UK Japan Disaster Risk Reduction Workshop
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Poster Session
Titles and Abstracts

[D1] Using the 2011 Tohoku-oki tsunami deposits to re-examine the AD869 Jōgan tsunami

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Tsunami deposits on coastal lowlands are useful for estimating recurrence intervals and magnitudes of ancient tsunami events. It enables us to expand our knowledge on the history of past tsunamis older than thousands of years ago. Maximum inland extent of tsunami deposits is assumed to represent a minimum of inundation distance.

On the coast of Sendai Bay, a recurrence interval for gigantic tsunami has been estimated at 500-800 years on the basis of the dating of the tsunami deposits (Sawai et al. 2012). Before the 2011 Tohoku-oki tsunami, the magnitude of the AD869 Jōgan earthquake was estimated at Mw 8.4 using numerical modeling taking into account the distribution of the tsunami deposit (Namegaya et al. 2010).

After the 2011 Tohoku-oki tsunami, we surveyed the tsunami deposit at over 700 sites along 14 transects in Sendai and Joban coasts. The maximum inland extent of the sand layer reached 3 km (57–76% of the inundation distance) from the shoreline, when the inundation distance exceeded 2.5 km. Distribution pattern of the thickness of the Tohoku-oki and the Jōgan tsunami deposit is quite similar. Considering the differences between the maximum extent of tsunami sand and the inundation limit in Sendai Plain, the inundation distance of the Jōgan tsunami might have been underestimated.

Investigation of the 2011 Tohoku-oki tsunami deposits is essential to understand the giant tsunamis including the AD869 Jōgan and the AD1611 Keicho tsunamis, and valuable for the assessment of future tsunami risks in the Tohoku region.

References
Namegaya et al. 2010, Numerical simulation of the AD869 Jōgan tsunami in Ishinomaki and Sendai plains and Ukedo river-mouth lowland. Annual Report of Active Fault and Paleoearthquake Researches 10, 1–21.
Sawai et al. 2012, Challenges of anticipating the 2011 Tohoku earthquake and tsunami using coastal geology. Geophys. Res. Lett. 39, L21309, doi:10.1029/2012GL053692.

[D2] Understanding the Issues Involved in Landslide Risk Management and Climate Change Adaptation- A Case Study of Chittagong, Bangladesh.

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Urbanization is one of the most significant human induced global changes worldwide. Like many other cities in the world Chittagong, the port and second largest city of Bangladesh, is also the outcome of spontaneous rapid growth without any prior or systematic planning. This rapid urbanization, coupled with the increased intensity and frequency of adverse weather events (e.g. landslides), is causing devastating effects on the city, which also has lower capacities to deal with the consequences of climate change. Chittagong has been hit repeatedly by devastating landslides in recent years. At least 90 people were killed in a recent landslide in Chittagong on June 26, 2012. The reasons were heavy rainfall and multiple landslides over three consecutive days. The officials reported that at least another 15,000 people were stranded. Because of climate change, Bangladesh is experiencing high intensity of rainfall in recent years which is making the landslide situation worse. Moreover improper landuse, alterations in the hilly regions by illegally cutting the hills, indiscriminate deforestation and agricultural practices are aggravating the landslide vulnerability in Chittagong.

It is therefore essential that the trend of land cover changes (e.g. urbanization) in the hilly areas of Chittagong are assessed so that appropriate landslide mitigation strategies can be developed to help combat the impacts of climate change. It is also important to analyse how the local people and actors react to the landslides. The local people's perception, local level practices to disaster management and their real-world experiences also need to be incorporated (bottom-up integrated approach) in response to landslide hazard management planning of Chittagong City. Therefore, the aim of this research is to understand the issues involved in urban disaster risk management and climate change adaptation, based on the case study of recent landslide events in Chittagong City, Bangladesh.

[D3] Modern techniques in earthquake risk: Tsallis statistics of fracture-induced electric signals during triaxial deformation of Carrara marble

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We have conducted room-temperature, triaxial compression experiments on samples of Carrara marble, recording concurrently acoustic and electric current signals emitted during the deformation process as well as mechanical loading information and ultrasonic wave velocities. Our results reveal that in a dry non-piezoelectric rock under simulated crustal pressure conditions, a measurable electric current (nA) is generated within the stressed sample. The current is detected only in the region beyond (quasi-)linear elastic deformation; i.e. in the region of permanent deformation beyond the yield point of the material and in the presence of microcracking.

Our results extend to shallow crustal conditions previous observations of electric current signals in quartz-free rocks undergoing uniaxial deformation and support the

idea of a universal electrification mechanism related to deformation. Confining pressure conditions of our slow strain rate (10^{-6} s^{-1}) experiments range from the purely brittle regime (10 MPa) to the semi-brittle transition (30-100 MPa) where cataclastic flow is the dominant deformation mechanism. Electric current is generated under all confining pressures, implying the existence of a current-producing mechanism during both microfracture and frictional sliding. Some differences are seen in the current evolution between these two regimes, possibly related to crack localisation. In all cases, the measured electric current exhibits episodes of strong fluctuations over short timescales; calm periods punctuated by bursts of strong activity.

For the analysis, we adopt an entropy-based statistical physics approach (Tsallis, 1988), particularly suited to the study of fracture related phenomena. We find that the probability distribution of normalised electric current fluctuations over short time intervals (0.5 s) can be well described by a q-Gaussian distribution of a form similar to that which describes turbulent flows. This approach yields different entropic indices (q-values) for electric current fluctuations in the brittle and semi-brittle regimes (c. 1.5 and 1.8 respectively), implying an increase in interactions between microcracks in the semi-brittle regime. We interpret this non-Gaussian behaviour as a 'superstatistical' superposition of local Gaussian fluctuations that combine to produce a higher-order overall distribution; i.e. the measured electric current is driven to varying, temporary, local equilibria during deformation.

This behaviour is analogous to the self-organising avalanche-like behaviour of fracture events, suggesting that the observed behaviour of measured electric current is a direct response to the microcracking events themselves and supporting the idea of a fracture-generated electrification mechanism in the crust. Our results have implications for the earthquake preparation process and the application of Tsallis statistical physics to the analysis of electric earthquake precursors.

Tsallis, C., 1988. Possible generalization of Boltzmann-Gibbs statistics. Journal of Statistical Physics, 52(1-2), 479–487.

[D4] High temperature pressurization, fracturing and permeability in volcanic systems

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The formation and collapse of lava domes has been responsible for many of the most devastating volcanic eruptions in history. Although much progress has been made within this field, there remains a lot we still do not understand and these events remain largely unpredictable.

Lava dome collapse is largely controlled by how magma within the dome and conduit fractures and releases the pressurized gases from within the system. How gases escape from the system has a huge influence on what kind of eruptive activity occurs at a volcano. High pressure fracture leads to the opening of new pathways, which allows pressure to be released. In addition to fracturing, how gas escapes from the system depends on the permeability/porosity of the body it has to travel through, i.e.

the conduit or lava dome. Conversely, rapid crystallization can be the agent for large excess pressures to be maintained within the system by sealing fractures. Competition between these processes results in complex behavior that, in turn, controls lava dome eruptions. The understanding of these controls however is poor; my project therefore aims to investigate these gaps in our understanding. I am taking an integrated laboratory experiment and fieldwork campaign approach to ascertain the mechanics and physics of the relationship between permeability and high temperature fracture growth during deformation and crystallization.

Previous laboratory studies have investigated the effect heating samples from the conduit of Mouth St Helens to magmatic temperatures has on the permeability of volcanic rocks. My project will continue this research by further constraining the influence on permeability of varying temperature during experiments, whilst adding deformation to the sample to more accurately simulate real conduit conditions. I will continue investigating the permeability of samples from Mount St Helens but also extend the scope of the project by collecting new samples from Chaitén Volcano, Chile. These experiments will be the first experimental investigations to combine permeability, high temperature and deformation and will provide real insights into previously only theorized volcanic processes.

[D5] Destructive interactions between mitigation strategies and the causes of unexpected failures in natural hazard mitigation systems.

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Large investments in the mitigation of natural hazards, using a variety of technology-based mitigation strategies, have proved surprisingly ineffective in a number of recent natural disasters. These failures reveal a need for a systematic classification of mitigation strategies; an understanding of the scientific uncertainties that affect the effectiveness of such strategies; and an understanding of how the different types of strategy within an overall mitigation system interact destructively to reduce the effectiveness of the overall mitigation system.

We classify mitigation strategies into permanent, responsive and anticipatory. Permanent mitigation strategies such as flood and tsunami defenses or land use restrictions, are both costly and "brittle" in that when they fail they can actually increase mortality. Such strategies critically depend on the accuracy of the estimates of expected hazard intensity in the hazard assessments that underpin their design. Responsive mitigation strategies such as tsunami and lahar warning systems rely on capacities to detect and quantify the hazard source events and to transmit warnings fast enough to enable at risk populations to decide and act effectively. Self-warning and voluntary evacuation is also usually a responsive mitigation strategy. Uncertainty in the nature and magnitude of the detected hazard source event is often the key scientific obstacle to responsive mitigation; public understanding of both the hazard and the warnings, to enable decision making, can also be a critical obstacle. Anticipatory mitigation strategies use interpretation of precursors to hazard source events and are used widely in mitigation of volcanic hazards. Their critical limitations are due to uncertainties in time, space and magnitude relationships between precursors and hazard events.

A more complete understanding of the interactions between these different types of mitigation strategy, especially the consequences for the expectations and behaviors of the populations at risk, requires models of decision-making under high levels of both uncertainty and danger.

[D6] Rheological controls on seismic hazard in Italy

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It has been long recognized that faults are the Earth's superficial structures that generate earthquakes; however, what happens at their lower crust roots where the earthquakes nucleate and the mechanical link between surface faults and the deeper Earth dynamics, which provides the energy, has remained quite enigmatic. It is thought that the contrast between brittle faulting at the surface and viscous flow at lower crust depths of about 15km plays a key role in earthquake nucleation. Before this study, no direct measurements on the rheology of rocks over geological time at the pressures and temperatures where earthquakes nucleate existed and the question remained as to whether viscous flow deformation in the lower crust occurs by distributed flow or in shear zones. In this study we quantify the relationship between strain-rates calculated using field data from active surface faults in the Italian Apennines (where there has been many damaging historical earthquakes including the magnitude 6.3 2009 L'Aquila earthquake, which caused over 300 fatalities) and elevation. This study shows, for the first time, that the fault zones are deforming as predicted by laboratory experiments; the strain-rates scale with the elevation (a proxy for the stress) to the power of three indicating that it is probable that most of the flow will occur in narrow shear zones, which form at the lower tip of the earthquake-prone fault and extend downwards into the deep crust. The results further suggest that the rate of surface strain accumulation along active faults and earthquake recurrence intervals are controlled by viscous flow in shear zones over multiple earthquake cycles. These findings also have important implications for the geography of seismic hazard. This work is published in Cowie et al. (2013), Viscous roots of active seismogenic faults revealed by geologic slip rate variations, Nature Geoscience, doi 10.1038/ngeo1991.

[D7] Water risk and its management in the Lake Poopó Basin, Bolivian Altiplano

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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. Over the past year a review of the water situation and two field studies have identified the Lake Poopó Basin on the central eastern margin of the Altiplano as the primary area of study. The lake and the rivers that feed it, along with the communities that depend on these waters, are highly impacted by mining activities. The research will now (1) quantify surface and groundwater quality and quantity in the Poopó River and the Antequera/Pazña River sub-basins, (2) quantify the respective hazard to the environment and local indigenous communities,(3) quantify/estimate the degrees of vulnerability to the communities and in turn evaluate risk of water contamination and scarcity, and (4) combine these findings with a parallel social vulnerability assessment that engages directly with the communities. Results will be used to inform water management strategiesat the community level and larger scale decision-making processes for future water resource planning and development.

[D8] Seismic risk management of insurance portfolio using catastrophe bonds
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Parametric earthquake catastrophe bonds are emerging risk management tools for governments and insurers, which transfer earthquake risk to the capital market having much greater risk-bearing capacity than insurers and reinsurers. This study presents a summary of a new station-intensity-based (SI-based) CAT bond trigger method that utilises direct observation of ground motions at recording stations and allows a flexible multiple-discrete payment structure. It outperforms a conventional scenario-based cat-in-box trigger method for binary payments (i.e. no or full payment) in terms of both total trigger error and balance between positive and negative errors. The balance between positive and negative errors is important, because it directly affects the payment distribution between investors and sponsor. A calibration procedure of the bond trigger mechanism for the new approach is demonstrated by focusing upon a realistic portfolio of conventional wood-frame houses in Vancouver, Canada. Numerical results indicate that the new method with a multiple-discrete payment structure decreases the magnitude of trigger errors significantly in terms of seismic loss, and facilitates the flexible adoption of various payment structures for catastrophe bonds. Furthermore, a synergy between the calibration of parametric catastrophe bonds and the current performance-based earthquake engineering framework is highlighted.

[D9] Oil spill risk in the Arctic

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The Arctic is estimated to hold around 100bn barrels of recoverable oil: enough to cover global demand for about four years. However, many oil companies, under pressure from NGOs, have forsworn Arctic drilling, in part due to the risk of catastrophic spills. What is the likelihood of an Arctic oil spill? Simple estimates can be made from the global record of historical oil spills. In this poster I assess likely Arctic oil spill volumes and discuss the limitations of such an approach.

[D10] The Development of a method for generating analytical tsunami fragility functions

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The onshore flow of a tsunami can generate significant loading on buildings and infrastructure leading to various levels of damage or failure. Fragility functions provide a probabilistic link between a tsunami Intensity Measure (IM) and the structural response, represented by an Engineering Demand Parameter (EDP). They allow for quantification of risk and so are vital to both building loss estimation and Performance Based Tsunami Engineering (PBTE). Fragility functions for buildings are generally derived using regression methods on data for onshore structural response under tsunami loading, based on either empirical or analytical studies. One limitation which has previously prevented the development of analytical tsunami fragility functions is the lack of sufficiently accurate quantification of tsunami loads on buildings. With the development of the ASCE-7 draft chapter on Tsunami Loads and Effects (Chock, Carden, Robertson, Olsen, & Yu, 2013) and further work carried out by Rossetto & Lloyd (Lloyd & Rossetto, 2012) on laboratory-generated long-wave experiments to derive tsunami time- histories, it has been possible to define time-dependent tsunami forces on buildings for structural analysis.

This poster presents the development of a method for generating analytical tsunami fragility functions. Tsunami forces are presented based on literature and experimentation, and the structural analysis methodology is discussed. The selection of suitable tsunami Intensity Measures (IMs) and an Engineering Demand Parameter (EDP) is briefly discussed, as well as definition of suitable damage states in relation to this EDP.

Chock, G., Carden, L., Robertson, I., Olsen, M., & Yu, G. (2013). Tohoku Tsunami-Induced Building Failure Analysis with Implications for U.S. Tsunami and Seismic Design Codes. Earthquake Spectra, 29(S1), S99–S126. doi:10.1193/1.4000113

Lloyd, T. O., & Rossetto, T. (2012). A comparison between existing tsunami load guidance and large-scale experiments with long-waves . 15 World Conference on Earthquake Engineering.

[D11] Temporal Correlations in Earthquake Activity: Insights from the West Corinth rift

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The temporal properties of the earthquake activity have been the subject of intensive study during the past decade. Research on the subject focused on whether inter-event times, i.e. the time intervals between the successive earthquakes for various cut-off magnitudes and scales, follow particular distributions, the form and the physical mechanism of which is of great importance in earthquake modeling and hazard assessment. Most authors used a gamma distribution to fit inter-event times, rescaled according to the mean earthquake rate (e.g. Corral, 2004), indicating a bimodal character between correlated and uncorrelated earthquake events (Touati et al., 2009). Here, we study the form and the physical properties of the inter-event time distribution in one of the most seismotectonically active areas in Europe, the West Corinth rift (central Greece). The earthquake activity in this area is concentrated in its great majority in a narrow 52.23km×44.4km zone. By using a catalog that comprises of more than 60000 earthquakes and spanning over the period 2001-2008, we study the rescaled inter-event time distribution. Its form exhibits two power law regions, in contrast to previous studies, where an exponential tail was appearing for greater inter-event times. In order to interpret this result we use a stochastic dynamic mechanism with memory effects. During stationary periods where the mean inter-event time does not fluctuate, the solution of this mechanism is the gamma distribution, while for non-stationary periods the solution is a q-generalized gamma distribution that exhibits a power-law tail. The perfect agreement between the observed distribution and the q-generalized gamma distribution indicates nonstationarity, multifractality and correlations at all-time scales (Michas et al., 2013). Persistent long-range correlations in inter-event times are also supported by the application of detrended fluctuation analysis, a well-established technique for the estimation of correlations in non-stationary time series. The results of this study reveal a novel character in the time-series of earthquakes, dominated by long-range correlations at all-time scales. This property should be considered in probabilistic hazard assessments, especially in localized seismicity where highly nonrandom activity may be expected.

[D12] Measuring fragility of ships based on numerical model of the 2011 East Japan tsunami

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We carried out analyses of the damages caused by the tsunami to the ships in the ports to   describe their fragility subjected to tsunami flow depth and velocity. We used the reported damage data of about 20,000 marine vessels in seven prefectures namely Hokkaido, Aomori, Iwate, Miyagi, Fukushima, Ibaraki and Chiba calculate damage ratios and fit the fragility curves using logistic and/or ordinal regression model. We developed the curves by taking into account the damage types and loss estimation as the vulnerability parameters. Additionally, the influence of the ship's material and engine type will discuss herein.

[D13] A non extensive statistical physics analysis of seismicity in Japan

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In the present study, we analyse the magnitude distribution of successive earthquakes in Japan using the concept of Non Extensive Statistical Physics (NESP). NESP (Tsallis, 1988; Tsallis, 2009) which is a generalization of Boltzmann-Gibbs statistical physics, seems a suitable framework for studying complex systems exhibiting phenomena such as fractality, long-range interactions, and memory effects (Papadakis et al., 2013; Vallianatos and Telesca, 2012; Vallianatos et al., 2012).
The dataset used in this study is based on the earthquake catalogue provided by the Japan University Network Earthquake Catalogue (http://kea.eri.u-tokyo.ac.jp/CATALOG/junec/monthly.html - last accessed October 2013) and covers the period 1993-1998.
The analysis of the magnitude distribution is performed for the whole period 1993-1998. It should be noticed that in the framework of the fragment-asperity model, the q magnitude thermostatistical parameter (q_M), which is related with the frequency-magnitude distribution, could be used as an index to inform us about the physical state of an active seismic area.
Moreover, the temporal analysis of the magnitude distribution is performed using time windows for the period 1993-1998. It seems that the q_M parameter is a very important index for the description of the seismicity in Japan.

[D14] Risk to Arctic Offshore Operation; Structure, formation and strength of freeze bonds in sea ice

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Arctic sea ice cover has had a high profile in the media over the last few years. There has been a growing interest in the region from across the scientific community, in particular from oceanographers and marine engineers. The Arctic ice cover is decreasing, allowing increasing access to the natural resource base in the Arctic and has the potential to open new shipping routes. There is widespread concern that increased activity in the region could pose a threat to our fragile arctic environment as well as a wider threat to our global ecosystem.
Although until now, we have avoided disasters in the Artic region, the risk has, and will increase further with expansion of industrial activities. It is the job of researchers and industry alike to look at the associated risks and work on designs and practices that will mitigate and manage these risks.
As part of my PhD project researching the risks of Arctic offshore operations I am involved in investigating thick sea ice structures, in particular ice ridges. These are thick ice structures formed by ice rubble as a result of collisions between level ice sheets. They are largely underwater and can be up to 30 meters thick. It is suspected that these could pose a significant threat to offshore structures and understanding their strength is of paramount importance in design criteria for offshore operations in the region.

My project is comprised of two main parts, theoretical and experimental. This will involve modeling the formations of freeze bonds within ice rubble structures together with supporting laboratory experiments at UCL's cold rooms.

The project is part of a wider collaboration; Sustainable Arctic Marine and Coastal Technology (SAMCoT), bringing Artic researches together from several European universities as well as key industrial partners. Regular meetings and workshops between researches are organized and allow for exchange of ideas as well as focusing on relevant problem issues.

[D15] Learning from the 2011 Tohoku Tsunami: Effects of Different Slip Inversion Models on Tsunami Hazard Prediction

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The 2011 Tohoku Tsunami is by far the best recorded event. Extensive data are available for damage observations and bathymetrical, geological and topological information. As a result, many high quality earthquake slip inversion models have been developed, which are useful for assessing accuracy of current tsunami simulation tools and their uncertainty. Although individual slip models have been validated against observed data, relative reliability of the simulation results as well as comprehensive performance of the predictions as an ensemble has not been investigated thoroughly. Therefore, it is important to investigate the epistemic uncertainty of estimated tsunami hazard as an empirical benchmark for future predictions. This study adopts a total of 16 published inversion-based earthquake slip models for the Tohoku event, and conducts numerical tsunami simulations to assess the sensitivity of tsunami waveforms at GPS buoys and tsunami wave heights along the coastal line of Tohoku to key characteristics of earthquake slips. The statistical results indicate that using different slip models leads to tsunami waves with high variability. Although the median results match the observed data closely, the range between 16% and 84% curves may differ by a factor of 2 with respect to the median values. From the viewpoint of tsunami hazard prediction, this variability can be interpreted as epistemic uncertainty. Importantly, the magnitude of the uncertainty can have significant impact on the evaluation of potential tsunami threat for the municipal planning and structural design processes. A design example for a Tsunami Evacuation Building in Yamamoto, Miyagi, is presented to illustrate the effect of such uncertainty.

[D16] Tsunami deposits and their numerical modeling: case study on the 2011 Tohoku-oki tsunami in the Sendai Plain

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Tsunami deposits may provide useful information to assess the frequency and magnitude of past tsunamis. However, studies on both modern- and paleotsunami deposits sometimes encounter difficulties in interpreting the deposits and extracting the magnitude information, due to the lack of in-situ observation of the phenomena.

Numerical modeling is a powerful tool to quantify tsunami hydrodynamics and to understand the behavior of tsunamis in the coastal areas. However, numerical modeling of tsunami sediment transport sometimes suffers from the lack of field data and insufficient validation. In this regard, observational data on the 2011 Tohoku-oki tsunami is valuable to overcome these difficulties.

In this study, the tsunami erosion and deposition in the Sendai Plain, northeast Japan, was numerically investigated. Pre-tsunami high-resolution digital elevation model, as well as aerial photographs, enabled us to develop a combined topography/land use model of the Sendai Plain, which is necessary to simulate complex behavior of the tsunami sediment transport on the modern well-developed coastal area.

The simulation showed that the sediment supply from the sandy beach to the inland areas was significantly reduced due to the presence of concrete dikes. The modeling suggested that sandy sediments on the lee side of the dike and coastal forests were the main source of the tsunami deposits. Thickness distribution pattern of the sand layer showed a satisfiable agreement between the simulation and observation. In addition, the simulation showed that contribution of sea-bottom sediments was quite minor, which is quite consistent with the paleontological data of the tsunami deposits from the Sendai Plain.

The modeling of tsunami hydrodynamics and sediment transport is capable of simulating tsunami erosion and deposition observed in the field. A better understanding on tsunami sedimentation, as well as extracting magnitude information, will be achieved through the combined research of geology and engineering.

[D17] Investigating use of social media by authorities and citizens in the disaster recovery phase

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With new media gaining prominence in the last decade, we have assisted to a "shift of paradigm" from centrally controlled data to data gathered from the crowd (crowdsourced data) in many disciplines as well as in disaster management. The involvement of the affected population in the collection, negotiation and analysis of information during the response phase has become paramount for the effectiveness of the rescue and response operations. New media have also proven to be useful for emergency organizations' internal communications and for the communication between disaster management organizations, governments and the public. Despite to the fact that the recovery is one of the phases on which the larger amount of funds are allocated compared to the other pre-emergency phases (preparedness and mitigation), studies on this stage remain scarce. Additionally, research on the use of new media in disaster situations has been mainly focused on the response phase, stressing the ability of these technologies to spread information quickly across a distributed network. By contrast, other studies have demonstrated that new media might be of great help in the reconstruction phase as well. Indeed they can support communication and information exchange between authorities and citizens affected by a disaster and make the recovery process more participative. Community involvement is believed to be one of the key-element to achieve an effective and fast community recovery. The aim of my PhD project is therefore to investigate the requirements for a Web 2.0 platform able to support authorities-citizens

communication during the reconstruction phase. The first part of the project aims to give an insight of the actual communication occurring between authorities and citizens via new media in the aftermath of different disasters and with different cultural backgrounds. The analysis will be conducted by means of a questionnaire.

[D18] Ubiquitous power for sectional compact emergency shelter
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This paper introduces a mobile power for the Sectional Compact Emergency Shelter (SCES), which is used for the field hospitals, disaster response offices, and so on under the great disaster. The proposed mobile power consists of the fuel cells (FCs), photovoltaic cells (PVs) and lead-acid batteries. All of the power resources and necessary electrical equipment are constructed in a container car. Therefore, the constructed mobile power is easily moveable and constructive with the SCESs. The FCs can supply power continuously. PVs are installed on the roof of SCES. The generated power from the PVs is fluctuated by weather conditions. Thus, lead-acid batteries are installed for levering the difference between the generated power and consumed power in the SCES. The basic principle of the proposed ubiquitous power is discussed in detail, then confirmed by digital computer simulation using PLECS software. Simulation results demonstrate that the ubiquitous power can supply the power to the SCES continuously in winter in Japan. It is concluded that the proposed ubiquitous power is the good solution for power supply of SCES under the great disaster.

[D19] Impacts of the 2011 Tōhoku-oki tsunami along the Sendai coast protected by hard and soft seawalls; interpretations of satellite images, helicopter-borne video footage and field studies.
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A combination of time-series satellite imagery, helicopter-borne video footage and field observation is used to identify the impact of a major tsunami on the low-lying Sendai Plain located in eastern Japan. A comparison is made between the coast protected by hard sea walls and the coast without these structures. Changes to the coast are mapped from before and after imagery, and sedimentary processes identified from the video footage. The results are validated by field observations. The impact along a 'natural' coast, with minimal defences, is erosion focussed on the back beach. Backwash on such a low lying area takes place as sheet flood immediately after tsunami flooding has ceased, and then subsequently, when the water level landward of coastal ridges falls below their elevation, becomes confined to channels formed on the coastal margin by the initial tsunami impact. Immediately after the tsunami coastal reconstruction begins, sourced from the sediment recently flushed into the sea by tsunami backwash. Hard engineering structures are found to be small defence against highly energetic tsunami waves that overtop them. The main cause of damage is scouring at the landward base of concrete-faced embankments constructed to defend the coast from erosion, that results in foundation-weakening and collapse.

[D20] The seismic behavior of the twin skew bridges under the strong excitations

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The Great East Japan Earthquake with moment magnitude 9.0 occurred on March 11, 2011. Since the strong ground motion and the tsunami attacked the broad area of east coast of Japan, many infrastructures including bridge viaducts were damaged in these areas due to both ground motion and tsunami inundation. The seismic performance of bridges has been significantly enhanced after 1990 by the development of the ductility design. In Japan also, drastic revisions of the seismic bridge design codes has been carried out after 1995 Kobe earthquake. So the seismic performance of many bridge structures has been enhanced based on the post-1990 seismic codes. That's why less damage of bridges due to the strong ground motion occurred during the Great East Japan Earthquake. However, seismic behavior which should not be ignored was observed.

The unseating of decks is one of the most fatal failure modes of bridges. All over the world, the unseating of decks has been observed at skewed bridges after the past major earthquakes (1995 Kobe earthquake, 2010 Chilie Earthquake, and etc). These fatal failures were caused by the rotational behavior of skewed bridge deck around the vertical axis. Even if the unseating of skewed decks did not occur, the trace that the skewed deck rotates around the vertical axis was observed in 2011 Great East Japan Earthquake, also.

In a twin skewed bridges, each skewed bridge decks were excited during an earthquake. When the rotational movement of the skewed deck starts, it collides to the side face of the adjacent bridge deck. This collision may induce the force to accelerate the rotational behavior, to each other, and it finally may cause the unseating of skewed deck. In this research, we focus on the seismic behavior of a twin skewed bridge, especially about the rotational movements. And we clarify the inter action effects between the adjacent skewed decks to the rotational seismic response during strong earthquakes.

[D21] The link between earthquake recurrence and structural geology: the role of slip rates, elapsed time and stress transfer

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Seismic hazard in the Italian Apennines is due to active normal faults. Earthquakes are typically around Mw 6-7 causing extensive damage and loss of life. An extremely-detailed historical record is available for this region, which is believed to be complete from 1349 A.D., with the record extended further back in time by an extensive set of palaeoseismic trench sites. Slip-rates and earthquake recurrence intervals on the faults are relatively-well constrained, and a strain-rate field is available, which is constructed from offsets of deposits and landforms formed since the last glacial maximum (15 ±3 ka). Despite this, some faults have no record of surface rupture for

the last earthquake so the elapsed time since the last earthquake is not known, foiling attempts to map the probability of rupture on specific faults in stated time periods.

Holocene fault scarps are well-exposed at the surface throughout the Apennines, due to the slip rate being greater than the rate of erosion and the bedrock type (Mesozoic limestone). By conducting detailed structural mapping along these fault scarps, the kinematics of the faults over the last 15kyr can be deduced, this is a long enough period of time to cover many seismic cycles, unlike the historic record. This project aims to extend the detailed fault map into the Umbria-Marche region of the Apennines, to build on previous work. Using ^{36}Cl dating on the exposed fault scarps, it is hoped that this method will resolve the elapsed time since the last earthquake on specific faults relative to their recurrence intervals. This will be combined with study of Coulomb stress transfer in an attempt to identify faults that are late in their seismic cycles and whose stress has been raised by neighbouring earthquakes.

[D22] Coulomb stress driven earthquake sequences in the central Apennines

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Within the historical records of earthquake damage in the central Apennines, Italy, there are examples of sequences of earthquakes occurring closely in space and time. Two notable sequences occurred in 1349 and 1703. On 9th September 1349, three magnitude 6+ earthquakes occurred on the same day starting in the southern part of the central Apennines and sequentially rupturing faults to the north along a distance of 140km. In 1703, three magnitude 6+ earthquakes occurred within 3 weeks of each other rupturing faults from north to south along a distance of 70km. Coulomb stress transfer is a mechanism that could potentially link the earthquakes within these two sequences. The faults responsible for each earthquake have been identified through a combination of historical records and palaeoseismological techniques. These faults were modeled using data collected in the field in combination with published relationships between earthquake magnitude and fault geometry. The results show that initial earthquakes in the sequences transferred stress to the subsequent faults that ruptured. However, there were many faults that experienced an increase in stress during these earthquake sequences that did not rupture. In order to understand the reasons behind these observations, more research is necessary to determine the preceding state of stress and the time elapsed since the last earthquake on each fault. This study forms part of a wider study that will use in situ ^{36}Cl cosmogenic dating to constrain both the slip-rate and the elapsed time normalized to the slip-rate across the whole system of faults in the region.