IRDR Annual Conference 2012 Poster Abstracts: Assessing and Communicating Risk

Electrical earthquake precursors from laboratory to field: simultaneous measurements of acoustic and pressure-stimulated current emissions during triaxial compression experiments on Carrara marble

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Earthquakes have long been associated with electromagnetic disturbances in the atmosphere (e.g. earthquake lights, ionospheric turbulence) and anomalies in the naturally-occurring electrical (telluric) currents that flow throughout the earth's crust. These phenomena have been detected in the field and often found to precede large earthquakes; however, their underlying causes and relationship to fracture are still largely unknown.

In the laboratory, conditions in the shallow crust can be simulated and rock deformation carefully controlled. Such experiments are essential to investigate and isolate the different processes that occur during deformation and fracture, providing information that can help explain field observations. Current-generation and flow mechanisms such as the piezoelectric effect and electrokinetic effect have been studied with such experiments.

Similar experiments have shown that, under dry conditions, currents still accompany the process of crack formation and growth even in non-piezoelectric rocks such as marble. The expression 'pressure-stimulated current' (PSC) describes the emission of small $(10^{-12} - 10^{-9} \, \text{A})$ transient, polarising electric currents from a solid undergoing a gradual change in pressure. Mechanisms for the generation of these currents are still unclear, although some have been proposed, such as the motion of charged edge dislocations during crack formation/propagation or the flow of defect electrons due to peroxy bonds breaking under stress.

Further understanding of the processes that generate these particular currents and how they relate to the cracking process is especially important in the study of seismic precursors. To this end, we have conducted constant strain rate, compression experiments in a triaxial deformation apparatus at room temperature with effective confining pressures of 30 MPa (c.f. 3 km depth) on dry marble samples. Acoustic emissions, pressure-stimulated currents and mechanical loading information were recorded simultaneously to examine specifically how PSC emissions relate to the cracking process.

Preliminary results show that PSC emissions occur during the non-linear region of mechanical behaviour related to permanent slip or dislocation at an atomic level and are associated with changes in acoustic emissions. In addition, we apply novel approaches in statistical physics to the data in order to understand the relationship between PSC emissions and the cracking process in a probabilistic sense.

Groundwater Arsenic Contamination in Bangladesh: Communicating Science with Policy-makers

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Nearly 100 million people living in Asian Mega-Deltas and low-lying floodplains of the Himalayan rivers are currently exposed to elevated (>10 µg L-1, the World Health Organisation Standard) arsenic (As) concentrations in drinking water supply1. In the Bengal Basin of Bangladesh alone the health of nearly 50 million people is threatened by chronic consumption of As concentrations exceeding the WHO standard. Arsenic contamination affects approximately 50% of hand tubewells pumping shallow (<100 m below ground level) groundwater across the floodplains in the Bengal Basin; deeper groundwater (150-350 m bgl) is generally free of As because it has been flushed in the past or is recharged primarily from the basin margins. To reduce the exposure to As contamination high-yielding deep wells have been installed recently >100 rural areas in Bangladesh. However, these deep tubewells are vulnerable to invasion by As from shallow levels under the vertical gradients imposed by pumping. To address this sustainability issue, numerical models of groundwater flow and As mobility in SE Bangladesh have been developed2. The aim of the current project is to consult with water managers, public-health and agricultural authorities, and NGOs in Bangladesh, and to test their proposed future pumping strategies at selected locations by applying the existing groundwater models. The project will seek answers to questions: (1) how long the deep tubewells can provide an As-free water supply for, and (2) what limit these pumping rates should be restricted to, and (3) how various modes of groundwater pumping should be optimised to safeguard against As invasion of deep groundwater. We will apply groundwater models to answer these questions and to propose policy guidance to the authorities in Bangladesh, so as to help safeguard the deep, As-free groundwater source for the millions of people in Bengal Basin and other similar Asian Mega-Deltas.

- 1. Ravenscroft, P., Brammer, H., & Richards, K.S., Arsenic pollution: a global synthesis, First ed. (Wiley-Blackwell, U. K., 2009).
- 2. Hoque, M.A., Models for managing the deep aquifer in Bangladesh, unpublished PhD thesis, University College London, 2010.

Statistical emulation of a landslide-generated tsunami model

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Due to the catastrophic consequences of tsunamis, early warnings need to be issued quickly in order to mitigate the hazard, and additionally represent the uncertainty in the predictions of tsunamis' characteristics corresponding to the uncertain trigger features (e.g. either position, shape and speed of a landslide, or sea floor deformation associated with an earthquake). Unfortunately, computer models are expensive to run. This leads to significant delays in predictions and makes the uncertainty quantification impractical. Statistical emulators run instantaneously and may represent well the outputs of the computer model. In this paper, we employ the Outer Product Emulator to build a fast statistical surrogate of a landslide-generated tsunami computer model. This Bayesian framework enables us to build the emulator by combining prior knowledge of the computer model properties with a few carefully chosen model evaluations. The good performance of the emulator is validated using the Leave-One-Out method.

Arctic Engineering: Opportunities and Risks

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Sea ice cover has been reduced by climate change to the extent that new seaways have opened and new hydrocarbon production has become economically viable in the Arctic. Because of this, billions of dollars will be invested in the Arctic over the next ten years. I will discuss how this investment is likely to be distributed, geographically and across industries, and how the associated risks might be different in the Arctic to those in other environments. I will also show results from experiments at UCL which give new understanding into basic mechanical properties of ice. I'll then suggest how the results of these experiments can be scaled up to provide better engineering estimates of the risks associated with economic development in the Arctic. An example of a numerical output might be the predicted ice loading on an offshore structure under extreme weather conditions. Finally I will consider how direct monitoring of offshore structures might help us test and refine models of sea ice behaviour, with the aim of reducing the associated risk.

Water risk and its management in Bolivia's Altiplano development strategy

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Global concern over the availability and quality of water is increasing as pressures on this essential resource grow with rising population, demand for food and energy, resource exploitation, waste disposal, urban and rural development, and local and global environmental (including climate) change. The Bolivian Altiplano represents a potential water-risk hotspot in this context, as the livelihoods and wellbeing of its communities, as well as the environments upon which these depend, are at risk from limited ground and surface water resources of highly variable quality. If these water resources are to be properly understood and responsibly managed, their responses to changes in natural processes and human activities must be adequately constrained. Consequently, our new collaborative and multi-disciplinary project employs the collective expertise and knowledge of the research team, in combination with local traditional knowledge, to meet its aims of: (1) understanding and separating the drivers controlling ground and surface water quality and quantity on the Bolivian Altiplano; and (2) quantifying the respective risks. Results will be used to inform water management strategies associated with different pathways to development. A fundamental objective of the project is to ensure that the research findings are effectively

communicated to, and utilised by, humanitarian and development practitioners and the communities with which they work, and government policy makers.

Non-Extensivity in the Corinth Rift, (Greece).

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The Gulf of Corinth region (Central Greece) has long been recognized as one of the most seismotectonically active areas in Europe (Ambraseys and Jackson, 1990), with an important continental N-S extension of about 13 mm/yr and 6 mm/yr in the western and eastern parts respectively (Clarke et al., 1997). The evolution of such tectonically active regions is expressed through seismicity and is characterized by complex phenomenology. Earthquakes can be considered as a critical phenomenon (Sornette, 2006) where Self-Organized Criticality, scale-invariance, multi-fractality and complex correlations in space, time and magnitude have been recognized (Main, 1996; Turcotte, 1997; Bak et al., 2002). Recently a consistent theoretical framework for the analysis of systems, where nonlinear dynamics, multi-fractality and long-range interactions are present, has been proposed by Tsallis (1988). The Non-Extensive Statistical Physics concept [NESP] refers to the non-additive entropy Sq, which is a generalization of Boltzmann-Gibbs entropy and has found many applications in nonlinear dynamical systems including earthquakes (Tsallis, 2009, Vallianatos et al., 2012). In the present work some examples for the application of the NESP concept to earthquake physics are given concerning the seismicity distribution in the Corinth rift. These examples support the idea that the NESP is an appropriate framework for the Statistical Physics interpretation of seismicity and that in the future it could have direct applications in probabilistic seismic hazard assessments.

References

Ambraseys, N.N. and J.A. Jackson (1990). Seismicity and associated strain of central Greece between 1890 and 1988. Geophys. J. Int., 101, 663–708.

Bak, P., Christensen, K., Danon, L. and T. Scanlon (2002). Unified scaling law for earthquakes. Phys. Rev. Lett., 88(17), 178, 501. Clarke, P.J., Davies, R.R., England, P.C., Parsons, B.E., Billiris, H., Paradissis, D., Veis, G., Denys, P.H., Cross, P.A., Ashkenazi, V. and R. Bingley (1997). Geodetic estimate of seismic hazard in the Gulf of Korinthos. Geophysical Research Letters, 24, 1303-1306. Main, I. (1996). Statistical physics, seismogenesis, and seismic hazard. Reviews of Geophysics, 34(4), 433-462. Sornette, D. (2004). Critical Phenomena in Natural Sciences: Chaos, Fractals, Selforganization and Disorder: Concepts and Tools. 2nd ed., 529 pp., Springer, Berlin.

Tsallis, C. (1988). Possible generalization of Boltzmann–Gibbs statistics. J. Stat. Phys., 52, 1-2, 479-487.

Tsallis, C. (2009). Introduction to Nonextensive Statistical Mechanics: Approaching a Complex World. Springer, New York. Turcotte, D. L. (1997). Fractals and Chaos in Geology and Geophysics. 2nd ed., 398 pp., Cambridge University Press, Cambridge, UK. Vallianatos F., Michas G., Papadakis G. and P. Sammonds (2012). A non-extensive statistical physics view to the spatiotemporal properties of the June 1995, Aigion earthquake (M6.2) aftershock sequence (West Corinth rift, Greece). Acta Geophysica, 60, 3, 758-768.

Analysis of the Hellenic subduction zone seismicity using the concept of Non-Extensive Statistical Physics (NESP)

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The Hellenic subduction zone is the most seismically active region in Europe [Becker & Meier, 2010]. This high seismic activity is caused by the subduction of the oceanic African lithosphere beneath the continental Anatolian-Aegean plate (Becker et al, 2010). The evolution of such tectonically active regions is expressed through seismicity and is characterized by complex phenomenology (Vallianatos et al, 2012).

The spatial and temporal distribution of seismicity as well as the analysis of the magnitude distribution of earthquakes concerning the Hellenic subduction zone has been studied using the concept of Non-Extensive Statistical Physics (NESP) [Tsallis, 1988; Tsallis, 2009]. Non-Extensive Statistical Physics, which is a generalization of Boltzmann-Gibbs statistical physics, seems a suitable framework for studying complex systems (Vallianatos, 2011). Using the external seismic zones of 36 seismic sources of shallow earthquakes in the Aegean and the surrounding area [Papazachos, 1990], we formed a dataset concerning the seismicity of shallow earthquakes (focal depth ≤ 60km) of the subduction zone, which is based on the instrumental data of the Geodynamic Institute of the National Observatory of Athens (http://www.gein.noa.gr/, period 1990-2011). The cumulative distribution functions of the inter-event times and the inter-event distances as well as the magnitude distribution for each seismic zone are been estimated, presenting a variation in the q-triplet along the Hellenic subduction zone. The models used, fit rather well to the observed distributions, implying the complexity of the spatiotemporal properties of seismicity and the usefulness of NESP in investigating such phenomena, exhibiting scale-free nature and long range memory effects. Moreover, our aim is to find any possible connection between

the calculated q thermodynamic parameters and the temporal and spatial properties of the Hellenic subduction zone seismicity.

References

Becker, D., Meier, T., 2010. Seismic slip deficit in the Southwestern forearc of the Hellenic subduction zone. Bull. Seismol. Soc. Am., 100. 325 –342.

Becker, D., Meier, T., Bohnhoff, M., Harjes, H.P., 2010. Seismicity at the convergent plate boundary offshore Crete, Greece, observed by an amphibian network. J. Seismol, 14, 369-392.

Papazachos, B. C., 1990. Seismicity of the Aegean and surrounding area. Tectonophysics, 178, 287-308.

Tsallis, C., 1988. Possible generalization of Boltzmann-Gibbs statistics. Journal of Statistical Physics, 52, 479.

Tsallis, C., 2009. Introduction to Nonextensive Statistical Mechanics: Approaching A Complex World. Springer, Berlin, 1-378. Vallianatos, F. (2011). A non-extensive statistical physics approach to the polarity reversals of the geomagnetic field. Physica A, 390, 1773-1778.

Vallianatos, F., Michas, G., Papadakis, G., Sammonds, P., 2012. A non-extensive statistical physics view to the spatiotemporal properties of the June 1995, Aigion earthquake (M6.2) aftershock sequence (West Corinth rift, Greece). Acta Geophysica, 60, 758-768.

Earthquake Recurrence intervals from offset Late Pleistocene-Holocene landforms and sediments

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Italy has a well-documented historical record of the damage caused by earthquakes that have occurred within the last thousand years. However, palaeoseismic trench investigations and in situ cosmogenic dating of fault scarps show that recurrence intervals on individual faults are clustered in time and are variable for individual sites along faults. Due to the variability in the seismic cycle and the long recurrence intervals on many of the faults in the Italian Apennines, the time period covered by the historical record is insufficient to provide a representative sample of palaeoearthquakes in the area. In order to determine the long-term average surface deformation rates, a time period is needed that covers several seismic cycles.

Field measurements of slip-vectors and throw-rates from striated fault planes and offset Late Pleistocene-Holocene landforms and sediments (15kyr), have been used to calculate long-term average surface strain-rates; these provide deformation rates over a time period that is long enough to cover several seismic cycles. These long-term strain-rates have been compared to published short-term strain-rates calculated using geodesy, strain-rates inferred from historical seismicity, topography, free air gravity, and SKS splitting delay times in order to comment on the variability in the seismic cycle, fault interaction, and the role that different forces play over various length-scales and timescales.^{1, 2}

Concurrent to this progress in our improving understanding of the mechanics of continental extension, immediate information is needed regarding the present seismic hazard in the region. Therefore, although the time intervals between earthquakes on individual faults is variable, the average recurrence intervals inferred from the long-term rates of deformation can be used to identify the probabilistic relative seismic hazards of different locations and thus where risk and disaster reduction policies should be prioritized.

Average recurrence intervals have been calculated in the central Apennines from long-term strain-rates using a simple model that assigned an average amount of slip per event, which is the same on each fault.1 Future work aims to expand this study to produce an earthquake recurrence interval map of the central and southern Apennines determined from long-term strain-rates with the amount of slip per event on each fault determined from the fault-specific average slip per event measured in trench sites and relationships between fault length and surface displacements. It is hoped this will provide an earthquake recurrence interval map for the central and southern Italian Apennines that can be used by the community of policy makers and industry to improve awareness of the earthquake hazard and to increase preparedness.

References

1. Faure Walker, J. P., Roberts, G. P., Sammonds, P., Cowie, P. A. (2010). Comparison of earthquake strains over 100 and 10,000 year timescales: insights into variability in the seismic cycle in the central Apennines, Italy. Journal of Geophysical Research 115 (B10418) 2. Faure Walker, J. P., Roberts, G. P., Cowie, P. A., Papanikolaou, I., Michetti, A. M., Sammonds, P., Wilkinson, M., McCaffrey, K. J. W., Phillips, R. J. (2012). Relationship between topography, rates of extension and mantle dynamics in the actively-extending Italian Apennines. Earth and Planetary Science Letters 325-326, 76-84

Assessing and communicating flood hazard in the context of integrated urban flood risk management

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Urban flooding is a serious and growing development challenge, particularly for the residents of the rapidly expanding towns and cities in developing countries. The occurrence of floods is the most frequent among all natural disasters globally. The numbers of people affected by floods and financial, economic and insured damages have increased too. Against the backdrop of demographic growth, urbanization trends and climate changes, the causes of floods are shifting and their impacts are accelerating. The current and projected levels of flood impacts make it urgent to prioritise flood risk management in urban settlements on political and policy agendas. Understanding the causes and effects of flood impacts and designing, investing in and implementing measures which minimise them must become part of mainstream development thinking and be embedded into wider development goals. An integrated flood risk management approach is a combination of flood risk management measures which, taken as a whole, can successfully reduce urban flood risk. Flood management measures are typically described as either structural (engineered) or non-structural. Structural and non-structural measures do not preclude each other, and most successful strategies will combine both types. The challenge with many nonstructural measures lies in the need to engage the involvement and agreement of stakeholders and their institutions. The increasingly prominent role of non-structural measures such as early warning systems requires a much greater involvement of the public, including clear communication of flood risks and a dialogue about mitigation options as key elements of any integrated flood risk management plan. Continuous communication to raise awareness and reinforce preparedness is thus necessary. Ongoing communication counters the tendency of people to forget about flood risk. This challenge is also made greater by the fact that most non-structural measures are designed to minimise but not prevent damage, and therefore most people would instinctively choose a structural measure. The use of maps for communicating hazard and associated risk is a valuable aid to decisionmaking, and are important for planning development activities, for emergency planning, and for policy development. Generating the necessary attitudinal and behavioral change requires commitment and investment in wide communication and consultation over time. The benefit to flood management from stakeholder involvement and engagement are the gains made by, and for communities in building resilience to floods.

The above abstract is based on the World Bank's flagship guidebook entitled Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century. The guidebook was published in February 2012 by the World Bank, with launches in Tokyo and Washington D.C. The guidebook was produced with the financial support of the Global Facility for Disaster Reduction and Recovery. Partners include the World Meteorological Organization (WMO) and Japan International Cooperation Agency (JICA).

ICF GHK (http://www.ghkint.com) has led a consortium of specialists on the preparation of the guidebook. The guidebook is supported by a website: http://www.gfdrr.org/gfdrr/urbanfloods. The website aims to form a platform for practitioners for dialog around the guidebook's themes and content as well as a vehicle for dissemination of the guidebook. The website contains additional resources related to the content of the guidebook.

The Individual in the Population: Understanding personal risk through statistical simulation

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Much academic discussion of the public understanding of risk dwells on the inevitability of confusion: that the human brain is hard-wired with heuristic processes evolved over millennia of evolution of a nomadic huntergatherer species, leaving us fundamentally ill-fitted to deal with the demands of modern society.

Our interest, as educators, is not in dissecting faulty thinking but in considering how thinking and communicating about risk can be improved for everyone through the teaching of mathematical ideas and ways of thinking, and the use of mathematical tools.

Mathematical analysis is powerful but, until recently, inaccessible to the majority because of the complexity of the machinery involved. Ubiquitous computers change the possibilities for access; particularly using simulation, having a model of a real life situation which can be run many times to assess the range of possible outcomes, the "possible futures". But problems involving risk generally do not have any mathematical answer, or any universal answer: the answer must be found in the combination of mathematical and contextual information, and the socio-cultural circumstances of the people involved.

We consider a form of risk problem that is most commonly encountered in healthcare. Medical treatments can cure conditions that are a risk to life and health, yet the treatment itself poses risks to the life and health of the patient. What is the balance of risk? The patient must choose and give informed consent to treatment; doctors advise, but patients may only choose if all the information is meaningful to them.

A key conceptual problem for interpreting and communicating risk in the medical context is that the individual patient needs to assess probabilities of outcomes of the medical intervention – how do we understand a "1 in 100 operation" possibility of spinal paralysis in surgery for an operation that will only be experienced once, by the patient? To put it more generally, how does the individual interpret risk that is framed as a property of a population? To explore such situations, we developed a prototype software called Deborah's Dilemma: users must advise a fictitious person on whether to have an operation that could cure a serious spinal condition. The operation entails the possibility of hazards that need to be assessed from (sometimes ambiguous) information provided in a descriptive scenario. Choosing not to have the operation entails making choices about ways of living in order to manage the ongoing pain resulting from the spinal condition – thus there is a balance of risk that must be assessed. Simulation tools are offered for users to analyse the information presented, and to use their results to present a reasoned argument to Deborah. (The software is free to access at: www.RISKatlOE.org/dilemma) In our poster we will present some of our results of testing the Dilemma, and the implications of this that we see for developing tools for the public understanding of individual and collective risk.

RCDRR Data for Resilience Initiative (DRI)

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The second priority for Hyogo Framework for Action (HFA#2) of the UNISDR has identified understanding and knowledge of disaster risks as the starting point for reducing risk and building resilient societies. Knowledge of disaster risks requires the collection, use and analysis of data on risk parameters (hazards, exposure, and vulnerability).

Therefore, Risk communication is an excellent tool for sharing risk parameters to different stakeholders, exchanging data and information, forcing transparency, and providing parameters for developing strategy for risk management. Without risk communication and creating the appropriate awareness of risk, risk analysis findings may never be integrated within the agenda of each function of those impacted by the risk, such as local or national governments.

In this sense and in alignment with the second priority of (HFA#2), with the objective of managing the escalating risk trends across the Islamic region one of the programmes of the Regional Centre for Disaster Risk Reduction (RCDRR) is to support national governments and regional partners to develop the required capacities through enabling access to climate change, risk analysis, knowledge and disaster risk reduction practices relevant to the region.

In partnership with Global Facility for Disaster Reduction and Recovery of the World Bank (GFDRR), RCDRR has launched RCDRR Data for Resilience Initiative (RCDRR-DRI) to build capacity and promote effective risk communication and use of risk data in the region. The initiative aims to support decision makers to make better-informed disaster risk management decisions by obtaining better data through promoting the collaborative use of geospatial data and establishing partnership with countries in the region for Data for Resilience initiative at national and regional level.

The Initiative is part of the World Bank's Open Data for Resilience Initiative (Open DRI) Which implements the policy recommendation of the joint World Bank / UN flagship report, "Natural Hazards, UnNatural Disasters, the Economics of Effective Prevention," which establishes the importance of data sharing to reduce vulnerability to disasters. OpenDRI is currently being implemented in 25 countries around the world to improve disaster and climate change resilience.

RCDRR-DRI seeks to work closely with the governments, national and regional institutions to facilitate dialogue, exchange of knowledge, and capacity building on risk data governance, best practices of data sharing, and use of various mapping tools and data sharing platforms.

RCDRR initiative is built using GeoNode tool, an open platform for the access, management, and publication of geospatial data. The tool is built upon mature and free open source software and is designed to allow non-technical users to easily share their data and create interactive maps.

GeoNode's data management systems allows for integrated curation of data, metadata, and map visualizations and provides accost-effective and scalable tool for developing information management systems.

Effects of forecast formats and forecast exposure levels on forecast interpretation.

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Most of the research into uncertainty focuses on uncertainty magnitude, describing for examples how individual differences or contextual factors shape subjective probability perception. By contrast, this paper focuses on how people interpret probabilities and why they often misinterpret them. Indeed, probabilities are hard to interpret correctly and, in fact, most people do not interpret probabilities of precipitation correctly. This study aims to understand which aspects of probabilities trigger wrongful interpretations, and, to test new formats hypothesised to promote a correct interpretation. The absence of an explicit reference class and the polysemy of percentage are hypothesised to cause false interpretations. The hypotheses are tested by comparing interpretations using a traditional probability of precipitation format to a forecast specifying the reference class or using a non-polysemous probability quantifier. A secondary goal has been to test the effect of exposure to probability of precipitation in the United States (N = 339) and the United Kingdom (N = 614). Results show that exposure and the level of education increase the understanding of probability of precipitation, but not the explicit mention of the reference class or a non-polysemous probability. Implications of the findings at the basic and applied levels are discussed.

Low perception of control and hypersensitivity to outcome severity

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Communicating the risk of climate change to the public is a challenging task that is likely to result in biased risk perceptions. One of the bias, the severity bias, features a positive relationship between the perceived severity of an outcome and its perceived probability of occurrence. For example, a likely severe outcome is perceived to be more probable than a likely neutral outcome. Recently, it has been suggested that severity inflates probability only when the outcome at hand is controllable. Thus one could expect that people who are low in control are less sensitive to severity and that they should not perceive a severe outcome as more probable than a less severe one. In contrast, we propose that to compensate a lack of control, people are more sensitive to severity. As a result people with low sense of control should have an inflated probability perception of both severe and less severe outcomes. This probability perception should be equal to the probability perception of individuals with high control in severe forecast situations. This hypothesis of hypersensitivity to severity was tested in climate change scenarios employing verbal probabilities to communicate risk. Study 1 (N = 289) showed that participants with a low personal control perceived the probability of occurrence of a severe and a less severe outcome as equally likely as individuals with a high personal control in the severe condition. The second study (N = 305), featured an experimental manipulation of controllability perception and led to the same pattern of results in two scenarios and given two probability magnitudes. These findings concur the interdependence of probability and utility of the outcome and give credit to the arousal mismatch hypothesis as the underpinning mechanism of the severity effect. The theoretical advancement and practical implications of the findings are discussed.

Interpreting the 11th March 2011 Tohoku, Japan Earthquake Ground-Motions Using Stochastic Finite-Fault Simulations

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We performed stochastic finite-fault simulations for the M9 Tohoku earthquake, accounting for the effects of site response at each station. In the simulations we also accommodated the expected fore-arc/back-arc attenuation and Q. Time series at each station that recorded the event were generated by EXSIM (Atkinson et al., 2009), and used to calculate the average predicted response spectra at different distance ranges, for comparison with observed ground motions. The simulated spectra are normalized based on an acceleration normalization scheme (Boore, 2009), considering a single-event stress drop of 200 bars. We used a modified version of the GSI model for the fault geometry parameters. The high-frequency decay of ground motions is modeled using a kappa value of 0.036 s. Geometrical spreading is modeled with a slope of -1 for all distance ranges, and the duration of time series is modeled using: T = source duration + 0.1208Rhypo. We examined the implications of different slip distributions, including a single event with randomly-generated or prescribed slip (Yagi, 2011), and a multiple-event model (Kurahashi and Irikura, 2011). The double shock feature of the Tohoku earthquake can be modeled in EXSIM by joining simulations with different nucleation points. The predicted ground motions are in good agreement with the observations. The calibrated simulation model for Tohoku can be modified for use in predicting ground motions in other regions (e.g. Cascadia region of North America).