YSSP Participants 2011
Biographical Sketches and Research Project Abstracts
<table>
<thead>
<tr>
<th>Program</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced System Analysis Program (ASA)</td>
<td>2</td>
</tr>
<tr>
<td>Evolution and Ecology Program (EEP)</td>
<td>10</td>
</tr>
<tr>
<td>Energy Program (ENE)</td>
<td>15</td>
</tr>
<tr>
<td>Ecosystems Services and Management Program (ESM)</td>
<td>20</td>
</tr>
<tr>
<td>Exploratory and Special Projects (ESP)</td>
<td>38</td>
</tr>
<tr>
<td>Mitigation of Air Pollution and Greenhouse Gases Program (MAG)</td>
<td>40</td>
</tr>
<tr>
<td>World Population Program (POP)</td>
<td>45</td>
</tr>
<tr>
<td>Risk, Policy and Vulnerability Program (RPV)</td>
<td>48</td>
</tr>
<tr>
<td>Transitions to New Technologies Program (TNT)</td>
<td>56</td>
</tr>
</tbody>
</table>
Advanced System Analysis Program (ASA)  
Program Leader: Arkady Kryazhimskiy

Jing Dai

Supervisor: Brian Fath

Research Project: Network Analysis of a Social-economic Consumption System Based on Ecological Thermodynamic Theory: A Case Study of China

Abstract: The prominent conflict between consumption and environmental resources is acknowledged as a significant force in affecting the social-ecological community balance. The whole process of resource allocation, utilization, efficiency and outcome are crucial clues in uncovering the structural and functional characteristics in complex consuming systems. Herein, network analysis provides a system-oriented modelling technique for examining the structure as well as flow of materials or energy from an input-output perspective. Meanwhile, extended exergy, the only currently available second-law based metric for social-economic environmental impacts associated with energy consumption, manpower and monetary operation as well as environmental emission, is an extension of the labor theory of value and a possible sustainability metric. The core purpose of this research is to make a network analysis based on thermodynamic flow to explain the interrelationship among different sectors within a social-economic system. Therefore, we firstly make a database of extended exergy accounting in the Chinese consumption system. Data are available for 2008, which can be divided into seven sectors, namely, 1) Agriculture, 2) Extraction, 3) Conversion, 4) Industry, 5) Transportation, 6) Tertiary, and 7) Domestic sectors. Then we will construct an extended exergy network to gain insight into the thermodynamic distribution within sectoral criterion. Thirdly, the network analysis results are used to analyze China’s social metabolism maintained by a large quantity of energy, resources, and labor. Finally, the environmental costs, with a second law foundation, are demonstrated at the sectoral level.

Biographical Sketch: Jing is a PhD student at the School of Environment, Beijing Normal University. She graduated in July 2008 from Qingdao University of Science and Technology majoring in Environmental Science with a Bachelor of Science degree. In September 2008, she began her postgraduate career in Beijing Normal University, focusing on ecological accounting and urban ecosystem management. Her research plan for YSSP at IIASA is to analyze the ecological and social flows using a unified measurement by developing an ecological network model for the social-economic consumption in China.
Advanced System Analysis Program (ASA)
Program Leader: Arkady Kryazhimskiy

Supervisor: Elena Rovenskaya
Co-Supervisor: Arkady Kryazhimskiy
Research Project: Toward a Greater Understanding of Social Mood and Extreme Events

Abstract: Socionomic theory proposes that social mood influences the character of social events, including extreme events (Prechter 1999). Researchers have used the theory and its methodology to model and anticipate the tenor and character of many extreme social events, including the ascent and descent of globalization trends (Casti 2010), financial crises (Prechter 2002), and terrorist attacks (Galasiewski 2008). The primary metrics of social mood used in these studies are financial market indexes. Market indexes possess many properties that make them strong gauges of social mood. For instance, they reflect waves of optimistic and pessimistic sentiment within a context of uncertainty (Keynes 1936), investors can act swiftly to express changes in mood (Prechter & Parker 2007), meticulous data on price fluctuation is kept on many timescales and is available going back centuries in some countries, and financial market price fluctuation has fractal properties making their trajectories amenable to Elliott’s (1938) multifractal wave model. However, recent research shows that sentiment expressed on online social networks and via measures of wellbeing may precede mood’s expression in financial markets (Gilbert & Karahalios 2010; Bollen, Mao & Zeng 2011; Hall 2011). But the manner and degree to which these indicators can complement financial market indexes as both measures of mood and harbingers of extreme events remain unclear. My YSSP research seeks to untangle these dynamics using the Elliott wave model, an expert system for time series modelling, and other econometric techniques. The ultimate goals are to both better understand how social mood is expressed within a population and to produce a model complementary to financial markets to anticipate mood change and concomitant changes in the tenor and character of social events with utility for extreme event forecasting.

Biographical Sketch: Matthew is in his second year in the Department of Sociology at the University of Cambridge where he received the MPhil in Modern Society and Global Transformations in 2010. His macrosociological doctoral work seeks to understand how social mood motivates social change over time with an emphasis on economic, financial and political institutions. Prior to enrolling at Cambridge, he served as associate director at the Socionomics Institute in the United States where he remains a research fellow. Lampert holds undergraduate degrees in sociology and economics from the University of Georgia.
Advanced System Analysis Program (ASA)
Program Leader: Arkady Kryazhimskiy

Program Leader: Arkady Kryazhimskiy

Huayi Lin

Supervisor: Brian Fath
Co-Supervisor: Elena Rovenskaya

Research Project: Modeling Multi-agent Scenarios of Swedish Wolf Management

Abstract: The objective of this research is to build a model involving the multiple socio-ecological factors influencing sustainable management of the Swedish wolf population. The model simulates a set of heterogeneous agents in a given environment such that the interactions and adaptations between agents produce emergent properties of the whole system. The Swedish wolf is an endangered species whose management is influenced by the administration, the viewpoints of scientists and conservationists, the presentation of wolves from mass media, the opinion of hunters and farmers, as well as the geospatial positions of the different agents. The model will identify these main players and will focus on the behavioral and adaptive rules in this multi-agent environment. Viable data will be collected from publication, statistic institution, mass media and even a distant telephone-interview with the locals. Different scenarios will be presented as a basis for decision makers.

Biographical Sketch: Huayi received her Bachelor’s degree in Environmental Science from Jilin University, China, in 2009. Afterwards, she took part in a laboratory project on sorption characteristic of organic pesticides in the Environment and Resources Department at Jilin University. She also served an internship at the Environmental Monitoring Station of Liuzhou City, China. She is currently a Master’s student at the Sustainable Development Program at Uppsala University, Sweden. Her main fields of scientific interest include systems analysis and interdisciplinary study in environmental issues.
Abstract: Collapse analysis is a methodology used for understanding pre-cursors of critical changes in dynamical systems, such as extinction of species and populations in ecological systems, irreversible shifts in the state of the environment, economic and financial crises and others. Standard mathematical and data processing methods are often not applicable in collapse analysis because the systems under consideration are as usual uncertain and poorly formalized. Development of effective collapse analysis methods is a highly important methodological task. My research will employ a collapse analysis method (that I refer to as inclination analysis) proposed by Arkady Kryazhimskiy and Bruce Beck in 2002. The method works with families of stochastic binary models. Each model suggests path-dependent probabilities for positive and negative changes in the local transitions of the underlying dynamical system. The proposed approach sets up a technique, which, based on observed past transitions, identifies whether the system exhibits a tendency toward a collapse or toward a survival. Namely, for each binary model one finds the non-conditional (prior) probability of collapse/survival and the posterior one, conditioned upon the historical observations. The models, for which the posterior probabilities of collapse/survival exceed the prior ones, are judged to be collapse-oriented. I will investigate how inclination analysis could help to identify tendencies to collapse in the world financial system. Financial data preceding the latest world financial crisis will be used. In addition I will develop a prototype of a software package for inclination analysis of uncertain dynamical network models.

Biographical Sketch: Alena graduated in 2009 from the Faculty of Computational Mathematics and Cybernetics, Lomonosov Moscow State University, Russia. She is currently a second year PhD student at the Department of Optimal Control of MSU. Her thesis deals with nonlinear models of optimal control. Her scientific interests include optimization, optimal control theory and their economic, biological and ecological applications.
Abstract: The Kyoto Protocol is a first try to decrease pollution of atmosphere with the greenhouse gases (GHG), most probably responsible for the rise of the world temperature. The Kyoto Protocol provides for so called flexible mechanisms that includes trading of emissions aimed at diminishing the costs of GHG emission reduction. Although some markets of GHG emissions have been already implemented, they were limited to the firms’ level and selected types of emissions, the latter characterized by small uncertainties, say, of 2-5%. Other emissions to be traded within the Kyoto Protocol framework may be much more uncertain, e.g. 40-50%. Thus, simulation of trading emissions with larger uncertainties is of great interest. Actually, its significance goes even further, as it can help in designing markets for other environmental pollution permits, typically encumbered with high and differentiated uncertainties.

My research plan for the summer is to combine the existing models of GHG market: dynamic approach with considering uncertainties of emission inventories, and to create a multi-agent application to simulate the trading session. Such simulations aim at providing characteristics of the corresponding market. I also plan to test the negotiation protocols and develop algorithms for supporting decisions to be taken by agents.

Biographical Sketch: Weronika graduated in May 2010 from Warsaw School of Information technology, Warsaw, with a Master’s degree in software engineering. Her thesis dealt with using Web services for integration of multi-agent system of the commodity market with external systems. Presently, she is a researcher and a first year PhD student at the Institute of System Research of the Polish Academy of Sciences in Warsaw; she was also chosen for International PhD Projects in Intelligent Computing. Weronika’s main fields of scientific interest include multi-agent systems and their application in energy markets and emission trading.
Abstract: Access to clean drinking water is becoming harder, especially for the developing nations with their limited technical capacities. Water security in these countries, including Bangladesh, is particularly vulnerable due to the impacts of climate change on countries with low incomes, poor institutional capacity and limited ability to cope with changing condition of water supplies and escalating demands. The coastal area of Bangladesh is highly vulnerable due to rapid ingresson of salinity, frequent natural disasters and changing land-use, etc. Salt-water intrusion in coastal groundwater aquifers also reduces supply of drinking water for coastal households. People of the Satkhira district (Southwestern Bangladesh) are suffering from scarcity of safe drinking water caused by several natural and anthropogenic factors. The rural livelihoods strongly depend on water availability and use, so a proper assessment of water supply and demand, especially for the coastal region, is necessary for ensuring food security and sustainable development.

The general objective of my YSSP research is to estimate drinking water demand and availability for the southwestern Bangladesh, and analysis of the related uncertainties. The main aim is to demarcate inter-sectoral water demands and its distribution, options for water availabilities and incorporation of community based innovative ideas considering the uncertainties to ensure drinking water security under changing climatic conditions. The outcome of my YSSP research will be an integrated drinking water security model considering all important factors (hydrological, environmental) with their associated uncertainties.

Biographical Sketch: Shahriar has completed his B.Sc. (with honors) attaining first class position, and a Master’s degree with distinction in Environmental Sciences from Jahangirnagar University in 2009. Having a broad field of research interest, he is now working on water, climate change, Remote Sensing and GIS. He works as an Environmental & GIS Associate at the International Union for Conservation of Nature (Bangladesh). Shahriar has several international publications on Water, Remote Sensing, GIS and Environmental Issues. The main focus of his research is to define a drinking water security model for the vulnerable coastal areas of Bangladesh.
Abstract: There is no doubt that two major factors affect processes included in water cycle and the available water resources; these are changes of climate and land use. Direct controlling of the first one is currently impossible. The only actions a global community can take are decreasing negative anthropogenic influence on climate change, and creating adaptive solutions for ongoing changes. We can do much more in the area of water resources protection by understanding the significance of, and controlling the second factor – the land use.

In order to effective manage agricultural and urban water resources, tools like statistical decision support systems or physically based models are available and can be applied. These methods should be used for solving problems at both global and local levels.

The general objective of my YSSP research planned is to collect information on length and time resolution of data series that shall be used for determining the impact of particular sources (land use types and activities) on the quality and quantity of water resources.

This work is a part of a larger project aimed at creation of a physically based model for simulating the whole water cycle (surface and groundwater, water transfer, water use and discharges) and for tracking the paths of waterborne pollutants. My YSSP project should help to avoid fundamental mistakes at the stage of project structure preparation and development of basic assumptions and choosing the methods of work on models for the water balance and waterborne pollutants transport.

Biographical Sketch: Rafal graduated in 2007 with a Master’s degree in the water management from the Silesian University of Technology, Faculty of Mining and Geology. He is currently a second year PhD student at the University of Silesia. The draft title of his doctoral thesis is “Modelling of the transport of water and waterborne pollutants in the urban Nacyna River Basin”. He works in the Institute for Ecology of Industrial Areas and his research interests include: environmental modelling (surface and groundwater); transport of the pollutants in water bodies, soils and aquifers; revitalization of degraded areas; and water management in urban areas.
Abstract: The atmospheric CO₂ concentration is one of the factors that influence the vegetation cover development. Analyzing responses of the ecosystems in Ukraine to atmospheric CO₂ concentration helps us to predict the ecosystems tolerance (resilience) limits and its stability. Remote sensing data provide information about development and state of the vegetation cover in a particular moment of the time. Calculating indexes such as Normalized Difference Vegetation Index, Enhanced Vegetation Index, Photochemical Reflectance Index, and Perpendicular Vegetation Index allows to estimate changes in the terrestrial ecosystem and to derive conclusions about its tolerance limits. Remote sensing data helps to improve the available assessments of the limits and verify the results of the mathematical modeling related to the stability of ecosystems. Results of the research can be used for designing optimal management strategies enhancing sustainable development including the ecology and food security concerns.

Biographical Sketch: Mar'yana graduated from the National University of “Kyiv-Mohyla Academy” in 2008. She has a specialization in Ecology and Environmental Protection. She is currently a second year PhD student at the National Centre of the Aerospace Research of the Earth IGS of the NAS, Ukraine. Her first steps in research were taken in the land reclamation sphere in 2003; she was also a participant of the UNEP project “Oil Spill in the Kerch Strait”. Her current research interests are: benefits of ecosystems, climate change adaptation and stabilities of ecosystems.
Evolution and Ecology Program (EEP)
Program Leader: Ulf Dieckmann

Gustavo Burin Ferreira

Supervisor: Åke Brännström
Co-Supervisor: Oskar Franklin
Research Project: Effects of Temperature and Precipitation on Vegetation Structure

Abstract: With human activities altering the Earth’s natural environments at an accelerating rate, it is important to understand how Earth’s living organisms will respond to the ensuing environmental changes. Plant species might be particularly susceptible to environmental changes as they lack the option of migrating to environments to which they are best adapted. Studies of non-perennial traits, such as leaves, phenological characters, and physiological rates have helped to reveal how the Earth’s vegetation is responding to the most recent changes in climatic conditions. However, it is difficult to extrapolate future climatic impacts from present responses, and it is also challenging to disentangle responses caused by anthropogenic climatic changes from those that would be occurring also under natural conditions. To address these questions, a longer record of how vegetation has changed in response to climatic conditions is needed: such a long-term record can be obtained by studying tree rings, and dendrochronology (from the Greek dendron = tree, chronos = time, and logos = knowledge) is a well-established science that can be used to infer growth rates under different environmental conditions. Guided by dendrochronological data for two tree species in Brazil, I will aim to incorporate temperature- and precipitation-dependence in an established model of plant growth developed by a former YSSP participant (Falster et al. 2010). The model will then be used to study how salient aggregate properties of vegetation, such as net primary productivity and total biomass, are expected to be affected by future changes in temperature and precipitation.

Biographical Sketch: Gustavo received his undergraduate degree in Biology from the University of São Paulo, where he is currently a Master’s student. His degree project is focused on urban Cedrela fissilis L. trees and will be completed by the beginning of 2012. He intends to take a more theoretical/numerical approach in his PhD research, trying to adapt statistical filters commonly used in dendrochronology (but developed using only temperate species data) to the reality of tropical trees. Furthermore, he would like to employ computational modeling and simulations to understand the responses of tropical forests to climatic changes.
Abstract: As world population increases, anthropogenic habitat destruction becomes more prevalent and poses an increasing threat to biodiversity. To identify species at risk of extinction, it is important to understand the interplay between species interactions and habitat destruction. While recent modeling efforts have made great strides towards understanding the principal factors causing the extinction of species in response to habitat destruction, a common simplifying assumption made in these models is a hierarchical ranking of competitive abilities among the species occupying a focal habitat. Empirical studies, however, have suggested that this assumption is not always valid. Therefore aim to investigate the ecological consequences of incorporating intransitive competition in a habitat-destruction model. As previous studies have shown that spatial scales affect the outcomes of intransitive competition, both spatial and non-spatial models will be analyzed. Model outcomes will be contrasted with those resulting for a perfect hierarchical ranking of competitive abilities among species. Of particular interest is the extent to which intransitivity in competitive interactions affects biodiversity dynamics and extinction risks, and how the frequency and spatial extent of habitat destruction alter these results.

Biographical Sketch: Matthew graduated in 2003 from the University of Idaho with a Bachelor’s degree in Mathematics and a minor in Computer Science. He earned a Master’s degree in Mathematics in 2008 from Washington State University, where he is currently a PhD candidate scheduled to graduate in May 2012. His main fields of scientific interest include mathematics and its applications to biology, with an emphasis on habitat destruction and conservation biology.
Abstract: Humans are reciprocal animals cooperating with each other even though such behavior is costly. Indirect reciprocity is a mechanism for sustaining cooperation when individuals rarely interact with the same partners; such situations are increasingly ubiquitous in human societies (e.g., anonymous encounters in online marketplaces). For indirect reciprocity, reputation plays a key role: individuals help others with a good reputation, but not those with a bad reputation. Sharing information about reputations is therefore crucial for indirect reciprocity. In practice, however, it often seems costly to share information about the reputation of individuals. For example, while Amazon.com adopts a feedback mechanism to assess each seller, customers often do not submit such feedback because for them this involves extra work. More in general, collecting, sharing, and maintaining information is costly, so the availability and quality of information may suffer from a tragedy of the commons. Individuals, or a marketplace as a whole, may try to address these challenges by charging fees before allowing individuals to access reputation information, which can lead to the emergence of a reputation market operating alongside the dynamics of indirect reciprocity. During the YSSP, I will study cooperation dynamics under indirect reciprocity based on costly reputation information. I will identify the conditions that sustain cooperation and examine the following specific aspects. (1) Individuals may exchange reputation information either through pairwise interactions or through a centralized institution, so I will examine which mode is more efficient. (2) I will study competition among information providers and clarify conditions for the emergence of hubs among them. (3) I will study how conditions for cooperation change when erroneous reputation information can spread via gossip, or when information sellers have an incentive to cheat information buyers by providing them with inaccurate or false information.

Biographical Sketch: Mitsuhiro received a Bachelor’s degree in Integrated Human Studies from Kyoto University. He obtained a M.Sc. degree specialized in Complex Systems Science from the Tokyo Institute of Technology. He is currently a second-year Ph.D. student at the University of Tokyo and a research fellow of the Japan Society for the Promotion of Science. His research interests include the fields of evolution of cooperation, particularly indirect reciprocity, and the social dynamics in human societies.
Abstract: The rapid development in Asian countries has led to unprecedented economic growth, but endangered the stability of ecosystems. Aquatic ecosystems, in particular, are very vulnerable to certain anthropogenic disturbances, like pollution from industrial plants, which threatens their ability to provide food and clean water. Benthic macroinvertebrates and aquatic insects are regarded as one of the most suitable ecological indicators for water quality and play a fundamental functional role in aquatic food webs. In this project, I will analyze the response of benthic macroinvertebrate communities to disturbances using an individual-based eco-evolutionary model that describes essential life events (birth, death, movement, drifting, and adult flight), includes the effects of competition within the community, and enables local adaptation to, or tolerance for, extrinsic environmental factors (e.g., oxygen, temperature, pollution). I expect that my results will contribute to the prediction of community compositions in response to disturbances and thus facilitate the establishment of efficient assessment methods and management plans for aquatic ecosystems.

Biographical Sketch: Tuyen received his Bachelor’s degree in Theoretical Physics from the Honors Program for Talented Students of Hanoi National University of Education in 2006. He then completed the Master’s Program in Mathematical Ecology at the Department of Biological Sciences of Pusan National University in 2009. He is currently a second-year PhD student at the Department of Mathematics of Pusan National University. His scientific interests include the development of spatially explicit models, individual-based simulation, and the application of adaptive dynamics theory to analyzing the behavior and ecology of invertebrate (e.g., insects) and vertebrate (e.g., fish) animals.
Evolution and Ecology Program (EEP)
Program Leader: Ulf Dieckmann

Ziqiang Wu

Supervisor: Rupert Mazzucco
Co-Supervisor: Ulf Dieckmann

Abstract: Financial markets provide an efficient way to trade assets of various kinds. Asset prices determine investor decisions and depend on them in turn, leading to complex dynamics that are prone to drastic fluctuations in both asset price and investor wealth; an issue that, although not new, has recently attracted a lot of public attention. Investors themselves are intrinsically heterogeneous and adaptive with respect to their decision-making strategies, and while the market may reward “following the herd” for a while, any strategy is ultimately bound to fail when it is universally adopted. I will analyze the interplay between investor types and financial-market dynamics by studying a modified version of the agent-based Santa Fe Institute artificial stock market model, augmented to allow for the emergence of different investor personalities and to include a mechanism for social learning. I will study the emerging investor-type patterns, and try to draw qualitative conclusions about conditions that promote, or threaten, the stability of financial markets.

Biographical Sketch: Ziqiang received his Master’s degree from Tianjin University of Finance and Economics in 2009. He is currently a first-year PhD student at Tianjin University, majoring in Management Science and Engineering. His academic interests include agent-based computational finance, financial engineering, and evolutionary finance.
Abstract: As a result of current climate change concerns, policy efforts on both a local and global level are being designed to encourage the implementation of energy technologies that reduce greenhouse gas emissions. Energy models such as IIASA’s MESSAGE model are important in designing optimal energy policies that attain climate goals while still promoting economic growth. As part of reducing greenhouse gas emissions in the energy sector, increasing the usage of renewable energy sources is crucial. When designing energy policies to encourage the optimal amount of renewable energy, it is integral to have accurate supply curves of regional wind and solar power.

In recent years increasing amounts of wind and land geographic information system data have become available. Mesoscale wind models have also improved, greatly increasing the accuracy of wind maps. Taking advantage of these improved data sources, this study will review current renewable energy supply curve studies and attempt to implement improved energy supply curves in the MESSAGE model.

Biographical Sketch: Danielle graduated from Duke University in May 2005 with a degree in electrical engineering. In addition, she received a Master’s degree from Stanford University’s Civil and Environmental Engineering Atmosphere/Energy Department in June 2011. Currently, she is a second year PhD student in Stanford’s Management Science and Engineering Department where her main field of interest is the modeling tools used to evaluate the long-term environmental and economic effects of energy policies.
Abstract: Modeling the energy systems of developing countries is a particularly difficult task. These countries are different from industrialized nations in the challenges they face (poverty and social inequity, rapid population growth and mass migration to urban centers), their market structures (especially in rural areas), and the paths by which technological diffusion occurs. Moreover, the dramatic transformations currently taking place in these countries may in some cases require radical policies that present a clear break from the past. Scenario analyses can help to inform such policies, particularly those scenarios which take into account the specific concerns and challenges of the developing world.

In this project, we will study potential energy futures for the Asian region. First, we will review the various modeling approaches that have previously been used to develop energy scenarios for Asia, for example outcomes of the Asian Modeling Exercise. Then, we will develop our own scenarios utilizing MESSAGE, a well-established integrated assessment model at IIASA that possesses considerable technological detail of the global energy system. We will improve the treatment of Asian countries in MESSAGE, in terms of data representation and with respect to a variety of context-specific factors. The ultimate goal of this research project is to provide insights on overcoming the energy challenges faced by developing countries. To this end, we will focus on the climate and energy security impacts of alternate energy futures and what this implies in terms of policy costs and the required levels of technological deployment and demand management.

Biographical Sketch: Munsu is currently a PhD student and graduate research assistant at the Department of Energy Science, Sungkyunkwan University, Korea. His research interests include the utilization of systems models to analyze renewable energy technologies and green growth policies. Munsu has gained experience with techno-economic modeling tools through his work at the Greenhouse Gas Inventory & Research Center of Korea, where he has been involved in building an energy systems model for Korea. Munsu studied Political Science and International Relations for his B.S. degree, which he obtained from Korea University in 2009. During this time, he focused on Southeast Asian regional studies.
Abstract: Even in this 21st century, many rural dwellings are still using agri-residue, animal dung and fuel wood, to meet their cooking and heating energy demands. Utilization of these low-grade biomass fuels with traditional stoves results in significant indoor pollution, which women and children are exposed to the most. The mode of energy consumption and types of stoves in use may change with changes in prosperity. But there are various other socio economic parameters that may also influence these choices. This project will aim to analyze and model cooking fuel and stove choices including standard economic variables such as income, prices and costs, along with some variables unique to the developing country setting such as inconvenience costs. The objective is to model access to modern forms of cooking fuels or stoves that are less polluting and harmful to human health and more efficient in developing countries. Understanding the factors that determine household choices and demand for cooking energy services will form the basis for developing policy scenarios that can accelerate a quicker transition to either modern fuels or improved stoves.

Biographical Sketch: Brijesh, a PHD researcher in the Energy and Climate Studies division of Royal Institute of Technology (KTH) in Sweden, is working with Renewable Energy for Developing Countries. He holds a Master's degree in Energy Engineering from same institution. He has 15 years’ experience in the field of Rural Electrification with development agencies, NGO and private sector as a consultant/expert. He has expertise in project development, and human resource development, curriculum development for various vocational and academic courses and trainings. He was editor of a national energy related quarterly magazine. He has participated in various national and international trainings and conferences. He has published several popular science articles and some peer reviewed research articles in international journals.
Abstract: For a developing country like India, the twin problems of energy universalization and emission reduction can be achieved by increasing the share of Renewable Energy (RE) in the total energy mix. Governmental policies and incentives play an important role in encouraging private participation in increasing energy supply (RE generation). Specifically, off grid RE generation presents a promising opportunity to provide access to electrification. Hence, identifying the relationships between various input factors and incorporating them in a model are critical to quantify the impact of these policies on increasing electrification access in the country. This work on modeling (MESSAGE) of decentralized RE generation would contribute to extend the electrification access modeling framework to include some off-grid RE options.

Biographical Sketch: Kapil is an Electrical Engineer by profession and has been serving at the rank of a Commander in the Indian Navy for the past 15 years. After his three year military training at the ‘National Defence Academy’ he completed his BTech followed by MTech from IIT, Kharagpur in Control Systems Engineering. He is a certified ‘Energy Auditor’ and is presently pursuing his PhD at Indira Gandhi Institute of Development Research, Mumbai, in the field of ‘Energy Economics’. His research interests include Energy markets, Decentralized Energy solutions and Sustainable Development. He aims to formulate and implement an ‘Energy Policy’ for the Indian Navy and develop market innovations in energy finance.
Abstract: Since its creation in 1992, the United Nations Framework Convention on Climate Change (UNFCCC) has had as its ultimate objective to stabilise atmospheric greenhouse gas concentrations at levels that would avoid dangerous anthropogenic interference with the climate system. Since recently, also temperature limits are appearing in the international climate negotiations arena. For example, the Cancun Agreements of December 2010 recognize that the increase in global temperature should not exceed 2°C and also include considerations for a 1.5°C target. Assessing which future emission levels could be consistent with these temperature limits is a challenging task. The current scenario literature has not extensively explored this very policy relevant question. Therefore, this research project will aim at answering the following question: “What are the implications of different 2020 emissions levels for the attainability and costs for meeting stringent climate targets in the medium and long term?”

In order to answer this question, a scenario analysis with an integrated assessment model (IAM) is required. An IAM connects knowledge from different scientific fields (like energy systems, global climate impacts and socio-economic aspects) into one single framework. With IIASA’s MESSAGE model a set of emission mitigation scenarios with varying 2020 levels, in combination with different emission reductions pathways thereafter, will be constructed. The implications of these scenarios for the 1.5°C and 2°C temperature limits are then assessed with the reduced complexity carbon-cycle and climate model MAGICC. Finally, the underlying energy system and cost implications of the generated scenarios will be analysed to assess lock-in and inertia constraints on 2020 emission levels with respect to a given temperature limit.

Biographical Sketch: Joeri is a second year PhD candidate at the Institute of Atmospheric and Climate Science at ETH Zurich, Switzerland. In his thesis research he tries to quantitatively assess climate system uncertainty for deep mitigation emission scenarios. His main fields of scientific interest include climate physics, low-carbon and climate change resilient development paths, and climate policy analysis. He holds a M.Sc. in Mechanical Engineering and a complementary Master’s in Cultures and Development Studies from KULeuven, Belgium. Previously Joeri has worked three years in the field of development cooperation in Rwanda and as a researcher at the Potsdam Institute of Climate Impact Research in Germany.
Abstract: The agricultural sector of Pakistan consumes 96% of the country’s available fresh water resources. With a population of 187 million and increasing at an annual growth rate of 1.57%, the fresh water resources of the country will face severe stresses in the coming years. At the same time, there is uncertainty in the region about climate change, timing and intensity of rainfall, flood and drought events, and glacial melt coupled with unresolved issues pertaining to transboundary water resource management. Under these circumstances, investment in agricultural practices that ensure crop productivity and water conservation are critical to Pakistan’s food security. This research study will examine whether an investment into a water-saving irrigation system, such as drip irrigation system, would be a feasible option for agriculture in Pakistan. Irrigation in Pakistan is conducted through flood irrigation, which is not only wasteful but is also causing problems of water logging, salinity and very low yield per unit of water. By comparing the discounted costs and benefits under the two irrigation systems, this study will attempt to find out whether the adoption of drip irrigation systems will lead to higher profitability in the study area, a sub-region of Punjab. The economic analysis will be accompanied by an assessment of sources of uncertainty and analyze their potential impacts. The net present values of the revenue generated for wheat grown under flood irrigation system in Pakistan will be compared with that grown under flood and drip irrigation systems in countries with similar water stresses and soil conditions. Successful examples from countries where drip irrigation has been used will be reviewed.

Biographical Sketch: Mariya graduated in 2009 from Yale University, School of Forestry and Environmental Studies with a Master’s degree in Environmental Management, where she concentrated on water science, economics and policy. Her Master’s project assessed the behavior of farmers with respect to farm inputs in response to uncertain irrigation supplies in Pakistan. She is currently a research associate at Lahore University of Management Sciences in Pakistan. Her research interests include water economics and modeling, climate change impact assessments and efficient water management strategies particularly in developing countries. Mariya was previously a water policy researcher at COMSTECH Secretariat and also holds a Bachelor of Science degree in Computer Science from Lahore University of Management Sciences.
Abstract: It is indispensable to have timely and reliable crop production estimates prior to harvest at national to global scales. Such estimates are critical to managing food security policies and programs, mitigating food shortages, and formulating trade decisions and policies. The recent volatility in grain market prices and the mounting pressure on agricultural production due to extreme weather events, rising energy costs, civil conflicts, population growth, increased demand for meat, and land degradation underscore the importance of crop intelligence that is timely and global. Remotely-sensed satellite data, owing to their synoptic, real-time, repetitive coverage offer an invaluable tool for agricultural monitoring and pre-harvest assessment of crop yield and production in particular. Despite extensive research in this field, operational yield forecasting using earth observation still presents significant challenges to the agricultural monitoring community. My PhD research is focused on developing simple and robust methods for forecasting wheat yields using coarse-resolution, remotely-sensed surface-reflectance data. Wheat is one of the key cereal crops grown worldwide, providing the primary caloric and nutritional source for millions of people around the world. During the course of my PhD I have been working on developing a simple generalized regression-based wheat yield estimation model using daily coarse resolution data. The yield model was first developed for, and applied in, Kansas State (U.S.) to forecast wheat yields at the state level and was then applied directly to Ukraine, successfully forecasting wheat yields at the national scale. The objective of my YSSP research is to continue to enhance this model and assess its robustness and the feasibility of its application in other major wheat growing countries, including Australia, to forecast yields prior to harvest.

Biographical Sketch: Inbal is currently a PhD candidate and faculty research assistant at the Department of Geography at the University of Maryland. Her dissertation is focused on developing a generalized empirical approach for forecasting wheat yields at national scales using earth observations. Her main research interest is exploring applications of earth observations for agricultural monitoring at national and global scales, including methods for crop yield forecasting, crop type and extent mapping, and agricultural drought monitoring.
Abstract: The SAHEL region is largely impacted by the effects of climate change. Given the large role of the agricultural production (in some states more than 60% of people work in the agriculture sector) the proper understanding of extreme climate conditions on crop yield is necessary. In my work I will study the effects of extreme soil moisture conditions on crop yields in the SAHEL region by using soil moisture datasets from active microwave products and crop yield results from the Erosion-Productivity Impact Calculator (EPIC) model. The soil moisture dataset is derived from medium (ASAR GM) and coarse (ERS/ASCAT) resolution sensors, respectively. The SAHEL region is the transitional region between wet and dry climates known for strong soil moisture-evapotranspiration coupling. The question to be answered by my work is: Is there also a strong coupling between soil moisture conditions and crop yield in the SAHEL region? An investigation will be performed that compares the ASAR GM soil moisture and crop yield anomalies in years 2005-2011. The soil moisture anomalies will be first analyzed on yearly basis. In addition, the sensitivity of the crop yield to soil moisture anomalies at different growth stages will be investigated. The soil moisture anomaly computation will be based on the usage of the 17 year-long soil moisture time-series from the ERS satellite as a reference measure. A discussion will be provided summarizing the role of mean soil moisture and soil moisture distribution on the crop yields.

Biographical Sketch: Marcela's research interests encompass application of microwave remote sensing for studies of water in vegetation and soils, and development of practical tools for data processing in remote sensing platforms. Her PhD thesis aims to improve understanding of ASAR backscatter over land surface to facilitate advanced retrieval of geophysical parameters. Marcela gained five years of combined education in Geography at the Charles University in Prague, Czech Republic and at the University of Nebraska-Lincoln (UNL), USA. Since April 2007 she has been a radar and GIS analyst at the Institute of Photogrammetry and Remote Sensing at the Technical University in Vienna, Austria. She has presented her research work at numerous conferences, published numerous conference papers and currently finalizes two journal papers.
Abstract: Agriculture is one of the major economic sectors of Ukraine (71% of total area is agricultural land, 15.6% of total population is involved in agricultural production, agricultural GDP makes 8.2% of total GDP), therefore, improving agricultural practices is of critical importance for economy, environment, and society in Ukraine. Rapidly increasing intensification of agricultural production promotes occurrence of the large agrarian enterprises. These processes lead to certain consequences. An export-oriented business has a raw character, does not fulfill social goals and carries environmental risks. From viewpoint of environment protection, often, uncontrolled fertilization produces negative environmental footprints. Negative impacts include water, air, and soil pollution due to chemical overuse; degradation of soils; loss of soils fertility, etc. due to inadequate mechanization and intensification rates. Main sources of agricultural N2O emissions are mineral fertilizers. The main goal of my YSSP research is to identify agricultural practices and crops portfolios which will meet local agroecological conditions and fulfill consumers’ demands satisfying constraints on financial resources and availability of infrastructure. My research will help to improve local policies for robust land resource utilization and integrated management of diverse risks.

Biographical Sketch: Aleksey graduated from the Agrarian University (Vinnitsa, Ukraine) with specialization in agricultural economy. He is currently a junior researcher at the Department for Economy and Policy of Agrarian Transformations of the State Organization, Institute for Economics and Forecasting (IEF) of the Ukrainian National Academy of Sciences. His main research interests focus on identifying and estimating socio-economic and ecological impacts of agricultural production intensification. At present, Aleksey is developing a methodology concerning agro-ecological impacts in conditions of large scale enterprises activity.
Abstract: Austria has been committed to a 16% reduction of CO₂ emissions compared to the reference year 2005 and to an increase of renewable energy production to 34% of final energy consumption by 2020. Even though Austria has implemented a number of policy instruments to attain these targets, it is still far from complying with them. My thesis assesses the cost-effectiveness of policy instruments that are currently in place such as feed-in tariffs and fuel blending obligations or that may be implemented in the future such as a CO2 tax. Synergies and trade-offs between these instruments are analyzed with respect to CO₂ emission reduction and the substitution of fossil fuels. An existing spatially explicit bio-energy system model is used for this purpose and will be extended to include wind and photovoltaic electricity generation. The model will be applied to assess cost-effective policy instruments as well as to estimate the effect and the costs of policy instruments on the deployment of renewable energy technologies.

During my stay at the YSSP the model will be extended for wind energy. By using a spatially explicit model geo-physical and environmental restrictions as well as spatial variations in wind supply can be considered in order to determine the technical potential of wind energy in a first step. Upon the completion of the technical potential, the economic and the competitive economic potential will be identified.

Biographical Sketch: Viktoria graduated 2007 from the Vienna University of Economics and Business Administration. She is currently a third year PhD student at the University of Natural Resources and Life Sciences, Vienna and works in the advisory department of PwC PricewaterhouseCoopers, Vienna as a senior consultant. In her thesis she focuses on cost-effective policy instruments for CO₂ emission reduction and renewable energy support. Her main fields of scientific interest include quantitative methods, optimization models and investments under uncertainty.
Abstract: Evaluating the quality, quantity and location of agricultural production is essential for quantifying the earth’s capacity to meet growing food demands, competition among food, textiles, fuel or feed, and for improving the understanding of the current and potential agricultural production vital to sound economic and environmental decisions. Theoretical research is currently being conducted at IIASA in collaboration with the Food and Agricultural Organization (FAO) with the development of the most recent version of the Global Agricultural Ecological Zone (GAEZ) model v.3.0. The GAEZ v. 3.0 includes a spatially explicit assessment of global agricultural productivity potentials by matching biophysical characteristics with plant physiological requirements to describe potential crop suitability, extent and yield. The primary objective of the YSSP research is to evaluate potential yields and extent of agricultural production by incorporating finer, and more recent agricultural statistical data with the newest version of the GAEZ model. Creating downscaled 5 arc-minute (possibly, 30 arc-second) resolution spatial data layers of actual production for 2008 by employing recent statistics and state of the art remote sensing products will provide improved spatial estimates of actual agricultural yield and production. Inconsistencies between the actual and potential agricultural productivity reveal yield gaps that identify areas where the current agricultural production might be modified to increase yield. The results of this research can contribute to increasing agricultural productivity and land-use efficiency on an international scale.

Biographical Sketch: LeeAnn is a third year PhD student in the Department of Geography at the University of Maryland, College Park, U.S.A. She currently holds a Bachelor of Science degree in Environmental Science and Policy with specialization in Society and Environmental Issues from the University of Maryland. During her studies at Maryland, she has served as an instructor of Biogeography and a research and teaching assistant. Her scientific research interests include the use of remote sensing products in conjunction with social and economic statistical data, to evaluate current agricultural extent and yield for sustainable agricultural development and agricultural resource-use efficiency.
Ecosystems Services and Management Program (ESM)  
Acting Program Leader: Anatoly Shvidenko

![Profile Picture]

Julian Matzenberger

Supervisor: Petr Havlik
Co-Supervisor: Hannes Böttcher
Research Project: Demand-side Modelling of Biomass Products

Abstract: Biomass and bioenergy markets are expected to grow substantially in the next decades as a result of increasing prices of fossil fuels, concerns regarding the security of supply, the aim to diversify fuel supplies, costs of carbon emissions and subsequent strong political willingness to support bioenergy and other renewable energy sources. Competition for forest (by-)products, especially for low-grade commodities such as “waste” and pulp wood, can be anticipated to get stronger due to the increasing demand for bioenergy purposes. Historically low-grade fractions have been used to a large extent by the pulp and paper industry. Therefore the competing use for resources (generally resulting also in higher commodity prices) will affect demand for products from the pulp and paper processing industry. Analysing the demand side for products from the wood processing industry will contribute to a better understanding of the forestry sector, provide the possibility to forecast demand with better resolution and might therefore ideally lead to more accurate estimates.

In a first step the hypothesis that demand for certain wood products follow a Kuznets-like curve, according to which the per capita income determines commodity intensity will be tested. The focus lies on the pulp and paper industry in the first place and will, if possible, be extended to other forest products, such as fuel wood, wood based panels, sawnwood and the like. The analysis will presumably be based on Data from the FAO Forestry statistics. In a second step further variables affecting consumption based on econometric and regression analyses as well as techno-economic estimates are analysed. Variables with significant impact can be included in a system dynamic model, consistent with the regional aggregation of the GLOBIOM model.

Biographical Sketch: Julian has been working as a Researcher at the Economics Energy Group / Technical University Vienna since May 2010. His current research focuses on system dynamics modeling, sustainability and certification of bioenergy. Julian Matzenberger studied “Sustainability Management and Energy Economics” at the University of Applied Life Sciences Vienna (BOKU Wien), University of Leoben and ETH Zürich. He graduated in April 2009 after concluding his diploma thesis on „Supercritical water gasification of algal biomass” during a research stay at Paul-Scherrer-Institute. Prior to joining the Energy Economics Group, he was employed at a civil engineering office for Rural Engineering and Water Management.
Abstract: Past decades increasing shares of forest resources have been diverted from the forest sector to the energy sector. The increasing utilisation of forest fuel is, to a large extent, caused by policies introduced to reduce the emission of greenhouse gases. Because of emission targets the energy sector, and primarily the heating industry, is believed to continue to increase its use of forest fuel in their energy production. In order to assess possible effects of this increase on the forest sector as well as in the energy sector I have developed a partial equilibrium model. It is an economic model, and includes the supply of forestry wood and the wood demand from the sawmill industry, the pulp and paper industry and the heating industry in Sweden. However, a strong development of alternative technology, such as second generation biofuels is required to increase as well. Therefore, the general objective of my proposed research for the YSSP is to extend and refine the model to also incorporate the power industry, the refined wood fuel industry and the vehicle fuel industry. Alternative scenarios with a focus on the transport sector will then be developed and simulated using the extended model.

Biographical Sketch: Anna received her B.Sc. from Luleå University of Technology, Sweden, and her M.A. from the University of Toledo, U.S., both in economics. She is currently a second year PhD student at Luleå University of Technology and has recently completed her licentiate thesis with the title “Examining the competition for forest resources in Sweden using factor substitution analysis and partial equilibrium modelling”. Her research interests include the markets for bioenergy primarily from forest resources and equilibrium modelling.
Abstract: Ahmed's YSSP research is attempting to determine expected changes in soil properties that have occurred in the past and will occur in the future, taking into account the impact of climatic change on three main themes: Soil Salinization, Soil Erosion, and Soil Organic Carbon and Nitrogen cycling.

The research is also going to study the influences of these three themes on land use change. He will also map the land use in both previous decades and the current situation, and link these land use changes to changes in soil properties. In addition, modeling the land use changes in the future, taking into account future climate changes and changes in soil properties. The research will try to find relationships between climate change and land use change, and the impacts on the environment. Because the study will be carried out in two different climatic zones (Italy and Egypt), we may try to conclude whether these effects vary according to climatic zone or it is stationary effects in all cases.

Biographical Sketch: Ahmed is an Assistant Lecturer at Faculty of Agriculture, University of Alexandria, Egypt. He holds a Master's degree in Soil and Water science from Alexandria University (2007) and Bachelor's of Science from Faculty of Agriculture, Alexandria University (2001), with cumulative grade “Very Good with Honor degree”. He is currently a second year PhD student at the university of Napoli "Federico II", Italy. Title of his doctoral school is Improvement and Management of Agricultural Resources and Forests. His main fields of scientific interest include soil science, GIS and remote sensing, impacts of climate change on soils, land use change and climate change modeling.
Abstract: Biomass based fuels are used to replace fossil fuels in order to reduce greenhouse gas emissions of energy production and mitigate climate change. However, in some cases using bioenergy may not be only beneficial for the global climate. Carbon neutrality of biofuels has been questioned because of land-use change related emissions. These emissions are related to deforestation and consequent conversion of the forest land to energy crop cultivation, in which case bioenergy production reduces the carbon stocks of biomass, soil or both. These emissions are not limited only to land use change but important changes in carbon stocks may also occur within the same land use, e.g. when forest harvest residues are removed in addition to industrial wood. Increasing biomass removals from forests for bioenergy can decrease the amount of carbon stored in forest soil and litter. These effects can decrease the overall net GHG emission reduction potential of forest residue bioenergy significantly. Land-use-related emissions make it necessary to carry out a full-system carbon accounting and system analysis to assess the actual climate change mitigation potential of different bioenergy systems. The objective of my research is to link Yasso07 soil carbon model with IIASA’s G4M Global Forestry Model and assess impacts of bioenergy use scenarios in Europe. By adding soil and litter carbon effects of producing bioenergy from forest residues on the forest carbon balance, a more comprehensive greenhouse gas emission budget of forest bioenergy options can be calculated.

Biographical Sketch: Anna graduated from the University of Jyväskylä, Finland with a Master’s degree in Environmental Science in 2008. She is currently a first-year PhD student at the Aalto University, School of Science, Department of Mathematics and Systems analysis, Finland. In her PhD thesis she focuses on the climate impacts of forest bioenergy. Her main scientific interests are carbon cycle and carbon neutrality of biofuels.
Abstract: For the estimation of various forest resource variables such as biomass or biodiversity, the spatial extent of forests is an essential requirement. A series of initiatives for mapping forests aimed at providing harmonised forest information through consistent mapping approaches based on remote sensing imagery. All of these maps are potential input data sets for forest-related models, however each contains different properties in terms of spatial detail or thematic accuracy due to differences in methodologies. Since forest cover input in any environmental model can have a large effect on the results, the selection requires an awareness of the advantages and limitations of different options. Furthermore, uncertainties inherited in these maps are seldom included in the error budget of the model used to ensure the reliability of the output parameters.

The main objective of this study is to evaluate in detail the influence of the input data sets using a generic forest-related model at the European scale and to propose an approach how uncertainties of input maps can be incorporated in the error budget of the model. In order to achieve this objective, freely available pan-European forest/land cover data sets will be first tested for their applicability as input data sets for modeling. These maps have been compared in previous studies concerning their spatial agreement and in their forest area estimated including their uncertainties. This information will then be used for the error budget approach including input uncertainties. As a last step, an optimized forest data set derived from the three above mentioned maps will be produced for further use in forest-related models.

Biographical Sketch: Lucia received her diploma (Master equiv.) in geocology at the University of Bayreuth, Germany in September 2003. After her graduation she worked as a scientific officer at the Joint Research Centre of the European Commission in Ispra, Italy. Currently, she is a third-year PhD fellow at Department Forest&Landscape of the University of Copenhagen, Denmark. Her PhD thesis, which is entitled “Comparative analysis of harmonised forest maps in Europe: applicability for forest resource modeling”, is carried out in collaboration with the Joint Research Centre. Her main areas of scientific interest are monitoring and modeling of forest resources, uncertainty analysis and assessment of applicability of remote sensing derived maps.
Abstract: In my summer work I plan to investigate a method for integration of stochastic observation data provided by alternative sources. The method has been proposed by the ASA group; it suggests an approach to constructing an integrated probability distribution, based on the assumption that alternative data come from empirical observations of the same natural value. The latter assumption gives rise to a posterior event in the product of the probability spaces associated with the alternative data sources; a conditional probability restricted to that posterior event is a basis of the proposed integration method. I will work on theoretical foundations of the method and will apply it to accounting uncertainties and reducing final error estimates in the Terrestrial Biota Full Greenhouse Account (TBFGA) problem. More specifically, in my summer work I will, first, carry out a comparative analysis of uncertainties associated with alternative data sources used in analysis of the TBFGA problem; and, second, develop an integrated method for reducing uncertainties via combining data coming from different sources. In my research I will use the data base of IIASA’s ESM Program.

Biographical Sketch: Tatyana graduated in 2008 from the Faculty of Applied Mathematics and Physics at Vladimir State University (VISU) and in 2009 from the Faculty of Economics at the same university. She is currently a second year PhD student at the Faculty of Applied Mathematics and Physics at Vladimir State University (VISU), Russia. Her thesis deals with obtaining the Optimal control of cyclic processes with discount. Her main fields of scientific interest include optimization and optimal control theory and their economic and environmental applications.
Abstract: Algae are an attractive source for renewable energy (biofuels) and biochemicals. They grow using sunlight and can be cultured on arid land, therefore not competing with food crops. The design of a large-scale algae facility is not straightforward and many process steps are required. Biomass production is the first step involved and it influences many other processes in the production chain. The production of algae biomass itself depends on several input variables; among these are the type of reactor, the cultivation location, the production scale, substrates and operating conditions. The daily and yearly variation of light and temperature make this system very dynamic and these conditions determine the amount of algal biofuel that is produced. The production also depends on the availability of other resources that should be available near the production site. Thus, the design of algae production systems is dependent on the opportunities of the production environment. The interactions change constantly due to the dynamics of the system.

In the summer program I will focus on the suitability of different locations for large scale production. Models for algae production using 3 basic systems have been developed before and take into account light dynamics and the effect of design parameters and location. These models will serve as a basis to quantify the interaction between raw material sources and algal biomass production. Examples of such flows are fresh water, carbon dioxide and nutrients. The flows and their associated energy costs are important performance indicators for large scale algal biofuel production. Scenario studies will be used to deal with the variation in the flows during the day and year. Critical elements in the production system will be identified. Second milestone is the evaluation of patterns and trends in the logistics around algae cultivation, uncertainties will be included in the analysis.

Biographical Sketch: Ellen graduated with distinction in 2009 from Wageningen University (the Netherlands) in the field of biotechnology and operations research & logistics. She is currently in her third year of PhD at the Systems and Control Group of Wageningen University. The subject of her thesis project is advanced scenario studies for the design of large scale algal biofuel production systems. Her main fields of scientific interest include innovative energy systems, biobased economy, system analysis, logistics and dealing with uncertainties in models.
Abstract: The proportion and allocation of the principal land uses and the actual structure of forest cover determine the potential production of agricultural and forest products and have implications for hydrology, biogeochemical processes, biodiversity and aesthetical values of landscapes. Adequate spatial representation of the land use pattern and the forest cover structure provides essential information for assessing various features of landscapes and their changes. Therefore there is a need for integrated spatial land use / forest dynamics modeling approach. A particular challenge for planning and promoting socially and environmentally desirable allocation of land uses at landscape level is the small-scale land ownership which involves a multitude of individual decision makers having different objectives, attitudes and conditions. The main objective of my YSSP project is to further develop a modeling tool for analyses of land use and forest management planning problems at landscape level with consideration of the land ownership pattern. The model will be used in a case study to investigate land use change and forest cover structure development scenarios based on different policies for a selected area in Southern Sweden. Data from different sources will be used including the spatially explicit forest data produced from satellite images and forest inventory plots using a k-NN (k-nearest neighbor) algorithm.

Biographical Sketch: Renats graduated from the Latvia University of Agriculture in 2008 with a Master’s degree in Forest Engineering and from the Swedish University of Agricultural Sciences in 2009 with a Master of Science’s degree with a major in Forest Management. He is currently a second-year PhD student at the Southern Swedish Forest Research Centre of the Swedish University of Agricultural Sciences. In his PhD work Renats focuses on land use and forest management planning problems at landscape level in regions with small-scale land ownership. His research interests include land use, forest management planning, spatial and social simulation modeling.
Abstract: Wildfires can greatly affect air quality of surrounding cities. During the Russian wildfires in 2010, thousands of people were killed due to the effects of the smog and heat wave. To investigate these fire cases, I would like to 1) understand what had happened by matching predicted concentrations from fire/air quality simulations the observed air quality data, 2) see how the citizens could have escaped from the smog if the wildfire burned differently. Meteorological model, fire model, dispersion model outputs will all go into an air quality model (CMAQ) to predict the air quality in Moscow. Different parameters in these models will be adjusted to estimate how the smog impact could have been reduced.

Biographical Sketch: Aika graduated from Georgia Institute of Technology in 2010 with a Master’s degree in Environmental Engineering. She is currently a third-year PhD student in Environmental Engineering at the Georgia Institute of Technology. Title of her thesis is “Combining Fire Models and Air Quality Models for Predicting Impacts of a Prescribed Burning”. Her research interests include fire/plume dynamics and dispersion, fire emissions and their effect to air quality in the surrounding area.
Abstract: This research contributes to the overarching analysis of the water uses trade-off between ecosystem services and human beings. We will assess the trade-offs between green/blue water uses with ecosystem services and human beings in the Heihe River Basins in China. There are three reasons to analyze the trade-off the green/blue water use between ecosystem services and human beings in the Heihe River Basin. Firstly, ensuring sufficient water supplies are available is essential not only for human beings but also for ecosystems. With population growth and socioeconomic development, more and more water is used to meet the requirements of human beings. Secondly, water resources assessment and management often emphasize on blue water, and ignore green water. However, green water plays an important role in crop production and other ecosystem services. Lastly, the Heihe River Basin is a typical inland river basin. However, mainly as a result of human over-use of water, the Heihe river basin is confronted with serious ecosystem degradation. It is very urgent to investigate trade-offs between water uses of ecosystem services and human beings. For assessing water use for ecosystem services, we propose to use SWAT model to access the green/blue water resources quantities of Heihe River Basin. The products (wood and fiber, crop product, meat and fish) which have been supplied by the typical ecosystem and the typical water use associated with these will also be calculated according to the socioeconomic statistical data. We will to calculate the water use in the typical ecosystems (forestry, grass land, crop land and wetland) respectively. After the calculation of water uses for ecosystem services and human beings, the trade-offs will be studied and their policy implication will be analyzed.

Biographical Sketch: Chuanfu graduated from the Research Institute of Resources (Insect Research Institute) at the Chinese Academy of Forestry (CAF) in 2010. He is currently a first-year PhD student at the Nature Conservation College of Beijing Forestry University. The title of his thesis is “Water for Ecosystem Services and Human Beings: a trade-off analysis in the Heihe River Basin in China”. His interests include the green/blue water resources assessment and use in typical ecosystems, the ecosystem services in ecosystems and the trade-off between ecosystem services and human beings.
Ecosystems Services and Management Program (ESM)
Acting Program Leader: Anatoly Shvidenko

Supervisor: Laixiang Sun
Research Project: Spatial Up-scaling of Crop Dynamic Model: DSSAT and MCMC Algorithm

Abstract: Food security is one of the most challenged tasks faced by the humankind in this century, especially for China. Climate change represents an immediate and unprecedented threat to the food security, and the increased food import-dependence in many developing countries, including China, may be exacerbated under climate change. Concerted action is urgently needed to address this complex challenge. New research initiatives are needed to inform this action, by means of integrating and applying the best and most promising approaches, tools and technologies. The DSSAT and AEZ model are chose as the basis for a new platform, AEZ is a spatially explicit crop suitability and productivity assessment model, while DSSAT model is a point crop simulation model requiring specific and detailed environmental point data. Both models have many common parameters as far as crop genetics and adaptability characteristics are concerned. Here using field experimental data, and multi fuse methods to develop multi-scale mechanistic agro-ecosystem model. Accordingly, our research objective is to identify—through a quantitative approach involving data and model analysis— future crop management and land use patterns that minimize negative risks to food production. This proposed project will not only promote the understanding of the forces which drive the future dynamics of the agro-ecosystem and agriculture in China, but also quantify the future pathways in the face of serious climate change challenges, by identifying suitable and sustainable adaptation responses.

Biographical Sketch: Honglin graduated in May 2011 from East China Normal University, China, with a Master’s degree in Cartography and GIS, and works as a research assistant in Shanghai Climate Center (SCC), Shanghai Meteorological Bureau (SMB). His research interests include remote sensing data assimilation, especially assimilate the remote sensing data in the field of agriculture, climate change and its impact to the crop yield in China under different IPCC CO2 emit scenarios. His research plan for the YSSP is to up-scale the site specific model and integrate it into the AEZ model, use it to evaluate the climate change and its impact to the agriculture in China.
Abstract: Forests are locally and globally important ecosystems, providing habitat, timber resources, carbon storage and recreational opportunities. The carbon balance of forest ecosystem will significantly influence atmospheric CO$_2$ concentration and consequently climate. Therefore, it is important to quantify carbon storage and fluxes of forest ecosystems and analyze mechanisms involved in carbon cycling to better monitor the processes that regulate the uptake, storage and release of CO$_2$. Elevated CO$_2$ may increase the carbon sequestration of forest ecosystems, but nitrogen availability potentially limits the carbon assimilation in most terrestrial ecosystems. The integrated terrestrial ecosystem Carbon model (InTEC model) integrates the effects of disturbance (fire, insect-induced and mortality) and non-disturbance factors (growing season length and temperature, abiotic decomposition factors, annual precipitation, atmosphere CO$_2$ concentration, and nitrogen deposition). It can estimate the carbon sink/source of China’s forest but also allows estimating potential yields. These yields can be used in IIASA global forest growth model G4M as in input variable and get its carbon sink/source estimates under different management scenarios. To allow wider applicability G4M needs to be parametrized with the most important tree species of China’s forests. The research area is the entire China which covers a broad range of climates, from tropical to subarctic/alpine and from rainforest to desert. The result will be an estimate of the carbon sink/source of China’s forest ecosystem under a variety of scenarios (such as increasing CO$_2$, nitrogen deposition, extreme climate, forest management) until 2100 with two different approaches.

Biographical Sketch: Lei graduated from the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences in 2009 with a master degree in ecology. Sh is currently a second-year PhD student in Institute of Geographic Sciences and Natural Resources Research. Title of her thesis is ‘The effect of climate change and nitrogen deposition on carbon cycle of China’s terrestrial ecosystem coupling with an ecosystem processed-remote sensing model’. Her research interest includes climate change and ecosystem modeling, with an emphasis on the forest ecosystem.
**Exploratory and Special Projects (ESP)**  
**Research Scholar: Forrest MacKellar**

---

![Qianlai Luo](image)

**Supervisor:** David Horlacher  
**Research Project:** Documenting the Subjective Well-Being Gap Domestic and Cross-National: Income and Well-Being in China and a Cross-National comparison with the United Kingdom

**Abstract:** China has experienced impressive economic growth in the past three decades. The level of economic growth varies across the country. The changing economy has resulted in profound changes in health patterns. The area of subjective well-being has received increasing attention, but there has been scarce literature on this subject for China. In light of the gap in literature, this study will use World Value Survey and look at two health indicators for subjective well-being: self-assessed health and life satisfaction scale as outcomes.

The proposed study tries to answer these questions:
1.) Do rich and poor people age differently in China (measured by self-assessed health)? How does that compare to the UK?
2.) Do relative higher income predict overall better life satisfaction and better self-assessed health? How does that compare to the UK?
3.) Does other factor such as perceived social fairness modify the relationship between income and subjective well-being in China?

**Biographical Sketch:** Qianlai, who is from the Yi ethnic group in Southwest China, is currently a third year PhD student in Epidemiology at University of North Carolina-Chapel Hill. She holds a Master of Science degree in Health Ecology and Health Economics from Harvard University and a Bachelor’s degree in Chemical Engineering from Tsinghua University, China. Her main research interest lies in studying changing health patterns, particularly among disadvantaged groups, in the context of a rapidly changing national economy. Someday, she hopes to work in the United Nations System (e.g the World Health Organization or the United Nations Development Program). In everything she does, she hopes to be a worthy representative of her people.
Abstract: The numbers of deaths that occur in the world as a result of injury are greater than the total of HIV/AIDS, Malaria, and Tuberculosis deaths put together. 90% of all injuries occur in Low and Middle Income Countries (LMIC) yet the real determinants of injury in these areas are poorly understood and undocumented. Public participatory processes provide a seemingly viable alternative for creating injury data in low resource settings to help identify injury patterns and their socio-economic determinants. These processes are at the heart of the Volunteered Geographic Information (VGI) phenomenon which thrives on user generated content. The VGI principle has mainly had significant influence in aiding quick generation data useful in responding natural disasters (e.g. The 2010 Haiti Earthquake) and more recently the Libyan conflict. It has not been fully explored responding to the burden of injury in low resource settings yet it there is a huge potential for this.

The main aim of my YSSP research is to investigate how the VGI concept can be used to generate meaningful injury data and data on the socio-economic determinants of injury to inform and equip policy and decision makers to adequately respond to the burden of injury in LMIC. This will be achieved through a review of literature on the widely used method of gathering injury data and interpreting the determinants of injury. The Information Systems Research framework will be the framework for doing this research, to understand the application of the VGI in gathering and interpreting injury data.

Biographical Sketch: Prestige received his Master’s in Geomatics from the University of Cape Town in 2010. He is currently working as a Researcher at the African Centre for Cities based also at the University of Cape Town. His major research interests include the role of maps in presenting evidence on urban trends, particularly health trends and the role of geography as an organizing principle for information on urban spaces.
Mitigation of Air Pollution and Greenhouse Gases Program (MAG)
Program Leader: Markus Amann

Abstract: The specific climate impact for different types of passenger and freight transport has mostly been investigated for average travelers using average technology and globally averaged climate responses. During the YSSP, I will combine IIASA’s expertise on emissions and CICERO’s work on climate responses to look at the climate impacts from the transport sector beyond the average global values. We will look at the mitigation potential within a 20 years time period, but covering climate responses over different time horizons. The work will be divided into three phases. The first phase is to analyze the implications of using emission metrics based on pulse, sustained, or life cycle emissions. Most of the literature is based on pulse emissions. We will consider modeling sustained or life cycle assessment emissions, as these may be more relevant than pulse emissions in a policy context. The second phase is to consider regional conditions. First, the regional climate response differs for some of the species depending on the location of emissions. Emission metrics with different regional responses will be collected from the literature and incorporated into this work. Second, the emissions will vary between countries since the technologies and behaviors differ. The final and most important phase is to define “idealized mobility groups” within some core countries (EUR, USA, JPN), such as “green” travelers, average travelers, and “frequent” travelers over short, medium, and long distances. By considering different mobility groups, we can assess if mitigation is more effective by improving technology, changing transport mode, or reducing travel distances. This third phase will be prioritized.

Biographical Sketch: Borgar graduated in June 2009 from the University of Oslo with a Master’s degree in Geosciences and specialization in Meteorology. Most of the studies were completed at the University Centre in Svalbard. Borgar is currently a Research Fellow at the Center for International Climate and Environmental Research – Oslo (CICERO). His current research is on climate metrics and emissions from the transport sector. His main fields of scientific interest include climate metrics (GWP/GTP), greenhouse gas and aerosols emissions, black carbon (BC), and snow albedo impact of BC.
**Abstract:** The increasing use of renewable energy sources drives important changes in the energy system, such as growing fluctuations in the feed-in to the electricity network as a consequence of varying weather conditions. These fluctuations can be balanced by various means, namely grid extension, demand side management, energy storages and rapidly adjustable power plants. The energy conversion efficiency of thermal power stations can be enhanced by using excess heat for purposes of district heating or industrial processes. The proportion of combined heat and power (CHP) production is expected to increase in the future due to its potential for primary energy savings and the flexibility of gas and coal cogeneration plants. The country-specific potential for CHP depends on a variety of factors, such as heat demand, climate characteristics, population density and industrial structure.

The primary research goals are a quantification of the potential for CHP in Europe until 2050, and an assessment of the corresponding Greenhouse Gas (GHG) mitigation effect. The determination of the potential for CHP will be build on a comprehensive analysis of the techno-economic characteristics of CHP plants and an evaluation of the current and future heat demand accessible for district heating and industrial cogeneration plants. A possible expansion of CHP production by the installation of thermal energy storages and absorption refrigerators is also considered. Based on the changes in the energy system resulting from an extended CHP use, the GHG mitigation potentials and costs are estimated for a specific scenario.

**Biographical Sketch:** Hans Christian studied physics with emphasis on astronomy, particle physics and security policy at the Universities of Konstanz, Padua and Hamburg (Graduation in 2009). In April 2010, he joined the department of Systems Analysis and Technology Assessment of the German Aerospace Center (DLR) as a doctoral candidate. His main fields of scientific interest are the modeling of energy systems and the integration of high temporal and spatial resolution data into energy system models. Specific research foci are the future role of load management and electricity-driven Combined Heat and Power (CHP) in the electricity and heat market.
Abstract: Cost-efficient abatement strategies geared towards improving air quality and other environmental indicators have been of interest to policy makers and subject of research. IIASA’s GAINS model has been applied in Europe and Asia, at a regional and national scale, to support policy discussion. However, the existing model structure and resolution is insufficient to support the analysis on city scale. Given the importance of city emissions in China, developing a city-level model is necessary to assess the air quality and greenhouse gases (GHGs) mitigation benefits for their energy and environmental policies, as well as develop climate-friendly air quality management policies.

During the YSSP program, I will develop the structure of GAINS-City model by integrating the GAINS model and the bottom-up emission inventory tool developed by Tsinghua University. I will work with GAINS team to revise the input/output menu of current GAINS-China model to adapt the model to the needs of local policy makers. I will also work with Tsinghua team to develop a user-friendly “policy option” tool which can create emission scenarios and prepare inputs for GAINS-City model. After the completion of model structure, a careful review of emission factors and activity data from recent publications will be carried out to develop a local database for China. Then I will compare the updated database with the underlying data in current GAINS-China model, to explore the differences in model assumptions and their impacts on emission estimates. Finally, I will use GAINS-City model to estimate GHGs and air pollutant emissions in Beijing, for both base year (2005) and future years (2020 and 2030).

Biographical Sketch: Fei graduated in 2009 from the University of Science and Technology of China (USTC) with a Bachelor’s degree of Environmental Science. She is currently a first year PhD student at Tsinghua University. Her main fields of scientific interest include estimating emission inventory and modeling the relationship between economic development and air pollution.
Mitigation of Air Pollution and Greenhouse Gases Program (MAG)
Program Leader: Markus Amann

Pallavi Marrapu

Supervisor: Wilfried Winiwarter
Co-Supervisor: Markus Amann
Research Project: Analysis of the Impacts of Pollutant Emissions on the Air Quality and Radiative Forcing in South Asia

Abstract: The world's most polluted megacities are located in Asia highlighting the urgent need for efforts to improve the worsening air quality. There is also keen interest in understanding the interactions between air pollution and meteorology/climate in order to identify opportunities for using air pollution reductions to also reduce short term climate forcing. The Weather Research Forecasting - Chemistry (WRF-Chem), a state-of-the-science mesoscale meteorology and chemical transport model, is used to simulate atmospheric processes over a wide range of spatial and temporal scales. The study employs IIASA’s Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS)-Model to provide a consistent framework of emission reduction strategies targeted towards air pollution and greenhouse gas co-benefits. To accomplish the goal scenarios driven by the GAINS model are interfaced with the WRF-Chem simulations. The primary objectives of the research are to:
1) Understand the contribution of various emission sectors including transportation, power, industry, and domestic to pollutant concentrations at regional and megacity scales, specifically focusing on New Delhi (India).
2) Assess the impacts of long range transport of regional pollution on local air quality.
3) Assess the impact of the air pollutants from the source sectors on radiative forcing at multiple scales (from the megacity scale to the regional scale).
4) Explore the impact of future emission scenarios on air quality and radiative forcing in South Asia.
5) Evaluate the role of aerosol feedbacks in air quality models to observe interactions between meteorology, chemistry, and aerosols.

Biographical Sketch: Pallavi is a fourth year graduate student working under guidance of Prof. Gregory Carmichael at University of Iowa, Iowa City. Her research concentrates on sector based emission studies over megacities in India. She worked on the air quality forecast for the commonwealth games held in Delhi, India, 2010. Her main focus is to understand the aerosol and meteorology feedbacks and their interactions. She completed her Master from Indian institute of technology, Delhi from environmental engineering and management studying urban scale EPA model AERMOD.
Mitigation of Air Pollution and Greenhouse Gases Program (MAG)  
Program Leader: Markus Amann

Fang Yan

Supervisor:  
Kaarle Kupiainen

Co-Supervisor:  
Zbigniew Klimont

Research Project:  
Role of Superemitters in Transport Emissions and Impact of Potential Mitigation Strategies

Abstract: Superemitters, also termed as high emitting vehicles (HEVs) have been shown to be responsible for a relatively large fraction of air pollutant emissions from the transportation sector, though they represent a small portion of the vehicle fleet [Lawson et al., 1993; Pujadas et al., 2004; Bluett, 2008; Ban-Weiss et al., 2009; Zhou et al., 2009; Wang et al, 2011]. My early research shows that superemitters could contribute more than 50% of global on-road emissions around 2020, and therefore they should be specifically included in modeling work and addressed in mitigation policies [Yan et al., 2011]. However, there are no rigorous definitions or guidelines for identifying vehicles as superemitters. Furthermore, information about feasibility and efficiency of potential mitigation measures is lacking too. Limited observation data in only few world regions makes their characterization and inclusion in emission models difficult and current assessments are burdened with large uncertainty. Last but not least, most of the data and assessment work targeted on-road vehicles while off-road machinery needs certainly more attention; also because this sector is less strictly controlled and becomes more important in global emission balance.

During the YSSP program, my research will focus on 1) identification and parameterization of superemitters in emission models, 2) investigation of the effectiveness of policies which aim at eliminating superemitters. The main tasks will include understanding the key parameters that determine when and which vehicles turn into superemitters, and examining the efficiency of more frequent maintenance programs. The methods will include the review of the definition of superemitters in the literature, collection of background data source, and statistical analysis of available datasets.

Biographical Sketch: Fang is a third year PhD student in the Department of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign in the US. Her research interests include future emission projections, integration of economic and emission models, uncertainty analysis and climate mitigation strategies. She graduated from Tsinghua University, China in 2006 with a Bachelor’s degree in Environmental Science and Engineering and University of Illinois at Urbana-Campaign in 2008 with a Masters’ degree in the same field.
Abstract: Although a great deal of research has been done on aging in the Russian Federation, very little has been done on its Arctic population (Arctic Human Development Report 2009, where conditions are generally quite different from the rest of Russia. My YSSP research aims to reduce this gap in knowledge by focusing on aging in the circumpolar territories of Russia. There are 3 practical tasks to be done in this study: (1) to compute and analyze selected ‘aging’ indicators comparing conventional aging measures with 'prospective' ones (Sanderson, Scherbov, 2008); (2) to devise new measures of aging based on epidemiological data, and (3) to devise possible policies on a basis of my findings in (1) and (2) above. I expect the last point to be particularly challenging because the Russian North has few resources for adjusting to the consequences of population aging and has given aging a rather low policy priority. Available epidemiological characteristics of northern residents will supplement the profiles of health and wellbeing of populations across the chosen regions. The work will be based on data collected beforehand from Goskomstat and ArcticStat meta-databases as well as annual regional official publications.

Biographical Sketch: Anastasia holds a Master’s degree in Health Sciences awarded by the University of Oulu (Finland) in 2010. Born in Arkhangelsk (Russia), Anastasia’s background has a long focus on social issues, since she received her first diploma of higher education in social work at Pomor State University (2008) where she now serves as a tutor and assistant lecturer. Taking part in courses of International Institute on Aging (UN, Malta), Anastasia devoted her MA thesis to population aging, its demographical aspects and northern specificity. In this particular field her interests lie in the sphere of health and wellbeing in old age, aging indicators, its projections and policy planning within the Circumpolar area. Anastasia plans to continue the project within one of the doctoral programs she currently is being considered as an applicant.
Abstract: My summer research will focus on the determinants and spatial structure of interprovincial migration in China, and how they have changed over the period 1985-2005. To fulfill this objective, my proposed study will be carried out using Exploratory Spatial Data Analysis (ESDA) and spatial interaction models. Firstly, I will use GIS-ESDA to establish the spatial structure of interregional migration in China during the period 1985-2005. The key origins and destinations of migrants and changes over time will be identified. Secondly, I apply the widely-accepted factors on migration such as distance, the economic level, education level, living conditions, job opportunities, etc, with a multiple stepwise regression model to a cross-sectional time series data set, which consists of the interprovincial migration flows over last two decades in China. It is expected that different factors have disparate impacts on migration in China, and they can be decomposed into push and pull factors. Economic factors such as income may have become more important factors shaping China’s interprovincial migration, due to the economic transition period in China after the late 1970s. Thirdly, through determining the changes in migration spatial structure and its determinants, I intend to impose Morkov chain models to forecast the spatial distribution of migrants and determinants on interprovincial migration in China until 2020 based on the previous data and different policy scenarios. Finally, I will discuss the impacts of different factors on interprovincial migration and the policy implications of these factors for future population projections. Taking China's interprovincial migration during the period 1985-2005 as a case study, the proposed research helps to understand the mechanisms of migration determinants for internal migration. Moreover, my study will provide references for development planners and policy-makers to develop sound population policies to achieve regional sustainable development in China.

Biographical Sketch: Yang graduated from Beijing Normal University, China, in July 2008 with a Bachelor’s degree in GIS. She is currently a first-year PhD student at the Institute of Geographical Sciences and Natural Resources Research, at the Chinese Academy of Sciences. The title of her thesis is “Determining the spatial-temporal patterns of interprovincial migration in China, 1985-2005”. Her main fields of scientific research include migration, GIS and geosimulation.
Abstract: The demographic consequences of low fertility combined with a very high sex ratio in China are still poorly understood, decades after they first appeared in tabulations from the China 1990 Census. Partly, this is due to the novelty of female scarcity; most of the marriage squeeze literature previously published examined cases of male shortage after conflicts, and in contexts of above-replacement fertility. Although the first cohorts of males to be affected by double-squeeze on the marriage market are already born, population projection methods can play an important role in understanding the potential consequences of a variety of behavioral responses. My proposed contribution is an analysis of the ways in which marriage sorting behaviors including educational hypergamy interact with changing patterns of educational attainment to affect demographic dynamics. To this end, the research project at IIASA will build upon a previously validated cohort component population projection model for China that incorporates a marriage model and analytic models of the marriage squeeze. The marriage matching algorithm will be enhanced in order to incorporate the empirical marriage matching frameworks (Choo-Siow) and to model the consequences of patterns of increases in educational attainment in China that might be anticipated in the future. A possible output of this research is a new population forecast for China that takes the interaction of the relative scarcity of women and the educational attainment of men and women into account.

Biographical Sketch: Ethan is currently a third year PhD student in Demography at the University of Pennsylvania. His research interests include marriage markets, sex ratios, low fertility, and the demographic squeeze in China. His dissertation chapters address trends in health and mortality and consequences of high sex ratios in Central and East Asia. Ethan completed his undergraduate studies at the University of Washington in Economics and Chinese in 2003. He completed Master's degrees in Public Policy and East Asia Studies at the University of California, Berkeley in 2006.
Abstract: IPCC predicts increase in intensity and frequency of climatic extreme events (CEs) in 21st century. Pakistan, being a developing country with a heavy agricultural and natural resource based economy, is also highly vulnerable to climate change and CEs. Droughts, floods, heat waves, tropical cyclones and other meteorological disasters keep on challenging Government’s capacity to respond optimally to CEs in an efficient way. The recent disastrous CEs were 1998-2001 drought, 2001 flood in Islamabad/Rawalpindi and 2010 flood where approximately one-fifth of Pakistan's total land area went under-water. These events caused heavy losses to the national economy, especially to the agricultural sector. Pakistan’s agriculture is already confronting challenges of increasing temperatures and insufficient rainfall. If the frequency of these CEs is to increase in the future, the cost of crop losses in the coming decades could rise dramatically if proper adaptation measures are not taken in time. There is pressing need for research to discuss and interpret the multidimensional aspects of such CEs which are threatening nation’s food security and, based on such information, to resort to good adaptation practices for reducing associated risks related to CEs. The research will explore the direct climate-related threats on yields of major crops of Pakistan from 1961 till present. The focus will be to develop crop-weather statistical relationships to study how extremes like hot temperatures, warm spells, droughts, floods and other weather related extreme events had been affecting the crop yields in different agro-climatic zones of Pakistan. The results will be compared with other crop simulation methods and benefits and disadvantages will be discussed. Furthermore, possible effects for the future, based on SRES storylines, will be looked at too.

Biographical Sketch: Javeria graduated from the Quaid-e-Azam University, Islamabad in 2004 with a Master’s degree in Statistics. Since 2005, she has been working as a scientific officer at the Global Change Impact Studies Centre (GCISC) Islamabad where she is involved in Climate related research that includes Statistical Analyses of Climate (gridded & observational) datasets such as development and study of climate extreme indices, statistical downscaling for the seasonal forecast of rainfall (seasonal prediction) for different regions of Pakistan and analysis of climate change scenarios for the South Asian region. She is also a student of M.Phil in Statistics at the Allama Iqbal Open University where her research is focused on “Potential Predictability of Climate Extreme Events”. 
Abstract: While recent development designated South Africa as one of Africa’s leading nations, it also exemplified a major shortfall in the South African Energy Grid. In addition, with more than 80% of South Africa’s energy being produced by non-renewable sources, and as the leading carbon emissive nation in Africa, the South African Government has reaffirmed its stance on shifting towards renewable energy. This study will investigate the possibilities of harnessing geothermal energy from anonymously high geothermal gradients along orogenic zones by producing geothermal and hydrogeological models using available heat-flow and groundwater data. These models will then be scrutinised for their potential of supporting and generating energy from a wet-rock or hot dry-rock heat exchange geothermal energy system. If successful, this may initiate the use of geothermal energy and aid in South Africa’s carbon footprint.

Biographical Sketch: Taufeeq completed his geology degree with honours from the University of Cape Town in 2008 and is currently completing a Master’s degree at the Nelson Mandela Metropolitan University, specialising in mantle evolution, heat flow and geothermal energy. Furthermore, he is a member of the Council for Geoscience working in the north of South Africa on alternative energy, rural development and geological mapping.
Abstract: The sensitivity of crops to climate variability and a high dependence of a large proportion of population on agricultural activities would mean that any changes in the climate would affect the livelihood of millions of small and marginal farmers in India. This sector is particularly vulnerable to current climate variability, including years of low and erratic rainfall. With variable coping and adaptive capacity, farmers are likely to be differentially vulnerable to the current and expected impacts of climate change. This research study will focus on two aspects. First, we will carry out an analysis of key aspects of adaptive capacity which lead to differential impacts of drought on farmers. Second, we will examine the question what is the process through which existing coping and adaptive capacity among farmers translates into adaptation actions? This question is important to examine, because there is anecdotal evidence that even if farmers have the adaptive capacity to deal with climate variability, they may not able to translate it into adaptation actions. Various mediating factors such as local institutions, economic globalization, government policies plays important role in facilitating and constraining adaptation among farmers. The proposed research intends to examine these questions at length by analyzing the primary data collected during doctoral field work. The geographical focus of this study would be two districts of Western Orissa which is among the poorest and a drought prone region in the state. This research would contribute to the body of research on adaptation and adaptive capacity in the agricultural systems and among farmers to deal with climate variability and change among vulnerable farming households.

Biographical Sketch: Architesh graduated from Sambalpur University, Orissa, India, with an M.A in Economics in 2004. He completed his M.Phil in Economics in 2007 from the same university. He is currently a third year PhD student at the Institute for Social and Economic Change, (ISEC), Centre for Ecological Economics and Natural Resources, (CEENR), Bangalore, India. His thesis is titled “Climate Induced Vulnerability and Adaptation of Rural Households: A Study of Some Drought Prone Districts in Orissa”.
Abstract: The task over the summer is to develop a methodology to analyse typhoon-flood risk from a dynamic perspective. In traditional methods reliability of models depended on the assumption that the development of one risk system is a stationary Markov-random-process. In this research PPD (possibility-probability distribution) models are used to calculate fuzzy risk values of typhoon-flood events. Afterwards, taking the preprocessed data including typhoon-flood data, basic geographic data and distribution of building types as input, simulations are performed and the methodology is applied for different typhoon-flood loss scenarios on a GIS platform. Finally, a series of typhoon-flood risk development maps over time and description of relevant risk measures will be shown as the main research outputs. The methodology should provide useful information for emergency pre-arranged planning and proactive risk management strategies such as catastrophe insurance.

Biographical Sketch: Xilei graduated from the P.L.A Information Engineering University of China with a Bachelor’s degree of Geographical Information System, and got his Master’s degree in Physical Geography from the Hunan Normal University, China. He is currently a second year PhD student majored in Natural Disaster at Beijing Normal University. His main fields of scientific interest include dynamic risk analysis of natural disaster, risk decision-making and catastrophe insurance.
This research aims at developing a framework to identify and evaluate marketing strategies for farmers facing systemic yield risk, input credit repayment and liquidity constraints. The study focuses on the Dewas district in Madhya Pradesh where the voids in marketing infrastructure, storage and processing infrastructure and communication facilities have not allowed farmers to market their crops at stable and proper agricultural prices. Appropriate marketing strategies are particularly important given the fact that the farmers in this region have started cultivating more cash crops in recent years. In a liberalized market scenario and given weather fluctuations, these cash crops, which are dependent on world demand and supply, are associated with severe price fluctuations. The small and medium farm households who produce these cash crops are at times forced to make distress sales at low prices to the village middlemen because of various reasons that include liquidity constraints, storage risks, credit repayment constraints and high costs of transportation to the agricultural market. Novel initiatives suggest to provide important remedies, such as efforts to aggregate the produce of farmer groups and sell it effectively. There is also a nascent futures market that is present for marketing the aggregated produce. This research project aims at assessing these efforts and various marketing and price risk management strategies for farmers in the spot, futures and possibly options or price insurance markets.

Biographical Sketch: Thiagu graduated as an MBA from Indian Institute of Management Bangalore (IIMB) in May 2006. He has worked as a development consultant with the Center for Insurance and Risk Management, IFMR, Chennai. He is currently a doctoral candidate in Statistics and Economics at the Shailesh J Mehta School of Management in Indian Institute of Technology, Bombay (IITB). His thesis looks at issues in Agricultural Price Risk Management and Commodity Derivatives. His main areas of research interests include agricultural price risk management, commodity futures and options, advanced time series analysis, choice modeling and financial products development for low-income households.
Abstract: An essential part of stresses and risks on societies and their environments is imposed by worldwide catastrophic events. That is why the research, devoted to finding the optimal strategies for risk management of catastrophic events, is motivated by different needs of people on international, national and local policy levels. The goal of this project is to study the problem of catastrophe risk management from the multi-period, multi-hazard and multi-region points of view. Because of the uncertainty about the recurrence of the catastrophic event and the risk of zero risk capital at this point, it is necessary to consider the catastrophe risk management problems in multi-period environment. The goal of this part of the project is to consider the problem of risk management of catastrophic event as a multi-stage stochastic optimization problem with random variables, describing the catastrophic event, given by their distributions only, and to find optimal strategies for the policy in case of catastrophic event.

Multi-hazard approach should be considered as there might be the dependence of one catastrophic event on another, i.e. one catastrophic event occurs in some periods (or in the same period) as a result of another with some probability. This probability and the number of periods should be estimated. That could be done by the use of data on catastrophic events. Multi-region approach arises when there is a dependence of catastrophic events in different regions. In this situation the copula approach should be considered to study this dependence. By the combination of these three approaches the behavior pattern, that promotes the adaptation, resilience and resistance of societies to catastrophic events and contributes to decreasing their risk and vulnerability, could be developed and used on international, national and local policy levels, especially in developing countries with high risk of catastrophic event and low risk capital.

Biographical Sketch: Anna graduated in 2009 from the Moscow Institute of Physics and Technology with specialization in Applied Mathematics and Physics. She is currently an assistant of the project "Approximation in Stochastic Optimization with Application to Finance and Energy" at the University of Vienna and a second year post-graduate student in the field of System Analysis at the Institute for Control Sciences of Russian Academy of Sciences. Her main fields of scientific interest include stochastic optimization and approximation, risk management, adaptive and robust systems.
Abstract: The objective over the summer is to show how catastrophe bonds can become useful instruments that will contribute to a reduction of inefficiencies in the reinsurance market in the face of natural disasters. The proposed model looks at asymmetric information between insurance companies wanting to transfer part of their risks and the risk buyer (i.e. reinsures and investors in CAT bonds). Asymmetric information between insurers and reinsurers limits the reinsurance capacity for some insurance companies. The question is whether those, and only those, insurers can extend their coverage by issuing CAT bonds? The idea is that basis risk of CAT bonds, in particular the correlation between the insurer's risks and the CAT bonds' payoffs, can be crucial for such an extension of coverage. Designed in a certain way, CAT bonds can extend the coverage of the less risky type and thereby improve the optimal risk transfer. The model should offer also some empirical predictions that can contribute to the management of extreme event risk. CAT bonds would be issued by companies that are safer. The basis risk raised by CAT bonds will serve as a tool to address market inefficiencies which become even more pronounced in the face of natural disasters. A discussion of a possible application of the model on the global level should give a link to current efforts to transfer high layer risks to the international markets.

Biographical Sketch: Natallia is a third-year doctoral student in the department of Finance, Accounting and Statistics at the Vienna University of Economics and Business (Austria). She holds a Master of Science in Financial Mathematics from the Technical University of Kaiserslautern (Germany), and a Diploma in Mathematics from the Belarusian State University (Belarus). She was previously a financial engineer at Erste Bank (Austria), research assistant in the department of Financial Mathematics at the Fraunhofer Institute of Industrial and Financial Mathematics (ITWM, Germany). Her research interests include: reinsurance demand, catastrophe risk, alternative risk transfer.
Abstract: Land degradation poses a severe threat to the sustainability of agricultural production in the Ethiopian highlands. Soil erosion is greatest on cultivated land, compared with pasture land. As a result, nearly half the soil loss comes from land under cultivation. Efforts have been made to launch soil conservation programs in order to overcome the problem though many of these soil conservation programs in the past were disappointing and ineffective. Therefore, the main objective of this study will be investigating the factors that influence farmers’ conservation decision in one of the erosion affected highland regions of the country. The analysis will be based on a household survey conducted in July 2009. The data analysis techniques include conceptual models, descriptive statistics and econometric model. The conclusions drawn from the study might help in the design and implementation of intervention policy and programs for wider application.

Biographical Sketch: Abonesh graduated in 2007 from Haramaya University in Ethiopia with M.Sc. degree in Agricultural Economics. She is currently a third year PhD student in the Institute for Environmental Studies (IVM) at the Vrije University in Amsterdam. Her thesis is ‘Valuation of the Externalities of Improved Land and Water Management in the Upstream and Downstream of the Blue Nile River Basin.’ Her main fields of scientific interests include identifying the institutional-economic incentives for farmers to participate in improved land management practices, examine the impact of Payment for Ecosystem Services (PES) intervention in a watershed management and estimating the costs and benefits of soil conservation measures.
Transitions to New Technologies Program (TNT)
Program Leader: Arnulf Grübler

Md. Mokter Hossain

Supervisor: Arnulf Grübler
Co-Supervisor: Shonali Pachauri
Research Project: The Influence of Human Capital on the Adoption Rates of New Technologies

Abstract: Technology is increasingly bringing tremendous ease and comfort in human life. However, many people who are living in developing countries get relatively little advantages from new technologies either because they lack physical or economic access to new technologies or because of institutional and information barriers. Studies have shown that among others, education, income, policies, gender issues etc. have a huge impact on the adoption rates of new technologies especially in developing countries, which are generally slow. The proposed YSSP project aims to explore in particular the influence of human capital in adoption rate of new technologies as this variable (contrary to income or policy effects) has been to date under-researched in the technology diffusion literature. Two technologies are considered for this study: clean cooking stoves and cell phones. This project will try to test for significant relationships between different measures of human capital and the adoption rates of cell phones and cooking stoves using data sources at the level of consumer or household-level surveys. The geographical, demographic, and technological coverage of the final case study selected will depend on data availability. In terms of methodology, existing models of estimating human capital developed by the POP Program at IIASA will be used and linked to technology adoption rates via multi-variate regression analysis. The project is expected to contribute to an improved understanding on the influence of human capital on the adoption rates of new technologies in developing countries and to help to craft policies of closing technology gaps such as evidences in the much discussed “digital divide”.

Biographical Sketch: Mokter is a second year doctoral candidate at Aalto University, Finland. His research interests include new technologies adoption in developing countries and open innovation. He has earned MBA in International Business, MBA in Marketing and Post Graduate Diploma in Financial Management along with under graduation in Civil Engineering. Mokter has worked in Financial and Real Estate sectors.