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YSSP Young Scientists Summer Program

YSSP Participants 2016

Biographical Sketches and Research Project Abstracts

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

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Advanced Systems Analysis Program (ASA)
Program Director: Elena Rovenskaya

Osama Ibrahim

Supervisor: **Matthias Wildemeersch**

Research Project: **A systems tool for prescriptive policy analysis.**
Labelled causal mapping, A problem structuring method for policy modelling, simulation and decision analysis

Abstract: Elicitation and processing of the relevant information is the core of any policy decision-making process. Modelling is about making sense of the available information. Models are able to incorporate the contextual influences on policy making (e.g. political and economic environments, community sentiment etc). Using simulation and visualisation techniques on the outputs of these models can help policy makers to reduce uncertainties on the possible impacts of policies.
In an effort to enable adoption of the systems thinking approach to address the central problem of empirical political study, this research presents an operational approach for structuring policy problems and prescribing preferred policies. Systems analysis allows quantitative, empirical testing of models that exist in the study of public policy. The proposed approach supports a prescriptive analysis for policy that includes: the problem definition, ex-ante impact assessment and evaluation activities carried out at the policy formulation stage of the policymaking process. This research presents a new tool[1] for systemic modelling and simulation of policy decision situations. It aims to facilitate the cognitive activity of representing complex mental models using system dynamics simulation modelling. Using the *'labelled causal mapping*' method, a policy-oriented problem structuring method is introduced in this research, the tool bridges the gap between the user's mental model and the explicit graphical representation, in order to enable knowledge representation and system analysis. We are in several iterations of the build-evaluate cycle, using multiple demonstration and use cases, from various policy areas and different EU policymaking levels for the tool evaluation.

Biographical Sketch: Osama Ibrahim is a 3rd year PhD candidate at the Department of Computer and Systems Sciences, Stockholm University, Sweden. His research interests includes: decision support systems, risk and decision analysis, policy modelling and simulation, mathematical and statistical analysis, and stochastic operations research. He received his B.Sc. in Computer Engineering, (honours) and MSc in Engineering Mathematics and Operations Research, from Military Technical College in Egypt in 2000 and 2008.

[1] A web-based prototype for the tool is reached through the URL: http://dev1.egovlab.eu:4001/

Advanced Systems Analysis Program (ASA)
Program Director: Elena Rovenskaya

M. Nazli Koseoglu

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

Research Project: **Detecting systemic risk in the financial system by sentiment analysis of textual big data**

Abstract: Unmatched supply and demand is experienced differently at every region and for different development levels. On East coast of Scotland, agricultural run-off limits the availability of water to farmers themselves, as well as to environment and to other users. It is projected that the need for irrigation will increase greatly in the future in comparison to current amounts. These projections for increased agricultural water demand and variability in future makes the regulation of catchment based water resources and pollution a pressing issue for decision makers.
Water quality trading schemes and markets, are similar to carbon emission trading, and they are becoming popular as an economic tool to control ambient water pollution at reduced cost. However such schemes are also inherently uncertain, in particular, due to uncertainties of nonpoint and point pollution sources. Adequately addressing the risks and uncertainties in the design of water pricing pollution taxation (trading) scheme is essential to create non-stagnant markets and achieve water quality targets in a safe and cost-effective manner, which is the aim of this research. In our research we aim to revise and to apply the IIASA stochastic decentralized water pollution taxation model (WAP) operating under inherent uncertainties to one of these problematic catchments in Scotland. The overall objective is to investigate pathways to equalize the marginal value of pollution permits to shift water from low value users to high value users and achieve higher fairness and social return (with improved economic return and ambient water quality) at catchment level.

Biographical Sketch: Nazli Koseoglu is a third-year PhD student at the School of Geoscience, the University of Edinburgh and Scotland's Agricultural College. Her PhD is a part of the Scottish Government's Hydro Nation Programme and looks to evaluate the economic value of water and its optimal allocation to its competing uses in Scotland (as well as a partial identification of key Scottish industries' water footprint). Her research aims to inform the Hydro Nation policy aspiration. Prior to her PhD, she received a joint MSc in Environmental Studies from Autonomous University of Barcelona and Technical University of Hamburg..

Advanced Systems Analysis Program (ASA)
Program Director: Elena Rovenskaya

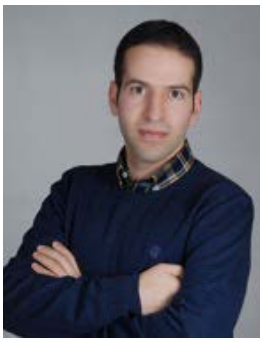
Julia M. Puaschunder

Supervisor: **Elena Rovenskaya**

Research Project: **Financing climate stability**

Abstract: Global warming has become reality in temperature anomalies, extreme weather events, unprecedented hurricane seasons and up to 50 inches sea level rise predicted until the end of the century. History has also been made in reaching an iconic agreement on global warming mitigation at the UN Paris climate change conference.
The project proposes an innovative climate change mitigation approach with bonds funded through taxation imposed on future generations. Shifting the ultimate costs of climate change aversion to later generations leverages climate stability into a Pareto improving strategy for mankind.
While intergenerational burden sharing on climate change appears as viable real-world relevant emergent risk prevention; we currently lack an analytical understanding of the impact of climate mitigation through bonds on economic growth, the coordinated implementation of climate change burden sharing bonds as well as the model's long-term effects.
The planned project will introduce intergenerational burden sharing into contemporary growth models of the Nordhaus type with attention to public deficit spending and tax ethics. Empirical analyses will help revealing the model's viability in order to derive suggestions for global governance policy makers to efficiently herald climate justice in the 21st century.

Biographical Sketch: Julia M. Puaschunder graduated from the University of Vienna (2003 Master of Philosophy/Psychology, 2010 Doctor of Natural Sciences), Vienna University of Economics and Business (2006 Doctor of Social and Economic Sciences, 2007 Master of Business Administration), and the Maxwell School (2008 Master of Public Administration). She currently studies Law and Economics at the University of Vienna and The New School Department of Economics.
Julia launched and administered research projects on four continents. She was invited to present her research at Harvard, Princeton, Columbia, Oxford and Cambridge as well as The Academic Council on the United Nations System. As a current Prize Fellow in the Inter-University Consortium of New York, she supports the Economics of Climate Change Project Speaker Series hosted at The Schwartz Center for Economic Policy Analysis. At The New School, her research investigates western world intergenerational equity constraints in the domains of environmental sustainability, overindebtedness, and demographic aging.



Navid Rekabsaz

Supervisor: **Stefan Thurner**
Co-Supervisor: **Sebastian Poledna (RISK)**

Research Project: **Detecting systemic risk in the financial system by sentiment analysis of textual big data**

Abstract: Detecting instability and predicting systemic risk in financial systems is of crucial importance for promoting long-term safety and stability of systems. In contrast to the common approaches to systemic risk assessment based on recorded numbers and statistical data (hard information), we measure the attitude and opinions of the financial system stakeholders toward risk by analyzing textual data (soft information). The study exploits annual reports and publications of the publicly traded corporation. It extracts the opinions with forward-looking attitudes as a novel information resource for systemic financial risk prediction. We use sentiment analysis techniques to make a quantified assessment of the sentiments expressed in the financial texts. Beside systemic risk detection, an essential event in the financial system is when corporations or institutes face bankruptcy or are delisted from stock markets. Considering the importance of these cases, we also explore identifying them by modeling observed change patterns in the quantified risk indicators.
For these purposes, we apply state-of-the-art approaches in sentiment analysis, namely deep learning. Deep learning is an effective Neural-Network based method that has recently shown superior improvement for the sentiment analysis tasks in different domains e.g. social opinion mining, product reviews. The effectiveness of the method in other domains promises an interesting potential to study it on the financial data.

Biographical Sketch: Navid Rekabsaz is a second-year PhD candidate in the Vienna University of Technology, with research interest on information retrieval, natural language processing, and text mining. He graduated (2015) from the master program of Software Engineering and Internet Computing from the same university. His research focus is on domain-specific search based on semantic text processing by applying information retrieval, machine learning and specifically deep learning techniques. Currently, he works at the Vienna University of Technology as research assistant on two projects on professional search in the domains of patent and health data.

Corinthias Pamatang Morgana Sianipar

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

Research Project: **System modeling of Appropriate Technology integration into the cocoa industry in Aceh, Indonesia**

Abstract: Cocoa is one of the most important commodities in Indonesia, contributing a significant portion to the country's agricultural exports. Among others, Aceh has been recognized as one of the most vulnerable cocoa-producing regions in Indonesia. This results in a fragile cocoa industry in the region, consisting of an ineffective supply chain, an unequal distribution of economic value, less environmental-friendly production and distribution, and social frictions between producing/transporting sub-regions. To enhance the supply-chain, an Appropriate Technology has been introduced into the system, requiring a system modeling to properly discover interventions for sustaining the technology and expanding its effects all over the chain. This research aims at developing the model by investigating the existing cocoa supply-chain in Aceh. The interventions are first established through a multidisciplinary approach by being separated based on four perspectives. Technically, Appropriate Technology is posited as intervening cocoa post-harvest processing. Based on an economic perspective, Appropriate Technology is posited as intervening cocoa value-chain. Next, the system is interpreted by observing the system boundary of new intersection(s) between Life-Cycle Assessments of cocoa supply-chain and Appropriate Technology. Then, the technology is posited to affect accessibilities within the social system as a key to establish social interactions between producing/transporting cities/regencies. Finnally, these multidisciplinary approaches are treated as an interdisciplinary one to holistically solve interconnected problems within the observed system. The expected result includes an effective supply-chain, an equal economic value redistribution and environmental-friendly production and distribution, as a means to establish a more harmonious society.

Biographical Sketch: Corinthias P.M. Sianipar (Morgan) is a third-year PhD candidate at the School of Business and Management, Bandung Institute of Technology (ITB), Indonesia. Besides, he is currently enrolled as a third-year EngD candidate at the Department of Industrial Administration, Tokyo University of Science, Japan. His research foci in Indonesia include local economic development, community empowerment and the design & engineering of Appropriate Technology, while he has corresponding research interests in Japan, including systems engineering and social engineering. In terms of organizational activities, he is an active member of the Triple-Helix Association (THA) and the International Society for Horticultural Science (ISHS).

Advanced Systems Analysis Program (ASA)
Program Director: Elena Rovenskaya

Dina Subkhankulova

Supervisor: **Artem Baklanov**
Co-Supervisor: **David McCollum (ENE)**

Research Project: **Decentralised coordination of demand-side under the high renewable energy penetration scenario**

Abstract: Traditionally, energy systems evolved to have a hierarchical structure with central control. This has been working well with large dispatchable power generators and central grids feeding our homes with electricity. However, such a set-up has been demonstrated to be unsustainable posing threats to human security in the form of climate change, environmental pollution, unstable energy prices and geopolitical conflict.
Renewable electricity generation has been recognised as a very promising solution to tackle today's energy sustainability problem. However, increasing penetration of renewable energy resources raises concerns for grid stability due to their intermittent nature of electricity generation. Plug-in electric vehicles (PEVs) offer a natural source of flexibility to the grid since charging can be coordinated with the power output from intermittent energy resources. 'Smart grid' technologies can provide the framework for optimal component management through bi-directional flow of information and energy. However, the distributed nature of renewable energy resources and the many stakeholders involved in the system challenge the effectiveness of centralised control.
This work explores the possibility of decentralised control of PEV charging guided by autonomous agents (representing self-interested consumers). Agents' performance is evaluated in terms of their ability in reaching the global system goal of balancing intermittent energy supply with consumer demand. The simulation is performed using agent-based modelling and a number of mathematical approaches are investigated in terms of optimal agent behaviour.

Biographical Sketch: Dina is a second year PhD student at the UCL Energy Institute aiming to graduate in March 2018. Her interests include using DSM for integrating renewable energy and exploring different modelling approaches to test future energy scenarios. Her background is in Physics (MSci, Imperial College). She has worked for an engineering startup (Duvas Technologies) developing pollution sensors and finance (Credit Suisse). Dina has presented her work at the AAG conference in Chicago and completed an internship at the International Energy Agency working on the Energy Efficiency Market Report, published in October 2016. She is on the committee for a Clean Technology Competition ("CleanTech challenge") aimed at kick-starting student business ideas in the domain of clean technology.

Advanced Systems Analysis Program (ASA)
Program Director: Elena Rovenskaya

Mingshu Wang

Supervisor: **Anna Shchiptsova**

Research Project: **Effects of spatial urbanization pattern on the emissions in the transportation sector**

Abstract: In recent decades urban areas have undergone rapid development. Urbanization is accompanied by a change in human lifestyle and, as a consequence, increasing energy consumption through encouragement of the use of private vehicles, causing traffic congestion and air pollution. As centers of economic activity, population migration and energy consumption, urban areas contribute heavily to global climate change, particularly through carbon emissions produced by transportation sector. Understanding how spatial urbanization pattern is connected with the amount and frequency of vehicle usage facilitates solutions of sustainable and smart city development and helps to find paths to emission reduction in the growing urbanized centers.

This project aims to provide a generic framework for studying transportation emissions in connection with spatial urbanization pattern. Firstly, we will produce a set of detailed land use maps from satellite remote sensing, geographical information systems (GIS), and user-generated contents (UGC), which capture various patterns of urban development. The aim is to classify the area of interest into different categories based on both land cover characteristics (e.g., impervious surface, urban forest, urban agriculture land) and human activity features (e.g., residential center, business center, recreational center). Secondly, we will develop a model to simulate how different types of land use characters interact with vehicle usage and transportation emissions. Thirdly, we will examine the spatial patterns of urban carbon emissions in relation to the dynamics of transportation sector, land use and human activity in the selected urban areas using multiple geo-visualization techniques.

Biographical Sketch: Mingshu Wang is a first-year PhD student at the University of Georgia, where he also received his Master's Degree (2014). He is currently the secretary of the Sensor Web and Internet of Things Working Group of the International Society for Photogrammetry and Remote Sensing (ISPRS). His research focuses on integrating big data and geospatial analytics for urban informatics and computational social science. He had several industry experiences, including being an intern at the NASA DEVELOP National Program (2015), a senior associate at the Capital One Financial Corporation (2014-2015), a research associate at the U.S. Environmental Protection Agency (2013-2014), and an intern at the World Wildlife Fund (2013). He was one of three recipients of the Cartography and Geographic Information Society (CaGIS) scholarship (2014) and was one of the twelve speakers in the TEDxUGA 2016 event.

Air Quality and Greenhouse Gases Program (AIR)
Program Director: Markus Amann

Fabian Heidegger

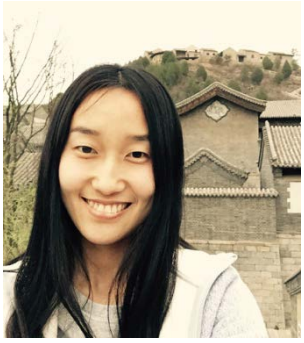
Supervisor: **Jens Borken-Kleefeld**

Research Project: **ITS (Intelligent Transport Systems) environmental monitoring: Using improved energy consumption and emission data from road traffic for the GAINS Model**

Abstract: Transportation might be one of the biggest stumbling blocks for efficient climate protection. Worldwide traffic is a sector whose emissions have gone up, especially in the road transport sector – although it has major potential for emission reduction. Measures to reduce respectively control local emissions require a good knowledge of the point of origin of the emissions. Intelligent Transport Systems (ITS) are able to make major contributions.
ITS Vienna Region calculates the local traffic condition on all major roads in the city of Vienna and the neighbouring states "Lower Austria" and "Burgenland" every 5 minutes. These frequent and detailed calculations are based on the fusion of various data sources. They are the main source of information for traffic management and traffic information in this region and beyond.
The purpose of the research project is to use improved energy consumption (respectively emission) data from road traffic to study the impacts of real-time traffic emissions for the environment by means of several scenarios. These scenarios will be extended by different technology implementations (e.g. electric vehicles) in the fleet over time horizon to allocate suitable emission factors to the roads of the traffic network. The most important interactions and synergies between mitigation of air pollution and climate relevant gases can be studied in the GAINS (Greenhous Gas and Air Pollution Interactions and Synergies) Model. The results of the more exact calculations can help to assess efficiency of (transport) policies in the very long term to reduce or even avoid emissions.

Biographical Sketch: After a BSc in Transportation Economics (2011) from the Faculty of Transportation and Traffic Sciences „Friedrich List", TU Dresden (Germany), Fabian Heidegger obtained a MSc in Transportations Systems (2014) at TU Munich, Germany. Currently he is a second year PhD student at the University of Natural Resources and Life Sciences (BOKU) in Vienna and works for ITS Vienna Region, the telematics project of the Public Transport Authority Eastern Region (VOR). His main field of scientific interest includes understanding the impacts of transport emissions to the environment and climate change. His current research involves calculation of road based energy consumption, air pollution and greenhouse gases under consideration of current traffic situations.

Air Quality and Greenhouse Gases Program (AIR)
Program Director: Markus Amann



Meng Li

Supervisor: **Zbigniew Klimont**

Research Project: **Evaluation of emission inventories over Asia from bottom-up and top-down perspectives**

Abstract: Asia, especially China, has become an important contributor in global emission budget during the last decade for both gaseous pollutants and greenhouse gases. Tremendous efforts have been made to develop a reliable emission inventory for atmospheric modeling on Asia and global scales in projects of MICS-Asia (Model Inter-Comparison Study for Asia) and ECLIPSE (Evaluating the Climate and Air Quality ImPacts of Short-livEd Pollutants, developed based on GAINS model) based on different methodologies and dataset.

In this research, we propose to conduct comprehensive evaluations for the MICS-Asia and ECLIPSE emissions (i.e. GAINS) in both bottom-up and top-down perspectives. Inter-comparisons and trend analyses between MICS-Asia and ECLIPSE will be conducted by sector and species to illustrate the differences of methodologies and dataset used in inventory development since 2000 (bottom-up); Simulations using an Asian-nested chemical transport model (CTM) will be performed and compared with satellite observations to identify uncertainties for both emission inventories (top-down). For China, evaluations on provincial level will be done, especially regions where special priorities of emission control measures are implemented and heavy pollution episode occurs frequently. The comprehensive evaluations will help understand the effects on policy implications due to different emission inventory used, and further improve the accuracy of emission estimates over Asia.

Biographical Sketch: Meng Li graduated from Beihang University, China in July 2011 with a bachelor's degree in Environmental Engineering. She is now a five-year PhD candidate in Center for Earth System Science, Tsinghua University since 2011. Her main scientific interests are emission inventory development, policy analyses, atmospheric modeling, and emission constraints using multiple techniques.

Air Quality and Greenhouse Gases Program (AIR)
Program Director: Markus Amann

Li Cheng

Supervisor: **Jens Borken-Kleefeld**

Research Project: **Prediction and cost-benefit assessment of control polices from non-road mobile sources in China**

Abstract: Strong economic growth in China has fueled development of mechanization in transportation sector, which increased energy demand and led to air pollution. As great efforts have been paid in controlling emissions from major emission sources such as power plant and vehicle mobile sources, further reduction potentials from these types of sources are limited. Emission control efforts, both national and local levels, should be shifted to non-road mobile sources due to their significant contributions to air pollutants. However, for non-road mobile sources, significant knowledge gaps are still present in the accuracy of emission inventories and the cost and benefit of pollution control strategies.
In this study, sectors include aviation, railway locomotives, ship (including those from both river and marine ships and boats), engineering machinery, agricultural machinery, agricultural vehicles, port machinery, and other non-road sources. An up-down approach was adopted in emission calculations using 'emission factor' approach for major pollutants such as SO_2, NO_X, CO, PM_{10}, $PM_{2.5}$, VOCs, and NH_3. In order to predict and assess potential emission reduction of polices scenarios for non-road mobile sources in China and to formulate effective control strategy to alleviate the deteriorating air pollution. This project will: i) calculate the emissions trends of non-road mobile sources from 2003 to 2025; ii) estimate the spatial distribution map on a 27 km × 27 km resolution spatial grid, iii) simulate emission reduction cost in the control scenarios by using GAINS China model.

Biographical Sketch: Cheng Li received his master's degree in Environmental Engineering in 2013 from the AChina University of Mining and Technology, Beijing. He is currently a third-year PhD student at the South China University of Technology, His dissertation topic is "Current and Future Non-road Mobile Source Emissions and Their Impacts on Air Quality in China." His research focuses on predict and assess potential emission reduction of polices scenarios for non-road mobile sources in China and to formulate effective control strategy to alleviate the deteriorating air pollution. Research tasks include emission inventory compilation, spatial and temporal characteristics of non-road mobile sources, historical trends, future trend projection, and cost-effectiveness calculations with the use of GAINS model.

Air Quality and Greenhouse Gases Program (AIR)
Program Director: Markus Amann

Yue Qin

Supervisor: **Lena Höglund Isaksson**
Co-supervisor: **Zbigniew Klimont**

Research Project: **Air quality-Carbon-Water Nexus: China's natural gas policies**

Abstract: Facing severe domestic air pollution and growing international pressure on carbon emissions mitigation, the Chinese government has been actively developing domestic unconventional gas. However, most proposed unconventional gas projects are located in high-water stress regions and have substantial upstream carbon emissions. Using an integrated assessment approach, our study aims to evaluate the potential air quality-carbon-water impacts of different unconventional gas projects to prioritize national and regional natural gas projects in China. We use Gains-China model and Regional atmospheric model (WRF-Chem) to estimate the air quality and associated health impacts, as well as net changes in carbon emissions under different unconventional gas projects. Simultaneously, we will quantify the water withdraw and consumption for different unconventional gas development and evaluate the corresponding impacts on local water stress. Comparing across unconventional gas projects, we try to identify the trend of optimal natural gas development policies that can potentially bring win-win-win situations regarding air quality, carbon and water.

Biographical Sketch: Yue is currently a PhD candidate in the Science, Technology and Environmental Policy (STEP) program at Woodrow Wilson School of Public Policy and International Affairs at Princeton University.
Yue's research focuses on the environmental implications of China's natural gas policies, advised by Professor Denise Mauzerall. Her current research focus on the lifecycle climate performance of China's various natural gas sources, as well as the air quality and human health impacts of natural gas substitution for coal in China's energy structure. She is also interested in China's energy policy-making processes.

Air Quality and Greenhouse Gases Program (AIR)
Program Director: Markus Amann

Zhanqing Zhao

Supervisor: **Wilfried Winiwarter**

Research Project: **Sustainable pathways for GHGs and NH_3 mitigation from crop and livestock production in the North China Plain**

Abstract: The North China Plain (NCP) provides food to hundreds of million people. Dominant food production systems are (i) winter wheat – maize double cropping, (ii) intensive livestock production (pig, poultry and dairy), and (iii) intensive vegetable and fruit production. These systems are spatially separated, but interspersed with traditional mixed systems. Yields of these systems have greatly increased during last decades, but there are serious concerns about high nutrient inputs and greenhouse gases (GHGs) and NH_3 emissions from crop and livestock production. In the next three decades, NCP will require 30-50% more food because of the growing demands by the increasing human population, and the rapid increase of income. The challenge here is "which options are available for securing future food supply and at the same time safeguarding environmental sustainability in NCP, and what are there likely impacts?" In a collaborative project, propose to address the following research questions (1) What is the impact of current agricultural activities on nutrient inputs, GHGs and NH_3 emissions in NCP? (2) What is the impact of future agricultural activities on nutrient inputs, GHGs and NH_3 emissions in NCP? (3) What is the gap between expected and desirable nutrient inputs, GHGs and NH3 emissions in 2030 and 2050? And (4) What combinations of technical measures and structural changes in agriculture in the NCP could reduce the gap between expected and desirable nutrient inputs, GHGs and NH3 emissions? We will address these questions using GAINS model developed by IIASA, NUFER model developed by our group and back-casting approach.

Biographical Sketch: Zhanqing Zhao received her master's degree in Cartography and Geographical Information System in 2009 from Southwest University, China. She has extensive knowledge on the application of GIS and programming. She is currently a third-year PhD candidate at the Center for Agricultural Resources Research, Institute of Genetics and Developmental Biology, Chinese Academy of Sciences. Her current research focuses on agricultural nutrient management and its impact on environment in the North China Plain in China. The research includes modeling current agricultural nitrogen and phosphorus flows and losses at multiple scales (e.g. farm scale and regional scale), and exploring future sustainable pathways.

Arctic Futures Initiative
Scientific Director: Paul Berkman

Malgorzata Smieszek

Supervisor: **Anni Reissell**
Co-Supervisor: **Mia Landauer**

Research Project: **Developing a conceptual model for enhancement of science-based decision-making in the arctic council**

Abstract: In consequence of climate change and globalization, the Arctic is one of the most rapidly changing regions of the world. In such circumstances science-policy interfaces become critical in shaping governance able to meet challenges of rapid socio-ecological shifts. Scientific assessments, one form of those interfaces, are considered the most effective products of the Arctic Council (AC), the primary circumpolar - as well as increasingly global - forum for cooperation on matters pertaining to the region. However, whereas the *Arctic Climate Impact Assessment* has been appraised for being fundamental to our understanding of processes altering the Arctic, the instantaneous value of numerous assessments produced by the AC Working Groups in providing specific decision-support is arguably limited. To address this problem this project has two objectives. First, it aims to identify main difficulties in utilization of science-based information from the AC assessments in the actual decision-making in the Council. Conceivably, those difficulties may be related to perceived role that science should play in policy-making and discrepancies in this respect between producers and receivers of the AC assessments. Acquiring understanding on how both producers and receivers of the assessments' products evaluate their usefulness and learning about their scientific needs and expectations with regard to content as well as format of delivered scientific information is of central importance to the second objective of this research: development of a conceptual model for enhancement of science-based decision-making process in the Arctic Council. The applied methods will include semi-structured interviews with selected individuals involved in different roles in the AC, a questionnaire and possibly social network analysis. Overall, this research aims to move beyond the usage of scientific assessments and reports as primary science-policy interface within the Arctic Council toward a more integrated, innovative and holistic system of decision-making based on science.

Biographical Sketch: Małgorzata (Gosia) Śmieszek is a researcher in the Arctic Centre, University of Lapland, a doctoral candidate at the Faculty of Social Sciences of the University of Lapland and a fellow of the International Arctic Science Committee since 2014. She is the alumna of the Jagiellonian University (Poland), University of Vienna (Austria) and the College of Europe in fields of international relations and European studies. Her academic interests encompass primarily questions of Arctic governance, science-policy interface, science diplomacy and prospects of scientific cooperation in the Arctic.

Evolution and Ecology Program (EEP)
Program Director: Ulf Dieckmann

Diana Erazo

Supervisor: **Rupert Mazzucco**

Research Project: **Land-use change effects on infectious disease transmission: the case of Chagas disease in Colombia**

Abstract: For several centuries, human intervention has changed land cover, in particular through land conversion for agriculture. Land-use changes can alter not only atmospheric composition and climate, but also influence ecosystem dynamics by changing species diversity and abundances. As many species transmit infectious diseases to humans, land-use change can have a significant impact on endemic levels and infection risks. The 2020 goals set by the World Health Organization constitute a program for controlling the burden of morbidity of nine neglected tropical diseases. One of them, Chagas disease, is endemic in Latin America and it is transmitted to humans by kissing bugs. Without treatment, Chagas disease can cause serious heart and digestive complications. Chagas disease persists not only in domestic habitats, but also in the wild, which implies that it may be affected strongly by land-use change. Supporting policy development with quantitative research is one of the main approaches recommended by the WHO for achieving their 2020 goals. Thus, considering the expanding economy of oil-palm plantations in Latin America, the aim of my study is to analyze the effect of land-use change on Chagas-disease infection risk in Colombia. The principal objectives are to: (i) understand the relative importance of wild and domestic reservoirs of the disease and (ii) assess the possible impacts on human transmission rates due to altered insect vector inflows caused by land-use changes. I will approach these questions by using field data and geographic information systems coupled with an epidemiological model.

Biographical Sketch: Diana Erazo is a second-year PhD student at Universidad de los Andes in Bogota, Colombia. She holds a master's and bachelor's degree in environmental engineering with a minor in biology from the same university. Currently, her research objective is to assess the possible impacts of oil-palm monocrops on Chagas-disease infection risk in Colombia. Diana's main scientific interests are disease ecology, host–parasite interactions, vector traits, and ecology.

Evolution and Ecology Program (EEP)
Program Director: Ulf Dieckmann

Vera Pfeiffer

Supervisor: **Rupert Mazzucco**
Co-Supervisor: **Åke Brännström and Ulf Dieckmann**

Research Project: **Network analysis of anthropogenic pollinator declines**

Abstract: Flowering plants are assisted by insect pollinators in producing fruits and seeds, with high-quality pollination increasing seed numbers and fruit sizes. Therefore, the decline of high-quality pollinators such as bumble bees and other wild bees, reported worldwide, is a cause of concern. Because interactions among plants and pollinators are intricate, the ultimate consequences of this trend for ecological diversity and food security are still mostly unclear. In this model-based study utilizing a five-year multi-site record of plant and pollinator observations in North America, I will examine the dynamics of pollination networks. This will help me understand interspecific interactions and analyze correlations between the structural properties of pollination networks and vulnerability indicators derived from how these networks respond to anthropogenic stressors, with the latter including species invasions and species disappearances caused by climate change or human intervention.

Biographical Sketch: Vera Pfeiffer is a fourth-year Environment and Resources PhD student in the Nelson Institute for Environmental Studies at the University of Wisconsin-Madison in the United States. Her academic interests revolve around the effects of human land use on biodiversity in ecosystems. She is curious how ecological and evolutionary mechanisms contribute to the structure and resilience of ecological communities and what factors may support or detract from ecosystem resilience and functionality. Vera received her bachelor's degrees in Biology and International Relations at Boston University and worked at a decentralized network of 200 small urban farms in San Francisco before undertaking her master's degree in Geography at Oregon State University.

Evolution and Ecology Program (EEP)
Program Director: Ulf Dieckmann

Rebecca Pike

Supervisor: **Peter Bednarik**
Co-Supervisor: **Ulf Dieckmann**

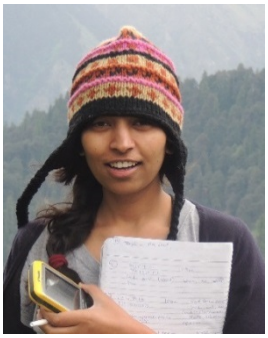
Research Project: **Cultural evolution of low fertility at high socio-economic status**

Abstract: Life-history theory predicts that individuals should behave to maximize their lifetime reproductive success, measured by the number of successful offspring. One would thus expect that parents with greater means have more children. Paradoxically, this is not the case: in modern societies socio-economic status is negatively correlated with fertility. As a result, over half of the global population live in countries with below-replacement fertility. Explanations of this pattern based on genetic evolution have traditionally focused on the trade-off parents face between the quantity and quality of their offspring. Reducing the number of offspring allows greater investment in each. Thus, parents may increase their relative reproductive success by producing a small number of high-quality offspring. However, explanations along these lines assume that high-quality offspring will have high reproductive success; the fact that this does not seem to apply in modern societies is the very pattern that needs to be explained.

This project aims to address the paradox by broadening the framing from genetic evolution to cultural evolution. We consider socio-economic status as a cultural equivalent to fitness and the target investment in a child as an individual's evolving trait. We conjecture that, owing to the highly nonlinear benefits accrued from such investment, high-income parents are constrained by a quality-quantity trade-off and choose a lower number of offspring, whilst low-income parents are not and choose a higher number of offspring. On this basis, we will devise a model in which the number of children can be influenced genetically and culturally. Since genetic evolution is better understood, the main focus of this project will be on the cultural evolution of fertility decisions.

Biographical Sketch: Rebecca graduated from the University of Bristol, UK in 2011 with a bachelor's degree in Mathematics. Her third-year project was titled 'Evolution of cooperative behaviors in human society and the role of social norms.' After graduating, Rebecca completed the two year Teach First leadership development program in London, becoming a qualified teacher of Mathematics. She is currently a third year Theoretical Biology PhD student in the School of Biological Sciences at the University of Bristol, UK. Her doctoral research focuses on using mathematical modelling techniques to study the pair bond and parental-care strategies in avian species. Her main fields of scientific interest are the evolution of cooperation, parental care, the pair bond, division of labor, and cultural norms.

Evolution and Ecology Program (EEP)
Program Director: Ulf Dieckmann



Pooja Rathore

Supervisor: **Ulf Dieckmann**
Co-Supervisor: **Åke Brännström**

Research Project: **Trait-based modeling of forest-biodiversity dynamics in India**

Abstract: Human-induced climate change is causing widespread alterations in species distribution patterns. The increase in global surface temperature over the 20th century has already changed the composition of forest plant communities around the world. While detailed projections of future climate change are available, these alone do not suffice to estimate changes in species-range dynamics. There are several other factors, such as the ecologically important life-history traits, evolution, and species dispersal that affect population growth rates and species distributions. The debate concerning the strengths and limitations of species-distribution models and potential areas for their improvement ranges from the incorporation of land-cover variables and biotic interactions to biological traits. More detailed forms of data, becoming available on the life histories of many taxa, can significantly improve biodiversity projections. The proposed project will investigate the roles of functional traits and eco-evolutionary dynamics in determining forest-biodiversity processes and patterns. Specifically, I will use the PLANT model, which has recently been developed in collaboration with IIASA researchers, to predict spatial variability in the community structure of Moist Bhabar Doon Sal (*Shorea robusta*) forests in Tarai central province, situated between the Ganges River and the Shiwaliks Hills in the lower Himalaya. The core of my research effort will be devoted to parameterizing and calibrating the PLANT model to match empirical observations from Indian forests. Time permitting, I will then use the calibrated model to predict the impacts of climate change and global warming on these Indian forests.

Biographical Sketch: Pooja Rathore is currently a third-year PhD student at the Forestry and Ecology Department at the Indian Institute of Remote Sensing, Indian Space Research Organization, Dehradun, India. She received a master's degree in Environmental Sciences at Rajasthan University in 2011. She enrolled into her current PhD program after working for the Arid Forest Research Institute, India, for almost two years. Her current research focuses on the vulnerability assessment of Western Himalayan temperate and alpine species in terms of their spatial variability under projected climate change.

Evolution and Ecology Program (EEP)
Program Director: Ulf Dieckmann

Easton White III

Supervisor: **Ulf Dieckmann**
Co-Supervisor: **Kalle Parvinen**

Research Project: **Plasticity and evolution of species in a changing climate**

Abstract: Living in seasonal environments, the ecological and evolutionary dynamics of many animal and plant species depends on the timing of life-history events such as reproduction. This timing depends on factors like snowfall, food availability, and predation pressures, which not only change unpredictably from year to year but may also follow trends caused by climate change. While it is well established that the reproductive timing of many species has advanced in response to climate change, it remains unclear if these responses suffice for population persistence. Two processes allow such responses: phenotypic plasticity, through which an individual's expressed phenotype is contingent on the environment it experiences, and adaptive evolution, through which the mean phenotype a population expresses shifts so as to enable higher reproductive success. Research on separating the effects of these two processes and determining how they interact has begun only recently. For some species, phenotypic plasticity has shielded them from the effects of climate change, but this raises a range of questions. First, for how long can such shielding continue? Second, what mechanisms might cause it to break down? Third, can such shielding result in a false sense of security on the part of conservation managers? Fourth, what early-warning signals might be available to anticipate break-downs? Fifth, could the shielding eventually be counterproductive, by disabling needed adaptive evolution? Sixth, are there conditions under which the phenotypic plasticity of reproductive timing accelerates needed adaptive evolution? We will investigate these questions using a model incorporating phenotypic plasticity and adaptive evolution in reproductive timing, calibrated from and confronted with field data. Results of these investigations will help us understand and improve the population persistence of species threatened by climate change.

Biographical Sketch: Easton White studied Biology at Scottsdale Community College and Arizona State University, Phoenix, United States, from where he graduated in 2013. He then spent a year as a Fulbright Student working at the University of Victoria in Canada. He is currently a second-year PhD student at the University of California, Davis. His PhD work focuses on how seasonal forces affect ecological and evolutionary dynamics. He has broad interests in theoretical ecology, marine systems, time-series modeling, and population ecology. He is also interested in science education, particularly the teaching of quantitative skills in science courses.

Energy Program (ENE)
Program Director: Keywan Riahi

Julia Janke

Supervisor: **Narasimha Rao**

Research Project: **Socioeconomic and spatial dimensions of welfare and energy in India**

Abstract: Energy and carbon footprints are differently distributed across households depending on various factors such as income level, educational attainment and cultural embeddedness. Both individual and structural drivers play a crucial role for household energy consumption. Income often correlates with higher energy consumption especially indirect energy consumption due to energy-intensive lifestyles. In addition structural characteristics such as agglomeration size, the availability of public services and infrastructure explain heterogeneity in energy carbon footprints as well.

The aim of this project is to analyse direct and indirect energy consumption patterns of Indian households and to contrast it to individual welfare levels. Based on a household micro-census survey for India, we assess energy consumption of households by differentiating the use of direct energy carriers for cooking, electricity and heat as well as indirect energy use for food, consumable and durable goods. Then applying statistical and econometric methods allow answering our research questions on the distribution of energy footprints and its relationship to individual welfare levels. Since spatial structures play a crucial role in determining energy and carbon footprints the project also investigates spatial dynamics driven by population density and urban form. Insights of this project should improve understanding of energy planning in urbanisation processes and inform urban and regional policy.

Biographical Sketch: Julia is a first-year PhD student at the University of Technology in Vienna at the Department of Spatial Planning. She has a master degree in Economics from Vienna University of Economics and Business and worked several years in applied research in the field of economics of climate change applying CGE modeling. In her PhD she investigates energy and carbon footprints aiming to contribute to the field of energy planning. Her current research focuses on energy transformation processes in urban neighborhoods and spatial dynamics of energy consumption.

Energy Program (ENE)
Program Director: Keywan Riahi

Alexandre Köberle

Supervisor: **Volker Krey**

Research Project: **Downscaling of Shared Socioeconomic Pathways (SSPs) to Brazil using the MESSAGE modelling framework**

Abstract: In order to be used by national modelling teams, SSPs need to be downscaled from the global to the national level, in a process by which information on a coarser scale is transformed and made available on a finer scale. Global SSP scenarios provide boundary conditions for the creation of the storylines and datasets of the national scenarios so that the latter are consistent with the former, while integrating long-term trends based on SSPs with short- to medium-term trends based on national assessments and modeling. This project proposes to create a set of SSPs for Brazil that include their respective storylines and datasets. In order to develop the data associated with each storyline, an integrated assessment model is required to run projections from a starting point that represents the present-day reality. The research will use IIASA's models (MESSAGE, GLOBIOM, MAGGIC) to generate self-consistent datasets associated with each SSP, including energy demand and supply, land use change, water, and economic variables. However, because Brazil is not represented as a separate region in IIASA´s MESSAGE, the country must first be separated from the rest of Latin America in the model. Leveraging the current effort at COPPE to expand MESSAGE-Brazil to MESSAGE-Latin America and MESSAGE-Global, I propose to implement Brazil as a separate region in IIASA's MESSAGE, and then use it to run the global SSPs to generate the downscaled SPP scenarios for Brazil.

Biographical Sketch: Alexandre Köberle is a third year PhD student and researcher at the Energy Planning Program of the Universidade Federal do Rio de Janeiro in Brazil. His research topics focus on environmental impacts of energy use, biofuels and land use, renewable energy, energy modelling, and integrated assessment modelling. He has a BSc in Plant Biology and Ecology from University of California Davis and a MSc in Environment and Resource Management from Vrije Universiteit Amsterdam. He is an associate researcher at PBL and a visiting scholar at Copernicus Institute in the Netherlands.

Energy Program (ENE)
Program Director: Keywan Riahi

Lu Liu

Supervisor: **Matthew Gidden**
Co-Supervisor: **Michelle van Vliet**

Research Project: **Developing high-resolution surface water availability indicators for long-term energy infrastructure planning models**

Abstract: Energy and water systems are interconnected and dependent on one another. Energy generation relies on the sustainability of the water supply system, which is strained by increasing water demand due to growing populations and other needs. Such adverse impacts may be exacerbated during droughts and heat waves when water availability is lower than normal. Therefore, understanding the reliability of water supply capacity is extremely important for long-term planning of energy infrastructure in relation to other sectors which use large amounts of surface water.

This summer research project will focus on the development of technical potentials for surface water supply in the various freshwater basins worldwide utilizing results from a suite of global hydrological models. The technical potentials will incorporate reliability indicators tailored towards the long-term planning of water-related infrastructure systems including energy systems such as thermal and hydro-power generation as well as irrigation, reservoirs, municipal supply capacity, and long-distance water transfers. The resulting analysis will be used to investigate the importance of seasonal and inter-annual variability, as well as low- and high-flow duration metrics. The technical potentials will be assessed across different climate pathways and environmental flow requirements to identify energy infrastructure systems particularly sensitive to future water availability.

Biographical Sketch: Lu Liu holds her BSc. (2010) and MSc (2012) degree from the University of Oklahoma, USA. She is currently a second-year Ph.D. student at the University of Maryland, USA, and studying Water Resources Engineering. She is also affiliated to the Joint Global Change Research Institute, USA. Lu's main fields of scientific interest generally includes the development of global hydrologic models and implementation of global and regional sectoral water demand models from an integrated assessment framework. Her PhD research is to investigate and analyze the interplay between energy and water systems and understand the role of climate change in the water-energy complex.

Energy Program (ENE)
Program Director: Keywan Riahi

Clara Orthofer

Supervisor: **Daniel Huppmann**
Co-Supervisor: **Volker Krey**

Research Project: **Modeling South Africa for the Message Model. South Africa's Energy Future: Scenarios for the development of an emerging economy's power system under the influence of the UNFCCC Paris Agreement**

Abstract: South Africa, Africa's biggest CO2 emitter, is struggling to provide electricity in line with national demand. Consequently, the country's population and its economy suffer from widespread – planned and unplanned – blackouts. This situation is unlikely to be overcome soon, as the growth in energy demand contrasts the decline in the country's accessible coal deposits. In the meanwhile, South Africa's presidency has come under heavy critique for trying to counter the looming crisis through the purchase of expensive Russian nuclear reactors.
My research shall shed light onto the intriguing question: why a country with such an abundance of renewable energy sources would fare so poorly in providing its population with adequate electricity. In order to better understand the ongoing development I want to portray the South African energy system in more detail within the existing model MESSAGE. I am planning to do an energy-economic analysis of the system's status and investigate its possible future transition pathways.
Additionally I would like to use the model to study the effects of the recent UNFCCC Paris Agreement. I am planning to identify the most influential decrees of the Agreement and the most sensitive system parameters by running the model on various scenarios: comparing straightforward economic optimizations and such respecting the Agreement.

Biographical Sketch: Clara Orthofer is a first-year PhD candidate at the Electrical Engineering Graduate School of the Technical University of Munich. She conducts her research at the Institute for Energy Economy and Application Technology and holds a master's degree in Power Engineering form the same University. Her current research focuses on the modeling of power systems, in order to better understand the integrated development process of these interconnected systems.

Energy Program (ENE)
Program Director: Keywan Riahi

Eveline Vasquez Arroyo

Supervisor: **Oliver Fricko**

Research Project: **Optimization of the Brazilian energy system expansion under water availability restrictions**

Abstract: Water is a natural resource, which is increasingly limited in quality and quantity. The energy sector requires large quantities of water and currently accounts for approximately 15% of global water withdrawals. Often, the decision about using a specific technology for the energy production is based on the lowest cost, without considering important aspects such as availability of water, the non-energy water demands and the aquatic ecosystems. Recent research highlights the importance of defining the potential vulnerability of the energy system as a result of water stress.

This proposal explores the nexus between water use and energy supply in Brazil. The research will look at the actual and future needs for freshwater in energy production, taking into account the Brazilian climate change pledge, the availability of water and the socio-economic development of the country. To do that, the current MESSAGE-Brazil energy model will be enhanced to reflect regional water constraints. This new constraint could influence energy projections by the energy model by, for instance, altering the energy technologies portfolio or indicating the necessity to shift a technology to other areas with lower water stress. The consideration of the non-energy water uses, energy water demand and their contribution to the water availability restriction in the energy model makes the modeling exercise more complex and realistic, despite the uncertainties related to water issues.

Biographical Sketch: Eveline Vasquez graduated from Callao National University (Peru) with a bachelor's degree in Environmental and Natural Resources Engineering. After working in the environmental management area for many years, she obtained an MSc in Environmental Planning at the Energy Planning Program (PPE) at the Rio de Janeiro Federal University (UFRJ), Brazil (2012). Her thesis was about a methodological proposal for assessing the vulnerability of Brazilian coal-fired power plants to climate change. She is currently a third-year PhD student in the PPE/UFRJ. Her research interests include the water necessities for energy production and the possible vulnerability because of climate change (water-energy-climate nexus).

Ecosystems Services and Management Program (ESM)
Program Director: Michael Obersteiner

Roshan Adhikari

Supervisor: **Hugo Valin**
Co-Supervisor: **Esther Boere**

Research Project: **Coupling regional technology adoption and impact models with market equilibrium models to assess sustainability of agricultural systems**

Abstract: My research aims to advance the state of the art in linking disaggregate data and models with a partial equilibrium model by coupling the TOA-MD (a disaggregate impact assessment model) to the Global Biosphere Management Model (GLOBIOM; a recursive-dynamic partial equilibrium model). This study will develop a conceptual framework for integrated assessment of agricultural and environmental policies, and methods for linking farm level models with national level models. The framework will be applied to the case of to evaluate the impacts of infrastructure and irrigation investment, and improved access to inputs such as fertilizers, on the poverty and food security status of smallholder farmers in Ethiopia.

Biographical Sketch: Roshan Adhikari is a PhD student in the Applied Economics department at Oregon State University in Corvallis, Oregon. He received his bachelor's degree in Economics-Mathematics from Whitman College in Walla Walla, Washington. His research interests include sustainability of agricultural systems, including climate change impacts, adaptation and mitigation in agriculture, and assessment of environmental and social impacts of agricultural technologies. His recent projects include an ex-ante impact analysis of the introduction of agricultural technology adoption on income and food security of smallholder farmers in Tanzania, and a study of potential adoption and farm-level economic impact of Camelina Sativa in the Pacific Northwest dry land wheat systems.

Ecosystems Services and Management Program (ESM)
Program Director: Michael Obersteiner

Anu Akujärvi

Supervisor: **Anatoly Shvidenko**
Co-Supervisor: **Nicklas Forsell**

Research Project: **Effects of land management on ecosystem sustainability – Mapping carbon stocks, water quality and biodiversity at a landscape scale**

Abstract: Climate warming, loss of biodiversity and exploitation of natural resources threaten the availability of ecosystem services in Europe. Mapping the human impacts on ecosystem services is required to promote sustainable land use. Policy measures to increase bioenergy production, stop the loss of biodiversity and enhance food-security can also lead to trade-offs between the forestry, agricultural and bioenergy sectors. In the ecosystem services research, carbon budgets have usually been estimated using simple land-cover based proxies. Coupling biophysical modeling of the carbon cycle with spatial data on land cover could improve the assessments significantly and cost-efficiently. The objectives of this study are to map the impacts of alternative land management and land use change scenarios on the carbon budget for a set of European landscape mosaics and to identify synergies and trade-offs between ecosystem service and biodiversity indicators (e.g. carbon stocks, timber volumes, water quality). These are estimated using the models GLOBIOM and G4M, with CORINE Land Cover data as input. The scenarios are defined based on future projections of harvest levels and bioenergy use in Europe. GIS analysis and geo-statistical methods are used to analyze the spatial and functional relationships between ecosystem service indicators. The expected results include recognizing potential hotspots of selected ecosystem services. The scenarios are evaluated based on their climate mitigation potential, other environmental effects and economic returns.

Biographical Sketch: Anu Akujärvi works as a researcher at Finnish Environment Institute (SYKE). She graduated from University of Helsinki in 2011 with a master's degree in Agriculture and Forestry. She is currently a PhD student at University of Helsinki, The Doctoral Program in Geosciences. The title of her thesis is: "Coupling carbon sequestration of forests and croplands with ecosystem service assessments". Her main research interests include modelling carbon budgets of forested and agricultural landscapes and mapping ecosystem services under climate and land use change.

Ecosystems Services and Management Program (ESM)
Program Director: Michael Obersteiner

Kemen Austin

Supervisor: **Aline Mosnier**
Co-supervisor: **Ian McCallum**

Research Project: **The sustainable palm oil puzzle: Comparing land management strategies for minimizing environmental consequences of oil palm expansion in Indonesia**

Abstract: In Indonesia, agricultural expansion is a principle driver of deforestation and peat land conversion, resulting in significant greenhouse gas emissions, degradation of ecosystem services, and loss of biodiversity. The national government has pledged to reduce emissions by 29-41% by 2030, while simultaneously doubling production of several major agricultural commodities and expanding subsidies for biofuels. One proposed strategy for reconciling the apparently conflicting goals of agricultural development and forest protection is to prioritize expansion onto low carbon stock and low conservation value degraded lands. However, successful implementation of this strategy will require more robust analysis of the potential implications of alterative definitions of 'degraded' land.

I will evaluate two proposed approaches for defining and delineating degraded land for palm oil production in Indonesia; a High Conservation Value (HCV) approach, which focuses on safeguarding biodiversity and ecosystem services; and a High Carbon stock (HCS) approach, which emphasizes 'zero deforestation' production, forest protection, and climate change mitigation. I will assess tradeoffs between HCV and HCS approaches, by quantifying the forest and peat land area, carbon stock, and biodiversity resources protected under each conservation scheme. In addition, I will quantify the opportunity costs of each approach, in order to illustrate the challenge of balancing economic and environmental considerations in the oil palm industry.

Biographical Sketch: Kemen Austin is a PhD candidate at Duke University, where she investigates the climate change mitigation potential of alternative scenarios of agricultural expansion and forest restoration in the tropics. Her research is results oriented, providing decision makers in private sector and government with the information needed to design effective low-emissions land use strategies. Kemen holds an MA and BSc from Brown University, and previously worked as a Research Associate at the World Resources Institute.

Ecosystems Services and Management Program (ESM)
Program Director: Michael Obersteiner

Sudhanya Banerjee

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

Research Project: **Evaluation of biological use and geological sequestration of CO_2**

Abstract: CO_2 is an important greenhouse gas (GHG) and emission of CO_2 to the atmosphere needs to be reduced in order to mitigate climate change. It is imperative to device ways of proper CO_2 utilization and storage. CO_2 can be sequestered geologically as well as there are other ways of CO_2 utilization which can be economically viable in places where geological storage is not the most optimal solution. In this particular work, the primary focus is on the integration potential of two GHG abatement options which are geological sequestration of CO_2 and biological sequestration of CO_2 via microalgae growth, harvest and conversion to energy and/or value added products (fish and animal feeds and others). There are several ways of microalgae conversion to an array of products. The present proposal aims to quantify the techno-economic tradeoffs and optimize the entire supply-chain of CO_2 utilization to ensure the most economically feasible alternative of CO_2 usage. We propose a multi-scale optimization model for the work. The model takes into account the design of pipeline network for CO_2 transport, different processing routes for microalgae conversion as well as CO_2 geological storage. A case-study will be considered to assess the optimal design of GHG capture, storage and/or utilization for a particular location (for the state of Texas in United States). The present study will help inform decision and policy makers the optimal pathway of CO_2 storage and utilization procedures for a particular location.

Biographical Sketch: Sudhanya Banerjee is a 2nd year PhD graduate student at the Department of Bioproducts and Biosystems Engineering at the University of Minnesota – Twin Cities, USA. He is also pursuing a Minor in Science, Technology and Environmental Policy at the Hubert H. Humphrey School of Public Affairs at the University of Minnesota. Previously, he obtained his MSc in Mechanical Engineering and BSc in Chemical Engineering from Iowa State University, USA and Jadavpur University, India, respectively. His primary research interests include process systems engineering of microalgae growth, harvest and conversion to value-added products and chemicals.

Ecosystems Services and Management Program (ESM)
Program Director: Michael Obersteiner

Poh Ying Hoo

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

Research Project: **A spatial-economic optimization of waste to biogas in Malaysia**

Abstract: According to Malaysia Energy Statistics Handbook, in 2012, 97% of primary energy supply in Malaysia used to rely on its abundant fossil fuels resources: oil (32.4 %), natural gas (45.9 %) and coals (18.9 %). Higher accessibility and lower cost of fossil fuels become the reasons why it is a hindrance to the development of renewable energy (RE) technology in the nation. There are several shortcomings when promoting RE implementation. These include lack of systematic planning for supply and demand side, lack of incentives, infrastructure and lack of cost-competitiveness of RE generation. Biogas, as one of the most sustainable biofuels option, uses various biomass materials as feedstock, e.g., food waste, palm oil waste, animal manure etc. This study aims to develop a spatial-techno-economic optimization model of biogas generation and utilization network. The model will be able to select the optimal location, centralized or decentralized biogas generation plant, capacity of biogas plant and least cost strategy of biogas utilization based on supply and demand factors in Malaysia. The model will be formulated under the BeWhere platform (www.iiasa.ac.at/bewhere).

Biographical Sketch: Poh Ying Hoo graduated in 2015 from Universiti Teknologi Malaysia (UTM). She is currently a first-year PhD (fast track) student in UTM. Her main research interest is on biogas planning. Her current thesis project is about spatial-economic optimization of biogas utilization in Malaysia and to propose policy tools in promoting biogas implementation in the country.

Ecosystems Services and Management Program (ESM)
Program Director: Michael Obersteiner

Victor Manabe

Supervisor: **Steffen Fritz**
Co-supervisor: **Aline Mosnier**

Research Project: **Mapping integrated crop-livestock systems in Brazilian agricultural frontier**

Abstract: A dramatic increase in agricultural production can be observed during the past decades in Brazil. Furthermore the sugarcane and grains productions increased in recent years based on area expansion, mainly over pasture areas. In the same period Brazil became a leading global beef producer in less pasture areas. Grains and sugarcane expansion over pastureland lead to livestock intensification in the remaining pasture of those regions. In Brazil, a implantation of mixed crop-livestock systems - wherein crops are harvested and animals are fed in the same location at different times of year or at different years - are a indicative of pasture production improvement and land use intensification. The combination of this production system with conservation tillage have been shown to result in an impressive mix of economic, productivity, social, and environmental benefits. Dissemination and improvement of mixed crop-livestock agriculture is widely seen as a key to improving economic development and food security in the developing world.
Although general agricultural statistics indicate that pasture intensification has occurred in recent years, a more detailed analysis is needed, considering for example the geographical distribution, the types of systems involved and management variables. Some efforts have been made in order to study these aspects, especially in the Brazilian agricultural frontiers. Detailed monitoring of land use and management is possible using remote sensing, and would be of great utility for analysis of pasture intensification and integrated mixed crop-livestock systems. So, the objective of this research is identify areas of crop-livestock integration in the Brazilian agricultural frontier through the development of remote sensing method.

Biographical Sketch: Victor Manabe is a third-year PhD student at Geotechnology Applied in Agriculture group of the School of Agricultural Engineering, University of Campinas, Brazil. He received his master's degree in Agricultural Systems Management from University of Campinas. His PhD thesis focuses on land use intensification in pasture lands in Brazilian agricultural frontier.

Ecosystem Services and Management Program (ESM)
Program Director: Michael Obersteiner

Stephanie Roe

Supervisor: **Michael Obersteiner**
Co-Supervisor: **Aline Mosnier**

Research Project: **Responsive landscapes: translating land-use modeling outputs into planning and policy**

Abstract: Dramatic land use changes are projected by 2050, due to increases in human population and per capita demand for urban living, food, fuel and and fiber. Land use change decisions – like zoning policies to create new urban areas or converting forests into agricultural fields due to diet demands – will catalyse land-atmosphere responses to the Earth's energy balance, carbon cycle and hydrological cycle, which in turn can engage feedbacks into the environmental and agricultural system. To shift the current land-use paradigm to a more sustainable system, not only must land use be planned in correlation with land suitability, but it must also mitigate long-term negative feedbacks.

My research will investigate the impact, feedbacks and tradeoffs of land use decisions and allocations on biosphere-atmosphere interactions, and assess their implications for climate change, water security and food security in tropical developing countries. Specifically, I will assess the regional and global impact of increasing demand in key commodities including livestock, biofuels and cereals to determine the most sustainable land uses and allocation in a given landscape. My approach is to 1) examine the political, social and economic drivers of land use change to determine alternative land-climate futures 2) simulate the effects of land use decisions on climate and feedbacks using the Global Biosphere Management Model (GLOBIOM) and 3) translate findings into policy-relevant actions. Ultimately, this research aims to connect modeling and its outputs to policy and decision making as a way for optimizing environmental and economic outcomes.

Biographical Sketch: Stephanie Roe is a first year PhD student at the University of Virginia, where her doctoral work involves exploring the impact of agriculture, bioenergy and forest policies on biosphere-atmosphere interactions. She is also currently a Senior Land-use Specialist with advisory company, Climate Focus where she consults governments, multilateral organizations, foundations and NGOs on forestry, agriculture and climate mitigation and adaptation related projects. Previously, she worked with the United Nations in Indonesia, the Public Ministry in Brazil and The Climate Group in New York. Stephanie holds a Master of Environmental Management from Duke University and a Bachelor of Arts from San Diego State University.

Ecosystem Services and Management Program (ESM)
Program Director: Michael Obersteiner

Vilma Sandström

Supervisor: **Hugo Valin**
Co-Supervisor: **Tamas Krisztin**

Research Project: **GHG emissions of the food consumed in the EU: the case of Finland**

Abstract: Food industry is a major producer of greenhouse gas (GHG) emissions and currently one of the biggest sectors contributing to climate change. In a globalized world, international trade plays an increasing role in food and feed supply. Therefore to assess the country level food consumption impact on the environment, both domestic production and trade have to be accounted. This research investigates the GHG emissions from the food consumption in the European Union, with a close look at Finland. The aim is to investigate the GHG emissions associated to the production and transport of the primary production of food and feed, from a consuming country perspective. The analysis will help understanding the amount of emissions that are displaced abroad through food and feed imports and how impacts of Finnish consumption patterns compare with other countries. An important attention will be paid to emissions generated through the livestock sector, using the IIASA database on feed consumption structure.

Biographical Sketch: Vilma Sandström completed her master's degree in environmental science and policy in 2013 at the University of Helsinki, Finland. She is currently a doctoral student in the Doctoral Program in Sustainable use of renewable natural resources at the University of Helsinki. She is interested in sustainability questions related to food consumption, resource use, food security and the environment. Her current research is focused on the environmental issues related to the international trade of agricultural products.

Ecosystem Services and Management Program (ESM)
Program Director: Michael Obersteiner

Frank Sperling

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

Research Project: **Realizing the SDGs and the Paris Agreement: Implications for land-use interactions in Africa**

Abstract: In 2015 the international community agreed to the Sustainable Development Goals (SDGs) as humanity's collective vision for the future. 17 Global Goals and 169 targets focus on meeting basic human needs, creating the conditions for advancing human prosperity, while seeking to safeguard the environment and climate system. While the SDGs offer several quantifiable and time-bound targets for the socio-economic dimension of development (e.g. eradication of extreme poverty, food security, universal access to modern energy by 2030), the environmental goals and targets are partly qualitative in nature and reference is made to relevant international conventions and agreements for further specification. The 2015 UN Climate Conference (COP21) defines in its outcome document, the so-called Paris Agreement, the ambition for addressing climate change by agreeing to the collective goal of limiting global warming to below 2 ^{O}C and, if possible, 1.5 ^{O}C by the end of century. This will require rapid decarbonization of energy systems and deployment of negative emission technologies by the middle to the end of century with associated demands for land. Global and regional demands for land to ensure food security of a growing world population, the implications of dietary changes with rising affluence are juxtaposed to (i) the changing necessity for land-use based mitigation measures and (ii) the shifting agriculture potential of land associated with different warming scenarios. Using GLOBIOM, an integral assessment model, the implications for land-use interactions in Africa are being explored in relation to the global development and environmental ambitions specified by the SDGs and the Paris Agreement.

Biographical Sketch: Frank's professional and academic interests are driven by the desire to understand the implications of global environmental change for development policies and practices. After obtaining degrees in biological and environmental sciences he has worked for several years with international organizations on adaptation to climate change, natural resource management, carbon finance, REDD+, and green growth. He is an author of several articles, reports, knowledge products and strategy documents and has led and contributed to programmatic and project activities in Latin America, Africa and SE Asia. Building on these operational experiences, Frank has returned now to academia to pursue research at Oxford University into sustainable development pathways, which underlies also the motivation of his participation in the IIASA YSSP program. He is particularly interested in finding ways to harness synergies and minimize trade-offs between development and environmental objectives.

Ecosystem Services and Management Program (ESM)
Program Director: Michael Obersteiner

César Terrer

Supervisor: **Oskar Franklin**
Co-Supervisor: **Christina Kaiser (EEP)**

Research Project: **Quantification of the terrestrial CO_2 fertilization effect based on nitrogen availability and mycorrhizal association**

Abstract: Plants buffer increasing atmospheric CO_2 concentrations through enhanced growth, but the question whether nitrogen availability constrains the magnitude of this ecosystem service remains unresolved. Synthesizing experiments from around the world, we have found that the CO_2 fertilization effect is best explained by a simple interaction between nitrogen availability and mycorrhizal association. Plant species that associate with ectomycorrhizal fungi (e.g. conifers) show a strong biomass increase (~30%) in response to elevated CO_2 regardless of nitrogen availability, whereas nitrogen limits CO_2 fertilization in plants that associate with arbuscular mycorrhizal fungi (0 ± 6%) (e.g. grasslands).

The main goal of this YSSP project is to quantify the terrestrial CO_2 fertilization effect based on the above framework, using IIASA global map of "constraints on nutrient availability", and the global distribution of mycorrhizae. The project has the potential to improve the projections of Earth's future climate, as these findings indicate that current global models overestimate responses to CO_2 in N-limited arbuscular mycorrhizal-dominated ecosystems, including grasslands, which cover 40% of the terrestrial surface.

Biographical Sketch: After completing his studies in environmental science from the University of Murcia (Spain) and University of Western Sydney (Australia), César Terrer initiated his PhD at Imperial College London (UK) in June 2014. Currently, his research focuses on the topics of climate-change, plant ecology and modelling. He is particularly interested in disentangling current uncertainties regarding the role of increasing atmospheric CO_2 concentration in plant growth and its interactions with the nitrogen cycle, in order to improve predictions of climate change in the "next generation" of global vegetation models.

Ecosystem Services and Management Program (ESM)
Program Director: Michael Obersteiner

Marcus Thompson

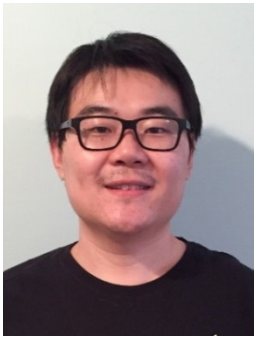
Supervisor: **Tamas Krisztin**
Co-Supervisor: **Juraj Balkovic**

Research Project: **Pre-columbian Native American maize farmers as a model for future subsistence farmer response to climate change**

Abstract: Evidence suggests that Amerindian maize farming cultures were remarkably resilient in the face of environmental changes prior to the 14th century, but soon afterward their greatest sites were abandoned. The transition from a relatively warm and consistent climate during the "Medieval Climate Anomaly" (MCA, ~800-1350 CE) to a cool and variable "Little Ice Age" (LIA, ~1350-1850) made intensive maize agriculture unsustainable throughout much of the Southwest. Between the present and 2100 CE, extreme heat and precipitation event frequencies will increase globally, and interannual precipitation variability will increase over drought susceptible parts of the world. This will be extremely disruptive to dryland farming which depends above all on the regularity of seasonal rainfall. In Amerindian responses to the MCA-LIA transition is a model of complex socio-ecological dynamics which might follow from a transition from a warm and stable 20th century to a warmer and highly variable near-future. In that sense, these are natural experiments in human societal adaptation to rapid environmental change which have already been run. We are left to interpret what results are useful in predicting future scenarios. I use downscaled climate and measured environmental data to reproduce occupation patterns seen in the archaeology of Native American (Fremont) maize farmers in Utah and generalize this to predict future dynamics of similarly environmentally dependent subsistence farmers in arid climate regimes.

Biographical Sketch: Marcus Thomson is a 5th year PhD candidate in geography at the University of California, Los Angeles (UCLA). His academic interests include paleoclimatology, biogeography and human-environment interactions with particular attention to marginal environments in the US Southwest and Middle East. He received his BSc (honours physics) and MSc (neutrino astrophysics) from Queen's University and the Sudbury Neutrino Observatory (SNO) in Canada.

Ecosystem Services and Management Program (ESM)
Program Director: Michael Obersteiner



Shenghao Xie

Supervisor: **Nicklas Forsell**
Co-supervison: **Stefan Frank**

Research Project: **Quantification of regional carbon emissions from the harvested wood products sector using Global Biosphere Management Model (GLOBIOM), Global Forest Model (G4M) and the Carbon Budget Modelling Framework for Harvested Wood Products (CBM-FHWP)**

Abstract: IIASA's Global Biosphere Management Model (GLOBIOM) is a land-use model that estimates market equilibria based on supply and demand of products from the agricultural, bioenergy and forestry sectors. Once an equilibrium is formed, some parameters may be projected into the future or a series of possible scenarios evaluated. Re-forming the equilibrium will generate possible predictions of the other parameters. Global Forest Model (G4M), another IIASA model, provides data on the C dynamics of the forest given information about harvest levels from GLOBIOM.
Carbon Budget Modelling Framework for Harvested Wood Products (CBM-FHWP) developed by the Canadian Forest Service (CFS) simulates the temporal and spatial carbon dynamics of harvested wood based on user-defined harvested wood products mass-balance models. This model quantifies the movement of wood-based C from harvest to use and disposal by society. The existing CBM-FHWP model functions at different scales and has been used to report the C dynamics of the Canadian HWP sector for the National GHG Inventory Report (NIR), the provincial scale and for national-scale mitigation analyses.
Although GLOBIOM has a simple HWP module, CBM-FHWP includes a more realistic representation of C dynamics in the HWP sector. This project proposes to generate more accurate regional HWP models based on CBM-FHWP using future wood supply scenarios from GLOBIOM. Linking these models will better quantify temporal and spatial carbon flows, pools and emissions arising from the HWP sector to support the analysis of climate change mitigation options.

Biographical Sketch: Sheng H. Xie is a second year PhD student in Wood Science Department at University of British Columbia, Canada. His current research focus is on modelling the fate of carbon in harvested wood products and conduct quantitative analyses of greenhouse gas emission consequences of different regional forestry sector strategies. He holds a MASc degree in Forestry and a BSc degree in Wood Products Processing from University of British Columbia.

Ecosystem Services and Management Program (ESM)
Program Director: Michael Obersteiner

Maria Xylia

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

Research Project: **Exploring charging infrastructure requirements for public transport electrification in Sweden**

Abstract: The issue of charging infrastructure requirements is lately a major question in the context of urban energy planning for transport electrification. As electric vehicles are gaining momentum, the issue of locating and securing the availability, efficiency and effectiveness of charging infrastructure becomes a complex question that needs to be answered. In this study, such questions are addressed in the national context of Sweden, with a focus that is sector-oriented to public transport and region-oriented to Stockholm. The BeWhere model will be adapted and used for optimizing the distribution of charging infrastructure. BeWhere has not been used in this way before, but the analogy and necessity to link this proposed adaptation to the model is quite evident, since biofuels and electricity are both promoted for reducing the environmental impact of transport. The proposed study can result in an interesting addition to the BeWhere Sweden model regarding the development of the transport sector under different demand scenarios and policy frameworks, where the ways that power and biofuel can complement each other are highlighted. The linkages can be further enhanced if one considers that electricity used in transport can be surplus electricity derived from biomass-based feedstock or other renewable sources. Moreover, synergies with infrastructure for other transport modes (goods transport, Light-Duty Vehicles) and renewable fuels are explored.

Biographical Sketch: Maria Xylia holds a Dipl.Eng. in Mechanical Engineering from the University of Patras, Greece, and a MSc in Sustainable Energy Engineering from KTH Royal Institute of Technology, Sweden. She is presently a PhD student at Energy and Climate Studies Unit at KTH. Her doctoral research focuses on energy policy to promote energy efficiency in industry and transport in Swedish and European contexts. Her current research investigates public transport electrification in urban contexts. She has experience from the private sector, as she has offered services as a consultant for renewable energy projects and energy consumption certification in the residential sector.

World Population Program (POP)
Program Director: Wolfgang Lutz

Phillip Andrew Cantu

Supervisor: **Daniela Weber**
Co-Supervisor: **Nadia Steiber**

Research Project: **Health and aging trajectories in the HRS using a latent variable approach**

Abstract: This project will examine trajectories of health and aging in the HRS using latent class analysis and a latent variable approach to measuring health and aging. We will analyze data from multiple waves of the Health and Retirement Survey. We will first model health as a latent variable using IRT methods, combing survey measurements of activities of daily living, instrumental activities of daily living, functional limitation, and chronic conditions. Likewise we will estimate a latent variable of aging using objective physical measures, such as hand grips strength, and biomarkers, such as C-reactive protein. We will then use latent class analysis to study trajectories longitudinally. By using survey measurements of function to estimate health and objective measurements to estimate aging we hope to gain deeper perspectives on the meaning of both

Biographical Sketch: Phillip Cantu is a third-year PhD Student in Sociology at The University of Texas at Austin. He previously received a bachelor's degree in Sociology (2008) from Southwestern University in Georgetown Texas, and a master's degree in Sociology (2014) from the University of Texas at Austin. His research focuses on aging populations, measurements of disability, and caregiving for aging families.

World Population Program (POP)
Program Director: Wolfgang Lutz

Wei Qi

Supervisor: **Raya Muttark**
Co-supervisor: **Guy Abel**

Research Project: **Carbon footprint related to inter-regional population migration in China**

Abstract: Carbon emission is regarded as a key factor that contributes to greenhouse effect and global warming. As a major form of population growth, population migration contributed to both spatial demographic shift and carbon emission transfer, which forms the carbon footprint of inter-regional population migration. The energy consumption structure and per capita carbon emission level may be various in different regions, which contribute to a net carbon emission between places of origin and destination. Being the most populated and having the highest carbon emissions level in the world, China is facing a great challenge of environmental changes, which is partly caused by population migration.

This research aims to develop a model to calculate carbon footprint of inter-regional population migration in China. Based on the per capita difference between origins and destinations, inter-regional migration population flow data can be used for modeling the inter-regional carbon footprint. Furthermore, per capita residential carbon emission difference between urban and rural areas, migrants' employment structure and demographic composition will also be taken into account in the model. Using the geographic information technology, census and survey data (i.e. social investigation data of migrants' energy consumption) the flow map of population migration and carbon emission footprint can be produced. Furthermore, the main factors that affect the carbon footprint of inter-regional population migration in China will be identified.

Biographical Sketch: Wei Qi earned a bachelor's degree from Nanjing University of Information Sciences & Technology, China in June 2011. He is currently a PhD student at Institute of Geographic Science and Natural Resources Research, Chinese Academy of Sciences. He was also a visiting scholar at UMR Geographie-Cités, National Center for Scientific Research in France from March, 2015 to March, 2016. His main fields of scientific interest include spatial demography, population migration, urban system and environment changes.

World Population Program (POP)
Program Director: Wolfgang Lutz

Ankita Shukla

Supervisor: **Samir K.C**
Co-supervisor: **Markus Speringer**

Research Project: **Contribution of environmental risk factors and spatial characteristic on mortality disparities**

Abstract: Environment is a critical factor in the lives and livelihoods of the people. The long-term good health of population depends on the continued stability and functioning of the biosphere's ecological and physical systems. Exposure to environmental risk factors and its effects on human health are well established. Studies in past have established that environmental health factors play an important role in human survival even when controlling for socio-economic variation. Air Pollution, Ambient Temperature and Rainfall also influences mortality. A substantial burden of communicable and non-communicable diseases in the developing countries is attributable to environmental risk factors. According to recent estimates environmental risk factors account for about one-fifth of the total burden of disease in low income countries. The burden of disease associated with environmental exposures is likely to vary across population subgroups, based on their socioeconomic status (SES). SES largely determines an individual's environmental risks, as well as access to resources to deal with those risks. Due to disparity in SES there can be disparity in exposure to risks as well as disparities in health-care access and treatment that can reduce disease severity and mortality risk. The problem is even worse in developing countries where a substantial proportion of population lives below poverty line. This study uses comparative risk assessment methods to calculate the mortality effects of environmental risk factors in India. Moreover, it also attempts to examine disparities in mortality caused by environmental risk factors and surrounding spatial characteristics.

Biographical Sketch: Ankita Shukla is pursuing her PhD degree at the International Institute for Population Sciences (IIPS), Mumbai. Ms Shukla holds a master's degree in Population Studies (MPS) and MSc in Health Statistics from Banaras Hindu University, Varanasi. Currently, Ms Shukla is working on her doctoral thesis, "A study of Spatial Clustering and Inequality in Mortality rates and Life Expectancy among Indian districts". She has attended many national and international conferences.

World Population Program (POP)
Program Director: Wolfgang Lutz

Selvamani Yesuvadian

Supervisor: **Serguei Scherbov**
Co-supervisor: **Warren Sanderson**

Research Project: **Comparing physiological markers of aging in six low and middle-income countries**

Abstract: In recent years, many countries across the globe experience the demographic process of population aging. Traditionally, a country is referred as aging when the proportion of population 60 and above years reaches 7 percent. The estimated aging population will be doubled by 2050 according to current measure of aging. However, evidence suggests that recent cohorts of aging population are taller, having better cognition and physical capability than the earlier counterparts which will provide growing aging population to increase their contribution in the society. As the projected aging population is growing faster, alternative measurement of aging based on observed characteristics will be useful to understand the aging speed in developing countries. Therefore, using WHO-SAGE wave 1 and 2 and LASI Pilot data, this study aims to measure the aging speed based on observed characteristics of aging population in six low and middle-income countries namely India, China, Ghana, Russia, Mexico and South Africa. Also, this study compares the physiological aging markers across six countries and by socioeconomic characteristics, which will explain the speed and quality of aging in selected countries by subgroups of the population. The study uses selected physiological markers of aging such as grip strength, cognitive ability, functional ability, and lung function to examine the aging speed in selected countries.

Biographical Sketch: Selvamani Yesuvadian is currently a second year PhD Scholar at the International Institute for Population Sciences (IIPS), Mumbai, India. He has completed MPhil and Master in Population Studies from IIPS, Master in Social Work from Loyola College, Chennai. His PhD thesis examines the association of early life conditions such as stature, childhood socioeconomic status and childhood health on later health and wellbeing outcomes. He uses data from 27 high and low-income countries to understand the quality of aging and aging process across countries. His research interests include life course determinants of health and wellbeing, quality of aging, measurement issues in health and aging and global public health.

Risk and Resilience Program (RISK)
Acting Program Director: Joanne Bayer

Elisa Calliari

Supervisor: **Reinhard Mechler**
Co-Supervisor: **Thomas Schinko**

Research Project: **Tackling the financial constraints to adaptation as a mean to address loss & damage: a climate justice perspective**

Abstract: The years-long negotiations on loss and damage (L&D) associated with climate change impacts got to a milestone during the twenty-first session of the UNFCCC Conference of the Parties (COP 21), with the inclusion of a dedicated article in the Paris Agreement. L&D has been attracting growing academic interest in recent years. Nevertheless, its main conceptual and operational issues remain widely debated, including its positioning with respect to the adaptation space and the definition of appropriate tools to minimize it. In particular, limited attention has been devoted to exploring strategies to address the L&D materializing from slow onset events.

The proposed research explores the role of international cooperation in tackling the financial constraints to adaptation, as a mean to address L&D. It discusses alternatives for i) financing and ii) allocating adaptation investments, and the macro-economic implications of these choices. In particular, different burden sharing (eg. historical responsibility considering various time frames, or ability to pay) and allocation rules (eg. GDP per capita or vulnerability/disaster risk indexes) are analysed from a climate justice perspective. Then the distributional implications of these rules are assessed in the context of different conventional (i.e. official development assistance, ODA), unconventional (i.e. global carbon tax revenues from mitigation policies) and hybrid financing instruments. The exercise is to be carried out using the Computable general equilibrium (CGE) model ICES.

The aim of the research is to provide insights for an efficient and fair financing of measures to reduce the risk of L&D in vulnerable developing countries.

Biographical Sketch:

Elisa holds a bachelor's and master's degree in International Sciences and Diplomatic Relations from the University of Trieste (Gorizia Campus). In 2011, she also obtained a Master in Environmental and Energy Economics and Management from Bocconi University and she is currently enrolled in her 2nd year of the PhD Programme in Science and Management of Climate Change at the Ca' Foscari University of Venice. Her PhD thesis aims at exploring the loss & damage associated with climate change impacts in vulnerable developing countries from an inter-disciplinary and multi-scale perspective. She also works as junior researcher for the Euro-Mediterranean Center on Climate Change (CMCC) and Fondazione Eni Enrico Mattei(FEEM).

Risk and Resilience Program (RISK)
Acting Program Director: Joanne Bayer

Tonje Grahn

Supervisor: **Joanne Bayer**
Co-Supervisor: **Taher Kahil**

Research Project: **Systematic evaluation of flood damages to guide policy choices**

Abstract: The availability of applicable and reliable methods for quantitative analysis of flood hazard consequences is scarce. Most previous studies in the literature address direct tangible flood damage. Several synthetic and real damage functions (stage damage functions, depth damage functions, vulnerability functions, susceptibility functions) have been used. However, it is not often that the statistical methods, the damage distributions and significance levels of explanatory variables are clearly presented. To address this gap in the literature, this study presents a systematic review of data sources, statistical methods, and explanatory variables, used to derive different national and regional flood damage functions. The objective is to evaluate the adaptiveness of these functions to different spatial settings and types of floods (e.g. fluvial/ pluvial). Moreover, this study shows how improved quantification and estimation of flood damage can be used in economic analysis such as the cost-benefit analysis, with the purpose of guiding the design and implementation of efficient flood risk management strategies.

Biographical Sketch: Tonje Grahn has a master degree in economics from Karlstad University in Sweden. After graduation she worked in different governmental projects at the Swedish Geotechnical Institute and at the Swedish National Contingency Agency. She also worked as a teaching assistant at the Economic department at Karlstad University and as a research assistant at the Center for climate and safety. Now Tonje is a 3rd year PhD Candidate in Risk- and environmental science at Karlstad University. Her research focuses on economic analysis of natural hazard damage. Tonje also teach Environmental Economics and Natural Resource Management at Karlstad University.

Risk and Resilience Program (RISK)
Acting Program Director: Joanne Bayer

Kejia Hu

Supervisor: **Stefan Hochrainer-Stigler**
Co-Supervisors: **Wei Liu, Linda See (ESM)**

Research Project: **Urban heat health risk assessment – A multi-hazard approach**

Abstract: With climate change forecast to continue into the foreseeable future, extreme heat events (also referred to as heat wave) will become more intense, more frequent, and longer durative. The potential exposure of urban populations to extreme heat events will be enhanced with continued urbanization, such as urban heat island (UHI) and air pollution. The combined effects of extreme heat, UHI and air pollution pose an acute threat to human health in cities and lead to more mortalities. However, research on their interactions and synergistic effects on human health is very limited.

This research seeks to fill this gap with a longitudinal analysis based on detailed high temporal resolution (hourly or daily) datasets of temperature, ozone concentrations and mortalities. A comprehensive and spatially explicit analysis will be conducted to quantitatively assess the multi-hazard health risk in Hangzhou, China. With more than 4 million urban residents, Hangzhou is a large city in the urban agglomeration of the Yangtze River Delta featured by hot and humid summer. The risk assessment will use the general framework of the key determinants of risk—hazard, exposure and vulnerability. The relationship between various health outcomes (e.g. mortality) and multi-hazard factors (e.g. heat stress, ozone pollution) will be investigated to develop two-dimensional smooth surface models for characterizing vulnerability. A human settlement estimation model based on multi-sensor remote sensing data will be applied in exposure measurement on a per-pixel basis to solve the mismatch of hazard and exposure data. The purpose of this study is to apply multi-risk perspective and assessment for climate change induced urban health risk, and to explore policy options for reducing health risk of extreme weather events for urban population.

Biographical Sketch: Kejia Hu graduated from Zhejiang University in 2014 with a bachelor's degree in Land Resources Management. She is currently a second-year PhD student at the Institute of Islands and Coastal Ecosystems, Zhejiang University. Her research interests include climate and weather-related risk assessment, and mitigation-adaptation interaction in climate and development policy.

Risk and Resilience Program (RISK)
Acting Program Director: Joanne Bayer

Chibulu Luo

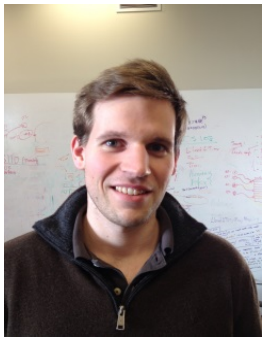
Supervisor: **Wei Liu**
Co-Supervisor: **Brian Fath (ASA)**

Research Project: **Diagnosing urban resilience in Africa – a socio-ecological system approach**

Abstract: Africa's cities and urban areas are facing an unprecedented rise in their populations. Communities in the region are experiencing dramatic shifts in living and placing ever-increasing pressure on infrastructure networks and other urban system components. In many countries, the rate of urban growth has exceeded the capacity for city authorities to ensure adequate and equitable provision of services, as cities are often poorly planned and growing in the context of increasing environmental and climate risks, and socio-economic vulnerabilities. In this regard, a more nuanced assessment of the resilience of African cities to the drivers of rapid urbanization is needed to understand the region's urbanization challenges and future infrastructure needs.

In response, this research aims to take a socio-ecological system (SES) approach to conceptualize and understand, in a more holistic manner, Africa's urbanization process and the interdependencies between different system components, focusing on the infrastructure dimension. While the SES study of urbanization has been recently established and applied in several western societies, its relevance and applicability to developing countries remains unclear. Therefore, the research approach is twofold: to apply existing SES frameworks to a selected group of African cities; and to develop a more specific framework that can be better utilized in the region. This is also coupled with an assessment of resource use and economic development patterns for key infrastructure sectors and socio-economic variables. Fundamentally, the specific framework will be founded on the "socio-techno-ecological" approach that recognizes technology as an important influence on urban resilience in the region**.**

Biographical Sketch: Chibulu Luo is a 1st year PhD Student in Civil Engineering at the University of Toronto. She is also affiliated with the Centre for Resilience of Critical Infrastructure (CRCI) and the Centre for Global Engineering (CGEN). She is currently conducting research to explore infrastructure resilience strategies for high-density populations. Her specific research interests include urban resilience, metabolism and climate change adaptation approaches. She is keen to explore these interests in the context of developing countries.



Sebastian Maier

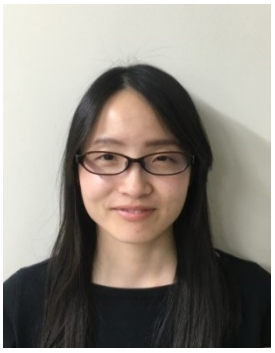
Supervisor: **Georg Pflug**
Co-supervisor: **Nadejda Komendantova-Amann**

Research Project: **Risk-managing a portfolio of systemic low-carbon urban infrastructure investments using approximate dynamic programming with decision dependent uncertainties**

Abstract: Massive capital investment in systemic low-carbon urban infrastructures such as in energy, transport, waste, water, and ICT is required in order to address historically unprecedented challenges including climate change, natural disasters and sustainable development. Investment decisions in infrastructure systems are frequently made in the context of enormous uncertainty surrounding exogenous volatility in supply and demand conditions as well as intrinsic technical and other risks. However, most existing investment appraisal techniques such as those unified under the umbrella of investment under uncertainty are widely regarded as inadequate since they do not take into account the intrinsic dependence of risks on past decisions, thereby neglecting decision maker's ability to pro-actively manage such risks.
The overall aim of this research is therefore to develop a new portfolio-based framework for the application of approximate dynamic programming to the valuation and risk-management of urban infrastructure investments with decision dependent uncertainties. Using the real-case of district heating network investments in London, this research will investigate, among other things, the effects of the consideration of decision dependent uncertainties on both the optimal portfolio value and the underlying optimal strategic and operational decisions. This research is expected to contribute to a better understanding of how uncertainties which depend on decision-makers actions can be integrated in a sequential decision-making framework and be adequately managed in order to reduce intrinsic risks associated with urban infrastructure investments.

Biographical Sketch: Sebastian Maier is a postgraduate researcher in the Department of Civil and Environmental Engineering at Imperial College. He joined Imperial in 2013 after studying for an MSc in Operational Research at the University of Edinburgh. Prior to this he graduated from the Vienna University of Technology with a BSc in Electrical Engineering and Information Technology and was then awarded an MSc in Energy Engineering from the same university (2011). In his PhD research he is focusing on urban infrastructures and how investments into these can be appraised adequately when made in the context of multiple interdependencies and enormous uncertainty. Besides his PhD research, he is interested in applying mathematical techniques to tackle real-life decision problems that involve decision making under uncertainty.

Risk and Resilience Program (RISK)
Acting Program Director: Joanne Bayer



Fuko Nakai

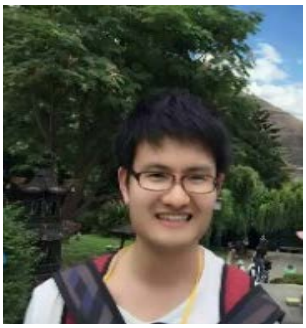
Supervisor: **Junko Mochizuki**
Co-Supervisor: **Sebastian Poledna**

Research Project: **Design and evaluation of evacuation policies taking account of uncertainty of tsunami and heterogeneity of evacuees**

Abstract: The design of evacuation plans has been extensively discussed in the field of engineering with the use of evacuation models. However, evacuation plans developed using such models are sometimes not acceptable for residents since they disregard evacuees' preferences and intentions; thus it may not be taken into practice by residents in an actual emergency. Hence, considering policies based on evacuee's preferences before a disaster happens is important. My doctoral research focuses on collaborative development of tsunami evacuation strategy with stakeholders under uncertainty. The study develops evacuation policy collaboratively among residents, municipality and researchers, focused on resident's heterogeneity and various patterns of hazard regarding the use of cars during evacuation (note that "heterogeneity" mentioned in the context of this study is evacuees' attributes, preferences and intentions about their evacuation).
During my YSSP participation, I would like to do design and evaluation of evacuation policies: two parts in whole developing process. I set three steps to come up with this topic: 1) design of alternative evacuation policies by a specific mathematical formula including uncertainty of disaster and heterogeneity of evacuees, 2) examining simulation model which can calculate the result of each policy and 3) developing scheme to evaluate each policy by some criteria. 2) has already been developed so far; thus main task will be 1) and 3). Upon completion of this procedure, we come up with some policies examined comprehensively; moreover, criteria-based discussion gets us some strategy to take the policy into practice.

Biographical Sketch: Fuko Nakai is a third-year PhD student in Disaster Prevention Research Institute Kyoto University in Japan. Her master's thesis is entitled: "A Study on Communication Support System for Tsunami Evacuation Planning in Local Community." She developed a communication support system integrating human system and agent-based evacuation simulation system in her study. Her topic of doctoral research is "Collaborative Development of Tsunami Evacuation Strategy with Stakeholders under Uncertainty" which has been developed based on requirements from residents in the field.

Transitions to New Technologies Program (TNT)
Acting Program Director: Arnulf Grubler



Jiangjiang Zhao

Supervisor: **Arnulf Grubler**
Co-Supervisor: **David McCollum (ENE)**

Research Project: **Calibrating the TNT's agent-based model on the diffusion of environmental friendly products with the case of electric vehicles**

Abstract: There have been increasing concerns on developing environmental friendly products. IIASA's TNT program developed an agent-based model on the diffusion of environmental friendly products. However, lack of validation with empirical data is a challenge for such models, which precludes many models from being appropriately initialized and validated, limiting the value of these models for policy evaluation or study emergent properties. EVs (electric vehicles) as one kind of environmental friendly products, zero emission, has becoming a promising alternative fuel vehicle in the future. This research will focus on the calibration of the model with empirical research on the case of EVs. I will first gather the historical diffusion data as well as R&D effort on EVs in USA, China, Japan, and Germany, and then use the data to calibrate the agent-based model, especially the peer-effect module, by applying the maximum likelihood methodology which was developed by researchers at IIASA's TNT and ASA group recently. The expected results of the research are the calibrated initial settings of the agent-based model which will make the simulation results more historical-friendly and more convincing. The research in this project can offer theoretical-bases and methodologies for decision makers when they promote the diffusion of environmental friendly products, and the application research can provide policy implications for diffusion of EVs.

Biographical Sketch: Jiangjiang Zhao graduated from Huazhong Agricultural University in the year of 2012 with a bachelor's degree of information management and information system. In September 2012 he became a five-year PhD candidate at the school of Business at East China University of Science and Technology. His research is concerned with the various issues related to the agent-based model and optimization problems. The title of his PhD thesis is: "Optimizing the layout of initial AFV's refueling stations in the perspective of complex adaptive systems."

Water (WAT)
Program Director: Simon Langan

Zakir Hussain Dahri

Supervisor: **Peter Burek**
Co-supervisor: **Yusuke Satoh**

Research Project: **Hydrological implications of recent and projected climate changes in the high-altitude Indus basin**

Abstract: The high-altitude Indus basin is the largest source of fresh water resources (153 BCM Year^{-1}) of Pakistan and plays a crucial role in water, energy and food security of the region. Yet, little is known about environmental change and mountain hydrology in this highly diversified and complex mountain region. The current knowledge base is seriously constrained by overall scarcity of and inaccessibility to the hydro-meteorological observations. Therefore, hydro-climatologists have been increasingly using numerous gridded products derived through various means to overcome the observational data gaps. However, the strong gradients and very high variability of climatic variables at the local scale are inadequately captured by the gridded datasets leading to significant uncertainties in the estimation and spatiotemporal distribution of climatic variables. Hence, the limitations and internal inconsistencies of the gridded datasets in hydrological modelling studies are often compensated by other variables. This study aims to use very high resolution (1km) statistically downscaled and bias corrected reference meteorological dataset to derive two different hydrological models(VIC and SPHY) to analyze streamflow response to the recent (1961-2015) and projected (2016-2100) climate changes at sub-basin scale. Frequency, intensity and spatial distribution of floods and droughts will be investigated from 140 years long time series of meteorological and data observed and simulated runoff. Finally, vulnerability of the basin's hydrological system to the future extremes of floods and droughts will be assessed and appropriate risk management and adaptation strategies will be identified using CATSIM model.

Biographical Sketch: Zakir Hussain Dahri is a final-year PhD researcher at Water Systems and Global Change group of Wageningen University, Netherlands. He is also Principal Scientist at the Water Resources Institute of Pakistan Agricultural Research Council, Islamabad, where he leads the Water Policy and Governance program. Mr. Dahri graduated in Agricultural Engineering from Sindh Agriculture University, Tando Jam - Pakistan, did masters in Water Resources Management from University of Engineering and Technology, Lahore - Pakistan and another masters in GIS and RS from The University of Melbourne, Australia. The key areas of his interest include water policy and governance, climate-water-society interactions, improving crop water productivity under different agro-ecological conditions and groundwater management.

Water (WAT)
Program Director: Simon Langan

Yinghao Ji

Supervisor: **Laixang Sun**
Co-supervisor: **Günther Fischer**

Research Project: **Assessing the potential of planting rapeseed in winter fallow fields in the Yangtze River Basin of China**

Abstract: For nearly 20 years, along with the economic structure adjustment and rural labor force trans migration in China, parts of the area of the winter fallow fields have significantly increased. The Yangtze River Basin, as one of primary rapeseed production regions, is at the same time one of highest potential area of winter fallow fields, in some places reaching even more than 50% of the cultivated land area. How to develop and utilize winter fallow fields in Yangtze River Basin effectively and scientifically relates directly to our social stability and economic growth. The predecessors have done a lot of related research about the potential yield simulation of winter fallow fields; however, large numbers of researches focus on a remote sensing discriminant method to extract the time nodes which has the disadvantage of inaccuracy. In addition, most researches only simulate production from winter fallow fields directly without taking sowing date and cycle length into account. Consequently, how one assesses the potential benefits of winter fallow fields scientifically and accurately has a great significance for national food security and energy security.

AEZ has been developed over 30 years by IIASA and it's good at simulating the production and yield of crop. In this research, we observed stations' sowing date and harvest date as time nodes of winter fallow fields by multi-disciplinary integration in Yangtze River Basin. Subsequently, we also controlled rapeseed's sowing date and selected the optimum cultivars in AEZ automatically. In this way, we can simulate potential yield relatively accurately. By applying the method, we are aiming to provide technical support and scientific basis for remarkable developing and efficient utilization.

Biographical Sketch: Yinghao Ji received his bachelor's degree in Science from Henan Polytechnic University, 2013. He is currently a second-year master's student at Shanghai Institute of Technology and Climate Change. His main scientific interests focus on the influence of climate change on agricultural potential yield.

Water (WAT)
Program Director: Simon Langan

Omid Mazdiyasni

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

Research Project: **Water resources vulnerability assessment: A multivariate approach**

Abstract: Socioeconomic drought broadly refers to conditions whereby the water supply cannot satisfy the demand. Most previous studies describe droughts based on large-scale meteorological/hydrologic conditions, ignoring the demand and local resilience to cope with climate variability. Reservoirs provide resilience against climatic extremes and play a key role in water supply and demand management. Here we outline a unique multivariate approach as a measure of socioeconomic drought, termed Multivariate Standardized Reliability and Resilience Index (MSRRI) by analyzing major reservoirs in Asia. The model combines information on the inflow and reservoir storage relative to the demand. MSRRI combines (i) a top-down approach that focuses on processes/phenomena that cannot be simply controlled or altered by decision makers, such as climate change and variability, and (ii) a bottom-up methodology that represents the local resilience and societal capacity to respond or adapt to droughts. MSRRI is based on a nonparametric multivariate distribution function that links inflow-demand reliability to water storage resilience, the indicators used to assess socioeconomic drought in reservoirs. MSRRI is superior to univariate indices because it captures both early onset and persistence of water stress over time. The suggested framework can be applied to both individual reservoirs and a group of reservoirs in a region, and it is consistent with the currently available standardized drought indicators. MSRRI provides complementary information on socioeconomic drought development and recovery based on reservoir storage and demand that cannot be achieved from the commonly used drought indicators.

Biographical Sketch: Omid Mazdiyasni is a second year PhD student at University of California, Irvine, working under the direction of Dr. Amir AghaKouchak in the Center for Hydrometeorology and Remote Sensing. He graduated with a BSc degree in Civil Engineering from California State Polytechnic University, Pomona, and an MSc. degree in Civil and Environmental Engineering from University of California, Irvine. Mr. Mazdiyasni's research interests lie in statistical analysis of climatic extremes, compound events, and assessing the interdisciplinary effects of climatic extremes. He is currently the principle investigator in a study, analyzing the effects of heatwaves and warming temperatures on heat-related mortalities in India. Two other projects he is involved in are analyzing temperature changes conditioned on droughts across the United States and determining the effects of drought in agriculture energy consumption due to higher pumping rates in California. Mr. Mazdiyasni has published several papers in high level journals, such as the Proceedings of the National Academy of Sciences, Geophysical Research Letters, Journal of Geophysical Research, and Theoretical and Applied Climatology.

Water (WAT)
Program Director: Simon Langan

Honglin Zhong

Supervisor: **Günther Fischer**
Co-Supervisor: **Laixiang Sun**

Research Project: **Balancing crop production and groundwater table recovery by cropping system adaptation in the North China Plain**

Abstract: The research plan of the Water Program (WAT) at IIASA includes climate change impacts on water resources (Dile et al., 2016), future crop irrigation water demand (Fischer et al., 2007) and assessment of solution options for addressing future water challenges. A recent case study focused on water scarcity and agro-environmental impacts in the North China Plain, and a new irrigation water saving solution was proposed by reducing winter wheat sowing area (Wang et al., 2015). My proposed research will systematically assess alternative multi-cropping adaptation options and explore their potential application and impact on water saving, in particular on reducing unsustainable groundwater use under climate change. Such agricultural adaptation could advocate a more sustainable practice in balancing water withdrawal and food security. Methods and results can then also be used to refine the water scenarios being developed by the WAT program. In particular, the model coupling between the process-based DSSAT crop model and the agro-ecosystem China-AEZ model can improve the regional performance of the multi-scale agricultural adaptation and the water consumption estimation. Moreover, uncertainty of the projected future climate change and its impacts and importance for water management and water use in agriculture will be examined under various greenhouse gas emission scenarios. The proposed study can inform Chinese agricultural adaptation policies and will contribute to the scoping of possible Water Solutions in the Water Program at IIASA. I will also target a high-ranked journal to publish my YSSP study results.

Biographical Sketch: Honglin Zhong is currently a third-year PhD candidate from the Department of Geographical Sciences, University of Maryland. Honglin received his MSc in Environment Remote Sensing from Shanghai Normal University (2011). His current research interests focus on agriculture cropping system adaptation under climate change, agriculture water use and water resource management, especially on the sustainable multi-cropping system adaptation at regional scale using an inter-scale crop model integration methodology. Further studies and research interests include application of remote sensing in crop monitoring and yield prediction, and its effective use to inform the agricultural economy and food policy.