Biographical Information

John G. Anderson

Seismological Laboratory, MS 174, University of Nevada, Reno, Nevada 89557

Education

Ph.D. Geophysics, 1976 Columbia University, New York City, New York
B. S. Physics, 1970 Michigan State University, East Lansing, Michigan

Professional Positions

University of Nevada, Reno – College of Science - Mackay School of Earth Sciences and Engineering

Department of Earth Sciences and Engineering (formerly Geological Sciences)
Associate Professor, Professor of Geophysics: Sept 1988 - present
Nevada Seismological Laboratory: Sept 1988 - present
Director, Feb. 1998 – June 2009

University of California, San Diego

Institute of Geophysics and Planetary Physics
Asst., Associate Research Geophysicist and Lecturer: Aug 1980 to June 1990
Department of Applied Mechanics and Engineering Sciences
Asst, Associate Research Engineer: Aug 1980 to 30 June 1988

University of Southern California, Los Angeles

Research Associate, Senior Research Associate: Oct. 1976 to 1980

California Institute of Technology, Pasadena, California

Research Fellow: November 1975 to 1976.

Lamont Doherty Geological Observatory of Columbia University, Palisades, N. Y.

Research Assistant: July 1970 to 1975.

Additional Professional Experiences

Project Professor at Earthquake Research Institute, University of Tokyo, July 1, 2009-March 31, 2010.
Visiting Professor at Laboratoire de Geophysique Interne et Tectonophysique, April 27, 2010-July 23, 2010.
Visiting Researcher at Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences, Potsdam, Germany, September 18, 2017-January 28, 2018
Research visit to DPRI, Kyoto University: October 15-Nov. 5, 2015
Research visit to DPRI, Kyoto University: July 24-August 4, 2016
Visiting Professor, Disaster Prevention Research Institute, Kyoto University, Uji, Kyoto, Japan, March 3 2018-June 8, 2018.
Consultant on problems related to seismic hazard and engineering seismology.

Major Research Interests
All aspects of engineering seismology, including applications of geological and seismological information to estimate seismicity and seismic hazards (probabilistic and deterministic); recording strong ground motions; understanding the physics of near-source ground motions; and applications to engineering problems. Dr. Anderson is an author or coauthor on over 250 publications, mostly related to some field of engineering seismology.

Major Committees
National Seismic Hazard and Risk Assessment Steering Committee (chair), U. S. Geological Survey, May 2013-present.
Scientific Earthquake Studies Advisory Committee, U. S. Geological Survey, 2014-present.

Major Honors
Bruce A. Bolt Medal, 2015, awarded jointly by COSMOS, EERI, and SSA.

John G Anderson 教授　防災研究所への貢献の足跡

長期滞在（1 週間以上）

1998（平成 10）年度：招へい外国人学者

　　1998 年 11 月 29 日～1998 年 12 月 11 日

2015（平成 27）年度：招へい外国人学者

　　2015 年 10 月 15 日～2015 年 11 月 5 日

2016（平成 28）年度：招へい外国人学者

　　2016 年 7 月 24 日～2016 年 8 月 4 日

2017（平成 29）年度～2018（平成 30）年度：外国人客員教授

　　2018 年 3 月 3 日～2018 年 6 月 8 日

短期滞在（1 週間未満）

1996（平成 8）年度：　外国人来訪者

　　1997 年 1 月 30 日～1997 年 2 月 2 日

2009（平成 21）年度：外国人来訪者

　　2009 年 10 月 26 日

　　2010 年 1 月 10 日

2012（平成 24）年度：外国人来訪者

　　2012 年 11 月 25 日～2012 年 11 月 27 日

JOHN GREGG ANDERSON

Publications

1 Journal Articles (136)

136. von Seggern, D. and J. G. Anderson (2017). Velocity change in the zone of a moderate Mw 5.0 earthquake revealed by autocorrelations of ambient noise and by event spectra, Pure and Applied Geophysics, Vol.17, DOI 10.1007/s00024-017-1521-2.

135. Biasi, G. and J. G. Anderson (2016). Disaggregating UCERF3 for Site-Specific Applications, Earthquake Spectra, Vol. 32, 2009-2026.

134. Anderson, J. G. and G. P. Biasi (2016). What is the basic assumption for probabilistic seismic hazard assessment, Seismological Research Letters, Vol. 87, published online Feb. 10, 2016, DOI: 10.1785/0220150232.

133. Anderson, J. G. (2015) Introduction. Earthquake Spectra, Vol. 31, No. S1, v-vi. DOI: http://dx.doi.org/10.1193/8755-2930-31.1s.v

132. Yagoda-Biran, G. and J. G. Anderson (2015). Investigation of the Ground-Motion Variability Associated, Bulletin of the Seismological Society of America, Vol. 105, No. 2A, 1011-1028, DOI: 10.1785/0120140224.

131. Yagoda-Biran, G., J. G. Anderson, H. Miyake, and K. Koketsu (2015). Between-Event Variance for Large Repeating Earthquakes, Bulletin of the Seismological Society of America Vol. 105, 2023-2040, First published on June 2, 2015, DOI: 10.1785/0120140196.

130. McBean, K. M., J. G. Anderson, J. N. Brune, and R. Anooshehpoor (2015). Statistics of Ground Motions in a Foam Rubber Model of a Strike-Slip Fault, Bulletin of the Seismological Society of America, Vol. 105, 1456-1467, First published on May 12, 2015, DOI: 10.1785/0120140276.

129. Yagoda-Biran, G. and J. G. Anderson (2015). Investigation of the ground-motion variability associated with site response for sites with V_{S30} over 500 m/s, Bulletin of the Seismological Society of America, Vol. 105, 1011-1028, DOI: 10.1785/0120140224.

128. Pancha, A., J. G. Anderson, G. Biasi, S. K. Pullammanappallil, and A. Anooshepoor (2015). Empirical site response and comparison with measured site conditions at ANSS sites in the vicinity of Reno, Nevada, Bulletin of the Seismological Society of America, Vol. 105, 889-911, DOI: 10.1785/0120140028

127. von Seggern, D. H., J. G. Anderson, I. M. Tibuleac, and G. P. Biasi (2015). Double- difference location and ground-truth classification of the 2008 Mogul, Nevada, very shallow earthquake sequence, Seismological Research Letters, Vol. 86, 146-157, First published on December 3, 2014, DOI:10.1785/0220140121.

126. Anderson, J. G. (2015). The composite source model for broadband simulations of strong ground motions, Seismological Research Letters, Vol. 86, 68-74, First published on December 17, 2014, DOI: 10.1785/0220140098.

125. Ktenidou, O.-J., F. Cotton, N. A. Abrahamson, and J. G. Anderson (2014). Taxonomy of κ: A Review of Definitions and Estimation Approaches Targeted to Applications, Seismological Research Letters, Vol. 85, 135-146, DOI: 10.1785/0220130027.

124. Anderson, J. G., H. Kawase, G. P. Biasi, J. N. Brune, and S. Aoi (2013). Ground motions in the Fukushima Hamadori, Japan, normal faulting earthquake, Bulletin of the Seismological Society of America. Vol.103, 1935-1951.

123. Anderson, J. G. (2013). Surface motions on near-distance rock sites in the 2011 Tohoku-oki earthquake, Earthquake Spectra, Vol. 29, No. S1, S23-S35.

122. Anderson, J. G. and K. Nanjo (2013). Distribution of earthquake cluster sizes in the western United States and in Japan, Bulletin of the Seismological Society of America. Vol.103, 412-423.

121. Kilb, D., G. Biasi, J. G. Anderson, J. Brune, Z. Peng, and F. L. Vernon (2012), A Comparison of Spectral Parameter Kappa from Small and Moderate Earthquakes Using Southern California ANZA Seismic Network Data, Bulletin of the Seismological Society of America, Vol. 102, 284-300, DOI: 10.1785/0120100309.

120. Tibuleac, I. M., D. H. von Seggern, J. G. Anderson, and J. N. Louie (2011). Computing Green's functions from ambient noise recorded by accelerometers and analog, broadband, and narrow-band seismometers, Seismological Research Letters, Vol. 82, 661-675.

119. Anderson, J. G. and Y. Uchiyama (2011). A methodology to improve ground-motion prediction equations by including path corrections, Bulletin of the Seismological Society of America., Vol. 101, 1822-1846.

118. Anderson, J. G., J. N. Brune, G. Biasi, A. Anooshehpoor, and M. Purvance (2011). Workshop Report: Applications of Precarious Rocks and Related Fragile Geological Features to U.S. National Hazard Maps, Seismological Research Letters, Vol. 82, 431-441.

117. Ghasemi, H., Y. Fukushima, K. Koketsu, H. Miyake, Z. Wang and J. G. Anderson (2010). Ground-motion simulation for the 2008 Wenchuan, China, earthquake using the stochastic finite-fault method, Bulletin of the Seismological Society of America. Vol. 100, 2476-2490.

116. Anderson, J. G. (2010). Source and site characteristics of earthquakes that have caused exceptional ground accelerations and velocities, Bulletin of the Seismological Society of America, Vol. 100, No. 1, 1-36, February 2010, DOI: 10.1785/0120080375.

115. Anderson, J. G., I. Tibuleac, A. Anooshehpoor, G. Biasi, K. Smith, and D. von Seggern (2009). Exceptional ground motions recorded during the 26 April 2008 M_W 5.0 earthquake in Mogul, Nevada, Bulletin of the Seismological Society of America, Vol. 99, 3475-3486.

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113. Pancha, A., J. G. Anderson, and C. Kreemer (2006). Comparison of seismic and geodetic scalar moment rates across the Basin and Range province, Bulletin of the Seismological Society of America, Vol. 96, 11-32.

112. Pancha A., J. G. Anderson, J. N. Louie, et al. (2008). Measurement of shallow shear wave velocities at a rock site using the ReMi technique, Soil Dynamics and Earthquake Engineering, Vol. 28, 522-535.

111. Tibuleac, I. M., D. H. von Seggern, J. G. Anderson, K. W. Smith, A. Aburto, and T. Rennie (2008). Location and Magnitude Estimation of the 9 October 2006 Korean Nuclear Explosion Using the Southern Great Basin Digital Seismic Network as a Large-Aperture Array, Bulletin of the Seismological Society of America, Vol. 98, 756-767.

110. von Seggern D. H., Anderson J. G., and Miyata Y. (2008). Demographics of the 2007 SSA membership, Seismological Research Letters, Vol. 79, 25-32.

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105. Anderson, J. G. and Miyata, Y. (2006). Ranking States by Seismic Activity. Seismological Research Letters, Vol. 77, 672-677.

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103. Ichinose G.A., Anderson J.G., Smith K.D., et al. (2003). Source parameters of eastern California and western Nevada earthquakes from regional moment tensor inversion, Bulletin of the Seismological Society of America., Vol. 93, 61-84.

102. Purvance M.D. and Anderson J.G. (2003). A comprehensive study of the observed spectral decay in strong-motion accelerations recorded in Guerrero, Mexico, Bulletin of the Seismological Society of America., Vol. 93, 600-611.

101. Sucuoglu H., Anderson J. G., and Zeng Y. H. (2003). Predicting intensity and damage distribution during the 1995 Dinar, Turkey, earthquake with generated strong motion accelerograms, Bulletin of the Seismological Society of America., Vol. 93, 1267-1279.

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99. Anderson, J. G. Precautionary principle: applications to seismic hazard analysis, Seismological Research Letters, Vol. 72, 319-322.

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97. Lee, Y. and J. G. Anderson (2000). Potential for improving ground-motion relations in southern California by incorporating various site parameters, Bulletin of the Seismological Society of America, Vol. 90, S170-S186.

96. Lee, Y., J. G. Anderson, and Y. Zeng (2000). Evaluation of empirical ground-motion relations in southern California, Bulletin of the Seismological Society of America, Vol. 90, S136-S148.

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92. Anderson, J. G., J. N. Brune, R. Anooshehpoor, and S.-D. Ni (2000). New ground motion data and concepts in seismic hazard analysis, Current Science, Vol. 79, 1278-1290.

91. Ichinose, G, A., J. G. Anderson, K. Satake, R. A. Schweickert, and M. M. Lahren (2000). The potential hazard from tsunami and seiche waves generated by large earthquakes within Lake Tahoe, California-Nevada. Geophysical Research Letters, Vol. 27, 1203-1206.

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H. Sandoval, N. Shapiro, M. Torres, C. Uribe, R. Vazquez, J. M. Velasco, and J. Ylizaliturri (1999). A preliminary report on the Tehuacan, Mexico earthquake of June 15, 1999, Seismological Research Letters, Vol. 70, 489-504, 1999.

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Seismic hazard analyses in three decades of research with special emphasis on the importance of quantitative strong motion predictions

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The approach to seismic hazard analysis has, for many cases, transitioned from “deterministic” to “probabilistic”. The probabilistic approach takes into account the rate of earthquakes and uncertainties in both rates of earthquakes and estimates of ground motions in a defined way. However, there are many uncertainties. I have been deeply involved in development and review of the National Seismic Hazard Model for the U. S. Geological Survey, and in related efforts. This presentation will be organized around some of the difficult and persistent research problems, the solution of which would decrease the uncertainties in hazard estimates. This list, of course is not complete, and others may well add more questions with great impact.

With those caveats, the research questions that I propose can be separated into four broad themes:

Related to estimating the “seismicity model”, i. e. the description of locations, magnitudes, and earthquake occurrence rates:

1. Should the seismicity catalog be declustered? If so, how?
2. What is the magnitude – frequency distribution for the network of faults?
3. How deeply do large continental earthquakes rupture? Is the depth predictable?
4. Is moment balancing based on slip / strain rate the best approach to estimate earthquake rates? Are there other methods?

Related to ground motion prediction equations (GMPEs):

5. What is the ground motion very near Mw>7 earthquake in the continental crust?
6. How should site response be represented in (GMPEs)?
7. Can sigma be reduced in GMPEs?
8. How do we adjust ground motion models for different regional geology and tectonics?

Related to synthetic seismograms:

9. What is the shape of the seismic “source spectrum”, E(f)?
10. Why are measurements of “kappa” so variable?
11. Can synthetic seismograms be better than GMPEs?
12. How effectively can site response by represented in synthetic seismograms?

General issues:

13. Hazard maps should show uncertainties. How should those uncertainties be measured?
14. How can hazard maps and hazard curves be tested?
15. Do we need to change our practices to achieve greater resilience?

Global collaboration is essential to improve on the current solutions to these questions, and to see that the resulting best practices are implemented wherever seismic hazard analysis is applied. In the past 30-40 years, the collaboration between UNR and DPRI has made significant contributions on several of these questions. In the context of overall issues, the presentation will highlight some of these achievements. However, the following discussion will focus instead on the definition of these problems.

1. **Should the seismicity catalog be declustered? If so, how?**
For the U.S. National Seismic Hazard Model, the seismicity catalog is declustered, with the intention of removing foreshocks and aftershocks. This declustered catalog is used to create a model of background seismic activity, intended to cover seismicity that occurs off the known faults or potentially from faults that have not yet been identified or characterized. At present, however, there is no consensus on how to determine whether any specific earthquake is or is not part of a cluster. Different methods affect hazard estimates. Beyond the technical challenge of how to decluster, there is the question of whether the information about earthquake occurrence that is not used as a result of the declustering is significant for hazard estimates.

2. **What is the magnitude – frequency distribution for the network of faults?**
The question is simply stated: given a geologist's observation of the surface trace of a fault, and some information on the slip rate or recurrence rate at one or a few trenches, how does one determine the distribution of magnitudes on the fault, and the rates of their occurrence? The solution is a key part of the source model used to generate hazard curves, but it is seriously underdetermined given the current state of knowledge about fault behavior.

3. **How deeply do large continental earthquakes rupture? Is the depth predictable?**
This question occurs when the slip rate or strain rate is used to estimate the seismic moment rate of a fault or a volume of the crust. It is also important when setting up a fault model to generate synthetic seismograms.

4. **Is moment balancing based on slip / strain rate the best approach to estimate earthquake rates? Are there other methods?**
Moment balancing does not apply for regions like eastern North America, northern Europe, or central Australia, where strain rates are nearly undetectable with present uncertainties. Furthermore, we do not know if it is the right approach in these regions, as we do not know what physical processes control the rate of earthquakes.

5. **What is the ground motion very near Mw>7 earthquake in the continental crust?**
This is a question driven by the lack of recorded ground motion data within, say, 10 km of the fault. Related questions include whether the motion is particularly severe on the hanging wall of a thrust fault in general, or in only some circumstances, and whether it is reduced on the hanging wall of a normal fault in general or in some circumstances. Data is needed, and since such events are relatively rare, obtaining the needed data is a challenge for instrumental strong-motion seismology. Records from several earthquakes of each mechanism are needed, as records from individual events raise the question of whether that specific event is typical.

6. **How should site response be represented in (GMPEs)?**
Representation of site characteristics has advanced with the adoption of Vs30 as a proxy for site conditions. However, the explanatory power of Vs30 is limited, so additional proxies are needed.

7. **Can sigma be reduced in GMPEs?**
Sigma is the measure of misfit between data and a model for the amplitude of ground motion parameters. It can be divided into multiple terms that represent different contributions, in a process that can get quite complicated. However, in the end, the total value has a very large impact on seismic hazard at low probabilities. The challenge is to reduce sigma by understanding the different physical processes that contribute. One significant contribution is recognizing and working around the ergodic assumption, which uses the spatial variability of ground motions as a temporal uncertainty in a hazard analysis.

8. **How do we adjust ground motion models for different regional geology and tectonics?**
While strong motion data is available for many earthquakes in some places, such as Japan or along the San Andreas system in California, there are many other regions with much less data. Data from Japan, for instance, may be systematically somewhat stronger than in the US or Italy. How can we make adjustments for source, path, and site conditions that

transfers the knowledge from regions of abundant data to regions where little to none exists?

9. **What is the shape of the seismic "source spectrum", E(f)?**
Generating synthetic seismograms, it is necessary to use a model for the source, for the wave propagation along the path, and for the effects of near-surface geology (the site). While some data is consistent with the model that the source spectrum follows an "omega-square" trend at high frequencies, other data suggests this is not universal.

10. **Why are measurements of "kappa" so variable?**
The high-frequency decay parameter "kappa" characterizes a linear approximation to the shape of the seismic spectrum at high frequencies when the spectrum is plotted on semilogarithmic axes (linear f, log A(f)). One simple model assumes that it is predominantly controlled by attenuation provided the source spectrum is "omega-squared". With this assumption, regional differences in kappa may be useful for the problem of adjusting ground motion models to different regions. While kappa is affected by fine structure in the spectrum, and possibly by source processes, a complete physical understanding of the variability would provide a stronger justification for this type of application, as well as improved guidance for models that seek to generate realistic synthetic seismograms.

11. **Can synthetic seismograms be better than GMPEs?**
One procedure to test synthetics is to compare their estimates of ground motion parameters with equivalent estimates based on GMPEs. Where and when the synthetics predict the full spectrum of data with less bias and smaller total uncertainty, there is a good case for their use as an alternative to GMPEs. Can these criteria be met?

12. **How effectively can site response by represented in synthetic seismograms?**
This involves the issues of how to measure site conditions and convert the measurements into a form that can be used in the development of synthetic seismograms. This question is not entirely independent of the previous question, and testing would be performed the same way.

13. **Hazard maps should show uncertainties. How should those uncertainties be measured?**
In the spirit of considering a hazard curve and a hazard map as a scientific model prediction, quantified uncertainties are essential to allow testing of the model. Uncertainties are also useful for the engineering application of the results. However, there are multiple ways to

measure uncertainties. For instance, in one extreme we can look at the highest and lowest logic tree branch to estimate the outer limits of our current understanding. A second approach is to find the second moment of the weighted logic tree distribution. Finding the 15^{th} and 85^{th} percentile of the hazard curves may give approximately the same result as the second moment. Would there also be any use for an "uncertainty of the mean" separate from the uncertainty of the distribution? When we sample a random process following a normal distribution, we would never claim that the two extremes of the distribution are the best way to characterize our uncertainties. We would also give the standard deviation and the uncertainty of the mean, as these also provide useful information.

14. **How can hazard maps and hazard curves be tested?**
    This is a difficult problem, as the exceedance rates of engineering interest (e.g. $\sim 4 \times 10^{-4}$ per year) are far below rates that can be verified experimentally. Precariously balanced rocks or other fragile geological features may be useful for the few points where they exist, but still generally give only a one-sided test. It is possible to test some input components, and then trust the basic probability theory to get the hazard right. Also, I am not aware of any general consensus of how to recognize failure, should it occur.

15. **Do we need to change our practices to achieve greater resilience?**
    Our most fundamental goal is a safer society, which means that our infrastructure should not only protect life safety, but also be highly resilient to recover quickly after a strong earthquake. Do our current practices in seismic hazard analysis, and the use of those practices in seismic-resistant design, achieve a socially acceptable level of resilience? In the US, the National Earthquake Hazard Reduction Program was recently reauthorized, with a new mandate for the program is to consider this question.

This is a long and difficult set of questions. I believe that they are essential for improving our assessment of seismic hazard in our increasingly technological world. I also believe that they cannot be solved without global involvement and cooperation. DPRI is among the leaders in the effort, and I have been honored that I have had the opportunity to be a part of the effort.

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