4th Open Science Meeting 2019

Transforming Land Systems for People and Nature

April 24 – 26, 2019 • Bern, Switzerland

List of Sessions

Guide to Session Numbering

The first digit of each session number refers to the three main conference themes:

1 = What are the visions for the planetary land system?

2 = What do people want from land?

3 = How do we support transformation?

The second and third digits of each session indicate the session number.

The final letter in each session number indicates what type of session it is:

P = Poster

R = Research

N = Innovative or immersive

T = Training or workshop

** Note to session organizers: All session numbering has been changed from the initial submission phase. Please note your new session number using the above format.*

Important!

- Each conference participant may be presenting author to only one submission. This rule will be strictly enforced. Submissions for which the presenting author does not register for the conference in due time will be canceled.
- Invited speakers are those that were invited by session organizers during the session submission process.
- All abstracts will be subject to the full review process.
- Abstracts are limited to 300 words.

**Note that some 'innovative and immersive' and 'workshop and training' sessions are not accepting abstracts. This is noted in the session title*

Abstract selection will be based on 4 criteria

- Scientific quality
- Relevance for the GLP community
- Societal relevance
- Matching of the abstract with the conference themes and session topic.

Visit https://www.conftool.com/osm2019 to Register and submit an abstract

Theme 1: What are the visions for the planetary land system?

100P WHAT ARE THE VISIONS FOR THE PLANETARY LAND SYSTEM? (POSTER SESSION)

This is the poster session for Question 1. What are the visions for the planetary land system? Land as the nexus for addressing global challenges"

101R Trade-offs between agriculture and biodiversity in dynamic landscapes

Rapidly evolving land systems often bring about drastic changes in the trade-offs between production-oriented land uses and social-ecological outcomes. These trade-offs are often strongest between agriculture and biodiversity. Where agriculture expands and intensifies, habitat conversion and degradation typically causes the erosion of biodiversity and many non-provisioning ecosystem services. Conversely, relaxing land-use pressure can translate into substantial opportunities for conservation. How can we best understand and manage trade-offs in dynamic landscapes in order to create co-benefits between agricultural production and conservation?

This session explores how we can best understand and mitigate trade-offs between agriculture and biodiversity in dynamic landscapes. Such landscapes can occur across the full land-use transition spectrum: from agricultural frontiers into natural areas that might emerge as a result of technological breakthroughs, to rapid transformations of traditional framing landscapes to intensified, globally integrated landscapes as a result of market integration, to rapid land abandonment as a result of institutional shocks. The potential for conflict between economic and environmental outcomes increase in such situations, but the spatial re-arrangement of land systems also brings about opportunities for lessening environmental impacts and for restoration and rewilding.

Making use of these opportunities, however, is challenging for research and policymaking. Land-use and conservation planning need to move from a static to a dynamic paradigm: socio-economic models and causes of land system change are likely to be shifting as new actors enter and new trends emerge, and data may be unavailable or outdated in rapidly changing environments. These challenges require bold transportation of models over new spatial and temporal contexts, and an explicit consideration of uncertainty is central. This session will showcase emerging approaches and applications to characterize and analyse trade-offs in dynamic landscapes, to translate tools and insights into information relevant for stakeholders and policymakers, and thus to re-imagine land systems through these dynamic futures.

Session Organizers: Tobias Kuemmerle, Ralf Seppelt, Elizabeth Law, Michael Beckman Brett Bryan
Keywords: Land use, biodiversity, agriculture

102R The role of warfare and armed conflicts in land systems

Armed conflict impacts land-use decision making, and thus land-system change, in major ways. Armed conflicts are frequent globally, with about 50 active conflicts in 2017 and 285 conflicts since WWII. Our understanding of how this impacts land-use agents and land systems, however, remains limited. For example, armed conflict may have diverging effects including increasing and decreasing land-use pressure, and it remains unclear whether combinations of land systems and conflict types result in similar land-use outcomes. Likewise, critical feedbacks between land use and armed conflict are poorly understood. This hampers our understanding on the causal mechanisms behind this relationship, and therefore our ability to quantify the impacts that armed conflicts can have over different scales, including at distal locations. The GLP emphasizes the importance of armed conflict in shaping land use, particularly in the interrelation with other megadrivers of future land-use change, “[…] such as globalization, climate change and food security…]”.

This session aims at bringing together social and natural scientists as well as a mix of qualitative and quantitative researchers to explore these core overarching questions: (1) What are typical land-use outcomes of warfare, and what is the role of land use in triggering conflict? (2) Through which mechanisms do armed conflicts forge distal linkages

(telecouplings)? (3) What is the role of armed conflict on land use in the context of other megadrivers of future land-use change?

The session seeks contributions to all three questions, and strongly relates to theme 1 (What are visions for the planetary land system?), as armed conflicts have impacts on land systems locally as well as at distal locations. More broadly, the session directly addresses a central theme of the Global Land Program (i.e., land use and conflict), and has the major goal of identifying interested GLP members to discuss a future research agenda.

Session Organizers: Matthias Baumann, Lina Eklund and Andreas Foro Tollefsen
Keywords: warfare, armed conflict, forest loss, degradation, distal linkages

103R Large-scale behavioral models of land use change

The session will explore the development of the next generation of large-scale (global to continental/national scales), land-use models that are based on human behaviour, agency and decision-making processes. The purpose of these models is to explore a wide range of key research (and policy) questions at the nexus of food, ecosystems, water, climate and energy. This will support understanding of adaptation and mitigation processes within the land system as an exemplar of other socio-ecological systems. The session will provide alternatives to the current range of 'top-down' global models.

Since there are many different ways of modelling land use change processes, especially with respect to theories of land-use decision-making, we will explore alternative model realisations of decision processes. This includes new representations of institutional processes and their relationships with local land users and taking account of telecoupling across a globally (inter-)connected world. The session will also evaluate the coupling of large-scale, land-use models with other models types, such as Dynamic Global Vegetation Models (DGVMs), biodiversity models and/or climate emulators to explore a wide range of environmental change drivers and to evaluate the consequences of these for ecosystem services.

This session is directly relevant to the GLP topic of modelling land system change (section 4.1.4 of the GLP Science Plan), specifically the use of multi-agent models as learning-tools to test alternative conceptualisations of land system dynamics and scenario analysis. The session will also explore the GLP thematic area of telecoupling of land use systems (section 4.2.1 of the GLP Science Plan) and land governance (section 4.2.4 of the GLP Science Plan) through the development and testing of models of institutions (public policy organisations).

Session Organizers: Mark Rounsevell, Peter Verburg, and Calum Brown
Keywords: land use modelling, large-scale, agency, telecoupling, decision-making

104R Roads to sustainability: Land use within sustainable development goals and planetary boundaries

Achieving the Sustainable Development Goals (SDGs) requires large effort and transformative change in socio-ecological systems. In this regard, changes in land use systems are highly relevant because land use--directly and indirectly--relates to a number of SDGs -ranging from Zero Hunger and Clean Water, over Responsible Consumption and Production, to Climate Action or Life on Land. Since SDGs are universal and require integrated implementation, their local and national implementation must account for (i) international and global effects and (ii) trade-offs and synergies between the often conflicting individual goals.

This session deals with the complex interplay between socio-economic transformation processes, land use change, environmental limits and the achievement of SDGs. Emphasis lies on systems analysis to identify synergies and trade-offs of available land management and governance options as well as on transformative land use pathways with respect to achieving different sustainability targets. Presenters are encouraged to address the externalization of land-related costs and benefits across regions (teleconnections and telecoupling) and related common but differentiated

responsibilities in land use. We invite contributions that help to evaluate and compare different scientific approaches, methods, tools, indicators and data, suited to derive conclusions for integrated land management and nested multi-level land governance and policy coherence. Presenters are encouraged to present the drivers of change, socio-environmental consequences, and potential response strategies in a structured causal-effect relationship.

Session Organizers: Benjamin Stuch, Holger Hoff, and Patrick Hostert
Keywords: planetary boundaries, SDGs, cross-scale integration, teleconnections, telecoupling

105R Designing sustainable urban land systems

Land systems scientists have demonstrated that many current patterns of urbanization are degrading the environment, driving social inequity, and suggest that alternative approaches are imperative to improve the long-term sustainability of cities. The need to integrate science and design has been formally recognized in what some have labelled "urbanization science."

Planners and architects have proposed alternative patterns and processes of development that are intended to enhance the sustainability of cities and have begun to put these ideas into action in built sites that constitute experiments in sustainable design. Research has built a greater understanding of the functioning of urban social-ecological systems (SES) and is feeding into the production of tools for supporting the needs of urban land-use planners and decision makers. Despite these advances and mutual interest in designing more sustainable urban land systems, the engagement between SES and design-oriented communities has been slow to emerge, inhibiting potentially transformative knowledge exchange.

A key goal of this session is to bring scholars and practitioners from planning, architecture, design, and environmental engineering together with ecologists, economists, and sociologists to identify cutting-edge approaches and potential new points of synthesis between land systems science and design. A second goal of this session is to begin to forge overlap between the institutions that support land systems science and the design fields. Specific questions this session will address include: What are the challenges to bridging empirical and design-oriented approaches? What theoretical frameworks, data, tools, and methods have enabled synthesis between SES and design-fields? Are there approaches to synthesis that could be potentially helpful but have not yet been fully explored? How do the challenges and solutions related to synthesizing design and science vary based on regional context internationally?

This session will include a series of short "flash" talks and leave ample time for discussion related to geospatial and field-based data and analysis for evaluating outcomes of design interventions; enhancing institutional fit to enable cities to plan, build, and manage for long-term sustainability; expanding stakeholder engagement to enhance outcomes, especially marginalized communities and private sector actors; and means for forging pathways for information sharing and collaboration between between science and design communities and on-the-ground urban decision makers.

Session Organizers: Victoria Turner, Heather Sander, Dagmar Haase, and Annegret Haase
Keywords: urban design, urban ecology, sustainability, urban planning, urbanization science

106R Land systems for conservation science

Land use change is and will continue to be, the main driver of biodiversity loss, yet the systemic and complex nature of land use remains widely underappreciated in conservation science and practice. This translates into conservation actions that are less effective and less aligned with other land-use goals than they could be. Land system science has developed a range of concepts, approaches and datasets that could greatly enrich conservation science if better integrated. For example, the identification of typical land systems and pathways of change can help to structure the sometimes-overwhelming diversity of land-use actors, land-use practices and socio-ecological contexts. In particular, since land systems are linked to distinct portfolios of threats, identifying such portfolios provides opportunities to

understand the occurrence of threats, and the interactions and feedbacks among them. Moreover, the increasing emphasis in land system science on decision-making at the level of actors provides new avenues for assessing how land-use actors relate to diverse threats, how conservation action and outcomes can influence their land-use decisions, and thus ultimately what determines effective conservation. Finally, the increasing focus on linking place-based and network-based analytical lenses in land systems science provides means to assess the importance of distal factors in shaping geographies of local threats to biodiversity and reveal new entry points for conservation action, such as through supply-chain mechanisms.

This session explores new concepts and approaches to shift to a more systemic consideration of land use in conservation science. This will highlight how a land systems paradigm can help to better understanding threats to biodiversity, how to effectively address them, and where and how conservation opportunities emerge. As such, this session strongly relates to all three themes of the conference, but particularly to theme 1, as it will discuss new ways to analysing conservation challenges in land systems, and theme 2, as it will discuss new concepts and showcase applications how to navigate biodiversity/land-use trade-offs in land systems.

Session Organizers: Tobias Kuemmerle, Yann le Polain de Waroux, Takuya Iwamura, Ana Benítez-López, and Alex Zvoleff
Keywords: conservation science, systematic conservation planning, trade-offs

107R Assessing, modelling, and analysing land use and land management impacts on the Earth system

Currently, by far more than half of the Earth's ice-free land surface are managed by humans for the provision of essential resources and services such as food, fibre, energy, and living space for about 7 billion people. These activities affect key processes of the Earth system, including biogeochemical and biophysical properties of the biosphere, and result in daunting sustainability challenges such as climate change or biodiversity loss. A central prerequisite to overcome these sustainability challenges is an improved understanding of the complex and dynamic interactions between the various Earth system components, as well as the various and ubiquitous influence of human activities.

Many remaining unknowns, however, relate to the extent and degree of human impacts on the natural components of the Earth system. While a relatively robust body of knowledge exists on the effect of land-cover conversions (i.e. the land-use induced change from one land cover type to another, for example deforestation), land-use activities that result in changes that occur within the same land-cover type (denoted "land management") remain much less analysed. However, well-established insights, e.g. on the effects of fertilization or harvest activities, have been reinforced by recent evidence, suggesting the magnitude of management impacts to be substantial and of global proportion. Thus, omitting land management in assessing the role of land use in the Earth system may result in substantial difficulties to elucidate spatiotemporal dynamics and patterns of crucial Earth System processes. Furthermore, an improved understanding of management impacts on the Earth system is required to exploit the possibly large potentials of land use in mitigating the sustainability challenges while at the same time avoiding massive trade-offs or target conflicts that may reduce or even overturn the benefits of such strategies.

Two interacting impediments are responsible for this at least partial neglect: First, major knowledge gaps exist in our qualitative and quantitative understanding of the biogeochemical and biophysical impacts of land management. Second, substantial data gaps on the magnitude and pattern of various management practices prevail. This session assembles contributions that address these currently prevailing impediments in research from a multitude of disciplinary perspectives and spatio-temporal scales, including Earth System modelling, socioecological accounting or ecological case study research. It presents empirical and conceptual approaches aimed at assessing, modelling and analysing the impacts of land management on various components of the Earth system and will discuss novel approaches and databases. These findings are put into context of land use as a tool to mitigate sustainability challenges such as climate change. A particular focus will be on the trade-offs, but also synergies, that emerge when land-management is employed in such strategies.

Session Organizers: Karlheinz Erb, Sebastiaan Luyssaert, and Julia Pongratz
Keywords: land management impacts, trade-offs in the land system, Earth system, climate change mitigation

108R Farming into the future: balancing global competitiveness and localised comparative advantage?

Few doubt that globalization has significant impacts on agricultural land-use at the local level. However, scholars disagree about how to understand the relative importance of global and local drivers. Liberalized global trade in agricultural products was supposed to lead to greater production volumes because global competition would induce farmers to become more efficient. Production has indeed increased and prices decreased. However, the kind of industrialised agriculture that has been reinforced by the liberal, global trade regime has become one of the largest net contributors of greenhouse gases to the atmosphere, i.e. the search for competitiveness has forced farmers to adopt more uniform, but less sustainable practices that negatively impact the environment. Global competitiveness is superseding, in many places, local comparative advantage. This process is however highly dynamic and uneven, leading to variable outcomes in different places, making it difficult to identify key drivers and even define what are comparative vs. competitive advantages today.

This session explores the interplay of global and local drivers that determine variable agricultural land-use trajectories, looking empirically at farm decision making in different regions in its local context and expanding up to assess all drivers. We also look theoretically at ways to account for the complex and dynamic interplay between factors in different places, be they local or global, economic or ecological.

The session will thus aim to:

1. Reassess conceptualizations of traditional concepts such as comparative and competitive advantage from a geographic perspective. Among other things, we will seek to evaluate these concepts in relation to specific anthropogenic biomes under different market conditions.
2. Examine empirically how geography matters when farms are globally integrated. Interesting dimensions to explore include location effects, farm scale, distance to markets, technology, labour efficiency, and environmental impacts.
3. Find solutions for more optimal governance of agriculture in this age of global markets, based on a better understanding of global competitiveness and localised comparative advantage.

Session Organizers: Anders Wästfelt, Qian Zhang and Brian Kuns
Keywords: globalization, competitive advantage, comparative advantage, agricultural geography"

109R Mapping, analyzing and modeling human settlements at global scale

Recent studies have estimated that in the upcoming 30 years the land surface occupied by human settlements (HS) on Earth is going to double. This urbanization tsunami is expected to hit current megalopolis, but also to affect medium- and small-size settlements (including rural ones) thus playing a major role in driving global land-systems. In such framework, a precise and quantitative understanding of the entire spectrum of HS sizes is a fundamental requirement to implement any regulatory strategy for managing and containing future urbanization. Nevertheless, so far this has been precluded by the lack of reliable and detailed global inventories of HS, hence forcing the scientific community to mostly focus on large urban agglomerations with a consequent bias on the resulting analyses and modeling studies.

To overcome such drawback, in this session we present a novel pipeline for a global and comprehensive analysis of HS based on the use of big Earth Observation satellite data and advanced modelling techniques. Specifically, first we introduce Google Earth Engine (GEE), the most advanced cloud-based geospatial processing platform which combines a multi-petabyte catalog of satellite imagery and geospatial datasets with planetary-scale analysis capabilities. Next, we present the Word Settlements Footprint (WSF), a novel dataset generated by means of GEE which outlines HS globally over time with unprecedented accuracy and reliability. Finally, we discuss the output of a global spatial analysis on HS carried out by exploiting the WSF with focus on quantitative comparisons and explicit spatial urban modeling.

Session Organizers: Emanuele Strano, Mattia Marcooncini, Nicolas Clinton, Filippo Simini, Marco De Nadai and Noel Gorelick
Keywords: Google Earth Engine, Word Settlements Footprint, urban modeling"

110R Multi-objective optimization approaches to support visioning and decision-making in land-use system science

Understanding the underlying processes of land-use systems is a highly complex task. Yet, land-use system science goes even beyond this task towards designing visionary futures and developing advice for decision-makers on how to reach these futures. To design visionary futures and transformations requires the use of innovative modelling techniques and close cooperation with stakeholders and decision-makers. Multi-objective optimization approaches are such innovative modelling techniques that bare high potential for developing positive visions about the future. Their most desirable properties are that (1) they can be used to deal with conflicting objectives and reveal trade-offs, (2) they breathe a certain air of normativity that allows to implement visionary ideas and (3) they can help us to make the right decisions in very complex systems which will ideally lead towards the most desirable and sustainable futures. Although the use of multi-objective optimization approaches has increased during recent years, there are still some major challenges ahead before they may become an established tool to support visioning and decision-making. Challenges that need to be addressed are (1) designing optimization algorithms that can efficiently solve complex land-use system problems and depict optimal solutions, (2) show how the analysis of optimal solutions can be used to derive useful recommendations or even rules for decision-makers and (3) how multi-objective optimization can be used in real-world decision-making requiring close cooperation and interaction with stakeholders and decision-makers. A wide range of multi-objective optimization approaches that deal with one of the outlined challenges are invited to be presented and to facilitate a discussion on future research directions of optimization approaches in land-use system sciences.

Session Organizers: Jonas Schwaab, Sven Lautenbach, and Kalyanmoy Deb
Keywords: multi-objective optimization, visions, trade-offs, decision-making support, land-use modelling

111R Clandestine and illicit economies as drivers of land system dynamics

The importance of clandestine and illicit economies as drivers of land system dynamics is becoming more widely recognized. Yet, causally linking these activities and their associated capital flows to land system state and transformation remain difficult, and challenges attempts to conceptualize, detect, and study clandestine and illicit economies as land system components comparable to legal economic activities. This research presentation session will delve into how clandestine and illicit transactions –i.e., economic/capital exchanges involving land that are intentionally hidden or non-public because they break formal laws –influence land system dynamics. From off-shore banking (revealed in the Panama Papers) to the international drug trade, large flows of clandestine financial capital around the world move through and embed in social and ecological domains of land systems. Clandestine capital may precipitate land-use transitions between forests and cattle ranches or mining operations, or from agriculture to urban uses. As agents possessing capital engage in political or economic rent-seeking and pursue private property arrangements, the new land markets and transactions that emerge may disrupt collective land tenure or governance structures. Of particular concern are the consequences to ecosystems and people further marginalized through these transactions that may either buttress or thwart sustainable development in the short and long term. While illegal logging and land grabbing have been prominent issues on the Land System Science agenda, more attention is needed to understand these and other types of clandestine activity on agricultural frontiers, in conflict and paramilitary zones, drug production and transit sites, and in informal urban settlements. This session will seek submissions that explore 1) how clandestine and illicit economies support or threaten land systems (OSM Theme 1), and/or 2) how Land System Science (LSS) perspectives and approaches can be used to gain insights into how clandestine and illicit economies operate (OSM Theme 3).

Session Organizers: Nicholas Magliocca and Beth Tellman

Keywords: illicit financial flows, agricultural commodities, supply chain, mixed methods"

112R Sustainability impacts of large-scale agricultural investments in Africa

If a consensus emerges regarding the necessity of additional investment into agriculture (FAO, 2010), it is less evident whether large-scale agricultural investments (LAI) are a vector for broader agrarian and socio-economic transformations in a sustainable manner (Borras et al. 2012, Deininger and Byerlee 2011; Collier and Dercon 2014). Despite a growing literature (World Bank, 2010; White et al., 2012, Cotula 2014 etc.), most assessments of LAI impacts tend to remain local, in the form of specific case-studies and are often short-term without broader contextualization (Fairhead et al., 2012). Efforts to overcome these limitations through different types of meta-analysis have been undertaken (Oberlack et al., 2015, Schoneveld 2014, Schoneveld 2017, Dell'Angelo et al. (2017). However, a more empirical understanding of the various changes and impacts at various levels is necessary for reflecting on visions for the planetary land system.

The objective of the session is to discuss recent research results on sustainability impacts of Large-Scale Agricultural Investments at household and regional (sub-national) level in the global South. Priority is given to presentations of results going beyond individual cases studies by using different approaches such as comparative case studies, studies looking at regional/spatial or temporal changes. Other innovative approaches to shed further light on the dynamics and impacts generated by such investments can also be proposed.

Session Organizers: Ward Anseeuw, Sara Mercandalli, Wegayehu Bogale Fitawek, Marcus Giger, Perrine Bournod, Aurelien Reys, Sheryl Hendricks, Filippo Fossi, Christoph Oberlack, Sandra Eckert, and Julie Zähringer
Keywords: agriculture, investments, sustainability, impacts, Africa

113R The role of biodiversity in the relationship between people and land

Recent work by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and other consortia on the link between people and nature has served to illustrate the key role biodiversity plays in supporting human wellbeing through ecosystem functions and services, and the importance of nature for human subsistence. Land systems sciences in turns have contributed with extensive knowledge on the link between people and land and on how land governance and land-use decisions likely affect the trajectory of social-ecological systems and their biodiversity in the face global changes. Biodiversity therefore occupies a unique position in that its status and trends are both determinant for human wellbeing and people's livelihood and simultaneously largely determined by land use decisions and policies made by and for people. Developing visions for the sustainable use and management of land and supporting transformation in response to global changes therefore calls for a critical understanding of the role of biodiversity in the relationship between people and land and its importance for land system sciences.

This session on the role of biodiversity in the relationship between people and land invites contributions from comparative, experimental, synthesis, scenario, modeling and assessment approaches towards a common understanding of the role of local to global drivers of change in biodiversity, and of the consequences of these changes for land systems, their study, and their governance.

Session Organizers: Markus Fischer and Davnah Payne
Keywords: biodiversity, land system sciences, ecosystem services, human wellbeing

114R The deep history of global land use change – needs and potentials for earth system modelling and understanding of socio-ecological systems

Land-use and related land-cover change transform environments in multiple interacting ways, including feedbacks with human social change and land use itself. Early changes in land-use are known to have altered global patterns of biodiversity and climate that have potent impacts on these into the present time. This session explores relationships between land-use change and the environment, in particular biodiversity and climate, based on long-term

reconstructions from paleoecological and archaeological evidence that enable these complex processes to be understood and modelled over long time periods. Reconstructions of past land-use and anthropogenic land-cover change over past millennia also enable hypotheses on long-term processes, feedbacks and dynamics at global scale to be tested using Earth System Modelling and socio-ecological models. The PAGES LandCover6k working group is an example of recent efforts to achieve plausible quantitative reconstructions of past land use and land cover useful for Earth System Modelling, and that can also be used in other types of modelling. These reconstructions are based on pollen-inferred plant cover, and mapping and interpretation of archaeological data. Other initiatives have used alternative methods such as population-growth modelling based on databases of 14C dates from archaeological sites, and models of the relationship between population growth and land-use/deforestation. This session welcomes all contributions on sub-continental to global reconstructions of past long-term land-use change and/or applications of these reconstructions in hypothesis testing related to changes in biodiversity, climate and other global environmental change processes.

Session Organizers: Marie-Jose Gaillard and Erle Ellis
Keywords: Global land use, Holocene, climate, biodiversity, Earth system modelling

115R Water on land: The role of green water for social-ecological and Earth system resilience

Green water, i.e., soil moisture stocks and all evaporation flows from land, is fundamental for sustaining food production and terrestrial ecosystems, and for regulating the climate. By wettening the landscape, green water provides resilience, i.e., the capacity of a system to adapt and transform in the face of change, to social-ecological systems at the local scale as well as the Earth system at the planetary scale.

Land degradation, desertification, and deforestation are all human interventions in the land system that deplete social-ecological resilience through green water interference, and can locally manifest as drought, heatwave, and crop failure. Furthermore, green water interference through land system change can also have important non-local and regional-to-global scale implications, through influence on among others carbon sequestration, albedo of soil and vegetation, nutrient uptake, moisture recycling, monsoon onset, and partitioning between latent and sensible heat flux. Such biophysical resilience loss from human interference (e.g., deforestation of the Amazon) may trigger undesired self-amplifying feedbacks (e.g., slowdown of the water cycle) and cause regime shifts, i.e., drastic, persistent, and systemic changes (e.g., forest-savanna transition). The social consequences of biophysical resilience loss or regimes shifts can be severe and cause famine, political instability, and migration, especially in combination with climate change and weak social institutions.

On the positive side, knowledge of the role of green water have also created green water management solutions, such as vapor shift through rainwater harvesting, that increase harvest, serve local communities, and provide resilience a the larger scale. Great challenges, nevertheless, remain. What are the key processes through which green water matters for Earth system resilience at the planetary scale? How can synergies and trade-offs be built to manage green water resilience from the local to the global scale? And how can the full transformative potential of integrated land and water resources management be unleashed to deliver resilient and sustainable development? This session welcomes both qualitative and quantitative research that explore the relationship between land management and green water, or that advance our understanding of the role of green water for resilience from a wide range of perspectives.

Session Organizers: Lan Wang-Erlandsson and Patrick Keys
Keywords: social-ecological resilience, regime shift, soil moisture, evaporation, precipitation

150N Scenario narratives for agriculture and land systems across scales and locations

Future developments in agricultural management and land systems are difficult to anticipate. A thorough understanding of driving forces and their interactions is a prerequisite for governing multilevel decision making towards sustainable development under global change. This particularly holds for the agricultural sector as it is part of

a highly complex global system with multiple biophysical and socio-economic drivers with uncertain future outlooks. Scenario development is an important method to analyze the interactions of driving forces and their outcomes under different assumptions. Such scenarios support the understanding of the mechanism of change and facilitate stakeholder inclusive research and knowledge co-creation. However, scenario development is a scientific challenge.

This 2-hour-session offers a forum for scientific exchange and joint learning in scenario narrative development to tackle some of these challenges. The session will be introduced by a 15 min presentation of protocol-based development of storylines for European agriculture in 2050, in which numerous researchers and stakeholders from across Europe were involved and which connects to the so-called Shared Socio-economic Pathways of the climate research community. Further scenario cases can be brought in by posters introduced by 1 min pitches after the introductory talk. The subsequent structured discussion will address thematic and methodological issues of scenario development, including multi-scale scenario development (top-down versus bottom-up), using existing scenarios when down-/ upscaling, process of developing narratives, guaranteeing stakeholder buy-in and linking qualitative and quantitative scenarios.

Depending on the number of participants, a roundtable discussion or world café format will be chosen. It is anticipated that as the outcomes of the session, researchers from different world regions and projects will have learned from each other, created insights together and increased the basis for potential future cooperation. Contributions (poster with pitches, discussion topics) on recent developments of scenario narratives are highly welcomed.

Abstract submissions are welcome in this innovative and immersive session.

Session Organizers: Anja-Kristina Techen, Hermine Mitter, Martin Schönhart, Kasper Kok, Katherina Helming
Keywords: multi-scale scenarios, narratives, foresight, agriculture, land

151N Mapping socio-ecological land systems for South America

There is almost no place on Earth free from human influence, i.e., anthromes. Land classification systems that incorporates the human-environmental dimension is a key avenue in the land-use sciences to foster sustainability and conservation strategies (GLP regional workshop of Latin America 2016). Boillat et al. 2017 conceptualized social ecological land systems (SELS) for Latin America generating a biome-level typology, a brief characterization of the systems and some example regions. However, these definitions are only descriptive (i.e., non-spatial) and could include other spatial variables that contribute to understanding large-scale processes in Latin America. Besides, mapping exercises that include the participation of stakeholders ensure the coherence of the results and their future utilization from stakeholders because of their involvement in their generation.

In this session, we aim at revising and mapping SELS for South America which is part of an ongoing collaborative publication with some of the co-authors of Boillat et al. 2017 among others (specialists on the geography and social-environmental systems of South America). After a brief presentation of the methodology, the resulting maps will be open for discussing the clusters of ecoregions with similar socio-ecological systems. In this way “presenters” will be active participants in the open discussions with the audience.
Format: Roundtable discussions with stakeholder participation open to any GLP participant with expertise and interest in contributing and enriching interactive discussions. We aim at organizing a digital-touch-screen-coffee table such as https://www.d-table.com/d-easy/, where participants can physically interact with the maps.

This session is organized by GLPs Latin America Nodal Office.

*Abstract submissions **are welcome** in this innovative and immersive session.*

Session Organizers: Lucía Zarbá, María Piquer-Rodríguez, and H. Ricardo Grau

Keywords: anthromes, eco-regions, human-environmental systems, land-use, participatory mapping"

152N Can we give half the planet back to nature? (NO ABSTRACTS BEING ACCEPTED)

To deal with the biodiversity crisis we need to find a way to give nature more space. But how can we do this in a way that honors both the needs of other species and humans at the same time? Some leading conservationists propose to save other species we need to give 50% of the Earth back to nature. Critics say the grand plan would be unfair to local peoples, and poor landowners. The challenges of a global conservation plan go well beyond anything we have considered as a global land community in the past. If we are to discuss the possibility of Half-Earth we need to do it in a way that is rigorous, and fair. And we need to acknowledge the multitude of different perspectives. In this session will bring together leaders of different organizations mobilizing Half-Earth on the ground, alongside major critics of the idea, and experts in far-ranging disciplines within the GLP community, to see whether it is possible to (1) build a broader understanding of the challenges and opportunities surrounding the Half-Earth idea; (2) resolve some of the conflicts the idea presents; and (3) develop strategies navigating the trade-offs for Half-Earth and use these as a learning point for future discussions in GLP for optimizing land use for people and nature.

We will hold a roundtable discussion pulling together actors mobilizing Half Earth on the ground, with experts in land use optimization, biodiversity mapping, conservation, multifunctional landscapes, agriculture, ethics, law, sociology, economics, land tenure, and indigenous rights. The delegates will be posed an open set of questions –and the dialogue chaired with the aim to develop common strategies to bridge the gap between “visions for the planetary land system”, and “what people want from the land”.

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Zia Mehrabi and Erle Ellis
Keywords: nature, people, land, half-earth, trade-offs, governance

180T Using participatory scenarios to create common visions for the land (NO ABSTRACTS BEING ACCEPTED)

Scenarios are a systematic way to explore possible futures, and to evaluate policy and management interventions. Models are robust tools to compare the outcomes and impacts of the scenarios explored and can serve as a basis for action.

In the past, scenarios have proven highly effective in enabling response to unpredicted change, and are now proving highly effective in the contemporary context of understanding and planning for challenges such as climate change, biodiversity loss, crossing planetary boundaries and poverty and inequity. Scenarios are important and valuable tools used to explore sustainability problems, and to understand the viewpoints of different stakeholders and to build common visions. They thus aid in conflict resolution and generating realistic pathways for sustainability interventions. Since the Millennium Ecosystem Assessment, scenarios are an integral part of assessments, evaluating the impact of policy and management actions on biodiversity and ecosystem services provision, and for the exploration of possible future policy.

The workshop is intended for participants who are interested in learning about the use and implementation of scenarios in sustainability, biodiversity and ecosystem services studies, in particular with regards to integration of different stakeholder views and visions. The workshop will explore the purpose of using and applying scenarios in a decision-making context. It will introduce the scenario building process, placing a particular importance on approaches that allow integration of different stakeholder views and the evaluation of trade-offs and synergies in scenarios outcomes.

Participants will be invited to register for workshops following the call for abstracts.

Session Organizers: Cornelia Krug and Osamu Saito
Keywords: participatory scenarios, decision-support, common visions, biodiversity, ecosystem services"

Theme 2: What do people want from land?

200P WHAT DO PEOPLE WANT FROM LAND? (POSTER SESSION)

This is the poster session for Question 2. What do people want from land? Navigating the trade-offs and fostering synergies in land systems

201R Desertification, land degradation and drought – challenges, risks and response

The proposed session will address different risk topics and cross-cutting themes that focus on the role of science and society in managing desertification, land degradation and drought (DLDD) in all regions of the world. DLDD challenge is of a global dimension and poses a problem for sustainable development in all countries particularly in developing countries, in Africa drought means famine. How can people be made less vulnerable from the many threats of DLDD arising from climate change, how to increase resilience through the application of local and scientific knowledge and the contribution of policy makers, will be key questions to be addressed.

It is worthy to note that the Sustainable Development Goal 15 of the 2030 Agenda aims to 'protect, restore and promote sustainable use of terrestrial ecosystem, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss'. Land is a vital resource for producing food and other ecosystem goods and services; and is central to the "nexus" that links energy, food, water, and environmental health in an interdependent loop. Experts estimated that in 2030, the demands for energy will rise 50%, food 45%, and water 30%. It is also expected that continuing land degradation will drive 700 million people out of their homes. Therefore, land degradation issue became a matter which requires an immediate attention thus the need for this session to contribute to the wealth of knowledge for our future survival. This session welcomes presentations from different regions that showcases socioecological characteristics and best practices in managing DLDD.

Session Organizer: Chizoba Chinweze
Keywords: Desertification, land degradation, drought, climate change, food security

202R Integrating the landscape concept into land change science

The notion of "landscape" in socio-environmental science is variously interpreted, but is generally accepted to encompass people's needs and values, as well as the diversity of their perspectives. There is broad consensus that interpretations of cultural landscapes –together with local community history and character –defines a sense of place and the strength of such attachments. The 'landscape approach' seeks to take account of such social and cultural perspectives by embedding them in processes of landscape management policy, planning, and practice. We aim to evaluate the extent to which a landscape perspective has indeed changed the practice of science for impact, and identify the added value generated by the landscape approach. We also ask in what respect does a landscape perspective help for "navigating the trade-offs and fostering synergies in land systems" –as described in one of the conference themes.

Following up on a session organized at the OSM in Beijing, we want to specify the diversity of linkages between landscape and land change science, and explore the specific merits for land system transformations. All contributions are welcome which explicitly address the landscape dimension, be it by working at the landscape scale, adopting a landscape perspective or following a landscape approach.

Session Organizers: Felix Kienast, Harina Nagendra, Jaboury Ghazoul, and Matthias Bürgi
Keywords: landscape approach, landscape scale, context

203R Land use change processes and interactions along the urban-rural gradient

Rural land systems and urban land systems have often been studied in isolation as if both systems exist independently. Yet, these systems are related in many different ways, either because they're mixed in space, or because they depend on each other for services. At the same time, these interactions might yield new challenges related to the competing and /or increased claims for land, and thus to sustainable land use systems. In this session we will discuss studies that have this relation between rural and urban land, local or over distance) as a focal point. Specific topics include, but are not restricted to, analyses of the rural-urban continuum and related land use processes (such as including peri-urbanization, rural infill, sprawl, counter-urbanization), analyses of flows between rural and urban areas (including people, food, people, other material, but also services, such as recreation, aesthetics, flood protection,), changing rural land-use activities related to urban markets (including diversification of rural economies, functioning of small urban centres as markets, migration flows related to labor opportunities, and smallholder changes towards market production and agrifood systems), and studies on planning and management of these relations and interactions.

This session is sponsored by the GLP Working Group on Integration of Rural and Urban Land Systems

Session Organizers: Jasper van Vliet, Anton Van Rompaey, and Torben Birch-Thomsen
Keywords: urbanization, rural, competition for land, mosaic landscapes

204R Opportunities of farm and landscape level models in land use science for biodiversity and ecosystem service assessment

Human actions have rapidly growing impacts on terrestrial ecosystems. Understanding the processes of the decision-making process of land users that drive agricultural land management, needs attention in land use science. Responses of land users to changes in broad-scale, underlying drivers are difficult to anticipate because agents quickly change behavior to changes in framework conditions. A range of economic-based models of farmer decision-making in agriculture and land use under future policy and market scenarios exist. At the same time, research on decision-making of farmers shows clearly that many other important - mainly social - factors influence farmers. Consequently, additional modelling approaches occur including beside economic performance other relevant factors e.g. socio-demographic characteristics of the farm household, the wider social milieu, or other factors. With respect to spatial scales, models at farm and landscape level are closest to real-world land-use decision making. Although they are limited to case studies at landscape to regional level due to high complexities and data demand, high-resolution outputs become possible and offer interfaces for subsequent environmental analyses such as on biodiversity and ecosystem services.

In this session, we will explore the diversity of models at the farm and landscape level to analyze land use impacts from diverse future biophysical and socio-economic trajectories, such as climate change or environmental and agricultural policies. By comparing approaches such as bio-economic farm optimization models or agent-based models, the strengths and weaknesses of each option will be revealed in implementing scenario assumptions, translating scenario drivers to land use outcomes, and evaluating land use outcomes by their effects on biodiversity and ecosystem services. We will introduce this session by highlighting the variety of quantitative models at farm and landscape level compared to other spatial levels and scope in order to reveal good-practice options and future research demand.

Session Organizers: Veronika Gaube and Martin Schönhart
Keywords: land users, farm-based models, agriculture, biodiversity

205R Sustainable rainforest communities: Supply chains, trade-offs and emerging technologies

Deforestation continues across the tropics, with 15.8 million hectares of tropical tree cover loss recorded in 2017 (World Resources Institute, 2018). Tropical rainforests are locally and globally significant in terms of environmental, social, and economic values. Understanding and addressing the important trade-offs between these values and competing land uses is critical for meeting the UN Sustainable Development Goals (SDGs). This session brings together a series of presentations on approaches, solutions and supportive innovative technologies needed to meet the needs, and value the priorities of, communities living in rainforest landscapes, whilst maintaining forests and ecological wellbeing, and ensuring economic sustainability.

This session will examine the synergies and trade-offs between SDGs 9 (integrate small-scale business into value chains and markets), 12 (ensure sustainable production and consumption), and 15 (protect, restore and promote sustainable use of forest ecosystems).

Abstracts are invited that reflect on issues related to the following themes:

- *Sustainable supply chains:* How can local communities in tropical rainforests develop viable forest-based economies extracting non-timber products that secure economic benefits and wellbeing? How can non-timber forest products be integrated into sustainable supply chains, in ways that meet the needs and priorities of communities? How do such forest-based economies affect forest ecosystems, and do they present opportunities to help restore previously degraded areas? What emerging methodologies are there that give voice and ownership to communities in developing sustainable supply chains?
- *Technologies:* What are the emerging technologies for monitoring biodiversity, forest cover, and carbon stock? How can drivers of small-scale and/or large-scale deforestation be monitored on the ground and remotely? How can methodologies integrate new technologies and traditional ecological knowledge for the development of sustainable livelihoods?

Session Organizers: Izabela Delabre, Pedram Rowhani, Anthony Alexander, Anne Touboulic, and Elena Lobo
Keywords: rainforest conservation, community co-management, sustainable supply chains, new technologies, Sustainable Development Goals"

206R Relevance of long-term land-use change for sustainable land management

Managed land, such as agricultural land or used forests, is not only the result of current land use practices in a particular environment. Historical societal interventions, dating back decades or even centuries, also impact today's cultural landscapes. Past land management and its effect on current landscapes are shaped by past societal needs, rules and regulations and available technologies, and their assessment today depends on current values and appreciated land functions. We argue that sustainable land management needs to take into account legacy-effects of long-term land-use change in order to adequately cope with ongoing inert processes, and to avoid delayed negative impacts of today's land use. Past land uses may affect all kinds of land systems, and impact a variety of ecosystem features, such as spatial patterns, species distribution, age structure, or soil nutrient pools. Their effects may be beneficial to sustainable land management (e.g., when forest carbon sequestration today is made possible, among others, by historical deforestation), or detrimental (e.g., when past land management practices lead to extinction of species today). This session assembles conceptual and empirical contributions addressing the relevance of past land use and land-use change for current sustainable land management. The relevance may be established either by directly tracing the impact of past land uses on current features of the same land (i.e. land-use legacies of past events or processes), or by identifying generalizable features in historical processes (e.g. land-use transitions) which may apply to current processes elsewhere.

Session Organizers: Simone Gingrich and Matthias Bürgi
Keywords: land-use legacies; land use and land cover change; long-term socio-ecological research

207R New actors, global narratives, and renewed goals shaping farmland investment decisions

In today's commodity frontiers, not all key actors driving land use change are farmers and their interests are not entirely production-driven. The investment trend that followed the 2007-08 food and financial crises has spurred a new set of powerful actors such as development finance institutes, institutional and retail investors and an emergent group of fund managers. Farming is only one of their interests among others that may also include assetization of farmland, generating environmental services, or contributing to development. Furthermore, their decisions are now shaped not only by distance to market, productivity, or access to resources but also by the global narratives of business, development, and environmental protection. Understanding land use dynamics thus calls for a broader research scope encompassing new actors beyond the direct land users, global narratives that shape land use goals beyond the production of goods, and new modes of decision-making.

This session takes a closer look at the evolving global landscape of farmland investments (including forestry) that are not often farmer-led or entirely production-driven. We welcome submissions based on both empirical and theoretical work contributing to a stimulating discussion on new and emerging dynamics of farmland investment shaping today's commodity frontiers, its actors, their goals, and the global narratives modeling their decision space. This, in turn, will provide a foundation to revisit land use theories and to rethink contemporary commodity frontiers.

Session Organizers: Dilini Abeygunawardane, Angela Kronenburg Garcia, Mairon Bastos Lima, Sara Sippel
Keywords: farmland investments, investment decisions, commodity frontiers, farmland assetization, development financiers, impact investments

208R The water-energy-food nexus: progress and prospects

Over the past decade, international research and policy circles have been increasingly recognizing the need for more integrated research, planning and management of water, energy and food systems to address the interconnected risks to water, energy, and food security. In response, the water-energy-food nexus concept highlights the interactions between these systems and provides insight into the cross-sectoral implications of single-sector strategies. The need to manage resources in an integrated way has never been as urgent as today. Growing pressures on natural resources are making the interdependencies and trade-offs between food, water and energy systems, and their interactions with land, climate change and livelihoods, increasingly evident. Understanding their interplay is essential to effectively addressing sustainability challenges. Furthermore, managing food, water and energy systems is key to achieving the Sustainable Development Goals and requires a better understanding of the interactions between the Goals, both at and across different scales. Providing decision-makers with the multifaceted knowledge needed to seize all opportunities to enhance synergies and minimize trade-offs is, therefore, a major objective for sustainability science. This session will feature theoretical and empirical work aimed at better understanding the role of land as the nexus of water, energy and food.

This session is organized by GLP's North America Nodal Office.

Session Organizer: Bill McConnell
Keywords: water, energy, food, nexus

209R Agricultural land abandonment in the teleconnected world

Agricultural land abandonment globally is a widespread land-use change process, but not sufficiently studied like other land-use change processes, such as deforestation. As a result, there has been little progress in understanding patterns, drivers, and consequences of land abandonment, particularly outside Europe. Our session seeks to highlight important advances in our understanding the drivers of agricultural land abandonment stretching from neoclassical to behavioral economics over to political and social science perspectives. The session is a platform for studies that carefully disentangle the effect of land-use legacies, trigger events (e.g., political shocks), telecoupled land-use systems, including rural-urban transformation, deagrarization of landscapes and economies. We expect the presenting of studies

on implications of land abandonment to food security, human and environmental well-being and socio-ecological interactions. The session aims to shed light on the interaction of drivers of abandonment across various scales (from household to global level). While we are welcoming studies on remote sensing of patterns of land abandonment, earth science, and land use modeling of land abandonment, such studies should be presented in an integrative manner to address the topic of the session and the broader audience of the conference. The session is linked with Land MDPI special issue "Agricultural Land Abandonment: Patterns, Drivers, and Consequences" (http://www.mdpi.com/journal/land/special_issues/land_abandonment). Presenters will be encouraged to submit their works to the special issue.

Session Organizers: Alexander Prishchepov, Florian Schierhorn, Fabian Löw and Matthias Bürgi
Keywords: abandonment, telecoupling, drivers

210R Mountain futures: Innovative potentials and the trade-offs between food security, climate change mitigation, and biodiversity conservation in the global highlands?

Although there has been some recognition of the significant environmental and social implications of predicted climate change impacts on mountains and mountain communities across the world, little specific attention has been devoted to identifying, understanding, and further developing innovative and mountain-specific approaches for and by mountain communities. Faced with a rapidly changing biophysical and socio-economic environment, mountain communities urgently require innovative approaches and positive opportunities to meet the challenges of climate change and sustainable development.

There are persuasive reasons for taking a special look at mountains and the challenges they face in the coming decades. Mountains cover almost a quarter of the earth's surface. Both urban and rural areas depend on mountains for essential ecosystem services such as fresh water, crops and high-value products. Mountain landscapes are storehouses of natural and cultural diversity; they are on the front lines of global change and can provide insights and solutions to global problems. Mountains offer an escape from the uniformity and monocultures of modern life in the form of an alternative model of development: one that draws on the ingenuity and traditional knowledge of mountain peoples. This means taking proper account of ecological and cultural value; combining ancient wisdom with modern science; building equitable and just governance systems, and respecting the rights and intellectual property of mountain peoples. There is a need to unlock the potential of mountains as pathways to a better future. But doing this requires innovative mechanisms that can co-develop innovative solutions to provide a sustainable future for mountain landscapes and their people.

This session will explore both the unique socio-economic and ecological challenges mountain communities face, and seeks to highlight innovative approaches for facilitating adaptation. New models and mountain-specific solutions, as well as new technologies to benefit mountain farming communities are urgently required to achieve sustainability and prosperity for mountain communities all across the world.

This session is sponsored by the GLP Working Group on Land Systems for Mountain Futures

Session Organizers: Robert Zomer and Jianchu Xu
Keywords: mountains, communities, biodiversity, climate change

211R Advances in land monitoring for sustainable development

This session will explore the state-of-the-art in land monitoring, focusing on the use of freely available, global remote sensing data which can underpin land use assessments and contribute to solving pressing questions in the land use sector. The Paris Climate Agreement recognizes the importance of reducing emissions from deforestation and forest degradation, through the REDD+ results-based payments mechanism. Monitoring of forest cover and forest parameters (such as biomass) is an essential component. At the same time, increasing agricultural production is key in

reaching the zero hunger SDG target, and, as well as increasing production (on existing agricultural land), area of land under agriculture is also expanding. Some monitoring needs related to agricultural land area and forest area can be potentially addressed by land cover change maps, which can provide information on for example conversions from forest to agriculture.

This constantly evolving field (in terms of stakeholder demands, and available data from upcoming space missions and technology) calls for an expert-driven platform where researchers and other stakeholders can share knowledge, and work together to develop best-practices for land monitoring. GOFC-GOLD (Global Observation for Forest Cover and Land Dynamics) is currently supporting advances in the field and is developing guidance to overcome challenges including improving monitoring using interpretation of high-resolution satellite data for land cover (change) mapping and validation. Accurate, transparent and reproducible methods and results are required for monitoring purposes, and to enable decision makers (including forest managers, private sector, civil society and government agencies) to identify, plan and develop priority interventions and policies. This can also identify opportunities to reduce trade-offs from competing land-uses and to increase synergies, to achieve climate-smart land use.

Session Organizers: Martin Herold, Patrick Hostert, Sarah Carter, and Nicki De Sy
Keywords: forest monitoring, biomass, land use change, remote sensing, deforestation

212R Landscape ecological and social-ecological approaches in agro-ecological systems

A sound agro-ecological system is defined by how it sustains human beings with food crops, raw materials for fibers, fuels, and medicines as well as how it more broadly protects soil fertility, conserves water and soils, sequesters carbon, mitigates climate changes, and harbors wild species in its invaluable habitats. Various environmental impacts aggregate into an already complex and precarious condition, in which the agricultural landscape and habitats are fragmented by multi-sourced stressors. The excessive use of chemical fertilizers or herbicides in conventional farming practices leads to polluted water, soil, and agricultural products, a deteriorated ecological system, and affected human health. The issues that ensue not only affect farmers' livelihoods, but also rural area eco- and social systems—ultimately posing imminent threats to the agricultural environment by deteriorating ecological systems. Thus, eco-friendly, agro-ecological farming (i.e., organic farming), is one way to reduce the impacts of farming methods that may damage agro-ecological systems.

This session aims to explore all possible influences of land fragmentation, conventional farming, and organic farming on ecological system services and functions in order to shed light on pivotal issues, and move towards sustainability that generates not only environmental but also socio-economic benefits. Target topics within the scope of this session not only include the impacts of farmland fragmentation on agricultural environments and habitats but also micro climate changes, changes in hydrology, rural area water quality, and the relationship between paddy field pests, beneficial insects, and insect food chains. Additionally, stakeholder viewpoints and intentions play important roles in the sustainability of rural area agricultural environments. Thus, in this session, we will also discuss findings of a qualitative interview of stakeholders, the propagation of sustainable agriculture, the Satoyama Initiative, and policies pertaining to this theme.

Session Organizers: Yu-Pin Lin, Li-Pei Peng, Wan-Yu Lien, Kuo-Tsang Huang, and MeLinda Fan
Keywords: landscape ecology, social-ecological system, organic farming, eco-agriculture

213R Land tenure (security) and land use (change)

Land tenure form and security are key determinants of land use (change) and land governance. Land tenure security is on the agenda of international organizations and global initiatives, such as the Sustainable Development Goals, the Paris Climate Agreement, and REDD+. Yet, the underlying links between land tenure and land use (change) are still poorly understood. The widespread lack of area-wide tenure data constrains landscape-scale analyses and integration in remote sensing studies of land use (change) in many parts of the world. Case studies are therefore crucial to help

uncover the influence of site-specific social, economic, cultural, and political factors, institutions, and historical trajectories. However, site-specific features also imply heterogeneous causal links between land tenure and land use and constrain generalisations. Further, in many areas, often including those with the most dynamic land use changes, land tenure tends to be messy, insecure, or contested, often with discrepancies between de jure and de facto tenure and a large variety of not easily classifiable forms of land and resource access and control, which are continuously renegotiated in some cases. The links between these diverse and, in some areas, continuously emerging or abruptly changing tenure arrangements and land use are multifaceted and challenging to systematically analyse. Yet, these links have been the subject of increasing research interest over the past years. Our session aims to bring together some of this research on the varied links of tenure form, tenure (in)security, tenure contestations, and tenure changes and renegotiations with land use (change). We welcome empirical case studies, broader-scale and meta-analyses, conceptual contributions, as well as governance analyses.

Session Organizers: Martin Lukas and Brian Robinson
Keywords: land tenure, tenure security, tenure contestation, land use, land use change

214R Governance structures and competing narratives: how do multiple actors influence public policies on land?

The purpose of this session is to analyze diverse environmental and land policies related to sustainable forest management and 'land users' rights by considering, on the one hand, the environmental governance process and, on the other hand, narratives on land use and land users' rights adopted by the actors involved. Stakeholders' discourses and policy-making have important connections and divergences. How do different actors influence public policies processes through appropriation of narratives and shaping of specific discourses? In which step of the policy process are these practices the most effective? Some actors might hence have important influence on specific stages of the policy process (e.g. agenda-setting) but might be powerless in other stage (e.g. implementation), which could explain the relative gap between norms and their application in the field.

This session aims to explore how global narratives centered in the 'community', 'good governance', 'rights' and 'environmental sustainability' are experienced and appropriated from diverse social actors' points of views by exploring policy process and stakeholders' discourses on land use change, sustainable forest management and land users' rights. Across the globe, the complex tenure regimes of land users' rights and fragile economic situation leave rural communities severely exposed to the risk of land and resources appropriation. This session focuses especially on territories in dispute, where there are complex power relations and contrasting visions about land-use systems, ideas of development, and representations of social space.

An important case study is the Chaco region, which has gained relevance as a result of a convergence of interrelated factors: the advance of the agricultural frontier; increased importance of environmental policy especially Forest law; governmental and non-governmental policies on local communities' land rights. For some local social actors, fragile land-tenure rights could potentially accelerate deforestation and degradation of the environment. On the other hand, indigenous and criollos organizations use the attention derived from environmental issues to increase their visibility and to assert their land rights. The forest, the environment and water are concepts through which local actors try to channel their own interests and projects.

We are interested in multiple contributions addressing the complexity of the issues raised such as policy networks perspective, discourse analysis, organization decision making theory and anthropological perspective.

In particular, we are interested in contributions that tackle the following research questions:

- How do land users relate to land in economic and political terms?
- How diverse environmental and development policies relate to land conflicts or precarious land tenure and to sustainable forest management?

- What is the land project and policy 'solutions' proposed?
- How and under which conditions do environmental governance policies facilitate or hinder land rights of local communities and sustainable forest management?
- What kind of spatial representations produce public policies (land, forest and agricultural production) and how does these representations confront with land users' visions?

Session Organizers: Carla Inguaggiato, Natalia Biraben, Walter Mioni, and Maurice Tschopp
Keywords: environmental governance, policy networks, sustainable forest management, land representations, land rights

215R Forest restoration in complex landscapes

Interest in ecological restoration has been accelerating globally as a means to increase ecological integrity, mitigate and adapt to climate change, and enhance a range of ecosystem services. But the achievement of these restoration goals, especially in complex human-dominated landscapes and regions with high levels of poverty, will require an integrated restoration agenda that supports both ecological integrity and socio-economic development, whilst grappling with continued land-use pressures and climate change. Restoring ecosystems in a way that meets multiple and potentially conflicting goals, however, is challenging. It requires a fundamental understanding of ecosystem dynamics and how biodiversity and ecosystem function recover in response to restoration. It also requires a better understanding of trade-offs between conflicting goals, between ecosystem services, between stakeholder preferences, and analysis of how and where multiple goals can best be combined. It requires better multi-criteria planning approaches that work at multiple scales and involve a range of stakeholders.

In this session, we address restoration in complex landscapes, including trade-offs and synergies between competing goals, conceptual frameworks and planning tools for implementing landscape-scale restoration, and integrated approaches to restoration for long-term success.

Session Organizers: Jeanine Rhemtulla and D. Gabriela Barragan
Keywords: Forest restoration, social-ecological systems, complex landscapes, trade-offs, ecosystem services"

216R Equity and justice in telecoupled land systems: evaluative and transformative perspectives

Through globalization, geographically distant land systems are increasingly tied together. The notion of telecoupling has been proposed to assess these distant ties, putting emphasis on the flows of matter, species, people, money and information that connect systems. Recent advances on the governance of telecoupled systems have shown that land systems can also be shaped by human decisions taken far away from their direct impacts, for example through transnational acquisitions of land, transnational value chains and the implementation of transnational conservation initiatives. These decisions generate costs and benefits that are unequally distributed among distant and local actors, raising equity concerns. In parallel, recent research around the concept of environmental justice has sought to address equity beyond strictly distributive approaches and integrate other aspects such as procedural justice, social recognition, and non-human justice subjects. These developments have the potential to understand better the power relationships at work in distantly tied systems, which ultimately lead to more or less equitable outcomes in social-ecological terms

This session will have the objective to explore and discuss conceptual and empirical contributions on how to assess and evaluate equity issues in distantly connected land systems, and how to transform these systems to make them more equitable in both social and ecological terms.

In particular, we are interested in contributions that advance understanding of:

1. the governance mechanisms that lead to specific (in)equitable outcomes in distantly tied land systems

2. the role of distance in shaping power relationships between actors and in leading to multi-dimensional equity outcomes
3. the spheres of actions that different actors mobilize in their equity and justice claims
4. the characterization and evaluation of social-ecological systems in terms of equity and justice involving a broad array of subjects

Session Organizers: Sébastien Boillat, Chinwe Ifejika Speranza, Jorge Llopis, and Desiree Daniel
Keywords: environmental justice, telecoupling, equity

250N The role of culture in land-use change

Land systems studies commonly assume that land use actors in an area are motivated by rational profit-maximizing behavior. While this has allowed for generalizable explanations and modelling of land-use change, evidence suggests that actors may, in fact, respond differently to similar constraints and opportunities based on their endowments, experience, agency, beliefs, and other characteristics. The diversity of objectives and capabilities possessed by individuals within a community may help explain circumstances where economically driven policy interventions have failed to change land use behaviors. In this session, we propose to examine the role of culture in shaping the behavior of land users and their responses to external stimuli. While regularly mentioned as a contextual factor, culture has not figured very prominently in land systems studies. We wish to use this session to start a conversation among the land system science community on how to better account for the role of this important dimension of human behavior in land-use change research.

We welcome contributions that explore the role of different aspects of culture in land use. We are particularly interested in contributions that approach the following questions:

- What challenges does culture pose to current representations and explanations of the causes and consequences of land-use change?
- How should we approach the role of culture in empirical studies of land-use change and in land-use change modelling?
- What role does culture play in connecting land-use decisions in distant locations?

Abstract submissions are welcome in this innovative and immersive session

Session Organizers: Yann le Polain de Waroux and Rachael Garrett
Keywords: culture, land-use change, theory, decision-making

251N Exploring land change dynamics across the Mediterranean for meeting the needs and value the priorities of people

In this session, we will analyze current land change dynamics across the Mediterranean Basin –a region of stark social and ecological contrasts and a global biodiversity hotspot. Covering different scales, modeling approaches and countries, we aim for a better understanding of the relationships between landscape dynamics and ecosystem services across gradients of land use management in the Mediterranean. We will also explore possibilities to foster the multi-functionality of managed landscapes.

Goals: The overall goal of this session is to stimulate discussion regarding our understanding of the relationships between managed landscapes, people and ecosystem services provision. To this end we aim to bring together an interdisciplinary group of presenters that work across different countries in the Mediterranean (i.e. South Europe, North Africa and the Middle East) and from research institutions and non-profit organizations, to discuss the need of different social-ecological perspectives on the land systems dynamics in the Mediterranean Basin. Within the session, presenters from different parts of the Mediterranean covering land-use science and practice will discuss approaches

for land management strategies that minimize potential conflicts and support synergies between multiple ecosystem services. Specifically, we aim to: i) provide an overview of the variety of approaches to assess land use dynamics; ii) analyze case studies that develop landscape stewardship to mitigate land use conflicts and support synergies in land systems across different scales (from place-based studies to the Pan-Mediterranean level); and iii) identify research gaps and the road ahead to better inform decision-making in sustainable land management in the Mediterranean. Format: Panel presentations with opportunities for audience participation. Presentations of the latest research findings by the speakers and identification of new challenges emerging from the science. Fishbowl conversation. Output/Deliverables: Improved understanding of the dynamics and societal values of Mediterranean land systems that may lead to a joint synthesis paper.

Abstract submissions are welcome in this innovative and immersive session

Session Organizers: Tobias Plieninger, Cristina Quintas-Soriano, Andreas Buerkert, Angeliki Foutri, Thymio Dimopoulos, Ilse R. Geijzendorffer, Thanasis Kizos, Ugo D'Ambrosio, Antonio J. Castro, and Shalimar Sinno
Keywords: land dynamics, interdisciplinarity, Mediterranean basin, MENA countries, sustainability

252N Measuring diverse impacts of agriculture and conservation interventions in tropical forest landscapes: bringing human wellbeing into focus

Landscape transformations at the forest-agricultural nexus in the Global South are a major element of global environmental change. Numerous environment-related interventions have been implemented to influence such change trajectories towards more sustainable outcomes. These include strict conservation and agricultural intensification interventions representing two extremes of land sparing. Various interventions fall in-between these extremes, coupling agricultural investments with measures for forest protection and potentially representing forms of land sharing. While strict conservation strategies have been criticised for failing to incorporate human needs, agricultural intensification interventions have also raised concerns, including over their negative environmental impacts. Thus, coupled strategies that combine increased agricultural returns, with mechanisms for forest protection, have been proposed as preferable options. Yet, win-win outcomes are far from certain. Further, particular dimensions, such as non-material flows from nature to people (including relational values and place-based attachments to the land, locally defined priorities for human well-being or distinct impacts for particular user groups), are often under-explored in conventional impact evaluation approaches. This lack of focus highlights that discussions are needed (1) on the diverse impacts of distinct types of interventions across scales (from national to local), (2) on how they are being evaluated, and (3) about the politics of who decides what to measure. This interactive session will explore these three themes and present cases where the impact of environment-related interventions has been documented, with a particular focus on human wellbeing. The panel and discussion will centre on the forested tropics of the Global South and use interactive presentations that draw on synthesis and empirical research.

The session will comprise two parts, a panel followed by an interactive discussion session that involves the audience. The panel will comprise five speakers, who will give short presentations (five min) on complementary topics, drawing on novel communication approaches that integrate video, audio, and photography. The panel will then take questions from the audience, followed by group discussions. Participants can join one of three groups, each discussing for 25 min one of the three session themes. Each group will feedback their main discussion points to the whole group. The session will end with an overall discussion and panel member responses to key points raised by the three discussion groups.

- Examining diverse impacts across a typology of environment-related intervention strategies at the forest agricultural nexus: insights from Latin America (Rachel Carmenta, University of Cambridge)
- Impact of agricultural intensification on livelihoods, human well-being and conservation (Laura Rasmussen, University of British Columbia)
- Land use and human wellbeing changes in the context of conservation and cash crop booms: case studies from Madagascar (Jorge Llopis, University of Bern)

- Connection with nature among colonist farmers at the Transamazon Highway deforestation frontier highway (Kasia Mokolajczak, Lancaster University)
- Who measures and what counts: thinking about capturing human wellbeing across scales (Judith Schleicher, University of Cambridge)

Abstract submissions are not being accepted for this innovative and immersive session

Session Organizers: Julie Gwendolin Zaehringer, Rachel Carmenta, and Judith Schleicher
Keywords: conservation, agriculture, land use change, impact measurement, human wellbeing

253N Farming of the future –What type of farming systems will be producing sufficient sustainable and nutritious food for everyone in 2050? (NO ABSTRACTS BEING ACCEPTED)

Agriculture is central to human livelihoods, providing food and fuel, playing a crucial role in economic development, and supporting unique cultures worldwide. Yet, agriculture today is not only a leading driver of environmental degradation and a major force driving the Earth System beyond the 'safe-operating space' for humanity –many people also do not have sufficient access to nutritious food. By 2050, models suggest that agricultural production must double in order to provide sufficient calories to feed the changing diets of an expected human population of 9-10 billion. The agricultural intensification and expansion required for such increased production risks to further contribute to climate change, deplete freshwater resources, threaten biodiversity, and degrade soil fertility. Simultaneously, global climate change requires food producers to cope with altered temperatures, water availability, and frequency of extreme weather events. Moreover, we do not only need to ensure physical and economic access to additional calorie production, but also the nutritional and cultural adequacy of this food. Novel and diverse methods of food production will, therefore, be required for sustainable food security, in which all people have consistent access to sufficient food produced with minimal environmental impact.

Global agricultural systems are highly diverse, spanning traditional subsistence farming to technology-dependent agribusiness. This Roundtable discussion aims to assess the potential contribution of different existing and novel farming systems to global sustainable food security. Specifically, a panel consisting of experts with a diversity of backgrounds will be asked to discuss the agronomic, economic, social, and environmental costs and benefits of different farming systems. Panelists will also particularly be encouraged to consider how novel combinations of agricultural systems might support sustainable food production.

Format: We will hold a roundtable discussion with 5 participants. The Roundtable participants will each give a 5-minute speed talks, followed by a roundtable discussion on questions pre-defined by the session chairs, as well as questions raised by the audience.

Roundtable participants:
- Achim Dobermann, Director, Rothamsted Research Centre
- Line Gordon, Director, Stockholm Resilience Centre
- Urs Niggli, Director, Research Institute of Organic Agriculture (FiBL)
- Allison Thomson, Science and Research Director, Field to Market
- Hannah Wittman, Director, Centre for Sustainable Food Systems, University of British Columbia (UBC)

Abstract submissions are not being accepted for this innovative and immersive session

Session Organizers: Verena Seufert, Navin Ramankutty, Achim Dobermann, Line Gordon, Urs Niggli, Allison Thomson, and Hannah Wittman
Keywords: land management, sustainable agriculture, alternative farming systems, sustainable development goals

254N The role of farm and field size for food security, environmental sustainability, and social justice (NO ABSTRACTS BEING ACCEPTED)

Farm size is often assumed to be linked to environmental, economic, and human wellbeing, yet its spatial patterns and socio-environmental characteristics remain weakly understood. It is unclear how much food farms of varying size actually produce in different regions of the world, and how much they contribute to food security. Further, knowledge about the management intensity of farms along size gradients remains unclear. Through case studies suggest an inverse relationship between farm size and productivity, the causes are still debated and not usually assessed for field size gradients. In addition, several scholars suggest that small farms are more socially and environmentally sustainable than large farms, as they disturb less area of natural ecosystems, have more resilient production systems, and maintain intergenerational economic welfare and biodiversity. These claims are rarely quantitatively supported by typically rest on case study evidence. Lastly, as farm size information is usually expensive to collect and prone to bias, field size as a suitable proxy is promising to overcome this limitation. Further, field size is an important element to assess landscape configuration, and to indicate mechanized or monocultural production in agriculture. Yet, there is hardly any empirical knowledge about relationship between farm and field size, particularly for larger spatial extents.

This session will offer input presentations followed by a 45min interactive session on size-related characteristics of agricultural farms and fields worldwide. In this interactive session, the auditorium will be split into small break out groups that discuss questions related to the scale of farming in more depth, focusing on how size in global agriculture relates to environmental impacts, social justice, production and productivity, as well as how it could/should be addressed in policy making. Considering potential different notions of size in agriculture across the world, discussions will also focus on how comparable findings of different world regions actually are. The interactive session will close with short presentations of discussion outcomes by each group to the plenary. The outcomes of this session will be summarized by the organizers in a manuscript (e.g., opinion piece) as a workshop follow-up.

This session will feed into ongoing debates about globalization, land reforms and land grabbing, sustainable agriculture, agricultural transition, and supporting smallholders and welcomes participants who are interested in questions such as: What is the empirical relation between farm and field size? What factors determine the occurrence of larger or smaller farms and fields or their shifts in scale? How much food is produced along farm and field size gradients? Are larger farms and fields managed at higher intensities? Are smaller farms and fields more environmentally friendly? Do larger farms contribute more to food security than smaller farms? Why does scale matter in farming and how this scale of farming can be a useful perspective for policy makers? In how far can size be related to inequity and food insecurity? How do farm and field size link to socio-economic dynamics?

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Christian Levers, Vincent Ricciardi, Jordan Graesser, and Navin Ramankutty
Keywords: farm size, field size, food security, environmental sustainability, social justice

255N Accommodating mutual interests, values and knowledge bases in “Alconia”: Negotiating land-use standards for peripheral frontier regions in the Global South

Ways out of increasingly irreconcilable future scenarios of use of land and natural resources are being hampered by the lack of respectful exchange on goals, values, norms and functions that people assign to land. Each life-world of potential land users possesses experiences, knowledge and future visions that might be complementary. However, involved actors often conflict on mutually excluding political platforms and do not engage in differentiated exchange on issues of land tenure, large-scale land acquisitions, co-production of ecosystem services, food systems, livelihoods, climate change impacts, soil degradation and landscape restoration, human mobility and migration, multifunctional land uses, among others.

Our session simulates a negotiation of land-use standards in a peripheral frontier region in the Global South: "Alconia." Using background information on the natural context, institutional landscape, cultural composition and political system we select workshop-participants with previous experiences in land-use planning to address the following questions:

- What do the different actor-groups want from land and nature?
- What do they want for their children?
- Which standards are non-negotiable?
- Where can synergies and compromises be found?

The session's outcome will be a manifest of land-use standards for similar case study regions, which may serve as an innovative process for future stakeholder interactions. The audience will be involved as advisors of the negotiators.

Abstracts regarding land-use proposals are to be handed in according to the following characters acting as representatives of:

- Local authorities (Council of Mayors/ Kings etc.)
- Extractive industries & agribusiness (palm oil, soy, gas, petrol, gold etc.)
- Federal governmental environmental and/or zoning agency
- Big Farmers Association
- Small Peasants Union
- Indigenous Association
- Environmental NGO
- International Co-operation
- Land Use Scientist (natural and social sciences)

Abstract submissions are welcome in this innovative and immersive session

Session Organizers: Regine Schoenenberg and Anne Cristina de la Vega-Leinert
Keywords: sustainable land management, conflict transformation, extractivism, land-use scenario, stakeholder dialogue"

256N Exploring pathways out of crop booms in Southeast Asia

Within a few decades, intensive monocropping practices replaced traditional upland agriculture based on shifting cultivation, which historically prevailed across Southeast Asia. This dramatic land conversion was in many places associated with deforestation, erosion of soils and biodiversity, pollution from increasing use of chemical inputs that gradually undermined the sustainability of the intensive cropping systems. Within a few years, the initial benefits of no-input production of cash crops on former fallow fields and forests were gone, which made the production less economically attractive for smallholder farmers with low investment capacities and led them to abandon the newly adopted crops. This bust phase appears as an inevitable stage in the crop boom, with associated land degradation and economic losses.

An easy solution for the actors of the sector is often to move the intensive cropping systems to new locations along rapidly advancing pioneer frontiers, where the natural resources are still relatively preserved. Through that displacement process, the same land use dynamics happen repeatedly in different locations across the region. Lessons from previous failures may not help to avoid repeating such 'boom and bust' scenarios again. Once upland farmers have turned their complex landscape mosaics into fields under permanent crops, returning to shifting cultivation systems is not an option anymore. Many are then hoping for a new boom crop to replace the previous one, despite knowing that such alternative crop will not provide any long-term perspective on agricultural intensification.

Based on storytelling presentations (TED talk - like presentations of personal experiences) the session will explore pathways out of crop booms in Southeast Asia. Presenters will show how crop booms changed 'landscapes –livelihood

–social' patterns in their case study site and how related issues can articulate local and global narratives. They may also present their attempts to promote sustainable intensification of agriculture in such dynamic contexts.

Abstract submissions are welcome in this innovative and immersive session.

Session Organizers: Jean-Christophe Castella and Thilde Bech Bruun
Keywords: crop booms, sustainable intensification, learning approaches, Southeast Asia

257N Round table: Spatial justice: state, positions and future challenges

Land use systems and land use governance are strongly influenced by values and norms (Seidl et al. 2012, Davy 2012). In recent years, one important discourse reflects the ethical dimension of justice, in detail about environmental justice and spatial justice (e.g. Basta 2016, Edwards/Reid/Hunter 2015). But up to now a broader discussion about theoretical approaches and conceptual consequences in land use contexts is missing. In a round-table session, current thematic lines of discussion (spatial justice, environmental justice, energy justice) will be briefly introduced by Weith, Köck and Gailing (five minutes each). All three persons are involved in a new project about regional justice and fairness in a German context.

Subsequently three main open questions will be discussed by all participants:

- What does justice in land use and land governance mean? What do people want?
- What are adequate conceptual approaches?
- What are challenges for transformative land use policy and regional development?

We hope for participants and positions from different countries and different contexts. The contributions of the discussion as well as the results will be documented. We expect an intensive discussion about normative goals, regional contextual embeddedness as well as adequate concepts for their operationalization.

Session Organizers: Thomas Weith, Wolfgang Köck, and Ludger Gailing
Keywords: values, norms, land use policy, justice

280T Identifying and assessing hidden links between food systems, land degradation and human mobility to support sustainability transitions (NO ABSTRACTS BEING ACCEPTED)

Land use research is making considerable progress in biophysical and socio-economic approaches facilitating transitions towards sustainable land use. However, in practice progress towards sustainable land management is slow, with recent findings showing that "sustainable intensification" fails to deliver the full socio-environmental benefits it promised. Especially land degradation is still one of the major challenges of developing and transition countries, threatening livelihoods and food production, which is increasingly seen both as the cause and consequence of human migration.

The land science community has identified many biophysical and socio-environmental links between drivers and processes affecting rural land use. This workshop aims at focusing on issues which may have been "forgotten" or under-researched. More precisely, this workshop shall explicitly address (hidden) links between food systems and livelihoods, human mobility and migration and land degradation. By inviting scientists from relevant research topics, and engaging in a collective reflection, we aim to improve our understanding of what do people want from land - and how do they try to get it. The "how" may include transformational, but unknown or underestimated local/regional knowledge, potentially useful as low barrier 1st steps towards sustainability.

Structure & scheme: Topics will each be elaborated in moderated breakout groups. Workshop results will be compiled as recommendations for scientists working in the addressed fields. Options for disseminating workshop results, as in a joint position paper, will be discussed with participants. The workshop also aims to contribute to the identification of

research questions and hypotheses in land system science. 5 min General introduction| 25 min Input statements| 40 min Breakout groups| 15 min Presentation of results and discussion|5 min Synopsis

We strongly encourage interested participants to send comments regarding “hidden links” between food systems and livelihoods, mobility and land degradation to the organizers, thereby supporting focused discussions.

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Joerg A. Priess, Kathleen Hermans, Amare Haileselassie, Cristina A. de la Vega-Leinert
Keywords: driving factor; feedbacks; food systems and livelihoods; migration; land degradation

281T Hands-on-training session on evaluating three-dimensional urban expansion in mega cities in Asia

With rapid development within the Asian region in the last two decades, three-dimensional (3-D) growth has been the main feature of urbanization. However, most previous research has focused only on the planar area (2-D) expansion. It has been noticed lately that planar area expansion is not possible because of certain limitations of the boundary/territory as well as the ratio between green and urban and arable and non-arable areas. Therefore, most megacities in Asia are developing vertically to accommodate rural immigration and population growth. There is a clear knowledge gap in, how the vertical expansion is associated with urbanization and its impact on environmental degradation. Most of the previous policymakers design the policies based on planer expansion because of lack of vertical expansion data in developing countries. Therefore, this training is designed to monitor urban expansion in 3-D. We have developed a training using Python to extract building height information from ALOS- Global Digital Surface Model “ALOS World 3D (AW3D30) data. This training is based on 3D fractal analysis of AW3D30 data as well as we will integrate planar area expansion using Landsat data. As a use-case, we will also demonstrate how 3D urban datasets can be used along with nighttime light datasets to assist in air pollutant emission inventory management. The proposed training will support to implement the United Nations Sustainable Development Goals (SDGs) 11 sustainable cities and communities. It will aim to strengthen the capacity and knowledge of various stakeholders to monitor urban growth more precisely by considering 3-D growth.
This session is organized by the GLP Japan Nodal Office.

Session Organizers: Waturu Takeuchi, Ram Avtar, and Prakar Misra
Keywords: urbanization, mega cities, resilience"

Theme 3: How do we support transformation?

300P How do we support transformation? (POSTER Session) This is the poster session for Question 3. How do we support transformation? New frontiers in studying and governing land systems.

301R Multi-source land imaging for land-cover/land-use change studies: prospects for early career scientists

A synergistic use of spectral data with moderate to high spatial resolution from more than one source is getting momentum due to successful launches under the ESA Sentinel program. Landsat and Sentinel-2 optical data are now used synergistically by many researchers, often combined with Sentinel-1 radar data. Efficient and synergistic use of these sensor data increases the number of observations available for studies. The proposed session aims at bringing together early career scientists (within 5 years from getting their PhD) who work on innovative data-fusion approaches to study LCLUC issues by applying high-to-medium (1-30m) resolution data on various landscapes. On the other hand, social and economic science research plays an important role in land-change science and includes analyses of the impacts of changes in human behavior at various levels on land use, studies of the resultant impacts of land-use change

on society, or how the social and economic aspects of land-use systems adapt to climate change. Novel ideas on synergistic use of data from various sensors, including thermal IR and hyperspectral, to make breakthrough advances to the next level of understanding the LCLUC underpinning science are welcome.

Session Organizer: Garik Gutman
Keywords: data fusion, early career scientists, innovative methods, LCLUC

302R The role of supply-chain initiatives in reducing deforestation

Expansion of commodity production has driven substantial deforestation in recent years. In response to pressure from civil society, lenders, and consumers over the corporate role in this forest loss, many companies that are part of tropical commodity supply chains have made commitments to environmentally friendly sourcing. These pledges often aim to alter land use in production landscapes to eliminate deforestation, protect local rights to land, and/or conserve biodiversity and carbon. Commitments are implemented through a variety of supply chain policies including sustainability certifications, market exclusion mechanisms, supply chain transparency disclosures, and corporate codes of conduct.

Recent research demonstrates that fully implemented supply-chain interventions can have measurable impacts on producer behaviour and deforestation rates within target supply chains. However, these impacts vary widely by commodity and region of implementation and are insufficient to end global deforestation. Impact evaluations of supply chain governance have largely focused on estimating the direct effects of these policies. Questions about the relative effectiveness of different policies, spillovers of impacts from private governance, interactions with government policies, and unintended social consequences of private environmental policies have all been identified as requiring further research. Empirical analyses of implementation mechanisms and direct and indirect effects on land systems are critical for informing corporate supply chain policy design, as well as developing theoretical understanding of non-state market-driven governance.

This session will present the current state of empirical research evaluating the impacts of supply chain governance of land use. The selected empirical evaluations will address questions such as 1) How are supply chain initiatives being designed and implemented? 2) Under what conditions are supply chain governance initiatives effective at meeting their stated goals? 3) What are the unintended consequences of supply chain initiatives on land systems? 4) How does private supply chain governance interact with public policy? The session will highlight the complex policy ecosystems in which zero-deforestation commitments are implemented and how multiple, parallel initiatives influence commitment effectiveness.

Format: Research presentations. This session proposal is designed to complement innovative and immersive session 362N. These two sessions fit with theme 3 of the conference.

Session Organizers: Kimberly Carlson, Rachael Garrett, Robert Heilmayr, Eric Lambin, and Ximena Rueda
Keywords: supply chain, private governance, policy interactions, transparency, company commitments, agricultural intensification

303R Urban land-system synergies and governance using remote sensing, modeling and big data analysis

Worldwide, the urban dwellers are facing unprecedented multi-aspect challenges related to urban land system transformation and governance in order to achieve sustainable targets under climate change conditions. With the advent of remote sensing, process-based models and big data analysis, spatially explicit and fine-scale information will provide an important knowledge for urban land system transformation and governance. How to combine different source of information from remote sensing, process-based modeling, big data, and how to find synergies among multiples factors (i.e., urban function zones, land use/land cover, heat island, and so on) are becoming cutting-edge

issues in order to study fine-scale and multi-element detection and analysis of urban land system to be used for urban governance and management. With the development of remote sensing, modeling and big data technologies as well as the improvement of mapping algorithms, a set of products such as impervious surface area at national and global scales, surface radiation and heat fluxes, surface and canyon heat island, and surface runoff in urbanized areas with higher spatial and temporal resolutions have been developed to fill this gap.

This session expects to provide an opportunity for urban land-system synergies and governance with remote sensing, modelling and big data integration. We welcome any studies related to the application of remote sensing, modelling and big data in the urban field. This session will share the latest advances in how urban government and management are using remote sensing, modelling and big data analysis and products to respond to climate change, capturing perspectives from cities around the world.

Potential topics may include the following:

1. Data integration or fusion methods from remote sensing, process-based modeling, or big data
2. High-spatial resolution mapping of urban land cover/land use (i.e., impervious surface, green space) at global or nation scale
3. Spatial mapping and exploratory analysis on urban heat island, urban hydrological process, and other ecological factors.
4. Knowledge mining or discovery from available fine-scale spatially-explicit information for urban governance

This session is supported by the GLP Beijing Nodal Office.

Session Organizers: Dengsheng Lu, Wenhui Kuang, Rafiq Hamdi, Jian Peng, Qingxu Huang, Guoming Du, and Jinwei Dong
Keywords: urban land-system, synergies and governance, remote sensing, GIS

304R Transformative adaptation for land systems: ecosystem services in pathways of adaptation to global change

Uncertain, novel changes to social-ecological systems caused by climate change and other drivers mean that we can no longer assume the ecosystems and ecosystem services we currently depend on for livelihoods and wellbeing will be supplied in the future. As ecosystems transform, so does society, driven by changes in ecosystem services and livelihoods. Large-scale land ecosystem governance systems are emerging to address transformative adaptation, but it will increasingly fall to those whose livelihoods are most impacted to develop options for adaptation. To reflect on adaptation options for social-ecological systems, we need to envision possible adaptation pathways, assess how ecosystem services contribute to adaptation in those scenarios, and analyse how decision contexts should be reframed to allow new options for adaptation. Both bottom-up and top-down approaches are required to operationalize adaptation and to conceptualize how ecosystem services can be used for adaptation.

In this session, the objective is to focus on local-regional case studies on the design and implementation of transformative adaptation, with an emphasis on land social-ecological systems. In particular, we will focus on case studies that encompass progression from the conceptual phase to the operational phase to implementation and adoption, with an emphasis on identifying sets of fruitful approaches for methodological development and transfer. These case studies include issues of re-framing of governance structures for ecosystem-based adaptation, knowledge co-production and learning, overcoming operational barriers to ecosystem-based adaptation, and mainstreaming transformative adaptation into policy and management. The objective of the session is congruent with the conference theme of building and enhancing scientific capacity to enable transformations in land systems for a sustainable future.

Session Organizers: Sandra Lavorel, Matt Colloff, and Bruno Locatelli

Keywords: transformation, ecosystem services, adaptation, pathways, social-ecological system

305R Human health outcomes of land use decisions

Land cover and land use play a critical role in many outcomes for human health. Such outcomes include - but are not limited to - exposure to atmospheric pollution from land use-related fires, the spread of infectious diseases from forest cover change, and changes in nutrition from agricultural land use and urbanization. Analyses of health outcomes, which are directly relevant to stakeholders and decision-makers on short timescales, have often fallen outside the purview of land cover and land use science. At the same time, public health often does not include land use as a core component for analyses and recommended actions. The session will focus on case studies and theoretical underpinnings that can foster understanding, collaboration, and action on the land use-health nexus. The session will particularly stress links between health outcomes and land use policy decisions, suggesting alternative land use pathways that can improve public health in a range of geographies.

Session Organizers: Ruth DeFries and Meha Jain
Keywords: human health, air quality, disease, health outcomes

306R Emergent effects in telecoupled systems: challenges and lessons for governing local land-use in a globally connected world

In a globally connected world, drivers of change from distant locations can present challenges for governing local land systems. Economic growth and social change in some regions underlie changes in consumption behavior (e.g., increased meat consumption), driving other countries and regions to produce more than is needed locally to supply international markets and causing increases and changes in the international flow of commodities. Although the effects on land systems are manifested locally, the drivers of change can often seem diffuse and geographically indistinct. Revealing these drivers and making them clearer to local and regional land managers should enable better governance of land transitions and other emergent land-system effects. Thus, to address the challenge of governing local land-use systems under increasing and changing global pressures, studies and methods able to trace and identify expected and unexpected emergent outcomes are needed.

Over just the last five years, the telecoupling framework has been developed to aid investigation and understanding of these multi-scale issues of geographically distant causes and their emergent effects (e.g. introducing concepts such as spillover and cascading effects). This session is an opportunity for researchers to examine the possibility of innovative governance systems by understanding change through the lens of telecoupled systems. Additionally, it provides a forum on cutting-edge methods being applied to study telecoupled systems, including tracing spillover systems and quantification of flows between distant regions. The session thus provides lessons on how to anticipate and govern local land transformations and related emerging effects from multi-scale global drivers of change.

Session Organizers: James Millington, Ramon Silva, and Mateus Batistella
Keywords: telecoupling, globalization, systems, flows, multi-scale

307R Large-scale behavioural models of land use change

The session will explore the development of the next generation of large-scale (global to continental/national scales), land-use models that are based on human behaviour, agency and decision-making processes. The purpose of these models is to explore a wide range of key research (and policy) questions at the nexus of food, ecosystems, water, climate and energy. This will support understanding of adaptation and mitigation processes within the land system as an exemplar of other socio-ecological systems. The session will provide alternatives to the current range of 'top-down' global models.

Since there are many different ways of modelling land use change processes, especially with respect to theories of land-use decision-making, we will explore alternative model realisations of decision processes. This includes new

representations of institutional processes and their relationships with local land users and taking account of telecoupling across a globally (inter-)connected world. The session will also evaluate the coupling of large-scale, land-use models with other models types, such as Dynamic Global Vegetation Models (DGVMs), biodiversity models and/or climate emulators to explore a wide range of environmental change drivers and to evaluate the consequences of these for ecosystem services.

This session is directly relevant to the GLP topic of modelling land system change (section 4.1.4 of the GLP Science Plan), specifically the use of multi-agent models as learning-tools to test alternative conceptualisations of land system dynamics and scenario analysis. The session will also explore the GLP thematic area of telecoupling of land use systems (section 4.2.1 of the GLP Science Plan) and land governance (section 4.2.4 of the GLP Science Plan) through the development and testing of models of institutions (public policy organisations).

Session Organisers: Mark Rounsevell, Peter Verburg, and Calum Brown
Keywords: land use modelling, large-scale, agency, telecoupling, decision-making

308R Mixed-methods approaches to identify and include the peoples' needs in modeling urban spaces and their settings

Cities are the places where the majority of people worldwide lives and there is no sign that this trend will abate. Thus, cities represent their dominant 'habitat' for humans on the planet. Assessing peoples' needs in cities requires taking into account numerous variables to illustrate their specific local and regional embeddedness in the respective urban land system.

The needs and underlying motivations of urban dwellers of different gender, age, family status and socio-cultural origin lead to very specific individual choices and subsequent actions that determine the change of land use on a plot or the individual or household movement to another area which, in turn, significantly change the cities' structure, land use and related processes. Prominent distributions and structural patterns in cities result from processes such as segregation, suburbanization, or reurbanization. These processes have been studied in terms of their underlying drivers and motivations for quite some time however a land-change-impact related systematic comparison of the spatial outcomes is still missing. The aim of this session is, consequently, to discuss mixed-methods-approaches that combine qualitative approaches (e.g. focus groups, qualitative or narrative interviews) with spatially explicit quantitative approaches (e.g. agent-based modeling, cluster analyses, machine learning) to study a) the ongoing processes of urban land change driven by individual and household decision-making and b) likely future developments. We particularly invite young scientists to present and discuss their case studies and analysis approaches.

Session Organizers: Tobia Lakes, Dagmar Haase, Hannah Haacke, Sebastian Scheuer, and Chao Xu
Keywords: mixed methods, modeling, scenarios, urban systems, spatially explicit

309R Assessing and evaluating the impact of the consumption of land-based products on biodiversity and ecosystem services

In land systems, biodiversity is key to the maintenance of ecosystem functions, which in turn underpin the supply ecosystem services harnessed by human societies. While agricultural and forestry activities are essential for human survival and well-being, they are also one of the major drivers of global biodiversity loss and ecosystem degradation. Ultimately, the consumption of land-based products is the main force behind the demand for land and the intensity of land use. Increasing globalization and industrialization is telecoupling consumption in one place to production in remote regions. To devise land-use strategies that address both production and conservation targets, proper accounting tools that link consumption activities to their biodiversity impacts are essential. Main challenges in establishing such accounting tools include: quantifying different dimensions of biodiversity and its temporal trends at large scales; the attribution of these trends to individual land-based products and land-use processes; and the disentangling of complex international supply chains. These peculiarities are the main culprits why the development of

consumption-based tools for biodiversity and ecosystem services lags behind recent advances in accounting of other environmental pressures and impacts. In this session, we bring to together researchers at the forefront of consumption-based accounting of biodiversity and ecosystem services. Recent developments will be discussed, highlighting the potential, robustness and limitations of different approaches. The potential of consumption-based accounting to contributing to an alignment of production and conservation targets in land systems and to minimize trade-offs between the two will be critically explored.

Session Organizers: Thomas Kastner and Alexandra Marques
Keywords: consumption-based accounting, ecosystem services, biodiversity, consumption drivers

310R Landscape performance assessment as a method of knowledge co-production and framing equitable future pathways

Global challenges are often tackled at a landscape scale. The landscape is a unit in which interacting social, economic and ecological processes are more tangible and manageable. Landscape scale management initiatives can be designed to meet a variety of objectives including mitigating climate change, improving a regional economy, managing biodiversity as well as improving the well-being of the people in the landscape. Hence, these landscape initiatives can be the cornerstone of strategies to achieve the SDGs. However, given these complex set of objectives, assessing a landscape's performance broadly can be difficult.

The development of co-produced knowledge on landscape performance can be a challenge because of the variety of different, and often contradictory, perspectives among stakeholders. In addition to the underlying challenge of defining good landscape performance, the variety of audiences for landscape scale indicators can complicate assessment efforts. Governments and donors often look for indicators that are simple to define and communicate. Scientists look for rigor. Meanwhile, leaders of integrated landscape management (ILM) initiatives are often most interested in tracking a variety of landscape elements at once, while understanding interactions.

As ILM is based on principles of adaptive management, input-output indicators are only partly capable of capturing the added-value of ILM. Therefore, the ILM leaders recommend a combination of quantitative and qualitative measures to grasp landscape performance. This can potentially start by an evaluation of the quality of the ILM process itself. We propose this session to expand land system science by addressing three questions that are part of ongoing discussions in science, but also among scientists and practitioners. (1) How can outcomes of ILM initiatives and the quality of their process by monitored and evaluated? (2) How can landscapes' performance itself be monitored and evaluated? (3) How do these efforts lead to an increased co-production of knowledge and better outcomes for the landscape, its stakeholders and to more equitable future pathways?

For this session, we seek contributions that put the described challenges into a clear conceptual frame and/or show and discuss sound monitoring and evaluation schemes for landscape approaches. These might be in a conceptual phase or under implementation. They should show the attempt of crossing sectors and scales and taking into account the iterative characteristics of landscape approaches.

Session Organizers: Enrico Celio and Sara Scherr
Keywords: integrated landscape management, co-production of knowledge, landscape performance

311R Dynamics and governance of emerging and active commodity frontiers in tropics

Commodity frontiers are areas where the production of market-oriented agriculture and forestry expands rapidly over natural areas or subsistence-oriented land uses, often resulting in profound environmental and socio-economic impacts. These frontiers have been conceptualized as areas with an imbalance between abundant land and natural resources on the one hand, and comparatively scarce labor and capital to exploit these resources on the other. Commodity frontiers are also transition places, where processes of encounter between distinct modes of production

and cultures take place, and where conflicts between land-use actors play out particularly heavily. Today, many active and emerging agricultural frontiers are found in the tropics, where some of the last remaining undeveloped land reserves occur, but where environmental and social costs of frontier expansion are typically stark.

This session will focus on emerging and active land-use frontiers in tropical regions. It will explore the patterns and causes of land-use and land-cover changes, linkages of these land trends with distant regions of production and consumption, the determinants of decision making of land-use agents, and conditions for transformative governance and land-use planning. We welcome contributions that address questions such as: Where are the emerging and the most dynamic active land use frontiers fuelled by commodities with rising demand? What are the rates, patterns, causes, and impacts of land system changes in these frontiers? How do local and distal agents make decisions, form coalitions, and mobilize to open up and shape new frontiers? How does the concept of frontiers help our understanding of land system dynamics? How do territorial policies such as land-use planning and land-use zoning function in rapidly changing frontiers? How do policy instruments interact with new forms of commodities supply-chain governance? How to improve pro-active governance of emerging frontiers towards more sustainable land systems?

Session Organizers: Ignacio Gasparri, Patrick Meyfroidt, and Tobias Kuemmerle
Keywords: telecouplings, land systems, policies, decision making, actors

313R Social metabolism and land-system science: stocks, flows, services, and implications for sustainability transformations

Interrelations between socioecological flows of energy or materials and land systems have been on the agenda of land-system science for at least two decades. Obvious examples are biomass-based products such as food or bioenergy, as well as land-use intensity indicators such as the human appropriation of net primary production (HANPP), which assess socioeconomic and ecological flows of biomass or nutrients. Other aspects of social metabolism, e.g. the use of minerals or metals and their accumulation in long-lived material stocks (e.g., in buildings or infrastructures) have received less attention, perhaps due to their relatively minor direct land area demand.

New socio-metabolic research suggests that the accumulation of material stocks is of key importance. The fraction of all materials used worldwide to build up stocks has grown from ‚Äì20% to >50% in the last century. Stocks create legacies and lock-in effects, as infrastructures enable or incentivize certain, often resource-intensive behaviors. Large flows of energy and materials are required for maintaining and using stocks. Transforming social metabolism towards more sustainable patterns of resource use will require far-reaching changes in society's material stock patterns. A focus on material stocks holds great promise for land-system science because stocks are characterized by their location and spatial patterns, both of which are important in terms of their impacts, and in terms of their resource requirements. For example, transport energy demand strongly depends on the spatial patterns of settlements and workspaces, and the transport infrastructures through which they are linked.

This session will explore the links between material stocks, biophysical flows of materials and energy, and the services specific stock-flow combinations deliver to society. It will discuss their potential to forge new approaches in land-system science, e.g. through high-resolution mapping of material stocks, and cast new perspectives on long-standing discourses such as urban-hinterland relations or the role of infrastructure development for land-system change. Moreover, possible pathways towards more sustainable stock-flow-service relations and their implications for land systems will be in focus.

Session Organizers: Helmut Haberl, Fridolin Krausmann, Felix Creutzig, Patrick Hostert, and Christoph Görg
Keywords: social metabolism, urban areas, infrastructure, socio-ecological transformation, sustainability transformation

314R Forest transitions and the resurgence of tree cover in the Global South

Mather (1990) described large-scale forest regrowth, reforestation, and afforestation as the 'forest transition', a trajectory of change where initial forest loss is followed by recovery as a country undergoes social and economic changes. Hecht (2010) criticized prevailing forest-transition models for failing to examine the effect of globalization on forest cover, suggesting that the globalization of labor, discourses, knowledge, capital and new emergent markets provide a better optic for understanding the complexity of forest recoveries and that forest-transition theory does not currently capture these forces.

This session will explore forest transition and the resurgence of forest and tree cover in the Global South. It is important to distinguish between changes in tree cover and 'natural forest' because the loss of natural forest may go unnoticed if plantation forests displace natural forests in the course of forest transition. Scholars have hypothesized a number of factors as affecting tree cover [i.e., such as an active community forest management program (Nepal) or engagement in the global labor market, a key link in the deagrarianization process (the Philippines)]. The concurrent impact of community forestry programs and the delinking of household livelihood and land resources (both agriculture and forest) would presumably result in better extent and quality of forest and tree cover due to a changing agricultural landscape. This session invites seek papers addressing such issues of forest transitions and tree plantations, telecoupling, REDD, and forest definitions from across the Global South.

Session Organizers: Jefferson Fox and Kaspar Hurni
Keywords: forest transition, tree plantations, telecoupling, REDD, forest definitions"

315R The role of policy and planning in urban land change: conceptualizations and evidence

Spatial planning is a holistic process with political, technical and ecological aspects to address the development and design of land use in terms of plan-making as well as plan-implementation in urban regions. It typically engages in a sequence of overlapping steps, i.e. in the analysis of regional context and local situation, evaluation of potential alternatives, deliberation and negotiation of plans and concepts, and ongoing monitoring and evaluation of plan implementation to foster adaptive solutions. Thus, policy and planning is in a prime position to support transformations that mutually reinforce global sustainability visions and goals, and people's aspirations and needs. However, there is potential to better link the knowledge fields of urban and regional planning with land change science.

The objective of this session is to assemble talks that present and discuss novel conceptual and empirical contributions that address the role of policy and planning in urban land change. We encourage papers that assess the transformative capacity of governance processes, examine the content of policy and plans as expressions of envisioned transformations; investigate methods to efficiently collect data to describe and quantify plan implementation processes and outcomes, and address land functions, multifunctionality, density of use and other aspects crucial for understanding urban land change.

The session seeks to link researchers in this emerging theme from around the globe and encourage exchange and inspire future cooperation in order to stimulate scientific advancement in terms of understanding land system change related to urban regions.

Session Organizers: Anna Hersperger and Stefan Siedentop
Keywords: urban land use, built-up land, urban land expansion, spatial planning, territorial governace

316R High resolution remote sensing for understanding dynamics of forest and grassland systems

The rapid advancement of remote sensing technologies and increasing availability of open access data provides many opportunities to better understand land system transformations at a range of spatial and temporal scales and extents. In recent years satellite missions providing worldwide high spatial (<1-20m) and high temporal (up to daily) resolution have been launched, such as Worldview4, Sentinel-2, PlanetLabs CubeSats, etc. Some of these missions (e.g. the

Copernicus's Sentinel missions) also offer the data free of charge through an open-access portal. In addition, there have been continued advancements in the capture of laser scanning data, and very high resolution (spatial and spectral) aerial and terrestrial data including from unmanned vehicles. These new advances and data sources are considered a game changer for the application of remote sensing data to understand land system transition, management, disturbances and their intensities. The high spatial, spectral and temporal resolution of current remote sensing products allows for precise and continuous modelling and monitoring of landscape function such as phenology, primary productivity, 3D vegetation structure and fragmentation at wide extents. There are now excellent opportunities to gather data remotely in areas which have previously been understudied due to their remote or difficult to access locations. Forest and grassland systems are increasingly subject to transformation processes brought about by forces such as shifting population and climate dynamics, with significant implications for land system function.

This session will focus on forest and grassland systems. The aim is to bring together experts from land systems sciences and remote sensing and focus on recent advances in remote sensing and the specific advantages of high resolution (spectral, spatial, temporal, vertical) data for understanding land system transformation and its consequences in multi-functional forest and grassland systems.

Session organizers: Bronwyn Price and Christian Ginzler
Keywords: land use intensity, spectral resolution, temporal resolution, spatial resolution, vegetation structure"

317R The role of digitalization in land transformation

Digitalization has been promoted as a sustainability game changer, both as a driver of changing lifestyles and land resource use and a means to open possibilities for transformation towards sustainability goals. Although new Information and Communication Technology (ICT) and Artificial Intelligence have altered the way humans interact with their natural environment, e.g. by changing mobility or people's access to goods and services, digitalization has not been considered a driving factor in studies and models of land-use change and social-ecological systems. However, digital transformation has been shown to generate essential feedback for adaptive resource management in individual case studies, e.g. through the mobilization of citizens, visualization and communication of historical management shortfalls or digital governance. While theoretical discourse about the enormous opportunities and pitfalls of digitalization and big data in promoting sustainability has been launched, the potential to bridge disciplines and foster collaborative large-scale research still needs to be harnessed. In this session, we tackle how land resource management can use this technology to achieve sustainability. We investigate (1) how new digital social networks play a role in triggering and modifying these land-use changes, (2) how the new technology will allow science, engineering and design to generate effective feedback loops of sensing, processing, and learning/adaptive responses –thus creating new development opportunities and innovative linkages between disconnected social networks across sectors and administrative borders, and (3) how digital technologies will influence multi-scale land governance?

Session Organizers: Adrienne Grêt-Regamey, Julie Zaehringer, and Peter Messerli
Keywords: digitalization, blockchain, digital governance, big data, artificial intelligence

318R Uncertainty assessment of land system science products

Land System Science products have gained increasing importance in addressing global environmental issues. In particular, spatially explicit models and maps have a central role in supporting science and policy debates. However, the development and use of models and maps are permeated with uncertainties, most prominently: data uncertainty, inter- and extrapolation uncertainty, model parameter uncertainty, model structural uncertainty. Due to the relevance of models and maps when it comes to debates and decisions regarding land use and its impacts, it is of strategic importance for the scientific community to engage in more open and deeper dialogues about the sources, magnitudes and impacts of uncertainty in such products. These dialogues should address not only advances in uncertainty analysis techniques but also issues of transparency and liability.

To move the uncertainty dialogue in Land System Science forward, we will hold a research presentation session focusing on uncertainty analysis of spatially explicit products and exploring the following questions: (1) What is the state-of-the-art in uncertainty assessment related to spatially explicit products? (2) What are typical uncertainty magnitudes of those products? (3) Are there best practices that should be promoted to increase the transparency of Land System Science? (4) How to develop a strategic communication of scientific uncertainty to peers and to non-academic audiences?

Contributions are invited to the following topics:

- Uncertainty Analysis techniques applied to remote sensing products, GIS, and models for LULC studies and territorial planning
- Problems & Solutions related to sampling, interpolation, and representativeness of spatially explicit (distributed) models and GIS products
- Best Practices in assessing uncertainties in spatially explicit models and GIS products
- The Role of Uncertainty in the quality of scientific products related to LULC and territorial planning and in their use by policy makers and other end-users
- Communicating Uncertainty among academic peers and to non-academic audiences

Session Organizers: Letícia Santos Lima, Tobias Krueger, Letícia Barros Viana Hissa, Ana María Sanchez Cuervo, and Reinhard Prestele
Keywords: uncertainty analysis, environmental models, data representativeness, scale, model structural uncertainty

319R Understanding socio-ecological change and transformation of coastal land in low elevated coastal zones (LECZ)

Low elevated coastal zones (LECZ), which are the contiguous area along the coast with less than 10-meter elevations, is densely populated and economically developed. LECZ is the frontline of climate change, which is exposed to increasing risks of extreme events and sea level rise. The expansion of populations and socioeconomic activities in LECZ has resulted in growing pressure on ecosystems i.e. mangrove, coral reef and seagrass bed. In the meantime, effects of human pressures and interventions on coastal ecosystems are very difficult to separate from the effects of ecological pressures, limiting our understanding of social-environmental systems as well as co-benefits of these systems to global change. the Socio-ecological systems framework provides useful guidance of how to assess human-environmental interactions to increasing coastal resilience. A clearest example of socio-ecological system is the effect of transformation of coastal land use on ecosystem services. Coastal shrimp culture, coastal pollution and tourism infrastructure development, for example, have caused coastal resources and habitats declines while climate change has also driven widespread collapse of coral reef ecosystems. An integrated framework of ecosystem restoration, comprehensive land use planning, and capacity building will give more insight in understanding the relationship between socio-ecological change and transformation of coastal land in LECZ. The aim of this session is to focus on sharing research experiences in socio-ecological system and its impact on land use change, including varieties of decision-support methods and tools that have been emerged to support more spatially explicit trade-off analyze for land transformation and coastal ecosystem services.

Session Organizers: Sathaporn Monprapussorn, Hong Quan Nguyen, and Liu Gaohuan
Keywords: socio-ecological system, land use, low elevated coastal zones (LECZ)

320R Artificial intelligence and machine learning for land use modelling

This session will focus on new applications using artificial intelligence (AI) and machine learning (ML) in land use modeling. Identifying and reducing uncertainties in future land use projections are critical to integrated assessments of climate and social change scenarios. However, uncertainties related to model design and fit-to-data remain substantial. AI has great potential to improve the predictive performance of land use models following breakthroughs in satellite-

based land use classification, social media data analysis, and heterogeneous data mining. However, the application of these techniques in land use modeling is still limited.

On the other hand, we need to think further how LSS and data science can learn from each other. The LSS community has a long history of utilising extremely heterogeneous data and highly-abstracted concepts for modelling complex socio-ecosystems. We are therefore in a good position to share insights and advice with the AI / Big Data communities.

This session aims to bring together land use and land cover researchers and to exchange ideas and experiences on all aspects related to the application of AI and ML methods. Of particular interest is mining of heterogeneous 'big data' sources, such as social media data, camera trap and drone video data, large-scale statistics, and grey literature, all of which can provide information about land use and decision-making process. AI-based methods are used to process multimedia data (e.g., drone video) data for mapping land use and land cover in natural and urban areas. New ML-methods such as deep reinforcement learning can potentially provide a basis for robust calibration of complex land use models by exploring large parameter spaces efficiently. Overall, these established data sources in combination with new AI and ML technologies can open up new perspectives in land use modelling. It is also crucial in the session to have fruitful discussions about how to synthesize the lessons and insights for giving advice back to the AI / Big Data communities, so the learning goes both ways. The session intends to cover a wide range of ML topics related to land use models, including methodologies, technologies, empirical and experimental studies. We welcome submissions of AI and ML papers providing new insights into the future of land use models.

Session Organizers: Bumsuk Seo, Calum Brown, and Donggul Woo
Keywords: artificial intelligence, machine learning, land use modelling, deep learning, land system modelling

321R Land resources conflicts in Sub-Saharan Africa: Which knowledge and governance systems can end the siloed thinking?

The drivers of land resources conflicts keep changing whilst conflicts between a wide range of users are escalating. Land degradation and climate change, urbanisation, increasing population, migration, conflicts induced internal displacement of population, land grabbing and foreign direct investments are confounding conflict dimensions. Access to land for various forms of traditional and indigenous livelihoods that coexisted for centuries are being challenged and changed. Inter-livelihoods that existed on sharing land resources have changed into bloodshed as seen in the case of farmers-herdmen conflicts in many parts of Africa. Other forms of conflicts are seen at the edges and within protected ecosystems where human-wildlife conflicts threaten sustainability. Such conflicts put wedges on the path of implementing sustainable development goals (SDGs) in many sub-Saharan African countries. Unfortunately, policymakers, practitioners, environmental scientists operate in silos and often chase shadows and mirages. The proposed session seeks joint papers from practitioners, scientists, and policymakers that seek to promote interdisciplinary, co-designed and solution-oriented perspectives that may further our understanding of various forms of land conflicts in Africa. Individuals papers that shed light on innovative methodologies for co-creating knowledge and decisionmaking on land conflicts in Africa are welcome. Other papers exploring relevant international best practices on land governance and science may be submitted. Submissions to this session need to emphasise the importance of interdisciplinarity, and innovative governance for transformation to sustainable land use and development in sub-Saharan Africa.

Session Organizers: Aliyu Barau and Suraj Sae'da
Keywords: conflicts, innovation, co-creation, SDGs, governance, transformation

323R Understanding and operationalizing the sustainability concept for guiding urban transformations

As the world continues to be urbanized, sustainable development of the urban area is the vision to balance human livability and ecosystem diversity. The sustainability concept has been reflected in several urban planning initiates and practices worldwide from local up to national level. For instance, 'National New-type Urbanization Plan' was proposed

by the Chinese government in 2014 to shift its urbanization strategy towards a human-centered and sustainable pathway. In the USA, communities at various places have reformulated their comprehensive plans to focus on sustaining places.

The study of sustainable urban transformations is evolving from identifying and visioning possible actions to understanding and operationalizing the sustainability concept for guiding urban transformations for sustainable outcomes. For example, the design of "urban form" from a range of geographical scales (e.g., the spatial pattern of human activities including density and diversity of settlement and transportation structure) is a comprehensive way to operationalize sustainability concept in urban transformations. In this sense, 1) how to qualitatively and quantitively evaluate the sustainable approaches and measure sustainability, and 2) how to assess the role of relevant plan intentions and implementation in sustaining urban transformations, need to be addressed:

- Methods to understand and measure the sustainability in guiding urban transformations, e.g., three-dimensional indicators of sustainability, comprehensive sustainability metrics, etc.
- Tools and models to monitor urban transformations and transforming process, e.g., techniques from remote sensing, GIScience, "Big Data" techniques, etc., to measure the density, diversity, and spatiotemporal pattern of the urban land, simulation models in understanding the transforming urban landscape pattern, the dynamic social-environmental interaction in urban systems.
- Operationalizing practices and cases to evaluate roles of initiatives, planning, policies, etc., in guiding urban transformations, e.g., conformance and effectiveness of plans in terms of sustainable urban forms design, urban green infrastructure, questionnaire and interview for sustainable planning implementation, etc.

Session Organizers: Chunhong Zhao, Xiangzheng Deng, Zhan Wang, and Chen Zeng
Keywords: sustainability, urban transformation, urban forms, urban planning, evaluation and implementation"

324R Geospatial technology for land restoration and planning

Urbanization and industrialization are accelerating worldwide, especially in developing countries. Millions of people depend on agricultural land for their livelihoods. Due to large-scale utilization of land resources, it is degrading and is at high risk. Restoration and protection of land requires involving different stakeholders to co-design solutions that are socially, economically, and environmentally sustainable. Land degradation neutrality implies a balance between degradation processes and restoration activities. Most of the previous scientific research has been devoted to the assessment of land degradation, only limited information is available on the best practices for land restoration. There is a clear knowledge gap to use remote sensing in land ecosystem management and how land managers, practitioners, and policymakers evaluate loss, gain, and change in land-based ecosystems at multiple spatial and temporal scales. There are very few studies that clearly show the use of spatial tools for planning, implementing, and evaluating land ecosystem restoration projects and especially in multifunctional landscape restoration. In this proposed session we would like to welcome papers that incorporate novel and interesting techniques to study land restoration and planning. Priorities include novel techniques for quantifying and analyzing land change with the use of old and new remote sensors. Combining geographical data from multiple spatial, spectral and thematic scales and their spatial patterns are also among priorities. Well-prepared review papers are also welcomed. This session will support to implement United Nations Sustainable Development Goals (SDGs) 11 Sustainable Cities and Communities and 15 Life on Land. This will strengthen the capacity and knowledge of various stakeholders to sustainably manage land resources.

This session is co-organized by GLP's Japan and Taipei Nodal Offices.

Session Organizers: Teiji Watanabe, Ram Avtar, Yu-Pin Lin, and Li-Pei Peng
Keywords: land degradation, land restoration, land planning, remote sensing, land ecosystem management

325R Long-term drivers of land use change in South-East Asia

Southeast Asia is a region of ongoing rapid land transformations. Deforestation, expansion of annual cropping, perennial crop plantations, and aquaculture along the region's coastline has been identified as some of the proximate causes of transformation. Recent empirical examples include the boom (and burst) of rubber plantations, banana, and the introduction of annual cash cropping rapidly substituting subsistence production. Further, a plethora of primarily small-scale studies point to underlying causes of change, e.g. related to changing demographic, economic, or institutional conditions.

However, consistent analyses of country-scale, long-term (+2 decades) changes and their underlying causes are scarce. In this session, we call for presentations of long-term changes and their drivers at the country scale. The main objective of the session will be to identify the political, economic, and technological causes behind 'mega trends' within Southeast Asian countries during the past 30-50 years, with the aim of synthesizing how transitions have swept across the region, which underlying causes have been at play, and which barriers and opportunities each country have faced.

Session Organizers: Martin Jepsen and Thilde Bech Bruun
Keywords: land use change, long-term drivers, Southeast Asia

326R Can decision support tools enhance interventions towards land system transformation?

Land use and management systems are impacted by various environmental, economic and sociocultural factors while providing crucial ecosystem services for humanity. Planners of development interventions rarely have sufficient high-quality data to base their decisions entirely on well-established facts, but are faced with knowledge gaps and uncertainties that remain unaddressed. In consequence, policymakers and other development professionals often find themselves making decisions without meaningful and comprehensive scientific guidance. New approaches and tools are needed to support decisions in land use and management that consider both system complexity and all relevant uncertainties. One possible approach to bridge this gap is Decision Analysis based on Bayesian Network Modelling or other forms of probabilistic modelling, which has been applied in various fields (e.g. public health or computer science) for many years, but is rarely applied in land use decisions.

A major limitation to evidence-based land use decision-making is a lack of accurate screening of land use and management options and failure to involve all relevant stakeholders, from land users to decision-makers, in identifying solutions. Options to be promoted are often chosen by researchers and experts without adequately consulting the target groups. However, studies show that the selection of appropriate land use and management options requires the integration of diverse knowledge, perceptions and judgements of different stakeholders in participatory negotiation and evaluation processes. Tools that guide such processes have proven useful in supporting more inclusive land use decisions.

This session will showcase various decision support tools applied at different levels in the context of land use and land management. Participants will discuss whether and how these approaches can make development interventions more transformative and raise their prospects of having a true impact on livelihoods.

Session Organizers: Eike Ludeling, Keith Shepherd, Cory Whitney, Nicole Harari, Urs Baumgartner, and Isabelle Providoli
Keywords: decision analysis, participatory modeling, probabilistic modeling, ex-ante impact assessment

327R Archetype analysis in sustainability research: meanings, methods, and current applications

Archetype analysis is a powerful approach to reveal recurrent patterns of factors and processes that shape the sustainability of social-ecological systems. Knowledge of archetypical patterns across cases has supported a better understanding of key sustainability challenges related to land use, climate change adaptation, vulnerability, biodiversity, and large-scale land acquisition. The rapid growth and diversification of archetype analyses has generated variations, inconsistencies, and confusion about the meanings, potentials, and limitations of archetype research.

Archetypical patterns are analyzed using diverse qualitative, quantitative, and mixed methods (e.g. cluster analysis, qualitative comparative analysis, meta-analysis of case studies, scenario development). However, a consolidated understanding of the meanings of archetypes in sustainability research, the best practices of archetype analysis and promising combinations of multiple methods are currently a prime frontier of innovation.

This panel, organized by the GLP Working Group on Archetype Analysis, aims at presenting and discussing the current state of consolidating the multiple meanings and diverse methodologies for archetype analysis. The panel also features cutting-edge applications of archetype analysis in land system science. The format is a research presentation session, which involves: one presentation on the multiple meanings and motivations of archetypes and their relevance for evidence-based policy-making; one presentation on methodological options, best practices, and challenges; multiple presentations of cutting-edge applications of archetype analysis; and plenary discussion.

This session is sponsored by the GLP Working Group on Archetype Analysis in Sustainability and Land Governance Research

Session Organizers: Christoph Oberlack, Diana Sietz, and Klaus Eisenack
Keywords: archetypes, methodology, consolidation, applications"

328R Applying scenario tools for sustainable mountain development

In light of the 2030 agenda, having information on how plausible futures of mountain social-ecological systems may look like under different development scenarios is key to enable dialogues and negotiations with multiple actors having claims on mountain resources. Tools such as social-ecological systems modelling and participatory scenario approaches are developed to explore these scenarios and likely outcomes for communities, livelihoods and mountain resources, with the ultimate aim to better project the impact of local to global changes in mountains and help in designing management decisions towards sustainable mountain development. These tools are developed in various disciplines ranging from climate change- and land system- to ecosystem service- and biodiversity sciences, which offers unique opportunities for interdisciplinary collaborations towards sustainable mountain development. By representing these various disciplines, the three conveners of this session - the Mountain Research Initiative (MRI), the Global Land Programme (GLP), and the Global Mountain Biodiversity Assessment (GMBA) - meet the challenge of bringing research communities together to gain a common understanding of possible solutions towards a sustainable future for mountain ecosystems and their inhabitants.

We invite talks presenting mountain scenarios from different mountain regions of the world where modelling tools have been developed based on local needs. We encourage contributions from all segments of the mountain science community, including climate-, land system-, as well as ecosystem- and biodiversity scientists. We will discuss the toolsets and the challenges in applying these tools to the steep social-ecological gradients characteristic of mountains.

Session Organizers: Aino Kulonen, Robert Marchant, Davnah Payne, Andreas Heinimann, Adrienne Grêt-Regamey, Ricardo Grau, and Veerle Vanacker
Keywords: mountains, sustainable development, social-ecological systems, scenario tools"

329R Charting land-use pathways for reconciling tropical forests conservation, biodiversity protection and human well-being improvement in South and Southeast Asia

Tropical forest loss is an ongoing threat to biodiversity. It is also associated with habitat degradation, magnified disturbances and compromised livelihoods. In tropical South and Southeast Asia, the process is driven by land grabs for timber production and agriculture expansion. Despite generating economic growth and development, the unregulated and poorly planned nature of this land-use change has resulted in environmental and social challenges. In this symposium, we aim to bring together researchers who envision different land-use pathways for reconciling tropical forests, biodiversity and human well-being, and who use mixed methods, from spatially explicit land-use modelling to

ethnographic studies, to evaluate the impact of current land-use pathways on any aspect of tropical forests, biodiversity and human well-being. We hope this symposium could also provide a platform for researchers to discuss how to develop future land-use pathways that aim to reduce the impact on tropical forests and biodiversity, and improve human well-being. We would like to focus on South and Southeast Asia, but also open to other tropical regions.

Session Organizers: Janice Lee and Yuchen Zhang
Keywords: Southeast Asia, agriculture, tropical forests, biodiversity conservation, human livelihoods"

331R Land transformations through Food-Land-Energy-Water (FLEW) nexus approaches: lessons learned and key gaps

Over the past 50 years, climate, technology, and land uses have changed so rapidly and profoundly that the systems we rely on for food, energy production, water, and ecosystem services require new approaches to designing resilient landscapes. The food-land-energy-water (FLEW) nexus approach is one of approach being promoted for achieving global sustainability and resilience. Several landscape transformation and scenario-based tools have been developed for different contexts and have resulted in increases in land-use efficiency. There are also emerging issues, such as how to deal with accumulating food processing and agricultural wastes, that affect the integrity of water and land systems. In this session, the aim is to identify and assess the latest developments in achieving food, energy, and water securities and alleviating land degradation. This includes methods and approaches for dealing with conflicting objectives of stakeholders and techniques in co-production of knowledge related to the nexus. Based on the different case studies and methods, this session will compare and synthesize lessons learned and identify remaining key gaps and challenges.

Session Organizers: Grace Villamor and David Griffith
Keywords: food-energy-water nexus, land transformations, tools, methods

332R Land market dynamics and their effects on land use

Demand for land resources is increasing due to population growth, rapid urbanization, more land-demanding diets, the quest for bioenergy, and increasing ambitions to set aside land resources for ecological concerns. At the same time, agricultural land supply decreases due to land degradation, climate change, and water scarcity. As a result, land resources are increasingly scarce, competition for land is escalating, and empirical evidence suggests that land rents have been rapidly rising in many regions. The increase in agricultural land rents, brought about by the rising profit opportunities from farming, has fundamentally changed the structure of agricultural production by incentivizing the entry of new actors and by encouraging higher capital intensity of cultivation. Soaring investments into agriculture contributed to increasing farm and plot sizes, propagated large-scale farm structures, and contributed to higher concentration of land ownership in most middle- and high-income countries. These trends suggest a continuation of the “farm size transition” that has been observed in the past during the course of economic development.

In this session, we aim to take stock of the growing competition for land resources. We invite contributions that analyze land market developments and land reforms, and their impacts on land use. Specifically, we call for research that associates the rising land rent and farmland prices with the extent and structure of land use and of land-use intensity, or that assesses the repercussions of rising land prices for social, economic, and environmental outcomes. Contributions may pursue diverse methodological approaches, including analyses of retrospective dynamics or simulations of alternative futures, qualitative elicitations as well as quantitative, spatially explicit analyses of land-market dynamics. Combined, the session contributions should advance the understanding of the interrelationships between changes in land prices and land use, which can help guide decision-makers in the conception of appropriate planning and regulation mechanisms.

Session Organizers: Jaime García Márquez, Tobia Lakes, and Daniel Müller
Keywords: land market, land rent, agricultural production, land competition, farm-size transition

333R Mapping land system through coupling the biophysical and socioeconomic attributes based on remote sensing and big data approaches

Addressing the social-economic characteristics of land systems, besides biophysical attributes of land cover, is key to understand land system transformations in response to global changes. We have struggled for years to recognize the biophysical change of land systems using the remote sensing technology as well as the mapping algorithms. With the increasing availability of multi-sensor, multi-resolution, multi-temporal remote sensing images, accompanied by the boom of the crowd-sourced photos, social media data, and POI datasets, we can access to more information not only for land cover but also for land use, not only for land use but also for land management, and to understand the continuous process of land use changes instead of

This session will to provide an opportunity for the community to exchange the new progress in picturing the biophysical and social-economic aspects of land systems and tracking the process of land system transformations and changes using remote sensing and big data. We welcome any studies related to the application of remote sensing and big data for the analysis of land system sciences and specific case studies in different regions of the world.

This session is sponsored by the new GLP Working Group on "New Contributions of Remote Sensing to Land System Science in the Big Data Era"

Session Organizers: Jinwei Dong, Patrick Hostert, Graciela Metternicht and Le Yu
Keywords: remote sensing, mapping, land cover, land use, Anthropocene

350N Social-ecological outcomes of shifting cultivation in transition (NO ABSTRACTS BEING ACCEPTED)

Early research on shifting cultivation provided intricate analyses of how these systems function whereas more recent research increasingly focus on how rapid land use transitions in current and former shifting cultivation areas affect people and environment. While being a farming practice that is in decline or in a functional transition in some areas, it persists or increases elsewhere. Its impact –and especially the impacts of transitions to other land uses –on ecosystem services such as greenhouse gas emissions and sequestration, biodiversity conservation, land degradation and water resources management are increasingly debated in the literature and of concern to international environmental agreements such as UNFCCC and CBD. Simultaneously development actors are concerned with linkages between shifting cultivation and human well-being. In most countries, where shifting cultivation is still common, governmental systems remain convinced that shifting cultivation has negative social-ecological impacts, but there is little agreement in the literature on the direction of these impacts. A recent meta-analysis of social-ecological outcomes of land use intensification demonstrated that outcomes vary widely from win-win to lose-lose, with many combinations of win-lose in between (Rasmussen et al. 2018: Social-ecological outcomes of agricultural intensification. Nature Sustainability 1:275-282).

The objective of this session is therefore to outline a future agenda of research on the outcomes of shifting cultivation and transitions to other land uses. Moreover, the session will initiate a GLP Working Group entitled “Social-ecological outcomes of shifting cultivation in transition,” including an outline of activities for the coming 3-4 years.

The format of the session will be four invited flash talks (5 minutes each, max 30 minutes in total with questions) that 1) set the stage for current critical research on shifting cultivation, 2) provide overviews social-ecological research on shifting cultivation in Africa, Asia-Oceania and Latin America. This will be followed by ‘café-style’ small break-out groups of 3-4 session participants who will discuss the shifting cultivation research agenda and the more practical matters on how the working can be organized, including funding of activities. The final part of the session will be a plenary where the ideas for the research agenda and the working group are put together and an action plan developed. Invited participants to the session will be both scientists and as broad a representation from other stakeholders and civil society as possible to allow for co-design of the research agenda.

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Ole Mertz, Andreas Heinimann, and Thilde Bech Bruun
Keywords: forest frontiers, shifting cultivation, land use transitions, impacts, global south

351N Governance of natural heritage in peri-urban open spaces (PUOS)

Research on urban and rural systems and their interactions is well established. However, it is often ignored that both systems have no strict boundaries, but are connected through a transition peri-urban area (PUA), where settlement takes smoothly place and where still natural ecosystems are abundant.

New developments in PUAs encourage the process of more in-depth analyses of parts of these areas to understand their dynamics and particular contribution to biodiversity and ecosystem services. Particularly, peri-urban open spaces (PUOS) are of high interest as they form places of highest land-use conflicts and pressures from urban sprawl. By "PUOS" we understand non-build-up areas, located within PUAs, whose land use does not belong to the following types: urban fabric, industrial, commercial, military, private and transport units and mine, dump and construction sites.

Control mechanisms against pressures on PUOS are weak because of their transitional character. In many regions, the natural heritage of PUOS is neither conserved, protected, promoted, nor part of everyday planning practice. Therefore, investments in PUOS tend to be unsustainable over time, and do not address well the real capacities of these areas to contribute to biodiversity conservation and ecosystem services provision. Additionally, policy and planning instruments do not address properly the development of PUOS so that informal settlements and degrading of natural ecosystems take place.

The overall objective of this session is the identification of good practices and policy experiences related to the conservation and sustainable development of PUOS. We wish to discuss challenges and opportunities to improve the consideration of PUOS in existing planning instruments. We intend to analyze how planned and unintended development of PUOS are taking place across different world regions and what the implications have been in the past. We intend to explore how future PUOS pattern should be conceived to contribute to a sustainable development.

The proposed format of the session will contain two main parts: (1) a theory-based one, where different scholars will present their contributions; (2) a practice-oriented one, the immersive workshop, where World Café and rich picture formats will be used to identify good practices and policy experiences related to the protection of natural heritage in PUOS.

The symposium intends to publish either a Special Issue or a synthesis paper to the new Springer Journal Social-Ecological Practice Research (SEPR):

Abstract submissions are welcome in this innovative and immersive session.

Session Organizers: Marcin Spyra, Christine Fürst, Wei-Ning Xiang, Wei Wei, Luis Inostroza, Daniele La Rosa, and Janina Kleemann
Keywords: peri-urban areas, governance, natural heritage, planning and policy instruments

352N Capturing and understanding telecoupling in complex land systems

Building a better understanding of how global interconnectivity –or telecouplings –shapes the pressure on land in various places, the spatially distributed trade-offs between different land uses and the implications for social and environmental sustainability is a key challenge and priority area of investigation for Land System Science. In recent years, land system scientists have made analytical and methodological progress in relation to capturing and

understanding the complexity of telecoupling on land systems. Yet, outstanding challenges call for continued collaboration and exchange.

This session brings together leading and upcoming land-use scientists to discuss the methodological and conceptual challenges of capturing and understanding telecouplings in relation to unsustainable land-use practices, as well as opportunities to overcome them. The session is structured as a panel discussion with five invited scholars representing different methodological backgrounds. Each scholar will give a 7min flash-talk from their particular methodological perspective, and this is followed by an interactive discussion with the audience.

This session will launch the new GLP Working Group for Telecoupling Research towards Sustainable Transformation of Land Systems and will set the scene for the next three years of collaborative research on telecoupling within GLP, as well as introduce and discuss the work of the Innovative Training Network COUPLED. Operationalising telecouplings for solving sustainability challenges for land use.

Abstract submissions are welcome in this innovative and immersive session.

Session Organizers: Cecilie Friis, Julie Zähringer, and Jonas Østergaard Nielsen
Keywords: telecoupling, methodological challenges, transformative interventions, sustainability

353N Towards transformative interventions in unsustainable land systems - a science-practice-policy perspective

The pressure on land resources globally is increasing rapidly–to a large extent exacerbated by a number of spatially distributed processes, including population growth, urbanisation, changing consumption patterns, climate change impacts, biodiversity and carbon conservation efforts, as well as economic and cultural globalisation. These social, economic and environmental processes lead to new types of interconnectivity between places around the world, either intentionally when different powerful actors seek new locations to meet their various land demands or as unintended spill-over processes in the form of displacements, leakages or cascade effects of land use decisions made elsewhere. Global interconnectivity –or telecouplings –represent a central challenge for the governance of land systems, and there is an urgent need for tools to better identify leverage points for transformative interventions into unsustainable land-use practices and for the design of novel governance mechanisms.

This session aims to bring together leading and upcoming land-use scientists, policy-makers, nongovernmental organizations and private sector representatives to discuss pathways for transformation of land systems influenced by telecoupling. The format of the session is a roundtable discussion where four representatives from different science, practice and policy perspectives will give a short 5 min input of 3 key points related to the opportunities and challenges for creating transformative science-policy-practice actions into unsustainable land systems influenced by telecoupling. This is followed by a roundtable discussion facilitated by a think-pair-share format to kick-start a general discussion and brainstorm on solutions.

The session is co-organised by the newly established GLP Working Group for Telecoupling Research towards Sustainable Transformation of Land Systems and the Innovative Training Network COUPLED. Operationalising telecouplings for solving sustainability challenges for land use.

Session Organizers: Cecilie Friis, Julie Zähringer, Jonas Østergaard Nielsen, Cornelia Hett, and Kaitlin Mara.
Keywords: sustainability, transformative interventions, leverage points, science-practice-policy collaboration, trade-offs

354N Participatory and evidence-based land use policy making –Insights from the RESTORE+ approach (NO ABSTRACTS BEING ACCEPTED)

This session showcases results of the Restore+ project which aspires to inform land use and restoration policies in Indonesia and Brazil through integrating participatory processes and big earth observation data analysis into land use modelling. Members of the Restore+ team will share their insights and experiences in communicating science to policymakers through presentations and live demonstration of a mobile application. The panel will also include policymakers from the Central African Forests Commission and Indonesia Ministry of Environment and Forestry to facilitate pan-tropical knowledge exchange on evidence-driven policymaking.

Dr Fernando Ramos (INPE) will discuss how Science-to-Policy processes answer current policy questions and trigger future initiatives. Brazilian researchers adapted the GLOBIOM model to accommodate detailed land use dynamics of Brazil. Results from the GLOBIOM-Brazil model successfully informed Brazil's NDC submitted during the COP23 in Paris. This stimulates further requests from policymakers for more information to assess the impact of Brazil's forest code implementation under climate change.

Dr Sonya Dewi (ICRAF) will discuss combined bottom-up stakeholder engagement with top-down modelling approaches to: (i) upscale and sustain the positive impacts of initiatives at site levels and (ii) ensure consistency in informing policy makers at sub-national and national levels. Linking evidence-based sub-national and national policymaking requires a suite of tools and data that address multiple spatial resolutions and handle localized context-specific scenarios for a diverse archipelagic country like Indonesia. This requirement is innovatively addressed through the application of crowdsourcing techniques to generate subsets of input data for land use modelling in Indonesia, which will be discussed interactively using a mobile application by Dr. Inian Moorthy (IIASA).

Finally, policymakers from different tropical regions will share the challenges of evidence-based policy making and how experiences discussed can be applied/strengthened.

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Florian Kraxner, Fernando Ramos, Sonya Dewi, and Inian Moorthy
Keywords: science-to-policy, restoration, land use modelling, crowdsourcing, multilevel governance"

355N Co-production of knowledge in landscape restoration

Transformation from degraded landscapes to regenerative landscapes requires not only international collaboration and financial resources but most of all, a grounding in local communities and cooperation between multiple stakeholders. Collaborative production of knowledge (co-production) is, therefore, an approach that becomes increasingly used in many projects that support transformation to sustainability, particularly also within landscape restoration. The approach is promising, but it bears many challenges for scientists to apply it. The practice of co-production can be very different from theory and care must be taken to avoid 'participation-fatigue'. This session aims to provide space for sharing and learning about what works and what doesn't work in practice. We invite practitioners, policy makers and scientists alike to take part in an immersive session for learning about co-production of knowledge and landscape restoration. Storytelling and Open Space Technology will be used as a means to facilitate our learning in this session. We encourage sharing of lessons learned –including epic failures –but will also open up the floor for participants to ask for advice on challenges (i.e. feed forward) to tap into the wisdom of the present crowd.

The session will contribute to the conference by enabling knowledge exchange about co-production of knowledge - an emerging field of science and practice that explores how transformation to sustainable land systems and landscape restoration can be supported.

Abstract submissions are welcome in this innovative and immersive session

Session Organizers: Christine Ornetsmüller, Simon Moolenaar, Rajeev Goyal, and Dieter Van den Broek
Keywords: co-production, landscape restoration, transformation, transdisciplinary, sustainability"

356N Participatory shaping of GLP's roadmap towards knowledge co-production (NO ABSTRACTS BEING ACCEPTED)

Is land system science relevant for sustainability transformation? Have the more than 5000 publications produced by GLP scientists since 2015 found their way into societal processes and supported practitioners in addressing sustainability issues? We land system scientists might never answer these questions unless we engage in research co-production processes that help us to verify if our science is aligned with societal knowledge needs.

Recognizing this, the GLP working group on co-production of sustainable land systems aims to foster the development and use of co-production approaches in the GLP community. It is conducting a series of webinars to tap the experience of GLP members, which it will use to elaborate a draft roadmap for co-production in land system science. Based on a coherent change theory, this roadmap will allow GLP scientists to align their work with, and find entry points into, co-production approaches.

Participants in this session will have the opportunity to discuss, review, and approve this draft and to be among those who shape GLP's co-production strategy:

1. Three speakers will present (a) the structural and functional characteristics of the GLP network and their implications for collaborative processes, (b) the state of the art of knowledge co-design and co-production in the GLP community, and (c) the main parts of the roadmap.
2. Groups of participants, composed of GLP scientists and representatives from policy and implementation organisations (e.g. Swiss national departments, IUCN, ILC), will each discuss and review one part of the draft.
3. Based on the group discussions, participants will engage in a moderated debate aiming to test the overall coherence of the roadmap.
4. The moderator will summarize aspects of the roadmap needing amendment and participants will be requested to mandate the GLP working group to elaborate a consolidated version to be submitted to GLP's scientific steering committee.

This session is sponsored by the GLP Working Group on Co-production of Sustainable Land Systems

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Albrecht Ehrensperger, Isabelle Providoli, Jean-Christophe Castella, Narcisa Pricope, Flurina Schneider, Theresa Tribaldos, and Ariane de Bremond
Keywords: co-production, participation, sustainable land systems, GLP, roadmap

357N Monitoring integrated restoration activities: enabling track-changes in complex land systems

Worldwide people and nature are suffering from degrading landscapes. To turn the tide, governments, companies, and NGOs have shown interest in investing in integrated restoration to support sustainable land system transformations. Integrated restoration efforts are targeted actions to enhance human well-being by improving the natural environment. However, decision-makers remain hesitant to commit resources due to the lack of robust evidence on the impact of these actions in complex and dynamic land systems. This lack of information hampers the smart allocation of resources and represents a lost opportunity for improved decision-making based on lessons learnt.

Therefore, governments, practitioners, and scientists are calling for consistent and effective systems to monitor these targeted land transformations. This call was reflected in the key messages of the 2018 Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) assessment report on Land Degradation and Restoration, and subscribed by 130 governments, highlighting the need for "Effective monitoring strategies, verification systems and adequate baseline data—on both socioeconomic and biophysical variables—provide critical information on how to accelerate efforts to avoid, reduce and reverse land degradation and conserve biodiversity".

To be able to translate this urgent call into action, this session will explore the requirements, current scientific advances and user-experiences of monitoring systems to capture restoration effects for people and nature over time. For this World Café we have invited speakers who will provide food-for-thought on the topic, and we ask session participants to come inspired to share their views on:

- What to monitor? Selection of cost-effective relevant indicators, including ecosystem services, for integrated land monitoring;
- How, when and where to monitor? Opportunities for monitoring at relevant spatial and temporal levels, including innovative use of remote sensing, Big-Data, crowd-sourcing, and spatial statistics;
- How to support sustainable land transformation? Implementation of monitoring systems and use of monitoring results for improved land governance.

Abstract submissions are welcome in this innovative and immersive session.

Session Organizers: Louise Willeman and Nichole Barger
Keywords: social-ecological systems, M&E, land degradation, restoration, IPBES

358N Gridded population and settlement data and models for integrative analysis of land systems

Sustainability initiatives that target coupled land system dynamics rely on data products that provide spatio-temporal information about land cover, land use activities, human population distributions and movements. Specifically, there is a need to integrate settlement, infrastructure, and population data to improve models that support monitoring, planning, and decision-making efforts for sustainable development, conservation and land management. While many data products exist at various spatial and temporal resolutions, gridded, raster-based products that represent settlement patterns, population density and socio-demographic characteristics have rapidly advanced and proliferated in recent decades. We propose an interactive session of panelists that represent data producers and data users of gridded population and settlement products and are experts in their respective fields. Short presentations will highlight various data products and set up an interactive discussion with the land system science community on issues of endogeneity, temporal-explicitness, and spatial conformity in these data products. Discussion will center on scale and projection considerations for user-specific applications, continued method development and advancement for integrating these products in land change studies. An important part of this discussion will be the analysis, treatment and integration of various uncertainty measures as one of the most persistent challenges not only in land use science.

Abstract submissions are welcome in this innovative and immersive session

Session Organizers: Andrea Gaughan, Catherine Linard, Alessandro Sorichetta, Forrest Stevens, Stefan Leyk, Deborah Balk, and Greg Yetman
Keywords: population and settlement modeling, uncertainty measures, sustainable development, user-specific application

359N Are there archetypes of land system transformations towards sustainable development? (NO ABSTRACTS BEING ACCEPTED)

Transformations of land systems towards more sustainable development proceed in highly context-specific ways. This complicates efforts at cumulating and transferring knowledge about successes, trade-offs and failures of land system transformations across contexts. The archetypes approach is increasingly used as a methodological approach to understand recurrent patterns of factors and processes that shape the sustainability of land systems. Archetypes of land system transformations can be understood as recurrent but non-universal building blocks that explain how and under what conditions land systems transform towards more sustainable development.

The GLP Working Group on Archetype Analysis organizes this World Café to stimulate lively debate about the overarching question: are there archetypes of land system transformations towards sustainable development?

This session takes the format of a World Café. In the first step, four resource persons will provide brief, provocative statements and examples on the panel's question (3-4 minutes each). In the second step, all session participants gather at moderated World Café tables for in-depth discussion in smaller groups in multiple rounds (ca. 50 minutes). In the final step, discussion in the plenary synthesizes the positions formed on the panel's question (ca. 30 minutes).

The guiding questions at the tables are:

- Table 1: Are there archetypes of land system transformation? Under what conditions will we observe what archetype?
- Table 2: Methodological options, challenges and progress using quantitative/qualitative/'big-data' approaches to identify and analyse archetypes of land system transformation
- Table 3: Using case insights to extrapolate towards archetypes of land system transformations
- Table 4: Using archetype thinking to upscale land-based sustainability solutions, e.g. in knowledge co-production

The final plenary discussion will aim at formulating a set of concise positions on the session's overarching question on archetypes of land system transformations towards sustainable development. We invite researchers, policy-makers and practitioners working on any dimension of land system transformation towards sustainable development. Background in archetype analysis is not necessary to participate, a stronger interest in the opportunities and challenges of transferring insights into land system transformations across contexts is key.

This session is sponsored by the GLP Working Group on Archetype Analysis in Sustainability and Land Governance Research

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Diana Sietz, Tomas Vaclavik, Klaus Eisenack, and Christoph Oberlack
Keywords: land system transformations, sustainability transformations, archetypes, world café"

360N Modelling human-environment interactions in land systems: Current status, challenges and ways forward (NO ABSTRACTS BEING ACCEPTED)

Land systems are coupled social-environmental systems (SES) that are characterized by intrinsic complexity entailing non-linear dynamics, self-organization, multi-scale feedbacks, and emergence. Modelling the complex interactions and feedbacks in SES is pivotal to understand the essence of land-system behaviors and characteristics, such as regime shifts, path dependence, and system resilience, and has profound policy implications in transforming land systems towards the SDGs. It is particularly challenging to model interactions between the social and environmental sub-systems in an integrated framework due to, for example, the mismatch in spatial and temporal scales. So far, most SES models are unbalanced and loosely-coupled with a focus on one of the sub-systems. Variables from the environmental

sub-system often merely serve as boundary conditions or constraining factors in a predominately social model, or the other way around; dynamic interactions between human and environment are to date weakly implemented.

The goal of this session is to assess the current status, identify challenges and opportunities, and discuss new trends in modelling human-environment interactions in land systems. Session topics will cover the following theories and concepts:

- Human-environmental systems; complexity; complex system thinking
- Regime shifts, tipping points, and critical transition of land systems
- Path dependence, lock-in, path breaking
- System dynamics; differential/difference equations; agent-based models
- Human decision-making; integrated modelling.

Followed by a general introduction, we will have four panelists to give 5-minute flash talks to set the scene for the discussion. We will engage the audience using crowd-sourcing methods such as instant polling with Poll Everywhere and Slido to ensure that all thoughts of the audience are heard and to enable active participation and engagement. Depending on the size of the audience, we will use World Café or Fishbowl to facilitate open discussions on the key questions identified. We will strive to jointly produce a position paper on potential ways forward in SES models of land systems (TBD).

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Zhanli Sun, Daniel Müller, Birgit Müller, Martha Bakker, Pytrik Reidsma, and Dawn Parker
Keywords: human-environmental interactions, complex system, regime shift, resilience, agent-based models

361N Policy and governance of illicit and/or clandestine transactions and land-use changes (NO ABSTRACTS BEING ACCEPTED)

Academic research and investigative journalism have revealed the role of illicit and/or clandestine transactions (financial and in-kind) in driving land-use changes. Examples include illegal deforestation, agricultural expansion funded through tax havens, urbanization and infrastructure development via bribes, and large-scale commodity agriculture established for money laundering. Given the growing influence of illicit and/or clandestine transactions on land systems, this immersive session invites a range of practitioners and watchdog organizations to reflect on the role of science in informing policy on this topic, and present what they see as the types of evidence and/or research required to better govern the harmful effects of illicit capital flows and/or clandestine transactions on people and nature. While data to study these activities becomes increasingly available (e.g. Panama/Paradise papers, satellite data, and social media), the movement of capital and new technologies to obfusticate digital trails is also growing. Closer collaboration between scientists, journalists, and civil society actors may aid efforts to make headway.

This session invites perspective from diverse global settings and will explore questions such as:

- For what phenomena are there sufficient evidence to warrant taking action or informing policy, and what kind of illicit economic links to land require more research?
- What data could or should scientists make better use of? What policies are needed to ensure data on these transactions could be made more available?
- What are possible or existing governance structures (formal and informal) that could be leveraged or need to be built (e.g. certifications and consumer pressure from timber to oil palm, international agreements, or national laws)?

Panelists will comment on these key questions and the policy relevance (or lack thereof) of the research in the preceding panel on the same topic, as well as field audience questions, to discuss this important issue. This innovative/immersive session supports OSM theme 3 by proposing steps forward in supporting transformation regarding this global challenge.

Invited speakers include: UNODC- UN office on drugs and crime, ICJ International Consortium of Investigative Journalists, GIGA- German Institute for Geographical Analysis, Transparency International, Illegal Deforestation Monitor, Global Witness

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Elizabeth Tellman and Nicholas Magliocca
Keywords: civil society, illicit economies, clandestine transactions, NGO, governance

362N Industry perspectives on achieving zero-deforestation (NO ABSTRACTS BEING ACCEPTED)

One of the most important recent developments in the governance of land use has been the emergence of corporate, supply chain interventions to improve environmental and social sustainability. Actors across many commodity supply chains have made explicit pledges to achieve an end to deforestation within their supply chains. Now, practitioners within companies are grappling to ensure that implementation of these pledges maximizes on-the-ground impacts and reduces deforestation, while the scientific community is interested in quantifying these impacts and developing theory around what constitutes effective zero-deforestation commitment design and implementation.

This panel discussion will gather industry representatives to reflect on their experiences, including challenges and successes, with implementation of zero-deforestation commitments. The panel will provide diverse perspectives by including representatives from a variety of commodities (e.g., cacao, palm oil, beef) and points within the supply chain (e.g., producers, traders, manufacturers, retailers).

By convening this immersive panel with two associated research presentation sessions, we hope to facilitate a dialogue between the scientific community and practitioners implementing policy within individual companies. We believe that this dialogue will yield two important benefits. First, the research community will refine its research trajectory through improved understanding of corporate motivations to adopt commitments, the rationale for choosing certain implementation mechanisms, and corporate experiences with implementation. Second, increased exposure to emerging scientific research on commitments will empower industry representatives to work more closely with the scientific community to measure the impact of their efforts and may help them better design and implement supply chain policies that achieve reduced deforestation.

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Robert Heilmayr, Ximena Rueda, and Kimberly Carlson
Keywords: agriculture, forests, supply chains, nonstate market driven governance, zero-deforestation commitments

363N Decision support systems for land degradation neutrality: How to make tools relevant at local scales? (NO ABSTRACTS BEING ACCEPTED)

Land degradation –the reduction or loss of the productive potential of land –is a global challenge. Over 20% of the Earth's vegetated surface is degraded, affecting over 1.3 billion people, with an economic impact of up to US$10.6 trillion. Land degradation reduces agricultural productivity, increases the vulnerability of those areas already at risk of impacts from climate variability and change, and complicates efforts to accomplish the Sustainable Development Goals (SDGs). Achieving Land Degradation Neutrality (LDN) is essential to improve the livelihoods of those most affected, and to build resilience to safeguard against the most extreme effects of climate change. The key question decision-makers

face now is: how do we support transformation? New methods and tools are continually being developed to support the implementation of on the ground actions in order to monitor their performance and to support the scaling of successful interventions. In this session, we will use an interactive Decision Theater to trigger a conversation on how different decision support systems can contribute to the achievement of land degradation neutrality. The Decision Theater, developed by Arizona State University in collaboration with Conservation International, uses a series of screens in a dynamic, immersive environment to allow attendees to explore the tradeoffs among land condition, nature conservation, and human well-being. The session will last 1.5 hours, combining a demonstration of the Decision Theater with a panel discussion involving experts from the United Nations Convention to Combat Desertification (UNCCD), the World Overview on Conservation Approaches and Technologies (WOCAT), the Commonwealth Scientific and Industrial Research Organisation from Australia (CSIRO), and the Food and Agriculture Organization (FAO) who will present their perspectives on how the earth observations and monitoring community can better support the implementation of restoration projects to support land degradation neutrality. Following the panel discussion, attendees will be able to experiment with the Decision Theater.
Structure:

- 10 min - Demo of the decision theater
- 25 min - 5 minute presentation by each panelist
- 25 min - Q&A and discussion
- 60 min - Decision Theater open to the audience

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Mariano Gonzalez -Rogloich and Alexander Zvoleff
Keywords: remote sensing, monitoring, land use, land cover, degradation, restoration

364N Strengthening data ecosystems to meet the needs of the SDGs and VGGTs (NO ABSTRACTS BEING ACCEPTED)

The inclusion of several land-related indicators in Agenda 2030 marked a significant step towards the recognition of land and tenure security as fundamental to a number of the overarching Sustainable Development Goals. The SDGs call for monitoring, evaluation and accountability to increase the availability of “high-quality, timely, and reliable data,” disaggregated to reflect the characteristics of local contexts. In late 2017, three priority land indicators –1.4.2, 5.a.1, and 5.a.2, recognized by the land community for their transformative potential –were promoted to Tier II, signaling that a clear methodology had been established and data collection was underway.

Coinciding with the promotion of land issues to Tier II, the fifth anniversary of the landmark Voluntary Guidelines on the Responsible Governance of Tenure (VGGT) highlighted the successful creation of multi-stakeholder processes that had integrated principles of the VGGTs into laws and decision-making processes. Encouraged by the growing uptake of the tool, participants raised questions about ongoing promotion and implementation of the tool, as well as its monitoring and evaluation. As more countries adopted the VGGTs, questions of who should monitor this progress, and how, remained. Responding to this need, the last five years have seen a range of monitoring and data generation initiatives blossom, both State and non-State: initiatives such as PRIndex, the Dashboard, and the Land Matrix. In alignment with the VGGTs, GLII, and custodian-driven partnerships with NSOs, these are also generating people-centered data that, alongside official data, can offer nuance and depth to an evolving picture of local land governance.

Building on this momentum, the current moment presents an opportunity to further reflect on the role of datasets that can complement one another, add novelty to debate, and further reflect the complex character of land governance in local contexts. But there is still work to do: This innovative and immersive session will discuss the collective significance of these complementary initiatives and how they –and the tools they have developed –are positioned to answer key questions on land and progress framed by the SDGs and VGGTs.

We aim to offer a critical reflection on the role of the growing ecosystem of data and how to further improve collaboration among actors. Specifically, we will use this session to consider the potential roles that GLP and its scientists, as well as the field of LSS, can play in supporting the construction of a comprehensive data ecosystem that is conscious of what purpose –and whom –the data will serve.

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Ward Anseeuw, Ariane de Bremond, Jérémy Bourgoin, Markus Giger, and Eva Hershaw
Keywords: data, VGGTs, SDGs, digital ecosystems, co-design

365N Governing primary forest protection: An integrated community-based approach to managing landscapes for conservation, climate change and sustainable livelihoods

Protecting forests is as much about people and livelihoods as it is trees, biodiversity and ecosystem integrity. Hence there is a need for integrated approaches to protecting forests that support sustainable livelihoods in culturally appropriate ways. Primary forests face ever-growing deforestation and degradation because they are usually only valued as a source of timber or as obstacles to population growth and development. However, primary forests provide a range of unique and high quality ecosystem services and benefits including significant carbon stores, clear water, reservoirs of biodiversity, and non-forest wood products that hey provide products to local people and for international markets. An integrated approach is needed that can harness this 'basket of benefits' to both support livelihoods and protect forest. Creating such a conservation economy is a challenge that needs science, governance, economics, landscape planning, and community development. This session will provide a forum to discuss how the practicalities of such an integrated approach drawing upon case studies in Brazil, Solomon Islands and the Democratic Republic of Congo and the kinds of governance integrity systems needed.

The session will provide two panel discussions separated by an interactive session on governance:

1. Panel Discussion: Understanding Primary Forest Land System
    - Science of Primary Forests: How forests provide a basket of benefits (Brendan Mackey)
    - Microeconomic assessment: identifying options for the conservation economy (Fitalew Tye)
    - International policy helping or hindering forest protection: How forests are seen in the international policy arena and the potential of a basket of benefits (Virginia Young)
    - Land use planning to integrate and transform: The challenges of integrating knowledge (Edward Morgan)
2. Interactive Governance Session: Using online surveys as a means of developing stakeholder governance standards (Tim Cadman)
3. Panel Discussion: Case study insights --Lessons from Brazil (Barbara Zimmerman), Lessons from Democratic Republic of Congo (Glenn Bush) and Lessons from Melanesia (Stanley Wapot)

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Brendan Mackey, Tim Cadman, Edward Morgan, Glen Bush, Stanley Wapot, Barbara Zimmerman, Virginia Young, and Fitalew Tye
Keywords: primary forests, livelihoods, sustainable development, climate change, conservation

366N Essential land-use variables world café (NO ABSTRACTS BEING ACCEPTED)

Much of Land System Science (LSS) is concerned with understanding changes in, and interrelations between, a large variety of different state variables that together form the "building blocks" of highly complex land systems. Several of the disciplines contributing to LSS have started conceptualizing and developing "Essential Variables" (EVs) –that is, a narrow set of core state variables that are fundamentally important for studying, managing, and reporting status and

trends in their focal systems (e.g. Essential Climate Variables: goo.gl/6CkV3D, Essential Biodiversity Variables: goo.gl/M2Y4jF). Conceptually placed between raw observations (remotely sensed or in-situ) and more abstracted policy indicators, the EV concept was introduced to harmonize monitoring, streamline efforts and unite strengths around those fields' core scientific and policy endeavours.

Despite the central role of land-use/land-management variables in LSS, similar momentum has not yet emerged around "Essential Land-Use Variables" (ELUVs). While various state variables might intuitively seem "essential" descriptors of agricultural, forestry, infrastructural, and other land-uses (e.g., crop species harvested areas and yields, livestock species abundances, forest management types, land-tenure types), the conceptual and operational development of ELUVs remains poorly organized among the respective scientific and other stakeholder communities.

This session addresses this issue by initiating a discussion about (i) the status of current activities and proposals around ELUVs, (ii) how to conceptualize and distinguish ELUVs from the EVs of neighboring fields, given the interdisciplinary nature of LSS and land-use issues, (iii) organizing the production of interoperable global ELUV data products, and (iv) strategies for harmonizing global monitoring efforts to capture these variables.

After a short introduction, the session will proceed with open table and plenary discussions among the participants around the above four questions. Those interested can use this session to network and initiate longer-term activities to advance the ELUV idea within LSS and the Global Land Programme.

Abstract submissions are not being accepted for this innovative and immersive session.

Session Organizers: Carsten Meyer and Steffen Fritz
Keywords: essential variables, land use, land management, global datasets, monitoring

380T RUS: EO exploitation made simple (NO ABSTRACTS BEING ACCEPTED)

Understanding of the land system and monitoring its transformation implies identification of spatial patterns and evolution over time. The large volumes of free data acquired systematically by the Copernicus satellites (with continuity of observations ensured for the next decades) offer an invaluable source of information, however technical and knowledge barriers seem to prevent their exploitation. The Research and User Support (RUS) for Sentinel Core Products (funded by EC and run by ESA) aims to foster user's uptake of such data, by offering free Virtual Machines and processing power with pre-installed open source SW, and by training prospective users (researchers, scientists, public authorities, SMEs, trainers…) to derive information from the data.

We plan to explain how to get this free service and to demonstrate one application relevant for the Land community. Complexity would depend on the background of the majority of the participants.

Two options may be offered:
1. Simple demo during which we explain step by step how to process the EO data to derive the final product (exploiting Open source toolboxes available in RUS). In this case we have no specific technical requirements (apart for one lan cable+ Internet connection for the trainer and a projector + screen),

2. Real training session during which participants access with their laptop the Virtual Machines pre-configured by the RUS service, following the step by step exercise demonstrated by our trainers. In this case we have strict requirements in terms of Internet connection (we need a Lan cable for each participant and a connection per participant of 2.5 Mb/s: this normally limits the number of participants to 20-22 and may require selection of the candidates; furthermore a duration of 2 hours would perhaps be more appropriate for this format).

Participants will be invited to register for workshops/training sessions following the call for abstracts.

Session Organizers: Francesco Palazzo, Chloe Gilles, Miguel Castro Gomez, and Tereza Smejkalova
Keywords: virtual machines, earth observation, information extraction, Copernicus missions

381T Dinamica ego 4 - an environmental modeling platform: Introduction and innovative features (NO ABSTRACTS BEING ACCEPTED)

Dinamica EGO is a sophisticated platform for environmental modeling with outstanding possibilities for the design of complex dynamic models. It is available at no cost and provides a user-friendly graphical interface suitable for modelers of all levels. Models can include nested iterations, dynamic feedbacks, cellular automata, and many other complex spatial algorithms. In this one-day training session, we will introduce Dinamica EGO, highlighting the new features of the latest version, which has an improved graphical interface. The training session will comprise an overview of the interface, examples ranging from simple to complex models, hands-on exercises, tricks and tips, and an introduction to the tools to support end-users such as Dinamica Wizard and Map Viewer. All topics will be covered in a practical way in order to allow participants to start creating their own models promptly. To attend the session, participants are expected to bring their own laptops with Dinamica EGO 4 already installed (see requirements and download the freeware at https://csr.ufmg.br/dinamica/).

The training session will cover the following topics:

- Introduction to Dinamica: computational requirements, options, documentation
- Dinamica EGO 4 interface: libraries, sketch, tabs, submodels, tracking model issues
- Creating a model using map algebra, feedback loops and regions
- Building submodels and new operators including R code encapsulation
- Organizing and documenting your model: tips and tricks for a transparent model
- Presenting your model and outputs: Dinamica Map Viewer, Wizard and Movie Maker

Participants will be invited to register for workshops/training sessions following the call for abstracts.

Training Organizers: Letícia Santos de Lima, Britaldo Soares Filho, Hermann Oliveira Rodrigues
Keywords: environmental modeling, geospatial dynamic models, scenario simulation, territorial planning, land use change

382T An introduction to using Google Earth Engine for land system science (NO ABSTRACTS BEING ACCEPTED)

This workshop contributes to the third conference theme, “New frontiers in studying and governing land systems,” by demonstrating how Google Earth Engine (GEE) can be used as a powerful tool for studying land change. GEE is an emerging cloud-based geospatial processing platform that hosts open datasets and provides the computational power required for large-scale analyses. The platform enables researchers around the world to access tools required for advanced remote sensing analysis without charge. GEE holds the potential to address many of the limitations of past remote sensing techniques, particularly for research at the state, regional, and global spatial scales, which use massive amounts of data. In this workshop, I will provide a brief overview of the GEE platform, and then demonstrate an example workflow in the online Code Editor. The demonstration will walk through a simple time series analysis to quantify forest change for a region of interest and visualize the results. Participants may follow along on their own computers as we work through the key steps of writing and running a script in JavaScript. Participants will learn to bring in and process satellite data for multiple time periods, manipulate image bands, chart spectral changes over time, and export the results and desired images. No coding experience is necessary to take part. The session will close with questions and an overview of online resources available for further advancing GEE skills.

Participants will be invited to register for workshops/training sessions following the call for abstracts.

Workshop/Training Organizer: Jared Stapp
Keywords: big data, cloud computing, Earth Engine, land use change, remote sensing

383T An introduction to system dynamics for understanding the sustainability challenges of land system transformations (NO ABSTRACTS BEING ACCEPTED)

Land use and land cover change have been one of the main drivers of changes in climate and biodiversity and are increasing. Therefore, there is increasing attention to land system transformations in response to global change, in order to stay within an environmentally-safe operating space, a pre-condition for human development. However, land systems are characterized by complex interactions. Thus, despite the progress in land use and land cover change modelling, understanding the dynamics (interaction and feedbacks) among land, ecological (e.g. climate, water) and social systems remain a major challenge to sustainable transformations in land system. For example, the feedbacks between land use change and climate can be triggered by the feedbacks from socio-economic systems, such as large-scale investments in land, which can lead to higher incomes, but in turn, can trigger investments in further expansion of such land use. Therefore, land system transformations without understanding and incorporating such social-ecological systems' (SES) dynamics could lead to erroneous conclusions and could limit the long-term benefits of sustainable land system transformations.

System dynamics (SD) modelling can contribute to achieving sustainable land system transformations through understanding and capturing the dynamics (e.g. interaction and feedbacks) between SES. Using a systems perspective, this modelling technique provides insights into the behavior of a system, including feedbacks, delays and nonlinearities and can be used to explore pathways to sustainable transformations of land systems.

This training session aims to improve understanding about system thinking and system dynamics modelling, applied to SES and sustainable land system transformations, through introducing the theories, concepts and steps of SD modelling and through a short practical and discussion session.

Training format:

1. General introduction to system dynamics modelling (50')
    - Overview of modelling approaches
    - Introduction to system dynamics (SD)
    - SD modelling concepts and process
    - Application of SD model
    - General overview of modelling software
2. Brief introduction to STELLA (Practical session) (25')
3. Question and answer session (10')

Training session will be recorded and will be uploaded online

Pre-requisite:

- Basic understanding of statistics (e.g. regression, correlation, linearity, and non-linearity)
- Interest in system thinking and social-ecological systems approach

Participants will be invited to register for workshops/training sessions following the call for abstracts.

Session Organizers: Sarwar Sohel and Chinwe Ifejika Speranza
Keywords: system dynamics, land system transformations, sustainability challenges

384T Exploring scenario tools for sustainable mountain development –modelling session (NO ABSTRACTS BEING ACCEPTED)

Tools such as the participatory scenario approaches are developed and applied in order to understand complicated socio-ecological interactions and model future scenarios under global and local changes in land use, use of ecosystem services, or impact of changes (policy to climate) on livelihoods. Such frameworks can be effective tools for management decisions towards sustainable mountain development, but they are also considered challenging to apply and adjust to meet the needs of different study systems and the visions of local stakeholders.

In this hands-on workshop/training session we will get to know and compare some of the recently developed scenario tool sets; e.g., Participatory Scenario Tools and Participatory Bayesian network-based Land-use Modeling Approach (BLUMAP).

We will start with an introduction to the theoretical background and assumptions of these models, and discuss types of questions these tools can be applied to. Finally, we will test the models with parameter sets from different mountain regions.

This session is open to all who are interested in applying such scenario tools in their own research in mountains or other systems. After the meeting, a short guide to the modelling tools presented will be prepared and made available to the wider research community through the Mountain Research Initiative. This session is a follow-up session for the Research Presentation session 'Applying scenario tools for sustainable mountain development'.

Participants will be invited to register for workshops/training sessions following the call for abstracts.

Session Organizers: Robert Marchant, Enrico Celio, Aino Kulonen, Adrienne Grêt-Regamey, Veerle Vanacker, and Ricardo Grau
Keywords: scenario tools, social-ecological systems, mountains, sustainable development, capacity building