vYSSP

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Biographical sketches and research project abstracts

Young Scientists Summer Program

International Institute for Applied Systems Analysis
IIASA www.iiasa.ac.at

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Ben Brooker

Supervisor: **Elena Rovenskaya**
Co-Supervisor: **Åke Brännström (EEP)**

Research Project: **TEMPORARILY OPEN-CLOSED ESTUARY ECOSYSTEM LIMITS AND THE ROLE OF HYDROLOGICAL DRIVERS**

Abstract:
Temporarily open-closed estuaries (TOCEs) are important in provisioning ecosystem services which span biological, social and economic spheres. They are characteristically small in size, are subject to limited tidal influence, but are highly influenced by the seasonal catchment flows entering therein, exhibiting high levels of variability. As such, they are broadly classified into states according to magnitude of flow volumes and associated physical processes. The manipulation of hydrological regimes via development within catchments may extend this variability beyond a system's natural ranges and cause an alteration from natural ecosystem development cycles. However, due to the high natural variability in estuarine communities and processes, the point at which ecosystem dynamics exceed their natural ranges is difficult to quantify and link to ecosystem functionality and structure. This study seeks to elucidate the extent of shifts in ecosystem functionality and structure through the analysis of empirical food-webs across a range of hydrological scenarios for a TOCE system, the uMdloti estuary in KwaZulu-Natal, South Africa. Networks will be modelled using a linear inverse modelling (LIM) approach to reflect the upper and lower-bound constraints of boundary and biotic flows. The result is a plausible 'solution space' for flows in the network, from which solved networks are extracted. Ecological Network Analysis (ENA) metrics from the solved networks provide quantitative information and system indicators as reference points for system states. These metrics will be related to hydrological regime and physico-chemical parameters of the system, thereby providing insight into food-web functioning under differing climatological and flow allocation scenarios.

Biographical sketch:
Ben is currently a 4th year PhD candidate at the University of KwaZulu-Natal, in Durban. His current research involves investigating the influence of human and natural drivers on estuarine ecosystems in terms of how they cause shifts in food-web functioning and structure. Prior to this, he graduated from the University of Stellenbosch with his BSc in Conservation Ecology and University of Cape Town in 2016 with his Master's in Applied Marine Science, where his research focused on biological invasions within South Africa's Marine Protected Area network.

Lauri Neuvonen

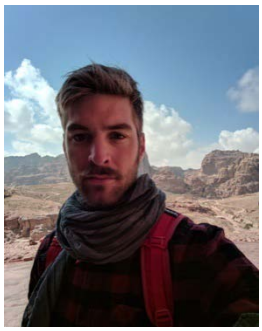
Supervisor: **Matthias Wildemeersch**

Research Project: **OPTIMAL TESTING AND QUARANTINE STRATEGIES FOR EPIDEMIC CONTROL**

Abstract:
When resources are limited, healthcare interventions should be carried out where they are expected to yield the most benefit. In an epidemic, in particular, testing plays a crucial role. First, testing patients with symptoms results in better-informed treatment decisions, thereby leading to improved health outcomes. Second, testing symptomless patients helps mitigate the spread of disease and alleviate adverse impacts on the economy by imposing targeted instead of population-wide quarantine measures. Finally, antibody tests provide information about the development of immunity in the population, thereby supporting decisions concerning social distancing and restrictions on the economic life.

Control of epidemics through interventions such as vaccinations, school closures and quarantines has been studied extensively through simulation, optimal control theory, and simulation-optimization approaches. However, despite the crucial role of testing, research on optimal testing strategies has been lacking. In this project, we propose a multi-objective modeling approach to support the optimal allocation of resources to testing to maximize health benefits and minimize costs. The approach combines optimization with epidemiological modeling to account for the impacts of testing on the spread of disease. As a case example, we use the expected second wave of the current Covid-19 epidemic.

Biographical sketch:
Lauri Neuvonen is a third year PhD student at the Aalto University School of Business. His research focuses on the use of optimization methods and data to support decision making in complex situations, especially in the personalized health care context. Before his PhD he worked for six years as a management consultant in the energy industry. He holds a MSc in engineering physics from the Aalto University School of Science. His research interests include the study and control of complex systems, the use of optimization and data analysis, and the generation of decision support tools to help solve complex real world problems.



Simon Plakolb

Supervisor: **Nikita Strelkovskii**

Research Project: **USING THE FUTURE STATE MAXIMISATION PARADIGM TO ANALYSE THE EMERGENCE OF SOCIETALLY SUB-OPTIMAL MOBILITY BEHAVIOUR**

Abstract:
In the 21st century the human population has grown beyond the seven billion mark. An unprecedented global interconnection and mobility of people leads to the emergence of problems requiring holistic solutions taking into account collective behavior. The concept of future state maximization (FSM) allows for a simple yet exhaustive model of various behavioral patterns. An agent based on such an algorithm, i.e. an agent acting such that it maximizes its possibilities, can for instance find its way through a realistic road network. Recently FSM has also been used to model collective behavior. However, so far it has only been used to model positive outcomes in collective behavior. E.g. the formation of lanes in pedestrian flow and flocking of birds can be expressed using FSM. However, so far this principle has not been applied to phenomena where the collective behavior leads to sub-optimal stable states. This is especially the case where agents fail to consider other agents' goals when looking for personal optima. What can cause road congestion on a small scale can lead to vast consequences on the macroscopical scale of migration. Therefore, we aim to test FSM as a framework grasping the mechanisms behind these emergent phenomena. Consequently, we plan to test it as a model for policy evaluation through the application to a real-world problem like migration. Within such a framework also other sub-optimal collective behavioral patterns could be analyzed. It could thus proof be of great interest to policy makers in finding means to influence people's choices towards a more sustainable society.

Biographical sketch:
After acquiring both a BSc and an MSc degree in Environmental Systems Science at both the Technical University and the University of Graz, Simon continued to do a PhD in Systems Science. He has just started his second year as a PhD candidate at the University of Graz. As such he is member of the research group led by Prof. Manfred Füllsack. His thesis mainly focuses on refining the methodology of a novel traffic model to enable GPU acceleration. Furthermore, he is enrolled in the doctoral program "Human Factor in Digital Transformation" and part of the COLIBRI Field of Excellence at University of Graz.

Tahereh Zobeidi

Supervisor: **Nadejda Komendantova**

Research Project: **IMPACT OF SOCIAL MEDIA ON PERCEPTIONS OF RENEWABLE ENERGY SOURCES**

Abstract:
A sustainable energy transition implies that future energy systems will more strongly rely on renewable energy sources, such as solar or wind energy. This will be also connected with the necessary changes of behavioral attitudes from all stakeholders, involving energy producers and energy consumers. Therefore, it is commonly assumed that behaviors and lifestyles need to be modified to secure a sustainable energy future. Social media plays a key role in changing people's attitude and lifestyles. Particularly, social media can be an important information and communication source for youth to enhance their environmental behaviors by increasing their knowledge of environmental issues and the specific actions that youth must take to reduce greenhouse gas emissions. Although social media has made great efforts to expand the use of renewable energy for private households and industrial sectors, no satisfactory results have been undertaken yet. Therefore, the current research is focused on understanding how social media influence using renewable energies (in particular, solar energy). This research will involve qualitative and quantitative methods. Empirical data were collected during semi-structured interviews and through cross-sectional survey. The methodology will also include testing renewable energy-related messages in social media and their impacts on perception of energy users. The theoretical framework will be based on the Technology Acceptance Model (TAM) (Davis, 1986), the Extended Parallel Process Model (EPPM) (Witte, 1992), and the information adoption model (IAM) (Sussman and Siegal, 2003). Interpretation of qualitative data and structural equations modeling as the main analysis will be performed over the YSSP period.

Biographical sketch:
Tahereh Zobedi is a PhD candidate in Agricultural Extension and Education at the Department of Agricultural Extension, Communication, and Rural Development, University of Zanjan. During the YSSP she plans to study the impact of social media on individuals' perception and behavior toward renewable energy. Her main fields of scientific interest include renewable energy use in urban and rural areas. In particular, she is focusing on social psychology theories to identify individual perceptions and behaviors.

Katie Lee

Supervisor: **Petr Havlik**
Co-Supervisor: **David Leclere**

Research Project: **GLOBALLY OPTIMIZED DISTRIBUTION OF BEEF PRODUCTION SYSTEMS TO RECONCILE CLIMATE CHANGE MITIGATION, BIODIVERSITY CONSERVATION AND FARM PROFITS**

Abstract:
Global demand for beef is growing rapidly, which is economically profitable for beef producing nations. Unfortunately, beef production also plays a significant role in depleting the world's rapidly declining biodiversity and increasing already record-high global emissions. Differing grazing intensities and fertilizer inputs can alter potential beef production and in turn affect biodiversity and GHG emissions. For example, intensification of production may reduce GHG emissions, but may result in reduced biodiversity because of habitat changes, nutrient pollution and chemical inputs. On the other hand, strategic intensification and relocation of beef production could lead to land sparing for biodiversity conservation. Owing to the clashes between food production and conservation, we will assess how to meet future beef demand whilst minimizing impact on biodiversity and emissions over a gradient of intensities. This will be achieved using a global spatial model coupled to a beef distribution model, an emissions model and a biodiversity assessment. A weighted sum optimization will be used to balance the trade-offs across environmental outcomes to determine the best spatial distribution of beef production. These global outputs will be analyzed by country and compared to current distributions and to the outputs of GLOBIOM. It is expected that the results will suggest a major shift in where and how (level of intensity) beef is produced and an overall reduction in the land required.

Biographical sketch:
Katie is currently a 2nd year PhD candidate under the supervision of Associate Professor Eve McDonald-Madden, Dr Adam Charette-Castonguay and Dr Matthew Holden. She received a Bachelor of Science from Monash University in Melbourne, Australia completing Honours in Physics. Following this, she worked as a Research Assistant at Monash University in conjunction with the Hudson Institute of Medical Research in X-ray Optics working in an interdisciplinary group focused on neonatal lung development. Her experience in modelling and spatial analysis are currently being applied to her PhD research looking at the global distribution of livestock to minimize environmental impacts.

Felipe Mello

Supervisor: **Florian Hofhansl**
Co-Supervisor: **Kalle Parvinen (EEP)**

Research Project: **MANAGEMENT IMPLICATIONS OF HABITAT ASSOCIATION MODELS IN COMPETING TROPICAL WOODY PLANTS**

Abstract:
Understanding the ecological processes that determine species abundance and distribution can give insights for a better planning of ecosystems management. Species are distributed across gradients of abiotic resources and their ability to exploit available resources while interacting with other organisms determine their abundance along the landscape. Therefore, interactions among species across resource gradients may explain species spatial distribution. A functional trait approach can be used to determine the ability of species to specialize on different habitat abiotic conditions in face of biotic interactions, such as competition, mainly in highly diverse ecosystems such as tropical forests. Tropical forests harbor a stunning diversity of organisms of which woody plants play a central role in the global carbon cycle. Trees and lianas comprise most of the woody plant species of tropical forests and together they contribute to the vast majority of the tropical forest' biomass. Trees and lianas compete strongly for resources, however the effects of competition between trees and lianas have not been fully addressed in habitat association models. Here I propose to integrate a spatial process modeling and functional trait approach to better understand how habitat specialization, competitive interactions between trees and lianas and functional traits create variation in the spatial structure of woody plants in a tropical forest of Panama. This project will also aim to derive management implications based on the results obtained from habitat association models to develop management recommendations for fragmented forest landscapes of Southern Brazil.

Biographical sketch:
Felipe Mello completed his Bachelor's degree in biology at the "Luiz de Queiroz" college of the University of Sao Paulo, Brazil, in 2013, where he also obtained his Master's degree in Forest Resources (2015), studying the ecological relationships between lianas and trees in forest fragments and their management implications. After his Master's, Felipe worked as scientific project manager in a large-scale experiment with the objective of scientifically evaluating forest management practices to support public policy. Felipe is currently a 4th year PhD student in Ecology at Marquette University, US, and is always keen to apply basic ecology to derive nature-based solutions and management practices for sustainable development under projected climate change scenarios.

Ecosystem Services and Management Program (ESM)
Acting Program Director: Petr Havlik

Janet Molina Maturano

Supervisor: **Juan Carlos Laso Bayas**
Co-Supervisor: **Steffen Fritz**

Research Project: **RESPONSIBLE SCALING OF AGRICULTURAL CITIZEN SCIENCE PROJECTS AT THE BASE OF THE PYRAMID (BOP)[1]: THE CASE OF AGROTUTOR.**

Abstract:
Crowdsourcing and Citizen Science (CS) are reported to be a cost-effective way of collecting observations relevant to environmental monitoring and contributing to science. However, ICT driven-only applications and their scalability may be hindered by technical barriers and data privacy issues. Additionally, these type of applications might raise social and ethical challenges such as inequalities due to lack of infrastructure, technology ownership, and access by small scale farmers at the BOP. To leverage the scaling up of both agricultural research and farming applications, innovation ecosystem and responsible partnerships are key. In addition, frugal approaches to innovation that target users at the BOP provide a unique approach to address innovation processes and their challenges at this level, by responding to resources limitations and turning constraints into an advantage. Thus far, the impact assessments of CS projects are based mostly on qualitative methods (interviews and focus groups). The focus of this YSSP work will be to bring frugality lenses as a complementary framework for the AgroTutor case study, a mobile app developed for Mexican farmers through a cooperation between IIASA and CIMMYT[2]. A list of impact tools applied by the EOCS[3] at IIASA will be collected. A comprehensive CS-adapted 'Sustainability Evaluation Framework' will be applied to the AgroTutor app to identify the ex-ante potential impacts on the different dimensions of sustainability. Finally, an exploratory survey will be conducted focusing on limitations and partnerships, to gather general insights on innovations needs and development. The results will inform potential upscaling and improvements to the AgroTutor app.

Biographical sketch:
Janet Molina, originally from México, is at the end of her PhD at the 'Economics & Management of Natural Resources' at Ghent University (Belgium). Her main research interest are constraint-based innovations and frugal innovations of the water and agricultural sector in developing countries. Over three years, she gained professional experience while working for a multinational company. From October 2020, she will act as the Frugal Innovation Practitioner liaison for the Centre for Frugal Innovation in Africa (CFIA) at the International Institute of Social Studies of Erasmus University Rotterdam (The Netherlands).

[1] BOP - Bottom of the pyramid, the largest and poorest economic groups
[2] CIMMYT - International Maize and Wheat Improvement Center
[3] EOCS - Center for Earth Observation and Citizen Science

Ingrid Schulte

Supervisor: **Ping Yowargana**
Co-Supervisor: **Florian Kraxner**

Research Project: **LEVERAGING STAKEHOLDER INPUT TO IMPROVE THE CONSIDERATION OF CONTEXTUAL FACTORS IN RESTORATION SCENARIOS FOR INDONESIA**

Abstract:
The importance of societal aspects in the implementation of climate interventions, such as the restoration of natural ecosystems, is underrepresented within the current academic literature. To a large extent, these parameters are excluded from the estimates of technical mitigation potential, feasibility, and the tools that inform the development of policies, such as integrated assessment models (IAMs). This study aims to explore how data and information on the "contextual" factors (i.e. non-biophysical) that influence the uptake of restoration activities can be better considered in the GLOBIOM-based RESTORE+ scenarios for Indonesia. Within this framing, the objectives of this research are to: (1) deepen our understanding of citizen and stakeholder decision-making processes; (2) contribute to a balanced evaluation of options for implementing restoration; and (3) consider practical realities that may complement modelling approaches. Specifically, we are interested in understanding the factors that citizens and stakeholders perceive to be important to the effective implementation of restoration in Indonesia and how they interact with each other. Using participatory methods, this study will triangulate data from citizens and experts to provide insight on stakeholder perspectives around barriers, opportunities, and tradeoffs of restoration activities in the country and propose an approach to integrate these bottom-up perspectives into the scenario development process. The outcomes of this research have also implications for the enhancement of IAMs more broadly, as there is increasing recognition that involving communities in research can improve the relevance and quality. The proposed research will illustrate an avenue for stakeholder input to be considered and for economic models to make *ex-ante* predictions that reflect realities of local contexts on-the-ground.

Biographical sketch:
Ingrid is a PhD candidate at the Geography Institute and Integrative Research Institute on Transformations of Human-Environment Systems (IRI THESys) at Humboldt Universität zu Berlin (Germany). She is an experienced researcher and policy advisor on agriculture and land use topics, including forest conservation and restoration, food systems, and commodity supply chains. She is a senior land use consultant at the think tank, Climate Focus, and a visiting researcher at the Mercator Research Institute on Global Commons and Climate Change (MCC). She holds a Master´s degree in Public Policy from the Hertie School (Germany) and a BSc degree in Biology and Anthropology from Brandeis University (USA).

Xiaobo Wang

Supervisor: **Christian Folberth**
Co-Supervisor: **Rastislav Skalsky**

Research Project: **ADJUSTING CROPPING CALENDARS OF RICE-BASED SYSTEMS TO MITIGATE HEAT STRESS UNDER CLIMATE CHANGE IN SOUTH ASIA**

Abstract:
Future changes in the climate pattern present an array of challenging consequences for humankind in the coming decades. Food systems in South Asia, in particular, are at risk from rising temperatures and extreme heat events in the dry season. Although global warming is expected to induce aggregate production losses of wheat, rice and maize in tropical regions, most yield loss in rice-based cropping systems might be avoided, or even reversed with suitable adaptation strategies such as changes in planting times, varieties, irrigation, and residue management according to previous studies. Thus, his research will focus on how to adjust cropping calendars of farming systems in South Asia to mitigate heat stress of rice and wheat under climate change. Given that few crop models could well simulate the effects of specific heat stress on crop yields, this study will use a regional-scale calibration method based on available statistical datasets to optimize crop parameters of the EPIC model in extreme heat seasons, and simulate potential yields with adjusted cropping calendars under future climate scenarios. The study will provide scientific evidence for local climate change adaptation policies to ensure food security.

Biographical sketch:
Xiaobo Wang graduated in 2017 from Central China Normal University. He is currently a 3rd year PhD student at Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences. Title of his thesis is 'Adaptive management of agroecosystem in Bangladesh, India and Myanmar in the context of climate changes and regional food security'. His main fields of scientific interest include remote sensing and model simulation of crop growth, carbon cycle in agroecosystem.

Marina Andrijevic

Supervisor: **Simon Parkinson**
Co-Supervisor: **Edward Byers**

Research Project: **ACCOUNTING FOR ADAPTIVE CAPACITY IN INTEGRATED ASSESSMENT MODELS**

Abstract:
Full understanding of climate resilient pathways – development trajectories that account for adaptation and mitigation to climate change with the objective of sustainable development – will require a more elaborate representation of adaptation in research tools such as the Integrated Assessment Models (IAMs). Since damages from climate change, as well as relevant mitigation options, are contingent on the level of adaptation, IAMs need to incorporate more detail on adaptive capacity and how it may evolve in the future.

This research project builds on the previous work in my PhD, which focused on operationalizing adaptation-relevant socio-economic variables within the framework of Shared Socioeconomic Pathways (SSPs). The aim of the project is to (1) identify entry points in IAMs where adaptive capacity could be accounted for, and (2) design a sectoral indicator of adaptive capacity based on specific adaptation interventions identified in the first stage. The analysis will cover three major sectors: energy, water and land, and use a set of socioeconomic indicators from the SSPs to assess adaptive capacity. The indicator of adaptive capacity will be designed for use in new runs of IAMs and contribute to more robust assessment of climate change impacts.

Biographical sketch:
Marina is a PhD student at the Integrative Research Institute on Transformations of Human-Environment Systems (IRI THESys) at Humboldt Universität zu Berlin (Germany), working on socio-economic development pathways in relation to climate change adaptation and Loss and Damage. She is also working as a research analyst at Climate Analytics in Berlin where she supports the economics core of the team in research related to climate change damages and adaptation. Marina holds and MSc degree in Socio-Ecological Economics and Policy from Vienna University for Economics and Business (Austria) and a BA in Financial management from University of Sarajevo (Bosnia and Herzegovina).

Maarten Brinkerink

Supervisor: **Behnam Zakeri**
Co-Supervisor: **Daniel Huppmann**

Research Project: **ASSESSING 1.5-2°C SCENARIOS OF INTEGRATED ASSESSMENT MODELS FROM A POWER SYSTEM PERSPECTIVE - LINKAGE WITH A DETAILED HOURLY GLOBAL ELECTRICITY MODEL**

Abstract:
Achieving the goal of limiting global average temperature increase by 1.5°-2°C requires a radical transformation of the global energy system. Among others, increased levels of electrification and increased integration of variable renewables such as wind and solar power will become part of this transformation. Yet, there is an open question regarding the ability of future power systems to absorb extremely high levels of variable renewables. While Integrated Assessment Models (IAM's) such as MESSAGE are computationally advanced, they generally struggle with examining the impact of high levels of variable renewable electricity in power systems. This is due to their limited temporal resolution which is often restricted to a few time slices per year, while international best practice in power system modelling recommends at least hourly resolution. In this research, we assess the technical robustness of global power system results from IAM's Shared Socioeconomic Pathways (SSPs) 1.5-2°C scenarios at hourly levels by utilizing PLEXOS integrated energy model. Furthermore, benchmarking exercises will be conducted to compare the simulation outputs of the given scenarios between the IAMS and PLEXOS to identify strengths and weaknesses within both sets of global models and its underlying assumptions. For this latter part, a special focus will be laid on a model soft-link between MESSAGE and PLEXOS to assess whether the detailed power system results from the PLEXOS simulations can be fed back into MESSAGE as data input for future model simulations.

Biographical sketch:
Maarten holds a BSc from Saxion University of Applied Sciences (Deventer, The Netherlands) received in 2013 and obtained his MSc degree in Energy and Environmental sciences in 2017 from the University of Groningen (Groningen, The Netherlands) and KTH Royal Institute of Technology (Stockholm, Sweden). He is currently in his 3rd year of a PhD program within the Research Centre for Energy, Climate and Marine (MaREI) at University College Cork (Republic of Ireland). Maarten's research interests lie in energy- and power system modelling, electricity markets and renewables integration.

Setu Pelz

Supervisor: **Shonali Pachauri**

Research Project: **UNDERSTANDING THE EFFECTS OF RELIABLE ELECTRICITY AND INFRASTRUCTURE ACCESS ON NON-FARM ENTREPRENEURSHIP IN RURAL ETHIOPIA**

Abstract:
With universal electrification planned by 2025, rural Ethiopia is poised to undergo a similar energy access transformation to that seen in rural India over the last decade. In this study, household and community panel datasets from rural Ethiopia are analysed to determine the effects of reliable access to infrastructure and related services on non-farm entrepreneurship likelihoods, enterprise revenues and survival between 2012-2016. In view of the rural electricity access deficit and the Government's plan to achieve electricity access for all by 2025, the project specifically contrasts the effects of electricity access and quality with other infrastructure and services such as roads, information and communications technologies and financial institutions. The results will shed light on some of the poorly understood microeconomic processes underpinning the structural transformation of labour out of the agricultural sector in rural Ethiopia. Novel empirical evidence is drawn by exploiting spatio-temporal variations in the panel datasets and instrumenting electrification with spatial hydropower potential to minimise endogeneity with rural entrepreneurship. The utility of the analysis is emphasised by recent cross-country analysis into determinants of non-farm employment in sub-Saharan Africa, which found high heterogeneity within the region calling for country-specific analysis. With investments in electricity infrastructure expected to require 1.5B USD over the next five years, the outcomes of this work could help Ethiopian decisionmakers better understand potential development outcomes and complementary infrastructure requirements of proposed electricity expansion plans.

Biographical sketch:
Setu graduated with a double degree in Mechanical Engineering and Business Management from RMIT University, Australia in 2010. He is currently a 4th year PhD candidate with the department of Energy and Environmental Management at Europa Universität Flensburg, Germany. His research focusses on multidimensional energy poverty assessment, inclusive energy access planning and energy policy development. He is a member of the Off-grid Systems research unit at the Reiner Lemoine Institut and is a student fellow with the Initiative for Sustainable Energy Policy at Johns Hopkins University. His research interests include energy access, just transitions and sustainable development.

Tong Wang

Supervisor: **Narasimha Rao**
Co-Supervisor: **Jihoon Min**

Research Project: **ASSESSING COPPER DEMAND AND ASSOCIATED ENERGY USE AGAINST FUTURE SCENARIOS**

Abstract:
The effect of climate mitigation pathways is modeled with expected technical and economic characteristics, but the biophysical basis of the pathways is not fully included due to the lack of consideration of material uses. The fact that material consumption underlies the generated service scenarios and interacts with the technical characteristics makes the material aspect an indispensable part of the modeling. Copper, for example, the metal of energy transition, is contained by a typical home of about 100 kg and by a wind turbine of around 5 metric tons. Copper production was estimated to account for about 1%-2.4% of the projected 2050 overall global energy demand, compared to the current share of about 0.3%.

This project aims to explore the copper requirements and associated energy consumption of different scenarios to assess the change on total copper demand and energy use. Multiregional input-output (MRIO) data will first be used with the waste input-output material flow analysis (WIO-MFA) approach to determine the copper composition of different economic sectors. Second, the copper demand underlying different categories like buildings, transport, infrastructure, consumer products, and industry to fulfill the service scenarios like Low Energy Demand (LED) scenario, will be derived based on the copper composition results from the first step, followed by the analysis of the associated energy use through conducting life cycle assessment (LCA). Time permitting, panel analysis will be performed to analyze the coupling situation of copper demand and economic development for comparison. The result will serve as a preliminary step to integrate the information of material use in generating mitigation pathways and provide a basis for assessing the performance of resource efficiency measures, like recycling, to expand the spectrum of mitigation strategies.

Biographical sketch:
Tong Wang graduated with a BS degree in Environmental Science and Engineering and a Secondary Bachelor's Degree of Management in Business Administration from Shanghai Jiao Tong University, China in 2011. She received her Master's degree in Environmental Science and Engineering from Tsinghua University, China in 2014. She is currently a 3rd year PhD candidate at the Department of Chemical and Environmental Engineering and Center for Industrial Ecology at Yale University. The title of her thesis is *Modeling large-scale copper recycling to support transition to sustainable economy*. Her main field of scientific interest includes assessing the life-cycle impact of recycling technologies, understanding future copper demand and the role of recycling, and optimizing economy-wide recycling under different socioeconomic scenarios.

Yang Zhang

Supervisor: **Fei Guo**
Co-Supervisor: **Alessio Mastrucci**

Research Project: **SUSTAINABLE PATHWAYS OF CHINA'S BUILDING SECTOR BASED ON BOTTOM-UP MODELLING**

Abstract:
A rapid rise in China's construction scale due to urbanization has resulted in a large amount of energy consumption and carbon emissions. In order to achieve carbon emissions reduction and energy security, it is important to assess the energy use, emissions and other environment impacts from the building construction sector and explore future sustainable development pathways.
This study aims to analyze China's building stock, energy and environmental impacts of building construction, and assess the synergies between building operation energy use and embodied energy of building materials. A bottom-up model has been established, including the estimation of the existing building stock, embodied energy and emissions of new completed buildings over time. This research will improve the existing model by communicating the modeling method and data source. Several scenarios will be established for China's building sector until 2050, building stock controlling, construction mode selection and synergy with industrial efficiency will be considered in the scenarios. Based on the scenario analysis, insights on the development of China's building stock in the near future will be identified, and relevant low carbon development pathways of China's building sector will be proposed.

Biographical sketch:
Yang Zhang is a 3rd year PhD student at the Building Energy Research Center, Tsinghua University. His main research interests lie in the fields of building energy modelling and climate change mitigation policies. His current research at THU focuses on building stock modelling and building embodied energy estimation based on the official data and survey data collected by BERC. Yang also worked at the International Energy Agency as an analyst intern in early 2019, which resulted in a publication entitled *The Future of Cooling in China*.

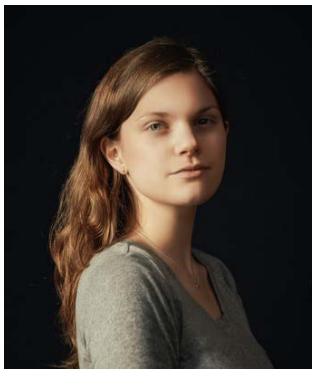
Bernardo Buarque

Supervisor: **Gergely Boza**
Co-Supervisor: **Gerald Silverberg (ASA)**

Research Project: **EVOLVING THE KNOWLEDGE-SPACE: A DYNAMIC MODEL OF PATENT CLASS COMBINATION IN NEW PRODUCTS**

Abstract:
Evolutionary Economic Geography explores how regions specialize in different industries. Foremost, it describes product (or technological) relatedness as a fundamental driver to regional knowledge output. Indeed, several studies revealed these patterns of specialization while using data on the co-occurrence of exports (Hidalgo et al., 2007), occupations (Jara-Figueroa et al., 2018), and technological classes within patents (Kogler et al., 2015; 2017).
Nonetheless, few models grounded on evolutionary theory sought to understand the mechanics behind this process. Along these lines, the present research aims to develop an evolutionary game theory setup (Nowak, 2006) to explore the creation of new knowledge through the combination of patent classes. At each round of this dynamic model, two technological classes (i.e., CPCs) assemble to construct a new product. Still, the likelihood they will successfully output a new patent depends on their relative distance – which is measured by the co-occurrence network as in Kogler et al. (2017). Thus, the model aims to illustrate the dynamics of specialization while employing the knowledge-space methodology to define the fitness of each patent class. That is, the expected payoff of each CPC is a function of its relative frequency, and the incidence of the other codes weighted by their relatedness. In other words, the model is designed to represent the frequency-dependent dynamics of knowledge diversification and specialization as a result of technological combination and relatedness.

Biographical sketch:
Bernardo Buarque is a PhD candidate working for the Spatial Dynamics Lab at the University College Dublin (UCD). Bernardo holds a scholarship from the European Research Council (ERC) and is working alongside Prof. Dieter Kogler on the project "Technology Evolution in Regional Economies (TechEvo)." The main objective of the said project is to understand how specific knowledge capabilities influence the evolution of local technology trajectories and thus shape the geographies of economic prosperity. Using data from scientific publications and patents, Bernardo seeks to estimate the competence of regions to produce certain technologies. In the past, he examined the creation and diffusion of Artificial Intelligence across Europe and now seeks to develop an evolutionary game theory model to study the patterns of regional specialization, and ultimately appraise which places have the core competence to produce new, emergent technologies - e.g., AI.



Lisa Thalheimer

Supervisor: **Reinhard Mechler**
Co-Supervisor: **Raya Muttarak (POP)**

Research Project: **ATTRIBUTING DISASTER DISPLACEMENT TO ANTHROPOGENIC CLIMATE CHANGE IN EAST AFRICA**

Abstract:
Displacement triggered by natural hazards and extreme weather events (disaster displacement) is estimated to account for 72% of all new internal displacements in 2019; the remaining 18% is associated with conflict and violence. Increased human mobility, voluntary and involuntary, is often portrayed as a key impact of anthropogenic climate change. Yet, causal, quantitative evidence on such links remains sparse and suffers from disciplinary hurdles. Mobility decisions, when not as a reactive response to extreme weather events, i.e. sudden displacement, are multi-causal and rarely due to climatic stress alone. With anthropogenic climate change, push and pull factors of human mobility may change significantly. However, whether and to what extent it will change is unknown. With increased frequency and intensity of extreme weather, affected populations could run out of resources enabling them to migrate. Broader policy questions arise: How can we develop and increase adaptive capacity in regions vulnerable to climate change impacts? Bringing together Probabilistic Event Attribution (PEA) and econometric methods, we will quantify the impacts of extreme weather events and displacement in East Africa, seeking to answer the question: Whether and to what extent did anthropogenic climate change alter the likelihood of extreme weather- related displacement? Modeling interaction channels of mobility drivers, the project runs the exact same calculation in a hypothetical scenario excluding anthropogenic emissions (PEA). The research results will support in the understanding of the role of anthropogenic climate change in disaster displacement and eventually inform debate on climate and migration policies.

Biographical sketch:
Lisa is a DPhil (PhD) candidate at the University of Oxford. Her research focuses on quantifying the impacts of human mobility and extreme weather events, attributing the role of anthropogenic climate change. Her current research also spans multivariate models and forecast-based financing for humanitarian assistance. Lisa holds a MSc in Sustainability Management from Columbia University. Before beginning her doctoral studies, Lisa worked in a variety of roles on the linkages between the environment and inclusive growth at the World Bank and the IMF in Washington, D.C., and The Earth Institute in New York, NY.

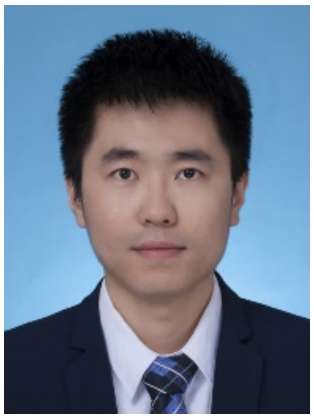
Eleftheria Vavadaki

Supervisor: **Stefan Hochrainer-Stigler**
Co-Supervisor: **Georg Pflug**

Research Project: **EXPLORING FARMERS' WILLINGNESS TO BUY INDEX-BASED FLOOD INSURANCE: EXPERIENCES FROM NEPAL**

Abstract:
The latest IPCC (2018) report indicates that global warming is likely to reach 1.5°C between 2030-2052, if the emissions continue to increase at the current rate. This will lead to an increase in the frequency and intensity of hydro-meteorological hazards and will put additional stress to developing countries to cope with disaster events. The Sendai framework for Disaster Risk Reduction (DRR) underlines the need of the promotion of insurance and risk transfer mechanisms, as a means of preparedness for such events for today and in the future. The usefulness of Index-based insurance even though increasingly mentioned as an option for risk reduction is still unclear. Especially its usage in conjunction with the existing informal risk sharing mechanisms and its contribution to DRR remains controversial. This is essentially an empirical question and this study aims to shed light on this issue focusing on farmers' willingness to buy index-based flood insurance for crops in a developing country context. The case study area selected for this analysis are the lowlands of the Karnali river basin in Nepal, where smallholder farmers are exposed to frequent flood events. The research will employ a quantitative household survey of 705 questionnaires with some of the most flood-exposed communities of the Karnali river basin. By bringing evidence from a new location this study should contribute to the further understanding of index-based insurance for DRR and Disaster Risk Finance (DRF).

Biographical sketch:
Eleftheria holds a BSc in civil engineering from the National University of Athens (NTUA) and a MSc on Water Resources Science and Technology (WRST) from the same university. She continued her studies with a MSc in Flood Risk Management (FRM), jointly awarded by four European universities: The Institute of Water Education IHE Delft (the Netherlands), the Technical University of Dresden (Germany), the University of Catalonia (Spain) and the University of Ljubljana (Slovenia). Eleftheria is a 3rd year doctoral student at the Business School of Durham University in collaboration with the Institute of Hazard Risk and Resilience (IHRR) in the United Kingdom. Her research is on the topic of financial instruments for natural hazards in developing countries with a focus on index-based insurance and floods in Nepal.



Daoping Wang

Supervisor:	**Thomas Schinko (RISK)**
Co-Supervisors:	**Célian Colon (ASA), Nepomuk Dunz (RISK & ASA)**

Research Project: **MODELING THE PROPAGATION OF DISASTER SHOCKS IN ECONOMIC NETWORKS: AN AGENT-BASED APPROACH**

Abstract:
While increasingly complex economic networks contribute to socioeconomic development by improving allocation efficiency and promoting technology spillovers, they also provide a channel for the propagation of negative shocks and thus amplify risks throughout global supply chains. Given projected increases in disaster risk due to climate change, developing methodologies that more accurately simulate the propagation of shocks through economic networks becomes crucial for developing effective prevention and recovery strategies. Computable general equilibrium (CGE) models and input-output (IO) models are the two most widely used methods for performing such economic assessments, due to their ability to capture interactions in economic networks. However, both of them have inherent shortcomings, which may lead to biased results: CGE is considered to be overly optimistic on market flexibility and overall substitution capacity, while IO analysis does not take into account productive capacity and producer/consumer behavior. Based on pioneering work in the existing literature, this project aims to develop an agent-based model that combines the strengths of both model frameworks and contributes to a more realistic representation of disaster aftermath. The main contribution of this model to the simulation of the propagation of negative shocks is a novel local-optimization mechanism that more realistically allocate commodities in case of shortage. This innovation circumvents the rigidity problem of IO models and the overly optimistic market flexibility of CGE models.

Biographical sketch:
Daoping Wang is a 2nd year PhD candidate in Regional Science and Urban Economics at the School of Urban and Regional Science, Shanghai University of Finance and Economics (SUFE). Before joining SUFE, Daoping received a Master of Economics from Shandong University in 2018, and a BA in Engineering from Xi'an Jiaotong University in 2013. His current research focuses on modeling the propagation of negative shocks on supply-chain networks. His main fields of scientific interest include risk assessment, agent-based modeling, computable general equilibrium modeling, mathematical optimization, network analysis.

Ramanditya Wimbardana Wimbadi

Supervisor: **Paul Kishimoto**

Research project: **THE LANDSCAPE PRESSURE OF SOCIO-TECHNICAL REGIMES OF URBAN PUBLIC TRANSPORT FOR LOW CARBON MOBILITY IN INDONESIA**

Abstract:
Cities are the major hotspots of CO2 emission, and their passenger mobility is collectively responsible for at least 20% of the overall transport sector contribution to the global CO2 emission. Cities in Indonesia are currently urbanizing rapidly among Asian countries that could increase urban passenger mobility and, thereby, the amount of CO2 emission from the sector. In the theory of sustainability transition, pressures from the landscape level play significant roles in creating the window of opportunity for niche-innovation to foster a sustainability transition. Public transport has the potentials to take roles to cut CO2 emission by improving its energy efficiency on the technological side and shifting passenger mobility from private automobiles. Currently, urban public transport still gets lacking attention on how to promote urban public transport roles as the frontier for cutting CO2 emission within the sector in Indonesia. This research aims to unfold factors at the landscape level that give pressure on the socio-technical regime of urban public transport to support low carbon mobility transition. This research is a qualitative one since we will collect the data through the combination of literature review and stakeholder interviews. We will gather the data from peer-review articles and newspaper articles to identify sources of pressure, particularly economic and political pressures at both local, national, and global levels. For the analysis, we will apply content analysis to identify different categories and inter-relationship to create the pressure. First, we expect the results will shed light on which exogenous factor plays a prominent role in influencing the regime. Second, we could identify different ways of the factors in stimulating niche innovation for public transport to cut CO2 emission in cities in Indonesia. This comprehension will be a basis in what ways cities should take strategic steps in investing and building transport initiatives for low carbon mobility.

Biographical sketch:
Ramanditya is a 2nd year PhD student in Sustainability Science from the United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS), Tokyo, Japan. He is currently developing his research interest in low carbon transition and urban governance. He is also a researcher at Resilience Development Initiative (RDI) in Bandung, Indonesia, where he researches climate change adaptation and disaster risk management. In 2015-2017, he received the Fulbright Scholarship to support his Master's program in urban planning at the University at Buffalo, the State University of New York.

Bingqing Ding

Supervisor: **Tieju Ma**
Co-Supervisor: **Behnam Zakeri (ENE), Marek Makowski (ENE)**

Research Project: **AN ANALYSIS OF CHINA'S LIQUID FUEL INDUSTRY'S TECHNOLOGY PORTFOLIO AND CAPACITY CONFIGURATION UNDER ENERGY SECURITY AND UNCERTAIN CARBON PRICE**

Abstract:
With the improvement of China's economic strength, the liquid fuel consumption of China has increased dramatically. More than 80% of liquid fuels come from crude oil refining, and China is a less oil country. These led to China have a high dependency on crude oil imports. In 2018, China imported more than 461 million tons of oil, which accounted for 72% of China's total oil consumption. These far exceeded the internationally recognized warning line of 60%. Consequently, it greatly challenged the nation's energy security. In crude oil consumption, more than 60% is made into liquid fuels. Thus, alternative technologies for producing liquid fuel from coal, biomass, and oil shale will play a significant role in reducing crude oil dependence. The oil dependence, combined with the uncertainty of carbon price, will influence these technologies' adoption, the existing models pay little attention to these aspects. In this study, we plan to develop an optimization model with uncertain carbon price from long-term perspectives, with this model. We optimize the technology portfolio by minimizing the accumulative cost and reducing oil dependence. This study will offer implications for decision-makers to make better policies for promoting the development of the liquid fuel industry.

Biographical sketch:
Bingqing Ding is currently a 2nd year PhD student in the School of Business, East China University of Science and Technology (ECUST). In 2018, she graduated from Yunnan University of Finance and Economics with a master's degree in management science and engineering. Now, her main research topic is the technology portfolio and optimal dynamic capacity configuration of China's new coal chemical industry under price fluctuation of crude oil and other uncertainties.

Anna Amankwah-Minkah

Supervisor: **Mikhail Smilovic**
Co-Supervisor: **Sylvia Tramberend**

Research Project: **EVALUATION OF HYDROLOGICAL RESPONSE TO EXPANSION OF IRRIGATED RICE PRODUCTION IN THE EXTENDED LAKE VICTORIA BASIN**

Abstract:
The Lake Victoria Basin has been touted as having the potential to meet rice demand in East and Central Africa. Current irrigation production and yield rates are low and attention is turning to expansion of irrigated rice production. Some studies have demonstrated sustainability of increased production of irrigated rice but the effect on the hydrology of the basin is yet to be fully understood. This study will analyse the impact of increased production of irrigated rice on the water balance of the extended Lake Victoria Basin. Specifically, it will assess the changes in return flow and stream flow under current scenario as well as the increased irrigated rice production scenario. The Community Water Model will be used to estimate the water balance components in the basin and subsequently explore the effects of increased irrigation. Recommendations are given on how to expand irrigated rice production according to sustainable water management practices.

Biographical sketch:
Anna Amankwah-Minkah graduated from Kwame Nkrumah University of Science and Technology with a BSc in Civil Engineering and an MSc in Water Resources Engineering and Management. She is currently a 3rd year PhD student at the Regional Water and Environmental Sanitation Centre at the Kwame Nkrumah University of Science and Technology, Kumasi-Ghana. Anna's research focuses on sustainable management of groundwater resources in light of climate change. Her areas of research interest are natural recharge, groundwater management, climate change and drought risk management.

Denise Cáceres

Supervisor: **Luca Guillaumot**
Co-Supervisor: **Yoshihide Wada**

Research Project: **ASSESSING WATER STORAGE VARIABILITY IN LARGE EXORHEIC RIVER BASINS AND ITS CONTRIBUTION TO GLOBAL OCEAN MASS CHANGE FROM GLOBAL HYDROLOGICAL MODELS OVER 1948-2016**

Abstract:
Recent studies have shown that the total continental water storage anomaly (TWSA) remains one of the most uncertain components of the global ocean mass budget. This component can be derived from GRACE observations and also from global hydrological models (GHMs). A key advantage of using GHMs is the possibility to decompose TWSA into mass changes in individual water storage compartments (e.g. soil, groundwater etc.). In the present study, the contribution of TWSA to global ocean mass change (OMC) during 1948-2016 will be assessed with two GHMs, WaterGAP2.2d and CWatM. As a first step, modeled monthly TWSA over the global continental area (except Greenland and Antarctica) will be compared to GRACE spherical harmonic solutions over 2002-2016. The next step will consist in deriving monthly TWSA at the scale of multiple large exorheic river basins corresponding to different characteristics (e.g. climate, anthropogenic pressure etc.). Modeled monthly streamflow at the basin outlet will be evaluated against gauging station observations. Monthly TWSA time series at basin scale will be decomposed into individual temporal components (seasonal, linear trend and inter-annual) and mass components. We will evaluate the relation between TWSA and global-scale climate phenomena (e.g. ENSO) by comparing modeled TWSA inter-annual variability to climate indices (e.g. MEI). By comparing the outputs from the two GHMs, we will identify the main sources of uncertainty in modeled TWSA.

Biographical sketch:
Denise holds a BSc in Environmental Sciences from the University of Aix-Marseille (2010-2013, France) and a MSc in Hydrology and Environmental Risks from the University of Montpellier (2013-2015, France). She is a fourth-year doctoral student in the Hydrology Working Group of Prof. Dr. Döll at the Institute of Physical Geography of the Frankfurt Goethe University (Germany). Her research focuses on the assessment of large-scale continental water storage mass changes and the identification of their main natural and human drivers, through the application and development of the WaterGAP global hydrology and water use model.

Marko Kallio

Supervisor: **Peter Burek**
Co-Supervisor: **Sylvia Tramberend**

Research Project: **A PROCESS-AWARE INTERPOLATION METHOD FOR DOWNSCALING HYDROLOGICAL VARIABLES**

Abstract:
Water is an essential resource for human society. Numerous approaches have been developed in order to assess the availability of water for our societies, and how much water is required for its proper functioning. Information on both availability and water demand is readily available from various databases, which, however, often come in spatial aggregation which is too coarse for detailed analysis or local use cases. In this research, we propose a novel Process-Aware Interpolation (PAI) technique based on advanced areal interpolation methods. In areal interpolation, the value of a variable from a source zone is divided among intersecting target zones. We develop a method which can utilize our understanding of the physical phenomenon governing water availability, and the societal process(es) driving water demand in guiding the interpolation process. PAI is based on areal interpolation, because it is a simple and intuitive approach, but which is flexible enough to accommodate process descriptions of any complexity; data-driven or expert knowledge-based models. PAI can additionally be used for purposes of upscaling, downscaling, and simply representing data in an alternative, non-conforming areal units. We perform a case study where we develop process descriptions for selected hydrological variables relating to water availability and demand and evaluate how the selected variables fare when compared against observation data and high-resolution model results.

Biographical sketch: Marko is a 4th year DSc researcher in Aalto University conducting interdisciplinary research in Geoinformatics Research Group, and Water and Development Research Group. He holds a BSc. degree in Environmental Engineering (water management) and an MSc. in Geoinformatics (cartography). He is looking to improve water scarcity assessments in data scarce areas in his DSc research, particularly in the Greater Mekong Region in Southeast Asia. Marko's main research interests are related to modelling methodology, and how we can increase the usability of already-existing model outputs in order to save time, money and effort.

Milan Das

Supervisor: **Michaela Potancokova**
Co-Supervisor: **Erich Striessnig**

Research Project: **EDUCATIONAL DIFFERENCES IN TIMING AND QUANTUM OF FERTILITY IN INDIA: A COHORT APPROACH**

Abstract:
The postponement of childbearing in the early reproductive age is widespread among women with higher levels of education. India has currently experienced a significant decline in fertility driven by the shifts in the timing of childbearing and by reduction of higher-order births among uneducated women. A large body of research has been focused on women's education and fertility, but these studies remain restricted to period analyses of fertility change. Only a few studies have examined cohort fertility trends in India. One specific question that has yet to be investigated is how completed cohort fertility differs with respect to age at entry into motherhood and whether an improvement in girl's educational attainment played a role in the delay of first motherhood and in cohort fertility decline. Thus, it is necessary to understand the relationship between the timing of childbearing and women's education across subsequent births cohorts. Therefore, studies of the actual fertility experience of women with their educational level born in different calendar years are needed. Using the retrospective birth histories of women born in1943 to 1976, I aim to study differences in completed cohort fertility and timing of childbearing by educational attainment of these women. The analysis will make use of the four rounds of the National Family Health Survey of India conducted in 1992-2016. Understanding the cohort completed fertility considering timing and female education would produce more precise estimates and will help us to better understand the postponement of birth by parity of women in recent fertility decline.

Biographical sketch:
Milan graduated in Geography from The University of Burdwan, India in 2013. He is currently a 3rd year doctoral candidate at the International Institute for Population Sciences in Mumbai, India, where he also earned a Master's degree in Population Studies. His PhD thesis is entitled "Understanding the Socioeconomic and Proximate Determinants of Fertility Decline in India". His main research interests lie in the study of fertility change in India, education and fertility, use of contraceptives, abortion, and spatial demography.

Yingji Wu

Supervisor: **Dilek Yildiz**
Co-Supervisor: **Samir KC**

Research Project: **ANALYSIS OF THE EDUCATION IMPACT ON CHINA'S SUB-NATIONAL POPULATION AND HUMAN CAPITAL DYNAMICS**

Abstract:
China's population has increased from 0.56 Billion in 1950 to 1.37 billion by 2010, and China's economic development benefits a lot from its large amount of high-quality labor force with basic education. However, the strict one-child policy, increasing of mother's education, and cost of childbearing shaped a different trend of China population and human capital in the past decades. The fertility rate quickly declines after the 1970s and become below the replacement level in the 1990s. With the quick decline of fertility, the population aging progress and the labor force is declining much faster than other countries. The decline of fertility and population transition in the past three decades always gives the credit to China one-child policy by the Chinese family planning committee and many Chinese demographers, but the effect of educational expansion in the same period usually being neglected. Education is believed as one of the keys to China's economic development as well as the fertility decline. The candidate plans to analyze the impact of education on the past population and human capital dynamics both on the national and subnational levels. The understanding of education influence will be used to set scenarios for the multi-dimensional population and human capital projection model of China and further provide the suggestion for the policymaker to plan policies either to avoid or to change the undesirable future or to be prepared for the inevitable ones.

Biographical sketch:
Yingji Wu is a 3rd year PhD student at Asian Demographic Research Institute at Shanghai University. He previously received a Master's degree in Sociology from Shanghai University. His current study mainly focuses on the educational impact on China's population and human capital dynamics. Moreover, his research interest includes education policy and education development, population projections, and the relationship between education and demographic dynamics.