YSSP23

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Young Scientists Summer Program

International Institute for Applied Systems Analysis

Biographical sketches & abstracts

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Jalal Awan

Mentors: **Inian Moorthy, Gerid Hager**

Research Project: **EVALUATING PERFORMANCE OF SOCIO-TECHNICAL SYSTEMS FOR IMPROVED RELIABILITY: EVIDENCE FROM COMMUNITY AIR MONITORING NETWORKS USING LOW-COST AIR QUALITY SENSORS**

Abstract:
Particulate Matter (PM) pollution is responsible for 1 in 5 deaths globally (~8mn annually) (Vohra et al.,2021). However, the current network of regulatory-grade monitors to measure PM pollution is limited in its spatio-temporal coverage, leading to significant uncertainties in neighborhood-level measurements. Moreover, these monitors are large, heavy, and expensive, costing upwards of $100,000 in the United States. In contrast, low-cost air quality monitors (ranging from <$100-$2000) that rely on volunteer citizen networks as sensor hosts offer a new paradigm for pollution monitoring that requires further exploration.

Most studies on low-cost sensing devices in the United States have focused on evaluating sensor technologies in laboratory and field settings, rather than examining how perceptions, motivations, and other human factors influence participation in community air monitoring. A thorough understanding of these devices requires evaluating both the sensing technologies and the "human networks" that are part of the sensing and sense-making ecosystem. The aim of this study is to evaluate the technical accuracy of low-cost sensor data and identify specific opportunities and barriers to sensor deployment, access, and use in communities, with a particular focus on low-income communities.

This research uses EPA's base testing guidelines for long-term sensor evaluation (>1-year) and survey data from sensor hosts in two distinct urban locations in the US. The research further tests various calibration algorithms from published literature to compare pre-post calibration performance. Findings from our sensor deployment experiments are applicable insofar as the meteorology, geography, and deployment context for testing locations are similar to the two experimental locations for this research.

Biographical sketch:
Jalal Awan is a PhD Fellow (2017-present) and Assistant Policy Researcher at the Pardee RAND Graduate School and the RAND Corporation, respectively. His research involves technology governance and policy issues, including low-cost particulate matter sensing, public health incident response, climate-related threat mitigation, biosurveillance, AI governance, and equity concerns arising from emerging technologies. Jalal is inspired by the positive potential of emerging technologies for global human well-being and motivated to mitigate risks posed by these technologies through appropriate guardrails.

Reihaneh Bandari

Mentors: **Ali Kharazi, Robert Sakic Trogrlic**

Research Project: **CO-PRODUCTION OF KNOWLEDGE AND ASSESSMENT OF LOCAL INTERVENTIONS FOR THE ACHIEVEMENT OF LOCALLY RELEVANT SOCIOECONOMIC AND ENVIRONMENTAL SUSTAINABLE DEVELOPMENT GOALS**

Abstract:
The 2030 Agenda has a comprehensive and multi-sectoral approach to sustainability, with an ambitious results-based framework encompassing a wide-ranging scope, a long-term perspective, and a transformative outlook. Achieving sustainable development through localisation presents a pervasive challenge. Adopting a systems-based approach can aid in understanding the causal systems that are specific to a locality, identifying key leverage points, and promoting participation necessary for localising and initiating development interventions. Our approach involves using system modelling to evaluate the effectiveness of locally-driven interventions in achieving Sustainable Development Goals under the global change scenarios, namely the Shared Socioeconomic Pathways and the Representative Concentration Pathways. These interventions are developed through the co-production of knowledge with local expert stakeholders and applied in the Goulburn Murray Irrigation District (GMID), a case study and a critical local region in Victoria, Australia. A group of local interventions are developed and will be modelled to address four high-priority SDGs, including clean water and sanitation (SDG 6), agricultural activities (SDG 2), economic growth (SDG 8), and life on land (SDG 15) to assess the achievement of sustainability in this area. By incorporating global scenarios and local interventions, our analysis will examine a diverse range of potential future trajectories and identify crucial drivers of change across multiple SDGs.

Biographical sketch:
Reihaneh Bandari is a 4th year PhD student at the School of Life and Environmental Sciences of Deakin University in Australia. Her research interests are sustainability science, systems modelling, and water resources management. She studies sustainability science at the Deakin University's Centre for Integrative Ecology (CIE), focusing on computational and participatory approaches for modelling socioeconomic and environmental Sustainable Development Goals (SDGs) under future uncertainties at the local level. Reihaneh completed a bachelor's degree in Agricultural Engineering and a master's degree in Water Resources Engineering.

Thomas Bossy

Mentor: **Thomas Gasser**

Research Project: **WINNERS AND LOSERS IN COOPERATIVE VERSUS UNILATERAL CLIMATE MITIGATION STRATEGIES**

Abstract:
The Paris climate agreement sets the goal of keeping global temperature change below 2 ° C and continuing efforts to stabilize it at 1.5 ° C. The agreement also includes a process of reassessing national commitments (the Global Stock-take). This reassessment of mitigation efforts (or even the reassessment of climate objectives) must be done according to "the best available scientific knowledge" to link the impacts of climate change to mitigation efforts.
This research project starts from an observation of limit of the approach currently used by the IPCC to link impacts and climate policies. The climatic impacts are only evaluated ex-post due to an approach that follows the natural causation of the Earth system and is based on several types of complex models.
Here, I propose to reverse the natural causality of the system. Climate objectives will be defined in terms of land or population exposure in every country and directly associated with temperature and radiative forcing trajectories. These trajectories will be numerically inverted to obtain an anthropogenic CO2 emission pathway compatible with a given objective. In a second step, the trajectories of global emissions will be disaggregated, by means of sharing quotas models, into country-level CO2 emissions pathways. Finally, I will explore and analyse the actual climate impacts produced by climate change if every country was emitting according to its own agenda in terms of local impact limitation.

Biographical sketch:
Thomas Bossy graduated in 2020 from Ecole Normale Supérieure de Lyon (France). He is currently a third year PhD student at Paris-Saclay University. Title of his thesis is *Impact-defined climate targets: estimating ensembles of pathways of compatible anthropogenic drivers through inversion of the cause-effect chain.*
His main fields of scientific interest focus on the intersection of climate science and economics, particularly on issues related to climate change mitigation, impact emulation, and simple climate modelling.

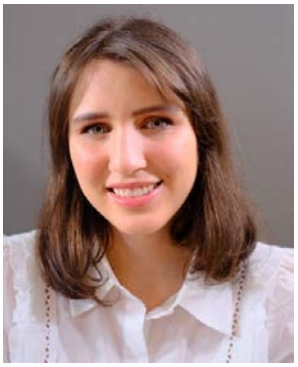
Or Elroy

Mentor: **Nadejda Komendantova**

Research Project: **ANALYSIS AND COMPARISON OF MISINFORMATION ON SOCIAL MEDIA IN DIFFERENT REGIONS**

Abstract:
Misinformation is false or inaccurate information that can easily spread globally through social media and raise the risk of worsening the harms of an emergency by leading to poor judgment and decision making. The fight against misinformation depends on quality research to better understand how misinformation evolves and progresses on the internet. My research objective is to analyze the discussion of misinformation on social media. To achieve this objective, different natural language processing methods, machine learning algorithms, and deep learning models, will be used. The analysis will include behavioral patterns and differences in the discussion in different languages at times of emergency. This research will provide insights into how users in different regions perceive misinformation on social media, and how certain regions affect or influence other regions. The results of this research will help fight misinformation by analyzing behavioral patterns and finding relations between regions, hence enabling efficient active and progressive measures against misinformation.

Biographical sketch:
Or Elroy is a PhD student in Computer Science at the University of Oregon, USA. He received his LL.B. and B.Sc. in Information Systems from the College of Law and Business, Israel, and his LL.M. in Intellectual Property from the University of Washington, USA.



Anaís Ostroski

Mentor: **Brian Fath**

Research Project: **A SYSTEMS-BASED APPROACH FOR MODELING AND ASSESSING POLLINATION PROVISION NETWORKS IN AGRICULTURAL LANDSCAPES**

Abstract:
The global food system is highly dependent on a range of ecosystem services. One such critical ecosystem service is pollination provided by wild and managed bees. Approximately 90% of flowering plants and at least one-third of total crop weight produced globally are dependent on pollinators. In the United States, the economic value of insect-mediated pollination was estimated to be 34 billion USD. Despite the critical importance of insect pollination services, there exists a knowledge gap regarding the relationship between crop production, land-use change, and pollination from a system's perspective. Furthermore, the abundance and diversity of bees are threatened by habitat loss, pesticides, and climate change. Declines in honeybee populations have been observed around the world, thus pollination supplied and complemented by wild bees can be a factor in crop risk management. There exists a need for understanding how agriculture simultaneously affects and depends on pollination. I propose a framework that couples well-established spatially explicit probabilistic models of wild bee abundance with landscape ecological networks for agriculture in the United States. The framework leverages spatial information on bee habitats, the Crop Data Layer, and central foraging behavior assumptions. This will provide a unique opportunity to link supply and demand of pollination service. Dynamic ecological network analysis will be used to assess pollination provision under different habitat conservation scenarios. Risk will be assessed based on the level of service provided by natural patches, the level of pollination dependency and marginal effects. This work will help elucidate the provision of ecosystem services to agricultural lands and the risks associated with loss of insect abundance.

Biographical sketch:
Anaís Ostroski is a PhD candidate in the department of Civil and Environmental Engineering at the University of Pittsburgh, United States. She has a bachelor and a master's in environmental engineering from Federal University of Paraná, Brazil. Her previous research focused on hydrological modelling in heavily impacted watersheds. Currently, her research interests are in the intersection of sustainability and food systems with an interdisciplinary approach. Specifically, she is interested in modeling food systems as flow systems at different scales, as well as understanding agricultural sustainability through satellite imagery and data science.

Ehsan Pashanejad

Mentors: **Ali Kharrazi, Zuelclady Araujo Gutierrez (BNR)**

Research Project: **DISENTANGLING COMPLEXITIES AND INTERACTIONS OF MULTIPLE ECOSYSTEM SERVICES USING FUNCTIONAL CONNECTIVITY AT A SMALL LANDSCAPE SCALE**

Abstract:
Ecosystem services (ES) are dynamic benefits derived from nature, which depend on ecosystem structures and functions. Examining the interactions between abiotic factors and biotic components across time and space is crucial for estimating ecosystem benefits. As ecosystems are intricate systems, the services they generate are interconnected across landscapes with varying structural and functional connections. This project aims to develop a modeling framework to comprehend the spatial dynamics of multiple ES at a landscape scale. Utilizing spatially explicit ES mapping platforms, such as ARIES and InVEST, the study will map the supply of individual ES, including pollination, soil carbon, water quantity, and water quality. A network model will be constructed to assess the connectivity of ES, employing spatial units of service provision areas as nodes and functional connections between these units as links. Network analysis and functional connectivity will enable a deeper understanding of the complex interactions and relationships among ES. This approach will also aid in identifying trade-offs and synergies among multiple ecosystem services, ultimately providing valuable insights for effective ecosystem management and sustainable landscape planning.

Biographical sketch:
Ehsan is a PhD candidate in Earth and Environmental Sciences at the University of British Columbia, Canada. As a member of the NSERC ResNet Strategic Network, he focuses on modeling interactions between multiple ecosystem services in the Canadian Prairies. Ehsan completed his MSc research on ecosystem change impacts, vulnerability, and resilience, as well as human-natural system interactions. He has actively participated in strategic spatial planning and decision-making processes at various scales in Iran and Canada. During his time as a UBC Sustainability Scholar, Ehsan conducted hydrological ecosystem service mapping for climate change planning in the Comox Valley, Vancouver Island. He has also collaborated with federal government agencies, including Parks Canada, where he assessed climate change vulnerability for species at risk in Wood Buffalo National Park.

Nabin Pradhan

Mentors: **Ian Mc Callum, Fernando Orduña, Juan Carlos Laso Bayas**

Research Project: **ESTIMATING INEQUALITY USING NIGHTTIME LIGHTS AND MACHINE LEARNING.**

Abstract:
Social assistance programs provide a safety net for millions of poor and vulnerable households around the world. Previous research on social assistance focuses primarily on well-being outcomes, with little emphasis on its impact on equity. While economic and environmental indicators of social assistance are relatively easy to identify through existing data, inequality indicators are not. Assessing the equity effect of social assistance is especially difficult due to the absence of data on inequality at regional and temporal scales. The study proposes to address data gaps in India by developing a reliable inequality dataset using satellite imagery and machine learning approaches at various spatial and temporal scales. The resulting dataset is intended to impact policy and help advance equity in government spending on public works in rural India. The methodological and analytical advances made in this study could be applied to other low- and middle-income nations worldwide, helping international donors prioritize spending and facilitating progress toward the UN's 2030 SDG goal 10 (Reduced Inequalities).

Biographical sketch:
Nabin Pradhan is a PhD candidate at the School for Environment and Sustainability, University of Michigan. He works in interdisciplinary research that focuses on public policy, rural livelihoods, and the environment. Three primary themes have motivated his work: 1) the effects of welfare spending on equity; 2) the effects of forest Commons on livelihoods, biomass, and tree species variety; and 3) the effects of climate change on agricultural production and food systems. He employs causal inference, Bayesian models, and machine learning methods to analyze large-scale data from censuses, household surveys, and satellite imagery.

Julius Schlumberger

Mentors: **Robert Šakić Trogrlić, Yung-Hee Hyun, Stefan Hochrainer-Stigler**

Research Project: **UNLOCKING THE POTENTIAL OF VISUALIZATION TECHNIQUES FOR DISASTER RISK MANAGEMENT (DRM) PATHWAYS IN MULTI-RISK SYSTEMS: FROM DATA TO DECISIONS**

Abstract:
Efficient communication of scientific findings is vital for decision-makers, especially when dealing with complex research problems that involve multiple layers of information. However, the integration of diverse information poses a significant challenge, particularly for climate adaptation and risk reduction strategies that need to account for multi-risk scenarios, including interactions between multiple hazard events and interdependencies across sectoral boundaries. The lack of effective communication means hinders the paradigm shift towards more integrated decision-making for disaster risk management.

To address this gap, this study aims to identify and tailor effective visualization techniques to communicate complex systems, uncertainties, tradeoffs, and synergies in long-term DRM planning. The study will analyze the strengths and weaknesses of different visualization approaches and propose a set of techniques that can support collaborative development of adaptation pathways and decision-making for multi-sector systems. The study will use a stylized multi-risk test case that involves managing risk by droughts and riverine flooding for 100 years across three sectors (agriculture, housing, and shipping). The respective model produces a large amount of information that captures a wide range of uncertainties and system characterizations. To leverage feedback regarding different visualization types, the study will involve a range of interactions with practitioners, stakeholders, and experts through semi-structured interviews, online questionnaires, and serious gaming. These techniques will contribute to operationalizing the Dynamic Adaptive Policy Pathways framework for Multi-Risk systems (DAPP-MR).

Biographical sketch:
Julius Schlumberger is a second-year PhD candidate in the Department of Water and Climate Risk at VU Amsterdam, NLD. He is also affiliated with the Department of Climate Adaptation and Disaster Risk at Deltares. Julius's PhD, which focuses on modeling adaptation pathways in complex, multi-risk systems, is part of the H2020 research project MYRIAD-EU. He obtained a B.Sc. in Environmental Engineering from RWTH Aachen University, GER, and a M.Sc. in Hydraulic Engineering with a track in Flood Risk from TU Delft, NLD. His primary scientific interests include adaptation, multi-hazard risk, multi-sector dynamics, and decision-making under deep uncertainty.

Amy Shurety

Mentors: **Elena Rovenskaya, Brian Fath**

Research Project: **MODELING NORTHEAST ATLANTIC MARINE FOOD WEBS UNDER FUTURE GLOBAL CHANGE SCENARIOS**

Abstract:
Global climate change contributes to sea surface warming causing gradients in numerous environmental variables, which together with commercial fishing, prominently alter ecosystem trophic dynamics and consequentially ecological resilience. A primary goal of this project is to provide robust understanding of ecological resilience across multiple scales by modeling the response of ecosystems to changing sea surface temperatures and commercial fishing, helping to highlight vulnerable systems, communities, and species. This project makes use of the Allometric Diet Breadth Model (ADBM) to construct northeast Atlantic food webs based on body size driven foraging behaviour. We use a novel empirical database of fish stomach contents, spanning more than 40 years and over 400 thousand predator-prey body mass measurements to validate the ADBM food web models. After which the food web models can be used to forecast northeast Atlantic food web structure in response to future sea surface warming and commercial fishing scenarios. A suite of ecological metrics such as flow diversity, redundancy and efficiency will be calculated from both the empirical and modelled food webs, which due to their systemic nature can be used to infer current and future ecological resilience of northeast Atlantic systems. In addition, this project investigates the sensitivity of ecological metrics to food web construction, for example changes in taxonomic groupings, evaluating the reliability of any conclusions made from changing trophic dynamics. This project has the potential to provide the scientific advice needed for climate change and sustainable fisheries management to be effective despite the uncertainty of global change.

Biographical sketch:
Amy Shurety is currently a 2nd year PhD student at the University of Essex, UK. The title of her thesis is *Environmental drivers of food web dynamics in the Northern Atlantic*. She graduated in 2020 with an MSc in Biology from the University of KwaZulu-Natal, South Africa. Her professional experience includes research scholar at the Australian Research Council Centre of Excellence for Coral Reef Research. Her main fields of scientific interest include quantitative ecology, food web ecology, and global change research.

Melissa Tier

Mentors: **Elisa Calliari, Teresa Deubelli-Hwang, Thomas Schinko, Reinhard Mechler**

Research Project: **EQUITY PREFERENCES IN URBAN CLIMATE ADAPTATION FLOOD POLICY**

Abstract:
The need for ex-ante climate adaptation policy design is ever increasing in urgency as climate-related disasters continue to increase in frequency and severity, with diminishing hope of mitigating global emissions sufficiently to reduce catastrophic harm – especially for those most vulnerable. However, policy preferences for climate adaptation strategies remain woefully understudied. Meeting robust environmental justice and equity standards will require innovative practices and foresight, but little is known regarding how such standards influence preferences for or against multifaceted climate policies. One set of climate adaptation strategies ripe for such consideration is urban housing resilience in preparation for and recovery from worsening flooding. These strategies are often complex and controversial (e.g., choices between protection, retreat, and relocation), and can vary widely in structure with regard to equity prioritization (e.g., types of distributive, procedural, and restorative justice). This project compares survey data of residents, using an online conjoint methodology, in several urban locations globally. The survey examines the variegated values that underlie participants' flood policy preferences, as well as their differing perceived experiences with extreme weather disasters, inequality, and political engagement. We aim to improve the understanding of how equity and climate justice in flood policies are conceptualized differently across distinct urban locations and cultures. These insights will help to 1) refine climate justice theory to better encompass cross-cultural perspectives; and 2) directly inform human-centered climate adaptation policy design.

Biographical sketch:
Melissa O. Tier is a 3rd-year PhD candidate at the Princeton School of Public & International Affairs in the Science, Technology, & Environmental Policy program. Her research on climate adaptation policy interweaves topics in multi-level governance, environmental justice, behavioral science, and urban planning. She previously served for 5 years as the first Sustainability Program Manager at Swarthmore College (in the Philadelphia metropolitan area), helping to launch the Office of Sustainability and to facilitate environmental and climate institutional decision-making. She holds an MSc in Sustainable Urban Development from the University of Oxford (2019) and a BA in Psychology from Swarthmore (2014).

Haoyu Wang

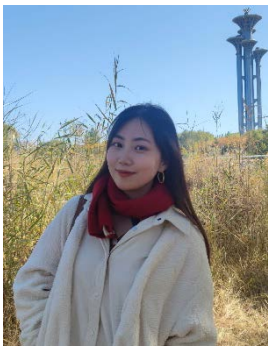
Mentors: **Piotr Żebrowski, Åke Brännström**

Research Project: **INTEGRATING TIME SERIES DATA WITH EPIDEMIOLOGIC MODELS TO IMPROVE PREDICTION OF COVID-19 DYNAMICS IN CHINA**

Abstract:
Mathematical models have proven invaluable in enhancing our understanding and predicting the dynamics of epidemics, which is essential for governments to design containment policies, allocate resources, and prepare effectively for future outbreaks. Mechanistic models of epidemics, such as the Susceptible-Exposed-Infected-Recovered (SEIR) model, offer clear interpretations and facilitate counterfactual scenario analysis. However, the reliability of their predictions may be hampered by incomplete or unreliable data. In contrast, statistical models offer high predictive power but lack interpretability. This study aims to merge these two methodologies by integrating empirical time series data on mobility and social activity into mechanistic epidemic models.

We focus on China as a case study, particularly the period following the lifting of lockdown policies on December 7, 2022, which led to a virtually unmitigated spread of SARS-CoV-2. This situation provide a valuable opportunity to analyze COVID-19 dynamics under conditions similar to those experienced by other countries at the onset of the pandemic. With a comprehensive understanding of the virus's characteristics now available, we aim to calibrate a mechanistic mathematical model for more reliable predictions of pandemic's spread. To overcome data unreliability caused by insufficient testing and potential underreporting, we employ statistical methods in the model calibration process to infer the number of infections using proxy data. This data includes the number of deaths, frequency of searches for keywords related to COVID-19 symptoms, and information from social platforms. Subsequently, we will test whether integrating empirical data on mobility can further enhance the accuracy of COVID-19 predictions, thereby facilitating improved decision-making and pandemic preparedness.

Biographical sketch:
Wang Haoyu is a third-year direct doctoral candidate from the Faculty of Geographical Science at Beijing Normal University, China. She earned her Bachelor’s degree in Mathematics and Applied Mathematics from the School of Mathematical Sciences, Beijing Normal University, China, in 2020. Owing to her academic background, her research focuses in the application of mathematical models and algorithms in geography. Her primary areas of interest include land use optimization and spatiotemporal analysis.



Yuanhui Wang

Mentors: **Nikita Strelkovskii, Rotem Zelingher**

Research Project: **NATIONAL STRATEGY ANALYSIS TOWARDS MUTUAL ACHIEVEMENT OF SDGS: A METHOD COUPLING DYNAMICAL MODEL AND NETWORK HIERARCHY ANALYSIS BASED ON SDG INTERACTIONS**

Abstract:
The 2030 Agenda adopted by the United Nations includes 17 sustainable development goals (SDGs) and 169 specific targets, which calls for global efforts towards various sustainable challenges. Among the efforts, national implementations play critical roles, and national sustainable development strategies thus receive increasing attention in preceding studies. Although studies have explored national sustainable development strategies by various methods, mutual achievement of SDGs remains challenging due to the insufficient consideration of influences of SDG interactions. National sustainable development strategies designed without considering SDG interactions have been proven to make unsatisfactory gains due to trade-offs among targets. Some pioneer studies have recognized two types of critical SDGs that deserve more effort due to SDG interactions from two perspectives, namely influences of individual SDGs on the SDGs system and the influences of the SDGs system on individual SDGs. However, sustainable development strategies considering only individual or systemic influences may suffer from efficiency problems or systemic risks. Taking China as an example, this study aims to develop a method to provide target-specific strategies toward mutual achievement by combining individual and systemic influences due to interactions among SDG targets. The core idea of the method is to couple a dynamical model and an improved network hierarchy analysis method for individual and systemic influences, respectively.

Biographical sketch:
Yuanhui Wang graduated from Beijing Normal University, China, in 2019 with a degree in Geographical Information Science. She was once a master's student at Beijing Normal University (in 2019) and then turned into a doctoral student in the same school in 2021. Now she is a 2nd-year doctoral student in Human Geography at the Center for Geodata and Analysis, Faculty of Geographical Science of Beijing Normal University. Yuanhui Wang worked with system dynamics modeling, regional development evaluation, social network analysis, and land change modeling. Her current main scientific interest lies in modeling internal interactions within SDGs system and the high-quality development system of China.

Huiying Ye

Mentors: **Nikolay Khabarov, Michael Kuhn (EF), Michael Freiberger (EF)**

Research Project: **LINKING R&D INVESTMENT TO EMISSION REDUCTION COOPERATION: OVERCOMING FREE-RIDING WHILE ACHIEVING DEEP DE-CARBONIZATION**

Abstract:
Effective action on climate change necessitates international cooperation among sovereign nations, given the global nature of the externality and the need to internalize its negative impacts. However, it has proven difficult to forge international agreements without supra-national authority: nations have strong incentives to free-ride, desiring the benefits of reduced carbon emissions while avoiding the responsibility of taking action themselves. Therefore, putting forward an incentive mechanism to promote climate cooperation is an urgent need. However, such mechanism is much less investigated in comparison to other issues relevant to climate change and reducing emissions. This project proposes and analyzes an incentive mechanism that establishes a link between R&D investment and emissions reduction cooperation. The key part of the mechanism is that participants who agree to cooperate on mitigation efforts must collectively fund R&D for mitigation technology. A larger R&D fund pool is associated with lower carbon intensity and lower abatement costs.
Unlike previously proposed alternatives, such as trade sanctions or side payments, this mechanism has the potential to not only promote cooperation, but also help achieve deep de-carbonization. In this project, we will conduct both theoretical and empirical analysis of the mechanism, taking a self-enforcing perspective into account. For that purpose, we will employ: (1) multi-stage game theory and "internal & external stable" concept to analyze how the mechanism operates and under which conditions it is effective; and (2) a multi-regional IAM that includes the proposed incentive mechanism and is capable of investigating its effectiveness.

Biographical sketch:
Huiying Ye graduated from Beijing Normal University, China, in 2017 with a double degree in Law and Economics. In 2020, she completed her MS degree at China university of Petroleum. From 2018 to 2019, she was a visiting scholar at Institut Français du Pétrole (IFP), France. Currently, she is a PhD candidate at the Center for Energy & Environmental Policy Research, Beijing Institute of Technology (CEEP-BIT), majoring in Energy and Climate Economics. Her thesis is titled "*Economic Structure, Mitigation Strategies and Cooperation Incentives in Global Climate Governance*. Huiying's primary scientific interests include Integrated Assessment modeling in Climate Change Economics and incentive mechanisms for climate cooperation.

Ifedotun Aina

Mentors: **Sylvia Tramberend, Taher Kahil**

Research Project: **MODELLING ECONOMIC PRODUCTIVITY AND ENVIRONMENTAL FLOWS UNDER DROUGHT: A HYDRO-ECONOMIC METHODOLOGY FOR THE FOOD-ENERGY-WATER NEXUS**

Abstract:
The sustainable management of water resources faces the difficult task of coordinating multiple, often competing uses of water in a way that balances environmental and socioeconomic demands. The complexity drastically increases in many urban regions where climate change alters water availability, and water resource allocation must account for the interdependencies between food production, energy generation, and water networks. This study will employ an optimization framework that uses historical water availability and economic benefit patterns across the food-energy-water (FEW) nexus in the Western Cape Water Supply System (WCWSS). The large water system supports a population of 6.2 million in the Western Cape Province of South Africa. The objective is to develop an integrated hydroeconomic model for assessing the value of water resources and the potential effects of different institutional water-sharing scenarios for a range of FEW nexus applications under varying water availability conditions. The modelling framework explicitly represents the connections and feedback between hydrologic systems (e.g., river and stream networks) and economic systems (e.g., agriculture, energy production, and urban consumption). This study will provide an approach that optimizes and replicates base water use conditions in order to build system capacity and adapt to future water stresses in water-scarce areas.

Biographical sketch:
Ifedotun Aina is a PhD candidate at the School of Economics at the University of Cape Town, South Africa. He focuses on water resource management by leveraging insights from economic and environmental modelling methods. In his doctoral research, Ifedotun is examining specific themes in the water sector, including households' preferences for water conservation technologies, the impact of tariffs on the choice of water supply sources, and policy measures to optimize water allocation decisions in large water systems. Ifedotun holds a Bachelor of Agriculture and Master of Science in Agricultural Economics from the University of Ilorin, Nigeria. He is also a Senior Researcher under the Water and Production Economics (WPE) program at the University of Cape Town.

María Dolores Castro Cadenas

Mentors: **Petr Havlík, Andrey Lessa Derci Augustynczik**

Research Project: **DOWNSCALING GLOBAL SOCIO-POLITICAL SCENARIOS FOR THE WESTERN MEDITERRANEAN SEA TO TEST NATURE-BASED SOLUTIONS WITHIN AN ECOSYSTEM-BASED APPROACH**

Abstract:
As overfishing and climate change compromises the delivery of ocean benefits such as food security, there is an urgent need for sustainable and adaptive fisheries management worldwide. Yet, many fish stocks are overfished and there is little evidence about the implementation of adaptation solutions to climate change in the ocean. Integrating nature-based solutions (NbS), which emphasise ecosystem-based approaches and biodiversity benefits, into fisheries management can likely increase their sustainability and decrease social-ecological vulnerability to climate change while ensuring ecosystem and human health. For marine ecological models to be useful for management processes, it is essential to account for plausible future scenarios of climate and socio-economic drivers of change. This project aims to explore the consequences of NbS implementation on the marine ecosystem in the Western Mediterranean Sea under future scenarios of climate change. To do so, global narratives of socio-political scenarios developed during previous EU projects will be downscaled and tailored to the Western Mediterranean Sea. Descriptors of the scenarios will be incorporated mechanistically into an available marine ecosystem model developed with Ecopath with Ecosim and Ecospace (EwE). Then, the impact of fisheries management measures such as marine protected areas on the marine ecosystem under the above-mentioned scenarios will be explored using EwE. Developing policy-relevant scenarios is key to assessing the long-term effects of plausible and contrasting management actions, and so to inform policy-making.

Biographical sketch:
María Dolores studied Biology at the University of Sevilla and holds an Erasmus Mundus Master in Marine Biological Resources (IMBRSea). She is currently doing her PhD at the Institute of Marine Sciences (ICM-CSIC) and the University of Barcelona. Her PhD is about evaluating nature-based solutions for fisheries sustainability and climate change adaptation. Her main fields of scientific interest include sustainable fisheries management, climate change adaptation and mitigation, and the science-policy interaction. Prior to her PhD, she did a traineeship at the European Parliament and at the Biodiversity Foundation of the Spanish Ministry for Ecological Transition and Demographic Challenge.

Nihar Chhatiawala

Mentors: **Taher Kahil, Matthias Wildemeersch (ASA)**

Research Project: **WATER GOVERNANCE IN THE GANGES-BRAHMAPUTRA BASIN AMID UNCERTAINTY**

Abstract:
Utilized by 630 million people in China, India, Bhutan, Nepal, and Bangladesh, the Ganges-Brahmaputra basin (GB) is unique among major basins for its lack of multilateral governance. Across all encompassed nations, the long-term utility of the GB for water supply, agriculture, and economic development necessitates governance practices in response to conditions of uncertainty which lack consensus as to their probabilities and magnitudes. Such conditions include climate change, water quality, demand patterns, environmental flows, and the compounding constraints faced by downstream nations. IIASA's ECHO model is uniquely equipped to inform long-term strategies in transboundary basins such as the GB subject to such evolving constraints. This research builds upon ongoing efforts at IIASA to develop an ECHO model of the GB. The first goal of this research is to develop a module for efficient model iteration within the ECHO framework against conditions of uncertainty, usable for testing the robustness of policies. The second goal of this research is to test the module in limited case studies examining water management and hydropower planning robustness against future socioeconomic conditions, water consumption, and climate change outcomes across the GB; basic mechanics of transboundary governance and conflict; and uncertainties affecting environmental flow constraints. The outcome will be a sensitivity analysis of various policy portfolios against an illustrative subset of futures.

Biographical sketch:
Nihar Chhatiawala is a 3rd year PhD Candidate (policy analysis) at the Pardee RAND Graduate School. His thesis *Managing Environmental Impacts of Climate Action Under Uncertainty* applies an assortment of model-driven case studies to explore how policymakers might avoid counterproductive environmental impacts as climate action necessitates new patterns of land use and resource consumption. At RAND, he works on a variety of climate change-related research for government agencies and NGOs. Prior to his current studies, he earned an MS in physics (2019) and BSE in engineering physics (2017) from Case Western Reserve University, after which he worked in the software industry.

Biodiversity and Natural Resources Program (BNR)
Program Director: Petr Havlík

Defeng Wu

Mentors: **Mikhail Smilovic, Ting Tang**

Research Project: **ANALYSIS OF THE CROP-GROUNDWATER INTERACTIONS IN NORTHERN CHINA**

Abstract:
Agriculture is a complex coupling system involving climate impact, soil condition, water and fertilizer inputs, management practices and environmental effects. As the most populous country in the world, China's agriculture is particularly facing multiple problems such as food security and contradiction between water supply and demand, and groundwater depletion. Studies have shown a 10 – 100 years shortage of groundwater resources in northern China. As of 2015, about 569 million people lived in areas with decreasing water resources. The continuous development of Chinese society and population growth will bring considerable challenges to China's water resources management. Therefore, this study investigates the water-food coupling system in northern China based on the global hydrological model -- Community Water Model (CWatM). This complex coupling system will be described in depth at the regional scale, and relevant adjustment suggestions and strategies for irrigation will be put forward. The main objectives of this project include: 1) collecting local data of crop management measures (including crop calendar, irrigation, cultivars, and fertilization), water resources, crop yields, soil data, and climate information in northern China; 2) setting up a high-resolution version of the CWatM model (a resolution of 5 arc-minute) fed with locally collected data and verify the model performance; 3) improving the representation of crop growth module of CWatM; 4) demonstrating the water-food relation and the effects of irrigation on crop yield and groundwater sustainability.

Biographical sketch:
Defeng Wu graduated from North China University of Water Resources and Electric Power, China, in 2018 with a degree in Hydrology and Water Resources Engineering. He completed his MS degree in Water Conservancy Engineering at the North China University of Water Resources and Electric Power (2021). He is currently a PhD candidate at China Agricultural University in Water Conservancy Engineering and the title of his thesis is “Impacts of irrigation on crop-water-environment interactions in northern China”. His main fields of scientific interest include assessment of water resources and water quality, water-crop simulation with Python.

Adrian Dwiputra

Mentors: **Ping Yowargana, Andrey Krasovskiy**

Research Project: **IMPROVING TROPICAL FOREST FIRE MODELING USING GRAPH THEORY**

Abstract:
Southeast Asian forests provide nature-based climate solutions by sequestering atmospheric carbon dioxide. However, these forest carbon sinks will abruptly release the carbon accumulated over a long time into the atmosphere in the event of wildfires. Therefore, it is crucial to enhance our understanding of tropical forest fires using rapidly advancing modelling tools and remote sensing technologies. I propose an implementation of Graph theory in constructing spatial networks of satellite-acquired fire occurrence data to improve fire modeling. Networks of fire points can be used to identify influential points, e.g. points with high centrality or points closest to the probable ignition locations. Based on the wildfire occurrences in Indonesia in the past El Nino years 2014-2015, I will develop spatial directed graphs and divide unrelated wildfire events based on the points' spatiotemporal properties. The earliest occurring point(s) from each spatial graph are collectively input to Maximum Entropy (MaxEnt) model together with spatial predictors that include anthropogenic and biophysical variables. MaxEnt will produce a map that pinpoints areas with the most similar characteristics to the initial ignition sources across the study region and response curves that summarize the characteristics of the identified ignition sources. The map will allow for comparison with other fire models that comprise a map derived from the MaxEnt model with a different set of inputs and outputs from FLAM, a process-based fire model well suited for the region. An overlay of the results with a map of nature-based climate solutions potential can unveil high-carbon forests with high wildfire risk.

Biographical sketch:
Adrian is a student from the Centre for Nature-based Climate Solutions (CNCS) at the National University of Singapore, working on a thesis titled "Remote ecological monitoring of high-carbon or biodiversity conservation landscapes in Southeast Asia". Before joining CNCS, he obtained his Master's degree in Geography from the University of British Columbia. Most of his working experience was acquired from his work with the World Agroforestry as a Natural Resources Management Tools Developer. His research interests revolve around landscape ecology, which involves remote sensing and various applications of spatial analysis in ecology, especially in the context of sustainable natural resources management.

Nadine-Cyra Freistetter

Mentors: **Andrey Lessa Derci Augustynczik, Mykola Gusti, Andrey Krasovskiy**

Research Project: **FUTURE INSECT OUTBREAK RISKS AND IMPLICATIONS FOR EUROPEAN FORESTS UNDER ALTERNATIVE MANAGEMENT PRACTICES AND CLIMATE CHANGE**

Abstract:
Foresight modelling of forest pest insect outbreaks and associated damages is a pressing issue for the forestry and conservation sectors, as well as for the strategic planning of climate change adaptation and mitigation measures. The multilayered interactions between drivers of insect outbreaks – forest management practices, climate change impacts on forest ecosystems, and the presence of natural enemies or promoters – remain not fully understood.

In this study, we aim to tackle this issue, gathering the latest data and current modelling practices of insect outbreaks across Europe and model future damages, as well as the implications to mitigation goals and profitability. First, we carry out a review of literature, statistical models and process-based models that represent insect outbreaks' risks and damages, including 3PGmix (IIASA), G4M (IIASA), PICUS (BOKU) and iLand (TUM). We obtain additional historical data from the European Forest Institute's database for forest disturbances in Europe (DFDE). Subsequently, we use the findings to extend the biophysical models with a refined representation of insect outbreak risks and damages, which possibly can be used to assess the economic impact of the disturbances with GLOBIOM (IIASA).

The findings of our study shall deepen the knowledge of the forest management-climate change-insect outbreaks nexus. This will help find answers highly sought after by decisionmakers in the forestry sector and climate change policies, about how to improve the European forest resilience against pest insect disturbances and how to limit outbreak associated damages.

Biographical sketch:
Nadine-Cyra Freistetter is a socio-environmental researcher specializing in policy-relevant climate and ecosystems health topics. With a background in physics (2017, TU Vienna) and environmental sciences and management (2019, Technikum Vienna), she currently is a third-year doctoral researcher at the Finnish Meteorological Institute modelling long-term climate change mitigation scenarios on a global level. Her previous studies include climate change impacts on traffic and pedestrians, greenhouse gas emissions from boreal forests and invasive insect species management in U.S. forests. Apart from that, she is heading the Young Scientists network at the Finnish Meteorological Institute.

Esther Greenwood

Mentors: **Ting Tang, Linda See (ASA)**

Research Project: **MAPPING SAFE DRINKING WATER USE WITH GEO-CLUSTERED HOUSEHOLD SURVEY AND EARTH OBSERVATION DATA: A CASE STUDY OF LAO PDR**

Abstract:
To date less than half of the Sustainable Development Goal (SDG) indicators of the United Nations 2030 Agenda have global data coverage. This includes SDG indicator 6.1.1 on "universal and equitable access to safe and affordable drinking water for all". Existing national estimates on safe drinking water reflect geographic inequities, with insufficient or unavailable data at sub-national levels and are only updated every 4-5 years. Lao People's Democratic Republic (PDR) is an example of a lower middle-income country which is highly affected by drinking water contamination and water insufficiency. In this case study we aim to use Earth Observation (EO) and citizen science data to update estimates of safe drinking water use from Lao PDR in 2017 using geo-clustered multiple indicator survey data. We will apply a machine learning approach and map the use of safe drinking water currently (2023) and in 2030 based on population growth, land use change and climate change scenarios. Our maps will highlight regions in Lao PDR that are at risk of not achieving SDG 6.1.1 by 2030 to inform future data collection strategies and water safety planning. Additionally, a generalized geospatial mapping pipeline for monitoring SDG 6.1.1 using EO data will be developed and applied to data sets from Malawi and Fiji.

Biographical sketch:
Esther Greenwood graduated in 2017 from Lund University with a Master of Science in Water Resources Engineering. She is currently a third year PhD student at ETH Zürich and the Swiss Federal Institute of Aquatic Science and Technology (Eawag). Her thesis is focussed on mapping the use of safe drinking water in low- and middle-income countries with a geo-spatial machine learning approach combining household survey and Earth Observation data. She is also interested in how the use of safe drinking water and sanitation facilities modifies climate effects on child health (diarrheal disease and undernutrition) in low- and middle-income countries.

Sarah Hanus

Mentor: **Peter Burek**

Research Project: **COMPARISON OF WATER SUPPLY AND DEMAND IN MOUNTAIN AREAS AND LOWLANDS**

Abstract:
Mountain areas are often referred to as “water towers” because of their important contribution to water resources. This contribution is significantly impacted by climate change due to decreased snowfall fraction affecting the seasonality and melting of glaciers affecting the quantity of water resources, among others. Moreover, total water consumption is subject to socio-economic changes and likely increases in future. Previous studies have shown that the percentage of lowland population depending on mountain water resources will increase in future (Viviroli et al., 2020). However, this analysis was based on decadal means until mid-21 century. In that context, this proposal aims to assess changes in water supply and demand in mountain areas and lowland areas of several large-scale river basins with a focus on annual to monthly scale. Recent publications have concluded that glaciers are an important water resource of mountain regions (Huss and Hock, 2018, Immerzeel et al., 2020). Therefore, an additional focus of this study is on the role of glaciers for water supply in the mountain areas and their contribution to future changes in water supply.

For this study, simulations of the large-scale hydrological model CWatM and potentially of other large-scale hydrological models participating in ISIMIP will be used to assess water availability and potential water scarcity in mountain areas and lowlands. For future simulations, differences between socioeconomic pathways will be assessed. The ultimate goal of this study is to unravel the relevance of mountains for water resources under climate and global change.

Biographical sketch:
Sarah Hanus is currently a 3rd year PhD student at University of Zurich, Switzerland. In her thesis, she studies the relevance of mountain water resources for water availability in large river basins worldwide under global and climate change.

Rebekah Hinton

Mentors: **Dor Fridman, Mikhail Smilovic, Barbara Willaarts**

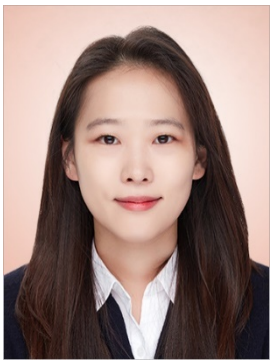
Research Project: **MODELLING NATIONAL LEVEL THREATS TO GROUNDWATER FOR WASH FROM WATER ABSTRACTION IN MALAWI**

Abstract:
At least 76% of Malawi's rapidly growing population relies on groundwater to meet their daily domestic water needs. For Malawi to meet Sustainable Development Goal 6 (SDG6) sub-target 1, "To achieve universal and equitable access to safe and affordable water for all", groundwater must therefore be protected. Furthermore, heavy reliance on groundwater means that local dynamics of groundwater scarcity can significantly influence water accessibility for communities.

This project aims to generate a high-resolution prediction of Malawi's groundwater needs for domestic water usage under multiple socioeconomic and policy scenarios. The project will involve developing a high-resolution model of anticipated domestic demands on groundwater under multiple shared socioeconomic pathway (SSP) population projections. Multiple policy scenarios, developed alongside key stakeholders through semi-structured interviews, will also be evaluated.

Projected domestic water requirements will be combined with forecast groundwater availability, produced to a high resolution for Malawi through the Community Water Model (CWatM). Multiple climate change scenarios will be used to investigate multiple scenarios of groundwater availability. A large dataset of where communities experience groundwater scarcity (with data from over 100,000 water points) will be used to validate the model. Through combining scenarios of both groundwater availability and projected usage, the project will identify areas where groundwater availability may threaten domestic water availability and what policy interventions might be necessary to ensure that groundwater is protected in Malawi.

Biographical sketch:
Rebekah is a third year PhD Student at the University of Strathclyde and James Hutton Institute whose research focuses on modelling challenges to groundwater quality and availability in Malawi as well as how local communities can protect groundwater. She also has an interest in how serious games can be used to communicate challenges in land and water management. She graduated (2020) with a degree in Natural Sciences from the University of Cambridge. Her main fields of scientific interest include groundwater management and policy, groundwater modelling, and sustainable development. In her free time, she enjoys hiking, camping, and art projects.



Whijin Kim

Mentors: **Christian Folberth, Dmitry Shchepashchenko, Rastislav Skalsky, Florian Kraxner**

Research Project: **ASSESSMENT OF THE LAST FOUR DECADES' LAND COVER PRODUCTIVITY IN THE KOREAN PENINSULA**

Abstract:
The mid-latitude region is habitat not only for more than half of mankind but also for wildlife with high diversity. South and North Korea, located in the Korean peninsula, share the environmental and ecological conditions of mid-latitude region, but land cover change has been highly different due to socio-economic discrepancies. For sustainable land use management, it is essential to identify the individual land productivities to inform land use strategies. This study aims to assess trajectories of land productivity and land cover change from the 1980s to 2010s in the Korean peninsula. The two most frequent land cover changes in the Korean peninsula were agricultural land to forest and forest to agricultural land. Therefore, this project specifically concentrates on estimating cropland and forest productivity in terms of crop yield and wood harvest. In the case of South Korea, the major crop is rice, which covers more than half of cultivated areas. The agricultural land in North Korea is covered by two main crops, rice, and maize, accounting for about 66% of the total cultivated land. Crop productivity will be estimated using the EPIC-IIASA modelling framework. The wood harvest and productivity of forests will be estimated with G4M. The Korean peninsula consists of more than 65% forest area because of vertically spread mountainous ranges, but large parts were deforested after the Korean War. The governments in both South Korea and North Korea initiated afforestation policies over the past decades, but outcomes diverged due high risks of energy and food insecurity in North Korea. Outcomes from the two models will be combined with land use data and feed into an assessment framework combining productivity and land use scenarios to identify drivers of past land use change and optimal strategies for forest conservation to support the design of sustainable land management strategies.

Biographical sketch:
Whijin is a PhD candidate at Korea University, Environmental Science and Ecological Engineering. She got her master's degree majoring in International Development and Cooperation from Korea University and her bachelor's degree in international studies from Kyunghee University. Recently, her major research interest is related to climate change, Land use and Land Cover Change (LULCC), land use management, biomass estimation, and spatial analysis using Geographic Information System (GIS) and Remote Sensing (RS). She is involved in mainly two projects: GHGs estimation in settlements and supporting Climate Smart Agriculture.

Laura Montoya

Mentors: **Andrey Krasovskiy, Florian Kraxner, Shelby Corning**

Research Project: **DATA-DRIVEN MODELING EXTREME FIRES IN ECOSYSTEMS ACROSS MEXICO UNDER EL NINO IMPACTS USING FLAM**

Abstract:
In recent years, the ecological and socio-economic impacts of wildfires in Mexico have been increasing, primarily due to extreme El Niño effects. This project aims at a better understanding of the complex interactions between forest management, climate change, and fire regimes in Mexico, offering insights for designing effective forest fire management policies and adaptation strategies. We will utilize the IIASA Wildfire Climate Impacts and Adaptation Model (FLAM) to accurately represent forest fires in different ecosystems across Mexico. Through the creation of a comprehensive dataset, incorporating forest structure, vegetation composition, climate patterns, and fire regimes, we will calibrate and validate the FLAM model, identifying key drivers of forest fire occurrence and severity specific to different ecosystems. By enhancing the applicability and usefulness of the FLAM model, this project has the potential to address the critical issue of wildfires in Mexico and provide valuable knowledge for managing forest fires under climate change globally.

Biographical sketch:
Laura Montoya is a biologist who graduated from the National Autonomous University of Mexico (UNAM). She earned her MSc in Botanics from Postgraduate College in 2019. She is currently PhD candidate at the Ecology Institute in the UNAM and her doctoral thesis research is focused on the fire effects on forest ecosystem resilience in Mexico.
She has previously worked in landscape fragmentation and environmental impact assessments in Mexico. With the Biodiversity and Natural Resources (BNR) Program, she will be working on application of the IIASA´s FLAM model to wildland fires in Mexico. Outputs will be used to analyze the effects of fire on forest ecosystems.

Alexander Mozdzen

Mentor: **Tamas Krisztin**

Research Project: **STUDYING THE IMPACT OF AGRICULTURAL SUBSIDIES ACROSS EUROPE USING A BAYESIAN SPATIO-TEMPORAL CLUSTERING MODEL**

Abstract:
The global climate crisis has conceived the need for impactful policies reducing greenhouse gas emissions across all sources, including emission stemming from agricultural expansion. In order to study the effectiveness of mitigation policies, statistical methods need to consider complex biophysical and socio-economic processes. We propose a Bayesian spatio-temporal model for exploring the impact of agricultural subsidies on land usage while simultaneously controlling for other relevant drivers. By combining recent developments in the literature on land use models with a Bayesian nonparametric prior we enable the clustering of areas which exhibit similar effects of the policy in question. Furthermore, we control for individual impacts of essential spatial processes and explicitly model spillovers between regions. Additionally, we develop a suitable Markov chain Monte Carlo (MCMC) algorithm and test the model in an extensive simulation study. Using European regional data, we investigate the effectiveness of mitigation policies concerning agricultural expansion across Europe and reveal the diversity of the problem.
The contribution of our work is threefold: (a) present a novel Bayesian model which combines the merits of the spatial multinomial logit model with a Bayesian nonparametric prior, enabling model-based clustering; (b) develop a tailored MCMC algorithm for efficient sampling; (c) analyze the impact of biophysical and socio-economic variables as well as agricultural subsidies on land usage.

Biographical sketch:
Alexander Mozdzen graduated with a B.Sc. in Civil Engineering from the Technical University of Munich and continued as a master's student in Quantitative Finance at the Vienna University of Economics and Business, where he finished his degree with a distinguished thesis in Bayesian Statistics. After a year in financial consulting he decided to try his luck again in the academic world and started his PhD with Prof. Gregor Kastner at the University of Klagenfurt, where he has been updating his prior beliefs ever since. Not surprisingly his main scientific interests include topics from the immersive field of Bayesian Statistics, encompassing Bayesian Econometrics, Nonparametrics and Computing. His previous work dealt with model-based clustering of spatio-temporal data and the implementation of an efficient Markov Chain Monte Carlo algorithm for posterior sampling.

Maximilian Schulte

Mentors: **Fulvio di Fulvio, Pekka Lauri, Andrey Lessa Derci Augustynczik, Petr Havlík**

Research Project: **DEMAND-DRIVEN CLIMATE CHANGE MITIGATION OF WOOD PRODUCT SUBSTITUTION IN SWEDEN**

Abstract:
Wood product use instead of fossil or mineral-based alternatives tends to produce lower fossil greenhouse gas emissions, and thus can mitigate climate change, the so-called substitution effect. Sweden is amongst the forerunners in the European Union when it comes to wood production and wood use. However, most assessments of climate change mitigation potentials for Swedish wood production commonly ignore market leakage effects, and thus tend to overestimate substitution effects. This is as increased supply of wood-based products and energy in Sweden does not necessarily result in an equal increase in Global consumption. Instead, the increased provision of wood-based products and energy, as reported in previous studies, risks to merely add to overall supply and to result in net additions of GHG emissions. In order to address this inconsistency, the research project seeks to apply a demand-perspective in the substitution effect assessment of wood use in Sweden. This is done by integrating official national projections of Swedish wood harvest potentials with demand scenarios based on the GLOBIOM-forest model. Therewith, substitution effects will be limited by a demand cap, which, depending on data availability, will be considered either at the level of semi-finished, or final wood products level. In addition, the effect of changes in marginal energy mixes in Sweden on the potential substitution will be tested.

Biographical sketch:
Maximilian Schulte is currently a third year PhD student at the Swedish University of Agricultural Sciences (SLU). His research deals with time-dynamic climate effect assessments of the forest sector including the impact from biogenic carbon in forests and wood products, as well as fossil greenhouse gases from the forest supply chain, and substituted products. He graduated in 2019 from University of Hohenheim, Germany, with a M.Sc. Bioeconomy, and holds a B.Sc. Geography from University of Bonn, Germany.

Vili Virkki

Mentors: **Reetik Kumar Sahu, Mikhail Smilovic**

Research Project: **ATTRIBUTION OF HISTORICAL RIVER STREAMFLOW DEVIATIONS TO DIRECT AND INDIRECT ANTHROPOGENIC DRIVERS**

Abstract:
Human actions have caused river streamflow to deviate from stable pre-industrial conditions, which affects not only ecosystems but also other Earth system functions of freshwater, such as carbon sequestration, nutrient transportation, and moisture recycling. Mitigating these deviations requires understanding their human drivers – for instance, water use, climate change, and land cover change – and assessing their contributions to net change in streamflow. Global studies often do this by comparing outputs from hydrological model runs with and without human impact parameterisation. This approach artificially isolates the interdependent human drivers from one another and derives hydrological change strictly following processes that are implemented in the mechanistic model. Hence, I propose experimenting with a new attribution approach to learn how human drivers precede discharge deviations. I test a suite of statistical and machine learning models, modelling change in streamflow directly as a function of change in human drivers – instead of modelling streamflow as a function of factors affecting its generation (thus considering change in human drivers implicitly). The models are trained with observed data at the basin scale and in a hydrological state that is absent of major human impacts. The models concentrate on persistent (decadal or longer-scale) changes in hydrological signatures, and performance is evaluated in near-present time. I further set up a calibrated regional hydrological model CWatM to repeat the attribution analysis and compare how it performs against models that are not restricted by the mechanics of a traditional hydrological model. If the models prove skilful against observations, the proposed shortcutting of driver attribution could be useful in increasing the actionability of initiatives such as environmental flows and planetary boundaries by shedding light on the relative contributions of human drivers to streamflow deviations.

Biographical sketch:
Vili is a Doctoral Candidate in the Water and Development Research Group in Aalto University, Finland. He holds an MSc. (Tech.) in Geoinformatics (2019) and a BSc. (Tech.) in Energy and Environmental Technology (2016). His research mainly focuses on global freshwater change during the last two centuries and on identifying and quantifying interactions between biophysical processes that maintain Earth system resilience. Research on these themes is used to develop and apply the Planetary Boundaries framework, which aims for delimiting a safe operating space for humanity.

Francis Akugre

Mentors: **Shonali Pachauri, Setu Pelz**

Research Project: **ASSESSMENT OF THE ECOLOGICAL FOOTPRINT OF GHANA'S CHARCOAL VALUE CHAIN**

Abstract:
Rapid urbanization coupled with the increasing cost of alternative energy for cooking and heating continues to stimulate an increase in the demand and supply of charcoal in Ghana. About 1.1 million tonnes of charcoal is produced annually in Ghana and this is projected to increase over the next years. The charcoal industry in Ghana does not only serve as a primary source of energy for cooking and heating but also as a major source of employment and income for people within the supply chain.

Notwithstanding this, the industry is perceived as one of the major sources of greenhouse gases (GHGs) and air pollutants in Ghana. In particular, there are growing concerns from the government, non-governmental organizations, and many individuals regarding the devastating effects of the charcoal industry for climate change and human health. This calls for empirical research to provide an understanding of the environmental footprint of the charcoal value chain.

Few empirical studies that investigate the environmental footprint of the charcoal value chain exist for Ghana and these have mainly focused on the production stage. At IIASA, I will use a time series dataset on charcoal production and consumption including socioeconomic and household energy consumption data for Ghana over the period 2016 to 2022, to analyze annual charcoal production and consumption in Ghana and examine key factors influencing charcoal production and use. I will also quantify GHGs (both Kyoto gases and short-lived climate pollutants) associated with the charcoal value chain annually over the period 2016 to 2022. Based on the analysis of factors influencing the production and use of charcoal, I will then explore scenarios of future emissions from the charcoal value chain for the period 2022 to 2052.

Biographical sketch:
Francis Awaafo Akugre graduated in the year 2017 from the University of Ghana, Legon, Accra, with a Master of Philosophy (MPhil) degree in Climate Change and Sustainable Development. He is currently a fourth-year PhD candidate in Environmental Science at the Institute for Environment and Sanitation Studies (IESS), University of Ghana. His PhD thesis investigates the environmental sustainability of Ghana's charcoal value chain. Francis's main field of scientific interest is in the areas of green economy, circular economy, and climate change mitigation and adaptation with a focus on energy, food security, health, and governance issues affecting Lower-Middle-Income countries, including marginalized and vulnerable groups in society.

Marzieh Bagheri

Mentor: **Adriana Gomez Sanabria**

Research Project: **TECHNO-ECONOMIC-ENVIRONMENTAL INVESTIGATION OF ENERGY AND NUTRIENT RECOVERY FROM SEWAGE SLUDGE**

Abstract:
Access to clean energy and water, as well as food security are crucial for achieving the UNs Sustainable Development Goals. Pertinent in achieving these goals is the management of phosphorus. High phosphorus and centralized access through wastewater treatment plants make sewage sludge a promising alternative to limited and unevenly distributed phosphate rock as fertilizer feedstock. However, while sewage sludge contains useful resources, it is legally classified as a waste and often perceived as a burden to the holder. This dichotomy culminates in techno-economic, environmental, and societal challenges for sustainable sewage sludge management.

To simultaneously address pollution prevention and resource recovery targets of sustainability, the proposed work aims to develop a techno-economic-environmental analysis of the energy and nutrient recovery, mainly phosphorus, from sewage sludge for selected countries (Sweden and Germany). This analysis will identify available technical opportunities, trade-offs, and cost-benefit distribution among the actors across the value chain, which is essential to develop well-designed energy and phosphorus recovery policy. In this project, the performance and feasibility of different treatment systems will be studied using the GAINS model. A part of this project includes expanding the GAINS model to cover phosphorus recovery technologies such as crystallization and precipitation under different scenarios.

Biographical sketch:
Marzieh graduated from Sharif University of Technology (Iran) in MSc Energy Systems Engineering in 2016. She received her Bachelor's degree in 2013 from Azad University, Science and Research Branch (Iran) in Chemical Engineering. Currently, Marzieh is a 4th year PhD student at Energy Science Department of Luleå University of Technology in Sweden. Her research focuses in techno-economic analysis of resource recovery from sewage sludge. Her main fields of scientific interest include modeling and analysis of energy-environment-economy interaction, system analysis, and nutrient recycling.

Roee Ben Nissan

Mentors: **Keywan Riahi, Jan Steinhauser, Florian Maczek**

Research Project: **INTEGRATED ASSESSMENT MODEL OF ELECTRO-MICROBIAL CO_2 VALORIZATION AS A PLATFORM FOR BIO-PRODUCTION OF BULK COMMODITIES**

Abstract:
Climate change, pollution and biodiversity decline are major crises connected to indispensable industries that produce our food, energy or other commodities. Finding sustainable and economically viable large-scale alternatives is one of the biggest challenges humanity is facing in the near future. For example, plant-derived fermentation biofuels were considered promising but competition with food crops and the limited global production capacity proved otherwise. Here, I propose using renewable energy for cultivation of microbial biomass as a modular platform for the production of essential commodities, mitigating the negative environmental footprint of the other industries while avoiding competition for limited resources such as land and water. I aim to create a holistic analysis of different economic and environmental aspects of electro-microbial production and compare it to the traditional industries. This analysis will facilitate finding economically viable production scenarios and identifying policy change strategies for promoting the implementation of such a technology.

Biographical sketch:
Roee Ben Nissan is a PhD student in the Milo lab and a Sustainability and Alternative Energy Research Initiative fellow at the Weizmann Institute of Science. He received a BSC with honors in Life Science from Ben Gurion University of the Negev and an MSc in Life Science at the Weizmann Institute of Science, under the supervision of Prof. Ron Milo. In his PhD, Roee works on carbon fixation metabolism in bacteria. During his MSc and PhD, Roee has been part of an effort of converting *E. coli*, a sugar dependent model bacterium, to consume CO_2 as its sole carbon source for constructing the cell building blocks and characterizing the genetic and metabolic changes allowing for

Yuheng Cao

Mentors: **Volker Krey, Gamze Ünlü**

Research Project: **MODELING SCENARIOS FOR CHEMICAL PRODUCTION AND CONSUMPTION UNDER CHINA'S CIRCULAR ECONOMY AND CLIMATE GOALS**

Abstract:
China has the most comprehensive large-scale chemical sector in the world. It is responsible for nearly half of the global chemical sector's energy consumption and carbon emissions. The hard-to-abate sector is facing urgent needs for insights about a low-carbon and circular transition. A scenario analysis supported by integrated modeling will be essential for guiding this transformation, for example as in aluminum production. However, few studies have investigated the future development of the chemical industry with the integrated assessment models (IAM). A pioneering study examined plastic futures and their carbon emissions. It also reflects the lack of synergies between the circular economy and climate change mitigation. This research will explore the possibility of extending IAMs to include the chemical sector and processes in China in sufficient detail. With a focus on key primary chemical processes, a portfolio of policy interventions, industry transition strategies, and other socioeconomic factors will be assembled and parameterized under the framework of the Shared Socioeconomic pathways (SSPs). To evaluate the synergies and tradeoffs between various transition pathways, industrial ecology tools (including material flow analysis and life cycle assessment) will be employed. In addition, the research will provide policymakers and practitioners with policy and technology development implications to support a low-carbon and circular transition of the chemical industry.

Biographical sketch:
Mr. Yuheng Cao is currently a PhD candidate at the Department of Chemical Engineering, at Tsinghua University. He obtained his bachelor's degree in polymer material and engineering and a second bachelor's degree in administration from Tsinghua University in 2021. His main research focuses on the macro-level transformation of the chemical industry under the perspective of synergies between circular economy and climate change mitigation. He has also been closely following the progress of the Intergovernmental Negotiating Committee (INC) towards an international legally binding instrument to end plastic pollution.

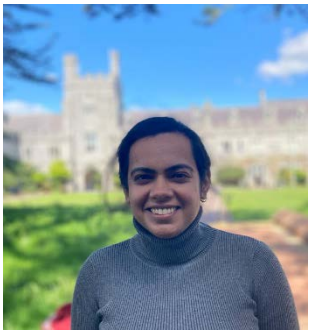
Gaurav Ganti

Mentors: **Setu Pelz, Matthew Gidden**

Research Project: **OPERATIONALISING EQUITY IN MITIGATION PATHWAYS TO INFORM THE PARIS AGREEMENT**

Abstract:
Equity is an important normative pillar of the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. However, long-term emission reduction scenarios developed using Integrated Assessment Models (IAMs) rarely represent dimensions of equity. In this research project, I aim to operationalise a three stage framework to better include notions of equity in quantitative IAM frameworks. First, I aim to **identify** quantitative dimensions of equity that are reflected in the Articles of the Paris Agreement. I would then aim to explore how IAMs currently represent these dimensions (for instance, regional distribution of emissions reflecting differentiated responsibilities) in (1) the quantitative elements of the scenario narratives (e.g., the Shared Socioeconomic Pathway, or SSP narratives), (2) how these elements are translated into model-specific inputs, and (3) model-specific constraints and objectives (e.g., a focus on cost optimisation). I then aim to **diagnose** why current IAM scenarios (using MESSAGE GLOBIOM IAM as a case study) deviate from normative thresholds from the literature that operationalises equity. This benchmarking exercise will identify direct and indirect drivers of (mis)alignment across the IAM representation stages above. Finally, I aim to develop a **set of recommendations** to better incorporate notions of equity in a new generation of quantitative mitigation pathways.

Biographical sketch:
Gaurav is a second year PhD student in the Geography Department at Humboldt University of Berlin, and a Research and Climate Policy Analyst at Climate Analytics, Berlin. He is a Mechanical Engineer by training, and holds a Master of Public Policy from the Hertie School of Governance, Berlin. His research is focused on how to integrate notions of equity in quantitative mitigation science.



Ankita Gaur

Mentors: **Aneeque Javaid, Paul Kishimoto**

Research Project: **MOBILITY AS A FORM OF ENERGY ACCESS- CASE STUDY OF SOUTH ASIAN COUNTRIES**

Abstract:
The importance of reducing energy demand in meeting climate action goals and limiting global warming is increasingly recognised. Integrated Assessment Modelling (IAM) and energy systems modelling communities are developing Low Energy Demand (LED) scenarios that decouple energy service demands (ESDs) with economic growth to demonstrate the climate mitigation potential and wider sustainable development benefits. However, these scenarios are generally aggregated and lack granularity. Further, the drivers of ESDs within most scenarios typically are not underpinned by empirical evidence. This research addresses this gap by mapping out the drivers of passenger transport ESDs and the options available to leapfrog car dependency while ensuring access to mobility increases in South Asian countries. A comprehensive literature survey is conducted to understand the relationship between passenger mobility demand and the various drivers that have been explored to date. The evolution of these drivers in the future will determine passenger mobility demand. Thereafter, future passenger transport demand scenarios are developed based on bottom-up quantification of drivers, underpinned by a rich description of scenarios and available data. South Asian countries are undergoing a big transformation in economic and infrastructure development. Since investment in infrastructure has long-term lock-in effects, choices made in the near term will determine ESDs and therefore climate mitigation options and trajectories in the coming century. The impact of the scenarios on the costs of transforming the passenger transport sector and rare earth mineral requirements will be determined using the MESSAGEix model.

Biographical sketch:
Ankita is a third year PhD student at the SFI Centre for Energy, Climate and Marine (MaREI), University College Cork, Ireland. Her doctoral research focuses on capturing technological, economic, and social realities in energy systems models. She previously worked as a research assistant at the Economic and Social Research Institute in Dublin, Ireland. She holds a master's in Renewable Energy and a bachelor's in Electrical and Electronics Engineering, both from India. Her research interests include energy systems modelling, energy service demands projection, developing global energy transition scenarios and evaluating the impact of this transition on SDGs.

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Ebbe Kyhl Gøtske

Mentors: **Behnam Zakeri, Yoga Pratama, Matthew Gidden**

Research Project: **ENHANCING THE REPRESENTATION OF VARIABLE RENEWABLE ENERGY IN INTEGRATED ASSESSMENT MODELS: SOFTLINKING OF PYPSA-EUR AND MESSAGEIX-GLOBIOM**

Abstract:
Integrated assessment models (IAMs) are essential tools for projecting the interdependencies among climate, environment, energy, economy, and human health. In global scenarios, IAMs are often limited to annual timesteps and a course spatial resolution, making them incapable of capturing the dynamics of variable renewable energy (VRE) generation explicitly. This limitation poses challenges to investigating VRE generation and the integration costs necessary for a reliable energy supply. To address this issue, IAMs rely on parameterization based on region-specific residual load duration curves (RLDC) for different VRE penetration levels, which are derived from historical load conditions. To advance previous efforts in improving VRE parametrization and in analyzing IAM results from a power system perspective, we propose utilizing detailed energy system models (ESMs) to update the VRE parameterization in IAMs. For this, we use a high-resolution ESM, PyPSA-Eur, to obtain more granular and realistic information on the temporal aspects of VRE generation and the associated integration costs. By imposing a uni-directional soft-link to feed the ESM-derived metrics into MESSAGEix-GLOBIOM, we aim to provide a more realistic depiction of VRE used in the decision-making in the transition to a global energy scenario. We use the EU as a case study, considering the EU 2040 and EU Fit-for-55 policy scenarios, but the proposed linkage is intended to be consistent regardless of the region.

Biographical sketch:
Ebbe is a 3rd year PhD student at Aarhus University. He holds a BSc and a MSc degree in Mechanical Engineering. His PhD research interests lie within the modeling of large-scale energy systems with high renewable penetration, with a special emphasis on the role of storage and the resilience of energy systems to extreme weather events.

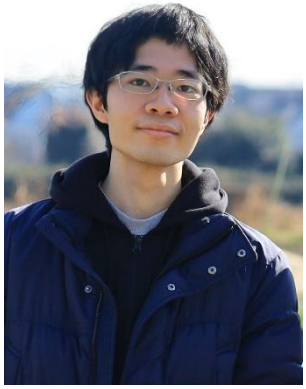
Jenna Greene

Mentors: **Matthew Gidden, Elina Brutschin**

Research Project: **ASSESSING THE DYNAMICS OF TECHNOLOGY ADOPTION IN LEAD AND FOLLOWER COUNTRIES**

Abstract:
Understanding the conditions under which fast technology adoption occurs through a systematic study of historical technology adoption can lead to improved assumptions in integrated assessment models (IAMs). Adding insight about historical technology adoption into IAMs can also then lead to a better understanding of possible future technology pathways for policy makers. Robust insights across many different technological analogues can also better characterize the existing assumptions about the speed and scale of carbon dioxide removal (CDR) technologies, where a high level of uncertainty about future developments exist. In this study, I will combine and analyze data on technology adoption over time, characteristics of these technologies (for example, granularity), and country-level governance indicators to understand technical, economic, and social dynamics of technological growth. This research will measure the differences in speed of technology adoption between the countries where technologies are first adopted compared to countries that later adopt these technologies. Using statistical regression analysis, this research will indicate which technology characteristics and which governance characteristics impact the speed of technological growth within and between countries. The goal of this study is to understand the extent, drivers, and direction of knowledge spillovers for technology adoption across countries, the technological factors that impact growth rates, and the role of regional factors (such as governance and political economy indicators) in technology growth. These results can then be incorporated into scenarios assessed by integrated models to better characterize the dynamics of potential technology growth across countries and the technology characteristics that impact adoption.

Biographical sketch:
Jenna Greene is a first-year PhD student at the Nelson Institute for Environmental Studies at the University of Wisconsin – Madison. She is interested in broadly climate change policy, particularly the adoption of energy technologies and local climate policies. At UW-Madison, her research is focused on carbon dioxide removal at the national and local level. Before her PhD studies, she worked on city-level climate action planning and received a Master of Public Administration from UW-Madison. Outside of research, Jenna enjoys downhill skiing, ceramics, and exploring parks with her dog.



Takuya Higashitani

Mentors: **Paul Kishimoto, Takuya Hara**

Research Project: **PASSENGER ELECTRIC VEHICLE DIFFUSION MODEL CONSIDERING HOME CHARGER SELECTION**

Abstract:
This study focuses on the interaction between consumers' preferences for EVs and for home EV chargers. Some home chargers have a bidirectional power supply function, which enables so-called vehicle-to-home (V2H) interaction, where EVs act as residential electricity storage, and thus EVs can provide additional revenues to their owners. It means that bidirectional home chargers might encourage more vehicle owners to adopt EVs, to accelerate the deployment of EVs and the associated reduction in greenhouse gas emissions from the passenger transportation sector. To evaluate this possibility, this study addresses two research questions: (1) Can bidirectional home chargers promote the diffusion of EVs? (2) In what situation will that be expected?
For this aim, a new nested-logit model will be developed to simulate the consumer's choice of both vehicles and their home chargers. Researchers have used such discrete-choice models to understand the critical factors and determine the optimal promotion strategy for EV diffusion, but these two important choices have not typically been combined in the same model. Additional revenues by V2H, one of the inputs, will be calculated using a household energy system optimization model that the author has already developed. Next, this model will be combined with a vehicle stock model for a long-term dynamic analysis of the passenger vehicle market. Finally, the integrated model will simulate the diffusion of EVs and the resulting greenhouse gas mitigation under various scenarios and policy options. The combined model framework will be calibrated and validated using data for Japan.

Biographical sketch:
Takuya Higashitani is a second-year PhD student at Tokyo University of Agriculture and Technology (TAUT) in Japan. He graduated from TUAT in 2020 with a bachelor’s degree of Engineering in Mechanical Engineering. He also received a master’s degree of Engineering in Energy Systems Analysis from TUAT in 2022. His current research topic is the optimal design of residential district energy systems combining photovoltaics with electric vehicles. His main fields of scientific interest include the techno-economic assessment of distributed energy resources, designing community-scale energy systems and transition strategy of demand-side energy technologies.

Jintae Kim

Mentors: **Siddharth Joshi, Jihoon Min, Behnam Zakeri**

Research Project: **THE NET ZERO TRANSITION AND ROLE OF ENERGY TRADE IN NORTHEAST AISA**

Abstract:
The assessment of climate change impacts and policies has primarily been conducted globally, considering the world into a few regional groups. Lately, researchers have raised the importance of analyzing effects and policies at the regional and sectoral levels and for different periods. Northeast Asia (NEA) is a critically important region characterized by fast economic growth (27% of global GDP) and a significant impact on global climate change (40% of global carbon emissions). Yet, the amount of GHGs emissions attributed to energy trade in the NEA region has received little attention. Additionally, Countries with fewer renewable energy resources, like South Korea and Japan, plan to import hydrogen from Australia as the final solution to achieve a net-zero target. Energy markets in these regions are competitive and, unlike North America and Europe, have a low level of integration. Naturally, the potential emission reduction in Northeast Asia will play an essential role in international carbon neutrality. This study will consider interregional heterogeneity, which is challenging in the existing GLOBAL model using a bilateral trade scheme. I will discuss the role of energy trade needed to achieve a net-zero target in NEA by developing the MESSAGEix-NEA model based on the Global model structure (MESSAGEix-GLOBIOM R11).

Biographical sketch:
Jintae Kim is a 3rd year PhD program in The Department of Environmental Planning of the Graduate School of Environmental Studies, Seoul National University (Seoul, South Korea). He received a Master in Environmental Planning from Seoul National University in 2018 and a 4year post-master associate in Sustainable Development Center, KAIST (Korea Advanced Institute of Science & Technology). His research focuses on assessing the economic & environmental effects of climate policy through the CGE (Computable General Equilibrium) model and ESM (Energy System Model). He has been developing the Global CGE model and environmental global input-output table to assess the NEA region’s past & future GHG emissions.

Jin Li

Mentors: **Shaohui Zhang, Wolfgang Schöpp**

Research Project: **A SPATIALLY EXPLICIT STUDY ON THE DECARBONIZATION PATHWAY OF CHINA'S IRON AND STEEL INDUSTRY**

Abstract:
In order to achieve the temperature goals outlined in the Paris Agreement, it is imperative for human economic activities to undergo significant decarbonization. The decarbonization of the iron and steel industry (ISI) is critical for achieving global climate change goals, as it is account for 7% of global greenhouse gas emissions. However, there is significant spatial heterogeneity in the decarbonization pathway of the ISI in terms of both existing old capacities and future new capacities. When it comes to phasing out existing fossil-fuel based facilities, the heterogeneity of a facility's characteristics and local environmental vulnerability may lead to differences in economic costs or environmental benefits across individual facilities. Deploying carbon-neutral technologies is also influenced by local constraints, e.g., renewable resources and carbon storage sites, which could change the spatial pattern of suitable areas for constructing steel plants.

Taking China as an example, which accounts for 58% of global crude steel production and has a large territory, this study aims to propose an integrated assessment framework to examine the future decarbonization pathway at a fine spatial resolution. We will employ the MESSAGEix model to explore national technology pathways of China's iron and steel industry, under different targets. Next, the facility-level datasets and multi-sources geographic data will be used to develop criteria to downscale national pathways to a fine-resolution. Finally, we will explore the potential regional inequality embodied in the ISI's decarbonization pathway, as well as the role of capacity spatial transfer strategy.

Biographical sketch:
Jin Li is currently a PhD candidate at school of environment at Tsinghua University. He earned his bachelor's degree from the same school in 2015. His research interests are centered around the decarbonization pathway and its multidimensional effects. Jin's research is primarily focused on developing phaseout strategies for existing fossil-fuel based facilities and deploying emerging low-carbon technologies. The highlight of his research lies in the application of high-resolution facility-level and spatial grid-level information to develop effective and sustainable solutions. Jin has also worked with several non-profit research institutions such as ICCT, RMI, and EDF (as a Climate Corps fellow), focusing on climate issues.

Francesco Semeria

Mentors: **Adriano Vinca, Giacomo Falchetta**

Research Project: **REDUCING FOOD LOSSES TO IMPROVE SUSTAINABILITY IN TRANSFORMATION PATHWAYS FOR THE AGRI-FOOD SYSTEM IN SUB-SAHARAN AFRICA – MODELLING IMPACTS ACROSS THE WATER, ENERGY, FOOD NEXUS**

Abstract:
Currently, the agri-food system in Sub-Saharan Africa (SSA) is almost entirely based on rainfed agriculture, which exposes smallholder farmers to unstable yields and incomes, that are already very low. Moreover, climate change is increasing temperature and precipitation variability, exacerbating existing challenges and putting at risk the livelihoods of the communities in the region. Transformation pathways are urgently needed to make the whole agri-food system more sustainable and resilient, but their development is particularly challenging as also rapid socioeconomic changes are occurring. One of the possible actions that public and private actors of the region can undertake is to implement policies and technologies to reduce food losses at the agricultural, post-harvest and processing levels, which account for over 75% of total food loss and waste and cause the loss of around 21% of produced food in SSA. Lost water, energy and land resources are inherently associated with food loss and waste, and the food trade network can transfer impacts on these resources across even distant countries. In this work, we link state-of-the-art modelling tools to quantify past and current impacts of food loss and waste in SSA at a regional scale. Then, we investigate how future socio-economic changes would affect food loss and waste profiles of countries in SSA. Eventually, we assess what is the potential that loss-reducing policies could have in saving associated resources, as well as their costs and benefits. The models used (WaterCROP, NEST, M-LED) will allow assessing the different dimensions of the Water-Energy-Food Nexus. The methodology is applied for the case of Zambia, to develop feasible future transformation pathways, within the scope of the LEAP-RE RE4AFAGRI project.

Biographical sketch:
Francesco Semeria is a second-year PhD student in Civil and Environmental Engineering at Politecnico di Torino. He received his M.Sc. degree in Environmental and Land Planning Engineering from Politecnico di Milano in 2020, with a thesis investigating the impacts of dams on traditional agricultural practices in rural Sub-Saharan Africa. His research interests are within the Water-Energy-Food-Ecosystem Nexus, and his studies at Politecnico di Torino aim at evaluating the implications of food loss and waste on water resources at the global scale. In his work, he is building and validating a modelling framework able to link water footprints of crop production to consumed food quantities, through global food value chains.

Carmen Séra

Mentors: **Marina Andrijevic, Caroline Zimm**

Research Project: **SOUTH-SOUTH TECHNOLOGY TRANSFER: BARRIERS AND ENABLERS FOR A SUSTAINABLE ENERGY TRANSITION**

Abstract:
This project analyses South-South technology transfer focusing on enablers and barriers that can influence the success of the sustainable energy transition. A focus will thereby be put on institutions and their relation to technology transfer to investigate the patterns and mechanisms of an enabling environment. In addition, the diffusion of and access to sustainable energy and low carbon technologies as well as inequalities between countries will be examined by analysing strategies that favour certain types of technologies.
Methodologically, a systematic literature review will be conducted to examine practices of technology transfer between countries of the Global South.
The findings will lead to a mapping of the results outlining common characteristics. It is expected that knowing about the drivers and barriers at work in practices of South-South technology transfer to broaden the use of low carbon and sustainable energy technologies enables a better understanding of how to fast-track and improve conditions for technology transfer generally. The outcomes of this research project are expected to be relevant for policy as they will point out where currently problems occur within the transfer of technology and how to increase the benefits of technology transfer for a transition to sustainable energy.

Biographical sketch:
Carmen Séra is a PhD student at the Institute of Social Ecology and in the Doctoral School "Transitions to Sustainability" at the University of Natural Resources and Life Sciences, Vienna. In her thesis funded by a DOC Fellowship of the Austrian Academy of Sciences, she is looking into sustainable energy transition politics in the Global South, technology transfer and regional institutions active in the promotion of renewable energy and energy efficiency.
Her main fields of scientific interest include socio-ecological transformations, instruments and mechanisms to counter the climate crisis, South-South cooperation, (asymmetric) power relations and knowledge exchange. She graduated in 2018 in Political Science and in 2014 in International Development from the University of Vienna.

Yisheng Sun

Mentors: **Shaohui Zhang, Peter Rafaj**

Research Project: **CO-BENEFITS OF CHINA REACHING GHG NEUTRALITY: HOW THEY ACCELERATE AIR QUALITY IMPROVEMENT TOWARDS WHO AIR QUALITY GUIDELINES**

Abstract:
China and many developing countries face simultaneous climate change and air pollution challenges. Actions to achieve carbon neutrality in China by 2060 would be essential for air quality improvement, due to emissions from many of same sources. Many integrated assessment models have only estimated the mitigation pathways of CO_2, under different climate targets. The evaluation of measures for non-CO_2 greenhouse gases reductions, and the associated co-benefits to agricultural system and air quality is missing. Therefore, we plan to examine the GHGs reduction pathways (including CO_2 and main non-CO_2 greenhouse gases) and the associated impacts on air pollutants, under the Chinese carbon neutrality goal, as well as modelling the long-term air quality improvement vision of the latest released World Health Organization global Air Quality Guidelines (WHO AQG). An integrated assessment model which consist of GCAM-China coupled with Air Benefit and Cost and Attainment Assessment System (ABaCAS), GAINS and the emission-concentration response surface model (RSM, or WRF-CMAQ) will be used to quantify how China achieve carbon neutrality targets and air quality improvement pathways. The key findings of this this study would help to support the policy actions for China.

Biographical sketch:
Yisheng is currently a 3rd year PhD student at School of Environment (division of air pollution control), Tsinghua University, China. He received his bachelor's degree also from School of Environment (Global Environment Program with a background of environmental management), Tsinghua University in 2020. His research focuses on long-term pathways of greenhouse gas and air pollutants control in China, under both carbon neutrality goals and the vision of air quality improvement towards WHO global air quality guidelines. Specifically, his research fields include regional energy system modeling, high-resolution emission inventories and atmospheric chemistry modeling.

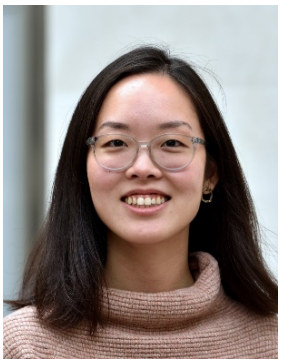
Lucas Vivier

Mentor: **Alessio Mastrucci**

Research Project: **BRIDGING THE ENERGY EFFICIENCY GAP: A COMPREHENSIVE MODEL FOR POLICY DESIGN AND EVALUATION IN THE HOUSING SECTOR**

Abstract:
The diffusion of energy efficiency in the residential sector is critical to achieving carbon emission targets in the European Union (EU). However, empirical research has long shown that homeowners do not systematically invest in energy efficiency measures that pay off in the long run - a phenomenon known as the energy efficiency gap. To address this problem, public authorities have introduced numerous incentives and regulatory programmes such as subsidies, white certificates, taxes or interest-rate regulated loans to encourage carbon reduction in the housing sector of EU Member States. Despite the doubts about the effectiveness of policies, empirical studies are limited in their ability to provide a comprehensive assessment of the policy portfolio due to the empirical context and data. On the other hand, global forward-looking studies roughly model household energy efficiency investment decisions by using an implicit discount rate that does not allow for clear evidence of specific policy action. To address this gap, we propose to use a structural approach and update the household decision model in MESSAGEix-Buildings to explicitly account for the key drivers and barriers to energy efficiency investment. Our model explicitly accounts for key market failures in energy efficiency investment, such as the landlord-tenant dilemma, collective decision-making or credit constraints, based on recent work on the national model for France Res- IF. We use this framework to simulate and compare the welfare and distributional effects of different policies at the EU level. Our model aims to identify policy portfolios that are both cost-efficient, socially balanced and effective in achieving the desired goals.

Biographical sketch:
Lucas Vivier is a third-year PhD student at the Centre International Recherche sur l'Environnement et le Développement (CIRED) near Paris. His work focuses on optimal and desirable mitigation strategies for the residential sector. He is developing a microsimulation model for France and using it to study the interaction between energy supply and housing demand to achieve net zero consumption by 2050. Lucas has a Master's degree in engineering and energy economics and previously worked as a quantitative analyst for a large energy producer and supplier in France and as a market analyst for a renewable energy developer in New York (USA).



Jingwei (Judy) Xie

Mentor: **Elina Brutschin**

Research Project: **SOCIAL, POLITICAL, AND INSTITUTIONAL BARRIERS AND ENABLERS TO A JUST TRANSITION AWAY FROM COAL AND GAS**

Abstract:
Despite the global consensus on the threat of climate change, the phase-out of fossil fuels is a more controversial subject amongst the public and in climate negotiations. Developing countries bounded by the need for expanding energy access are more hesitant towards fossil fuel reduction. Some developed countries have committed to phasing out coal, yet no broader political agreement on phasing out natural gas exists. Social, political, and institutional factors play a crucial role in the energy transition, especially in the move away from fossil fuels. These factors are often not evaluated in detail compared to their techno-economic counterparts in energy systems models, which presents a gap in understanding the socio-political feasibility of transition. This study builds on recent work that argues for a better understanding of the interaction of techno-economic and socio-political systems during transitions. We aim to understand how social, political, and institutional factors may influence the early retirement of coal and gas power plants. We will further identify how changes in techno-economic and socio-political systems co-evolve across different regions. The insights would then inform the speed of coal and gas phase-outs in climate mitigation scenarios. Our analysis will contain three parts: (1) a quantitative analysis including a global sample and a sample focusing on the US states, (2) the development of new scenario narratives accounting for the heterogenous pace of coal and gas phase-out across regions, and (3) the generation of new scenarios that will be compared to those with standard techno-economic assumptions. We argue that improving existing assumptions in IAMs with insights from social and political sciences could address some of the feasibility and justice concerns that policymakers have recently raised about IAM pathways.

Biographical sketch:
Judy is a third-year PhD student at the Centre for Environmental Policy at Imperial College London, UK. Her research focuses on operationalizing concepts of Just Transition in quantitative energy systems modelling, such as the distribution of employment outcomes and the influence of social factors on transition pathways. She is broadly interested in the interactions between society and low-carbon technologies and transitions. Previously, Judy worked as a chemist at a USA-based direct air capture startup and researched biomass conversion at the Paul Scherrer Institute, Switzerland. She holds a BSc in Chemical and Biomolecular Engineering from the Georgia Institute of Technology, USA.

Shiya Zhao

Mentors: **Jihoon Min, Jarmo Kikstra**

Research Project: **EXPLORING THE SYNERGIES AND TRADEOFFS BETWEEN DEEP CLIMATE MITIGATION AND POVERTY ALLEVIATION: INCORPORATING HOUSEHOLD HETEROGENEITY INTO A GLOBAL MACRO-ENERGY MODEL**

Abstract:
Deep mitigation pathways limiting warming to 1.5℃ have major uncertainties. One part of this uncertainty is the impact climate policies may have on progress in a broad set of sustainable development goals (SDGs), such as SDG1 No Poverty, SDG7 Affordable and Clean Energy, and SDG10 Reduced Inequalities. An important avenue for increasing our understanding of how climate policies affect household energy demand, energy poverty, and inequality is improving the granularity of household energy demand modeling in the context of climate change mitigation.

During YSSP, I will soft-link MESSAGEix, a perfect foresight energy system model, with AIM/PHI, a household income distribution and expenditure projection model to depict poverty and inequality dynamics under climate policies. In this modeling framework, we can depict the poverty implication, the income distribution among different population groups, and the household consumption choices in a variety of climate change mitigation scenarios. It complements previous studies by expanding an integrated assessment model to focus not only on the energy system but also on the mitigation-poverty. By comparing the results with the poverty and distributional effect projection in the climate policy pathways revealed by another Computable General Equilibrium model (AIM/Hub), the difference in policy packages between the two models could be distinguished. It then facilitates the design of pathways that can improve household living standards, reduce inequality, and achieve a decarbonized society.

Biographical sketch:
Shiya is a second-year PhD candidate in Environmental Engineering at Kyoto University, Japan. She holds a MSc in Environmental Engineering (2022) from Kyoto University and a BSc in Environmental Sciences (2019) from Wuhan University. Her study at Kyoto University focuses on analyzing trade-offs and synergies between climate change mitigation policies and progress on other SDGs (especially SDG1 No Poverty and SDG10 Reduced Inequalities), for example, the impacts of emission reduction policies on multidimensional poverty. Outside of research, she enjoys playing badminton and reading books.

Caesar Agula

Mentors: **Omkar Patange, Yuliya Kulikova**

Research Project: **SOCIO-DEMOGRAPHIC HETEROGENEITY IN THE COST OF ACCESSING MEDICATION ABORTION: INSIGHTS FROM GHANA**

Abstract:
Most women in developing countries increasingly choose to self-manage abortion with medication. Studies suggest that medication abortion (MA) is generally safe and effective at the early stages of pregnancy. In Ghana, abortion is permitted only under certain conditions and only certain health facilities are authorized to provide such services. However, to avoid stigma, associated with abortion, women clandestinely seek MA services from non-sanctioned providers such as pharmacies. While the challenges relating to abortion stigma and covert abortion services are known, there is a lack of understanding regarding the price discrimination women face when purchasing MA pills and the cost of time spent in accessing these services. Literature suggests that certain characteristics of women, such as youth, remoteness and limited knowledge about legal framework for abortion, are more vulnerable to abortion stigma and price discrimination. Thus, this study examines how women's socio-demographic characteristics differentially affect cost of accessing MA in Ghana. Data from a broader non-inferior and prospective study (MOC-Ghana), which surveyed women who had procured MA pills with similar regimens from either clinic-based or pharmacy providers in Ghana, will be used for this study. The survey collected data on the price at which women purchased MA pills and the time spent accessing MA, which was used to calculate the response variable: cost of MA. Given heterogeneity in MA access, understanding the degree of diversity is crucial for policymakers. This project will explore distributional differences using quantile regression analysis.

Biographical sketch:
Caesar Agula is a doctoral candidate at the Regional Institute for Population Studies (RIPS), University of Ghana. He is a multidisciplinary researcher, with a keen interest in population and health issues. His current research focuses on disparities in cost of accessing essential healthcare services. Prior to becoming a student, he coordinated several projects and garnered vast experience in community-based research. He has a background in economics and development studies. He is also a member of IUSSP and UAPS and has publications in journals such as SSM-Population Health, BMC Women's Health, Studies in Family Planning and Journal of International Development.

Rajdeep Singh

Mentors: **Stefan Wrzaczek, Michael Freiberger**

Research Project: **OPTIMAL VACCINE ALLOCATION STRATEGIES**

Abstract:
Developing vaccines against SARS-CoV-2 in record time brought optimism in combating the increasing number of infections. However, the disparity in demand and supply of vaccines during the early phase of vaccination programs called for judicious use of each available dose, especially in the Lower and Middle-income countries (LMICs). For administration and allocation of the available capacities, the population was divided into subgroups and consequently prioritized. This research analyzes different strategies that policymakers can use for administering doses under supply constraints. A Susceptible-Infected-Recovered-Deceased-Vaccinated (SIRDV) system dynamics model is developed to capture the propagation of the virus in the population. This framework allows for a comprehensive look into the contribution of each tier (unvaccinated, partially vaccinated, and fully vaccinated) towards the total number of infections and can be used to improve prioritization for dose administration. The parameters of this model are obtained using publicly available data on the number of daily infections, deaths, and vaccinations for the Indian state of Tamil Nadu. Bootstrapping is performed to obtain confidence intervals for each respective parameter. Then, different allocation scenarios are analyzed and compared regarding the number of cases and deaths. Some preliminary results of our model suggest that the second dose should commence after a gap of about 6 weeks. Secondly, we observe that the inter-dose interval does not have a significant impact on the outcome. Thirdly, partial vaccination should be preferred over full vaccination, i.e., dose stretching is a viable option that can be considered. Finally, these three variables are optimized simultaneously, resulting in considerably fewer cases than the actual.

Biographical sketch:
Rajdeep Singh is a PhD scholar at Department of Management Studies in the Indian Institute of Technology, Madras, India. He holds a Bachelor of Technology degree from National Institute of Technology Jalandhar, in the field of Industrial and Production Engineering. His doctoral research topic is "*Understanding vaccine allocation strategies and capacity investment decisions*". At IIT Madras, he is a part of the Decision Engineering and Pricing (DEEP) Lab, and his research interests include Operations Management, Game Theory, and Healthcare Operations. With his research, he aims at contributing towards the improvement in healthcare delivery of vaccines- their allocation, procurement, and coordination of the supply chain, especially in the LMICs.

Markus Dörflinger

Mentors: **Michaela Potancokova, Guillaume Marois**

Research Project: **PAST AND FUTURE MIGRATION IN ASIA: THE (POTENTIAL) IMPACT OF MIGRATION ON POPULATION AGEING**

Abstract:
Population ageing is a global demographic trend and one of the main demographic challenges of the 21st century. Trends in population ageing do not only have far-reaching implications for welfare and health systems worldwide, but are closely related to various social, economic, and environmental challenges of sustainability. In policy debates, immigration is often discussed as a factor which potentially can slow down population ageing. Starting with the UN report on replacement migration in 2000, the interaction between migration and population ageing was elaborated on in a number of studies particularly for Europe and Northern America but also for some countries in Asia. As the number of Asian countries experiencing population ageing has risen since then, this study provides a comprehensive analysis of the recent and the (potential) future impact of migration on the age-structure in Asian countries. In addition to chronological measures of age, prospective measures based on the remaining life expectancy are used to take into account increasing life expectancy.
Using data from UN's World Population Prospects 2022, we decompose changes in the (prospective) old-age dependency ratio into cohort turnover, mortality and net migration for the period 1970-2021. Next, we calculate 'replacement migration', which is the number of migrants needed to maintain the (prospective) old-age dependency ratio 2022-2070.
First, our results show the heterogeneous impact international migration had on the age-structure of Asian countries during the last decades. Second, replacement migration is compared to recent net migration and policy implications are discussed to assess the potential impact of future migration in ageing societies in Asia. Third, we aim to underline the usefulness of the prospective age concept to analyze the interaction between migration and population ageing.

Biographical sketch:
Markus is a 2nd year PhD candidate at University of Koblenz and Junior Researcher at the Federal Institute for Population Research in Wiesbaden (Germany). He holds a master's degree in Social and Population Geography from the University of Bamberg. Prior to his doctoral studies, Markus worked as a researcher at the Institute of Social Research and Opinion Polling in Bolzano (Italy). His current research focuses on migration and population ageing in Asia. His main fields of scientific interest include demographic change, migration, and spatial demography.

Dhruba Raj Ghimire

Mentor: **Samir KC**

Research Project: **POPULATION PROJECTION FOR TRACKING SOCIAL DIMENSION SDG TARGETS AND INDICATORS AT SUBNATIONAL LEVELS IN NEPAL**

Abstract:
The Sustainable Development Goals (SDGs) are a set of global goals established by the United Nations in 2015 to address various social, economic, and environmental challenges. While the global monitoring framework for the SDGs provides a comprehensive set of indicators and targets, the framework cannot be directly implemented and measured at subnational levels. Therefore, it is necessary to localize the SDGs by defining, implementing, and monitoring strategies at the subnational levels. In Nepal, the poor vital registration system, the low resourced-environment, and low-technical competency have created challenging in monitoring localized SDG indicators at subnational levels. Additionally, Nepal is a diverse country with significant spatial and demographic heterogeneity, which further complicates the task of monitoring SDG indicators at subnational levels. To address the challenges in monitoring localized SDG indicators, a novel approach needs to model subnational population projection and target population computation. The approach will utilize publicly available population census and household survey datasets to study population dynamics and population projection at subnational levels. In YSSP, I plan to develop future scenarios (assumptions about future trends related to fertility, mortality, and migration) – a crux of this research, for population projection at subnational levels by incorporating spatial and demographic heterogeneity.

Biographical sketch:
Dhruba is currently a fifth-year PhD student at the Asian Demographic Research Institute, Shanghai University. His thesis is Design of a Subnational Population Projection Model for Nepal. He receives a Master of Science degree in Geoinformation Science and Earth Observation from International Institute for Geoinformation Science and Earth Observation, The Netherlands and a Master of Science degree in Statistics from Tribhuvan University, Nepal. His main fields of scientific interest include data science, demographic modeling, population projection, and sustainable development.

Population and Just Societies Program (POPJUS)
Program Director: Anne Goujon

Ann-Christine Link

Mentor: **Roman Hoffmann**

Research Project: **THE TAIL END OF MIGRATION: ASSESSING THE CLIMATE RESILIENCE OF MIGRANT HOUSEHOLDS IN ETHIOPIA**

Abstract:
Climate change is associated with increasing frequencies and intensities of extreme weather events. These can, directly and indirectly, shape human (im)mobility. While most research on the climate migration nexus focuses on climate as a migration driver in origin areas, there is a gap in knowledge on the role of migration for climate resilience in the destinations. This project studies differences in the resilience to climatic shocks between migrant and non-migrant households in Ethiopia, a country that is highly exposed and vulnerable to climate change impacts. We use longitudinal data from the Living Standards Measurement Study (LSMS) conducted by the World Bank. The data contain comprehensive information on households' migration histories, exposure to different environmental and non-environmental shocks, and resilience, which is measured with a range of well-being indicators. The project aims to examine whether the well-being of respondent households changes when they are faced with a climatic shock and whether there is a difference in the resilience between households with and without a migration background. The methodological approach will model the impacts of shocks on well-being over time for migrant and non-migrant households using fixed effects panel regression models. Further explorative analyses will yield insights into mechanisms explaining differences between households. This research is highly relevant to policy. It improves the understanding of underlying factors shaping differential climate change impacts and supports targeted interventions to increase the resilience of vulnerable populations.

Biographical sketch:
Ann-Christine Link is a second-year PhD student at Philipps-Universität Marburg, Germany, in the Department of Geography. She also works as a research assistant at the United Nations University: Environment and Human Security in Bonn. Ann-Christine's research areas include the nexus of climate change, human (im)mobility, and health. Her dissertation aims to examine the connections of different parts of the nexus in Europe as well as in selected countries of the Global South. Currently, she is also involved in a project that assesses the integration and well-being of Ukrainian refugees in Germany and internally displaced people (IDPs) in Ukraine due to the Russian war on Ukraine.

Mengxing Ma (Joshi)

Mentors: **Anne Goujon, Daniela Weber**

Research Project: **WHO GOT LONELIER DURING THE COVID-19 PANDEMIC? EVIDENCE FROM THE ENGLISH LONGITUDINAL STUDY OF AGEING**

Abstract:
Loneliness is a social condition that exacts a significant toll on both mental and physical health, particularly among the older population. The loneliness issue was highlighted by the social restrictions imposed during the COVID-19 pandemic. Disease control measures such as social distancing and lockdowns disproportionately affected older adults. This research aims to quantify longitudinal changes in loneliness during the pandemic compared with a pre-pandemic baseline and identify contributing risk factors. This research will analyse data from the English Longitudinal Study of Ageing Wave-9 and Covid-19 sub-studies. Loneliness, measured by the 3-item UCLA Loneliness Scale, in June/July 2020 will be compared with baseline data from 2-3 years prior. Regression models will be applied to investigate a number of variables, with a focus on pandemic factors that could explain variance in change in loneliness. This research will also focus on how these pandemic factors disproportionately impact older adults with different social positions (e.g., age, gender, ethnicity, socioeconomic status, health status). The differences in resources of older adults to counteract pandemic factors of loneliness will also be explored. The findings of this research can inform future risk stratification and intervention strategies, particularly in the event of future pandemics.

Biographical sketch:
Mengxing is a second-year PhD student in Human Geography at the Population and Health Research Group, School of Geography and Sustainable Development, University of St Andrews. Her thesis is Loneliness, Social Isolation and Social Support of Ethnic Minority/Immigrant Older Adults in the UK: A Mixed-Method Investigation. She studied Master of Social Work from the University of Melbourne and MA in International Development from the University of Sheffield. She uses mixed methods to explore the health and social (in)equalities within the older population and focuses on the intersection of migration and population ageing. She aspires to bridge the academic and practical worlds and empower underserved communities using rigorous and innovative research.