



University of Nottingham
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UNNC-IGSNRR, CAS Doctoral Training Partnership

It's essential that you have contacted the UNNC and/or IGSNRR supervisors before applying.

Formal applications should follow the instructions in ['How to apply'](#) section.

Research areas

- Environmental Sciences
- Geography

Available PhD topics

PhD topic	China's aviation network resilience in the context of climate change
IGSNRR Supervisor	Prof. Jiaoe Wang
UNNC Supervisor(s)	Dr Faith CHAN
Short introduction & description of the PhD project	<p>The aviation industry plays an essential role in the economic development of regions and nations, and its stable and effective operations have been given significant attention. However, the aviation network consisting of interconnected and interacted subnetworks is highly vulnerable to disruptive events, e.g., the capacity reduction or closure of a single airport due to extreme weather events can have widespread systemic effects. The intensity and frequency of extreme weather events (heavy thunderstorms, typhoons, snowstorms, etc.) are expected to increase as the climate changes, bringing aviation networks more uncertainty about flight delays and cancellations that affects the operations on aviation transport includes freight logistics and passengers.</p> <p>Assessing the aviation network's resilience against various extreme weather events contributes to a better understanding of the best business practices and industry policies in a dynamic aviation environment and facilitates the sustainable growth of the aviation industry.</p> <p>This project will focus on two major dimensions on (i) exploring the performance of airport resilience to various extreme weather events and (ii) measuring the aviation network resilience to climate change from both structural and dynamic aspects.</p> <p>The candidate expects to have excellent English and Chinese language ability plus have passed the requirement of the English test (exclude the graduates from the UK and Recognised countries – US, Oz, NZ, Canada, etc.) and have got substantial knowledge and</p>

	background on urban geography, transport studies, climate change, complex system research.
Contact points	Informal inquiries may be addressed to Dr Faith Chan (Faith.Chan@nottingham.edu.cn) and Prof Jiaoe Wang (wangjie@igsnr.ac.cn).
PhD topic	Evaluation of hydro-climatic effects of the “Sponge City” program for urban water disasters control in China
IGSNRR Supervisor	Yanfang Sang
UNNC Supervisor(s)	Faith CHAN
Short introduction & description of PhD project	<p>How to evaluate the risks of urban water disasters and further mitigate them is one key topic for urban stormwater management, which is also the foremost challenge for sustainable urban developments. The Chinese government proposed the concept of “Sponge City” in 2013 to handle the aggravating urban water disasters (i.e. urban surface water floods/waterlogging) over China. Over the last decade, many measures and technologies have been developed for guiding the designs and implementation of the “Sponge City” program (SCP) in the 30 pilot cities and also many other cities.</p> <p>However, there still have many challenges that prevent the positive feedback of the SCP, questioning its functions and effects. This project will focus on three major dimensions on (i) solve the key hydrology-related issues (e.g. estimation of proper rainfall threshold in the various magnitude of rainfall) for guiding the design of the SCP; (ii) evaluate the effects of SCP by considering the trade-off between the investment and its potential benefits and (iii) explore the projected changes of the SCP effects by considering the climate change impacts.</p> <p>The candidate is expected to have an excellent language skill (English and Chinese) and technical skills of handling big-data and relevant geo-spatial techniques, as well as a strong understanding of the climate change, floods, droughts and urban water knowledge. We prefer candidates with a strong background in these research areas, such as finishing the relevant Bachelor and Master studies in GIS, Geography, Environmental Science, Urban Planning, Computer Sciences in these research directions. Candidates are expected to have a good maturity and passions to take on the research pressure and challenges, with the experiences on previous research and already published (e.g. in CAS Q1 and Q2 journals as first author) that are considered prudentially advanced. We expect candidates to be independent and have a strong research interest to work with our research groups at the University of Nottingham (across campuses) and the CAS IGSNRR in Beijing by spending equity of time during the funding period of 36 months.</p>
Contact points	Informal inquiries may be addressed to Dr Faith Chan (Faith.Chan@nottingham.edu.cn) and Prof Yanfang SANG (sangyf@igsnr.ac.cn).
PhD topic	Explainable and uncertainty-aware GeoAI and GeoML
IGSNRR Supervisor	Prof Jianghao Wang
UNNC Supervisor(s)	Dr Nicholas Hamm

Short introduction & description of PhD project

Artificial intelligence and machine learning techniques are currently being extensively used in the realm of geographical and environmental research. Geospatial machine learning (GeoML) and artificial intelligence (GeoAI) have become increasingly popular as they offer the potential to create more accurate and adaptable models. Nevertheless, these innovative approaches also pose challenges in terms of incorporating data and model uncertainties, as well as lacking interpretability. Consequently, accurately quantifying and modelling the uncertainties and determinism inherent in geographic big data within the context of GeoAI and GeoML has emerged as a crucial and leading-edge concern in geographical modelling.

In geospatial modelling, we usually need to fuse point observations, multi-source remote sensing and socio-sensing information. How to characterize observational errors and selective biases in these ubiquitous data, how to take them into account by GeoAI modelling to reduce uncertainties, and how errors propagation to the final model outputs are the core questions we want to answer in this direction. The key issues to consider are:

1. Incorporation of spatial information and its uncertainties into ML and AI modelling.
2. Develop a framework to characterize data uncertainty and propagate it through ML or AI models. Here we see different challenges according to the class of data. For example, survey and point observations data might be characterized using statistical distributions whereas novel big datasets are more vague and ambiguous, and may be further affected by issues such as preferential sampling.
3. Characterize and visualize uncertainty in model predictions and use this to support explaining these predictions.

We expect to use datasets drawn from the above three categories and will utilise a range of use cases, which may include:

- Urban air pollution modelling and mapping based on traditional datasets and remote sensing
- Urban air pollution modelling and mapping enhanced by the incorporation of novel datasets.
- Human behaviour monitoring, modelling, and linking it to health and well-being, including air pollution exposure and access to urban green space.

The candidate is expected to have an excellent language skill (English and Chinese) and technical skills in handling big data and relevant geospatial techniques and preferably a solid understanding of the environment, climate change knowledge. We prefer candidates with a strong background in these research areas, such as finishing the relevant Bachelor and Master studies in GIS, Geography, Environmental Science, Mathematics, Computer Sciences in these research directions. Candidates are expected to have a good maturity and passion to take on the research pressure and challenges, with research experience from a Master degree or employment. We expect candidates to be independent and have a strong research interest to work with our research groups at the University of Nottingham (across campuses) and the CAS IGSNRR in Beijing by spending equity of time during the funding period of 36 months. In particular, we welcome candidates who are willing to develop novel open-source geospatial technology.

	Potential candidates will need to develop their proposals as part of the application process. They are advised to first contact the supervisors to discuss this (contact details below).
Contact points	Informal inquiries may be addressed to Prof Jianghao Wang (wangjh@lreis.ac.cn) and Dr Nicholas Hamm (nicholas.hamm@nottingham.edu.cn)
PhD topic	Future urban climate resilience systems: toward smart technological driven and dynamical complex systems approaches
IGSNRR Supervisor	Prof Jianghao Wang
UNNC Supervisor(s)	Dr Faith Chan ; and Dr Nick Hamm
Short introduction & description of PhD project	<p>Urban climate resilience systems are facing increasing challenges due to the rapid, transformative, and recurrently startling, changes in the conditions under which they used to operate thus under climatic extremes, urban flood occurs. Therefore, it is crucial to innovatively explore spatial-temporal uncertainty, for both climate and non-climate related issues, when planning, designing, and operating such systems.</p> <p>The potential drivers of change are manifold and today's decision makers struggle with the systems' complexity, and particularly with possible solutions for uncertain futures. This Ph.D. topic expects candidates to integrate human behaviour datasets (e.g. mobile phone data, satellite imagery, etc.) and dynamic system modelling approaches to escalate the understanding of static measures in prior to improving the understanding of the single or compound urban disaster resilience processes.</p> <p>Contributions are expected to show how to transition from deterministic approaches to those that incorporate different levels of uncertainty. Studies should present research that contributes state-of-the-art knowledge to the development of solutions for uncertain futures, in line with the future directions of the IPCC AR7 report and post-COP 28 foci.</p> <p>The candidate is expected to have an excellent language skill (English and Chinese) and technical skills of handling big-data and relevant geo-spatial techniques and preferably a solid understanding of the climate change, floods, droughts and urban water knowledge. We prefer candidates with a strong background in these research areas, such as finishing the relevant Bachelor and Master studies in GIS, Geography, Environmental Science, Urban Planning, Computer Sciences in these research directions. Candidates are expected to have a good maturity and passions to take on the research pressure and challenges, with research experience from a Master degree or employment. We expect candidates to be independent and have a strong research interest to work with our research groups at the University of Nottingham (across campuses) and the CAS IGSNRR in Beijing by spending equity of time during the funding period of 36 months. In particular, we welcome candidates who are willing to develop novel open-source geospatial technology in the context of urban resilience.</p> <p>Exact research proposal is encouraging the submission of your application that discuss concepts and present models and methods for building strategies, plans, and actions to accomplish sustainable development of urban climatic resilience systems in an uncertain</p>

	world (we are not expecting the research only focusing in Chinese cities and could be focused on global pattern).
Contact points	Informal inquiries may be addressed to Prof Jianghao Wang (wangjh@lreis.ac.cn) and Dr Faith Chan (faith.chan@nottingham.edu.cn) and Dr Nicholas Hamm (nicholas.hamm@nottingham.edu.cn)
PhD topic	Geo-cultural landscape, economic geography and their impacts on rural resilience
IGSNRR Supervisor	Zhenbo Wang
UNNC Supervisor(s)	Yi Wang
Short introduction & description of PhD project	<p>Geo-cultural landscape has been classified as a complex spatial entity, with specific dynamics and attributes from both geographical locations and specific human factors. Its evolution is closely linked with the cultural heritage evolution in the place, and linked to the local/regional spatial-temporal dynamics. Therefore, geo-cultural landscape often involves natural, cultural and anthropic components.</p> <p>In the contexts of rural development, much of the intellectual efforts has been put in land use, rural economies and populations. However, the impacts of becoming geo-cultural landscape in rural areas are neglected.</p> <p>It is interesting to see how geo-cultural landscape has developed in rural China. How do they merge institutions, economies, communities and culture in the evolution? And how do they provide representations and universal symbols for rural development?</p>
Contact points	Informal inquiries may be addressed to Dr. Yi Wang (Yi.Wang@nottingham.edu.cn) and Prof. Zhenbo Wang (wangzb@igsnrr.ac.cn)
PhD topic	Plant response and adaptation to environmental change
IGSNRR Supervisor	Prof Shuli NIU
UNNC Supervisor(s)	Dr Tengwen LONG
Short introduction & description of PhD project	<p>Global warming is one of the most pressing challenges that profoundly impacts soil microbial communities and microbially driven ecosystem functioning. Peatlands cover only 3% of the Earth's land surface, but store more than 1/3 of global soil carbon that exceeds the amount of carbon stored in all terrestrial vegetation types, thus playing an important role in the global carbon cycle and mitigating climate change. Soil microbes are important engines driving an array of ecosystem functioning, such as soil organic carbon formation and decomposition, greenhouse gas emissions, and nutrient cycling. Although surface and deep soils will warm at nearly the same rate throughout the next century, the response of deep-soil microbes to climate warming is still unknown. Therefore, how warming affects soil microbial communities and microbially driven ecosystem functioning through the soil profile is valuable to be explored for improving our understanding and predictions on peatlands' responses to global warming.</p> <p>This project will focus on the new generation whole-ecosystem warming (0-1 m, +2°C) in a high-altitude peatland in western China, which is sensitive to climate warming. The candidate is expected to address the following questions through his/her research: (1) How does warming affect soil microbial diversity, composition, physiology, and biomass</p>

	in surface and deep soils? (2) How do warming-induced changes in soil microbial communities along the soil profile regulate soil carbon and nitrogen dynamics?
Contact points	Informal inquiries may be addressed to Dr Tengwen LONG (Tengwen.Long@nottingham.edu.cn) and Prof Shuli NIU (sniu@igsnrr.ac.cn).
PhD topic	Research and development of green and efficient materials for stabilization of heavy metals in soil
IGSNRR Supervisor	YAN Xiulan
UNNC Supervisor(s)	Yong Ren
Short introduction & description of PhD project	Based on machine learning, screening, identifying and assembling heavy metal solidification/stabilization materials, investigating the redistribution of heavy metal elements at the soil-material interface, morphology and enrichment processes, analyzing the pathways and mechanisms for transforming and removing pollutants, and researching and developing new green materials with the synergistic functions of complex pollutant passivation and abatement.
Contact points	Informal inquiries may be addressed to Xiulan Yan (yanxl@igsnrr.ac.cn) and Yong Ren (yong.ren@nottingham.edu.cn).
PhD topic	Soil Heavy Metal Pollution in Industrial Agglomeration Areas: Machine Learning for Precision Characterization and Specific Risk Management Research
IGSNRR Supervisor	Prof. Mei LEI
UNNC Supervisor(s)	PhD Yong Ren
Short introduction & description of PhD project	The rapid development of industrial agglomeration has provided crucial support for the manufacturing industry, but the industrial clustering model has brought challenges in the form of heavy metal pollution to regional environmental protection. Variability in production functions and processes within industrial clusters results in the complexity and comprehensiveness of heavy metal pollution characteristics. Accurate investigation and assessment of soil pollution characteristics are essential for a comprehensive understanding of the ecological and environmental risks posed by urban industrial agglomeration to the surrounding areas. It is crucial to delineate soil heavy metal pollution risk zones and propose differentiated risk control measures. Precise characterization of the spatial distribution of pollutants is a key factor in understanding the soil pollution status of the site. This study aims to use machine learning algorithms to accurately depict the spatial distribution of soil heavy metals in industrial agglomeration areas. The research will focus on two main aspects: (i) precise characterization of industrial activities (e.g., time scale, atmospheric conditions, pollution irrigation, and isotope identification) and (ii) differentiated risk control (emphasizing industrial upgrading and controlling pollution pathways).
Contact points	Informal inquiries may be addressed to PhD Yong Ren (yong.ren@nottingham.edu.cn) and Prof. Mei LEI (leim@igsnrr.ac.cn).
PhD topic	Sustainable production and land use in agricultural systems
IGSNRR Supervisor	Prof. Wenjiao Shi
UNNC Supervisor(s)	Dr. Tengwen Long
Short introduction & description of PhD project	Global change and agricultural systems play crucial roles in achieving the Sustainable Development Goals 2 (Zero Hunger) and 13 (Climate Action) outlined by the United

	<p>Nations. Investigating the impacts of global change on agricultural systems is vital for climate change mitigation and adaptation, as well as for food security and agricultural development.</p> <p>While previous studies have explored the effects of climate change and land use change on food security in agricultural systems, there is still a need for further investigation into agricultural land use, resource utilization, and the eco-environmental impacts arising from crop production. Additional research is necessary to delve into sustainable production and land use in agricultural systems.</p>
Contact points	Informal inquiries may be addressed to Prof. Wenjiao Shi (shiwj@lreis.ac.cn) and Dr. Tengwen Long (tengwen.long@nottingham.edu.cn).
PhD topic	Sustainable watershed management based on the coupling of human and natural systems
IGSNRR Supervisor	Prof Feng Wu
UNNC Supervisor(s)	Dr Meili Feng
Short introduction & description of PhD project	<p>This project addresses the complex challenges at the interdisciplinary studies in physical geography, socio-economic dynamics, and environmental management. Through the lens of the food-water-energy nexus, it looks at the interplay between nature geography and socio-economic issues, and the urgent need for understanding and mitigating sudden disasters such as flood risks or emerging pollutions etc from the perspective of human behavior. The project adopts a holistic approach, interweaving policy modelling with empirical research to dissect and understand the dynamics of water environment and their broader implications on socio-economic structures under energy transition.</p> <p>Ideal candidates should have a good foundation in environmental science, geography, economic, GIS. Skills or experience on mathematics, modelling, or big data analysis would be highly preferred.</p>
Contact points	Informal inquiries may be addressed to Prof Wu (wufeng@igsnr.ac.cn) and Dr Feng (meili.feng@nottingham.edu.cn)
PhD topic	Urbanization and Global Environmental Change, Land Use and Spatial Planning
IGSNRR Supervisor	Prof. Xiangzheng Deng
UNNC Supervisor(s)	Prof. Ping Fu
Short introduction & description of PhD project	<p>The continuous acceleration of urbanization is driving systemic changes in the global environment at a faster pace, some of which are irreversible. The regulation of human land-use behaviours, such as regulating and strictly implementing land use spatial planning, can alleviate the environmental stress of urbanization to a certain extent.</p> <p>Throughout the relevant research, there has been a certain accumulation of scientific research achievements, but there are still some deficiencies in the method guidance and practical operation guidance at the practical level. With this regard, this project will focus on the research and development of system models (e.g. structural dynamic models, pattern succession models and effect assessment models) and the planning strategies and practices for adapting climate change, reducing carbon emissions and guaranteeing food security from regional, national and global perspective. These</p>

	studies are conducive to the much-needed expertise on sustainability-based decision making.
Contact points	Informal inquiries may be addressed to Dr Ping Fu (Ping.Fu@nottingham.edu.cn) and Dr Xiangzheng Deng (dengxz@igsnr.ac.cn).
PhD topic	Water resource monitoring and management for climate change adaptation and disaster risk reduction in Central Asia
IGSNRR Supervisor	Prof. Juanle WANG
UNNC Supervisor(s)	Dr Faith CHAN
Short introduction & description of PhD project	<p>Central Asia, as a crucial component of the Belt and Road Initiative, is witnessing an increasingly pronounced vulnerability in its ecological environment. Rational management of water resources emerges as a pivotal factor in ensuring ecological balance. Conducting comprehensive research on water resource monitoring and management is of paramount importance in addressing the challenges of climate change and reducing disaster risks. It holds significant implications for ecological conservation and the sustainable utilization and management of natural resources. Climate change has influenced Central in various aspects such as agricultural productions, dust storms and desertification, and more. This study encompasses the monitoring of surface water, estimation of groundwater, and water resource management.</p> <p>This PhD project is to focusing on the enhancement of monitoring on surface water allows for timely access to dynamic water information and the monitoring of water quality, providing foundational data for scientifically informed ecological decisions. Estimating groundwater contributes to a comprehensive understanding of the distribution and trends in underground water resources, serving as a scientific basis for sustainable water resource management.</p> <p>In particular, we look at the sustainable water resource management and large-scale water footprint and potentially on the water nexus, in the context of agricultural utilization, the judicious use of water resources can improve irrigation efficiency in farmlands, enhance the sustainability of agricultural production, and drive the overall development of the sustainable agricultural and circular economy.</p> <p>In the prevention of dust storms and the mitigation of desertification, providing necessary moisture conditions helps prevent land degradation and the further expansion of deserts.</p> <p>Candidates to have an excellent basic knowledge about the soil-water interactions, processes, with the understanding on water footprint and life-cycle assessment and the techniques on geo-spatial and basic skills on modelling with software such as python will be an advantage. Candidates also expect needs to conduct field work in C Asia and China for the outdoor activities. We expect candidates to have a fluent English and Chinese language on oral, listening and writing ability.</p>
Contact points	Informal inquiries may be addressed to Dr Faith Chan (Faith.Chan@nottingham.edu.cn) and Prof Juanle WANG (wangjl@igsnr.ac.cn).