a new generation of scientists

YSSP Young Scientists Summer Program

YSSP Participants 2015

Biographical Sketches and Research Project Abstracts

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

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Dian Andriana

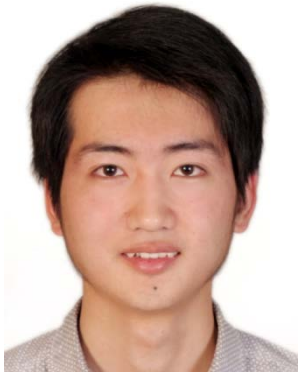
Supervisor: **Matthias Jonas**
Co-Supervisor: **Piotr Zebrowski**

Research Project: **Building neural networks to analyze uncertainty in global warming models**

Abstract: Climate change and global warming are examples of complex system processes affected by multiple interdependent factors. To gain insight in the dynamics of these systems, scientists build mathematical models of both a diagnostic and prognostic nature. Typically, scientists try to establish the relationships between variables, parameters, and other key factors and aim to capture the general trend of major processes. Typically, the issue of uncertainty underlying the model and in the input data—and the effect of those uncertainties on model output—receives much less attention. In this exploratory project we propose to use Artificial Neural Networks (ANNs) to gain insights into global warming.

A considerable advantage of ANNs is that they do not assume any particular dependency structure between factors and modeled quantity. They can capture even subtle dependencies by learning from a data set. However, the ANN often yields significant approximation errors and still has drawbacks in terms of long-term prediction. The idea is to compare the performance of ANNs with a simple Earth systems model suitable for describing the effect of increasing CO_2 emissions and/or concentrations on global mean temperature (numerically and analytically). The overall objective is to validate whether ANNs can be used to reproduce the historic warming trend, to compare its performance with the Earth systems model, and to assess how uncertainty in the input data affects both the structure of the ANN and its output. Another objective is to assess the horizon of reliability of (historic) model projections. This research is intended to contribute to ASA's work on prognostic learning from the past.

Biographical Sketch: Dian Andriana is currently a first-year PhD candidate at the Institute of Technology Bandung, where she also completed her bachelor's degree in Informatics and her master's degree in Multimedia and Game Technology. She is also a researcher at the Research Center of Informatics of the Indonesian Institute of Sciences. There, she has participated in various projects related to Decision Support and Intelligent Systems. She has had one paper published in international conference (2013) proceedings of the Institute of Electrical and Electronics Engineers (IEEE) and two further papers accepted for publication by Scopus indexed journals (2015).



Zhaomiao Guo

Supervisor: **Dan Jessie**
Co-Supervisor: **David McCollum**

Research Project: **Impact of OPEC's oil production strategies on the structure of US domestic transportation fuel supplies: A stochastic game-theoretic model**

Abstract: Transportation in the United States is still mainly dependent on fossil fuels, more than one-third of which comes from the Organization of the Petroleum Exporting Countries (OPEC). With its historical support for increasing the oil price by reducing supplies, OPEC has not actively addressed the recent drop in the crude oil market price. This unusual decision may be attributed to growing domestic crude oil production in the United States and the continuing efforts to seek clean alternative fuels. Although there is a consensus around the decision, the extent of its impact remains unclear.

In this research, we quantitatively study the impact of OPEC's production decision on long-term domestic transportation fuels investments in the USA. Using a stochastic game-theoretic modeling framework, we incorporate into our analysis both the strategic interaction between different energy producers and the highly uncertain energy scenarios (policies, demand, technologies). Although the original focus of the proposed research is on transportation fuels (petroleum, biofuel, natural gas, electricity, etc.), the tool and the methods developed could be generalized to study other energy security and energy capacity issues involving the strategic interaction of multiple players.

Biographical Sketch: Zhaomiao Guo received his master's degree in Civil Engineering in 2011 from the University of California, Berkeley. He is currently a third-year PhD student at the University of California, Davis. His dissertation topic is "Energy Infrastructure Planning under Uncertainty Interconnection, and Competition." His research focuses on addressing the critical issues arising during transforming to a clean energy future using network modeling, stochastic optimization, and game theory. Research projects include solar/wind impact mitigation, contingencies constrained unit commitment problem, electricity vehicles charging station siting, renewable energy infrastructure planning, and long-term impacts of some energy policies (e.g., price cap and low carbon fuel standard).

Yolanda Lopez Maldonado

Supervisor: **Brian Fath**

Research Project: **The early identification of the human drivers affecting groundwater system of Yucatan, Mexico, using material flow analysis**

Abstract: Groundwater systems are the predominant accessible reservoir of freshwater storage on Earth. Problems arise when studying the interconnections of groundwater with society and successful groundwater resource management relies on models that effectively capture those interactions. In Yucatan, Mexico, the effects of a meteor impact 65 million years ago dominate the geomorphology, forming a complex groundwater system that is the only source of freshwater for the population. In this region, water demands are growing, and inhabitants have to deal with water shortages; however, groundwater data remain limited.

As groundwater flows need to be quantified as part of a strategy to secure water for the future, my research will shed light on the problem of Yucatan by developing a Material Flow Analysis (MFA) of the Yucatan groundwater system. MFA is a method of analyzing flows and exchange of materials and energy with the environment. It is an instrument for the early recognition of environmental problems and prediction of future environmental loadings. MFA has not been carried out in Yucatan; thus, to quantify the role of sectors in the system, we will analyze fluxes with mass balance and run sensitivity analysis. This will reveal the freshwater resource supply, demand balance, and factors affecting it, and serve as a basis for long-term strategic planning. Results do not depend only on the literature, as we have gained new data through stakeholder workshops, statistical data sources, and expert opinion; assumptions will be made if data are unavailable. MFA will show what parameters have to be considered to identify human drivers affecting groundwater and to detect red points. MFA can be applied in regions with similar characteristics and different environmental management states.

Biographical Sketch: Yolanda Lopez Maldonado is a third-year PhD candidate at the Department of Geography, Lehr- und Forschungseinheit Mensch-Umwelt-Beziehungen at the Ludwig-Maximilians Universität Munich. She is also participating in the Doctoral Program at the Rachel Carson Center for Environment and Society, LMU, Munich. She has a master's degree in Human Ecology (Center for Research and Advanced Studies of the National Polytechnic Institute, Mexico). Her current research focuses on material flow analysis and groundwater resource management, with an emphasis on social-ecological systems and common pool resources.

Oleg Nurmukhametov

Supervisor: **Artem Baklanov**
Co-Supervisor: **Dmitry Shchepashchenko**

Research Project: **Systems approach to integration of labels from crowdsourcing campaigns**

Abstract: Land cover is of fundamental importance for many applications, including nature protection and biodiversity, forest/water management, urban/transport planning, natural hazard prevention and mitigation, and evaluation of agricultural policies. Geo-Wiki researchers have compared the effectiveness of crowdsourcing versus experts in determining land cover. Recent results show that crowdsourcing is an efficient tool for annotating large datasets. Humans are good at recognizing visual and audio patterns (e.g., faces, images, voices). Labels collected from the crowd, however, can be of a low quality as crowdsourcers are often non-experts and may be unreliable. That is why advanced methods for integrating annotations are necessary for increasing the reliability of estimates.

The goal of the research is to develop a robust approach to solving the problem of crowdsourcing related to aggregation of votes—how to infer true labels from noisy labels provided by non-expert volunteers. We propose a solution based on a boosting meta-algorithm that constructs an ensemble of learners by training a weak learning algorithm on iteratively modified datasets. To test the proposed approach we will run numerical assessment using real life data (not a synthetic dataset).

Biographical Sketch: Oleg Nurmukhametov completed a master's degree at the Department of Mathematics and Mechanics, Ural Federal University, Ekaterinburg, Russia, where he began his PhD studies in 2014. His PhD thesis focuses on the problem of combinatorial optimization applied to models of taxonomy. The research deals with the construction of effective methods of cluster analysis. His main fields of scientific interest include machine learning, pattern recognition, approaches and algorithms of collective recognition, approximation algorithms, and NP-hard optimization problems.

Teppo Repo

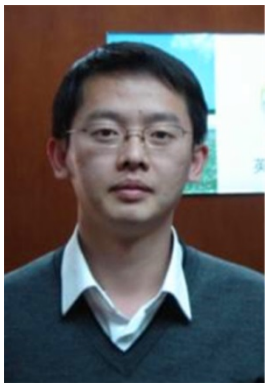
Supervisor: **Stefan Thurner**

Research Project: **Exploring suitable approaches for a CVD patient health care service model for the North Karelia, Finland, hospital district**

Abstract: Cardiovascular diseases (CVD) are the main health burden in industrialized countries. There are spatial and socioeconomic (SES) differences in non-communicable disease morbidity and in the quality of care. However, the cause of the spatial differences and the best ways of improving the situation and reducing the inequalities in health are not well known. As North Karelia is a sparsely populated area with an aging population, the optimal use of health care resources is crucial. Allocation of resources between preventive and acute care and ways of implementing health care services are key issues in optimizing the healthcare solutions.

This work aims to explore possible approaches to better allocation of health care service resources using agent-based models. The objective is to gather experience of the challenges related to model building and devise a framework for a healthcare service model that could utilize patient register data, SES indicators, and spatial datasets.

Biographical Sketch: Early Stage Researcher Teppo Repo graduated from the University of Eastern Finland (UEF) as a human geographer (MSc in 2014). He is now a first-year PhD student at the UEF and his health geography-related thesis covers spatial variation in quality of care and the prevalence of cardiovascular diseases. His main fields of scientific interests are health GIS and spatial analyses. He is keen to extend his fields of interests in spatial simulations and modeling.



Cuiqing Sun

Supervisor: **Yurii Yermoliev**
Co-Supervisor: **Tatiana Ermolieva**

Research Project: **Integrated systems analysis approach to robust energy, food, and water provision in coal-rich areas of China: Shanxi case study**

Abstract: It is imperative for China to investigate how to jointly tackle energy, water, agriculture, environment, and security goals in order to alleviate environmental pollutions and socioeconomic impacts from coal-based industries. As even global and national (coal-related) energy demand projections ignore local heterogeneities, the consequences of "projecting" aggregated demands to local scales by including local resource constraints, land suitability, and environmental and social conditions also need to be investigated.
Although the Chinese government has taken action to overcome the negative impacts of the coal industry, it is failing to address the issues in a systems analytical way.

My proposed research will develop a harmonized strategic approach for integrated modeling to discover how to achieve a secure sustainable supply of nature resources, food, and water under natural and human-related intentional and unintentional threats.

Biographical Sketch: Cuiqing Sun received his bachelor's and master's degree in Water Conservation Engineering from Hohai University of China in 2001 and 2005, respectively. He is currently a first-year PhD. candidate at the Center for Resources and Environmental Policy Research, School of Management, China University of Mining & Technology, Beijing. His main fields of scientific interest include integrated systems analysis of energy, water, and the environment system.

Siyuan ("Kelsi") Yang

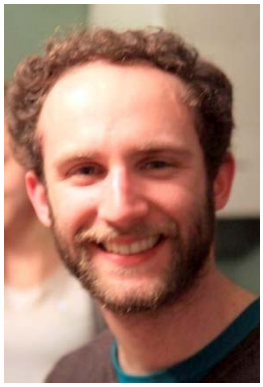
Supervisor: **Brian Fath**

Research Project: **Ecological network analysis of virtual total suspended particulate matter (TSPM) within China**

Abstract: Human activities such as coal combustion, industrial processes, and road transportation are disturbing the natural balance of total suspended particulate matter (TSPM) in the atmosphere. To trace embodied (virtual) emissions back to their original sources at a sectoral scale, input-output analysis (IOA), is a useful tool. Ecological network analysis (ENA) can also determine which economic sectors drive the virtual TSPM emissions. The two approaches are therefore applied to investigate the virtual TSPM emissions that result from current monetary flows and economic structures. China, which has been suffering from serious air pollution for years, is selected as the study site. The virtual TSPM emissions from 41 aggregated sectors are considered in accordance with the economic sectors of the Chinese Input-Output Table.

The research objectives are to: i) quantify the direct and indirect TSPM emissions embodied in consumption from interconnected economic sectors using IOA; ii) trace the transferring routes of TSPM emissions among various economic sectors according to the IOA results; and iii) identify the dominant emitting sector(s) based on the simplified virtual TSPM emission matrix and network control analysis (NCA), a key metric of ENA that could implicate the control intensity between sectors. To that end, I intend to establish an input-output framework and develop a virtual TSPM network model combined with IOA to trace TSPM emissions back to their original sectors. I will next construct a control matrix to reveal the control relationship of each economic sector based on NCA to depict each sector's degree of control over the other sectors and thereby identify the dominating factors of TSPM emissions sectors. The so-called "control relationship" is derived from NCA which presents the extent to which TSPM emissions from a given economic sector are controlled by other sectors and also indicates the relationship among these sectors. Finally, policy and economic suggestions to alleviate the air pollution problem in China, based on these results, are put forward.

Biographical Sketch: Siyuan Yang graduated from Shandong University, China in June 2013 with a bachelor's degree in Environmental Engineering. In September 2013 she became a five-year PhD candidate majoring in ecological modeling at the School of Environment, Beijing Normal University. Her main scientific interests include ecological network analysis, multi-regional input-output analysis, climate change economics, and urban metabolism.



Célian Colon

Supervisor: **Åke Brännström**
Co-Supervisor: **Elena Rovenskaya**

Research Project: **Disruption risks in an adaptive firm network**

Abstract: The globalization and interconnectedness of economic activities seem to carry with them new types of risks, often termed systemic risks. The recent financial crash is a prototypical example of a situation in which an exogenous shock has a disproportionate impact on the economy. One of the main amplification mechanisms is the propagation along supply chains via input-output relationships. The network structure of economic activity is therefore likely to influence the vulnerability of the system to external perturbation. This structure results from agent-level interactions.

The project investigates a simple theoretical model of adaptive inter-firm networks. Firms are represented as nodes, and trade relations as edges, directed from the supplier to the buyer. Firms produce using inputs from their suppliers, and sell their production to their customers, including households. Shocks on the production process are then applied exogenously and randomly to some firms. These perturbations create production shortages and profit losses that propagate along the trade links.

Firms are able to change their supply network and "rewire" trade links, in order to maximize profit while minimizing potential loss due to supply disruption. We will examine the influence of firms' risk aversion on this rewiring process and on the resulting network topology. Are risks covered when all firms are risk adverse? What if a small proportion of firms are risk prone? We will also investigate the influence of the knowledge that firms have on their supply network. Finally we will consider a social learning process by which firms imitate the strategy of the top performers.

Biographical Sketch: Célian Colon holds a master's degree from the Ecole Polytechnique in Paris, France (2010) and an M.Sc. degree in Environmental Technology from Imperial College London, UK (2011). He is currently a second-year Ph.D. student at the Ecole Polytechnique, also affiliated to Imperial College's Grantham Institute, and to the Centre for the Environment and the Society at the Ecole Normale Supérieure in Paris, France. Celian has worked for two years in the private sector, in consultancy and in a start-up company. His main fields of scientific interest include the application of system dynamics, agent-based modeling, and adaptive networks to investigate economic dynamics, and how these dynamics affect sustainability.

Mehdi Shojaei

Supervisor: **Rupert Mazzucco**

Research Project: **Trait-based community dynamics of a North-Sea ecosystem**

Abstract: Species living in or on the seabed form an integral component of marine ecosystems, constituting a food source for fish and other predators. Distribution, abundance, and community composition of such benthic species are strongly influenced by a variety of physical, chemical, and biological factors: temperature, water depth, food supply, and sediment type have critical, though sometimes variable, effects on their distribution. Additionally, biological interactions (e.g., competition, predation) among species influence the diversity of marine assemblages. Predatory fish may directly reduce abundances of species living on the seabed, while their effects on species living in the seabed may be less pronounced.

Traditional analytical procedures, which derive information on biodiversity and community structure from species abundance/biomass data, do not take into account the functional features of species. However, functional diversity, i.e., the range and number of functional traits represented within an ecosystem, is a useful indicator of ecosystem functioning. In this project, I use biological trait analysis (BTA) to explore the ecological functioning of benthic assemblages and to compare functional diversity across different assemblages. BTA combines quantitative structural data (e.g., abundance) with information on biological characteristics to functionally characterize species assemblages. Based on this analysis, I will construct a trait-based model of the community dynamics. The ultimate objectives of this study are a) to detect functional responses of benthic assemblages to extreme events, and b) to examine the traits that contribute most to the observed temporal development of benthic functional structure over the region. The results will be discussed in the context of ecosystem functioning.

Biographical Sketch: Mehdi Shojaei is a third-year Ph.D. student at the Alfred-Wegener-Institute, Helmholtz-Center for Polar and Marine Research, Germany. He received a bachelor's degree in biology and a master's degree in marine biology from Tarbiat Modares University. His Ph.D. thesis focuses on the effects of climate change and anthropogenic stressors on benthic macrofauna in the North Sea.

Vincent Hin

Supervisor: **Ulf Dieckmann**

Research Project: **Fisheries-induced evolution of cannibalism**

Abstract: Natural populations react to harvesting by showing demographic, plastic, and evolutionary responses. The evolutionary responses to fisheries can be rapid, a conclusion well supported by observational, experimental, and modeling studies. However, research on fisheries-induced evolution mainly focuses on a limited number of life-history traits, such as those characterizing maturation schedules, growth patterns, and reproductive investments. Trophic traits that describe the interaction of a harvested species with its environment are often not considered, probably because many studies on fisheries-induced evolution focus on single-species dynamics. Yet, harvesting might lead to adaptive responses in traits associated with trophic interactions, possibly mediated through changes in life-history traits.

An important trophic interaction in many fish species is cannibalism. The evolution of cannibalism is predicted to depend on the profitability of cannibalistic prey in relation to the availability of alternative prey types. Both of these factors are heavily influenced by harvesting, but there is no clear understanding of how this changes the evolution of cannibalism. My project aims to elucidate this by studying how (size-selective) harvesting affects the evolutionary success of cannibalistic individuals. Furthermore, I will study how other interactions, such as intraspecific competition, alter the fisheries-induced evolution of cannibalism.

Biographical Sketch: Vincent Hin completed his master's degree in ecology and evolution at the University of Amsterdam in 2013. He is currently a second-year Ph.D. student in the Theoretical Ecology group of the Institute for Biodiversity and Ecosystem Dynamics at the University of Amsterdam. In his Ph.D. research he uses mathematical modeling to study the evolution of intraspecific interactions within size-structured populations.

Jaideep Joshi

Supervisor: **Åke Brännström**

Research Project: **Evolution of cooperation in spatially heterogeneous environments**

Abstract: Cooperation is an evolutionary paradox, because cooperators are easily invaded by defectors. For example, consumer-resource systems can easily collapse through the 'tragedy of the commons,' which occurs when each individual tries to optimize its own gain. Recent research has focused on spatial mechanisms for the evolution of cooperation, like local dispersal, collective movement, and spatial heterogeneity. In this project, we investigate whether, in spatially heterogeneous environments, the tragedy of the commons can be averted when harvesting rates and dispersal rates coevolve. We further explore whether spatial heterogeneity can itself spontaneously arise because of such coevoutionary dynamics.

Biographical Sketch: Jaideep Joshi graduated in 2011 from the Indian Institute of Technology, Bombay, India, with a major in electrical engineering. He is currently a third year Ph.D. student at the Indian Institute of Science, Bengaluru, India. He works on collective animal behaviour, and in particular, on the evolution of cooperation. His main fields of scientific interest include the evolution of cooperation and collective behaviour.

Hanna ten Brink

Supervisor: **Ulf Dieckmann**
Research Project: **Fisheries-induced evolution of metamorphosis**

Abstract: Approximately 80% of all animal species undergo a metamorphosis during their life cycle. Diet changes during ontogeny have been postulated as the first step in evolutionary history towards life cycles including metamorphosis. Such changes can lead to opposing selection pressures on a trait in different life-history stages, since different diets often require different morphologies to be effectively utilized. It is therefore thought that in species with an ontogenetic diet shift metamorphosis has evolved to allow for the independent evolution of stage-specific traits. However, metamorphosis is an energetically costly process that results in weight loss and higher predation rates. It is unclear when the potential benefits of metamorphosis can outweigh these disadvantages. The aim of the proposed project is to understand under which ecological conditions metamorphosis can evolve in species that change their diet over their life cycle.

Many fish species that are of commercial interest undergo metamorphosis in order to change habitat during their life. Harvesting of fish is typically size-selective, because larger individuals in a population are often the target of harvesting. High harvesting pressure on large individuals in a certain habitat changes the profitability of this habitat and therefore influences whether it is beneficial for individuals to switch to this habitat or not. I will therefore also study how size-selective harvesting affects the evolution of metamorphosis.

Biographical Sketch: Hanna ten Brink completed her master's degree in biological sciences in 2013 at the University of Amsterdam, Netherlands. She is currently a third-year Ph.D. student in the Theoretical Ecology group of the Institute of Biodiversity and Ecosystem Dynamics at the University of Amsterdam. Her current research focuses on the evolution of ontogenetic diet shifts and complex life cycles. Her main fields of scientific interest include eco-evolutionary dynamics, theoretical ecology, adaptive dynamics, and complex life cycles.

Anne-Perrine Avrin

Supervisor: **Nils Johnson**

Research Project: **Quantifying the role of electricity transmission in integrating large shares of variable renewable energy into the power sector**

Abstract: Long-term energy planning modeling tools such as MESSAGE, which have limited spatial and temporal resolution. They thus face difficulties in i) identifying the best configurations between the numerous available options for maintaining power system reliability while ii) integrating large shares of variable renewable energy (VRE). Significant research has been conducted to represent the implications of high VRE shares for curtailment, storage, and system flexibility in MESSAGE, but very little has been done to examine how electricity transmission can facilitate integration by better matching VRE generation with electricity demand on a spatial basis. This project will explore how transmission can aid in integrating VRE and will quantify the trade-offs between expanding transmission lines and maintaining system reliability through other options, such as curtailment, storage, and demand-side management. These trade-offs will be quantified using SWITCH, a high-resolution modeling tool developed at the University of California, Berkeley, that uses historical hourly data for load and wind and solar generation. These trade-offs will then be incorporated into MESSAGE to improve its representation of the role of spatial and temporal heterogeneity in integrating large amounts of VRE.

Biographical Sketch: Anne-Perrine Avrin is a second-year MS/PhD student in the Energy and Resources Group at the University of California, Berkeley, and a research fellow within the company Areva. Her master's thesis is entitled: "Accounting for forecast uncertainty in policy making: China's electricity pathways by 2050." In the Renewable and Appropriate Energy Laboratory, her research focuses on long-term capacity expansion planning for the energy mix in China. She is particularly interested in the challenges posed by high penetration levels of renewable energies in centralized power grids, and in the development of advanced nuclear technologies and electric vehicles in Asia. She holds an MSc in industrial and nuclear engineering from Arts et Métiers in France, and has worked on nuclear safety and non-proliferation in China, France, and the USA.

Gillian Foster

Supervisor: **David McCollum**

Research Project: **The future of plant-based ethylene in the era of shale gas: An economic and environmental assessment of a sustainable technology**

Abstract: The research explores the future of plant-based production of ethylene, an important petrochemical, in the context of the North American natural gas boom and estimates the corresponding environmental impacts (carbon equivalent emissions). Ethylene is widely used in the modern fossil fuel-based economy, which is characterized by pollution and anthropogenic carbon emissions leading to climate change. Sustainability transition approaches call for replacement of non-renewable fossil fuel as the main feedstock for petrochemicals. However, the overall fossil fuel-demand for non-energy purposes, such as production of bulk chemicals is poorly understood. For example, comprehensive energy analyses that are used by policymakers such as the IIASA MESSAGE model consider petrochemical feedstock as one category. This leaves a gap in our understanding of alternative energy carriers for feedstock of individual bulk petrochemical products, particularly ethylene. In addition, the recent advent of shale gas from hydraulic fracturing and horizontal drilling in North America has redefined the economics of ethylene manufacturing because it is used as feedstock. The impact of this change on infant sustainable technologies/business models to derive critical basic chemicals from biomass is not fully understood. My project explores the economic aspects of the topic through scenario analysis, modeling and regression analysis. The goals for the summer are to: i) develop a vector autoregressive model to predict future ethylene demand and feedstock selection under varying feedstock price projections using multivariate exploratory analysis and multivariate time series analysis; ii) incorporate scenarios for societal approaches toward climate change in the Shared Socioeconomic Pathways ; and iii) using MESSAGE to predict feedstock mix by incorporating techno-economic data for plant-based ethylene manufacturing.

Biographical Sketch: Gillian Foster is a second-year Doctoral Candidate at the Institute for Ecological Economics of Vienna University of Economics and Business (Wirschaftsuniversität). She conducts quantitative and qualitative socioeconomic analyses to investigate factors that make sustainable technologies successful within an evolutionary economics and ecological economics framework. She focuses on non-energy uses of fossil fuels and the potential for biomass alternatives in the context of climate change and a dynamic energy market.

Zarrar Khan

Supervisor: **Oliver Fricko**
Co-Supervisor: **Michelle Van Vliet**

Research Project: **Integrating water and energy models for optimal long-term resource management**

Abstract: Economic development, increased population, pollution, and climate change are expected to have a significant impact on the demand for and availability of energy and water in the future. According to some climate change scenarios the availability of water in certain regions may decrease by up to 60% by 2050. A decrease in water of this magnitude will have serious consequences for all dependent activities and will require active efforts to adapt to and satisfy the simultaneous increase in both water and energy demands. The energy sector has been shown to be considerably reliant on water resources, which are needed in all phases of the sector, including extraction of raw materials, hydropower production, biofuel irrigation, and power plant cooling. At the same time there is a feedback loop, with the water sector using energy for freshwater extraction, transmission, treatment, and desalinization. The decrease in resources coupled with the interdependencies of the two sectors calls for integrated management methods.

After a review of existing literature, current models were found to be particularly weak in addressing the direct impacts of regional and temporal water shortages on energy systems. The aim of this research is to create an integrated water and energy model capable of capturing the impacts of spatial and temporal water scarcity as a result of climate change.

Biographical Sketch: Khan is a second-year PhD student in the Mundus Joint Doctorate (Comillas Pontifical University – Spain, TUDelft – Holland, KTH – Sweden) in Sustainable Energy Technologies and Strategies (SETS). Before his PhD, he worked as a professional geotechnical engineer in New York, California, and Pakistan. He has a master's degree in Civil Engineering from Cornell University (NY) and a bachelor's degree in Engineering and Environmental studies from Dartmouth College (NH). He also has a master's degree in Project Management from COMSATS, Pakistan. His current research interests include integrated energy and water resource optimization for future climate change scenarios.

Devyani Singh

Supervisor: **Dr. Shonali Pachauri**

Research Project: **Uncertainties in carbon emissions & the impact of biomass renewability**

Abstract: As the literature has failed to account for clack carbon (BC) and other non-CO_2 emissions in the estimation of inequalities of carbon emissions, we will analyze the impact of non-Kyoto emissions and of the differences in biomass harvesting on household carbon emissions within India.

Significant efforts have been made to understand the extent of global inequalities in carbon emissions and to distribute the underlying responsibility for past, present, and future emissions. The literature on climate mitigation responsibilities has usually compared emissions between developed and developing countries. However, it is known that carbon emissions are inequitably distributed within countries and that they do not scale with income in a neat, linear fashion. To understand carbon emission inequalities, we need to understand underlying energy consumption patterns. Rural populations tend to use large quantities of biomass to meet their household energy needs, and how this biomass is harvested (sustainably or not) can have an impact on the emission burden of households. However, the limited research into the uncertainties surrounding sustainability of household biomass use and its impact on household emissions looks at relatively large spatial scales and overlooks the context of understanding emission distribution within countries. Unsustainable harvesting of biomass is not the only way that household biomass consumption influences the climate. The emissions of short-lived climate-forcing agents from household cooking and heating have significant effects regionally and globally. In particular, BC emissions have recently drawn attention to the possibility that transitioning households away from biomass burning for their energy needs could—given their high global warming potential—result in quick reductions in emissions.

Biographical Sketch: Devyani Singh is currently a third-year PhD student in the Faculty of Forestry at the University of British Columbia, Canada. She received a bachelor's degree in Commerce at Delhi University and an MBA in Finance at the University of Iowa (2007). After working in corporate finance for many years, she switched fields to obtain a MSc in Environmental Social Science from Ohio State University (2012). Her current research focuses on the issues surrounding forest biomass measurements for improved cookstove carbon credits. Her main field of study is environmental finance, specifically payments for ecosystem services and household energy transitions.

Luis Gustavo Tudeschini

Supervisor: **Narashima Rao**

Research Project: **"Decent living" standard in Brazil—Household energy consumption and carbon footprint**

Abstract: Based on the standard of the decent living framework, this research focuses on investigating the characteristics of the direct and embedded energy consumption of Brazilian households and its carbon footprint. Using quantitative methods and official data, the study will access the living conditions of Brazilian households taking into account nourishment, clean water, sanitation services (i.e., sewage and waste disposal), electricity access, and non-slum urban housing. The study research questions are: i) How many households are below the "decent living" threshold? ii) How much energy would be required to improve household conditions above this threshold? and iii) What would be the impact on carbon emission by improving household conditions?

Biographical Sketch: Luis Gustavo Tudeschini received his bachelor's degree in Economics from the University of São Paulo in 2012. He is currently a second-year PhD candidate at the Research Group on Bioenergy, Institute of Energy and Environment, University of São Paulo. Currently, he is a team member of the French-Brazilian research project, "Evolution of consumption patterns, economic convergence and carbon footprint of development: A comparison Brazil– France". His PhD research focuses on regional economics, consumption patterns among income classes, and their impact on energy consumption and carbon footprint.

Oludunsin Tunrayo Arodudu

Supervisor: **Juraj Balkovic**
Co-Supervisor: **Ligia Azevedo**

Research Project: **Spatio-temporal analysis of LCA indicators within a sustainability assessment framework for assessing agro-bioenergy land use**

Abstract: Sustainability assessment of agricultural-based bioenergy (agro-bioenergy) using relevant life cycle assessment (LCA) indicator frameworks such as energy return on energy invested (EROEI), human appropriation of net primary production (HANPP), resource footprint (RF) and greenhouse gas (GHG) balance indicator frameworks are often used for assessment of agro-bioenergy-related ecosystem services and/or land use functions (e.g., energy provision, carbon emission regulation etc.) without adequate consideration being accorded to the spatio-temporal dimensions of the sustainability discuss.

This study will examine the spatio-temporal dimensions of yield-dependent agro-bioenergy LCA indicators (i.e., EROEI, HANPP, RF etc.), using as case studies maize ethanol and biogas production across generic agro-climatic zones (tropics, sub-tropics, and temperate). Inputs from spatio-temporal yield predictions over specific time frames (2030, 2050, 2070 etc.), from available datasets and models such as GAEZ (which captures the maximum attainable data yield under different agro-ecological conditions), GLOBIOM (which captures the spatio-temporal effects of global land use change on future yields), EPIC (which captures spatio-temporal effects of change in management practices on future yields) will be deployed for time series analysis and spatio-temporal sustainability assessment of agro-bioenergy LCA indicators of maize ethanol and biogas production activities globally. Associated sustainability implications of considering local and regional agronomic factors such as farm power types (tractor/man/animals); tillage methods (conventional/conservation/no-till); fertilizer sources (synthetic/animal manure/biogas digestates); irrigation techniques (rain-fed/surface/sprinkler/drip) and seed-sowing options (native/GMO-genetically modified/hybrid seeds) over same time-frames (e.g. 2030, 2050, 2070, etc.) will also be evaluated.

Biographical Sketch: Oludunsin Tunrayo Arodudu earned his bachelor's degree in Geography from Obafemi Awolowo University, Ile-Ife, Nigeria, and a multiple EU Erasmus Mundus MSc degree in Geoinformation Science and Earth Observation for environmental modeling and management (GEM) from Lund University, Sweden and ITC, University of Twente, Netherlands. He is currently an EU Marie-Curie CASTLE (Careers in Sustainability Excellence) ITN (Initial Training Network) doctoral fellow at the Leibniz Centre for Agricultural Landscape Research, Müncheberg, Germany, and a second-year PhD student at the University of Potsdam, Germany. His main research interests are impact assessment methodologies, land cover/use studies, and sustainable bioenergy production.

Ecosystems Services and Management Program (ESM)

Program Director: Michael Obersteiner

Natalia Borisevich

Supervisor: **Anatoly Shvidenko**
Co-Supervisor: **Dmity Shchepashchenko**

Research Project: **Organization specially protected areas of local importance Krasnoyarsk territory**

Abstract: Specially protected natural areas have an important social and environmental value. Natural conditions and the level of regional socioeconomic development will ordain how a protected areas functions. . A set of protected areas should thus be considered as an integrated system; this would include an individual protected area that has a different status within a protection regime. A systematic approach to protected areas can address the full range of environmental and social issues, including formation and maintenance of a favorable environment, preservation of natural ecosystems and biological diversity, and meeting people's recreational needs.

This project will examine ecological and economic assessments of the organization of specially protected natural territories of local importance, using GIS technology and remote sensing data. One promising approach to automating the allocation of types of site condition is the use of morphometric parameters of relief and remote sensing data. For this I will use a system landscape methodology requiring selection of the relevant quantitative morphometric parameters of landscapes and ecosystems, as well as assessment of the relevance of their use in forestry and ecology; the study will be based on data from digital elevation models (DEMs), remote sensing, and field observations. In the selection of morphometric characteristics, features of the terrain of specific territories will be considered, as will the specificity of its mechanisms of influence on the processes of differentiation of environmental factors and vegetation. The information capabilities of different characteristics have not been studied enough, which is why it is impossible to recommend a universal list of morphometric parameters suitable for any purpose and for any study areas.

Biographical Sketch: Natalia Borisevich graduated from Department of Economics of the Siberian State Technological University, Russia, in 2011. She then entered the post graduate program at the Institute of Forest, Siberian Branch of Russian Academy of Science. The title of her PhD thesis is: "Fundamentals of development of specially protected natural territories of local importance."

Kakoli Borkotoky

Supervisor: **Hugo Valin**
Co-Supervisor: **Petr Havlik**

Research Project: **The nutrition transition, the nutritional status of children, and the demand for food in India**

Abstract: People's eating habits have changed over time, influenced by income, individual preferences, and geographical and social factors. India is no exception to this global trend. Food consumption patterns in India have registered a dramatic change in the last two decades, and changes in eating habits are not limited to higher castes or better-off people—the habits of a considerable percentage of poor people are also changing. It is important to examine the changes in eating habits given that the level of under-nutrition in India is among the highest in the world. It is also important to know how changes in eating habits will influence future demand for food in India.

This study will try to address the following question: what are the possible scenarios for future food demand and dietary patterns in India and what are the implications for the nutritional status of children? This study will use consumer expenditure data from National Sample Survey Organization (1993-2012) and anthropometric information about children from the National Family Health Survey (1992-2006). First, the study will examine food diversity related to different socioeconomic backgrounds. Trends in consumption patterns will be projected using the background drivers identified in the analysis. The association of different contextual and other factors with the nutritional status of children will be examined using the anthropometric indicators. Production and environmental impacts associated with the different scenarios will then be estimated using the GLOBIOM model.

Biographical Sketch: Kakoli Borkotoky has a bachelor's and master's degree in Statistics from Dibrugarh University, Assam, India. She has an M. Phil in Population Studies from International Institute for Population Sciences (IIPS), Mumbai, India. Currently she is enrolled in the PhD program at IIPS and her doctoral research focuses on the nutrition transition in India with special focus on dietary shifts and the association of these shifts with the nutritional status of children. Her main areas of interest are the nutrition transition and food security, child health, education of women and children, and quality of survey data.

Tamara Fetzel

Supervisor: **Petr Havlikuraj Balkovic**
Co-Supervisor: **Juraj Balkovic**

Research Project: **Toward sustainable livestock production systems: Analyzing ecological constraints to grazing intensity**

Abstract: Increasing food production from cropland and grassland is essential to meet the future demand for food of a growing world population without further expansion in land use. On pasture lands, a growth rate 40% larger than the production increase between 1962 and 2005 is required to close the estimated food gap. Yet differences in livestock systems across regions and continents are large, and understanding the underlying drivers and major ecological and socioeconomic determinants is essential to sustainably increase food production from grasslands.

In my project, I aim to assess the intensity of grazing at the global scale (e.g., the share of Net Primary Production [NPP]consumed by grazing animals) and to analyze the role of seasonality for limits to grazing intensity (GI). In many regions of the world, seasonality creates periods of shortages and surpluses in NPP, which can (partly) be overcome by social organization, such as the use of storage technologies or through imports. The project will: i) assess the geographic distribution of areas of high and low GI in a spatially explicit manner, and ii) gather information on the concomitant socioeconomic and ecological frame conditions, with a special focus on seasonality of NPP dynamics. This study aims to contribute to an improved understanding of the systemic interlinkages between GI, seasonal biomass supply, and socioeconomic and ecological trade-offs. The resulting data on GI and the associated trade-offs will be spatially explicit (5 arc min resolution) and of global coverage; such data are essential for analyzing the intensification potentials of grasslands.

Biographical Sketch: Tamara Fetzel is a third-year PhD student at the Institute of Social Ecology in Vienna. She holds a master's degree in Environmental System Sciences with a major in Geography and a special focus on geographic technologies (GIS, cartography) and a master's degree in Mountain Geography and Climatology from the Karl-Franzens-University, Graz. Her PhD research focus is on land-use intensity and its socioeconomic and ecological determinants with a particular focus on grasslands, GIS, and spatial analysis.

Wenfeng Liu

Supervisor: **Rastislav Skalsky**
Co-Supervisor: **Juraj Balkovic**

Research Project: **Challenges and opportunities of organic farming: Global modeling of the impacts of organic farming on food security and the environment**

Abstract: Agriculture is facing the twin challenges of providing enough food for continuing population growth, economic development, and diet change, while simultaneously decreasing environmental and ecosystem interventions. Compared with conventional farming, organic farming—an alternative farming system which aims to mitigate impacts on the environment—is a proposed solution. However, as organic farming tends to produce lower yields, it is important to investigate the challenges (food security) and opportunities (environmental benefits) of organic farming and identify the hotspots at a large scale, particularly globally.

In this project, a simulation framework for organic farming based on the Python-based EPIC (PEPIC) model will be developed at a global scale with a resolution of 0.5 arc degree. A wheat – soybean – maize system will be selected to define the organic farming. We will investigate global crop yields of wheat, soybean, and maize, as well as environmental impacts in terms of carbon emissions, nutrient leaching and losses, and soil erosion under organic farming. At the same time, simulated yields and environmental variables under conventional and organic farming systems will be compared to identify the hotspots, that is, where the impacts are more sensitive. Results from this project are expected to support policymakers in deciding which regions have higher potential to convert from conventional to organic farming.

Biographical Sketch: Wenfeng Liu graduated from Sichuan University in 2010 with a bachelor's degree in Water Resources and Hydropower Engineering. He then received a master's degree in Hydrology and Water Resources from Beijing Normal University. He is now a second-year PhD candidate at Swiss Federal Institute of Technology Zurich (ETHZ) and Swiss Federal Institute of Aquatic Science and Technology (Eawag). The title of his thesis is "Spatially explicit modeling of the water-food-environment-trade nexus in the context of agricultural intensification." His research interests include crop modeling, global crop water use, environment impacts of crop production, and food trade.

Sennai Mesfun

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

Research Project: **Intermittent renewable power generation for increased biofuel production: Systems performance and localization**

Abstract: The feasibility of intermittent renewable energy sources such as wind and solar energy is significantly impacted by a number of factors, including geographic location, intermittency of the generated power, and the relatively high capital investment per power output. Investment costs in stand-alone systems can be particularly prohibitive. To increase the share of intermittent renewable power in the energy mix, the power-to-gas/power-to-liquid process may offer benefits that would make it an interesting alternative to conventional technologies. In this process, the power generated in a wind/solar park is stored in hydrogen via electrolysis of water. The hydrogen can then be used as a feedstock for the synthesis of higher-grade transportation/gas fuels.

The proposed research work will primarily focus on the synthesis of gas/liquids from CO_2 and H_2O, with potential extension to a systems analysis of integrating such processes in biomass gasification-based production of biofuels. In this project, systems performance and localization of wind/solar power based hydrogen for boosting biofuels production will be studied using the BeWhere model.

Biographical Sketch: Sennai Mesfun has been a PhD candidate at Luleå University of Technology, Sweden, since 2012. His research focuses on the transition of Swedish forest industries into future biorefineries, using advanced process integration and optimization tools from a systems perspective.

Daniel Sanchez

Supervisor: **Florian Kraxner**
Co-Supervisor: **Nils Johnson**

Research Project: **The influence of complementary renewable seasonality on bioenergy development: Application to alpine energy**

Abstract: The Alps have great potential for renewable energy use, which is an important aspect of climate change mitigation. However, the need to protect ecosystems limits the renewable energy potential of the Alpine region and necessitates the use of decision-making tools to understand possible deployment. The renewable energy potential of wind, water, and solar (WWS) in the Alpine region also has large seasonal variation. Without strategies for managing intermittency, supply variation may limit the potential of renewable energy technologies.

This project will develop seasonal scenarios for wind, solar, and hydro, as well as their potential contribution to different energy demands, such as electricity, heat, and transportation fuels. Building on previous work at IIASA, these scenarios will be constrained by environmental considerations and will apply existing decision making tools to determine the relative contributions of renewable energy to potential supply, including wind, water, solar, and bioenergy. In evaluating renewable energy deployment, I will leverage the Ecosystem Services and Management (ESM) Program's BeWhere model, a techno-economic model for the optimization of renewable energy systems that, among other things, determines the optimal size and geographic distribution of bioenergy production plants and complementary renewables at the local, regional, and continental levels. This project will contribute to strategies for managing intermittency and seasonal variation across a portfolio of renewable energy technologies. It will also investigate novel technologies for managing intermittency, such as power-to-gas (P2G), which can convert excess electricity into gaseous fuels.

Biographical Sketch: Daniel L. Sanchez is a PhD. candidate in the Energy and Resources Group and a researcher in the Renewable and Appropriate Energy Laboratory at the University of California, Berkeley. He is interested in quantitative analysis to inform public policy, focusing on bioenergy and climate policy. His current research focuses design, deployment, and commercialization of bioenergy with carbon capture and sequestration (BECCS) technologies. He has previously held positions with the Advanced Research Projects Agency-Energy (ARPA-E), Green for All, and the California Public Utilities Commission. He holds an master's degree in Energy and Resources and a bachelor's in Chemical and Biomolecular Engineering from the University of Pennsylvania.

Sunyong Sung

Supervisor: **Nicklas Forsell**
Co-Supervisor: **Georg Kindermann**

Research Project: **Estimating carbon stock changes considering vegetation shift and land use changes: Case study of the Korean Peninsula**

Abstract: Vegetation provides food, wood, and energy. Vegetation can sequester CO_2 from the atmosphere, with the Net Primary Production (NPP) of vegetation closely linked to climate change mitigation. Vegetation growth is closely related to albedo and evapotranspiration, which are also related to climate change. Changes in NPP have thus attracted global attention given the possibility of increased climate change in the future. This makes it necessary to understand how climate change affects the forest ecosystem function. As 64% of South Korea's territory is forest, research into the impact of climate change on the forest ecosystem would bring significant implications for the Korean Peninsula.

My focus at IIASA will be on improving the G4M model for the Korean Peninsula to enable estimation of NPP change under climate change taking into account land use and socioeconomic changes. As the frequency of natural hazards has shown an increasing trend, its impact on the forest ecosystem is expected to increase. Thus a further objective will be to include the impact of forest disturbances in the G4M model to understand how forest ecosystems might be restored.

Biographical Sketch: Sunyong Sung received a BSc and a MSc degree in Landscape Architecture, from Seoul National University, South Korea. He is currently a third-year PhD student of the Interdisciplinary Program in Landscape Architecture at Seoul National University. His scientific interests includes the impact of climate change on the forest carbon sequestration and monitoring of forest ecosystem recovery from disturbances (e.g., forest fire, landslides etc.) using GIS models and remote sensing techniques.

Sie Ting Tan

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

Research Project: **Renewable energy production from municipal solid waste to mitigate climate change: A spatially explicit assessment for Malaysia**

Abstract: Rapid urbanization, population growth, and industrialization are contributing to the large-scale increase of total waste generation in Malaysia and changing the characteristics and composition of the municipal solid waste (MSW) generated. Due to greenhouse gas (GHG) emissions and land scarcity, Malaysia urgently needs a better waste management strategy. Among the options, Waste-to-Energy (WTE) stands out as a promising alternative for simultaneously tackling the waste problem and adding to the sustainable renewable energy potential of Malaysia. The utilization of MSW as a renewable resource could overcome waste disposal issues, generate power for fossil fuel displacement, and mitigate GHG emissions from waste treatment by converting CH_4 to CO_2. However, because of the high cost of resource transportation and large distribution pattern in the WTE supply chain, MSW in Malaysia is mostly disposed of in landfill.

This study aims to evaluate the energy and climate change mitigation potential of MSW in Malaysia through a techno-economic approach. The model used in this study is based on IIASA's techno-economic engineering model for renewable energy optimization system (BeWhere). The model optimizes the scale and location of waste treatment plants with potential energy and fertilizer co-generation, given the locations of feedstock and energy demand. The model minimizes the costs and CO_2 emissions of the WTE supply chain, including MSW generation, MSW transportation, conversion to biofuel, transportation and delivery of the final energy commodity (e.g., biofuel, power) and fertilizer.

Biographical Sketch: Sie Ting Tan graduated in 2012 from the Universiti Teknologi Malaysia. She enrolled in the fast-track PhD program in Universiti Teknologi Malaysia, and is currently in her fourth year of study. Her thesis is devoted to the design and operation of sustainable solid waste management system. In parallel, she involved in low-carbon society research project in the Asian region at the Low-carbon City Research Center in Malaysia. Her main fields of scientific interest include optimization in waste management, and low-carbon city planning and indicator system.

Johanna Wehkamp

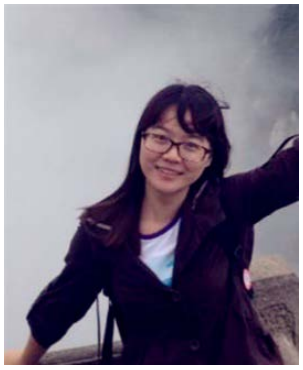
Supervisor: **Florian Kraxner**
Co-Supervisor: **Stephan Pietsch**

Research Project: **Do weak institutions drive deforestation? Identifying relevant governance indicators for global forest modeling**

Abstract: Decisions on policy design need to be taken in the context of REDD+ (reducing emissions from deforestation and forest degradation); however, there are still huge uncertainties about the effectiveness of different policy tools. There is no historical experience of large-scale payments for ecosystem services and no effective policies to reduce deforestation. Thus, forest models are particularly relevant in terms of facilitating decision making. IIASA's global forestry model (G4M) calculates the net present value of land use, comparing forestry and agriculture. While the model results globally match the observed deforestation patterns, regional differences in modeled vs. observed deforestation rates are treated as fixed residuals per country.

This YSSP project aims to better understand and reduce this this residual by relating it to institutional differences. Using existing and new data sources on institutions, this project will test whether the size of the residual correlates with the level of institutional quality. A more detailed application to a case country (e.g., Indonesia) is expected to reveal country-specific forest governance drivers of deforestation which can then be used to identify the levers for policy.

Biographical Sketch: Johanna Wehkamp completed her studies with a master's degree in 2012 at Sciences Po Paris, in International Affairs with a particular focus on Environmental and Development Economics. In 2013 she started her PhD in Economics at the Technical University of Berlin and the Mercator Research Institute on Global Commons and Climate Change (MCC) and works on the role of governance issues for sustainable tropical forest management.



Jie Zhang

Supervisor: **Juraj Balkovic**
Co-Supervisor: **Ligia Azevedo**

Research Project: **Modeling the biogeochemical process of the phosphorus cycle and assessing the sustainability of phosphorus fertilizer in China**

Abstract: Phosphorus is a major factor in plant growth in many ecosystems, like tropical forests, coastal wetlands, and semi-arid areas. It is the key factor in DNA, ATP, photosynthesis, and other metabolic process, and has no substitute in crop growing and food production. Phosphorus also plays a vital role in global food security. Modern agriculture and food production rely heavily on phosphorus fertilizer which is mainly derived from phosphate rock. It is a nonrenewable resource and current global reserves may be depleted in 50-100 years; although the global population and food demand keep increasing, the emerging crisis receives little attention. On the other hand, eutrophication, caused by the massive inputs of nitrogen and phosphorus from farmland, is a common and serious problem in lakes, rivers, and on coasts. It is thus essential to find a more integrated and effective approach to reducing phosphorus as a fertilizer in the agro-ecosystem while maintaining crop yield and minimizing environmental risk. Models can help us to measure the current status of phosphorus in the soil and quantitatively simulate phosphorus responses in crops.

In this study, we use the EPIC model to simulate phosphorus dynamics in the soil-plant system. Firstly, we will model the phosphorus balances in the agro-ecosystem based on the long-time field experiments of the National Soil Fertility and Fertilizer Effects Long-term Monitoring Network. Second, we will analyze the spatial and temporal dynamic changes of soil phosphorus in China. Finally, we will assess sustainability and find the management practices to maintain crop yields while reducing the use of phosphorus fertilizer.

Biographical Sketch: Jie Zhang received her bachelor's degree in Geographic Information System (GIS) from Wuhan University, China in 2012. Currently, she is a third-year PhD student in Global Change Ecology at Tsinghua University, China. Her main fields of scientific interests include biogeochemical modeling and its applications, such as water resources and food security. Her PhD thesis will be about the biogeochemical process and modeling of phosphorus cycle in different ecosystems.

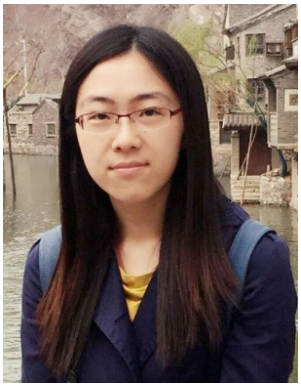
Erasmus zu Ermgassen

Supervisor: **Aline Mosnier**
Co-Supervisor: **Johannes Pirker**

Research Project: **The influence of property size on sustainable agricultural intensification in Mato Grosso**

Abstract: The property size is known to strongly influence patterns of land use: the dynamics of land use change differ greatly, for example, between areas dominated by smallholder farming or export-orientated industrial agriculture. However, models of land use and land use change which are commonly used to evaluate alternative policy or development scenarios often do not include the distribution and ownership of land. During the YSSP at IIASA, I will evaluate the potential impacts of financial mechanisms, such as green bonds, on land use change in Mato Grosso, Brazil in the framework of the Unlocking Forest Finance initiative (UFF). Our project will integrate sub-municipality level maps of landholdings into a spatially explicit land use optimization model in order to differentiate pathways to sustainable development between smallholders and large landholders in Mato Grosso. Even if production is dominated by large farms, smallholders make up 81% of properties in the Brazilian Legal Amazon. Smallholders usually lack access to credit and face other constraints that large farms do not have. They are also responsible for an increasing proportion of deforestation. Consequently, future efforts to promote equitable, sustainable development in Brazil must consider the distribution of landholdings.

Biographical Sketch: Erasmus graduated in 2014 with a veterinary degree and Masters in Food Security from the University of Cambridge. He is currently in the second year of his PhD in the Conservation Science Group, University of Cambridge. Interested in sustainable strategies to meet the growing global demand for livestock products, Erasmus' research focuses on the potential for, and socio-economic impacts of, efforts to increase livestock yields and the use of low-impact animal feed in Brazil and the EU.



Chuchu Chen

Supervisor: **Zbigniew Klimont**

Research Project: **Assessment of abatement potential of ammonia emissions from agricultural management practices in China**

Abstract: Ammonia (NH_3) is a key precursor to atmospheric fine particulate matter ($PM_{2.5}$) and an important component of the reactive nitrogen cycle. It has strong implications for both regional air quality and ecosystems. Because of the limited parameterization of the complex interactions between fertilizer usage, farm practices, soil and meteorological conditions, ammonia emission estimates for agricultural fertilization and livestock farming over China—two of the most important ammonia emission sources—are usually based on time-averaged emission factors and temporal profiles. This leads to uncertainties of the evaluation of controls on ammonia in emission levels and control technologies.

In this project, I will develop a process-based ammonia emission model for fertilizer use and livestock management at fine spatial and temporal scales based on the parameterization of geographic information, farm practices, and meteorological conditions. Using this, I will analyze specific agricultural management measurements and estimate the potential for each measurement to reduce ammonia emissions based on this inventory model. The research will conduct a comprehensive agricultural management strategy to reduce ammonia emissions.

Biographical Sketch: Chuchu Chen graduated in Geographic Information Science from the Department of Earth Sciences, Zhejiang University in 2012. She is currently a third-year master's student at the Center for Earth System Science, Tsinghua University. Her main fields of scientific interest include emission inventories, regional air quality modeling, and mitigation policy and its effect on air quality and human health.

Carlijn Hendriks

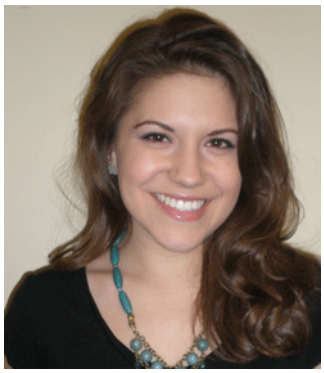
Supervisor: **Wolfgang Schöpp**
Co-Supervisor: **Nicklas Forsell**

Research Project: **Effects of increased biofuel plantations on ground level ozone and health impact in Europe**

Abstract: To meet the EU goals on renewable energy production, one important option is increased use of biomass for energy production. Increasing biomass use leads to an increase in production plantations for fast-growing biomass, for example, short-rotation coppice (SRC) of poplar trees. The land-use changes associated with SRC will cause increased emissions of isoprene, an ozone precursor; this is because fast-growing tree species like poplar emit much more isoprene than the species they are likely replacing (agricultural crops, grass, or mature forests). High levels of tropospheric ozone cause damage to human health, ecosystems and crop productivity, and tropospheric ozone also contributes to global warming.

This study will start from different EU energy scenarios. These will use GAINS model to calculate emissions and the GLOBIOM model to calculate well land use change. Emission changes from the induced land use change will be calculated using newly available measurements on the isoprene emission factor for SRC poplar plantations. The emissions from GAINS and the calculated biogenic emissions will drive the chemistry transport model LOTOS-EUROS to allow assessment of the impact of increased biomass production on ozone levels. A calculation of damage to human health, plant growth, and climate forcing is also foreseen.

Biographical Sketch: After a BSc in Chemistry (2008) from Radboud University Nijmegen, Carlijn Hendriks obtained a MSc in Energy Science (2010) at Utrecht University. She has worked at TNO (the Dutch institute for applied sciences) as an air quality researcher and modeler since 2011. She worked on projects on topics like source attribution of particulate matter, air quality impacts of energy scenarios and nitrogen deposition, combining this project work with the ambition to obtain a PhD in the field of air quality modeling for policy support purposes sometime next year.



Alexandra Karambelas

Supervisor: **Gregor Kiesewetter**
Co-Supervisor: **Chris Heyes**

Research Project: **Urban versus rural emission contributions to air pollution in India**

Abstract: India's economic transformation and population growth in recent decades is coupled with a decline in air quality conditions in both urban and rural India. The emissions from these regions, however, are vastly different. Urban pollution in India is a combination of nitrogen oxides, ozone, and primary and secondary fine particulate matter from transportation and electricity generation; rural pollution is dominated by combustion of biomass to meet the heating and cooking needs of nearly two-thirds of India's population. These conditions present a unique situation where strong emissions from different sectors blend to affect overall air quality conditions. This study aims to understand how urban and rural emissions contribute to air quality in very populous northern India and how air quality may change in the future with new policies and further population growth.

To assess rural and urban contributions to regional air quality in northern India, we will use the US Environmental Protection Agency Community Multi-scale Air Quality Model (CMAQ). Several simulations will be run to understand the contributions of urban and rural emissions to regional air quality. Satellite data of ozone and particulate precursor gases will be used to assess emissions trends and evaluate the air quality model output. In the second part of this project, future emissions sensitivity scenarios output by GAINS will be included in the CMAQ to assess future changes to air quality based on policy adoption and urbanization.

Biographical Sketch: Alexandra (Alex) Karambelas is a PhD at the Nelson Institute's Environment and Resources and Energy Analysis and Policy Programs at the University of Wisconsin—Madison. Her research focus involves understanding the contribution of various emission sectors to ambient concentrations of fine particulate matter and ozone. Her current research uses satellite observations of nitrogen dioxide, formaldehyde, and aerosols in combination with a regional air quality model to assess urban and rural air quality conditions in India.

Zhimin Mao

Supervisor: **Zbigniew Klimont**

Research Project: **Assess the costs and benefits of the Air Pollution Action Plan in Pearl River Delta region**

Abstract: The purpose of this research is to better understand and assess potential costs and benefits of proposed action plan in China's Pearl River Delta that aims to control the negative environmental and health impacts of air pollution. Poor air quality is the most visible sign of China's and Guangdong's struggle to control pollution from the increasing number of vehicles on the road, the combustion of coal for electricity generation, and manufacturing, all of which continue to emit high levels of pollutants. Many strategies and action plans have been proposed to tackle this problem. There are compelling economic and social reasons for heightened focus throughout China and Guangdong on reducing pollution. However, the costs of pollution control strategies and associated benefits have not been well quantified. Using the Pearl River Delta as a case study, this research project plans to conduct a cost-benefit analysis of the proposed action plan and alternative plans in order to estimate which are most robust across a range of uncertainties.

Biographical Sketch: Zhimin Mao is a fourth-year Doctoral Fellow at the Pardee RAND Graduate School and an assistant policy analyst at the RAND Corporation. Her research interests include energy, environment policy, and economic development. Her experiences prior to RAND focused on energy and environmental policy. During her time at the Heinz Center for Science, Economics and Environment, and the University Corporation for Atmospheric Research, she worked on issues related to U.S. and China collaboration on low carbon development. She was an international consultant and summer intern at the Asian Development Bank where she conducted a household energy usage survey and completed a project aimed to provide affordable energy efficiency solutions for the extremely poor families. Her undergraduate honors thesis on supply chain strength and sustainable development was published by the Journal of Cleaner Production.

Zihan Zhai

Supervisor: **Pallav Purohit**
Co-Supervisor: **Lena Höglund Isaksson**

Research Project: **HFC emissions and mitigation strategies for China using GAINS model**

Abstract: Non-CO_2 emissions accounted for 24% of total greenhouse gas (GHG) emissions in 2010 according to the Fifth Assessment Report of the IPCC. The importance of non-CO_2 emissions will continue to grow as low-cost carbon mitigation options are exhausted. One such critically important category of gases is hydrofluorocarbons (HFCs), potent greenhouse gases, expected to contribute significantly to global warming by 2050. The key underlying activity drivers for increased use of HFCs is their use as refrigerants in air-conditioners and refrigerators and in industrial processes as solvents and foaming agents. With the right mitigation strategy and policy incentives, the technological prerequisites exist for decoupling HFC emissions from growth in underlying activities. China has a large production and consumption market for HFCs. At present, China is in the early stages of phasing out HCFCs in accordance with the Montreal Protocol. Due to the significantly high global warming potential (GWP) of conventional alternatives like HFCs, it is critically important to understand the growth in HFC emissions if no actions are taken to replace these in the different activities and to find the potential and associated costs for HFC reduction from different sectors.

In this research, activity data and emission factors of HFCs for China will be updated and validated in the GAINS model. Based on the historic consumption of HCFC/HFC in China, the business-as-usual (BAU) scenario will be developed. The GAINS model will be used to assess emissions on a medium-term time horizon, and the atmospheric concentrations of HCFCs/HFCs under different mitigation scenarios will be simulated. Finally, a maximum feasible reduction (MFR) scenario will be developed to obtain the cost curves. In a related development, the China-USA Agreement on the phase down of potent GHGs in June 2013 provides China with specific policy scenarios. The research results will provide alternative emission control strategies of HFCs for China to maximize environmental benefits, meet multiple policy objectives, and yield potentially large economic synergies.

Biographical Sketch: Zihan Zhai received her undergraduate degree in Ecology from the College of Resources and Environmental Sciences, China Agricultural University in July 2012. She is currently a third year PhD student at the College of Environmental Sciences and Engineering, Peking University. Her main fields of scientific interest include atmospheric transformation of F-gases, regional pollution and climate change, and greenhouse gases mitigation policy.

Arda Aktaş

Supervisor: **Warren Sanderson**

Research Project: **Subjective age**

Abstract: Age, as a human characteristic, is used in all kinds of economic, social, and demographic studies. Most of these studies use "chronological age," that is, how many years people have already lived. However, we know that the health of today's 50 year-olds differs from their counterparts a century ago thanks to improvements in health care, living conditions, education, etc. Indeed, today's 50 years old have 30 years left to live, whereas, a century ago, they had only 20. In other words, "50 is the new 40." How can this change in the understanding of age, which is not captured by the conventional age measure in a scientific way, be expressed? Age can be reconsidered in terms of years left to live instead of number of years lived (i.e., chronological age). In this research, we particularly focus on how many more years people *think* they have to live. We call this new measure "subjective age." It allows us to include heterogeneity in the discussion, as individuals with different characteristics (e.g., health issues, education level, etc.) may have different expectations of how long they will live; and these may be dynamic, as such expectations can change over time. Furthermore, as the future is uncertain, people make decisions (such as consumption, saving, retirement etc.) based on their expectations, including how long they expect to live. We can thus test whether subjective age, which takes into account people's expectations about how long they will live, are more predictive of people's actual behavior than their chronological ages.

Our aims are, first, to develop a general methodology to calculate subjective life tables from given subjective survival probabilities for a specific target age; second, by using the Characteristics Approach developed by Warren Sanderson and Sergey Scherbov to produce subjective ages for different characteristics; and third, to test the hypothesis as to whether in fact they are more predictive of people's behavior than their chronological ages.

Biographical Sketch: Arda Aktaş is a fourth year PhD candidate in Economics, with specialization in applied microeconomics, demographic economics, and labor economics, at Stony Brook University. She received a Bachelor and Master degree in Economics from Yildiz Technical University in 2005 and Middle East Technical University in 2007.

Dolly Kumari

Supervisor: **Valeria Bordone**
Co-Supervisor: **Raya Muttark**

Research Project: **Role of social cohesion and informal care givers in life satisfaction among elderly in urban areas**

Abstract: The present study aims: i) to study the role of social cohesion in the life satisfaction and happiness of the elderly, controlling for demographic and socioeconomic characteristics in urban areas, and ii) to examine the role of the informal caregiver as a mediating factor in life satisfaction.

A cross-sectional study was conducted using primary data collected in structured and semi-structured interviews. The sample size was 530 households (1,060 individuals, with two respondents from each selected household; one aged 65+ and the other an informal caregiver in her sixties or under 60). Data will be analyzed by using STATA 12.01.

Social cohesion is a complex thing to understand and explain. Women have long been key players as caregivers to the family in India society, but at present they also participate in the labor force, particularly in urban areas. The typical role and characteristics of the caregiver is now changing and this has had a substantial influence on the perception and satisfaction of those receiving care. The happiness of an individual depends on various factors, but in the proposed study, we will try to see how the happiness of older people is affected by their caregiver. It is expected that if the older person is satisfied with the informal caregiver then they will also be have a high level of life satisfaction.

Biographical Sketch: Dolly Kumari is currently a third-year PhD candidate at International Institute for Population Sciences, India. Her PhD focuses on social cohesion and its influence on elders overall wellbeing in Urban areas. Her main research interests are social aspects of aging and public health. She has received two master degrees, one in Economics in 2011 from Patna University, India, and other one in Population Sciences in 2012 from International Institute for Population Sciences, India.

Miguel Poblete Cazenave

Supervisor: **Warren Sanderson**

Research Project: **Labor market dynamics and projections using the Characteristics Approach of Sanderson and Scherbov**

Abstract: A significant number of developed countries are facing a conflict in their labor market policies. Aging populations are providing a motivation to governments to increase the retirement age as more and more people are reaching older ages in better physical and mental health. On the other hand, for younger generations, entering the labor market is becoming increasingly harder, as can be seen by the high youth unemployment rates. This creates an important pattern of change in the labor market, as the age-specific percentage of younger people entering the labor market is decreasing while that of older people is increasing. Can this phenomenon be explained by changes in life cycle behavior as people's age is seen from a different perspective?

I propose to develop a dynamic model of the labor market. Specifically, I will use the Characteristics Approach by Sanderson and Scherbov to try to explain why we are seeing a delay in younger people's entrance to the job market and older people's retirement age. By focusing on prospective age and differences in human capital, I will project different scenarios of labor market structures for the future and look at their potential impacts on other areas, like dependency ratios, economic growth, investment, and savings.

Biographical Sketch: Miguel Poblete Cazenave is a second-year PhD student in Economics at Stony Brook University. He previously received a BSc in Engineering (2009) and an Industrial Engineering degree (2010) from the University of Santiago, Chile, and a master's degree in Economics from the University of Rochester , New York (2012). His research focus is on applying decision theory to develop agent-based models specifically related to demographic and labor economics problems.

Jiayi Fang

Supervisor: **Wei Liu**
Co-Supervisor: **David Wiberg**

Research Project: **Coastal disasters in China: Impact, risk and resilience**

Abstract: Coastal areas, characterized by dense population and economic activities, are vulnerable to natural disasters and climate change. In China, more than 40% of the population (ca. 530 million) live in coastal areas, which contribute 55% of the national GDP. Currently, there is a lack of holistic studies on coastal disaster risk in China and the issue attracts little attention from policymakers who usually place more emphasis on socioeconomic development over coastal disaster and climate risks.

This research aims to illustrate the current situation of coastal vulnerability, then to explore the ability of coastal adaptation options to reduce vulnerabilities and improve coastal resilience. There are three main objectives of this research proposal. First, I will map the spatio-temporal changes of disaster impacts in coastal China during 1993-2012; second, I will assess coastal disaster risks in China by quantifying changes in hazards, exposure, and vulnerability (social and financial) over the two decades; third, I will use a diagnostic framework to illustrate changes in coastal disaster resilience and explore potential options to build coastal disaster resilience in China. I will further discuss how the results from this study may provide can be used for the evaluation of flood risk management or Integrated Coastal Zone Management (ICZM) with a specific focus on risk reduction measures and risk financing tools.

Biographical Sketch: Jiayi Fang received her BSc in Marine Science (Physical oceanography) from Ocean University of China in 2013. She is currently a second-year PhD student studying Natural Disaster at the Academy of Disaster Reduction and Emergency Management in Beijing Normal University (BNU). She has a background in oceanography, meteorology, mathematics, and physics. At BNU her research interests focus on natural disasters and risk in coastal areas, such as ICZM; coastal flooding in the context of climate change and urbanization; coastal vulnerability and resilience; and risk of coastal critical infrastructure.

Franziska Gaupp

Supervisor: **Georg Pflug**

Research Project: **Risks of correlated droughts to food supply in the world's breadbaskets**

Abstract: Not only are droughts among the most severe natural disasters, with significant economic, environmental, and societal impacts, but they also have a tendency to become more extreme due to climatic change. As the 2008 food price crisis or the 2010 drought in Russia and other cereal producing areas have shown, it is mainly the confluence of weather extremes in different parts of the world that causes immense price shocks and risks to food security that can lead to famine and political instability. However, to date, little is known about the drought dependence structures of the global "breadbaskets." It has been shown that large-scale atmospheric circulations such as the El-Nino-Southern Oscillation (ENSO) influence the climate in regions all over the globe. Furthermore, numerous papers have found impacts of ENSO on agricultural production in different parts of the world. These findings lead to the hypothesis that drought occurrences are dependent and can be modeled jointly. This research will investigate globally correlated drought events in six major food-producing areas and their overall influence on agricultural production. The copula methodology will be used to model joint probabilities of drought events and resulting yield losses in these regions. The results can then be used to develop improved crop insurance schemes and inform policy, and may lead to changes in land use.

Biographical Sketch: Franziska Gaupp is a second-year doctoral student in the Environmental Change Institute investigating spatio-temporal correlation of droughts and their influence on agricultural production in the major global crop production areas. She also participates in the Global Water Partnership (GWP)/OECD "Global Dialogue on Water Security and Sustainable Growth." She holds a BSc in Economics from the Free University Berlin where she also worked as a teaching assistant for the modules "Macroeconomics" and "State and Allocation." She holds an MSc in Ecological Economics from the University of Edinburgh. Prior to joining the University of Oxford, she spent time at the Potsdam Institute for Climate Impact Research (PIK) where she investigated cereal price changes caused by supply shocks from a global perspective.

Jenni Koivisto

Supervisor: **Michael Thompson**
Co-Supervisor: **Junko Mochizuki**

Research Project: **Whose voice do we hear? Participation and staff mobility in the DRR policy subsystem in Mozambique**

Abstract: Mozambique, one of the least developed countries in the world, is exposed to different types of natural hazard, which further complicates development efforts. As a result, disaster management and risk reduction have gained much attention in recent years and are integrated into Mozambique's development programs. In accordance with international frameworks, a variety of actors participate in the policy process in the Mozambique disaster risk reduction (DRR) policy subsystem, including governmental bodies, UN organizations, and NGOs. There is, however, high staff mobility in the organizations involved in the DRR. While this can help in policy diffusion from other countries, it also poses a challenge for organizational memory – an important asset when dealing with disasters in a context of recurrent natural hazards. However, staff not only moves to and from the policy subsystem but also between the organizations within the subsystem. While this can be beneficial in terms of making collaboration between organizations easier, it may also reduce the requisite variety in different voices needed to ensure positive development outcomes.

Combining cultural theory and theoretical concepts within the policy process literature, this study contributes to the "new development paradigm" revealing how different voices, represented by cultural theory's "social solidarities," are being variously included in or excluded from the policy subsystem. Based on six months' fieldwork in Maputo, Mozambique, the study contributes to efforts to move beyond the typically normative DRR literature by trying to reveal how the inclusion of different actors and voices may impact the policy process and policies and, in the end, the success of implementing these policies.

Biographical Sketch: Jenni Koivisto completed her BA in Sustainable Development from Turku University of Applied Sciences in 2005 and MSc in international development and management from Lund University in 2009. She is currently a fourth-year PhD student in Risk and Environmental Studies at Karlstad University, Sweden. She is part of the Centre for Natural Disaster Studies (CNDS), a multidisciplinary research centre involving scholars from Uppsala University and the Swedish National Defence University in addition to Karlstad. Her PhD research interests revolve around connecting questions on development and disaster risk reduction and the uncertainties and challenges in DRR policy processes.

Mavhungu Muthige

Supervisor: **Love Ekenberg**

Research Project: **Future changes in tropical cyclone activity in the Southwest Indian Ocean Basin**

Abstract: The Conformal Cubic Atmospheric Model, a variable-resolution global model will be used at high spatial resolution of ~50 km (0.44°) to investigate potential future changes in tropical cyclone activity within the Southwest Indian Ocean Basin. The model will be forced by lateral boundary and surface boundary conditions from the European Centre for Medium-Range Weather Forecasts (EMCWF) Interim Re-analyses (ERA-Interim), and all the downscaled data will be available for the period 1961–2100. The simulations will be run under the RCP4.5 and the RCP8.5 scenarios. ERA-Enterim Data will be used to evaluate the ability of the Regional Climate Model to simulate the tropical cyclone tracks realistically.

Biographical Sketch: Mavhungu Muthige graduated in 2010 from the University of Venda with a BSc in Mining and Environmental Geology and in 2013 graduated from the University of the Witwatersrand with a master's degree in Environmental Sciences. His MSc research report was entitled "Ambient air quality impacts of a power station in Lephalale." He is currently a first year PhD student at the University of the Witwatersrand. His thesis is entitled "Tropical cyclones over the Southwest Indian Ocean Basin under climate change." His main areas of interest are in regional climate modeling and vulnerability studies.

Erik Nilsson

Supervisor: **Stefan Hochrainer-Stigler**
Co-Supervisor: **Junko Mochizuki**

Research Project: **Socio-hydrological relationships and risks in the Lake Chad district in Chad**

Abstract: The Lake Chad Basin in Central/Western Africa has gone through extensive hydrological changes since the 1960s, with the surface area of Lake Chad shrinking from 25,000 km^2 to 3,000 km^2 and its volume decreasing by nearly 60%. The livelihoods around the lake are rural and mostly based on agropastoral and fishing activities. They are thus directly dependent on hydrological factors such as rainfall, freshwater availability, floodplains, and soil moisture. Hydrological variations are common in this region and human societies have generally adopted flexible livelihood strategies to adapt to this. However, there are signs that the adaptive capacity has been reduced lately due to increased population, poverty, and prolonged environmental stresses. This reduction in adaptive capacity, together with expectations of increased hydrological variability due to global climate change, puts the rural communities in this area in an increasingly difficult situation.

This research will focus on the linkages between rural livelihoods and hydrological variation from a risk perspective. Based on multivariate analysis of past data, adaptive capacities will be estimated and changes due to hydrological factors investigated. This should result in a risk modeling tool that may be used to determine future changes and adaptation needs in important socioeconomic dimensions that are due to climate and global changes and that will probably cause effects similar to those experienced in the past.

Biographical Sketch: Erik Nilsson has Bachelor degrees in Development Studies (2010) and Civil Engineering (2010), and a master's degree in Water Resources Engineering (2012), all from Lund University and as an exchange student at McGill University. He is currently a 2nd year PhD student at Lund University where he is working in a multidisciplinary research group to explore the relationships between climate variability and food security in the Lake Chad Basin in Central/Western Africa. Besides his specific research topic he is interested in how multidisciplinary systems analysis can be used in policymaking.

Benedict Singleton

Supervisor: **Michael Thompson**
Co-Supervisor: **Wei Liu**

Research Project: **What's missing from Ostrom? Design principles, cultural theory and Faroese *grindadráp***

Abstract: Elinor Ostrom's design principles have been influential in efforts to understand the multifaceted nature of human-ecosystem interactions; they provide a way for the management, sustainable or otherwise, of common pool resources to be understood and recommendations made. Cultural theory (CT) also covers similar ground, focusing on the complexity of different understandings of any given environmental situation. This proposed research compares an Ostrom-inspired analysis of the Faroese common property institution of *grindadráp* (driving pilot whales for slaughter) with a CT-inspired analysis of the same thing.

The objective of this research is to compare the different forms of analysis produced by Cultural Theory and Elinor Ostrom's design principles for governing Common Pool Resources. *Grindadráp* has been identified as exemplifying all eight design principles, while various "logics" of CT can be observed in different situations. The leading research questions will be: What are the main contributions and weaknesses of Ostrom's design principles and CT? To what extent is it possible to synthesize the two approaches? What implications do theories of plural rationality have for Ostrom's design principles? This synthesized analysis of Faroese resource use can then be used to examine other contexts where Ostrom's design principles and CT have been applied. This allows the strengths and weaknesses of each approach to be clarified and makes apparent opportunities for synthesis. By providing a theory of changing contexts CT augments Ostrom's rational-choice-led approach, allowing researchers to better grasp the changing situations within which common pool resources are harvested.

Biographical Sketch: Benedict Singleton completed his BA in social anthropology from Queen's University Belfast in 2006. He subsequently graduated from Lund University in 2009 with an MSc in international development and management. He is currently a third-year PhD student in Environmental Sociology at Örebro University. Prior to his current position he was employed as a researcher at the University of Leeds. He has conducted research in various parts of the world, notably in Zambia, Jamaica, and the Faroe Islands. A theoretical pluralist, his research interests revolve around environmental conflicts, citizenship, local rights and constructivism.

Anton Talantsev

Supervisor: **Love Ekenberg**
Co-Supervisor: **Leena Ilmola-Sheppard**

Research Project: **Structured approach for stakeholder analysis in public policymaking**

Abstract: Public policymakers often have to balance the interests of many different groups of people who can affect, or be affected by, the achievement of the policy goals. Thus, attention to the stakeholder configuration and distribution of interests should be a basis for finding implementable and effective solutions to policy issues. Typical policy stakeholder analysis is limited to identification of immediate stakeholders and a qualitative description of the latter. While contemporary policy analysis practices are greatly facilitated by advanced quantitative decision and risk analysis techniques, there is an evident lack of relevant analytic applications for the issue of policy stakeholders' assessments.

As a step to operationalize policy stakeholder analysis, this research seeks a structured format to identify and profile policy stakeholders. The data framed by this format is to be further used as input to formal decision and risk analysis. A case study of a policy for promoting ultra-low emission vehicles (electric cars) is used to exemplify the approach and perform the proof-of-concept.

Biographical Sketch: Anton Talantsev is currently a second year Ph.D student in Decision and Risk analysis at Stockholm University. His main fields of scientific interests include application of advanced decision and risk analysis to contextualized policy analysis and modelling. Anton earned two degrees: a specialist's degree in management from the State University of Management, Russia (2008), and a master's degree in Computer and Systems sciences from Stockholm University, Sweden (2013). Prior to returning to school, he worked for three years as a Management Consultant in construction, oil & gas, and international aid development domains.

Rui Hu

Supervisor: **Arnulf Grubler**

Research Project: **Innovation and technological capabilities of the Chinese wind turbine industry: An international comparative study**

Abstract: Technological innovations are vital to move to a more sustainable energy system. Driven by the concerns of climate change and energy security, public expenditures on energy RD&D by the world's major economies have increased again after decades of stagnation and decline. In addition, many countries have incentivized market development efforts for renewable energies and energy efficiency via direct subsidies, portfolio standards, or feed-in tariffs, totaling hundreds of billions of US dollars per year.

Given this growth of spending on energy innovations, my research is to develop a quantitative framework to evaluate how well a nation's energy innovation system functions, using the Chinese wind turbine industry as an example. Renewable energy has grown rapidly in China due to its huge energy demand growth and environmental concerns caused by fossil fuels. Between 2009 and 2013, a total of $242 billion was invested into renewable energy, comprising 21% of the world's total renewable energy investment. In terms of wind energy, about 29% of global cumulative wind power capacity was installed in China by 2013. Of the world's ten biggest wind turbine manufacturers, three are Chinese enterprises. This project aims to use an innovation systems approach as well as derived quantitative indicators to study how effectively the Chinese wind technology innovation system has operated over the past decades in comparison with its international counterparts. The research will also identify opportunities to strengthen the Chinese wind technology innovation system, an area of great interest to industry and government stakeholders in China.

Biographical Sketch: Rui Hu is a second-year PhD student at the Centre for Environmental Policy, Imperial College London, with a research interest in energy innovation policy. He is particularly interested in how China's wind technology innovation system operates and evolves and in making comparisons with its counterparts internationally. He is currently working with the RCUK Energy Fellowship on a research program for measuring the effectiveness of energy innovation systems across countries and technologies. He holds both an MSc in Economics and Management of Technology and a BSc in Business Administration from the China University of Geosciences, Wuhan.

Water (WAT)
Acting Program Director: David Wiberg

Jens de Bruijn

Supervisor: **Günther Fischer**
Co-Supervisor: **Sylvia Prieler**

Research Project: **The impact of non-renewable groundwater use on global food security toward 2050**

Abstract: Non-renewable groundwater use, defined as groundwater abstraction in surplus of recharge, has drastically increased over the last decades. Due to rapidly growing food demand, the extent of irrigated areas and consequently groundwater abstraction has greatly increased. Crops produced in irrigated areas now account for 40% of the global food production. However, the strain on the environment is becoming increasingly clear. Recent modeling efforts with PCR-GLOBWB show abstraction is higher than recharge in several main production areas. Although no reliable estimates of the size of the respective groundwater storage places have been made, the current practice is not sustainable.

This study associates specific crops with non-renewable water use by estimating a spatially detailed water balance for major 26 crops considering crop-specific cultivation dates and water requirements, natural recharge, recharge from irrigation, and groundwater abstraction in production areas. Results indicate that currently annual global non-renewable water use is approximately 190 billion m^3, to which wheat (20.8%), rice (17.1%), and cotton (8.5%) are the main contributors. The amount of non-renewable water use as compared to total water use is estimated to be less than 7% for most irrigated crops. Estimated non-renewable water use mainly occurs in the China, Iran, the Ganges Basin, Pakistan, and the USA. The aim of my YSSP research is to quantify for different future scenarios for IIASA's Water Futures and Solutions (WFaS) initiative the amount of non-renewable groundwater use in the coming decades. I will also assess how production based on non-renewable water use is connected with final consumption using IIASA's LANDFLOW model, which uses bilateral trade data and food allocations to track the physical quantities of non-renewable water use embodied in agricultural products.

Biographical Sketch: Currently Jens de Bruijn is finishing his Master's in Hydrology at Utrecht University in the Netherlands. His research interest lies mainly in large scale hydrology. His thesis is focused on non-renewable groundwater use and its relation to global food security. On graduation he will start a PhD at the VU University in Amsterdam on global flood risk assessment.

Julio Enrique Herrera Estrada

Supervisor: **Yusuke Satoh**
Co-Supervisor: **David Wiberg**

Research Project: **Compound drought and heatwave events and their impacts on the water-energy-food nexus**

Abstract: Water, energy, food, and climate form a tight nexus; impacts on any of them will cause impacts on the others. To strive for sustainable development, it is crucial to study this system and how it responds to shocks, such as droughts and heatwaves. Furthermore, during this century we will observe further population growth in several regions in the world with associated changes in water use from the domestic, agricultural, and industry sectors. Thus, increased risk to water shortages may come from both the supply and the demand side in different regions.

This study will focus on how compound events of droughts and heatwaves around the world may change in the future due to climate change, and what this means for water stress in different regions, given trends in water use. Simultaneous occurrences of droughts and heatwaves have not been studied thoroughly in the past, but they have a double impact on the water-energy-food nexus by reducing water and energy supply (i.e., droughts) and increasing their demand (i.e., heatwaves). Using the ISI-MIP modeling framework, the analysis will be carried out by using different combinations of climate forcings, hydrologic models, and impact models for each RCP. This will allow us to generate a probability density function of changes that each region might experience under each scenario. By considering stress from increasing compound events as well as increasing water use, regions with increasing risk to water scarcity will be identified.

Biographical Sketch: Born and raised in Mexico, Julio Estrada is a third-year PhD candidate in Environmental Engineering and Water Resources at Princeton University, USA, and is also pursuing a certificate in Science, Technology and Environmental Policy at the Woodrow Wilson School of Public and International Affairs. His research focuses on the land-atmosphere interactions that control the evolution of droughts and heat waves, on how the characteristics of these extreme events might be different in the future due to climate change, and on quantifying their impacts on the Water-Energy-Food Nexus. Julio received his bachelor’s degree in Applied Mathematics from Columbia University, New Yor

Asif Khan

Supervisor: **David Wiberg**
Co-Supervisor: **Yusuke Satoh**

Research Project: **Impact of climate change on spatial and temporal variations in stream-flow components during 1970-2010 in the Upper Indus Basin**

Abstract: Large Asian rivers with basins in the Hindukush-Karakoram-Himalayan (HKH) mountain ranges, whose stream-flow includes significant snow- and glacier-melt components, are highly susceptible to climate change. A major Asian river basin is the Upper Indus Basin (UIB), which originates from the HKH region; snow- and glacier-melt contribute 50–80% of its stream flow. Glaciers in the Karakoram and Himalayan region have contrasting signals of mass balance. Thus, it is vital to understand the spatial variation in the components of stream-flow (i.e., rain runoff, snow, and glacier melt), and the temporal impact of climate change on them; this allows precise and accurate estimates to be made for individual sub-basins, and forecasts of future flows to be produced. Recent studies have estimated stream-flow components for limited periods, using different methods, precipitation, and temperature datasets, and different hydrological models; their estimates and implications vary significantly.

This research will compile, for the first time, long time series (30-40 years) of stream-flow component estimates for individual years and will identify relationships between change in precipitation, temperature, and stream-flow components for the sub-basins of the UIB. Based on the relationship between variation in temperature, precipitation, and stream-flow components, improved forecasts will also be produced, which will enhance the reliability of decision-making and planning of sustainable water resource development. The robust methodologies developed for this research will expose the limitations of recent claims about the hydro-climatology of the HKH region, will provide much improved bases for water resource planning in the region. They will also be applicable in future climatic studies in other similar high mountain regions of the world, particularly in the adjacent HKH basins.

Biographical Sketch: Asif Khan has a BSc in Civil Engineering and an MSc in Water Resources Engineering from KPK University of Engineering UET and Technology (UET) Peshawar, Pakistan. He has a post-graduate one-year diploma in GIS and Remote Sensing in 2010 from University of Peshawar, Pakistan. Currently, he is 3rd year PhD student at Cambridge University, UK, and his research topic is "The hydro-climatology of the Upper Indus Basin: A critical analysis of data and modelling needs in a complex mountain environment."

Yilong Niu

Supervisor: **Laixiang Sun**
Co-Supervisor: **Lena Höglund lsaksson**

Research Project: **Quantifying GHG emission from paddy field in China under climate change: Based on the coupling of DNDC and AEZ models**

Abstract: Agricultural greenhouse gas (GHG) emissions are the second major source of total GHG emission in China. The main forces driving the rising rate of methane(CH_4) and nitrogen dioxide (N_2O) emissions is rice planting, which plays an important role both in food security and climate change alleviation. How to balance the trade-off between food security concern and GHG emission reduction by planning rice planting is thus an important scientific and policy issue. Accurately quantifying the nonpoint pattern and extent of agricultural GHG emissions based on agro-ecological and biogeochemical model simulations is of fundamental importance for science-based decision making in balancing the above-mentioned trade-off between food security concerns and GHG emission reduction. However, as the agro-ecological model and biogeochemical model both have the advantages and disadvantages there the two models should be coupled to diminish the errors and uncertainties in agricultural GHG emission simulation.

In this project, the rice cultivar in the Agro-ecological Zone AEZ will be translated into the DNDC model, which will first be verified by site-level observation data. After verifying and updating, the DNDC model will be used to simulate GHG emissions in paddy fields in China in the future with different climate change scenarios, with the objective of finding the scientific approach to balance the trade-off between food security concern and GHG emission reduction.

Biographical Sketch: Yilong Niu received his bachelor’s degree in Horticulture from Shanghai Institute of Technology, 2012. He is currently a second-year master’s student at Shanghai Institute of Technology and Climate Change. His main scientific interests focus on the relationship between climate change and agricultural GHG emission, especially in the paddy field.

Kamshat Tussupova

Supervisor: **Luzma Fabiola Nava**
Co-Supervisor: **Sylvia Tramberend**

Research Project: **Indicators for consumers' willingness to pay to improve water supply services in rural Kazakhstan**

Abstract: If rural water projects are to be both sustainable and replicable, an improved planning methodology is required where the participation of water users and the concept of willingness to pay (for water) play an important role. This research will thus develop and evaluate indicators for consumers' willingness to pay for piped water supply. The results can be used to better identify the right technological choices in the water supply scenario and the level of service needing to be provided. The overall aim is to make rural water projects feasible at a larger scale. Furthermore, integration of people into the water process is quite unique approach for the Central Asian countries; it should facilitate the water-related decision-making processes and improve water policy efficiency. The secondary objective therefore is to provide a draft methodological outline of "Involving rural water users in to the water supply planning processes: Methodological guideline for the willingness to pay (for water) in Kazakhstan," presented to water authorities.

Contingent Valuation (CV) and Averting Behavior Methods are used to collect the willingness to pay for data. About 2,500 household questionnaires were collected from 25 villages in Kazakhstan. Econometrical model and statistical analysis will be provided to analyze the data. Therefore, several statistical tools will be used to identify determinants of WTP: Multivariate analysis (logit/probit/tobit models), PCA, and cluster analysis.
The results obtained will become a journal article and serve as a basis for the draft of methodological guidelines.

Biographical Sketch: Kamshat Tussupova is currently a third-year PhD student at the Department of Water Resources Engineering, Lund University, Sweden. Her research topic deals with the sustainable access to safe drinking water in rural Kazakhstan. She mainly works on developing tools to integrate local water users into water supply planning processes in rural areas. She holds specialist diploma in Public Administration, a MSc in Environmental Management and Engineering from Eurasian National University, Kazakhstan, and a MSc in Public Health from the University of Debrecen, Hungary.