Poster Session Abstracts

1. Proposing tsunami magnitude scale based on a perspective of cascading disasters

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In 2015, cascading disasters is defined as "cascading effect or dynamic impact of a physical event or the development of an initial technological or human subsystems that result in physical, social or economic disruption". In 2018, a magnitude scale for cascading disasters was qualitatively defined to six levels, Level 0 [Simple or major incident], Level 1, Level 2, Level 3, Level 4 and Level 5. However, the proposed magnitude scale is still lacking of 1) quantitative criteria/definition for each magnitude level and 2) detailed analysis of cause, effect and escalation point of each magnitude scale. Tsunami disaster was selected as the first case study applying perspective of the cascading disasters in our study. Hazard parameters (i.e. maximum tsunami height) as well as consequences from recently occurred several tsunamis in Japan and other countries were reviewed and classified to each magnitude scale. As examples, the 2016 Fukushima tsunami was classified as Level 2 as the consequences were only limited to offshore area, no long-term interruption of infrastructure and no casualty as well as damage to buildings. The 2018 Palu tsunami is a good example for Level 4 as the tsunami itself was the consequence of earthquake, submarine landslide and liquefaction. Damage to ports causing interruption of shipping (both domestic and international) and local business/tourism and damage to a prison causing riot, escaping of prisoners which increased criminal rates and reduced social security were examples of escalation point of this event. The 2011 Great East Japan tsunami was selected as a case study to analyse the process of Level 5 in detail. Results from this proposal can be used for future planning and management against tsunamis in the future.

2. What Enables Disaster Voluntarism to be a Significant Force in a Civil Protection System?

Dr. Khuloud Al Mufarraji, Prof. David Alexander, Dr. Katerina Stavrianaki

UCL IRDR

With every catastrophe, individuals, communities, and organisations from everywhere in the world will offer to help and will always have an essential role in the response to different hazards. Volunteers are individuals who actively involve themselves in doing good for the society, people and communities. Volunteers who provide their knowledge, time and skills in

the time of a disaster are crucial workforce during crisis especially with limited governmental resources. More often, they are the initial responders in an event where the governmental force will need some time to organise.

There is a rising emphasis that volunteers will play a bigger role in disaster management today as compared to their role in the past. This is determined mainly by a mounting effort in building resilience to disasters through a "bottom-up" approach.

In order for voluntarism to be successful in disaster management, it must be well integrated to civil protection system. Furthermore, it is imperative to implement effective strategies to recruit, develop and retain volunteers and to guarantee efficient surge capacity from this workforce. Consequently, volunteers need to be trained, equipped

Some countries around the world have been successfully working to incorporate voluntarism within their civil protection systems while many others have failed to do so. In this research, using a case study from Oman, the researcher is looking into how organised integrated voluntarism can be a significant force within the emergency management system, linking the official efforts in managing disaster with community-based initiatives. The main aim of this research is to identify how disaster voluntarism can be integrated and incorporated effectively within a civil protection System. In the context of Oman, the research is intended to answer the following research questions:

1. What are the factors that hinder or facilitate the process of integrating disaster voluntarism within the emergency system?
2. What is needed in order to make it easier to incorporate volunteer organisations into each relevant part of the civil protection system?
3. What are the challenges that can face the process of integrating disaster voluntarism within the emergency

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3. Engineering applications of Earthquake Early Warnings

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The development of earthquake early warning (EEW) systems has recently received much investment and research interest worldwide. EEW usually involves the early detection of an incoming earthquake, the estimation in real-time of the ground shaking/damage/loss likely to result, and the issuance of an alert to people in the region where the ground shaking is likely to be hazardous. The last decade has seen the rapid development of methodologies for EEW systems that currently can provide typical warning times ranging from a few to tents of seconds, with an upper limit of about 1min. Considering these warning times, this research aims to investigate and address the issues faced in the design of automatic fast-mitigation actions for real-time vulnerability reduction in structural performance of buildings. Specifically, three are the applications to be designed,

1.- Semi-active control of structures
2.- Rapid assessment of respond demands of buildings
3.- Human evacuation models and human response to EEWs.

Regardless of the action to be designed, the following key questions must be answered,

What is the required time to carry out the action? What is the cost of implementing it?
Is it feasible and cost effective?
What is the false alarm acceptability?

How are earthquake early warnings perceived by the population?
How can we improve the message earthquake early warnings intend to provide?

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4. Experiments on the Micromechanics of Ice using Scanning Electron Microscopy

Mark W Shortt and Peter R Sammonds

UCL Institute for Risk and Disaster Reduction

From both geophysical and engineering perspectives, a comprehensive characterisation of the micromechanical behaviour of ice is desirable. The deformation of ice observed on larger scales, both in the field and laboratory, is controlled by the underlying microstructure of the ice, as well as internal defects incorporated into the microstructure. Thus, to fully understand the deformation behaviour of the sea ice cover across the Arctic Basin, or at a more local scale, interactions between sea ice floes and offshore structures, knowledge of the microstructure of the ice, and its micromechanical response under applied stresses are imperative. We have developed an experimental methodology for in-situ mechanical testing of millimetre-scale ice samples within the chamber of a scanning electron microscope (SEM). This enables the measurement of the stress-strain behaviour of the ice as well as simultaneous real-time imaging of the surface topography, providing a visual indication of the micromechanical processes occurring during deformation. In this paper, we give a description of the experimental methodology, followed by results from preliminary compression tests on freshwater ice samples – both level and freeze-bonded. Prior to testing, the surface of each sample was imaged, revealing microstructural features such as grain boundaries. Stress-strain curves were obtained for each test in addition to videos of the SEM display during deformation. The SEM imaging revealed various deformation features during the tests, most notably crack initiation and propagation and the eventual failure of the samples. Applying this methodology to saline ice, in conjunction with concurrent mechanical tests on larger scales, we aim to establish empirical scaling relations for sea ice mechanics. These results may then be implemented into basin-scale sea ice models as well as models for ice-structure interactions.

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5. Angular Dependency of Freeze-Bond Mechanics in Saline Ice

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The degree of freeze-bonding in the keel of a sea ice ridge is an important parameter governing the overall strength. If we assume the ice rubble in the keel to behave as a Mohr-Coulomb material, freeze-bond strength can be seen as analogous to the keel cohesion, which gradually increases with depth as the ridge consolidates. Freeze-bond strength is thus an important input parameter in models for ice-structure interactions. Since the ice rubble is randomly orientated in the keel, freeze-bonding between constituent blocks is also expected to occur at random angles. However, the dependence of angle on freeze-bond strength is yet to be investigated. We present preliminary results from field and laboratory experiments conducted in Svalbard, where the influence of angle on inclined freeze-bonded saline ice samples was investigated. Field tests were conducted on large-scale cores of sea ice in the Van Mijenfjorden, whilst the laboratory tests were conducted on smaller saline ice samples in the UNIS Cold Laboratory. In both cases, the freeze-bond angle (dip) was varied between 25°-65° and subjected to uniaxial compression, thus producing shear stress along the freeze-bond layer. In the field tests, the formation of freeze-bonds was limited by the influence of convective and turbulent oceanic heat fluxes. In the laboratory, freeze-bond strength was minimum at an angle ~36° and increased rapidly thereafter. At angles greater than 60°, the failure mode transitioned from shear freeze-bond failure to ductile barreling of the sample. By analogy with thrust faults in rock mechanics, we aim to apply Anderson's theory of faulting to model the shear stress in the freeze-bond layer as a function of angle and coefficient of friction. The results of this model will then be compared to the experimental data.

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6. The Influence of Gravity Drainage on the Formation and Salinity Development of Freeze-Bonds in Saline Ice

Mark W Shortt, Peter R Sammonds

UCL Institute for Risk and Disaster Reduction

Gravity drainage is one of several observed desalination processes in sea ice, in which brine is expelled from the base of the ice sheet as a result of an unstable density profile through its depth. A number of recent studies have incorporated the process of gravity drainage into thermodynamic models of growing sheets of level sea ice. However, this process has been neglected in thermodynamic models for consolidation in sea ice, despite the necessity for its incorporation to enable accurate predictions for the salinity development of freeze-bond layers. From an engineering perspective, accurate characterisation of the freeze-bond salinity is necessary as it is suggested that this is a governing factor in determining the freeze-bond strength. Using existing models for gravity drainage in level ice, we have developed a one-dimensional thermodynamic consolidation model that incorporates the effect of gravity drainage on the time required to bond two layers of sea ice together. The model also predicts the temporal development of the salinity of the freeze-bond layer, which is then compared to measurements from the field and laboratory.

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7. **Risk Assessment and Risk Management of Natural Disasters in Saudi Arabia**

Mater Almehmadi

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This research will be undertaken to investigate risk assessment and risk management processes for natural disasters in the Kingdom of Saudi Arabia. Natural disasters such as flooding have unfortunately been highly devastating in Saudi urban areas despite continued efforts by authorities to mitigate against them. The aim of this study will be to investigate how natural disasters interact with anthropogenic factors such urbanization in determining the degree of risk exposure to natural disasters. Both qualitative and quantitative data relating to the causes and contributors to natural disasters in Saudi Arabia will be included in the study. Additionally, the data collection and analysis method to be applied will be a systematic review. The expected findings of the study will be that there are indeed significant fragilities in both critical emergency management policy and infrastructure in many Saudi urban areas that magnify the effects of natural disasters. These findings would contribute to the creation of policies relating to controlled urbanization and environmental management, among Saudi urban planners and emergency management authorities.

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8. How foresight tools apply in managing cascading disasters

Ardeshir Sayah Mofazali (BSc, MSc, MA, PhD), Middlesex University of London

The human efforts to be prepared better for the future challenges of natural disasters go back ages. There are several trends which suggest that mega-disasters occurring more frequently in the future. So, there is no way than improve preparedness in a diverse future-oriented manner.

One of the main applications of foresight in Disasters is avoiding systematic failures. In this research, the relations between 'risk management', 'Foresight', and 'Cascading Disasters' elaborated. On one hand, Foresight practices have recently grown in many disciplines and there is limited evidence of applying foresight in Disasters. On the other hand, variety of available Foresight tools are not commonly used in DRM; therefore, it is an opportunity to apply foresight as a new area of improving long-term insights and extend foresight application in cascading disasters.

In this research, extensive methodological literature review in disaster risk management (DRM) and Foresight have done to introduce an emerging opportunity to shape the future. The model is validated by two rounds of Delphi, with the participation of 43 qualified experts. The generic model could be used widely, while the main source of data for validating the model is limited to the expert's opinions in Iran.

An applicable foresight framework is provided within the context of DRM. The position of Foresight in DRM framework and cascading disasters has been proposed as well. The results of this study reveal that there are significant conceptual similarities and differences in these two fields.

The main value of this research is to clarify the relationship between the two interdisciplinary fields of Foresight and DRM. Also, a specific conceptual model is provided in which a novel matrix recommends to select proper foresight approach in DRR. Finally, a cumulative framework of foresight patterns that includes the new model is presented to be applied in DRM.

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9. Disaster-Resilient Housing Performance Criteria

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Building Performance Evaluation (BPE) aim at discovering how the completed building and building in use performs, identifying possible misfits or failures, and collecting information for future improvement. BPE has been developed using performance categories/ indicators that comply with certain standards in normal and ideal situations. Post-disaster reconstruction and development that should be conducted in disrupted and complex situations tend to be less able to comply with ideal building specification and standards. Thus, using BPE model might not be compatible to evaluate building/housing in post-disaster context. This study aims to develop sets of performance criteria to evaluate Disaster-Resilient Housing performance of Post-Disaster Housing (PDH). Performance criteria developed in this study are not limited to assessment and evaluation criteria for the general housing evaluating system, but also performance criteria that allows understanding to what extent resilience has been achieved in Post-Disaster Housing (PDH). At the initial phase, review of secondary data establishes a data set about housing performance indicators from the regulators and experts' point of view. The indicators are classified and categorized according to their relevance to the characteristics of disaster-resilient housing. Preliminary indicators which has been established from the review of secondary data is utilized as the basic approach to the primary data collection process. The study adopts exploratory semi-structured interviews that is carried out at the second phase of data collection process. Semi-structured interviews with professionals and academic experts in the field are conducted to refine the preliminary housing performance indicators and to investigate possible unforeseen dimensions and the corresponding indicators and criteria. This presentation will provide initial findings from 20 exploratory semi-structured interviews with experts/resource persons. It was revealed that housing significantly contribute to society's resilience to disasters and disaster risk reduction. Post-disaster housing procurement and design have demonstrated to affect particularly to social, economic and physical/technical resilience of its resident. These findings will be used to develop performance criteria to assess and evaluate resilience in post-disaster housing.

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10. Changes in the organizational structure of a civil protection system after experiencing a series of emergencies: its implications on sharing information and resources among its actors

Saqar Al Zaabi

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After a crisis and during the window of opportunity, a number of lessons are usually identified and may be translated into 'new' organizational changes, with the aim to optimize the functioning and performance of the civil protection system. This research concentrates on analyzing the changes in the organizational structure of the system at the national level after experiencing a series of cyclone events. It aims to identify the forces behind these change and their implications on the functional interrelationships and collaboration patterns between the different actors, and on its implication on the system's flexibility in integrating new non-traditional actors into the system.

In this research, an organizational learning framework is adopted to explain how knowledge produced by an event is turned into organizational changes. Qualitative in-depth interviews (N=19) were conducted with the emergency managers of the civil protection system in Oman. Participants were actively involved in coordinating the different emergency operations at the national level during cyclones Gonu 2007, Phet 2010 and Mekunu 2018. They were asked to describe what they learned from these experiences, what changes have occurred in the coordination and collaboration between them and the challenges experienced when working in multiorganizational networks.

Data are being thematically coded using the qualitative data analysis tool 'NVivo'. We initially found that the socio-political context where the EMS functions played a bigger force than the events themselves in the process of selecting new changes. We also found that the transition from an agency-based to a function-based system was viewed as an effective mechanism in bringing organizations into a collaborative network and in creating reciprocal trust between them. An increased level of information and resources sharing was attributed to this 'grouping' platform. On the other hand, this transition strengthened the control-and-command style of management and created further challenges, most prominently new difficulties in integrating voluntary actors into a predominantly governmental-based system.

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11. Uncertainty in strain-rate from detailed field structural geology data and implications for seismic hazard assessment

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Data are presented on the geometry, kinematics and rates of deformation across an active normal fault scarp in the Southern Italian Apennines. Our aim was to determine: (1) how detailed the mapping of those parameters and the fault trace need to be, in order to calculate a representative strain-rate for seismic hazard calculations; (2) what aspects of the geometry and kinematics would introduce artificial variability in the strain-rate if not measured in the field. We find that the strain-rate averaged since the demise of the last glacial maximum (15 ± 3ka) shows a gradual decrease towards the tip of the fault. However, the results reveal that the magnitude of vertical offset (throw) varies across areas of structural complexity, such as along-strike bends in the fault plane where the fault dip is greater. If such locations are included or excluded in field surveys, different values for a representative strain-rate would be produced, and hence different values would result in seismic hazard calculations. To demonstrate this effect, we progressively degrade our dataset, calculating the implied strain-rate at each step. We show that excluding measurements can alter strain-rate results beyond

one sigma uncertainty and thus we urge caution when using only one or two measurements of slip rate along a fault for calculating hazard. We discuss how improved understanding of the potential implied errors in strain-rate calculations from field structural geology data should be implemented in seismic hazard calculations.

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12. Towards localising disaster management, what operational frame assists? A view of Nigeria flood incidents.

Agbo Emmanuel , Alexander David

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Disaster management and response structure function as a network of institutions that focus on a common goal of achieving disaster risk reduction, and continuity of mitigation actions in communities exposed to hazards[1]. The existence and functioning of this management structure depend largely upon the collective capacity of its individual institute to manage risk, and the degree of collaboration to which they can mutually achieve while implementing disaster management activities. Whereas the different organisations that makes up disaster management team strives to heighten their capacities for effective disaster risk reduction, in many instances the operational framework for their collaborative network serves as deterrent to the effectiveness of the less resourced member organisation. Notable instance is with communities' poor participation in disaster management, occasioned by the top-down hieratical operational structure of disaster management framework[2]. While some line of thoughts argued that flaws occasioned by top-down operational structure are filled by bottom-up operational framework, contrary indications suggests that inconsistencies within the different government tiers impends the realisation of grassroot input as proposes bottom-up disaster operational structure[1]. For other scholars, both the bottom-up and top-down structures focuses its functions on command and control approaches that are defined by emergency management personnel through one-directional source of disaster information and communication[3], "a measure that do not acknowledge the important that individuals and households play in facilitating effective risk information and management strategies in communities". On this reading, this research recognises the need for a balance in framework that secures shared knowledge and rural capacity base action for disaster risk reduction. An approach that entails balance in association between the different disaster management cohorts and encourages shift towards localising disaster management, for a possible communal disaster risk reduction and sustainable community resilient attainment.

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13. Microinsurance for disaster recovery: Business venture or humanitarian intervention? An analysis of potential success and failure factors of microinsurance case studies

Rebekah Yore, Joanna Faure Walker, UCL Institute for Risk and Disaster Reduction

David Jones, *Rescue Global*

To understand what elements of a microinsurance initiative may lead to an increased likelihood of its success as a disaster recovery support mechanism, characteristics of multiple microinsurance case studies were examined to test whether common trends could be identified. A review of 40 worldwide microinsurance initiatives from the last 20 years, both successful and unsuccessful, was conducted using the current literature. Examined characteristics were grouped into motivations for product development, insurance type, whether there was a pilot scheme for product launch, product coverage, product bundling, premium subsidisation, networks and partnerships, delivery channels, target markets, community input into the product design and built in education and awareness campaigns. Statistical testing suggested potential relationships between the likelihood of success and a number of varying factors, such as premium subsidisation, the incorporation of an international reinsurer, and the presence of a donor in the stakeholder network. Moreover, potential links between success likelihood and the motivation for and timing of the initiative launch were discovered. These findings, along with suggestions of minimum metrics for recording the performance of microinsurance programmes over time, are intended to help further the discussion on defining microinsurance, to inform microinsurance initiatives that may be set up to address the challenges of post-disaster transitions to recovery, and to aid in the tracking of longer-term community impact

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14. Early Warning Systems and Evacuation: The Rare and Extreme Hazard among Frequent, Small-Scale Events. Windstorm Case Studies from the Philippines (Super Typhoon Yolanda (Haiyan)) and Dominica (Hurricane Maria)

Rebekah Yore, Joanna Faure Walker, UCL Institute for Risk and Disaster Reduction

David Jones, *Rescue Global*

To test the efficacy of early warning systems in prompting residents to seek safety in line with warning messages ahead of severe windstorm hazards, surveys were carried out among affected populations following Super Typhoon Yolanda (Haiyan) in the Philippines in 2013 and Hurricane Maria in Dominica in 2017. Both events were examples of rare and extreme hazards that occurred in locations familiar with experiencing windstorms, but more frequently of a much less severe nature. In order to determine whether the early warning process was effective and prompted action among recipients, we asked if, how and when residents received warnings, what the warnings instructed people to do, and where and when respondents decided to seek safety. We found that in both examples studied, the residents were aware of the approaching storms, but critical information regarding the severity of the event and potential impacts were either not received in time or not understood fully. This resulted in lower than desired levels of evacuation and safety seeking behaviour as advised by the warnings. We suggest that future planning and public communication need to focus on the uncertainty surrounding the severity, impact and multifaceted nature of windstorms and accompanying hazards. This is especially critical where populations are used to less severe hazard events but where more infrequent extreme events can occur.

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15. Statistical Analysis on the Satellite Anomalies and its Implication in the case of a Disastrous Solar Flare

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Our active star, the Sun, often produces eruptive phenomena called solar flare. Solar flare disturbs the interplanetary and near-Earth plasma environment, and often causes miscellaneous adverse effects on artificial satellites. Recently, it was revealed that so-called “superflare” which has 10–100 times larger energy than the largest flare ever observed could occur on the Sun once in 100–1000 years. However, though there are several studies to analyze the relationships between the probability of satellite anomalies and various physical quantities related to the solar disturbances, little study has been conducted to assess the potential impact by a “disastrous” solar flare. In this study, we show the first impact assessment of satellite anomalies in case of a superflare. By takingsimple linear regressions between the satellite-anomaly rate defined as the number of anomalies per satellite per flare event and 19 solar-disturbance-related physical parameters, we found that the 6-days averaged proton flux with its energy above 100 MeV had a very good correlation (R2 score > 0.9) to the anomaly rate of GEO and GPS satellites, and its extrapolation showed that in case of 1-in-100-years and 1-in-1000-years events, the GPS-satellite-anomaly rates should be 6.34 and 43.2, respectively. These rates are ~8 (1-in-100-years case) and ~50 (1-in-1000-years case) times larger than the worst case ever observed. Thus, we suggest that in case of 1-in-100-years and 1-in-1000-years superflares, all the satellites could suffer from the anomalies and the damages could be ~8 and ~50 times severer than our worst case.

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16. Assessing temporal probability of landsliding at regional scale: a methodological approach to build a comprehensive landslide inventory. The case study of *Subappennino Dauno* (Southern Italy)

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Worldwide, natural or human-induced hazards can affect population and their assets causing potential fatalities, damages and losses. Hazard assessment is one of the main aspect in risk analysis field, inasmuch it allows to define areas most prone to potential damaging phenomena. Hazard is defined as a function of spatial and temporal probabilities, which are related to predisponding and triggering factors. Concerning landslide hazard studies, many difficulties are related to the generation of landslide databases that include information about time of occurrence, typology and magnitude of landslides, and the determination of their spatial and temporal probabilities. Nowadays, most hazard maps are just focused on susceptibility, which can be seen as a spatial probability indicator. The lack of comprehensive historical landslide records associated to historical records of triggering factors (such as rainfall and earthquakes) determines the inability to assess temporal probability of landsliding. In truth, in many countries there are national or regional administrative offices in charge of providing funds for the safety and design of soil protection works, that receive alerts issued by

several local actors, such as municipalities and citizens. Therefore, they can provide a comprehensive historical records of landslide events in a hazard-prone area with accurate information about time, location and magnitude. Starting from warnings collected by the administrative office *Difesa del Suolo* (namely "Soil protection") of the Apulia region located in Southern Italy, this work aims at describing the phases of landslide data collection and their positioning in a landslide-prone area located in such region, called *Subappenino Dauno*. The obtained database will be compared with existing landslide inventories to show strengths and weaknesses of this database for hazard mapping purposes at different scale. Then, historical landslide records will be used as input to a probabilistic model to assess the landslide temporal probability at regional scale.

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17. Earthquake Forecasting under Short Term Aftershock Incompleteness

Tasnuva Tabassum

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Data missingness due to overlapping is common in an ongoing aftershock sequence. This makes short term aftershock forecasting even harder. Available methods for treating non random missing earthquake data heavily depend on the normality assumption. We present a Bayesian technique for better treatment of the missing data as well as better forecasting during this crucial moment of time.

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18. Insurance loss data – a useful common metric to allow insights into multi-hazard environments: Have you tried sharing this, succeeded or failed?

Hillier, J. K.,

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Insurance is one important aspect of providing resilience to various natural hazards (e.g. flooding, extra-tropical storms, hurricanes). Providing natural hazard insurance reliably, accurately and fairly is underpinned by robust, peer-reviewed environmental science. Collaborations between practitioners and university-based scientists to enhance risk assessment models, however, could be more frequent and effective. In theory, sharing data (e.g., claims or losses) is a common metric that may allow multi-hazards environments to be better assessed (e.g. Hillier *et al*, 2015). In practice, difficulties exist, which I believe might be overcome by a range of options. Here, after a year of my 3-year role as a NERC (UK funding body) Knowledge Exchange Fellow I present some initial thoughts on both difficulties and potential solutions for establishing collaborations between scientists and insurers. More importantly, however, **please come and tell me your experience** in as much or as little detail as permitted by confidentiality. All views on working practices, useful protocols etc …. welcomed from both academics and industry practitioners.

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19. Are earthquakes self-similar? How do observations of aseismic and seismic slip tell us about how the physical processes driving earthquakes scale with size?

Mohamed Alwahedi, Peter Sammonds and Katerina Stavrianaki

UCL Institute for Risk and Disaster Reduction

It has been proposed in a previous theory that earthquakes are self-similar: that the properties of earthquakes or the regions that surround earthquakes vary systematically with earthquake size. However, my results showed a magnitude variation in postseismic slip with coseismic moment which suggests that earthquakes may not be self-similar.

20. Female Community Health Volunteers as the 'backbone' of rural health care in Nepal, and their prospective role in disaster relief

Sophie Gray, on the behalf of *HEADLINE Nepal*

Funded by the *UCL Grand Challenges Health Systems Initiative 2018*

In Nepal, the Female Community Health Volunteer (FCHV) Programme was started in 1988 by the Ministry of Health and Population. The cardinal role of FCHVs has been to act as community-based health educators and agents to facilitate access to local primary health care services; 97% of these volunteers are based in rural areas. As an integral part of the community health worker network, these FCHVs are primed to act as first responders, to provide relief services in the event of a natural disaster, especially in remote areas where it will take longer for national or international aid services to arrive. However, there is a lack of emergency response training available to them.

HEADLINE Nepal is a social enterprise focusing on providing an online platform to enhance the training of FCHVs, through providing an interactive interface for knowledge presentation and learning consolidation. *HEADLINE Nepal* has been awarded a grant by the UCL Grand Challenges Health Systems Initiative 2018, to run a pilot study on the ground. This pilot will be a small-scale, two-day teaching and knowledge testing programme run by *HEADLINE Nepal* team members in concert with *Nepal Development Society,* an NGO which has previously constructed skill-based training for over 250 people from regions effected by the 2015 earthquake. In the future, *HEADLINE Nepal* is envisioning the deployment of further bottom-up FCHV programmes, in coordination with grassroot organisations, would act as a method to facilitate the standardisation of emergency response training, and empower FCHVs to be able to mitigate hazard-related risk in their local community.

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21. Children's flood risk perception and preparedness: Flooding experiences in Kocaeli, Turkey.

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Understanding children's perception is a key component of building community resilience for disasters. The aim of this research is to give insights into how flood experience shapes children's perception of flood risk and preparedness. The study location is Golcuk, in the

Kocaeli region of Turkey, which is exposed to many flood events, mostly due to the combined effects of heavy rainfall, rapid urbanization and poor drainage systems.

A flash flood in Golcuk on 27th May 2018 damaged 514 houses and 133 workplaces, causing at least US$ 235,000 of economic damage. Five government schools in Golcuk were sampled; the age range of the participating children was between 11 and 13 years old (n=425). A mixed methods survey was used to determine pre-flood and post-flood risk perceptions and preparedness, with questionnaires and interviews, augmented by the PRISM (Pictorial Representation of Illness and Self Measurement) methodology.

The findings show statistically significant differences in the perceived importance of preparedness ($Z=32.9$, $p < .000$, $N=425$) and no significant difference in flood risk perception ($Z=41.2$, $p< .262$, $N=425$) before and after the 2018 flood event. Gender is not a major factor in children's perception of flood risk and preparedness. Research results regarding angles of PRISM indicate that children who place their results along the diagonal axis on PRISM are more optimistic than those who placed their result near the X and Y axis of the PRISM.

The importance of the children's perceived flood preparedness does not correspond to their actual flood preparedness, as more than half of the participants did not take any flood preparedness actions even after the 2018 flood event. The flood risk perception of the surveyed children and their risk awareness level does not match the actual flood risk in their home area, as the majority of the participants live in a flood-designated area.

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22. Déjà vu or jamais vu? Cultural memory and forgetting of tropical cyclones in Mauritius in the longue durée

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Tropical cyclones are a considerable threat to the people, economy and environment of Mauritius, with intense cyclones having an approximate return interval between 8 to 15 years. It is suggested that the strength of cyclones will increase with climate change, and that recent events are directly caused by climate change. However, the digitalised instrumental record available is relatively short and there is little known about community memory and learning from cyclones, either from a current or historical standpoint. Critically, while community awareness of environmental risk is shown to be present in Mauritius and key to the capacity to response, the levels and distribution of this knowledge is almost entirely unknown.

In order to adequately understand community response to cyclones, and other impacts of climate change on SIDS, this research suggests that it is essential to first understand the *longue durée*, since the prerequisites and conditions for any so called 'natural' disaster, trace their origins far into the distance, in both time and space. To address this, the research conducts a multidisciplinary methodological approach, which deploys a combination of interviews with archive research to illustrate not only the past experience and impact of tropical cyclones in Mauritius, but equally importantly, the patterns of social and cultural learning from disasters.

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23. Informal Disaster Governance in Svalbard and Dominica

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Informality is a core element of disaster risk reduction and response (DRR/R) efforts but is further catalysed when formal disaster governance (FDG) fails—a common occurrence across disasters. However, despite the widely recognised importance that academics and practitioners attribute to informality in DRR/R, and despite significant scholarly attention to related themes (e.g. convergence, emergence, volunteerism), informality in DRR/R has not been systematically studied. Rather, these already limited interpretations either emphasise informality as a deviant, troublesome phenomenon that requires managing by FDG; or, uncritically hail informal DRR/R as a positive expression of participatory community-based DRR/R that results in enhanced flexibility and innovation—yet, without considering crucial nuances such as the power dynamics inherent in informal DRR/R. In both instances, a balanced counternarrative that conceptualises what actually *is* taking place is required. To this end, this project analyses informal DRR/R in two case study locations: Svalbard (Arctic) and Dominica (Caribbean). Drawing on an extensive review of interdisciplinary literature, in-depth semi-structured interviews and focus groups aided by the use of PRISM (Pictorial Representation of Illness and Self Measure), this research studies the drivers and dynamics of informal DRR/R actions, stakeholders and networks and develops the concept of informal disaster governance (IDG) to conceptualise its findings. In doing so, it highlights the importance of IDG, assesses its applicability within the wider context of disaster governance and calls for greater attention to informality's role as a crucial element of DRR/R.

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24. Assessing the socio-economic impact of flooding in economically developing countries using catastrophe models.

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JBA Risk Management Ltd.

Flooding occurs frequently in Sierra Leone leading to loss of life, disease outbreak and damage to infrastructure and housing. The effects on the population can be widespread and devastating. Of the total number of people affected by disasters in Sierra Leone in the last 30 years, 90% were affected by flooding. Vulnerability to flooding is increased by construction on floodplains and land reclamation.

To better understand the impacts of flooding, the World Bank commissioned JBA to develop a probabilistic flood model for three cities in Sierra Leone using statistical and physical modelling methods. Our model uses methods that are well established in the insurance industry, adapted to account for the limited availability of hydrological and socio-economic data in Sierra Leone. A flood event set was generated at locations distributed across the country by applying advanced statistics and hydrology to historical rainfall and flow observations. The event set was combined with flood maps; for each event, flood depth and extent were extracted from the flood maps to create a catalogue of tens of thousands of realistic future flood event footprints. The resulting catalogue includes physically-plausible

events that are more extreme than experienced in recent history. Vulnerability functions that relate flood water depth to damage were created for a selection of property types, and for people affected and fatalities.

The probabilistic flood model was run to estimate number of people affected, fatalities and economic property loss associated with the flood events modelled. The outputs are now being used to identify the locations with the highest risk of flooding, so regions can be prioritised for intervention. The results can also be used to inform urban planning to avoid development in high-risk zones. A large flood event in August 2017 highlighted an unintended benefit of the modelling for real-time event response and recovery.

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25. Developing a Consistent Approach to Ensuring Community Resilience to Risk during times of Financial Crisis: A study of Fire Services in Southern Europe and the importance of Quality Assurance systems.

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Fire services around the world share one common objective. This is to protect life and property. Different fire services will have a variation of functions covered under their mission statements, but the protection of life and property appears to be a universal theme irrespective of nationality, religion or faith. However, the way this crucial objective is addressed from country to country, and even between fire services within the same country, varies significantly. As such, there is no homogeneity in how fire services operate. Despite empirical evidence and a wealth of experience documented in books, manuals and training guides establishing a broadly defined methodology towards effective emergency response, the status quo precludes the creation of an international benchmark for fire services.

The capacity to provide effective emergency services to the public will be influenced by a number of complex and inter-related factors that include cultural make-up, corruption, politics, financial and socio-economic stability / equality, demographic and geographical indicators such as location and access. This thesis examines the issues related to fire services in Southern Europe with its main focus on Greece. The financial crisis has had a compounding effect on countries in this region. Fire services have to do more with less, with out-dated equipment, understaffed and subject to deteriorating employment conditions.

While the financial crisis is an obvious causal factor influencing the quality of service provided to the public, it is one that, at least notionally, has a simple resolution (greater funds = improved quality of service). It is the more complex factors linked to culture, politics and corruption that are much harder to change. These inter-related factors are a reflection of dominant culture. Therefore, when certain behaviours that have such a restrictive impact on the development of a fire service represent dominant cultural values, it is logical that there is little possibility of affecting change.

If this is the case, then what are the possibilities of improving standards to ensure the provision of a quality service to the public? Can a benchmark for fire services around protecting life and property realistically be established? If not, do we accept that, in certain cases, the level of emergency services provided to the communities will not be adequate? These are some of the questions my thesis aims to challenge.

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26. Multi-hazard risk assessment: the Stromboli case study

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In territories affected by different geo-environmental risks, transcalar and multidisciplinary analyses to evaluate specific and total risk are crucial, properly estimating the potential damage, in terms of number of element at risk and vulnerability. Territorial analysis should be treated considering territory as the result of long-term co-evolutionary process between anthropic settlement and natural environment, implying to separate vulnerability into three sub-components, related to geohazard intensity and value of element at risk: physical, environmental and social vulnerability. The territorial heritage is composed by tangible or "material" (i.e. buildings types, agricultural systems, settlement rules) and intangible or "cognitive" (i.e. socio-cultural models, knowledges, agricultural practices) settlings, defining qualitative and quantitative information for damage estimation. The research has been focussed on Stromboli island (Italy), optimal case study of multi-hazard occurrence that impacted the communities and the territory. Stromboli is characterized by Strombolian activity, effusive eruptions, and higher-intensity explosive events. Landslides usually occur within the Sciara del Fuoco and "Rina Grande-Le Schicciole" depressions, located in the NW and SE flanks of the volcanic cone, respectively. Since the 1900, Stromboli has been affected by 6 tsunamis, partly related to intense volcanic activity and/or landslides on the Sciara del Fuoco (the last one occurred on 30 December 2002). Stromboli was also affected by several earthquakes, with epicentres located in the surroundings of the island or in Calabria and Sicily, characterized by higher magnitudes (Mw ≈7), impacted the island with intensity up to 11 on the MCS scale. This study is the first one that considers the risk related to tsunami, seismic, volcanic and landslide events in Stromboli at the same time. First step of the research is physical vulnerability assessment. Physical vulnerability surveys were conducted on 2304 buildings, using data sheet that linked geohazard intensity to structural and non-structural characteristics of buildings and infrastructures. Surveys, together with preliminary cartographic data and information from non-structured interviews to the local population, allowed to classify elements. Structures have been classified according to: coverage type, masonry type, number of floors, ground floor openings (doors, windows), state of conservation, etc. Further classifications have been carried out in relation to: ground floor use, presence of adjacent lot, presence of suitable emergency spaces, road connections, etc. Preliminary results show that structural and non-structural characteristics of buildings, together with territorial aspects, can give detailed information to accurate potential damage evaluation.

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27. Multi-level framework for the seismic risk assessment of Reinforced Concrete buildings

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Regional seismic risk assessment is paramount in earthquake-prone areas, for instance to define and implement prioritisation schemes for earthquake risk reduction. As part of the *INdonesia School Programme to Increase REsilience*(INSPIRE), we propose an ad-hoc rapid visual survey form, allowing to 1) calculate the newly-proposed INSPIRE seismic risk prioritisation index, which is an empirical proxy for the relative seismic risk of reinforced concrete (RC) buildings within a given building portfolio; 2) calculate the Papathoma Tsunami Vulnerability Assessment (PTVA) index, in any of its variations; 3) define one or more archetype buildings representative of the analysed portfolio; 4) derive detailed numerical models of the archetype buildings, provided that simulated design is used to cross-check the model assumptions. An attempt to define a multi-hazard prioritisation scheme is proposed, combining the INSPIRE and PTVA indices. Such a multi-level framework is implemented for 85 RC school buildings in Banda Aceh, Indonesia, the mostly affected city by the 2004 Indian Ocean earthquake-tsunami sequence. As part of the proposed framework, two archetype buildings representative of the entire portfolio are defined based on the collected data. Their seismic performance is analysed by means of non-linear static analyses, using both the analytical Simple Lateral Mechanism Analysis (SLaMA) method and numerical finite element pushover analyses to investigate the expected plastic mechanisms and derive displacement/drift thresholds to define appropriate damage states. Finally, non-linear dynamic analyses are performed to derive fragility curves for the archetype buildings. Additional work is ongoing to include earthquake losses in the assessment procedure (casualties, economic loss and downtime). Moreover, a multi-criteria decision-making approach is under development to provide resilience-enhancing solutions based on structural retrofit and risk transfer (insurance), also including possible tax incentives from the government. Finally, the effects of both main-shock/after-shock and earthquake-tsunami sequences will be included in the framework.