

vYSSP

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Biographical sketches and research project abstracts



Young Scientists Summer Program



International Institute for
Applied Systems Analysis

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Cristina Apetrei

Supervisor:

Nikita Strelkovskii

Co-Supervisors:

Nikolay Khabarov, Valeria Javalera-Rincón

Research Project:

**THE ROLE OF KNOWLEDGE AND LEARNING IN
SMALLHOLDER FARMERS' ECONOMIC DECISIONS**

Abstract:

Integrated land-use change models often represent farmers' economic decisions in aggregate ways and as a direct response to market influences. As such, it is expected that farmers will adjust their production efforts so as to maximise their profit within given environmental or economic constraints. However, this assumes perfect information on market conditions, strategy options and the associated payoffs. In reality, such information is not easily available, or is inaccurate, and agents do not act according to rational choice theory. This can be due to inherent uncertainties about input availability, or fluctuations of costs and prices, but it can also be a consequence of how social structures and institutions mediate the flow and access to information. In particular, learning-by-doing and social learning are two mechanisms that have been shown to explain human decision-making. What remain unclear are the specific ways in which these mechanisms interact, as well as how various levels of information and contextual conditions affect choices on strategies. In this project we aim to construct a stylised agent-based model representing farmers' selections of economic strategies under different learning and knowledge settings, as mediated by heterogeneous behavioural rules, social structures and institutional settings. Time allowing, we will validate this model using empirical data from pre-existing case studies of smallholders' agricultural practices. We hope that our research will contribute to the literature on modelling human behaviour, but also to the broader field of sustainability science by advancing our understanding of knowledge and learning processes in economic decision-making.

Biographical sketch:

Cristina is a PhD candidate in Sustainability Science at Leuphana University Lüneburg (Germany). She is currently investigating the role of knowledge in sustainability transformations, while her broader interests are in integrated social-ecological systems analyses, computational/modelling approaches, and understanding human behaviour and worldviews. She has an M.Sc. in Environmental Sciences from Utrecht University (the Netherlands) with a thesis in behavioural economics. In 2011 she was a Donella Meadows Fellow of the Balaton Group. Prior to starting her Ph.D. Cristina worked in a social startup where she co-designed and managed an online platform for sharing sustainability performance data across food supply chains.



Matthew Ashcroft

Supervisor: **Artem Baklanov**

Co- Supervisor: **Nikita Strelkovskii**

Research Project: **INTERCONNECTIVITY OF THE UNITED NATIONS
SUSTAINABLE DEVELOPMENT GOALS**

Abstract:

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

Biographical sketch:

Matthew Ashcroft is a 5th year PhD candidate in Sustainable Engineering at Villanova University. Villanova is located outside of Philadelphia Pennsylvania, but he is originally from upstate New York. His YSSP research is on the interconnectivity of the United Nations Sustainability Development Goals (SDGs). He uses data from the Sustainable Development Report and different modeling techniques to extract information about the relationships of the metrics within the UN framework. Matt has also been actively involved in the development and implementation of Villanova's sustainability plan. He and his team built the plan around the SDGs and a materiality study of the campus community's priorities that utilized the Analytical Hierarchy Process (AHP). In his free time, he enjoys supporting Tottenham Hotspur, playing video games with his friends, and investing in cryptocurrency.



Caterina Barrasso

Supervisor:
Co-Supervisor:

Myroslava Lesiv
Juan Carlos Laso Bayas

Research Project:

**TESTING A DATA FUSION METHOD FOR MULTISCALE AND
MULTICLASS LAND-USE/LAND-COVER (LULC) MAPS TO
IMPROVE SPATIAL PATTERNS AT MEDIUM RESOLUTION**

Abstract:

Land-use/land-cover (LULC) is an essential input variable for many studies that involve the Earth surface and feed into worldwide policies, but high uncertainties are found during inter-comparison of LULC maps derived from remote sensing imagery. Among the reasons of classification mismatch, specially in coarse maps and heterogeneous areas characterized by mixed pixels, is that the landscape heterogeneity is ignored by providing only the LULC class covering the largest portion of a pixel. Recent high-resolution maps (at 30m or finer) upscaled to coarser resolutions are more suitable for representing LULC-class distributions than natively-coarse maps, but they remain uncertain in many parts of the world and, currently, hardly provide more than one LULC class. Data fusion is found to improve thematic accuracy due to the characteristics contributed by each map being fused. Within this broad scope, my YSSP's research will focus on testing a data fusion method to improve spatial patterns at medium resolution. I will exploit information from multiscale and multiclass LULC maps and consider, during the data fusion, their relative merits previously assessed. The method will model LULC class proportions in a bounded interval (0-1) and the many zeros and ones present in the data. It will be tested in several small study areas that represent both homogeneous and heterogeneous landscapes in different climatic and world regions. The output will be validated (and compared to each individual map used as input) with a sub-pixel ground-truth database that better describes, on the ground, spatial LULC patterns.

Biographical sketch:

Caterina is a 2nd year PhD student at the German Center for Integrative Biodiversity Research (iDiv) in Leipzig. Her research focuses on improving the quality of LULC global remote sensing derived maps. Her scientific interest is in filling data gaps and processes understanding of direct and indirect local LULC changes at a global scale, as well as its drivers. She has a MSc in Crop Science from Wageningen University since October 2017. During the MSc she gained insights in understanding the pressures of agricultural practices on ecosystems and biodiversity. Prior to her PhD she had scientific collaboration in the field of crop modelling in France and Australia, and worked as trainee at the DG Joint Research Center of the European Commission and the European Food Safety Authority.



Nikita Belyak

Supervisor:

Nikolay Khabarov

Co-Supervisor:

Alexey Smirnov

Research Project:

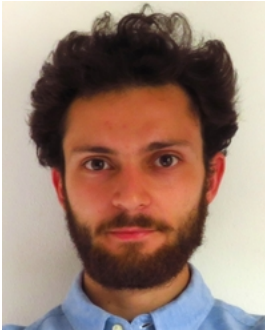
**OPTIMISING TRANSMISSION INFRASTRUCTURE
EXPANSION TO EFFICIENTLY INTEGRATE RENEWABLE
ENERGY GENERATION**

Abstract:

prevalent trends among the operations research community target the development of efficient strategies to replace the energy generation technologies with environmentally friendly and renewable alternatives. This tendency is caused by the steady increase in emissions of CO₂ and other greenhouse gases. Responding to these issues, several countries have paid significant attention to developing efficient solutions to mitigate emissions, aimed at increasing the share of renewable alternatives among energy sources. However, transmission systems were not designed to cope with such levels of renewable penetration. Consequentially, renewable-driven generation expansion demands new approaches for transmission network planning. Therefore, we study an efficient modelling assessment for planning optimal transmission network expansion considering the market competition between the generation investors, while stimulating the further expansion of renewable energy sources. In the modelling approach, we refer to a bi-level model to consider welfare-maximising transmission system operator making investments in transmission lines at the upper level and power system operations model at the lower level. We apply the aforementioned modelling approach to implement a realistic case study for European energy systems. Solving the large-scale mixed-integer quadratically constraint quadratic programming instances representing energy systems pose obstacles associated with satisfying quadratic strong-duality conditions. To overcome the latter, we investigate the integration of the p-Lagrangian relaxation with a branch-and-bound strategy. The outcome of the research can be further utilised in a broad set of applications associated with planning energy system transformations targeting greenhouse gas mitigation. In addition, the case study for European energy systems could be exploited in the context of developing strategies to meet the European Union 40% CO₂ emission reduction target.

Biographical sketch:

Nikita holds a BSc and MSc in Applied Mathematics and Informatics from the Southern Federal University (SFedU, Russian Federation) and an MSc in Computational Engineering from the Lappeenranta University of Technology (LUT, Finland). Nikita is a 3rd year PhD candidate at Aalto University (Finland) in the Department of Mathematics and Systems Analysis. His research focuses on the development of efficient solution methods for mixed-integer nonlinear optimisation problems. His current area of study also spans the development of a comprehensive modelling assessment for planning energy systems targeting greenhouse gas mitigation.



Angelo Carlino

Supervisor: **Matthias Wildemeersch**

Research Project: **ROBUST DAM PLANNING IN THE ZAMBEZI RIVER BASIN**

Abstract:

Current and projected population growth in Sub-Saharan Africa, and in many countries belonging to the Southern African Power Pool (SAPP), challenges energy, food and water security in the region. Additionally, transitioning from a fossil-based to a low carbon power system is needed in order to mitigate the effects of climate change. In this context, the untapped hydroelectric potential of the Zambezi river basin, presently generating renewable power accounting for between 10% and 15% of current SAPP final electricity consumption, represents a promising clean energy investment. Indeed, new dams are under consideration along the main river course to almost double the currently installed hydroelectric capacity.

Yet, the uncertainties regarding future hydroclimatic regime, as well as socio-economic and technological development, hinder the economic assessment of such infrastructural projects. As a matter of fact, financial viability of the proposed dams is affected by future spatiotemporal availability of water but, even more importantly, by the future electricity demand and the cost of alternative technologies to meet it. Since global scale climate action is expected to be driving the evolution of socio-economic systems, the integration of models operating at different spatial and temporal scales is required to formulate and solve a robust decision-making problem. Alternative dam portfolios need to be designed based on some plausible scenarios and then screened based on their robustness with respect to the uncertainties discussed. Finally, potential vulnerabilities have to be explored and reported in order to inform the infrastructural development decisions.

Biographical sketch:

Angelo graduated in Environmental and Land Planning Engineering at Politecnico di Milano in 2018. Currently, he is a third year Information Technology PhD student at Politecnico di Milano in the Environmental Intelligence Lab. His main research interest is decision-making under uncertainty across different spatiotemporal scales in complex environmental systems with a specific focus on water-energy nexus and climate policy.



Alex Clark

Supervisor:

Sebastian Poledna

Research Project:

**UNDERSTANDING THE FINANCIAL, EMPLOYMENT AND FISCAL
CONSEQUENCES OF COAL PHASE-OUT FOR CHINA'S STATE-
OWNED ENTERPRISES: A NETWORK APPROACH**

Abstract:

Globally, state-owned enterprises (SOEs) account for around half of installed and planned fossil fuel power generation capacity. In China, an estimated 96% of coal power generation is under the control of SOEs. This project will attempt to map, using a network modelling approach, the distribution and features of the financial, employment, and fiscal impact of coal phase-out in China. The project will also seek to map, to the greatest extent possible, the links between specific coal plants, mines and coal-using industrial facilities and China's SOEs.

SOEs present a difficult analytical problem, being heterogeneous and not typically pure profit-maximisers, hence the inclusion of employment and fiscal impacts in this project. Using existing asset-level datasets combining thermal power assets and industrial facilities with ownership information, and estimates of the (financial) economics of those assets from prior work and a collaboration with Carbon Tracker, this project focuses on building a layered network arrangement with industrial plants and coal plants as nodes, and the relationships between them (edges) on one level, and asset ownership on another. To make the project tractable in 3 months, the only 'agent' is the government, which introduces top-down demand shocks or direct regulation on coal, with the aim of understanding the impact of exogenously determined policies. This assumption can be relaxed in future work.

This project can create an empirical basis for ultimately modelling the decisions of SOEs and understanding or anticipating the political economy implications of coal closure in China. By creating a detailed network arrangement, I hope to open the door to later, more sophisticated agent-based modelling of SOE decision-making on coal assets, or other extensions including mapping of China's financing of energy assets overseas.

Biographical sketch:

Alex Clark is a second year PhD researcher at the Smith School of Enterprise and the Environment, University of Oxford. His research focuses on the financial and societal consequences of the energy transition in China, with a particular focus on the role of state-owned enterprises. His primary field of enquiry is the political economy of energy, and he is looking to extend prior work in industrial economics to incorporate new methods in complexity economics and adaptive systems, including network analysis. Alex holds an MSc in global governance and diplomacy from the University of Oxford, and a BA (Hons) in philosophy, politics, and economics from the University of Warwick.



Pavel Kiparisov

Supervisor: Georg Pflug

Research Project: URBAN SYSTEM RESILIENCE TO FLOODS: A SPATIAL PERSPECTIVE

Abstract:

At the moment, our understanding of resilience in the real topological networks lags behind compared to its understanding in their non-embedded counterparts. The efforts on examining urban systems will eventually lead to discovery of certain spatial patterns, knowledge of which can be taken into account when working out disaster preparedness strategies and planning a recovery. My work is an attempt to understand how the availability and accessibility of critical infrastructure and critical services affect resilience of communities in cities during floods. The project will utilise methods of geographic information systems and network-based approaches to assess resilience of urban systems.

I study urban resilience because I want to find out how to make lives of people safer in modern cities. To do that, I try to explore the role of spatial configuration, availability, and diversity of critical services in cities during extreme events. I assess vulnerability of residential areas in selected cities prior, during, and in the aftermath of floods. With help of remote sensing, I will quantify the damage of roads and buildings and reflect the results on the network. Various network-related robustness and resilience assessments will help me to see how vulnerable certain parts of the network is, and how the access to critical services change in course of the extreme event. In a result, I expect to complete an in-depth analysis of two or three cases of major flood in urban areas.

Biographical sketch:

Pavel is a PhD candidate in environmental systems at Central European University in Vienna. He studies resilience of cities to various catastrophes that cause physical damage. The methods he uses include geospatial and network analysis. He holds a Master's in economic policy in global markets and a Master's in public policy. Prior to a PhD programme, he was the economist at the Regional Office for Europe and Central Asia of the Food and Agriculture Organization of the United Nations.



He LI

Supervisor: Elena Rovenskaya

Research Project: PUBLIC-PRIVATE PARTNERSHIPS FOR FUTURE CRISES:
CASE STUDY OF THE ICT SECTOR AND COVID-19

Abstract:

The COVID-19 pandemic is the greatest challenge that humanity has faced since World War II. It is truly redefining our society. During COVID-19, new digital services such as websites and mobile applications have been developed to help society cope with the pandemic. Some of these services resulted from Public-Private Partnerships (PPPs) in the ICT sector. But PPPs face a number of barriers at the creation and development stages including challenges related to research capacity, finances, strategy plan, and business environment.

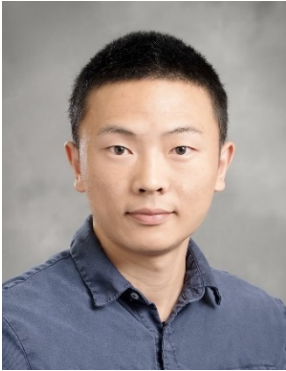
The research questions of this project include the following: How can the government create a favorable regulatory and legal environment to promote PPPs? How can the Research and Development (R&D) capacity be enhanced? How to break the barriers to develop innovative business to support the society in the post COVID-19 age?

To address these questions, we will analyze a few examples from the ICT sector focusing on how they operated during the COVID-19 crisis. The research will rely on in-depth interview, secondary data, and literature review. We will study motivations and barriers of the ICT sector to create and effectively operate in PPPs. On this basis, recommendations will be proposed.

Biographical sketch:

He LI is currently a first-year PhD candidate at the ELLIADD Lab, Université de Bourgogne Franche-Comté, France. The title of his thesis is Designing Resilience through Information and Communication Technologies. His main fields of scientific interest include public-private cooperation for crises, ICT for the resilience design, and crisis communication. He received an honorable Master's

degree in Engineering on 2018 from Peking University, China and a Bachelor degree from Yunnan University, China. He is a member of the Design Society.



Yingjie Li

Supervisor: Brian Fath
Co-Supervisor: Petr Havlik

Research Project: INTERNATIONAL SOCIO-ENVIRONMENTAL SPILLOVER
EFFECTS ON ACHIEVING THE NATIONAL SUSTAINABLE
DEVELOPMENT GOALS (SDGS)

Abstract:

In an increasingly globalized world, countries' abilities to achieve SDGs are affected by positive or negative spillovers from other countries. Most of the spillovers are becoming prominent across large distances through international trade (aka telecoupling effects). Yet, little research has included these effects in monitoring SDG progress. Ignoring these hidden effects may result in achieving one country's SDGs at the cost of the other. To fill the gap, I propose to integrate Multi-Regional Input-Output (MRIO) analysis and network analysis to quantitatively assess the impacts of multiple socio-environmental spillovers and their interactions on achieving national SDGs. I will use the Eora MRIO database to quantify the impacts of a list of trade-related environmental spillovers (e.g., land/water/energy use, carbon/nitrogen emissions, biodiversity loss) on SDG scores. I will also link Eora with the novel Social Hot Spots Database to quantify the impacts of several trade-related social spillovers (e.g., occupational injuries/fatalities, child/forced labor) on SDGs. Using integrated network analysis, I will reveal how the multiple spillover networks interact and shape trading nations' sustainability. The study will help better understand the often-ignored spillover effects and trade-offs in achieving sustainability, and help (inter)governmental agencies manage these effects and achieve SDGs globally. The findings will be useful for future work with the GLOBIOM and LANDFLOW models.

Biographical sketch:

Yingjie is currently a fourth-year PhD candidate in the Center for Systems Integration and Sustainability at Michigan State University (MSU). He holds an MSc in Geography from Shaanxi Normal University (2017), and a BSc in Land Resource Management from Hunan Normal University (2014). Yingjie's dissertation research at MSU focuses on understanding how telecouplings impact global sustainability. His research interests include SDGs, telecoupling, ecosystem services, and environmental policy.



Amelie Paszkowski

Supervisor:

Reinhard Mechler

Co-Supervisor:

Finn Laurien

Research Project:

**MAKING SPACE: THE IMPACT OF CLIMATE CHANGE
ADAPTATION ON LIVELIHOODS IN BANGLADESH**

Abstract:

Deltas are growing centres of risk, with over 70% of large deltas being under threat from a combination of rising sea levels, subsidence, and anthropogenic sediment trapping. Geomorphic processes, such as erosion, siltation, and subsidence, are all too often ignored in assessments of deltaic risk and vulnerability, with the Ganges-Brahmaputra-Meghna (GBM) delta being no exception. My research spatially quantifies the role that geomorphic processes play in driving flood risk and poverty across Bangladesh, and aims to assess how livelihoods are impacted by floodplain adaptation. Using satellite-based analyses, the hotspots of geomorphic change will be delineated, establishing the areas most in need of adaptation measures. In order to answer the question of how local livelihoods are affected by flood and geomorphic risks and subsequent floodplain adaptation, the focus will be narrowed down to specific riverine communities. The Flood Resilience Measurement for Communities (FRMC) approach, developed by the Flood Resilience Alliance, collects pre-event resilience and general socio-economic livelihood data, based on community-level stakeholder engagement, across 22 communities in three riverine districts in Bangladesh. It is the first time that these geomorphic and resilience datasets are combined to form the basis of assessments on the suitability and effectiveness of climate risk management and adaptation measures. This study will therefore contribute to deepening our understanding of environmental risks in the face of future climate change occurring at a range of scales, and how community-based resilience can guide more widespread sustainable management decisions.

Biographical sketch:

Amelie is a PhD student at the University of Oxford. Her research focuses on mainstreaming geomorphic processes in delta vulnerability assessments, by quantifying the role that geomorphology plays in driving flood risk and poverty in Bangladesh. Amelie holds a BSc in Geography and Oceanography from the University of Southampton, a MSc in Hydrology and Water Resources Management from Imperial College London, and has worked as a water engineer at Buro Happold prior to her PhD studies. Amelie's research interests include flood risk modelling and management, nature-based solutions, and research on the interface between hydrology, morphology and society.



Andreas Paulsson

Supervisor:
Co-Supervisor:

Love Ekenberg
Nadejda Komendantova

Research Project:

**MULTI-STAKEHOLDER ELICITATION METHODS FOR
PARTICIPATORY GOVERNANCE**

Abstract:

A municipal strategy ought to address a number of known as well as unknown current and future challenges, needs, and opportunities. The success of a municipal strategy will partly depend on anticipated future changes and events as well as its alignment with the objectives and preferences of the citizens. With input from a large number of citizens, from different age groups with a diverse set of interests and occupations, and with knowledge of local and general specifics, including their personal preferences, it is more likely that tenable objectives, along with the necessary attributes, and value functions can be elicited in order to shape and evaluate viable strategy alternatives. The odds that a selected municipal strategy is meaningful and aligned with the local context would likely increase with a cost-effective, participatory governance approach that takes a wide range of citizens into account. Multi-agent elicitation can result in a wide range of values with a large degree of uncertainty, even when surveying experts. Therefore, elicitation methods should reasonably account for vague and imprecise input, such as rank orderings with uncertainty intervals. Aggregating such data is inherently difficult and complex; the underlying sets of objects can be of different sizes as well as disjoint. This study presents a participatory governance process based on a method for market assessment combined with multi-criteria decision analysis for objectives and value elicitation from a disparate set of experts and stakeholders, including techniques for aggregating and validating the input. The study includes a demonstration and evaluation of the process through a case involving the design and selection of a municipal strategy in Sweden.

Biographical sketch:

Andreas Paulsson graduated in 2018 from Stockholm University with a Master's degree in Computer and Systems Sciences with a specialization in Decision Support and Risk Analysis. He is currently a third-year PhD student at the Department of Computer and Systems Sciences at Stockholm University. The title of his thesis is Multi-Stakeholder Objectives Elicitation for Strategy Evaluation. His main fields of scientific interest include multi-agent preference elicitation, value modeling, argumentation, probabilistic reasoning, decision and risk analysis, and resilience.



Jennifer Richmond

Supervisor: Stefan Hochrainer-Stigler
Co-Supervisor: Finn Laurien

Research Project: **BUILDING BETTER: AN ANALYSIS OF THE ADOPTION AND EFFECTIVENESS OF WILDFIRE BUILDING CODES IN THE WESTERN UNITED STATES**

Abstract:

Wildfires ravage communities, forests, and government budgets each year in the U.S. The risk of wildfires continues to evolve as climate change enables conditions that are hotter, drier, and conducive to more frequent and intense fires. It remains unclear to what extent public policy is nimble enough to respond effectively at the local, state, and federal levels. A patchy web of disaster resilience policies and building codes meant to “harden” structures, as a defense against wildfires, exist in some places to attempt to protect public safety, property, and forests. However, it is unclear whether codes are enforced, if codes are enforced differently by local jurisdictions or states, and whether codes are effective at changing consumer behavior. To shed light on this issue a spatial modelling approach will be applied to predict homeowners’ level of adoption of fire-resistant building materials based on policy changes as well as spatial and risk characteristics. Additionally, the correlative propensity for designated fire hazard severity zones to predict where wildfires occur will be tested. Finally, options, such as retrofit programs, to harden existing homes in wildfire-prone areas will be analyzed. The findings should ultimately help to identify where public policy is making strides in community wildfire resilience and where improvement and investment are still needed.

Biographical sketch:

Jennifer is currently a PhD candidate in the School of Public Policy at the University of Maryland. Her research has focused broadly on evaluating sustainable development interventions, assessing climate resilience measures and policies, and modelling household energy dynamics in developing countries. Prior to her doctoral work, she was a research assistant at an international development think tank where she worked on natural resource management projects. Jennifer holds an MA in Global Environmental Policy from American University and a BS in Political Science from Shepherd University.



Shipra Singh

Supervisor: Åke Brännström
Co-Supervisor: Florian Hofhansl

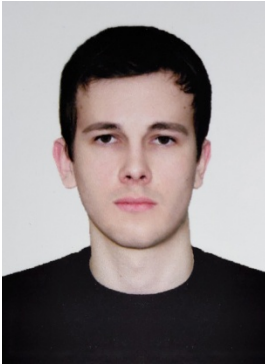
Research Project: TRAIT-BASED MODELLING OF TEMPERATE FORESTS IN WESTERN HIMALAYA, INDIA

Abstract:

A central goal of ecology is to understand how ecological communities assemble and how species assemblages determine ecosystem functioning in response to environmental factors. Community assembly is facilitated by how plant functional traits respond to environmental factors (response traits), and how ecosystem functioning is influenced by the functional composition of the community (effect traits). Two common applications of functional traits are (i) to characterize community responses to changes in the environment, including community assembly processes and (ii) to quantify the influence of community shifts on ecosystem processes. So far, few studies have used a functional trait approach to evaluate vegetation dynamics and species composition (Falster et al. 2011). However, such an approach can be used to study community level processes such as competition among coexisting species in response to limiting factors and how this affects plant functional traits and associated ecosystem functioning. Here, I propose to assess the variation of plant functional traits along environmental gradients with the goal to identify associated effects for crucial ecosystem processes, such as vegetation carbon storage. The identified relationships among ecosystem functioning and trait variance will be tested by applying statistical models (Poorter et al. 2018) and emerging plant functional traits will subsequently be used to parameterise and validate trait-based vegetation models i.e., Plant/Plant-FATE. The core of my research effort will therefore be devoted for parameterising and calibrating the Plant/Plant-FATE model to match in-situ observations from my study site located in Western Himalaya, India.

Biographical sketch:

Shipra Singh completed her Bachelor's degree in Zoology at Banaras Hindu University, India in 2013, where she also obtained her Master's degree in Environmental Sciences (2015). After her Master's, Shipra got enrolled in integrated MPhil/PhD program in School of Environmental Sciences, Jawaharlal Nehru University, India and studied the role of topography in governing vegetation attributes and associated soil properties in Western Himalayan forests. Shipra is currently a 4th year PhD student working on plant functional traits in temperate forests of Western Himalaya. Her main fields of interest include plant-soil interaction, trait-based ecology and ecosystem functions and services in montane landscapes.



Ivan Stepanov

Supervisor: **Nadejda Komendantova**

Research Project: **IMPACT OF INFORMATION IN SOCIAL MEDIA ABOUT
PANDEMIC RISK MITIGATION MEASURES ON
PERCEPTIONS: EVIDENCE FROM USA, GREAT BRITAIN
AND RUSSIA**

Abstract:

The COVID-19 pandemic has caused numerous extremely negative global consequences. To mitigate the risk of human losses and of further spread of the risk national states took risk mitigation measures which were very different, from partial limitations of economy to complete lockdowns. These measures were differently successful and did not always lead to expected results. All the successes and, most importantly, the failures of countries to manage the COVID-19 risk became the subject of widespread consideration in social media. The positive or negative discourse of COVID-19 pandemic risk management measures strongly influenced perceptions about countries. This research project examines the correlation between public perceptions in social media about COVID-19 risk mitigation measures in the United States of America, United Kingdom, and Russia. These cases were selected because of various risk mitigation measures and various discourses about their success. The empirical data collection includes surveys among social media users as well as artificial intelligence methods of analysis of messages in social media such as Twitter.

Biographical sketch:

After graduating from Volgograd State Pedagogical University with BA and MA degrees acquired in 2018 and 2020 respectively Ivan Stepanov became a PhD candidate at the School of International Relations, Saint Petersburg State University. His current research is devoted to the in-depth analysis of American and German media images comparing their interrelations in the context of the 10s and 20s of the XXI century. Ivan's main fields of scientific interest include international relations (Russia – EU – USA), political communication, media and discourse interpretation.



Lyndsie Wszola

Supervisor: Mikko Heino
Co-Supervisor: Ulf Dieckmann

Research Project: PLASTICITY AND EVOLUTION: FISHING IN A WARMING WORLD

Abstract:

Many harvested fish populations now mature at smaller sizes and younger ages than they did historically. Abundant evidence suggests that fishing-induced life history changes result from selection toward early and small maturation. However, many fish species also exhibit plasticity in growth as a function of temperature, making it difficult to disentangle the selective effects of fishing from the plastic effects of a warming climate. My project uses a large empirical growth and harvest dataset from walleye (*Sander vitreus*), a species with a well-known relationship between temperature and growth to simulate the eco-evolutionary dynamics of growth and maturation in the context of socially-driven variation in harvest and warming waters.

Biographical sketch:

Lyndsie Wszola graduated from the Pennsylvania State University in 2014 with a Bachelor's degree in Wildlife and Fisheries Science. She earned her Master's degree in Applied Ecology from the University of Nebraska in 2017 and is currently in the third year of her PhD in Biological Sciences at the University of Nebraska. Her dissertation is entitled "Scales of selection: Life history evolution in warming waters" and her work focuses on the social, ecological, and evolutionary dynamics of freshwater fisheries.



Stephen Bell

Supervisor: Oskar Franklin
Co-Supervisors: Andrey Krasovski, Juraj Balkovic, Rastislav Skalsky
Research Project: SOIL CARBON SEQUESTRATION FOLLOWING
AGRICULTURAL LAND ABANDONMENT IN THE EU

Abstract:

Agricultural land abandonment (ALA) is a prominent land use change throughout the European Union (EU) with several notable implications for soil and ecosystem restoration. In particular, the cessation of certain agricultural practices (e.g., tillage and biomass removal) often induces an increase in soil organic carbon (SOC) and can potentially support land-based climate change mitigation efforts. However, large uncertainties on the variability of post-abandonment soil carbon sequestration rates and the absolute storage potentials across the EU hinders the development of dedicated policies leveraging the restoration benefits of both intentional (i.e., managed restoration) and unintentional ALA. We collected and synthesized SOC changes following ALA derived from field sites in EU member states using published chronosequence/paired plot data. In doing so, we determined how rates of soil carbon accumulation during ecological succession differ in space and time. We highlight key modulating factors including climate, soil type, natural vegetation type, land use history, and restoration intensity (i.e., active versus passive restoration). The combination of these results with EU-ALA maps also allows us to quantify the amount of SOC that has already been stored and estimate potential future storage based on existing and predicted abandonment rates. A preliminary analysis of southern EU countries indicates that SOC stocks are generally expected to increase post-abandonment over the course of several decades as previously carbon depleted soils regenerate. Soils with lower initial stocks (e.g., due to intensive cultivation and/or limited organic matter inputs) and under suitable climatic conditions are expected to exhibit the greatest potential for soil carbon sequestration over time. Our results help inform European ecosystem restoration policies and land management strategies on the potential benefits, costs, and challenges of ALA, especially from a soil carbon and climate change mitigation perspective.

Biographical sketch:

Stephen Bell graduated from the University of Waterloo (Bachelor of Environmental Studies) and the Norwegian University of Life Sciences (Master of Science). He is currently a third-year "*María de Maeztu*" PhD Fellow at the Institute of Environmental Science and Technology of the Universitat Autònoma de Barcelona. The title of his thesis is "Climate change mitigation potential of agricultural land abandonment via soil carbon sequestration". His main fields of scientific interest include soil science, land use change, the carbon cycle, and global change ecology. He is currently a Science Officer of the European Geosciences Union, Division on Soil System Sciences.



Peta Brom

Supervisor:

Piero Visconti

Co-Supervisors:

Martin Jung (BEC), Olga Danylo (NODES)

Research Project:

HOW DO URBAN GROWTH LEGACIES AND HEAT ISLAND AFFECT BIODIVERSITY IN AN AFRICAN CITY?

Abstract:

African cities defy many of the assumptions underlying the historical study of urban ecosystems. They do not typically follow the concentric development patterns of the global north, transitioning from natural to agricultural to urban over time and outwards from the urban center. Instead, they are rapidly expanding, characterized by urban sprawl, interspersed with high-density informal settlements, and typically expand, (when planned), along corridors in a spider-like pattern, filling in the areas between these corridors over time. Urban land-cover measures of environmental gradients which have shown to be correlated with changes in biological community structure, include urban intensity (soil-sealing), urbanization (development age), and socioeconomic status. A limited number of studies have been carried out in the rapidly urbanizing context of African cities which has left a gap in knowledge. In this project I will map and investigate the growth legacy, socio-economic status and urban heat effects on pollinator assemblages in an African city. Specifically, I will combine biodiversity data with remotely-sensed metrics of 5 year time-stamps between 2000 and 2020, and infra-red heat imagery, obtained from Google Earth Engine as well as data mapped from the South African 2011 census and the Popgrid data set from the European Commission, Joint Research Centre to establish relationships between urban land-cover metrics and patterns and trends in local species assemblage. I hypothesize that there is an extinction debt in newly urbanized areas, and that measures of biodiversity correlate with urban heat, socio-economic factors, and gradients of urban development. The outcomes of my project will yield important insights into the urban development patterns affecting biodiversity under rapidly urbanizing conditions, thus helping to improve conservation management and planning.

Biographical sketch:

I am a PhD candidate registered at the University of Cape Town. My PhD in urban ecology investigates the relationship between urban land-cover and pollinator assemblages. My research interest is in how to build cities which consider and integrate nature into the urban fabric. This moves beyond remnant patch conservation, or urban edge management towards systems and policies for urban land-use management.



Trisha Gopalakrishna

Supervisor: Ping Yowargana
Co-Supervisors: Esther Boere, Piero Visconti

Research Project: **TRADE-OFFS AND SYNERGIES BETWEEN ECOSYSTEM BENEFITS FROM FOREST RESTORATION IN INDIA**

Abstract:

There are many efforts underway to tackle climate change. Previous research has highlighted restoration of forests as a key contribution to a net zero goal, sequestering carbon from the atmosphere. And it seems to be a promising land-based option because of its relatively low costs, scalability, and multiple benefits. However, few studies account for the multiple benefits accrued from forest restoration and the trade-offs and synergies between them. This is especially the case in India, that has a big role in international climate and biodiversity dialogues but has limited attention on its ambitious forest restoration pledges. In this study, we propose to estimate the trade-offs and synergies between climate change mitigation potential, habitat for biodiversity and flood attenuation benefits from annual and seasonal flooding events (excluded from YSSP 2021 program), from passive and active forest restoration techniques. We will use a scenario-based approach of optimum combination of benefits, using a multicriteria and linear optimization techniques, at the pan-India scale. This will be the first of its kind national comprehensive analyses of multiple benefits from forest restoration, emphasizing local context by using national spatial datasets that account for the regional variation in opportunity for forest restoration. The expected outcomes will provide the scientific evidence to formulate robust policies and feasible targets that are not carbon-centric, but account for other benefits. Lastly, this holistic approach of landscape scale forest restoration, optimizing biodiversity and flood mitigation benefits, will connect climate change mitigation, adaptation and resilience.

Biographical sketch:

Trisha is a DPhil candidate at the School of Geography and the Environment and the Oxford-Indira Gandhi 2019 scholar at the Oxford India Center for Sustainable Development, University of Oxford (UK). Her doctorate research investigates the opportunities and realities of forest restoration for climate change mitigation in India. She previously worked as an Applied Scientist at an international environmental non-profit, The Nature Conservancy (Washington DC), conducting scientific research to support international and national climate policy. She holds a Master's in Environmental Management, focusing on Ecosystem Science and Conservation from the Nicholas School of the Environment, Duke University, (USA).



Thomas Lees

Supervisor: **Jens De Bruin**
Co-Supervisor: **Peter Greve, Reetik Kumar-Sahu**

Research Project: **INTERPRETING DEEP LEARNING MODELS IN
HYDROLOGY: CONCEPT FORMATION INSIDE THE BLACK
BOX**

Abstract:

Rainfall-runoff models simulate how a river catchment responds to rainfall under different conditions. Rainfall-runoff models are important for flood forecasting, hazard impact assessment and for assessing the impact of future climate changes. Long Short Term Memory Networks (LSTMs), a particular deep learning architecture, have demonstrated state-of-the-art accuracy in the USA, in Great Britain and China for rainfall-runoff modelling. However, traditional hydrological models, both conceptual and physically-based, remain more useful for policy makers and scientists because their inner-workings explicitly reflect known physical processes and parameters are more readily interpretable. Recent studies have demonstrated that the internal states of LSTMs can also be interpreted. By extracting the internal matrices which represent the learned translation from inputs (precipitation, temperature) to outputs (discharge), this research seeks to understand what patterns the LSTM learns in order to make accurate discharge simulations. We aim to test the hypothesis that "*LSTMs produce accurate forecasts because they are able to represent physical processes that are important for rainfall-runoff modelling*". Ultimately, we aim to show that the LSTM learns interpretable hydrological concepts from data alone.

Biographical sketch:

Tommy Lees is a 4th Year DPhil Candidate at the University of Oxford, part of the NERC Environmental Research DTP. His thesis explores data-driven methods for modelling hydro-meteorological systems, with a particular focus on deep learning. He has explored the efficacy of long-short term memory networks (LSTMs) for vegetation health forecasting and rainfall-runoff modelling. His research aims to better understand how these deep learning methods learn to make accurate predictions, and to explore methods for deriving insights from these models to improve our understanding of the underlying system.



Jincheng Li

Supervisor:

Ting Tang

Co-Supervisor:

Christian Folberth

Research Project:

**EFFECTS OF ENVIRONMENTAL PROTECTION POLICIES ON
NUTRIENT EXPORT IN THE YANGTZE RIVER BASIN**

Abstract:

The Yangtze River is the longest river in China and the third longest river in the world. The water pollution in the Yangtze River Basin has increased in the past decades. At present, research has mainly used the provincial and municipal data to calculate the pollutant emissions and loads, combined with land use downscaling, which ignored the differences of pollutant emissions among counties. At IIASA, a nutrient export model was built up using MARINA and global data of low resolution for the Yangtze River Basin, which was not validated using actual nutrient export fluxes, and can't accurately reflect the real situation. The study will construct a 0.1° nutrient production model of China (CEIN) with county-level data in 2017. On the basis, the study will refine the existing MARINA model for the Yangtze River Basin, and the nutrient export will be calculated and calibrated. The effects of different environmental management policies, such as "Comprehensive Planning of Yangtze River Basin (2012-2030)", will be analyzed on the nutrient export in the Yangtze River Basin.

Biographical sketch:

Jincheng graduated from Yunnan University with a BSc and MSc in Environmental Science. He is currently a second year PhD student in Water Science Lab of Prof. LIU Yong at Peking University. The title of his PhD thesis is Simulation of Environmental Processes in the Yangtze River Basin. His areas of research interest are simulation of watershed environmental processes, machine learning, climate change and policy evaluation.



Sebastian Luckeneder

Supervisor: Tamás Krisztin
Co-Supervisor: Michael Kuhn

Research Project: MINING, LAND-USE AND REGIONAL INCOME IN BRAZIL

Abstract:

Brazil is currently on the verge of opening peripheral indigenous and protected land for industrial mining, in particular in the Amazon region. Acts of environmental deregulation, such as the recently introduced PL 191-2020 bill, are meant to facilitate access to land for natural resource extraction. Actors in favor of such policies argue that economic stimulus from extractive industries would outweigh environmental and social concerns. Brazil has indeed experienced considerable economic growth from exporting primary commodities such as iron ore, crude petroleum and agricultural products, but also the fragmentation and degradation of natural livelihoods and economic turmoil caused by volatile commodity markets. In this study, we will examine the effects of natural resource extraction on short- and medium-term economic growth of Brazilian municipalities, a largely unchecked yet often-used narrative in debates about resource extraction in the name of development. The analysis will consider the period 2000-2020, covering ten years of extensive growth based on the export of primary commodities and subsequent moderate growth of a highly resource dependent economy until, eventually, an economic crisis hit the country in 2014. The assessment of potential growth-effects will be achieved employing a municipality-level panel-structure spatial growth model. It will be set up in the fashion of a Spatial Durbin Model and hence consider spatial autocorrelation and allow for the assessment of spillover effects between municipalities. Identification of effects will be attained using a combination of land cover data on mining, agriculture and land-use change at high spatial resolution and observations of socio-economic determinants of economic growth such as human capital, employment, infrastructure and the sectoral mix for approximately 5,500 Brazilian municipalities. Results will yield insights into the resource-development nexus at the regional level and thus inform current policy debates.

Biographical sketch:

Sebastian is a second year PhD candidate at Vienna University of Economics and Business (WU) and a teaching and research associate at the Institute for Ecological Economics. He has a background in economics and development studies, holding degrees from WU and the University of Vienna. In his dissertation, Sebastian is concerned with modelling the environmental and socio-economic impacts of mining activities. His main fields of scientific interest include spatial statistics, resource extractivism, development economics and political economy.



Valentina Marconi

Supervisor:

Martin Jung

Co-Supervisors:

Piero Visconti (BEC), Fernando Orduña-Cabrera (ASA), Juan Carlos Laso Bayas (ASA)

Research Project:

**MACHINE LEARNING TOOLS FOR THE PREDICTION OF
EXTINCTION RISK AND OF CHANGES IN WILDLIFE
ABUNDANCE**

Abstract:

Global biodiversity is changing in response to climate change and human pressures. Establishing and monitoring biodiversity conservation targets requires an understanding of how species populations respond to these pressures. Robust analytical tools are needed to be able to project the consequences of climate and land-use change on biodiversity into the future, particularly for regions where species are most at risk (like tropical areas, often the most biodiverse but also data-poor). Evidence suggests that preceding environmental change is a strong predictor of wildlife abundance trends. Understanding how these changes might alter the trajectory of population abundance is important, especially as population declines can be a prelude to extinction. In this project I am planning to compile data from some of the most comprehensive species abundance databases available and combine those with climate and land cover data, and information on anthropogenic impact on the environment. I will apply deep learning (DL) techniques to (a) establish the role and predictive power of past environmental change in determining current species abundance trends, (b) quantify the forecast horizon of species population trends after which uncertainty becomes intangible. With my research I aim to help overcome the factors limiting the use of indicators in biodiversity reporting and scenarios and to fill in gaps in our knowledge of species' extinction risk, providing outputs that can be used to inform the IUCN Red List criteria and policy outputs.

Biographical sketch:

Valentina is currently a second year PhD student at Imperial College London, working on “Assessing the predictability of extinction risk using machine learning”. She received a Masters degree in Animal Behaviour from Turin University and is also a Postgraduate Research Assistant within the Living Planet Index team at the Zoological Society of London. Valentina’s interest lies in investigating large-scale spatial and temporal ecological patterns, and in developing robust tools to assess biodiversity trends for managers and policy-makers. She is keen to provide outputs that can help fill in gaps in our knowledge of species extinction risk as well as being interested in the ethical use of AI in conservation.



Virginie Maret

Supervisor: Mikhail Smilovic
Co-Supervisor: Luca Guillaumot

Research Project: **IMPACTS OF LANDCOVER ON GROUNDWATER STORAGE AND STREAM DISCHARGE DYNAMICS IN A SMALL BEDROCK CATCHMENT.**

Abstract:

Recent studies have demonstrated that hydrological systems are strongly altered by landcover changes. The effects of landcover changes on surface and subsurface flows and storage processes are complex and variable. Predicting water resource availability requires understanding surface-subsurface interactions and accounting for landcover changes that control water redistribution. We adopt here a watershed scale modeling approach to explore these controls. The Meu-Chèze-Canut watershed (Britanny, France) is chosen because of the high stakes in the area, as the watershed feeds the largest urban community in the region, and because of our interest in crystalline basement environments. These environments, with high structural heterogeneity, experience higher rates of groundwater recharge than homogeneous environments (Hartmann and al., 2017). We want to explore the responses of these heterogeneous environments to changes in landcover (forest, agriculture, crop type), including vegetation density and spatial distribution. We make several hypotheses, in particular that the spatial and temporal variability of evapotranspiratory demand related to the plant type strongly impacts recharge and consequently stock and flows with different impacts on compartments and time scales. Using the Community Water Model (IIASA), with which we merged a lithologically calibrated subsurface model, we perform a sensitivity analysis of the soil parameters and observe the impacts on recharge and baseflow. The results of our modeling will allow to validate our hypotheses and to improve our fundamental understanding of the physical processes involved in surface-subsurface interactions under different landcover scenarios.

Biographical sketch:

Virginie Maret is a PhD student in Hydrogeology at University of Rennes (France). After studying History and Geography (University of Lyon, 2015-18), she turned to Water Sciences to address the major issues of water resources in the context of global environmental and climate changes. She holds a MSc on Risks and Natural Resources in Tropical Environments (University of Reunion Island, 2018-19) and a MSc in Hydrogeology, quantitative and qualitative (University of Montpellier, 2019-20). She works closely with water stakeholders to help develop strategies for sustainable resource management.



Henrique Moreno Dumont Goulart

Supervisor:

Esther Boere

Co-Supervisor:

Christian Folberth

Research Project:

FUTURE CLIMATIC IMPACTS ON SOYBEAN YIELDS IN SOUTH AMERICA AND ITS CONSEQUENCES ON AGRICULTURAL MARKETS: AN INTEGRATED CROP, STATISTICAL AND AGRO-ECONOMIC MODEL ASSESSMENT

Abstract:

Whilst consumed worldwide, the majority of soybean production takes place in specific regions. This causes the supply chain to be highly vulnerable to local climate shocks. With a changing climate, the impacts on crop productivity are expected to change as well. Crop models are commonly used to address the relation between climate and agriculture, simulating biophysical processes and estimating crop yields at a gridded location. However, the possibility for adaptation to soybean variability depends also on the local socio-economic conditions and on the agricultural market. For that, agricultural economy and supply models are used to map potential future market responses to changes on crop yields.

Recent advances in the field of attribution of extreme events in the context of climate change can help scientists to answer questions about the magnitude and frequency of yield variability that can be attributed to extreme climate events. In this study, a process-based crop model EPIC-IIASA is combined with a machine learning model to analyse the impact of future extreme weather events on soybean yields under different climate scenarios. The focus is put on low-probability high-impact extreme events and the extent to which these are expected to exacerbate in the future. These events are subsequently provided as input to GLOBIOM to analyze the socio-economic and market impact of extreme climate events on soybean production.

Biographical sketch:

Henrique is a PhD candidate at Deltares and VU Amsterdam, Netherlands. Member of the EU Horizon 2020 project RECEIPT, he focuses on exploring the interactions between climate and extreme impacts, using both statistical and physical models. His technical background is in civil and environmental engineer, with bachelor's degree at Federal University of Sao Carlos, Brazil, and master's degree at Politecnico di Milano, Italy. In the past, Henrique has worked with forecasting, water systems management and optimization. His research interests include climate modelling, compound events, water management, machine learning and data science.



Carina Miriam Mueller

Supervisor: David Leclere
Co-Supervisor: Petr Havlik

Research Project: SUB-NATIONAL IMPACTS OF FUTURE INTERNATIONAL DEMAND FOR AGRI-COMMODITIES: IN-DEPTH ASSESSMENT OF THE LINKAGE OF GLOBIOM WITH TRASE APPROACHES TO PREDICT THE CONSEQUENCES OF CONSUMPTION ON FINE-SCALE DEFORESTATION IMPACTS

Abstract:

Feeding an increasing world population while managing the world's natural resources sustainably and within climate targets will be a challenge and trade is seen as a fundamental part of the global response towards 'sustainable development'. It is argued that to understand implications of future production and trade strategies on food security, biodiversity and climate mitigation, a systems-based approach is needed that links both the supply (i.e. production) and the demand side (i.e. consumption). Recently, powerful information on the sub-national links between importing countries and local production locations has been developed. These include those provided by the Trase model. This sub-national detail allows an understanding of where global demand is driving agricultural expansion into ecosystems such as tropical dry forests (e.g. Chaco in Argentina). Within this proposed research we will undertake an assessment of opportunities to combine and harmonise the methods developed in Trase with the scenario-based model, GLOBIOM. The potential outcome of this integration will provide scenarios informed by the specific nature of linkages between actors in the supply chain and, for example, land-use change. This would allow stakeholders to explore future trade scenarios informed by data with detailed spatial resolution to understand the place-based impacts and supply chain pathways that could be targeted for mitigation policies.

Biographical sketch:

Carina is currently a third year PhD Student at the University of York. Her thesis focuses on how agricultural commodity consumption is linked to distant environmental sustainability impacts. Before her PhD she has been working for four years in a consumer goods company providing environmental sustainability expertise to guide decisions mainly related to food products. She holds an MSc in Environmental Sciences from the University of Bayreuth (Germany) and an MA in Social Research from the University of York (UK). Her areas of scientific interest include interdisciplinary research and in particular how science can be improved to guide decision-making towards sustainable land use.



Ida Nordin

Supervisor:

Sylvain Leduc

Co-Supervisor:

Fulvio di Fulvio

Research Project:

GHG EFFICIENT POLICIES FOR BIOFUEL PRODUCTION ON AGRICULTURAL LAND

Abstract:

The use of biofuel in the transport sector may be a valuable mitigation option to reduce greenhouse gas emissions. But the production of feedstock, its related land use changes, transport, and the biofuel production process also cause some emissions. There can also be other impact on sustainability, for example competition with food production and impact on nutrient leakage. Policies that encourage an economically efficient increase of biofuel production and minimize climate impact are important. This includes incentivizing an optimal production level and the optimal location of production.

In this project I will investigate the policies for biofuel production based on feedstock from the agricultural sector and focus on the contribution of emissions from the land use changes. Related to this is also the possible interactions with biofuel production from the forest sector, as these sectors could potentially compete for land. I will use an economic optimization model for the biofuel production localization that I developed in the first part of my PhD. I will further develop the model to cover land use changes and their emissions based on the BeWhere and GOBIOM models. In addition, I will consider potential supply of forest biofuel and analyze the abatement potential of biofuels and the optimal mixes of different types of policies. The results will be presented for Sweden as a case study.

Biographical sketch:

Ida Nordin is currently in her third year of PhD studies at the Department of Economics at the Swedish University of Agricultural Sciences, where she worked as a research assistant in economic modelling prior to commencing her PhD. She graduated in 2015 from Umeå University with a Master's degree in Economics. The title of her PhD project is "Pathways to climate friendly co-existence of food and bioenergy", where she investigates the possibilities and policies for bioenergy production from agricultural feedstock. She is mainly interested in environmental economics and economic modelling.



Eunbeen Park

Supervisor: **Andrey Krasovskiy**
Co-Supervisor: **Florian Kraxner**

Research Project: **ASSESSMENT OF AFFORESTATION OPTIONS WITH
SPECIAL EMPHASIS ON FOREST PRODUCTIVITY AND
CARBON STORAGE IN NORTH KOREA**

Abstract:

North Korea is a country in the Mid-Latitude Ecotone suffering from forest degradation due to climate change and deforestation. An efficient long-term and integrated restoration plan is still missing in the country. In this context, our research addresses the question whether we develop an optimal forest restoration plan for North Korea considering regional and national strategies based on biophysical modeling. This study aims to model afforestation scenarios and assess future forest dynamics in North Korea considering biophysical conditions (soil, climate) and forest management options. We will map the potential afforestation area and simulate afforestation scenarios by using the AFE-Land Modeling System (LMS) being developed at IIASA. The methodology will build upon work and experience gained from modeling afforestation scenarios for South Korea which has been carried out jointly between Korea University (KU) and IIASA's AFE group over the past years. As input, the model will use high-resolution time series from satellite data, as well as land cover maps and yield tables provided by KU. For each scenario, we will assess the forest biomass and wood production potentials. Finally, we will present forest restoration options informed by regional or national forest management strategies in North Korea. The analysis will deliver important information to policymakers and technical officials establishing regulations and action plans for forest management in the Mid-Latitude Ecotone.

Biographical sketch:

Eunbeen is a PhD candidate in environmental planning and landscape architecture at the Korea University, Republic of Korea. She graduated with a B.S. degree in Geology from Kangwon National University, Republic of Korea in 2017. Her research interest includes land change detection and disaster modeling related to dryland using remote-sensed data and restoration planning for reducing climate change impact.



Nariê Rinke Dias de Souza

Supervisor:

Sylvain Leduc

Co-Supervisor:

Fulvio di Fulvio

Research Project:

**VALORIZATION OF ECOSYSTEM SERVICES THROUGH
LOCATION OPTIMIZATION OF INTEGRATED VALUE CHAINS
FOR BIOFUEL AND LIVESTOCK PRODUCTION IN BRAZIL**

Abstract:

Appropriate land management practices will be fundamental for optimizing land-based outputs under climate change mitigation scenarios. Bioenergy-livestock integrated system is an important option for future land use management strategies. This study presents a bottom-up approach for identifying optimal locations to apply bioenergy-livestock integrated systems in Brazil, in order to understand their contribution to future energy demands and greenhouse gas (GHG) mitigation targets, and their impacts on Ecosystem Services (bioenergy production, GHG mitigation, zero direct deforestation, reduction of food competition). The expansion of bioenergy production on optimal locations happens using BeWhere model, based on land use restrictions and on economic and environmental factors. The integration considers livestock intensification and use of biofuels byproducts as animal feed supplement, taking advantage of synergies between these two value chains. Land use restrictions for sugarcane expansion consider pastureland inside Sugarcane Agroecological Zoning. The bioenergy-livestock integrated alternatives and their techno-economic and environmental implications will be modeled using the Virtual Biorefinery, a simulation and assessment platform developed at LNBR/CNPEN. This assessment might provide useful information to support more assertive public policies regarding biofuel expansion in Brazil and to achieve the ambitious targets assumed in the Paris Agreement.

Biographical sketch:

Nariê is a PhD student at the Bioenergy program from the University of Campinas (UNICAMP), with the main objective of understanding the climate and land use impacts of integration of bioenergy and livestock value chains in Brazil. She holds a MSc degree in Agricultural Engineering from UNICAMP with emphasis on techno-economic assessment and life cycle assessment of sugarcane ethanol and beef cattle integrated systems. Since 2018 she works at the Brazilian Biorenewables National Laboratory (LNBR/CNPEN) in the Biorefinery and Natural Resources department, focusing on environmental assessment of biorenewables. Her main fields of interests include bioeconomy, life cycle assessment, sustainable production of biomass, sustainability assessment and renewable energies.



Aradhana Roberts

Supervisor: **Andrey Krasovski**
Co-Supervisor: **Oskar Franklin**

Research Project: **INSECT HERBIVORY AND ECOSYSTEM CARBON FLUXES FROM
DISTURBED FORESTS (ELEVATED CO₂, FIRE, DROUGHT AND
LOGGING): A GLOBAL ASSESSMENT**

Abstract:

Forests cover around 30% of the Earth's surface, but the ecosystem-level effects of insect herbivory on forest types is still lacking. Global environmental change is increasing both the frequency and severity of forest disturbances in many biomes. Current understanding of herbivory is mostly taken from large ungulates. Measurements of insect herbivory provide insights into patterns of ecosystem change and productivity; our study shows approximately 25% contribution via insect herbivory to ecosystem productivity which is currently not included in forest models. This study provides a unique opportunity to understand the drivers of these disturbances on insect herbivory from forest ecosystems around the world. Specifically, field work was conducted from twenty-five study sites representing tropical, temperate and boreal forests globally. At each study site, leaf litter was collected monthly and quantified for insect herbivory which contributes to ecosystem carbon fluxes. In contrast to common theories, herbivory may increase nutrient fluxes of carbon even in unproductive ecosystems. Overall preliminary results indicate that logging disturbances increases forest litter and herbivory, drought and elevated carbon dioxide treatments show a decrease of insect herbivory and annual fires significantly increase insect herbivory, suggesting that herbivory could make major contributions to the carbon cycle influencing ecosystem change even in unproductive and/or disturbed forests. Understanding the effects of these disturbances in forest ecosystems globally could help to develop sustainable forest management policies and accurately inform ecosystem structure and function with the changing environment in global models such as the AFE- Land Modelling System (LMS) being developed at IIASA.

Biographical sketch:

Aradhana is currently a 4th year PhD Candidate at Lund University, Lund, Sweden at the Department of Physical Geography and Ecosystem Science. Her research focuses on understanding the effects of forest disturbances on insect feeding patterns and nutrient fluxes. My research interests include forestry and the application of field and modelled data to suggest sustainable forest management, especially in areas with severe forest fires, logging and drought. My goals for the future are to apply ecological research for the benefit of our communities and natural resources sustainably through education and policy.



Chandrakant Singh

Supervisor: Peter Greve
Co-Supervisor: Sylvia Tramberend

Research Project: SELF-INFLUENCING FEEDBACK OF DEFORESTATION ON THE ACTORS RESPONSIBLE

Abstract:

Transpiration from the forests influences the rainfall falling over the vegetation, and a portion of this transpired moisture gets transported to the downwind-region of the source forest. For Amazon, one-third of the rainfall originates from its own basin. Moreover, a significant portion of transpired moisture from within the Amazonian basin is transported to cropland and pasture areas outside the basin. This moisture transport is, however, hindered by deforestation, which influences the forest-rainfall feedback. This feedback has been shown to also negatively impact crop production downwind to the Amazon, speculatively leading to a self-defeating scenario (i.e., actors of deforestation are themselves affected by their actions). It has been unclear if the actors driving the deforestation and reducing rainfall are largely self-sabotaging their own interests, or if they are making gains on the expense of other downwind actors. In the former case, knowledge support may be important so that actors can better understand driver-impact relationships. In the latter case, however, strong regulation to manage externalities might be critical. Hence, shedding light on this aspect will contribute to more effective governance. In our research, using high-resolution moisture recycling and spatially explicit land-tenure data, we explore the potential of deforestation-rainfall feedback on actors and sectors responsible for driving the deforestation in South America.

Biographical sketch:

Chandrakant is a third year doctoral candidate in Sustainability Science at Stockholm Resilience Centre, Stockholm University. His previous academic background includes a Bachelor's in Civil Engineering (graduated 2015) and a Master's in Environmental Science and Engineering (graduated 2018). His doctoral research explores the dynamic feedback of rainfall on land systems and the implication of simultaneous human pressure on tropical ecosystems. In his research, he is trying to quantify resilience by investigating the intrinsic capacity of the ecosystem to resist and adapt to the natural and human (including human-influenced) perturbation. His broad research interest lies in contributing towards effective cross-boundary governance and efficient ecosystem stewardship.



Scott Spillias

Supervisor:

Hugo Valin

Co-Supervisors:

Petr Havlik, Miroslav Batka, Frank Sperling

Research Project:

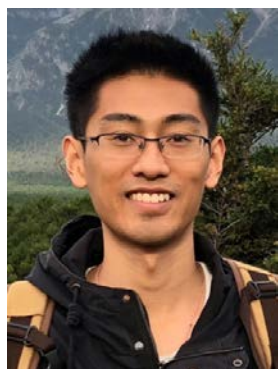
**THE ENVIRONMENTAL IMPLICATIONS OF LARGE-SCALE
SEAWEED FARMING**

Abstract:

Agricultural expansion due to humanity's growing material demands is a leading driver of land-use change and threatens to exacerbate ongoing crises of climate change and biodiversity loss. Seaweed biomass, farmed in the ocean as one facet of the rapidly growing 'Blue Economy', could help to mitigate these problems by providing a suitable, even advantageous, substitute for food, animal feed, and biofuels that could partially displace demand for terrestrially-produced crops. The World Bank has estimated that converting ~0.1% of the ocean to seaweed farming would generate enough biomass to spare 1,000,000 km² of global land from conversion to agricultural production and could yield a variety of other environmental co-benefits. It is unknown however where this land sparing might occur and the extent to which production on this scale can be achieved given existing real-world constraints and drivers. This project will use geographical, ecological and socio-economic data to estimate the global potential for seaweed farming growth and supply by region and IIASA's GLOBIOM (Global Biosphere Management Model) to provide a detailed estimation of the extent to which land-use change benefits will be realized from large-scale seaweed farming. These results will inform our understanding of the terrestrial climate and conservation benefits that may indirectly arise from seaweed farming, allow for the comparison of terrestrial benefits with local marine co-benefits and trade-offs, and provide valuable regional insight to countries seeking to include seaweed farming as part of their Blue Economy strategies.

Biographical sketch:

Scott is a 3rd year PhD student at the University of Queensland studying the socio-ecological implications of large-scale seaweed farming. He holds a Master of Environmental Management from the University of Queensland and a Bachelor of Marine Biology from Duke University. His research interests lie in the sustainable use of the oceans to meet the needs of a growing population and in the use of systems thinking and decision analysis to tackle complex environmental problems. Before beginning his graduate degrees, Scott made a living teaching marine science and seamanship to young people onboard ocean-going sailing vessels.



Han Su

Supervisor: Barbara Willaarts
Co-Supervisor: Diana Luna Gonzalez

Research Project: ESTIMATING THE CONSUMPTIVE WATER USE OF
SMALLHOLDERS: WATER PRODUCTIVITY AND
CONTRIBUTION TO WATER SCARCITY

Abstract:

Smallholders, generally refer to farms less than 2 ha, account for 24% of global farmland and produce around 30% of global food. They are critical to address local poverty and rural food insecurity because they are integrated into local markets and contribute heavily to local food supply, contrarily to medium and large-scale farms that are more oriented towards exports and international markets. The Sustainable Development Goals (SDGs) have even explicitly included smallholders as a target aiming to double their agricultural productivity and income by 2030. However, little is known about smallholders' water use efficiency and amount, and how they would affect future water availability and scarcity or vice versa. As a tentative step, this study aims to measure smallholders' consumptive water use, agricultural and nutritional water productivity, and the contribution to local water scarcity. We will estimate smallholders' yield and water consumption based on the previously developed ACEA model, multi-source global agricultural map and nutrition database for main crops across 55 countries. This study is expected to provide a comprehensive estimation of smallholders' water-related food security, water consumption and productivity on a global scale. Outputs of this study would highlight the ways to manage small-scale agriculture in a sustainable manner.

Biographical sketch:

Han Su received his Bachelor's degree in Environmental Engineering from Southwest Jiaotong University in 2014, and Master's degree in Environmental Science from Peking University in 2017. He worked as a researcher and project manager for one Chinese water modeling company before he started his PhD project in 2019. He is now a PhD candidate from University of Twente, the Netherlands. His PhD project focuses on the sustainability, equity, and productivity of water use related to food supply. He will finish his PhD project among his daughter's crying and smiling.



Rodrigo Valencia Cotera

Supervisor: Luca Guillaumot
Co-Supervisor: Susanne Hanger-Kopp

Research Project: **MODELLING WATER RESOURCES MANAGEMENT FOR CLIMATE CHANGE ADAPTATION IN AN AUSTRIAN AGRICULTURAL REGION.**

Abstract:

The frequency and intensity of droughts events are expected to increase in Europe due to climate change. During the last decade, drought has become a new problematic in central Europe. In the case of Austria, drought causes higher economic losses in the agricultural sector than hail, frost, storms and floods combined.

This research is focused on increase the resilience of Austrian agriculture to climate change by promoting adaptation measures based on water management. The main research tool is a SD-Model with a hydrological and a socio-economic sub-model. The model is calibrated to fit the study region based on historical data of precipitation, evapotranspiration, groundwater and superficial water levels and historical water demand. Afterwards the model is fed with climate projections for three RCP scenarios (2.6, 6 and 8.5) together with SSPs. The agricultural water demand is calculated with an irrigation demand equation. This equation correlates irrigation water demand with precipitation, evapotranspiration, soil humidity, the planted crops and agricultural area.

Modeling under climate change conditions should give an insight into the possible effects of climate change on the water resources in the study region. The model should shed light on the possible effects of climate change on agricultural water demand and its subsequent effect on the regional water resources. The project also seeks to test water management measures to assess their effectiveness as adaptation measures for regional agricultural systems to climate change.

Biographical sketch:

Rodrigo Valencia is a PhD researcher member of the HICSS cooperation between the Climate Service Center Germany (GERICS) and the University of Hamburg. He completed a BSc in Mechanical and Electrical Engineering at the Tecnológico de Monterrey and a MSc in Environmental Science with a specialization in water by the University of Natural Resources and Life Sciences of Vienna (BOKU). His PhD focuses on the adaptation of agricultural systems in northern Germany to climate change through water and drought management. He is deeply interested in climate change adaptation, water management and energy efficiency.



Kevin Van Sundert

Supervisor:

Oskar Franklin

Co-Supervisors:

Andrey Krasovskiyy, Florian Hofhansl

Research Project:

**INTERACTIONS OF NUTRIENT AND WATER AVAILABILITY
IN THE G4M GLOBAL FOREST MODEL**

Abstract:

The availability of nutrients is a key driver of forest productivity, and nutrients also modify forest responses to global change. A realistic implementation of nutrient availability in models such as G4M is therefore key to make accurate projections of future forest productivity, as well as other forest functions and structure. While currently, nutrient availability is only indirectly implemented in G4M by incorporating soil type, more detailed modeling of the nutrient status may thus be needed if environmental features change of which the influence depends on nutrient availability. In the current project, I therefore aim to introduce alternative approaches to implementing nutrient availabilities in G4M, and assess the effect of these varying model structures to uncertainty in projections of for example future forest productivity and carbon storage. I will also assess interactions of nutrient availability with water, and test to what extent effects of both a hypothetical future and an actual historic extreme drought on forest ecosystem functioning may depend on the soil nutrient status.

Biographical sketch:

Kevin Van Sundert graduated in 2017 from the University of Antwerp in Belgium, with a Master's degree in Biology, specialization Ecology & Environment. He is currently in the last year of his PhD at the Plant and Ecosystems research group of the same University of Antwerp. Title of his thesis is 'Elucidating the role of nutrient availability in terrestrial carbon cycling'. His main field of scientific interest is ecosystem ecology, with particular emphasis on the role of nutrient availability in terrestrial ecosystem function, interactions between land ecosystems and climate change (especially drought), and the role of nutrient availability in determining ecosystem responses to global change. His main findings to date were obtained through both field-site measurements as well as large-scale analysis on databases, including meta-analysis. The YSSP will offer him the opportunity to learn more about and apply his insights to a forest model.



Yazhen Wu

Supervisor: Andre Deppermann

Co-Supervisors: Petr Havlík, Stefan Frank

Research Project: GLOBAL LAND USE CHANGE AND FOOD SECURITY
IMPLICATIONS OF BIOENERGY DEVELOPMENT UNDER CHINA'S
CARBON NEUTRALITY TARGET

Abstract:

Most 1.5-degree climate change mitigation pathways modeled by Integrated Assessment Models (IAMs) require large-scale deployment of negative emission technologies in medium-to-long turn, especially the BECCS technology. However, the impacts and feasibility of such bioenergy developments are still under heated debate. Moreover, one country's climate actions and bioenergy demand may arouse strong spillover effects via international trade. As the world's top CO₂ emitter, China has just made the 2060 carbon-neutral pledge. In this context, whether the bioenergy needed for this target could be produced domestically, and what might be the global ecological and economic implications if China needs to import a large amount of bioenergy or crops (whose cultivation might be crowded out by bioenergy plants), are important scientific and policy questions.

This study will focus on key questions on the impacts of bioenergy development under climate targets via an integrated assessment method. We aim to: (1) collect scenario data for bioenergy demand and project the global demand-supply of biomass under China's stringent climate target by applying the GLOBIOM model; (2) explore the induced global land-use change and possible risks for SDGs, especially the food security target, by analyzing the GLOBIOM results; (3) uncover the potential policies or proactive measures for reducing risks on the global ecosystem, economy, and society. It is expected that policy implications could be raised in terms of balancing the risks and demand of bioenergy for achieving deep mitigation targets.

Biographical sketch:

Yazhen Wu received her Bachelor of Science and Bachelor of Economics from Peking University in June 2019. She is currently a 2nd year PhD student majoring in Environmental Management at Peking University, China. As a member of the Laboratory of Energy & Environmental Economics and Policy (LEEPP) led by Prof. Hancheng Dai, she is keen to investigate the co-benefits and trade-offs of climate change mitigation in terms of public health and food security. With experience in the energy-economic model (IMED|CGE) and health impact model (IMED|HEL) and by exploring their linkages with the biosphere model (GLOBIOM), she hopes to study the interactions between socioeconomy and land use.



Flora Brocza

Supervisor: Peter Rafaj
Co-Supervisor: Robert Sander

Research Project: COST-EFFECTIVE MERCURY POLLUTION CONTROL IN EUROPE AND CHINA

Abstract:

More than half (52%) of the world's primary annual mercury (Hg) emissions to the atmosphere are caused by industrial high-temperature processes where trace amounts of this heavy metal are present in fuels and ores. This grave pollution issue has given rise to the first global health and the environment agreement in almost a decade - the Minamata Convention on Mercury. Air pollution control devices (APCDs) for 'traditional' pollutants, e.g. for SO₂, NO_x and particulate matter (PM), often reduce Hg emissions in thermal power stations and other Hg-emitting industries like incinerators and cement production as a co-benefit, but this effect is highly specific to a plant's operating conditions. As emissions are being regulated more explicitly and strictly, Hg-specific APCDs have seen a boost in research and deployment. Additionally, Hg emissions are seen to decrease as a side-effect of decarbonising the energy sector. But what are the cost implications of abating industrial Hg today and in the future? I seek to answer this question by implementing and regionalising the technology and cost characteristics of Hg controls in the GAINS model. The project will focus on the EU and China, enabling both researchers and policy makers to re-evaluate European and Chinese Hg emission projections to 2050 according to selected policy scenarios, as well as provide an indication of the expenditures induced by future novel Hg-APCDs in order to meet the environmental regulations.

Biographical sketch:

Flora's fundamental research interest is the interaction between mercury and its natural and engineered environment, and how this effects emissions of the pollutant on a larger scale. She is currently a second year PhD student at the School of Chemical and Process Engineering at the University of Leeds, UK. The title of her thesis is "Mercury oxidation by manganese oxide-biochar composites in the context of air pollution control". Prior, she completed a BSc and MSc in Geosciences at the University of Vienna, Austria with exchange and research visits to the University of Belgrade and Háskoli Islands, as well as an MSc in Bioenergy at the University of Leeds. As part of Scientists4Future Austria, she advocates for science-based climate politics.



Daniël Düring

Supervisor:

Pallav Purohit

Co-Supervisor:

Fabian Wagner

Research Project:

**OPTIMISING THE MANAGEMENT OF AMBIENT
PARTICULATE MATTER POLLUTION IN GAUTENG, SOUTH
AFRICA**

Abstract:

According to the World Health Organisation, air pollution is now regarded as the world's single biggest environmental threat to human health. Amongst the principal air pollutants, particulate matter pollution has been identified as the dominant contributor to the global health burden of outdoor air pollution. While population densification and urbanisation are seen as key drivers for particulate matter pollution, by far the largest contribution to future urbanisation and densification is expected to occur in Africa. This renders the continent especially susceptible to rapidly increasing particulate matter pollution.

High particulate matter pollution levels are already observed in South Africa, specifically in the Gauteng Province, which makes it an excellent case study for other South African and African urban areas, experiencing similar challenges. In addition, the South African constitution entrenches an environmental right which provides for both ecological sustainability as well as promoting justifiable socio-economic development and human wellbeing. The inherent tensions contained within this right therefore requires a balanced approach towards air quality management which focusses on pollution prevention and environmental health on the one hand, while allowing for economic development and poverty alleviation on the other.

Given this background, the aim of my research at IIASA is to develop future scenarios which strike a balance between these tensions by means of an integrated approach which will optimise the South African air quality management framework through control measures which address both health as well as economic concerns.

Biographical sketch:

Daniël Düring is an environmental law specialist and scientist, holding a Masters degree in environmental law and governance, a BCom degree in economics as well as a BSc in Geology and Geography. He is currently studying towards a PhD in Environmental Science at the North-West University in Potchefstroom, South Africa. While his PhD studies are mainly focussed on atmospheric science and air quality management, other research interests include various aspects of the natural environment, applying available scientific methods to identify, monitor and make sense of real world problems and addressing these through targeted management intervention. He is a firm believer in a multi-disciplinary approach towards addressing complex environmental problems and his passion is to find ways to bridge the perceived gap between science, law and environmental management.



Nicholas Goedeking

Supervisor: Paul Kishimoto
Co-Supervisor: Caroline Zimm

Research Project: THE POLITICS OF ACCELERATING PUBLIC INVESTMENT FOR MASS TRANSIT INFRASTRUCTURE IN CITIES IN THE GLOBAL SOUTH

Abstract:

When, how and why do governments in the Global South scale-up public investment for low-carbon transport infrastructure in cities? In addressing this policy question, this project develops a political economic explanation of sustainable transport investment in middle-income economies. It moves beyond political will and individual leadership as explanatory factors and instead offers a structural understanding of when political support for accelerated public investment is likely to emerge. As its research design, it employs a comparative policy analysis of public investment programs for Bus Rapid Transit (BRT) systems in Mexico and Peru, two middle-income democracies in Latin America. Unlike Mexico, which deployed 11 BRTs between 2003 and 2016, Peru adopted a single BRT corridor in 2010 and never developed a national investment program, despite substantial multilateral assistance. I hypothesize that the variance in these policy outcomes (scaled-up investment in Mexico vs. meddled investment in Peru) can be explained by how political institutions shape the relationship between local and national public officials, and by how this relationship in turn rewards or punishes investment decision-making. Further important explanatory factors will include institutional capacity, access to financing, and regional diffusion effects. The case selection was informed by a large-n survival model analysis, which was implemented as part of a preceding project. My methods include process tracing, historical analysis, and expert interviews. The results will help refine input assumptions of econometric modelling, advance our understand of the social impacts of mass transit, and assist policymakers better identify and purse decarbonization pathways that are politically feasible.

Biographical sketch:

Nick is a PhD Candidate at UC Berkeley's Department of Environmental Science, Policy, and Management. His research focuses on urban energy transitions and the politics of low-carbon innovation. He developed his thesis project in collaboration with practitioners at the Inter-American Development Bank and the World Resources Institute. Before joining Berkeley, Nick worked for the Directorate-General for Energy at the European Commission. He holds an MSc in Comparative Social Policy from Oxford and a BA in Philosophy, Politics, and Economics from Durham. This summer he is based in Berlin. Nick's full profile can be found at www.linkedin.com/in/nicholasgoedeking.



Youjung Jang

Supervisor: Younha Kim
Co-Supervisor: Zbigniew Klimont

Research Project: DEVELOPMENT OF A SECTOR-SPECIFIC AND
CHEMICALLY-SPECIATED VOCS EMISSIONS IN
NORTHEAST ASIA USING THE GAINS-IV FRAMEWORK

Abstract:

This study aims to develop a comprehensive VOC emission data which are readily to use in the policy planning and evaluation of mitigation measures in Northeast Asia and can be utilized in support of air quality modeling.

I will analyze multiple emissions inventories to estimate sector-specific VOCs emissions. In addition, the speciation profiles will be linked with the by-sector VOCs emissions to estimated speciated VOC emissions. These emissions will be used in the air quality model to forecast and evaluate emission reduction policy over the East Asia atmosphere.

In order to improve the predictability of air pollution and climate change, it is essential to establish an emissions information not only for anthropogenic sources, but for natural ones. Since the Biogenic VOCs(BVOCs) emissions are another major contributor for the SOA formation, BVOCs will also be estimated along with GAINS-based anthropogenic VOCs(AVOCs).

Through this study, 1)detailed sector-specific AVOCs emissions will be calculated in the GAINS model, 2)chemically-speciated AVOCs emissions will be estimated in relation with the sector-based emissions inventory, 3)BVOC emissions will be estimated using the MEGAN Model(Guenther et al., 2006) model, 4)The result will be evaluated in an air quality model for better understanding of the effect of VOCs reduction policies in Northeast Asia region.

Biographical sketch:

Youjung Jang completed her Master's degree in Environmental Engineering at the Konkuk University, Republic of Korea, in 2019, where she is currently a third-year Ph.D. student in Environmental Engineering. Her main scientific interests are emission inventory improvement, policy analyses. She plans to improve the speciated VOCs emissions in Northeast Asia using the GAINS framework, for YSSP.



Siddharth Joshi

Supervisor:

Behnam Zakeri

Co-Supervisors:

Alessio Mastrucci, Volker Krey

Research Project:

ASSESSING THE ROLE OF ROOFTOP SOLAR PV IN GLOBAL ENERGY TRANSITIONS

Abstract:

Rooftop solar PV (RTSPV) currently accounts for 40% of the global solar PV installed capacity and one-fourth of the total renewable capacity additions in 2019. Being decentralised in nature, RTSPV technology can lead to consumer driven breakthrough in tackling climate change, reducing local air pollution, and providing affordable energy access to the areas lacking electrification. Thus, it is pertinent to assess the role of RTSPV in the future energy systems. Currently some global Integrated Assessment Models (IAMs) represent solar PV technology as an aggregation of Utility and RTSPV deployment application, which makes it difficult to assess the potential of RTSPV, including related socio-economic transitions at a global scale. This can be attributed to limited studies being conducted to assess RTSPV as a separate deployment application from utility scale application. To mitigate these gaps in the literature, here we will assess the role of RTSPV technology at a global scale by building upon the novel resource assessment framework that was developed during my PhD. The framework is capable of estimating RTSPV potential at a global scale with a high spatiotemporal resolution. We will utilise this framework to estimate future changes (medium time horizon) in potentials using spatially explicit urbanisation extent and population datasets derived from Shared Socioeconomic Pathways (SSP). Further, with the aid of sub-annual MESSAGE model and updated country-wise technology supply cost curves (derived from estimated potentials and costs), we will assess the role of RTSPV in achieving low carbon energy and climate mitigation scenarios.

Biographical sketch:

Siddharth Joshi is a third year PhD student in the Research Centre for Energy, Climate and Marine (MaREI) at University College Cork, Ireland. His research focuses on the use of high-performance computing and machine learning frameworks for global high-resolution spatiotemporal supply and demand modelling in energy systems. Before his PhD he worked as Head of R&D at a telemedicine start-up, business consultant and instrumentation engineer in oil and natural gas sector. He holds a MEngSc in Sustainable Energy from University College Cork and BE in Electronics, Instrumentation and Control from Thapar University, India. His research interests include the application of big-data, nature inspired machine learning architectures and Geographic Information Systems in tackling the real-world problems associated with the supply and demand estimation in the energy system models.



Xiaorui Liu

Supervisor:

Fabian Wagner

Co-Supervisor:

Shaohui Zhang

Research Project:

COST-OPTIMIZED PATHWAYS TO ACHIEVE THE CARBON NEUTRALITY AND PM_{2.5} AIR QUALITY TARGETS IN GUANGDONG PROVINCE OF CHINA

Abstract:

China's newly raised carbon neutrality target puts forward new requirements for the low-carbon transition in provinces. As one of the provinces with the most important economic powerhouses and largest carbon emissions of China, Guangdong Province plays a key role in helping achieve the national goal. At the same time, the Guangdong region is also facing the bottleneck problem of deep air quality improvement. Greenhouse gases and air pollutants share the common emission source of fossil fuel consumption and synergistic control of both can improve efficiency and reduce costs. How to achieve carbon neutrality and air quality goals simultaneously in a cost-effective way is essential for Guangdong and China.

In this study we will use a multi-model assessment approach which consist of the GAINS model, the macro-economic model (IMED|CGE), public health model (IMED|HEL), and multi-objective cost optimization model to investigate the costs and benefits of achieving the carbon neutrality and the PM_{2.5} air quality goal in Guangdong Province. The economically efficient and feasible pathways to achieve climate and air goals are explored. This methodology can not only scrutinize the transformation impacts of mitigation on energy, economy and social at the macro level, but also provide detailed roadmap from technical side. As a pioneering region for green and low-carbon development, the findings of this study would provide useful insights for Guangdong and other provinces in China.

Biographical sketch:

Xiaorui Liu is a third year PhD student in the Laboratory of Energy & Environmental Economics and Policy (LEEPP) at the College of Environmental Sciences and Engineering of Peking University — Beijing, China. Her current research focuses on the integrated assessment modeling based on the IMED model including an energy economic model (IMED|CGE) and a hybrid Input-Output model (IMED|HIO) and a health impact model (IMED|HEL) to investigate the pathways to achieve the carbon neutrality and air quality targets in the provincial level of China. Prior to starting her PhD, Xiaorui received her bachelor's degrees in Environmental Engineering from Peking University in July, 2018.



Wenjun Meng

Supervisor: Gregor Kieseewetter
Co-Supervisor: Shaohui Zhang

Research Project: COST-BENEFIT ANALYSIS OF HOUSEHOLD FUEL POLICIES
AND ALTERNATIVE STRATEGIES IN NORTHERN CHINA

Abstract:

Solid fuel burning in Chinese residential sector is one of the major emission sources of air pollutants. A large share of residents are still using solid fuels for cooking and heating, which contributes significantly to ambient fine particulate matter (PM_{2.5}). Moreover, use of solid fuels dominates rural household air pollution exposure, causing a significant disease burden in China. Northern China has the highest regional levels of air pollution in the country due to industrial structure with fossil-based energy mix, dense population, and its long heating season. The rapid transition from traditional fuels to clean fuels such as gas and electricity for cooking is essential for air pollution abatement. To address this issue, a campaign (Clean Heating Plan for Northern China in Winter for 2017–2021) was launched to substitute electricity or pipeline-based natural gas (PNG) for heating. However, some prefectures could not afford this substitution, due to high cost need. Further, the incremental demand of gas and electricity consumption is a challenge due to the additional financial burden and lacking current infrastructure. Hence, some alternative solutions such as clean coal, biomass pellets with gasifier stoves and other clean energy need to be discussed and quantified regarding this issue. In this study, the scenarios of several mitigations will be established from 2015 to 2030. And the GAINS and Health Impact Assessment tools will be used to quantify air quality improvements and health benefits of the alternative substitution solutions in Beijing, Tianjin and other 26 surrounding municipalities in 0.1°× 0.1°spatial resolution. Furthermore, their costs will be estimated and compared in order to find a more cost-effective solution. Finally, relative policy recommendations are provided.

Biographical sketch:

Wenjun Meng is a fourth-year PhD candidate in College of Urban and Environmental Sciences at Peking University. Her research interests include integrated assessment of air pollution mitigation strategies and air quality modeling. Her study mainly focuses on analyzing the environmental and health impacts of residential air pollution mitigation policies in China and quantifying the costs and benefits of alternative substitution solutions. Wenjun received her bachelor's degree in environmental science also from Peking University.



Mark Radin

Supervisor: Narashima Rao
Co-Supervisor: Shonali Pachauri

Research Project: ENVIRONMENTAL HEALTH SERVICES, EXTERNALITIES,
AND EDUCATIONAL ACHIEVEMENT

Abstract:

Without access to modern technologies and improved environmental health services, such as clean water, safe sanitation, and modern cooking fuels and technologies, children face numerous health and non-health obstacles to achieving a proper education. Numerous studies have demonstrated a link between the use of traditional or unimproved lighting, cooking, water, and sanitation services and respiratory and gastrointestinal illnesses. These illnesses can prevent children from attending school and learning. Without access to modern technologies children are often burdened with time-consuming chores such as cooking and collecting water and fuelwood. The time and energy spent on environmental chores may reduce the time available for studying and can lead to increased school absences, late arrivals, difficulty in paying attention, and having less energy to spend studying, which all can impede educational achievement.

I plan to explore the impact of access to modern environmental health services on education in rural communities. The main hypothesis is that access to modern services has positive impacts on educational outcomes that act through both health and non-health mechanisms. To test this hypothesis, I will estimate 1) the effect of access to these environmental services and technologies on education, 2) the effect of access to these services on health and non-health outcomes, and 3) whether there are interactions between having access to multiple environmental services. The longitudinal analysis will leverage the panel structure of the Uganda Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA), which has seven waves of publicly available data (2009-2019) to identify the causal pathways of the environmental services on education.

Biographical sketch:

Mark is a PhD candidate at the Gillings School of Global Public Health at the University of North Carolina at Chapel Hill. His research focuses on the economic costs and benefits of environmental health services, primarily in low- and middle-income countries. He has worked as a consultant with the World Bank and the Copenhagen Consensus Center on analyzing policies promoting water and sanitation services in Sub-Saharan Africa and a number of benefit-cost analyses of water and sanitation and family planning programs in Ghana, Haiti, and Malawi. He holds a Master's degree in International Development from the School of Advanced International Studies at Johns Hopkins University and a BA from Washington University in St. Louis.



Sagar Rathod

Supervisor: Peter Rafaj
Co-Supervisor: Zbigniew Klimont

Research Project: IMPACTS OF ENERGY TRANSITION ON GLOBAL
PARTICULATE MATTER AIR QUALITY

Abstract:

To limit global warming to 2 degrees Celsius compared to pre-industrial times, the currently-fossil-fueled economies will need to transition to renewable energy. The transition to a renewables-based economy involving solar and wind energy is estimated to require 10-20 times the current levels of mining and processing to bring conventional metals such as iron, copper, aluminum, and rare-earths such as nickel, lithium, and vanadium into the solar panel and wind turbine production cycle. Most of the metal-related mining and processing methods are particulate matter (PM) emissions-intensive. Only a fraction of the countries, mostly low- and middle-income, have feasibly-minable resources and are most likely to control their supply in the future, but also bear the burden of emissions, ambient air concentrations, and the public-health-related issues with them. Estimating the potential increase in PM concentrations in those countries might aid in proactive policy planning to reduce emissions and avoid public health damages. Two broader questions arise: which countries might see the most reductions due to a move to renewables and which might not? Are countries ‘exporting’ most of their renewables-related air pollution to low- and middle-income countries when they import solar panels and wind turbines from them? This proposal aims at estimating the global change in ambient PM concentration in various future scenarios when economies move from fossil to renewable energy. The proposed methodology involves estimating PM emissions from mining and smelting to extract metals required in manufacturing solar panels, wind turbines, and electric vehicles. These emissions would then be carried in an atmospheric transport model to estimate ambient concentrations in various climate scenarios.

Biographical sketch:

Sagar Rathod is a 3rd year PhD student in the Department of Atmospheric Science at the Colorado State University, Fort Collins, Colorado, USA. His current research focusses on the emissions and interactions of particle-phase metals such as iron and phosphorus in the Earth system, mainly for atmospheric radiation and oceanic biogeochemistry. His other research focusses on the equity and justice of greenhouse gas emissions, impacts redistribution, and how a shift to renewables might affect that at a global level. Sagar holds a BEngg. and MSc in Environmental Engineering from Gujarat Technological University and University of Illinois at Urbana-Champaign (UIUC), respectively.



Felix Schenuit

Supervisor: **Keywan Riahi**

Research Project: **CDR GOVERNANCE IN PRACTICE: ASSESSING DEVELOPMENTS IN BRICS COUNTRIES.**

Abstract:

Since the Paris Agreement and the IPCC's Special Report on 1.5°C Global Warming, transitions to net zero emissions societies have received increasing attention in scientific and policy circles. In this context, more and more actors address the need for carbon dioxide removal (CDR) to achieve net zero and net-negative greenhouse gas emissions targets. While political and corporate CDR initiatives are on the rise, empirical analysis of the political economy of CDR and related instruments in public policy processes has been largely missing. Analyzing current developments in policymaking in different societal contexts, including new instruments and alliances, however, is relevant to explore conditions, potentials and challenges of sociotechnical transition towards CDR deployment.

Following-up on a study on CDR policies in 9 OECD cases (Schenuit et al. 2021), the research project aims at conducting a systematic comparison of CDR(-relevant) policies in Brazil, Russia, India, China, and South Africa. The BRICS countries are relevant cases for several reasons, including: the large share of current GHG emissions from this group, and their strong influence in international climate negotiations under the UNFCCC and ongoing implementation of the Paris Agreement. Since the way CDR is addressed politically has an impact on the overall CDR deployment potentials, the project seeks to prepare the findings in a way that it can inform the climate change scenario framework and modeling efforts to improve assumptions about CDR availability and political feasibility.

Biographical sketch:

Felix Schenuit is a PhD student at the Center for Sustainable Society Research (CSS) and the Cluster of Excellence “Climate, Climate Change, and Society” (CLICCS) at Hamburg University (Germany). He’s a political scientist (MA, NRW School of Governance) and explores the role for scientific knowledge in political decision-making processes. In particular, he focuses on emerging carbon dioxide removal policy designs and assesses politically feasible and societal plausible pathways towards CDR deployment. Before starting his PhD in 2019, he was a research assistant at the German Institute for International and Security Affairs (SWP).



Paul Stegmann

Supervisor: Volker Krey

Research Project: DEVELOPMENT AND INTEGRATED ASSESSMENT OF A
LOW-EMISSION SCENARIO FOR THE PLASTIC SECTOR

Abstract:

The chemical sector is the largest industrial energy consumer and the third-largest industrial CO₂ emitter, with plastics being the key output. However, most Integrated assessment models (IAM) focus on energy and neglect non-energy services, i.e. chemicals and materials, and consequentially also related circular economy strategies. Assessing Greenhouse-gas emission mitigation pathways for the plastic sector in IAMs would offer a dynamic, long-term perspective and show the aggregated effects of biomass use, carbon sequestration in long-term products, recycling as well as further mitigation strategies.

We developed the first global plastic production and waste management model as part of a global IAM. By linking the upstream chemical production with the downstream production of plastics, their use in different sectors and their end of life, the model can assess mitigation strategies throughout the whole product life.

The goal of this YSSP project is to use and improve this model through a) developing low-emissions scenarios for the plastics sector by investigating mitigation possibilities throughout the entire supply and use chain, and b) implementing them in an IAM to assess the material, energy and emission reduction potential of the sector.

Biographical sketch:

Paul Stegmann is a PhD candidate at Utrecht University and a guest researcher at PBL (Netherlands Environmental Assessment Agency). He is working on the inter-linkages between the bio-based and the circular economy, namely the "circular bioeconomy". His current focus is the investigation of climate change mitigation pathways for the chemicals and plastics sector. Before, he worked for international organizations on projects in the fields of circular economy, waste management and development cooperation. His interdisciplinary education lead him from his Bachelor in European Studies to Magdeburg (Otto-von-Guericke University), Barcelona (University Pompeu Fabra), followed by a Master's in Sustainable Development at Utrecht University and Leipzig University.



Doris Virág

Supervisor: Narasimha Rao
Co-Supervisor: Jihoon Min

Research Project: MATERIAL STOCKS FOR DECENT LIVING STANDARDS

Abstract:

While the current level of global resource use by human civilization is overshooting a number of planetary boundaries, a significant share of the global population is living below or on the edge of poverty levels. The UN SDGs aim at achieving sustainable development. To investigate the potential realization of this vision, important work by Rao et al. has been done by defining ‘decent living standards’ as universal minimum conditions for wellbeing. These minimum standards require resources to provide need satisfiers such as biomass for food, manufactured goods, adequate infrastructures and housing. A recent study by Millward-Hopkins et al. has shown how advanced technology in combination with demand-side measures could provide decent living standards globally in 2050 despite expected population growth and requiring final energy consumption at 1960s levels. To fully understand resource use of decent living standards, this view needs to be extended to materials necessary for satisfying basic needs. Within the proposed research the focus lies on mobility services and an estimate for a decent level of mobility infrastructure until 2050 shall be presented. Mobility infrastructure is a large part of total societal material stocks and enables mobility services, which are currently a large source of GHG emissions. Within the project, the relationship between stocks and services for the case of mobility will be investigated. Service indicators will be used to connect mobility needs with the material requirements of need satisfiers and compare them to currently existing stock-flow relations from different countries.

Biographical sketch:

Doris Virág, MA, MSc is a researcher and PhD-candidate in her second year at the Institute of Social Ecology (University of Natural Resources and Life Sciences, Vienna). She graduated from the institute’s master’s program ‘Social and Human Ecology’ in 2019, when the institute still belonged to Alpen-Adria University. Her research focusses on society-nature interactions and their interdependences. She works on understanding societal metabolism, in particular material stocks and flows and potentials of Circular Economy strategies for achieving dematerialization and decarbonization, using the methods of material and energy flow analysis and stock-driven/bottom-up material stock analysis. Currently, she is working as a researcher in different projects with the aims of assessing prospects for a Circular Economy in Austria (ACRP) and South Africa (CSIR) and understanding the role of material stock patterns for the transformation to a sustainable society (ERC Advanced Grant).



Natália de Assis Brasil Weber

Supervisor: Julian David Hunt
Co-Supervisor: Behnam Zakery

Research Project: LONG-TERM ENERGY STORAGE ASSESSMENT TO ADAPT TO CLIMATE CHANGE: BRAZIL STUDY CASE

Abstract:

Brazil is vulnerable to climate change impacts, mainly due to its dependence on hydroelectricity. This raises for the need to include climate change adaptation strategies in the planning of its energy sector. This research has the objective to quantify the impact of climate change on the Brazilian electricity sector. This will be performed with the integration of an integrated assessment model (MESSAGEix) and regional climate model (RCM). The RCM provides future hydropower, wind and solar energy availability and MESSAGEix calculates the optimal energy supply scenarios of the Brazilian electricity up to 2100. Particular attention will be given to the role of energy storage technologies in the grid. To verify the robustness of scenarios proposed by MESSAGEix, the dispatch model EnergyPLAN will be applied to check if the supply of electricity meets demand in an hourly electricity balances.

Biographical sketch:

Natália is currently a third-year PhD student at the Post-Graduate Program in Mechanical Engineer (PROMEC) at the Federal University of Rio Grande do Sul (Brazil), working on the determination of long-term climate-change impacts in renewable energy production and evaluating the role of energy storage in the Brazilian energy system. Natália holds a MSc degree in Energy Planning from the Institute of Energy and Environment of the University of São Paulo (2017) and a BA in Energy Engineer from UERGS (2015). She has experience with machine learning and her main interests are climate change, energy optimization, and data science.



Jinyang Zhao

Supervisor: Tieju Ma

Research Project: **HOW POWER-TO-LIQUID TECHNOLOGY CAN CONTRIBUTE TO CHINA'S CARBON EMISSION REDUCTION IN THE TRANSPORTATION SECTOR?**

Abstract:

The transportation sector, one of the major contributors to almost 25% of the total world's greenhouse gas emissions, faces a severe challenge of decarbonization under the carbon-neutral target. To meet this target, governments around the world have issued industrial plans to promote electric vehicles. However, such plans require huge investments to radically replace current infrastructure and may raise the boycott of traditional industry. In this avenue, a negative emission liquid fuel supply system with multiple emerging negative emissions technologies during fuel production is intensively explored. Coupled with the original consumption process, a carbon-neutral transportation system can help to meet the decarbonization targets. However, the corresponding technologies are still in the laboratory stage and face huge uncertainties related to costs, learning rates, etc. So, this research plans to develop a model for supporting the configuration of technology portfolio and production capacity allocation to achieve the carbon-neutral target for China's transportation sector while balancing this target with the corresponding costs and energy security. To address this, I want to develop a model by adapting the MESSAGE_ix framework and other on-going IIASA works. Through multi-criteria analysis and sensitivity analysis, the best development strategy for these technologies can be evaluated. The proposed model can later be used to examine similar technologies in other sectors, such as power-to-olefin.

Biographical sketch:

Jinyang Zhao is currently a third-year PhD student at the center of energy economics and environmental management of East China University of Science and Technology. His dissertation research is primarily focused on energy system analysis and optimization, technology adoption and diffusion. His main fields of scientific interest include energy system modelling, multi objective optimization, hydrogen energy and climate change.



Sebastian Zwickl-Bernhard

Supervisor: Daniel Huppmann
Co-Supervisor: Fabio Sferra

Research Project: **DOWNSCALING INTEGRATED ASSESMENT MODELS: AN
OPEN-SOURCE APPROACH USING EMPIRICAL
STATISTICAL DOWNSCALING**

Abstract:

The core objective of this work is to elaborate on empirical statistical downscaling methods to downscale Integrated Assessment Model (IAM) results on a higher granularity (e.g., country, province, district, or even neighborhood). In the light of the ongoing energy system transition and pre-determined global climate targets such as the Paris Agreement, this work enhances the understanding of related implications on a higher spatial resolution. In particular, the analysis emphasis on the energy sector while taking into account socio-economic and policy-related key drivers. The method applied is an integration of the statistical downscaling calculation algorithm (e.g., linear and convergence downscaling) to the existing open-source Python package *pyam*. In doing so, this work builds on already existing but partly limited downscale methods and thus extends tailor-made the suite of functionalities in *pyam*. A case study should demonstrate the applicability of the downscaling implementation. Thereby, the focus is put on downscaled IAM results in the energy sector and its implications on distribution grid infrastructure and network topology requirements to meet local energy needs. In particular, the case study elaborates on energy carriers as well as energy technologies and their distribution networks playing a crucial role in the sustainable energy transition (e.g., hydrogen, geothermal sources).

Biographical sketch:

Sebastian Zwickl-Bernhard received the BSc degree in electrical engineering and the MSc degree in energy systems and automation technology from the Technical University of Vienna, Vienna, Austria, where he is currently pursuing the PhD degree. In 2020, he joined the Energy Economics Group, Vienna, as a Project Assistant, where he participates in international and national research projects. His research interests in energy economics include open-source modeling and optimization of sustainable energy systems under consideration of multiple-energy carrier grid structures as well as game theoretical approaches focusing on agent-based strategic behavior.



Ali Balhasan

Supervisor: **Guillame Marois**

Research Project: **THE PUZZLING DECLINE OF FEMALE LABOUR FORCE PARTICIPATION IN INDIA AND ITS PROSPECTS: AN AGE-PERIOD-COHORT APPROACH**

Abstract:

The participation of women in the labour market is a significant source of a country's potential economic growth and can be understood as a significant indication of declining gender discrimination and increasing women empowerment. Despite the rapid increment in female education and decline in fertility rate in India, the female labour force participation (FLPR) declined and reached a very low level (17.5 percent) in 2017-18. Conservative gender and social norms, patriarchy, lack of skills, and household status are major constraints in women's participation in the labour market, but little is known about the cohort behaviour of female labour force participation with age and period effects. Cohorts are more likely to behave in a similar way in getting education, employment opportunity, and in demographic events that occurred in their life course, as they experience similar historical, political, environmental, technical, economic and social time events. In this context, it is essential to explore and decompose (1) the age effect of women, (2) the period effect, and (3) the cohort effect on FLPR. For this study, we will use micro-level data from the labour surveys (1993-2018). For analysis, we will apply the age-period-cohort method to examine their respective effect on FLPR. Understanding the cohort behaviour considering age and period effect would produce a more precise explanation of the puzzling decline of FLPR. Further, the projection of FLPR considering cohort will help to understand prospects better.

Biographical sketch:

Balhasan Ali graduated in Economics from Banaras Hindu University, India in 2013. He is currently a 3rd year doctoral candidate at the International Institute for Population Sciences in Mumbai, India, where he also earned a master's degree in Population Studies. His PhD thesis is entitled "trends and prospects of female labour force participation rate and its linkages with fertility and longevity in India". His/her main fields of scientific interest include labour force, gender, human capital, caste discrimination, inequality, and the relationship between women work and demographic dynamics.



Andrea Aparicio-Castro

Supervisor:

Dilek Yildiz

Co Supervisor:

Michaela Potancokova

Research Project:

**FORECASTING MIGRATION FLOWS BETWEEN EUROPE
AND SOUTH AMERICA, 1986-2060**

Abstract:

European migration has been mostly intraregional, although this has been changing during the last years. While migration inflows from European countries (i.e. EU-27, EEA, UK and Switzerland) decreased by 7.8% between 2013 and 2018, non-European immigration increased by a similar proportion in the same period. This change is also noticeable in migrant stocks in Europe reported by the United Nations. The trend of migrant stocks suggests that migration towards Europe vary according to the region of origin, which in turn, respond to different determinants of migration. To gain a better understanding of the driving factors of migration towards Europe from a specific region and to quantify how migration may change in the future, forecasting migration flows is crucial. Considering that Latin America and the Caribbean (LAC) migrant stocks in Europe have had the greatest increase in the last decades and South America (SA) countries have had the sharpest growth amongst LAC territories, the main aim of this research is to forecast the spatial and temporal patterns of bilateral international migration flows between Europe and SA. This research proposes a Bayesian version of an Autoregressive Distributed Lag (ADL) model. This type of model can deal with the expected non-stationarity features of Europe-SA flows and enables quantifying the effect of covariates on future migration. The output will be a set of synthetic estimates of bilateral migration flows between Europe and SA until 2060 with measures of uncertainty.

Biographical sketch:

Andrea graduated as an MSc in Social Research Methods and Statistics from the University of Manchester (UoM) and as a Sociologist from the National University of Colombia. She is currently a Ph.D. candidate in Social Statistics at the UoM and a Fellow of the Higher Education Academy. She is also a scholar of the ESCR North West Social Science Doctoral Training Partnership and a research member of the Cathie Marsh Institute. Her thesis is about modelling and forecasting the spatial and temporal patterns of bilateral international migration flows. Her main fields of scientific interest include modelling and forecasting migration, integrating different data sources and Bayesian statistics.



Camille Belmin

Supervisor:

Guillaume Marois

Co-Supervisor:

Shonali Pachauri

Research Project:

**INCLUDING THE ENERGY-FERTILITY NEXUS IN
POPULATION PROJECTIONS TO INVESTIGATE
SYNERGIES BETWEEN ENERGY POVERTY
ALLEVIATION AND CLIMATE MITIGATION**

Abstract:

The Sustainable Development Goals seek to jointly increase the life quality of the world's poorest populations while mitigating climate change. In this proposed research, I aim to identify how an increase in well-being through access to energy and education policies in poorest, high-fertility countries could foster fertility decline – and lead to mid-term net energy savings. Evidence is growing that access to modern energy, in addition to education, is an important precondition for fertility decline: firstly by reducing time poverty thus facilitating access to education and secondly by reducing the need for child labor. However, improved energy access leads to two opposing effects on total energy demand: an increase due to higher consumption per capita, and a reduction due to smaller populations. Under what conditions would this lead to a net saving in energy consumption? To answer this question, I will build a micro-simulation model of population projection in which fertility will depend on energy use and education level, for one country in Sub-Saharan Africa. This model will allow to estimate the future total residential energy demand of a population under different energy transition and education scenarios, while taking into account the energy-education-fertility relationship. By finding under which conditions rapid investments in energy access and education would result in large energy savings, this work could contribute to further encourage investments in energy and education policies and help address simultaneously energy poverty and climate protection goals.

Biographical sketch:

Camille Belmin is a PhD researcher in the Future Lab Social Metabolism and Impacts at the Potsdam Institute for Climate Impact Research and at Humboldt University of Berlin (Germany). Her research focuses on the effect of access to modern energy on the fertility transition in low-income countries, and on relevant applications for sustainable development policies. Her main fields of scientific interest include energy in relation to gender and poverty, demography and social metabolism. Prior to this, she obtained a Master of Environmental Economics at AgroParisTech/Université Paris-Saclay (France).



Richard Moreira

Supervisor: Raya Muttarak
Co-Supervisor: Thomas Schinko

Research Project: **WHO IS AT RISK? DIFFERENTIAL VULNERABILITY TO
NATURAL HAZARDS IN THE CITY OF BELO HORIZONTE,
BRAZIL**

Abstract:

As much as 16,4% (390,000 people) of the population of Belo Horizonte, the sixth most populous city in Brazil, live in areas prone to hydrometeorological risk such as floods, landslides, mudslides, and other extreme events related to rainfall patterns. People living in high risk areas in the urban centers are particularly vulnerable due to a combination of lack of access to public services, socioeconomic disadvantages, and exposure to environmental extreme events such as heatwaves, storms and mass movements. It is thus necessary to identify which subgroups of population are vulnerable to which natural hazards and where they live in order to inform policy interventions to reduce differential vulnerabilities.

Using clustering methods, I compare the differential demographic and socioeconomic characteristics of three subpopulations in Belo Horizonte: 1) populations resettled from disaster-prone areas between 2010 and 2020; 2) the inhabitants of areas at risk, and 3) the city's general population. This approach allows me to capture the interactions between social, economic, and demographic factors underlying vulnerability, and consequently enabling me to construct demographic and socioeconomic profiles of those at risk or those resettled from areas threatened by environmental stress. These results can be used to understand the common profiles of the population relocated by the Belo Horizonte City Hall, and further provide information for policymakers about the resettlement of specific groups in a context of environmental risk.

Biographical sketch:

Richard Moreira is currently a 4th year PhD student of Demography in the Center for Development and Regional Planning (CEDEPLAR) at the Federal University of Minas Gerais, in Brazil. His research focuses on vulnerable populations living in areas prone to disaster risk and mobility/migration related to extreme events and climate change. Richard holds a BSc in Engineering and a MSc in International Relations. Moreover, his research interests include demographic impacts of climate change, urban vulnerability to disasters and the intersection between migration and climate change.



Ester Lazzari

Supervisor: Michaela Potančoková
Co-Supervisor: Tomáš Sobotka

Research Project: ESTIMATING THE CONTRIBUTION OF ASSISTED REPRODUCTIVE TECHNOLOGY (ART) TO COMPLETED COHORT FERTILITY.

Abstract:

The shift to delayed childbearing represents one of the major demographic changes of the past few decades in developed countries. Delayed parenthood is associated with lower completed fertility (the average number of children women have during their lifetime) and with a higher chance of remaining permanently childless as reproductive capacity rapidly declines with age. With the increase in the proportion of couples experiencing age-related infertility, demand for fertility treatments, such as assisted reproductive technologies (ARTs), has also increased. Utilisation of these technologies in Australia is currently among the highest in the world, partly due to the relatively supportive policy environment for ARTs. Quantifying the contribution of fertility treatment to current and future fertility levels is of interest to policymakers and researchers, particularly those in developed countries characterized by a pattern of low fertility rates. To date, research on the contribution of ART to the fertility rate is limited, existing studies focus on period fertility, and the relationships between ART and demographic processes remain largely unexplored. The aim of this proposal is to estimate the contribution of ART to current and future cohort fertility in Australia. Using data from fertility clinics and national birth registries, we plan to analyse the uptake of ART in subsequent cohorts, quantify the contribution of ART to the cohort fertility and forecast completed fertility of cohorts of women that have not yet completed their reproductive lives, under the assumption of different scenarios of ART's utilisation and childbearing delay.

Biographical sketch:

Ester Lazzari holds a BSc and MSc in Economics and Social Sciences from Bocconi University in Milan (Italy). She is a third-year doctoral student in the School of Demography at the Australian National University (Australia). Her thesis titled “Childlessness, late fertility and assisted reproduction in Australia” investigates the growing phenomenon of delayed parenthood and the contribution of assisted reproductive technologies to the fertility rate in the Australian setting.



Iulia Marginean

Supervisor:

Roman Hoffmann

Co-Supervisors:

Raya Muttarak, Jesus Crespo Cuaresma, Jing Gao

Research Project:

Population projections and vulnerability modelling under the Shared Socioeconomic Pathways (SSPs)

Abstract:

Heat stress is a key risk in Europe in the near and long-term future as temperatures are increasing with climate change. The main impacts of climate change on human health are related to extreme weather events, with heat waves being the deadliest extreme weather events between 1991 and 2015 in Europe. Heat stress increases mortality and can exacerbate a range of diseases, resulting in an increase in morbidity. The health of city dwellers is particularly affected by heat stress due to the urban heat island (UHI) effect. Urbanization patterns increase the exposure of urban populations to higher temperatures. However, heat stress affects different population groups disproportionately. Older adults (over 65 years), infants (under 5 years), women or those with lower socio-economic status or pre-existing health conditions are more vulnerable to the health risks of climate change. Projections of climate risks and the negative impact of heat stress on human health in cities will be determined by future climate conditions as well as population dynamics. This project will focus on modelling future demographic development under the Shared Socioeconomic Pathways (SSPs) at the local level, in two case study cities in Europe, Warsaw and Madrid. Population increase and future urbanization patterns will be used to determine exposure while population aging, sex and education factors will serve as indicators of underlying vulnerability.

Biographical sketch:

Iulia is a PhD candidate at the Center for International Climate Research (CICERO) in Oslo, Norway. Her research focuses on climate impacts on human health in cities. With an interest for transdisciplinary method development, Iulia's research employs methods from climate modeling, epidemiology and demography, to gain a more holistic understanding of climate risks to human health. She holds a BSc in environmental engineering and an MSc from the Joint European Master in Environmental Studies (JEMES), an international master's programme, designed to combine social and natural environmental sciences. Before starting her PhD, Iulia worked on a number of research projects related to climate impacts in finance, health and agriculture.



Linda Rosengren

Supervisor: Thomas Schinko
Co-Supervisor: Jan Sendzimir

Research Project: **LEVERAGE POINTS FOR STRENGTHENING ADAPTIVE CAPACITY OF AGRICULTURE AND FOOD SYSTEMS IN THE GLOBAL SOUTH**

Abstract:

Systemic leverage points are gaining ground within the socio-ecological systems and sustainability literature, but scientific work related to the *operationalization* of leverage points is still limited. This YSSP project explores the operationalization of leverage points through a collaborative process and critically discusses the potential to create positive change in the context of climate change adaptation in the food and agriculture system in Northern Ghana. The collaborative process applied in the study consists of a four-steps approach: 1) understanding, 2) visioning, 3) concretising, 4) reflecting. The study builds on a previous work by Rosengren et al (2020) that identifies four systemic leverage points for strengthening adaptive capacity in the agriculture and food systems in the Global South. These are: 1) access to finance, 2) access to and use of information and knowledge, 3) social learning and 4) gender equality. The study explores the barriers and enablers for operationalizing these leverage points in our empirical case study and explores the interdependencies of the four leverage points building on the working theory by Fischer & Riechers (2019) called “chain of leverage”. The resulting research article will contribute to the scientific discussion by providing empirical insights on the operationalization of leverage points for strengthening adaptive capacity in the Global South.

Biographical sketch:

Linda Rosengren is a 3rd year PhD candidate at the University of Helsinki, Faculty of Agriculture and Forestry. Her main scientific interest is related to climate change adaptation, resilience, transformation, and food systems. The objective of her PhD theses is to explore the use of systemic leverage points for strengthening the adaptive capacity of agriculture and food systems in the Global South. She has a professional background working in development cooperation, mainly related to natural resources management and climate change. She has extensive field experience from working in Asia, Africa and Latin America and has among others worked for FAO, WWF and the Finnish Ministry for Foreign Affairs. Linda holds a master’s degree in Agroecology from the University of Helsinki.



Caroline (Caz) Russell

Supervisor: Michael Thompson
Co-Supervisor: Dipak Gyawali

Research Project: DISASTER RISK REDUCTION RECONSIDERED

Abstract:

Increasingly resilience has become the favored approach to curb the severity of future impacts of natural hazards. It is a key strategy of the UNDRR and SDG's and championed by most, if not all, nations and civil society organizations working with disasters. But who decides what resilience looks like? We explore this question through the Nepali phrase *ke garne?* (what to do). Thought to be a fatalistic expression of defeat in the face of overwhelming obstacles, the true meaning of *ke garne*, a sense of resilience despite adversity, is often lost in translation (Gowne, 2015). We argue that this assumed fatalism is prevalent in disaster risk reduction (DRR) attitudes to landslides in Nepal. Drawing on the theory of plural rationality we explore how DRR actors at the national scale have assumed that communities have an inherently fatalistic view of landslides. By doing so they have overlooked the resilience of villagers who have adapted to and cope with the day-to-day realities of living in landslide prone areas. Drawing on semi structured interviews with national level DRR proponents we argue that this misconception of fatalism at the grassroots level is leading to problematic DRR interventions. These interventions bestow a top-down understanding of resilience on social systems that already have embedded within them, culturally salient, resilience mechanisms and practices. We conclude by suggesting that future interventions first need to ensure that they fully understand the pre-existing resilience measures and mechanism of the system they are pursuing.

Biographical sketch:

Caz is a 3rd year PhD student at the University of Birmingham exploring collaborative governance approaches to disaster risk reduction in remote mountain communities in Far-Western Nepal. Her background is in literature and she obtained her Ba from Liverpool John Moores University (2010) and a MA in Critical Theory from the University of Manchester (2011). She shifted her research focus onto environmental human geography and received a MA in Environment and Development from Lancaster University (2016), where she also worked as research assistant in rural Bangladesh looking at cyclone resilient housing projects. Her passion lies in DRR and Climate Change Adaptation.



Helena Zhemchugova

Supervisor: **Susanne Hanger-Kopp**
Co-Supervisor: **John Handmer**

Research Project: **RISK-INFORMED GOVERNANCE IN PRACTICE:
A CASE OF FOREST FIRES IN SWEDEN**

Abstract:

Disasters are increasingly seen as societal problems and building strategic capacity for societal resilience as a solution. Existing research points out that traditional, deterministic approaches to risk management fall short in complex socio-technical systems that comprise society today. Risk-informed governance grounded in rich knowledge behind the risks is more promising for resilience building. Hence, the Priority for Action no.2 of the Sendai Framework urges decision- and policymakers to re-design established governance mechanisms to include new forms of regional cooperation that can address transboundary risks. Implementing such changes might be challenging for public governance structures that have historically been operating out of traditional views on risk management. The present work sets out to trace whether and how the global ambition manifests itself in the current mechanisms of governance of forest fires in Sweden by comparing theory and practice. We look at the existing research that outlines the desired state of governance and carry out an empirical investigation of the current state. For the purpose of the latter, we interview representatives of the Swedish Civil Contingencies Agency (MSB), County Administrative Boards (Länsstyrelsen), and the Forestry Research Institute of Sweden (Skogforsk). We use thematic analysis to uncover the elements of a governance structure that involves a diverse array of actors as well as information sources and knowledge flows that are used for decision support. Further, we apply conceptual modelling to elicit connections between the elements in this socio-technical system. The results provide a detailed account of risk-informed governance in its development and highlight gaps in the strategic alignment of the practice with the global targets of resilience building. Potential entry points for strengthening risk-informed governance of forest fires in Sweden are discussed. The study contributes to the global discourse of disaster risk reduction.

Biographical sketch:

Helena is a 2nd-year PhD student at Stockholm University. Her research focuses on the interplay of risk and resilience in the context of societal disasters. She holds a MSc in Computer and Systems Sciences (2018) and a MA in Linguistics (2010). Her main fields of scientific interest include risk and decision analysis, knowledge management, as well as tabula rasa approaches to long-standing governance issues.