a new generation of scientists

YSSP Young Scientists Summer Program

# YSSP Participants 2013

## Biographical Sketches and Research Project Abstracts

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

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**Tiina Häyhä**

**Supervisor:** **Brian Fath**

**Co-Supervisor:** **Oskar Franklin**

**Research Project:** **Implementation of a Multicriteria Assessment Framework for Biophysical and Economic Evaluation of Ecosystem Services in Finland**

**Abstract:** Ecosystems are open systems of finite dimensions, highly integrated through matter and energy flow exchanges, and restricted by biophysical constraints. In addition, they are characterized by non-equilibrium and irreversible phenomena. Human societies greatly benefit from goods and services supplied by natural ecosystems. These benefits are known as ecosystem services (ES). The Millennium Ecosystem Assessment pointed out the vital role of ES in support of human societies, also warning about the possible consequences of ecosystem change for human well-being. In fact, if over-exploited, ecosystems can switch into a new equilibrium state that can lead to a loss of life sustaining benefits. A major reason for the decline in the stocks of natural capital and flows of ES is that their value and importance is often not taken into proper consideration in economic decision making. Therefore, there is an on-going debate about the need for using multiple notions of value and assessment methods to account for natural capital and ecosystem services. My research project is focused on implementing an interdisciplinary and systems-based ecosystem services assessment framework. The main tasks of the project are: 1) mapping of land uses and identification of related ES at Finnish national level, 2) implementation of a multicriteria assessment framework for biophysical and economic evaluation of ecosystem services in Finland, 3) scenario and trade-off analysis for exploring possible losses and changes in ES, and 4) interpretation of results and discussion of their policy implication. The research outcomes will provide scientific information useful to policy makers committed to adopt optimal decisions for long-term economic development.

**Biographical Sketch:** Tiina Häyhä received a Master's degree in Economics from University of Jyväskylä, Finland in 2010. She is currently a third year PhD student in the International PhD programme "Environment, Resources and Sustainable Development" at Parthenope University of Naples, Italy. Her main scientific interest includes ecosystem services assessment and valuation, multi-criteria environmental accounting, and Ecological Economics.

**Matt Leduc**

**Supervisor:** **Elena Rovenskaya**

**Co-Supervisor:** **Alexander Tarasyev**

**Research Project:** **Systemic Risk with Strategic Interactions**

**Abstract:** In recent years, there has been an increasing interest in the study of systemic risk, which was intensified by the recent financial crisis. Systemic risk is a property of systems of interconnected components in which the failure of individual components can lead to the failure of others. Such cascades of failures can occur in various types of systems, including power grids, computer networks, financial or interbank systems as well as human populations in the case of epidemics. The existing literature, often inspired by statistical physics and interacting particle systems, mostly focuses on assessing this risk given a certain interaction structure or determining which types of networks are most or least resilient to such failures.

Much less addressed is the influence of strategic behavior on systemic risk. When the components are agents whose actions can affect their failure risk, either by choosing their level of interaction with others or by a costly investment in security, the problem changes considerably. Network game theory—the intersection of game theory and graph theory—provides an alternative to study the problem in this strategic context. In some of my recent work, I developed a fairly general and tractable framework to study systemic risk with strategic interactions. These so-called "immunization games" involve a large number of interconnected agents who must choose whether to invest in security. Security can often be regarded as a public good and is generally underprovided in equilibrium due to a free-riding problem.

My work at IIASA will consist, among other things, in enriching the current modeling framework by adding information asymmetries. This is important since there is generally uncertainty about things such as the side effects of vaccines, the quality of a computer security solution or the riskiness of a financial counterparty. To characterize how these information asymmetries affect equilibrium behavior is crucial in designing mechanisms that incentivize agents to invest in security and lead to improved equilibrium behavior. Mechanisms that take advantage of this rich model structure will also be an area of study. In brief, this work can help us better understand the incentives leading to a better allocation of immunization resources such as vaccines, capital buffers or computer security solutions.

**Biographical Sketch:** Matt Leduc is currently a fourth-year PhD student in the department of Management Science & Engineering at Stanford University. Prior to his doctoral studies, he completed Master's degrees in Mathematics and Statistics, also at Stanford. His research focuses on game theory, with an emphasis on network games. He is particularly interested in large instances of those games and methods to make them tractable. Applications include problems of network diffusion and how the latter is affected by strategic interactions. He is also interested in a wide range of other problems in computational and experimental social sciences. He attended the summer school in algorithmic economics at Carnegie Mellon University in 2012.

**Emilio L. Cano**

**Supervisor:** **Yurii Yermoliev**

**Co-Supervisor:** **Tatiana Ermolieva**

**Research Project:** **Stochastic Energy Optimization Problems and Robust Solutions for Energy-Efficient Buildings**

**Abstract:** Energy Systems Optimisation is increasing its importance due to deregulations of the energy sector and the setting of targets such as the 20/20/20. This raises new types of dynamic stochastic energy models incorporating both strategic and operational decisions (short-term decisions have to be made from long-term perspectives) involving standard technological as well as market-oriented financial options. Thus, public buildings managers are challenged by decision making processes to achieve robust optimum portfolio. Moreover, those decisions must be made under inherently uncertain conditions. Stochastic Programming is a framework widely used for decision making under uncertainty. In this regard, I will exploit "beyond the state-of-the-art" methods including advanced stochastic optimisation methods under quantile-based security constraints for optimal and robust operational and capacity expansion policies in energy-efficient buildings and areas of public use. Such complex energy systems need to be accurately described in a condensed way representing the huge amount of variables, parameters and constraints. Thus, a systemic view on all interactions of energy sub-systems, their interdependencies, possible systemic risks, which may propagate through the system, magnify and cause system's collapse, is followed. A comprehensive Symbolic Model Specification (SMS) development is part of the research work. Using the R statistical software and programming language, an integrated framework is proposed to cover the needs of the whole decision making problem, ranging from data analysis and estimation to effective representation of models and decisions to be consumed for both humans and machines. Furthermore, such a framework will allow to communicate with different types of optimization software.
The research is being carried out in the context of the EnRiMa project (Energy Efficiency and Risk Management in Public Buildings), funded by the European Commission (EC) within the Seventh Framework Program.

**Biographical Sketch:** Emilio Cano got a Diploma in Statistics at Complutense University in 1994. After a 14 years period working as statistician in several companies, he resumed his studies, graduated in Applied Statistics (Complutense University, 2010), and got his MSc in Decision Systems Engineering (Rey Juan Carlos University, URJC, 2011). His PhD research title is "A New Framework for the Representation of Stochastic Energy Optimisation Models: Algebraic Modelling, Reporting, and Interfaces for the Integration of Solvers" while working as researcher at URJC for the EnRiMa FP7 project. His main research interests are optimization under uncertainty, energy systems planning, and Six Sigma methodologies.

**Talha Manzoor**

**Supervisor:** **Elena Rovenskaya**

**Co-Supervisor:** **Sergey Aseev**

**Research Project:** **Investigating the Observability of Complex Networks**

**Abstract:** The focus of my work at IIASA will be to investigate the observability properties of complex networks. Such properties can be used either to guarantee full state reconstruction or to devise efficient control strategies in the event of partial reconstruction. In my YSSP project, I would like to focus on hydro systems as application.
The consumption of many natural resources (e.g., water, forests, oil and gas) can be modeled by a complex network with individual nodes representing consumers, linked together through the propagation of behaviors in a society. Whereas non-renewable resources such as oil and gas are inevitably doomed to depletion (the rate of renewal is practically negligible as compared to that of consumption), renewable resources such as water are self-sustainable. Water resources include ground water, water stored artificially and water present in pipelines with renewability appearing as natural processes like melting of glaciers and rainfall. Hence, control strategies (in the form of policies) can be devised to steer such systems to sustainable states. However, such control should necessarily include feedbacks, which may be highly expensive (social feedback, e.g., surveys over large areas or technical feedback, e.g., installation of sensor networks to measure discharge). An observability analysis can be used to gain insight into necessary conditions for such feedback. At IIASA I plan to initiate such an analysis for a network model of the consumption of the total water resource available to a society on a regional level. The results of this analysis can provide valuable guidance for formulating policies to encourage proper feedback for such networks.

**Biographical Sketch:** Talha Manzoor completed his BSc in mechatronics engineering from the National University of Science and Technology (NUST) Pakistan, in 2010, and MSc in Computer Engineering from Lahore University of Management Sciences (LUMS), Pakistan in 2013. Currently he is a first year PhD student of electrical engineering at LUMS. His scientific interests include optimal state estimation and its application to complex networks and problems in robotics and computer vision.

**Alexandr Tarasyev**

**Supervisor:** **Gui-Ying Cao**

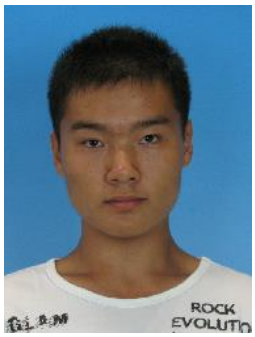
**Co-Supervisor:** **Elena Rovenskaya**

**Research Project:** **Dynamic Modeling of Migration Flows between Russia and CIS Countries**

**Abstract:** Management of migration flows is a necessary condition for the sustainable development of Russian regions and the Commonwealth of Independent States (CIS) countries. The experience of the EU and the USA shows that that current international migration appears to be characterized by growing complexity as migration connects people and societies over ever larger distances and over an increasingly diverse array of countries and places of origin and destination. In the process the migratory load increase, the problem of migration management becomes more complicated from year to year. A decisive step towards liberalization of the migration policy in Russia was made in 2007, when a simplified procedure of entry and registration was introduced into force. This has led to the increase of migration flows from neighboring countries into Russia due to higher wages and overall life quality there.

My work at IIASA will be devoted to construction of a dynamic model for prediction of migration flows, in which migrants will be classified by skills and age groups. The major task will be to establish a database, which will demonstrate sources, sinks and paths of migration in 2000-2012. For the model construction it is worth to use the following concepts of the economic theory. According to neoclassical economics, migration is caused by the difference in wage levels between countries, due to difference in labor and capital inputs between countries. The wage differential stimulates workers from countries of low wages to move to countries with a high salary, while the investment in capital, which is essential for creation of the expected income, flows into a country with low wages. The dynamic model will combine economic and demographic factors (age groups, growth of labor force, and living standard in the host regions).

**Biographical Sketch:** Alexandr Tarasyev graduated from the Ural Federal University, Ekaterinburg, Russia in 2011. He is currently a second year PhD student at the Institute of Economics (IE), Ural Branch of the Russian Academy of Sciences. His research focuses on the modeling of socio-economic processes and the analysis of the economic situation and security of regions in Russia, specifically, of the Ural Federal District.



**Wei Wang**

**Supervisor:** **Alexander Tarasyev**

**Co-Supervisor:** **Gui-Ying Cao**

**Research Project:** **Study on Multisector Optimal Control Model for Resource Productivity in China**

**Abstract:** Natural resources have been a critical issue for sustainable economic development. Increasing the new approaches in economics, in which resource management will be a central point. Moreover, the relationship between economic growth and economic structure is now a new research frontier and will provide a possible way to uncover the relationship between economic growth and economic structure. China as a developing country, undergoing rapid economic growth, demonstrated a steeply increasing demand for resources. The Chinese government are now giving top priority to sustainable development and attempting to change economic growth pattern, improvement of resource productivity by 15% in the period from 2011 to 2015 has been proposed as an anticipated target in China's Twelfth Five-Year Plan for National Economic and Social Development for the enhancement of the circular economy. During the YSSP participation, my general research objective is to construct a model which include optimization model as the center, multi production factors and economic structure will be taken into account. Model components will be material flow analysis, resource productivity, resource economics and proportional economic growth, the model tries to provide options for optimal investment and for the efficient resource allocation policies. To meet the objective two tasks are proposed for the study. First, a basic control theoretic economic growth model will be constructed, then the model will be extended to multisector economic system.

**Biographical Sketch:** Wei received his Bachelor's degree in chemical engineering and economics in July 2012 from Tsinghua University. He is currently a Graduate Student at the Department of Chemical Engineering at Tsinghua University. His scientific interests focus on Material Flow Analysis and Resource Productivity. His research plan for YSSP at IIASA is to explore the dynamic mechanism of resource productivity in China by constructing an optimal control model.

**Eleanor Brush**

**Supervisor:** **Åke Brännström**

**Co-Supervisors:** **Ulf Dieckmann, Brian Fath**

**Research Project:** **Joint Evolution of Cooperation and Information Gathering**

**Abstract:** Information about other agents' behaviors and memory of previous interactions can affect how agents in a social system interact with each other. For instance, reputation, reciprocity, and ostracism can help stabilize cooperation when defection would otherwise prevail, and these mechanisms require that agents obtain and remember information about their peers. In economics, models in which consumers have imperfect information (a phenomenon called rational inattention) predict that the ability of consumers to make optimal decisions about their interactions with sellers will be constrained. In both of these types of established models, information-gathering strategies and memory are introduced all at once and at full strength. However, these features are themselves under selection and will evolve according to how much they benefit the agents who use them. While adaptive dynamics theory has already been used to model the separate evolution of cooperation and memory, little work has as yet been done to examine the joint evolution of both features. Hence, my plan is to develop a model of the joint evolution of strategies determining cooperative investment on the one hand, and information gathering and memory on the other. By modeling such joint evolution, I will be able to study how the evolution of cooperation depends on the ability or inability of agents to observe and remember previous interactions, and whether evolution can lead to strategies for information gathering and memory that stabilize cooperation when it would otherwise disappear. Ultimately, this research will help to better understand how information gathering and memory can promote and stabilize cooperation, and how to design systems so that cooperation is stable on evolutionary timescales.

**Biographical Sketch:** Eleanor Brush graduated with a BA in mathematics from the University of Chicago, USA, in 2010. She is currently a third-year PhD candidate in the Program for Quantitative and Computational Biology at Princeton University, USA. Her research focuses on information processing in biological systems, the evolution of information-gathering strategies in social systems, the effects of individual-level behavior and optimization on group-level performance, and developing mathematical models to describe these processes.

**KaYin Leung**

**Supervisor:** **Rupert Mazzucco**

**Co-Supervisors:** **Hans Metz, Ulf Dieckmann**

**Research Project:** **Concurrent Partnerships and Their Impacts on HIV Transmission**

**Abstract:** Many societies have monogamous partnerships as a social norm, with most individuals having at most one partner at a time. If, instead, a society has concurrent partnerships as a social norm, so that many individuals have multiple partners at a time, does this enhance the spreading of sexually transmitted infections such as HIV? So far, opinions expressed on this point in the literature differ. The posed question is particularly pertinent with regard to the HIV epidemic in sub-Saharan Africa. In this region, HIV is widespread among heterosexual populations, which is very different from the rest of the world, where HIV remains concentrated in specific high-risk groups, such as injecting drug users. If concurrent partnerships are driving the HIV epidemic in sub-Saharan Africa, then prevention and intervention programs will need to account for their epidemiological implications. Therefore, we need to understand how concurrent partnerships actually impact the spreading of HIV. In previous work, I have already developed a mathematical framework for dynamic sexual networks that incorporates demography and allows for concurrent partnerships. For these networks, I defined two measures of partnership concurrency. In this project, I will analyze how initial disease spread and eventual endemic level are related to these two concurrency indices. Likewise, I will use the modeling framework to investigate how other concurrency measures proposed in the empirical literature relate to the disease dynamics. The anticipated improved understanding of the role of concurrent partnerships will facilitate the design of better HIV-prevention strategies and provide guidance for which observables should be monitored in the field.

**Biographical Sketch:** KaYin Leung graduated with a master's degree in mathematical sciences in August 2011 at Utrecht University, The Netherlands. She is currently a PhD student at the Mathematical Institute at Utrecht University and the Julius Centre at the University Medical Centre Utrecht. In her Ph.D. research, she is studying the potential impact of concurrency on the spread of sexually transmitted infections by means of mathematical modeling. Her main fields of scientific interest include applied mathematics (analysis), infectious disease epidemiology, and mathematical models in biology.

**Anne Seppänen**

**Supervisor:** **Karl Sigmund**

**Co-Supervisors:** **Ulf Dieckmann, Kalle Parvinen**

**Research Project:** **Evolution of Multilevel Cooperation: Analogies between Social and Medical Systems**

**Abstract:** While cooperation is common at many levels of life, ranging all the way from from micro-organisms to complex social structures, cooperative behaviors are fundamentally vulnerable to selfish defection. Hence, their prevalence in nature is often considered puzzling. In line with an expectation of prevalent defection, cancer can be interpreted as a disruption of cooperation within a multicellular organism, with tumor cells jeopardizing the multicellular common good through a process analogous to the tragedy of the commons well-known from resource economics. This analogy is enriched by the fact that, while defecting the host, tumor cells might cooperate at other levels, e.g., within the tumor or with its microenvironment, with such complexity also having natural counterparts in the social world. To study the evolution of multilevel cooperation and defection, we will apply the framework of adaptive dynamics theory. Concentrating on analogies between cancer and the social world, we will try to build a suitable encompassing model to capture key characteristics common to both types of organization. This multidisciplinary project integrates disciplines, from cell biology to ecology, social science, and mathematics, which we hope will provide new insights into oncogenesis as well as social systems.

**Biographical Sketch:** Anne Seppänen received her MSc degree in applied mathematics from the University of Turku, Finland, in 2002. She has worked at the University Hospital and at the Faculty of Medicine in the same city. Currently, she is a fourth-year PhD student in the biomathematics group of the Department of Mathematics and Statistics. Her PhD project includes applications to the evolution of dispersal, as well as the evolution of cooperation. Her main research interests are in mathematical biology and evolution, especially with regard to questions related to cooperation, selfish cheating, and cancer.

**David Shanafelt**

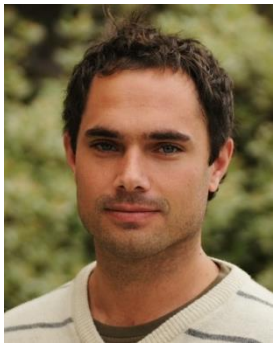
**Supervisor:** **Ulf Dieckmann**

**Co-Supervisors:** **Oskar Franklin, Matthias Jonas**

**Research Project:** **Species Dispersal and Spatial Insurance as a Coupled Ecological-Economic System**

**Abstract:** International trade has promoted the exchange of goods and services, but has also facilitated the spread of pathogens and invasive species. Although most invasive species cause little or no harm, the addition of new competing species to an ecosystem impacts its biodiversity, which has been linked to its functioning and the resultant flow of ecosystem services. One explanation for the effect of invasive species on ecosystem functioning is offered by in the spatial insurance hypothesis, which suggests that the stability of primary production in a meta-community increases with the biodiversity of each of its spatially distributed constituent communities. Despite mixed empirical evidence, Loreau et al. (2003), in an influential theoretical analysis, provided an illustration and corroboration of this hypothesis. Their model and analysis, however, did not account for the effects of human behavior on species dispersal and competition. In this project, we will investigate the effects of incorporating this human component into the model by Loreau et al. (2003), resulting in a coupled ecological-economic system. Specifically, we will consider dispersal as a function of the trade of goods and services between spatially distributed ecological communities. The species coexisting within those communities will depend on human decisions to promote or suppress particular species: we assume that humans determine the amount of trade and species harvest within each community according to an objective of maximizing utility or well-being. This work will shed light on the consequences of tight ecological-economic couplings and stress the importance of cooperation between trading partners for environmental protection and economic development.

**Biographical Sketch:** David Shanafelt received his master's degree in biology in 2012 from Arizona State University, USA, and is currently in the second year of his PhD at ASU. His thesis investigates the ecological and economic effects of species spread. His research interests include invasive-species management, human-environment interactions, population/community ecology, and bioeconomic modeling.



**Henrik Sjödin**

**Supervisor:** **Rupert Mazzucco**

**Co-Supervisors:** **Åke Brännström, Ulf Dieckmann**

**Research Project:** **Contingent Dispersal and the Formation of Cooperative Groups**

**Abstract:** Cooperation can be observed at all levels of biological and social organization. This is puzzling from a theoretical perspective, since simple models predict that, while cooperation would be most advantageous for a group as a whole, non-cooperation is always the most successful strategy for each individual comprising such a group. In the real world, however, interaction groups are not fixed. Individuals can typically choose which groups to interact with, and over time often derive their long-term benefits from participating in many groups. Consequently, accounting for the movement of individuals between groups must be of pivotal importance for understanding the emergence of cooperation in realistic scenarios. Here, I investigate how cooperation is maintained in large populations in which individuals freely move between interaction groups, making decisions to stay or leave based on certain cues, such as group size or cooperation level. In this context, I will analyze the evolution of contingent dispersal, by which individuals respond to such cues in their local environment. The resulting dispersal strategies are likely to underpin the formation and stability of cooperative groups. This analysis will contribute to the theory of the emergence and dynamics of cooperation in larger systems, such as ecological communities or large-scale social organizations, and may lead to new policy recommendations concerning the governance of public goods.

**Biographical Sketch:** Henrik Sjödin graduated in 2008 from the Institute of Technology at Umeå University, Sweden, with a master's degree in engineering biology. He is currently a fourth-year PhD student at the Department of Ecology and Environmental Science at Umeå University. His research interest is in the role of spatial mechanisms in ecological and evolutionary processes. Currently he is studying the effects of density-dependent movement processes in predator-prey theory and in game theory using stochastic individual-based models.

**Melissa Whitaker**

**Supervisor:** **Ádám Kun**

**Co-Supervisors:** **Rupert Mazzucco, Ulf Dieckmann**

**Research Project:** **Evolution of Mediated Cooperative Interactions**

**Abstract:** Cooperative interactions are ubiquitous in socio-economics as well as in biology. In both contexts, adaptations are expected to favor selfish individuals over those investing into costly services for maintaining cooperation. Often, the evolution and maintenance of cooperation is investigated using evolutionary game theory, with games usually involving two players. However, such two-player games likely represent an oversimplification of cooperative interactions, as it is increasingly recognized that tight pairwise interactions between groups or species are far less common than associations among sets of interaction partners. Motivated by a concrete biological example (the well-known interaction between ants, caterpillars, and microbes), we will analyze a specific class of three-player interactions, in which the third player initially acts as a neutral mediator of a cooperative interaction, but may over time evolve a participation strategy for itself. Such mediated games with a non-neutral mediator will extend evolutionary games theory towards more realistic cooperative interactions, with results contributing new insights not only into the ecological and evolutionary dynamics of biological species interactions in nature, but also into the dynamics of structurally analogous socio-economic and political processes.

**Biographical Sketch:** Melissa Whitaker is currently a PhD candidate at the University of California, Davis, USA, where she studies positive interspecific interactions among microbes, insects, and plants. She completed a master's degree in geography at UC Davis in 2009, and a bachelor's degree in environmental science at Prescott College, Arizona, USA, in 2004. She is interested broadly in the ecology and evolution of cooperation, and particularly in ant-lycaenid associations. In addition to research, Melissa is dedicated to scientific outreach, education, and service; for more information, visit www.melissawhitaker.net.

**Vassilis Daioglou**

**Supervisor:** **Keywan Riahi**

**Co-Supervisor:** **Petr Havlik**

**Research Project:** **Bioenergy Chains: Evaluation and Comparison of CO2 Mitigation Possibilities of the Complete Bioenergy Chain from Two Model Frameworks**

**Abstract:** Bio based energy or material flows offer a wide set of possibilities in order to mitigate emissions compared to the use of fossil fuels. However due to their diverse production methods, competing uses as well as complicated supply chain, any such analysis requires an integrated approach and a wide scope to account for indirect effects and feedbacks. The complexity of the issue is highlighted by the fact that studies focusing on the emission reduction potential of such uses of biomass vary widely. This YSSP research will conduct a systematic and structured assessment of the potential of biomass use and resultant emission mitigation. The study will include the effects of land-use change, and optimal final use of biobased options in different energy or material sectors. For this purpose, results from two separate model frameworks, those of IIASA and my home institute PBL, will be analyzed. The work is split into three parts. First, a qualitative assessment of the biomass representation and parameterization in each model framework will be conducted. Second, existing scenarios of both models will be reviewed with respect to emission feedbacks of biomass due to changes in land-use and related greenhouse gas intensities. Finally, a comparative assessment of the emission mitigation possibilities for different final uses of biomass will be conducted.
This work will give insight into the emissions (reduction) of various bioenergy chains. Employing and integrated perspective, I will assess direct and indirect effects. Furthermore, since it will also act as a comparison across modeling frameworks, the influence of uncertainties and the structure of each framework will also be evaluated.

**Biographical Sketch:** Vassilis Daioglou holds degrees in Mechanical Engineering (MEng, University of Southampton, 2007) and Sustainable Development-Energy and Resources (MSc, Utrecht University, 2010). He is currently in the third year of his PhD, conducted at Utrecht University and the Netherlands Environmental Agency. His current research focuses on assessing the long term possibilities of using bioenergy for carbon dioxide emission mitigation. In order to tackle this, he uses long term global energy system and land-use models. His interests lie in the relations between energy-economy-environment and how models which assess these interactions can be developed and used effectively.

**Nicholas Lam**

**Supervisor:** **Shonali Pachauri**

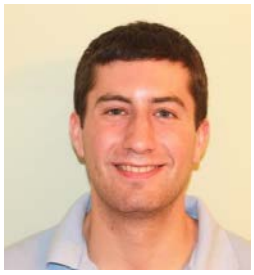
**Co-Supervisor:** **Pallav Purohit**

**Research Project:** **Assessing Health and Environmental Impacts of Measures that Supplant Kerosene Use in Developing Country Households: Lighting**

**Abstract:** Interventions to reduce emissions from household energy use in developing countries have been proposed as important actions to decrease short-lived climate forcers and global disease burden associated with impacts to air quality. These recommendations are often based on analyses of scenarios that assume best-case replacement from traditional fuel and technology combinations to "modern" ones. However, such a shift may not be the first-step solution given that other interim measures can deployed (e.g. LED lanterns) while barriers in the energy infrastructure and distribution networks are resolved. Improvements in our understanding of household energy use patterns (e.g. fuel consumption), household energy policies (e.g. subsidies), adoption of replacement technology (e.g. technology "stacking"), and previously overlooked emission sources (e.g. kerosene lighting) provide an opportunity to improve projections of the benefits and uncertainties of mitigation measures in the household sector of developing countries.

Focusing specifically on South Asia and sub-Saharan Africa, we propose to apply a set of household mitigation measures considering uncertainties and data gaps mentioned previously, and assess impacts on air quality and selected health outcomes. This will first be explored in the context of household kerosene lighting and potentially expanded to include other household uses of kerosene. Using the MESSAGE-Access framework, issues such as secondary fuel-use (e.g. kerosene use during brown-outs), technology stacking (e.g., multiple lighting sources), and subsidies impacting household-level energy use will be explored. This work will incorporate new information on household kerosene lighting, now identified as a significant source of global black carbon and potential risk factor for several health outcomes. Updated household energy use estimates developed as part of the recent Comparative Risk Assessment and applied in the 2010 Global Burden of Disease will also be applied. Results from models considering these new sources, and without, will be compared to determine if their consideration is merited in future projections.

**Biographical Sketch:** Nicholas Lam is currently a doctoral student in Environmental Health Sciences at the University of California, Berkeley. His primary research interests address the relationships among household fuel use, air quality and human health. His current research focuses on measuring and modeling the contribution of household cooking and lighting in developing countries, specifically from kerosene, on human exposure, disease risk, and emissions of climate-altering air pollutants. He holds a MSc in Global Health and Environment (UC Berkeley, 2009) and BSc in Applied Ecology (UC Irvine, 2006).



**Benjamin D. Leibowicz**

**Supervisor:** **Volker Krey**

**Co-Supervisor:** **Arnulf Grübler**

**Research Project:** **Representing Knowledge Spillovers on Technology Diffusion in an Integrated Assessment Model**

**Abstract:** The pace at which advanced, low-carbon energy technologies diffuse is a critical determinant of the level and cost of greenhouse gas emissions reductions. While the representations of energy technologies in integrated assessment models have improved in recent years, there is still considerable room for enhancement. This is particularly true for their formulations of technology diffusion. To prevent abrupt shifts in the energy mix and to enforce gradual technology transitions more in line with historical trends, integrated assessment models typically impose limits on the percent growth in deployment of a technology between consecutive periods. Compared to other technology parameters such as costs, efficiencies, and learning rates, parameters that control the scale-up of advanced technologies are poorly understood and are not thoroughly verified. The recent paper by Wilson et al. (featuring Krey and Grübler) entitled "Future Capacity Growth of Energy Technologies: Are Scenarios Consistent with Historical Evidence?" demonstrated that integrated assessment models predict advanced technology diffusion trajectories that are conservative (longer duration to reach a given extent of penetration) relative to historical data on technology growth.
As a YSSP fellow, I will work to improve the representation of technology diffusion in IIASA's MESSAGE integrated assessment model. In particular, I will build on recent empirical work describing the expansion of a technology first within its core region of development, then in rim and periphery regions. There is evidence that diffusion occurs slowly but pervasively in the core region. Subsequent expansion in the rim and periphery regions is rapid due to knowledge spillovers from the core area, but is ultimately limited by infrastructure that is not ideally suited to the adopted technology. I intend to incorporate these empirical findings into the MESSAGE integrated assessment model. In doing so, I hope to make model scenarios for technology diffusion more reliable and more consistent with observed trends.

**Biographical Sketch:** Ben Leibowicz completed his undergraduate studies at Harvard University, where he received an A.B. in Physics with a minor in Economics and earned the distinction Magna Cum Laude. He is currently a PhD student in Management Science and Engineering at Stanford University. Ben's research interests span a broad range of topics in energy-economic and integrated assessment modeling. His recent projects at Stanford include modeling international technology spillovers for energy technologies, conducting an inter-model comparison of prominent integrated assessment models, and developing a stochastic electricity sector model to evaluate Japanese electricity generation alternatives in the aftermath of the Fukushima disaster.

**Kalai Ramea**

**Supervisor:** **David McCollum**

**Research Project:** **Integrating Vehicle Consumer Choice into an Integrated Assessment Model: Implications for Energy Efficiency and Advanced Technology**

**Abstract:** Integrated Assessment Models (IAMs) have been widely used as key instruments to develop long-term energy and emission scenarios and to identify cost-effective patterns of resource use and technology deployment over time, particularly in the context of climate change mitigation. However, one of the major deficiencies of current models is their limited representation of heterogeneity on the demand-side. More specifically, systems-engineering optimization models are often very rich in representing supply-side technological details but, in general, represent behavioral parameters much more simplistically. Consumer behavior cannot be ignored, however, when it comes to system-wide modeling, as it is a critical aspect of policy and decision making. Outside of the IAM community, consumer choice has typically been modeled using non-linear simulation approaches. The objective of this project is to develop a bridging approach to bring in consumer behavioral parameters – specifically for the transport sector – to a linear-programming IAM framework and to test this approach through scenario analysis. A particular focus will be on further enriching the end-use side of the IIASA Energy Program's MESSAGE-Transport model by incorporating utility-based consumer choice decisions in the light-duty sector. Potential scenarios to be run with the improved modeling framework include climate policy scenarios with varying carbon tax levels and scenarios involving increasing vehicle fuel economy standards and subsidies.

**Biographical Sketch:** Kalai Ramea is a PhD candidate in Transportation Technology and Policy program at University of California, Davis. She received her Master's degree in Transportation Engineering from University of Southern California, and her Bachelor's degree in Civil Engineering from CEG, Anna University, India. Her research interests focus on developing transition scenarios in energy models, emphasizing on climate policy analysis; studying consumer preferences, and integrating consumer demand response in energy models.

**Pedro Rochedo**

**Supervisor:** **Keywan Riahi**

**Co-Supervisor:** **Nils Johnson**

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

**Abstract:** The proposed research plan for the YSSP Program derives from current research that is being developed in the Energy Planning Program of Universidade Federal do Rio de Janeiro (PPE/COPPE-UFRJ). A major objective is to improve the "MESSAGE Brazil" model, developed by our research group, which is currently in its fourteenth version. Currently, the role of CCS has been considered in the scientific literature as a major option to reduce emissions of greenhouse gases at large scale. Despite being commonly related to fossil energy, the role of CCS in association with biomass or bioenergy development (BioCCS or BECCS) is gaining increasing attention. This could represent a greenhouse gas abatement option with negative emissions or, in other words, an energy option with net removal of carbon from the atmosphere.
The objective is to further develop the CCS chain in MESSAGE, particularly by introducing BioCCS options as one of the many low-carbon technologies. Also, the emission pattern of Bioenergy and BioCCS should account for the carbon stock change through the use of a Land Use, land-use change and forestry (LULUCF) detailed model, such as GLOBIOM. This could provide some clues to the potential role of BioCCS in a possible carbon restricted scenario.
Additionally, it would be interesting to study how improvements by technological learning can be shared with or restricted by fossil CCS and BioCCS. That is, how the development of a fossil CCS chain can provide learning improvements for BioCCS or, by another perspective, how the role of BioCCS is related with the prior development of a CCS market and regulatory framework from the fossil fuel industry.

**Biographical Sketch:** Pedro Rochedo is a second year doctorate candidate at the Energy Planning Program (PPE/COPPE), in Rio de Janeiro. He received a chemical engineering degree in 2009 and a master's degree in Energy Planning in 2011. In his master's thesis, he assessed the economic feasibility of investing in capture-ready coal-based power plants under uncertainty. Currently, his main interests include engineering economic analysis of energy systems, technology development through innovation and learning, and stochastic analysis of integrated energy-and-environmental models.

**Ligia B. Azevedo**

**Supervisor:** **Marijn van der Velde**

**Co-Supervisor:** **Steffen Fritz**

**Research Project:** **Effects of Land Use Changes on Endemic Species Richness Due to Habitat Fragmentation**

**Abstract:** Transformation of landscapes by anthropogenic practices has occurred for thousands of years and can trigger the disappearance of species and, ultimately, a decline in species richness. Today, areas that remain relatively untouched by humans are fragmented and spread out across the world (for example, National Parks). These fragmented habitats incorporate many endemic species. Similarly to transformed landscapes, fragmented natural habitats may also undergo biodiversity losses. However, these losses may go unnoticed. Endemic species losses may be triggered by the decreasing number of refuge areas for prey species and the increasing frequency of inbreeding and stochastic events, such as flooding or fire.
The hypothesis of this summer's research is that fragmented habitat characteristics (i.e. their size, perimeter, shape, and proximity to other fragments) is correlated with the relative number of endemic species that are decreasing in abundance. To test this, we will employ databases incorporating the geographical distribution of endemic fauna and of fragmented habitats. The credibility of the model will be verified with observational land use data (Geo-Wiki project) by comparing if the most strongest landscape transformations are nearby areas of most intense biodiversity losses. Additionally, we will incorporate the relationships of habitat characteristics – endemic species richness into the context of life cycle impact assessment.

**Biographical Sketch:** Ligia Azevedo has been a PhD candidate at the Department of Environmental Science at the Radboud University Nijmegen (the Netherlands) since 2010. The title of her thesis is "Global scale analysis of the impact of environmental stressors on species richness". Her research interests include life cycle impact assessment, ecological risk assessment, ecological modeling, biogeography, and biogeochemistry. She received a MSc degree in Soils and Biogeochemistry in 2009 from the University of California, Davis (USA) and a B.Sc. degree in Agronomic Engineering in 2006 from the University of São Paulo, ESALQ (Brazil).

**Juliana Gil**

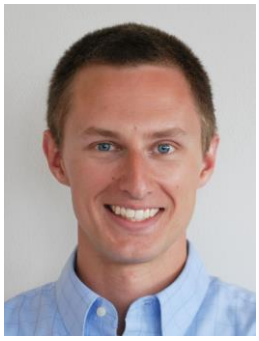
**Supervisor:** **Aline Mosnier**

**Co-Supervisor:** **Petr Havlik**

**Research Project:** **Land Use Dynamics in Mato Grosso, Brazil and the Dissemination of Integrated Agricultural Systems**

**Abstract:** In 2010, the Brazilian federal government launched special credit lines aimed at supporting farmers to adopt low-carbon agricultural practices. One of these practices – the so-called "integrated systems" (IS) – deserves to be highlighted as an interesting strategy to intensify agricultural production at comparatively lower environmental impacts in the state of Mato Grosso (where large areas need to be restored). However, even though ambitious goals have been announced by the government (i.e. 4million hectares with IS by 2020, which should prevent the emission of about 20 million tons of $CO_2^{e-}$) several uncertainties remain about whether such goals can be fulfilled, what the state's land use map will look like in the future and how associated GHG emissions will be really affected. In this sense, Juliana's research project seeks to explore the land use change dynamics in Mato Grosso and contribute to a better understanding of the extent to which anti-deforestation measures and high grain prices may lead to livestock farming intensification, particularly through the adoption of integrated systems. This will be done by coupling census and spatial data collected during field work in Mato Grosso from August 2012 to January 2013 within the land use model GLOBIOM. Results will later serve as input for the "REDD-PAC Project – Land use modeling at global and regional scales to support national and regional REDD+ policies".

**Biographical Sketch:** Juliana Gil graduated from the University of Sao Paulo in 2006 in Environmental Management and acquired a MSc degree in Environmental Protection and Agricultural Food Production from the University of Hohenheim, Germany, in 2010. She is currently a second year PhD student at the Food Security Center at the University of Hohenheim, where she is affiliated to the Institute of Land Use Economics in the Tropics and Subtropics. Her main fields of scientific interest include sustainable agriculture, land use scenarios, territorial planning and climate change.



**David Eitelberg**

**Supervisor:** **Petr Havlik**

**Co-Supervisor:** **Hugo Valin**

**Research Project:** **Advances in Global Modeling of Intensity and Expansion of Agricultural Systems**

**Abstract:** Human population is expected to continue growing in the foreseeable future. In many locations on Earth, this population growth is accompanied by increasing affluence which leads to greater consumption of goods, especially those in the form of food and fiber. The increasing demand for these goods will place greater demands on land and resources required for their production. The ability to meet these growing demands depends on the degree to which production can be intensified on currently cultivated land as well as the amount of land that is available for expansion of agriculturally productive systems. Estimates of available land vary widely, with some as low as 89 million ha and others as high as 1.5 billion ha, indicating that there remains a lot of uncertainty in these estimates which can greatly affect the modeled future scenarios of global land use. This research will focus on the effects of using different resolutions (i.e. cell size, or simulation unit size) of input data (e.g. biophysical, socioeconomic, governance, etc.) on the allocation of agricultural land use systems in the GLOBIOM model. The outputs of the model will be analyzed in terms of area allocated to specific land uses (which can also indicate the degree of intensity) as well as spatial patterns and distributions of land uses. Additionally, a selection of land availability estimates from current literature will be utilized in the modeling environment and their influence on the allocation of agricultural systems will be explored in terms of assumptions and methods relied upon in determining what land is considered to be available. A final step of this research is to build the groundwork for developing an innovative validation strategy for establishing a measure of confidence in modeled future scenarios of global land use.

**Biographical Sketch:** David Eitelberg is a first-year PhD candidate at VU University in Amsterdam, Netherlands focusing on global modeling of land use change, partly contributing to the development of the spatially explicit CLUMONDO model. He received his MSc in GIS for Development and Environment from Clark University in Worcester, Massachusetts in 2012, and his Bachelor's in Environmental Studies and Geography in 2007 from the University of North Carolina at Chapel Hill. His main field of interest is the role of agricultural intensification, expansion, and land availability in modeling future scenarios.

**Markus Enenkel**

**Supervisor:** **Steffen Fritz**

**Co-Supervisor:** **Linda See**

**Research Project:** **Integration of Vulnerability-Assessments into the Satellite-Derived Combined Drought Index**

**Abstract:** Among all natural disasters droughts are the most complex and severe regarding casualties, spatio-temporal extent or economic consequences. In addition, there is no physically measurable parameter for drought. Also commonly accepted thresholds are missing. As a consequence, the Combined Drought Index that had been developed by the UN FAO (Food and Agriculture Organization) for East Africa was revised and extended. Point measurements of rainfall and temperature were replaced with satellite-derived information. A soil moisture component was developed based on active and passive microwave datasets.
In order to make the index useable for humanitarian aid organizations it has to be linked to real-time information on local vulnerabilities. A mobile phone application can help to fulfil this task. At the same time the application can be used to "validate" the outputs of the index. If, for instance, the index shows severe atmospheric drought conditions people might still have access to clean water sources or grain storages and vice versa. All these circumstances influence the actual risk of food insecurity that people are exposed to. In combination with an in-depth analysis of the index and the interaction of its components this user-focused approach holds the potential of integrating new technologies into the decision-making process of aid organizations. As a result, aid organizations should be able to react faster and premised on a more complete knowledge base.

**Biographical Sketch:** In 2007 Markus Enenkel received a BSc degree in bio-resource-management from the University of Natural Resources and Applied Life Sciences (BOKU), Vienna. He focused on water and risk management and finished a double Master's degree at BOKU and Lincoln University, New Zealand in 2010. Since 2010 Markus has been working at the Department of Geodesy and Geoinformation (Vienna University). Markus's PhD concentrates on the use of satellite-derived information for improved decision-making of humanitarian aid organizations. Graduation is planned for 2014.

**Mariia Halushchak**

**Supervisor:** **Anatoly Shvidenko**

**Co-Supervisor:** **Dmitry Shchepashchenko**

**Research Project:** **Modeling and Spatial Inventory of Greenhouse Gas Emissions in the Industry and Construction Sector**

**Abstract:** Greenhouse gases (GHG) inventory at the national and spatial scales, verification of implementation of international commitments concerning GHG emissions are highly relevant and important problems. In order to solve the task of GHG emission reduction the effective inventory tools in all sectors of human activity are needed. Industry and Construction Sector is one of the most considerable fields for GHG emissions reduction. The emissions in this sector are caused by burning fossil fuel, and technological processes. Nowadays several GHG emission inventory approaches (IPCC and others) in this sector are developed, but they can be applied only on regional or national levels. However, GHG sources are located irregularly; therefore, existing approaches do not allow to take fully into account industry location 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 opportunities 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 generic approach, mathematical models, algorithms and software for spatial inventory of GHG emissions in industry and construction sector, caused by burning coal, natural gas, other fossil fuels and wood, to create geo referenced databases for spatial inventory GHG emissions (digital maps) and to implement the approach for one EU and one non-EU Member State regions.

**Biographical Sketch:** Mariia Halushchak graduated from the Faculty of Applied Mathematics of the Lviv Polytechnic National University in 2012, where she is currently a Master's student in the Mathematical and Computer Modeling Program. The title of her thesis is "Spatial Modeling and Analysis of Greenhouse Gas Emissions in the Industry and Construction Sector". Her main fields of scientific interest include spatial-distributed inventory of GHGs in the industry and the construction sector on regional, country levels, and at the level of elementary objects. The analysis differentiates between the models for GHG emissions inventory in industry and construction sector for the EU member states and other countries.

**Long Ji**

**Supervisor:** **Linda See**

**Co-Supervisor:** **Steffen Fritz**

**Research Project:** **Spatial and Temporal Changes of Vegetable Production in China**

**Abstract:** Ensuring the supply of vegetables plays an increasing important role in achieving the food security goals. China is a major player in the world vegetable market, the pattern and distribution of vegetable production in China has greatly changed with the rapid economic-demographic growth, urbanization and industrialization. To ensure the supply of vegetables, it is vital to figure out the spatial and temporal changes of vegetable production in China. The general objective of my proposed research is to map the spatial distribution and pattern change of the vegetable production and investigate the determinants of the spatial distribution of vegetable production. To achieve this goal, the Exploratory Spatial Data Analysis (ESDA) and centroid method, as well as the Gini index and Location Quotient (LQ) will be used to investigate the spatial patterns and changes of vegetable production, and a random panel data model with a provincial dataset will be applied to investigate the underlying forces that determine the spatial distribution of vegetable production.

**Biographical Sketch:** Long Ji graduated from Huazhong Agricultural University in July 2010, majoring in Marketing. He is currently a first-year PhD student in College of Economics and Management at Huazhong Agricultural University. His main fields of interest include the evolution of agricultural clusters and spatial analysis of agricultural production, and more recently, the spatial distribution of vegetable production and the price volatility of agricultural products in China.

**Mathias Kirchner**

**Supervisor:** **David Leclere**

**Co-Supervisor:** **Stefan Frank**

**Research Project:** **Modeling the Impacts of Climate Change and Market Integration on Agricultural Production and Land Use Management in Austria**

**Abstract:** My research project at the YSSP will focus on how climate change and agricultural trade can impact Austrian agriculture, the environment, and how decision makers can respond in a sustainable way to negative impacts as well as opportunities. A major objective is to not only consider direct impacts of climate change (i.e. the impact of higher temperatures, higher atmospheric $CO_2$ concentrations, and changes in precipitation patterns on crop yields and agricultural emissions) but to also account for indirect impacts of climate change via its effect on global production patterns (i.e. agricultural trade). An integrative analysis of such effects is indispensable, given the high importance of agriculture to global sustainable development, especially with respect to poverty eradication, food security and environmental degradation.
At the Institute for Sustainable Economic Development, BOKU, Vienna, we are currently developing an integrated modeling framework for agricultural and forestry production in Austria that links an economic bottom-up land use model (PASMA_pixel) with biophysical, agronomic and climate change models at high spatial resolution (1 km²). This allows for the assessment of a wide range of sustainability indicators and the consideration of heterogeneities in agricultural production and the environment. However, it cannot account for global changes in agricultural production and trade endogenously. Together with IIASA's GLOBIOM team we therefore aim to extend our framework in order to embed the Austrian bio-economy into the global bio-economy (i.e. the Integrated Global2Austria Impact Model Framework). A primary task of my YSSP research will thus be the integration of PASMA_pixel into the global agricultural and forest market model GLOBIOM.

**Biographical Sketch:** Mathias Kirchner graduated from the University of Natural Resources and Life Sciences Vienna (BOKU), Austria, and Lincoln University, New Zealand, in 2011 where he finished the international joint Master programme Natural Resources Management and Ecological Engineering. He currently is a second year PhD candidate at the Institute for Sustainable Economic Development, BOKU. The title of his thesis is "Global Change and Sustainable Land Use – An Integrative Analysis of Mitigation and Adaptation Measures in Agriculture." The need to identify sustainable strategies and policy response to issues such as globalization and climate change are major driving forces behind his research interest. His specific focus lies in the integrative analysis of global change impacts on agricultural land use management and the environment.

**Kalvis Kons**

**Supervisor:** **Sylvain Leduc**

**Co-Supervisor:** **Nicklas Forsell**

**Research Project:** **Efficient Forest Biomass Handling at Terminals with Focus on Bio-Refinery and Fuel Wood Supply Chains**

**Abstract:** Forest biomass terminals serve as buffers to secure raw material deliveries. This makes them an important link in the fiber and energy security of the regions where they are located. Because of an increased interest in advanced biofuels, the role of terminals as merely storage or transition points is changing towards more processing facilities. The amount of market actors in the woody biomaterial industry will most probably increase in the future. Consequently, this will lead to an increased number of well-defined assortments with specific quality requirements. The future biomass terminals should be able to receive different biomass assortments and to process or upgrade, sort, screen, store and deliver these different assortments and products to ordering buyers in their required delivery time.

The objective of my research is to identify potentials for productivity development in operations at biomass terminals. The first step is a mapping of the existing terminals, to understand how operations are done today and what storing capacities exist. More assortments and customers will lead to an increased number of operations in the production systems at terminals. Over time in storage, some assortments are losing in value and energy content. Other assortments, like round-wood for energy, are instead improving their energy fuel properties as they dry. Second step is to optimize operations with all new constrains in the production systems of terminals simulations of different production models which can offer valuable insights. This approach saves much time and resources before physical production facilities are built. By knowing the location of new terminals and the incoming and outgoing flow of raw materials, the optimal size of facilities can be calculated and purposeful production systems can be developed. This will increase the efficiency of the supply chain from raw material to consumers.

**Biographical Sketch:** Kalvis Kons received a BSc in Forest management at Latvia University of Agriculture, in the year 2008 and an MSc with a major in Forest management at the Swedish University of Agricultural Sciences, in the year 2011. Currently he is a second year PhD student at the Swedish University of Agricultural Sciences in Umeå, Sweden. The title of his PhD project is "Efficient forest biomass handling at terminals with focus on bio-refinery and fuel wood supply chains". The main fields of interest are technological development of forest machines, logistics and system modeling and simulations.

**Kanae Matsui**

**Supervisor:** **Florian Kraxner**

**Co-Supervisors:** **Ian McCallum**

**Research Project:** **Creating Web-Based Gaming Simulation for Green Electricity Consumption "GEC"**

**Abstract:** This research aims at gaining insight of people's behavioral change with respect to general energy consumption patterns and choice of energy supply portfolios. The portfolios will focus on renewable energy with the help of a specially designed online gaming simulation tool. The aim is to make an electricity usage gaming simulation, which has the functions: 1) selecting a power company, which has different energy portfolios, and b) selecting people's energy-related behavior in households. After developing a prototype, we will analyze the simulation's influence by questionnaires for the simulation's participants comparing the pre-and post-gaming experience. The questionnaires have: a) basic information (housing, family style…etc.) and b) life style (working style…etc.). After developing the game, we will upload the online game for the global community.

**Biographical Sketch:** Kanae Matsui is a PhD student at the Graduate school of Media Design, Keio University in Japan. Her main research interest is information visualization for human behavior modification.

**Dmytro Melnyk**

**Supervisor:** **Tatiana Ermolieva**

**Co-Supervisor:** **Aline Mosnier**

**Research Project:** **Analysis of Possible Climate Change Impacts on Ukrainian Agriculture Using the GLOBIOM Model**

**Abstract:** According to recent studies, climate change may substantially influence agricultural production in the Ukraine. The main climate changes expected are: in winter, increase in average wintertime temperature, fewer days of frost and snow, widening of frost-free areas, increase in rainfall. In summer, increase in summer dry periods, decrease of precipitation. These aggregate changes have complex spatial patters and will therefore affect the allocation and the portfolio structure of the agricultural production. For example, the area under winter wheat which currently occupies about 90% of the agricultural land is expected to decrease, the areas under barley, oat, corn, legumes, as well as green fodder are expected to enlarge. Changing the structure of grains-crop portfolio may affect the livestock production and forward intensification of the sector. Changed crops portfolio may induce investments into new agricultural practices, increase fertilization rates, and promote further production intensification. Altered precipitation patterns require adequate allocation and investments into new irrigation technologies. Current irrigation infrastructure is outdated and inefficient.

The main goals are: to use the GLOBIOM model to analyze the extend of potential climate change effects on agricultural production and food security in the Ukraine; to identify and estimate climate change adaptation strategies including introduction of new agricultural technologies and practices, e.g., higher fertilization, new types of irrigation; explore mechanisms of international trade to improve climate change adaptive capacity.

There are major uncertainties and risks related to climate changes. My research creates a basis for the analysis of climate change adaptation measures robust against these uncertainties and risks.

**Biographical Sketch:** Dmytro Melnyk graduated in June 2012 from the Vinnitsa Institute of Trade and Economics with a Master's degree in economics of enterprises. Currently, he is a first year PhD student at the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine. His scientific interests include foreign trade of agricultural products, food security of Ukraine and climate change impacts on Ukrainian agriculture. He has experience in developing investment projects and business plans.

**Xi Pang**

**Supervisor:** **Eva-Maria Nordström**

**Co-Supervisor:** **Hannes Böttcher**

**Research Project:** **Sustainability Assessment of Forest Bioenergy Options in Multiple-Use Landscapes**

**Abstract:** Globally, biodiversity is declining due to loss of habitat and species extinction, which undermines ecosystem functioning and therefore threatens also the ability of ecosystems to supply ecosystem services. Moreover, there is a need for adapting to climate change as well as securing the supply of energy, which have led to a shift in energy consumption from fossil fuel to renewables, especially biomass, which in turn put pressure on ecosystems and biodiversity. In Sweden, forest bioenergy has an important role and high forest biomass production is an important societal objective. Intensified forestry could increase the biomass production through monocultures of native or introduced trees as well as forest fertilization. However, due to negative effects on natural forest structures and processes, a more intensive forestry could be detrimental to large numbers of forest species. The balance between energy demand and the long-term capacity of ecosystems to supply goods and services is therefore crucial. The YSSP project is based on a case study of forest biomass extraction in Kronoberg, a region in southern Sweden. The aim of this project is to develop and test methods for assessing the sustainability of forest biomass extraction for bioenergy purposes by incorporating effects on biodiversity and important ecosystem services in the assessment. The landscape simulator LANDSIM will be used to model forest growth under different management scenarios between 2010-2050 and beyond, while the Heureka model will be used to estimate bioenergy yield of these scenarios. The GIS-based approaches for assessment of impact on biodiversity and ecosystem services will involve an integrated baseline assessment of prioritized ecosystems and ecological profiles, as well as assessment of resources and selected ecosystem services across the landscape. Thus, a baseline ecological (biodiversity and ecosystem services) assessment as well as impact assessment of the scenarios will be performed. In this way, a methodology for integrated sustainability assessment of bioenergy options will be developed and tested.

**Biographical Sketch:** Xi Pang received her Master's degree from the school of School of Architecture and the Built Environment, KTH Royal Institute of Technology, Sweden in 2007. She is currently a PhD student at the Department of Land and Water Resources Engineering, School of Architecture and the Built Environment at KTH Royal Institute of Technology in Stockholm, Sweden. Her main scientific interest is using GIS models to study the environmental impact of forest bioenergy on biodiversity and ecosystem services.

**Victor Wegner Maus**

**Supervisor:** **Aline Mosnier**

**Co-Supervisor:** **Ian McCallum**

**Research Project:** **Satellite Time Series Analysis for Land Use/Cover Change Detection**

**Abstract:** Currently, land use data for Brazil comes basically from the agricultural census and land cover data comes from global data sets. This no longer meets the needs of the earth system modeling community. Potentially, long-term satellite images with high temporal frequency could be used to detect and monitor land use and land cover changes. The observation of each pixel in the satellite images, over time, yields a sequence of data points in a time series. The vegetation phenological cycles are reflected in the satellite time series, allowing the potential classification of some vegetation types cultures in time segments. Therefore, this research aims to develop a new methodology for satellite time series analysis and produce accurate land use and land cover data. The proposal is to use the Dynamic Time Warping (DTW) and Dynamic Bayesian Network (DBN) with 2-band Enhanced Vegetation Index (EVI2) available from Brazil's National Institute for Space Research (INPE) to improve land use and land cover data. The state of Mato Grosso, Brazil will be used as a test area. This proposed research is in closed cooperation with the REDD-PAC Project, for which it can provide better quality land use and land cover data. Open source tools such as the statistical software R, library GIS TerraLib and TerraView geographical data viewer will be used during the development of this work.

**Biographical Sketch:** Victor Wegner Maus has a Bachelor of Engineering degree in Environmental Engineering (2009) and received his MSc degree in Computational Modeling from the Federal University of Juiz de Fora in 2011. He is currently a third year PhD student in Earth System Science of the National Institute for Space Research, Brazil. His main fields of scientific interest include mathematical modeling, numerical simulation and geoinformatics. Victor has been professor at Federal University of Pampa and member of the INPE's team in the REDD-PAC Project.

**Xinxin Zhang**

**Supervisor:** **Juraj Balkovic**

**Co-Supervisor:** **Tatiana Ermolieva**

**Research Project:** **Spatially Explicit Assessment of Future Water Use in the Heihe River Basin: Application of Coupled Socio-Economic and Hydrology Models with a Downscaling Approach**

**Abstract:** Unreasonable water use and management in turn have led to many global, regional and local problems. Appreciating the global and regional dimensions of water resources in a spatially explicit way is a key to solving today's most urgent water problems. Changes in anthropogenic (e.g. land use, population, GDP) and natural (e.g. climate change) driving forces will further affect water uses in more and more countries all over the world, especially in arid and semi-arid regions The Heihe River Basin is a typical inland river basin located in the arid regions of Northwest China, where water shortage is the key limiting factor for human and ecology. Hence, the aim of the proposed project is to analyze future water uses in the Heihe River Basin under climate change, land use and socio-economic situations in a spatially explicit way through a range of coupled models. We propose to first model spatial and temporal distributions of land use, climate change, and socio-economic development based on IIASA'S Global change scenarios and downscaling methodology. These results will provide input to GEPIC/SWAT to assess spatial and temporal distribution of water uses under different scenarios in the Heihe River Basin in the future up to 2050. Furthermore, this study is part of the Major International (Regional) (IIASA-China) Joint Research Project, and the results can provide a basis for assessing water scarcity in Heihe River Basin.

**Biographical Sketch:** Xinxin Zhang graduated from Beijing Forestry University in July 2012 with a Bachelor's degree in Environmental Science. She is currently a first year Ph.D student at this University majoring in Nature Reserve Science. Her main scientific interest is wetland ecosystem service, focusing on the relative research of water resource.

**Kandice Harper**

**Supervisor:** **Chris Heyes**

**Co-Supervisor:** **Fabian Wagner**

**Research Project:** **Regional Assessment of Short-Lived Climate Forcer Mitigation Measures**

**Abstract:** Black carbon, methane, and tropospheric ozone are known collectively as short-lived climate forcers (SLCFs) because of their short atmospheric lifetimes, particularly compared to the long-lived greenhouse gas carbon dioxide. SLCFs influence both regional and global climate by affecting the Earth's radiative balance and also negatively impact human and ecosystem health. Reducing anthropogenic emissions of the short-lived climate forcers and their precursors has been suggested as a way to simultaneously slow the rate of global warming and achieve human and ecosystem protections. In a 2011 report, the United Nations Environment Programme (UNEP) outlined a set of priority measures aimed at SLCF reductions at the global scale. This project will assess the regional importance of the UNEP-identified SLCF emission reduction measures in China under different baseline assumptions. Specifically, this work will continue the development of metrics for estimating the regional climate impact of the measures and also assess their cost effectiveness. Based on the results of the work, alternative policy scenarios to maximize the impact of SLCF mitigation measures will be developed that can be used in planned global chemistry-climate model runs.

**Biographical Sketch:** Kandice Harper has a BSc in chemistry from Iowa State University, an MSc in physical chemistry from The Ohio State University, and a Master of Environmental Management from the Yale School of Forestry & Environmental Studies. She is currently a first-year PhD student at Yale University where she works in the field of climate modeling, focusing on chemistry-climate interactions.

**Paunu Ville-Veikko**

**Supervisor:** **Zbigniew Klimont**

**Co-Supervisor:** **Kaarle Kupiainen**

**Research Project:** **Spatial Modelling of Global Agricultural Field Burning Emissions**

**Abstract:** Agricultural field burning is an activity in which crop residue is burned to clear excess residue, control pests and produce ash fertilization. It is a significant source of aerosols and trace gases to the atmosphere. Burning of agricultural residue has been subject to legislative measures like limiting or banning the practice in several countries in Europe. However, remote sensing data indicates that the burning continues regardless of the legislation. Furthermore, some countries have ceased to report emissions assuming the legislation is correctly enforced. Therefore, in order to understand the emissions and their spatial and temporal distributions, emission models and inventories need to be improved. Already some spatially resolved emission inventories of agricultural field burning have been developed to assess emissions of several pollutants. These models include GFED, FINN and the GAINS model. Significant differences between the global emission inventories exist due to differences in emission calculation and spatial allocation of the data.
The aim of my YSSP2013 research is to create the best possible global calculation and spatial representation of emissions from agricultural field burning using the best available data sources. The results will be applied to the GAINS model. Future changes in the spatial distribution of the emissions will be projected to serve scenario assessments. To achieve these goals, specific crop type and biomass amount information is combined with crop specific emission factors. The effect of temporal variation will be taken into account using the information on seasonal cycle of different crop types in different areas. The resulting emissions and spatial distributions will be compared with other global and regional products, such as GFED and FINN.

**Biographical Sketch:** Paunu Ville-Veikko graduated with his Master of Science (Tech.) degree in energy sciences from Aalto University in June 2012. He is currently a research engineer at Finnish Environment Institute SYKE, working on his PhD thesis “Spatial modelling of air pollution in integrated assessment framework”. He is a first year PhD student at Aalto University. His main fields of scientific interest include spatial modelling, air pollution emissions and integrated assessment.

**Sasha Yin**

**Supervisor:** **Wilfried Winiwarter**

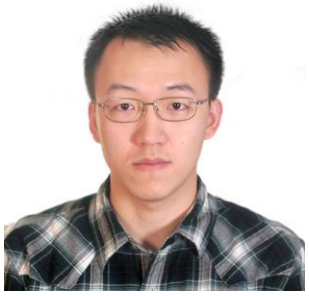
**Co-Supervisor:** **Zbigniew Klimont**

**Research Project:** **Modeling Ammonia Emission Control Potentials and Costs in the Pearl River Delta (PRD) Region, China, Using an Integrated Approach**

**Abstract:** Ambient air pollution issues in the Pearl River Delta (PRD) region, China (including Hong Kong) persist as major public environmental and health challenges for policy makers. Particularly $PM_{2.5}$ is of concern for human health, haze pollution, and property damage. $NH_3$ together with $SO_2$ and NOx is a precursor compound of $PM_{2.5}$. In recent years, PRD and Hong Kong local government agencies have implemented strict measures on reducing $SO_2$ and $NO_X$ emissions and control strategies have been evaluated using regional air quality models to understand impacts of emissions reduction. However, only few studies in China are available on $NH_3$ emission inventories or potential control measures for $NH_3$, compared with $SO_2$ and NOx.

During the YSSP period, I am planning to conduct a study of identifying $NH_3$ emissions as well as control potentials including their costs for the PRD region, China, using an integrated approach following the methodological framework shown by the GAINS-China model. I will conduct my proposal by the following specific tasks: improving and updating PRD regional $NH_3$ emission inventory; identifying $NH_3$ control measures and potentials with a focus on agriculture sources by investigating the cycle of $NH_3$-N mass-conservation for livestock-specific (housing, storage, application and grazing); assessing emission control costs for PRD and China of proposed abatement scenarios (baseline, low nitrogen feed, air purification, covered storage, low ammonia application, combinations of the above options ) by referring to the cost calculation method of the GAINS model and providing region-specific parameters.

**Biographical Sketch:** Shasha Yin graduated from Zhengzhou University in 2007 with a Bachelor's degree of Environmental Science and in 2011 with a Master's Degree of Environmental Engineering in South China University of Technology. She is currently a second year PhD student at the College of Environment and Energy at South China University of Technology under the supervision of Professor of Junyu (Allen) Zheng. Her scientific expertise includes regional emission inventory, temporal and spatial characteristic of emission, emission control potentials, and modeling contribution assessment of regional air quality, especially the PM pollution.



**Bo Zheng**

**Supervisor:** **Jens Borken-Kleefeld**

**Research Project:** **Projection of Chinese Vehicle Growth, Energy Demand and Emissions Through 2050**

**Abstract:** Chinese vehicle stock experienced tremendous growth during the past three decades. As a result, vehicle emission has become one of the major sources of air pollutants in China, especially in urban areas. However, China's per capita vehicle ownership is still much lower than that of other developed countries, even the world average level. It is believed that vehicle population in China will continue to increase rapidly. In this case, how to control vehicle emissions and improve urban air quality is a major challenge to policy makers in China. Because transportation sector plays an important role on urban and regional air quality in China, projecting its energy use and future emissions have become a hot topic in the community. However, previous studies usually projected emissions at national level, which assumed vehicle growth and technology distribution were consistent across the country. For vehicles have various development trajectories in provinces or cities with different socio-economic features, using national averages may severely underestimate or overestimate results for different regions. Projecting vehicle emissions with high resolution is an essential task which can benefit both future air quality modeling and management with improved spatial accuracy. My main objective of the YSSP program is to project vehicle emissions at high resolution for China. To achieve this goal, I will collect and project vehicle activity from 2010 to 2050 for China. Then a scenario analysis for different development trajectories will be made to help understand vehicle emission trend.

**Biographical Sketch:** Bo Zheng graduated from Tsinghua University in July 2011, majoring in environmental engineering. He is a second-year PhD student in School of Environment at Tsinghua University. The planned research of his PhD program is projecting vehicle emission and estimating its environmental effect on air quality in China. His research interests include emission inventory and air quality modeling.

**Alessandra Carioli**

**Supervisor:** **Bordone Valeria**

**Co-Supervisor:** **Serguei Scherbov**

**Research Project:** **Projecting Provincial Period Fertility in Spain**

**Abstract:** Spain underwent serious socio-economic changes since the end of the Francoist regime in 1975. Moreover, the dawn of the Second Demographic Transition, which reached Spain later with respect to other Western-European countries, set in motion a series of substantial variations in fertility patterns in the Iberian Peninsula (Devolder & Ortiz, 2010; Reher, Ortega, & Sanz-Gimeno, 2008). Total Fertility Rates started to decline; postponement shaped severely the new fertility schedule advancing mean age at childbirth and cutting off higher order births. These changes were far from homogeneous as heterogeneity has always been a peculiarity of the regional fertility in Spain (Leasure, 1963; Livi-Bacci, 1968)
My project as participant to the IIASA Young Scientist Summer Program aims at forecasting TFR of 52 Spanish provinces using time series of Total Fertility Rates from 1975 to 2011, taking into consideration the spatial component that affects correlation among geographical units. In particular, looking at the differences of TFR across the various provinces with respect to fertility indicators over time, I single out through means of time series cluster analysis three main groups of provinces that maintain similar trends of TFR over time. These groups of provinces will serve as basis for future forecasting of TFR trends to obtain probabilistic projections of TFR.

**Biographical Sketch:** Alessandra Carioli graduated from Bocconi University in year 2006 attaining a Master of Science in Economics, with a thesis on spline interpolation models in Demography "Analysing fertility trends through Schmertmann's model: Italy and Sweden compared". She worked for a year at Dondena Centre for Research on Social Dynamics.
She is currently a PhD Student at PRC (Population Research Centre) department of Spatial Sciences at Groningen University, realizing her research at NIDI, the Hague. Her PhD subject is the evolution of fertility at regional and provincial level in Italy and Spain during the recent decades.
Her main research interests are fertility, life tables, formal demographic methods, spatial econometrics, forecasting techniques and spline interpolation techniques.

**Solveig Christiansen**

**Supervisor:** **Vegard Skirbekk**

**Co-Supervisor:** **Dalkhat Ediev**

**Research Project:** **The Future Environmental Impact of Divorce**

**Abstract:** In the last decades there has been a growing interest in how changes in demographic variables influence the environment. Quite a few consumer decisions that affect the environment take place at the household rather than at the individual level. Furthermore, larger households benefit from economies of scale which means that the per capita consumption, of for example energy, is smaller the larger the household. The purpose of my project is to forecast the impact divorce will have on the environment. I will compute a household forecast 30 years into the future broken down by age, sex, household position and number of children. Computing alternative scenarios that differ only with respect to divorce rates and combining the projected household numbers with information about household energy patterns, I will be able to explore how divorce affects future energy use.

**Biographical Sketch:** Solveig Christiansen is currently a third-year PhD student and research fellow in Demography at the Department of Economics at the University of Oslo. Her research interests include household forecasting, ageing and mortality. She completed her master's degree in economics at the University of Oslo in 2009.

**Praveen Kumar Pathak**

**Supervisor:** **Raya Muttarak**

**Co-Supervisor:** **Valeria Bordone**

**Research Project:** **Social Networks and Fertility Behavior Among Women in Rural Uttar Pradesh, India**

**Abstract:** Uttar Pradesh remains the most populous state of India in the 21st century. Although fertility has declined across several Indian states in the 1970s, with varying historical points of onset and pace of decline, women in Uttar Pradesh, on average, still bear around four children in their reproductive lifetime due to the interplay of a complex set of demographic, socio-economic and cultural factors. However, apart from investigating the standard set of socioeconomic factors, little attempt has been made in the past to examine the role of diffusion on precipitating fertility change in the Indian context in general, and Uttar Pradesh in particular.

Understanding the mechanism of diffusion through social networks in influencing fertility change may be crucial from a policy perspective. Using ego-centric social network data of more than 500 currently married women (18-35 years), my work at IIASA as a Young Scientist participant focuses on investigating the relationships between informal social interactions with network partners and childbearing and fertility experiences of women in Uttar Pradesh. In addition, I will also examine the association between informal social interactions with network partners on matters of family planning and use of contraceptive methods. Furthermore, the study plans to test available and alternative measurement methods of social interactions effects in order to generate robust measures. The study will also discuss the potential policy relevant issues and its wider implications emerging from the present research.

**Biographical Sketch:** Praveen Pathak is an Assistant Professor of Geography at the University of Pune, India. He is also pursuing a PhD from the International Institute for Population Sciences, Mumbai, India since April, 2008 under the supervision of Prof. Faujdar Ram. His research interests are social networks and demographic behavior; socioeconomic inequalities in population, nutrition and health; geospatial analysis of demographic/health outcomes. He completed undergraduate studies in Geography and English Literature from Ewing Christian College at the University of Allahabad in 2004. He also completed postgraduate studies in Geography from the Banaras Hindu University, Varanasi, India in 2006. He earned his MPhil degree in Population Studies from the International Institute for Population Sciences, Mumbai, India in 2008.

**Joshua Ramos**

**Supervisor:** **Vegard Skirbekk**

**Co-Supervisor:** **Marcin Stonawski**

**Research Project:** **An Analysis of Religious Conversion and Secularization, with its Application in Demographic Projections of Religion**

**Abstract:** Since the last four decades, we wave witnessed an era of global resurgence in every major world civilizational religion that has effected a striking increase in religious influence within the public sphere and dominant global political structures. (Toft, Philpott, Shah 2011) Due to a combination of higher fertility rates, migration trends and the intergenerational transmission of values of those who are religious, it is projected that there may occur a stalling and possible reversal of secularization within the United States and Europe around 2050. (Kaufmann, Skirbekk 2012) Within this context of the resurgence of religion, the goal of this research project is an analysis within a global perspective of religious conversions and secularization and its overall impact on population dynamics, with the intent to use these findings to create scenarios for the Pew-IIASA religion model, and apply them as case studies for specific countries and regions, using data to interpret and project value changes that focus on the cultural character and religious composition of secularized societies. This research hopes to contribute to the current discussion within political demography that highlights the pronatalism of religious conservatives or fundamentalists in contrast to the low fertility of the non-religious or seculars, and how this growth in religious population may provide a countervailing force to secularization by reason of intergenerational transmission, thus challenging liberal values and engendering further 'culture wars' in secularized societies

**Biographical Sketch:** Joshua Ramos is a third year doctoral candidate in Religious Studies in the Joint PhD Program in Religious Studies at the University of Denver and Iliff School of Theology, whose research interests include political theology, religion and global affairs. He graduated from Gordon-Conwell Theological Seminary in 2009 with a Master's degree in Religious Studies, and has studied at Harvard Divinity School and Boston College (2007-2008).

**Noran Bakr**

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

**Research Project:** **Could Renewable Energy Promote Economic Convergence in Euro-Mediterranean Area?**

**Abstract:** Convergence has increasingly drawn the attention of scholars who are concerned with examining the impact of trade and economic integration between developed and developing countries. It is evident that GDP per capita notably increased in the Arab region due to exporting crude oil to industrialized countries. Nowadays, energy resources have played an important role in influencing the rate of economic growth and development. It was always perceived as a boost up to long term growth when new energy sources and technologies were deployed. The technologies used in transforming the renewable sources are still in the R&D phase while the technologies converting non-renewable energy sources are well established long time ago. This proposed research will test the potentiality of the economic convergence occurrence if renewable energy integration takes place between the developing countries in the Mena region, which have abundance in renewable sources of energy and wealthy developed countries which are technologically developed. Empirical researches show that regional integration succeeded in many cases in achieving economic convergence. In brief this research aims to study how energy could achieve convergence between Egypt and some of the developed Euro-Mediterranean countries. This research will review the monetary convergence/divergence, measured by per capita income. It will estimate the role of renewable energy in Mediterranean economies as an independent productive sector on one side and as a feeding sector to other production sectors within these countries on the other side. This will be done through solving the appropriate set of equations that represent such framework. Besides, simulating different policy targets will be performed to give different scenarios on which policy makers can depend. Since there is no historical data about the effect of energy on economic convergence due to the non-existence of such situation until now, simulation model such as the CGE will best suit this case. This simulation will be used to analyze the impact of different policy alternatives on the benefits of the Mediterranean region. Finally, the proposed research will evaluate the impact of economic cooperation initiative that the European community revealed in the field of renewable energy on the Mediterranean economies. Data used will basically be the GDP per capita for developed and developing countries in the Mena region ,the intensities of renewable energy, the quantitative contribution of energy in the different industries, the current investments in the energy sector, the cost of the technology used in the renewable energy sector and prices of renewable energy.

**Biographical Sketch:** Noran Bakr graduated from the Faculty of Economics and Political Science in 2001; Statistics Department. In 2011, she obtained a Master's degree in economics from the American University in Cairo. Her main fields of scientific interest are economics of energy, environmental economics and economic growth and development. She is currently working as a senior economic researcher at the Cabinet of the International Cooperation Minister.

**Veronika Bertram Hümmer**

**Supervisor:** **Reinhard Mechler**

**Co-Supervisor:** **Wei Liu**

**Research Project:** **Household Vulnerability and Risk-Management Strategies with Climate Extremes**

**Abstract:** The socio-economic impacts of climate extremes on people in development countries arise both due to their high dependency on agriculture as well as their lack of means to invest in adaptation. As one case in point, Mongolian nomadic households, with their large dependency on livestock, are especially vulnerable to extreme climatic events. Dry summers followed by harsh winters, so-called dzuds, are highly damaging. In a changing climate, dzuds are predicted to occur more frequently, which poses a threat to nomadic livelihoods. During the 2009/10 winter, the most disastrous dzud ever recorded led to the loss of one-third of Mongolia's livestock population. Against this background, Mongolian households use a variety of risk-management strategies. My research project aims at contributing to a deeper understanding of the socio-economic impacts of climate extremes. Using a micro-economic approach, I will explore households' vulnerability and strategies designed to cushion the negative welfare impacts of dzuds. The proposed research project focuses on two aspects. First, the set of different coping strategies in use, such as short-term movements, livestock sales, and informal insurance in combination with their impact on livestock mortality during the 2009/2010 disaster will be investigated. In a second step, households' risk-management in the form of micro-insurance in Mongolia will be explored. The recently introduced Index-Based Livestock Insurance (IBLI) scheme enables the pooling of livestock losses and provides an alternative possibility for herders to smooth income. The research will analyze the effectiveness, efficiency and acceptability of chosen and novel options for managing risk in this context. The work aims at informing policy-makers on successful strategies and policies, which may best assist herding households in coping with climatic risk.

**Biographical Sketch:** Veronika Bertram Hümmer graduated in 2009 from the University of Tübingen, Germany, earning a Masters' degree in Economics. She is currently a third year doctoral student at the DIW Berlin Graduate Center and Humboldt University Berlin, Germany. In her thesis she explores household vulnerability and risk-management with respect to climate extremes. Her scientific interests include development microeconomics, especially the vulnerability of households and their coping strategies against the backdrop of climate change.

**Trond Husby**

**Supervisor:** **Reinhard Mechler**

**Research Project:** **Economic Modeling of Flood Risk**

**Abstract:** Climate change is expected to result in an increased frequency of floods. Besides the damage caused by the direct impact from floods, there are substantial indirect effects often labeled as business interruptions. Little is in fact known about these indirect effects, both in terms of mechanisms and in terms of size. It is however widely recognized that they can be large. One reason is that indirect effects tend to persist through time, slowing down the recovery process.
I focus on the interaction between housing- and labor-markets and household location decisions, while incorporating the necessary level of detail to allow for heterogeneity. Studies have found a negative impact on house-prices from floods, one candidate explanation being that the flood leads to an increase in risk awareness. The extent to which such risk perceptions affect households' location decision differs between household groups. One possibility is that a flood leads to an increased concentration of certain household types in flooded areas, for example low income types. On the supply side, firms wish to locate in areas close to qualified labor and consumers. The exodus of firms from flooded areas can further strengthen the concentration of low income households.
Current economic models employed to assess the long term and indirect effects of floods are ill suited for analyses of such nonlinear phenomena as natural disasters. The existing literature of recognizes the need for a modeling framework which takes heterogeneity and non-rationality into account. The main added value of this project will be the formulation of a model which includes such elements.

**Biographical Sketch:** Trond Husby is a PhD candidate at the department of Environmental Economics of IVM Institute for Environmental Studies at the VU University Amsterdam. He holds an MPhil degree in Environmental Policy from the University of Cambridge, as well as an MSc in Economics with a specialization in Spatial Economics from the VU University of Amsterdam. His MPhil-dissertation discussed the effectiveness of climate change mitigation in the built environment, while his MSc-dissertation investigated cross-country convergence in carbon productivity using a modified climate-economy model. His PhD-project aims at developing a methodological framework for integration of Computable General Equilibrium and multi-agent modeling approaches for flood risks. This research is part of the Kennis vor Klimaat (Knowledge for Climate) project. His current interests include macroeconomic modeling, decision making under risk and uncertainty as well as the economics of climate change.

**Naghmeh Pakdellahiji**

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

**Research Project:** **Earthquake Risk Modeling and Possible Earthquake Insurance Options: A Case Study in Shiraz**

**Abstract:** There is a high level of seismic hazard almost in all parts of Iran. Additionally, low quality of constructions and increases in the populations of major cities has caused extreme losses after earthquake events. In these situations, the government was and likely will be a major risk bearer. Due to direct and indirect losses of earthquakes it can be recognized that there is essential need to have a systematic strategy to spread and reduce the earthquake risk among the country and encourage the people to take mitigation measures. Earthquake insurance can reduce potentially disastrous economic losses to householders and is therefore a prime method of mitigation against the worst economic effects of damaging earthquakes. This research intends to design an effective earthquake insurance plan for Shiraz metropolitan area in the south of Iran. For financing catastrophe events, underwriting strategies, profitability, and solvency of insurers that provide coverage for catastrophe risk have to be considered. Since insurers are concerned with insolvency, they focus on worst-case scenarios in determining the portfolio of risks to which they offer coverage. The proposed study aims at determining risk-based insurance premiums based on expected losses of the region and how to designate the affordable premiums to householders in high and low risk areas. In financing catastrophe events in many cases, using some kinds of risk transfer mechanisms is ineludible.

**Biographical Sketch:** Naghmeh Pakdellahiji received her MSc in Earthquake Engineering in 2010 from Building and Housing Research Center (BHRC) of Tehran. She is currently a second-year PhD student in Earthquake and Structural Engineering at the Science and Research Branch IAU of Tehran. The draft title of her PhD thesis is “Expected Earthquake Losses to Buildings in Shiraz Metropolitan Area and Implications for Designing Iranian Earthquake Insurance Pool”. Her main fields of scientific interest include risk modeling, risk financing and earthquake risk reduction measures.

**Mehdi Sadeghi**

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

**Co-Supervisor:** **Georg Pflug**

**Research Project:** **Earthquake Risk Modeling for the Evaluation of Different Mitigation Measures to Reduce Losses to Property Owners in the Metropolitan Area of Shiraz**

**Abstract:** In recent years, natural disasters caused large human and economic losses, and caused high post disaster relief, recovery and reconstruction investments by governments and international donors. Reliable and up-to-date estimation of risk is a key towards developing effective risk management strategies and risk reduction activities. In this study it is planned to focus on earthquake risk of Shiraz, the 4th largest city of Iran located in high seismic hazard zone with high socio-economic and historical importance. Considering that risk analysis of Shiraz is a huge task and requires comprehensive information on all elements at risk, the first focus will be on the vulnerability of assets, economic loss assessment and as well as cost-benefit analyses for various option of retrofitting and vulnerability reduction of the buildings in district 1 of the city. For this purpose, hazard analysis of Shiraz city is needed and a building inventory should classify number of stories and occupancy in a comprehensive manner. In a next step an Exceedance Probability curve (EP) will be constructed for the given hazard. Finally, by simulating changes in the EP curve related to the most popular Disaster Risk Reduction (DDR) measures in Iran, cost-benefit ratios of the DRR will be analyzed. The research should conclude by emphasizing the advantages and challenges of earthquake model-based risk assessment and risk reduction strategies within Shiraz city.

**Biographical Sketch:** Mehdi Sadeghi received his MSc in Earthquake Engineering in 2009 from Science and Research Branch IAU of Tehran. He is currently a third-year PhD student of Earthquake and Structural Engineering at the Science and Research Branch IAU of Tehran. The draft title of his PhD thesis is “Earthquake Risk Models of Shiraz Metropolitan Area for Evaluating Disaster Risk Reduction Investment and Cost Benefit of Reducing Losses to Property Owners and Insurers”. His main fields of scientific interest include risk modeling, risk financing and earthquake risk reduction measures.

**Claudia Seibold**

**Supervisor:** **Georg Pflug**

**Co-Supervisor:** **Åke Brännström**

**Research Project:** **Monetary Loss Estimation of Cascading Failures Caused by Christchurch's Earthquake Series**

**Abstract:** An earthquake causes radical changes not only for individual human living but also for communities. Christchurch, New Zealand was not only hit by one but by a series of high-magnitude earthquakes in 2010 and 2011. One direct effect on the community was the failure of networks such as traffic and water supply. These damaged networks caused further economic problems such as closure of businesses and reduced tourism. This example highlights that earthquakes not only cause direct damage on infrastructure, but that this sequence of cascading failures leads to widespread outages which can be even more critical for the economic situation. Therefore, the risk-based decision making for management strategies under low-probability high-consequence events should include not only direct but also cascading effects on an affected area. During this research our objective is to explain the direct and cascading effects of Christchurch's earthquakes. We estimate loss curves for the earthquake series in Christchurch. These loss distributions are the basis for calculating optimal risk management strategies, including mitigation and insurance debts. The research increases the knowledge about the economic impacts of extreme events, such as the earthquake series in Christchurch. This project helps policy makers not only in New Zealand but all over the world to make wise decisions regarding the potential economic loss caused by natural hazards.

**Biographical Sketch:** Claudia Seibold graduated in 2009 from RWTH Aachen University, Germany, with a MSc in Psychology. She is currently doing a PhD in Statistics at University of Canterbury in Christchurch, New Zealand. In her thesis, she focus on statistical modelling of tectonic processes, particularly identifying a spatial pattern for the fault system on the South Island in New Zealand. The research includes describing the distribution and the direction of the fault lines. This knowledge supports to indicate unknown fault lines and therefore to predict earthquakes.

**Transitions to New Technologies Program (TNT)**
**Program Leader: Arnulf Grübler**

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**Dominique Thronicker**

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| **Supervisor:** | **Arnulf Grübler** |
| **Co-Supervisor:** | **Charlie Wilson** |
| **Research Project:** | **Scaling Dynamics and Cost Trends of Environmental Add-On Technologies in Germany and Japan** |


**Abstract:** Research of the spatial and temporal diffusion of technologies and their performance trends such as costs offers important insights for patterns, drivers, constraints and impacts of future technological change, for instance the one required to achieve climate stabilization. My research goal is to further the understanding of technological change in the area of environmental add-on technologies for traditional air pollutants that offer potential analogies for similar technologies in the climate fields (e.g. CCS). My research project builds on earlier work conducted at IIASA by Stephen Healey (YSSP 2012), who used multi-factor regressions to explain cost developments for flue gas desulphurisation (FGD) units in the US. I will analyse whether the observed cost trends for FGD units (and other large-scale environmental add-on technologies) are mirrored in Germany and Japan, who also have a long standing history of deployment of these environmental add-on technologies. While FGD in the US has received a fair amount of attention following the introduction of the SO2 emissions trading scheme, technological innovation and cost development of FGD in Japan and Germany remain largely unknown. Should the results of the costing analysis be similar to Healey's findings, who found no significant historical cost improvement trends, it would have important implications for the projection of cost trends for large-scale environmental add-on technologies like carbon capture and storage or direct air capture technologies.

**Biographical Sketch:** Dominique Thronicker is a third year PhD student in Economics at the University of Stirling, Scotland. She graduated there in 2010 with an MSc degree in Energy Management. She also holds an MA degree in European Studies from the Jagiellonian University of Krakow, Poland from 2005. In her PhD she researches implications of a possible deployment of climate-engineering technologies for optimal climate policy. Her research interests include energy and resource economics, technological change, choice analysis, and climate and technology policy analysis.

**Ali Shaukat**

**Supervisor:** **Michelle van Vliet**

**Co-Supervisor:** **David Wiberg**

**Research Project:** **Two-Way Coupling of Regional Climate Models and Hydrological Models for the Impacts of Climate Change on Water Resources**

**Abstract:** There are generally two ways to couple Regional Climate Models (RCMs) and Hydrological Model (HyMod) for the Climate Change impacts on water resources. The simple one is one-way coupling, in this the output of RCM is used as input to HyMod but there no feedback from HyMod to RCMs. The second way is the simultaneous run of RCM with HyMod called two-way coupling in this both models interact and provide feedback to each other during the simulation. There are some studies of RCM and HYMOD with one-way coupling [Akhtar et al., 2009; Ashfaq et al., 2010; Wang et al., 2011; Li et al., 2012] and few studies with two-way coupling [Rasmussen et al., 2010; Florian et al., 2010]. So there is an acute need to explore the application of both coupling technique. The primary objective of this study to develop a framework called coupler for two-way coupling of interaction and feedback of RegCM (REGional Climate Model) and CHYM (Cetemps Hydrological Model) models of ICTP. In addition, as secondary objective of this article to compare the results of both coupling and identify suitable approach (On-way/two-way) to study Regional Climate Change impact on water resources over East/South Asia.

**Biographical Sketch:** Ali Shaukat is a PhD student at the Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences (CAS), China. He graduated from COMSATS Institute of Information Technology (CIIT), Islamabad. After working as Scientific Officer in the Global Change Impact Studies Centre (GCISC), Islamabad, Pakistan from 2008 to 2011, he is currently on study leave and pursuing his PhD. His main research interests are the Regional Climate Change impacts on water resources.

**Martin Bruckner**

**Supervisor:** **Sylvia Prieler**

**Co-Supervisor:** **Güther Fischer**

**Research Project:** **Global Biomass Flows and Associated Environmental Footprints**

**Abstract:** Various approaches exist for quantifying environmental footprints of biomass consumption by estimating the virtual natural resources (e.g. land, water) embodied in international trade flows. These can be classified into A) final demand approaches, applying environmentally extended input-output analysis, B) apparent consumption approaches, using information on physical trade of raw materials and processed biomass products combined with yield factors, and C) hybrid approaches. The results of these methodologies often vary widely, not only between type A, B and C approaches but also between single applications within approach families.
This study aims at giving a structured overview of different approaches for the calculation of virtual land and water embodied in traded goods and the recent literature on this topic, providing insights into the technical and structural differences and comparing selected results derived from the considered approaches. The comparison will give special emphasis to IIASA's LANDFLOW and multi-regional input-output models (MRIO) and will draw conclusions on the characteristics, strengths and weaknesses of the individual approaches.
Finally, options for enhancing the models will be examined, considering also the integration of type A and B models into a hybrid IO-LCA model. The study will propose a research agenda towards a common framework for the robust and transparent assessment of environmental footprints in agriculture and forestry, urgently demanded by European policy makers for achieving resource efficient economies.

**Biographical Sketch:** Martin Bruckner graduated 2005 in Economics and Computer Science from Vienna University of Technology and received 2010 a Master's degree in Social and Human Ecology from Alpen-Adria-Universität Klagenfurt. He was visiting scholar in the master course of Ecological Economics at Universitat Autònoma de Barcelona. He is currently a PhD student at University of Natural Resources and Life Sciences, Vienna. His main fields of scientific interest include global trade with bio-products, environmental footprints, input-output analysis and hybrid life cycle analysis.

**Water (WAT)**
**Program Leader: Pavel Kabat**

**Prajal Pradhan**

**Supervisor:** **Güther Fischer**

**Co-Supervisor:** **Harrij van Velthuizen,**

**Research Project:** **Closing the Yield Gaps: How Sustainable Can We Be?**

**Abstract:** Globally, food consumption patterns are changing towards affluent diets. Food production usually requires anthropogenic inputs, e.g. fossil fuels and fertilizer, and induces high environmental stress, e.g. greenhouse gas emissions. Presently about a billion people mostly from developing countries is living under hunger. However, crop production could be increased by more than 50% closing the yield gaps that mostly exist in these countries. Due to dietary changes and expected global population of around 9 billion, food production needs to be almost doubled by 2050. This might demand more external inputs and exacerbate environmental stress raising an important sustainability question: how to achieve food self-sufficiency on global, regional and local scale addressing the need to minimize the agriculture induced environmental stresses? My YSSP research will address the issue raised above. Specifically, the study will explore pathways to close the yield gaps investigating reasons behind the existing gaps and will estimate associated environmental stresses and anthropogenic inputs demand. The study will be carried out applying statistical tools, artificial neural network, and Geographic Information System on various freely available dataset, e.g. Global Agro-ecological Zones (GAEZ v3.0), FAOSTAT, Global map of irrigation areas, etc. Starting with identification of the regions with the yield gaps, the study will analyze causes of the gaps considering factors like anthropogenic inputs, technology, management and trades. Furthermore, the study will try to figure out relations between these factors and crop yield on a country scale based on their trends for the last decades. Using these relations, the study will try to project crops yield on a country scale based on plausible anthropogenic inputs, technology and management scenarios along with estimation of associated environmental stresses and anthropogenic inputs.

**Biographical Sketch:** Prajal Pradhan received a BE Agricultural Engineering degree from Tribhuwan University (Nepal, 2006) and a MSc Environmental Management degree from University of Kiel (Germany, 2009). He is currently a third year PhD student at Potsdam Institute for Climate Impact Research (PIK), Germany. The working title of his thesis is “Demand and Supply of Ecosystem Services Under Global Change”. His main fields of scientific interest include ecosystem services, food security, sustainability science, sustainable transitions, sustainable agricultural, climate change impacts, and climate change adaptation.

**Yihun Dile**

**Supervisor:** **David Wiberg**

**Co-Supervisor:** **Harrij van Velthuizen,**

**Research Project:** **Understanding the Implications of Water Harvesting on Upstream-Downstream Social-Ecological Resilience: A Case Study in the Lake Tana Basin, Ethiopia**

**Abstract:** A large number of people in the sub-Saharan are poor and depend on agriculture for livelihood security. Agriculture plays a key role in economic development and poverty reduction. However, agriculture in the tropics is characterized by extreme rainfall variability with dry spells and droughts which causes yield reduction and/or failures. Research has shown that innovative water and land management approaches such as water harvesting are options to achieve productivity gains in these agro-ecosystems. However, the implications of intensifying water harvesting schemes on downstream social-ecological systems are not yet adequately investigated. The objective of this research is to understand the implications of intensifying water harvesting systems at meso-scale catchment on upstream-downstream social-ecological resilience. The case study area for this research is located in the Lake Tana basin, the Upper Blue Nile Basin, Ethiopia. A hydrological model called SWAT is used to simulate the consequences of the water harvesting interventions on upstream productivity improvements (e.g. increase in agricultural yield) with water harvesting during good climatic years, and at the same time assessing the potential of water harvesting systems as dry spell and drought proofing options during bad climatic years. Moreover, the consequences of implementing water harvesting on downstream social-ecological systems will also be studied. These includes examining both the negative consequences (e.g. reduction in stream flow, degradation of water-related ecosystems, etc) as well as positive consequences (e.g. ground water recharge and sustaining stream flows during dry seasons, water quality improvement, etc). This is a collaboration research project between Stockholm Resilience Center, and Stockholm Environment Institute.

**Biographical Sketch:** Yihun Dile received his BSc. in Hydraulic Engineering from Arba Minch University-Ethiopia, in 2005. He pursued his MSc degree in Water Resources Engineering from 2007-2009 at Lund University (Sweden). Since 2009, he is a PhD student at Stockholm University in the Stockholm Resilience Center. The title of his PhD degree is water resources and social-ecological resilience in dryland agricultural landscapes. Yihun's main fields of interest are water resources management for poverty reduction, and sustainable development. Yihun also holds research associate position at Stockholm Environment Institute.

**Jacob Teter**

**Supervisor:** **Paul Yilla**

**Co-Supervisor:** **David Wiberg**

**Research Project:** **Exploring the Water Implications of Future Energy Portfolios Under Climate Policy Scenarios: California Case Study**

**Abstract:** In the coming decades, growing demand for energy and water and the need to address climate change will create huge challenges for energy policy and natural resource management. Synergistic strategies to conserve and use both resources (energy and water) more efficiently must be developed. Existing research identifies California (CA) as one of two regions (of 21 within the U.S.) where water use unambiguously increases across multiple policy and technology scenarios to 2050. But a watershed-level analysis is necessary to evaluate impacts & formulate mitigation strategies. I will develop a methodology that examines water demands & quality impacts of the energy sector, and will then identify water constraints and opportunities to improve water use efficiency.

My project focuses on the lifecycle water use implications of the key energy supply chains servicing CA's consumption of energy services. I will separately assess the water use impacts of energy supply in the form of (a) traditional liquid fuels; (b) electricity – including natural gas and shale gas feedstocks, as well as renewable generation technologies such as geothermal and CSP – which have potentially substantial water use impacts –, and (c) biofuels sourced from domestic feedstocks (i.e. from within CA as well as elsewhere in the U.S.)

Working with IIASA mentors, I will develop methods to translate non-spatial energy facility built out projections into spatially explicit scenarios. Accurately predicting facility locations to complement aspatial supply projections is impossible. Instead, the challenge is to create plausible siting scenarios that bound the range of possible water impacts and construct a narrative that offers insights into how to best allocate water. In consultation with IIASA mentors, I will analyze a mix of carbon policy and siting scenario outputs, seeking salient policy relevant lessons.

**Biographical Sketch:** Jacob Teter's research interests include lifecycle analysis, resource economics, and sustainability metrics. His concern is how these academic frameworks can inform wise policy. Jacob aims to gain expertise in scientific and statistical computing methods – his current five-year plan entails accruing proficiency in C, *R* and SQL. He further aims to refine his grasp of issues at the 'water-energy nexus' as well as in energy and integrated assessment (IA) modeling.

**Xue Wang**

**Supervisor:** **Günther Fischer**

**Co-Supervisor:** **Laixiang Sun**

**Research Project:** **Impact of the Changing Winter Wheat Sowing Area on Agricultural Water Footprint in the North China Plain**

**Abstract:** The North China Plain is the major wheat producing area in China. The sowing area of wheat in the plain occupies more than 50% of that in China. However, water is the most important limiting factor for wheat production here. In the Hebei Plain, the annual average effective precipitation of winter wheat ranges between 100mm and 130mm. The precipitation fill rate of winter wheat was only 20%-30%, and the irrigation water resources demanded during the winter wheat growing season are large, ranging between 270mm and 380mm. In comparison, the annual average precipitation fill rate of winter wheat in the south part of the North China Plain is larger, and the demand for the irrigation water resources is lower. From the statistics, sowing area of winter wheat in the North China Plain is shifting to the south part, where the precipitation fill rate is larger. Then, how will the winter wheat water consumption pattern, especially the irrigation water consumption pattern of this plain change as a result? I decide to use the water footprint theory to analyze the changing blue and green water use pattern in the plain as a result of winter wheat sowing area changes. Additionally estimation of the yield and water consumption of winter wheat will be fulfilled by applying GAEZ model proposed by IIASA and FAO.

**Biographical Sketch:** Xue Wang graduated in 2012 from Shandong Normal University. She is currently a first year PhD student at the Institution of Geographic Sciences and Natural Resources. Title of her thesis is Impact of agricultural land use changes on water resources in the North China Plain. Her main fields of scientific interest include land use changes, land use policy, water resources and hydrological models.