoscienceworld.org/ssa/bssa/article/58/5/1583/116673/engineering-seismic-risk-analysis
https://news.stanford.edu/news/2008/january9/cornell-010908.html

PSHA 2031. . . *When I'm 64?* - The Beatles

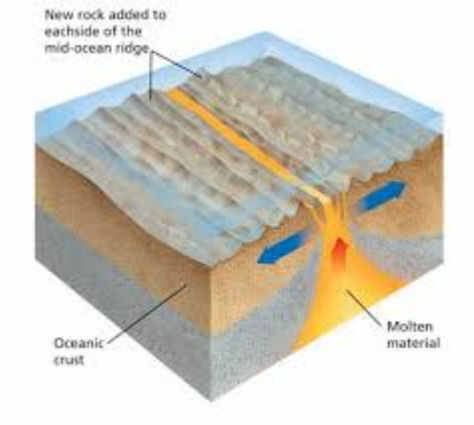
https://www.youtube.com/watch?v=38uSiYoP29Y

Freudenthal, A.M. (1968) "Critical Appraisal of Safety Criteria and their Basic Concepts", *Prel. Publ. 8th Congress AIPC-IABSE*, New York, pp. 13–16. https://www.e-periodica.ch/cntmng?pid=bse-cr-001:1968:8::8

Wilson, J. T. (1967-1968) "A revolution in earth science", paper delivered at plenary session, annual meeting, *Canadian Institute of Mining and Metallurgy*, 27 March, 1967; published in *Canadian Mining and Metallurgical Bulletin,* (Feb., **1968**), 1-8; in *Geotimes* (Dec., **1968**), pp. 10-22.

Wilson, J. T. (1968) "A Revolution in Earth Science", *Geotimes*, Washington DC. 13 (10), pp. 10–16. https://www.americangeosciences.org/geotimes

1968 ─ The vessel Glomar Challenger set sail on an exploration of the mid-ocean ridge between South America and Africa. Core samples obtained from drilling revealed that rocks close to mid-ocean ridges are younger than rocks that are farther away from the ridges, confirming sea-floor spreading. *



* **Timeline of the development of the theory of plate tectonics**
https://eagle.rrps.net/common/pages/DisplayFile.aspx?itemId=2493742

** **J. Tuzo Wilson, *in* ROCK STARS**
https://www.geosociety.org/gsatoday/archive/11/9/pdf/i1052-5173-11-9-24.pdf

─ 1969─

─ 20 July 1969 ─
First Moon Landing
Apollo 11: Tranquility Base - The Eagle has Landed
https://www.youtube.com/watch?v=c6BUf2tOR8k

Oliver, J.E., Sykes, L.R. and Isacks, B.I. (1969) "Seismology and the New Global Tectonics", *Tectonophysics.*, 7 (5), pp. 527-541. First published: 15 September 1968, *J. Geophys Res*., 73(18), pp. 5855-5899. https://doi.org/10.1029/JB073i018p05855

What did one paradigm say to the other? ***SHIFT HAPPENS!***

A comprehensive study of the observations of seismology provides widely based support for the new global tectonics founded on the hypotheses of continental drift, sea-floor spreading, transform faults, and underthrusting of the lithosphere at island arcs. At present within the entire field of seismology there appear to be no serious obstacles to the new tectonics. Seismic phenomena are explained, in general, as the result of interactions and other processes at or near the edges of a few large mobile plates of

lithosphere that spread apart at the ocean ridges where new surficial materials arise, slide past one another along the large strike-slip faults, and converge at the island arcs and arc-like structures where surficial materials descend. Study of world seismicity shows that most earthquakes are confined to narrow continuous belts that bound large stable areas. In the zones of divergence and strike-slip motion, the activity is moderate and shallow and consistent with the transform fault hypothesis; in the zones of convergence, activity is also at shallow depths but includes intermediate and deep shocks that grossly define the present configuration of the downgoing slabs of lithosphere. Seismic data on focal mechanisms of about 100 widely distributed shocks give relative motions that agree remarkably well with Le Pichon's simplified model in which relative motions of six large and rigid blocks of lithosphere covering the entire earth were determined from magnetic and topographic data associated with the zones of divergence. The lengths of the deep seismic zones appear to be a measure of the amount of underthrusting during approximately the last 10 million years. The presence of volcanism, the generation of many tsunamis (seismic sea waves), and the frequency of occurrence of large earthquakes also seem to be related to underthrusting or rates of underthrusting in island arcs.

Algermissen, S.T. (1969) "Seismic Risk Studies in the United States", Preprint Presented at Fourth World Conf. on earthquake Engr., Jan. 14, 1969, Santiago, Chile, pp. 22. https://files.eric.ed.gov/fulltext/ED030265.pdf

— 1970 —

GIULIANO F. PANZA
Fulbright* Fellow *1970

U.C. Berkeley Releases Structural Analysis Program (SAP)

Atwater, T.M. (**1970**) "Implications of plate tectonics for the Cenozoic evolution of western North America", *Geol. Soc. Am. Bull.,* 81 (12), Dec. 1970, pp. 3513-3536.
https://doi.org/10.1130/0016-7606(1970)81[3513:IOPTFT]2.0.CO;2

Benjamin, J.R. and Cornell, C.A. (1970) "Probability, Statistics, and Decisions for Civil Engineers", Dover Publications, Mineola NY (reprint of the 1970 McGraw-Hill company, New York), pp. 704.

— 1971 —

GIULIANO F. PANZA
Post Doc Fellow University of California Los Angeles (USA) 1971 / 1974

— 09 Feb. 1971 —
M 6.6 San Fernando Earthquake
— 26 March 26, 1971 —
Fukushima Daiichi Nuclear Power Plants Commissioned

Newmark, N.M. and Rosenblueth, E. (**1971**) "Fundamentals of Earthquake Engineering," *Prentice□Hall, Englewood Cliffs, N.J.*, 1971, pp. 640. ISBN 013336206X

— 1972 —

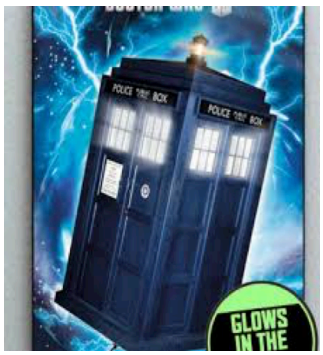
Committee on the Alaska Earthquake (**1972**) "The Great Alaska Earthquake of 1964", by Committee on the Alaska Earthquake, Division of Earth sciences, *National Res. Council*, National Academy of Sciences, Washington, D.C., pp. 556. ISBN 0-309-01605-3

Gelfand, I.M., Guberman, S.I., Izvekova, M.L., Keilis-Borok, V.I. and Ranzman, E.J.A. (**1972**) "Criteria of high seismicity, determined by pattern recognition", *in* Ritsema, A.R. (ed.), "The Upper Mantle", *Tectonophysics,* 13 (1–4), April 1972, pp. 415–422. https://doi.org/10.1016/B978-0-444-41015-3.50028-8

Housner, G.W, and Jennings, P.C. (1972) "The San Fernando California Earthquake", *Earthquake Engr. and Struct. Dyn.*, v. 1, pp. 5-34.

Wiggins, J.H. (1972) "The balanced risk concept, new approach to earthquake building codes", *Civil Enginering* — ASCE, (August 1972), pp. 55–59.

Wilson, J.T. (1972) "Introduction", in: *Continents Adrift: Readings from Scientific American*, San Francisco, W.H. Freeman, pp. 172. ISBN 10: 0716708574



https://www.youtube.com/watch?v=5

Time-Dependent Model

– 1973 –

Hewlett Packard introduces "HP-35" Hand Held Calculator

Intel introduces First Microprocessor

Lazer Printing invented at Xerox

First U.S. Hand-Held Mobile Phone

Applied Technology Council (ATC) Established by Structural Engineers Association of California (SEAOC)

Båth, M. (**1973**) "Introduction to Seismology", John Wiley, New York, pp. 395. ISBN 978-0470056608 https://doi.org/10.1016/0012-8252(81)90014-3

Caputo, M., Keilis-Borok, V., Kronrod, T., Molchan, G., Panza, G.F., Piva, A., Podgaezkaya, V. and Postpischl, D. (1973) "Models of earthquake occurrence and isoseismals in Italy", *Ann. Geofis.*, 26**,** pp. 421–444.

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Committee on the Alaska Earthquake (1973) "The Great Alaska Earthquake of 1964: Engineering", vol. 6 - by the Committee on the Alaska Earthquake of the Division of Earth Sciences, *National Research Council*, National Academy of Sciences, 2101 Constitution Avenue, Washington, D. C. 20418, 1973. 1198 pp. + 1928 illus. ISBN 0-309-01606-1

– 1974 –

Housner, George W. (**1974**) "Report on The Great Alaska Earthquake of 1964: Engineering", Bulletin of the Seismological Society of America, 64 (2). pp. 493-497. ISSN 0037-1106. http://resolver.caltech.edu/CaltechAUTHORS:20140915-124420865

– 1975 –

Computers and Structures, Inc. (CSI)
structural and earthquake engineering software company founded
www.csiamerica.com

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Acceptable Risk = Balanced Risk
https://www.youtube.com/watch?v=PUkRatOSxaI

Wiggins, J.H. (1975). Procedure for Determining Acceptable Risk Ground Motion Design Criteria, *J. H. Wiggins Company, Redondo Beach, California Technical Report No. 75-1229.*

– 1976 –

– 20 July 1976 –
First Mars Landing

– 1976 –
Cray 1 Supercomputer Introduced
California Earthquake Prediction Evaluation Council (CEPEC) Established
USGS Begins *Four Decades Long* National Seismic Hazards Model Project NSHMP

Algermissen, S.T., and Perkins, D.M. (**1976**) "A Probabilistic Estimate of Maximum Acceleration in Rock in the Contiguous United States, *U.S. Geol. Surv.,* Open File Rpt. 76-416, 2 plates, scale 1:7,500,000, pp. 45. https://pubs.er.usgs.gov/publication/ofr76416 https://doi.org/10.3133/ofr76416

McGuire, R.K. (1976) "Fortran computer program for seismic risk analysis", *U.S. Geological Survey* Open-file Rpt. 76-67.

STAR WARS – 1977 . . . "May the Force be with you!"
https://www.youtube.com/3watch?v=-*bzWSJG93P8*

– 1977 –

Apple II Computer
NEHRP Established by Earthquake Hazards Reduction Act of 1977

Slemmons, D.B. (1977) "State of the Art for Assessing Earthquake Hazard in the United States", Report 6: Faults and Earthquake Magnitude, *U.S. Army Corps of Engineers, Waterways Experiment Station*,Vicksburg, Mississippi, Miscellaneous Paper S-73-1, pp. 129.

– 1978 –

ATC 3-06 (**1978**) "Tentative provision for the development of seismic regulations for buildings", *Applied Technology Council*, ATC 3-06. NBS Special Publication 510, NSF Publication 78-8, pp. 505.
https://digital.library.unt.edu/ark:/67531/metadc171053/

"ACCEPTABLE RISKS", Commentary: Sec. 1.4.1, pp. 312-313.
https://books.google.com/books?id=EbMWTV7-sVgC&pg=PA312&lpg=PA312&dq=Wiggins+++Acceptable+Risk&source=bl&ots=uRoA-a65h-&sig=ACfU3U0IDEuKadNoqfttRxaOrAlVlpHTAw&hl=en&sa=X&ved=2ahUKEwi6zJCk5LfgAhXBIDQIHSDrCbEQ6AEwCHoECAQQAQ#v=onepage&q=Wiggins%20%20%20Acceptable%20Risk&f=false

– 1979 –

Building Seismic Safety Council (BSSC) Established
National Earthquake Prediction Evaluation Council (NEPEC) Established

– 28 March 1979 –
Three Mile Island Nuclear Accident

Hanks, T.C. and Kanamori, H. (1979) "A Moment Magnitude scale", *J. Geophys. Res*., 84, B5, pp. 2145-2400. 10 May 1979. https://doi.org/10.1029/JB084iB05p02348

– 1980–

The Pasta is the key to the present

K-T Boundary in Italy

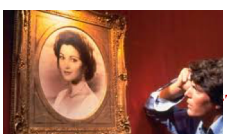
Luis and Walter Alvarez hypothesize that the mass extinction of the dinosaurs during Cretaceous-Paleogene extinction was caused by impact of a large Asteroid.
Luis, left and his son Walter at the K - T Boundary in Gubbio, Italy near Florence.

Indiana Jones theme
https://www.youtube.com/watch?v=-bTpp8PQSog

Alvarez, L.W., Alvarez, W., Asaro, F. and Michel H.V. (**1980**) "Extraterrestrial cause for the Cretaceous-Tertiary extinction", 06 Jun 1980, *Science* 208 (4448) , pp. 1095–1108. https://doi.org/10.1126/science.208.4448.1095

– 18 May 1980 –
Eruption of Mt. St. Helens
https://www.youtube.com/watch?v=AYla6q3is6w

National Earthquake Prediction Evaluation Council (NEPEC) created by legislation reauthorizing NEHRP
https://earthquake.usgs.gov/aboutus/nepec/



The idea seemed so *obvious* to me and so *elegant* that I fell deeply in love with it" *
***Somewhere in Time* (film)**
"He sacrificed life in the present to find love in the past"

*Feynman, 1965

American Romantic Science Fiction Drama . . . (and metaphor for SHA): Playwright Richard Collier (Allin Cornell) becomes obsessed with a photograph of a young woman (extreme value statistics) at the Grand Hotel (Seismic Risk Analysis); and through self-hypnosis (psha) travels back to (the 10% in 50 yr) 1912 to find love with Actress (Performance Based) Elsie McKenna. https://www.youtube.com/watch?v=bhahbyEjFPw

GIULIANO F. PANZA
Prof. Geophysical Prospecting University of Trieste (Italy) 1980-1988

─ 1980s ─
Development of GPS by U.S. ─ Beginnings of Satellite Geodesy

Keilis-Borok, V.I., Knopoff, L. and Rotvain, I.M. (1980) "Burst of aftershocks, long-term precursors of strong earthquakes", *Nature*, 283, pp. 259-263.

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Tall, D. and Vinner, S. (1981) "Concept Image and Concept Definition in Mathematics with particular reference to Limits and Continuity", *Educational Studies in Mathematics*, 12 (2) , pp. 151–169. https://link.springer.com/article/10.1007/BF00305619

Pirates of the MCE: The Curse of the PSHA
https://www.youtube.com/watch?v=2DXNYUTmGxA

Algermissen, S.T., Perkins, D.M., Thenhaus, P.C., Hanson, S.H., and Bender, B.L. (**1982**) "Probabilistic Estimates of Maximum Acceleration and Velocity in Rock in the Contiguous United States, *U.S. Geol. Surv.*, Open File Rpt. 82-1033, pp. 99.

ATC-3-06 Amended (1982) "Amendments to ATC-3-06 Tentative Provisions for the Development of Seismic Regulations for Buildings for Use in Trial Designs" (Appendix B), pp. 93. https://www.govinfo.gov/content/pkg/GOVPUB-C13-4f9a133cf43e9f39524d11397f6aadf9/pdf/GOVPUB-C13-4f9a133cf43e9f39524d11397f6aadf9.pdf

Mileti, D.S. (1982) "Public perceptions of seismic hazards and critical facilities", *Bull. Seismol. Soc. Am.* 72(6B), S13–S18. https://pubs.geoscienceworld.org/bssa/issue/72/6B

Seed, H. B. (1982) "The selection of design earthquakes for critical structures", *Bull. Seismol. Soc. Am.* 72(6B) , S7–S12. https://pubs.geoscienceworld.org/bssa/issue/72/6B

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Lauden, R. (1983) "Redefinitions of a Discipline: Histories of Geology and Geological History", *In* Graham, L, Lepenies, W. and Weingart, P, eds, *Functions and Uses of disciplinary Histories*, Sociology of the Sciences a Yearbook (SOSC vol. 7), Springer, pp. 79-104. https://doi.org/10.1007/978-94-009-7035-9_4.

— 1984 —

THE CENTER, BODY AND RANGE OF THE MISINFORMED COMMUNITY!

Try to Remember
https://www.youtube.com/watch?v=ipLSb17o9kI

EARTHQUAKE SPECTRA The Professional Journal of the Earthquake Engineering Research Institute EERI

begins publication . . . with, to date (May 2019) ─ out of 161 Issues (Quarterly + Special Issues): 145 Search Results for "PSHA" and 773 Search Results for "probabilistic"

EERI PSHA (**1984**) "Glossary of Terms for Probabilistic Seismic Risk and Hazard Analysis", by EERI Committee on Seismic Risk and Haresh C. Shah, *Earthquake Spectra*: November 1984, Vol. 1, No. 1, pp. 33-40. https://doi.org/10.1193/1.1585255

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Keilis-Borok, V. I. and Kossobokov, V.G. (1984) "A complex of long-term precursors for the strongest earthquakes of the world", *Proc. 27th Geological Congress*, 61, pp. 56, Nauka, Moscow. (Preliminary to 1987)

I should like to save the Shire (a region in Middle Earth), if I could –
though there have been times when I thought the inhabitants too stupid and dull for words,
and have felt that an earthquake or an invasion of dragons might be good for them.

- J. R. R. Tolkien

Mathiessen, R. (1984) Recommendations concerning seismic design and zonation. In *ATC-10-1: Critical Aspects of Earthquake Ground Motion and Building Damage Potential*, Applied Technology Council, pp. 213–246. https://www.atcouncil.org/files/ATC-10-1TOC.pdf

Meehan, R.L. (1984) The Atom and the Fault: Experts, Earthquakes, and Nuclear Power", MIT Press, Cambridge, vol. xiv pp. 208. ISBN 0-262-13199-4 ISBN: 9780262131995 https://mitpress.mit.edu/books/atom-and-fault https://doi.org/10.1177/016224398501000422

Schwartz, D.P., and Coppersmith, K.J. (1984) "Fault behavior and characteristic earthquakes: Examples from the Wasatch and San Andreas fault zones", *Journal of Geophysical Research* **89**, pp. 5681-5698. doi.org/10.1029/JB089iB07p05681

— 1985 —

— 3 July 1985 —
Back to the Future
https://www.youtube.com/watch?v=e8TZbze72Bc

— 19 Sept. 1985 —
M 8 Mexico City Earthquake

UNIVERSITÀ DEGLI STUDI DI TRIESTE

GIULIANO F. PANZA
Director Istituto di Geodesia e Geofisica University Trieste 1985-1991

Parkfield EQ Prediction (**1985**) "The Parkfield, California, earthquake prediction experiment", by Bakun, W.H., and Lindh, A.G., *Science*, 229, Issue 4714, pp. 619–624. https://doi.org/10.1126/science.229.4714.619

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─ 1986 ─

─ 28 Jan. 1986 ─
Challenger Space Shuttle Disaster

─ 26 April 1986 ─
Chernoybl Nuclear Disaster

Feynman, R.P. (**1986**) "Volume 2: Appendix F - Personal Observations on Reliability of Shuttle", *in* Report of the PRESIDENTIAL COMMISSION on the Space Shuttle Challenger Accident. pp.9.
https://history.nasa.gov/rogersrep/v2appf.htm

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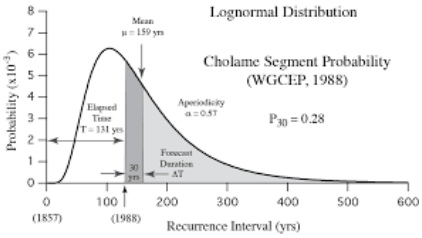
USGS PSHA (1986) "Proceedings of Conference XXXIV – A Workshop on Probabilistic Earthquake-Hazard Assessments", by Hays, W. *ed.*, Nov. 25-27, 1985, San Francisco, Calif. USA; by *U.S. Geol. Survey USGS* and *U.S. Nuclear Regulatory Commission USNRC*, pp. 368 plus appendices pp. 12.
https://www.nrc.gov/docs/ML0322/ML032230475.pdf

─ 1987 ─

Academia dei Lincei, Rome ─ "Academy of the Lynx-Eyed"
"the academy was named after the lynx, an animal whose sharp vision symbolizes the observational prowess that science requires."
https://en.wikipedia.org/wiki/Accademia_dei_Lincei

GIULIANO F. PANZA
Membership Accademia Nazionale Lincei, Italy 1987 ─

─ 02 April 1987 ─
National Earthquake Prediction Evaluation Council (NEPEC) establishes
Working Group on California Earthquake Probabilities (WGCEP) under USGS



On March 30, 1987, Dallas L. Peck, the Director of USGS, wrote to NEPEC specifically charging it to evaluate the earthquake threat to southern California and to assess the likelihood of a great earthquake in southern California. during the next few decades. At its meeting on April 2, 1987, NEPEC recommended that such a working group be constituted and report its findings to NEPEC. USGS PSHA – WGCEP (1988), iii

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ftp://ftp.gps.caltech.edu/pub/avouac/Ge277-2007-fall/Atwater_Science1987.pdf

Celebi, M., Prince, J., Dietel, C., Onate, M, and Chavez, G. (1987) "The Culprit in Mexico City—Amplification of Motions", *Earthquake Spectra*: May 1987, Vol. 3, No. 2, pp. 315-328. https://doi.org/10.1193/1.1585431

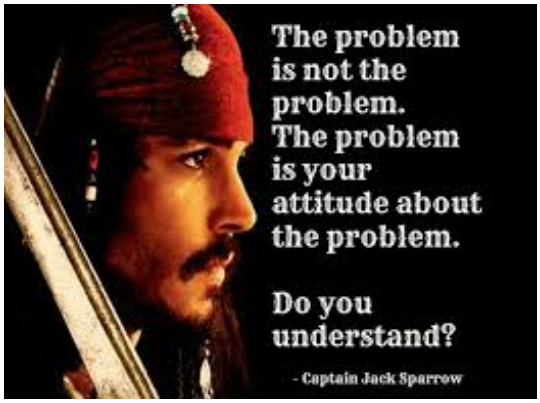
Keilis-Borok, V.I. and Kossobokov, V.G. (1987) "Periods of high probability of occurrence of the world's strongest earthquakes", *Computational Seismology*, 19, 45-53, Allerton Press Inc., New York.

– 1988 –

– 07 Dec. 1988 –
M 7 Spitak, Armenia Earthquake Disaster

" remember and shine "
born to be "a wish and, at the same time, a perennial warning"

GIULIANO F. PANZA
Prof. Seismology University of Trieste (Italy) 1988-2015



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National Research Council (1988). "Probabilistic seismic hazard analysis: Report of the Panel on Seismic Hazard Analysis", National Research Council, National Academy Press, Wash., D.C., pp. 97. https://doi.org/10.17226/19108

Ogata, Y. (1988) "Statistical models for earthquake occurrences and residual analysis for point processes*", J. Am. Stat. Assoc.* 83, 401, 9–27. DOI: 10.1080/01621459.1988.10478560 Published online: 12 Mar 2012

Peterson, D.W. (1988). "Volcanic hazards and public response", *Journal of Geophysical Research,* 93, pp. 4161-4170. https://doi.org/10.1029/JB093iB05p04161

USGS PSHA – WGCEP (1988) "Probabilities of large earthquakes occurring in California on the San Andreas fault", by WGCEP (Working Group on California Earthquake Probabilities), *U.S. Geol. Surv. Open-File Rept. 88-398,* pp. 62. http://www.resolutionmineeis.us/documents/wgcep-1988 http://www.wgcep.org/

– 1989 –

Base Shear Rocks Game 3 of 1989 World Series in San Francisco
Quake Me Out to the Ball Game!
https://www.youtube.com/watch?v=gt4H-xrJf-4
https://www.youtube.com/watch?v=xk7twFdW2f8
https://www.youtube.com/watch?v=3qwav5pRGX4

– 17 Oct. 1989 –
M 7 Loma Prieta Earthquake . . . "The Pretty Big One!"
https://earthquake.usgs.gov/earthquakes/events/1989lomaprieta/

– 18 Oct. 1989 –
Galileo Spacecraft Launched
First Spacecraft to visit an Asteroid and to orbit an Outer Planet

The Abdus Salam International Centre for Theoretical Physics

GIULIANO F. PANZA
Consultant

Abdus Salam Int. Center for Theoretical Physics (ICTP) Trieste 1989-2015

Egan, T. (**1989**) "Building Codes: Designs for Last Quake, Not Next" - Special to The New York Times Published: October 22, 1989. https://www.nytimes.com/1989/10/22/us/building-codes-designs-for-last-quake-not-next.html

Spectra SI (1989) "Special Issue on the M_s 6.8 Dec. 07, 1988 Spitak, Armenia Earthquake", *Earthquake Spectra*: Aug. 1989, Vol. 5, No. S1, pp. 173. http://earthquakespectra.org/toc/eqsa/5/S1

— 1990 —

GIULIANO F. PANZA
***Premio Linceo* Award, Accademia Nazionale dei Lincei Roma**

GIULIANO F. PANZA

Membership of the Academia Europaea, MAE, 1990 —
Award conferred to individuals that have demonstrated "sustained academic excellence"
https://en.wikipedia.org/wiki/Member_of_the_Academia_Europaea

NEHRP Reauthorization adds *Performance-Based Seismic Engineering* to Agency Responsibilities

Adams, J., (**1990**) "Paleoseismicity of the Cascadia Subduction Zone—Evidence from turbidites off the Oregon-Washington margin", *Tectonics,* 9, pp. 569–583. https://doi.org/10.1029/TC009i004p00569

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Barosh, P.J. (1990) "Neotectonic movement and earthquake assessment in the eastern United States", in Krinitzky, E.L. and Slemmons D.B., eds., "Neotectonics in Earthquake Evaluation", *Geol. Soc. Am. Rev. in Engr. Geol*., 8, pp.77-110. ISBN electronic: 9780813758084 https://doi.org/10.1130/REG8

Grand Algorithm M8
https://www.dailymotion.com/video/x2ppgne

Keilis-Borok, V.I. and Kossobokov, V.G. (**1990**) "Premonitory activation of seismic flow: Algorithm M8", *Phys. Earth Planet. Inter*., 61, 73-83.
http://elpub.wdcb.ru/journals/rjes/v10/2007ES000251/2007ES000251.shtml

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USGS PSHA – WGCEP (1990) "Probabilities of large earthquakes in the San Francisco Bay region", by WGCEP (Working Group on California Earthquake Probabilities), *U.S. Geol. Surv. Circular 1053,* pp. 51. https://doi.org/10.3133/cir1053 http://www.wgcep.org/

Zacher, E.G. (1990). "U. S. Earthquake Zoning Map - History of the Structural Engineers Association of California's (SEAOC's) involvement in the development of the U. S. Earthquake Zoning Map", *Proceedings of the 50th Regional Conference*, Feb. 25–26, 1988, Los Angeles, California. Council on Tall Buildings and Urban Habitat Council Report 903.377, Lehigh University, Bethlehem, PA, 17–23.

– 1991 –

The Abdus Salam International Centre for Theoretical Physics

GIULIANO F. PANZA
Co-Founder and Head of Group Structure and Non-Linear Dynamics of the Earth (ICTP) Trieste 1991-2015

SCEC AN NSF+USGS CENTER

Southern California Earthquake Center (SCEC) Established

Bolt. B.A. (**1991**) "Balance of Risks and Benefits in Preparation for Earthquakes**",** *Science*. 251 (4), pp. 169-174. http://www.jstor.org/stable/2875129

Cox, A. and Hart, R.B. (1991) "Plate Tectonics: How It Works", Wiley-Blackwell, pp. 418. ISBN 13: 9780865423138

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Kantorovich L.V. and Keilis-Borok, V.I. (1991) "Earthquake prediction and decision-making: social, economic and civil protection aspects", *Proc. International Conference on Earthquake Prediction: State-of-the-Art*, pp. 586-593, Scientific-Technical Contributions, CSEM-EMSC, Strasbourg, France, 1991). Based on "Economics of earthquake prediction" (*Proc. UNESCO Conference on Seismic Risk, Paris, 1977*)

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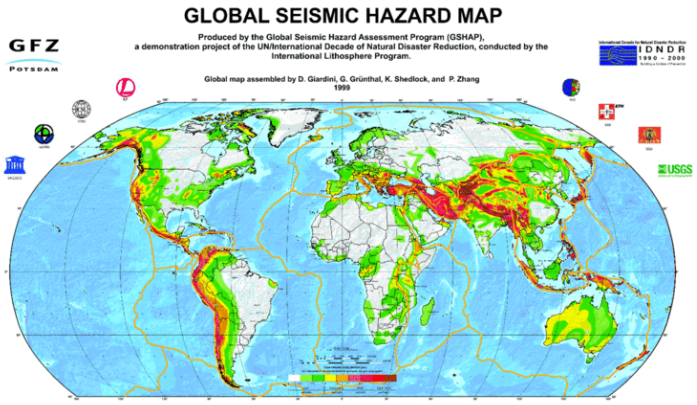
– 1992 –

GSHAP PSHA Hazard Mapping Program Launched



Ancient Macedonian Shield

"Upon the conduct of each depends the fate of all"

- Alexander the Great

https://www.youtube.com/watch?v=VfmYx9OBSW0

Alexander - The Battle of Issus (Isso) https://www.youtube.com/watch?v=MaJVxPBvuB4

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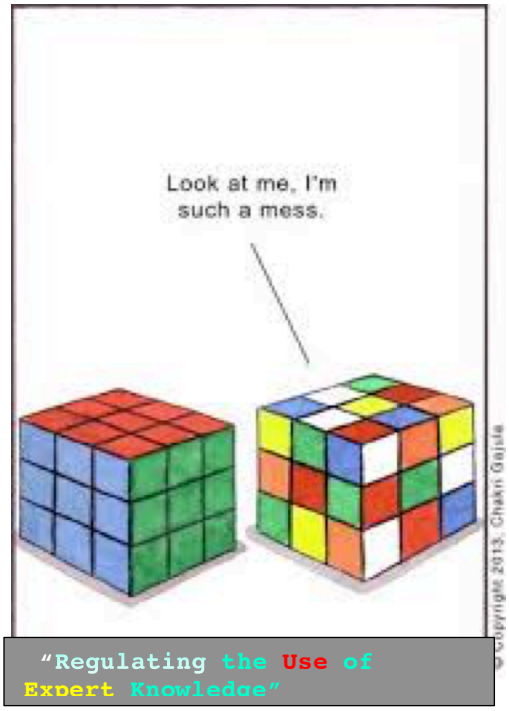
Taylor, C.E., Reaveley, L.D., Tillman, C.W, and Porush, A.R. (1992) "Seismic Code Decisions under Risk: The Wasatch Front Illustration", *Earthquake Spectra*: February 1992, Vol. 8, No. 1, pp. 35-55. https://doi.org/10.1193/1.1585669

USGS PSHA – WGCEP (1992) "Future Seismic Hazards in Southern California, Phase I: implications of the 1992 Landers Earthquake Sequence", by Agnew, D., Harris, R., Jackson, D., Jones, L., Sieh, K., Simpson, B, and Stein, R.: National Earthquake Prediction Evaluation Council, California Earthquake Prediction Evaluation Council, and Southern California Earthquake Center ad hoc Working Group on the Probabilities of Future Large Earthquakes in Southern California, California Earthquake Probabilities *Geol.Surv. Progress Report,* pp. 42.



Star Trek - The Borg Collective: Center, Body, and Range
https://www.youtube.com/watch?v=bQc6HF-vyFs

A History of the Borg
https://www.youtube.com/watch?v=hNxPTk9gR54

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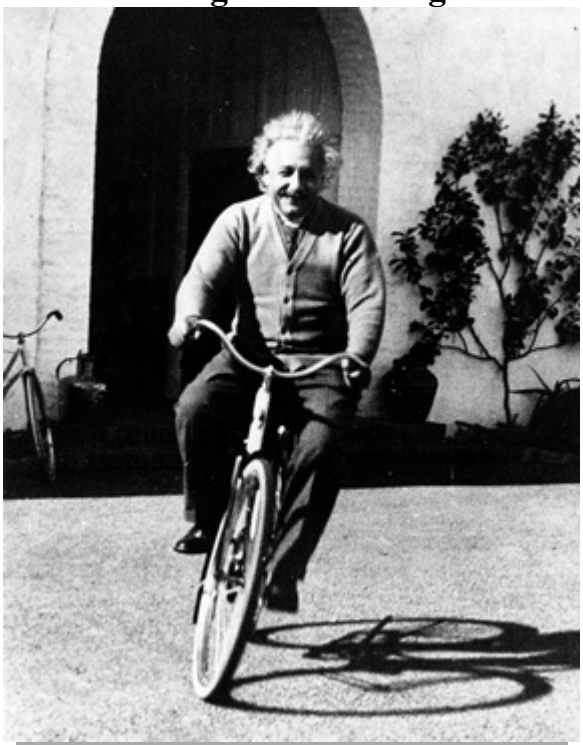
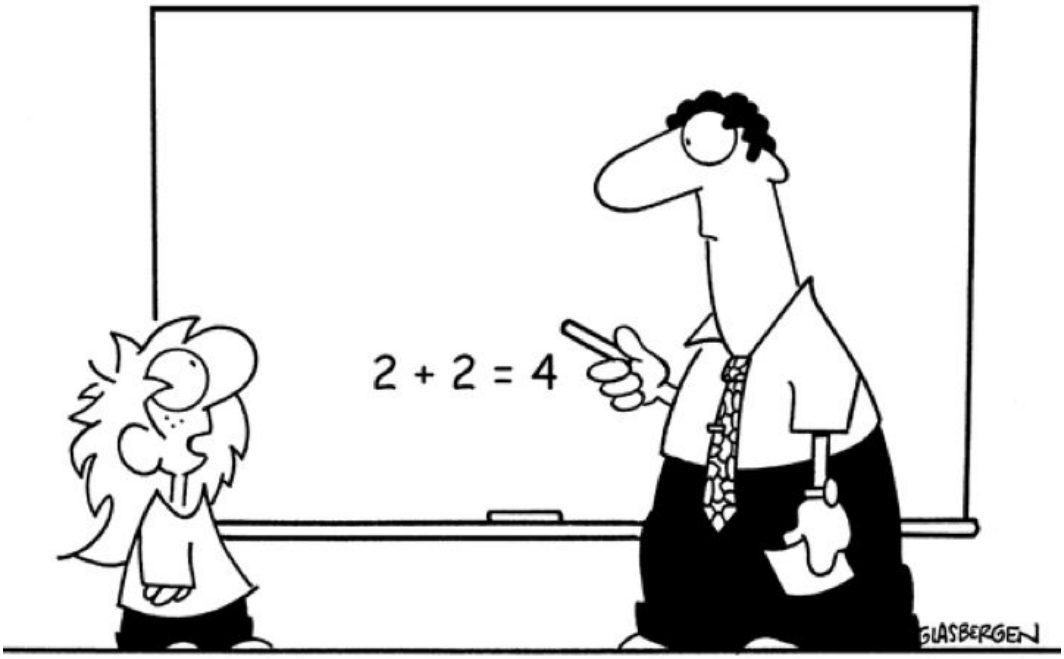


Albert Einstein on a bike in Santa Barbara in 1933.

"I thought of that while riding my bicycle."

- Albert Einstein on his *Theory of Relativity*



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"We're not talking about whether it's right or not, it's required!"

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GIULIANO F. PANZA

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promoting scientific capacity and excellence for sustainable development in developing countries
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GIULIANO F. PANZA

Chairman of UNESCO-IUGS-IGCP project 414: "Realistic Modeling of Seismic Input for Megacities and Large Urban Areas" 1997-2001

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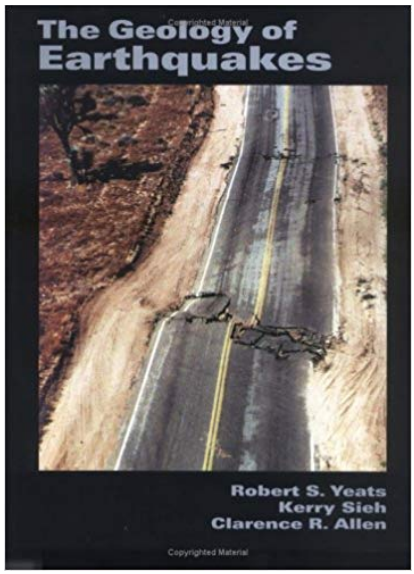

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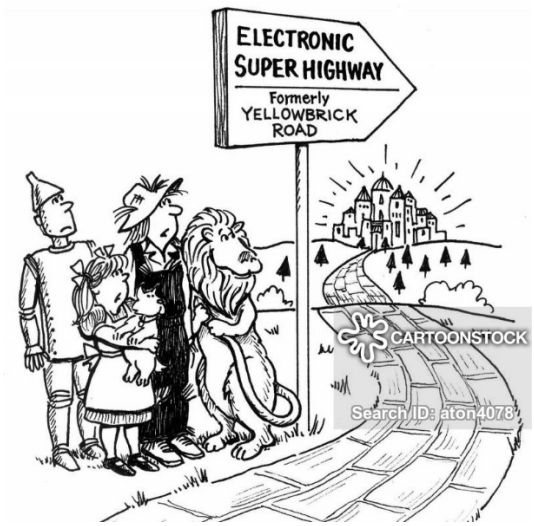

"If you were really Great and Powerful, you'd keep your Promise!"

- Dorothy

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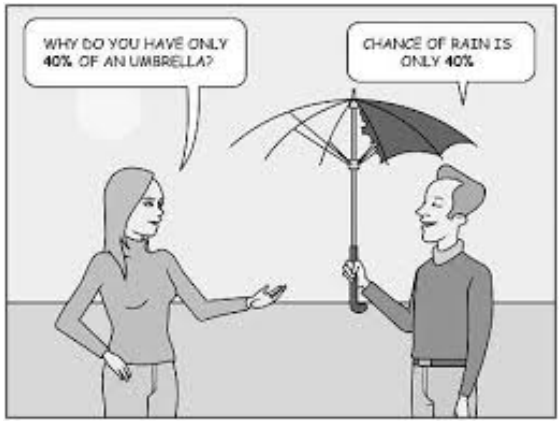

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— 2003 —

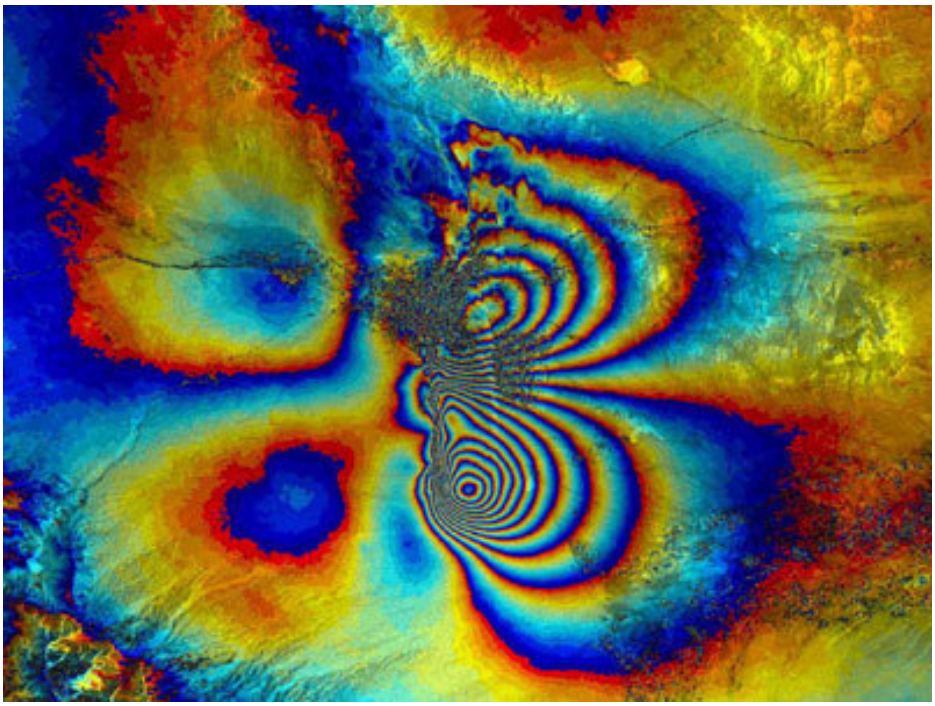
"First, inevitably, the idea, the fantasy, the fairy tale.
Then, scientific calculation. Ultimately, fulfillment crowns the dream."
GIULIANO F. PANZA

Membership of the Russian Academy of Science, 2003 —
Award conferred to individuals that have demonstrated "sustained academic excellence"

https://en.wikipedia.org/wiki/Russian_Academy_of_Sciences

California Geological Survey issues New Regulatory Directive:
Critical Buildings shall be Designed for 50- and 100-year Earthquakes obtained by PSHA

— 26 Dec. 2003 —
M 6.6 Bam, Iran Earthquake
First Major Destructive Earthquake for which both Pre- and Post-Seismic Envisat ASAR (Advanced Synthetic Aperture Radar) Satellite Data were Available



This interferogram, created by using Envisat's Advanced Synthetic Aperture Radar (ASAR) data, shows ground motion associated with the 26 December 2003 earthquake at Bam in Iran.
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— 2004 —

GIULIANO F. PANZA
Membership of the Accademia Nazionale delle Scienze detta dei XL
Italy's "National Academy of the Sciences", 2004 —

https://en.wikipedia.org/wiki/Accademia_nazionale_delle_scienze

The Trieste System
considered internationally as one of the most suitable tools for sustainable development to face the enormous and growing gap between the industrialized Global North and the poor Global South of the planet, a source of crisis, instability, violence and, ultimately, even terrorism.
***Honorary* Fellow**

Fondazione Internazionale Trieste per il progresso e la liberta' delle scienze, 2004

https://www.fondazioneinternazionale.org/

https://www.cei.int/

CEI Medal of Honour

for eminent services to the organization and the demonstrated highly qualified scientific work performed by the Earth Sciences Committee* of the Central European Initiative (CEI) , 2004

Since 1991 ─ Giuliano F. Panza has served as President of the EARTH SCIENCES COMMITTEE of the CEI WORKING GROUP SCIENCE AND TECHNOLOGY
https://en.wikipedia.org/wiki/Central_European_Initiative

USGS Begins Program to Create New Foreign PSHA Hazard Maps
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─ Oct. 23 Oct. 2004 ─
M 6.6 Niigata Ken Chuetsu Earthquake

Kashiwazaki-Kariwa Nuclear Power Plant
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─ 26 Dec. 2004 ─
Giant M 9.2 Sumatra Megathrust Earthquake and Tsunami
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It was clear after the unexpected giant earthquake of 2004 that new criteria and a new paradigm were needed for assessing earthquake risk.

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"Accountability for results can legitimately be considered the Achilles heel of performance-based regulation."

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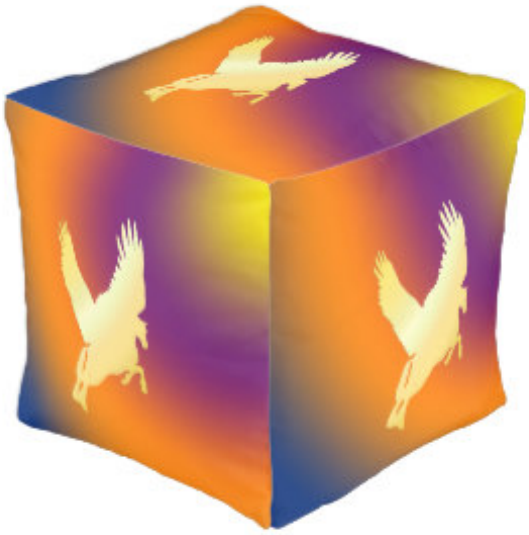

" *You did not disturb me,* said the pegasos. *I disturbed myself, that I might speak to you."*
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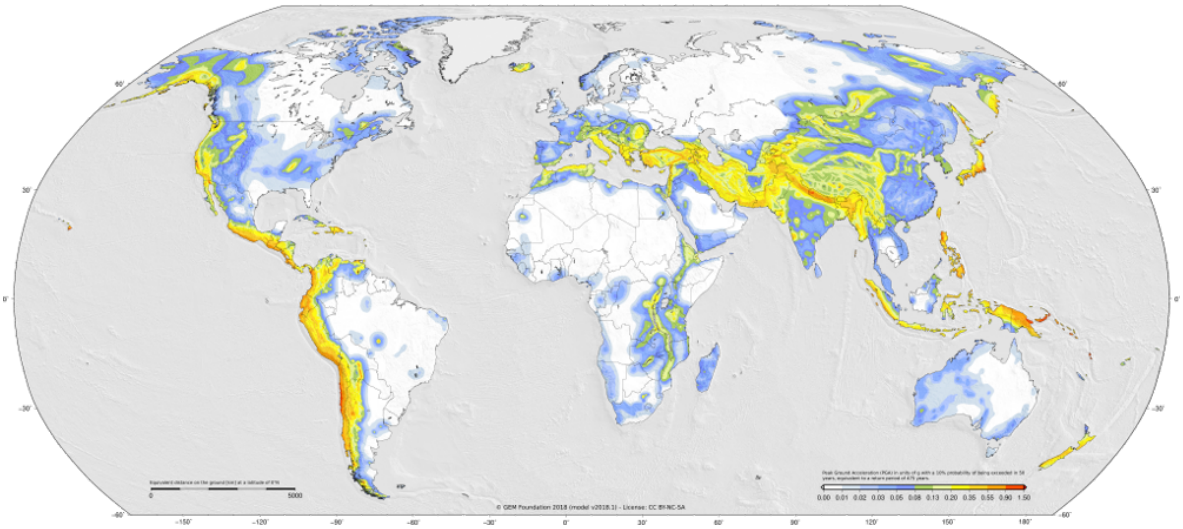
– 2005 –

GIULIANO F. PANZA

***Honorary Professor* - Institute of Geophysics, China Earthquake Administration, 2005**

Marco Polo in Seismology
http://www.cea-igp.ac.cn/en/newsandviews/264652.html



PSHA (PGA) with a 10% probability of being exceeded in 50 years

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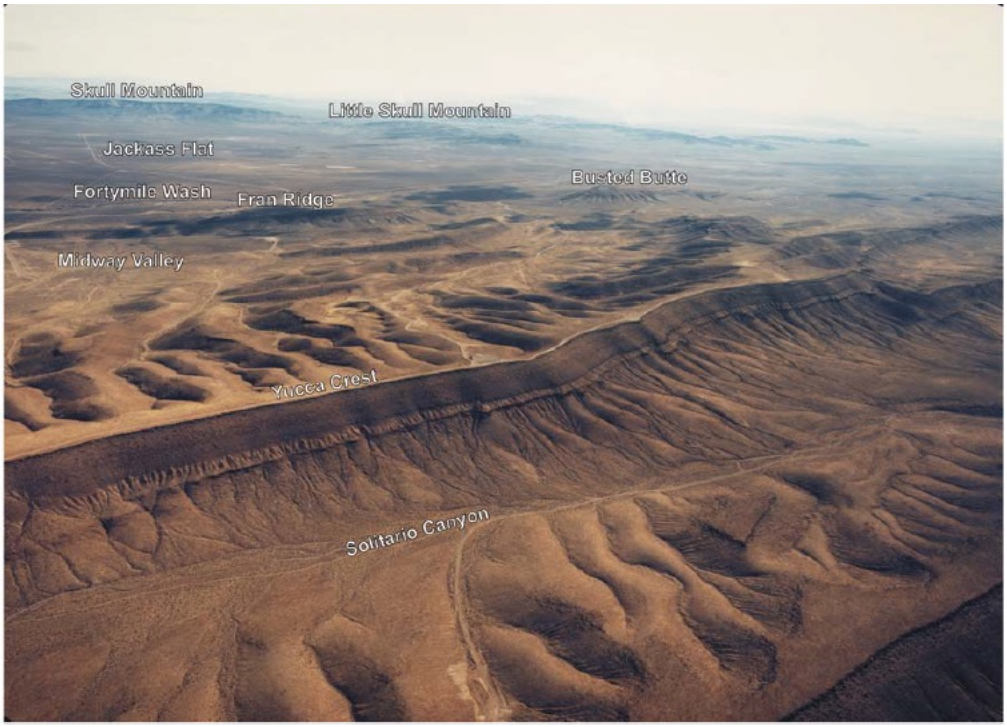
— 2007 —

— 29 June 2007 —
Steve Jobs releases the first "iPhone"

– 08 Aug. 2007 –
National Science Foundation (NSF) approves $208 million grant to the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign for a new "Blue Waters" petascale supercomputing project.

– 16 July 2007 –
M 6.6 Niigata Chuetsu Oki (offshore) Earthquake

Kashiwazaki-Kariwa Nuclear Power Plant
https://en.wikipedia.org/wiki/Kashiwazaki-Kariwa_Nuclear_Power_Plant



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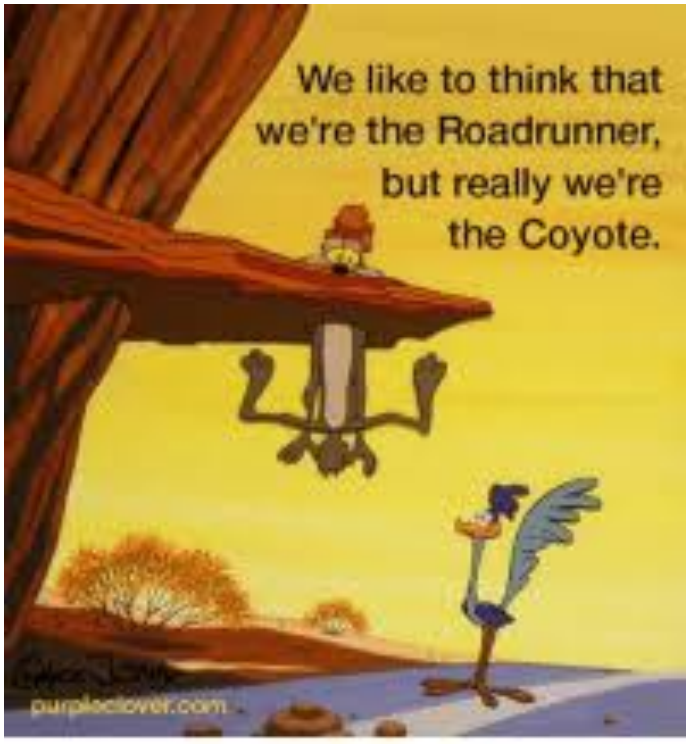

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Peak Ground Acceleration for the Maximum Credible Earthquake (MCE)

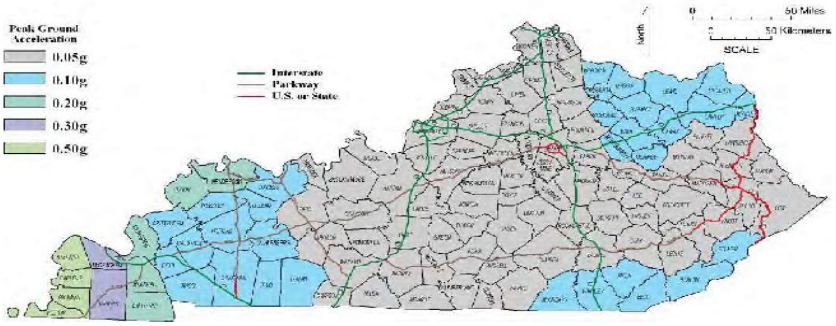

Figure 7-9. **Maximum Credible Earthquake (MCE) Median Horizontal Peak Ground Acceleration for the Commonwealth of Kentucky, Site Class A (Hard Rock)**

— 2009 —

Vietnam Academy of Science and Technology

GIULIANO F. PANZA

Commemorative Medal from the Vietnam Academy of Science and Technology, 2009
http://asemconnectvietnam.gov.vn/default.aspx?ID1=2&ZID1=11&ID8=194483

The Christchurch, New Zealand, skyline at the moment of the 22 February 2011 M 6.2 earthquake.
https://www.youtube.com/watch?v=2XyXR0MN19Q

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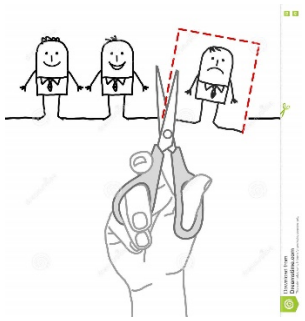

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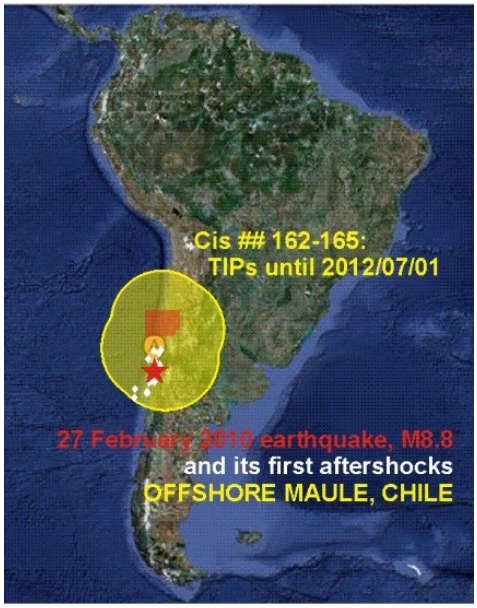
─ 2010 ─

─ 12 Jan. 2010 ─
M 7.0 Haiti Earthquake

─ 27 Feb. 2010 ─
M 8.8 Great Maule, Chile Megathrust Earthquake and Tsunami



Prediction of the 2010 Great Maule, Chile megathrust earthquake (27.02.2010, Mw = 8.8) by the Algorithm M8. The Alarm Area is shown in yellow; the red star is the epicenter of the predicted earthquake; white rhombs – its first aftershocks – outline the source.

– 4 Sept. 2010 –
M 7.1 Darfield, New Zealand Earthquake

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– 2011 –

International Union of Geodesy and Geophysics (IUGG)

GIULIANO F. PANZA

President of the Italian National Committee to IUGG 2011-2019

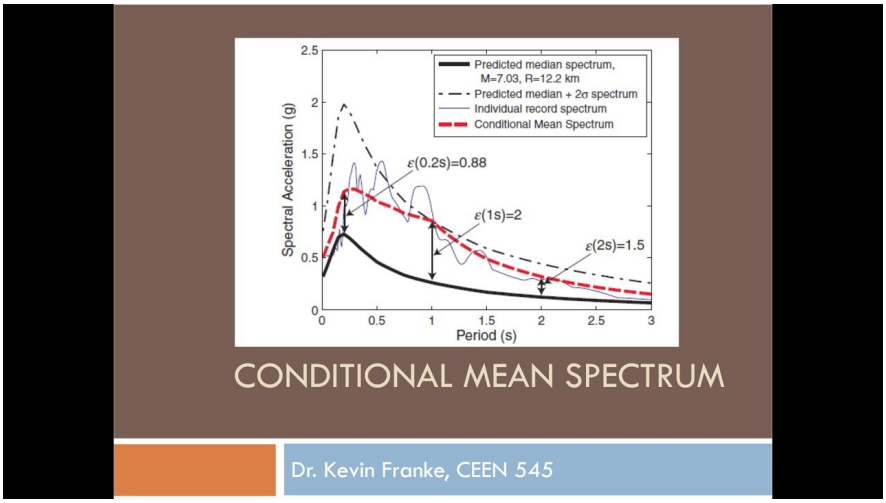
http://www.iugg.org/

– 22 Feb. 2011 –
M 6.2 Christchurch Earthquake

– 13 June 2011 –
M 6.0 Canterbury Earthquake Sequence

– 23 Dec. 2011 –
M 5.8, 5.9 Canterbury Earthquake Sequence

– 11 March 2011 –
Giant M_w 9.0 Tohoku-Oki Megathrust Earthquake and Tsunami



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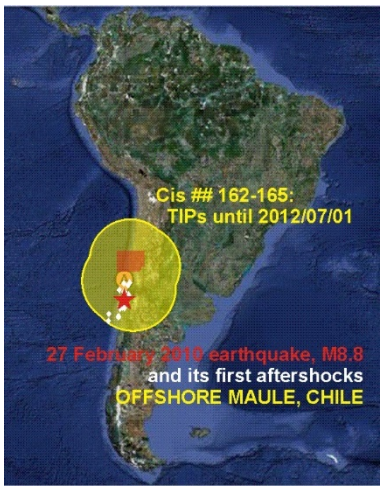

> "The 2010 great Chilean earthquake (27.02.2010, Mw=8.8) was predicted within the framework of the experiment aimed at a real - time intermediate-term medium - range earthquake prediction at a global scale by means of the M8 algorithm. The alarm was announced at the website
> http://users.ictp.it/www_users/sand/index_files/DevelopmentofPrediction.html
> in July 2007 till June 2012 (fig. 1). During the last 10 years this is the only alarm area obtained by the algorithm in the South America region."

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"I know so much that I don't know where to begin." 9

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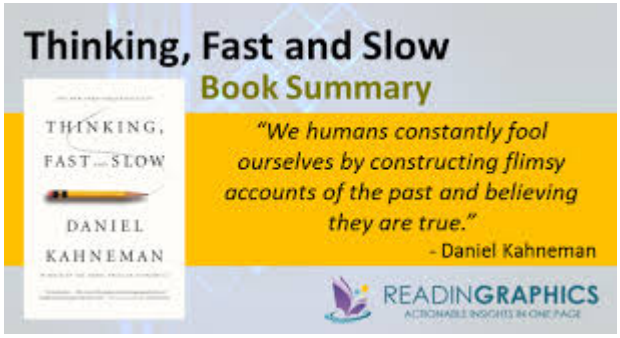

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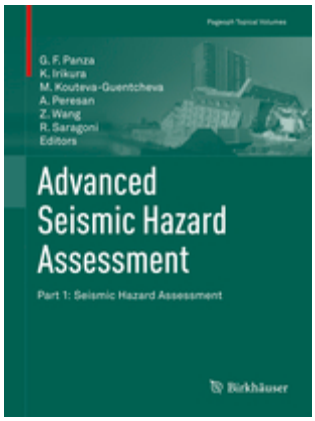
PSHA



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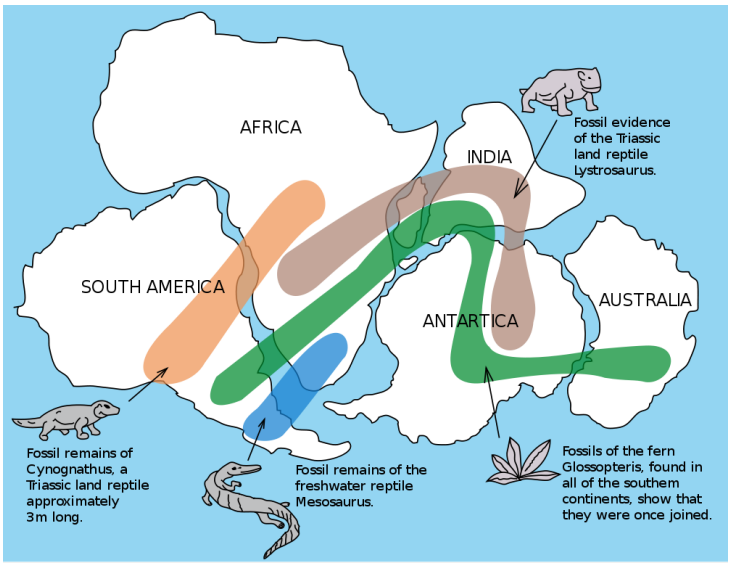


100th Anniversary of Alfred Wegener's Theory of Continental Drift

"He cut out maps of the continents, stretching them to show how they might have looked before the landscape crumpled up into mountain ridges. Then he fit them together on a globe, like jigsaw-puzzle pieces, to form the supercontinent he called Pangaea (joining the Greek words for "all" and "earth"). Next he assembled the evidence that plants and animals on opposite sides of the oceans were often strikingly similar: It wasn't just that the marsupials in Australia and South America looked alike; so did the flatworms that parasitized them. Finally, he pointed out how layered geological formations often dropped off on one side of an ocean and picked up again on the other, as if someone had torn a newspaper page in two and yet you could read across the tear." See Conniff, R.J. (2012) below. Animation showing *plate tectonic* evolution of the Earth from the time of Pangea, 240 million years ago, to the formation of Pangea Proxima, 250 million years in the future.

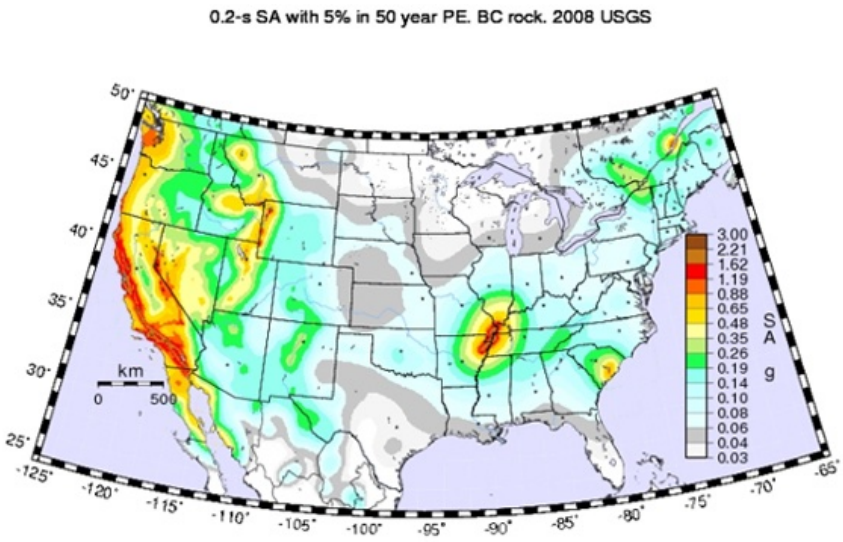
https://www.youtube.com/watch?v=uLahVJNnoZ4

– 2012 –

GIULIANO F. PANZA

Founding and Core Member, International Seismic Safety Organization and Science Counsel 2012

http://issoquake.org/isso/



Kentucky Geological Survey Challenges the USGS National Seismic Hazard Map
https://www.youtube.com/watch?v=zlHM9tUFT8g

. . . " the seismic hazard and resulting seismic risk estimates from PSHA can be viewed as *artifacts*, and the mitigation policies developed, the NEHRP (National Earthquake Hazards Reduction Program) provisions and resulting building codes in particular, are *problematic*.

Scenario seismic hazard analysis is a more appropriate approach for seismic hazard assessment, seismic risk assessment, as well as *policy* development in the New Madrid region." (Wang and Cobb, 2013)

MAYBE YOU ARE SEARCHING AMONG THE BRANCHES, FOR WHAT ONLY APPEARS IN THE ROOTS?

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"Upon the conduct of each *SHA* depends the fate of all."

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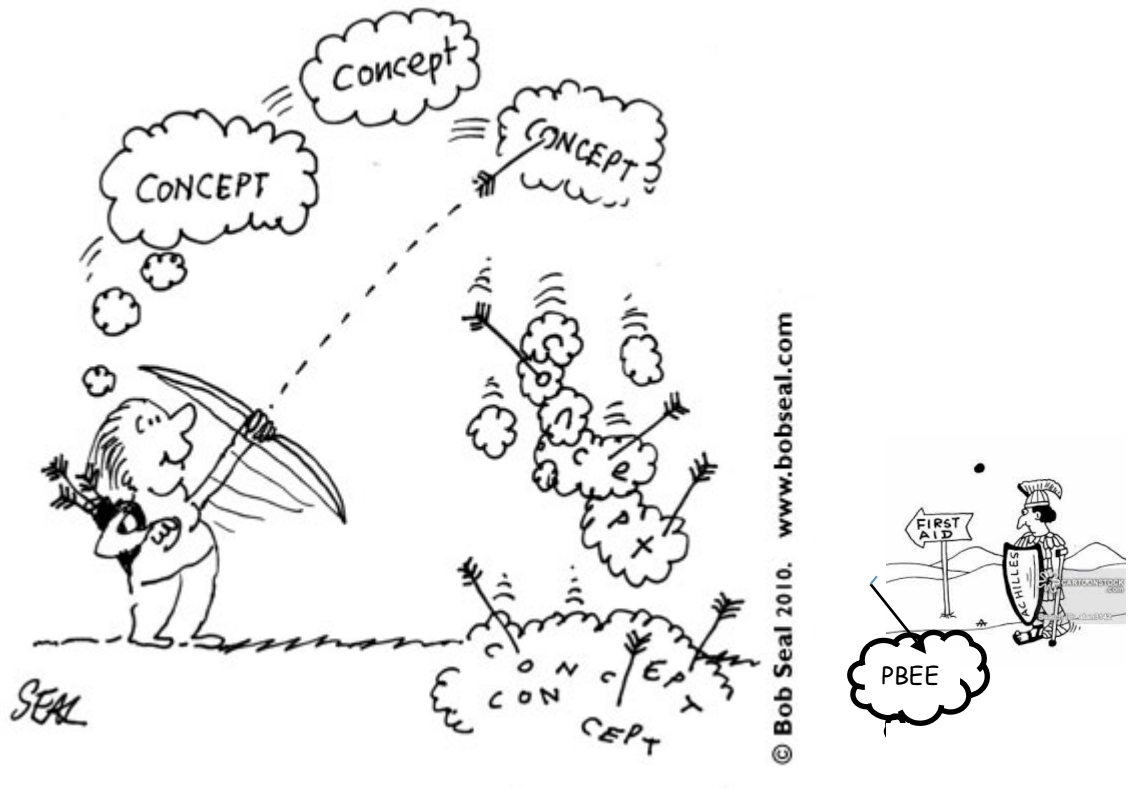
"In view of the devastation produced by large earthquakes and associated phenomena exemplified by the 2004 Sumatra earthquake and tsunamis, the 2008 Wenchuan earthquake in China, the 2010 Haiti earthquake, and the 2011 Tohoku earthquake and tsunamis in Japan [see Bela (2014) *Table 1*] , it is imperative that structures should be designed and constructed to withstand the largest or Maximum Credible Earthquake (MCE) events that include or exceed such historic events; and the *public* should be advised to be prepared and ready for such possible events *beforehand*. These are the most dangerous and destructive events that *can happen at any time* regardless of their low frequencies or long recurrence intervals. Therefore, earthquake hazard assessment to determine *seismic design loads* should consider the MCE events. Emergency management policy should consider *scenarios* for possible MCE events."



"Why should we *hesitate* to toss the old views overboard?"

- Alfred Wegener

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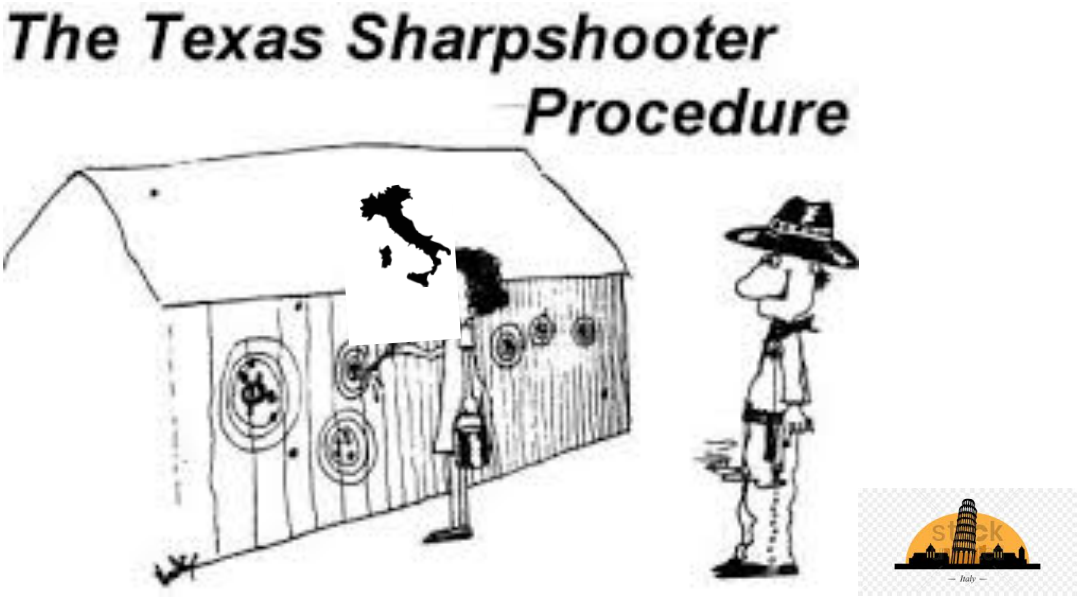

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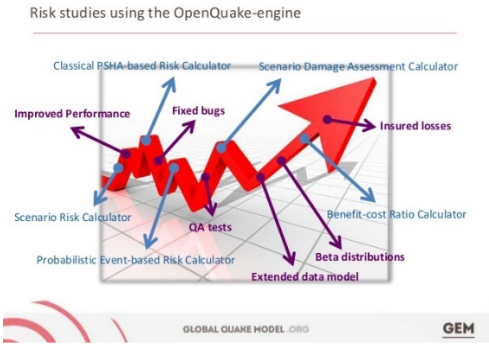

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Order of Merit of the Italian Republic

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author and coauthor of more than 500 scientific papers in refereed journals

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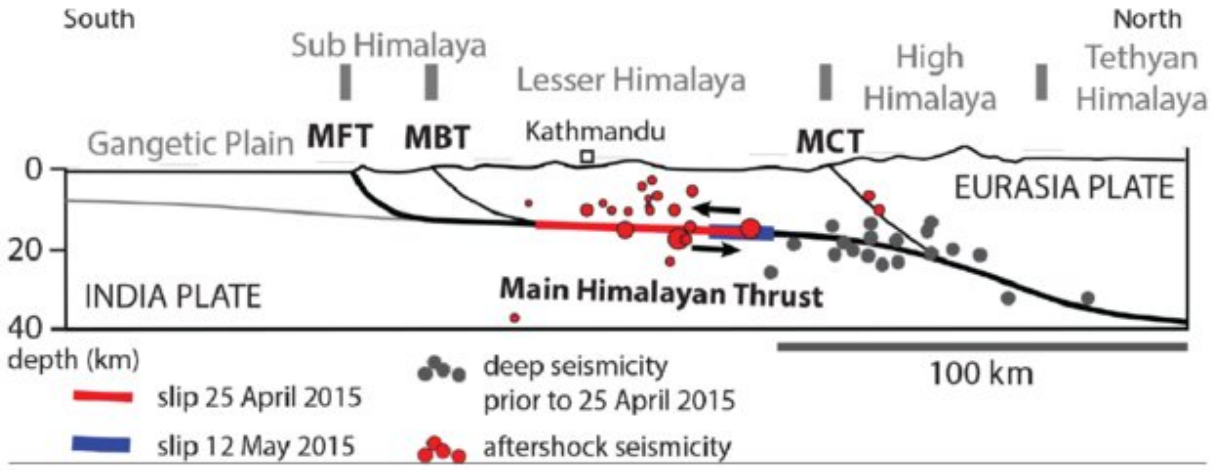

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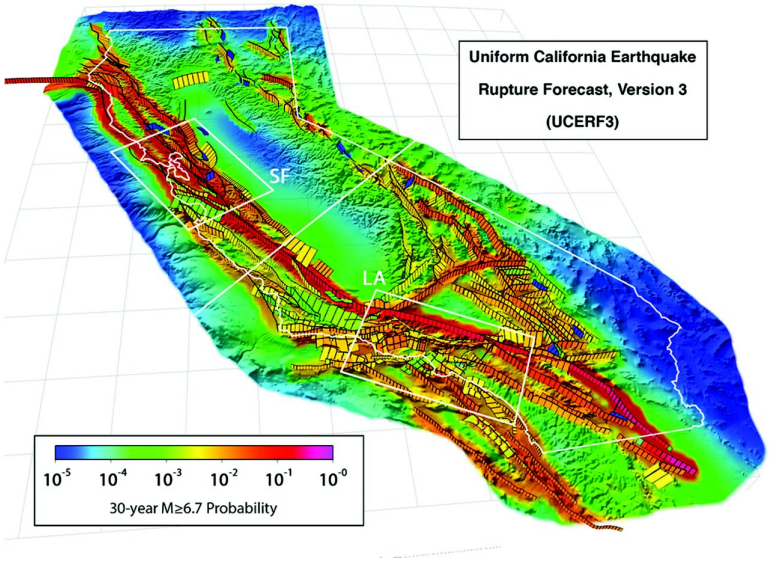

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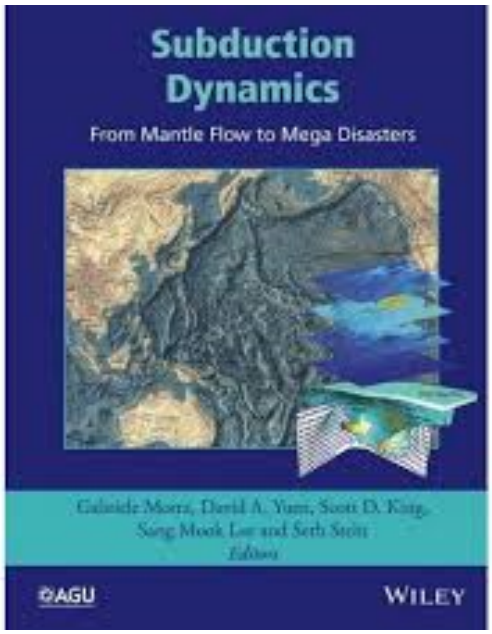

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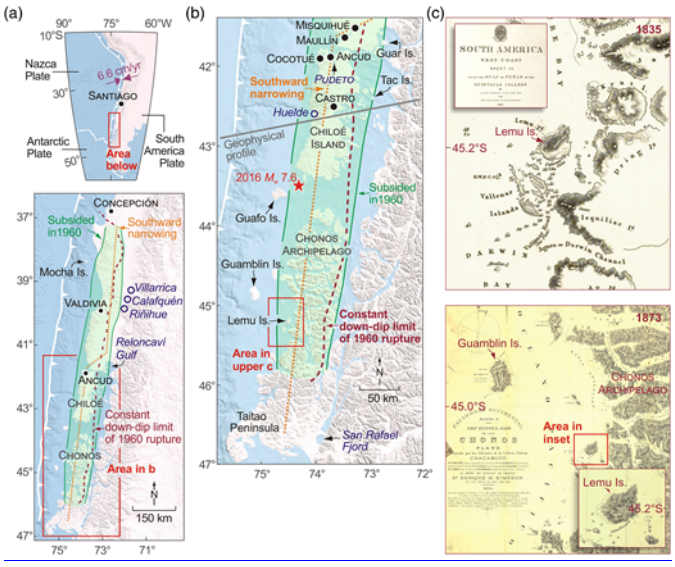

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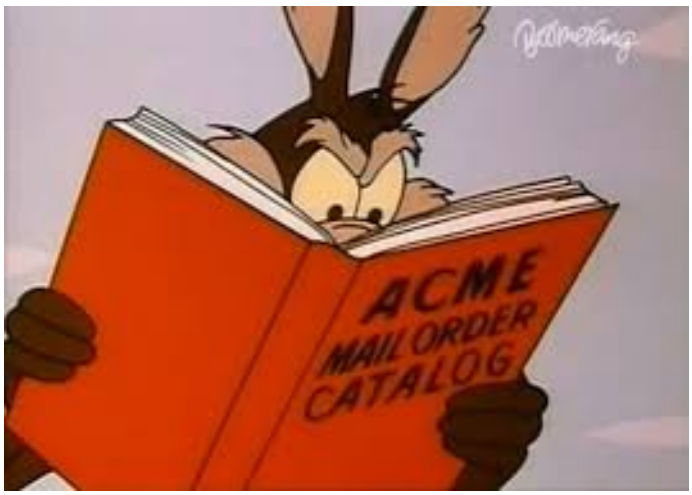

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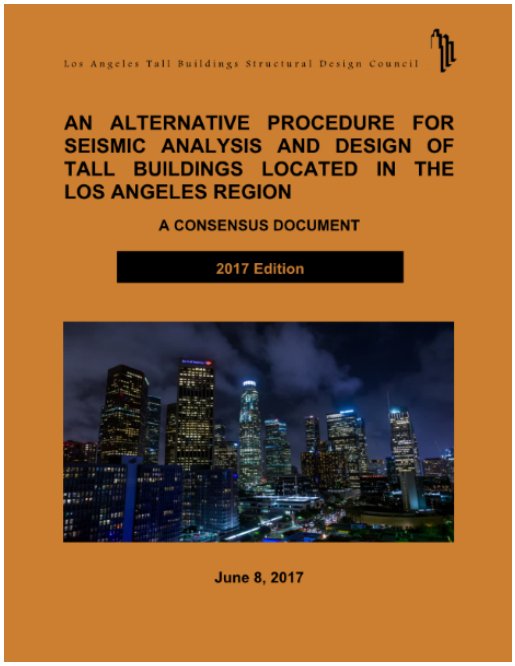

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GIULIANO F. PANZA

Honorary Professor **Beijing University of Civil Engineering and Architecture (BUCEA) 2018**

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2018 AGU International Award Winner

The award honors an individual "for making an outstanding contribution to furthering the Earth and space sciences and using science for the benefit of society in developing nations."

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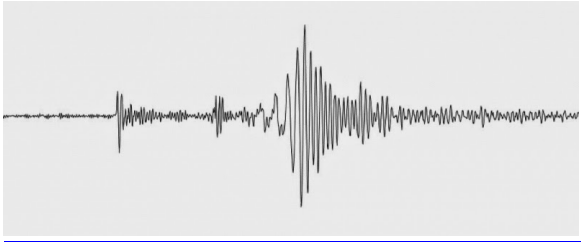

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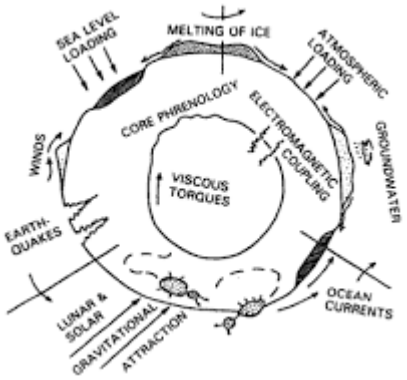

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Italian legislation consists of 3 levels of trial

1 - Corte d'assise: An Italian court found six Italian scientists and an ex-government official guilty of manslaughter over the earthquake in L'Aquila, Abruzzo in 2009.

2 - Corte d'assise d'appello: Acquits six of the seven indicted.

3 - Corte di Cassazione: Confirms above Acquittals of six of the seven indicted.

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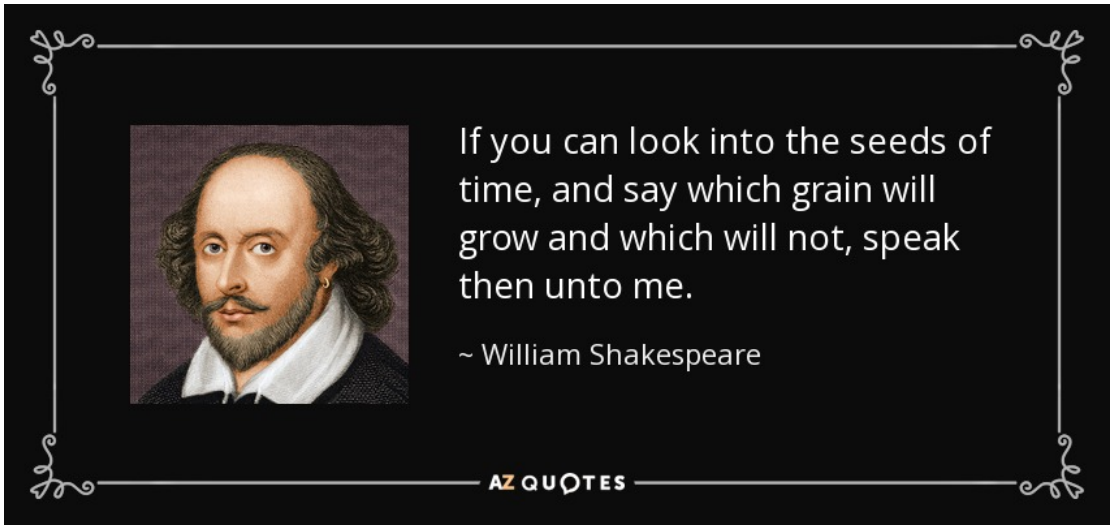

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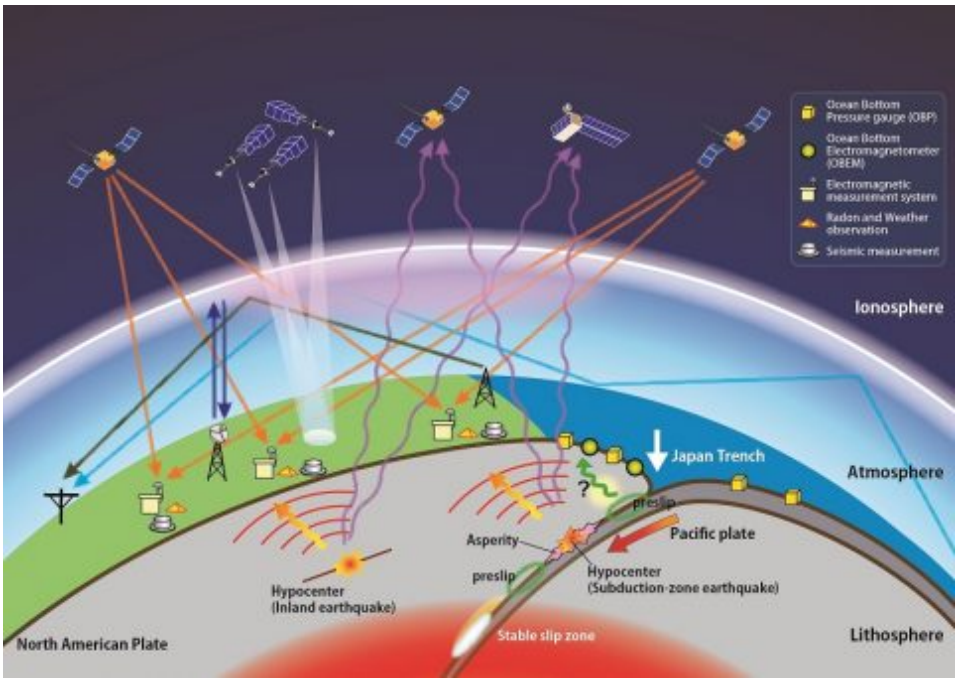
Pre-Earthquake Space . . . The Final Frontier!

To Boldly Go Where Earthquakes Have Gone Before



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Conceptual diagram of an integrated satellite and terrestrial framework for multiparameter observations of pre earthquake signals in Japan. The ground component includes seismic, electro-magnetic observations, radon, weather, VLF–VHF radio frequencies, and ocean bottom electro-magnetic sensors. Satellite component includes GPS/total electron content, synthetic-aperture radar, Swarm, microwave, and thermal infrared satellites. Credit: Katsumi Hattori, presented in Ouzounov et al, 2018, Chapter 20

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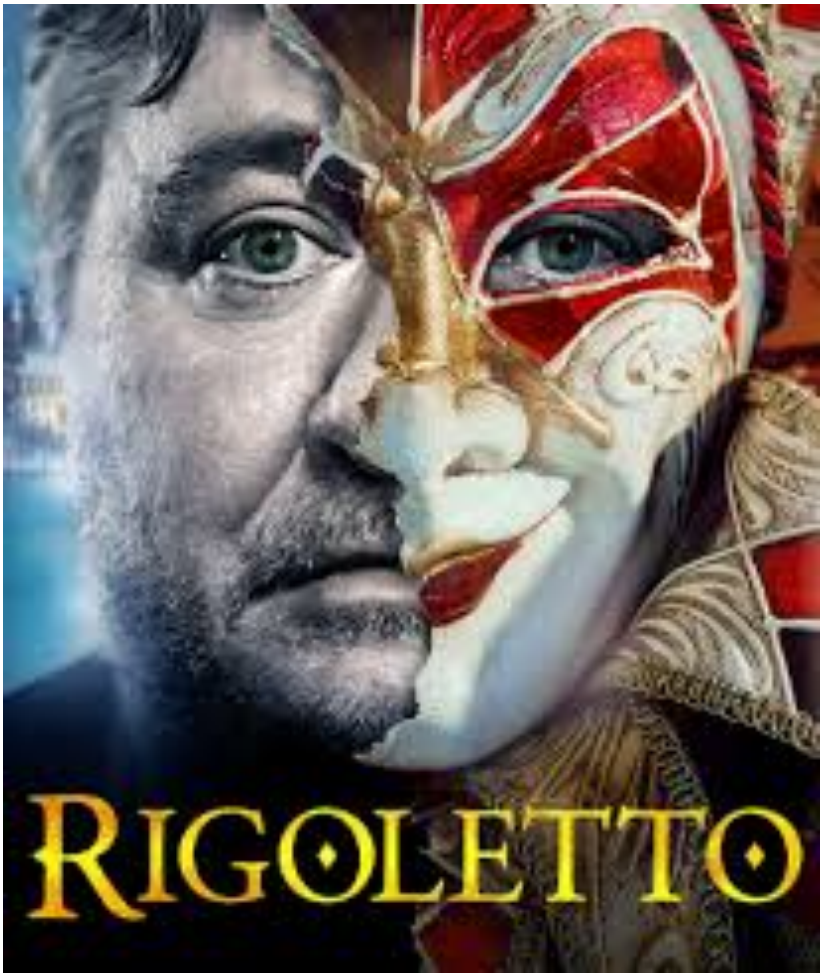

There is no curse
or evil spell,
That's worse than one
we give ourselves!

Rigoletto: The Curse ─ "There is no curse, or evil spell; that's worse than one we give ourselves." https://www.youtube.com/watch?v=h3Qv6T6_yts

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P. Rugarli - Image of the author

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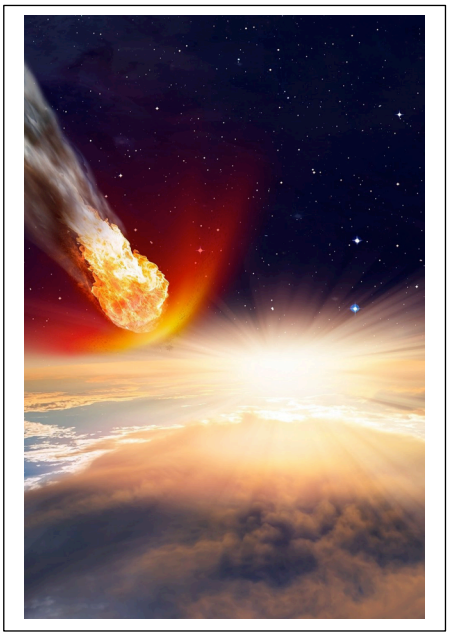

— 2019—

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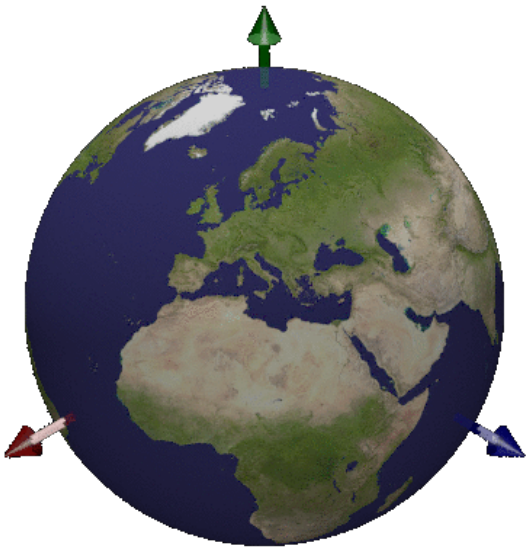
Greshko, M. (2019) "These fossils may capture the day the dinosaurs died. Here's what you should know", *National Geographic.com*, March 31, 2019, pp. https://www.nationalgeographic.com/science/2019/03/fossils-found-from-day-dinosaurs-died-chicxulub-tanis-cretaceous-extinction/

DePalma **,** R.A., Smit, J., Burnham, D.A. et al (2019) "A seismically induced onshore surge deposit at the KPg boundary, North Dakota", by Robert A. DePalma, Jan Smit, David A. Burnham, Klaudia Kuiper, Phillip L. Manning, Anton Oleinik, Peter Larson, Florentin J. Maurrasse, Johan Vellekoop, Mark A. Richards, Loren Gurche, and Walter Alvarez, *Proceedings National Academy of Sciences PNAS, USA,* first published April 1, 2019, PP. 10. *Edited* by Henry J. Melosh, Purdue University, West Lafayette, IN, and approved February 22, 2019 (received for review October 10, 2018) https://doi.org/10.1073/pnas.1817407116



Free Oscillations of the Earth

Kanamori, H., Rivera, L. and Lambotte, S. (2019) "Evidence for a large strike-slip component during the 1960 Chilean earthquake", *Geophysical Journal International*, 218 (1), July 2019, pp. 1–32. https://doi.org/10.1093/gji/ggz113

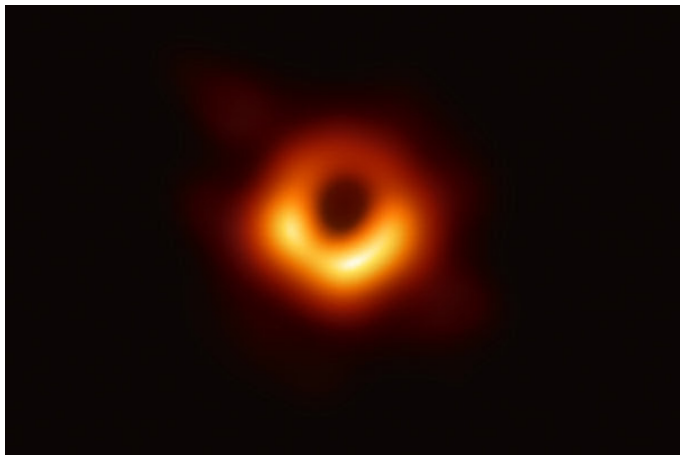
Revisiting the 1960 Chilean Earthquake -For the 50th Anniversary – https://pubs.usgs.gov/of/2010/1152/presentations/of2010-1152_20100719d_kanamori.pdf

Forced Vibrations due to Earthquake Hazards

Free Damage

Darkness Visible, Finally: Astronomers Capture First Ever Image of a Black Hole

Astronomers at last have captured a picture of one of the most secretive entities in the cosmos.



The first image of a Black Hole, from the galaxy Messier 87. Event Horizon Telescope Collaboration, via National Science Foundation

Dunham, W. (2019) "'Seeing the unseeable': Scientists reveal first photo of black hole", *Reuters SCIENCE NEWS*, April 10, 2019. https://www.reuters.com/article/us-space-exploration-blackhole/seeing-the-unseeable-scientists-reveal-first-photo-of-black-hole-idUSKCN1RM1OP

Overby, D. (2019) "Darkness Visible, Finally: Astronomers Capture First Ever Image of a Black Hole", April 10, 2019, The New York Times, pp. 6. https://www.nytimes.com/2019/04/10/science/black-hole-picture.html?emc=edit_nn_20190414&module=inline&nl=morning-briefing&nlid=79828170_nn_20190414&te=1&login=email&auth=login-email

Interstellar Main Theme

https://www.youtube.com/watch?v=UDVtMYqUAyw

The Atacama Large Millimeter Array in Atacama, Chile, one of several telescopes across the globe that make up the Event Horizon Telescope, below the southern sky. Y. Beletsky (LCO)/ESO

Rugarli, P., Amadio, C., Peresan, A., Fasan, M., Vaccari, F., Magrin, A., Romanelli, F. and Panza, G.F. (2019) "Neo-Deterministic Scenario-Earthquake Accelerograms and Spectra: a NDSHA approach to seismic analysis", Chpt. 6 in "Engineering Dynamics and Vibrations: Recent Developments", Jia, J. and Paik, J.K., Eds., pp. 187-241, CRC Press Boca Raton, Florida, USA. ISBN 978-1-4987-1926-1 https://doi.org/10.1201/9781315119908-6 https://doi.org/10.1201/9781315119908 https://www.crcpress.com/Engineering-Dynamics-and-Vibrations/Jia-Paik/p/book/9781498719261
https://www.researchgate.net/publication/329613989_Neo-Deterministic_Scenario_Earthquake_Accelerograms_and_Spectra_A_NDSHA_Approach_to_Seismic_Analysis_Recent_Developments

When **we forget our past, we allow another narrative to come in that isn't true."**

- Ken Burns

Ne quid falsi dicere audeat, ne quid veri non audeat

De oratore II, 15, 62 (Cic)

https://www.youtube.com/watch?v=aNxY_8sHOjg

Carl Sagan's Pale Blue Dot https://www.youtube.com/watch?v=GO5FwsblpT8

Earthquakes are one of the most destructive natural hazards, if not to human life itself, most certainly to the works of man and to his social and economic structures.

The intricacies of the man-nature relationship are such that it is frequently impossible to ascribe a hazard exclusively to Nature. However, we must agree that most natural hazards are created by man, but their harmful effects are transmitted through natural processes.

Natural hazards are indeed closely connected with our technological development, and although they cannot be prevented, their magnitude and after-effects can be minimized.

N.N. Ambraseys
Engineering Seismology, 1988

* * *

GIULIANO F. PANZA
***OLIM* Professor of Seismology - University of Trieste, Italy**
Head of SAND group at the Abdus Salam International Centre for Theoretical Physics
Emeritus Honorary Professor CEA Beijing
Honorary professor Beijing University of Civil Engineering and Architecture (BUCEA)

Orcid Author ID: http://orcid.org/0000-0003-3504-3038
Scopus Author ID 7005935881

EDUCATION AND ACADEMIC EXPERIENCE
Born: Faenza (Ravenna-Italy) 27/4/1945
Maturita' Classica Liceo M.Minghetti Bologna (Italy) 1963
Laurea in Fisica University of Bologna (Italy) 1967
Post Doc University of Bologna (Italy) 1968-1970
Visiting post Doc University of Uppsala (Sweden) 1969
Assistant Professor University of Bari (Italy) 1970-1980
Post Doc Fellow University of California Los Angeles (USA) 1971/1974
Associate Professor University of Bari (Italy) 1973-1980
Associate Professor University della Calabria Cosenza (Italy) 1975-1977
Visiting Professor Polytechnic of Zurich (Switzerland) 1977
Prof. Geophysical Prospecting University of Trieste (Italy) 1980-1988
Professor of Seismology University of Trieste (Italy) 1988-2015
Lecturer Diploma Course in Earth System Physics at ICTP, 2006-2015
Organizer and lecturer Lezioni Lincee di Fisica at UNITS, 2007-2015

Other appointments:
Chairman School of Geology University Trieste 1983-1986
Professor of the PhD courses Trieste University 1984-2015
Director Istituto di Geodesia e Geofisica University Trieste 1985-1991
Adjunct Prof. Cientro Int. de Ciencias de la Tierra Colima (Mexico) 1991-1993
Consultant Abdus Salam Int. Center for Theoretical Physics (ICTP) Trieste 1989-2015
Co-Founder and Head of Group Structure and non-linear dynamics of the Earth (ICTP) Trieste 1991-2015
Chairman of Beno Gutenberg medal committee dell'EGU/EGS, 2001-2008
Scientific Council of the PhD school in Scienze della Terra, Padova university 2005-2011
Italian Geological Committee 2005-2008
Italian co-ordinator for the Project Metodologie avanzate in campo geofisico e geodinamico (Dottorato) in partnership with China Earthquake Administration and Chinese Academy of Sciences for the

Internazionalizzazione del sistema universitario italiano 2005-2009
Member commission Prize SGI 2007
Delegate of Accademia nazionale dei Lincei in the Comitato Tecnico-Scientifico dell'Anno Internazionale del Pianeta Terra (2007-2009)
Lecturer: Lezioni Lincee in Fisica at University of Trieste (2007-2015)
Board of Directors INOGS – Trieste 2009-2011
Lectio Magistralis {Keynote Address} at the opening ceremony of the Academic year 2009-2010 of Trieste University, at the presence of the President of the Chamber of Deputies.

TEACHING
22 research students awarded PhD's; 26 postdoctoral scholars from 15 countries; 3 PhDs award-ed at Institut of Geophysics – China Earthquake Adminstration, and Institute of Geology and Geophysics – China Academy of Sciences, 1 PhD awarded at IIEES – Teheran, 1PhD awarded at Mansoura University Faculty of Science Geology Department, Egypt. Supervisor of 29 post-docs from 15 different Countries – with numerous publications in peer reviewed journals.

HONORS
Prize *Ettore Cardani*, Università di Torino 1968; *Fulbright* Fellow 1970; *Premio Linceo* Accademia Nazionale dei Lincei Roma 1990; *Beno Gutenberg Medal* from the European Geophysical Society, for "Outstanding Contributions to Seismology", 2000; *Doctor Honoris Causa* in Physics from University of Bucharest – Romania, 2002; *Honorary* Fellow Fondazione Internazionale Trieste per il progresso e la liberta' delle scienze, 2004; *CEI Medal of Honour* for "eminent services to the organization and the demonstrated highly qualified scientific work performed by the Earth Sciences Committee of the Central European Initiative (CEI)", 2004; *Honorary Professor* Institute of Geophysics, China Earthquake Administration, 2005; Commemorative Medal from the Vietnam Academy of Science and Technology, 2009; NRIAG Medal of Honor, 2014; 5th Class/Knight (Cavaliere Ordine al Merito della Repubblica Italiana) 2015; *Honorary Professor* Beijing University of Civil Engineering and Architecture (BUCEA) 2018; 2018 AGU International Award winner.

MEMBERSHIP OF ACADEMIES
Accademia Nazionale Lincei, Italy 1987-; Academia Europaea, 1990-; The Academy of Sciences for the Developing World 1997-; Russian Academy of Sciences 2003-; Accademia Nazionale delle Scienze detta dei XL 2004.

SERVICES
Council member: European Geophysical Society 1982-1986; European Union of Geosciences 1983-1994
Vice President European Union of Geosciences 1991-1994
Chairman UNESCO-IUGS-IGCP project "Realistic Modeling of Seismic Input for Megacities and Large Urban Areas" 1997-2001
Project leader NATO SfP project "Impact of Vrancea earthquakes on the security of Bucharest and other adjacent urban areas" 2000-2004
External expert for IAEA under Technical Cooperation Program 2003
Chairman of EGU Beno Gutenberg medal Committee 2001-2008
President of the EARTH SCIENCE COMMITTEE of the CEI WORKING GROUP SCIENCE AND TECHNOLOGY 1991 –
Member of Italian Comitato Geologico 2005 –
Member of Scientific Council Centro di studi e ricerche di sismologia applicata dinamica strutturale – Univ Brescia 2006 –
Member Board of Directors Istituto Nazionale di Oceanografia e Geofisica Sperimentale 2009-2011
President of Commission for the Evaluation of Research (CVR) University of Trieste, 2010-2012
President of the Italian National Committee to IUGG 2011 – 2019
Member Italian Commission for the participation of CNR to ICSU 2011 –
President of Commission Abilitazione Scientifica Nazionale – MIUR - Competition Sector: 04/A4 – Geophysics 2012-2014
Member Comitato di Selezione PRIN (Sector ERC PE) 2013
Referee for PRIN and other MIUR projects since many years
Referee for proposals submitted to Czech Science Foundation 2007 –
Referee for proposals submitted to Research Council of Norway 2002 –
Referee for proposals submitted to Romanian National University Research Council 2008 –
Referee for proposals submitted to Ministry of Education, Youth and Science of Bulgaria 2010 –

MEMBERSHIP OF ASSOCIATIONS
Royal Astronomical Society, London 1983-; American Geophysical Union (life time); Seismological Society of America 1986; European Geophysical Society (life time); Lions Club, Trieste Miramar 1992-; **Funding member** of the *International ASsociation for Seismic Isolation and energy disSIpation (ASSISi)*, 2001; Honorary Member *(ASSISI)* 2008; Honorary Member of *GLIS*

ADVISORY BOARDS
Board of Governors: Universita' di Trieste 1987-1989

Scientific Boards: Gruppo Nazionale per la Difesa dai Terremoti 1993-1997; Istituto Nazionale di Oceanografia e Geofisica Sperimentale 1993-; Environment and Large Disasters Commission of Accademia Nazionale dei Lincei 1993-; Large Risks Commission, Ministry of Emergency Relief 1994-1995; European Advisory Evaluation Committee for Earthquake Prediction Council of Europe 1993-1999

Editorial Boards: TERRA Nova 1990-1996; Revista de Geofisica 1990-; Acta Geod. Geophys. Hungarica 1994; Engineering Geology 2007-; The African Physical Review 2007-2018; *Associate Editor* Rendiconti Lincei 2008–; *Editor-in-Chief* Earth Sciences Review 1997-2018; *Editor* Pure and Applied Geophysics 1997-2004; *Editor* Bollettino di Geofisica Teorica ed Applicata 1998–; *Associate Editor* Journal of Seismology and Earthquake Engineering 2001–; *Advisory Editorial Board* of Journal of Theoretical and Applied Mechanics 2015–; *Board member* of Vietnam Journal of Earth Sciences 2016–

TECHNOLOGY TRANSFER

2005 Responsible for ICTP of the agreement with Protezione Civile Regionale FVG for the *"Sviluppo e l'aggiornamento di carte di pericolosità sismica dipendenti dal tempo"*

2011 *Audizione* in the framework of risoluzioni n. 7-00409 Alessandri e n. 7-00414 Benamati in materia di isolamento sismico delle costruzioni civili e industriali presso Commissione Ambiente, territorio e lavori pubblici della Camera dei Deputati

2012 *Audizione* in the framework of the Indagine conoscitiva sullo stato della sicurezza sismica in Italia presso Commissione Ambiente, territorio e lavori pubblici della Camera dei Deputati

PUBLICATIONS
Author and coauthor of more than 500 scientific papers in refereed journals
Co-Author, Editor and Co-editor of 12 books

h-index (2010) 25; above 90th percentile of area 04 among Italian full professors; 9th as h-index; 4th as citations; first as total number of publications (source Scopus)

In June 2010 SCIENCEWATCH.COM stated: According to their *Special Topics* analysis on earthquake research over the past decade ─ the work of Dr. Giuliano F. Panza ranks at #4 by papers, based on 74 papers cited a total of 434 times.

In the Web of Science® from Thomson Reuters, G.F. Panza's record includes 109 original articles, reviews, and proceedings papers, cited 715 times between January 1, 2000 and May 6, 2010;
H-factor =37 (2016 Scopus);
ResearchGate score higher than 97.5% of ResearchGate members (June 2019)
https://www.researchgate.net/profile/G_Panza

FIELDS OF EXPERTISE
elastic wave propagation; interior structure of the earth; plate tectonics; earthquake prediction; active tectonics; seismic microzonation of urban settlements; seismic hazard; volcano seismology

REFERENCE LISTINGS
Who's Who in the World; Who's Who in Italy; Who's Who in Science and Engineering; Dictionary of

International Biography.

ADDRESS

Olim: Dipartimento di Matematica e Geoscienze - Universita' di Trieste, Via Weiss, 4 – 34127 Trieste (Italy);
Home: Phone: +39-040-363410; Fax: +39-040-0640852; e-mail: giulianofpanza@fastwebnet.it

BACKGROUND AND BASIC INFORMATION

The scientific activity of Prof. Giuliano Francesco Panza is marked by the **broad and multidisciplinary nature of the problems considered**: (i) integrated analysis of *structure* and *dynamics* of the lithosphere-asthenosphere system; (ii) integrated approaches to realistic *modelling* of the seismic waves in the *near-field* and *far-field*; and (iii) the nature of *earthquake-prone lineaments* and *premonitory seismicity patterns*. A very wide range of **sophisticated theoretical methods and also models have been developed** in these studies, providing advanced methodologies for: (a) seismogram synthesis; (b) seismic inversion; and (c) pattern recognition techniques.

The rewards for *excellence* (in the use of these techniques) are in the **extension of their results to *applications,* without sacrifice of the *scientific* level** of the study. The various applications concern: (1) strong ground motion simulations; and (2) reduction of seismic and volcanic risks.

Prof. Panza, who was recipient of the **2000 Beno Gutenberg Medal of the European Union of Geosciences** for "Outstanding Contributions to Seismology", is presently considered by many to be the strongest Italian seismologist. As the dedicated and successful leader of several *international* projects, perhaps the most emblematic one (completed in 2003) was: **Realistic Modelling of Seismic Input for Megacities and Large Urban Areas** ─ supported by UNESCO-IUGS-IGCP. This project showcased the "Trieste System" ─ involving more than 100 scientists, who were distributed in more than 25 centers (several of them located in Central European Initiative or CEI countries).

He has been coordinating (for the CEI University network) Seminars and Workshops on ***"Earth and Environmental Physics: Geodynamical Model of Central Europe for Safe Development of Ground Transportation Systems"***, at the Department of Earth Sciences of the University of Trieste and at The Abdus Salam International Center for Theoretical Physics. This activity represented a natural extension of the project "Lithospheric studies of the Periadriatic domain and the geodynamics of the Circum-Pannonian belt", launched in 2001 by CEI's Committee on Earth Sciences. CEI activity continues now in the framework of CERES-ICTP fellowships.

To further improve the assessment of seismic hazard (from a statistical point of view), in co-operation with scientists from IIEPT of the Moscow Russian Academy of sciences, it is proposed to apply **use at variable scale of the fractal Gutenberg-Richter relation**. This result has important implications in the future developments of *intermediate-term, middle-range earthquake prediction* methods (to be done again in collaboration with scientists of IIEPT, Moscow). With the Seismology Group of Dipartimento di Scienze della Terra dell'Universita' di Trieste and with the SAND group of the Abdus Salam International Centre for Theoretical Physics (ICTP) which he supervises, Prof. Panza has developed now a very powerful *theoretical-numerical tool* for the **computation of complete synthetic seismograms.** These synthetic seismograms form the base of his earlier methodology for the **Neo-Deterministic Seismic Hazard Assessment (NDSHA)**, which currently has been applied in several large urban centres and megacities.

Recently, in cooperation with ASI, the Italian Space Agency, the simultaneous use of: (a) the neo-deterministic approach for the ground motion estimation; and (b) the monitoring of the *space-time variation* of hazard utilizing satellite Earth observation data ─ have now lead to the construction of **time-dependent hazard models** based on the entire suite of *simultaneously monitored* geophysical signals of both *ground deformations* and *seismicity*. This new research tool has generated particular interest at the **Civil Defence** level.

* * *