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Oh Pin Pin

Supervisor: **Marek Makowski**

Co-Supervisor: **Yurii Yermoliev**

Research Project: **Grey Box Model to Support Membrane Reactor System Design and Optimization**

Abstract: The goal of my PhD project is to develop a novel process scheme for biodiesel production in a multiphase membrane reactor system. I develop the corresponding grey box model to integrate the pertinent engineering knowledge and data, and will validate the model by experimental studies. The grey box model will be composed of the "first principle engineering model" (mechanistic model) and the empirical model (black box model). Mechanistic (white box) is derived from a detailed understanding of the generic underlying mechanisms that govern the membrane reactor system behaviour, whereas the empirical (black box) will be based on statistical inference and machine learning from training data. During the YSSP, the mechanistic model developed by our research group will be enhanced by considering the heterogeneity (two-phase) behaviour and the chemical phase equilibrium, the two elements important for the membrane reactor design. Next, the artificial neural network technique will be employed for the black box model of the phase behaviour in the close-loop membrane reactor, in particular to model highly dynamic close-loop operation of the process. Finally, I will integrate both models through the grey box modelling approach (hybrid mechanistic-empirical modelling). The grey box model will then be employed to the design and optimization of the complete novel process scheme for biodiesel production in the multiphase membrane reactor system.

Biographical Sketch: Oh Pin Pin has completed her Bachelor's degree (with honours) attaining first class position in Chemical Engineering from University Malaysia Sabah in 2009. She is currently second year Ph.D student at the Department of Chemical and Environmental Engineering of The University of Nottingham, Malaysia Campus and a researcher at the Malaysian Palm Oil Board. The draft title of her Ph.D thesis is "Development of a novel multiphase membrane reactor system for biodiesel production". Her main fields of scientific interest include mathematical modelling, process simulation and optimization, bioenergy and membrane separation.

Morag Ayers

Supervisor: **Elena Rovenskaya**

Co-Supervisor: **Åke Brännström**

Research Project: **Marine Ecosystem Robustness and the Role of Modularity**

Abstract: When considering global issues such as food security, freshwater storage and ecosystem responses to climate change it is important to be able to identify potential indicators of ecosystem robustness and how ecosystems react to anthropogenic activities. Modularity helps to maintain ecosystem robustness by containing the spread of negative impacts. Modules have strong links within them and weak links between them and are essentially non-overlapping subsets of species. Thus positive or negative impacts affect species within a module before spreading to another module and throughout the ecosystem. Modularity is often studied in networks described using energy or flows rather than carbon, nitrogen or phosphorus.
My YSSP research will involve the use of carbon, nitrogen and phosphorus networks of, among others, the KwaZulu-Natal Bight (South Africa), Chesapeake Bay (USA), Twin Cays (Belize) and the Sylt- Rømø Bight (Denmark) to explore the robustness of marine ecosystems to climate change and anthropogenic activities such as fishing, freshwater abstraction from rivers, eutrophication etc. Within each network I aim to 1) describe and analyse modules, specifically "strongly connected components" (SCCs), and their constituent cycles, 2) perturb specific biotic groups via scenarios of various anthropogenic activities, 3) redescribe the SCCs and cycles, and 4) compare these before and after perturbations. It is hoped that these methodologies can be used to identify the robustness of empirical ecosystems to perturbations from anthropogenic activities, the links within and between modules likely to change, the level of perturbations which can cause these changes, and any overall changes to ecosystem structure e.g. regime shifts.

Biographical Sketch: Morag received a Bachelor of Science degree in Zoology from the University of Canterbury, New Zealand in 2003. She received her Master's degree from the School of Life Sciences, Heriot-Watt University, Scotland in 2008 and is currently a final-year PhD student at the School of Life Sciences at the University of KwaZulu-Natal, South Africa. Her main scientific interest is the use of ecosystem models to study the effects of anthropogenic activities on marine ecosystems.

Hiroto Shiraki

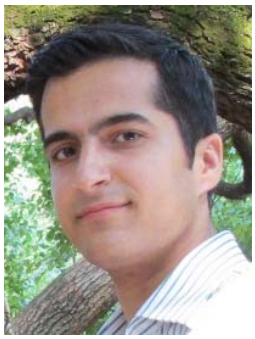
Supervisor: **Marek Makowski**

Co-Supervisor: **Hongtao Ren**

Research Project: **Analysis of Relationships between Primary Energy Composition and Economical/Technological Factors**

Abstract: It is commonly known that GHG emission reductions are necessary for mitigating future temperature increase and the climate change. Primary energy supply composition affects the amount of GHG emission from each country, because the GHG emission caused by energy consumption is one of the major emission sources. There are several factors which affect to the choice of primary energy in each country. For instance, energy supply infrastructures, prices of each energy source, industrial structure, and energy security affect to the choice of the primary energy. However, some uncertainties remain on how different factors affect selection of primary energy sources in each country. I plan to analyze the influences of these factors quantitatively. During YSSP, I plan to focus on selected industrialized countries, i.e. Japan, United States and some European countries; the choice of countries will depend on the data availability. The results of this analysis will be represented as s relations to be added to the global scale energy model, which has been developed as a part of my doctoral research. Such a model enhancement will improve the model use for analysis of future energy structure

Biographical Sketch: Hiroto received his M.Sc. degree in environmental studies from the University of Tokyo in 2011. He is currently a second-year Ph.D student at the University of Tokyo and a research assistant of the National Institute for Environmental Studies Japan. His research interests include the global scale energy modeling, and technology diffusion processes.



Ali Kharazi

Supervisor: **Jerry Silverberg**

Co-Supervisor: **Stefan Thurner**

Research Project: **Quantifying the Sustainability of Economic Networks: An Ecological Network Approach**

Abstract: The importance of sustainability continues to increase as a new paradigm on which to base future policies. However, a universally accepted definition for sustainability has been difficult to achieve as the terminology remains highly subjective and open to interpretation. In this light, efforts towards minimizing the influence of subjective arguments in the determination of an indicator for sustainability make it possible to create common grounds to compare alternative policies and to include sustainability as an objective for various systems. Several modeling techniques based on thermodynamic principles and the notion of energy quality may be employed towards sustainability quantification. These include, emergy analysis, exergy analysis, and information indices through ecological network analysis (ENA). The methods related to emergy and exergy analysis approach the quantification of sustainability from an accounting perspective and therefore these methods are limited in their ability to include any measurement of resilience. In the case of the relatively less researched information indices and its related methods derived from ENA, the quantification of sustainability is approached from a network perspective where sustainability is argued to be realized as a balance between network efficiency and resilience. The challenge remains however to find an optimal balance between these two system level indicators. This research will attempt to explore whether and why the sustainability of economic networks tends to be more dependent upon the resiliency or the efficiency of the network. Furthermore, this research will investigate whether the network configurations of economic networks, resiliency and efficiency, fall within a certain range of values and whether if these values can indicate an unsustainable system.

Biographical Sketch: Ali is a second year PhD student at the Graduate School of Frontier Sciences at the University of Tokyo. Ali completed his undergraduate studies at the City University of New York in Economics and Mathematics and earned a Master's degree at the London School of Economics in Information Systems. His research interests include sustainability science, data intensive research, and ecological economics.

Yadong Yu

Supervisor: **Alexander Tarasyev**

Research Project: **Construction of an Optimal Model for Resource Productivity in China**

Abstract: Nowadays, natural resources is a critical factor for economic development, and the economic growth theory is facing challenges while addressing the issue of resources naturally constrained by the total reserve. It is urgent to explore new approaches in economics, in which resource management will be a central point. Undergoing rapid industrial growth, China demonstrates a steeply increasing demand for resources. Improvement of resource productivity by 15% in five years has been proposed as an obligatory indicator for enhancement of the circular economy in China's Twelfth Five-Year Plan for National Economic and Social Development. In order to explore the dynamic mechanism of resource productivity, and characterize the optimal strategy for improving resource productivity on a macro level, with a specific focus on mid-term economic development of China, an optimal control model will be constructed during the YSSP study. In the model, Material Flow Analysis, Resource Productivity, and Resource Economics are important blocks for the analysis and construction of optimal investment policy. To meet the objective, 4 tasks are proposed for the YSSP study. Firstly, identify the evolutionary characteristics of China's resource productivity in 1978-2009. Secondly, construct a basic control-theoretic model (EGM) for resource productivity optimization. Thirdly, develop a solution technique for EMG and simulation of China's optimal growth trajectory. Fourthly, analyze empirically of the optimality of the resource productivity trajectory.

Biographical Sketch: Yadong is a PhD candidate in Department of Chemical Engineering at Tsinghua University. He received his Bachelor's degree in July 2008 from Beijing University of Chemical Technology. In September 2008, he became a Ph.D. student in Tsinghua University, and focus on material flow analysis and resource productivity. His research plan for YSSP at IIASA is to explore the dynamic mechanism of resource productivity by constructing an optimal control model.

Dmytro Movchan

Supervisor: **Yurii Yermoliev**

Co-Supervisor: **Tatiana Ermolieva**

Research Project: **Assessment of Parameters' Dynamics of Forest Cover in Ukraine Using Remote Sensing Data**

Abstract: Forests play a very important role in human life. They serve many social and health purposes, as well as provide industrial resources. In addition, forests form the main component of the stocks and acquisition of carbon in the terrestrial biosphere. The growth and distribution of forests has a critical impact on atmospheric carbon dioxide concentrations. Measuring the size and complexity of forest canopies over large areas would enable scientists to understand better these environmental processes.

Despite the accumulation of large data sets from monitoring forest systems that have already been carried out over several decades, there are still some uncertainties and inconsistencies. Using modern methods of remote sensing in combination with traditional ground-based methods can significantly improve these estimates.

A variety of image-processing techniques have been developed for the estimation of forest inventory and biophysical parameters from remote sensing. In my YSSP researches I plan to use different spectral indexes (such as Photochemical Reflectance Index (PRI), Enhanced Vegetation Index (EVI), Normalized Difference Vegetation Index (NDVI)) and other vegetation parameters (such as Leaf Area Index (LAI), Fraction of Photosythetically Active Radiation (FPAR)) for assessment of parameters' dynamics of Ukrainian forests. The parameters mentioned above support estimation of important biophysical parameters of forests and to monitor the changes which occur in forests through the time and space.

Biographical Sketch: Dmytro graduated in June 2006 from Cherkasy State Technological University with the MSc degree in ecology. He is currently a Ph.D student at the Scientific Centre for Aerospace Research of the Earth (CASRE), Institute of Geological Sciences of National Academy of Sciences of Ukraine. His scientific interests focus on studying ecosystems; in particular: changes caused by various factors; the role of ecosystems in the natural carbon cycle and the related changes; climate change and feedbacks to changes in ecosystems; use of remote sensing data for studying ecosystems.

Anton Platov

Supervisor: **Arkady Kryazhimskiy**

Co-Supervisors: **Oskar Franklin, Åke Brännström**

Research Project: **Optimal Exploitation of Size-Structured Populations**

Abstract: The last decades have seen major improvements in human living standards and purchasing power, with the world's gross domestic product rising more than tenfold since 1970 and about sixfold since 1980. This development has been paralleled by an increase in the demand for food and resources. With many commercially important species having been subjected to increased exploitation as a result, there is an urgent and growing need for developing efficient and sustainable management methods. I will address this need by developing theory for optimal exploitation of size-structured populations, such as fishery and forestry. First, I will consider the existence and stability of stationary solutions for dynamic models of exploited populations, Second, the optimal exploitation rate will be determined for selected criteria, e.g. to optimize forest harvesting and fishing with respect to productivity. The results are expected to be relevant for the utilization of living resources, both from an ecological and economic point of view.

Biographical Sketch: Anton graduated in 2011 from the Faculty of Applied Mathematics and Physics at Vladimir State University named after Alexander and Nikolay Stoletovs, Russia. Currently he is a first year PhD student at this faculty. His scientific interests lie in mathematical control theory and its applications. His PhD thesis is devoted to the analysis of stationary solutions in dynamics of size-structured population and the optimization of exploitation of such solutions with respect to various criteria.

Shaoqing Chen

Supervisor: **Brian Fath**

Research Project: **Information-based Network Analysis: A New System Technique and its Application to Ecological Risk Assessment**

Abstract: The responsive behaviors and underlying mechanics of ecosystems exposed to a wide range of anthropogenic disturbances have been of great interest to both ecosystem ecologists and environmental managers. Mathematical models employed for ecological risk assessment (ERA) have been restricted to instant cause-effect computation of single factors and have relatively poor capacity for fitting into a holistic assessment framework at an ecosystem scale. Herein, I attempt to incorporate the concept of information-based environmental flow into the current subject of ecological network synthesis and therefore shed some light on the application of eco-network model in ERA. First, I formulate a novel form of network analysis termed information-based Network Analysis (INA) in which all the changes of environmental factors and the contribution of indirect effect caused by interactive pathways can be quantitatively tracked; second, INA is adapted to the eco-risk evaluation of river ecosystem intercepted by dam construction as a case study, through which the variation of structural and functional properties of the perturbed ecosystem is uncovered. With the consideration of multi-factor risk propagation, a holistic picture showing both the whole risk scenario of a system and micro-dynamics of its components can also be captured. Based on this inspection, we generalize the exemplified methodology to an analytical framework of applying INA to broader ecosystem-oriented environmental assessment and management.

Biographical Sketch: Shaoqing Chen graduated from Sun Yat-Sen University in July 2010 with a Bachelor's degree in Ecology. He is currently a Ph.D student at Beijing Normal University majoring in Environmental Science. His research plan for YSSP at IIASA is to develop an information-based network analysis and apply it to the dam-induced eco-risk assessment. His main fields of scientific interest include ecological accounting and network analysis of urban systems as well as in the natural world.

Karol Opara

Supervisor: **Marek Makowski**

Co-Supervisor: **Hongtao Ren**

Research Project: **Nonconvex Optimization for Emission Trading Models**

Abstract: Trading on greenhouse gases (GHG) emission permit market is a way of reducing total costs of meeting the levels imposed by the Kyoto protocol. Analysis of various models of this market is helpful in settling many practical questions, such as split of the profit resulting from emission trading between participants of the market or achieving the globally efficient solution.
At IIASA, an agent-based GHG emission trading model was developed, where each region was represented by independently acting agent. This model is currently being extended in my home Institute to introduce market interactions based on various types of auctions. Currently, emission reduction costs are modeled by convex functions. It is desired to include into the model more accurate representations of those costs, which are actually non-convex. Solving the resulting optimization problems requires global optimization methods.
During my stay at IIASA I would like to enhance the GHG emission market model by implementing more accurate, i.e. non-convex cost functions. Moreover, I plan to implement global optimization methods for analysis of GHG emission markets and possibly problems investigated by IIASA researchers or other YSSPers.

Biographical Sketch: Karol received M.Sc. degree in Computer Science from Warsaw University of Technology in 2010 and M.Sc. degree in Quantitative Methods in Economics from Warsaw School of Economics in 2011. Currently, he works in the Systems Research Institute, Polish Academy of Sciences. His research interests focus on stochastic optimization algorithms, applied statistics and economic aspects of road management.

Victoria Veshchinskaya

Supervisor: **Åke Brännström**

Co-Supervisors: **Elena Rovenskaya, Ulf Dieckmann**

Research Project: **Ecosystem Vulnerability to Species Loss**

Abstract: Species losses have always occurred as a natural phenomenon, but the pace at which species are going extinct has recently accelerated dramatically as a result of human activities. The disappearance of a species can have far-reaching and often unexpected consequences for other species, since changes can propagate throughout ecosystems. The principal aim of this project is to investigate the consequences of species losses in ecosystems. In this project, we develop and analyze a dynamic ecosystem network model, calibrated to a set of real ecosystems, to predict the cascading changes that can follow the extinction of a species. The impacts of such primary species losses are measured in terms of secondary species losses and biomass changes. Fundamental descriptors of ecosystem structure (such as the number of coexisting species, their connectivity, the ecosystem's maximum tropic level) are assessed for their capacity to predict indicators of ecosystem vulnerability to species loss (such as the average number of species losses, the average biomass loss or gain, the average time to extinction). Particular emphasis is given to the relationship between an ecosystem's structural complexity and vulnerability. It is anticipated that the results will be useful for ecosystem management and will contribute to community ecology's long-standing complexity-stability debate.

Biographical Sketch: Victoria Veshchinskaya graduated in 2010 from the Department of Optimal Control, Faculty of Computational Mathematics and Cybernetics, Lomonosov Moscow State University, Russia. She is currently a second-year Ph.D. student there. Her thesis deals with optimal-control problems in systems described by partial differential equations. Her main fields of scientific interest include optimal-control theory and its applications in biology and ecology.

Sarah Evans

Supervisor: **Christina Kaiser**

Co-Supervisors: **Ulf Dieckmann, Oskar Franklin**

Research Project: **Microbial Mechanisms in Moisture-Induced Soil-Respiration Pulses**

Abstract: The cycling of carbon and nitrogen in soils is controlled by microorganisms. How such microbial communities respond to novel climates regimes in the future will thus affect carbon and nitrogen fluxes, which in turn can change greenhouse-gas fluxes, soil fertilities, and other aspects of ecosystem functioning. Current models are limited in accurately predicting biogeochemical pulses during large rainfall events after droughts. As future climate regimes are expected to be characterized by an increased frequency of droughts and floods, overcoming this limitation, by better understanding the underlying microbial mechanisms, is important for predicting future ecosystem dynamics. Specifically, sudden changes in soil moisture resulting from droughts and floods induce moisture stress on microorganisms, which is bound to influence the distribution of microbial functional groups and traits. Changes in soil moisture also affect physical processes, like the diffusion of substrate, enzymes, and microbial cells, which must be in contact for microbial metabolism and many gas fluxes to proceed. Methodological challenges hinder investigating these mechanisms experimentally, leaving much unexplained variability in current biogeochemical models. In this project, we use an individual-based model of soil microbial communities developed at IIASA to examine how droughts and floods affect enzyme activity and the distribution of microbial traits, and how changes in these factors affect carbon and nitrogen cycling at larger scales. This work will inform efforts to more accurately predict biogeochemical fluxes under future rainfall regimes, as well as improve our understanding of the role of soil microorganisms in larger-scale ecosystem dynamics.

Biographical Sketch: Sarah Evans completed her undergraduate degree in biology at Grinnell College in Iowa, USA. She is currently a fourth-year Ph.D. student in the Graduate Degree Program in Ecology at Colorado State University, USA. Her dissertation work addresses how climate change, especially changes in rainfall, will alter ecosystem nutrient cycles. Because these cycles are controlled by soil microorganisms, this work has led to studies on the ecological responses of bacterial and fungal communities to climatic stress. At IIASA, she plans to use a theoretical model to examine different mechanisms through which soil microbial communities can influence carbon and nitrogen cycling under changing rainfall patterns.

Kyeongah Nah

Supervisor: **Rupert Mazzucco**

Co-Supervisor: **Ulf Dieckmann**

Research Project: **The Evolution of Malaria Incubation Time**

Abstract: Malaria is one of the most dangerous infectious diseases, responsible for a significant fraction of human deaths in a large part of the world. Yet, past eradication efforts have failed. To design effective eradication campaigns, the infection cycle must be well understood. Malaria's infectious agents (parasites of one of several species of the genus *Plasmodium*) are transmitted between mosquitos and humans through mosquito bites: after transmission, symptoms occur only after a certain incubation period. In particular, *Plasmodium vivax* − the malaria-inducing parasite species most prevalent in temperate zones − remains dormant in the human liver for longer periods than other species, which makes its combatting especially difficult. While incubation periods of *P. vivax* malaria in Korea show a clearly bimodal distribution, with short-term and long-term incubation periods, the reasons for this bimodality are not known. Using adaptive dynamics theory, we study the evolution of incubation times and investigate the evolutionary constraints guiding the emergence of bimodality. Based on the evolutionary insights gained in this first step, we identify and investigate the simplest suitable transmission model for *P.vivax* malaria that is in agreement with observed data.

Biographical Sketch: Kyeongah Nah graduated in 2010 from Kyungpook National University, South Korea, with a master's degree in mathematics. The title of her master's thesis is "The effect of zooprophylaxis on *P. vivax* malaria transmission." She is now a first-year Ph.D. student at the Bolyai Institute, Faculty of Science and Informatics, University of Szeged, Hungary. Her main scientific interests lie in mathematical epidemiology, and she is currently analyzing and comparing mathematical models for *P. vivax* malaria.

Joung Hun Lee

Supervisor: **Karl Sigmund**

Co-Supervisor: **Ulf Dieckmann**

Research Project: **Curbing Corruption in Public Good Games**

Abstract: By distorting group-beneficial resource allocation, corruption prevents the efficient governance of public goods. Corruption can be reduced, and public goods can thus be managed successfully, if appropriate systems for monitoring and sanctioning are put in place. The purpose of this project is to analyze which conditions facilitate the curbing of corruption. Using evolutionary game theory, we investigate a scenario in which members of a group are encouraged by an endogenous or exogenous social institution to contribute towards a public good. Each group member decides whether or not to contribute, and if no contribution is made, whether or not to attempt bribing the institution. The institution provides positive and/or negative incentives accordingly, with successful bribes causing non-contributing members to receive the same incentives as contributing members. Bribes are unsuccessful if they are rejected by the institution or if they are detected by other group members or an outside observer. On this basis, we identify conditions under which bribing strategies thrive or perish. We compare governance systems in which the enforcement of contributions is imposed from the outside or is jointly established by the group members, and in which the detection of bribes is operated from the outside or is jointly accomplished by the group members. Based on this analysis, we may consider extensions to multiple groups, multi-part institutions, multi-tier institutions, or dynamic public goods.

Biographical Sketch: Joung Hun Lee received her bachelor's degree in economics from Ajou University, South Korea, and her master's degree in environmental studies from Seoul National University, South Korea. She currently is a third-year Ph.D. student at Kyushu University, Japan. Her research interests include coupled socio-ecological dynamics and social dynamics mediated by human institutions.

Taiki Fuji

Supervisor: **Åke Brännström**

Co-Supervisors: **Mikko Heino, Ulf Dieckmann**

Research Project: **Effects of Climate-Induced Changes in River Flows on Temperate Seabass**

Abstract: Anthropogenic impacts are increasingly altering the native environment of many fishes. Developing sustainable fisheries-management practices that are capable of mitigating the detrimental effects of these changes require a good understanding of the mechanisms driving the dynamics of fish populations and their interactions with the changing environment. Rivers are known to be important in the ecology of coastal marine fishes: first, rivers change coastal water flows and the transport of fish larvae, and second, rivers function as nurseries for juvenile fish. The temperate seabass *Lateolabrax japonicus* is an important coastal fishery species in Japan, which utilizes both rivers and the sea as nurseries. To predict how this species will be affected by the anticipated degradation of river nurseries and changes in river discharge brought about by human activities, we develop and analyze a model of its population dynamics. It is expected that this study will help elucidate the role of rivers in the population dynamics of estuarine fishes.

Biographical Sketch: Taiki Fuji graduated from Kyoto University, Japan, in March 2009. He is currently a second-year Ph.D. student at Kyoto University. The title of his Ph.D. thesis is "Biology of juvenile temperate seabass *Lateolabrax japonicus* in the Yura River estuary, Japan." His main fields of scientific interest include biology and fisheries science.

Harald Ficker

Supervisor: **Rupert Mazzucco**

Co-Supervisor: **Ulf Dieckmann**

Research Project: **A Management Model for Alpine Fish Populations under Temperature Stress**

Abstract: The last century has seen an overexploitation of many economically relevant fishes in marine and freshwater habitats, leading to dwindling catches and the collapse of many stocks. Management practices involving juvenile stocking or fishing restrictions based on size classes and bag limits have not always been successful in restoring populations. One reason is that, mostly due to life-history variability in highly abundant early life stages, interannual population fluctuations are often pronounced. Another reason is that life-history dynamics are affected by harvesting and that harvesting, in turn, is affected by life-history dynamics. It is necessary to account for these two complicating factors when assessing the ultimate effects of management interventions. In this project, we do so using a model based on stochastic population projection matrices calibrated with empirical catch data for a whitefish population (coregonids) in Lake Irrsee, Austria. We consider populations with stable, as well as with non-equilibrium, demographic distributions. Since life-history rates and their fluctuations depend on water temperature, which is currently slowly increasing in Alpine lakes, we will use this model to investigate the joint impacts of climate change, management, and harvesting on Alpine fish populations.

Biographical Sketch: Harald Ficker graduated with a master's degree from the Department of Organismic Biology and Ecology of the Paris Lodron University, Salzburg, Austria. He is currently a second-year Ph.D. student at the Institute of Limnology of the Austrian Academy of Sciences, in Mondsee, Austria. In his Ph.D. thesis, he focuses on models describing the population dynamics of cold stenotherm freshwater fish, in particular whitefish (coregonids), under ecotoxic and climatic impacts (Project RADICAL, funded by the Austrian Climate Research Program). His scientific interests range from physical and chemical processes in freshwater lakes, over species interactions in aquatic communities, to mathematical models for fish populations, fisheries, and aquatic ecosystems.

Mariliis Lehtveer

Supervisor: **David McCollum**

Co-Supervisor: **Marek Makowski**

Research Project: **Multi-Criteria Analysis of the Role of Nuclear Power in the Global Energy System**

Abstract: My main aim during the YSSP is to address key uncertainties surrounding nuclear energy technology, considering its potential future role as a part of the global energy system. Since the decision to build nuclear power plants is never based on one criterion only, I will look into various synergies and trade-offs by using multi criteria analysis.
Under the framework of the Global Energy Assessment, IIASA has recently been involved in developing transformational energy pathways that simultaneously achieve a variety of energy sustainability goals. In this and other analyses, it is clear that nuclear power is a key uncertainty for the future: it could play an important role in achieving stringent climate targets, or it could not, either because of technological or socio-political concerns.
To execute the study, I will add new functionality to the IIASA Energy Program's MESSAGE integrated assessment modelling framework so that issues like nuclear waste and proliferation risk can be quantified using standard indicators. Together with previously developed indicators of health, energy security, climate change and energy affordability, this will provide the basis for assessing the nuclear sector's role in achieving energy and climate targets. In addition, I plan to apply and expand upon some of the multi-criteria model analysis (MCMA) methods developed by researchers in IIASA's Advanced Systems Analysis program. By expanding the variety of nuclear technologies in MESSAGE (as well as providing an option to restrict them) and then exploring synergies and trade-offs using MCMA, I hope to highlight the importance of nuclear power in achieving climate and other goals.

Biographical Sketch: Mariliis Lehtveer received her Master's degree in economics from the University of Tartu in 2011. She is currently a second year Ph.D. student in the Physical Resource Theory Section at Chalmers University of Technology. Her thesis assesses the role and potential of specific energy technologies in a global energy context with the primary focus on nuclear power. Her main fields of scientific interest include energy economics, energy modelling and interdisciplinary sustainability analysis.

Kathleen Bohan

Supervisor: **Keywan Riahi**

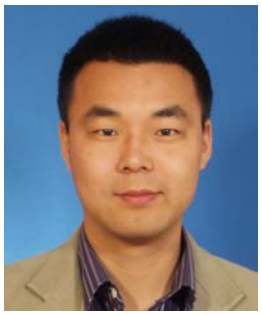
Co-Supervisor: **Jessica Jewell**

Research Project: **Incorporating Energy Security Framework into the MESSAGE Model**

Abstract: Global energy modelling efforts, such as those conducted at IIASA, aim to understand the potential requirements of future energy systems and provide guidance to policy makers. It is this goal of guiding policy that is particularly problematic, for policy decisions are made, or at least implemented, at the national level, and global models typically do not produce output data for individual countries. To improve the policy relevance of global energy system modelling scenarios, constraints and concerns faced at the national level, such as energy security, need to be integrated into modelling frameworks.

My YSSP summer research will involve incorporating an energy security framework into IIASA's systems engineering model MESSAGE. This model is used for energy policy analysis and for the development of scenarios, especially those with a strong focus on decarbonization. My work will build on previous research by the IIASA Energy Program in identifying energy security indicators that are feasible to use in integrated assessment models in general, and MESSAGE in particular. I will then work to incorporate these indicators into MESSAGE, which will allow me to investigate how energy security goals impact decarbonization scenarios and explore if it is possible to meet stringent climate goals and energy security goals simultaneously.

Biographical Sketch: Kathleen Bohan is a first year PhD student at the Central European University's Department of Environmental Science and Policy in Budapest, Hungary. Her research interests include the modeling of energy system transitions, energy policy development, and energy security analysis. She holds a Bachelor of Engineering degree in Biological and Environmental Engineering from Dalhousie University, and a Master of Applied Science degree in Aerospace Engineering from the University of Toronto in Canada. Before beginning her PhD studies Kathleen worked on the development of industrial gas turbines for Rolls-Royce Energy in combustion, development and systems engineering roles.



Fangyi Li

Supervisor: **Shonali Pachauri**

Co-Supervisor: **Rao Narasimha**

Research Project: **Impact of Consumption Structure Change on Regional Energy Demand in China**

Abstract: The relationship between economic growth and energy consumption has always been a hot topic in energy-related research. In the case of household energy consumption, income of the family is one of the determinants. There exists significant regional difference in economy and living standards in China. In some provinces, energy consumed by households is increasing rapidly. The spatial pattern of household income must be considered in an allocation of CO_2 abatement targets based on principles of equity and efficiency. Regions of low household consumption should take less responsibility, while high consumption regions should take relatively more. The interest of our research is to examine how changes in household consumption, across all regions, impacts the spatial pattern of energy demand. Energy embodied in goods and services can be transferred to different regions through trade flows, as all of the regions in China are bonded together by industrial chains. So consumption ascension in one region could cause energy consumption growth in other regions. Economic connections across different regions will be considered in this research. The regional-industrial connection can be simulated by an inter-regional input-output model. This study will focus on the following objectives: 1) to predict the trend of changes in household consumption in different regions based on spatial-temporal consumption and income data; 2) to estimate industrial restructuring caused by consumption changes using an inter-regional input coefficient matrix; 3) to estimate the future spatial pattern of energy demand in China. Through this research, we aim to estimate consumption-caused energy increases in each region of China and draw implications in support of energy-saving targets allocation. Regression analysis, an inter-regional input-output model, and scenario analysis will be used in this research. GIS tools will also be necessary for spatial expression.

Biographical Sketch: Li is currently a second year PhD student at the Institute of Geographic Science and Natural Resources Research, Chinese Academy of Sciences. He graduated in 2007 from University of Science and Technology of China, majoring in Environmental Science. In addition, he received a master's degree in Environmental Economics from the Chinese Academy of Sciences in 2010. His thesis deals with the relationship between household consumption and energy demand in China. His main fields of scientific interest include regional development, energy policy simulation, and input-output models.

Christoph Bertram

Supervisor: **Keywan Riahi**

Co-Supervisor: **Volker Krey**

Research Project: **Energy Demand Scenarios for the Industry Sector**

Abstract: For studying the anthropogenic forcing on the climate system over the next century, the evolution of greenhouse gas emissions from the industry sector is of high importance. For exploring the full space of political and technical options for reducing emissions, and for making the analytical treatment transparent it is necessary to consider the entire causal chain leading to the emissions: from general socio-economic developments to the development of industrial output (1), to the energy consumption required by this industrial activity (2) and finally to the emissions that the supply of this energy entails (3). There are simple models that explore the relationship between industrial output, energy demand and economic development (link 1 and 2 from above). Improving these existing models conceptually, including further scenario differentiation beyond GDP and population assumptions will be the first part of this research project.
The second part of the project will build upon the MESSAGE model in its explicit version of the industry sector, which offers a powerful tool to explore the upstream effects of industrial activities for energy demand, supply, and greenhouse gas emissions. Through explicit modeling of different technology portfolios for various industrial service levels, the project will assess how energy demand and emissions may evolve under different technology, energy supply, resource and emission price assumptions. The aim of this research project is to generalize the findings in order to derive a reduced form model of energy demand based on the analysis of the different scenarios. Such a tool would be useful for integrated assessment models (IAMs) with less technology details on the demand side as well as for longer term scenario evaluation.

Biographical Sketch: Christoph is a second year PhD candidate at the Potsdam Institute for Climate Impact Research. In his thesis he explores different energy demand trajectories for the 21st century and assesses the implication of energy intensity development for climate change mitigation. His research interests range from energy system analysis and technology development to climate policy analysis. He holds a Masters equivalent degree in physics as well as the German State Examination in Political Science from the University of Tübingen.

Katalin Petz

Supervisor: **Marijn Van der Velde**

Co-Supervisor: **Hannes Böttcher**

Research Project: **Modelling the Impact of Land Management on Ecosystems Services and Biodiversity**

Abstract: The way people treat the land for its purpose (i.e. land management) is essential for making decisions on land use and conserving ecosystem services (ESS) and biodiversity. In order to support policy formulation, ESS and biodiversity models are developed that describe the impacts of socio economic developments. Land management activities include pesticide and fertilizer use, infrastructure development, and nature protection and restoration. These aspects, however, are underrepresented in most models and generalized information is missing. Models often do not represent the full diversity of ESS. This can lead to an incomplete assessment. My study aims at including the impact of land management in mapping and modelling tools. I apply a stepwise framework, which differentiates between ecosystem properties, functions and services, and management activities, to develop comprehensive ESS models. I use secondary data to establish spatial relationships in GIS. Food production, fuel wood provision, climate regulation, pest-control, recreation and biodiversity are, among others, included. I adopt the models to Baviaanskloof Nature Reserve in South Africa to determine the influence of ecosystem restoration on ESS. I also make a link to global modelling frameworks (e.g. IMAGE-GLOBIO). This enables to determine global change impacts on the management and provision of ESS in a more general way. During my YSSP stay I aim to use my experience in developing GIS models in case studies to formulate a more generic modelling approach. I will further integrate land management activities into the models by synthesizing information from scientific literature into model relationships and adopt relationships from other models. The analytical tools and global data of IIASA (e.g. agricultural and land use models, and Global Forest Biomass) can also help to refine the biophysical and management relationships.

Biographical Sketch: Katalin received a BSc Horticulture Engineer degree at Corvinus University of Budapest (Hungary, 2006) and a MSc Environmental Sciences, Environmental Systems Analysis degree at Wageningen University (The Netherlands, 2008). She is currently a third year Ph.D student at Wageningen University. Title of her thesis is “Modelling the impact of land management on ecosystem services and biodiversity”. Her main fields of scientific interest include ecosystem services, integrated assessment, spatial analysis and science-policy interface.

Yuanyuan Zhao

Supervisor: **Steffen Fritz**

Co-Supervisors: **Linda See, Christoph Perger**

Research Project: **Improving Training and Validation Datasets for Land Cover Mapping**

Abstract: Land cover mapping is the most direct way in portraying and understanding the dynamic changes of earth physical surface, and consequently is the key to global change and Earth system studies. With the efforts of remote sensing community, several global land cover maps are finished and freely available at various spatial resolutions. However, considerably high disagreements were found among those products in many parts of the world, especially in ecological transition zones where landscapes are highly heterogeneous. This calls for finer land cover mapping and further validation. From the experience of former mapping activities, collecting training and testing samples is the most time- and labor- consuming part. Integrating crowdsourcing will be the best way to solve this problem. Geo-Wiki is an on-line platform for global volunteers to provide relatively accurate and up-to-date land cover information based on Google Earth and their local knowledge. The general objective of my planned YSSP research is to establish a well-described validation sample dataset based on the Geo-Wiki platform, so that we could validate land cover products of different spatial scales (with 1km/ 500m/ 300m/ 30m spatial resolution). To achieve this goal, I will review the Geo-Wiki samples, and standardize the spatial scale and classification system. This new dataset could be used to validate and compare all existing land cover products. The spatial distribution of disagreement and difficult-to-map categories will be discovered to contribute to future mapping works.

Biographical Sketch: Yuanyuan graduated from Beijing Normal University in July 2010, majoring in remote sensing and geographic information system. She is a second-year Ph.D student in Center for Earth System Science at Tsinghua University. The planned research of her Ph.D program is spatially explicit terrestrial carbon cycle modeling using remote sensing inputs. Her research interests include: land cover mapping; carbon cycle modeling; remote sensing and GIS application on environment and public health.

Emma Johnson

Supervisor: **Tatiana Ermolieva**

Co-Supervisor: **Michael Obersteiner**

Research Project: **Agent-Based Modeling of Land Use with Applications to Food and Bio Energy Competition**

Abstract: There are many studies arguing that increased demand for bioenergy have a significant impact on food prices. Most of these studies rely on large partial or general equilibrium models, based on a detailed description of the land characteristics and the crops produced, like the Globiom model developed at IIASA. These models can be a useful tool for investigating how changes in policies, demand etc. pull the system in certain directions. However, the models assume that the system is in equilibrium, or at least that there is a recursively dynamic path that adapts to equilibrium at each point in time. The question how equilibrium is approached or even if it is reached cannot be analyzed with this method, nor can the stability of the equilibrium be satisfactorily investigated. The purpose of the research is to construct an agent-based model, based on Globiom data, and compare the two modeling approaches. The model would include a large amount of crops and the possibility to model different levels of farming intensity. Each agent in the model represents a farmer that controls a given land area. Agents seek to maximize profit and choose among growing different types of crops, or no crop at all. Different planning mechanisms of agents could be tested as well as a variety of inertia, primarily regarding how fast and under what circumstances agents can shift from one production strategy to another, including switching crop. It would be possible to study how these features affect the behavior of the market and how close the system gets to equilibrium. The mechanisms include predicting future market price, reinforcement learning, and taking into account strategies of other agents.

Biographical Sketch: Emma received her M. Sc. in Sustainable Energy Systems in 2009 from Chalmers University of Technology, Sweden. She is currently a second year PhD student at the department of Energy and Environment at Chalmers. Her main fields of interest include the effects of increased bioenergy demand on food prices and CO_2 emissions from land-use change. In her thesis she focuses on modeling land-use with agent-based models and comparing it with partial equilibrium counterparts.

Olha Danylo

Supervisor: **Dmitry Shchepashchenko**

Co-Supervisor: **Anatoly Shvidenko**

Research Project: **Modeling Spatial Inventory of Greenhouse Gas Emissions in the Residential Sector**

Abstract: Human activity increases the concentration of greenhouse gases (GHG) in the atmosphere. GHG emissions are considered as a main cause of climate change. That is why searching for way of reducing the GHG emissions is a crucial issue of global policy. Residential sector is one of the most considerable sector for GHG emissions reduction. The emissions in this sector are caused by burning coal, natural and liquefied gas, wood and other fossil fuels. Nowadays several GHG emission inventory approaches (IPCC and others) in residential sector are developed, but they can be applied only on regional or national levels. However, GHG sources are located very unevenly; therefore, existing approaches do not allow to take fully into account population distribution features, fuel characteristics and burning technology. Consequently, easy-to-use tool development for spatial-distributed GHG emissions inventory remains an open challenge. Such tool will provide new possibilities for GHG emission analysis and help scientists and policy makers to find effective ways for emission reduction.
The objective of my research is to develop an universal approach, mathematical models and software for spatial inventory of GHG emissions in residential sector, to perform numerical experiments for creation georeferenced databases for spatial inventory GHG emissions (digital maps) and to implement created approach for one from EU and one from non-EU Member State regions.

Biographical Sketch: Olha graduated from the Faculty of Applied Mathematics of the Lviv Polytechnic National University in 2011, where she is currently a Master's student at Mathematical and Computer Modeling Program. Title of her thesis is *"Spatial modeling and analysis of greenhouse gas emissions in residential sector"*. Her main fields of scientific interest include spatial-distributed inventory of GHGs in residential sector on regional, country levels, and at the level of elementary objects; methods for evaluation of GHG inventory uncertainty; analysis differences between the models for GHG emissions inventory in residential sector for the EU Member States and other countries.

Xiaopeng Song

Supervisor: **Georg Kindermann**

Co-Supervisor: **Hanner Böttcher**

Research Project: **Reducing Uncertainties for REDD+ Using Improved Remote Sensing Products**

Abstract: Global deforestation is estimated to account for 12-20% of global greenhouse gas emissions in the 1990s and early 2000s. The United Nations Framework Convention on Climate Change has recently launched a financial mechanism to stimulate developing countries to reduce emissions from deforestation and forest degradation and enhance carbon stocks in forests (REDD+). Policies would be misplaced without reliable scientific support. However, substantial uncertainties exist in measuring carbon emissions from deforestation mainly because the uncertain rates of deforestation monitoring and biases in forest biomass estimation. Forest cover and forest cover change maps are increasing derived with spatially contiguous and temporally repetitive satellite data, and thus uncertainties may be reduced through the improvements of remote sensing products. Accurate global forest cover map is essential for deriving global forest biomass map, both of which are critical input data for deforestation models such as IIASA's Global Forestry Model (G4M). The primarily objective of my IIASA visit is to study the sensitivity of G4M to six existing global forest cover maps derived from remotely sensed data and an improved forest cover map derived in my previous research by synthesizing these existing maps. My outreaching objective is to investigate the possibility of G4M for taking time-series fine-resolution forest cover change data sets.

Biographical Sketch: Xiaopeng received a B.S. in Geographical Information Science and a B.S. in Economics from Peking University (2008). He is currently a fourth year Ph.D. student at the University of Maryland, College Park, USA. His research interests are primarily in global land cover / land use change, including monitoring the rates of change with remotely sensed data from satellites, as well as investigating the causes and consequences of land use change from a joint ecological-economic perspective.

Pheakkdey Nguon

Supervisor: **Hannes Böttcher**

Co-Supervisor: **Florian Kraxner**

Research Project: **A Socio-Ecological Framework for the UN-REDD+ Initiatives**

Abstract: The goal of the UN-REDD+ initiatives is to improve current forest management and conservation practices in order to avoid scenarios where deforestation and forest degradation have negatively affected local communities, biodiversity, and global greenhouse gas emissions. Contemporary forest ecology and management are based on the recognition that forests are dynamic, and are often affected by both anthropogenic- and naturally-induced disturbances. Content analysis of the REDD+ participating countries' Readiness Preparation Proposals indicates that there is a lack of discussion of the influence of natural disturbances on the drivers of deforestation and forest degradation. Therefore, the goal of my project for the YSSP is to develop a conceptual framework for the REDD+ initiatives that would facilitate production of socio-ecological knowledge on the drivers of deforestation and forest degradation. Prior to the YSSP, I have reviewed various existing socio-ecological frameworks (e.g. Ostrom 2007; Millennium Ecosystem Assessment 2005; and others), and explored how these frameworks have been applied in empirical research projects. At IIASA, my tasks will include (1) synthesize lessons learnt from empirical applications of the reviewed frameworks, (2) identify lessons that are relevant to the UN-REDD+ conceptualization of drivers of deforestation and forest degradation, and finally (3) from these lessons, propose a conceptual framework for the UN-REDD+ policies.

Biographical Sketch: Pheakkdey is a PhD student/ Fulbright research fellow at the Graduate School of Geography, Clark University. He holds a Bachelor in Education from Royal University of Phnom Penh and University of Tasmania (2006), and a Master's in International Development and Environmental Analysis from Monash University (2009). Pheakkdey is interested in how knowledge on the drivers of deforestation and forest degradation in the context of the UN-REDD+ policies is first produced, and then acquired by policymakers at the global, national and local level.

Yaw Sasu-Boakye

Supervisor: **Petr Havlik**

Co-Supervisor: **Hugo Valin**

Research Project: **Land Use Change Emissions from Protein Feed Substitution in European Livestock Production**

Abstract: Land use change emissions contribute significantly to global greenhouse gas emissions. Soybean production is cited as one main driver of land use changes in the biomes of South America. Soymeal from soybeans is used extensively as livestock protein feed. Increased global demand for livestock products implies an expansion of land used for soybean production, resulting in further emissions of greenhouse gases. In addition, most soybean producers are embracing genetically modified crops, which are not cleared for use in Europe. Since Europe imports most of its soymeal, substitutes for soymeal would be vital for the security of livestock production in Europe. Soymeal in livestock feed can be replaced with alternative products such as peas and by-products of bioenergy productions. However, the environmental benefits of such feed substitutions are not fully known. Previous studies on the environmental benefits of protein feed substitution in Europe have excluded emissions from land use changes as well as the interactions between feed, food and bioenergy markets. The aim of this research is to assess the contribution of land use changes to the emissions of greenhouse gases from European livestock when soymeal is substituted with feed sources produced in Europe. We will adapt IIASA's Global Biomass Optimization Model (GLOBIOM) for this study. GLOBIOM is a partial equilibrium modelling approach that integrates agricultural, bioenergy and forestry sectors, paired with a geographically explicit land use description.

Biographical Sketch: Yaw received a master's degree in Energy and Environmental Engineering from Linkoping University, Sweden. He is currently a second year doctoral student in Chalmers University of Technology. His research studies at the Department of Energy and Environment focuses on modelling and analysis of greenhouse gas emissions from land use and food production. His primary research interest is in the environmental impacts of agriculture and bioenergy production.

Dilip Khatiwada

Supervisor: **Sylvain Leduc**

Co-Supervisor: **Ian McCallum**

Research Project: **Modeling of Sugarcane Bioenergy Systems in Brazil**

Abstract: In the research period at IIASA, modeling of sugarcane bioenergy systems will be performed. The aim is to optimize the environmental performances and cost benefits associated with the production of bioethanol and bioelectricity based on the lifecycle approach. Within the study, cane-yield (productivity), transportation distance (i.e. location of sugarcane mills), agricultural practices (e.g. harvesting systems including cane-trash collection), conversion technologies, allocation methods for multiple products in the lifecycle assessment, among others, are simulated. An optimized model - BeWhere - which considers techno-economic and environmental parameters will be used with regard to locations of sugarcane biorefineries. In order to find the best optimum energy solution, new technologies and associated constraints such as investment, biomass availability, collection and transportation are considered in the model. Process integration for the production of the first and second generation bioethanol, and bioelectricity will also be simulated for finding best options for implementation.

Biographical Sketch: Dilip is a PhD researcher at the division of Energy and Climate Studies, KTH – Royal Institute of Technology, Sweden. He holds a Swedish Licentiate Degree in Energy and Climate Studies, after completing two Masters Degrees in Sustainable Energy Engineering and Public Administration. Mr. Khatiwada has professional experiences in several private, public and international development agencies for about 15 years. He held several positions such as assistance spokesperson at the Ministry of Environment, component manager at an environmental project of Danish International Development Agency, national focal person at the Regional Air Quality Project, specialist/consultant at Asian Development Bank sponsored project, and under-secretary (technical) at the government of Nepal. His current research is focused on the sustainability assessment of sugarcane bioenergy systems: net energy and greenhouse gas balance, and synergies for sustainable development. The topic of his PhD research is ‘assessing the sustainability of bioethanol production: key criteria and methodological improvements’.

Bishnu Poudel

Supervisor: **Eva-Maria Nordström**

Co-Supervisor: **Hannes Böttcher**

Research Project: **Optimizing Total Carbon Balance of Forest Biomass Production in the Boreal Forests of Northern Sweden**

Abstract: This study analyses the total carbon balance for forest biomass production systems in Swedish boreal forests. The integrated modeling work includes forest biomass production with improved silviculture, total carbon benefit of forest products use, and soil carbon development as a result of improved silviculture and forest product use. Moreover, carbon benefits are calculated when no product is used and left in the forest. Finally, the radiative forcing implications of forest biomass production and no product use option are calculated and compared for the carbon balance. Forest biomass production is estimated using the DT-model. The empirical growth model (DT) forecast the stand development from young stands (>5 yr of age) to final harvest, where stand characteristics are calculated with a yearly time step. Calculations are made for growth, height, stem shape, quality, and harvest volumes in thinnings and final harvests. Harvested biomass is estimated and classified into different assortments and then optimized for best result for total carbon benefit. Carbon sequestration and standing biomass carbon stock is calculated for each year time step. Soil carbon dynamics is calculated based on litter input using Q model. The final part of analysis includes the radiative forcing implications of use and no use of forest products considering time value of greenhouse gas emissions and removals from the atmosphere. The overall effect of greenhouse gases in the atmosphere for product use and no use alternatives is calculated using a method of natural decay of greenhouse gases earlier developed by IPCC.

Biographical Sketch: Bishnu Chandra Poudel is a PhD candidate with the Ecotechnology research group in the Department of Engineering and Sustainable Development at Mid Sweden University in Östersund, Sweden. He has been involved in forestry research for 10 years. He has published scientific papers and popular articles on forest biomass production. His research focuses on carbon balance implications of forest management and products utilization to contribute to climate change mitigation.

Stefan Schreier

Supervisor: **Anatoly Shvidenko**

Co-Supervisors: **Ian McCallum, Dmitry Shchepashchenko**

Research Project: **NO_x Emissions from Wildfires in Northern Eurasia**

Abstract: Biomass burning has an important role in determining the composition of Earth's surface and atmosphere. It comprises agricultural fires, use of biofuels, and wildfires of forests and other vegetation. Biomass burning represents an important source of aerosol particles and greenhouse gases such as CO_2, CH_4 and N_2O, but also chemically active gases such as CO, NO_2 and later ozone are observed in the plumes. In the near future, conditions might become even more favorable for fires in some regions as a consequence of climatic changes (e.g. IPCC Report) making wildfires an issue of growing importance.
My research plan for the summer is the estimation of nitrogen emissions for a specific area (e.g. northern Eurasia) and time period (e.g. 2001-2010) by using a multi-sensor remote sensing concept and an Integrated Land Information System, developed by the International Institute for Applied Systems Analysis for Russia. The calculated emissions are then compared with tropospheric NO_2 columns retrieved from state-of-the-art satellite instruments (e.g. SCIAMACHY and GOME-2) and other available bottom-up estimates (e.g. GFED3). At the best, new insights on the impact of wildfire in northern Eurasia on the nitrogen budget will be achieved.

Biographical Sketch: Stefan received his diploma in Geography at the University of Vienna, Austria, in May 2010. After his graduation he worked as a researcher at the University of Natural Resources and Life Sciences in Vienna, Austria. He is currently a first year PhD student at the Institute of Environmental Physics (IUP) at the University of Bremen, Germany. The title of his PhD thesis is "Satellite observations of nitrogen dioxide from biomass burning". His main fields of scientific interest include the use of satellite measurements in tropospheric chemistry studies and the improvement of gas retrieval from satellites with the main focus on biomass burning regions.

Alexander Laletin

Supervisor: **Anatoly Shvidenko**

Co-Supervisor: **Dmitry Shchepashchenko**

Research Project: **Ecological and Economical Assessment of Wood Resources Accessibility**

Abstract: Dissatisfaction of needs in wood resources and low profitability of forest sector in Russia indicates about failure of the current model of forest management. Many traditionally timber producing regions of Russia have faced the following situation: the part of economically accessible wood decreases constantly, while the calculated wood-cutting area is significantly underused. So, the existing model of planning wood-cutting areas cannot be considered a reliable basis for an inexhaustible and permanent harvest of forests. In order to estimate an economically inexhaustible level of wood harvesting, the data of resource efficiency and expenses for exploitation of the accessible areas of forests are required. Proper evaluation of ecological and economic accessibility will lead to setting the industrial developing parameters and rational use of timber resources, well-grounded determination of wood-cutting area, and also correct calculation of labor, materials and financial resources necessary for wood resources developing. This will lead to operation of enterprises on the basis of inexhaustible and sustainable forest use.
The main objective of the proposed research is to create a methodology and a model which would give opportunity for enterprises and authorities engaged in forest sector to evaluate stocks of wood resources taking into consideration their ecological and economic accessibility. Another specific task of my research is to assess accessibility of forest resources for some areas in Central Siberia and to classify these areas by their economic accessibility to show the effectiveness of the model as an example.

Biographical Sketch: Alexander graduated in 2009 from the Siberian Federal University (Institute of Economics, Management and Natural Resources Use) with specialization in International Relationships Management; in 2011 he obtained a Master's degree in Environmental Management at the same university. He is currently a third year PhD student at the Institute of Forest n.a. V.N.Sukachev (Siberian Branch of Russian Academy of Sciences). His main fields of scientific interest include economic assessment of natural resources, project management, financial and environmental management.

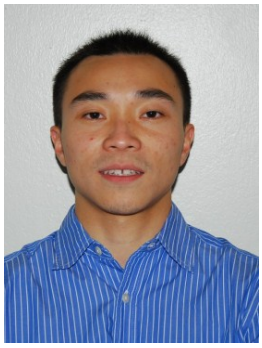
Maragatham Kumar

Supervisor: **Peter Rafaj**

Research Project: **Assessment of Air pollution and GHG Mitigation Strategies in Malaysia using the GAINS Model**

Abstract: Planning for future energy development, taking into account the national obligations to mitigate climate change and air quality pressures is a major challenge faced by Malaysia. Therefore, new research initiatives are needed to better understand combined impacts of climate change and air pollution strategies for the energy sector. Adopting balanced measures is important in addressing long-term environmental issues and this research aims to facilitate the impact assessment of air pollution and GHG abatement in Malaysia. The goal of this research is to develop a set of cost-effective emission control measures and to quantify co-benefits from meeting national policy targets. The GAINS (Greenhouse Gas-Air Pollution Interactions and Synergies) model is used for the estimation of emissions and costs, while the outputs of the MESSAGE (Model for Energy Supply System Alternatives and their General Environmental Impacts) energy system model of Malaysia provides the underlying energy projections by 2050. This research explores different energy and GHG policies that affect air quality and determines scope for policy interventions. In the long term planning, this study will help the national decision and policy makers in deciding cost-effective air pollution control measures. A quantitative assessment of co-benefits generated will be useful for the country in strengthening implementation of air pollution control measures and climate change mitigation actions.

Biographical Sketch: Maragatham graduated in 2006 from University Science Malaysia, with a Master's degree in Mathematics, and works as a research officer in Planning and International Relations Division, Malaysian Nuclear Agency. Her key responsibility lies in economic-energy-electricity-environmental (4E) interaction modeling using a comprehensive set of computer models and she is responsible for developing research studies on viability of future power plant projects under the different scenarios arising from the key national issues faced in energy sector development, also taking into consideration pollutant emissions.



Yuche Chen

Supervisor: **Jens Borken-Kleefeld**

Co-Supervisor: **Kaarle Kupiainen**

Research Project: **High Emitting Vehicles: Identification, Relevance, and Policy Strategies**

Abstract: Health and environmental concerns request that emissions of air pollutants are to be reduced. For road vehicles this has been – partially – achieved with technical measures across the whole fleet. However, some vehicles pollute more than others and targeting measures specifically at those vehicles could be a very cost-effective approach. However, how these vehicles are identified, and how big their relevance really is, is quite uncertain. Here we propose to re-analyze emission measurement data again to identify amount and contribution of high emitting vehicles, and possible changes across successive stages of emission limit values.

We propose to contrast data from remote sensing campaigns (RSD) with detailed data from laboratory measurements. The remote sensing is capable to sample large numbers of vehicles in real driving, yet the exact engine mode and the vehicle condition are usually unknown. The recorded unit emissions usually display a wide spread also when clustered for vehicles of the same technology/emission control level. However, what is normal operation, what is exceptional, and what is really deficient cannot be told from these data alone. The distribution of unit emissions from lab tests can therefore be used as a benchmark for normal operation.

Contrasting the two distributions gives a measure for the emission level and the frequency of occurrence of high emitting vehicles. Plotting the data over time (i.e. vehicle age) allows to identify deterioration or improvement of real world emission behavior.

Biographical Sketch: Yuche is a fourth year PhD student at the Department of Civil and Environmental, University of California Davis. He graduated in July 2008 with a master degree in Management Science and Engineering. His main research interests focus on systematically evaluating the uncertainties in energy and environmental system and analyzing the physical and social impacts from those uncertainties, with a particular application in transportation. Now he is on the way toward his career goal and he believes "if you do not know where to go, you can go nowhere."

Hem Dholakia

Supervisor: **Pallav Purohit**

Co-Supervisor: **Shilpa Rao-Skirbekk**

Research Project: **Health Impact Assessment of Air Pollution in Two Major Indian Cities by Modelling Local Air Pollution Projections**

Abstract: The positive health impacts due to improvement in air quality as a consequence of air pollution and climate change related mitigation policies have been well documented in research. The synergies and trade-offs presented hold important implications in India given the objective of promoting economic growth, while enhancing equity in distribution of resources, improving energy security, mitigating climate change and minimizing the negative health impacts of future air pollution. The current study focuses on major Indian cities and assesses the health impacts due to ambient air quality improvement and related equity dimensions - as a consequence of local air quality and climate change related mitigation policies. Using the GAINS (Greenhouse Gas and Air Pollution Interactions and Synergies) model and income based health impact assessments, multi-sectoral air pollution and climate change mitigation policies will be evaluated to further assess how health impacts of ambient air pollution can be effectively reduced in the cities of Mumbai and Delhi.

Biographical Sketch: Hem holds a degree in physical therapy from Seth G.S. Medical College, India and a master's degree in Exercise Science from Brighton University, England. He is currently pursuing his doctoral degree from the Indian Institute of Management, Ahmedabad and the title of his thesis is *Climate change and Public Health in India: Impact Assessment and Adaptation Strategies*. Hem's research interests include environmental public health, climate change adaptation and public health financing.

Vijay Limaye

Supervisor: **Markus Amann**

Co-Supervisor: **Wolfgang Schöpp**

Research Project: **Impacts of Non-Linearity in Particulate Matter Dose-Response Relationships: A Case Study of India Using GAINS-Asia**

Abstract: Ambient air pollution persists as a major public health challenge in many Asian cities, particularly for small particulate matter, which is linked to increased risk of premature mortality, asthma attack, bronchitis, and heart attack. Current integrated energy-air quality-health impact assessment models including the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) program, employ linear concentration-response functions based on epidemiological studies to link chronic exposure to air pollution to an increased risk of premature mortality as a proportional increase in the baseline mortality rate. However, the recent World Health Organization Global Burden of Disease assessment discusses the potential for non-linearity in the health responses to small particulate matter concentrations, as each additional increment in ambient particulate matter concentration is associated with a lower increase in overall relative risk. The implications of incorporating a more sensitive dose-response function for the assessment of health risks, air pollution and climate mitigation measures, and ultimately policymaking are potentially significant and could vary regionally depending on the spatial and temporal distribution of pollution. This project will explore implications for health impact function refinement in developing countries, using India and GAINS-Asia as an example. National-level energy scenarios (baseline, low carbon, low solid fuels in residential sector, and a potential new scenario based on estimated increases in demand for air conditioning in the commercial sector due to climate change) will be analyzed under new assumptions about concentration-response relationships to quantify changes in population health outcomes and evaluate implications for policy.

Biographical Sketch: Vijay Limaye graduated in 2007 with a B.A. in Environmental Sciences from the University of California, Berkeley. He is currently a third year Ph.D. student at the University of Wisconsin, Madison and advised by Dr. Jonathan Patz in a joint program combining Population Health Sciences and Environmental Studies. His main field of interest is environmental epidemiology, particularly the links between climate change, energy demand, urban air pollution, and public health.

Ki-Chul Choi

Supervisor: **Chris Heyes**

Co-Supervisor: **Young Hwan Ahn**

Research Project: **Development of Source-Receptor Relationships over South Korea and East Asia in support of the GAINS-Asia model**

Abstract: Fine particles and tropospheric ozone are pollutants of concern for human health, vegetation, and property damage. Control strategies have been designed and evaluated using regional air quality models to understand impacts of emissions reduction. IIASA's GAINS model has been developed as an integrated tool to identify effects of emission control strategies and their contribution to regional-local air quality. It can assess the impact of emission reductions of sources on air quality in a receptor region (S-R) based on a simple meta-model derived from a large number of calculations made using a chemical transport model (a.k.a. Brute force method). For the current GAINS-Asia model S-R estimations with a global chemical transport model (i.e. TM5) have so far been performed for China and India only. It is clearly desirable to include emission sources from other Asian countries, such as South Korea, using a model with appropriate spatial resolution. The source tagging tools attached to a comprehensive regional model such as CMAQ could be a better alternative to the traditional brute-force approach to get source-receptor (S-R) relationships because of its less demanding computational resources requirement and less perturbing regional atmospheric chemistry conditions.

During the YSSP period, I am planning to develop S-R relationships of regional air pollution with a focus on South Korea using CMAQ source tagging tools (e.g. CMAQ/OPTM) in support of the GAINS-Asia framework. I also improve the present framework for South Korea by adding more resolution for administrative regions (i.e. from 4 to 14 sub-regions). For this study, I will use a US EPA SMOKE-based emissions processing system (i.e. SMOKE-Asia) which was developed by my advisor (Woo et al, AE, 2011). The production of tagged emissions for each sub-region and CMAQ tagging model run will be conducted during my YSSP period. After assessing the performance of tagged air quality model, the new S-R for South Korea for ozone will be developed.

Biographical Sketch: Ki-Chul is currently a PhD candidate in the Department of Advanced Technology Fusion at Konkuk University in South Korea under the supervision of Professor Jung-Hun Woo. His research interests are Asian emissions inventory and modelling from anthropogenic and biomass burning sources, emissions processing, and contribution assessment of regional air quality. He graduated from Konkuk University in 2008 with a Bachelor's degree of Environmental Engineering and in 2010 with a Master's degree in the same field.

Key Kabaya

Supervisor: **Janusz Cofala**

Research Project: **Assessment of the Potential for Energy Efficiency Improvement in the Japanese Domestic and Industrial Sectors and their Benefits on Greenhouse Gases and Air Pollution**

Abstract: The work will assess various ways to improve efficiency of energy use to meet energy needs in the domestic (residential and commercial) sector and in industry for the next 20 years. Efficiency measures for the domestic sector will be identified for major energy needs, like space heating and cooling, hot water preparation, cooking and electrical appliances. In industry potentials for more efficient energy use will be assessed for major energy-intensive sectors and products, the rest of manufacturing industry as well as the power generation sector. While up-to-now work done at IIASA for the GAINS model Mitigation Efforts Calculator (MEC) was based on international literature data, the YSSP project will focus on collecting and using information from Japanese sources. In this way more up-to-date and more robust estimates for the possible improvements and their co-benefits will be developed, which in turn will be used for the MEC calculator update. Implications of such energy efficiency improvement for greening economy in Japan may also be discussed.

Biographical Sketch: Kei Kabaya completed his Master's degree in biodiversity conservation in Durrell Institute of Conservation and Ecology (DICE), University of Kent in United Kingdom in 2009. He joined Institute for Global Environmental Strategies (IGES) in Japan in 2010 and currently serves as a researcher in Economy and Environment Group. While he has mainly studied biodiversity economics with econometric techniques insofar, he is now broadening his research scope to include green economy, geographical information system (GIS) and Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model.

Angan Sengupta

Supervisor: **Samir K.C**

Co-Supervisor: **Anne Goujon**

Research Project: **Projecting the Potential of the Demographic Dividend of India: Is there Enough Reason to be Optimistic?**

Abstract: Debates are floating around the emergence of demographic dividend in India in recent times. There are two views: optimist and pessimist, regarding the potential impacts of this working age population on economic growth, which has largely been unexplored. India is going to be the largest contributor to the global demographic transition. Declining fertility rate along with a fall in infant and child mortality rate for last few years is resulting in an increase in proportion of the working age people in Indian population. It has been found that even today the fertility rate has been very high among less educated and lower socio-economic stratum people, with high but declining mortality rates. Hence, according to Demographic Transition Theory, it is most likely that there will be a high representation of these under-privileged people within the young working age population of India in near future. A mixed trend in the female labour force participation and falling juvenile sex ratio in recent years surely increase the ambiguity over the composition and characteristics of the future working age population of India. During this research our objective is to examine the age-sex composition of the population by background characteristics across states and to explore the potential of working age population, employing multi-state population projection techniques and econometric methods. In this study we will utilize the data provided by the Census of India and various sample surveys. This research hopes to contribute to the policy interventions regarding the development of human resource and appropriate involvement of the labour-force in order to utilize the demographic dividend ensuring economic growth of India.

Biographical Sketch: Angan graduated with Economics from Calcutta University, India in 2006 and with Population studies from International Institute for Population Sciences (IIPS), India in 2008. He is currently a third year PhD scholar in Population Research Centre at Institute for Social and Economic Change (ISEC), Bangalore, India. Angan is registered as an external PhD student in School for Public Health and Primary Care (CAPHRI) at the Maastricht University, Netherlands. Title of his doctoral thesis is 'Double Burden of Malnutrition in India: Macro and Micro Perspectives'. His research interests include Fertility, Health, Environmental and Development Economics.

Collin Payne

Supervisor: **Warren Sanderson**

Research Project: **Health Transitions and Social Capital in Sub-Saharan Africa**

Abstract: Though the median age most of SSA is still quite young, early-life mortality declines, combined with slowing rates of fertility and persistently high rates of HIV, are expected to cause rapid population aging in upcoming decades (Heuveline 2004, Cohen & Menken 2006, Zaba et al. 2004). However, little research to date has addressed aging process in this resource-poor environment and even less is known about the protective role of social capital factors in this context. Gaining micro-level insight into the potentially protective role of social capital context would also provide invaluable information to conduct advanced cohort-component projections of this population. Using a multi-state life table (MSLT) approach, I will analyze the processes of mortality and disability using micro-level data from the Malawi Longitudinal Study of Families and Health (MLSFH). My analyses will use a logistic discrete-time hazard model to calculate rates of transitioning between health statuses, and generate MSLT functions from these transition rates through microsimulation. My work as an IIASA Young Scientist participant will extend this model by investigating the micro-level impact of social capital factors on the aging process in this context. Existing methodologies for MSLT calculation using longitudinal data are not able to incorporate time-varying covariates into analysis. In the context of SSA, time-varying factors such as HIV status, presence of adult children (and their HIV status), marital status, and agricultural profits may be key for healthy aging. My IIASA project will incorporate time-varying factors into this MSLT model using a simultaneous equations approach to limited dependent variable modeling. In my time at IIASA I propose to further develop and apply this method for incorporating time-varying covariates into MSLT calculation, and analyze how these covariates may reduce/delay disability onset and increase survivorship.

Biographical Sketch:
Collin is currently a second-year PhD student in Demography at the University of Pennsylvania. His substantive research interests include health and mortality in the US and sub-Saharan Africa, HIV and sexual networks, and processes of aging and disability. Collin's methodological work centers on multistate life table methodology, formal demography, multilevel modeling, and Bayesian estimation methods. He completed his undergraduate studies at the University of Wisconsin in Sociology and Quantitative Analysis in 2008.

Sam Hyun Yoo

Supervisor: **Bilal Barakat**

Co-Supervisor: **Thomas Sobotka**

Research Project: **Research Project: Impact of Female Education on the Process of Childbearing Postponement and Recuperation in South Korea**

Abstract: Many countries in Europe and East Asia have experienced low or very low fertility over the past several decades. Research has pointed out an increase in childbearing age as one main cause of low fertility. This is partly due to social changes: an improvement in female education, continuing gender inequality and economic insecurities. There is an ongoing debate on whether low fertility is a temporary phenomenon due to the shift of childbearing to later age that will eventually stall, or a permanent decline in the number of children. It is also not clear to what extent female education contributes to the postponement and recuperation process of childbearing. Despite numerous studies on low fertility, the situation in East Asia is much less understood due to geographical distance and cultural difference from Europe.
With Census and birth registration data, this project provides a better understanding of fertility trends in South Korea and analyzes the contribution of women's education to the process of childbearing postponement and recuperation. The result of this project is expected to demonstrate whether the process of childbearing postponement and recuperation in East Asia has a similar pattern to those of European countries.

Biographical Sketch: Sam is currently a third year PhD student in Sociology at Arizona State University, Tempe, Arizona. He graduated from Hanyang University, Seoul, Korea, with a Bachelor's degree in Sociology. He completed a Master's degree in Sociology in 2007 from the same university. His work primarily focuses on changes in fertility intention and fertility behavior. His research interests also cover family relations, migration, reproductive health and social networks.

Lan Hoang

Supervisor: **Jan Sendzimir**

Research Project: **Robustness and Resilience in Water Resources Planning: Towards Well-Prepared Adaptation in a Changing Climate**

Abstract: Climate change is creating new challenges for water resources planning to cope. In south-east England, droughts are already a serious risk to water security, as seen in the historic droughts of 1975/1976, 1995/1996 and the current widespread state of hosepipe ban in 2012. Under climate change impacts, that risk may exacerbate, not only from higher water demands and drier weather in summer; but also from increased frequency of intense rainfalls that instead of recharging our water sources, results in abrupt surface runoffs, and subsequently, floods. My work seeks to enhance water systems' capacity to cope with such risks via the concept of robustness and resilience. These concepts ensure that the system can cope with a wide range of circumstances (robustness) and if at risk, can quickly bounce back to a functional state (resilience). The focus of the work is on water availability in North Sussex and various water management options as promoted by its managing water company, using guidelines from the UK Environment Agency, and to a certain extent, influenced by EU policies on water scarcity. Methodologies of the project include Monte Carlo simulations of UK climate projections under the Medium Emission scenario, which act as a platform to test performances of water management options. The project will use visualization tools which utilize the Scenario Discovery Toolkit (RAND Corp.) to explore simulation results, and subsequently the interplay of decision making and system adaptability to climate change impacts. The project hopes to contribute towards adaptive water planning in the region, not only from a traditional engineering perspective, but also from a social science stance that enhances the effectiveness of adaptation decisions.

Biographical Sketch: Lan Hoang (BSc. Melb., MSc Newcastle) studied Geography and Environmental Sciences at various universities before continuing her education at the Exeter University and later Leeds University working on a PhD in the same subject. Her work focuses on decision making under uncertainty, particularly unknowns resulting from climate change impacts. Her current PhD project looks at a study area in southern England and explores packages of robust and resilient drought measures that might work under a large range of uncertainty. Other research interests include hydrology, water management, geomorphology and communication tools that facilitate interactive feedbacks between research and decision-making practice.

Danielle Nel

Supervisor: **Nadejda Komendantova-Amann**

Co-Supervisor: **Michael Thompson**

Research Project: **An Integrated Risk Assessment of the BRICS Countries' Green Infrastructure Market Development and Governance in Public Private Partnerships (PPPs)**

Abstract: Green infrastructure development is crucial towards integration of the green economy in order to respond to climate change. The rapid development of Brazil, Russia, India, China and South Africa (BRICs), imply that by 2050 the joint economies could surpass the combined economies of the current wealthiest countries of the globe (Gerasimchuk, 2010: 40). However, both conservationists and politicians have concerns regarding this repositioning of investment forces given the controversial socio-environmental record of resource companies from BRICS economies, domestically and internationally (Gerasimchuk, 2010: 41). The purpose of the research is to assess the integration of green infrastructure in BRICS countries. The scope of the research focus on cross cutting risks in the public and private realm, specifically in PPPs, and governance gaps at a micro and macro level. The research will conduct a systematic risk assessment of the BRICS countries in order to identify impediments to developing green infrastructure for a green economy. A case study approach will be utilised through a mixed-methods research design and methodology.

Biographical Sketch: Danielle is a Political Science graduate from the University of Johannesburg, South Africa. Her Master thesis in International Political Economy (IPE) focused on international political risk analysis. She is currently in the process of obtaining her PhD from the University of Johannesburg in Public Governance, the title of her PhD research is *Systematic Risk Management and Strategic Control in Public Private Partnerships (PPPs)*. Danielle's main fields of research interest include political risk analysis, public management and governance, integrated systems management, PPPs, risk management and monitoring and evaluation.

Anubhab Pattanayak

Supervisor: **Georg Pflug**

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

Research Project: **Poverty, Risk and Climate Change in Rural India: Characterizing Sensitivity of Farming Communities to a Changing Climate**

Abstract: Endowed with a wide range of agro-ecological and agro-climatic zones, Indian agriculture is highly climate sensitive and is expected to get adversely affected by climate change. Potential negative impacts on agriculture would make those rural households, which are primarily dependent on this sector, vulnerable to climate change. Moreover, the distributional consequences would be disproportionate; vulnerability to climate change would differ across households depending upon a host of socioeconomic, institutional, and behavioural factors. In view of such effects of climate change at the household level, the present study attempts at characterizing the climate sensitivity of agricultural household income from land and labour for different wealth classes. The study would focus on rural agricultural households, including land owners, cultivators, and agricultural labourers in India. Using household level survey data available from India's National Sample Survey Organization and gridded climate data, the proposed study specifically aims at assessing: (a) the climate sensitivity of income across agricultural and non-agricultural households for different population sub-groups; and across land class for agricultural households; and (b) the effects of climate change on agricultural labour income and possible consequences to poor households. The study would contribute to the existing literature on micro-level assessments of climate change impact and poverty. Furthermore, it would also inform policy designs and strategic adaptation planning in counteracting the distributional effects of climate change.

Biographical Sketch: Anubhab graduated from Madras School of Economics (MSE), Chennai, India, with an M. Sc. in Economics in May 2008. His Master thesis titled "Climate Change Burden Sharing" dealt with equity issues in climate change mitigation. He worked as Business Research Analyst at Hewlett-Packard (India) and as Research Economist at Nathan Economic Consulting, Chennai, till September 2010. He is currently a second year Ph.D. student at MSE. The title of his thesis is "Economic Analysis of Climate Change Impacts and Adaptation in India". His main areas of scientific interest include economics of global climate change, cross-cutting issues in climate change and development, and applied econometrics.

Tobias Nielsen

Supervisor: **Jan Sendzimir**

Co-Supervisor: **Michael Thompson**

Research Project: **REDD+ a Clumsy Solution to a Complex problem: How Cultural Theory Can Aid the Emerging REDD+ Governance Architecture**

Abstract: The initial progress in shaping abfuture governance architecture on REDD+ (Reducing Emissions from Deforestation and forest Degradation) has been hampered by the increasing complexity and fragmentation of REDD+. This research project looks to generate an overview of the REDD+ governance formation by uncovering and categorizing the underlying process of preference formation. The paper argues that dominant approaches to REDD+ are heavily influenced by two main worldviews, namely the market (individualism) and technical (hierarchy) solutions to REDD+. To improve the current policymaking process, Cultural Theory argues that social (egalitarianism), and fatalist worldviews need to be more adequately represented. Cultural Theory deviates from predominant social and political theories in arguing that neither market nor technical solutions (or any other for that matter) should dominant, nor be excluded from, the future governance architecture of REDD+. Instead, incorporating all four worldviews is pivotal, both in policymaking processes and the final governance architecture in what Cultural Theory referrers to as a 'clumsy solution'. This project will identify the presence of the four worldviews of Cultural Theory within REDD+, including the much overlook fatalist worldview, and investigates their role in shaping the future architecture of REDD+, by extracting Cultural Theory framing from texts. By testing the relevance of Cultural Theory, this research will build on a collection of similar case studies each, qualitatively tests the same hypotheses as for this study. In addition, this research proposal seeks to engage with the IIASA Forestry Program, investigate whether assumptions on forecasting are set in accordance with the four ideal type of value orientation of Cultural Theory. Hence, it will look at how applying plural rationalities can strengthen the policy outcomes, especially under conditions of uncertainty, and how it applies to the policy-oriented natural-science research.

Biographical Sketch: Tobias Dan Nielsen graduated 2010 from Lunds University, Sweden, earning a Master of European Affairs. He is currently a second year Ph.D. student at Lunds University. The topic of his thesis is international climate politics. His main fields of scientific research include, how ideas and structures of arguments shape and influence policy processes and outcomes in risk governance, in the case of sustainable forest management (REDD+).

Syed Ali Asjad Naqvi

Supervisor: **Reinhard Mechler**

Co-Supervisor: **Elena Rovenskaya**

Research Project: **SHELscape: A Simulation Model of Natural Disasters**

Abstract: The existing literature on natural disasters suffers from two shortcomings. First, the theoretical literature models post-shock processes in a general equilibrium framework, which lacks the ability to adequately analyze out-of-equilibrium states. Since the feedback mechanisms after a natural disaster occurs are complex and there is ample heterogeneity in these systems, models using dynamic systems of equations quickly become untractable. Second, the empirical literature does not have credible micro level data available fast enough in order to be able to investigate the effects of natural disasters for policy decisions. This literature thus tries to understand outcomes retrospectively or focuses on collecting primary data revolving around post-disaster policy planning.
In order to move towards solving both of these problems, the proposed project at IIASA will develop an agent-based model that helps to understand human interactions and flows, and the resulting economic outcomes in low-income regions. Agent-based models are a powerful tool that can analyze decentralized, spatially-represented autonomous systems both at the micro and the macro level. They are flexible enough to deal with out-of-equilibrium states and feedback effects between their elements and parameters. In the proposed model, various modules like production and consumption, labor markets and migration, local markets and transportation of goods will be built and integrated in a spatially represented artificial economy. This economy will then be subjected to various types of shocks to investigate the emerging patterns in migration flows, consumption levels and supply and prices of goods.

Biographical Sketch: Asjad holds a Master's degree in Economics from the Lahore University of Management Sciences, Pakistan. He is currently a 5th year PhD Candidate in Economics at the New School for Social Research (New York) working under the supervision of Professor Duncan Foley. His dissertation develops an agent-based model that helps understand economic outcomes in post-disaster situations, especially for low-income regions. This research stems from his four years of fieldwork and research experience in earthquake and flood affected regions of Pakistan. He also actively engages with the Crisismappers network where various innovative tools are developed and tested to effectively "crowdsource" information in crisis scenarios. Asjad's other research interests include analysing the impact of historical institutions on current socio-economic outcomes in colonial states, spatial analysis of social indicators, caste networks, and crime patterns.

Sebastian Busch

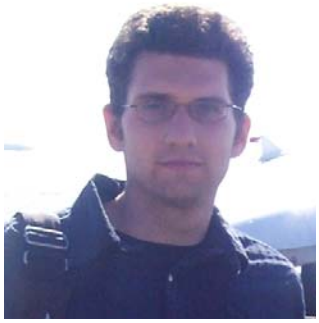
Supervisor: **Anthony Patt**

Co-Supervisor: **Nadejda Komendantova-Amann**

Research Project: **Regulatory Framework to Facilitate Cooperation in Renewable Energy**

Abstract: The transformation towards sustainability has a significant impact on the structure of energy systems. On the one hand decentralized generation will provide energy close to consumption and on the other hand energy (mainly electricity) will be transported from over large distances from sites with the best resource conditions for RES production to the load centers. The latter will require increasing cooperation between states in energy planning and regulation across borders. For the case of Europe, The EU Directive on the promotion of the use of renewable energy sources (RES) (2009/28/EC) and the energy roadmap recently released by the European Commission set the course for a far reaching transformation of the energy system with a high share of renewable energies. In order to allow for greater flexibility and cost efficient target achievement so called cooperation mechanisms were introduced under the RES directive, which provide an opportunity for EU members to cooperate among each other as well as with third countries. However, further details with regards to the actual design of the mechanisms still need to be specified.
A main challenge in this context is to adapt current legislation to account for critical aspects of cooperation such as allocation of power generation, cross-border transmission or policy support and distributional effects. The goal of the YSSP research is to develop a framework that captures the relevant effects that need to be reflected in the policy design of such a mechanism. In a subsequent step some elements shall be addressed in further detail building on methods from time series analysis, electricity system analysis and cooperative game theory.

Biographical Sketch: Sebastian is currently a PhD candidate and research associate at the Vienna University of Technology and research analyst at the German Advisory Council on Global Change. His main research interests are the intersection of (renewable) energy system analysis and policy as well as several aspects of global sustainable development. Sebastian received his university education at the Universities of Cologne and California, at Berkeley. He graduated from the Faculty of Management, Economics and Social Sciences, University of Cologne in 2008 with a specialization in energy economics and a thesis on technological learning in the energy sector.



Stephen Healey

Supervisor: **Arnulf Grübler**

Research Project: **An Analysis of the Dynamics of Environmental Energy Technologies**

Abstract: Objective: Analyze cost dynamics and market growth (scaling dynamics) of environmental energy technologies with respect to their underlying drivers and under alternative model formulations (including both bottom-up engineering and top-down "learning-curve" model based approaches).
Methods and Data: The theoretical concept of learning by doing, whereby costs decline as a consequence of experience, practice, and familiarization with a given technology's production process, pervades the energy-economic literature. However, there are a number of unresolved statistical issues in estimating the learning phenomenon using more traditional econometric/statistical approaches and thus, a full understanding of the causes of observed historic cost declines remains elusive. An alternative approach, first employed by Nemet (2006) at IIASA, is to model the drivers of cost for a given technology from a bottom-up technical/engineering perspective and then disaggregate the historic cost reductions according to these factors. My hope is to expand this methodology to a number of other alternative technologies, with a principal focus on Flue Gas Desulphurization units (FGD units), and compare these results to estimates using traditional learning curve approaches. I will use data from form EIA-767, containing observations of FGD technologies installed in US utilities, to inform a number of key parameters in my study (efficiency gains, cost declines, cumulative capacity, etc.). The results of my analysis will be useful both for the empirical corroboration of cost reduction models advanced in the literature, as well as for research aiming to draw analogues for other environmental energy technologies, most notably Carbon Capture and Sequestration (CCS).

Biographical Sketch: Stephen Healey graduated from Queen's University (Kingston, Ontario) in 2007 with a degree in Applied Economics (Honours) and, three years later in 2010, graduated from Simon Fraser University in Vancouver with a Masters in Public Policy. Continuing at Simon Fraser, he is pursuing his PhD in Energy Policy and Energy Systems Modeling under the supervision of Dr. Mark Jaccard. Research interests include energy policy, technological diffusion, energy models, and risk and uncertainty. When not researching, Steve loves exercise, reading, sports, people, and travelling.

Water (WAT)
Program Leader: Pavel Kabat

Debra Perrone

Supervisor: **Oskar Van Vliet**

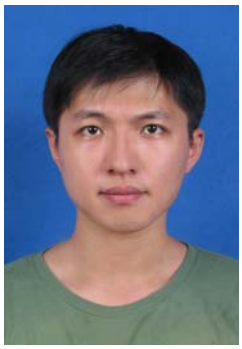
Co-Supervisor: **Marijn Van der Velde**

Research Project: **U.S. Water Demand Scenarios in a Changing Climate**

Abstract: Increased population and patterns of population density, economic growth, and development all increase water, energy, and food demands. The impacts of a changing climate will exacerbate competition for these resources, especially given the strong interrelationships among water, energy, and food. Although demand for individual resources has been studied, a systematic evaluation of readily available data has not been undertaken to evaluate water-energy-food linkages.
My dissertation focuses on developing a comprehensive understanding of the complex tradeoffs and risks involved in water, energy, and food management. The objective of my proposed work for the YSSP is to estimate how demand side management of U.S. water resources may be affected by anthropogenic climate change. I will use historical data on and assumptions regarding future trends of population, economic growth, technological development, and resources to make a portfolio of scenarios. These scenarios will be used in conjunction with climate scenarios to estimate how water demands from thermoelectric, agricultural, industrial, domestic, and public sectors, as well as water requirements for ecosystem services, may change over the next seventy years.

Biographical Sketch: Debra Perrone received her undergraduate degree in Civil & Environmental Engineering from Lafayette College in 2008. After graduation she began the Ph.D. Program in Environmental Engineering at Vanderbilt University and has been a fellow of Vanderbilt Institute for Energy and Environment for the past 3 years. The title of her dissertation is *Spatial and Temporal Patterns of Water, Energy, Food, and Climate Relationships in a Decision Support Context.*

Water (WAT)
Program Leader: Pavel Kabat



Zhuoran Liang

Supervisor: **Günther Fischer**

Co-Supervisor: **Laixiang Sun**

Research Project: **Assessment of Climate Change Impacts on the Potential Productivity of Major Crops in China Using a Fusion Model System Based on AEZ and DSSAT Models**

Abstract: Global climate warming has discernible impacts on natural resources and biological systems. Being highly exposed and dependent on climate conditions, agriculture is subjected to the most direct impacts of climate change in many developing countries, including in China. Spatially detailed model simulation is an important way to study the effects of climate change on agriculture. Empirical bio-geographical models and mechanistic crop models each have their advantages and weaknesses. Building a fusion model system, as successfully developed in the NSFC-IIASA collaboration project on "Assessing the Impact of Climate Change and Intensive Human Activities on China's Agro-ecosystems and its Supply Potentials", can realize their complementary advantages for improved scientific assessment of climate change impacts on potential productivity of major crops in China. The general objectives of my YSSP research are: First, to improve the applicability of the Agro-Ecological Zones (AEZ) model in China by implementing a refined water balance module and calibration of key LUT (cultivar) parameters in the AEZ model, taking wheat as an example. Second, to assess the changes in China's agricultural climate resources due to climate change and extreme events in the past 50 years and is impact on China's production potential. Third, to estimate the impacts of future climate changes on China's agricultural climate resources and crop production potential, and to evaluate the uncertainty of the estimated impacts, including model uncertainty and scenario uncertainty, and fourth, to evaluate the effectiveness of a set of possible agronomic adaptation measures, including optimal utilization of the altered climate resources, e.g. in the form of extended multiple cropping zones, introduction of new crop varieties, or refined irrigation practices and management of water resources.

Biographical Sketch: Zhuoran graduated in June 2010 from Nanjing University of Information Science & Technology, China, with a Master's degree in Climate system and global change, and works as a assistant engineer in Shanghai Climate Center (SCC), Shanghai Meteorological Bureau (SMB). His current research interests are in the areas of climate change impacts on water balance and potential productivity of agriculture, uncertain assessing of climate change impacts on agriculture by using ensemble climate models and agriculture models.

Firdos Khan

Supervisor: **David Wiberg**

Research Project: **Assessment of Water Flow in the Indus River and Management of Water at Tarbela Dam under Different Climate Change Scenarios**

Abstract: Water resources play an important role in agriculture, energy, industry, households, and ecological balance. In Pakistan, ninety percent of agriculture depends on the Indus River System (IRS). The main source of water to rivers is the Himalaya-Karakorum-Hindukush (HKH) glaciers and rainfall. There is high uncertainty in the availability of water in the river due to the variability of the monsoon, western disturbances, prolonged droughts and melting of glaciers in the HKH region. Therefore, proper management of water resources is undeniably important. Due to the growing population, urbanization and increased industrialization, the situation is likely to get worse. In this study a stochastic hydrological network model will be developed for water management by taking into account all the inflows and outflows. Upper Indus Basin (UIB) having latitude from 34^0 N to 37^0 N and longitude 72^0 E to 79^0 E is chosen for the proposed project. The total area of upper Indus basin is 162,393 square kilometres.

The runoff will be simulated with a hydrologic model by utilizing precipitation, curve number tables, slope of the UIB, maximum and minimum temperature, land use data, and soil data. The main objectives of the study are: to assess water availability and to study the impact of climate change on water resources and water management at Tarbela Dam under high, medium, low and very low water availability scenarios. The future projection will be calculated using validated Global Climate Models (GCMs) and Regional Climate Models (RCMs) over the UIB region with different IPCC scenarios. In the dam the flow of water has been divided into four components e.g. seepage, evaporation, flow into the canal system and river flow important for ecological balance. Efforts will be made to provide a network model to manage outflows at Tarbela dam. Within the model, water will be allocated to the four components to minimize and assess the loss and shortage of water under the various scenarios.

Biographical Sketch: Firdos Khan earned his M. Sc. degree in Statistics from University of Peshawar and M. Phil degree in Statistics from Quaid-i-Azam University Islamabad in January, 2008. Mr. Khan is currently working as Scientific Officer in Global Change Impact Studies Centre (GCISC) Islamabad since 2008. The areas of interest to Mr. Khan are Geo-Statistics, Time Series Analysis, Regression Analysis, Seasonal Climate Predictions and Applications of Statistics in Atmospheric Sciences. His research plan for YSSP 2012 at IIASA is the assessment of water flow in Indus River and water management at Tarbela dam under different climate change scenarios.