International Institute for Applied Systems Analysis
IIASA

YOUNG SCIENTISTS SUMMER PROGRAM

YSSP2026

A NEW GENERATION OF SCIENTISTS

Participants and calendar overview

iiasa.ac.at/yssp

YSSP 2026 CALENDAR

JUNE 2026

MON	TUE	WED	THU	FRI	SAT	SUN
1 Opening and Orientation; Castle Tour	2	3 Intro to Systems Analysis Session	4 Holiday in Austria – IIASA closed	5	6	7 Vienna City Walk
8 Intro Presentations	9	10 Weekly Exchange	11	12	13	14
15	16 Lunch with IIASA Council	17 YSSP Weekly	18 Interaction Festival	19	20 Schneeberg Hiking Trip	21 Schneeberg Hiking Trip
22	23	24 Weekly Exchange	25	26	27	28
29	30					

JULY 2026

MON	TUE	WED	THU	FRI	SAT	SUN
		1 Manuscript Writing Workshop	2	3	4	5
6	7	8 Weekly Exchange; Movie Night	9	10	11	12
13	14	15 Weekly Exchange	16	17	18	19
20	21	22 Weekly Exchange	23	24	25	26
27	28	29 Weekly Exchange	30	31		

AUGUST 2026

MON	TUE	WED	THU	FRI	SAT	SUN
					1	2
3	4	5 Weekly Exchange	6	7	8	9
10	11	12 Weekly Exchange	13	14	15	16
17	18	19 Weekly Exchange	20	21	22	23
24 Final Colloquium	25 Final Colloquium	26 Final Dinner and Awards Ceremony	27	28	29	30
31						

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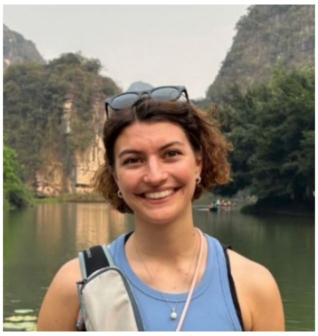


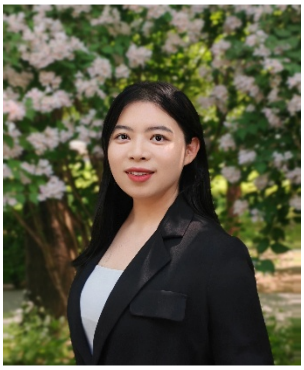
Petra Bistričić

Mentor: **Johannes Bednar**
Co-Mentor: **Michael Obersteiner**

Research Project: **Financing Overshoot: Regional Responsibility, Financing Pathways, and Policy Design**

Abstract: The international community increasingly relies on carbon dioxide removal (CDR) to reverse temperatures and sustain a 1.5°C-compatible long-term trajectory. Scenarios produced at both global and regional levels depend on net negative emissions, and the EU is committed to pursuing net negative emissions after achieving net zero. The recent International Court of Justice advisory opinion further strengthens the legal basis for climate accountability. Despite its growing prominence in mitigation pathways, large-scale CDR deployment remains limited, and existing climate policy frameworks provide no credible mechanism for financing temperature reversal. This research assesses the feasibility of reversal financing by examining how alternative inter-regional responsibility allocations and intra-regional cost-burden placements shape CDR financing capabilities. Using iamLite, an integrated assessment model emulator developed at IIASA, the analysis first quantifies regional CDR costs under overshoot pathways, demonstrating how regional financing responsibility varies across responsibility-sharing arrangements. It then focuses on the European Union, comparing projected CDR financing requirements with feasible revenue-raising pathways. Three cost-burden placements are evaluated – public budget financing, extended emitter responsibility, and extended fossil fuel producer responsibility – across two temporal scenarios: financing from the point of net-zero emissions and financing triggered by overshoot using intertemporal liability. Publicly available actor emissions and financial data are collected and linked across the emitter and fossil fuel producer value chains to assess the finance accessible. The analysis highlights the distributional and temporal trade-offs inherent in temperature reversal financing and their implications for policy design.

Biographical sketch: Petra Bistričić is a second-year PhD candidate at the School of Geography and Environment at the University of Oxford. Her doctoral research uses modelling insights on the economic and climate impacts of climate policy, alongside insights on the political feasibility of policy implementation, to inform policymaking in a world projected to exceed 1.5 °C of warming. Petra is a Researcher with Oxford Net Zero and a European Union Policy Advisor with Carbon Balance Initiative. Petra holds an MSc in Environmental Change and Management from the University of Oxford and a BA in Social and Political Sciences from the University of York.



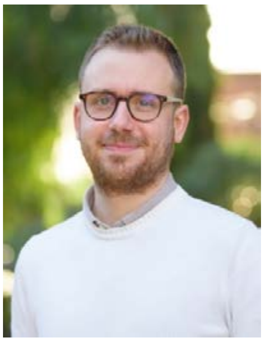
Shiwei Chen

Mentor: **Stefan Hochrainer-Stigler**
Co-Mentor: **Piotr Zebrowski**

Research Project: **Quantifying Multiple Resilience Dividends of Climate-Adaptive City Policies in China**

Abstract: Against the backdrop of the global climate crisis, climate adaptation policies face a dual deficit of investment and attention compared to mitigation, largely because their long-term benefits are difficult to quantify precisely. It has therefore become a critical scientific and policy question how to systematically assess and demonstrate that adaptation actions can not only reduce physical risks but also synergistically unlock urban development potential. However, existing research has not yet provided an integrated causal identification and mechanism analysis of the triple dividends of urban adaptation policies – risk reduction, development unlocking, and co-benefits. To address this gap, this study will take China's "Climate-Resilient City" pilot policy as a quasi-natural experiment and apply, for the first time in this context, the Multiple Resilience Dividends (MRD) framework. The core objectives are to quantify the causal effects of the policy on urban resilience, to reveal the underlying transmission mechanisms through the "5C" capitals (human, social, financial, physical, and natural capital), and to further explore the heterogeneous impacts of urban governance capacity and external climate shocks. The research will apply difference-in-differences and double machine learning methods for causal inference using city-level panel data from 2005 to 2022. While estimating the net policy effects, the study will also test the mediating role of the 5C capitals and the moderating effects of governance capacity and external shocks. In addition, multi-hazard dependencies and corresponding impacts will be looked at as well, including an analysis of changes in MRD under different future scenarios. The study should provide clear evidence that adaptation policies can generate development dividends and support resilient urban pathways.

Biographical sketch: Shiwei Chen is a PhD candidate at the Center for Energy and Environmental Policy Research, Beijing Institute of Technology (CEEP-BIT). She leads an NSFC doctoral grant on adaptation strategies for climate-vulnerable cities. Her research on urban resilience policy evaluation has appeared in Nature Cities and Cities. At IIASA, she will work with Dr. Stefan Hochrainer-Stigler and Piotr Zebrowski to further develop the Multiple Resilience Dividends (MRD) framework for China's climate-adaptive policies. She is committed to bridging rigorous empirical research with policy-relevant insights for climate adaptation.



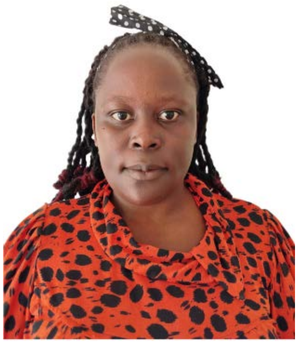
Federico Grossi

Mentor: **Brian Fath**
Co-Mentor: **Elena Rovenskaya**

Research Project: **Assessing Structural Stability, Threat Cascades, and Conservation Action Coverage in Biodiversity Networks**

Abstract: Biodiversity endangerment and loss emerge from the interaction of multiple threats to species and habitats. These threats interact at various spatial and temporal scales and propagate through ecological networks. Ignoring such interactions can hide indirect ecological and human-driven pressures, as well as systemic vulnerabilities. Our research aims to integrate IUCN Red Listed species co-occurrence records, threat data, and conservation actions into a network-based framework to simulate secondary losses through structural extinction cascades and identify species acting as structural (de-)stabilisers. We model species loss under alternative removal strategies (structural, IUCN risk-based, or random) to quantify cascade vulnerability and evaluate how the extinction of different sets of species increases systemic collapse risk. In parallel, we model the diffusion process of threats to biodiversity across the projected species network. Finally, we map conservation action coverage and co-occurrence across species exposed to different threats, highlighting bundles of alternative conservation actions, substitution patterns, as well as gaps in current conservation responses. The project aims to generate network-informed diagnostics for biodiversity risk, identify species that deliver disproportionate (de-)stabilizing effects, and reveal mismatches between threat exposure and conservation actions. Overall, we aim to contribute a systems-level perspective to global conservation policy by diagnosing mismatches between network-mediated threats and existing conservation responses, and by supporting strategic allocation of limited conservation resources via the prioritization, protection, or impact avoidance for species that act as ecological stabilizers.

Biographical sketch: Federico is a third-year PhD Student at the Helsinki Lab of Interdisciplinary Conservation Science (HELICS), University of Helsinki. Funded by the Doctoral Programme in Interdisciplinary Environmental Sciences, his research investigates indirect socioeconomic and ecological drivers of biodiversity loss. He obtained a MSc degree in resource economics and sustainable development from the University of Bologna. His thesis focused on the management of common-pool resources in the face of social-ecological regime shifts and was conducted at the Beijer Institute of Ecological Economics and the Stockholm Resilience Centre. Prior to joining HELICS, he was a visiting student at the Complexity Science Hub Vienna on a project related to economic complexity and green trade opportunities.



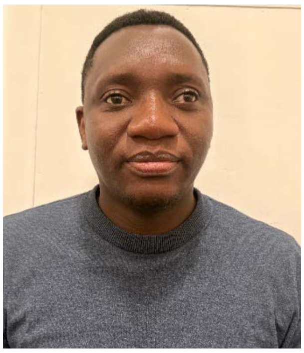
Esther Wairimu Kinyua

Mentor: **Stephan Pietsch**
Co-Mentor: **Zebrowski Piotr**

Research Project: **Modeling Acacia Medicinal Trees for Sustainable Dryland Livelihoods**

Abstract: Medicinal trees play a central role in sustaining health systems and livelihoods across African drylands, particularly in regions where access to conventional healthcare is limited. In semi-arid landscapes such as Makueni County, indigenous species of the genus Acacia are widely used for their bioactive compounds with antimicrobial, anti-inflammatory, and therapeutic properties. However, the influence of environmental variability and ecological stress on the production and distribution of these medicinal compounds remains insufficiently understood. This study aims to integrate field-based ecological data with phytochemical analysis to model the relationship between environmental factors, plant growth, and medicinal compound production in selected Acacia species. Soil properties (pH, organic carbon, nitrogen, phosphorus, cation exchange capacity, and moisture), environmental gradients, and tree growth parameters (diameter at breast height, height, canopy cover, and health status) are collected across multiple transects. Methanolic extraction followed by Gas Chromatography-Mass Spectrometry (GC-MS) is employed to identify and quantify key secondary metabolites. Using multivariate statistical approaches, including correlation analysis and Principal Component Analysis (PCA), the study will evaluate how soil fertility and environmental stress gradients influence both plant performance and phytochemical profiles. These empirical relationships are further positioned to inform ecosystem modelling frameworks such as the BioGeoChemistry Management Model (BGC-MAN), supporting scenario-based predictions of medicinal tree productivity under varying climatic and management conditions. The study will contribute to a deeper understanding of the ecological drivers of medicinal compound production in dryland ecosystems and provides a scientific basis for sustainable management, conservation, and policy development aimed at enhancing the resilience and economic value of medicinal tree resources in Africa and beyond.

Biographical sketch: Esther Wairimu Kinyua is a Biology Tutorial Fellow at Lukenya University and a PhD candidate in Zoology at Mount Kenya University. She holds a Master’s degree in Animal Physiology from Egerton University, where her research focused on the pharmacological effects of plant extracts. Her work combines interests in plant-based medicine, ecology, and physiology, with a focus on how environmental factors influence the production of bioactive compounds. She has laboratory experience in molecular and biochemical techniques, including phytochemical analysis, and is actively involved in teaching, research, and student mentorship. Her research aims to support sustainable use and conservation of medicinal plant resources.



Reason Mlambo

Mentor:	**Ian McCallum**
Co-Mentors:	**Juan Carlos Laso Bayas, Fernando Orduña-Cabrera and Martin Hofer**
Research Project:	**Explainable AI – Based Poverty Assessment Through Knowledge-Driven Approaches**

Abstract: The scarcity of frequent, fine-scale data on socioeconomic conditions remains a major hindrance towards achieving SDG1 in many developing countries. Although recent Earth Observation (EO) and machine learning – based poverty estimation approaches have shown great potential to address data gaps, their reliance on unintuitive features, disregarding of local context and black-box nature restrict their usefulness for understanding of poverty dynamics and for adoption by policymakers. Recently, knowledge-driven modelling approaches have been suggested as better suited to address these challenges but these are relatively underexplored.
This project advances a more interpretable and context-aware framework by exploiting very high-resolution satellite imagery for three locations in Zimbabwe, to derive intuitive and explainable geospatial proxies that align with variables used in the Demographic and Health Survey wealth index. Geospatial Foundation Models (GFMs), specifically satellite embeddings, will be used to (i) expand training data through context-based transfer of ground truth labels and (ii) to enable selection of locally-relevant model covariates for estimating poverty. The resulting models will be evaluated against recent data-driven EO4Poverty approaches and independently validated using national census data. The findings aim to improve the interpretability, contextual relevance, and scalability of EO-derived poverty estimates, thereby enhancing the understanding of subnational inequalities and supporting targeted interventions in data-poor settings.

Biographical sketch: Reason is a third year PhD student in Environmental Science at the University of Edinburgh, and holds a Master's degree in Geographical Information Science from the same institution. His background is in geospatial science and his research interests lie at the interface of geospatial analytics, development research, and public policy. His doctoral research focusses on spatiotemporal poverty mapping using earth observation data and machine learning techniques. He has previously worked as a Data Scientist on research projects investigating the climate impacts of environmental exposure on maternal and neonatal health outcomes in Africa.

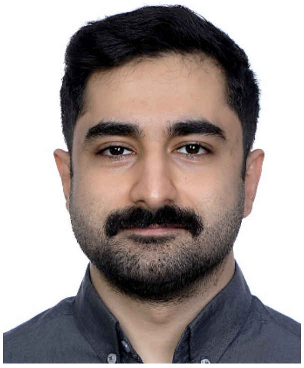
Madhura Pawar

Mentor: **Nadejda Komendantova**
Co-Mentor: **Tahereh Zobeidi**

Research Project: **Collective Action Under Misinformation in Algorithmically Infused Social Networks**

Abstract: Online social networks are prominent media through which people access information, form opinions, and coordinate collective action. They are also widely recognized for enabling the rapid spread of misinformation, which can distort users' perceptions of social norms, risks, and others' behavior. These platforms additionally deploy recommendation algorithms that shape who becomes connected to whom, driving network evolution over time. In such environments, it is important to understand how the network structures evolve, driven by algorithmic recommendations, and how that in turn affects biased beliefs about others' behavior. This project makes two contributions. First, we study how perception biases induced by misinformation affect cooperation in collective action problems. Using an evolutionary game theoretic framework, we model agents playing a public goods game whose strategy updates are governed by biased beliefs about others' cooperative behavior. We examine how different types and magnitudes of perception bias shape whether cooperation emerges or collapses. Second, we extend this framework to dynamic networks, asking how algorithmic link recommendations affect cooperation among perception-biased users. Users interact on a network whose structure evolves according to a link recommendation algorithm, and we examine how different recommendation strategies determine collective outcomes. Together, the results provide insights into how platform-level link recommendation policies interact with user-level misperception to shape collective action in digital societies.

Biographical sketch: Madhura Pawar is a PhD candidate at the University of Amsterdam (Prosocial Dynamics Lab,SIAS, Informatics Institute). Her research focuses on algorithmic fairness, cooperation, and collective action in evolving social networks, within the ERC-funded RE-LINK project. She develops computational models for responsible link recommendation systems that balance user engagement with socially desirable outcomes. Madhura holds an MSc in Artificial Intelligence from the University of Amsterdam and a Bachelor’s degree in Computer Engineering from Pune Institute of Computer Technology.

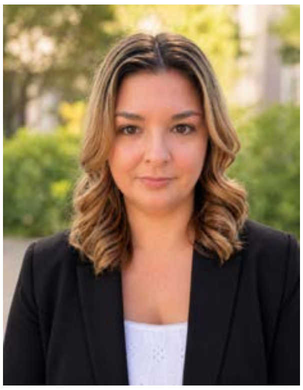


Moien Rangzan

Mentor:	**Linda See**
Co- Mentors:	**Steffen Fritz, Myroslava Lesiv**
Research Project:	**Active Learning in the Era of Earth Embeddings**

Abstract: Recent Earth observation foundation models can encode multi-sensor and multi-temporal satellite imagery into compact Earth embeddings, enabling large-scale search across geographic regions. This project explores how these embeddings can improve crowdsourced annotation of satellite images through active learning. Current annotation workflows often rely on random sampling, which can be inefficient and biased, especially under class imbalance or strong geographic distribution bias. For example, mapping rare objects such as solar panels requires retrieval of scarce positive samples, while naturalness mapping may suffer from geographic sampling bias, where random sampling reflects highly uneven real-world distributions of natural and human-modified landscapes. Such sampling patterns can introduce spurious correlations and limit the gathered data. The project proposes an embedding-driven active learning framework for more efficient dataset curation. Starting from an initial labeled set, models will identify uncertain predictions while exploring the embedding space and underrepresented regions. Earth embeddings will then be used to retrieve informative candidate samples and prioritize them for annotation, reducing redundant labeling while improving dataset balance, geographic coverage, and model robustness. The framework will be evaluated on retrieval-oriented and bias-sensitive mapping tasks, including solar panel detection and naturalness mapping. The project will also integrate AI-assisted annotation tools: Segment Anything Model based interaction will support faster object-level mask creation, while vision-language models may assist annotators with image interpretation, label suggestions, and quality control. By combining Earth embeddings, active learning strategies, and human-centered annotation tools, this work aims to deliver a scalable framework for more efficient, reliable, and geographically robust crowdsourced annotation of satellite imagery.

Biographical sketch: Moien Rangzan is a second-year PhD student at the Max Planck Institute for Biogeochemistry and the Computer Vision Group at Friedrich Schiller University Jena. His research focuses on deep learning and domain generalization methods for Earth observation, with the aim of developing models that can generalize globally. He holds a B.Sc. in Electrical Engineering and an M.Sc. in Remote Sensing from the University of Tehran. His interests lie at the intersection of advances in deep learning and innovations in satellite imaging, and in how it is shaping a new era of Earth observation.



Marissa Sogluizzo

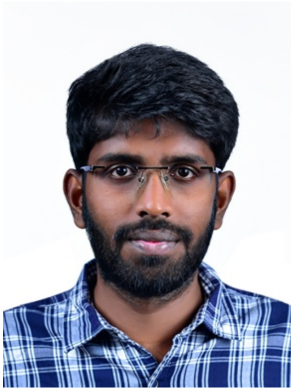
Mentor: **Raquel Guimaraes**

Research Project: **Innovating Disaster Risk Reduction Through a Novel Population Health Resilience Index**

Abstract: Climate change has transformed natural hazards into a global, multi-hazard risk environment, dramatically escalating the global burden of disasters and generating large, uneven population health impacts driven by exposure and pre-existing vulnerabilities. Consequently, understanding disaster risk as a population health phenomenon is a global policy priority within disaster risk reduction (DRR), yet, existing indices rarely integrate population health comprehensively, often treating health as a downstream outcome rather than a dynamic driver of risk. This omission overlooks the health dimension of population resilience: the antecedent capacity of a community to resist and recover based on its underlying health profile, including disease burden, health behaviors, and healthcare accessibility. Without considering health resilience, current tools cannot capture how health risks interact with structural and environmental conditions to shape differential disaster impacts.

To address this gap, this study develops a conceptual framework grounded in systems-based models (i.e., Sendai Framework, Andersen's Behavioral Model, Sustainable Development, UNFCCC) to operationalize a health-centered view of resilience through a novel Population Health Disaster Resilience Index (PHDRI). This multidomain index integrates health risk factors with established vulnerability and resilience indicators to predict post-disaster population health outcomes, shifting emphasis from post-hoc impacts to pre-disaster health resilience. Using publicly available data, the PHDRI will be constructed and evaluated through analyses of predictive capacity, convergent validity with existing indices, and spatial distribution of resilience. By embedding population health into disaster risk metrics, this research advances more predictive, prevention-oriented DRR and informs equitable, health-centered climate adaptation and resilience policy.

Biographical sketch: Marissa Sogluizzo, a second-year PhD candidate in the Program in Public Health at Stony Brook University, holds an MPH in Epidemiology with an Advanced Graduate Certificate in Disaster Science, Policy, and Practice from NYU. Her research focuses on reducing disaster-related population health impacts by translating evidence-based research into interdisciplinary public health disaster planning interventions. She aims to develop a novel measurement of population health-based resilience to predict disaster-related impacts and highlight the interdisciplinary nature of disaster epidemiology. Her work underscores the need for new policies to improve disaster preparedness and mitigate negative health consequences among vulnerable communities.



Surender Raj Vanniya Perumal

Mentor: **Celian Colon**

Research Project: **Supply Chain Criticality of EU TEN-T Corridors**

Abstract: Transportation networks such as roads, railways, and inland waterways are vital to economic activity by enabling the movement of people and freight. In Europe, Trans-European Transport Network (TEN-T) corridors are central to this system but are increasingly vulnerable to climate hazards such as floods. Disruptions to these corridors have far-reaching supply-chain impacts beyond direct damage. For example, disruptions may lead to input shortages for production and increase the prices of goods due to higher rerouting costs. Hence, there is a clear need to adapt these corridors to future climate extremes. However, such decisions are often driven by assessments of potential damages (direct risk), while the broader economic (or supply-chain) criticality of the corridors receives limited consideration.

This research aims to conduct a supply-chain criticality assessment of major TEN-T corridors in Europe.
The novelty of the research lies in its comprehensive approach to linking transportation flow modelling with economic modelling (input-output analysis) at a continental scale. This research will deliver the following outcomes. First, we produce a supply-chain criticality map of EU TEN-T corridors, identifying the important corridors for interregional trade. Second, we compare the proposed supply-chain criticality results with conventional damage-based and network-topology-based criticality assessments. Finally, we model system-level interventions, such as inventories and flexibility to source inputs from alternate suppliers, to assess how these measures alter criticality. The findings of this research will support organizations responsible for TEN-T corridor operations, such as DG-MOVE, in making supply-chain risk–informed adaptation decisions.

Biographical sketch: Surender Raj is a Ph.D. candidate within the MIRACA (Multi-Hazard Infrastructure Risk Assessment for Climate Adaptation) project, and is based at the Water and Climate Risk Department of the Institute for Environmental Studies, Vrije Universiteit Amsterdam. His Ph.D. focuses on economic modelling of disaster impacts with a special emphasis on the economic consequences of Critical Infrastructure failure. He holds a Master's degree in Structural Engineering. Before pursuing his PhD, he worked as a flood vulnerability model developer at Impact Forecasting, where he contributed to the development of flood-damage and business interruption functions for insurance applications.

Ruobing Wang

Mentor: **Elena Rovenskaya**

Research Project: **Systemic Risks and Resilience in Energy Infrastructure Under Artificial Intelligence-Driven Demand Growth**

Abstract: The rapid acceleration of Artificial Intelligence (AI) is driving U.S. electricity demand beyond conventional forecasts. Beyond simple load growth, AI workloads introduce unique risks, such as synchronized power spikes during model training and systemic vulnerabilities from "behind-the-meter" energy solutions.

Building on IIASA's systemic-risk and resilience framework, this project analyzes the electricity–AI interface as an adaptive, multi-layer system. Using Texas (ERCOT) as a case study—chosen for its unique energy-only market and transparent data—the research links digital infrastructure, grid operations, and governance structures.

Methodology and Goals:

- Quantification: Utilizing network science and stochastic modeling to measure systemic risk.
- Scenario Analysis: Exploring uncertainties like demand surges, renewable variability, and extreme heat through Robust Decision Making (RDM) principles.
- Simulation: Stress-testing the system against cascading failures to calculate metrics such as loss-of-load probability and recovery time.

As part of the YSSP, I will develop a proof-of-concept model using ERCOT and EIA data. This work aims to demonstrate how AI-driven demand alters grid topology and institutional coordination, providing IIASA with new methodological tools to enhance resilience in interdependent digital-energy systems.

Biographical sketch: Ruobing (Robin) Wang is a quantitative policy researcher and PhD candidate at the RAND School of Public Policy, where his work examines systemic risk and resilience in electricity infrastructure under AI-driven demand growth. He combines data science, systems analysis, and energy-climate modeling to empower public policy deliberations. Over the past decade, he has led and supported data-driven research for RAND, the Urban Institute, the World Bank, WHO, ADB, and the United Nations. His recent work focuses on the AI-energy nexus, including power capacity expansion, data center siting, and infrastructure resilience in the United States and internationally.

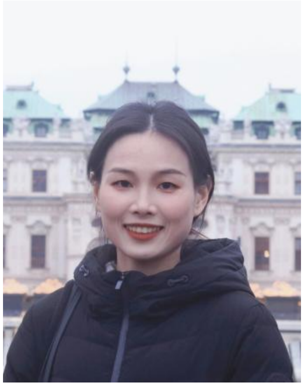
Zhenyu You

Mentor:	**Juan Carlos Laso Bayas**
Co-Mentor:	**Milutin Milenkovic**
Research Project:	**Shelterbelts Monitoring and Their Impact on Farmland Resilience**

Abstract: As a specialized form of agricultural infrastructure, farmland shelterbelts serve to prevent wind erosion and stabilize sand, improve the microclimate of farmland, and enhance both the quality and productivity of crops. In recent years, international organizations such as GEF and GEO have placed significant emphasis on the role of agroforestry systems in enhancing climate resilience and ecosystem services. Consequently, monitoring farmland shelterbelts and evaluating their impact on the climate resilience of farmland represent crucial research topics. Numerous existing studies have employed remote sensing data to extract information concerning field shelterbelts, establishing correlations with crop growth and yield. However, research on monitoring and evaluation methods for farmland shelterbelts that integrate multimodal remote sensing data based on artificial intelligence (e.g., computer vision approaches) remains relatively scarce. Furthermore, when evaluating the impact of farmland shelterbelts on the resilience of farmland, spatial heterogeneity across fields has not been taken into account.

This research integrates multimodal remote sensing data and ground measured data, and adopts a hybrid deep learning model to extract the integrated feature vectors of farmland shelterbelts. Meanwhile, taking within-field heterogeneity into full account, this research focuses on crop growth and yield to explore the influencing mechanism of farmland shelterbelts on farmland resilience. On this basis, an AI-enabled monitoring and evaluation method for farmland shelterbelts utilizing multimodal remote sensing will be developed. The research findings can further provide theoretical guidance and practical references for the layout design and effectiveness assessment of farmland shelterbelts.

Biographical sketch: Zhenyu You is a second-year PhD student majoring in Agricultural Remote Sensing in the Institute of Agricultural Resources and Regional Planning of Chinese Academy of Agricultural Sciences, China. He holds an M.S. in Agricultural Engineering and Information Technology from the same institution, and a B.S. in Optoelectronic Information Science and Engineering from Xi'an Jiaotong University. His research interests include resilience of farmland, land surface phenology, crop monitoring, as well as the perception and assessment of farmland infrastructure, with a particular focus on farmland shelterbelts.



Danni Zhang

Mentor: **Thomas Gasser**
Co-Mentor: **Biqing Zhu**

Research Project: **Integrating Multi-Pollutant Wildfire Emissions into the OSACR Model**

Abstract: Wildfires are a major source of atmospheric pollutants, yet their multi-species emissions remain poorly constrained in Earth system models, limiting our ability to assess their combined climate and health impacts. This project develops a physically consistent wildfire multi-pollutant emission framework within the OSCAR reduced-complexity Earth system model, enabling integrated simulation from historical records through future climate and socio-economic scenarios. The emission module explicitly represents multiple pollutant species across biomes and biomass pools, with emission factors compiled and harmonized from the NEIVA v1.0 database and supplementary literature. A Monte Carlo ensemble of 2,000 simulations is generated by perturbing emission factors, fuel loads, combustion completeness, and land-process parameters. Ensemble members are evaluated against fire emission inventories and satellite-based atmospheric observations and weighted by observational agreement to yield best-estimate emissions with quantified uncertainties. Historical and future wildfire emission trajectories are analyzed to characterize regional and interannual variability and their sensitivity to alternative modeling assumptions. Health impacts are quantified by combining population-weighted exposure estimate, derived from region-specific intake fractions with epidemiological concentration–response functions to estimate wildfire-attributable premature mortality. Climate impacts, including radiative forcing and global mean temperature responses, are assessed through factorial simulations isolating individual pollutant contributions. This integrated framework bridges wildfire process modeling, atmospheric chemistry, and impact assessment, providing a unified tool for evaluating wildfire feedbacks in the Earth system under global change.

Biographical sketch: Danni Zhang is a Ph.D. candidate at Tsinghua University. Her research focuses on wildfire emissions and their climate feedbacks, with his doctoral work centered on improving the simulation of global wildfire full-cycle carbon dynamics from historical reconstruction to future projection, using the reduced-complexity Earth system model OSCAR. At IIASA this summer, she will extend this framework to explicitly represent multi-pollutant wildfire emissions across region, biomes and biomass pools, and assess their integrated impacts on air quality, human health, and radiative forcing.

Anqi Zhu

Mentor: **Robert Šakić Trogrlić,**
Co-Mentor: **Reinhard Mechler**

Research Project: **Integrating QCA and Bayesian Networks to Evaluate the Resilience Effectiveness of Household Flood Adaptation by Mountainous Communities in China**

Abstract: Assessing the resilience improvements of adaptation measures is a central challenge in climate adaptation research and practice, as resilience emerges from complex interactions between diverse human and environmental factors that are difficult to quantify with large uncertainties. A critical gap remains regarding how household flood adaptation and underlying drivers interact to shape system resilience. Focusing on flood-prone mountainous communities in Southwest China, this study addresses this gap by examining the causal pathways driving low-, medium-, and high-cost household flood adaptation measures and evaluating their flood resilience effectiveness. Drawing on data from 1632 household surveys and 29 expert surveys, the study develops a hybrid framework that combines recovery curve estimation, Qualitative Comparative Analysis (QCA), and Bayesian Networks (BN) to embed causal pathways into probabilistic modelling for resilience effectiveness assessment. First, household data are aggregated to the community level to estimate recovery curves for measuring community flood resilience. Expert assessments are used to weigh parameters. Second, QCA is used to capture causal complexity by identifying configurations of actor-level capacities (generic and flood-specific) and structural enabling conditions (institutional, physical and socio-cultural) driving the adoption of flood adaptation measures. These configurations are then translated into a BN to incorporate complex dependencies under uncertainty. The BN supports probabilistic inference to quantify how changes in conditions and measures interact to influence system resilience. We anticipate the findings to reveal evidence-based leverage points to inform effective flood adaptation investments for practitioners.

Biographical sketch: Anqi Zhu is a second-year PhD student at the Department of Geography, Ludwig-Maximilians-University Munich (LMU). Her research focuses on community resilience to floods and environmental governance, using methods like agent-based modeling, fieldwork, household surveys, GIS, and environmental policy analysis. She is interested in the emergence of macro-level outcomes from micro-level interactions, comparative studies, and developing insights and strategies for practitioners. She co-organizes Human Geographers of the Future (HUG Future), a platform connecting early-career Chinese and international human geography scholars.

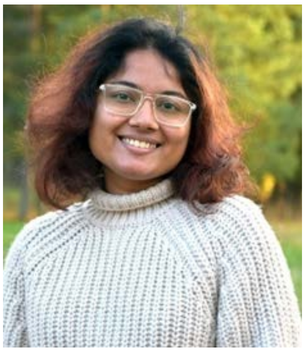
Sarah Bebb

Mentor:	**Rebekah Hinton**
Co-Mentors	**Barbara Willaarts and Sylvia Tramberend**
Research Project:	**The Strategic Water Resources Analysis (SWRA) as a Tool for Science Diplomacy in the Nile Basin**

Abstract: This research examines how the Strategic Water Resources Analysis (SWRA) under the Nile Basin Initiative (NBI) functions as a tool for collaborative science diplomacy in supporting technical cooperation among riparian states. The SWRA provides a basin-wide assessment of current and future water, energy, and food demands, evaluates water availability under various climate and development scenarios, and proposes management options for sustainable resource use. Initiated in 2012, the process has produced important technical results but has faced both technical and institutional obstacles. This raises fundamental questions about what such joint analytical exercises can realistically achieve and where their genuine added value for transboundary cooperation lies.

Boundary work theory (Gieryn, 1983; Guston, 2001; Cash *et al.*, 2002) provides the meso-level analytical lens for this research, examining how credibility, salience and legitimacy are negotiated across the interface of science and policy. Rather than treat the tensions that emerge as obstacles, the study draws on Tsing's (2011) concept of friction to reframe them as productive features of cross-border practice; the negotiation and compromise that arise when diverse actors and development priorities interact around a shared model. It is precisely in how such frictions are managed, rather than necessarily resolved, that the real added value of joint analytical exercises such as the SWRA should be assessed, and through which this study advances the understanding of collaborative science diplomacy not as a neutral or depoliticizing force, but as a political process of friction by design, through which tensions are identified and managed.

Biographical sketch: Sarah Bebb is a third-year PhD candidate at University College London (UCL). Her thesis, entitled *Science Diplomacy in the Nile Basin,* examines the role that scientific knowledge plays in the various negotiations and cooperation processes over water resources in the region. She previously worked on transboundary water resources management with the German agency for international cooperation, GIZ, in both the Nile and Mekong Basins. She also previously coordinated the Nile Basin Media Network, designing capacity development and publication opportunities for journalists reporting on water cooperation along the Nile.



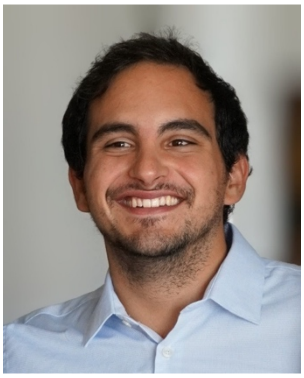
Swastika Chakravorty

Mentor: **Oskar Franklin**
Co-Mentors: **Dmitry Shchepashchenko, Fulvio di Fulvio, Florian Kraxner**

Research Project: **Assessing Trade-Offs and Externalities of Energy Biomass Harvesting from Early Management of Planted Silver Birch in Conifer-Dominated Forests Using Land Expectation Value and Ecosystem-Service Indicators**

Abstract: Early thinning in planted silver birch-conifer mixed production forests generates substantial volumes of small-diameter trees. In Sweden, this material is often left on site (thin-to-waste) because extraction costs are high and energy-biomass prices are low, yet residue accumulation may affect ecosystem services such as recreation, accessibility, biodiversity, and reindeer husbandry. This project assesses whether harvesting small-diameter trees for bioenergy can deliver a net societal benefit relative to thin-to-waste, considering both market outcomes and quantified ecosystem-service impacts over a full rotation. We will simulate stand development, thinning removals, and long-term harvest outcomes for representative silver birch-conifer mixed stands using the Swedish forest decision support system Heureka. For each stand and thinning strategy, we will estimate operational costs and revenues (harvesting, forwarding, transport, and product assortments) and quantify selected non-market impacts using a structured indicator framework, drawing valuation primarily from simulated data and the literature and validating key assumptions through stakeholder input where needed. Market and non-market components will be integrated in a stand-scale societal cost-benefit assessment reported as land expectation value per hectare. The study will identify trade-offs between land expectation value and ecosystem-service indicators and determine the cost and price thresholds at which small-diameter birch shifts from a low-value by-product to a viable bioenergy resource when externalities are accounted for. Expected outputs include a decision matrix linking stand characteristics and market conditions to feasible management options.

Biographical sketch: Swastika is a fourth-year PhD candidate at Luleå University of Technology, Division of Energy Science, Luleå, Sweden. Her research focuses on first-thinning biomass from Scandinavian mixed stands, examining how early silvicultural decisions affect bioenergy supply, logistics costs, and economic outcomes at the estate and stand level. Her work spans stand-level techno-economic analysis through to societal cost-benefit assessment of harvesting versus leaving thinning residues on site. Her main fields of scientific interest include energy systems analysis, spatial modelling, and forest-based value chains. Swastika holds an MSc in Sustainable Forest and Nature Management and a BSc in Botany.



Costantino De Palma

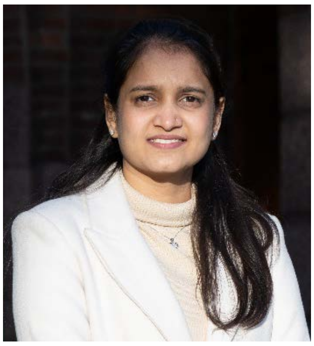
Mentor: **Felicity Addo**
Co-Mentor: **Federico Frank**

Research Project: **Resilient Framing Practices and Labor Requirements for Dietary Transition**

Abstract: Food system transformation hinges upon consumers adopting healthier, more sustainable diets but also on reimagining how food is produced. Resilience in farming systems shapes food security outcomes. Nevertheless, food system models rarely link farm-level decision-making to national transition pathways, creating an evidence gap in connecting agricultural transition with dietary change. While the UK Government advocates for healthier food environments and stronger domestic supply in its National Strategy, it remains unclear how such ambitions translate into action-based, agro-environmental schemes within the Agricultural Transition Plan.
This project aims to assess whether the transition to agroecological farming can support improved diets, while meeting government goals, and diagnostically evaluates how agricultural labor is affected in the process. By framing such transformation as a regime shift in the socioecological system, this project employs an integrated modelling approach combining farm-level surveys with the UK FABLE Calculator to identify national production configurations under changes in food demand.

By framing resilience as a continuous improvement trajectory linked to farm decision-making and expertise, this project strengthens IIASA's efforts to link modelling with national policy agendas and to integrate richer human–nature interaction dynamics into food system analysis.

Biographical sketch: Costantino De Palma is a second year PhD candidate in the Planetary Health and Climate Change Centre at London School of Hygiene and Tropical Medicine. He holds a Msc in Economic Policy and Analysis at Paris School of Economics and several years of experience as biostatistician in the public health sector. His research seeks to integrate knowledge from agricultural sciences and production economics with the public health agenda under a unified resilience thinking framework, in the attempt to understand how the UK agricultural sector can best align with national nutrition, environmental and justice goals.



Rutuben Gajera

Mentor: **Shubham Tiwari**
Co-Mentors: **Fabian Schipfer and Florian Kraxner**

Research Project: **Geospatial Optimization of Municipal Solid Waste Management Systems: Environmental and Social Trade-Offs**

Abstract: Municipal solid waste (MSW) management poses increasing challenges for sustainable land and resource governance, particularly in rapidly urbanizing regions where waste infrastructure competes with other land uses and generates environmental and social pressures. Globally, around 2.1 billion tonnes of MSW are generated annually, with a large share disposed of in landfills and open dumps. It contributes to land degradation, soil and water contamination, and air pollution, while simultaneously missing opportunities for material and energy recovery. These dynamics reflect systemic inefficiencies and highlight trade-offs between environmental protection, social acceptability, and resource efficiency. Despite advances in waste treatment technologies, strategic MSW planning often lacks spatially explicit, systems-based analysis that integrates environmental constraints, social considerations, and resource efficiency within unified analytical framework.
To address this gap, the study analyses how spatial factors and policy constraints influence MSW system performance. Specifically, it aims to evaluate geospatially explicit trade-offs among environmental protection, social constraints, and resource recovery in MSW management systems. The analysis applies the BeWhere spatially explicit system optimization model, using existing datasets on waste generation, land use, population distribution, transport networks, and environmental constraints to identify optimal MSW management pathways under multiple policy-relevant scenarios. The findings will provide insights into how geospatial and planning constraints influence sustainable MSW management systems, supporting more efficient, equitable, and circular urban waste management. Ultimately, the study will inform urban land-use planning and resource governance by delivering decision-relevant evidence for sustainable waste management strategies.

Biographical sketch: Rutuben Gajera is a doctoral student at KTH Royal Institute of Technology in the Division of Energy Systems. She holds a bachelor’s degree in civil engineering and a master’s degree in environmental engineering from India, where she developed strong foundations in infrastructure and environmental systems. Her PhD research is part of the BioCircularR project, “Towards Zero Waste through Circular Recovery Model,” examining municipal solid waste management in Sweden and India. Her research interests include circular economy, resource recovery, life cycle assessment, and spatial optimization of waste systems to support carbon-neutral and sustainable urban development.

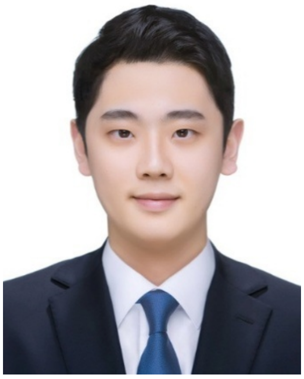
Verena Kröner

Mentor: **Tamás Krisztin**
Co-Mentors: **Stefan Frank and Omid Zamanidadaneh**

Research Project: **PASMEG-Modelling of EU Agricultural and Land Use Policy Impacts Using FADN Data for Germany**

Abstract: The 2023–2027 Common Agricultural Policy (CAP) marks a fundamental shift towards result- and performance-oriented governance, moving from a compliance-based implementation to national Strategic Plans. Under the new Performance Monitoring and Evaluation Framework (PMEF), EU Member States must demonstrate how their CAP Strategic Plans contribute to economic viability, environmental sustainability and social cohesion. However, current impact assessment methods rarely establish a consistent link between farm-level production choices and broader impacts such as market responses, land use change, or greenhouse gas emissions. Therefore, this research aims to use PASMEG in order to analyse EU agricultural policy impacts exemplified for Germany. The positive agricultural sector model for Germany (PASMEG) will be linked with the IIASA's global biosphere management model (GLOBIOM). The Farm Accountancy Data Network (FADN) for Germany is the primary data source and used for model specification and calibration. The model results demonstrate inherent trade-offs between agricultural production and sustainability goals, therefore enhancing agricultural and climate policy design. The PASMEG approach based on FADN data can be scaled up to other EU Member States, supporting consistent CAP impact assessments and informed decision-making under the PMEF.

Biographical sketch: Verena Kröner is a doctoral student and research assistant at the University of Natural Resources and Life Sciences, Vienna. She holds a master's degree in Agricultural Economics from the University of Hohenheim, Germany. Her research focuses on agricultural land-use modelling, climate change adaptation and mitigation.



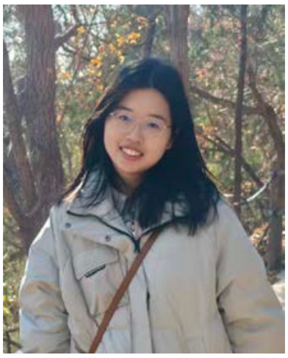
Younghun Lee

Mentor: **Albert Nkwasa**
Co-Mentor: **Rebekah Hinton**

Research Project: **Climate Change Alters Groundwater–Surface Water Connectivity, Reshaping Nitrate Transport Pathways**

Abstract: Climate change is a significant influence on water quality, impacting precipitation regimes, groundwater recharge patterns, and hydrological connectivity across watersheds. Nitrate is a major contaminant in agricultural systems, posing risks to aquatic ecosystems through eutrophication and, at elevated concentrations, to human health through drinking water contamination. In many agricultural regions, excessive fertilizer application leads to high nitrate inputs to soils, which can leach into groundwater systems. Once in the subsurface, nitrate can persist and later return to streams through baseflow, sustaining elevated concentrations even when surface inputs are reduced. Understanding these coupled pathways requires integrated representation of both surface and subsurface processes, which conventional watershed models often fail to capture. This study applies a coupled hydrogeological model (SWAT+gwflow), which integrates a grid-based groundwater flow component within the SWAT+ (Soil and Water Assessment Tool) framework, to examine how climate change influences surface water - groundwater connectivity and nitrate dynamics in an agricultural watershed. The model explicitly simulates groundwater heads, lateral subsurface flow, stream–aquifer exchanges, and nitrate transport processes, including advection, dispersion, and denitrification. The Tuckahoe Creek Watershed in the Chesapeake Bay region, Eastern United States, is selected as the case study due to its shallow Coastal Plain aquifers, intensive agricultural activity, and well-documented nitrate enrichment. Model calibration and validation are performed using multiple observational datasets, including streamflow, stream nitrate concentrations, groundwater levels, and groundwater nitrate concentrations. Future climate projections under different socio-economic development scenarios will be used to assess future changes in groundwater recharge, baseflow contributions, and nitrate transport. The findings are expected to inform water quality management by identifying how climate-driven shifts in recharge and subsurface flow pathways influence nitrate transport in agricultural watersheds.

Biographical sketch: Younghun Lee is a Ph.D. student in Environmental Science and Ecological Engineering at Korea University. His research focuses on hydrological modeling and water quality analysis across watershed systems, including surface water, groundwater, and soil systems. He applies data-driven approaches, including machine learning and deep learning, alongside process-based modeling to investigate biogeochemical processes such as carbon and nitrogen cycling.



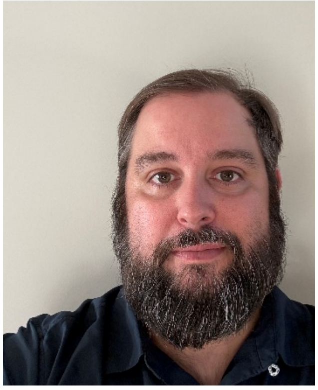
Shiyu Li

Mentor: **Taher Kahil**
Co-Mentor: **Julian Joseph**

Research Project: **Low-Carbon Allocation Pathways for Global Unconventional Water Resources**

Abstract: Global water scarcity is increasingly addressed through unconventional water resources, including desalination, wastewater reuse, groundwater abstraction, rainwater harvesting, and inter-basin transfers. While these options enhance water availability and reduce water scarcity, they are often energy-intensive and associated with considerable carbon emissions, creating trade-offs between water security and climate mitigation. This research aims to quantify the historical energy and carbon burdens of unconventional water use and to develop future low-carbon allocation pathways under climate change. Historical unconventional water allocation (1985–2014) will be reconstructed at 0.5° resolution by identifying water supply gaps from sectoral demand and surface water availability. A harmonized global database of unconventional water resources will be developed and combined with machine-learning–based probabilistic allocation and Monte Carlo sampling to generate ensembles of feasible historical configurations. Future pathways will be explored under SSP1-2.6, SSP3-7.0, and SSP5-8.5 using a multi-objective optimization framework that minimizes energy use and CO_2 emissions while maintaining water service provision. The study will identify regional transition strategies, offering a roadmap for decarbonizing the water sector while ensuring reliable service provision under climate change.

Biographical sketch: Shiyu Li is a fourth-year PhD candidate at the College of Environmental Sciences and Engineering at Peking University. She holds a Bachelor’s degree in Environmental Science from Beijing Normal University. Her broader research focuses on coupled water-energy systems under climate change. At IIASA, she aims to investigate how unconventional water resources have historically supported water supply systems, their associated energy and carbon costs, and how future allocation pathways can facilitate low-carbon transitions. Her previous expertise includes assessing global hydroclimatic risks to thermal power generation and identifying strategic decommissioning pathways to maintain operational reliability under changing climates.



Richard Manner

Mentor: **Pekka Lauri**

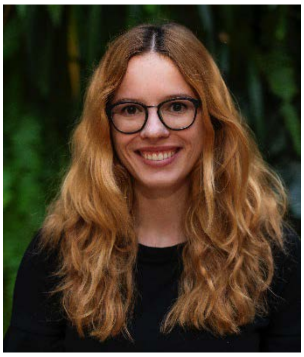
Research Project: **EU Sub-Regional Timber Supply Model**

Abstract: With the Biodiversity Strategy, Forest Strategy, and Nature Restoration Regulation, the European Union (EU) has outlined forest preservation and restoration targets for the Member States (MS). This more multi-pronged EU forest strategy, coupled with EU Member States' (MS) diverse forest management practices and priorities, results in a wide variety of adoption and implementations at the national level. A new EU focused implementation of the Sub-Regional Timber Supply (SRTS) model will enable study of the feedback loop among strategic targets, market forces, and forest resource evolution as MS implement various national policies. Land use change (LUC) is a direct tool to reshape forests. One of the proposed technical innovations of this study will design and develop a new LUC module to capture MS priorities and the resulting forest LUC directly in SRTS.

The SRTS model structure lends itself to the study of sub-regional conditions within a broader market context; a natural fit for modeling MS within the broader EU. It is a bio-economic model, providing advantages over more forest inventory-focused models by capturing market dynamics in addition to forest inventory accounting. The detailed MS-level forest projections will identify how forest inventory composition evolves through time under a variety of policy and economic conditions. It will, therefore, be possible to explore the state of future forest climate resiliency as current forest compositions give way to future cohorts.

The aims of this work are threefold: 1) leverage EU MS forest data to produce inputs for the SRTS model, 2) build a forest LUC module that projects MS forest conversion given EU directives, and 3) develop a set of forward-looking forest inventory and market projections for EU MS.

Biographical sketch: Richard holds a B.S. from Michigan State University in Economics, a M.S. from NC State University in Forestry and Environmental Resources (FER) with a minor in Economics and is currently enrolled in a FER PhD program at NC State University. Prior to graduate school, he embarked on a career in retail analytics, helping apparel retailers identify assortment and supply chain efficiencies through the application of data analysis, modeling, and optimization. His current research focuses on the application of machine learning/data science to climate-related forest risks and forest economics modeling.



Sandra Neubert

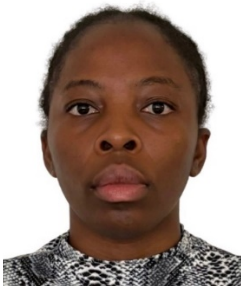
Mentor: **Piero Visconti**
Co-Mentor: **Martin Jung**

Research Project: **Aligning Nature Finance Objectives with Systematic Conservation Planning**

Abstract: Nature finance mechanisms and emerging nature markets have become central tools for addressing global environmental crises, including biodiversity loss, ecosystem degradation, and climate change. These mechanisms aim to mobilize capital toward nature-positive outcomes. However, there remains a clear disconnect between financial instruments and approaches identifying where to take action for the best outcomes for biodiversity, for example through systematic conservation planning, which has a long history of supporting cost-efficient, transparent, and ecologically robust conservation decisions. Financial mechanisms are often designed to allocate capital with little consideration of core systematic conservation planning principles for biodiversity persistence such as representation, adequacy, and connectivity, while conservation planners rarely frame planning outputs in ways that align with financial incentives, constraints, or risk frameworks.

In my YSSP project, I will examine how integrated spatial planning approaches and nature finance mechanisms can be more systematically linked. This will involve implementing a systematic conservation planning case study that incorporates information relevant to financial decision-making, such as costs, constraints, and risk-related considerations. Using this case study, I will identify conceptual mismatches, institutional barriers, and opportunities for integration, and demonstrate how spatial planning outputs and datasets can be translated into finance-relevant information that supports investment and allocation decisions. These findings can contribute to the uptake of integrated spatial planning by embedding it within nature finance processes, supporting conservation outcomes that are both ecologically effective and financially credible.

Biographical sketch: Sandra is a third-year PhD candidate as part of a collaborative project between the University of Queensland in Australia and the University of Exeter in the UK. Her research focuses on multiple-use spatial planning and aims to explore how human activities can be effectively integrated into conservation planning to optimize benefits while minimizing the associated costs for both conservation and sustainable use. Sandra holds a BSc (Hons) in Marine Biology from the University of Plymouth and an MSc in Bioinformatics from the University of Leipzig.



Bright Olunusi

Mentor: **Martin Jung**
Co-Mentor: **Oskar Franklin**

Research Project: **Modeling Adaptive Behavior and Institutional Dynamics in Climate-Stressed Human-Elephant Conflict**

Abstract: Human-elephant conflict emerges from interacting ecological, behavioral, and institutional processes that intensify under climate variability and land-use change. Existing models often represent either ecological dynamics or human decision-making in detail, while treating the other as fixed and non-adaptive. This project builds on an existing socio-ecological agent-based model in which elephants and farmers act as adaptive agents and evaluates how institutional responses shape conflict outcomes.

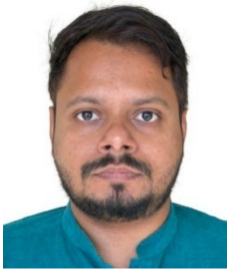
The model simulates elephant movement using optimal foraging theory and farmer decision-making based on expected utility under risk aversion within a spatially explicit landscape. It incorporates vegetation dynamics, drought stress, and crop attractiveness to generate spatial patterns of crop raiding and farmer responses. Prior to the YSSP, fieldwork in Omo Forest Reserve, Nigeria, will provide empirical data on conflict experiences, crop choices, and perceptions of risk and institutional response.

During the YSSP, ecological and drought mechanisms will be refined using field data and published studies. Institutional response is introduced as an exogenous condition, focusing on compensation timing and reliability, and scenario-based experiments examine how climate stress and institutional performance shape conflict trajectories. Factorial simulations varying drought intensity and compensation design identify threshold conditions under which cooperation is sustained or collapses into self-reinforcing conflict traps.

The model is grounded in observed patterns of human-elephant conflict in southwestern Nigeria and plausible parameter ranges from the literature, with validation focused on reproducing spatial clustering of raids and seasonal dynamics. This approach provides insights into how adaptive behavior interacts with climate stress and institutional response, informing effective, resilient conservation policies.

Biographical sketch:

Bright Oluwatomilola Olunusi is a PhD candidate in the Department of Global Development at Cornell University, working at the intersection of socio-ecological systems, rural development, environmental governance, and human-wildlife conflict. Her research uses agent-based modeling and social science theory to examine how climate change, land-use dynamics, and human decision-making shape conservation outcomes. She has conducted research on food security and wildlife trade in Nigeria and human-wildlife interactions in the United States. Bright holds an MA in Earth and Environmental Science from Boston University and a BSc in Wildlife Management from the University of Ibadan, Nigeria.



Ayush Kumar Pandey

Mentor: **Shubham Tiwari**
Co-Mentors: **Fabian Schipfer and Florian Kraxner**

Research Project: **Cost-Optimal Design of Hydrogen Supply Chains**

Abstract: Hydrogen acts as a bridge between renewable and non-renewable energy sources due to its diverse production pathways. Emissions from fossil-based routes require sequestration, while variability in feedstocks, conversion, and purification complicates adoption. Moreover, hydrogen's properties at ambient conditions demand transformations in form, storage, and transport, which are technologically demanding and costly. These challenges underpin techno-economic analyses of hydrogen production, storage, and transportation, guiding integration into the energy spectrum and assessing scalability of delivery systems. At the system level, such variabilities complicate decision-making, especially when hydrogen is embedded within supply chain frameworks.

Hydrogen supply chains are central to enabling adoption. They encompass feedstocks, production, storage, transport, and demand, all influenced by spatial distribution of resources. Effective allocation based on demand and natural resource availability enhances cost-effectiveness and planning. The proposed study examines facility allocation in hydrogen supply chains using the BeWhere model. Centralized hydrogen production relies on renewable energy (RE) potential, which is inherently temporal, while demand reflects consumption patterns distributed across geographic entities. Addressing these temporal dynamics requires spatial analysis to optimize resource placement. By considering technical and economic constraints, the study configures an optimal supply chain that balances disparities in renewable energy potential with the temporality of demand. This approach supports efficient resource allocation, strengthens supply chain resilience, and advances hydrogen integration into broader energy systems.

Biographical sketch: Ayush Kumar Pandey is a PhD candidate at the Center for Energy and Environment, Malaviya National Institute of Technology, Jaipur, India. He holds an MTech in Computer-Aided Design and a BTech in Mechanical Engineering from HBTU Kanpur and KIET Group of Institutions, Uttar Pradesh. His research focuses on techno-economic analysis, supply chain optimization, and hydrogen energy adoption. He has published two peer-reviewed articles and presented them at four national and international conferences. Ayush also has experience in ambient air pollution measurement and conducts hydrogen-related experiments, including plasma-based production, integrated systems, and fuel cell testing.

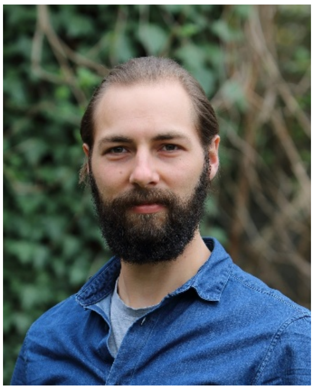
Aatralarasi Saravanan

Mentor: **Rastislav Skalsky**
Co-Mentor: **Florian Hofhansl**

Research Project: **Supporting Agro-Hydrological Governance in Data-Scarce Regions with Inverted Aquacrop Modeling**

Abstract: The IPCC's Sixth Assessment Report stated that global warming is projected to intensify the water cycle, increasing evaporation, shifting rainfall timing, and amplifying the severity of both wet and dry events. Hydrological projections, especially in developing countries, tend to be less accurate due to the limited availability of ground agro-hydrological data. Additionally, the spatial resolution of remote sensing and reanalysis products is coarse, which, if relied on solely, increases uncertainty. Hence, this leads to the mismanagement of hydrological resources in the developing countries. The present YSSP project aims to enhance data availability in data-scarce regions by using vegetation data as an indicator of soil moisture. I propose using an Inverted-AquaCrop (I-AC) model, in which crop yield serves as input to simulate irrigation amounts and soil moisture profiles. The primary objective of this project is to calculate drought exposure, irrigation gaps, and other vulnerability indices based on high-resolution soil moisture profiles simulated by the I-AC model for data-scarce regions. Initially, the I-AC model will be used to simulate soil moisture profiles for scenarios sustainably designed using EPIC-IIASA Hypercubes: the Historical period (HIS), the Future period with Business-as-usual management (FUT-BAU), the Future Period with ideal climate-resilient management (FUT-CRI), and the Future Period with pragmatic climate-resilient management (FUT-CRP). Following this, using the I-AC output and the knowledge of farmers and irrigation experts, drought and vulnerability indicators will be calculated. These indicators will help determine the regions with the highest marginal yields and identify those that are consistently disadvantaged. The results of this project will serve as guidelines for policymakers and experts in Cotton Research Institutes to manage agro-hydrological resources for sustained production.

Biographical sketch: Aatralarasi Saravanan is a Doctoral Researcher in the Joint PhD Program in Integrated Management of Soil, Water and Waste at the Technische Universität Dresden in cooperation with UNU-FLORES, Germany. Her doctoral research focuses on climate change and water availability in data-scarce regions, advancing the nexus of water, soil, and atmosphere through remote sensing and modeling. Specifically, her work aims to address data scarcity by integrating remote-sensing-based vegetation products into an inverse crop simulation model. She holds a Master of Science in Agricultural Meteorology from Punjab Agricultural University and a Bachelor of Science in Agriculture from Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA & RI). Her research interests span hydroclimatic modeling, remote sensing, climate change adaptation, and sustainable agricultural water management.



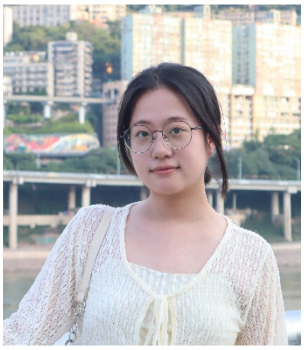
Jendrik Windt

Mentor: **Adrienne Etard**

Research Project: **Collision and Avoidance: How Red Kites Navigate Europe's Wind Energy Facilities**

Abstract: Rapid expansion of wind energy across Europe has intensified concerns about lethal collisions between birds and turbines, prompting restrictive permitting and exclusion zones that can stall deployment and potentially undermine climate goals. The red kite (*Milvus milvus*) is an ideal candidate to represent various species possibly affected by wind power. While collision mortality is implicated in regional population declines in Germany and Spain, populations elsewhere remain stable or are increasing. Leveraging the EU wide distribution of the species and conservation frameworks, this study quantifies how intrinsic and extrinsic factors associated with wind power influence red kite collision risk and avoidance behavior. Using GPS telemetry across breeding, migration, and wintering periods, we apply integrated Step Selection Analysis to estimate relative selection strength with respect to turbine proximity within multiple buffers. Intrinsic predictors include age, sex, conspecific density and extrinsic factors weather, season, time of day, region, and land cover as well as various management implications to reduce collision risk. This design enables the first empirical, multi-country estimates of mortality probability while traversing wind farms, distinguishing meso- and macro-avoidance from conditions that elevate collision risk. Anticipated outputs will identify effective mitigations, and evaluate previously known methods such as targeted shutdowns, siting and design adjustments, and habitat management to reduce attraction near turbine bases. Results will therefore enable to examine whether and to what extent individual red kites avoid wind farms, indicating potential habitat loss and degradation, as well as to support further selection of management tools to conserve the red kite and similar species.

Biographical sketch: Jendrik Windt is a doctoral candidate at the Institute of Wildlife Biology and Game Management, BOKU University Vienna. He holds an MSc in Wildlife Ecology and Wildlife Management from BOKU University Vienna and University of Veterinary Medicine Vienna. In his research, he develops, tests and evaluates modeling approaches to investigate ecological questions and to inform sustainable management and conservation of wildlife. His research focuses on the population dynamics and behavioral ecology of a wide variety of species, including birds and mammals.



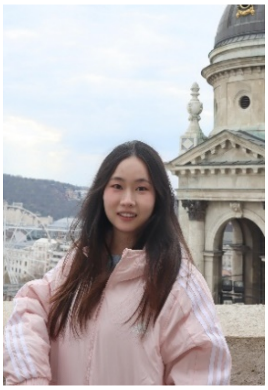
Wenxiu Yan

Mentor: **David Leclere**

Research Project: **Integrated Assessment of Nitrogen, Phosphorus and Potassium Cycling and Sustainability in Global Agricultural Systems**

Abstract: Sustainable nutrient management is essential to maintain agricultural productivity and address environmental pollution within a Safe and Just Operating Space. Analyzing the interactions between nutrients and improving resource recycling are therefore critical for reducing nutrient losses and enhancing system efficiency. However, current large-scale assessments often overlook potassium (K), despite its key role in crop growth and its interactions with nitrogen (N) and phosphorus (P). This research aims to advance integrated modeling of agricultural nutrient systems by explicitly incorporating K cycling into GLOBIOM and jointly analyzing N–P–K interactions. Building on existing representations of N and P, the study develops a consistent framework to quantify NPK inputs, outputs, soil balances, and nutrient use efficiencies across cropland systems. Using this framework, the research evaluates nutrient use under different management and policy scenarios, with a focus on conditions where potassium limits crop yields. For scenarios involving simultaneous increases in K inputs and yields, the study quantifies the associated changes in N and P requirements under assumed trajectories of nitrogen and phosphorus use efficiency (NUE and PUE), thereby capturing cross-nutrient interactions. By embedding integrated N–P–K cycling into an assessment model, the study assesses the socio-economic and environmental implications of alternative nutrient management strategies, including impacts on crop production, fertilizer demand, and nutrient-related environmental pressures.

Biographical sketch: Wenxiu Yan is a PhD candidate majoring in Agricultural Resources and Environment at Zhejiang university. Her research focuses on integrated assessment of agricultural nutrient management for sustainable development, covering food security, economic performance, environmental sustainability, and social outcomes, with an emphasis on the coordinated analysis of nitrogen, phosphorus, and potassium. She has experience with GLOBIOM modeling through the Horizon Europe project ForestNavigator and NSFC-IIASA project, and is skilled in analyzing large-scale simulation outputs.



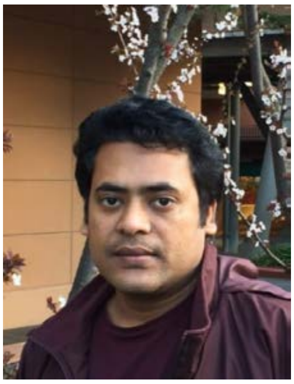
Longyi Zhang

Mentor: **Andrey Krasovskiy**
Co-Mentor: **Hyun-Woo Jo**

Research Project: **Global Wildfire Projection Under Climate Change**

Abstract: Global wildfires have become a major environmental and public health challenge under climate change. Although global burned area has generally declined in recent decades, wildfire emissions, smoke exposure, and related health risks have not changed in parallel. This mismatch suggests that burned area alone is insufficient for assessing future wildfire risks, especially as climate change and population exposure may further amplify fire-related impacts.
This study applies the wildFire cLimate impacts and Adaptation Model (FLAM), a process-based fire model, to simulate future global burned area, carbon emissions, pollutant emissions, and associated health burdens under multiple scenarios. FLAM operates at a daily time step and integrates climate conditions, fuel availability, vegetation structure, human activities, and fire suppression processes to represent ignition probability, burned area, fire spread, and fire-related emissions. By combining climate, vegetation, fuel, land-use, population, and socioeconomic drivers under different climate scenarios to the end of this century (i.e., SSP119, SSP126, SSP245, and SSP370), this study will project future wildfire activity and emission changes across spatial scales, which support further assessment of wildfire impacts.
One of the key aspects of this study will be to examine the historical variation and future trends of fire suppression efficiency in FLAM, and to quantify the relative contributions of climate change, fuel dynamics, vegetation change, population change, socioeconomic development, and suppression processes to future changes in burned area, emissions, and health burdens. The results will help identify future wildfire hotspots, reveal dominant drivers of regional risk, and provide scientific support for wildfire management, air pollution control, and public health protection under climate change.

Biographical sketch: Longyi Zhang is a PhD candidate in Environmental Science and Engineering at Tsinghua University. Her research focuses on wildfire activity, fire emissions, $PM_{2.5}$ exposure, and health risk assessment under global environmental change, with particular interest in how climate change, human activities, land-use change, and fire management jointly shape future wildfire risks. Her doctoral research integrates process-based modeling, machine learning, chemical transport modeling, and health risk assessment to analyze historical changes and future trends in global burned area, fire emissions, $PM_{2.5}$ exposure, and related health burdens. From 2025 to 2026, she was a visiting scientist at the International Institute for Applied Systems Analysis (IIASA), where she researched global wildfire simulation and future scenario analysis using the FLAM process-based model.



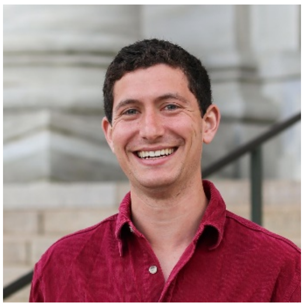
Muhammad Jahangir Alam

Mentor: **Martina Otavova**
Co-Mentor: **Shonali Pachauri**

Research Project: **Quantifying the Mediating Role of Decent Living Standards in the Climate-Child Health Nexus in India**

Abstract: While the link between hydroclimatic stress and undernutrition is well documented, the role of material living standards in mediating this relationship remains critically underexplored. This project aims to empirically validate the "Protective Shield" hypothesis: that fulfilling the Decent Living Standards (DLS) prerequisites significantly reduces the adverse effects of climate vulnerability on child health outcomes, specifically anemia and anthropometric failure.
Utilizing a systems-based approach, the study first establishes a household-level DLS Deprivation Count for India. It then employs multilevel mixed-effects modeling to quantify the mediation effect of these DLS inputs (e.g., energy for food preservation, clean cooking, and sanitation) in the climate-health nexus. Finally, the research estimates the magnitude of resource investment required to achieve DLS for the most deprived populations. By linking these empirical findings to future Integrated Assessment models, the project provides a quantitative foundation for the "Climate Dividend," arguing that targeted social infrastructure is the most effective strategy for building climate resilience in vulnerable populations.

Biographical sketch: Muhammad Jahangir Alam is a Joint Director at Bangladesh Bank and a PhD Scholar at the Indian Institute of Science. A former JDS Scholar with a Master's in Economics from the International University of Japan, he has over 15 years of experience in central banking, specializing in sustainable finance and financial inclusion. A recipient of the SAARCFinance Scholarship and the 2026 NCI Research Laureate Award, his research integrates climate risk, human vulnerability, and development policy. At IIASA's Energy, Climate, and Environment Program, he investigates how Decent Living Standards (DLS), such as clean energy, water, and sanitation, act as a "climate dividend" to protect against health risks. His work aims to translate household-level empirical evidence into frameworks that enhance resilience and optimize resource allocation.



Ari Ball-Burack

Mentor: **Leila Niamir**
Co-Mentor: **Paul Kishimoto**

Research Project: **Empirically Grounded Agent-Based Modeling to Inform Road Transport Decarbonization Policy in California**

Abstract: Agent-based models (ABM) are ideal tools for modeling complex systems of interacting agents, making them well-suited for informing public policy to accelerate household energy decarbonization. However, they are difficult to calibrate, obfuscating the link between their behavioral insights and real-world policy implications. This study uses neural simulation-based inference (SBI) to calibrate a large-scale ABM of vehicle choice in California. In doing so, it helps illuminate which factors are most important for vehicle adoption, and illustrates which policy interventions might be most effective in accelerating the diffusion of zero-emission vehicles. Furthermore, its high degree of spatial granularity allows policymakers to assess not only the pace of decarbonization, but also distributional effects across socioeconomic status and geography. This enables more equitable policymaking and infrastructure development. The use of neural SBI to calibrate large-scale ABM is promising for transfer to other sectors and geographies, enabling a wide range of decarbonization policy decision support applications.

Biographical sketch: Ari Ball-Burack is a third-year PhD student in the Energy & Resources Group at the University of California, Berkeley, advised by Dr. Duncan Callaway and Dr. Dan Kammen. His research works to incorporate key complexities, such as technological innovation and consumer adoption behavior, in energy system models and climate policy decision support tools. His current projects investigate decarbonization policy complementarities at the national and global levels, distributional equity in electric vehicle charging infrastructure, representations of consumer adoption in multi-sector energy system models, the limits of linear specifications for modeling technology adoption, and granular adoption modeling for low-carbon technologies. Ari graduated from Williams College, where he studied Computer Science and Physics, and received MPhil degrees in Advanced Computer Science and Environmental Policy from the University of Cambridge. Prior to joining UC Berkeley, he worked as a researcher at the Cambridge Institute for Sustainability Leadership. Concurrently with his PhD, he has worked for the World Bank, the County of Napa, and Evolved Energy Research, and he was a visiting researcher at the University of Chicago's Institute for Mathematical and Statistical Innovation.

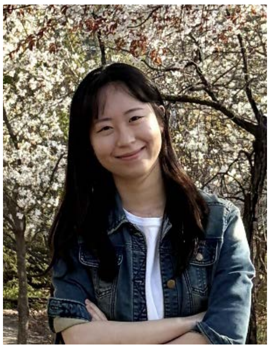
Wen Jiang

Mentor: **Keywan Riahi**
Co-Mentors: **Alessio Mastrucci; Shuhaib Nawawi**

Research Project: **Quantifying the Demand-Side Mitigation Potential of Residential Heating Behavior Change Under the 1.5°C Target**

Abstract: Individuals can contribute substantially to climate mitigation by changing their behaviors and lifestyles. Although everyday actions, such as adjusting indoor temperatures, may seem incremental, their cumulative impact can be significant, given that household consumption accounts for approximately two-thirds of global greenhouse gas emissions. Existing research consistently shows that lifestyle and behavioral changes can deliver meaningful and near-term emission reductions. However, current integrated assessment models (IAMs) typically represent behavior as static or exogenous, which limits their ability to realistically assess the mitigation potential of behavioral change and its role in meeting climate targets. This project focuses on residential heating-related behaviors and aims to address this gap by coupling a self-developed, mechanism-based behavior change model with the MESSAGEix-Buildings model. This coupling will enable the endogenous representation of evolving household behavior within an IAM setting. Building on this framework, the project will quantify how many people are likely to change their heating behaviors, how these behavioral changes interact with residential energy demand at the household level, and how much heating demand and associated emissions can be reduced under SSP2. Overall, the project will provide a more realistic and robust assessment of behavior-driven mitigation pathways and support the improved integration of demand-side dynamics into integrated assessment modelling.

Biographical sketch: Wen Jiang is a second-year PhD candidate in Geography and Environmental Sciences at the University of Birmingham, funded by NERC-CENTA. Her research focuses on climate-friendly behavior modelling and impact analysis, with the aim of developing a behavior change model to better understand how people may adopt climate-friendly behaviors and to inform the design of demand-side mitigation strategies.



Bomi Kim

Mentor: **Younha Kim**

Research Project: **High-Resolution Methane Mitigation Pathways in South Korea**

Abstract: Despite increasing global attention to methane mitigation, including initiatives such as the Global Methane Pledge (GMP), significant uncertainties remain. In particular, translating national reduction targets into practical and spatially explicit implementation pathways remains challenging. South Korea has also set a national target to reduce methane (CH4) emissions by 30% by 2030 compared to 2020 levels. Achieving this target requires consideration of sectoral characteristics and implementation conditions. Methane emissions in South Korea are largely dominated by non-energy sectors and depend on sector-specific management practices and regional conditions. However, existing studies mainly estimate mitigation potential at aggregated national or sectoral levels, providing limited insight into how targets can be implemented across sectors and regions. This study develops a framework to construct high-resolution methane emission pathways in South Korea, linking national targets with sectoral and regional pathways. Both baseline and mitigation scenarios are developed, enabling comparison between trend-based emissions and policy-driven reductions aligned with national targets. Spatial allocation methods are used to represent regional variation in emissions. The results show how mitigation outcomes differ by sector and region. They provide practical insights for implementing methane reduction strategies and highlight opportunities that are not captured in aggregated national assessments.

Biographical sketch: Bomi Kim is a Ph.D. candidate in Integrated Climate and Air Quality at Konkuk University. She received her B.S. in Geography and M.S. in Environmental Engineering from Konkuk University. Her research focuses on short-lived climate forcers in the context of climate and air quality policy. She develops and utilizes integrated assessment models to evaluate the impacts of environmental policies on future emissions, air quality, and health impacts, with a particular focus on Northeast Asia. Her work aims to improve the scientific basis for policy design by linking emission pathways with real-world environmental and health impacts.

Katelyn McVay

Mentor: **Gregor Kiesewetter**
Co-Mentor: **Fabian Wagner**

Research Project: **The Post-Socialist Pollution Burden: Emissions Contributions and Air Quality Inequity in Central and Eastern Europe**

Abstract: Despite two decades of air quality improvements across Europe, a persistent East-West divide remains, defining a pattern of continental pollution inequality. PM2.5 concentrations are approximately one-third higher in the poorest EU regions, which are concentrated primarily in Central and Eastern European countries. This disparity reflects the legacy of socialist-era industrialization, which is characterized by decades of heavy industry prioritized over environmental protection, coal-dependent energy systems, deteriorating infrastructure, and delayed adoption of EU environmental standards. Today, countries like Poland, Bulgaria, and Romania experience among Europe's highest pollution-attributable mortality rates, while the Western Balkans face even more severe conditions outside the EU regulatory framework.This project applies a contribution-burden attribution framework to examine which populations bear disproportionate pollution burdens relative to their emissions contributions across Central and Eastern Europe. Using IIASA's GAINS model outputs for 14 post-socialist countries (8 EU members: Poland, Czechia, Hungary, Slovakia, Romania, Bulgaria, Slovenia, Croatia; and 6 Western Balkan states: Serbia, Bosnia and Herzegovina, North Macedonia, Albania, Montenegro, Kosovo), this project will quantify PM2.5 contributions by sector and geographic origin and estimate attributable morbidity and mortality burdens. These outputs will be stratified across socioeconomic classes to describe inequities within and across the selected countries. Statistical and spatial-temporal analyses will identify where EU decarbonization policy interventions may be most effective along with the pathways that can maximize equity co-benefits for Central and Eastern European populations.

Biographical sketch: Katelyn is a second-year Ph.D. student in Environmental Health Sciences at Emory University. Her research integrates principles of planetary health and systems-thinking approaches to study the relationships between environmental risk factors and human health using geospatial modeling and mixed methodology. More specifically, she is interested in environmental justice issues and developing geospatial software for collaborative research. Katelyn holds a Master of City Planning degree from the Massachusetts Institute of Technology and a Bachelor of Science degree from the University of Wisconsin-Madison, where she majored in Global Health, Botany, and Environmental Studies. She is committed to utilizing her interdisciplinary background to better understand the sociopolitical and scientific factors that contribute to environmental health outcomes in built and natural environments.

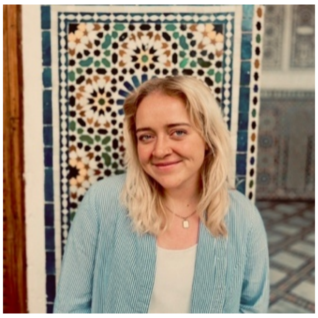
Tussle Mundowa

Mentor: **Kai Kornhuber**
Co-Mentor: **Carl Schleussner**

Research Project: **Attributing Mortality Losses and Damages to Anthropogenic Climate Change in South Africa**

Abstract: Climate change is increasing the frequency and intensity of extreme weather events, yet the excess mortality attributable to anthropogenic forcing and to specific historical emitters remains poorly quantified. The evidence base is dominated by temperature-only studies concentrated in developed countries, rarely examines compound hazards such as co-occurring heatwaves and droughts, and largely overlooks how pre-existing comorbidities amplify climate-mortality risk. This limits the global evidence available for loss and damage negotiations and climate justice. South Africa, with its high HIV/AIDS, tuberculosis, and cardiovascular and other non-communicable disease burdens alongside rising exposure to compound extremes, offers a uniquely informative case to address these gaps. This project conducts the first end-to-end climate-mortality attribution analysis for South Africa, establishing a transferable framework for developing countries, in three steps. First, using ~11.3 million individual death records (1997–2018) across 52 districts from the South African Medical Research Council, combined with high-resolution climate data, a panel fixed-effects regression framework estimates the causal impact of single and compound climate hazards on all-cause mortality, and tests how comorbidities amplify this risk. Second, these econometric estimates are combined with counterfactual climate data from IIASA's Rapid Impact Model Emulator (RIME) to isolate the mortality burden attributable to all anthropogenic forcing and to individual large historical emitters, including carbon majors and specific countries. Third, attributable excess deaths are valued using statistical-value-of-life estimates to quantify corresponding economic losses. By linking emitter-specific responsibilities to mortality outcomes in a high-burden developing country, the results contribute directly to global loss and damage discourse, climate justice and litigation, and health adaptation priorities.

Biographical sketch: Tussle Mundowa is a fourth-year PhD candidate in Economics at the University of Cape Town, affiliated with the African Climate and Development Initiative's Climate Risk Lab. His doctoral research quantifies socioeconomic impacts of anthropogenic climate change on mortality, education, and agricultural yields. Using econometric methods with counterfactual data from climate models and emulators, he isolates attributable losses and their monetary value, providing evidence for loss and damage, climate justice, and litigation. He holds an MSc in Big Data Analytics from Chinhoyi University of Technology, an MSc in Economics, and a BSc Honours in Economics from the University of Zimbabwe.



Georgia Ray

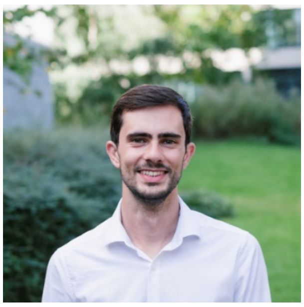
Mentor: **Verena Kain**
Co-Mentors: **Volker Krey, Vignesh Raghunathan, Keywan Riahi**

Research Project: **Emulating Climate Mitigation Scenarios: A Neural Surrogate Prototype for Message**

Abstract: Many downstream users of climate mitigation models treat individual integrated assessment model (IAM) runs as definitive forecasts rather than sparse, design-dependent samples of many plausible futures. Corporate target-setting frameworks and some policy applications often rely on a single pathway, or few pathways (for example, one net-zero or two-degree scenario), reinforcing a misleading sense of absoluteness in IAM outputs. This problem is amplified by misunderstandings of the Shared Socioeconomic Pathways (SSPs), where alternative "baseline" narratives are sometimes reinterpreted as action versus inaction trajectories.

This project proposes a neural surrogate for the MESSAGE IAM that emulates a single model framework's scenario ensemble and densifies it with additional, internally consistent futures. The surrogate is designed as an emulator passing stipulations required of all modelling teams, such as sum check. It learns from existing MESSAGE runs while incorporating domain-specific loss functions and internal consistency checks so that generated trajectories respect core feasibility constraints. By treating the IAM as a simulator and training neural surrogates on its outputs, the project aims to accelerate scenario generation and enable uncertainty-aware exploration around existing runs. The anticipated contribution is a fast, validated emulator producing synthetic scenarios and thereby shifting attention from single-point IAM projections to ranges of futures; futures which reflect the internal consistency of a MESSAGE model but in a way that is learned statistically rather than prescribed mechanistically.

Biographical sketch: Georgia Ray is a second year PhD student at Imperial College London, co-supervised by the Centre for Environmental Policy and Data Science Imperial. Her doctoral research focuses on the intersection of climate mitigation and machine learning, with a particular emphasis on corporate decarbonisation applications and emulations of climate mitigation models. She also has an interest in the epistemological foundations of modelling, and validation of generative model outputs. Concurrent to conducting doctoral research, she works as a machine learning engineer for an environmental legal non-profit, The Chancery Lane Project. She was previously a Data Science Fellow at Faculty AI, and holds a distinction in the MSc in Environmental Data Science and Machine Learning from Imperial College London.



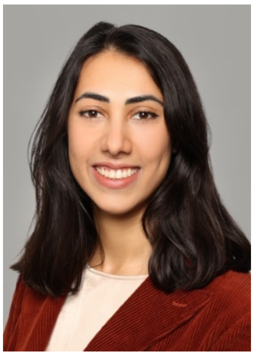
Alejandro Romero Prieto

Mentor: **Chris Smith**
Co-Mentor: **Alexander Nauels**

Research Project: **Evaluation Of Carbon Cycle Dynamics Across the Climate Modelling Hierarchy**

Abstract: Reduced-complexity Models (RCMs) are a crucial tool in climate science, enabling efficient climate projections. However, their usefulness is contingent on their accuracy. While previous RCM intercomparisons have analysed RCM projections of future global temperature and certain climate metrics, key gaps remain. Among these, the carbon cycle stands out, displaying substantial differences across RCMs. Accurate emulation of the carbon cycle is critical to understand possible climate futures in overshoot and post-net-zero scenarios, providing key insights into the effectiveness of future emission pathways in addressing climate change.
This project leverages IIASA's expertise to address this gap by continuing the Reduced Complexity Model Intercomparison project (RCMIP) with a third phase (RCMIP3) focusing on the carbon cycle. In collaboration with Dr. Chris Smith and Dr. Alexander Nauels, we will analyse carbon cycle dynamics across the model hierarchy under different idealised scenarios, comparing RCM output with Earth System Model (ESM) simulations. From this analysis, we will improve our understanding of RCM biases concerning the carbon cycle and the potential implications of using these models. Our results will inform the upcoming IPCC assessment report (AR7), thereby having a substantial impact in the wider climate science field, as well as guiding future RCM development.

Biographical sketch: Alejandro Romero Prieto is a Postgraduate Researcher at the University of Leeds, UK. He holds an MSc in Computational Applied Mathematics from the University of Edinburgh, and a bachelor's in physics from the Universidad Autónoma de Madrid. Before his time as a researcher, he also worked as a software engineer. He is passionate about leveraging his computational and mathematical skills to increase our understanding of the climate system and future climate change. His research focuses on Reduced-complexity Climate Models (RCMs), an essential tool in climate science that enables the rapid projections of climate futures, often employed in decision-making contexts.



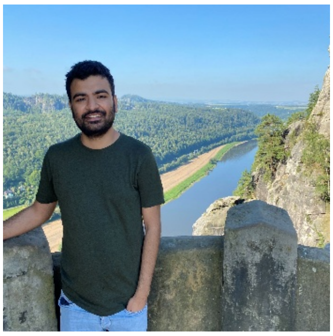
Gayatri Sehdev

Mentor **Setu Pelz**
Co-Mentor: **Shonali Pachauri**

Research Project: **A Justice-Informed Assessment of Marine Carbon Dioxide Removal Pathways**

Abstract: Carbon dioxide removal (CDR) is increasingly embedded in climate mitigation pathways, particularly to compensate for residual emissions and potential mitigation shortfalls. However, the large-scale deployment of CDR, especially in marine environments, raises unresolved questions of justice across spatial, social, and temporal dimensions. While integrated assessment models (IAMs) play a central role in shaping mitigation scenarios, justice considerations are often treated implicitly or remain outside the core logic of scenario evaluation. This project develops a justice-informed framework to assess marine CDR within mitigation scenarios. Building on IIASA's Applied Justice Taxonomy and Assessment Framework (AJUST), it operationalizes multiple dimensions of justice into qualitative and threshold-based criteria. The framework is applied to selected IAM-based scenarios to evaluate key dimensions such as governance capacity, permanence, monitoring and liability, and intergenerational risk transfer. Rather than modifying model structures, justice is introduced as an evaluative layer to identify ethical constraints, governance gaps, and tensions between feasibility and desirability. This approach enables systematic comparison across mitigation pathways while making underlying normative assumptions explicit, contributing to more transparent and ethically informed climate scenario analysis.

Biographical sketch: Gayatri is a PhD candidate at the Sant'Anna School of Advanced Studies (Pisa), where she works on the ethical and intergenerational justice dimensions of Carbon Dioxide Removal (CDR), with a particular focus on marine-based approaches. With a background in Environmental Economics and Urban and Territorial Planning, her research bridges climate ethics, global governance, and sustainability policy. She is particularly interested in how resource constraints, such as land and water use, and global inequalities shape the distribution of costs and benefits in CDR deployment. Her work aims to connect normative frameworks with policy-relevant tools to inform equitable and forward-looking climate strategies.



Jignesh Shah

Mentor:	**Edward Byers**
Co-Mentor:	**Adriano Vinca**
Research Project:	**Assessing Future Energy System Resilience to Droughts and Heatwaves Across Global Mitigation Scenarios**

Abstract: Several energy generation technologies, such as thermal power plants and hydropower, rely on water for electricity production and are therefore vulnerable to the impacts of climate change, particularly extreme events such as droughts and heatwaves. At the same time, as a major source of greenhouse gas emissions, the energy sector is expected to undergo significant transformation as a part of global climate mitigation efforts.

In this study, we assess the impacts of drought and heatwaves on the potential generation of hydropower and thermal power plants, including coal, oil, nuclear, and gas, and carbon capture and storage (CCS) technologies, across a range of future climate-socioeconomic energy mix scenarios derived from Integrated Assessment Models (IAMs) at the global scale. As IAMs typically provide projections at coarse region scales, these scenarios will be downscaled to enable a more detailed assessment of climate extremes.

By explicitly linking climate extremes to their impacts on water-dependent technologies within future energy mix scenarios, this study provides a framework for evaluating the resilience of energy systems and identifying potential vulnerabilities. The results can also inform improvements in IAMs by guiding estimates of the reserve capacity required to ensure reliable electricity supply under extreme conditions, thereby bridging climate mitigation and adaptation strategies.

Biographical sketch: Jignesh Shah is a doctoral candidate at Utrecht University, the Netherlands, where he is working on the ERC-funded project B-WEX (Balancing clean Water and Energy provision under changing climate and eXtremes). His research focuses on evaluating the impacts of climate extremes, such as droughts and heatwaves, on the power generation potential of water-dependent technologies, including, hydropower, thermal power plants and concentrated solar power (CSP) under both historical conditions and future evolving energy mix scenarios. Jignesh holds an MSc in Environmental Resource Management (Brandenburg Technical University, Cottbus, Germany), and B.Tech in Civil Engineering (Narsee Monjee Institute of Management Studies, Mumbai, India).

Keiki Shimura

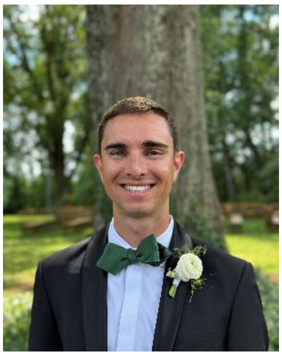
Mentor: **Volker Krey**

Co-Mentors: **Siddharth Joshi, Behnam Zakeri**

Research Project: **Evaluation of the Operational Feasibility of Power System Plans Determined by Long-Term Energy System Modeling with Renewable Integration Constraints**

Abstract: Energy system models (ESMs) used for long-term climate change mitigation planning often employ low temporal resolution, which may lead to misestimations in power system planning, particularly regarding the integration of variable renewable energy (VRE). To address this, static VRE integration constraints—such as flexibility and reliability requirements—are commonly implemented in ESMs. However, these static approaches often fail to capture operational dynamics such as short-term ramping, seasonal storage, and extreme weather events. This research aims to quantify the errors in capacity and generation projections under these constraints in low-resolution long-term models. Taking Japan—a region with significant solar PV penetration—as a case study, this study conducts a comparative analysis between two models: MESSAGEix-JPN, a long-term ESM with a time horizon up to 2100 utilizing aggregated yearly demand and supply profiles, and the Multi-Regional Energy Chains Model (ECM), a high-resolution ESM optimizing up to 2040 with 8,760 hourly time slices and high spatial resolution. The methodology involves three primary steps. First, capacity and generation outputs from both models are compared to assess how effectively the integration constraints in MESSAGEix-JPN compensate for its lack of temporal resolution. Second, the power supply and demand results from MESSAGEix-JPN are integrated into the ECM to evaluate their operational feasibility and the resulting differences in system costs. Third, based on these findings, the study will propose a hybrid method that includes sub-annual time resolution in part endogenously in MESSAGEix and determines remaining effects into integration constraint coefficients. This research provides a framework for long-term ESMs to yield more technically and economically feasible power system plans.

Biographical sketch: Keiki Shimura is a first-year PhD candidate in the Department of Electrical Engineering at Tohoku University’s Graduate School of Engineering, where he is affiliated with the Advanced Power Engineering Lab (APEL). He holds both a Bachelor’s and a Master’s degree in Engineering from Tohoku University. During his Master's program, he received the Electric and Information System Excellent Student Award. His research focuses on the economic evaluation of sector coupling using energy system models. By utilizing models with high spatio-temporal resolution, he explores feasible electrification strategies to achieve affordable and sustainable integration of variable renewable energy into the power system.



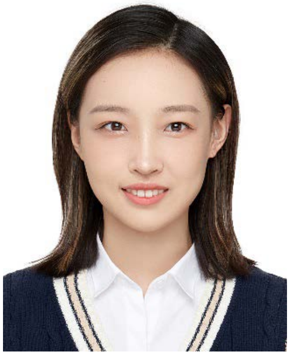
Zach Thomas

Mentor: **Jun Shepard**
Co-Mentor: **Florian Maczek**

Research Project: **Feasibility of Energy Transition Scenarios Under Mineral Supply Constraints**

Abstract: Feasibility assessments of energy scenarios typically focus on the technical, social, and political drivers of growth for renewable energy technologies such as solar PV, wind, battery storage, etc. However, they do not capture compounding uncertainties across upstream technologies such as mineral supplies. In particular, the U.S. Geological Survey lists 63 critical minerals, such as lithium, copper, nickel, etc., that may cause supply chain bottlenecks for energy technologies due to scarcity or vulnerability to restriction. This project will design representative scale-up critical mineral supply pathways according to the largest sources of uncertainty: inventories of energy technologies, annual variation in production data, and total estimated reserves. These scale-up pathways will be based on growth rates of analogous historical technologies, which represent multiple drivers and constraints to growth. Three expected outcomes for this proposed research include: (1) a set of scale-up projections for minerals using data on recent production from the British and U.S. Geological Surveys and growth rates of analogous historical technologies, (2) identification of scenarios in the Scenario Compass Initiative where energy demand is met by these supply pathways based on projected energy technology capacity additions and their material inventories, and (3) a characterization of the sources of uncertainty for such scenarios to frame narratives for describing these scale-up pathways. This framework can help identify which minerals are more likely to contribute to supply chain bottlenecks for energy technologies based on historical growth of analogous technologies. Policymakers can use these analogies to design technology-specific support for strengthening critical minerals supply chains.

Biographical sketch: Zach Thomas is a doctoral candidate in the interdisciplinary Environment and Resources Program in the Nelson Institute at the University of Wisconsin–Madison, USA. His research focuses on modeling the scale-up of new energy technologies and their consequences across human-Earth systems. He began researching clean-tech innovation at the Center for Global Sustainability at the University of Maryland and has previously consulted for Rho Impact to model avoided emissions of climate-tech startups. Outside of work, Zach likes to sail on soft water and kite on hard water.



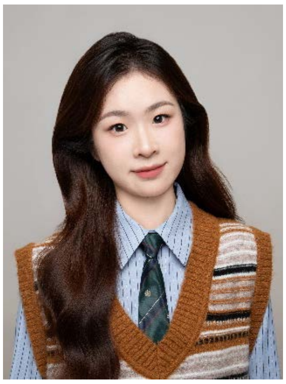
Bowen Wang

Mentor: **Marina Andrijevic**
Co-Mentor: **Edward Byers**

Research Project: **Construction of Event-Based Flood Damage Function Under Dynamic Adaptive Capacity**

Abstract: Extreme events, particularly floods, have caused substantial economic losses worldwide, yet existing disaster databases contain major gaps in reported economic damages, and widely used damage functions in Integrated Assessment Models (IAMs) fail to capture the impacts of climate extremes with sufficient accuracy. This study will develop an event-based flood damage function by integrating satellite-derived inundation observations, EM-DAT disaster loss records, and high-resolution socioeconomic indicators, while explicitly incorporating dynamic changes in adaptive capacity. Using the IPCC risk framework, the study will provide a comprehensive assessment of global flood risks under historical and future climate and socioeconomic scenarios. The resulting damage function will enable more empirically grounded estimates of both historical and future flood losses. Building on this foundation, the research will contribute to the development of a next-generation IAM framework that directly links climate extremes, adaptation dynamics, and economic impacts, advancing integrated climate risk assessment and informing effective adaptation strategies.

Biographical sketch: Bowen Wang graduated from Renmin University of China in 2023 with dual bachelor's degrees in Resource and Environmental Economics and Environmental Science. She is currently a third-year Ph.D. candidate at the Institute of Energy, Environment and Economy, Tsinghua University. Her research focuses on climate impact and adaptation modeling, with particular emphasis on assessing the economic impacts of extreme events such as floods at the global scale. Her work explores how adaptation can be systematically incorporated into extreme-event risk assessment and integrated into Integrated Assessment Models (IAMs) to better represent climate risks and adaptive capacity, aiming to provide scientific support for evidence-based climate adaptation policy design.



Xin Xu

Mentor: **Wilfried Winiwarter**
Co-Mentor: **Xiuming Zhang**

Research Project: **Synergies of Reducing Global Nitrogen Pollution and Greenhouse Gas Emissions in Agriculture**

Abstract: Human activities have profoundly altered global carbon and nitrogen cycles, leading to substantial emissions of greenhouse gases (GHG) and reactive nitrogen (Nr) that jointly threaten climate stability, air quality, and ecosystem health. These emissions often originate from common sources, particularly within the agriculture, forestry, and other land use (AFOLU) sector, highlighting the potential for coordinated management with multiple co-benefits. However, existing studies have largely focused on the energy and industrial sectors, while effective strategies for jointly reducing agricultural GHG and Nr emissions remain insufficiently understood, especially across countries with diverse agronomic practices and socioeconomic development pathways. This project aims to develop an integrated assessment framework by linking the Coupled Human And Natural Systems (CHANS) carbon and nitrogen coupling model with the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model. The coupled CHANS-GAINS framework will then be applied under alternative Shared Socioeconomic Pathway (SSP) scenarios to compare coordinated GHG-Nr mitigation with conventional single-pollutant control approaches in cropland, livestock, grassland, and forest systems, further quantifying health co-benefits, climate effects, ecosystem services, and associated social benefits. By advancing integrated modeling approaches and generating policy-relevant insights, this project seeks to support evidence-based environmental and climate policymaking and to inform the design of coordinated management strategies tailored to regional development needs and global sustainability objectives.

Biographical sketch: Xin Xu is a PhD candidate at the College of Environmental and Resource Sciences, Zhejiang University, China. She received her bachelor's degree from the same institution in 2022. Her research focuses on regional carbon-nitrogen cycle modelling in coupled human and natural systems, coordinated mitigation of GHG and Nr emissions, and cost-benefit assessment of environmental policies. She is committed to developing integrated modelling frameworks to quantify the interactions between human activities and biogeochemical cycles, aiming to identify cost-effective and policy-relevant pathways for climate mitigation, nitrogen pollution control, and sustainable development.

Rongqi Zhu

Mentor: **Alessio Mastrucci**
Co-Mentor: **Setu Pelz**

Research Project: **Evaluating the Distributional Effects of Scaling Up Heat Pumps Accounting for Peer Effects**

Abstract: Space heating accounts for approximately one-third of residential energy consumption globally, making the rapid scaling of electric heat pumps a cornerstone of building decarbonization. While technological progress and market-based subsidy instruments play a crucial role, empirical evidence increasingly demonstrates that the market diffusion of such demand-side technologies is driven by non-market factors. For example, spatial spillovers indicate that every three heat pump installations indirectly stimulate an additional adoption in neighboring areas. Furthermore, current assessment models that project adoption rates do not fully capture the socio-economic dimensions of these behavioral decisions. This study develops a framework bridging empirical evidence with integrated assessment models (IAMs) to capture how such non-market social dynamics shape building electrification. Specifically, by leveraging national household energy consumption surveys and heat pump installation data, we quantify region-stratified peer effects in the adoption of heat pumps for space heating. These behavioral insights are then incorporated into the IAM-based building sector model MESSAGEix-Buildings to parameterize disparities in the non-market factors driving technology uptake. Finally, we simulate diverse subsidy architectures (e.g., constant, front-loaded, and back-loaded incentives) to evaluate household electrification diffusion pathways and their resulting distributional disparities across world regions and income groups. The findings are expected to address the mitigation efficiency-cost-equity trilemma masked in conventional assessments, providing actionable insights for targeted policy interventions, ensuring building decarbonization is both technologically ambitious and socially just.

Biographical sketch: Rongqi Zhu is currently a second-year PhD candidate at the College of Environmental Sciences and Engineering at Peking University. His research focuses on equity and distributional justice within demand-side mitigation. He extends the province-resolved integrated assessment model (GCAM-China) to disaggregate residential energy demand into 20 consumer groups differentiated by urban–rural households and income deciles. He aims to explore how income heterogeneity reshapes building energy demand in China. He is also interested in leveraging AI to support climate mitigation pathways, such as categorizing scenario ensembles. Rongqi holds an MSc in Energy Economics from Beihang University. Outside of academia, he enjoys playing basketball and table tennis.

Stefani Rivić

Mentor: **Michael Freiberger**
Co-Mentor: **Stefan Wrzacek**

Research Project: **Identifying Bottlenecks in Circular Aluminum Management: An EU Policy Perspective Integrating Material Flows and General Economic Equilibrium Model**

Abstract: The European Union is increasingly advancing its circular economy agenda with a strong focus on raw material security, recognizing aluminum as a strategically important and increasingly demanded material. As aluminum use expands—particularly in construction, which already represents about 24% of European aluminum end use—new policy initiatives are emerging to promote higher recycling rates and circular material use. Demand is expected to grow further through building renovation, energy-efficiency technologies, and lightweight design, while the EU remains highly dependent on primary aluminum imports despite exporting substantial volumes of valuable scrap. This creates tensions between decarbonization, competitiveness, and resource security. Although recycling aluminum requires only about 5% of the energy needed for primary production, the feasibility of circularity policies depends not only on aggregate scrap volumes but also on the long-term availability, alloy quality, and segregation of construction-sector aluminum, which often remains in buildings for 25–50 years. Policy targets that overlook delayed scrap generation, alloy contamination, downcycling, and fragmented collection systems risk creating supply bottlenecks, rising costs, or ineffective mandates. Existing studies either examine aluminum stocks through material flow analysis without economic behavior or assess recycling policies through economic models that neglect physical stock-flow and alloy constraints. This study develops a dynamic general equilibrium model of the EU construction aluminum cycle that integrates building stock dynamics, demolition and renovation scrap generation, alloy sorting, and downstream market structure. It specifically evaluates proposed minimum recycled-content targets, whose actual effects remain unclear, to determine whether such policies genuinely advance circularity or instead create unintended material and economic constraints.

Biographical sketch: Stefani Rivic is a third-year PhD candidate at the Technical University of Vienna at the Faculty of Environmental Engineering. With a Master's degree in Statistics and Mathematical Methods in Economics, she applies mathematical modeling to better understand resource and waste systems. Her research focuses on evaluating policies that support circularity and promote more sustainable resource use. By combining quantitative analysis with environmental systems research, she aims to generate practical insights that help shape effective strategies for a more circular economy.

Olasunkanmi Oluwakayode Adebayo

Mentor **Joanne Linnerooth-Bayer**
Co-Mentor: **Juliette Martin**

Research Project: **A Relational Analysis of Traditional Ecological Knowledge and State Governance Interfaces in South Africa's Dwesa-Cwebe Marine Protected Area**

Abstract: Inclusive ocean governance remains elusive globally as dominant frameworks prioritize economic growth, security, and tourism while marginalizing justice claims of coastal communities. Efforts to expand marine protection promise biodiversity gains but can clash with local livelihoods, creating governance tensions. Existing research trying to close inclusion gaps by integrating Traditional Ecological Knowledge (TEK) into Western frameworks has faced assimilationist criticisms. This study addresses the gap by examining how TEK and state-led marine management frameworks interact in South Africa’s Dwesa-Cwebe Marine Protected Area- a site marked by legal disputes and contested participation. The proposed examination will be relational, aiming to identify entry points for inclusive ocean governance. For its analytical framework, the study will draw on Thompson's cultural theory of plural rationalities to qualitatively code policies, legal instruments, case study materials, and pre-collected interviews, classifying them into governance narratives. It will then construct an Integrative Qualitative System Map (IQSM) to visualize the relational dynamics and feedback loops that shape participation. Proposed outputs include coded data, a qualitative system map showing the interaction of governance logic and a 5,000-word dissertation chapter. The results will inform policy development in South Africa by clarifying how integrating TEK at strategic governance interfaces can enhance epistemic deliberation, recognition, and participatory justice in ocean governance. Contributing to IIASA’s EQU program on justice-oriented system analysis.

Biographical sketch: I am a second-year PhD student in Social Science in the Department of Sociology at the University of Fort Hare, East London Campus, South Africa. My research examines how coastal communities in South Africa experience and negotiate participation in ocean governance. It seeks to identify pathways to include traditional ecological knowledge in contemporary ocean governance policies. My project, funded by South Africa’s National Research Foundation, uses communities near the Dwesa Cwebe Marine Protected Area in the Eastern Cape as a case study.

Alaa Dafallah

Mentor: **Josephine Borghi**

Research Project: **Examining Vulnerabilities and Resilience of Systems for Health Amid Polycrisis in Sudan: A Qualitative Systems Dynamics Study**

Abstract: Sudan is currently the world's largest humanitarian crisis, characterized by armed conflict, economic collapse, mass displacement, disease outbreaks, and widespread food insecurity. These compounding shocks generate cascading disruptions across interconnected systems essential for health; including healthcare, water and sanitation, food systems, livelihoods, and critical infrastructure, undermining the capacity of these systems to respond to shocks, absorb, adapt or transform to maintain system functioning and delivery of essential services. Health systems resilience research, however, has predominantly focused on single-system analysis of formal health systems, with limited research on settings in extreme fragility such as Sudan. Thus, we aim to apply qualitative systems dynamics to examine: (1) the effects of conflict, alongside compounding shocks, on health system functioning through both direct and indirect pathways across interconnected systems; and (2) system responses to these shocks to mitigate disruptions and maintain essential services, employing maternal, neonatal, and child health (MNCH) services as a tracer of essential healthcare delivery. We draw on a review of documents and qualitative interviews with actors spanning national and subnational levels (Khartoum and North Darfur) to develop and validate causal loop diagrams. We aim to identify key variables, feedback pathways, and interdependencies that underpin shock impacts and system responses (absorptive, adaptive, and transformative); as well as the underlying capacities that contribute to resilience. Findings from this study will enable the identification of key vulnerabilities and leverage points to inform interventions aimed at strengthening the resilience of systems for health and improving MNCH services in Sudan.

Biographical sketch: Alaa Dafallah is a 3rd year PhD student at the Centre for Global Health Research, University of Oxford. Her research examines the resilience of systems for health in contexts of polycrisis, with a particular focus on maternal and child health services in Sudan. Prior to her PhD, she worked as a medical doctor and a researcher, leading and contributing to studies on community resilience and multisectoral service delivery in conflict-affected regions of Sudan, including Darfur and South Kordofan. Alaa holds an MSc

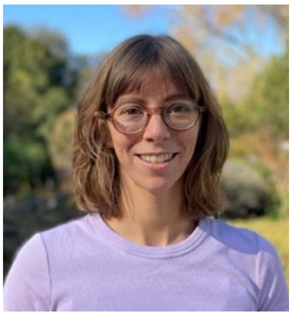
Sara Ghebremicael

Mentor: **Manya Oriel Kagan**
Co-Mentor: **Sofia Badini**

Research Project: **Integrating Climate Projections, Conflict Dynamics, and Agricultural Abandonment in Migration Scenario Models for Policy Recommendations**

Abstract: Political conflict and climate change are among the most significant drivers of migration globally, reshaping mobility at national and international levels, undermining livelihoods, and disrupting long-term settlement patterns. While climate, conflict, and migration are increasingly discussed as interconnected challenges that alter population dynamics, their causal or temporal relationships remain poorly understood, thus impacting integrated systems modeling and risk analysis for developmental policy. Most climate-conflict-migration studies treat climate change as the primary driver of conflict or migration, overlooking conflict as an autonomous factor that can shape migration alongside and in interaction with climate to mitigate or amplify climate-migration links – therefore obscuring their relative and joint contributions on migratory decision-making. As such, this project quantifies and models the impacts of climate and conflict dynamics on migration and land-use change in Ethiopia, integrating climate projections to predict how migration patterns and food security may change under different scenarios. Specifically, primary household surveys will be linked to climate, conflict, and land-use data, which will then be connected to a Climate Scenario Generation Tool and the Climate Analogues Tool to model projections and identify strategies for adaptation. In considering multiple perspectives through a multi-method and multi-scale approach, we will distinctively position our work within an emerging field of climate, conflict, and population studies, while addressing gaps in developing integrated analytical frameworks to design effective migratory interventions.

Biographical sketch: Sara Ghebremicael is a final year Geography doctoral candidate at the University of North Carolina at Chapel Hill. Her work examines how climate variability and political instability affect populations – and how these dynamics shape food security, migration, adaptive capacity, and resilience using statistical analysis, remote sensing, and a mixed-methods approach. Sara's current projects focus on the effects of climate change and conflict on food security in Ethiopia, and its further implications for coping capacity, post-harvest loss, and migration. She recognizes indigenous knowledge systems and traditional agricultural practices as viable, sustainable solutions to increase adaptive capacity and resilience. Sara is a Fulbright-Hayes scholar and is supported by the Carolina Population Center and the US NSF.



Jennifer Hennenfeind

Mentor	**Roman Hoffmann**
Co-Mentor:	**Sofia Badini**
Research Project:	**Ecosystem Intactness as a Mitigation Mechanism for Drought-Induced Human Migration**

Abstract: Biodiversity loss and climate change are interconnected challenges threatening global food and water security, livelihoods, and human health. While the impact of climate extremes, specifically the increasing intensity of droughts, on human mobility is well-documented, the role of ecosystem integrity in moderating these flows remains largely unexplored. This study assesses whether biodiversity intactness of ecosystems (i.e., how close an ecosystem is to its natural state) moderates the relationship between drought and internal migration. The diversity stability hypothesis suggests that high biodiversity intactness buffers climatic extreme events and thereby maintains essential ecosystem functions reducing the pressures for humans to migrate. In this study, I will assess whether the effects differ across regional socioeconomic and political conditions, such as agricultural dependence, economic development and institutional quality. The analyses will be conducted in a multi-dimensional fixed-effects framework, using census-based migration trend data across 102 countries. The expected outcome of this study will be a quantification of how healthy ecosystems can act as a buffer against climate-induced migration and how intact biodiversity can support resilience to climate change impacts.

Biographical sketch: Jen began her career as a microbial oceanographer using marine communities as biological sensors for pollution. The geographic context she was working in sparked an interest in how geopolitical shifts physically reshape landscapes and biodiversity, leading to an interdisciplinary PhD at the University of Vienna. Now a third-year candidate in the division of BioInvasions, Global Change, and Macroecology, Jen investigates the environment-climate-conflict nexus. Focusing on Nature’s Contributions to People, her work explores how climate and biodiversity hazards impact human safety and mobility. She argues that maintaining robust biodiversity is not just an environmental goal, but a fundamental requirement for human health, safety, and social stability.

Tianxue Hou

Mentor: **Daniela Weber**

Research Project: **Examining Social Pathways Between Cognitive Impairment and Depressive Symptoms in Older Adults**

Abstract: Cognitive impairment and depressive symptoms are common in later life and often occur together, yet the social pathways underlying their longitudinal relationship remain unclear. This study will examine whether social isolation and loneliness, reflecting objective and subjective social disconnection, mediate the association between cognitive impairment and depressive symptoms and whether these pathways differ by gender. Data will be drawn from Rounds 11-13 of the National Health and Aging Trends Study, collected between 2021 and 2023. Generalized structural equation modeling will be used to examine longitudinal associations between cognitive impairment and depressive symptoms and to test social isolation and loneliness as separate mediators. Models will be estimated in two temporal directions: from cognitive impairment to later depressive symptoms and from depressive symptoms to later cognitive impairment. Gender differences in these pathways will also be explored. To assess the robustness of the findings, sensitivity analyses will be conducted using an alternative three-wave cross-lagged panel model.

Biographical sketch: Tianxue Hou is a third-year PhD candidate at the School of Nursing, the University of Hong Kong. Her doctoral research examines the long-term impact of social isolation and loneliness on health outcomes and healthcare utilization in the context of global aging. She previously worked as a Research Fellow at the Cicely Saunders Institute, King's College London, contributing to projects on dementia care and palliative care from comparative and cross-cultural perspectives. With her interdisciplinary training and international academic experience, she is committed to advancing research on aging and the social determinants of health, with relevance for nursing practice and patient care.

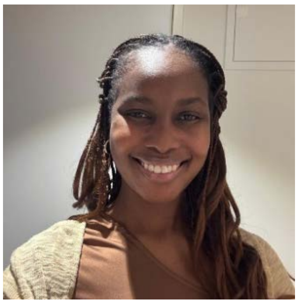
Shahar Livne

Mentors: **Josephine Borghi**

Research Project: **The Continuity of Health System Response to Climate-Induced Food Insecurity in Malawi: Bridging Acute and Slow Onset Hazards with Routine Care**

Abstract: For the last decade, Malawi has declared annual states of disaster, primarily driven by climatic hazards. Given that 70% of Malawians rely on subsistence farming, drought threatens both livelihoods and nutrition. Healthcare providers have historically played a central role in responding to severe food insecurity. However, the prevailing research paradigm often compartmentalizes health system responses based on single hazard types, neglecting how risk perceptions and interventions evolve across multiple, overlapping crises. There is a lack of understanding of how the healthcare workforce internalize and adapt to the shifting food insecurity landscape across the temporal spectrum of multi-hazards. This research addresses this gap by moving beyond hazard specificality to explore the continuity of health interventions across the disaster-to-routine care spectrum. Moving beyond a disaster-centric view that treats food insecurity risks in a narrow case-study manner, this research links responses across the full continuum: acute disasters, slow-onset hazards, and routine malnutrition care in facilities and communities. The recent crisis period in Malawi provides a crucial context to explore this continuum from the perspectives of both healthcare providers and affected communities.
This mixed-methods study is based on data collected during 2024. A cross-sectional survey of 371 households and 146 healthcare providers in two disaster affected districts of Malawi, and 53 in-depth semi-structured interviews of 20 community members and 33 healthcare providers across different levels of the local health system. The findings will provide empirical evidence to inform the design of adaptive nutrition programming that moves beyond episodic responses, aligning with the all-hazards approach promoted by the Sendai Framework for Disaster Risk Reduction and Sustainable Development Goal 2.

Biographical Sketch: Ms. Shahar Livne is a PhD candidate and lecturer at the School of Public Health and at Ben Gurion University (BGU) in Israel. Her doctoral research examines the nexus between extreme weather events, health, and food insecurity using a mixed methods design, with a particular focus on understanding climate change experiences within communities and health services in rural Malawi. Since 2020, she has conducted fieldwork in Malawi through a collaborative partnership with Partners in Health/Abwenzi Pa Za Umoyo (PIH/APZU), examining how cycles of extreme weather events shape the lived experiences of rural communities and healthcare providers.



Chantelle Ngwenya

Mentor: **Wolfgang Lutz**
Co-Mentor: **Guillaume Marois**

Research Project: **The Intergenerational Transmission of Human Capital: A Multistate Dynamic Microsimulation of Counterfactual Educational Trajectories in Zimbabwe**

Abstract: Parental education is a strong predictor of a child's productivity and earning potential, yet since Zimbabwe's independence in 1980, this human capital reproductive mechanism has been characterized by high mortality and migration rates caused by the HIV/AIDS pandemic and recurring socio-economic crises. This prolonged instability has created structural inequalities that derail progress toward universal education, thereby limiting individual and macroeconomic development. Macro-demographic projections of educational attainment neither account for mid-trajectory shocks, such as parental mortality, nor provide insight into how policies might reverse generational inequalities. This research employs a multistate dynamic microsimulation model to examine how parental presence, survival, and educational attainment shape children's educational attendance, progression, and attainment. Drawing on the cumulative dis(advantage) life course theory, the analysis examines the impact of generational inequality on educational outcomes through a 10-year simulation from 2012 to 2022. The 2012 Zimbabwean micro-census, comprising jointly observed parent-child attributes including educational attainment and parental survival, is used as the base population. The 2015 Zimbabwe Demographic and Health Survey (DHS) is employed to estimate education transition probabilities using logistic regression, controlling for province, rural/urban residence, and household wealth quintiles to account for geographic and socio-economic disparities. To quantify the impact of inequality, counterfactual scenarios are run by adjusting parental education, presence, and survival parameters and comparing them against baseline reconstructions of educational outcomes. The results will provide evidence-based insights into how improving parental education and ensuring parental presence can decouple a child's developmental potential from inherited parental constraints.

Biographical sketch: Chantelle Ngwenya is a PhD student in Demography at the University of Cape Town, in the Southern Africa Labour and Development Research Unit. She also holds a master's degree in Demography from the University of Cape Town. Her current research focuses on human capital in Africa, particularly, the impact of education policies on education attainment and the formation of human capital in Zimbabwe. Chantelle seeks to examine how individual educational pathways interact with demographic and socio-economic factors, and how understanding population heterogeneity is key to developing human capital through targeted policy formulation. Her professional experience includes monitoring, evaluation, and reporting of health and education outcomes in Zimbabwe.

Anna Reckwitz

Mentor: **Roman Hoffmann**
Co-Mentor: **Raya Muttarak**

Research Project: **Freshwater Availability and Conflict Risk: The Role of Terrestrial Water Storage**

Abstract: The relationship between freshwater availability and conflict is highly complex, as made evident by the disagreement in the existing scientific literature regarding the importance of drought as a driver of conflict risk. Therefore, identifying the contextual factors that influence how freshwater availability impacts conflict risk is of particular interest for mitigating future risk and thereby informing sustainable development pathways. Currently, a global, quantitative analysis of these factors is missing. This study will address that gap by empirically estimating the circumstances under which changes in freshwater availability exacerbate conflict incidence, onset, and intensity at the subnational level. We will build on previous work to ensure feasibility within the 3-month YSSP timeframe, using GRACE/GRACE-FO observations of terrestrial water storage (TWS) changes as a proxy for freshwater availability, the Social Unrest Index, and conflict event data in a fixed effect panel regression model. This approach uses exogenous variation to identify plausibly causal effects. The main objective of this project will be a heterogeneity analysis regarding socio-economic characteristics of the respective regions, which will reveal if and how important contextual factors such as migration, inequality, economic circumstances, and governance interact with TWS changes. Thus, the most vulnerable groups and possible adaptation levers with regard to future TWS changes will be identified. This analysis will link the planetary boundary of freshwater use to the 16th sustainable development goal (Peace, Justice and Strong Institutions), thereby providing policy-relevant insights into the mechanisms of conflict risk.

Biographical sketch: Anna Reckwitz is a PhD candidate at the University of Potsdam, Germany, and the Potsdam Institute for Climate Impact Research, where she works in the *Societal Transition and Well-being* Lab and is part of the *GeoClimRisk* project. Her current work primarily focuses on studying the socioeconomic impacts of freshwater changes, with an emphasis on how climate damages will influence global economic inequality. In her research, she applies a variety of quantitative methods from econometrics and machine learning to global climate and socioeconomic datasets. She holds a MSc in Physics from the Humboldt University of Berlin, Germany.