Dr Julian J Bommer CEng FICE

Seismic Hazard and Risk Specialist

DATE OF BIRTH 19 July 1964

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HIGHER EDUCATION

B.Sc. Civil Engineering (First Class Honours) 1985
Imperial College.

M.Sc. Soil Mechanics and Engineering Seismology 1986
Imperial College

Ph.D. Engineering Seismology 1991
University of London

APPOINTMENTS

Since 2011 **Independent Seismic Hazard and Risk Consultant**

Since 2013 **Senior Research Investigator / Visiting Professor**
Department of Civil and Environmental Engineering, Imperial College

2006 -2011 **Professor of Earthquake Risk Assessment**
Department of Civil and Environmental Engineering, Imperial College

2002 - 2006 **Reader in Earthquake Hazard Assessment**
Department of Civil and Environmental Engineering, Imperial College

1999 - 2002 **Senior Lecturer in Engineering Seismology**
Department of Civil and Environmental Engineering, Imperial College

1994 - 1999 **Lecturer in Engineering Seismology**
Department of Civil and Environmental Engineering, Imperial College

1993 – 1994 **Lecturer and Researcher**
Department of Civil Engineering, Universidad Centroamericana, El Salvador

1987 – 1992 **Research Associate**
Department of Civil Engineering, Imperial College

1986 – 1987 **Graduate Engineer**
Rendel, Palmer & Tritton Consulting Engineers, London

1985 **Graduate Engineer**
Dames & Moore International, London

HONOURS and AWARDS

Queen's Jubilee Scholarship from the Institution of Civil Engineers 1982

Imperial College Award for Excellence in Teaching 2000

EERI Outstanding *Earthquake Spectra* Paper Award 2008

LANGUAGES

Spanish (bi-lingual: fluent spoken, reading and writing)

Portuguese (fluent speaking and reading, intermediate writing)

MEMBERSHIP of PROFESSIONAL BODIES

Chartered Engineering registered with the Engineering Council

Fellow of the Institution of Civil Engineers

Society for Earthquake and Civil Engineering Dynamics (SECED)

- Chairman of SECED (the UK chapter of the European and International Associations for Earthquake Engineering) from 2000 to 2002
- Chairman of SECED Research and Education Sub-Committee 1996-1999
- Elected member of SECED Committee from 1995

Earthquake Engineering Research Institute (EERI)

Member of the Seismological Society of America

European Association for Earthquake Engineering

EDITORIAL APPOINTMENTS

Member of Editorial Board for Spring book series on *Geological, Geotechnical and Earthquake Engineering* since 2005

Associate Editor of the *Bulletin of the Seismological Society of America* 2005-2008

Member of Editorial Board of *Engineering Geology* 2002-2007

Member of editorial board of *Bulletin of Earthquake Engineering* 2002-2007

Member of editorial board of *Soil Dynamics & Earthquake Engineering* 2004-2011

Member of editorial advisory board of *Earthquake Engineering & Structural Dynamics* 2014-2016

CONSULTANCY EXPERIENCE

I have been engaged in consultancy related to the assessment of seismic hazard, earthquake loss estimation, and the definition of input to earthquake-resistant design, for almost 30 years, with increasing levels of engagement throughout this time. In 2011, I resigned from my academic appointment at Imperial College London to pursue consultancy work full-time. The paragraphs below provide an overview of some of the larger projects I have undertaken or am currently engaged in; a large number of smaller projects are not currently listed.

EXPERT PANEL on SEISMIC HAZARD, OFFICE for NUCLEAR REGULATION, UK
Appointed in 2011 to serve on the Expert Panel for Seismic Hazard and Climate Change to the UK *Office for Nuclear Regulation*, with responsibility for leading the technical review of the seismic hazard assessment at the Hinkley Point C, Wylfa B and Moorside nuclear sites. I also represent the Seismic Hazard group at meetings of the Climate Change group.

SSHAC GUIDELINES for US NUCLEAR REGULATORY COMMISSION (USNRC)
I was an invited participant in the NRC-funded workshops on lessons learned from practical experience of implementation of the SSHAC (Senior Seismic Hazard Analysis Committee) guidelines hosted at the US Geological Survey in Menlo Park in 2008. Subsequently I was engaged by the NRC to work with their staff members and Dr Kevin Coppersmith on the development of NUREG-2117 *Practical Implementation Guidelines for SSHAC Level 3 and Level 4 Hazard Studies*, which as issued by NRC in 2012. In 2016, I was contracted by SouthWest Research Institute to work with their staff, NRC staff members and Dr Coppersmith on updating the implementation guidelines in the light of additional practical experience and also to include guidance on SSHAC Level 1 and 2 studies.

SEISMIC EXPERT for INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
Registered as an expert in seismic hazard and risk with the IAEA for participation in assessment missions to countries around the world, and training workshops for regulatory bodies around the world. Engagements have included participation in workshops for nuclear regulatory bodies in Turkey (TAEK) and Brazil (CNEN).

SEISMIC HAZARD ADVISORY PANEL for GLOBAL EARTHQUAKE MODEL PROJECT
In 2013 I was engaged by the GEM Foundation to serve as an advisor and reviewer for the GEM Hazard Team responsible for developing the *OpenQuake* hazard calculation engine. This includes the formation and coordination of a seismic hazard advisory panel, which is composed of the following individuals: Paolo Bazzurro, Roger Musson, Frank Scherbaum, Gabriel Toro, Ivan Wong, and Bob Youngs.

SSHAC LEVEL 3 PSHA for the US DOE HANFORD SITE, WASHINGTON, USA
I am currently engaged to lead the Ground Motion Characterisation (GMC) Technical Integration Team for the SSHAC Level 3 Probabilistic Seismic Hazard Analysis, following the guidelines of NRC NUREG-2117, at the *US Department of Energy* Hanford site in eastern Washington state. The project will also assess the seismic hazard at the Columbia Generating Station (CGS) nuclear power plant operated by *Energy Northwest* on the Hanford site, and provide the basis for their response to NRC's 50.54(f) letter requesting update of the seismic hazard assessment for the site following the Fukushima accident of 2011. The project is managed by *Pacific Northwest National Laboratory*. The GMC TI Team consists of Linda Al-Atik, Adrian Rodriguez-Marek, Gabriel Toro, and Bob Youngs. The Participatory Peer Review Panel (PPRP) for this project is comprised of Ken Campbell, Brian Chiou, Bill Lettis, Carl Stepp and Woody Savage. The project ran from early 2012 to mid-2014.

The scope of the project is to re-assess the hazard in terms of ground shaking at the top of the basalt-sediment inter-beds to provide input to site response analyses at each of the DOE facilities on the site and the CGS. The GMC sub-project deals with a number of challenges, including the response of near-surface profile with multiple velocity reversals, and ground motions from multiple seismic sources including interface events on the Cascadia subduction zone and both shallow and deep crustal events in the vicinity of the site.

SSHAC LEVEL 3 PSHA for the THYSPUNT NUCLEAR SITE, SOUTH AFRICA

I led a SSHAC Level 3 PSHA, following the guidelines of NRC NUREG-2117, for a new-build nuclear site, working with the South African *Council for Geoscience* on behalf of the energy utility *Eskom*. I was Project Technical Integrator (PTI) and TI Lead for GMC component of the project. The project is a comprehensive assessment of the ground shaking hazard at the Thyspunt site, executed in accordance with NRC Regulatory Guide RG 1.208 including dynamic characterisation of the site and application of NRC approach 3 for the incorporation of site effects. The project began in February 2011 (with geological field investigation commencing a few months earlier) and the final report was delivered to the client on schedule in June 2013. The final report on the PSHA was accepted by Eskom without additional review, based on the unqualified concurrence from the PPRP. The PPRP for this project was comprised of Hilmar Bungum, Fabrice Cotton, Roger Musson, Richard Quittmeyer and Gabriel Toro. This project is the first application of the SSHAC Level 3 process for a site-specific study for nuclear new build, and adhered strictly to the project schedule and budget despite having technical teams distributed over three continents and separated by 10 hours of time differences.

The role of PTI entails overall technical coordination of the project, including responsibility for resolution of all interface issues between the SSC (seismic source characterisation) and GMC elements of the study, and coordination of the hazard calculations (including independent checks). The PTI role also includes responsibility for all communication of technical issues with the client, and presentation and defence of the study to the National Nuclear Regulator (NNR) in South Africa.

I am currently engaged in converting the PSHA study into the corresponding chapter of the Site Safety Report, and also drafting similar chapters for the SSRs for two other potential nuclear sites in South Africa, at Bantamsklip and Duynefontein, the latter being adjacent to the existing Koeberg plant.

SSHAC LEVEL 3 PSHA for NUCLEAR POWER PLANTS in SPAIN

I am serving as Technical Integration Lead for ground-motion characterisation in a SSHAC Level 3 PSHA being conducted for **all nuclear power plant sites in Spain**. The engagement is through *Iberdrola* who are managing the project on behalf of UNESA, which is organisation of Spanish nuclear energy utilities. The project is being conducted in response to a request for a re-evaluation of seismic safety at all nuclear power plants in Spain issued by the nuclear regulator CSN.

This project begins in February 2015 and is scheduled for completion in 2018. The scope of the project is to obtain robust assessments of the ground shaking hazard at the foundation level of all operating plants in Spain, including site amplification effects. The project is the first application of the SSHAC Level 3 process in Europe.

SEISMIC HAZARD ASSESSMENT for NUCLEAR FACILITIES (*multiple locations*)

I have been involved in providing guidance for and also review of seismic hazard assessments for various nuclear facilities apart from those covered by other headings. I am currently engaged (2012-2016) by *Eletronuclear* to advise on the re-assessment of seismic hazard at the **Angra dos Reis nuclear power plant** in **Brazil**, following the Fukushima accident of March 2011. My role includes review of studies conducted to date and advice on the development of logic-trees for seismic source and ground motion characterisation.

From 2011 to 2011, I served on the review panel for *Paul Rizzo Associates* the re-assessment of seismic hazard for Units 3 and 4 of the **Cernavoda nuclear power plant** in **Romania**; the re-assessment was performed specifically to address issue raised by a team from the International Atomic Energy Agency (IAEA).

Prior to that project, I served on another expert panel for the same client to review the seismic hazard study conducted for two new-build nuclear sites in **Abu Dhabi, UAE**, including the **Braka nuclear site** now selected for the first new units by ENEC (*Emirates Nuclear Energy Corporation*). This project ran from 2009 to 2010.

In 2007, I was contracted by *Organizational Analysis Corporation* to participate in the review of US Department of Energy license application for the **Yucca Mountain radioactive waste repository** in **Nevada, USA**, prior to its submission to the US Nuclear Regulatory Commission.

DIABLO CANYON SEISMIC ADVISORY BOARD, CALIFORNIA, USA

In 2008 I was appointed by the Pacific Gas & Engineering Company to the Seismic Advisory Board for the long-term seismic programme at the Diablo Canyon nuclear power plant on the coast of central California. The other members of the board were Kevin Coppersmith, Steve Day, Bob Kennedy and Ray Weldon. During the period of the Board's activity, re-location of seismicity data, followed by extensive offshore geophysical investigations, led to the discovery of the active Shoreline Fault Zone located in the surf zone about 0.6 km from the plant. The Board was disbanded in 2011 following the decision to initiate a new SSHAC Level 3 PSHA for the plant.

PEGASOS PROJECT, SWITZERLAND

From 2001 to 2004 I participated as a member of the Expert Panel on Ground Motions for the SSHAC Level 4 PSHA conducted for four existing nuclear power plant sites in Switzerland. The project was named PEGASOS from the initials of its German title. Although the project was successfully concluded, it generated considerable controversy and although approved by the Swiss nuclear regulator the outcome of the study was resisted by the nuclear utilities. The eventual outcome was the initiation of the so-called **PEGASOS Refinement Project** that was started in 2008, and aimed to refine the original hazard model taken advantage of additional data collection and new developments to reduce the uncertainty. The project was also conducted as a SSHAC Level 4 study, but with a new management structure. I was once again appointed to the Expert Panel on ground motion, but I finally left the project in 2011 (thereby classifying my contributions as those of a Resource Expert providing models for small-magnitude extensions of ground-motion prediction equations, a model for vertical-to-horizontal spectral ratios, and selected and scaled acceleration time-histories for use in the site response analyses) because schedule overrun that led to conflict with new engagements I had undertaken based on the target completion date for the PRP.

GROUND-MOTION MODELS for NUCLEAR PLANTS in CENTRAL & EASTERN USA

In 2005-2006, I jointly led a project with Dr Norm Abrahamson, funded by the *Electric Power Research Institute* (EPRI) to refine the aleatory variability component of the 2004 EPRI ground-motion prediction models that had been developed for use in seismic hazard assessments for nuclear power plants in the Central and Eastern United States. The project had two separate objectives, the first being to explore the possibility of developing a model for a truncated log-normal distribution of the ground-motion residuals, which would have the effect of limited the maximum levels of acceleration obtained from probabilistic seismic hazard analysis (PSHA). The conclusion of this part of the work that there is currently no statistical or physical basis to justify truncation at levels low enough to impact on PSHA at the annual frequencies normally considered in the design of nuclear power plants. The second objective of the project was to re-assess the models for the standard deviation (sigma) in the ground-motion prediction models, in particular the large penalty at short distances for those models based on horizontal distance metrics. The work made use of several strong-motion databases, including from Europe and Japan. The finding of the study were published as EPRI Report 1014381 "Truncation of the lognormal distribution and value of the standard deviation for ground-motion models in the Central and Eastern United States", The updated sigma model is now used in Central and Eastern US PSHA studies.

From 2010 to 2012 I chaired the Participatory Peer Review Panel (PPRP) for the **NGA-East Project** to develop new ground-motion prediction equations for use in PSHA studies for nuclear power plants in Central and Eastern US. The project was led by *the Pacific Earthquake Engineering Research* (PEER) Center at the University of California at Berkeley, and sponsored by the *US Department of Energy*, the *US Nuclear Regulatory Commission*, EPRI, and the *US Geological Survey*. During the period of my chairmanship the project transitioned from a traditional research project to a SSHAC Level 3 process, and developed a new project plan that included a number of structural changes to the project organisation.

GROUND-MOTION MODELS for NUCLEAR PLANTS in the UK

I was technical leader of a project entitled **Attenuation Laws for UK Nuclear Sites** from 2002 to 2003. The project was funded by *British Energy* and was a collaborative endeavour between *Imperial College London*, *Arup Geotechnics*, and the *British Geological Survey*. The scope of the project including a critical evaluation of the widely-used PML equations (including the strong-motion databases from which they had been derived), a review of ground-motion models for stable

continental regions (SCR), and the compilation of a ground-motion database from SCRs that could be used to develop or calibrate new equations.

In 2007 I was engaged by *Halcrow*, again on behalf of *British Energy*, to review some aspects of previous hazard studies for UK nuclear sites, and developed a series of recommended sensitivity studies to be conducted to explore the sensitivity of these studies to potential changes in the ground-motion models. These sensitivity studies were subsequently commissioned from BRGM in France.

As a result of my engagement with the Office for Nuclear Regulation, I am no longer engaged in any site-specific seismic hazard assessments for nuclear sites in the UK.

PANAMA CANAL SEISMIC ADVISORY BOARD, PANAMA

I was appointed to the Seismic Advisory Board of the *Panama Canal Authority* in 2003 to provide guidance and review of the assessment of earthquake design loads for the new construction associated with the expansion of the Panama Canal to accommodate post-Panamax vessels. The engagement has so far entailed field studies, recommendations for geological consultants, review of hazard estimates, and presentation of the work undertaken at a conference showcasing the Canal Expansion in 2012. The work undertaken identified active geological faults in central Panama, with compelling evidence for recent activity that could be correlated with accounts of historical seismicity.

SEISMIC HAZARD and DESIGN PARAMETERS for BRIDGES

I have participated in projects related to earthquake loading on bridges, the first engagement being in 1999 when I was contracted by *EQE International* to undertake the evaluation of acceleration and displacement spectra for assessment of earthquake-induced damage to bridge at Vanau Levu in **Fiji**. In the same year, I was engaged by *High Point Rendel* to perform the selection and scaling of acceleration time-histories for seismic analysis of Seyhan River Bridge in southeast **Turkey**.

During 2000, I served as a consultant once again to *High Point Rendel* with regards to the seismic retrofit of the Bolu viaduct in **Turkey**, which was damaged by both intense ground shaking and direct fault rupture displacement in the November 1999 Düzce earthquake. I served as an advisor and reviewer on many aspects of the project, including the processing and evaluation of acceleration time-histories provided for the seismic analysis of the improved design.

SEISMIC HAZARD and DESIGN PARAMETERS for DAMS

I have been involved in the review of seismic hazard assessments and the definition of seismic design parameters for several dams around the world. In 1999 I was engaged by *Knight Piésold* to provide technical guidance for seismic hazard assessment for four dams in the Ewaso Ngiro (South) Hydroelectric Project in **Kenya**, including probabilistic evaluation of OBE and deterministic assessment of MCE, defining ground motions and expected fault displacements.

In the same year, I was contracted by *GIBB Geotechnical Ltd.* to performed election and scaling of accelerograms for seismic analysis of Çine Dam in southwest **Turkey**.

In 2000, I was engaged by *Binnie Black & Veatch* for review and checking of seismic hazard assessment for raising of Mangla Dam in **Pakistan**.

In 2000, I also undertook a review of seismic hazard study and definition of earthquake actions (acceleration time-histories) for design of tailings dams at Olympias project in northeast **Greece**, once again for *Knight Piésold*.

In 2005, I performed a review of seismic hazard assessments for the Caracoles Dam, San Juan province, **Argentina**, for *MWH*, and advised on the seismic design parameters for Wadi Dayqah dam, Sultanate of **Oman**, for *Black & Veatch.*

In 2006, I was engaged by *URS* to review the seismic hazard study for Hinze Dam, Gold Coast, Queensland, **Australia**.

Between 2009 and 2010, I was given a contract by BC Hydro, **Canada**, to develop guidelines for the selection and scaling of accelerograms for dynamic analysis of hydro-electric dams British Columbia. The focus of the work was to provide guidance that would be used in conjunction with the output from the SSHAC Level 3 PSHA conducted for all of the hydroelectric dams in the province, when these would be subject to dynamic analyses to evaluate the risk in view of the new hazard estimates. The project included a state-of-the-art review of current practice in terms of selection, scaling and adjustment of acceleration time-histories, and a visit to Vancouver the present the findings to engineers at *BC Hydro* and also discuss and provide guidance on the development of summary in-house guidance notes on this topic.

In 2013 I undertook reviews of preliminary seismic hazard studies for the Rogun Dam project in **Tajikistan** on behalf of the *World Bank*. If constructed, Rogun will be the tallest hydro-electric dam project in the world.

In 2014 I was contracted by *GHD Pty. Ltd*. to review separate seismic hazard studies, with divergent results, for Clover and Junction Dams in Victoria, **Australia**. My task was to assess the individual studies and to adjudicate on the issue of which, if any, should be used to define the design basis motions for seismic retrofit of these hydro-electric dams. In 2016, I undertook a review of the revised PSHA study for *AECOM*.

SEISMIC HAZARD and DESIGN PARAMETERS for PIPELINES

In late 2003, I was engaged to undertake a review of the ABS consulting seismic hazard assessment for Deniz Shah gas pipeline in **Georgia**, for *JacobsGIBB*.

In 2015 I was engaged by *Worley Parsons* to review the seismic hazard assessment and specification of earthquake design loads for the Trans-Anatolina Natural Gas Pipeline (TANAP) across **Turkey**, including the appurtenant compressor and metering stations. The probabilistic seismic hazard assessment covered the 1,800-km length of the pipeline, including multiple locations where the pipeline crosses active geological faults.

HAZARD ASSESSMENT from INDUCED SEISMICITY (*multiple locations*)

I was contracted by *Shell International* in 2002 develop a protocol for real-time assessment and control of seismic hazard associated with the hydraulic stimulations of fractures in an enhanced geothermal system utilising an abandoned production well at the Berlín geothermal field in eastern **El Salvador**. Working with Dr Steve Oates from Shell, we developed a 'traffic light' system based on established thresholds (inferred from guidelines from other anthropogenic sources of vibration, intensity-ground motion correlations, and the vulnerability of local housing) of peak ground velocity, PGV; using locally-calibrated attenuation equations these PGV thresholds were then transformed to equivalent earthquake magnitudes and the traffic light defined in terms of recurrence (magnitude-frequency) relationships updated in real-time using a 3D seismograph array installed around the injection well. Acceleorgraphs were also installed at inhabited locations around the project site to monitor levels of motion resulting from induced events.

The 'traffic light' system developed for the El Salvador project has been widely adopted, including for the **Basel Deep Heat Mining** project in **Switzerland**, for which I was engaged as a member of the Scientific Advisory Board in 2005. This project was shut down after a widely-felt event was triggered in December 2006. I participated in the planning phases of the project and was also called to Basel for emergency meetings after the earthquake in 2006 to assist the company, *Geothermal Explorers Ltd*., in formulating their response to the event.

In August 2005 I was also engaged by *Prospección y Geotecnia* in Madrid to provide advice and review regarding possible reservoir-induced seismicity associated with the **Itoiz dam** in northeast **Spain**.

More recently, in 2010 I was engaged by *Geothermal Engineering Ltd.* as an advisor regarding induced seismicity and ground motion for the **United Downs geothermal project** in Cornwall, **UK**.

In 2011, I worked for *Mott MacDonald* to provide advice and review regarding seismic hazard and induced seismicity issues in relation to the proposed **Preesall Gas Storage** project in Lancashire, **UK**.

Since late 2012, I have been engaged by *Nederlandse Aardolie Maatschappij (NAM) B.V.* to review a study of the maximum earthquake potential from induced seismicity associated with production in the Groningen gas field in the **Netherlands**, and to provide assistance with the development of a seismic hazard model for induced seismicity related to the remaining productive life of the field. The model aims to characterise the hazard in terms of ground-motion parameters that will ultimately be used as input to modelling the consequent risk to local housing and infrastructure. The engagement includes providing input to the documentation of the study, and potential interfaces with the regulatory body in The Netherlands and other stakeholder groups as required. My responsibilities in the project are to lead the development of ground-motion prediction equations and a site response model, and to provide input on the seismic loading to the development of building fragility functions. I am also charged with leading the development of a probabilistic model for liquefaction-induced displacements in the field.

In 2013, I was appointed as Chairman of a Scientific Committee established by the oil company *GasPlus* to provide assistance with interactions with the International Commission on Hydrocarbon Extraction and Increased Seismcity in Emiglia (ICHESE) formed by the Italian government following the destructive earthquakes in Emiglia-Romana, **Italy**, in May 2012.

In 2017, I began work as an adviser and reviewer on seismic hazard and risk issue for the *Oil and Gas Authority* (OGA) in the **UK**. Working together with BGS seismologists and OGA geophysicists, I am developing guidelines regarding ground-motion thresholds for the control of hydraulic fracturing operations. The work also includes review of seismic hazard and risk mitigation plans in licensing applications.

EXPERT WITNESS, ILO-2 POWER STATION, PERU

A very large (magnitude 8.3) earthquake struck southern Peru in June 2001, and among its effects was extensive damage to a newly-opened coal-fired power station outside the town of Ilo in the southern deserts. Expert witness on ground motions and damage potential of the shaking at the Ilo-2 power plant due to the earthquake in arbitration hearings between the plant owner, the design engineers and the reinsurers. I was engaged for this work by *MacFarlane*s, who were the legal representatives of the reinsurance consortium, during 2002-2003.

SEISMIC HAZARD and RISK ASSESSMENTS, ITALY

From 2003 to 2004, I served on an international review panel for the development of the new seismic hazard maps for Italian seismic design code on behalf of the *Italian Department of Civil Protection* (DPC). The project was initiated following the San Giuliano earthquake in October 2002—in zone classified as being of low hazard—leading to the collapse of a school building and the deaths of 23 children.

The revision of the national seismic hazard map was the first phase of a series of measures in response to this tragedy, including a complete overhaul of the seismic design code. A unique and radical feature of the new seismic design requirements in Italy was that they were to be applied retrospectively to existing public buildings, and this led to a second engagement, this time as technical leader for a project to devise scheme for setting priorities and time scales for seismic strengthening of public school buildings in Italy, through the *European Centre for Training and Research in Earthquake Engineering* (EUCENTRE), again on behalf of the *Italian Department of Civil Protection*. The project was carried out from 2005 to 2006. The results were published as a monograph, and summarised in a paper in *Earthquake Spectra*.

NATIONAL EARTHQUAKE LOSS MODEL, TURKEY

Following the destructive 1999 Kocaeli and Düzce earthquake in the Sea of Marmara region, the Turkish government initiated a national catastrophe insurance pool against earthquakes and floods. In order to design the reinsurance model for this pool, *Willis* were contracted to developed national loss models for these two hazard and I was appointed to the team for the earthquake model. The work was conducted between 2000 and 2001 by a team comprised of Turkish and UK experts, using the HAZUS methodology. This prompted research undertaken by myself in collaboration with colleagues from the University of Pavia in Italy to develop new approaches for displacement-based assessment of building damage due to earthquake ground shaking. This new approach (DBELA) has been applied in a number of loss modelling exercises around Europe.

PUBLICATIONS

Rather than providing a chronological list of publications grouped by type (journal, conference, etc.), a large selection of my publications is presented below, grouped by topic and in reverse chronological order within each grouping. Although several of the publications could be classified under more than one heading, each paper is listed only once.

In terms of total numbers of publications and citations, as of the date of this CV, in the Thomas Reuters' *Web of Science* I have **118 publications** with more than 5,000 citations and an ***h*-index of 44**. On *ResearchGate*, I have 26 papers with 100 or more citations each and my *h*-index currently stands at 51.

Recording and Characterising Earthquake Ground-Motions

Midzi, V., J.J. Bommer, F.O. Strasser, P. Albini, B.S. Zulu, K. Prasad & N.S. Flint (2013). An intensity database for South Africa 1912 to 2011. *Journal of Seismology* **17**(4), 1183-1205.

Arango, M.C., F.O. Strasser, J.J. Bommer, R. Boroschek, D. Comté & H. Tavera (2011). A strong-motion database from the Peru-Chile subduction zone. *Journal of Seismology* **15**(1), 19-41.

Arango, M.C., F.O. Strasser, J.J. Bommer, D.A. Hernández & J.M. Cepeda (2011). A strong-motion database from the Central American subduction zone. *Journal of Seismology* **15**(2), 261-294.

Akkar, S., Ö. Kale, E. Yenier & J.J. Bommer (2011). The high-frequency limit of usable response spectral ordinates from filtered analogue and digital strong-motion accelerograms. *Earthquake Engineering & Structural Dynamics* **40**(12), 1387-1401.

Edwards, B., A. Rietbrock, J.J. Bommer & B. Baptie (2008). The acquisition of source, path and site effects from micro-earthquake recordings using Q tomography: applications to the UK. *Bulletin of the Seismological Society of America* **98**(4), 1915-1935.

Bommer, J.J., J. Hancock & J.E. Alarcón (2006). Correlations between duration and number of cycles of earthquake ground motion. *Soil Dynamics & Earthquake Engineering,* **26**(1), 1-13.

Akkar, S. & J.J. Bommer (2006). Influence of long-period filter cut-off on elastic spectral displacements. *Earthquake Engineering & Structural Dynamics* **35**(9), 1145-1165.

Hancock, J. & J.J. Bommer (2005). The effective number of cycles of earthquake ground motion. *Earthquake Engineering & Structural Dynamics* **34**(6), 637-664.

Boore, D.M. & J.J. Bommer (2005). Processing strong-motion accelerograms: needs, options and consequences. *Soil Dynamics & Earthquake Engineering* **25**(2), 93-115.

Bommer, J.J. & A. Martinez-Pereira (1999). The effective duration of earthquake strong motion. *Journal of Earthquake Engineering* **3**, 2, 127-172.

Bommer, J.J., A. Udías , J.M. Cepeda, J.C. Hasbun, W.M. Salazar, A. Suárez, N.N. Ambraseys, E. Buforn, J. Cortina, R. Madariaga, P. Méndez, J. Mezcua & D. Papastamatiou (1997). A new digital accelerograph network for El Salvador. *Seismological Research Letters* **68**, 426-437.

Ambraseys, N.N. & J.J. Bommer (1991). Database of European strong-motion records. *European Earthquake Engineering* **V**, 2, 18-37.

Damage Potential of Earthquake Ground-Motions

Hancock, J. & J.J. Bommer (2007). Using spectral matched records to explore the influence of strong-motion duration on inelastic structural response. *Soil Dynamics & Earthquake Engineering* **27**(4), 291-299.

Bommer, J.J. & J.E. Alarcón (2006). The prediction and use of peak ground velocity. *Journal of Earthquake Engineering* **10**(1), 1-31.

Hancock, J. & J.J. Bommer (2006). A state-of-knowledge review of the influence of strong-motion duration on structural damage. *Earthquake Spectra* **22**(3), 827-845.

Bommer, J.J., G. Magenes, J. Hancock & P. Penazzo (2004). The influence of strong-motion duration on the seismic response of masonry structures. *Bulletin of Earthquake Engineering* **2**(1), 1-26.

Bommer, J.J., G. Georgallides & I.J. Tromans (2001). Is there a near-field for small-to-moderate magnitude earthquakes? *Journal of Earthquake Engineering* **5**(3), 395-423.

Elnashai, A.S., J.J. Bommer & A. Martínez-Pereiera (1998). Engineering implications of strong-motion records from recent earthquakes. *Proceedings, Eleventh European Conference on Earthquake Engineering,* Paris.

Earthquake Ground-Motion Prediction Equations

Douglas, J., S. Akkar, G. Ameri, P-Y. Bard, D. Bindi, J.J. Bommer, S. Singh Bora, F. Cotton, B. Derras, M. Hermkes, N.M. Kuehn, L. Luzi, M. Massa, F. Pacor, C. Riggelsen, M.A. Sandıkkaya, F. Scherbaum, P.J. Stafford & P. Traversa (2014). Comparisons among the five ground-motion models developed using RESORCE for the prediction of response spectral accelerations due to earthquakes in Europe and the Middle East. *Bulletin of Earthquake Engineering* **12**(1), 341-358.

Akkar, S., M.A. Sandıkkaya & J.J. Bommer (2014). Empirical ground-motion models for point- and extended-source crustal earthquake scenarios in Europe and the Middle East. *Bulletin of Earthquake Engineering* **12**(1), 359-387. *Erratum*: **12**(1), 389-390.

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