Scenarios Forum Session List

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Scenario development and modeling that bridges scales and communities: the rich diversity of global transport futures

Session ID #: 24

Lead organizer(s): David McCollum[1], Sonia Yeh[2], Paul Kishimoto[3], Bas van Ruijven[3], Roberto Schaeffer[4], Pelopidas Siskos[5]

Institutional Affiliation(s): Oak Ridge National Laboratory[1], Chalmers University[2], International Institute for Applied Systems Analysis[3], Alberto Luiz Coimbra Institute for Graduate Studies and Research in Engineering (COPPE)[4], and E3 Modelling[5]

Session Type: Workshop Session

Session Description:

Global transport comprises many identifiable systems and subsystems. These range in scope from 'micro' (individuals, neighborhoods, cities) to 'macro' (countries and world regions). Analysis of and scenarios for these systems often focus on specific geographic areas or transport modes—or, conversely, sacrifice resolution to span the global system. A similar type of partitioning tends to be seen in the study of alternative fuel pathways (biofuels, electricity, hydrogen, and e-fuels). These choices on scale and scope lead to research communities that can be fragmented.

A future low-carbon transport system could be comprised of a more diverse mix of fuels and technologies than we see today and is expected to interact more and more with the broader energy system. But how might the fuel/technology mix look within countries, and how will it compare between them? And how can scenarios and modeling account for heterogeneity across multiple scales and multiple strategies, particularly with work being conducted across disparate communities?

Scenarios provide one potential answer to these questions, if they, and the tools used to quantify them, could be developed jointly by researchers in different disciplines. Such collaborative activities would strengthen connections, promote dialogue, and harmonize efforts that would otherwise remain disconnected. Scenarios can serve as a common language for discussing phenomena across subsystems, thereby facilitating integration of disparate modeling paradigms and outcomes. Currently, nothing resembling a common scenarios process exists for the study of transport worldwide. While much of the global (macro) modeling community frames their narratives in terms of the Shared Socioeconomic Pathways (SSPs), local/national scenarios tend to be crafted with more micro-scale considerations (technology, policy, socio-economics) in mind. Reconciling these different perspectives presents a challenge, but also an opportunity, in the analysis of transport futures.

This session will bring together diverse viewpoints with the aim of advancing scenario-based transport research that serves the knowledge needs of equally diverse researchers and stakeholders. Toward that end, the session welcomes abstract submissions on:

- What is the current state of the science with respect to transport technology potentials and costs and the modeling of transport alongside other sectors, in global/national and city/regional settings?

- Can standard ‘handshakes’ be organized by researchers from different communities, in order to bridge qualitative trends and their modeling quantifications across scales and fuels/technologies?
- What are critical features for a common transport scenarios process that would ease multi-scale and multi-strategy analysis?

Challenges and opportunities in constructing national scale scenarios from the SSPs/RCPs

Session ID #: 8

Lead organizer(s): Mark Rounsevell[1,2], Paula Harrison[3], and Rob Dunford-Brown[3]

Institutional Affiliation(s): Karlsruhe Institute of Technology[1], the University of Edinburgh[2], and UK Centre for Ecology and Hydrology[3]

Session Type: Research Session

Session Description:

The SSP/RCP framework, whilst originally developed at the global scale (O'Neil et al., 2020), has been interpreted extensively at the national scale (e.g. Pedde et al., 2021), often to inform both research and policy in support of climate change adaptation and mitigation actions. These interpretations involve a range of different methods in the development of both qualitative and quantitative interpretations of key socio-economic and climate change variables, often embedded within participatory processes that engage with key stakeholders (Kok et al., 2019). National scale RCP/SSP-based scenarios are critical in engaging with national governments since it is these governments who ultimately have the capacity to implement policy in response to the climate change crisis. Scenario analyses provide the basis for exploring alternative socio-economic development trajectories and the consequences of these trajectories for national economies.

This session will explore examples of the construction of both qualitative and quantitative scenarios from the SSPs/RCPs in different national contexts. This includes studies focused on interpreting the drivers of socio-economic change, quantitative modelling of future socio-economic indicators, and participatory approaches to storyline development. In particular, the session will address the questions:

1. How can the regional applicability of the SSPs/RCPs be improved?
2. Should we be aiming for consistency or diversity in methods for downscaling SSPs/RCPs to improve comparability across scales and studies?

We invite abstract submissions on how SSP/RCP scenarios have been constructed at the national scale for different countries. The session will comprise a mix of 2 invited, and 2-3 selected presentations as well as a panel discussion of the session speakers.

References: Kok, et al. (2019). Reg Env Chang 19, 643–654; O'Neil et al. (2020). Nat Clim Chang, 10, 1074-1084; Pedde et al. (2021). Sci Tot Env, 756, 143172. 12

The role of subnational governments in the fight against climate change

Session ID #: 19

Lead organizer(s): Federica Cittadino[1] and Alice Meier[2]

Institutional Affiliation(s): Eurac Research, Institute for Comparative Federalism[1] and the University of Innsbruck[2]

Session Type: Workshop Session

Session Description:

Climate change is a complex phenomenon in need of diversified responses. Adaptation and mitigation policies are decided at supranational level but must be implemented at different governmental levels. In this panel, we wish to discuss several case studies referred to the integration of climate issues in sectoral policies at the subnational governmental level.

In this workshop session, we would like to compare the results of an ongoing research on climate change mainstreaming in subnational policy-making with similar investigations conducted in other regions/countries, even characterized by different political structures, legal norms and cultural backgrounds. Our project focuses on two Austrian Länder (Tyrol and Vorarlberg) and two Italian autonomous provinces (Bolzano and Trento) and three main policy sectors, i.e. transport, energy and water, and spatial planning. To evaluate the success of integration, five main dimensions have been considered in our research: coordination (vertical and horizonal), funding, leadership, information and participation.

We appreciate both theoretical and empirical contributions, aimed at exploring how the five dimensions previously mentioned may positively or negatively influence policy-making in climate-related matters, and how they can contribute to improve actions conducted at the subnational and local levels to fight climate change. Furthermore, we also welcome contributions that explore the relations between these dimensions and the scenarios developed at subnational and local levels.

Some of the research questions that we want to tackle within the workshop are the following: what are the peculiarities of subnational policy-making when it comes to integrating climate issues in sectoral policies? And what the peculiarities of local scenarios? What is the role of interdepartmental collaboration and that of multilevel governance? Are there any specific differences in the perception and development of mitigation and adaptation policies? What is the role of information and public participation? What are the impacts of subnational climate policies?

Applying global socio-economic scenarios for regional climate change impact and adaptation analysis

Session ID #: 26

Lead organizer(s): Kasper Kok[1] and Timothy Carter[2]

Institutional Affiliation(s): Wageningen University[1] and Research and Finnish Environment Institute[2]

Session Type: Research Session

Session Description:

The global Shared Socioeconomic Pathways (SSPs) have been developed to serve a variety of scenario needs for analysing future climate change, in particular for supporting adaptation and mitigation policy. Scenario application for supporting adaptation is primarily addressed by the impacts, adaptation and vulnerability (IAV) community. Since SSPs provide a global frame, their application in regional or sectoral IAV studies can potentially enhance comparability among studies. A key question is how the SSPs have been used to develop regional scenarios, particularly by the IAV community. A central challenge is that the relevance and credibility of global scenarios can seem remote from the complexity and uniqueness of local conditions and needs. This double session examines how such an apparent quandary can be reconciled. It first presents the state-of-the-art of regional SSP development, followed by an overview of how regional SSPs have been used in the IAV community, thus testing the applicability of downscaled SSPs. The session will start with results from a systematic review that has been undertaken including thousands of peer-reviewed papers, out of which about 170 were selected. The review focused on papers that developed the broader global qualitative component of the SSPs into regional scenarios. Two invited speakers will present downscaling efforts. Subsequently, this session invites abstracts that illustrate applications from the IAV community, stocktaking how SSPs were regionally/locally extended, for what purpose, and which methods were used. Some issues to explore include methods of co-developing scenarios for use in analyses for sectors versus systems versus regional units; combining top-down and bottom-up methods; scenario needs to support national and regional adaptation plans; future evolution of reference scenarios (SSPs) to serve IAV needs; regional scenarios for framing co-development of coherent regional mitigation and adaptation (and other) policies. The last part of the session allows for discussion on knowledge advancements.

Communication/Scenario Users

Synthesis and communication of climate change risks in scientific assessments

Session ID #: 201

Lead organizer(s): Brian O'Neill[1] and Lena Reimann[2]

Institutional Affiliation(s): Pacific Northwest National Laboratory[1] and Vrije Universiteit Amsterdam[2]

Session Type: Workshop Session

Session Description:

Assessments of the scientific literature on climate change impacts and risks requires drawing on a wide variety of studies that use different methodologies and examine many different types of impacts to different regions, sectors, and population groups. Risks will further depend on levels and rates of climate change, societal conditions, and assumed adaptation efforts and effectiveness. Accurately synthesizing and clearly communicating these risks is therefore complex and difficult. The use of scenarios is one means of carrying out such synthesis, by combining results from various impact studies to produce a cohesive vision of how the world may unfold in terms of the consequences of climate change. Alternatives include assessing and synthesizing impacts by global warming level, time period, or specified levels of exposure, vulnerability, or adaptation.

This workshop session will explore the various approaches to synthesizing and communicating climate change impacts, with an eye toward identifying the strengths and weaknesses of scenario-related approaches and how they could be improved. It will consist of 4-5 short presentations followed by substantial discussion with all participants. We seek abstracts for brief presentations (or posters) that could include (but are not limited to) reflections on experience within existing climate impacts assessments from the IPCC, national institutions, or other organizations; relevant experience with assessments of other issues with impacts on society; and proposals for new approaches to synthesis and communication of scenario-based work. Note that abstracts on individual impact studies are not suitable for this session, which focuses on assessing large bodies of evidence.

What do non-state actors (e.g., corporations, NGOs, financial institutions, etc.) need from climate change scenarios?

Session ID #: 21

Lead organizer(s): Katie Mulvaney[1] and Nemi Vora[2]

Institutional Affiliation(s): RMI[1] and Amazon[2]

Session Type: Workshop Session

Session Description:

Non-state actors (corporations, NGOs, investors, financial institutions, civil society, sub-national governments, and philanthropies) are increasingly using SSP narratives and scenarios to make critical decisions on climate change risk as well as mitigation and adaptation actions. Improving the relevance of climate change scenario applications for users was an important recommendation coming out of the 2019 Scenarios Forum (as highlighted in O'Neill et al. 2020, Nature Climate Change). Equipped with the right information these non-state actors, in collaboration with national governments and through coalition-building, could help set off tipping points that accelerate policy and technological transitions to limit warming to 1.5°C. The objective of this workshop session is to begin a conversation on what will help make SSP-RCP scenarios more relevant by highlighting the perspectives of non-state actors on how scenarios are already being used in decision making processes and identifying bottlenecks. Potential outcomes from this workshop could include a compilation of needs, details on salient output metrics for non-state actors, initiation of guidelines for downscaling results of global scenarios, or identification of scenario co-production opportunities. Therefore, we seek proposals on a range of topics across climate change adaptation and mitigation. Examples include: how corporations are using scenarios to quantify and adapt to future shocks as they pertain to private sector supply chains; how scenarios can be used by sectoral change initiatives in the energy system transition; the use of scenarios in the financial sector; etc.

Interacting with integrated assessment models for target-seeking under uncertainty

Session ID #: 52

Lead organizer(s): Sibel Eker[1], Sarah Cornell[2], Merle Rémy[3], and Jan Kwakkel[4]

Institutional Affiliation(s): Radboud University[1], Stockholm University[2], Institute for Advanced Sustainability Studies, Potsdam[3], and Delft University of Technology[4]

Session Type: Research Session

Session Description:

Large integrated assessment models have been immensely useful in developing possible climate mitigation pathways, influencing political agendas and providing policy advice. But now, the 2030 Agenda highlights the urgent need to improve upon the well-established climate change scenario framework by capturing more diverse relevant perspectives, reflecting uncertainty ranges, and enhancing scenario relevance to users especially in policy analysis for coherence and implementation. There is demand for new target-seeking scenarios that achieve multiple interacting social, economic and ecological goals as well as meeting the Paris climate targets. An expanding international community of stakeholders, spanning world regions and sectors of societal action, is interested in scenario-based analysis to explore how interactions among these globally agreed goals shape future pathways to sustainable development. But large IAMs struggle to engage stakeholders actively in scenario development and to incorporate diverse uncertainties. In this session, we will explore ways to capture future uncertainties and diverse perspectives, through the use of simple IAMs to complement larger ones, combined with methods of decision-making under deep uncertainty, and through engaging stakeholders more actively in co-created scenario development processes. With invited speakers and open submissions, the session will present examples of research and science-society forums that can help improve today's scenario frameworks and interactive environments, so that they do better at reflecting the complexity and deep uncertainty of the world's often divergent societal perspectives and the necessary shifts in global governance for a sustainable future.

Building Better Climate Scenarios for Supervisors, Private Sector Financial Institutions, and Development Institutions

Session ID #: 10

Lead organizer(s): James Edmonds[1], David Carlin[2], Bas van Ruijven[3], Seth Monteith[4], Leon Clarke[5], Yu Sha[1], Christoph Bertram[6]

Institutional Affiliation(s): Pacific Northwest National Laboratory[1], UN Environment Programme-Finance Initiative (UNEP FI)[2], International Institute for Applied Systems Analysis[3], ClimateWorks Foundation[4], University of Maryland[5], and Potsdam Institute for Climate Impact Research[6]

Session Type: Workshop Session

Session Description:

This workshop session seeks to bring together producers and users of climate scenarios for a constructive dialogue about how these scenarios are being used in the financial sector and the role of finance within the scenarios themselves. The workshop will explore the needs of scenario users including financial supervisors, private sector financial institutions and development banks. The workshop session will also explore the abilities and challenges of scenario creators in addressing these needs. Finally, the workshop will cover the role of finance in climate scenarios: both how it is modeled and where the greatest needs for capital exist within the transition. This session aims to begin a continuing dialogue between scenario producers and users that will generate recommendations for future climate scenario development and application.

Interpreting and debiasing uncertainties in SSP-based model ensembles

Session ID #: 30

Lead organizer(s): Massimo Tavoni[1], Celine Guivarch[2], and Ben Sanderson[3]

Institutional Affiliation(s): RFF-CMCC European Institute on Economics and the Environment[1], International Research Center on Environment and Development (CIRED)[2], and CICERO Center for International Climate Research[3]

Session Type: Research Session

Session Description:

The increasing relevance of modelled pathways for climate policy making is evident from the rapidly rising number of scenarios reviewed by the IPCC. The SSP framework is one of the cornerstones of community exercises involving multiple models. SSPs provide coordinated guidelines for running model comparisons and for spanning future socio-technical uncertainties. Despite their importance, the SSPs span a relatively small set of uncertainties, and many driving factors are limited to the current century. Furthermore, model comparisons based on SSPs do not directly address model uncertainty. Models do not constitute independent estimates and uncertainty is influenced by both choices made in the model comparison project construction and in the design of scenario intercomparison exercises. The difficulty of separating effects of SSP, target and model structure poses a challenge for the statistical interpretation of scenario ensembles, and for their use to inform climate policy via illustrative pathways. This session discusses ways to explore a wider range of uncertainties and to improve the statistical understanding of scenarios ensembles. The session welcomes contributions from the climate, impact and mitigation modelling community on independence weighting, and use of clustering methods on output and input to classify model family trees and methods based on assessment of common heritage and SSP. It also encourages discussion of use of machine learning approaches for scenario classification, uncertainty quantification and reduction. Finally, methodological contributions of uncertainty analysis and proposed revised experimental designs to improve the predictive power and robustness of ensembles in the short term while retaining the capacity to explore a vast space of outcomes in the longer period are welcome.

Scenarios in IPCC assessments: Lessons from AR6 and recommendations for AR7

Session ID #: 63

Lead organizer(s): Jan Fuglestvedt[1] and Anna Pirani[2]

Institutional Affiliation(s): CICERO Center for International Climate Research[1] and The Abdus Salam International Centre for Theoretical Physics, Trieste[2]

Session Type: Workshop Session

Session Description:

The use of scenarios has been an integrating and cross-cutting element across the Working Groups (WGs) in the 6th cycle of the IPCC (AR6), with three Special Reports overseen by the three Working Groups (WGs), as well as the three WG reports and the coming Synthesis Report. Stronger collaboration and linkages across communities were developed thanks to the cross-cutting nature of the three Special Reports, and this was followed up in the writing of the three WG reports. IPCC WGI considered a core set of scenarios from the SSP framework from CMIP6, supplemented by RCPs from CMIP5. WGII used both SSPs and RCPs, and WGIII used scenarios from a database containing more than 2000 scenarios, complemented by bottom-up approaches.

The session will address the role of scenarios for the development of key findings from the WG reports and discuss knowledge gaps and challenges in the context of new and emerging research. Topics will include emissions, climate responses, risks and development pathways, on both near-term and long-term time scales, regional climate changes and impacts and costs and benefits of mitigation and adaptation in the context of sustainable development. Lessons learned that are useful for the AR7 cycle and beyond will be considered. The workshop will end with a discussion between the panel and all session participants of ideas and recommendations for strengthened coordination across the IPCC and its underlying scientific and technical communities, and will address how the use of scenarios can support addressing important climate research questions and the coming assessments from the IPCC.

This session will not be open to submissions of abstracts for oral presentations, but invites submissions for posters. The workshop will include approximately 4 invited speakers/panelists from various backgrounds and communities representing different perspectives and the breadth of the scenario assessment within the AR6. Each panelist will give a short presentation on successes and challenges in how scenarios facilitated and/or integrated the assessment in AR6, as well as key recommendations for AR7 based on that experience.

Scenarios in CMIP6 and CMIP7: Lessons learned and new design considerations.

Session ID #: 16

Lead organizer(s): Claudia Tebaldi[1], Bjørn H. Samset[2], Brian O'Neill[3], Jean-Francois Lamarque[4], Detlef van Vuuren[5], Geeta Persad[6], and Laura Wilcox[7]

Institutional Affiliation(s): Lawrence Berkeley National Laboratory[1], CICERO Center for International Climate Research[2], Pacific Northwest National Laboratory[3], Climate & Global Dynamics (CGD-NCAR)[4] Netherlands Environmental Assessment Agency[5], The University of Texas at Austin[6], University of Reading[7]

Session Type: Workshop Session

Session Description:

Scenarios have played a central role in CMIP6 activities, with the ScenarioMIP design built around the SSP-RCP framework and several other MIPs using SSP-based scenarios and variants to explore a range of scientific questions about future climate changes.The results have underpinned future projections assessed by the IPCC AR6 WG1 report, and many papers are being written about future climate change and its impacts based on the results from ScenarioMIP.

At this time, we can start to take stock of what worked, and what made the process more difficult. We can address questions about number and type of scenarios prescribed, the process that furnished forcing input to ESMs, and the utility of the set of scenarios for both Earth system and impacts research. For instance, some of the trajectories chosen for CMIP6 are distinct mainly in terms of total radiative forcing, not because of pathway shape or composition of individual forcing agents. It may be useful to consider how to better explore the shape of forcing pathways (e.g., more overshoots, regional heterogeneity), and their nature (e.g., the role of aerosols, whose changes on decadal timescales can dominate the climate response to anthropogenic emissions; the effects of different land-use change patterns).

The session will include invited speakers addressing lessons learned in the preparation, use and analysis of experiments from ScenarioMIP (and possibly paired MIPs). A panel discussion will then look towards the next iteration of ScenarioMIP addressing fundamental questions about usefulness, number, range, shape and mix of forcing agents in scenarios for CMIP7. Opinions will be elicited in the discussion process from the three research communities involved: scenario modelers (IAM community), Earth system modelers and VIA researchers.

Advances in human-Earth System interactions in scenario development

Session ID #: 42

Lead organizer(s): Tokuta Yokohata[1], Chris Smith[2], Hannah Liddy[3,4], Kaoru Tachiiri[5], and Jarmo Kikstra[2,6]

Institutional Affiliation(s): National Institute for Environmental Studies Japan[1], International Institute for Applied Systems Analysis[2], Columbia University[3], NASA Goddard Institute for Space Studies[4], Japan Agency for Marine-Earth Science and Technology[5], and Imperial College London[6]

Session Type: Research Session

Session Description:

In the scenario development of IPCC AR6, socio-economic scenarios (Shared Socio-economic Pathways (SSPs)) were developed by the integrated assessment modelling (IAM) community. Subsequently, in a coordinated effort emissions and concentrations pathways from SSP-RCP scenarios were used by Earth System Models, providing a link between socioeconomic scenarios and detailed climate research. At present this linkage is mostly one-directional. For instance, the SSP design explicitly excluded any climate impacts, and thus potential feedbacks from climatic characteristics to socioeconomic development are not taken into account. At present, the inclusion of more human-Earth system interactions is being actively discussed in multiple communities.

Implications where climate feedbacks may be important include energy supply/demand, food security and wider land use changes, water availability, air quality, climate damages, and population dynamics. Climate change, if included in the design of future scenarios, would therefore affect basic components of IAM scenarios like population and GDP pathways that normally serve as input data. One emerging way to study such complex interactions is to develop coupled models that consider the interaction and feedback between the human-earth system.

In this session, presentations on the linking of models for human activities and the natural environment with various complexities and different strategies are welcomed. Additionally, we would like to solicit from scenario developers and users where climate modelling efforts could be more focused and useful, and call for greater collaboration between IAM and Earth System Model groups in scenario development.

Emulators: New methods and role in integrating research across climate research communities

Session ID #: 46

Lead organizer(s): Sonia Seneviratne[1], Claudia Tedbaldi[2]

Institutional Affiliation(s): ETH Zurich[1] and Lawrence Berkeley National Laboratory[2]

Session Type: Research Session

Session Description:

Emulators, either simpler physics-based climate models or algorithmic representation of complex models' output in a computationally efficient manner, play a central role in exploring scenarios: They are used by the Vulnerability, Impact and Adaptation (VIA) research community to determine risk of impacts and by the mitigation and Integrated Assessment Model (IAM) research community to derive the implications of alternative pathways, thus supplementing what could not be done with computationally costly Earth System Models (ESMs). In the IPCC AR6 report, emulators in the form of simple models have played a central role in assessing the likely range of future projections of global temperature by allowing the exploration of uncertainty dimensions like model structural choices, and in particular equilibrium climate sensitivity. In this role the connection between WG1, WG2, and WG3 have been facilitated, but there is potential for more integration, including through the emulation of regional climate changes.

Our session invites contributions from developers of new methods of both types, i.e., emulators in the form of simple models, and ESM emulators, including emulators representing regional climate changes, extremes and impacts, and their inclusion in IAMs. We also want to hear from users of emulators in the VIA and IAM research communities. We are particularly interested in addressing the potential of emulators of ESM output to facilitate the further connection between WG1, WG2, and WG3, ahead of the next IPCC report. We hope that the session will spur ideas and ways by which new scenarios' climate output could be more promptly available to impact and mitigation researchers, so that the same set of scenarios would be more easily and systematically explored across the whole IPCC report.

Physical climate storylines: applications and perspectives

Session ID #: 51

Lead organizer(s): Marina Baldissera Pacchetti[1] and Suraje Dessai[1]

Institutional Affiliation(s): University of Leeds[1]

Session Type: Research Session

Session Description:

This session aims at collecting perspectives on physical climate storylines, a recently developed approach to address climate risk amongst other issues related to the interpretation and use of model projections and the related uncertainty. Physical climate storylines are physically self-consistent unfolding of past events, or plausible future events.

Physical climate storylines are described as tools for different purposes: for example, the IPCC AR6 WG1 suggests that they can be used for the exploration of low likelihood, high impact events (IPCC, WG1, §4.8), of cross-scale interactions for the purpose of informing adaptation (§10.3.4.2), as pseudo-global warming studies (§10.3.2.2), as information distillation exercises for stakeholders (§10.5.3) where sometimes climate information is integrated with socio-economic information and delivered the form of narratives delivered through climate services (Cross-Chapter Box 12.2), or as an alternative approach to attribution studies (§11.2.4).

In the context of climate related risk, storylines intend to inform stakeholders about the possible impacts of climate hazards by either complementing or replacing probabilistic approaches to represent uncertainty about future climate. Storylines focus on plausibility rather than probability and can offer an alternative way of dealing with deep uncertainty that is more accessible to local decision makers.

Many physical climate storylines are developed with the aim of incorporating stakeholder perspectives either by addressing questions identified by stakeholders or by co-producing storylines with stakeholders themselves. Storylines can combine climate and socio-economic information relevant to stakeholders to facilitate decision-making, thereby overlapping with scenario approaches.

For this session, we encourage submissions that develop one of the following: (i) physical climate storylines to address information needs of stakeholders for climate risk assessment and management, (ii) critical/evaluative perspectives on existing physical climate storylines (iii) comparative evaluations of physical climate storylines and scenarios, (iv) perspectives on the physical climate storyline approach in general.

Scenarios for Policy-Relevant SRM Research

Session ID #: 87

Lead organizer(s): Tyler Felgenhauer[1], Doug MacMartin[2], Daniele Visioni[2], and David Morrow[4]

Institutional Affiliation(s): Duke University[1], Cornell University[2], American University[4]

Session Type: Workshop Session

Session Description:

Making well-informed decisions about solar radiation management (SRM), also known as solar geoengineering, will require information about how different plausible geoengineered futures would compare to plausible non-geoengineered futures. Much existing SRM modeling research, however, uses scenarios that are designed to answer physical science questions rather than policy questions about plausible use-cases for SRM.

The goal of this session is to spur discussion on the development and coordination of scenarios for policy-relevant research on SRM, focusing mainly on scenarios for climate modeling. The session will begin with a brief survey of scenario development needs identified in the US National Academy of Sciences report on SRM research, followed by an overview of some recent efforts to develop scenarios to facilitate policy-relevant research into SRM or solar geoengineering, focusing especially but not exclusively on scenarios for climate modeling.

In the remainder of the session, participants will discuss the following question: Which plausible uses of SRM are most important for researchers to study in order to provide a scientifically sound and useful foundation of knowledge to current and future policymakers?

For the purposes of this discussion, a method of and goal for deploying SRM counts as a “plausible use of SRM” if it is plausible to imagine some future policymaker seriously considering using SRM in that way and for that purpose. This is a purely predictive claim; calling a use “plausible” does not imply any evaluation of the use (e.g., as good or desirable).

Ecological

Representative Agricultural Pathways – Cross-scale and trans-disciplinary storylines for agricultural development and decision-making

Session ID #: 83

Lead organizer(s): Alex Ruane[1] and Roberto Valdivia[2]

Institutional Affiliation(s): NASA Goddard Institute for Space Studies[1] and Oregon State University[2]

Session Type: Workshop Session

Session Description:

Countries are in the process of developing their National Adaptation Plans and Nationally Determined Contributions as part of their commitment to the Paris Agreement while at the same time, policy makers are developing strategies and interventions for agricultural development that could lead to achieving the Sustainable Development Goals. The next generation of development scenarios will benefit from an enhanced representation of the dynamic nature of agricultural production and food systems. The future of agricultural systems further influences (and is influenced by) economic growth, competition for land and water resources, rural/urban contrasts, producer/consumer divides and dietary demands across heterogenous populations. The Agricultural Model Intercomparison and Improvement Project (AgMIP) is an international community of 1200+ climate, crop, livestock, economics and health experts working to assess and address current and future agricultural development and food security challenges. AgMIP assessments augment the SSP-RCP framework with additional agricultural sector development pathways called Representative Agricultural Pathways (RAPs), which are designed to be compatible across different scales of application (from local to national and international). Examples of RAP information include illustrative pathways for food prices, agricultural fees and subsidies, risk management instruments, farm technology, and costs for equipment, labor and transportation. Conditions of agricultural systems at sub-national level are typically inadequately addressed by agricultural and climate change related action plans that would enable the implementation of the countries' Vision 2030. Recent work in the AgMIP Climate Change Adaptation and Resilience (CLARE) project indicates that national and sub-national detail is particularly important to evaluate specific systems transitions building, sustainable, climate resilient and just agricultural systems. This session welcomes contribution on how scenarios for the agricultural sector can be linked into broader scenario efforts, the use of RAPs in the AgMIP project and (discussion on) how RAPs and additional agricultural information may be connected to the next generation of scenarios.

New and on-going work on scenarios for biodiversity & nature contributions to people

Session ID #: 50

Lead organizer(s): David Leclère[1] and Rob Alkemade[2]

Institutional Affiliation(s): International Institute for Applied Systems Analysis[1] and Wageningen University[2]

Session Type: Research Session

Session Description:

Models and scenarios are increasingly used in research and policy support contexts for biodiversity and nature contributions to people (NCP). While the SSP/RCP scenario framework was developed in the context of climate change, it is widely used to provide storylines and/or quantification to biodiversity & NCP-relevant scenarios as it provides the largest exploration of environmental change drivers to date, many being directly or indirectly relevant for biodiversity & NCP. At the same time, new scenario frameworks are developing to specifically foster biodiversity & NCP-relevant knowledge generation and decision-making support, such as the Nature Futures Framework (NFF), spurred by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). These scenario frameworks are applied for biodiversity & NCP in various contexts: scales, geographies, knowledge vs decision-making support, knowledge generation and decision-making practices, etc.

This research session aims to feature new and on-going scenario work that contributes to biodiversity & NCP knowledge generation and decision-making support. It welcomes submissions on biodiversity & NCP scenario development and application in a variety of contexts (scales, geographies, knowledge vs decision-making support, knowledge generation and decision-making practices). The session will feature 5 presentations and conclude with a discussion on advancements and challenges. It will be followed by a workshop session discussing the cross-fertilization and linking across scenario frameworks.

Catalyzing climate and biodiversity coupled scenarios for assessments and policy

Session ID #: 59

Lead organizer(s): HyeJin Kim[1], Paula Harrison[2], Laura Pereira[3]

Institutional Affiliation(s): Martin Luther University Halle-Wittenberg[1] and UK Centre for Ecology & Hydrology[2], University of the Witwatersrand, South Africa[3]

Session Type: Workshop Session

Session Description:

O'Neil et al. (2021) in "Achievements and needs for the climate change scenario framework" highlighted the need to improve relevance of climate scenarios beyond the climate research community. The SSP-RCP scenarios have been applied in biodiversity and ecosystem services models (e.g. BES-SIM), but the lack of biodiversity interventions in the SSP scenarios reduced their relevance for IPBES assessments (Rosa et al. 2020). IPBES is therefore developing its own scenarios and modelling framework -- Natures Futures Framework (NFF) -- that places nature and people at the center and facilitates the inclusion of diverse worldviews (Pereira et al. 2020). Similarly, communities such as TWI2050 and FABLE working on Sustainable Development Goals (SDGs) have used a mix of SSP-RCP and other scenario frameworks with different successes and challenges. In this light, this session brings together the leading experts from these communities to discuss how various scenarios and modelling frameworks and ongoing efforts could be coupled (or mapped to each other) to improve their effectiveness in informing multiple policy agendas (e.g. Paris Agreement, CBD post 2020 biodiversity framework, and SDGs).

The aim of this workshop is to explore ways to cross-fertilize the SSP-RCP and NFF scenario frameworks and to catalyze collaboration in broader scenario and modelling communities going forward. The discussion will focus on the needs, challenges and opportunities for better linking scenario frameworks to IPBES/IPCC assessments and relevant policy goals. It welcomes submissions for panel members who would be willing to prompt an interactive discussion with the audience by sharing their experiences working across different scenario frameworks in a variety of contexts (scales, geographies, assessment vs decision support) and/or in linking scenarios to inform policy goals. The workshop will be preceded by the research session on new and ongoing work on scenarios for biodiversity and nature contributions to people.

References: O'Neill, B. C. et al (2020). Nat. Clim. Chang. 10, 1074–1084, Pereira, L. M. et al (2020). People and Nature 2, 1172–1195, Rosa, I. M. D. et al (2020). Global Ecology and Conservation 22, e00886.

Blue Scenarios: Ocean and Fisheries in Earth System Models

Session ID #: 203

Lead organizer(s): Mary Gasalla[1] and Jessica Strefler[2]

Institutional Affiliation(s): University of Sao Paolo[1] and Potsdam Institute for Climate Impact Research[2]

Session Type: Workshop Session

Session Description:

Oceans cover most of the surface of our planet and are home to a wide variety of current and future human activities and environmental concerns. Yet, there are important gaps in the incorporation of scenarios, especially the SSPs, in ocean and fisheries research. This workshop will address the use of scenarios in ocean and fisheries research and their incorporation in Integrated Assessment Models and Earth System Models. The session will explore the scenarios covering the sustainable use of blue resources, the role of ocean-based carbon dioxide removal, and how to make progress on the use of scenarios. This session invites contributions and examples of the use of scenarios, particularly SSPs for the “blue sector”, including methodological progress, co-benefits, research gaps, ocean-based carbon dioxide removal. While addressing methodological options in climate, biodiversity and socioeconomic development scenarios, the workshop also welcomes examples of scenarios based on both qualitative narratives and earth system modeling approaches.

Impacts/Vulnerability/Adaptation

Quantitative scenarios for adaptation and adaptive capacity

Session ID #: 15

Lead organizer(s): Nicole van Maanen[1], Tabea Lissner[1], and Marina Andrijevic[2]

Institutional Affiliation(s): Climate Analytics[1] and International Institute for Applied Systems Analysis[2]

Session Type: Research Session

Session Description:

In this session, we call for submissions from researchers and practitioners working on quantitative approaches to assess concepts relevant to better understanding adaptation broadly, and within the context of Shared Socioeconomic Pathways (SSPs) specifically.

Adaptation is currently underrepresented in quantitative global assessments of climate change. At the same time, adaptation is pivotal for reducing the magnitude of damages caused by extreme weather events, or slow onset climate change such as sea level rise. By not accounting for possible pathways of adaptation or when just assuming a certain level of adaptation will take place, models could risk to underestimate climate impacts, as well as possibly downplay the urgency and the extent of mitigation that is required.

Compared to mitigation, adaptation and adaptive capacity are more challenging to define, as adaptation is primarily context-specific, interacts on many scales, involves various stakeholders and actors, and provides more local rather than global benefits. Whether and to what extent an adaptation option can be deployed depends on adaptive capacity, which in turn depends on the present and future socio-economic conditions of countries. In this context, “adaptation challenges” pillar of the SSPs should be advanced to address the gap in research which is currently missing quantitative assessments of adaptation pathways and adaptive capacity.

Quantifying adaptive capacity in a fashion suitable for inclusion into climate impact models and integrated assessment models is an important step towards better-constrained estimates of the future co-evolution of impacts and adaptation. Proposals on how to assess adaptive capacity have become available (e.g., Andrijevic et al., 2021), but an inclusion by the modelling community is the next necessary step. To that end, we would particularly encourage submissions from researchers and practitioners working directly within modelling community to understand the entry-points in IAMs and/or other impact models.

Beyond illustrative scenarios - novel approaches to assess future climate risks

Session ID #: 32

Lead organizer(s): Carl-Friedrich Schleussner[1] and Joeri Rogelj[2, 3]

Institutional Affiliation(s): Climate Analytics[1], International Institute for Applied Systems Analysis[2], and Imperial College London[3]

Session Type: Workshop Session

Session Description:

Climate science often uses static illustrative scenarios to understand the impacts of a wide range of emission trajectories and associated warming outcomes. These scenarios are useful to align assumptions across research communities, but there is a risk that they become outdated and constrain the scope of research endeavors. With 90% of global emissions covered by net zero pledges, the policy discourse has shifted away from questions that pitch mitigation versus no-mitigation, to questions of how much mitigation, by whom, how fast and with which technologies. In this context, also the separate consideration of climate change adaptation and mitigation questions is increasingly left behind in favor of exploring questions of low-carbon climate resilient development. This new focus and dynamism in climate policy requires climate science to respond. Novel, versatile scenario approaches that can explore the implications of various portfolios of mitigation and adaptation measures are necessary, with a key component being a dynamic representation of the climate system that links them. Ultimately, such approaches will improve the integration of climate impacts into integrated assessment models, thereby paving the way for a true cross-working group integration in scenario development. In this session, we want to explore the latest advancements in integrating mitigation and adaptation questions in scenario development, as well as key research questions that would benefit from such an advance. This includes approaches towards improved climate impact integration in scenario development, how specific scenario components - such as land-based CO2 removal - can impact adaptation and mitigation, climate emulator development and integration, assessments of climate impacts for warming rates or temperature overshoots, and key questions this research can contribute to, such as those related to loss and damage or financial risk assessment.

Integrating sectoral impacts models into IAMs and development of integrated SDG scenarios

Session ID #: 58

Lead organizer(s): Edward Byers[1], Adriano Vinca[1], Zarrar Khan[2], Kiyoshi Takahashi[3], and Mathijs Harmsen[4]

Institutional Affiliation(s): International Institute for Applied Systems Analysis[1], Pacific Northwest National Laboratory[2], National Institute for Environmental Studies, Japan[3], Netherlands Environmental Assessment Agency[4]

Session Type: Workshop Session

Session Description:

In recent years a key area of innovation in IAMs has been improved integration of sectoral impacts models and data, to better incorporate biophysical and socioeconomic processes into integrated assessment frameworks. This includes linkages with land-use and agro-economic models, hydrological and climate model data, air quality and health assessments and distributional effects on labour, the economy, vulnerability and poverty. Numerous studies have identified both synergies and tradeoffs between various dimensions of the SDGs

In the wider context of the sustainable development agenda, IAMs are increasingly well suited to explore scenarios that aim to meet development targets (such as SDGs) and minimize tradeoffs between sectors, society and environment. Short- and long-term tradeoffs also exist between the development and climate mitigation agendas.

This workshop will feature a number of activities to share knowledge, open discussion and strengthen the networks of participants.

Session will begin with 2 short presentations from invited speakers on sectoral-impacts and SDG studies to introduce the motivations and innovations of their work, in particular with respect to the scenario design. Registered participants will be encouraged to familiarize themselves with 2-3 papers before the workshop.

A scoping exercise will be used to gather ideas on novel approaches and topics on the workshop theme, broadly on methodological approaches to sectoral impacts representation in IAMs or on cross-sectoral / SDG scenario design. This may include participatory audience activities such as smart-phone voting and a speed-dating round.

Roundtable discussions amongst participants will develop the ideas further to be reported back to the workshop.

A closing panel discussion with interventions from the audience will identify and reflect on the most promising outcomes of the session.

Exploring and expanding the cross-border dimensions of the SSPs

Session ID #: 69

Lead organizer(s): Stefan Fronzek[1], Magnus Benzie[2], Henrik Carlsen[2], Timothy Carter[1], Christopher Reyer[3]

Institutional Affiliation(s): Finnish Environment Institute[1], Stockholm Environment Institute[2], Potsdam Institute for Climate Impact Research[3]

Session Type: Research Session

Session Description:

Climate change impacts, adaptation and vulnerability studies tend to confine their attention to impacts and responses within the same geographical region. However, this approach ignores cross-border climate change impacts that occur remotely from the location of their initial impact and that may severely disrupt societies and livelihoods, e.g. through international trade, financial markets and issues related to migration and security.

For example, the 2011 flood in Thailand destroyed industrial parks of the electronics sector with wide-ranging consequences for the economy globally through disruptions of supply chains. The potential impacts of a recurrence of a similar event in the future depend on the vulnerability of the region directly affected, but also on what kind of ties and connections with other parts of the world are in place – both aspects can vary greatly under alternative scenarios of the future.

This session attempts to explore how current scenario frameworks such as the Shared Socio-economic Pathways (SSPs) can be used and extended to explore the cross-border dimensions of climate change impacts. How may the connections between countries and regions evolve into the future, how might these affect the propagation of climate change risks across borders, and what are possible responses to these changing risks?

We welcome contributions on the following topics:

- Studies advancing scenario assumptions that determine the level of inter-regional connectivity and cooperation
- Quantitative and qualitative assessments of the effects of cross-border climate change impacts under different scenarios using indicator, model-based (e.g. trade, integrated assessment, migration models) or stakeholder-driven approaches
- Development and discussion of response options of actors at various scales to address cross-border impacts of climate change under a range of different scenarios

The session is organized by the EU-funded CASCADES project (CAScading Climate risks: towards ADaptive and resilient European Societies – www.cascades.eu).

Addressing the gender dimension in socioeconomic scenarios, Part I: impacts of climate change and policy on gender inequality

Session ID #: 93

Lead organizer(s): Caroline Zimm[1] and David Bohl[2]

Institutional Affiliation(s): International Institute for Applied Systems Analysis[1] and Pardee Center for International Futures, University of Denver[2]

Session Type: Workshop Session

Session Description:

While it is recognized that gender matters in climate change mitigation and adaptation efforts and human development, to date it has been challenging to empirically address the gender dimension in socioeconomic scenarios – both regarding impacts of climate change and related policies on gender (in)equality, as well as the impact of gender (in)equality as a driver of change.

Accounting for gender differentials in policy is essential because women generally have reduced access to socioeconomic resources, services and social protection. A growing body of gender-focused analysis highlights both the disproportionate vulnerability faced by women during shocks (i.e, induced by climate change or COVID-19), and the disproportionate impact that investments can have on their development prospects. Meanwhile, risk perceptions and climate-related attitudes and behavior vary by gender.

Explicitly accounting for gender differentials in future socioeconomic scenarios requires both baseline empirical evidence and a scenario design that is gender-responsive. Gender- and sex-disaggregated data are becoming available from various sources. Nevertheless, there has been limited attention to sex-specific outcomes in long-range projections and scenario frameworks (e.g., SSPs). Much of our analysis may partially misrepresents outcomes related to half the global population and potentially sustainable human development policies. Accounting for gender heterogeneity enables more realistic representation of current and future socioeconomic development relevant to sustainable development.

This workshop is the first session of a two-workshop series exploring the progress, challenges, and opportunities associated with gender- or sex-disaggregate indicators in long-range projection and scenario analysis. In Part I we focus on the impacts of climate change and policy on gender inequality. This workshop aims to explore current empirical work which explicitly addresses the gender dimension in climate-related development issues (e.g., gender sensitive scenarios). We welcome abstract submissions on research and analysis, or evidence-based practice related to gender- or sex-differential impacts of climate change and other disruptions.

Note: please see Part II of this session (ID 94: Addressing the gender dimension in socioeconomic scenarios, Part II: promoting gender equality as a driver of change) in Population/Gender/Socioeconomic Change

Reference scenarios for community use: treating climate change impacts, policy responses and other factors

Session ID #: 95

Lead organizer(s): Brian O'Neill[1], Tim Carter[2], and Elmar Kriegler[3]

Institutional Affiliation(s): Pacific Northwest National Laboratory[1], Finnish Environment Institute[2], and Potsdam Institute for Climate Impact Research[3]

Session Type: Research Session

Session Description:

Climate change research is often structured around studying a feature of interest, such as a type of impact or a policy response, by comparing a simulated future with that feature to a future without it, known as a "reference scenario" or in some contexts as a "baseline". For that reason, reference scenarios are typically defined as futures in which there are no climate change impacts or climate policy responses. The SSP baselines are prominent examples of such reference scenarios.

However, reference scenarios can also be defined with impacts or policies contained within them, and for some purposes are more useful than no-impact, no-policy baselines. For example, baselines that include current mitigation or adaptation policies may serve as more credible and relevant reference scenarios and naturally connect to the concept of Shared Climate Policy Assumptions (SPAs); baselines that include some climate change impacts may serve as more useful reference scenarios for analyses of additional impacts.

This session invites abstracts on applied or conceptual research related to the development or use of reference scenarios that go beyond traditional no-impact, no-policy baselines. Applied topics of interest include, but are not limited to, assessing the benefits of avoided impacts, estimating the costs of additional impacts, the use of baselines that already include mitigation or adaptation policy, and the use of reference scenarios beyond the climate change issue (such as for biodiversity or sustainable development studies). Conceptual topics of interest include how to design reference scenarios with mitigation policy at a time of rapidly evolving pledges and national policies, how to connect policy reference scenarios to the concept of SPAs, how logically and credibly to integrate future climate projections, impacts and policy in baselines, and how to cope with uncertainty in impacts and the effect of policies in reference scenarios intended for wide use.

In all cases the goal will be to inform discussion within the session of whether and how the SSP-RCP or related scenario frameworks could be refined or modified to incorporate a wider variety of reference scenarios for common use across the research community. The session will be organized as 4-5 research talks selected from submitted abstracts, leaving sufficient time for discussion among session participants.

Mitigation/Energy

Future lifestyle changes at different geographical scales and in response to societal shocks (e.g., Covid-19)

Session ID #: 64

Lead organizer(s): Nicole van den Berg[1], Johannes Morfeldt[2], Oreane Edelenbosch[1], Daniel Johansson[2], Charlie Wilson[3], and Jörgen Larsson[2]

Institutional Affiliation(s): Utrecht University[1], Chalmers University of Technology[2], and Oxford University[3]

Session Type: Research Session

Session Description:

Lifestyle changes and demand-side transformations are critical enablers of stringent mitigation pathways in line with Paris Agreement targets. IAMs are traditionally stronger on supply-side measures and technological development than modelling diverse demand-side transformations. Potentials for transformations differ across countries and regions and can be affected by societal trends, policies, and norms. Nevertheless, they can significantly reduce emissions by decreasing product and service demand and enabling more energy-efficient services. It is critical to explore how demand-side transformations can be stronger represented within IAMs and how hybrid approaches, i.e. combined scenario and model approaches where IAM-outputs are used to describe the development in the "rest of the world" and where national scale scenarios and models are used for capturing the local specific context and the fine-scale nature of demand-side transformations.

Pandemics and other societal shocks have dramatic effects on social and economic activity. The policy responses triggered by Covid-19 forcibly changed lifestyles. However, change in the material and social fabric of life is strongly path-dependent. Long-lived infrastructures endure, and institutions provide stability. Daily practices are habitual, as are organisational modes of thinking and planning. Following a shock, the response of locked-in systems is to seek a return to stability - the 'old normal.' But humans' capacity to adapt allows for new lifestyle practices to emerge and embed, such as homeworking, e-retail, localised movement, e-health, and food preparation. Societal shocks can shape lifestyles over the medium-to-long term with related impacts on energy, materials and carbon emissions.

This session aims to explore the geographical and contextual detail needed for modelling lifestyle changes and demand-side transformations. We encourage presentations and posters on:

1. Scaling up demand-side transformations from national to regional and global levels and hybrid modelling using rest-of-world pathways to assess local developments.
2. Incorporating societal shocks, such as impacts of Covid-19, in modelling over decadal timescales.
3. Interlinking input-output analysis with IAMs to better understand rebound effects when assessing demand reductions.

Digitalisation scenarios and implications for climate change

Session ID #: 66

Lead organizer(s): Charlie Wilson[1], Laurent Drouet[2], Felix Creutzig[3], Zoi Vrontisi[4], and Elena Verdolini[2]

Institutional Affiliation(s): University of Oxford[1], RFF-CMCC European Institute on Economics and the Environment[2], TU Berlin[3], and E3 Modelling[4]

Session Type: Research Session

Session Description:

Digitalisation is a powerful and pervasive 'megatrend' shaping social and economic activity across the world. Digital devices, hardware, infrastructure, and general-purpose applications like the internet and artificial intelligence continue to transform how we work, live, interact, organise, participate, shop, and relax, and how goods and services are provided and consumed.

The net impacts of digitalisation on mitigation and adaptation of climate change remain highly uncertain. For example, digitalisation can help reduce energy demand by enabling shared and reduced mobility, smart metering, and data analytics. Conversely, digitalisation can increase electricity demand in growing IT sectors: data centres, network connections, cryptocurrencies are just a few of the examples. Digitalisation also has system wide impacts through changing patterns of consumption, political agency, and social organisation. Through these different forms of impact, digitalisation may have dramatically divergent consequences, steering us towards a digital utopia of efficient service provision in optimised systems ... or a digital dystopia of corporate exploitation and runaway energy demand. This bifurcation in future trajectories is shaped by institutions and governance of data, privacy, market power, democratic participation, skills, and sovereign rights in a digital age.

A systematic exploration of scenario narratives for digitalisation in the Anthropocene is a necessary precursor to robust quantitative modelling of emission impacts. This session will explore how the development of digitalisation narratives can support the modelling and assessment of digital transformation in a decarbonizing energy sector and the economy-wide low carbon transition.

Improving the representations of Carbon Dioxide Removal (CDR) options in the SSPs

Session ID #: 20

Lead organizer(s): Keywan Riahi[1], Haewon McJeon[2], and Frances Wang[3]

Institutional Affiliations: International Institute for Applied Systems Analysis[1], Pacific Northwest National Laboratory[2,1], and ClimateWorks Foundation[3]

Session Type: Workshop Session

Session Description:

This workshop sessions discusses the role of carbon dioxide removal (CDR) options in reaching stringent climate targets and how to improve the representation of CDR in the SSPs and the underlying emissions models. Limiting global warming to 1.5˚C will require large-scale carbon dioxide removal (CDR) to aid in deep decarbonization towards net zero CO2 emissions, and to reverse accumulated emissions in the longer term. Most integrated assessment modeling scenarios to date have emphasized afforestation or bioenergy with carbon capture and afforestation. As the negative side-effects of relying on large-scale land-intensive strategies (tens of Gt-CO2/year) have become clear, several recent studies have suggested alternative approaches for carbon removal including direct air capture, direct ocean capture, accelerated weathering, and increasing soil carbon density. This session aims to provide a forum for modeling teams, technology experts, and stakeholders to exchange ideas and improve representation of CDR in the SSPs and other integrated modeling scenarios. We welcome abstract submissions featuring new scenario analysis on carbon removal technologies and their potential side-effects and co-benefits that could influence their deployment at global and regional scales. Additionally, we welcome submissions with a social science, policy or technology focus that may help to understand the pace of deployment, public perception and other conditions under which CDR options may deploy into the market.

CDR might be needed to limit warming to well below 2C. Many CDR options are however not well represented in the SSPs or most of the related climate change pathways and models. This session tries to identify community activities to improve our understanding of CDR and how to include them better into the SSP framework.

'The session will include four complementary presentations (12 + 3 min) on key dimensions of future CDR deployment, followed by a discussion about possible community activities to improve their representation in the SSPs and related models.

Possible presentations:

- Keywan Riahi (moderators) – Introduction on the role of CDR is current mitigation pathways and the need for better including CDR in the SSPs
- Presentation on future CDR scenarios, co-benefits and side-effects
- Presentation on expert opinion and public perception about CDR
- Presentation on CDR from the perspective of technology diffusion, innovation, and life-cycle assessments
- Presentation on the policy perspective – how can we incentivize CDR and deal with issues of permanence, long-term monitoring, and associated legal/institutional challenges.

Scenarios of material stocks, flows, services, and practices: Exploring nexus approaches to address climate change, air pollution and sustainability.

Session ID #: 43

Lead organizer(s): Adriana Gomez Sanabria[1], Helmut Haberl[2], Edgar Hertwich[3], Oreane Edelenbosch[4], Gamze Ümlü[1], Jihoon Min[1], and Dominik Widenhofer[2]

Institutional Affiliation(s): International Institute for Applied Systems Analysis[1], University of Natural Resources and Life Sciences, Austria (BOKU)[2], Norwegian University of Science and Technology[3], Copernicus Institute of Sustainable Development, Utrecht University[4]

Session Type: Research Session

Session Description:

This session will focus on exploring approaches to analyse society-nature interactions and their implications for material cycles, GHG, air pollution, waste and sustainable development. The 'stocks-flows-services/ practices' approach connects biophysical stocks (e.g., buildings, infrastructure and machinery) and flows involved in social metabolism to the delivery of services. It can help to analyse relationships between resource use and the practices of everyday life. It is well known that material extraction and processing is a significant cause of environmental impacts and resource inputs ultimately translate into wastes and emissions i.e., pollution. Furthermore, current research of consumption practices focuses on structure-agency issues at the heart of socio-metabolic research. However, in current climate and sustainability scenarios, material demand is often directly related to economic indicators and as such cross-sectoral interactions between material stock and flows are not account for. Moreover, consistent representations of circular strategies (extraction, production, manufacturing, use, end of life, waste management) and consumer practices are still at a very early stage in scenario narratives. Better understanding these systemic interrelations is particularly important when aiming to forge demand-side solutions that address critical social goals such as eradicating poverty and hunger while at the same time reducing resource use in absolute terms, as required e.g., for meeting the Paris climate goals. This session aims to bring together different research communities to build and discuss consistent scenarios that might enable societies to satisfy human needs without compromising the climate and sustainability.

Narratives for scenarios and pathways to provide decent levels of energy services at low demand of energy and resources

Session ID #: 70

Lead organizer(s): Yamina Saheb[1], Gregory Nemet[2], Leila Niamir[3], Alessio Mastrucci[4], and Bas van Ruijven[4]

Institutional Affiliation(s): Sciences Po[1], Paris, University of Wisconsin, Madison[2], Mercator Research Institute on Global Commons and Climate Change (MCC)-Berlin[3], and International Institute for Applied Systems Analysis[4]

Session Type: Workshop Session

Session Description:

This workshop session will generate ideas for narratives and scenarios that reduce the demand for energy, materials, land, water, and resources in end use sectors, while providing decent levels of energy services. The overall goal is to gather input to develop a more robust set of pathways for how the combination of high energy service provision, and low resource demand could realistically come about over the next three decades. Specific foci include assessment of decent living standards and sufficiency; social and technological innovation including through digitalisation; as well as system change, infrastructure, and novel services; and how each play a role in facilitating low energy demand outcomes.

An important focus of the discussion will be on the importance of sufficiency, technological, and social innovations in demand reduction. Sufficiency is defined as a set of policy measures and daily practices which avoid the demand for energy, materials, land, water, and other natural resources, while delivering wellbeing for all within planetary boundaries (Saheb 2021).

As background, The French negawatt scenario (Negawatt 2003) (Negawatt 2011)(Negawatt 2017) is the first known scenario to go beyond efficiency improvement to reduce energy demand. The last update of this scenario shows high mitigation potential of consumption-based emissions and those related to the use of materials (Negawatt 2022). (ADEME 2022) and (RTE 2021) show similar results. At a global level, (Grubler et al. 2018) (Millward-Hopkins et al. 2020)(Kuhnhenn et al. 2020) (Fishman et al. 2021) found large mid-century mitigation potential from the adoption of sufficiency measures, behavioural, social and technological innovations and (Mastrucci et al. 2021) reached similar conclusions for global heating and cooling demand while (Barrett et al. 2021) showed similar results from in-depth analysis of low-energy demand futures specific to the UK.

The role of non-CO2 greenhouse gas emissions in mitigation scenarios and climate change

Session ID #: 6

Lead organizer(s): Lena Höglund-Isaksson[1]

Institutional Affiliation(s): International Institute for Applied Systems Analysis[1]

Session Type: Research Session

Session Description:

The urgency of mitigating non-CO2 greenhouse gas emissions methane, nitrous oxide and fluorinated gases (HFCs, PFCs and SF6) in addition to deep decarbonization of energy systems, is becoming increasingly evident if the world is to stay below 1.5 degrees warming both in the short- and long- terms. The idea of this session is to bring together researchers from the three communities (a) non-CO2 emission and mitigation scenarios, (b) earth system models and climate change impacts, and (c) technical opportunities for direct atmospheric removal of methane, with a purpose to improve the understanding of how different opportunities to limit warming from short-lived climate forcers can enable safe warming levels in the next few decades, while not forgetting the necessity of energy transformations and CO2 emission reductions to ensure safe warming levels in the mid- to long terms. This session therefore welcomes contributions on global and regional projections of non-CO2 emissions, mitigation potentials and costs, assessments of potentials for atmospheric removal of non-CO2 GHGs, and the timing and treatment of non-CO2 emissions in climate change mitigation scenarios, and their impacts on climate change in (reduced form) climate models. We also welcome contributions on the identification of policies and regulatory instruments in support of a continuous maintenance of safe levels of warming in both the short- and long terms, e.g., studies investigating implications of using single policy instruments to jointly address short- and long-lived gases.

National deep decarbonisation scenarios: policy analysis and global narratives

Session ID #: 7

Lead organizer(s): Johannes Svensson[1] and Daniel Buira[2]

Institutional Affiliation(s): IDDRI, France[1] and Tempus Analitica[2]

Session Type: Research Session

Session Description:

This session will discuss country-driven national deep decarbonisation scenarios consistent with global carbon neutrality between 2050 and 2070, in line with IPCC estimates of required emission reductions for achieving the Paris Agreement global mitigation target (Rogelj et al., 2018). The focus will be on the policy lessons that can be derived for national decision-making regarding synergies and trade-offs with country non-climate objectives, and on priority short-term policies and actions, with a focus on where shifts from current paths are most required. In addition to insights from individual country-scale analyses, the session will discuss how high-resolution national pathways defined in a bottom-up manner can inform global climate dialogues through the global enablers the national pathways depend upon (paper currently in process).

This session will be an opportunity to reflect on the methodological challenges faced when developing national scenarios, capturing a broad set of key national circumstances, with the primary objectives to inform in-country and international stakeholder consultation. These objectives require adopting a pathways design framework articulating detailed national narratives and dashboards in an iterative process guided by global benchmarks with detailed accounts of sectoral transformations (Waisman et al., 2019; Lefèvre et al., 2020; Svensson et al., 2021). The session will also discuss the methodological challenges of a bottom-up approach to the articulation between global and national scenarios, including the characteristics necessary in national pathways to be used by such an approach. The objective of this approach is to elaborate global narratives resulting from the international enablers emerging from national scenarios, and it is complementary to the widely used SSP/RCP/SPA scenario framework (Kriegler et al., 2014; Riahi et al., 2017; van Vuuren et al., 2017; O'Neill et al., 2020), using global scenarios as boundary conditions and consistency checks to national scenarios (van Vuuren et al., 2017).

Feasibility of scenarios

Session ID #: 48

Lead organizer(s): Aleh Cherp[1] and Jessica Jewell[2]

Institutional Affiliation(s): Central European University[1] and Chalmers University of Technology[2]

Session Type: Research Session

Session Description:

The policy impact and relevance of transition scenarios depends, in large part, on whether they are viewed as 'feasible', i.e. likely to unfold in the real world rather than only in the world of models. Yet, the science of assessing feasibility of scenarios is just emerging and at the moment struggling with a number of conceptual and methodological challenges. This session will discuss these challenges with reference to specific cases of assessing feasibility of national or global scenarios (pathways, roadmaps, etc.) as well as sectoral transitions relevant for addressing global long-term sustainability challenges. The session will not be able to accommodate narrow discussions of technical, economic or geophysical feasibility of specific technologies. The presentators are encouraged to focus on the following questions: "how is feasibility defined?", "how is feasibility assessed?", "how are the results of feasibility assessment used?". More theoretical presentations on conceptualising feasibility and exploring the principles of sound feasibility assessment are also invited.

Assessing the Impacts of the Global Energy Transition in the Global South

Session ID #: 56

Lead organizer(s): Jude Kurniawan[1], Andreas Goldthau[2], and Maria Apergi[1]

Institutional Affiliation(s): Institute for Advanced Sustainability Studies, Potsdam[1], Willy Brandt School of Public Policy, University of Erfurt[2]

Session Type: Research Session

Session Description:

To achieve the Paris climate target of "well below 2 degrees" of global warming, the global energy system needs to decarbonize. This means switching from a fossil fuel-based system to one that relies on renewables and low carbon technologies. While the push in the global energy transition is ongoing delivering numerous benefits, it is also creating new inequalities. The risks posed by this transformation will impact especially countries of the Global South, in part due to the lack of access to technologies and capital. What, then, can be done to ensure that these countries can also make the transition to a low-carbon economy? Although energy transition scenario studies may adopt a global perspective, the focus will be on countries of the Global South. This session invites oral and poster presentations on methodological insights for analyzing the social dimensions of the global energy transitions, touching on various issues including the politics of climate change mitigation; questions related to distributional justice; the political economy of national decarbonization; and the opportunities and barriers in the present of the systemic change. In this session we will discuss pertinent aspects including financial flows, the economics of going low carbon, and the role of technology and policy.

Regional and subnational scenarios of decarbonization and sustainable development

Session ID #: 104

Lead organizer(s): Gokul Iyer[1], Ryna Cui[2], and Vaibhav Chaturvedi[3]

Institutional Affiliation(s): Pacific Northwest National Laboratory[1], University of Maryland[2], and CEEW India[3]

Session Type: Research Session

Session Description:

As countries develop near- and long- term decarbonization strategies, decision-makers are interested in understanding the implications of national climate strategies at regional and subnational scales. Of key interest is to understand institutional and political economy issues surrounding transitions toward a low-carbon economy and the implications of those transitions for sustainable development priorities including but not limited to human health, employment, and equity at these scales. Existing scenarios literature largely focuses on global and national pathways toward deep decarbonization. Yet, a burgeoning literature is exploring regional and subnational scenarios in the U.S., China, Latin America and Caribbean, and other key emitting countries across the globe. This session will solicit presentations and posters based on recent and ongoing studies on regional and subnational scenarios focused on long-term decarbonization strategies. This session will also include presentations on implications of national decarbonization goals at subnational scales for various human and natural systems such as energy, water, land, and economy and the subsequent consequences for sustainable development priorities such as employment, human heath, economic development, food security, and water scarcity at those scales. While targeted at quantitative scenarios developed by integrated assessment models, the session will also be open to studies based on other methodologies, including qualitative methodologies and combined qualitative and quantitative scenario approaches.

Population/Gender/Socioeconomic Change

Updating the population and economic projections in the SSPs

Session ID #: 17

Lead organizer(s): Rob Dellink[1] and Samir KC[2]

Institutional Affiliation(s): OECD[1] and International Institute for Applied Systems Analysis[2]

Session Type: Workshop Session

Session Description:

The Shared Socioeconomic Pathways (SSPs) are underpinned by projections of population by age, sex, and educational attainment, as well as by projections of economic activity. Since the original projections were published, there have been significant developments that imply new population and economics projections would be quantitatively and qualitatively different. This session presents an analysis of how updated tools, newer data, and state-of-the-art assumptions affect the long-term projections of the socioeconomic drivers in each of the SSP scenarios, using the original storylines.

This session aims first to explore advancements made in the past decade and new approaches in population forecasting, including projections of demographic heterogeneity. Updated population dynamics scenario projections will be presented building on the assessment of future fertility, mortality, and migration. This session seeks to identify state of the art assumptions and scenarios for fertility, mortality, and migration, including new developments in the demographic community that can feed into the SSP scenarios.

Next, updated economic projections will be presented, exploring how recent economic trends and updated short-term economic forecasts affect the long-term GDP scenarios. The session will highlight the role of key assumptions on income convergence, trade openness, and the role of natural resource rents in making long-term economic scenarios.

Third, a dedicated part of the discussion will center on the long-term projections on the recovery from COVID-19 and the effects of uncertainty surrounding this on the long-term socioeconomic drivers.

This session will highlight how state-of-the-art future projections of environmental pressure, not least of greenhouse gas emissions, may benefit from a new generation of population and economic projections for the SSPs. It will also show how a full set of updated population and economic scenario assessments can improve on more ad-hoc updates of population and economic projections using only a recalibration to the latest economic data.

Multiscale and multidimensional demographic projections for the extended global scenario frameworks

Session ID #: 85

Lead organizer(s): Leiwen Jiang[1], Samir KC[2], and Bryan Jones[3]

Institutional Affiliation(s): Shanghai University[1], International Institute for Applied Systems Analysis[2], and City University of New York[3]

Session Type: Research Session

Session Description:

Population dynamics has been a key element in developing socioeconomic and environmental scenarios, including the Shared Socioeconomic Pathways (SSPs) for addressing climate change mitigation and adaption challenges. Over the past years, many efforts have been invested in updating and extending demographic projections of the global basic SSP scenarios, acknowledging the importance of changing population size, characteristics, spatial distributions and their associated production and consumption behavior. This session seeks to extend and improve the existing population scenarios that explicitly assess demographic and spatial heterogeneity. They are projections of changes in not only population sizes, compositions by age, sex, education, rural-urban residence, household structure, and income, but also their distributions across national, subnational, and spatial scales. By examining the available methods and data for producing the multiscale and multi-dimensional projections and discussing the methodological differences, it helps understand the challenges and implications associated with demographic scenarios over small areas and long time-horizons. The session also aims to update and explore new development in the research community to consider the feedback of external forces such as climate change, conflict, and COVID-19 pandemic on population dynamics. This is in line with the new initiatives in the integrated assessment modeling community to better account for interactions and causal mechanisms between different sectors and systems. Thirdly, the session invites novel, interdisciplinary, and evidence-based research submissions that develop localized sociodemographic scenarios tailored to specific communities and apply them to supporting community-based policies for building resilience through an equity and well-being enhancement lens.

Improving the representation and usability of socio-political factors in the Shared Socioeconomic Pathways (SSPs)

Session ID #: 23

Lead organizer(s): Ariel Macaspac Hernandez[1], Elisabeth Gilmore[2], Halvard Buhaug[3], Håvard Hegre[4], and Elmar Kriegler[5]

Institutional Affiliation(s): German Development Institute[1], Carleton University[2], Peace Research Institute Oslo (PRIO)[3], Uppsala University[4], Potsdam Institute for Climate Impact Research[5]

Session Type: Workshop Session

Session Description:

Socio-political factors, underpinned by institutions and governance, affect the vulnerability from climate hazards as well as the capacity to implement effective responses to climate change, including mitigation, adaptation, and achievement of the SDGs.

Presently, in the Shared Socioeconomic Pathways (SSPs), the political dimensions of development are described in aggregate assumptions about political changes in accompanying storylines. The implication is that the challenges posed by climate change and to the achievement of the SDGs, especially those that are known to be sensitive to the political context, such as food and economic security, may be poorly characterized or - more problematically – underestimated. In this roundtable, we discuss how to improve the representation of socio-political factors in scenarios by elaborating the evidence for characteristics of political context that may be critical for the evaluation of climate impacts and the effectiveness of mitigation and adaptation actions and opportunities for approaches to integrate these factors into the SSPs.

Two invited presenters will motivate these efforts that better harness the knowledge from political and social sciences. First, conceptual frameworks and theoretical models are needed to contextualize the various socio-political factors that better capture historical experiences, especially those that will most likely define variations between countries. For example, a former colony that emerged from a violent civil war and is highly vulnerable to climate change will have a distinct set of values and resource provisions that will inform its capacity for societal transformation. Second, socio-political dimensions can be better quantified along the existing SSPs to improve internal consistency and integration with modeling efforts.

The panel is relevant for modelers, social scientists and users. As socio-political trends and factors mediated by institutions are key to transformative actions, modelers can gain insight into how to include these factors in their scenarios. For social scientists, the panel can be beneficial by complementing systematic inquiry of “what it is” with “what ought to be” and “how to get there from here”. Taken together, this collaboration will enhance “goal-oriented” thinking in social science and the usability and salience of IAM efforts.

Qualitative and quantitative approaches to represent regional capacity for mitigation and adaptation in the Shared Socioeconomic Pathways (SSPs)

Session ID #: 82

Lead organizer(s): Elina Brutschin[1], Silvia Pianta[2], and Felix Schenuit[3]

Institutional Affiliation(s): International Institute for Applied Systems Analysis[1], RFF-CMCC European Institute on Economics and the Environment[2], and Hamburg University[3]

Session Type: Research Session

Session Description:

Integrated Assessment Models (IAM) are the primary tool for developing global and regional emission trajectories and carbon budgets that limit global warming in line with the Paris Agreement. However, these trajectories rely mostly on assumptions about technological and economic constraints/capacities and do not take into account possible constraints that might be imposed by regional variation in institutional and societal capacities that determine the political conditions for the implementation of more stringent climate action, effective climate adaptation, and alignment with achieving key SDGs.

Currently, institutions and governance are embedded in the narratives associated with the Shared Socioeconomic Pathways (SSP); however, this information is qualitative and can only be incorporated indirectly, for example, techno-economic assumptions can be adjusted from variation in institutional and social narratives. At the same time, there are newer approaches that are leveraging political and social sciences to improve the conceptualization and quantification of institutions and other societal constraints. For this research session we are inviting proposals that are looking into one of the following areas: (a) theoretical work pertaining to the conceptualization of state capacity, governance and institutions as it relates to climate action, (b) empirical work that proposes innovative operationalization of state capacity related concepts and historically analyzes key drivers and (c) qualitative and quantitative work incorporating institutions into projections and scenarios.

Scenario-based Approaches to Modeling Migration Futures

Session ID #: 31

Lead organizer(s): Carsten Keßler[1] and Alex de Sherbinin[2]

Institutional Affiliation(s): Bochum University of Applied Sciences[1] and Columbia Climate School[2]

Session Type: Research Session

Session Description:

The proliferation of scenario-based research around the climate crisis and global socio- economic development has led to an uptake of scenario-based approaches in migration studies. This includes a growing number of efforts to model internal and international migration either using the shared socioeconomic pathways (SSP) as a basis for projecting mobility or in ways that contribute to the SSPs directly (e.g., as a component of future country-level population projections). Relative to fertility and mortality, migration is the most dynamic and potentially hard to predict population dynamic to model. At the same time, new scenario frameworks are under development that focus on specific regions or social/political aspects of migration, as more disciplines are starting to utilize scenario-based research. The goal of this session is a) to provide a forum to discuss scenario-based migration research combining SSPs and RCPs from a variety of perspectives, and b) to enable a transdisciplinary exchange on migration scenarios including, but not limited to, social and political scientists, demographers, as well as experts in modelling and spatial analysis. To achieve this goal, we particularly invite submissions that go beyond a pure modeling perspective and also consider the cultural, social, and political realities of migration, including, but not limited to, aspects of educational attainment, the labor market, immigration policy, or the role of diasporas. In addition to two invited talks, the session will feature three paper presentations selected from the submissions, and a poster session for the remaining accepted papers. The session will be concluded with an open discussion to identify research gaps derived from the transdisciplinary perspectives from migration experts from different disciplines, aiming to develop best practices for the use of the SSPs across different disciplines and identify gaps that should be addressed in future scenarios.

Addressing the gender dimension in socioeconomic scenarios, Part II: promoting gender equality as a driver of change

Session ID #: 94

Lead organizer(s): David Bohl[1] and Caroline Zimm[2]

Institutional Affiliation(s): Pardee Center for International Futures, University of Denver[1] and International Institute for Applied Systems Analysis[2]

Session Type: Workshop Session

Session Description:

While it is recognized that gender matters in climate change mitigation and adaptation efforts and human development, to date it has been challenging to empirically address the gender dimension in socioeconomic scenarios – both regarding impacts of climate change and related policies on gender (in)equality, as well as the impact of gender (in)equality as a driver of change.

Accounting for gender differentials in policy is essential because women generally have reduced access to socioeconomic resources, services and social protection. A growing body of analysis highlights both the disproportionate vulnerability faced by women during shocks (i.e, induced by climate change or COVID-19), and the disproportionate impact that investments can have on their development prospects. Meanwhile, risk perceptions and climate-related attitudes and behavior vary by gender.

Explicitly accounting for gender differentials in future socioeconomic scenarios requires both baseline empirical evidence and a scenario design that is gender-responsive. Sex-disaggregated data are becoming available from various sources. Nevertheless, there has been limited attention to sex-specific outcomes in long-range projections and scenario frameworks, meaning our analysis may partially misrepresents outcomes related to half the global population. Accounting for gender heterogeneity enables more realistic representation of current and future socioeconomic development relevant to sustainable development.

This workshop is the second session of a two-workshop series exploring the progress, challenges, and opportunities associated with gender- or sex-disaggregate indicators in long-range projection and scenario analysis. In Part II we focus on gender inequality as a driver of change. This workshop aims to discuss and explore the ways forward to addressing gender disaggregated scenarios on climate change and SDG achievement. We welcome abstract submissions on research and analysis, or evidence-based practice related to the impact that improvements in gender equality have on questions of climate mitigation and adaptation, and on human, social, and economic development more broadly.

Note: please see Part I of this session (ID 93: Addressing the gender dimension in socioeconomic scenarios, Part I: Impacts of climate change and policy on gender inequality) in Impacts/Vulnerability/Adaptation.

Poverty, inequality, distributional impacts of climate change mitigation and impacts

Session ID #: 25

Lead organizer(s): Shinichiro Fujimori[1], Bjoern Soergel[2], Jihoon Min[3]

Institutional Affiliation(s): Kyoto University[1], Potsdam Institute for Climate Impact Research[2], and International Institute for Applied Systems Analysis[3]

Session Type: Research Session

Session Description:

A number of scenario based studies dealing with interactions between climate change mitigation and poverty (inequality) with numerical models have recently emerged1, 2, 3. While energy and land-use system transformation is required to reduce GHG emissions, identification of the poverty implications of such transformation as well as countermeasures to eradicate poverty or to reduce inequality should be considered alongside the climate policies, for example through national and international redistribution of carbon pricing revenues. Given that the goals of poverty, inequality and climate are separately emphasized by the SDG, this is an even more important task for the research community.

In this session, we, first, exchange information regarding latest scenarios and the modelling on poverty and inequality. Then, we discuss the required research directions for future scenarios of poverty and income inequality. To do this, we begin with the climate change mitigation and poverty interaction, but work towards a quantification of climate change impacts (and those avoided through mitigation). We also consider the link to multi-dimensional poverty, including aspects such as hunger, energy access, or health. We discuss advantages and disadvantages of using the current SSP-RCP scenario framework. In parallel, the modeling techniques and required data for the further improvement of representation of poverty and inequality would be also discussed.

We finally anticipate the following items and insights.

- Recommendation of poverty and inequality assessment research in terms of the future scenarios

- cover the full SSP-RCP matrix? Or deviate from the original SSP-RCP?

- How we should handle the baseline, climate mitigation and impacts concept within poverty and inequality research?

- Potential improvement of representation poverty and equality and its required data

Economic pluralism and post-growth scenarios

Session ID #: 37

Lead organizer(s): Jarmo Kikstra[1,2], Jason Hickel[3,4], and Bjoern Soergel[5]

Institutional Affiliation(s): International Institute for Applied Systems Analysis[1], Imperial College London[2], London School of Economics[3], Autonomous University of Barcelona[4], and Potsdam Institute for Climate Impact Research[5]

Session Type: Research Session

Session Description:

This session aims to explore the tools for including diverse economic theories in scenarios and for developing post-growth economic futures. The session will explore the steps to build useful post-growth narratives as well as the requirements to allow for their model quantifications, and potential barriers to be overcome. It will discuss whether current integrated assessment models (IAMs) are capable of sufficiently providing such model quantifications.

The vast majority of existing climate change mitigation scenarios feature strong global growth in terms of gross domestic product (GDP). This generally includes continued growth in regions where economic capacity is already more than sufficient to meet human needs at a high standard. The growing affluence in these scenarios stimulates increases in resource use and pollution [1].

Mitigation scenarios based on SSPs subsequently generally rely on either high rates of decoupling of GDP from energy and material throughput [e.g., 2], or project a large upscaling of negative emission capabilities in the second half of the century, both of which raises potential feasibility concerns [e.g., 3]. At the same time, besides lacking detail on the decoupling of energy demand and GDP, demand-side mitigation options have long been underexplored in IAM scenarios [3].

This research session invites presentations that focus on reviewing or introducing useful datasets and modelling methods that can be used to translate narratives of alternative economic developments into quantifications of scenarios. More specifically, presentations from integrated assessment modelling, social metabolism, industrial ecology, ecological economics and related disciplines are welcome.

In particular, this session would discuss the different aspects, both social and technical, involved in developing: – Post-growth and degrowth scenarios: exploring and utilising potentials to reduce energy use and material throughput while maintaining strong social outcomes, assessing the consequences for aggregate economic output – Convergence scenarios: reducing inequalities in resource and energy use both between countries and within countries.

References

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[2] Grubler, Arnulf, et al. "A low energy demand scenario for meeting the 1.5 C target and sustainable development goals without negative emission technologies." Nature energy 3.6 (2018): 515-527.
[3] Brutschin, Elina, et al. "A multidimensional feasibility evaluation of low-carbon scenarios." Environmental Research Letters 16.6 (2021): 064069.

Beyond GDP: Economic dimensions of integrated assessment scenarios

Session ID #: 38

Lead organizer(s): Rob Dellink[1] and Dominique van de Mensbrugghe[2]

Institutional Affiliation(s): OECD[1] and Perdue University[2]

Session Type: Workshop Session

Session Description:

Integrated assessment scenarios such as the Shared Socioeconomic Pathways (SSPs) are underpinned by projections of economic activity. Often, the economic dimension is limited to projections of GDP and income per capita. This session will discuss both the need and opportunities for providing broader and deeper economic projections for climate change and related integrated assessment modelling scenarios.

First, the session will look at the role of changes in the sectoral structure in the economy. Clearly, different economic activities are not projected to grow at equal speed, and as sectoral emission intensities vary widely across sectors, a sectoral approach can provide much better links with environmental pressures, including greenhouse gas and air pollutant emissions. Second, international trade matches regional consumption and production patterns. Exports of natural resources (including fossil fuels) also play a big role in macroeconomic development of resource-rich countries. Finally, the session will discuss the opportunities and pitfalls in downscaling economic projections to the local scale. The session will explicitly link these proposed economic projections to the SSPs.

The goal of the session is to highlight how deeper and broader economic projections can improve the quantification of integrated assessment scenarios more broadly. We expect the outcome to be a combination of recommendations for integrated assessment modellers on how to use more detailed insights from economic projections, and recommendations for economic modellers on how to ensure their tools and projections are useful for integration in integrated assessment models.

Local urban extensions of the Shared Socioeconomic Pathways (SSPs) for city-scale risk and adaptation assessments – state of research and ways forward

Session ID #: 53

Lead organizer(s): Matthias Garschagen[1] and Jan Petzold[1]

Institutional Affiliation(s): LMU Munich[1]

Session Type: Research Session

Session Description:

Urban areas are both hotspots of climate change and places that shape the solution space for not only mitigation but also adaptation. The assessment of future climate risks in urban areas and the feasibility as well as efficacy of adaptation and transformation pathways relies on plausible scenarios of not only future hazards but also future socio-economic dynamics and their implications for trends in exposure and vulnerability. Therefore, locally extended urban Shared Socioeconomic Pathways (SSPs), which translate global socio-economic dynamics to the local scale, are necessary for a holistic view of future risk trends in cities. However, while lessons can be learned from a number of first approaches to develop local urban SSP extensions, many conceptual, methodological and practical questions still remain open. This session aims to provide a forum for discussing different approaches, methods, and evidence bases, focusing on scenarios for risk and adaptation in urban areas. This includes differences with respect to which SSPs are adapted, data types (quantitative, qualitative), and spatial and temporal dimensions covered. It also discusses how urban areas are represented in global SSPs and regional extensions more generally. This session will feature an opening presentation by the organizers to the set the scene and provide a frame for the session. Two invited presentations will follow to discuss the current state and remaining challenges of urban extensions. Three further presenters will be selected through a call for contributions. These will focus on specific applications of local urban SSP extensions. A joint discussion with the audience will follow.

Incorporating multi-dimensional inequality into long-term socio-economic scenarios

Session ID #: 60

Lead organizer(s): Johannes Emmerling[1], Narasimha Rao[2,3], and Giacomo Falchetta[3,4]

Institutional Affiliation(s): RFF-CMCC European Institute on Economics and the Environment[1], Yale University[2], International Institute for Applied Systems Analysis[3], and Ca'Foscari University[4]

Session Type: Workshop Session

Session Description:

Long-term scenarios of socio-economic development for energy and climate change modelling research have been focusing on two macro drivers: (i) demographic change and (ii) macroeconomic growth. Whilst applied research has sought to assess the underlying implications of those scenarios for global income inequality within and across countries, the growing importance of multi-faceted socio-economic inequality, and its links with climate policy costs, residual impacts, and adaptation investment requirements call for a broader and more explicit consideration of inequality in long-term socio-economic change narratives and scenarios. This is relevant not only for IAMs but also for Impact, Adaptation, and Vulnerability (IAV) studies. This debate becomes even more relevant in the context of the quest for a "just transition". The future generation of scenarios should thus explicitly incorporate pathways of inequality and multidimensional distributional indicators.

In this context, this workshop session seeks contributions to improve the theoretical understanding of the drivers, dimensions, and consequences of inequality, and in particular for dimensions beyond income. Crucial open questions to be discussed in this session include:

(i) The limits of measuring and projecting future inequality based on a macro-economic indicator of per-capita GDP through measures such as the Gini index;

(ii) Approaches to measure and project inequality based on broader multidimensional deprivation indicators including wealth/assets, wage inequalities, health, education, and access to services;

(iii) Methods to jointly represent different aspects of inequality (e.g. access to modern energy services and adaptation technologies; access to functioning capital markets, etc.).

To address these questions, the challenge is divided into (i) identifying and calculating comprehensive measures of inequality, and (ii) designing and applying methodologies to project them and create different narratives around them. The ultimate aim is exploring potential advances in the explicit representation of inequality in long-term scenarios of socio-economic development for energy and climate change modeling.

Scenario Methodology

Reflexivity for sustainable and equitable futures: Broadening scenario inputs for linkages across methods, scales, and levels

Session ID #: 12

Lead organizer(s): Anita Lazurko[1] and Vanessa Schweizer[1]

Institutional Affiliation(s): University of Waterloo, Canada[1]

Session Type: Workshop Session

Session Description:

Scenarios are an important tool to anticipate trajectories of socio-environmental systems and to navigate transformations to sustainability. Amid such complex, uncertain, and potentially contested processes of change, scenario development requires reflexive processes that are open to a wide range of inputs. This drive toward more reflexive and inclusive scenario practice is reflected in emerging scenario research, which focuses on reconciling alternative forms of knowledge (e.g., qualitative and quantitative), linking global to sub-global scales, and combining bottom-up with top-down drivers of change. For example, emerging semi-quantitative methods like Cross-Impact Balances help systematically link drivers of change at different scales that are represented by both qualitative and quantitative data.

The opportunities and challenges associated with "opening up" scenario practice can be framed as a form of reflexive boundary selection, where the up-front choice of scenario framework and method creates a sweeping limit around the scope of future conditions and values considered in the detailed processes that follow. This delimitation may constrain the consideration of extreme scenarios that are increasingly plausible under 21st century conditions and to exclude ambitious or pluralistic visions of a sustainable future.

This session aims to 1) explore the need for more reflexive scenario research and practice and 2) highlight methods and case studies that address this need. Organizers invite abstracts that have successfully applied greater reflexivity in scenario development by widening the range of methods, inputs, or drivers of change included in the process, such as by using semi-quantitative or linked qualitative-quantitative methods and/or by connecting drivers of change across scales or levels. After introducing an emerging framework for reflexive scenario practice in sustainability science, 4 to 5 panelists will present their work. Through a Q&A and breakout groups, participants will interact with the panelists to discuss: what opportunities and challenges exist for more reflexive and inclusive scenarios, particularly when linking across knowledge types, scales, and levels?

Integrated scenarios of impacts, mitigation and adaptation

Session ID #: 22

Lead organizer(s): Franziska Piontek[1], Celine Guivarch[2], Jun'ya Takakura[3], Detlef van Vuuren[4], Massimo Tavoni[5], Kiyoshi Takahashi[3]

Institutional Affiliation(s): Potsdam Institute for Climate Impact Research[1], International Center for Development and Environment[2], National Institute for Environmental Studies Japan[3], Netherlands Environmental Assessment Agency[4], and RFF-CMCC European Institute on Economics and the Environment[5]

Session Type: Research Session

Session Description:

The SSP framework separates the exploration of mitigation pathways and the assessment of climate change impacts. However, there is an increasing demand to quantify avoided impacts as benefits of mitigation in a consistent, integrated framework. Furthermore, impacts from climate change affect energy demand patterns, demographic and economic development prospects, costs and potentials of mitigation options such as biomass-energy and more. Finally, adaptation is a dimension rarely explicitly considered in existing integrated approaches. While there has been substantial progress in IAM-based impact assessment, there are many remaining challenges. Therefore, there is a need to foster further integration of impacts, adaptation and mitigation in scenarios and models with the goal to quantify scenarios that consistently represent mitigation and adaptation possibilities together with the impacts of a warming world, as well as synergies and trade-offs with development goals. This session will feature presentations of recent advances for joint climate impact-mitigation-adaptation modelling and assessment focusing mainly on detailed process-based IAMs but other forms of IAMs are also within the scope. It will facilitate the discussion of questions like

- how to approach the large uncertainty from climate and associated impact assessments and its implications for projections of socio-economic development;

- how to reconcile top-down and bottom-up impact estimates;

- how to improve the uptake of impact research into IAMs and economic modelling, in particular consistency between scenarios and data sets and integration of high resolution spatio-temporal data;

- how to include risks (esp. from extremes and compound events);

- how to include adaptation, both autonomous for more realistic baselines and specific adaptation as part of the SPA framework.

This research session is complemented by a workshop session focusing on practical aspects of linking impact and IAM modeling.

Assessing the interactions between climate-change impacts and mitigation using biophysical impact models

Session ID #: 45

Lead organizer(s): Katja Frieler[1], Christian Otto[2], Kaj Ivar van der Wijst[2], Edward Byers[3], Jacob Schewe[1]

Institutional Affiliation(s): Potsdam Institute for Climate Impact Research[1], Netherlands Environmental Assessment Agency[2], International Institute for Applied Systems Analysis[3]

Session Type: Workshop Session

Session Description:

Both climate change and the measures to avoid climate change (mitigation) impact many systems simultaneously, and affect vulnerability as well as adaptation and mitigation capacity. This is true for e.g. agriculture, biodiversity, the energy system, economic development, or population dynamics; a prime example being effects of land-based mitigation measures on agriculture and biodiversity. Quantitative analysis of such interactions and conflicts is so far largely done using integrated assessment models (IAMs). However, they only operate on a coarse spatial and temporal resolution and use simplified representations of impacts. Biophysical impact models, on the other hand, allow for a representation of many of the interactions between impacts and mitigation measures in a spatially and temporally explicit way. This session aims at identifying critical spatio-temporal interactions between mitigation measures and impacts of climate change and possible ways to analyze them. The starting point is the Inter-Sectoral Impact Model Intercomparison Project framework, where spatially explicit mitigation measures (e.g. changes in landuse patterns due to increasing bioenergy demand, future dam construction accounting for increasing hydropower demand, or adjustment in agricultural management practices reducing greenhouse gas emissions) are implemented in a range of impacts models to assess their impacts on biodiversity, crop yields, water availability, natural vegetation etc. in the interplay with the impacts of climate change. Besides the examples above, the discussion will ask for critical interactions that may be missed so far but could be represented in similar frameworks; and explore ways to 'downscale' mitigation measures other than land use-based ones. On the other hand, the session will also address the question how such spatiotemporally explicit, combined impacts-mitigation analyses could in turn inform and improve the representation of impacts in IAMs. For instance, where and how do the projected benefits of mitigation change by accounting for spatial and temporal inhomogeneities, and for interactions between impacts and mitigation measures?

Learnings from stakeholder participation for the development and implementation of scenarios and long-term pathways towards sustainable systems

Session ID #: 29

Lead organizer(s): Jeffrey M. Bielicki[1], Maria Diaz[2], Jan Steinhauser[3], and Douglas Jackson-Smith[1]

Institutional Affiliation(s): Ohio State University[1], Sustainable Development Solutions Network[2], International Institute for Applied Systems Analysis[3]

Session Type: Workshop Session

Session Description:

Modelers and the integrated assessment models they create and use have fundamental roles at the interface where science and policy influence each other. Effective scenarios for these efforts contain reasonably plausible combinations of factors that reflect different perspectives on past, present, and future developments; they can help provide context for decision-making and intervention strategies for complex political, social, economic, and environmental uncertainty over various spatial and temporal scales. Scenarios—especially model-based scenarios like the popular RCP-SSP framework—set a pathway on a trajectory that can help guide policy for mitigating undesirable long-term outcomes.

In this workshop, we seek to elevate discussion and analysis of the scenario development process. Scenarios are often constructed by input from stakeholders with diverse perspectives and backgrounds, including using participatory methods. Yet subjective assessments underly scenario construction. Plausibility depends on perspective, and views on what is needed for decision-making as well as potential intervention strategies are also human constructs. As a result, the scenario development process is often a social process that occurs through the exchange between experts, academics, and others. The perspectives and dynamics of those 'in the room' matter, and the methods, open-access tools, and inputs from various stakeholders are as essential as selecting for and cultivating productively critical and flexible dialog, decision-making, transparency, and constructive group processes.

Participants are invited to: i) share experiences where pathways were used as a framework for engaging stakeholders in the design of scenarios, in particular for climate and land-use systems; ii) discuss challenges and how they were addressed (e.g., working with stakeholders to address limited understanding of complex models, misalignment between short-term national pledges and long-term global objectives (i.e., SDGs, Paris Agreement)); iii) showcase how participatory modeling influenced the ambition of national policies and strategies.

SSPb: (How) can we mitigate and adapt in a scenario with socio-economic breakdown?

Session ID #: 28

Lead organizer(s): Ajay Gambhir[1] and Seth Monteith[2]

Institutional Affiliation(s): Imperial College London[1] and ClimateWorks Foundation[2]

Session Type: Workshop Session

Session Description:

The existing suite of SSPs span a wide possibility space in terms of challenges to mitigation and adaptation, as well as underlying socio-economic and technological storylines. However, there is an increasing recognition and fear that climate impacts will hit harder and faster than previously thought, and that these, interacting with other environmental, economic, technological and societal stressors, could seriously inhibit our ability to mitigate and adapt to climate change, from as early as the 2030s.

This session, conceived as an exploratory workshop, will seek to understand in as structured a way as possible the key considerations that should be included in the development of a new, extreme socio-economic pathway that engages explicitly with a "breakdown" of social and economic systems in light of climate and other adverse impacts.

The workshop will open with remarks from panellists on plausible but extreme scenarios of adverse societal "tipping points" resulting from ecological, economic and societal system breakdown in the next two decades. There will be a concerted focus on asking what such scenarios mean for society's ability to achieve rapid mitigation and adaptation, considering potential limitations to international finance flows, international cooperation and a failure of institutions to channel efforts toward these goals in light of multiple emergencies.

The discussion will then encompass how existing modelling tools, as well as other futures analysis methods, can be developed and if necessary combined so as to produce useful, policy-relevant visions and storylines of the future, to stimulate actions to mitigate the risks and / or impacts of such breakdowns.

The intended output of the session will be a research agenda to develop over the coming years, with a specific focus on furnishing the IPCC AR7 report with a more considered view of the consequences and possible ways to avoid and / or address such extreme breakdown scenarios.

Modelling integrated scenarios for reaching climate and sustainable development goals

Session ID #: 47

Lead organizer(s): Bjoern Soergel[1], Elmar Kriegler[1], Sebastian Rauner[1], Detlef van Vuuren[2,3], Geanderson Ambrósio[2], and Bas van Ruijven[4]

Institutional Affiliation(s): Potsdam Institute for Climate Impact Research[1], Utrecht University[2], Netherlands Environmental Assessment Agency[3], and International Institute for Applied Systems Analysis[4]

Session Type: Research Session

Session Description:

The Sustainable Development Goals (SDGs) and the Paris Agreement set an ambitious agenda for human well-being within planetary boundaries. Given the narrow time horizon for delivering on climate action and progress towards the SDGs, there is an urgent need for pathways exploring how to advance these goals jointly. Requirements for modelling such sustainable development pathways (SDPs) are a fairly comprehensive coverage of the SDG target space, including interactions between targets [1,2,3].

Following the recent publication of a first model-based SDP scenario [4], this session aims to provide a forum for discussing the development of the next generation of SDP scenarios. By broadening and connecting the modelling communities developing such pathways, it also extends the existing SSP-RCP scenario framework with SDP scenarios.

The invited presentations will present i) first results from a multi-model comparison of a set of several SDP scenarios [5], reflecting different societal perspectives on how to pursue sustainable development, and ii) discuss recent methodological advances in integrated SDG modelling, as well as the need for future model development [6].

Submissions for presentations or posters can focus e.g. on the following topics: i) advancing integrated assessment models for SDG analyses, ii) model-based analysis of interactions between multiple sustainable development goals, or iii) target-seeking scenarios integrating climate and sustainable development targets.

Based on these inputs, the session aims to discuss how to arrive at robust insights about the interventions required to advance sustainable development, about synergies and trade-offs, and how such modelling work can inform policy processes.

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[4] Soergel et al. 2021, https://www.nature.com/articles/s41558-021-01098-3

[5] http://shape-project.org/

[6] http://www.sdg-futures.eu/

Machine Learning in Climate- and Sustainability-related Scenario Development and Analysis

Session ID #: 97

Lead organizer(s): Jing Gao[1]

Institutional Affiliation(s): University of Delaware[1]

Session Type: Research Session

Session Description:

With booming data availability and computational power in recent years, scientific machine learning (ML) and artificial intelligence (AI) have brought new, sometimes revolutionary, developments in many research fields and policy arenas. This session welcomes submissions on ML/AI applications in scenario development and analysis related to sustainability science, climate change, and its impacts/adaptation/vulnerability. Research or reviews focused on either environmental or social systems, their interactions, related policies, and methodological advancements are all encouraged. We aim to facilitate a broad survey of how ML and AI have been used in climate- and sustainability-related scenario development and analysis, as well as start a conversation among researchers and practitioners from diverse communities about (1) strengths and limitations of ML/AI for integrated socio-environmental scenario studies, (2) knowledge gaps impeding (better) applications of ML/AI in related research and assessments; (3) demands and opportunities for new research and collaborations.

Improving the scenario development process

Session ID #: 202

Lead organizer(s): Detlef van Vuuren[1], Bas van Ruijven[2], Brian O'Neill[3]

Institutional Affiliation(s): Netherlands Environmental Assessment Agency[1], International Institute for Applied Systems Analysis[2], and Pacific Northwest National Laboratory[3]

Session Type: Workshop Session

Session Description:

An important recommendation of the 2020 paper on the "Achievements and needs for the climate change scenario framework," which synthesized the insights from the first Scenarios Forum, was to improve the scenario development process. This recommendation included a range of topics, such as connecting the SSP-RCP framework to other scenario activities, define and promote the use of Shared Policy Assumptions (SPAs) for both mitigation and adaptation, make the scenario development process as inclusive as possible, and establishing a process for regular updates of the scenario framework. While some of these topics are partly discussed in other sessions throughout the Scenarios Forum, this session aims at a dedicated discussion on how the scenario framework and development process can be improved. The goal of this workshop session is to assess examples of progress on these topics, consider weaknesses in the framework, and identify concrete proposals on how the scenario process can be improved on these dimensions while relying on voluntary efforts from the scenarios community.

This session welcomes contributions that show examples of improvements of the scenario process or propose how the scenario framework or development process can be improved on these dimensions. This includes, for example, proposals on the development of adaptation SPAs, proposals on making the SSP/RCP framework more suitable for applications beyond climate, examples of perspectives/scenarios that currently are not contained in the Scenarios Framework, and considerations for establishing a regular update process for the scenarios framework.

Open Session

Abstracts may be submitted to one of the 54 sessions that have been proposed by the community, or to an open category. Abstracts submitted to the open category will receive equal attention and those accepted will be assigned to new or existing sessions. Please be sure to fill in "Open" for session title as well as the session id number, 204 to be processed accordingly.