YSSP

Young Scientists Summer Program

YSSP participants 2018

Biographical sketches and research project abstracts

International Institute for Applied Systems Analysis
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Ekaterina Antsygina

Supervisor: **Lassi Heininen**
Co-Supervisors: **Nadejda Komendantova-Amann (RISK), JoAnne Bayer (RISK)**

Research Project: **Dividing the Arctic: Sovereign rights on extended continental shelves in the High North**

Abstract: My research is devoted to the delimitation of continental shelves beyond 200 nautical miles (nm) in the High North. The global warming brings lots of negative consequences, but there are positive moments including commercially viable mining in the Arctic and possibility of construction of artificial islands. These activities can be carried out based on the sovereign rights on continental shelves. The delimitation of the extended continental shelves in the Arctic will impact how the Arctic states cooperate in environmental issues, scientific collaboration, and infrastructure projects.
A special attention will be given to the delimitation between Canada, Russia, and Denmark, as overlapping claims exist, and these states are claiming the sovereign rights in the North Pole. Most likely, these claims are dictated by geopolitical ambitions rather than by intentions to establish control over the natural recourses situated around the North Pole. Thus, the study will include some geopolitical review of the importance of the North Pole and the Arctic for the littoral states. Also, the analysis of the status of the Lomonosov Ridge as a submarine elevation under Article 76(6) of the UNCLOS will be necessary to establish which state has a legal standing.
The main objectives are to contribute towards a better understanding of a legal nature of extended continental shelves and to demonstrate interrelations between international law and geopolitics. The process and principles of extended continental shelves' delimitation, influence of geology, geomorphology, and geopolitics to delimitation are the core questions of the research.

Biographical Sketch: Ekaterina Antsygina graduated with honours from Mari State University, with a specialization in Russian civil law (BA Hon. Equivalent) and the Ohio State University with specialization in international and comparative law (LL.M). Her master studies were sponsored by the Fulbright Scholarship. Ekaterina is admitted to the New York State Bar. She is currently pursuing a PhD in international law at Queen's University. Scientific interests of Ekaterina include public international law, the law of the sea, maritime delimitation, and the Arctic governance.

[1] Article 77 of the UNCLOS. *United Nations Convention on the Law of the Sea*, 10 December 1982, 1833 UNTS 3 (entered into force 16 November 1994). [UNCLOS].
[1] Canada has not yet submitted its data to the Commission on the Limits of the Continental Shelf but expressed intentions in respect to the North Pole.

David Abel

Supervisor: **Fabian Wagner**
Co-Supervisor: **Matthew Gidden (ENE)**

Research Project: **Assessing the air quality and health benefits of solar photovoltaic electricity production in Paris Agreement scenarios for South Africa**

Abstract: The air quality and health benefits of solar photovoltaics (PV) have not been quantified in most regions of the world, even though it is qualitatively understood that PV offers ambient air pollution benefits from displacing emissions of health-damaging pollutants from the power sector. While at IIASA, I will perform a systems analysis to quantify the air quality and health benefits of solar PV in future energy scenarios for South Africa. This work will quantify the ambient air quality and health benefits of PV using GAINS-South Africa. Outcomes will include assessing power-sector emissions of nitrogen oxides (NO_X), sulfur dioxide (SO_2), and particulate matter (PM), as well as changes to ambient concentrations of fine particulate matter ($PM_{2.5}$) and $PM_{2.5}$-related mortality. The scenarios considered will be simulated using MESSAGE-South Africa to reflect realistic conditions consistent with South Africa's 2016 Integrated Resource Plan and Nationally Determined Contribution submitted for the Paris Climate Agreement. Air quality changes will be assessed by pollutant across temporal and spatial scales and results will consider cost, health outcomes, associated climate benefits, and uncertainties. This study will complement and draw on the skills of my PhD work quantifying the benefits of clean energy on air quality and health in the United States.

Biographical Sketch: David Abel is a third-year PhD student at the Nelson Institute Center for Sustainability and the Global Environment at the University of Wisconsin – Madison, USA. David's research focuses on interdisciplinary modeling to assess the air quality and public health impacts of the U.S. electric power sector and quantify the potential for clean energy technologies and policies to co-manage climate change, air pollution, and health. Prior to starting his PhD, David received a BS in Mechanical Engineering and Environmental Studies and a joint MS in Mechanical Engineering and Environment & Resources from the University of Wisconsin – Madison.

Boshu Li

Supervisor: **Shaohui Zhang**
Co-Supervisor: **Janusz Cofala**

Research Project: **Towards decapacity policy solutions for air quality and public health improvement in the Jing-Jin-Ji region of China**

Abstract: The decapacity policy (DCP) in resource-intensive heavy sectors has been widely launched as the key policy of current “supply-side structural reforms” in China since 2016 in the context of the "New Normal" state of the economy. As one of the key contributors to the increasingly heavy air pollution, the Iron and Steel (IS) sector plays a key role in eliminating overcapacity, which is estimated at 340 million tons of crude steel in 2015. The Jing-Jin-Ji (JJJ) region, where many of the most polluted cities are located, pledged to fulfill the largest share (over 40%) of the national IS capacity cutting targets. Previous policy impact assessments focused mainly on qualitative discussions on the reason and risk of overcapacity while ignoring the quantitative assessment of air quality, public health, and economic consequences. In this study, we plan to use and further develop an integrated assessment framework, consisting of the IIASA GAINS and MESSAGE-iron and steel model in addition to the Peking University Integrated Model of Energy, Environment and Economy/Computable General Equilibrium model (IMED|CGE) and the Health Impact model (IMED|HEL). With this framework we will:
a) Explore the changes in energy and emission pathways of the JJJ region due to the DCP
b) Investigate how the PM2.5 pollution-related health impacts affect the macroeconomy at the provincial level in China;
c) Analyze the costs and benefits of the application of DCP.
The conclusions and insights from this study could become a reference for similar overcapacity challenges in other sectors and regions, such as the coal, cement and construction sectors.

Biographical Sketch: Boshu Li is currently a third-year PhD candidate at the College of Environmental Science and Engineering at Peking University (PKU) in China. Boshu received his Master’s degree in Public Management at Aix-Marseille University in France in 2010. Prior to his joining the PKU in 2015, he had over five years working experience in energy consulting firms and institutions, including two years managerial level experience. Boshu’s academic interests include economics of environmental & energy policy, integrated assessment models, and the energy-environment-economy nexus. The title of his PhD thesis is “Study on the Economic and Environmental Impacts of Industrial Structure Transformation in China”.

Luckson Muyemeki

Supervisor: **Peter Rafaj**
Co-Supervisor: **Gregor Kiesewetter**

Research Project: **Assessment of emission reduction strategies in the Gauteng City-region in South Africa**

Abstract: The current state of air quality in the cities of South Africa presents a major challenge to policy makers. The approach used to manage air quality has not met the desired outcomes. This is in part due to air quality issues being given less priority and also due to financial constraints. With particulate matter (PM) levels in South African cities being well above WHO air quality limits there is need to identify alternative policy interventions that can reduce emissions with minimal costs to the economy. Integrated assessment models can offer practical solutions to tackle the air quality management challenges currently faced in South Africa. In this study potential mitigation options for the Gauteng City-Region will be explored using the GAINS model. A chemistry transport model will be utilised to evaluate the impacts of primary PM and PM precursor source emissions from different economic sectors on ambient concentrations. Impacts on air quality within the South African GAINS domain will be analysed under different policy scenarios. Results from this analysis will be used to form a basis for managing future air quality in South Africa.

Biographical Sketch: Luckson Muyemeki is currently a third-year PhD candidate in the Geo- and Spatial Science department at North-West University in South Africa, where he also completed his Master's degree in Geography and Environmental Management in 2015. His main fields of research interest include air pollution sources, integrated air quality management and atmospheric remote sensing. His doctoral research is focused on identifying the major sources contributing to air pollution in priority areas.

Jiamin Ou

Supervisor: **Zbigniew Klimont**
Co-Supervisor: **Shaohui Zhang**

Research Project: **Demand-driven ground-level ozone pollution in the Guangdong province, South China**

Abstract: While China's policies addressing emissions of particulate matter and sulfur dioxide (SO_2) resulted in declining $PM_{2.5}$ levels, the ambient concentration of ground-level ozone (O_3) has been increasing rapidly, especially in the South China. As a secondary air pollutant, ground-level O_3 is formed by nitrogen oxides (NOx) and volatile organic compounds (VOCs). The control of O_3 pollution therefore hinges on the reductions of NOx and VOCs. Past efforts in China generally focused on end-of-pipe controls, but the emission reduction potentials from this side have decreased year by year while O_3 levels keep increasing. As China is trying to adjust its relationships between domestic supply and demand sides for achieving sustainable development goals, demand and supply driving the production activities with O_3 precursor emissions should be investigated. In this way, O_3 control might be coordinated with China's structure adjustments and new opportunities for emission control might be exposed.

In this study, we will combine the input-output analysis with an air quality model to track down the emissions along the supply chain and reveal the demands (local or from other regions) behind the observed ambient pollution. Specifically, consumption-based VOCs and NOx emission inventories will be developed and ambient O_3 concentration in the Guangdong province will be allocated to sectors and demands along the inter-regional supply chain. Ultimately, we hope to provide a new angle to understand the ever-increasing O_3 pollution of the study area from the supply and demand side.

Biographical Sketch: Jiamin Ou is a second-year PhD student at the University of East Anglia (UEA), UK. Her current research interests include the consumption-based accounting for greenhouse gas and air pollutants, and their linkages with climate and air quality model. Before joining UEA, she obtained two Master's degrees, which are Master of Environmental Engineering in South China University of Technology, and MSc in Risk Management at the Chinese University of Hong Kong. Her Master's thesis focused on the VOC sampling, speciated VOC, OVOC inventories and O_3 chemistry.

Hans-Kristian Ringkjøb

Supervisor: **Fabian Wagner**
Co-Supervisor: **Sennai Mesfun (ESM)**

Research Project: **Representation of short-term solar and wind variability in long-term energy models – a European case study**

Abstract: Europe's energy system is undergoing rapid changes. Over the past two decades, driven by efforts to mitigate climate change as well as large cost reductions and technological development of zero emission technologies, integration of intermittent renewables, especially solar and wind, have grown rapidly. Solar and wind are projected to continue their expansion, and are expected to possess a large share of the energy mix towards 2050. However, solar and wind are variable renewable energy sources whose outputs vary according to the weather. This variability leads to several challenges ranging from short-term system operation to planning of future energy systems over the course of several decades. Long-term energy models are frequently used to investigate pathways to future energy systems and as the share of solar and wind technologies in the energy mix continues to grow it becomes increasingly important to adequately represent their short-term variability in such models. In this work, we assess the representation of short-term variability of solar and wind in a TIMES model of the European power sector under two different modelling approaches: (i) a conventional deterministic approach with a high temporal resolution; and (ii) a stochastic modelling approach that takes into account the uncertainty of solar and wind short-term variability. The aim of the research is to evaluate the performance of the two modelling approaches, and at the same time analyse the evolution of the European energy system towards 2050 with particular focus on how grid interconnections, storage and demand response can help accommodate for variable renewables.

Biographical Sketch: Hans-Kristian Ringkjøb is a PhD candidate at the Geophysical Institute, University of Bergen, Norway. His research is in renewable energy, with focus on modelling of energy systems using the TIMES modelling framework. He holds a double Master's degree in renewable energy from École Polytechnique (France) and Instituto Superior Técnico (Portugal), achieved through the MSc RENE program offered by InnoEnergy.

Jessica Burnett

Supervisor: **Brian Fath**

Research Project: **A relative performance analysis of ecological regime shift detection methods**

Abstract: Drastic shifts in the underlying structure or functioning of an ecological system (or regime shift) are manifested in the distribution and abundance of species in a given area. Understanding and forecasting these changes are critical for community and ecological planning and management. Although abiotic measures and indicator species are often used to monitor ecosystem dynamics, these indicators may be futile as we (humans) induce novel ecological conditions and configurations. Regime shift detection methods (RSDMs), or methods designed to detect abrupt changes in ecological and environmental conditions, abound in climatology and paleoecology and perform reliably in systems that are confidently described by one or a few state variables. Ecosystem management decisions based on results from some quantitative regime shift analyses may, as a result of ecosystem complexity coupled with uninformative data, result in missed opportunity for prevention or mitigation of abrupt changes in ecosystem functioning. I will evaluate the capacity of multiple RSDMs to identify regime shifts in high dimensional and noisy data, comparing the relative performances of each. Projected results include identifying gaps in the capabilities of ecological RSDMs, and reproducible tutorials for comparing and applying RSDMs for the theoretical and applied end users, respectively. This project uses a systems-analytical approach to address the methodologies available for detecting system transitions (and regime shifts) of high dimensional systems without a priori hypotheses. This project will primarily operate in two of the three pillars of ASA's strategy: 'exploratory applied mathematics' and 'transfer of methods'; and will operate under the ecological theory inherent within Domain 3: 'System transitions and resilience of systems'. This project will benefit both the theoretical and applied ecological research communities, respectively.

Biographical Sketch: Jessica is a macro- and quantitative ecologist and PhD candidate (expected 2019) of Natural Resource Sciences at the University of Nebraska, in Lincoln, Nebraska, U.S.A. She holds MSc (2015) and BSc (2013) degrees in Wildlife Ecology and Conservation from the University of Florida. Her dissertation research evaluates the efficacy of using large-scale avian monitoring program data to identify ecological regime shifts in space-time. Jessica's research interests include, but are not limited to, regime shift theory and application, ecological invasions, avian ecology, and dynamical systems. Jessica's long-term research goals are to optimize the quantitative methods for evaluating, interpolating, and forecasting large-scale ecological monitoring data.

Alessandro Mancuso

Supervisor: **Piotr Żebrowski**

Research Project: **Portfolio optimization of security measures against cyber threats**

Abstract: Cyber threats affect all kind of institutions with frequent and costly impacts worldwide, for instance the Petya and WannaCry cyber-attacks that hit thousands of large and small organizations across the globe in 2017. Nowadays, the extensive reliance on ICT systems make institutions vulnerable to physical and cyber threats, which are typically evaluated through qualitative risk matrices. In contrast, my YSSP project aims to formulate a framework for quantitative risk assessment of physical and cyber threats to ICT systems. On top of that, an optimization model would support the selection of cost-efficient strategies for security of an institution against cyber threats by accounting for financial and technical constraints. A common practice in risk analysis is an iterative evaluation of possible measures against individual threats, which could lead to inefficient or infeasible solutions. Instead, I propose to evaluate portfolios of measures designed to secure the ICT system against a variety of cyber-attack scenarios and select one that minimizes the likelihood and severity of damage. The framework builds on Bayesian Networks that enable a probabilistic representation of combinations of events possibly leading to severe outcomes. This model responds to the need for intuitive and computationally efficient methods for risk analysis, combining expert judgements and statistical analyses for quantitative risk assessment. In my YSSP project, I will apply the proposed framework to an illustrative case study of securing the ICT system of an institution against physical and cyber threats. The analysis can be performed for different budget levels to provide additional insight on risk management.

Biographical Sketch: Alessandro Mancuso graduated from Politecnico di Milano (Milan, Italy) with a Master of Science in Industrial Engineering and Management in 2015. He is currently a third-year doctoral candidate at Aalto University (Department of Mathematics and Systems Analysis) and at Politecnico di Milano (Department of Energy). His doctoral thesis focuses on the development of optimization models to support the selection of cost-efficient portfolios of risk mitigation actions. His research interests include the development and application of probabilistic methods for assessing the risk and safety of complex technological systems.

Tum Nhim

Supervisor: **Nikita Strelkovskii**
Co-Supervisor: **Matthias Wildemeersch**

Research Project: **Collective action and provision of public goods under water scarcity between individuals and communities**

Abstract: Water governance remains a challenge for human society due to increased scarcity and complex relationships between human and water systems. Recent work shows empirically that human intervention such as water withdrawals in the upstream can potentially increase water scarcity in the downstream. This problem entails a suboptimal or inefficient use of water among upstream and downstream farmers, and is a consequence of a social dilemma situation in which some farmers overuse water for personal gains at the expense of the group. The performance of local water governance depends largely on the capacity of water users to collectively overcome social dilemmas arising from both sharing the water and contributing to joint investment to water infrastructure. Most of the studies in commons literature, however, mainly focus on conditions under which users either overcome social dilemma related to common pool extraction or public goods provision, but rarely both combined. This study employs a stylized agent-based model to analyze a coupled social dilemma arising from water sharing and investment to water infrastructure within and between communities. This paper contributes to the literature in two main aspects. First, the model will incorporate the combined problems of collective action and provision of public goods taking into account the role of resource heterogeneity and inequality. Second, this study highlights the tension to cooperate within and between communities of resource users, providing theoretical understanding of polycentric governance arrangements.

Biographical Sketch: Tum Nhim is a third-year PhD student at Wageningen University, The Netherlands. His PhD is conducted in the Environmental Economics and Natural Resource Group, which mainly aims to analyze the robustness/fragility of different water governance arrangements under socioeconomic and environmental changes. His main research interests include water management and climate change, social complexity in natural resource management, social-ecological system dynamics, and hydrology. Prior to starting his PhD, he received a BEng in Water Resource Engineering and Infrastructure from Institute of Technology of Cambodia in 2011, MSc. in hydrology/hydrogeology from Uppsala University (Sweden) in 2012, and MSc in Natural Resources and the Environment from Michigan State University (USA) in 2015.

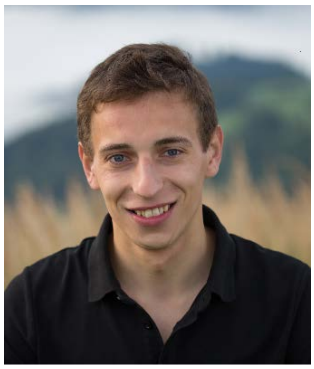
Aman Majid

Supervisor: **Yurii Yermoliev**
Co-Supervisor: **Tatiana Ermolieva (ESM)**

Research Project: **A networks based approach to the energy-water nexus**

Abstract: The energy and water sectors are closely interlinked in that water is needed for power generation and electricity is required for the production of drinking water. Whilst research on this topic, so-called the energy-water nexus, has grown substantially in popularity over the last decade, studies to date remain largely empirical. The current lack of methods based on physical models make it difficult to study dynamic interactions between these interlinked systems. In this project, we will develop a methodology to model the energy-water nexus using a networks-based approach, where nodes shall represent physical assets (e.g. reservoirs, power stations, water works etc.) and the connections between them will convey transfers (e.g. flowrates, transfer time etc.). By applying this methodology onto a case-study of the United Kingdom, we shall use the model to: (1) stochastically optimise a coupled-systems network and (2) understand the impacts of exogenous conditions (e.g. climate change) on the network through risk and resilience studies. We use quantile-based probabilistic constraints (VaR and CVaR) to study the conditions ensuring required level of reliability and robustness of the coupled-systems network towards dependent systemic risks emerging due to the systemic interdependencies and exogenous and endogenous shocks to the systems. Through this work, we aim to demonstrate that the co-dependence between water and energy pose significant risks in the future as climate change worsens, which warrant greater efforts to combine modeling and planning going forward.

Biographical Sketch: Aman Majid is a second-year DPhil student at the Environmental Change Institute and New College at the University of Oxford. His research interests include water resources, energy, optimization, and network theory. Specifically, he is interested in a coupled-systems analysis of the water and energy sectors to aid decision-making and planning. Aman graduated with a MEng in Chemical Engineering from the University of Sheffield before moving to Oxford for postgraduate studies.



Anton Pichler

Supervisor: **Stefan Thurner**
Co-Supervisor: **Sebastian Poledna**

Research Project: **Implications of heterogeneous technologies on climate policy: An agent-based model approach**

Abstract: It was recently shown that different technologies follow heterogeneous price trajectories which can be captured with a generalized version of Moore's law (Farmer, Lafond 2016). The heterogeneous evolution of product prices has important consequences for climate policy, which has to deal with the question of optimal technology investment to guide the green energy transition in a timely and efficient manner. In this research we use an agent-based model (ABM) of the Austrian economy (Poledna et al. 2018) to assess the efficiency of different climate policies where technology prices evolve endogenously. We extend the existing ABM with two novel features. First, we introduce an additional greenhouse gas layer which is coupled to the economic activity of the agents. Second, we discriminate the energy consumption of households and industries based on the used technology mix. Prices determine which energy technologies are consumed and are modeled as a geometric random walk with drift which follows from Moore's law. Consumption is endogenous and different price paths evolve based on cumulative production what in turn affects consumption patterns. The model allows to simulate different climate policies with controlling for key economic variables (e.g. GDP, unemployment) which are determined endogenously. We use this set-up to assess how efficient climate policies such as carbon taxes and feed-in tariffs decrease greenhouse gas emissions.

Biographical Sketch: Anton Pichler is a first-year PhD at the University of Oxford where he is affiliated with the Smith School of Enterprise and the Environment and the Complexity Economics group of the Institute for New Economic Thinking. His PhD is supervised by Cameron Hepburn and J. Doyne Farmer. He holds Bachelor's degrees in political science and in economics and a MSc in quantitative finance. Anton's research interests encompass complex systems, economic networks, agent-based modelling and systemic risk. In his current research he investigates structural properties of production networks with methods from complex system science to infer implications for the green energy transition.

Elham Sedighi

Supervisor: **Elena Rovenskaya**
Co-Supervisor: **Nadejda Komendantova-Amman (RISK)**

Research Project: **Water-energy nexus in light of regional integration processes: Addressing conflict and synergies in the development of hydropower electricity, agriculture and textile industries in Kyrgyzstan**

Abstract: Kyrgyzstan's economy is predicted to grow due to the population growth and the potential increase of the quality of life. National and regional policy-makers are faced the challenge to make evidence-based decisions towards desirable futures that should also take into considerations the peculiarities of each specific sector. The focus of this study is on the structuring of a participatory methodological framework, for the planning of an integrated future development of three economic sectors in Kyrgyzstan: hydropower energy, agriculture and textile. The purpose of the study is to identify future scenarios of development of these three sectors taking into account conflicting and synergistic factors, including the water-energy nexus regional integration processes etc. The methodology is based on the LIPSOR participatory analytical model and morphological analysis as a participatory scenario-planning tools, which will integrates views, opinions, visions and discourses of the Kyrgyz stakeholders. The proposed approach represents an example of participatory modelling and allows for handling uncertainty and complexity in the decision-making processes on the development of a country and is based on quantitative and qualitative data.

Biographical Sketch: Elham Sedighi received her BSc at Isfahan University of Technology (IUT) in 2010 as an engineer of Natural resource & Environment. In 2013 she received her MSc at Gorgan University of Agricultural Sciences and Natural Resources in the field of environmental sciences and land-use planning. Elham is currently a fourth-year PhD student at Gorgan University of Agricultural Sciences and Natural Resources. The topic of her dissertation is "Linking foresight approach with land-use planning of Gorgan watershed". Her main fields of scientific interest include land-use planning and development based on future studies.

Evolution and Ecology Program (EEP)
Program Director: Ulf Dieckmann

Yi Huang

Supervisor:	**Mikko Heino**
Co-Supervisor:	**Ulf Dieckmann**
Research Project:	**Reform of China's marine fisheries management using output control**

Abstract: Many marine fisheries are overfished, and appropriate management measures are necessary. These range from catch limits to effort limits, which represent so-called output control and input control, respectively. China ranks as the world's leading fishing nation. In response to overfishing and the steady degradation of coastal ecosystems, the Chinese government has introduced a series of management measures to rebuild marine fisheries. However, most of the measures are input controls and technical measures, for instance, licensing systems, vessel buyback programs, closed seasons and areas, fishermen relocation programs, etc. Recently, the Ministry of Agriculture of the PRC released a series of policy documents on fisheries management requiring a gradual transition from input controls to output controls. This is a paradigm shift in Chinese fisheries management. My research will focus on how to design such output controls in a way that recognizes the specific features of China's marine fisheries. In the first part of this project, I will use cluster analysis to arrive at a general description of the population of Chinese fishermen, especially in regard to their social stratification. By comparing current surveys with results from earlier surveys, I want to find out how the population of fishermen has been changing over time, following earlier policy revisions. In the second part of this project, I will design a community model for quantitatively comparing the advantages and disadvantages of input and output control systems. In this model, important points to consider are the enforcement of quotas and the degree to which fishing effort directed at one species leads to the bycatch of other species.

Biographical Sketch: Yi Huang graduated in 2011 from the Ocean University of China with a Bachelor's degree in Administrative Management. She obtained her Master's degree in Sociology from the same university in the year 2014. She is currently a third-year PhD student in Marine Affairs at the Coastal and Ocean Management Institute, Xiamen University, China. The title of her thesis is Reform of China's Marine Fisheries Management Using Output Control. Her main fields of scientific interest include fisheries management, fisheries policy, and the socio-economic status of fishermen.

Mozzamil Mohammed

Supervisor: **Åke Brännström**

Research Project: **Evolution and resilience of plant-frugivore communities**

Abstract: Frugivore species that feed on fruits play a central role in plant dynamics and ecosystem functioning. In particular, the interactions between fleshy-fruited plants and their frugivores benefit both partners: the plants benefit from enhanced seed dispersal, which reduces competition between seedlings, while the frugivores acquire nutritious food. The natural balance between plants and frugivores, which has evolved over long periods of time, is now increasingly being threatened by modern forestry, deforestation, and species invasions, with likely knock-on effects for plant communities and ecosystem services. In this project, I will develop an individual-based model to investigate how frugivorous seed dispersal evolves and how the loss of frugivorous species or their host plants affect ecosystem functioning and the risk of species invasions. Essential environmental and demographic factors (such as the germination probability of seeds, the availability of habitable sites in the neighborhood of plants, as well as birth, death, and movement rates) will be considered together with the dispersal efficiencies and fruit-consumption rates of frugivores. By allowing for evolution in fruit sizes and fruit preferences, I will assemble realistic plant-frugivore communities from first principles. I will then subject these communities to anthropogenic disturbances, represented by species extinctions, and study the consequences for ecosystem functioning and secondary extinctions. Finally, I will investigate conditions for plant and frugivore invasions and identify early intervention strategies against invading species.

Biographical Sketch: Mozzamil Mohammed graduated from the University of Western Cape, South Africa, with a Master's degree in Mathematical Sciences. He then joined the Mathematical Ecology Group at Stellenbosch University, South Africa, to pursue a research-based Master's degree in Mathematical Ecology. His main scientific interests are the study of plant-frugivore interactions and their role in the ecological and evolutionary dynamics of plant communities.

Anna Christina Vinton

Supervisor: **Ulf Dieckmann**
Co-Supervisor: **Åke Brännström**

Research Project: **Evolutionary rescue in variable environments**

Abstract: Evolution can rescue species facing population declines and extinctions as a result of environmental change. The potential for such evolutionary rescue to prevent species extinctions is of both pure and applied interest, as it could provide additional tools for managing ecological systems. Evolutionary rescue occurs when a genetic adaptation allows a population to recover from a decline that would otherwise lead to its extinction. Theory suggests that evolutionary rescue cannot help all populations amidst rapid environmental change, so delineating the limits of evolutionary rescue is a priority for conservation biology. Earlier work on evolutionary rescue has investigated the importance of factors such as temporal and spatial environmental heterogeneity, gene flow, and ecological interactions in isolation, whereas in natural systems these factors all play a role in concert. I will develop methods to examine the interactive effects on evolutionary rescue of the movement of and competition among individuals along a temporally changing spatial environmental gradient. Natural populations may experience a diversity of selection pressures across space and time due to differences in spatial and temporal environments, as well as in the inter and intra-species interactions they are subject to. Therefore, populations of species may respond in a variety of ways to climate change. Investigating these joint influences on evolutionary rescue will aid in defining which key factors, alone or in concert, limit adaptation to a changing environment, bringing scientists closer to predicting propensities for evolutionary rescue in the wild.

Biographical Sketch: Anna Vinton is a third-year PhD candidate at the Department of Ecology and Evolutionary Biology at Yale University, USA, in the lab of David Vasseur. She received her Bachelor's degrees from the University of Colorado at Boulder, USA, in Mathematics and in Ecology and Evolutionary Biology. She combines theoretical and experimental approaches to investigate what allows natural populations to adapt and persist in the face of environmental change and habitat loss. Specifically, she is interested in what allows populations to recover from declines, via evolutionary rescue.

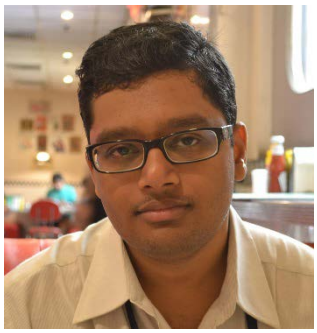
Fabio Diuana

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

Research Project: **Development of flexible basin-scale nexus assessment tools**

Abstract: Integrated assessment models increasingly feature the nexus between water, energy, and land-use sectors to support analysis of solutions addressing competition across sustainable development objectives. A key challenge towards the convergence of nexus assessment tools is that they are often case-specific and transferability to other case-study regions is difficult and time consuming. This research project will focus on the development of flexible nexus assessment tools for sustainable development analysis at the river basin-scale. The research will enhance an integrated basin-scale modelling tool developed at IIASA over the past few years by automating and testing its transferability to other case-study basins. Parameterization across basins will be achieved by tapping into increasingly rich data outputs from linkages established to global models. Key objectives of this research include: i) determining the suitable spatial representation of the model and automating the implementation for new basins; ii) development of multi-scale mapping tools for combining global and local datasets during model generation; and iii) implementing scenarios to test the suitability of the model to capture key interactions across sectors. The output of this research will provide tools and approaches that other researchers and regional planners can utilize to improve their analyses of nexus challenges.

Biographical Sketch: Fabio Diuana graduated with a Bachelor degree in Environmental Engineering and completed his Master's degree in Energy Planning, both from COPPE/UFRJ in Rio de Janeiro, Brazil. His MSc dissertation evaluated the impacts of growing wind power penetration in the power system. He also worked with the Cenergia lab's research team in a project assessing complementarity between wind and solar energy sources in Latin America and how they can be affected by climate change. He is currently a second year PhD student in Energy Planning at COPPE, and his research focuses on the development of computational tools and methods about water-energy-land nexus.



Abhishek Kar

Supervisor: **Shonali Pachauri**

Research Project: **Analysis of multi-year trends related to LPG enrollment and refills: How rural India consumes LPG and are Ujjwala customers any different?**

Abstract: Liquefied Petroleum Gas (LPG) is often considered the most scalable cooking fuel for developing countries to counter the menace of household air pollution. India's Ujjwala scheme has garnered global attention by enabling 35 million rural poor to become LPG customers through capital subsidies and zero-interest financing options within a period of 22 months. However, access to commercial cooking fuels often does not automatically translate into its regular usage for rural (mostly poor) populations with easy access to non-commercial biomass. In this study we examine two questions hitherto largely unexplored for rural Indian LPG consumers. One, how do rural households, in general, make choices about access (enrolment) and usage (refill purchase) decisions. Two, how does the refill pattern of rural Ujjwala beneficiaries compare with rural non-Ujjwala LPG consumers. While some studies have compared Ujjwala refill trends with the national average, it would be more relevant to assess if low-cost access is enough incentive for beneficiaries to match the general rural consumption trends. A database of LPG enrolment and refill purchase since 2015 covering >15,000 rural customers (including >6,000 Ujjwala beneficiaries) in Karnataka state will be analyzed for this research using the R platform. This will include a) descriptive statistics for identification of seasonal patterns and consumption trends, b) regression models to examine the role of refill price (volatility) and access (presence/ absence of home delivery) and c) a comparative analysis of refill trends among Ujjwala and non-Ujjwala customer groups.

Biographical Sketch: Abhishek Kar is a PhD candidate in 'Resources, Environment, and Sustainability' at the University of British Columbia, Canada. His thesis entails application of classical behavior change theories in conjunction with user consumption data to better understand clean cooking energy transitions (using Indian government's Ujjwala campaign to expand access to LPG as a case study). He has seven years of multi-disciplinary research experience at the Energy and Resources Institute (and has published work) that spans aerosols, human behavior, and policy analysis related to household air pollution, specifically, and energy access, in general. As a practitioner-scholar, he always endeavours to further dialogue among civil society, government, and academia to further knowledge mobilization and coordinate efforts to further a shared agenda.

Ansir Ilyas

Supervisor: **Ed Byers**
Co-Supervisors: **Simon Parkinson, Yoshihide Wada (WAT)**

Research Project: **Optimization of the water-energy nexus: Modeling the impact of advanced irrigation and canal technologies on sustainable development pathways for the Indus River Basin**

Abstract: Water and energy systems are interdependent: massive amounts of water are withdrawn and consumed to supply energy, and likewise, significant energy is required to utilize water for various purposes. Therefore, a nexus approach, which deals with interdependencies of various resources and optimization of their utility, is needed to find effective system development strategies. The proposed summer research will examine the water-energy nexus for current and future projections in the Indus River Basin, with specific focus on the role of advanced irrigation and canal technologies in achieving long-term water, energy and climate sustainability objectives. The Indus River Basin is an important case study because it is home to 300 million people, and features a tight coupling between water-energy systems due to the vast irrigation network, the thousands of distributed groundwater and conveyance pumping stations, and the large-scale exploitation of hydropower systems throughout the basin. The summer research project will adapt an existing basin-scale version of the MESSAGE model developed at IIASA for the Integrated Solutions for Water, Energy and Land (ISWEL) project. A reduced form representation of advanced irrigation and canal technologies will be incorporated into the MESSAGE framework based on an analysis of the current system and available technologies for increasing energy and water efficiency. The enhanced modeling framework will be used within a scenario analysis to explore how advanced irrigation and canal technologies impact different basin-wide sustainability objectives for water and energy, including strategies that limit groundwater stress, increase access to wastewater treatment and reduce the carbon intensity of electricity supply. The summer project will also establish contacts and collaborations, which can prove extremely valuable as the work is continued as part of the applicant's doctoral research beyond the YSSP in Pakistan.

Biographical Sketch: Ansir Ilyas is a first-year PhD student at Lahore University of Management Science (LUMS), Pakistan. He is doing his PhD research on topic of "Distributed Optimal Control of a Nexus of Socio-ecological Systems". His aim is to study the multi-resource nexus problem from an architectural perspective of system theory, and to study the organizational and peer-to-peer network as topological obstructions toward joint optimization. He is also serving as a lecturer in Electrical Engineering department (currently on leave) in University of Lahore (UOL), Pakistan. He received his BS and MS in Electrical and Control Engineering from UOL and LUMS respectively.

Judith Ament

Supervisor: **David Leclere**
Co-Supervisor: **Tamas Krisztin**

Research Project: **Do location-specific population density estimates improve predictions of wildlife population abundance trends under future global change scenarios?**

Abstract: The world is experiencing a global biodiversity crisis, in which biodiversity loss is now considered a global change stressor alongside other major anthropogenic threats such as climate change and land-use change. To mitigate further ecosystem breakdown and its consequences for human health and wellbeing, understanding the biodiversity consequences of future climate and land-use scenarios is crucial. To this end, models are needed that can accurately predict species diversity and abundance trends over large areas into the future. One approach to this challenge has been to use species distribution models to infer the extent of suitable habitat for different species, and reconstruct past abundance trends and project future abundance trends using species-level average population density estimates. Recently however, a new set of models have been developed to predict wildlife population density estimates from life history traits and environmental covariates directly, using predictors such as species body mass and diet, Net Primary Productivity, precipitation of the warmest quarter and precipitation seasonality.
The aims of this project are to: (1) combine these two existing modelling frameworks to predict species-level abundance trends in species-specific suitable habitat, both with and without species- and location-specific density estimates (hindcasting); (2) assess the predictive accuracy of both types of models (with and without location-specific density estimates) with observed population abundance trends from the Living Planet Database (validation); and (3) use these updated models to forecast species-level abundance trends under future global change scenarios (forecasting). The main hypothesis is that species- and location-specific density estimates greatly improve the quality of model predictions and should thus be included in forecasts where possible.

Biographical Sketch: Judith Ament graduated from Yale University in 2013 with a Master's degree in Environmental Science. Prior to this, she studied Ecology and International Development Studies at the University of Amsterdam. She is currently a third year PhD student at the Zoological Society of London and the Centre for Biodiversity and Environment Research at University College London. Her research focuses on human-wildlife coexistence in the Anthropocene, investigating wildlife population abundance dynamics in relation to anthropogenic changes on the landscape. Her scientific interests include conservation biology, community and ecosystem dynamics, macroecology, land use change, and geospatial analyses.

Raphael Asada

Supervisor: **Tamás Krisztin**
Co-Supervisors: **Fulvio di Fulvio, Florian Kraxner**

Research Project: **Towards a material-based indicator of bioeconomic transition**

Abstract: The terms *bioeconomy* and *bio-based economy* refer to one of the recently most prominent political-economic concepts in Europe addressing ecological objectives. Measuring bioeconomic progresses is vital for future socioeconomic and political decisions. Previous studies on the state of bioeconomy were based on an initial decision, what bioeconomy is, i.e. which sectors of an economy are considered as bioeconomic. However, this contradicts the fact, that sectoral prioritization within bioeconomy strategies around the world differ considerably. In order to overcome the problem of a lacking definition of bioeconomy we suggest to monitor the potential *outcome* of a bioeconomic transition instead, which is first and foremost a reduction in fossil fuels dependency.
Employing the World Input-Output Database (WIOD), extraction of fossil fuels and other raw materials embodied in the consumption patterns of a broad set of countries is calculated. Additionally, the same indicators derived from a different data source (EORA input-output tables) will be compiled. Using these two panel data sets as inputs, two independent regression models of raw materials consumption are constructed, including explanatory variables such as population, affluence, consumption of energy from other than combustion and metabolic processes, raw material productivity, domestic extraction of fossil fuels, geographical zone/latitude and land cover.
Particular attention will be paid to the similarities and differences between the two models in order to discuss the applicability of a material-based indicator of bioeconomic transition. Adopting Shared Socioeconomic Pathways (SSP) projections, future fossil fuels dependency will be estimated to demonstrate the sensitivity to model choice (WIOD/EORA) in relation to other uncertainties. These findings will be useful for IIASA's GLOBIOM and BeWhere models for refining future demand projections under bioeconomic transition.

Biographical Sketch: Raphael Asada graduated 2015 from the University of Klagenfurt (Austria), Faculty for Interdisciplinary Studies of Austrian Universities (IFF) in Social Ecology. He is currently a second year PhD student in Environmental Systems Sciences and holds an assistant position at the Institute of Systems Sciences, Innovation and Sustainability Research, University of Graz. The title of his thesis is Transition Towards Bioeconomy. Indicators, Determinants and Interventions from a Macro-level Perspective. His main fields of scientific interest include the transition towards bioeconomy, social metabolism and integrated socio-ecological modelling.

Elina Bryngemark

Supervisor: **Nicklas Forsell**
Co-Supervisor: **Anu Korosuo, Pekka Lauri**

Research Project: **Advanced biofuel production, feedstock supply constraints and REDII: The case of the Swedish forest biomass market**

Abstract: Recently, the EU proposed the so-called Renewable Energy Directive II (REDII). The main objective of this research is to study the market effects under the seemingly conflicting targets within the REDII, which encourages increased advanced biofuel production but in the presence of constrained biomass feedstock supplies. The study will investigate feedstock allocation and price formation in the forest biomass market and the effects on the bioenergy and forest sectors. REDII would mandate that 6.8% of transportation fuels must be derived from renewable sources, i.e., advanced biofuels or renewable electricity, in 2030. At the same time, however, with reference to the waste hierarchy in Directive 2008/98/EC, REDII excludes biomass feedstocks eligible for renewable energy if that feedstock can be used for manufacturing purposes. The proposed research will include scenario analyses of advanced biofuel targets and supply constraints on the specific biomass feedstocks, e.g. tall oil and sawdust, both of which are important feedstocks for advanced biofuel production in forest rich countries. The analysis will be carried out using an extended version of the so-called Swedish Forest Sector Trade Model II (SFSTMII), which is a national, regionally explicit, partial equilibrium forest sector model – based on the EFI-GTM (Kallio et al. 2004) model structure. For the purpose of this study, the model will be extended with an advanced biofuel module. The study will contribute to an understanding of what the possible implications of the proposed REDII could be on a national level; insights valuable for policy makers as well as for future work with further developing GLOBIOM.

Biographical Sketch: Elina Bryngemark is a third-year PhD student in environmental and natural resource economics at Luleå University of Technology (Sweden). Her research interests are forest biomass markets, second-generation biofuels, and numerical modeling. She investigates the market effect from introducing transport biofuels made from forest residues under feedstock supply restrictions by using numerical modeling methods. She received her MS and BE in Economics at Lund University (Sweden) in 2014, 2012 respectively.

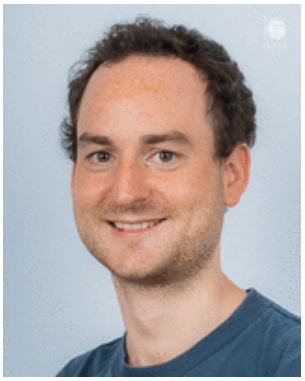
Meng Cai

Supervisor: **Linda See**
Co-Supervisor: **Olha Danylo**

Research Project: **Generating WUDAPT level 1 data from Google Maps – A pilot study in Kowloon Peninsula, Hong Kong**

Abstract: The process of urbanization has led to many environmental problems. The impact of these problems can be assessed using weather and climate models. The model settings require detailed urban canopy parameter (UCP) values, e.g. the sky view factor (SVF), the amount of space occupied by buildings in each grid cell or the building height, which are often not available to researchers. To address this data gap, the World Urban Database and Access Portal Tools (WUDAPT) initiative is building a global database of urban form and function, which will provide UCPs for models using freely available data sets. The WUDAPT level 0 data characterizes cities into local climate zones (LCZs) with standardized UCP values. However, different cities have their local urban context, features and morphological characteristics, so there is a need to develop a more detailed level 1 product based on level 0 data. Kowloon Peninsula in Hong Kong is selected as a pilot study due to its complex urban morphology and the need for more refined UCPs for the implementation of the New Town Development and Urban Renewal plan. This pilot study aims to create WUDAPT level 1 data for Kowloon Peninsula from open source data sets. Firstly, building footprints and road information will be acquired from Google maps. SVFs will then be computed using Google Street View panorama imagery. Using the building footprints, street networks and SVFs, additional UCPs required by the models will be calculated. The distribution pattern of UCPs for each LCZ will then be determined based on the LCZ map of the level 0 product. Finally, the WUDAPT level 1 data for Kowloon Peninsula can be generated. This pilot study will contribute to the methodology and the database for the WUDAPT level 1 data for high-density cities, where the results can be applied to the New Town Development and Urban Renewal plan in Hong Kong and for urban climate modelling, to further analyze the impact of urbanization on cities.

Biographical Sketch: Meng Cai is currently a first-year PhD student in the School of Architecture, the Chinese University of Hong Kong. Her educational background is in GIS and remote sensing. She received her Bachelor's degree in Geodesy and Geomatics from Wuhan University, China and her Master's degree in GeoInformation Science from the Chinese University of Hong Kong. Her research interests include urban morphology and its impact on the urban environment, remote sensing applications in urban climate studies and WUDAPT.



Tony Carr

Supervisor: **Juraj Balkovic**
Co-Supervisors: **Christian Folberth, Rastislav Skalsky**

Research Project: **The impact of climate change and land degradation on global crop yields**

Abstract: Land degradation from unsustainable management is thought to have already reduced food production in many areas of the world, and crop damage from climate change is now on the horizon. Though difficult to predict, interactions between climate change and land degradation will likely intensify pressure on food security. This study will provide new insights into the connections between climate change and land degradation, and their impact on global crop cultivation. A global gridded version of the Environmental Policy Integrated Climate (EPIC) model will be used to simulate the growth and development of major crops using soil, weather and field management data at more than 100,000 locations worldwide. The model is being coupled with outputs from different climate models to simulate future yields of staple crops. The simulations include processes limiting the growth and development of crops by estimating the loss of soil and its fertility due to water erosion and soil organic carbon decline, which are two of the most severe land degradation processes. Evaluated simulation outputs will be analyzed during YSSP to assess interactions between field management, water erosion and soil carbon with staple crops and their implications on global crop yield forecasts and crop yield variability.

Biographical Sketch: Tony Carr is a PhD student at University College London, where he is researching the impact of land degradation on future crop yields under climate change scenarios. His main research methods are biophysical modelling techniques to simulate soil, water and plant relationships. Tony is interested in a wide range of topics around water and food security. He holds a bachelor's degree (2013) in Geography from the University of Bonn and a Master's degree (2015) in water management and Biology from the University of Duisburg-Essen and the Radboud University Nijmegen.

Sungeun Cha

Supervisor: **Dmitry Shchepashchenko**
Co-supervisor: **Anatoly Shvidenko**

Research Project: **Improving spatial distribution of forest carbon stock estimation using Convolutional Neural Network (CNN) Classification**

Abstract: Forests are considered as a renewable energy source that can substitute for fossil fuels and reduce greenhouse gas emissions. One third of the earth's land surface consists of forest that serves as a carbon sequester and carbon sink for life on the earth's surface. AGB can be estimated in several ways, such as traditional methods that use destructive sampling and allometric equations, with the combination of remote sensing, field data and forest cover map, and through canopy texture analysis. However, this issue can be solved by the use of various techniques for processing remote sensing data. The boundary and spatio-temporal attributes of South Korean National Forest Inventory (NFI), forest map, and land cover map are not exactly matched. This research is expected to apply the CNN classification technique on the Korean Peninsula in order to make spatial data consistent, reliable, and ready to use in the models. Furthermore, the estimated result of forest carbon storage can be compared with the result from G4M and applied to create detailed data for running BeWhere. In this research, the following scientific results are expected; i) detection of forest area and land cover change based on satellite image, ii) development of Convolutional Neural Network (CNN) classification method, iii) estimation of carbon storage focused on the Korean Peninsula. These results will be interpreted as the basic information of decision making through developing forest carbon storage model. Decision makers can identify the location for restoration, impact of degradation, and designate forest carbon storage hotspot based on the results. Therefore, the project will help to understand the characteristic of forest carbon potential in Korea.

Biographical Sketch: Sungeun Cha is a third-year PhD candidate working under the supervision of Prof. Lee, with the Environmental GIS/RS Laboratory at the Korea University. His main interests center on the geographic information system and remote sensing on forest. His dissertation focuses on computer science, especially machine learning for forest management modeling under climate change.

Matt Cooper

Supervisor: **Steffen Fritz**
Co-Supervisor: **Stefan Hochrainer-Stigler (RISK)**

Research Project: **Mapping the natural areas that provide nutritional resilience to drought-vulnerable communities.**

Abstract: In spite of recent gains, low precipitation is still a major threat to adequate nutrition for subsistence farmers in many parts of the world. Even minor precipitation deficits can lead to worsened nutritional outcomes, and as climate change changes precipitation patters. In many traditional livelihood systems, the ecosystem services provided by forests and other natural areas are a major resource during times of drought. Case studies around the world have documented how these areas can provide services that enhance the resilience of agriculture by retaining soil moisture, creating microclimates, and dampening pest outbreaks in drought-weakened crops. Additionally, natural areas provide wild foods like fruits, leaves, nuts, seeds, bushmeat, fungi, and insects, with many of these foods acting as safety nets during years of low agricultural output. However, the effects of ecosystem services provided by these areas on livelihoods and nutrition have largely been studied via site-specific studies. Thus, while conservationists and policymakers are interested in using forests to enhance livelihood resilience, little work has been done in comprehensive or globally comparative ways, meaning that policymakers have no guidance on where to focus conservation efforts with the aim to maximize human well-being. The proposed project will combine global datasets on historical rainfall patterns, land cover, and child nutrition outcomes to determine where the presence of natural areas such as forests, shrublands and grasslands have historically mitigated the effects of low precipitation on child health outcomes.

Biographical Sketch: Matt Cooper is a PhD student in the Department of Geographical Sciences at the University of Maryland. Matt has a broad range of experiences at the intersection of environmental conservation, international development, and data science. He is interested in combining geolocated data on human wellbeing with environmental datasets derived from remote sensing to better understand the impacts of climate change on vulnerable populations. Matt holds an MA in Geography form UNC Chapel Hill and a BA in Geography from the University of Florida and has conducted social-ecological fieldwork in Mali, Uganda, the Philippines, and Alaska.

Camila Thiemy Dias Numazawa

Supervisor: **Stephan Pietsch**
Co-Supervisor: **Andrey Krasovskii**

Research Project: **Assessing the economic and environmental performance of the Brazilian Forest Code in the Amazon rainforest - using primary data and G4M modelling method**

Abstract: Sustainable Forest Management (SFM) has been adopted to avoid forest degradation and deforestation while increasing people's economic benefits and improving biodiversity preservation. Although the Brazilian Forest Code has existed since 1965, SFM plans only became mandatory after the 90s. Hence, there is an important need to evaluate the performance of forest strategies and practices. Based on original data collected from twelve logging sites of one of the main Brazilian Amazon timber producers in Pará State and by applying Global Forest Model (G4M) approach, we will estimate forest regrowth, potential harvest amounts and price on biomass, use logging residues for bioenergy and carbon stock for the next cutting cycle. This research will also contribute to the RESTORE+ Project regarding understanding the Brazilian context of economic and environmental implications related to Forest Code enhancement towards achieving climate change mitigation as well as the balancing economic development with long-term impact on carbon stock and restoration.

Biographical Sketch: Camila Thiemy Dias Numazawa completed her undergraduate studies in architecture and urbanism at the University of Amazonia in Brazil. Her first Master's degree was concluded at the Sapienza University of Roma in Bio-Ecological Architecture and Environmentally Sustainable Technologies, before completing a second Master's degree at the Federal University of Santa Catarina in Architecture, Design and Technology of the Built Environment. She is a fourth-year PhD student and researcher at the Department of Civil Engineering Construction at the Polytechnic School of the University of São Paulo. Her interests range from Life Cycle Assessment to Material Flow; Her Doctor of Engineering research investigates the CO_2 emissions by biomass waste from selective logging of wood in the Brazilian Amazon rainforest.

Bohdana Dubrovets

Supervisor: **Anatoly Shvidenko**
Co-Supervisors: **Dmitry Schepaschenko, Florian Kraxner**

Research Project: **Evaluation of ecosystem services of forests in the Chernobyl Exclusion Zone**

Abstract: The accident at the Chernobyl power station in 1986 caused radioactive contamination of ~20 million hectare of land, basically in Ukraine, Belarus, and Russia, and its impact was recognized in different continents. Currently a Chernobyl Radiation and Ecological Biosphere Reserve is organized around the station of the total area of ~227 thousand hectare, of which ~110 thousand ha make up the Exclusion Zone of the very high level of radioactive contamination with a very strong restriction for public accessibility. Uniqueness of the Chernobyl Radiation and Ecological Biosphere Reserve requires a special regime of forest management and specific approaches to assessment of forest ecosystem services. These questions, particularly with respect to relevant portfolio of ecosystem services and anti-services, as well their biophysical and economic valuation have never been considered. An assessment of the ecosystem services of forests of the Chernobyl Radiation and Ecological Biosphere Reserve will provide important knowledge about state, productivity and selected ecosystem services (like carbon sequestration) of forests of the study's region that is important for implementation of principles of sustainable forest management in radioactively contaminated territories of densely populated surrounding regions.

Biographical Sketch: Bohdana Dubrovets is a third-year PhD student of the Department of Forest Management at the National University of Life and Environmental Sciences of Ukraine. Her PhD thesis focuses on assessment of total stock of live biomass by components, sequestered carbon, and oxygen productivity of the National natural park "Holosiivskyi" forest ecosystems. Her research interests include assessment of forest ecosystem services, carbon sequestration, sustainable forest management, and climate change.

Fumi Harahap

Supervisor: **Piera Patrizio**
Co-Supervisor: **Sennai Mesfun**

Research Project: **Optimizing the production of crude palm oil for socioeconomic and environmental benefits along palm oil supply chains in Indonesia**

Abstract: Crude palm oil (CPO) is an important commodity for Indonesia to fulfill domestic demand for food and non-food uses while at the same time it is the number one export product of the country. The current Indonesian administration is aiming to produce 60 million tonnes of CPO per year by 2045, or double the current production. The production of CPO also generated by-product (palm kernel oil) and disposes large amounts of biomass residues (i.e. empty fruit bunches, shells, fibres, effluents). The biomass residues contain energy, organic matter and minerals, but their economic value have not been fully explored. The natural decomposition of the residues results in high GHG emissions. There are currently about 11 million hectares of oil palm plantation and 600 palm oil mills in the country. There is an opportunity for Indonesia to improve the current crop productivity and the utilization rate of palm oil mills. The study analyses the economic (costs and revenues), social (job creation) and environmental (GHG emissions) impacts of CPO and bioenergy production in palm oil agro-industry in Indonesia. The BeWhere model, a techno-economic optimization model, will be used to determine cost optimal scenario for the production of CPO, based on existing plantations, palm oil mills and transportation routes while considering different agricultural practices (e.g. crop productivity) and biomass conversion technologies. The model optimizes the entire system for the welfare of the region instead of single palm oil mill. The CPO demand accounts for domestic and international CPO demand, which will first have to meet domestic consumption for food and non-food uses, the remaining will be exported.

Biographical Sketch: Fumi Harahap received her MSc in Sustainable Energy System and Management from University of Flensburg, Germany. She is currently a third-year PhD candidate at the division of Energy and Climate Studies at KTH Royal Institute of Technology, Sweden. Her research is focused on the evaluation of biodiesel policies in Indonesia which uses palm oil as the main feedstock.

James Hawkins

Supervisor: **Stefan Frank**
Co-Supervisor: **Petr Havlik**

Research Project: **Low emissions development pathways in the East African livestock sector: Linking livestock to REDD+**

Abstract: In Tanzania, a developing country in East Africa, intensification of livestock production is proposed as a strategy for achieving the win-win of higher incomes for farmers, as well as reductions in greenhouse gas (GHG) emissions per unit product. Furthermore, given the large extent of grassland degradation, and significant rates of deforestation in the country, improving livestock productivity stands to reduce pressures on grazing lands and forest encroachment, therefore contributing to net GHG mitigation in the land use sector. The United Nation's Clean Development Mechanism stipulates that reductions in deforestation and forest degradation can contribute to certified emissions reductions under GHG reporting protocols for developing countries. This study couples a partial equilibrium market model with a landscape GHG emissions accounting framework to assess potential avenues whereby GHG emissions per unit milk and meat can be reduced concurrent with the national and global projected supply and demand growth expected to occur in coming decades. We explicitly account for the land footprint of the livestock sector in order to identify the potential whereby improvements in efficiency can reduce total land use, and therefore contribute to emissions reductions through C offsets in the forestry sector. The focus is on improved feeding and adoption of crossbred cattle genetics, because these two technologies/practices remain largely under-adopted by livestock producers. Focusing on the southern highlands region in Tanzania, spatially disaggregated production, consumption, and GHG emissions are simulated under both baseline and intervention scenarios. The results identify the combinations of practices which offer greatest potential for reducing the GHG footprint of livestock production in the southern highlands region concurrent with the expected growth in production in coming years.

Biographical Sketch: James Hawkins is a PhD student at Lancaster University (UK). A Canadian citizen, he obtained a BA in Economics and a MSc in Agricultural Economics, both at the University of Guelph, Ontario. For his MSc research, he specialized in identifying cost effective strategies for mitigation of greenhouse gas (GHG) emissions in the dairy sector in Ontario. After receiving a MSc, he worked at the International Food Policy Research Institute (IFPRI) in Washington, D.C., for two years, working on various aspects of sustainable intensification of agriculture in Africa south of the Sahara. His primary ambition in conducting his doctoral research is to provide the needed technical and policy related insights whereby developing countries can harness climate financing in order to expedite their (sustainable) development goals.

Moataz Medhat ElQadi

Supervisor: **Myroslava Lesiv**
Co-Supervisor: **Christoph Perger**

Research Project: **Automatic selection of geo-tagged images on social network sites to support land cover classification in geo-wiki.**

Abstract: The Geo-Wiki team has an expertise in running crowdsourcing campaigns to collect data on land cover and land use (See et al., 2015). The crowdsourced information, along with available satellite imagery, has led to the creation of the first hybrid forest cover map. This proved to be better than any of the individual datasets (Schepaschenko et al., 2015). It was shown, however, that in some cases, satellite imagery are hard to interpret by volunteers (See et al., 2013). Hence, there is a need for additional sources of information that would facilitate data collection by volunteers. Geo-tagged photos could serve as such a source.
Estima and Painho (2013) explored the adequacy of Flickr images to help the quality control of the Corine land cover. They have concluded there is a potential for such use, admitting however that their study has not looked into the actual content of the images.
I myself, in ElQadi et al. (2017), have automated Flickr image content checking, albeit for a different purpose, where we filtered images from Social Network Sites to develop a data source on species occurrence. Building on and evolving the content filtration ideas in (ElQadi et al., 2017), I will tap into the potential explored in (Estima & Painho, 2013), in order to help Geo-Wiki volunteers with the land cover classification tasks by presenting to them publicly available relevant imagery from Social Network Sites.

Biographical Sketch: Moataz Medhat ElQadi is a PhD candidate in the faculty of information technology, Monash University, Melbourne, Australia. His thesis explores innovative ways of leveraging open data on social network sites to study species distribution in space and time. His research interests include Geographic Information Systems (GIS), spatiotemporal data analysis, and citizen science. Moataz got his MSc in computer engineering from Cairo University, Egypt, in 2012, and his BSc in computer and systems engineering from Ain Shams University, Egypt, in 2006. When not in front of a computer, Moataz can be found in the dojo.

Ying Meng

Supervisor: **Sylvain Leduc**
Co-Supervisors: **Florian Kraxner; Yoshihide Wada (WAT)**

Research Project: **Modeling and visualization of optimal locations for hydropower in Indonesia in the context of global change**

Abstract: Energy has been a critical concern for human across the world under global change. The demand for energy increases dramatically due to the growth of global population and socio-economic development. Hydropower plays an important role as a renewable energy in the worldwide energy production, as it contributes substantially to the increasing global electricity demands. Especially in Indonesia, hydropower is the most favored energy option. Global change in terms of climate change and human activities alters the hydrological regimes resulting in changes of annual mean and seasonality of runoff, thus influencing the availability and stability of hydroelectricity production. Moreover, uncertainties associated with global change further impact the hydropower potential estimation and make hydropower planning and management even more challenging. Furthermore, as a large amount of hydropower plants are being constructed soon in this area, it will also be practically necessary to figure out the best positions for the hydropower plants in Indonesia based on the estimated economic hydropower potential. Therefore, this project will a) assess the streamflow under different global change (climate, socio-economy and population) scenarios using PCR-GLOWBE and b) apply the techno-economic model (BeWhere) to assess the economic hydropower potential and then determine the optimal locations for hydropower plants in Indonesia based on the estimation of economic hydropower potential. The study of impacts from global change on the hydropower potential in Indonesia will provide implications for planning and renewable energy production, which will further demonstrate an example of innovative solution to both energy security and sustainable development**.**

Biographical Sketch: Ying Meng is a first-year PhD student at Southern University of Science and Technology in Shenzhen, China. Her research project aims to assess the impacts of global change, including climate change, socio-economic development and other human- induced activities, on the economic hydropower potential in Indonesia. She holds a MSc degree in Groundwater Science and Engineering from Jilin University in Changchun, China.

Muhammad Nurariffudin

Supervisor: **Sylvain Leduc**
Co-Supervisor: **Florian Kraxner**

Research Project: **Sustainable oil palm biomass co-firing in Malaysia: A spatially-explicit optimization**

Abstract: Oil palm, one of the main agricultural crops Malaysia, has a great potential for biomass-based electricity production due to having the largest plantation shares in the country. According to the Malaysian National Biomass Strategy (NBS), oil palm is expected to produce up to 110 million tonnes of biomass in future. Despite various action plans by Malaysian government to promote renewable shares in the country, only a small capacity of about 90 MW of bioenergy facilities is currently installed in Malaysia. Biomass co-firing with coal offers a promising strategy to effectively utilize the biomass in existing energy facilities and reduce the greenhouse gas due to the unique zero net greenhouse effect of biomass combustion. Nevertheless, this does not neglect several associated issues such as low coal and biomass co-firing ratio, low energy density of biomass, degradation of combustion efficiency, sustainability of biomass supplies, procurement of large quantities of biomass and lack of policy supports by government to support co-firing technology. This study aims to adopt IIASA's BeWhere model to solve oil palm biomass co-firing issues in Malaysia in the aspects of technical, economic and environment. The model will be able to determine over time the optimal locations, scales and technologies of biomass collections and pre-treatment, the optimal co-firing rates in coal-fired power plants subjected to the policy supports required for co-firing development in Malaysia, based on the least cost strategy of the supply chain.

Biographical Sketch: Muhammad Nurariffudin received his bachelor degree from Universiti Teknologi Malaysia (UTM) in 2016. Currently, he is a second-year PhD candidate in the Faculty of Chemical and Energy Engineering at UTM. His current thesis focuses on the integrated supply chain design and operational planning of oil palm biomass co-firing in Malaysia through spatially-explicit optimization approach.

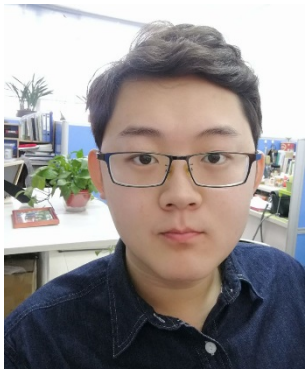
Davit Stepanyan

Supervisor: **Andre Deppermann**
Co-Supervisor: **Tatiana Ermolieva**

Research Project: **Application of Gaussian Quadratures in the Global Biosphere Management Model (GLOBIOM) as an efficient approach for uncertainty analysis**

Abstract: Economic simulation models (ESMs) are often deterministic in nature making the results highly dependent on point estimates of key exogenous variables. One way to deal with uncertainty is the application of stochastics in ESMs. However, this step transforms the ESM into a problem of multiple numerical integrations. In order to evaluate those integrals, two different approaches can be applied: Probabilistic formulae (e.g. Monte Carlo simulations) and Efficient formulae (e.g. Gaussian Quadratures (GQs)).
In the first approach, the multiple integrals are evaluated as a probabilistic problem and investigated using statistical experiments. However, such an approach requires large computational capacity as thousands of iterations are required for each stochastically treated exogenous variable, which makes this approach difficult for large-scale ESMs such as GLOBIOM. In contrast, efficient formulae require a minimal number of points (2n, where n is the number of the stochastically treated exogenous variables) to approximate the central moments of a joint probability distribution.
The aim of this project is to find applicable GQs for GLOBIOM such that the approximation error of the methodology is minimized. The approach will allow testing the uncertainty of a large number of exogenous variables simultaneously while reducing the computational requirements drastically compared to probabilistic approaches. The developed methodology will be applied to study the impact of yield variability on global food security.

Biographical Sketch: Davit Stepanyan is currently a third-year doctoral student and a research associate at Humboldt University in Berlin, with a strong interest in risk and uncertainty analysis in agriculture. His Ph.D. thesis is titled “Improving the Depiction of Uncertainty in Economic Simulations by Exploiting the Potential of Gaussian Quadratures”. He also serves as a teaching assistant for the “Partial and General Equilibrium Models in the Analysis of Markets and Policies” course. Davit Stepanyan holds a Master’s degree in Agricultural Sciences from the University of Hohenheim, Stuttgart, Germany. His research interests include Agricultural Economics, Risk and Uncertainty Analysis and Economic Modeling.



Hao Zhao

Supervisor: **Petr Havlík**
Co-Supervisor: **Michiel van Dijk**

Research Project: **Past changes and sustainable pathways of future land use in agricultural systems in China**

Abstract: China has hugely increased both domestic food production and imports of food and feed during the past few decades, to keep pace with the large increase in demand for food products. Increases in food production have been accompanied by significant land use changes in croplands, forest, pasture and marginal land etc. Moreover, China has become the biggest importer of agricultural products in recent years, thus influencing global markets as well as agricultural production, land and water use, greenhouse gas emissions, biodiversity and other environmental aspects. China is now challenged to find the solutions for achieving the ambitious targets through – from 2020 onwards – ensuring agricultural production growth without any increase in the utilization of land, water, fertilizers and energy. The aim of this project is to develop comprehensive pathways of land use in 2030 and 2050 in China. We will address these questions by developing GLOBIOM-China model and database of land use at regional level for China. As a result, we can create new knowledge about 'land use change – food security – environmental sustainability' in China and also allow for assessment of a range of policies under the framework of Food system and Agriculture transformation, Biodiversity protection, Land use changes, and Energy uses (FABLE) .

Biographical Sketch: Hao Zhao graduated from the Agricultural University of Hebei province in 2017 with a Master's degree in utilization of agricultural resources. He spent two years studying NUFER (Nutrient flows in Food chains, Environment and Resource use) model. He is currently a second year PhD candidate at the Center for Agricultural Resources Research, Institute of Genetics and Developmental Biology, Chinese Academy of Sciences. His PhD study is associated with nutrient flows in food chain and the environmental impact in China. His main fields of scientific interest include: yield gap analysis, planetary boundaries, land-use change, food security and climate change.

J. Luke Irwin

Supervisor: **Anne Goujon**
Co-Supervisor: **Asjad Naqvi (ASA)**

Research Project: **Skills resilient to impending automation: The future of work**

Abstract: From automation to artificially intelligent algorithms, the landscape of the types of jobs that may or may not exist in the coming decades continue to transform. Professions that until recently were completely in the purview of humans have shifted into tasks that can be accomplished with minimal manual supervision. Rather than searching for which jobs will "disappear" as technological disruption continues, a role- and task-based approach to identify which portions of jobs may be become automated will be performed to investigate professions that will be most resilient to technological disruption. Based on the identified jobs and skills, primary, secondary, and graduate level curricula will be assessed to determine where (or if) these capabilities are taught. Ecological systems methodologies and system mapping visualizations will be used to describe the connections, relationships, actors, and actions within the processes. This information, focused on the United States within an international context, will be useful to policymakers and academic institutions as they retrain currently displaced workforces, as well as reimagine the future of human work.

Biographical Sketch: J. Luke Irwin graduated with a Master's in Public Health in 2014 from the University of Texas Health Science Center. He also holds a B.S. in Neurobiology from the University of Texas, with minors in Programming and Biomimicry. He is currently a second year Ph.D. student at the Pardee RAND Graduate school. His dissertation will focus on the impacts of accelerating technological disruption on the future workforce and on the future of work. His primary fields of scientific interest include complex social and policy systems, technological disruption, science policy, and long-term planning. His areas of research have included education, population health, international security and stability, workforce development, environmental stewardship, and sustainable energy.

Hyunjae (Jay) Kang

Supervisor: **Warren Sanderson**

Research Project: **Dynamics of interaction between human capital and demographic structure, and its effects on economic growth**

Abstract: Do changes in human capital precede changes in demographic structure as a factor of economic growth? Building on Cuaresma, Lutz and Sanderson (2014), this study investigates the dynamics of interaction between human capital and demographic structure, and its effects on economic growth using the case of South Korea. Specifically, I will explore the details of the interaction dynamics. I am planning to analyze education policy changes associated with family policy and its effects on economic growth in different time periods between 1950s and 1990s. Given that it takes a long time for education policy changes to affect labor productivity (Lutz, Cuaresma and Sanderson 2008), I will have a close looker at the different lagged effects of education policy and family policy on economic growth. Combining different methods in economics and demography, I am going to approach the question with model simulations, counterfactual experiment, and population projection. This study uses time series data sets of economic growth, longitudinal data sets of different time data, and the demographic database of Wittgenstein Centre. With the simulation results of the calibrated model, I would like to investigate whether human capital indeed has been a driving factor of economic growth in different time periods.

Biographical Sketch: Hyunjae Kang is a second-year PhD student in Economics at Stony Brook University. His research focuses on the intersection between Demographic economics and Labor economics. He previously received a BA in Economics (2016) from Stony Brook University, United States, and a BA in Political Science (2016) from Dongguk University, Republic of Korea.

Sonja Spitzer

Supervisor: **Sergei Scherbov**

Research Project: **Growing old, growing healthy: projecting multidimensional health expectancies for 13 European countries**

Abstract: Chronological ageing is set to continue in Europe as a result of low fertility and greater longevity. We will live longer, but will we live healthier? We propose a multidimensional approach to capture the different phases and dimensions of disability and functional limitations at old age in 13 European countries. Instead of analysing one health indicator only, we will project a variety of health indicators measured in remaining years of life to better understand heterogeneities in the ageing process within and between countries. Prevalence rates of the following five measures will be forecasted: difficulties in activities of daily living (ADL) and in instrumental activities of daily living (IADL), functional limitations of upper and lower extremity, and self-perceived health. Projections will be done separately by sex and five-year age groups starting at age 50.

The analysis relies on representative data provided by SHARE, ELSA, and TILDA. Health expectancies will be calculated using the prevalence information from the survey data and Eurostat life tables applying Sullivan's method. Following recent literature, we will model the ratios of specific health expectancies to general life expectancy and make forecasts based on United Nation population projections (WPP 2017). As shown for self-reported health status, we expect large heterogeneities in health expectancies depending on the health indicator and country observed.

Biographical Sketch: Sonja Spitzer is a predoctoral researcher at the Vienna Institute of Demography (VID) in the research group on population economics as well as a second-year PhD student at the Vienna University of Economics and Business (WU). She holds a Master's of Science in Economics and a Bachelor's degree in Economics and Socio-Economics, both from WU. She has also completed parts of her studies at the School of Economics and the Department of Political Economy at the University of Sydney, Australia. Her research aims to identify the special needs and wants at each life stage by empirically analysing economic and non-economic indicators such as consumption expenditure and self-reported health.

Ankita Srivastava

Supervisor: **Guillaume Marois**
Co-Supervisor: **Nandita Saikia**

Research Project: **Future scenario of disability burden in India and states**

Abstract: Throughout most developed and developing world, one of the most daunting issues deals with challenges raised by population aging. A rapid increase in life expectancy, especially at older ages, alongside unprecedented declines in fertility will soon lead to never before seen rates of population aging. Most of the research focused on the number of additional years a person is going to live but here I would be interested in the question of "How many years in the life of a person will be spent without disability, i.e. a Healthy Life?" Consequently, assisting elderly people in performing daily activities should be a major concern of public policy over the next few decades. Countries with a large population like India have a large number of people now aged 60 years or more and as per Census 2011. Out of the 1.21 billion inhabitants, about 26.8 million are 'disabled' which is 2.21% of the total population. Among the disabled population 56% (15 million) are males and 44% (11.8 million) are females. The disability prevalence varies in different age groups and urban-rural areas. There exists no systematic research on future trends of disability in India, although this poses crucial input for current and future human capital of India. For my YSSP project, I want to critically analyse the current burden of disability among older population in India across population subgroups. Further I am also interested in estimating trends for inhabitants living with disability by age, sex, education, region etc. Later on, I would apply these estimates to project multistate and multiregional disability outputs in India.

Biographical Sketch: Ankita Srivastava has completed her MSc in Statistics (2011) later, she received her MSc in Population Studies (2014) and MPhil degree in Population Studies (2015) from International Institute of Population Sciences, Mumbai. Currently, she is a second year PhD student in the department of Center for the Study of Regional Development at Jawaharlal Nehru University, New Delhi, India. Her research interests span a broad range of topics in projections, aging, mortality and mathematical modelling of demographic data. Title of her thesis is "National and Sub-National Projections of Aging in India: A Probabilistic Approach". She has attended many national and international conferences and workshops.

Yuping Bai

Supervisor: **Wei Liu**
Co-Supervisors: **Asjad Naqvi, Günther Fischer (WAT)**

Research Project: **Investigating climate adaptation in semi-arid regions as complex adaptive social-ecological systems – An integrated modeling approach**

Abstract: Covering 15% of the earth's land surface and home to 14.4% of the global population, semi-arid regions are characterized by unique ecosystems, climatic variability, water scarcity and nature-resources-based traditional livelihoods. Past studies have mostly focused on the societal adaptation to climate variability in semi-arid regions, such as Mongolia, Kenya, East Africa, etc. Few have studied on how human land uses influences the regional climate system and spatio-temporal dynamics of natural hazards, let alone their complex interrelationship and feedback. There is an urgent need for an integrated approach to understand and model the complex social-ecological feedbacks in semi-arid areas. In this study, I will develop a generalized framework for modeling complex adaptive social-ecological systems in semi-arid regions in the context of climate change and water scarcity. I aim to operationalize this framework by developing a coupled climate-land interaction and agent-based modeling process and apply it for the semi-arid Hulunbeier Prefecture in Inner Mongolia, China. Specifically, the Weather Research and Forecasting modeling system (WRF) will be used to simulate climatic effects of land use/cover change and predict water-related hazard occurrence; an agent-based model will be developed to explore the adaptation behavior of vulnerable communities and to investigate adaptation strategies in response to water variability and intensifying hazards. Coupling the two models, I aim to simulate how a semi-arid social-ecological system evolves under different climate and policy scenarios. The results will help inform more robust policy for building climate resilience in semi-arid regions around the world.

Biographical Sketch: Yuping Bai received a Bachelor's degree in Geographic Information System from Wuhan University, China (2015). She is currently in the third year of a five-year PhD program at the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences. Her PhD thesis focuses on how vulnerable communities in semi-arid areas make livelihood decisions in the face of recurrent disasters and how the resulted land use/cover change patterns feed back into regional climate systems. Her main scientific interests include land use change, climate change adaptation, human-environment interactions, and environmental economics and policies.

Kedar Kulkarni

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

Research Project: **Quantifying climate vulnerability and risks of agricultural systems using partial and quantile moments: A case study in India**

Abstract: Agricultural systems are increasingly exposed to production risk associated with global environmental change. The exposure and sensitivity of an agricultural system to climate and its ability to adapt to changing conditions can be defined in terms of the system's vulnerability to climate change. Much emphasis has been placed on developing sophisticated models and methods to assess climate vulnerability following the recommendations of the Intergovernmental Panel on Climate Change in its report on vulnerability to climate change. A particular body of literature has focused on better understanding the higher-order impacts of climate change as the mean indicators are unable to fully capture the climate vulnerabilities of agricultural systems. Specifically, partial and quantile moments-based approaches seem more appropriate to model and better understand higher-order impacts of climate change. The two approaches are therefore adopted for exploiting a rich panel dataset from India to estimate the effects of climatic variables on the mean and high-order moments of the net returns distribution and thus evaluate the impact of climate change on the vulnerability of agricultural systems. This should lead to a new set of economic measures of agricultural producers' vulnerability to climate change as well as the identification of factors that can explain the vulnerability of agricultural producers in a region. Finally, the suggested approach will enable a comparative analysis of the partial moments and quantile moments-based risk measures for quantifying vulnerability to climate change from various perspectives.

Biographical Sketch: Kedar Kulkarni is a second-year PhD student in the Department of Applied Economics at the Oregon State University. His research interests are in agricultural and resource economics, risk and vulnerability analysis and climate change. His PhD work focuses on exploiting rich panel datasets using flexible moments-based models to assess the climate vulnerability of agricultural systems. Prior to starting his PhD, he received an Integrated Masters (I.M.A) in Economics from the University of Hyderabad, India and an Erasmus Mundus Masters in Quantitative Economics from the Université of Paris1 Panthéon Sorbonne, France and the Cá Foscari University of Venice, Italy.

Nain Martinez

Supervisor:	**Nadejda Komendantova Aman**
Co-Supervisors:	**Susanne Hanger, Isela-Elizabeth Tellez Leon**

Research Project: **Assessing the governance of social conflicts between renewable energy projects and communities in Mexico**

Abstract: The ongoing energy transition involves the transformation of the current energy system into a new system with different technical and social characteristics. This implies changes in technology and infrastructure, but also means changes in the social dimension of the energy systems, including political, regulatory, market, behavior, and cultural aspects. However, the social dimension of the energy transition has received scant attention, especially in the Global South. In this context, this research addresses one of the aspects of the social dimension by exploring the emergence of new governance instruments that seek to manage the relationship between renewable energy projects and communities. Specifically, I analyze the Social Impact Assessment and the Indigenous Consultation in Mexico, which were created within the framework of the Energy Reform (2013) and the Energy Transition Law (2015) with the aim of reducing the growing social conflicts associated with renewable energy projects. This summer I will analyze the discussion around these instruments, as well as their performance, limitations, and challenges through semi-structured interviews conducted with key stakeholders (governmental institutions, environmental and human rights NGOs, renewable energy companies, academics and experts, social leaders, and international cooperation organizations). The results of this research can contribute to improve both instruments in Mexico, but also help to have a better understanding of broader discussions including social conflicts associated with the energy transition and the transformation of the prevailing governance models in the electricity sector.

Biographical Sketch: Nain Martinez is a third-year PhD student in the program of Environmental Science Policy and Management with a Designed Emphasis in Science and Technology Studies at University of California, Berkeley. His research focuses on understanding the social dimension of the ongoing energy transition in Mexico. In this country, energy transition policies have been successfully promoting the investment in renewable energy projects, but they are facing stiff social opposition, especially in indigenous communities. Before starting his PhD, he obtained a Bachelor's degree in biology and a Master's degree in management of Arid Zones Ecosystems, both in Mexico. Professionally, he worked for seven years at Environmental NGOs in Mexico where he collaborated with the designee of educative models for rural communities and the assessment of environmental policies.

Kian Mintz-Woo

Supervisor: **Thomas Schinko**
Co-Supervisor: **Reinhard Mechler**

Research Project: **Obligations of private actors with respect to loss and damage**

Abstract: Loss and Damage, under the 'beyond adaptation' interpretation, includes the adverse effects of climate change that are beyond our ability to adapt to. Thus, we can think of climatic effects as being within our ability to mitigate, to adapt to, or beyond our ability to adapt to—that is, Loss and Damage. This project examines the links between losses and damages and obligations of the private actors, especially large energy producers, which have historically made disproportionate contributions to climate change. These actors have been called 'carbon majors', and they are so significant that 57% of emissions between 1880 and 2010 can be traced to 90 of them. Firstly, this project discusses whether carbon majors have obligations of compensation. In light of these traceable emissions, the project argues that carbon majors are especially responsible in a moral sense (as compared with, for instance, consumers or governments) and that this moral responsibility can be used to justify compensation. Secondly, it expands the theoretical connections between responsibility and Loss and Damage, arguing that such responsibility is more closely tied to costs associated with Loss and Damage than to the costs of mitigation or adaptation. Finally, it analyzes the fraction of historical emissions that are traceable to carbon majors under different carbon budgets and different historical baselines in order to determine how robust this framing is.

Biographical Sketch: Kian Mintz-Woo is in his final year as a philosophy PhD student at the University of Graz' Doctoral College in Climate Change. His doctoral work defends the role of expert elicitation for the moral parameters involved in discounting and welfare economics under prescriptivism. His current research interests include science to policy communication, social cost of carbon, loss and damage and the role of experts in democracy. Before coming to Graz, he studied at the University of British Columbia (BA), University of Amsterdam (MSc Logic), University of Reading (MA), and Oxford University (BPhil).

Laura Mononen

Supervisor: **Brian Fath (ASA)**
Co-Supervisors: **Gerid Hager (ESM), Gloria Benedikt (ESP)**

Research Project: **Systems view on creativity – Dynamics of emerging perceptions**

Abstract: In the prevailing society, creativity and innovation related skills are becoming ever more crucial. We have to be able to find and solve ill-defined problems, and create new solutions, which combine diverse disciplines - such as art, design, science and technology. Despite the increasing need, there is still an enormous lack in understanding how to support people in creative work. Creativity has been studied for centuries. Nevertheless, the use of systems sciences has been scarce. Especially, the systems self-renewal and individual thinking processes in the context of collective creation processes is all but absent. This project is a part of a PhD thesis aiming to contribute to this research gap. It is adopting a systems approach to investigate the research question: what is creative cognition? The project will conduct a meta-analysis, which uses previous research from diverse disciplines (e.g. systems sciences, cognitive science, psychology, social sciences, philosophy) in order to build a conceptual systems model of individual creative cognitive renewal. The results are expected to comprise: i) an integrative literature review; ii) a written analysis and synthesis as visualizations of systems parts and processes; and iii) future research gaps. The results will be integrated into a conceptual model indicating the aspects of creativity on individual and social levels. The theoretical contribution is expected to inform the following empirical research of the thesis. The practical benefit is aiming to support the work of adult educators and leaders aiming to foster creativity, especially in self-organizing multidisciplinary working settings.

Biographical Sketch: Laura Mononen is a Doctoral Candidate at the University of Jyväskylä, Faculty of Information Technology, Finland. Her major is Cognitive Science. She holds a Master of Economics and Business Administration (Entrepreneurship) and a Bachelor of Cultural Studies (Fashion Design and Marketing). In her PhD research, she is investigating creativity from a systems perspective with the intent to profoundly understand the dynamics of emerging perceptions. Her research interests are mind, design and the process of renewal in all its fascination. Through her work, she wishes to bend deeply-rooted mental models and initiate new insights in the interfaces between scientific and practical fields.

Sara Turner

Supervisor:	**Joanne Linnerooth-Bayer**
Co-Supervisor:	**Gergely Boza**

Research Project: **Stability and change in common pool resource governance regimes**

Abstract: A large and varied literature on the dynamics of environmental governance exists, but relatively little work explicitly considers the role group heterogeneity in the form of plural rationalities or worldviews, such as described by cultural theory, plays in these processes. Actors, discourses, and existing policy landscapes all interact and influence the ways that governance regimes change, or fail to, over time. This study proposes to explore the nature and significance of these relationships using a common pool resource management game called the Forest Game developed at IIASA. Using an experimental design to vary a variety of game conditions, we will explore the evolution of discourse among participants and the resulting governance regime outcomes. Analysis of the data will attempt to identify narrative and discursive elements predicted by cultural theory relating to risk, randomness, the resilience of natural systems, the importance of justice, among others, and describe the role that these played in discussions about policy choices. Results have implications for understanding the ways that governance regimes evolve over time and the ways that group dynamics influence regime stability.

Biographical Sketch: Sara is a third-year PhD student at the Pardee RAND Graduate School and an assistant policy researcher at the RAND Corporation. Her research interests include the structure and evolution of environmental governance regimes, decision making under deep uncertainty, environmental policy, and disaster risk reduction. Prior to returning to school, she worked at the Frederick S. Pardee Center for International Futures in Denver, CO and at the Institute for Security Studies in Pretoria, South Africa. She received her Master's degree in International Studies from the Josef Korbel School at the University of Denver in 2013.

Jie Liu

Supervisor: **Arnulf Grübler**

Research Project: **Identifying knowledge depreciation rate at industry level by calibrating agent-based model on patent application**

Abstract: The depreciation rate of technological knowledge is an important economic parameter, which contains information about technology evolution, determines knowledge stock and impacts on R&D investment revenue. However, the measurement of this parameter is still an open question. Existing studies that try to deal with it mainly depend on R&D expenditure data or patent renewal data. Both of the two streams use the econometric method but inevitably contain some exogenous and unreasonable parameter assumptions. In this way, it is necessary to identify knowledge depreciation rate with a new methodology. The proposed study aims to deal with this problem using agent-based model calibration. At first, an agent-based model that illustrates production of patented knowledge would be built. Knowledge depreciation rate is a key parameter in this model. After that, historical data about patent applications is used to calibrate this model and identify depreciation rate. Finally, the research illustrates the method with 1-2 case studies of energy related industries, and sensitive analysis would be used to explore policy implications.

Biographical Sketch: Jie Liu is now a five-year PhD candidate in the school of Business, East China University of Science and Technology, from which she graduated in June 2014 with a bachelor's degree in management. Her doctoral research focuses on modelling bounded rationality in organizational innovation process. Her main scientific interests are technology innovation and technology evolution.

Christopher Esposito

Supervisor: **Arnulf Grübler**

Research Project: **The geographical development, diffusion, and evolution of new technologies**

Abstract: The development of new technologies is a primary driver of long-run economic growth. For the most part, inventors develop new technologies by reassembling the components found in existing technologies. This process involves four key steps: 1) searching among the available components for components that may be recombined, such as existing pieces of hardware or snippets of computer code, 2) selecting and assembling promising combinations of components, 3) testing the performance of the resulting technology, and 4) debugging the technology by substituting components in and out of the mix. This four-step process of invention is fundamentally governed by geographical proximity. Because the expertise needed to assemble specific technological components is highly complex and does not readily diffuse across geographical distance, the set of components that are available to inventors largely depends on the city in which they live and work. My project will investigate how inventors develop new technologies by combining local and non-local components through an analysis of U.S. patent records. Patent records extend back to 1836 and record the home addresses of their inventors, and each patent lists a number of standardized components which are used in the invention. By tracking the use of specific components over time and across patent records, my research will show how inventors experiment with components by combining them with other components, how effective combinations of components are selected and reused, and how these processes are structured by the geographical distribution of technical know-how.

Biographical Sketch: Chris is a third-year PhD student in Geography at the University of California, Los Angeles. His research investigates how new technologies are developed, how the local economic and social environments of inventors shape the types of technologies they develop, and how the localized development of new technologies fosters uneven economic growth. Chris received an MA in Geography from UCLA in 2016 and a BA in Economics and Geography from Colgate University in 2014.

Thomas Boerman

Supervisor: **Peter Greve**
Co-Supervisor: **Yoshihide Wada**

Research Project: **Machine learning as tool for determining streamflow depletion due to groundwater pumping**

Abstract: Estimating streamflow depletion caused by groundwater pumping is one of the tasks performed by water managers to prevent negative ecological effects in terrestrial aquatic ecosystems. However, quantifying streamflow depletion typically requires a calibrated, site-specific groundwater flow model, making impacts and understanding hard to generalize across different settings. In this study, a neural network is used to predict streamflow depletion (output) based on several predictor parameters (including stream-well distance and hydraulic diffusivity). Specifically, the performance of the neural network on predicting streamflow depletion under transient conditions is tested. The dataset for training the neural network is obtained from four well calibrated groundwater models of areas in the states of Michigan, Illinois and Wisconsin in the United States (developed by the United States Geological Survey), with the possible addition of other groundwater models. This new method presents water managers with an additional tool to estimate streamflow depletion based on a few simple, easily obtainable parameters. This specific study is part of a larger project, where various machine learning techniques (neural networks, Bayesian networks, binary decision trees etc.) are used to predict streamflow depletion or stream vulnerability to streamflow depletion due to groundwater pumping over different time scales, spatial scales and climate regions.

Biographical Sketch: Thomas Boerman received both his Bachelor degree in Earth Sciences and his Master's degree in Environmental Hydrogeology at Utrecht University, the Netherlands in 2011 and 2013 respectively. After being employed as a junior hydrologist and soil scientist at a consultancy firm in the Netherlands for two years, he is now a second-year PhD candidate in the Civil Engineering department at the University of Victoria in Victoria, British-Columbia, Canada. His main research focus is on developing alternative methods for estimating streamflow depletion caused by groundwater pumping through the use of machine learning (f.e. neural networks and Bayesian networks).

Kelly Cortney Gustafson

Supervisor: **Laixiang Sun**
Co-Supervisor: **Kuishuang Feng**

Research Project: **System dynamic and input-output integration for regional hydro-socioeconomic modeling**

Abstract: The human and natural systems are inherently connected and should be modeled and researched as integrated components of a complex but united system. Integrated assessment models can provide a toolkit for decision-makers and politicians to make informed decisions regarding the complex systems we depend on. The proposed summer research is aimed to converge modeling efforts at IIASA and the University of Maryland (UMD) to help advance the framework of regional integrated assessment modeling. The novel integration of system dynamics (SD) and input-output (IO) tables used in the economic module of IIASA's global MEDEAS model is an exciting advancement for ecological macroeconomics. Translating the SD-IO integration to a regional scale would have significant impacts on the development of integrated hydrological models considering their spatial domains are ideally designated to watershed regions. The proposed project would consist of a critical review of the MEDEAS model's structure and behavior followed by a series of trial and error deigns and runs under the supervision of the MEDEAS research team. The MEDEAS mentorship will help guide the development of UMD's regional Coupled natural-human Water (COWA) model in efforts to inspire regional consideration of the SD-IO integration. Additionally, a hydrological perspective will be considered in the context of the COWA model and therefore sharing a secondary purpose of conceptually contributing water-related feedbacks currently absent from the MEDEAS model. The research collaboration provides a promising opportunity of mutual conceptual expansion of both modeling efforts.

Biographical Sketch: Cortney Gustafson graduated from Florida State University with a BSc in Environmental Sciences in 2010 and from Florida International University with an MSc in Environmental Sciences in 2014. She is currently a fourth-year PhD candidate in the Department of Geographical Sciences at the University of Maryland, where her research focuses on furthering our understanding of the long-term sustainability of complex water resource systems through system dynamics modeling and analysis. Her main fields of scientific interest include geographical information systems (GIS), hydro-socioeconomic systems, systems dynamics, input-output analysis and integrated modeling.

Merritt Harlan

Supervisor: **Peter Burek**
Co-Supervisor: **Lassi Heininen (AFI)**

Research Project: **Understanding the Arctic hydrologic cycle: A new regional model framework and calibration technique using CWATM**

Abstract: This research proposes a new Arctic regional circulation model (RCM) which builds off the Regional Arctic Systems Model framework, but uniquely incorporates the Community Water Model (CWATM) and the Model for Scale Adaptive River Transport (MOSART). Given recent changes in the Arctic such as polar amplification, sea ice melt, and urbanization, the Arctic hydrologic cycle is predicted to change in response, and these changes have large implications for both local Arctic communities and the global community. Current Arctic models that are used to predict how the Arctic may change and how feedbacks within the Arctic may interact have discrepancies between them and suffer for lack of sufficient data. This new Arctic model seeks to overcome some biases present in previous Arctic RCMs and incorporate new discharge data by including new model components, and relying on new advances within discharge estimation from remote sensing. The discharge estimates will come from both an exclusively remotely-sensed approach with the use of at-many-stations-hydraulic-geometry (AMHG), as well as a combination of in-situ data from stream gages and overhead drone data from Arctic field research. The proposed research aims to shed light on the Arctic hydrologic cycle, improve modeling of the Arctic, and incorporate remote sensing techniques into obtaining discharge data for remote areas.

Biographical Sketch: Merritt Harlan is currently pursuing her PhD in Environmental and Water Resources Engineering at the University of Massachusetts at Amherst. She received her Bachelor of Science degree from Williams College as a Mathematics major. Her research interests include hydrodynamic modeling of rivers, remote sensing of river discharge using satellite and UAV imagery, Arctic hydrology, and the global hydrologic budget.

Xiaoyu Liu

Supervisor: **Taher Kahil**

Research Project: **Modelling the water-energy-economy nexus at provincial scale across China**

Abstract: Most countries around the world, including China, have pledged to reduce their carbon emissions in the recent Paris Agreement, through the implementation of various mitigation policies. Moreover, with the rapid development of economy and urbanization in China, water resources and water-related ecosystems will be facing considerable challenges in the coming decades, which calls for the design and implementation of several water policy interventions. However, few studies have thus far investigated the interactions between climate mitigation and water policies in China, which give rise to important research questions such as whether and how the climate mitigation policies will affect water demand and wastewater discharging, and how existing water saving policies, for instance, could contribute to achieving national and provincial carbon mitigation targets. To address this gap in the literature, this study aims to: (1) extend the Integrated Model of Energy, Environment and Economy/Computable General Equilibrium model for 30 provinces of China (IMED/CGE) with a water demand module, using the detailed provincial sectoral water demand data over several years and hydrological simulations from the IIASA's Community Water Model (CWATM); (2) project how the trend of water demand, wastewater discharging, and carbon emissions will evolve under different Shared Socio-economic Pathways (SSPs) in each province of China; (3) quantify how the above indicators will respond to the Representative Concentration Pathways (RCPs); and lastly (4) evaluate the tradeoffs and synergies among water and mitigation policies in China under different future scenarios combining the SSPs and RCPs. According to the simulation results, adaptive water and mitigation policy interventions will be proposed under those scenarios.

Biographical Sketch: Xiaoyu Liu is a first-year PhD student in the College of Environmental Science and Engineering at Peking University, China. She graduated from Wuhan University (2017), China, with a Bachelor's degree of Harbor, Waterway and Coastal Engineering and another degree in Finance. She is majoring in Environmental Management. Her research focus is on water-energy-economy nexus. She is also interested in water quality modelling.

Jiayue Wang

Supervisor: **Günther Fischer**
Co-Supervisor: **Laixiang Sun**

Research Project: **An estimation of transaction cost of farmland transfer in China**

Abstract: With the arrival of the era of Chinese high labor costs, raising labor productivity has become one of the important challenges facing agricultural development in China. The prevailing small scale and decentralized management mode has become a major obstacle for achieving agricultural modernization in China. Increasing labor productivity calls for the expansion of farm size, which in turn requires the transfer of land management rights among farm households. In response to the Chinese government vigorously promoting land transfer and moderate scale management, agricultural land transfers increased rapidly, and the transfer rate reached as much as 35% in 2016; but its effect of farm size is not obvious. There are still 85% of the farmers whose management scale is below 0.67 ha (10 mu), and only 1.4% of the farmers with a management scale exceeding 3.33 ha (50 mu) by 2015. In the recent past, there has been a marked stagnation in the farm size expansion process, probably because of excessive transaction costs. Thus, there is an urgent need to analyze the determinants of the high transaction costs in order to provide a theoretical reference for China's land system reform. The basis of the determinants analysis is the robust quantitative estimation of the transaction costs. There have been only few studies in the past addressing the quantitative estimation of transaction costs of farmland transfer.
This study aims to make a contribution to China's ongoing land reform. It will (i) combine spatial and temporal analysis at the national level with farmers' household survey at a regional level, (ii) focus on the cultivation of food crops, and (iii) target farmers' scale-management as main research subject. The study will include land quality based on the Agro-ecological Zones (AEZ-China) model, apply the income capitalization approach, and use an agricultural household model to derive various components of farmland transfer transaction costs in China.

Biographical Sketch: Jiayue Wang received her Bachelor's degree in Geographic Information System from China Agricultural University in 2014. She is currently a second year PhD student at Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences. Her thesis tries to estimate the transaction cost of farmland transfer and analyze the determinants of the high transaction cost. Her main fields of scientific interest include land use and land cover change, rural land use change and its effect analysis.

Mengru Wang

Supervisor: **Ting Tang**
Co-Supervisor: **Peter Burek**

Research Project: **Modelling river export of nutrients from land to sea by Yangtze and Indus Rivers**

Abstract: Intensive human activities and poor nutrient management in some world regions (e.g., China and India) have led to considerable nutrient losses to aquatic ecosystems, causing water pollution. This study aims to develop a method to quantify present and future export of nutrients from land to sea by rivers, and the associated potential for coastal eutrophication. The first step is to explore possibilities to model nutrient export by rivers using existing models at IIASA such as the CWATM (Community Water Model) and GLOBIOM/EPIC (Global Biosphere Management Model/ Environmental Policy Integrated Model) and nutrient models that I am working with at Wageningen University: Global NEWS (Global Nutrient Export from Watersheds) or MARINA (Model to Assess River Inputs of Nutrients to seAs). The second step is to perform illustrative model runs for Yangtze River in China with linked model systems using historical data and SSPs (Shared Socioeconomic Pathways) - RCPs (Representative Concentration Pathways) - based scenarios to examine nutrient flows in rivers. The last step is to apply the linked model system to the Indus River. The Indus River is part of the current ISWEL (Integrated Solutions for Water, Energy and Land) project at the Water Program of IIASA. This project also involves collaboration with the Ecosystems Services and Management (ESM) Program at IIASA. This work will provide a better modelling of nutrient flows from land to seas by combining the strengths of models at IIASA and the two nutrient models at Wageningen University.

Biographical sketch: Mengru Wang received a BSc with Honors in Agricultural Sciences from Nanjing Forestry University, China in 2012 and an MSc with Honors in Environmental Sciences from Wageningen University, The Netherlands in 2014. She is currently a third-year PhD candidate at Water Systems and Global Change Group at Wageningen University, The Netherlands. Her PhD research focuses on nitrogen and phosphorus use in food systems and the associated coastal water pollution in China. Her main scientific interests are integrated modelling, scenario analysis, nutrient use in food production and consumption, biogeochemical cycling of nutrients, eutrophication.