YSSP Participants 2009:
Biographical Sketches and Research Project Abstracts
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Abstract: This project utilizes IIASA’s Greenhouse Gas and Air Pollution Interactions Synergies (GAINS) model to perform sensitivity analyses for various fuel-consumption reduction strategies in the U.S. transportation sector. Transportation in the U.S. comprises the second largest source of fossil fuel related CO\textsubscript{2} emissions (after electricity generation). The analytical method employed in this study includes 1) identification of key parameters for fuel-use reduction and their ranges (taken from relevant literature), and 2) calculating and implementing GAINS model sensitivity for each parameter. Though the initial goals of the project are to analyze U.S. transportation only, there is potential for applying this method to other countries as well. The final result will be a cost-benefit analysis of fuel-use reduction strategies, and recommendations for policy and implementation.

Biographical Sketch: Erica graduated from the University of Wisconsin-Madison, USA in December 2008 with a master’s degree in Atmospheric and Oceanic Sciences. In January 2009, she began a Ph.D. program at the University of Wisconsin in the Environment and Resources program as a member of the Nelson Institute Center for Sustainability and the Global Environment (SAGE). Erica’s research interests include interdisciplinary approaches to environmental and climate issues; particularly air quality modeling, environmental policy and mitigation strategies. Her Ph.D. research uses GIS and regional emissions modeling to quantify the contribution of freight transport to air pollution in the Midwestern U.S. and analyze how freight transport modes may be re-structured to achieve air quality and economic growth goals.
Abstract: In recent decades, a prime concern has been laid on the health effects of air pollutants. Several epidemiological and toxicological studies have well established that human mortality and morbidity rates have risen due to the criteria air pollutants, specifically particulate matter (PM). Studies have revealed that many hazards are associated especially with the particulates in the fine and ultrafine modes (PM2.5, PM1.0). In recent years, several measurement campaigns in India, mostly in urban areas, have focused on particulate matter and aerosols. Measurements have been carried out including chemical analysis and size speciation. Such data are invaluable not only in assessment of the local air quality and compliance with the respective standards but also in the evaluation of the performance of atmospheric models. Such models often operate at a regional scale and might be used to support the development of air quality policy. At IIASA, the APD project has applied the GAINS (Greenhouse Gas and Air Pollution INteractions and Synergies) integrated assessment methodology for India. The respective application (GAINS-Asia model) includes an assessment of the health impact of fine particulate in this region. Verification of the GAINS modelled estimates of PM2.5 concentrations will be the focus of the YSSP project this summer, based on a critical review of the published measurement data.

Biographical Sketch: Sapana graduated from the Guru Ghasi Das University Bilaspur, CG, India in July 2002. She holds a master’s degree in Chemistry with specialization in analytical chemistry and is currently a third-year Ph.D. student at the School of Studies in Chemistry, University of Raipur. Her thesis title is: ‘Studies on trace element composition and sources of aerosols’. She is currently employed as a Junior Research Fellow in the Department of Science & Technology working on a sponsored aerosol project entitled “Aerosol Pollution in Central India”. Her main scientific interest is investigation of chemical composition of aerosol particles, sources and their health impact.
Abstract: The North Atlantic Oscillation (NAO) constitutes the most important pattern of climate variability in the northern hemisphere midlatitudes. It describes variability in the "anomalous" atmospheric flow, i.e. variability not associated with the seasonal cycle. Through the influence on tropospheric flow, the NAO influences transport of anthropogenic pollution. For example, a large effect on transcontinental transport of anthropogenic ozone from North America to Europe has been shown; furthermore, there is evidence that the NAO phase largely controls transport of pollution to the Arctic. Both these features may have considerable implications in a changed future climate. This study will assess how the effect of the NAO phase on pollution pathways to and within Europe and the Arctic can be integrated in the GAINS model. Through this coupling, it should become possible to estimate the health impacts of different pollution transport pathways for selected European sites, or to assess the best mitigation options for reducing Arctic pollution. Exemplary runs with a tropospheric chemical transport model (CTM) will be planned, with the aim of identifying typical emission transport pathways for high and low NAO index polarity. From the CTM output, information about preferred transport pathways needs to be distilled, which will then be used to determine typical source-receptor relationships for European (and Arctic) model grid points, including transatlantic transport of emissions. These source-receptor relationships can then be integrated into the GAINS model, resulting in a version which explicitly considers low-NAO-index polarity, and one which explicitly considers high-NAO-index values. I will clarify how such source-receptor relationships are identified from the model output and coupled to the GAINS model, and if necessary, develop the relevant routines for this task.

Biographical Sketch: Gregor graduated in 2006 from the University of Vienna in Physics. He is currently a second-year Ph.D. student in the Atmospheric Chemistry and Physics group at the Institute of Environmental Physics, University of Bremen, Germany. Title of his thesis is “Data assimilation to study the inter-annual variability of the polar ozone layer”. His current research interests include the variability of the ozone layer, chemistry-climate interaction, stratosphere-troposphere coupling processes, and atmospheric physics in the environmental context in general.
Abstract: Available air quality data suggest that the pollutant of most concern regarding public health risk in South Asia is airborne particulate matter. Where measurements are available, some alarmingly high concentrations have been recorded, particularly in large cities. The strongest evidence for adverse health impacts is linked to fine particles, those smaller than 2.5 microns in diameter, known as PM2.5. IIASA’s GAINS model is an integrated assessment model designed for policy assessment purposes related to greenhouse gases and air pollution impacts. It includes an assessment of the health impacts due to fine particles as one of the most important endpoints to be considered. The GAINS estimates of PM2.5 concentrations are based on source-receptor relationships that, in the South Asia version of GAINS, have been developed using the full-scale TM5 chemistry transport model. To supplement the TM5 results, it is proposed to carry out further studies of the dispersion of fine particulate matter using an alternative modelling system ELMS (Eulerian-Lagrangian modelling System) comprising a combination of RAMS (Regional atmospheric modelling system) and LSPM (Lagrangian stochastic particle model), which is well established in this field. The study will focus on the Pakistan region to benefit from previous experience with these models. A further important element to the work will be to assess the effect of year-to-year meteorological variability on the calculated PM2.5 concentrations.

Biographical Sketch: Basit is a Ph.D. student in environmental engineering at the Pakistan Institute of Engineering and Applied Sciences (PIEAS), writing his thesis under the title of “Atmospheric dispersion and consequence modelling”. He graduated from the University of Engineering & Technology, Lahore in March 2000, with a bachelor’s degree in Civil Engineering. His areas of scientific interest include atmospheric particle dispersion and evaluation of consequences of any chemical/nuclear emergency.
Abstract: Recent studies reveal that anthropogenic emissions of aerosols might play a very important role in currently observed climate change and their sources could be addressed in designing a climate mitigation strategy. Domestic combustion is one of the key global contributors to aerosol emissions, especially fine particulate matter and carbonaceous particles. The estimates of these emissions, however, are burdened with large uncertainties. Consequently, the quality of projected future emissions is also poor, partly because most future emission calculations were developed by applying scaling factors with current emission inventories. Often, socioeconomic driving factors such as local economic structures, existing and future regulations, and technology development do not appear as parts of developing scaling factors. My YSSP research will focus on improving estimates of the current and future levels of emissions from domestic combustion sources, including (1) understanding sources and the mechanism of current household air pollutant emission, (2) studying how technologies will change in the future in different parts of the world, as well as (3) correlating different changes in household technologies with corresponding emission level. This work will link to the development and databases of the GAINS (Greenhouse Gas and Air Pollution INteractions and Synergies) and SpewTrend models (global air pollution emission model developed at the University of Illinois at Urbana-Champaign).

Biographical Sketch: Ekbordin graduated from Asian Institute of Technology (AIT), Thailand in 2002 with a master’s in Environmental Engineering. Before starting his Ph.D. in 2006 he worked on an international project in Thailand to develop diesel vehicle mitigation strategies for Asian countries. He is currently a fourth-year Ph.D. student at the University of Illinois at Urbana-Champaign, USA. In his thesis entitled “Response of future air pollutant emissions to socioeconomic conditions, infrastructure changes, and climate mitigation strategies” he will estimate future global air pollutant emission based on different socioeconomic and climate mitigation strategies. His research interests include emission estimation from transportation, light properties of different combustion sources, impact of climate change mitigation strategies and economic growth on air pollutants emissions as well as application of Geographic Information System (GIS) and remote sensing data in such analysis.
Abstract: Adaptive dynamics studies the evolution of continuous traits in a well-mixed population, assuming mutation is rare and incremental. We extend adaptive dynamics to structured populations, by combining the adaptive dynamics framework with previously obtained results on fixation probabilities for novel strategies that arise in structured evolutionary competition. We obtain a differential equation describing the most likely trajectory of long-term trait evolution which generalizes the canonical equation of adaptive dynamics. This equation is used to study how population structure promotes the evolution of cooperation in prisoner's dilemma and hawk-dove games.

Biographical Sketch: Ben received his bachelor's degree from Haverford College and master's from Bryn Mawr College, both in 2002 in Mathematics, with a concentration in algebraic topology. After teaching high school for three years, he enrolled in the mathematics Ph.D. program at Boston University, where he currently studies evolutionary dynamics, mathematical ecology, and the application of information theory to complex systems.
**Abstract:** Ecological community networks undergo phases of organization and disorganization both in ecological and evolutionary timescales. During this process, nodes and connections (the fundamentals of network structures) appear and disappear, governing the dynamics of species communities. The stability of a foodweb (in terms of persistence of a given community) as a function of the distribution and strength of its connectivity has been studied extensively. However, the relationship between network properties and resilience in foodwebs has not been addressed. Thus, the major objectives of my research are to investigate: a) whether we can quantify the resilience of an ecological network structure in terms of the system’s capacity to absorb disturbances; and b) whether we would be able to devise early warning signals for transitions in the dynamics of a foodweb. For this, we will study the responses of an ecological community to different intensities of perturbation on both network dynamics and structure. Our results will help develop general indicators of fragility for a wide range of complex systems which have similar network properties to the ones described for foodwebs.

**Biographical Sketch:** Vasilis studied biology in the Aristotle University of Thessaloniki in Greece and received his master’s degree from Wageningen University, Netherlands in Hydrology & Water Quality, with specialization in aquatic ecology. Since 2007, he is working on his Ph.D. thesis “**Generic early warning signals for catastrophic shifts in natural systems**”, under the supervision of Marten Scheffer and Egbert van Nes. His main research interest lies on the development of indicators for detecting impeding regime shifts in ecological systems.
Abstract: Promotion of compact cities is now enshrined in land-use planning policy in many countries, including China. Compact cities, characterized by relative high density, mixed land-use and pedestrian-oriented habitation, have been proposed as one solution for sustainable urban planning. China is in the process of rapid urbanization, and land saving is critical to the long-term sustainability of Chinese cities. Promotion of compact cities is helpful for land use sustainability. However, given the fact that Chinese cities are characterized by high population densities, the applicability of a more compact solution to expanding cities in China remains questionable; there is little evidence to support the many claims in its favor. Thus, this study is proposed for a quantitative simulation and optimization method integrating CA and GA about the compact city applied in land use pattern of Chaoyang District of Beijing City. The study provides a useful method for making effective and appropriate land-use planning policy with local context.

Biographical Sketch: Min graduated in July 2004 from the China Agricultural University with a master’s degree in Land Resources Management. She is currently a second-year Ph.D. student at the Institute of Geographical Sciences and Natural Resources Research, China Academy of Sciences. Title of her thesis is “Spatial optimization of land use allocation based on compact city theory”. Her main fields of scientific interest include urban land allocation and land policy.
Abstract: Various phenomena can be described as systems with dynamics covered by partial differential equations. The control of such processes often is distributed. Another characteristic of these systems is the presence of phase constraints. Several examples of these phenomena are:

a) ecological: optimization of shellfish production at a farm scale;
b) technological: minimization of pollution layer concentration by means of redistribution;
c) methodological: optimal search effort distribution subject to given density of object distribution.

Among the open challenges are two-dimensional problems and problems of optimal location of two or more licensed areas.

The general objective of my proposed YSSP research is to solve the optimal control problem with a two-dimensional advection-diffusion-reaction model in the case of control dependence only on one variable, namely, on transversal variable to the flow. This will be addressed in the following manner:

- to prove the existence of the solution of the optimal control problem;
- to create the approximation method to construct such a solution.

Biographical Sketch: Irina graduated in 2007 from the Faculty of Applied Mathematics and Physics, Vladimir State University, and received her master's degree in Applied Mathematics and Computer Science. Currently, she is a second-year Ph.D. student at the Department of Functional Analysis and its Applications, Vladimir State University. The topic of her Ph.D. thesis deals with the theory of optimization of distributed systems by distributed control in the presence of phase constraints, in particular, optimization problems with constraints in various ecological models covered by PDE.
Abstract: Rapid evolution and diversification plays an essential role in the formation of biodiversity and in the response of species and ecosystems to anthropogenic forces such as climate change, harvesting, invasions by introduced species, or treatment with pesticides or antibiotics. A particularly important evolutionary response involves biological diversification, causing an existing lineage to split into new forms or species. Traditional approaches to describing such evolutionary branching assume that fluctuating ecological conditions can be approximated by their equilibrium values when considering dynamics over longer evolutionary timescales. However, the fluctuations in natural populations due to demographic and environmental factors can have a significant impact upon their evolution. On the short timescales characteristic of anthropogenic evolution, the impacts of these fluctuations will be even more pronounced. The goal of this project is to devise a theoretical framework for understanding the impacts of demographic and environmental variation on evolutionary branching. We will develop numerical simulations and analytic approximations to quantify these impacts and determine under what conditions such fluctuations promote, frustrate, or forever prevent evolutionary branching.

Biographical Sketch: Carl received his bachelor's degree in Physics from Princeton University in 2007 with certificates in applied mathematics and bio-physics. He currently is a second-year Ph.D. student at the Center for Population Biology of the University of California, Davis. His research focuses on stochastic processes in ecology and evolution.
Abstract: A group’s public goods require costly investments by individual group members while benefiting all group members irrespective of their investments. This leads to a so-called social dilemma: as non-contributors cannot be excluded from the benefits of the public good, there is a strong incentive for free riding. Much research in the last decade has focused on public-goods games and on mechanisms that maintain cooperation, such as punishment of non-contributors or voluntary participation. However, important examples of public goods contain the strategic element of time, which has largely been neglected by both experimental studies and theoretical analysis to date. Without explicitly incorporating a temporal dimension, important features of several public goods are not adequately captured. Real-world examples, including investments into the prevention of climate change or effort levels in joint projects, suggest that the strategy “wait and see” plays a key role. Both examples are characterized by time pressure: joint projects usually have a deadline, and actions against climate change are more effective the earlier they are implemented. In order to incorporate temporal effects into the analysis of public-goods games, we consider an evolutionary model in which each individual determines not only the amount but also the timing of its investments. We include time pressure by assuming that the effectiveness of contributions to, or the benefits derived from, the public good change over time. The resultant evolution of strategies will be explored using analytical adaptive-dynamics techniques and agent-based simulations.

Biographical Sketch: Christian graduated in September 2008 from the University of Vienna with a degree in Mathematics. He is currently a first-year Ph.D. student in the biomathematics group of the University of Vienna. His thesis deals with public-goods games with incentives, in which players may be rewarded or punished according to their contributions to the public good. His main fields of scientific interest include game theory and its applications to biology and economy.
Abstract: Most epidemiological models focus on infection dynamics at the level of individual hosts or a population of hosts, without addressing the evolution of the infectious agent. Yet, disease evolution can significantly alter infection dynamics, at both the individual and the population level. The evolution of the virulence of an infectious agent is often analyzed in terms of a trade-off between the agent’s needs for achieving intense transmission between hosts while keeping hosts alive to prolong such transmission. Most research has therefore concentrated on the effects of virulence on classical epidemiological parameters, such as transmission rate or the length of the infectious period. Our aim in this project is to extend understanding of virulence evolution to host populations that are fragmented in space, forming patchy structures. This will require us to study, in addition, the effects of virulence on the spatial demography of hosts, including impacts on their residence time within patches, distance of movement between patches, and their chance of surviving such movement. We will use a stochastic model of a disease that is directly transmitted in continuous time in a host population that is patchy in space. The spread of the disease within and between patches will be modelled based on SIS-type dynamics excluding super-infection. The connectivity structure of the patchy host population is an important topic in this research, and different options will be studied; for example, all patches can be equally connected, or there can be a maximum movement distance for hosts.

Biographical Sketch: Marieke received her master’s (MSc) degree in Mathematics from the University of Amsterdam, the Netherlands, in 2006. In January 2007, she started her Ph.D. research at Utrecht University in theoretical epidemiology. Her thesis will deal with identifying conditions under which infectious diseases persist in fragmented host populations. Marieke’s scientific interests include applying mathematical models to biological and ecological questions.
Abstract: One of the most intriguing questions in biology is why there is such a high diversity of species. In a tropical rain forest, thousands of species of trees can coexist on only a few square kilometers of land as the result of a long process of evolutionary diversification. The general aim of my project is to develop a better understanding of the ecological mechanisms and principles underlying diversification in tree architecture. Using simple eco-evolutionary models, we will first determine tree architectures that maximize the seed production of a solitary tree, so that there is no influence of other trees. Second, we will analyze monomorphic or polymorphic outcomes of architecture evolution of trees in stands, in which competition for light, the risk of wind breakage, and the pattern of grazing a tree experiences depend on other trees in its stand. As a first approximation, trees will be assumed to have simple geometric shapes consisting of a spheroidal crown, whose top is attached to the tip of a conical trunk. Each tree will be characterized by three evolving traits: the trunk’s apex angle, the relation of crown width to crown height, and the amount of available energy invested into the crown relative to the trunk. In a horizontally well mixed stand, the effects of wind, grazing, and light competition depend on the stand’s vertical biomass distribution, and thereby on the architectures of all trees in the stand, rendering selection on trees in stands frequency-dependent. We will consider stands of trees that occasionally are destroyed through fires and then re-established from similar stands through global random seed dispersal.

Biographical Sketch: Magnus graduated in October 2005 from Lund University, Sweden, with a master’s in Physics, and in February 2007 he graduated from Malmö University with a teacher’s diploma. He then went on to work for a year as a secondary school teacher. He is currently a first-year Ph.D student at Umeå University, Sweden. His field of scientific interest is the basic mechanisms in plant ecology and evolution through adaptive dynamics methods. At IIASA he will be working on the evolution of plant architecture.
Abstract: According to life-history theory, the strong and size-selective mortalities imposed by modern fishing are supposed to induce evolution in life-history traits such as growth, age and size at maturation, and reproductive investment. In accordance with this expectation, many field studies have revealed altered growth rates, earlier maturation at smaller size, and higher reproductive effort in harvested populations. Experiments have corroborated these results, showing that surprisingly rapid adaptive evolution is possible in response to harvesting. Unfortunately, genes coding for detailed aspects of fish life histories have not been identified so far, which precludes validating the genetic nature of observed phenotypic trends. Genetic analyses of fish stocks have instead focused on neutral genetic markers such as microsatellites. This allowed studying the neutral evolution of genetic diversity, which has been shown to decline in some harvested populations. Life-history traits and neutral genetic markers are indeed subject to neutral evolution through genetic drift, i.e., through purely random processes affecting allele frequencies that are the more pronounced the smaller a population’s size. The aim of this project is to develop a generic model for studying the interplay between neutral and adaptive evolution in the context of fishing. For this purpose, an individual-based model will be devised that includes neutral genetic markers as well as quantitative life-history traits, and that accounts for the complex ecology of exploited fish stocks. Our model analyses are planned to address three objectives. First, we will explore whether we can identify relationships between fisheries-induced changes in the distributions of neutral genetic markers and changes in demographic stock characteristics such as population size, spawning stock biomass, and recruitment. Second, we will analyze the relative contribution of genetic drift and adaptive evolution in the responses of life-history traits to fishing. Third, we will investigate potential patterns linking neutral and adaptive genetic changes. If such a correlation were found, neutral markers, which are much easier to analyse empirically, could be used to establish early-warning signals for fisheries-induced evolutionary changes in exploited stocks.

Biographical Sketch: Lise graduated in September 2007 from ENSAR, the French Grande Ecole of Agricultural Sciences in Rennes, with a specialisation in Fisheries Sciences. She currently is a second-year Ph.D. student at Ifremer, the French Research Institute for the Sustainable Exploitation of the Sea, in Ifremer’s Fisheries Unit in Nantes. The title of her thesis is “Fisheries-induced adaptive changes in harvested populations”. Her fields of scientific interest include evolutionary biology, marine ecology, and fisheries management.
Abstract: The evolution of species interactions is central to understanding the structure and functioning of ecosystems. Improved insights into the underlying processes will shed light on how nature maintains its magnificent diversity of coexisting organisms. Although there are many types of interactions between species, trophic interactions between predators and their prey have particularly important evolutionary consequences, as these not only determine the viability of prey, but also affect interference and resource competition among predators. In this project, I will focus on the evolution of trophic interactions in multivariate niche spaces. The emerging properties of the resultant food webs, such as species number, connectance, as well as several other empirically measurable topological features of natural trophic networks will be studied. An individual-based model will be developed in which individuals are characterized by heritable multivariate traits describing the niches in which they are available as prey and in which they act as predators. Daisuke will also numerically analyze this model and compare the predicted evolutionary outcomes with empirical food-web statistics.

Biographical Sketch: Daisuke graduated from Kyoto University, Japan, in 2008 with a master’s degree in science. He currently is a first-year Ph.D. student at the Center for Ecological Research of Kyoto University. The topic of his thesis is “Mathematical modeling of the optimal defense schedule of an annual plant against seasonal herbivores”. His scientific interests include the evolution of ecological interactions.
Abstract: Seaweeds offer ideal habitats for many plants and animals in coastal ecosystems. In particular, kelp beds are important spawning and feeding grounds, and provide refuges for many fish species and other aquatic organisms. After kelp plants die, they are decomposed by bacteria and microorganisms in the water. This raises the level of nutrients in the ecosystem, leading to increased productivity of phytoplankton and zooplankton, which are key resources for juvenile fishes and mussels inhabiting the kelp-bed ecosystem. Using the modeling framework ‘Ecopath with Ecosim’, this project will integrate recent survey data and published information from the literature into a food-web model describing the trophic structure and energy flows of the kelp-bed ecosystem at Gouqi Island in the East China Sea. As Gouqi Island is one of the main mussel-cultivation areas in China, our research will focus on the potential interactions between mussel cultivation and kelp beds. We hope that this will provide new insights into the trophic ecology of this particular ecosystem and allow us to develop ideas pertinent to other instances of this unique kind of aquatic ecosystem. We aim to quantify the maximum carrying capacity for mussel production in the area around Gouqi Island. This would not only be useful for increasing the economic benefits and other services such an ecosystem can provide, but may provide managers with sustainable options for mariculture exploitation while minimizing the environmental degradation caused by mussel production.

Biographical Sketch: Lei graduated from Shanghai Ocean University, Shanghai, China, in July 2008 with a master’s degree in Fishery Resources. She currently is a first-year Ph.D. student at Shanghai Ocean University. Her fields of scientific interest include community ecology, spatial ecology of kelp beds, and fishery ecology. Her long-term goal is to model kelp-bed ecosystems used for cultivation and catch, to help fishers and local governments to increase economic benefits.
Abstract: A key issue in ecology is to understand mechanisms and processes causing speciation and extinction. Earlier theoretical studies have been based either on (i) physiologically unstructured populations of individuals characterized by one or more evolving traits or on (ii) continuously size-structured populations of individuals characterized by their maximally attainable size as the single evolving trait. While these models prioritize evolutionary or ecological realism, respectively, they suffer from complementary limitations: models (i) oversimplify individual life histories, while models (ii) are unable to explain the coexistence of ecologically different species with comparable asymptotic body size. A natural way of overcoming these limitations is to synthesize the two model types, by considering an evolving trait describing an individual’s ecological niche in addition to one describing its asymptotic size. Hence, the first goal of this project is to develop and implement a continuously size-structured population model with two evolving traits describing asymptotic size and ecological niche. We will then explore conditions under which species can diversify in these traits and examine the resultant multi-species communities. Technically, our model will use the canonical equation of adaptive dynamics theory together with numerical solutions of continuously size-structured population models to simulate the dynamics of evolutionary community assembly.

Biographical Sketch: Lai graduated in July 2008 from Yangzhou University in China with a master’s degree in Mathematical Biology. He currently is a first-year Ph.D. student at the Department of Mathematics and the National Institute of Aquatic Resources at the Technical University of Denmark. His Ph.D. project is concerned with the dynamical behavior of mathematical models for structured ecosystems. His fields of interest include community assembly, biological evolution with or without size structure, and traveling waves in reaction-diffusion dynamics.
Energy Program (ENE)
Acting Program Leader: Keywan Riahi

Benjamin Bryant
Supervisor: Keywan Riahi
Research Project: Applying Quantitative Scenario Discovery Approaches to Craft Robust Policies for Rural Energy Access

Abstract: Rural energy access is recognized as an important element of human development. Unfortunately, designing efficient and robust policies to promote rural energy access presents difficult challenges. Outcomes of interest are related to the disaggregated decision making of multitudes of heterogeneous actors. Additionally, these actors are faced with poorly characterized uncertainty, and may vary significantly in preferences and resources. In 2008, researchers at IIASA worked to address these challenges by developing a model of energy demand that accounts for many of the factors affecting private energy decisions in India. My summer research will build on this work by performing a variety of scenario and sensitivity analyses using techniques from IIASA and RAND, in addition to considering the model’s interaction with a dynamic supply side as provided by MESSAGE. This analysis will serve a direct goal in drawing solid policy implications from the model and in helping to find robust policies to promote energy access. The application of RAND’s “scenario discovery” techniques, in which model input spaces are searched with the goal of describing interpretable regions of policy vulnerability, will also serve a methodological purpose of assessing their potential contribution to IIASA’s already developed uncertainty analysis portfolio.

Biographical Sketch: Ben is a doctoral candidate in Policy Analysis at the RAND Graduate School, intending to graduate in the summer of 2010. He completed a Bachelor of Science in Mathematics from Harvey Mudd College, and has since worked in a variety of areas aiming to link quantitative analysis with policy relevance, including assessment of climate change implications for wildfire risk, clean energy advocacy in Washington DC, and generalized methods for decision making under uncertainty. His dissertation focuses on modeling the equity and sustainability impacts of water policies aimed at curbing the depletion of groundwater in North Gujarat, India. His long-term topical interests are in water and energy policy, with methodological interests in the appropriate use of mathematical models in support of decision making.
Abstract: A truly sustainable energy supply system would achieve a number of different objectives. While climate change mitigation nears the top of this list, other priorities include energy security; access to affordable, reliable energy for sustained economic growth; reduced impacts on air and water pollution; minimization of ancillary risks such as nuclear proliferation; and alleviation of global poverty via provision of modern forms of energy to the two billion or so people in the developing world who currently lack such access. The prioritization/ranking of each of these multiple objectives, however, is not shared equally by all entities (individuals, firms, and governments)—in fact the objectives are often in conflict with one another—and no single energy strategy has the ability to meet all of the objectives simultaneously. In this YSSP research project, I will examine the trade-offs between competing energy objectives and try to identify the energy strategies that are the most robust—those which fulfill society’s climate goals while contributing significantly to other aspects of sustainable energy development. To this end, IIASA’s global energy model, MESSAGE will be used to develop future energy scenarios that view the full range of energy challenges holistically and from multiple perspectives. This will be accomplished by applying multi-objective optimization to MESSAGE, providing a more realistic representation of real-world decision-making processes than the conventional approach of cost minimization under hard constraints. This YSSP research project will contribute directly to the Global Energy Assessment (GEA) at IIASA.

Biographical Sketch: David graduated from the University of Tennessee in 2004 with a B.S. in Chemical Engineering, and in 2007-08 he received M.S. degrees in both Transportation Technology and Policy and Agricultural and Resource Economics from the University of California, Davis. He is currently a graduate researcher and second-year Ph.D. student in TTP at the UC Davis Institute of Transportation Studies. His main research interests include energy systems modeling, scenario and policy analysis, greenhouse gas mitigation, and technology assessment, with a particular focus on transport technologies and fuels.
Abstract: Tropical deforestation is responsible for almost 20% of anthropogenic greenhouse gas emissions. Over the past few years, the role of forests in the climate regime has received increasing attention in international negotiations, where the topic is discussed under the acronym “REDD”. However, currently there is still heavy controversy about what an international mechanism for ‘avoided deforestation’ should actually look like. My YSSP project will be to design a Policy Exercise to examine global REDD policy options. Policy Exercises are a method for interactive, forward-looking policy appraisal. Departing from a future scenario, they bring together real-life stakeholders or experts in a future scenario setting. Participants are asked to act from within a given role and to execute a number of pre-defined tasks or make decisions that they need to take within a limited timeframe under the fictitious setting. Thus, Policy Exercises aim to expose, clarify and possibly reconcile contrasting viewpoints, to help grasp the topic in its full complexity and to devise options for future policy. The runs of the Policy Exercise itself are planned for the end of 2009.

Biographical Sketch: Constanze has a background in Environmental Law and Policy (LL.M. from the University of Kent, UK in 2005) and International Relations (B.A. from Dresden University of Technology). Currently, she is a junior researcher and doctoral candidate at the Institute for Environmental Studies at the Vrije Universiteit Amsterdam. Her main research interests are climate policy and law, both in their European and international dimension. Her Ph.D. research focuses on the potential of simulation-gaming approaches in climate policy appraisal.
Abstract: The upcoming international policy scheme for “reducing emissions from deforestation and degradation” (REDD) can play a pivotal role for climate protection and biodiversity conservation. The aim of the project is to research options for the spatial and temporal distribution of economic incentives in a REDD scheme, such that biodiversity and climate co-benefits are maximized. For this purpose, I intend to model deforestation for the case study country Papua New Guinea for the period 2000 – 2030 based on previous statistical deforestation driver analysis and opportunity cost data. Existing dynamic land use model structures (GEOMOD) will be used to simulate the country’s deforestation pathway in the future to test various REDD payment hypotheses. Not only the different effects of REDD payment duration, magnitude and distribution according to costs are interesting, but also according to deforestation risk. During the YSSP, I plan to create deforestation driver attribute tables (based on previously elaborated statistical results and scenario assumptions) of Papua New Guinea. In a later step these attributes (spatial properties, opportunity costs, etc.) will be incorporated in a GIS model to build a spatial deforestation probability map. Based on these results, several economic scenarios (variation in the amount and timing of opportunity costs, protection costs, demand drivers, etc.) can be tested under the model.

Biographical Sketch: Michael received a BSc degree in “International Forest Ecosystem Management” from the University of Applied Sciences Eberswalde in Germany in 2004. He graduated in “Environmental Sciences” for his MSc degree in 2007 from Wageningen University, The Netherlands. He is currently a second year Ph.D student at the University of Jena and affiliated with the Max-Planck-Institute for Biogeochemistry. The title of his thesis is ‘Economic and political alternatives for the gratification of emission reductions from deforestation and forest degradation under a future climate regime’. Michael’s research interests include political and economic incentive mechanisms for tropical forest protection and analysis of deforestation drivers.
Abstract: The optimal climate policy portfolio almost certainly includes both emission policies and technology policies, but deciding which of these is primary can significantly affect the design, implementation, and effectiveness of the portfolio. Emission policies induce technological change via a price on carbon, and technology policies push technological change through direct public support for research and development (R&D). Combining real options and risk minimization methods developed at IIASA with my current work of developing probability distributions for climate change, I aim to place climate policy portfolio selection in a risk management framework to determine how uncertainty about future climate change affects the relative weights of several types of emission and technology policies. I hypothesize that greater uncertainty about climate change over multi-decadal timescales favors policies that directly support R&D into carbon-free technologies as a means of hedging against bad outcomes. However, current levels of uncertainty may not justify significant near-term public support for R&D into air capture technologies that can remove previously emitted carbon dioxide from the atmosphere.

Biographical Sketch: Derek is a Ph.D. candidate in Energy and Resources and a master's student in Economics at the University of California, Berkeley. He is investigating how uncertainty and strategic considerations can influence the types of climate policies that should be adopted. He earned his M.S. in Energy and Resources in 2007, and obtained a B.A. in Philosophy and in Integrative Environmental Solutions from the University of the South in Sewanee, Tennessee in 2003. His previous work includes analyses of plug-in hybrid electric vehicles and digital mapping of land use change.
Abstract: An uncertainty-based approach is applied to carry out numerical experiments for the preparatory detection of greenhouse gas (GHG) emission changes (emission signals) under the Kyoto Protocol. The research will span the period 1990–2007 and cover the EU-27 Member States as well as a number of East European countries. The analysis will focus on the dynamics of the main parameters that impact preparatory signal detection (SD) during 1990–2007 (when preparatory SD is used in a monitoring mode) and that will impact preparatory SD in the future (here: during 2008–2012, the Protocol’s commitment period). The second part of the research will focus on estimating possible consequences of taking into account uncertainties and risk in implementing the EU’s "20-20-20 targets" considering GHG emissions after 2012. To keep the research focused, the production of energy will be considered and its structural changes analyzed from a long-term perspective. The aim is to investigate the influence of these changes on uncertainty and various emission scenarios, while considering uncertainty and structural change in the energy sector.

Biographical Sketch: Myroslava graduated in 2008 from Lviv Polytechnic National University in Applied Mathematics. She is currently a first year Ph.D. student at the same university. Title of her thesis is “Mathematical modelling and spatial analysis of greenhouse gas emission/absorption processes in regions bordering Ukraine”. Her main fields of scientific interest include analysis of the reduction of greenhouse gas (GHG) inventory uncertainties; studies of the influence of uncertainties on the verification of compliance with international obligations in consideration of risk and dynamics; approaches to the creation of geoinformation systems for GHG spatial inventory on a regional level; and studies on the influence of wind rose on processes of GHG emission.
Abstract: Climate change and its complex impacts on production, economics and environment are analysed in various scientific research projects. I am especially interested in trends and stochastic behaviour of ecological and economic changes of different crop production systems and their impacts on profitability, soil fertility and emissions. Climate scenarios for the future 30 years developed by linear regression have been integrated with other site-specific data such as soil types, crop rotations and different crop managements systems in the bio-physical process model EPIC (Environmental Policy Integrated Climate). The most important modules in EPIC are weather simulation, hydrology, erosion and sedimentation, nitrogen-, phosphor-, potassium- and carbon-cycles, plant growth, soil qualities and tillage operations. The simulated crop yields are used to stochastically assess the economic profitability of the different production systems, and to find optimal adaptation and mitigation strategies in crop production for the region. The method used is the calculation of certainty equivalents, which change with average variable costs and with the Pratt-Arrow-risk aversion coefficient. I want to deepen the economic analysis with respect to portfolio optimization. Therefore, the optimal choice within uncertain situations based on expected utility and risk aversion will be investigated. For instance, how much would a farmer be willing to pay for insurance to avoid uncertainty in crop production? We search an optimal mixture of risky assets that minimizes the standard deviation of the portfolio of each potential expected return. For this purpose, I will potentially work with Tobin’s separation theorem.

Biographical Sketch: Franziska graduated from the University of Vienna in January 2007 with a diploma in Meteorology. She is currently a Ph.D. student and research assistant at the University of Natural Resources and Applied Life Sciences in Vienna. In her Ph.D. thesis she focuses on climate change and its ecological and economic impacts on agriculture. Her main field of scientific interest is to analyze how sustainable agricultural production systems should be designed.
Forestry Program (FOR)
Program Leader: Sten Nilsson

Margarita Strelkova
Supervisor(s): Anatoly Shvidenko/Dmitry Shchepashchenko
Research Project: Assessment of Carbon and Nitrogen Lateral Fluxes in Terrestrial Ecosystems of Russia

Abstract: Carbon and nitrogen fluxes to hydro- and lithosphere are important components of the Terrestrial Biota Full Greenhouse Gas Account. However, they are insufficiently understood for terrestrial ecosystems of Russia. During the YSSP-2009, we plan to use two complimentary approaches for assessing lateral carbon and nitrogen fluxes. The first one is based on studying the process of decomposition of plant litter (aboveground wood, foliage, roots, and in particular fine roots) and its partition (the flux to the atmosphere, soluble part, products of humification). In order to provide spatially explicit distribution of litter’s input, its decomposition and transport, we will use the land cover map and corresponding databases developed by IIASA Forestry Program and published experimental data. Experimental data on concentrations of dissolved organic carbon (DOC) and nitrogen (DON) in rivers and lakes of the country will also be used.

My working plan includes:
1. Development of a database of concentration of DOC and DON in water reservoirs basin and fluxes of greenhouse gases from water surface. 2) Development of a map of catchments’ area of Russia. 3) Estimation of the area of water surfaces (rivers and lakes) based on a set of appropriate maps and remote sensing products. 4) Assessment of the amount of C and N that leaves terrestrial ecosystems with water. 5) Assessment of the amount of C and N that enters soil and accumulates on lithosphere biochemical barriers with decomposed organic matter based on IIASA’s set of maps (soil map, course woody debris, etc.) and models of organic matter decomposition. 6) Comparison of the results of two approaches used for the lateral fluxes assessment. We hope to get a spatially explicit distribution of carbon and nitrogen lateral fluxes in terrestrial ecosystems of Russia (aggregated by river basins and ecoregions). This study is a part of IIASA’s Forestry Program Project “Verified Terrestrial Biota Full Greenhouse Gas Account for Northern Eurasia”.

Biographical Sketch: Margarita graduated from the Faculty of Forestry, Moscow State Forestry University in 2006. She is a forestry engineer and a third-year Ph.D. student. Title of her thesis is “Assessment of carbon and nitrogen lateral fluxes in terrestrial ecosystems of Russia”.

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Abstract: As mentioned in Larson’s report in 2006, through replacing Tomlinson boilers in the pulp and paper industry, the refineries have economic incentives to become biorefineries and produce bioenergy, while at the same time satisfying the demand for paper and pulp products. Additionally, the adoption of bioenergy technology will result in a substantial level of bio power production, which has significant implications on GHG emission, employment, land use change, biodiversity loss, etc. Before starting to look at the potential impacts of the pulp and paper industry on GHG emission and land use change, it is necessary to understand the adoption process. Further, by identifying the factors that influence technology adoption and to allow for differences in new technologies provides great implications for policy making. During the summer I will examine the profitability of traditional refineries and the profit after adoption, under several policy scenarios. The profit functions are constructed in a geographical explicit manner for the USA with the BEWHERE model developed at IIASA. Then the difference between profits before and after adoption is regressed on possible factors, in order to find the most influential ones. Finally, the impacts from different new technologies and policies are compared.

Biographical Sketch: Yun received her master’s degree in Statistics from North Carolina State University, US, in 2008. Currently, she is pursuing her Ph.D. in Natural Resource Economics at North Carolina State University. Since 2007 she has been working on the supply of forest biomass in the US and her dissertation topic is on the economics of the forest biorefinery industry, in which she will explore the adoption of bioenergy technology in forest refineries.
Greenhouse Gas Initiative (GGI)
Scientific Coordinator: Fabian Wagner

Supervisor(s): Fabian Wagner/Markus Amann/Arnulf Grubler
Research Project: Quantifying the Interactions between Climate Change, Mitigation Policies, and Human Health

Abstract: Much uncertainty surrounds estimates of the effects of climate change, and greenhouse pollutant mitigation policies on human health. Warmer average surface temperatures may decrease the number of deaths associated with cold weather, for example, but are also expected to intensify heat stress in large cities. Yet, the specter of negative health impacts is a significant motivating factor behind efforts to stabilize atmospheric greenhouse pollutant levels. It is also an integral component of climate change adaptation and disaster risk reduction planning. I propose to study the interaction between climate change and health by 1) elucidating the co-benefits to health associated with greenhouse pollutant mitigation, 2) exploring whether data from the Global Burden of Disease Comparative Risk Assessment (CRA) might yield information helpful to the refinement of existing air pollution models, and 3) integrating lessons from the latest scientific findings on black carbon and aerosol health and climate interactions into climate change mitigation recommendations. Portions of this research will inform the Energy and Health Knowledge Module in the forthcoming Global Energy Assessment.

Biographical Sketch: Zoe graduated from Stanford University in 2003 with an interdisciplinary degree in Human Biology (Honors). From 2003-2008, she worked as a research associate at the Worldwatch Institute in Washington DC. She served as Washington Coordinator for the Center on Ecotourism and Sustainable Development (now Center for Responsible Travel) from 2003-2005, and held leadership positions with SustainUS, the US Youth Network for Sustainable Development. Zoe is entering her second year as a graduate student with the UC Berkeley Energy and Resource Group (ERG), where she focuses on the effects of climate change on human health. Her research interests include adaptation strategies, black carbon policy options, and effective climate change communication.
Abstract: Increasing demand and market liberalization loom a new cycle for investment in electricity production capacity. However, uncertainties inherent in this sector pose challenges for investors in terms of investment timing and the choice of investment scale and technology. Empirical evidences found in researches undertaken by Professor Patt et.al., from IIASA and PIK indicate that among various uncertainties, regulatory risks impose significant influence on investments. Built on those empirical evidences, I will work on MESSAGE and model regulatory uncertainty within that framework. The goal of the study is to examine the macro economic impact of regulatory risks through capacity investments in the sector.

Biographical Sketch: Lin holds a degree in Environmental Science and a minor in Statistics from Renmin University in China, with a specialization in economic analysis of environmental issues. She is currently a third-year Ph.D student at the Department of Geography and Environmental Engineering, Johns Hopkins University. She is interested in modeling the electricity market with uncertainties, especially uncertainties related to climate change policies. Her current project considers capacity expansion in the energy sector under carbon policy uncertainties and simulates investor’ investment portfolio when they are risk averse.
Abstract: Prioritizing malaria control strategies is a major concern for donor organizations seeking to reduce the prevalence of malaria among impoverished populations in tropical areas. However, while modeling the transmission of malaria in conjunction with single intervention strategies has constituted an active area of research, few studies have examined the possible interaction of multiple malaria interventions implemented as a package. Such interactions are likely to be counterintuitive due to well-known complexities inherent to malaria epidemiology. This project will parameterize a detailed and flexible model of age-structured malaria transmission and control, accounting for treatment using several antimalarial medications, as well as vector control through net usage and insecticide spraying. Parameters will be drawn from other researchers' field measurements of malaria transmission characteristics and of Anopheles mosquito biology, and combined with online demographic data and malaria-prevalence-by-age profiles for African countries with a high malaria burden. Estimates on malaria infection and intervention costs admit the possibility of calculating the cost-effectiveness of a variety of intervention portfolios and their simulated disease impacts and of assessing the feasibility and expected costs of achieving malaria eradication.

Biographical Sketch: Zack graduated from Lawrence University in Appleton, Wisconsin with a BA in Mathematics-Economics. He is currently in his third year of a five-year Ph.D. program in environmental and natural resource economics at Duke University. Zack’s dissertation will consist of three essays examining how methods in natural resource and environmental economics can be applied to malaria control, with a focus on the dynamic control of mosquito vectors and the management of insecticide resistance using intertemporal optimization methods.
Abstract: Mounting problems in healthcare of affluent countries have prompted patients to look for less costly alternatives elsewhere. In just over 10 years, medical tourism – mostly, but not exclusively, from developed to developing countries – has become a multibillion dollar global industry, growing 20-30% per year. This project aims to sketch a picture of medical tourism, examine the institutional characteristics of health systems in medical tourist destinations, and understand the impacts of medical tourism on these health systems in order to assess and predict future health system changes. Specific research questions are: (1) What are the delivery systems, financing regimes, and governance structures that comprise the health care system in each nation? (2) What is the number and distribution of medical tourist facilities and physicians? (3) What is the relationship between state governments and the international medical tourism industry? (4) What is the national health ideology of these countries? (5) Are there national redistributive policies in place with regard to profits from medical tourism? This rapidly growing industry has important implications for global health and health policy, as well as for social responsibility policies that govern such global industries. Despite potential benefits of medical tourism, absence of suitable regulation risks accelerate the flow of human and financial resources out of already beleaguered public health systems in middle-income countries. This then will exacerbate existing health system imbalances and worsen the access to adequate health care for the poor. The shape and form of ‘suitable regulation’, in turn, will depend strongly on the institutional and ideational structures of health systems.

Biographical Sketch: Courtney graduated in 2001 from Skidmore College with a bachelor’s degree in Anthropology, and in 2006 from the University of Colorado at Boulder with a master’s degree in Anthropology, concentrating in medical anthropology. Currently, she is a third-year Ph.D. student at the University of Colorado Denver in the Health and Behavioral Sciences Department. Her research interests are in health and globalization, and specifically how processes of globalization affect health systems, health policy, and global health disparities.
Abstract: Model-based decision support systems often require a lot of computational power. In many institutions, including IIASA, super computers are not available. In such situations, either a management of resources of networked workstations, or a low-cost HPC (High Performance Computing) environment can be deployed for supporting the resource demanding computations. During the YSSP, I plan to first explore the scientific computing needs of IIASA, including needs of fellow YSSPers who will work with resource-demanding models, and the IIASA computing environment (both hardware and software). Next, I will explore two complementary paths. First, the possibilities of improving the use of the available IIASA computing resources, e.g., by an efficient exploitation of tools like the SGE (Sun Grid Engine). Secondly, the different feasible HPC environments will be explored, including the Linux-based HPC available at my home institute. The ultimate goal of my YSSP research is to propose enhancements and more efficient use of IIASA’s computing environment.

Biographical Sketch: Muhammad works as a Scientific Officer in the public sector research organization, Global Change Impact Studies Centre (GCISC). His research interest is focused on High Performance Computing Clusters for the use of Regional Climate Models (RegCM3 and WRF). He completed his master’s at the Institute of Information & Technology (CIIT), Pakistan in 2007. He is an active member of a climate modeling team where he is involved in different climate change related studies for the South Asian domain. His research plan during the YSSP is to learn, explore and improve the computing environment of IIASA. He believes that together with the IME team, he will be able to share his knowledge in order to work together on HPC applications.
Integrated Modeling Environment (IME)
Project Leader: Marek Makowski

Oleksandra Borodina

Supervisor(s): Marek Makowski/Günther Fischer
Research Project: Towards Sustainable Agricultural Sector Development in Ukraine

Abstract: Agriculture has been a sector of great importance in the national economy of Ukraine. The natural potential of Ukraine's agriculture is based not only on a large area of agricultural land, but also highly fertile soils combined with favorable climatic conditions. Currently the debates about agriculture in Ukraine are concerned with a broad set of issues including the intensification of agricultural production, feedstock production and trade for biofuels development, the consequences of WTO accession, degradation and pollution of the environment, agricultural land ownership, and foremost the stability and welfare in rural areas. My research will consist of three main tasks. First, in close consultation with experts from the IEF (Institute of Economic Forecasting of National Academy of Sciences of Ukraine) I will specify alternative scenarios of future rural development in Ukraine. While analyzing these scenarios, attention will be given to the issues related to the main domains and principal criteria of sustainability. For comparing different facets of sustainability across the analyzed scenarios, I will construct various indicators based on the framework of sustainable rural livelihoods (SRL). These indicators will be further adjusted to reflect and account for risks and uncertainties. Second, these internally consistent but aggregate scenarios will be used in a regionally detailed model to reflect and represent specific regional characteristics and interdependencies across the selected indicators. Third, the results of the scenario analysis and modeling will be summarized to highlight main differences and impacts on rural welfare of these alternative agriculture sector development strategies.

Biographical Sketch: Aleksandra is a postgraduate student at the State Organization Institute for Economics and Forecasting, National Academy of Science of the Ukraine. Her main scientific interest is in the field of socio-economic and environmental modeling for agriculture. She completed her master’s in Economic Theory at the National University of Kyiv-Mohyla Academy, Kiev, Ukraine in 2006. Her research plan during the YSSP is to analyze the historical data according to scenarios of possible ways for future development of the situation in Ukrainian rural policy, by using a modeling methodology developed at IIASA, and to work on approaches to form robust decisions for further Ukrainian agriculture policy.
Integrated Modeling Environment (IME)
Project Leader: Marek Makowski

Supervisor: Marek Makowski
Research Project: The Use of a New Approach to Quantify the Impacts of Land Cover Changes on Flood Risks Across Multiples Scales

Abstract: Land surface characteristic has a strong effect on the hydrological response of river basins, and its change can dramatically modify the risks of floods. Considering that land use and land cover have been, and will continue to be extensively modified by human activities worldwide, there is an urgent need for a comprehensive knowledge of the effects of such changes. The main objective of my research is to evaluate how the flood risks are shaped by these changes. To achieve this goal, a calibration-free hydrological model based on the scaling properties of floods which takes advantage of available remote sensing information will be used. The advantages of this framework are twofold. First, it permits a multiscale analysis of runoff generation processes. Second, due to the hill slope basin discretization, the river network is properly represented. The innovative aspect of this study is the simultaneous analysis of these effects for multiple scale basins, providing information to assist different levels of governmental policies (local, regional and global) and their relationships. During my YSSP participation, I will develop a case study for Charlotte City, North Carolina. The city has experienced an extensive urban growth since 1960 which has led to significant changes in the city’s risk and vulnerability to floods. These changes are the result of land surface impacts on the hydrological processes that generate floods. A comprehensive study that highlights the complexity of land surface characteristics and its effects on peak discharge behavior is still lacking for this area. Using a simulation framework we focus our analysis on the prediction of peak flow and time to peak for a large range of basin areas and for different land cover configurations. The first step will be the evaluation of the impacts of different historical land cover on runoff generation. With the aim of predicting the impact of future changes on floods, and providing tools for the development of an optimal regional flood mitigation policy, the impact of different land cover scenarios based on different local and regional policies will be evaluated.

Biographical Sketch: Luciana is currently a third-year Ph.D. student in the Civil and Environmental Department of The University of Iowa. She earned her Bachelor’s Degree in Civil Engineering (2002) and her M.S. in Water Resources and Environmental Engineering (2004) from Universidade Federal do Parana, Brazil. Her main fields of scientific interest include measuring and modelling of hydrological variables, remote sensing and flood forecasting.
Integrated Modeling Environment (IME)
Project Leader: Marek Makowski

Tomoko Hasegawa

Supervisor(s): Marek Makowski/Laixiang Sun

Research Project: A Study on a New Accounting System for Agricultural Activities

Abstract: The world agricultural production has to be considered not only in terms of food but also in the context of the corresponding social, economic environmental problems. Therefore, a new accounting system that includes relations between human agricultural activities and greenhouse gas (GHG) emissions is expected to play an important role to provide a quantitative basis for analyzing and assessing an impact of policy options. My YSSP research will focus on a new estimation method for an emission accounting system of global agricultural activities; the system consists of accounting tables including agricultural commodity's flows from production to consumption, and the agricultural waste. The new accounting system includes agricultural waste and GHG emissions. Material and monetary flows are related to the agricultural commodities, and can be estimated using information on the production, trade and consumption from published statistics. I plan to research the system that covers 94 countries and 12 world regions in the period 1971 to 2000. I will explore the most plausible estimates in order to minimize the differences between the estimated and reported data subject to the constraints representing the knowledge about the modeled system.

Biographical Sketch: Tomoko graduated from Kyoto University, Japan, in March 2008. She holds a master’s degree in Environmental Engineering with a specialization in global integrated assessment modeling. She is currently a second-year Ph.D. student at Kyoto University. Title of her thesis is "A study on methane and nitrous oxide emissions and mitigation options in agriculture". Her main fields of scientific interest include the global accounting tables of global agricultural products.
Abstract: The replacement of forests, wetlands, savannas and other native landscapes is a severe threat to the capacity of the environment to sustain food production and maintain freshwater as well as other ecosystem services. If the current trends persist, it is expected that by 2050 around 10 billion hectares of natural ecosystems will be converted to agriculture, having the potential to cause massive and irreversible environmental impacts. My YSSP project aims at evaluating how the land use and land cover changes (LUCC) will affect water resources demand for crop production at Taita Hills, SE-Kenya. The first priority of the research is to implement and calibrate an Evapotranspiration (ET) model for the study area. The ET is an important component of the hydrological cycle and a good knowledge of this process is essential for a better water resources management. Three temperature based ET models will be evaluated, namely the Hargreaves, the Thornthwaite, and the Blaney-Criddle models will be tested because they are the most recommended approaches when only air temperature data are available at weather stations. One weather station with complete climate data sets will be used to calibrate the selected model using as reference the FAO-56 Penman-Monteith method. Historical LUCC will be assessed using SPOT satellite images, and used as inputs to the ET model in order to evaluate how agricultural expansion affected water availability in the region. Next, future land use scenarios will be simulated using a LUCC model, and integrated with the ET model in order to delineate exploratory scenarios for the study area. Finally, the simulated scenarios will be tested in their capacity of coping with changes in climate patterns. For instance, the modeling framework will evaluate how the system will behave when facing longer dry seasons and high average temperatures. The results of this project will be closely linked with the subsequent parts of my Ph.D. research, which will evaluate how the LUCC together with climate change will affect local food production and the economy.

Biographical Sketch: Eduardo is currently a Ph.D. student in Physical Geography at the University of Helsinki, Finland. He holds a BSc in Agricultural and Environmental Engineering from the Federal University of Viçosa in Brazil, with a training period at Iowa State University, USA. He completed his MSc in Remote Sensing at the National Institute for Space Research in Brazil. The aim of his YSSP research plan will be to evaluate the impacts of land use changes on water resources demand for agricultural production in Taita Hills, SE-Kenya, by integrating an Evapotranspiration model with results obtained from LUCC simulation models and Global Circulation Models.
Abstract: The use of biofuels is being promoted in many countries through various forms of government intervention due to concerns about energy security and climate change. However, the net welfare effect of biofuel production and use is uncertain. Biofuel provides a domestically produced, renewable, and less carbon intensive alternative to gasoline. Yet, biofuel production also competes with food production for arable land, which could increase food prices. The purpose of this paper is to examine the impact of policies that increase biofuel production – specifically a mandate, subsidy and tariff, by themselves or in conjunction with each other, and to determine whether these policies lead to an increase in social welfare and an improvement in environmental quality. I use a stylized general equilibrium model of the US in an open economy, wherein households are assumed to derive utility from energy security, trade balance and consumption of food and miles. Disutility is generated by GHG emissions and miles-related externalities. Miles are produced using gasoline and biofuel, which are modelled as imperfect substitutes. Food and biofuels are produced using land and labor inputs, while gasoline only uses labor. Rather than producing biofuels, the US can also export food and import gasoline and biofuel. Numerical simulation is used to estimate the market impacts and welfare cost of existing biofuel policies relative to an optimal scenario. Because there is some uncertainty in parameters that are used in the numerical model, I employ Monte-Carlo simulation to generate a range of outcomes across the uncertainty range in parameter values.

Biographical Sketch: Christine graduated from the University of the Philippines and worked as a technology analyst for Accenture before beginning post graduate work at Michigan State University, where she earned an MS Agricultural Economics degree in 2003. She is currently a Ph.D. candidate at the Department of Agricultural Economics and Energy Biosciences Institute at the University of Illinois Urbana-Champaign. Her ongoing research focuses on market, environmental and welfare impacts of expanding biofuel use. Her other interests include trade and international development.
Abstract: Organisms that occur artificially in locations beyond their known historical natural ranges are considered as non-native (alien, foreign, introduced, or non-indigenous). Invasions of non-native species (i.e. those moved to regions beyond their natural dispersal range) pose a major threat to the conservation of native species and integrity of ecosystems worldwide. It has become a major environment problem and a focus of ecological research. For example, in South Africa alien invaders are estimated to use approximately 7% of the estimated mean annual runoff of water, affecting the water resources system. In order to extend their population ranges, plants must overcome numerous barriers, including: (i) geographic barriers, which must be overcome by dispersal; (ii) habitat barriers, that require pre-adaptation and ecological interactions with other species in the habitat, or genetic adjustment to the condition of the new environment; (iii) biotic barriers that integrate the forces of predation, herbivory, competition, and; (iv) interference, or the new mutualistic relationships that must be developed. The main objective of this study is to understand the forces that drive future invasion of alien plants in African Savannas. It will also explore the role of disturbances (e.g. frequency of herbivory, mine dump, fire or frost that cause dieback or top kill of saplings) and land use on the distribution of alien plants. Using data from small scale experiments with *Schinus molle* (Peruvian pepper tree) as an example, this study aims to investigate key biological characteristics that may potentially limit or accelerate the spread of alien plant species.

Biographical Sketch: Donald graduated in March 2009 from Stellenbosch University, in South Africa with a Ph.D. in Ecology. He holds a master’s degree in Conservation Ecology and is currently a Postdoctoral Research Fellow at the Centre of Excellence for Invasion Biology (CIB), at Stellenbosch University. His main fields of scientific interest include: population and community ecology, disturbances ecology, restoration ecology. Plant, animal interaction and their environment and the role of competition on species distribution as well as predicting and quantifying the risk of invasive organisms are also his areas of interest.
Abstract: Rice and wheat (R-W) are main staple food crops that essentially play an important role in the food security of Pakistan. While food need is on the increase due to growing population pressure and, as a result, soil and water resources are continuously degraded, horizontal expansion of crop production is not an option. The available natural resources must be conserved and used judiciously. Rice and wheat crops are grown in sequence (rice in summer and wheat in winter). Land preparation for irrigated rice includes wet tillage (puddling) which results in a ploughpan. Such ploughpan due to physical compaction has higher soil bulk density and has very low permeability. The compact layer in the puddled rice field may delay attaining the suitable soil moisture for land preparation and wheat sowing after rice harvest. Consequently, wheat planting is delayed and results in wheat yield decline by 1 to 1.5 % per day delay after 20th November. Zero-till (ZT) wheat sowing may avoid late planting and mitigates the effects of poor seedbed preparation. ZT ensures timely planting, better stand establishment and higher grain yield than conventional tillage methods. But all soils are not equally suitable for ZT wheat sowing. ZT is currently being promoted on all soils, which results in deprivation of natural resources. The main purpose of this research is spatial modelling of soil information for ZT wheat sowing in R-W region of Pakistan, in order to assess spatial differentiation of ZT effects on wheat yields. The analyses will be based on remote sensing and field data. GIS based methodology will be used to integrate relevant soil parameters for creating a spatial inventory of ZT applicability in the R-W region in Pakistan.

Biographical Sketch: Faheem graduated from the University of Agriculture, Faisalabad, Pakistan, in Agricultural Engineering. In October 2008 he received his MS in Remote Sensing and GIS from the National University of Sciences and Technology, Pakistan. Since August 2008 he has been working as a Scientific Officer at the Global Change Impact Studies Centre (GCISC) Pakistan. His main fields of scientific interest are GIS/RS based spatio-temporal modelling, soil suitability mapping of cereals, climatic variability and their impact on crop production.
Abstract: High altitude Himalayan rangelands are generally reported as highly threatened with rapid degradation. Government, policy makers and development agencies’ understanding and policy intervention is overwhelmingly guided by the discourse of overgrazing driven degradation. However, studies carried out in some parts of the Trans Himalayan (TH) region of Nepal have found a high rate of outmigration and a declining trend of livestock population in the last decades. The scenario of the declining trend of livestock population and the generally considered increasing trend of rangeland degradation makes the understanding of environmental dynamics more complex. Why, then has it happened? What is the trend and pattern of rangeland dynamics in the Mustang valley of the region? Is it really degraded? How does alternative climatic variation changes hypothesis relate to the rangeland dynamics trend and pattern of the region? To answer these questions, we need to understand how these rangelands really do work. The general plan of my YSSP research is to assess rangeland changes over the last three decades in the Mustang, TH region of Nepal and analyze the potential impact of climate variability as well as human livestock management in the sensitive ecosystem of high altitude rangelands in Nepal. During my YSSP research, I am planning to further review, learn and develop a sound method to assess rangeland dynamics. The specific tasks I am planning to undertake are: 1) analysis of rangeland vegetation dynamics based on vegetation indices derived from the last four decades (1972 – 2008) using Landsat, SPOT and NOAA/AVHRR images, 2) assessing the climatic variability pattern and compare it with the rangeland vegetation change pattern, 3) quantify the relative impacts of rainfall and grazing on rangeland degradation based on time series analysis of vegetation dynamics, rainfall variability, grazing pressure and management practices.

Biographical Sketch: Paudel graduated from the Department of Geography, University of Bergen, Norway, with a M.Phil. degree in Mountain Ecology and Human Adaptation in 2006. He also received his master’s degree in Geography from Tribhuvan University, Nepal in 2001. He is currently a second-year Ph.D. student at the University of Bergen. His thesis deals with climatic variability, rangeland dynamics and grazing management of the Trans Himalayan Region of Nepal. His main fields of scientific interest include natural resource management, landuse and climate change.
Abstract: The popularity of mediation as a conflict management activity in international relations and recent proliferation of potential mediators gradually shifted the interest of academia to analyze the process and dynamics of multiparty mediation. The concept refers to simultaneous interventions by more than one mediator in a conflict, interventions by composite actors such as contact groups as well as sequential mediated interventions that again involve more than one party. Very important concepts for a successful multiparty mediation appear to be consistency in interests and cooperation and coordination between mediators. A general objective of this research would be to explore the relevance and ways of achieving coordination (even) when there is no consistency in interests between various mediators, and thus surmount the problems that multiple mediators face when operating without a ‘common script’ in attempting to mediate a dispute and move the parties toward a negotiated settlement. Using case study analysis of recent mediation activities, the research aims to explore what are the most effective mediation strategies in cases where the process is hampered by conflicting interests in the mediation coalition.

Biographical Sketch: Sinisa received his BA degree in Political Science and International Relations from the University of Rome 'La Sapienza' and MA degree in International Relations and Diplomacy from Leiden University (program offered jointly with the Netherlands Institute for International Relations 'Clingendaal'). He is currently a first-year Ph.D. student at Leiden University’s Institute of Political Science. His research focuses on comparative analysis of multiparty mediation process. His research interests include international relations, conflict resolution, international mediation, international organizations, former Yugoslavia, post-conflict peace-building and reconstruction.
Abstract: In the context of critical infrastructure protection the occurrence of extreme events (Xevents) play an important role. An event like a massive earthquake or devastating terrorist attacks that are unpredictable in time and have a considerable destructive consequence on social systems, need efficient and effective management procedures for mitigation and reconstitution. Furthermore, the analysis of the fragility of critical infrastructures as well as methods of risk analysis, are helpful means considering the management of Xevents. Additionally, the construction and study of scenarios of Xevents can improve the awareness and assessment of critical entities which consequently could alleviate the effects of those events. Decision support systems as well as systems for gaining situational awareness could prove to be helpful in this context. The development of certain action plans respectively management procedures with the support of those software tools might render a great service to dealing with the impact of Xevents.

Biographical Sketch: Goran graduated from the University of Cologne, Germany in 2006 with a diploma in Business Informatics. Since 2007 he is working as a research assistant at the Department of Operations Research, University of the Federal Armed Forces in Munich, Germany. He is currently in the third-year of his doctoral thesis that focuses on the development of decision support systems in the context of critical infrastructure protection. His further research interests include service oriented architectures, process management and software engineering.
Processes of International Negotiation (PIN)
Program Coordinator: Ariel Macaspac Penetrante

Emma Paulsson

Supervisor(s): Gunnar Sjoestedt/Anthony Patt

Research Project: The Role of Private Actors in the Negotiations on a Reform of the Clean Development Mechanism

Abstract: The Kyoto Protocol’s Clean Development Mechanism (CDM) has been a success story in many ways, with thousands of emission reducing projects being undertaken in developing countries, generating a multibillion-dollar market. However, the mechanism has also received a lot of criticism. NGOs question the additionality of CDM projects, developing countries criticize their inequitable distribution, and the business community complains about the arduous administrative process around the CDM. Over the last few years, a reform of the CDM has therefore been high on the agenda. Compared to most international agreements, the CDM gives private actors a very active role, with companies both implementing and supervising the projects. These companies thus have real stakes in the further development of the CDM, which affect their role in the negotiations. In traditional models of multilateral negotiations, state actors play the leading roles, and the influence of non-state actors is largely overlooked. Given the active involvement of private companies in the CDM, the negotiations on how to reform this mechanism provide an interesting test to such state-centred models. How does the fact that private actors have so large stakes in the outcome of these negotiations affect the dynamics of the process? Drawing on the empirical case of the reform of CDM, this project aims at investigating the characteristics of market actors in multilateral negotiations. Are private actors pursuing very specific market interests, or do their suggestions fall within the range of ideas presented by national parties? Through comparing the content of statements and position papers from carbon market actors with similar documents originating from the national delegations, the characteristics of private actors will be traced. These results will then be discussed in the light of existing models of multilateral negotiations.

Biographical Sketch: Emma graduated in 2006 from Lund University in Sweden. She holds a master’s degree in Political Science, but also studied environmental science at undergraduate level. She is currently a third-year Ph.D student in political science at Lund University. In her dissertation project she explores the various roles that private companies take on in the implementation of the Kyoto protocol’s Clean Development Mechanism (CDM), in order to study empirically the concept of “governance beyond the state”. Emma’s main research interests are climate policy and the role of private actors in global governance.
Abstract: Population projections, at the national as well as regional levels, are considered one of the main tools for policy makers in planning and decision-making processes. For a good quality population projection, the projection should be based on sound scientific methodology and reliable and quality data. My proposed research has three parts; firstly, to produce a population projection by age and sex for Syria during the period 2004-2029 using a cohort component method with three different scenarios based on future assumptions on fertility, mortality and migration; secondly, to extend the projection by adding the educational component and projecting the population by age, sex and education into the future and; finally, to produce a probabilistic projection for Syria by age and sex.

Biographical Sketch: Zakaraya graduated in 2002 from Damascus University, Faculty of Economy. He holds two Master degrees; one in Operations Research from Damascus University (2005) and the second from the Faculty of Economics and Political Science, Cairo University (2006). He is currently a second-year Ph.D. student, the title of his Ph.D. thesis is “Stochastic population projections: a suggested methodology”. 
Abstract: The United Nations projects that by 2030 five billion people will live in cities, and 81% of these people, or around four billion, will be located in the developing world. The intense expansion of third world urban centers is happening without concurrent infrastructure or resource development to support growing populations. As a result, the progressive status of cities as places of lower fertility, accessibility, and better health is being eroded away in developing nations. Yet the significant factors that are influencing population growth – fertility, migration, mortality, and education – do not occur equally throughout the space of a developing world city. Preconceived notions of slums and urban settlement suggest that population growth is highest in the peri-urban fringe, and the most slum like areas of a city. But are these assumptions correct? Understanding the spatiality of population growth in third world cities may have significant implications for planning and development projects, and for future public works. This project proposes to examine the Greater Accra Region in Ghana to understand how population growth is occurring within the city and around the urban fringe. It will utilize data from the Demographic and Health Surveys and the Ghana Census to examine past population growth in and around Accra, focusing on the spatial aspects of population change. The project will then turn to projecting population by location with methods developed by the World Population Program at IIASA, and mapping the spatial aspects of population growth in Accra.

Biographical Sketch: Marta will graduate from San Diego State University with a master’s in Geography in May of 2009. Her thesis is titled “Neighborhoods of health: using AMOEBA to draw neighborhood boundaries in Accra, Ghana”. She will begin her Ph.D. studies in Geography at the joint San Diego State, University of California Santa Barbara doctoral program in the fall of 2009. Her main research interests are place effects on health, spatial demographics, clustering algorithms, NGO networks, and spatial collaboration.
Abstract: The general objective of my research project is to quantify the possible effects of population aging on labor supply and human capital investment. Existing projections for the labor market in Europe focus on the quantity of future labor potential, not taking into account the fact that future cohorts will vary in their educational attainment compared to current workers. For my research project I will construct human capital projections for the labor market by combining age-specific educational attainment projections with projections of labor force participation, for several selected European countries. I plan on calculating two scenarios: one assuming that time-allocation decisions (between education, employment and leisure) are exogenous to the model, and one where they are as assumed to be endogenous, using a dynamic overlapping generations model (OLG).

Biographical Sketch: Elke graduated in 2004 from the University of Regensburg, Germany (major: geography, minors: political science and statistics) and 2007 from Duke University, USA (Master of Public Policy). She is currently a third-year Ph.D student at the Max Planck Institute for Demographic Research in Rostock, Germany. In her thesis, she analyses present and future labor force potential and labor utilization within several selected countries, focusing on age-specific differences. Her main research interests are the challenges and opportunities demographic change poses for the labor market.
Abstract: Research will be conducted to develop a coherent risk management approach against catastrophe risks (including natural hazards) on the regional scale and to identify suitable performance metrics to quantify those risks. The evaluation of the benefits and costs of alternative pre-disaster risk financing strategies, at the regional level for natural hazards will be based on a modified CATSIM (CATAstrophe SIMulation) model. Furthermore, comparative studies between different competing risk measures and their importance for developed and developing countries will also be conducted in this context. The different risk metrics and the quantification of risks should ultimately enable decision makers to make effective mitigation policy and resource allocation decisions. In developing this approach, a case study area has been selected that is comprised of three counties in the State of Tennessee, United States.

Biographical Sketch: Samrat graduated in 2003 with a bachelor’s degree in Civil Engineering from Punjab Engineering College, Chandigarh, India. He received his master’s degree in 2006 in Civil Engineering with a focus on transportation systems from the University of Texas, Austin. He is currently a third-year Ph.D. student in Civil Engineering at Vanderbilt University, Nashville. The title of his Ph.D. dissertation is “Development of an analytic basis for performing all-hazards operational risk management.” His research interests include transportation safety and security, risk assessment and management, applications of geographic information systems, and applied probability and statistics.
Risk and Vulnerability (RAV)  
Program Leader: Joanne Bayer

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Wei Li  
Supervisor: Georg Pflug  
Research Project: The Robust Pricing Model of Catastrophe Derivatives

**Abstract:** The capital markets have recently emerged as a complement to reinsurance for covering large losses from disasters through new financial instruments known as catastrophe derivatives, whereby payments are tied to an underlying indicator, such as an index of occurrence of a disaster of a given magnitude in a particular location. Although catastrophe derivatives have come into the limelight in recent years, little research has been published on the pricing and hedging issues associated with these complex instruments, as opposed to works on their benefits and their management. The main goal of my research is to develop robust models for the pricing of catastrophe index options, which account for the uncertainty of catastrophic losses and interest rate randomness. To reach the goal, I will complete the following tasks: A) First a binary tree pricing model will be built for the CAT index option, then the model will be extended into a fuzzy binary tree pricing model. The fuzzy stochastic process will be estimated under the assumption that catastrophe losses are fuzzy stochastic variables. B) The non-parametric drift and diffusion function together with jump diffusion process will be estimated. Based on this I will propose a non-parametric CAT index option pricing model and analyze the impact of kernel function and bandwidth selection on this pricing model. C) An estimate of the probability distributions based on limited history data will be made. As a result, parameter uncertainty is always present in the modeling of catastrophe losses. Thus the influence of this parameter uncertainty on the pricing of catastrophe derivatives will be investigated. D) Monte-Carlo simulations will be provided to illustrate the effects of stochastic interest rates and variance of the loss process on the option’s price, and empirical analysis with earthquake data in China will be done to test the proposed pricing models.

**Biographical Sketch:** Wei graduated from Xiangtan University School of Business in 2007. He is currently a second-year Ph.D. student at the School of Economics and Management of Beihang University. His thesis is entitled, “The robust pricing model of catastrophe derivatives”. His main fields of scientific interest include option pricing, catastrophe derivatives, risk management.
Abstract: In the aftermath of natural disasters during the last two decades, the insurance industry has suffered, and will still probably suffer, very large net losses. Thus, by considering such a scenario, my research deals with the type of premium incentives that insurers would want to provide to their policyholders for adopting risk mitigation measures. In doing so, I create an agent-based model of insurance and reinsurance markets by considering, along the institutional arrangements, the surplus of insurers, the rate structure of the market, as well as the concerns that both the insurers and policyholders have with insolvency. Furthermore, by constructing large, medium and small representative insurers, I examine the impact of different types of floods on the insurer’s profitability, solvency, and performance through simulation. Consequently, I would like to develop a tool to evaluate the performance of different mitigation measures and reinsurance on both expected net losses and worst case scenarios when considering flood damage. At the heart of my model lies an ACE (Agent-Based Computational Economics) Trading World. Within this framework, an economy is populated by profit-seeking firms and households who derive utility from consumption of these goods. By adding special agents that supply insurance, reinsurance, private goods for mitigation measures, and an agent that directly determines the rules of the market and other allocation methods for mitigation measures with public good characteristics, the agents handle the procurement processes by themselves rather than by a Walrasian Auctioneer. Thus, in a market in which clearing conditions are not imposed, all outcomes are generated through interactions that occur within the constraints imposed by currently prevalent institutional arrangements. Consequently, in order to survive and even prosper in this uncertain virtual world prone to flood damage, the firms and households must learn to coordinate their behaviours over time in an appropriate manner.

Biographical Sketch: Aldo graduated in 2006 from the University of Graz with a master’s degree in Economics and Environmental System Sciences. He is currently a second year Ph.D. student at the University of Innsbruck. Title of his thesis is “Linking insurance and mitigation to manage flood risk: an agent-based modelling approach.” His themes of scientific interest include the use of agent-based computational economics and the study of complex social and ecological systems. Specifically, he is interested in the performance of insurance and reinsurance markets, and the use of mitigation measures in the field of flood risk management.
Abstract: There is ongoing debate on whether disasters cause significant longer term economic impacts and are truly a potential impediment to development. A key gap in the literature has been the lack of combining economic models with good empirical data, which for extreme events are by definition scarce and associated with large uncertainties. Furthermore, research in this domain has focused on impacts on real goods, and not sufficiently studied financial flows, such as aid and disbursements of credit post-disaster. This research focuses on assessing the economic impacts of natural disasters to regional (subnational) economies with a special focus on the long-run effects. One entry point is to study capital inflows from outside the affected region, which contribute to the restoration of the capital stock, while increasing the external debt position of an affected region. In this case, although the flow of the economy (as measured by GDP) may rebound, the increase in external debt may give rise to long-run adverse impacts. We will focus on households' interregional borrowing decision for rebuilding their livelihoods and study this issue within a Dynamic Computable General Equilibrium (DCGE) model extended and calibrated by using disaster impact data from recent disaster events.

Biographical Sketch: Kazuyoshi graduated from Kyoto University, Japan, in March 2008 with a master’s degree in Informatics. He is currently a second-year Ph.D student at the Graduate School of Informatics, Kyoto University. His main fields of scientific interest include disaster risk management and modeling economic impacts of natural disaster.
Risk and Vulnerability (RAV)
Program Leader: Joanne Bayer

Supervisor: Michael Thompson
Research Project: Making Land the “Victim”: Environmental risk perceptions and clumsy solutions in the oil producing communities of the Niger delta region of Nigeria

Abstract: Nigeria ranks sixth highest exporter of crude oil in the world and fifth within the Organisation of the Petroleum Exporting Countries (OPEC). It provides the United States of America with a tenth of its oil imports. The oil and gas sector accounts for over 90 percent of Nigeria’s annual earnings and also attracts the highest proportion of Foreign Direct Investments (FDIs) in the country for the last fifty years. As a result of over a decade of grassroots rebellion in the oil producing communities of the Niger Delta (Nigeria’s oil producing province) over alleged unsustainable environmental and compensational practices of the state and the oil transnational companies, output has been cut by over 20 percent and violence has claimed thousands of lives. This research examines the environmental risk perceptions of indigenous people, international oil corporations and the state in the Niger Delta and identifies some “shifts” in cultural biases and “convergences” in land use practices of the three stakeholders (the indigenous population, state and the oil producing companies). It interrogates the consequences of such “convergences” on the environment. Using the Cultural Theory, it also identifies disparate arguments that drive the contestations between the state and the village-communities and examines how a “clumsy mediatory solution” of the interface could overrule “elegant” ideas of contending interests. Analysis is based on qualitative field data collected from the Niger Delta communities between 2007 and 2008.

Biographical Sketch: Ike graduated from Imo State University Nigeria in 1997 with a Master of Science degree in Industrial Sociology and Personnel Management. He holds membership of the Chartered Institute of Personnel Management of Nigeria and has worked in the private sector in Nigeria. He is currently a third-year Ph.D. student at the University of Fort Hare, East London Campus South Africa. The title of his thesis is: “Land use, compensational justice and energy resource extraction in Nigeria: a socio-historical comparison of coal and petroleum producing communities”. His research interests include: natural resource exploitation in indigenous communities, environmental sustainability and compensation.
Abstract: Research in climate change has mostly been applied top down for analysis of impacts and policies at macro-scales. Vulnerability to climate change impacts has been measured, often at the household and community levels, as differences between predicted impacts and hypothesized adaptation measures. These latter ‘bottom-up’ approaches assess climate change vulnerability by exploring the exposure, sensitivity and adaptive capacity at local scales. This raises the question of how local-scale vulnerabilities are linked to each other, to macro-scale phenomena and to an as yet undetermined number of levels at other scales in between. Such analysis should explore how local responses to local impacts and their drivers in multiple scales shape the vulnerability and adaptive capacity of the community and can be mediated by various processes to impact other geographically distant communities. To these questions we will apply a systems dynamics approach to model how responses of communities with varying vulnerabilities to a change are actually connected in different scales using data from coffee farmers in Mexico and Vietnam over the period 1985-2005.

Biographical Sketch: Navarun is a second-year Ph.D. student in the Department of Policy Studies, TERI University in New Delhi, India. His research topic is on vulnerability and climate adaptation in the local scale and he is interested to explore how appropriate adaptation strategies can be designed for vulnerable communities in order to help them to cope with adverse climate change impacts. He was a Guest Researcher from January to April, 2009 at the Environmental Policy Research Centre, Freie University, Berlin, Germany where he worked on institutions for diffusion of local initiatives regarding climate adaptation. He completed his master’s in Biotechnology from University of Abertay Dundee, Scotland in 2006 and has worked for the Environmental and Industrial Biotechnology Division, TERI (The Energy and Resources Institute) and also in the “Ecosystem Services and Poverty Alleviation” Project of TERI University.
Transitions to New Technologies (TNT)
Acting Program Leader: Arnulf Grűbler

Patrick Sullivan
Supervisor: Arnulf Grübler
Research Project: Developing Scenarios for the Global Energy Assessment

Abstract: The Global Energy Assessment (GEA) Scenarios are an important tool for a multifaceted analysis of the impact of energy policies on energy security, poverty and development, and environmental impact. A major undertaking, the GEA will attempt to address all energy challenges simultaneously rather than, for instance, focusing primarily on climate change while ignoring the challenge of providing energy access to the poor. As a result, the scenarios—rather than being of the traditional baseline-and-policies mold—each need to be designed to successfully address all of the (sometimes competing) global energy objectives. This summer, a major effort of the energy group at IIASA will be developing scenarios for the GEA using the MESSAGE model. One of the challenges of the scenarios will be integrating the scenario module with the other Knowledge Modules. The modules must be able to interact dynamically with each other—exchanging information about resource availability, energy demands of changing societies, technology development through the decades the scenarios encompass. The quality of the scenarios will depend strongly on the success of the module integration. I will assist on scenario development in a multifaceted way, centered around model development and improvement of MESSAGE. Beginning with sensitivity analysis of proposed scenarios, I would work to identify inconsistencies, knife-edges, or unexplained phenomena in the outcomes. Digging deeper, I would attempt to either explain the phenomena or develop strategies to improve the model and its interaction with the other Knowledge Modules. An outcome of my summer research, could, for instance, consist of improvements to the way the scenario module interacts with the renewable resource module to account for how the variability of renewable resources affects the dynamics of their integration into the grid. Another might be refinements to a section on rural electrification to help better account for the benefits of distributed generation in isolated grid systems. Whatever the eventual focus areas highlighted by the sensitivity analysis, the goal will be improved scenarios and a stronger GEA to provide better guidance to policy-makers and enterprises in the coming years.

Biographical Sketch: Patrick is an Energy Analyst at the National Renewable Energy Laboratory where his primary efforts center on linear programming and optimization, designing market penetration models for renewable technologies. Prior to arriving at NREL, Patrick worked as a technology analyst at a seed-stage venture capital firm in Chicago. His education background includes an M.S. in mechanical engineering at Stanford University (2006), preceded by dual undergraduate degrees in physics and mathematics at the University of Chicago (2004).
Transitions to New Technologies (TNT)
Acting Program Leader: Arnulf Grűbler

Jun Wan

Supervisor: Niels Schulz

Research Project: Spillovers and Energy Efficiency Convergence in the US Industrial Sector: A spatial econometrics approach

Abstract: My proposed research at IIASA during the summer of 2009 seeks to extend the analysis of convergence to the area of energy intensity among the different continental states (including Washington DC) in America. As energy saving technology advances and spillover effects are spread out due to geographic proximity, one might expect energy intensity also to converge. This research intends to borrow the recently developed methods of exploratory spatial analysis and try to provide some new insights on the geographical dynamics of US regional energy efficiency improvement patterns in the industrial sector over the period 1970 to 2005. Four fuels types are considered in this research: coal, natural gas, electricity and petroleum. Strong patterns of convergence and spatial correlation are expected to be found in the dynamic patterns of energy efficiency change in continental states for the industrial sector over the study period. Positive spatial autocorrelation indicates spillover effects we want to capture in energy efficiency improvement processes.

Biographical Sketch: Jun graduated from Boston University in 2008 with an MA in Economic Geography, in 2006 with an LLM in Environmental Law from Wuhan University Law School, in 2005 with a Graduate Certificate in International Relations from Johns Hopkins University. He is currently a first-year Ph.D. student at the Department of Urban and Regional Planning, University of Illinois at Urbana Champaign, working under the Regional Economics Applications Laboratory (REAL). His research mainly explores issues related to regional economic development with special focus on infrastructure, technology transfer and spillovers. Now, he is involved with several research grants working on economic recovery after the hit of natural disasters like floods, earthquakes and landslides on a county basis, collaborating with the World Bank and State Government of Illinois.