Project Title	Investigation of the topographic control for geohzards prone zone ecosystem functional properties by multiple remote sensing sensors
University (where student will register)	University of Warwick
Which institution will the student be based at?	As above
Theme (Max. 2 selections)	Climate & Environmental Sustainability ☒ Organisms & Ecosystems ☒ Dynamic Earth ☐
Supervisory team (including institution & email address	**PI: Dr Xueyu Geng (University of Warwick, xueyu.geng@warwick.ac.uk)** **Co-I: Qiuhua Liang (Loughborough University,** Q.Liang@lboro.ac.uk**)**

Overview:

With 71% of the earth's surface covered by water, hydro-hazards, including floods, droughts, onshore and offshore landslides and storm surges, can pose direct threats to lives and impact livelihoods by damaging and destroying critical lifeline infrastructure (e.g. transport links, power supplies) as well as our natural ecosystem; especially under the changing climate. To mitigate risks and protect our towns, cities and our planet, we need to improve our understanding of the human-landscape-ecology interaction and characterise the complex hierarchies of revenant proves-response systems in a context of a changing and uncertain climate and environment. Inevitably, our human's decision making and processes can also shape and change the natural environment, including ecosystems, river systems, vegetation and climate. We humans have caused such significant environmental change, which also has caused a great concern about whether social and ecological systems can coexist in a sustainable manner. There is an urgent need to seek to understand how human activities can exist without disrupting the ability of natural ecosystems to function in order to help advance the concept of sustainability, and the interaction between natural hazards and human activities in order to minimize the disturbance to the submarine and soil ecosystems, especially when we consider the next generation design of critical infrastructure. In particular, for example, plant root and shoot biomass - two important ecosystem attributes - are likely to influence the stability of hill slopes in complex ways. Although there is growing awareness on the benefits of ecosystem services for sustaining livelihoods in urban contexts, e.g. on the modification of climate, hydrology or soil dynamics, the potential for ecosystem-based and hybrid solutions that combine grey and green approaches has not been tapped fully yet. Therefore, several fundamental challenges exist in current research. All these recent challenges in the maintenance of the current lifeline infrastructure and design of the future lifeline infrastructure – so to be more resilience towards the changing climates and sustainable for the future changes – have emphasized the need for an inter-disciplinary approach drawing upon knowledge at the interface between traditional civil engineering with geophysics, hydrogeology, fluid mechanics, data science, uncertain quantification and ecology.

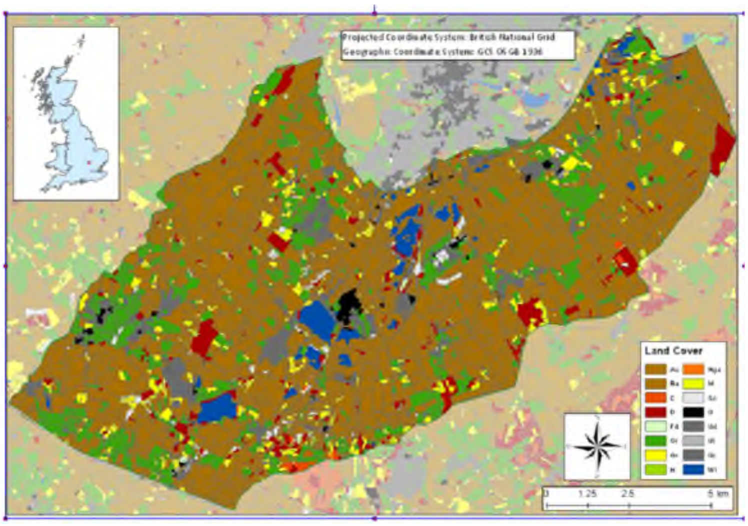

Figure 1: Fig. 1 e Broad Habitats in Marston Vale from the satellite derived Land Cover Map 2007 (Howard et al. 2013).

Methodology:

Two modelling paradigms that attempt encompass the complexity of response in railway and energy systems and sub-systems when subject to hydro-hazard stressors will be imbedded into the proposed programme: (1) functional resilience, and (2) networked resilience. Functional resilience will describe the underpinning normal and post-disaster dynamic behaviour, including loss in functionality and recovery profiles. Networked resilience will characterize propagation effects that arises from cascade failures, the interdependence between infrastructures as well as the links with the surrounding ecosystems. Together, the project will couple functional and network resilience to create a holistic understanding of rail transport and energy infrastructure resilience against hydro-hazards as well as how the ecosystem has been shaped by those man-made infrastructures especially after the natural disaster, harmonizing inter-disciplinary approaches in qualitative methods (e.g. social-economic impact), and quantitative analysis (e.g. model building and data science).

Training and skills:

Students will be awarded CENTA2 Training Credits (CTCs) for participation in CENTA2-provided and 'free choice' external training. One CTC equates to 1⁄2 day session and students must accrue 100 CTCs across the three years of their PhD.

Training for the research will be delivered in a combination of network-wide and local activities. Local activities including combined summer training school within the related research areas by the funded projects, e.g. training courses on Remote sensing for earth observation; Advanced spatial database methods; Statistical learning theory and applications. Field trips and engagement with local industry partners will also be also provided as part of the training programme

Partners and collaboration (including CASE):

The partners include existing links with Arup, National Grid. And new built collaborations with the MET office and Jacobs

COVID-19 Resilience of the Project:

Due to the outbreak of COVID-19 pandemic, the project will be potentially impacted by not being able to go to the office on campus. And any protentional licensed software need to be utilized through remote access, which will be set up by the IT service from the University. Since the nature of the project is numerical modelling based, which will be expected to have the minimum impact from the COVID-19. After mitigation, the impact from the COVID-19 pandemic will be low.

Possible timeline:

Year 1: training courses on Remote sensing for earth observation; Advanced spatial database methods; Statistical learning theory and applications.

Year 2: field trip and engagement with industry partners

Year 3: further engagement and secondments with industry partners.

Further reading:

Eleni Papathanasopouloun, Nicola Beaumont, Tara Hooper, Joana Nunes, Ana M. Queirós, Energy systems and their impacts on marine ecosystem services, Renewable and Sustable Energy Reviews, 2015, 917-926.

Carleigh Ghent, Mitigating the Effects of Transport Infrastructure Development on Ecosystems (2018), The journal of Sustainable Development. 58-68

Sam Asher, Teevrat Garg, Paul Novosad, The ecological impact of transportation infrastructure, World Bank Group, July 2018.

Emily Riley, Patrick Harris, Jennifer Kent, Peter Sainsbury, Anna Lane, Fran Baum, Including Health in Environmental Assessments of Major Transport Infrastructure Projects: A Documentary Analysis. Internal Health Policy Management, 2018, 7(2): 144 – 153.

D.C. Howarda, P.J. Burgessb, S.J. Butlerc, S.J. Carverd, T. Cockerille, A.M. Colebyf, G. Gang, C.J. Goodierh, D. Van der Horsti, K. Hubacekj, R. Lordk, A. Meadl, M. Rivas-Casadob, R.A. Wadswortha, P. Scholefielda. Energyscapes: Linking the energy system and ecosystem services in real landscapes. Biomass and Bioenergy, 2013, 55, 17-26

Further details:

Xueyu Geng, University of Warwick, https://warwick.ac.uk/fac/sci/eng/staff/xg/

HERCULES project: https://warwick.ac.uk/fac/sci/eng/staff/xg/hercules/

Qiuhua Liang: https://www.lboro.ac.uk/departments/abce/staff/qiuhua-liang/