Our Mission

The Society for Decision Making Under Deep Uncertainty is a multi-disciplinary association of professionals working to improve processes, methods, and tools for decision making under deep uncertainty, facilitate their use in practice, and foster effective and responsible decision making in our rapidly changing world. While we share interests with other societies, ours is unique in its focus on developing, disseminating, and using these new approaches.

Welcome to the newsletter of

The Society for Decision Making Under Deep Uncertainty

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2019 DMDU Society Annual Meeting

Greetings to the members of the DMDU Society! Our DMDU 2019 annual meeting which will be held on November 6-7 in Delft, The Netherlands, is in the final planning stages. Up-to-date information is available on the annual meeting's webpage (http://deepuncertainty.org/annual-meetings/2019-annual-meeting/), and we are regularly updating the webpage when new information becomes available.

Location

The venue for the upcoming meeting is the Faculty of Technology, Policy, and Management at Delft University of Technology (TU Delft). The faculty is within walking distance of the city center.

Registration

You can register for the meeting at http://www.deepuncertainty.org/annual-meetings/2019-annual-meeting/ . This year, we are charging a registration fee of €50 for all participants. Participants with financial concerns may be considered for a registration fee waiver through reimbursement procedure.

Training day

Similar to previous years, we will have a Training Day on November 5. We have not yet released the complete program for the training day. We are currently coordinating with the contents with the society's leadership team.

Program for the meeting

We have 18 parallel sessions (16 open sessions and 2 closed sessions), 2 plenary sessions, and around 100 accepted abstracts for the upcoming meeting. The description of the sessions as well as a preliminary schedule is available on the meeting's webpage. We will update and finalize the schedule in the following week.

Best Regards,

Jan Kwakkel

Upcoming Events

DMDU 2019 Annual Meeting Post Conference Workshop

Join us in the post-conference workshop on **"The governmental challenge of anticipating the future with decisions about end-of-lifetime water infrastructure"**, to be held on Nov 8th, 8:30 – 13:00.

Climate change, digital transformation, and the energy transition are among the grand challenges that increase the need for governments to take into account, anticipate, and shape the long term with their current-day investment decisions. Furthermore, in the Netherlands, United States, and other countries water infrastructure is ageing and in need for replacement. This workshop will specifically zoom in on the challenge of anticipating future challenges with decisions about end-of-lifetime water infrastructure. Research findings about this topic will be shared at the beginning of the session. The workshop will include three presentations from practitioners from the Dutch national water authority, a regional water authority, and the Dutch foundation for urban drainage. These presentations will zoom in into three different long-term challenges: of the energy transition, of climate change adaptation at the local level, and of the challenge of ageing/end-of-lifetime water infrastructure. The group will then break out in three to discuss the challenges in more detail and formulate recommendations for practice. We invite both practitioners and academics, from the Netherlands and abroad. You can join this workshop together with signing up for the DMDU annual conference, but also by signing up only for this particular post-conference workshop.

If you have any questions, please contact Wieke Pot (wieke.pot@wur.nl)

AGU Annual Meeting: December 2019, San Francisco, CA

For those planning to attend this year's AGU conference, there are several sessions on characterizing, reducing, and communicating uncertainty, as well as on machine learning, that we believe might be of interest to the DMDU community.

Job Opportunities

Most of Job Vacancies have short application deadlines, so please check our website's Jobs Section often and follow us on twitter to get timely updates. You will find bellow some of the postings sent by members of the DMDU Community over the past few months. If you would like to share a job opportunity, please forward the job description / link to webisite@deepuncertainty.org.

Cornell Reed Group Post Doctoral Positions

http://www.deepuncertainty.org/2019/05/30/cornell-reed-group-post-doctoral-positions/

Senior Water and Climate Finance Advisor position at Deltares

http://www.deepuncertainty.org/2019/05/21/senior-water-and-climate-finance-advisor-position-at-deltares/

Recent Publications

These publications have been submitted to our website by their authors, or were shared by them through twitter. To see your publication on our next issue, please submit them here, or mention @deepuncertainty in your tweets.

Transportation infrastructures in a low carbon world: An evaluation of investment needs and their determinants

Fisch-Romito, V., & Guivarch, C. (2019). Transportation infrastructures in a low carbon world: An evaluation of investment needs and their determinants. Transportation Research Part D: Transport and Environment, 72, 203-219.

Transportation infrastructures will either lock in transportation patterns in high CO2 modes or foster low-carbon pathways. At the same time, increases in future mobility demand require the rapid development of new infrastructures. Here we quantify investment needs for transportation infrastructures over time to achieve both development and climate objectives. We compared investment needs between world regions and analyzed their main determinants. To do so, we built socioeconomic scenarios with the Imaclim-R integrated assessment model, combining alternatives for model parameters that determine mobility patterns. We then estimated the levels of investment that are consistent with the passenger and freight transportation trends in the different scenarios with and without climate policy. Finally, we used a global sensitivity analysis to identify the determinants of investments in low-carbon scenarios. We find that the expenditure needed for transportation infrastructure is lower in low-carbon pathways than in baseline scenarios. This result holds true at both the global and regional scales and is robust to the uncertainties considered. This overall decrease is brought about in particular by a reduction in transport activity. Rail utilization rates and road construction costs are determining factors for investment in all regions. Modal shift from road to rail can be a lever to reduce investment needs only if combined with action on rail infrastructure occupancy. To obtain a comprehensive assessment of the costs related to the transport sector in a low-carbon world, additional investments not considered in this study related to energy efficiency or alternative fuels use should be integrated.

Learning about climate change uncertainty enables flexible water infrastructure planning

Fletcher, S., Lickley, M., & Strzepek, K. (2019). Learning about climate change uncertainty enables flexible water infrastructure planning. Nature Communications, 10(1), 1782. https://doi.org/10.1038/s41467-019-09677-x

Water resources planning requires decision-making about infrastructure development under uncertainty in future regional climate conditions. However, uncertainty in climate change projections will evolve over the 100-year lifetime of a dam as new climate observations become available. Flexible strategies in which infrastructure is proactively designed to be changed in the future have the potential to meet water supply needs without expensive over-building. Evaluating tradeoffs between flexible and traditional static planning approaches requires extension of current paradigms for planning under climate change uncertainty which do not assess opportunities to reduce uncertainty in the future. We develop a new planning framework that assesses the potential to learn about regional climate change over time and therefore evaluates the appropriateness of flexible approaches today. We demonstrate it on a reservoir planning problem in Mombasa, Kenya. This approach identifies opportunities to reliably use incremental approaches, enabling adaptation investments to reach more vulnerable communities with fewer resources.

Water Resource Planning Under Future Climate and Socioeconomic Uncertainty in the Cauvery River Basin in Karnataka, India

Bhave, A. G., Conway, D., Dessai, S., & Stainforth, D. A. (2018). Water resource planning under future climate and socioeconomic uncertainty in the Cauvery River Basin in Karnataka, India. Water resources research, 54(2), 708-728.

Decision-Making Under Uncertainty (DMUU) approaches have been less utilized in developing countries than developed countries for water resources contexts. High climate vulnerability and rapid socioeconomic change often characterize developing country contexts, making DMUU approaches relevant. We develop an iterative multi-method DMUU approach, including scenario generation, coproduction with stakeholders and water resources modeling. We apply this approach to explore the robustness of adaptation options and pathways against future climate and socioeconomic uncertainties in the Cauvery River Basin in Karnataka, India. A water resources model is calibrated and validated satisfactorily using observed streamflow. Plausible future changes in Indian Summer Monsoon (ISM) precipitation and water demand are used to drive simulations of water resources from 2021 to 2055. Two stakeholder-identified decision-critical metrics are examined: a basin-wide metric comprising legal instream flow requirements for the downstream state of Tamil Nadu, and a local metric comprising water supply reliability to Bangalore city. In model simulations, the ability to satisfy these performance metrics without adaptation is reduced under almost all scenarios. Implementing adaptation options can partially offset the negative impacts of change. Sequencing of options according to stakeholder priorities into Adaptation Pathways affects metric satisfaction. Early focus on agricultural demand management improves the robustness of pathways but trade-offs emerge between intrabasin and basin-wide water availability. We demonstrate that the fine balance between water availability and demand is vulnerable to future changes and uncertainty. Despite current and long-term planning challenges, stakeholders in developing countries may engage meaningfully in coproduction approaches for adaptation decision-making under deep uncertainty.

Answers to questions on uncertainty in geography: Old lessons and new scenario tools

Derbyshire, J. (2019). Answers to questions on uncertainty in geography: Old lessons and new scenario tools. Environment and Planning A: Economy and Space, September 2019. https://doi.org/10.1177/0308518X19877885

In many domains, including geography, there can be the implicit assumption that improved data analysis and statistical modelling must lead to improved policymaking, and its perceived failure to do so can be disconcerting. Yet, this assumption overlooks the fundamental distinction between epistemological and ontological uncertainty, as discussed herein. Epistemological uncertainty describes the known and bounded inaccuracy of our knowledge about the world as now. Whereas ontological uncertainty describes the rendering completely obsolete of this present knowledge by surprises in the form of currently unknown future events, and by cascading changes to beliefs, attitudes and behaviours made by diverse actors in response to – and in anticipation of others' responses to – new developments. This paper does the following: (a) shows that because of ontological uncertainty, improved data analysis and statistical modelling can never lead straightforwardly to improved policymaking, no matter how well implemented; (b) outlines how probability-based tools offer little assistance with ontological uncertainty because they are based on present perceptions of future possibilities; (c) urges geographers to reconcile with ontological uncertainty as a source of potentially transformational change, rather than viewing it as a problem to be overcome or something to be defended against; and (d) reviews a range of new, non-probabilistic scenario tools that, when used in combination, can assist in harnessing ontological uncertainty for transformational purposes by surfacing what is to be gained and by whom from enabling, blocking or altering intended policy outcomes, and by searching for future possibilities unconstrained by the present.

A generalized many-objective optimization approach for scenario discovery

Kwakkel, J. H. (2019). A generalized many-objective optimization approach for scenario discovery. Futures & Foresight Science, e8.

Scenario discovery is a model-based approach for scenario development, aimed at finding one or more subspaces within the uncertainty space associated with a model that is decision-relevant. These identified subspaces can subsequently be translated into narratives or shared in other ways a broader participatory process. Finding such as subspace involves solving a three-objective optimization problem. A subspace should cover many of the decision relevant model runs, while containing as few as possible nondecision relevant model runs and being easy to interpret. Existing techniques for scenario discovery, however, focus only on finding a subspace that minimizes the number of nondecision relevant model runs. Adopting a single objective optimization approach for a many-objective optimization problem implies that the full trade-off space is not identified. In this paper, we introduce a many-objective optimization approach for scenario discovery. We compare this with an improved usage of Patient Rule Induction Method (PRIM) for identifying the multidimensional trade-offs amongst coverage, density, and interpretability. We find that the many-objective optimization approach produces results which slightly dominate those of the improved version of PRIM on all three objectives. Qualitatively, however, both approaches identify essentially the same subspaces. The prime benefits of the many-objective optimization approach are its potential in bringing additional scenario relevant concerns such as consistency or diversity into the scenario discovery framework, as well as its ability to avoid overfitting. Potentially more important, it also paves the way for future work on using more sophisticated metaheuristic optimization approaches for scenario discovery.

A framework for characterising and evaluating the effectiveness of environmental modelling

Hamilton, S. H., Fu, B., Guillaume, J. H., Badham, J., Elsawah, S., Gober, P., ... & Curtis, A. (2019). A framework for characterising and evaluating the effectiveness of environmental modelling. Environmental Modelling & Software, 118, 83-98.

Environmental modelling is transitioning from the traditional paradigm that focuses on the model and its quantitative performance to a more holistic paradigm that recognises successful model-based outcomes are closely tied to undertaking modelling as a social process, not just as a technical procedure. This paper redefines evaluation as a multi-dimensional and multi-perspective concept and proposes a more complete framework for identifying and measuring the effectiveness of modelling that serves the new paradigm. Under this framework, evaluation considers a broader set of success criteria, and emphasises the importance of contextual factors in determining the relevance and outcome of the criteria. These evaluation criteria are grouped into eight categories: project efficiency, model accessibility, credibility, saliency, legitimacy, satisfaction, application, and impact. Evaluation should be part of an iterative and adaptive process that attempts to improve model-based outcomes and foster pathways to better futures.

A coupled simulation architecture for agent-based/geohydrological modelling with NetLogo and MODFLOW

Jaxa-Rozen, M., Kwakkel, J. H., & Bloemendal, M. (2019). A coupled simulation architecture for agent-based/geohydrological modelling with NetLogo and MODFLOW. Environmental modelling & software, 115, 19-37.

The modelling of social-ecological systems can provide useful insights into the interaction of social and environmental processes. However, quantitative social-ecological models should acknowledge the complexity and uncertainty of both underlying subsystems. For example, the agent-based models which are increasingly popular for groundwater studies can be made more realistic by incorporating geohydrological processes. Conversely, groundwater models can benefit from an agent-based depiction of the decision-making and feedbacks which drive groundwater exploitation. From this perspective, this work introduces a Python-based software architecture which couples the NetLogo agent-based platform with the MODFLOW/SEAWAT geohydrological modelling environment. This approach enables users to design agent-based models in NetLogo's user-friendly platform, while benefiting from the full capabilities of MODFLOW/SEAWAT. This workflow is illustrated for a simplified application of Aquifer Thermal Energy Storage (ATES).

Modeling with Stakeholders for Transformative Change

van Bruggen, A., Nikolic, I., & Kwakkel, J. (2019). Modeling with Stakeholders for Transformative Change. Sustainability, 11(3), 825.

Coherent responses to important problems such as climate change require involving a multitude of stakeholders in a transformative process leading to development of policy pathways. The process of coming to an agreement on policy pathways requires critical reflection on underlying system conceptualizations and commitment to building capacity in all stakeholders engaged in a social learning process. Simulation models can support such processes by providing a boundary object or negotiating artifact that allows stakeholders to deliberate through a multi-interpretable, consistent, transparent, and verifiable representation of reality. The challenge is how to structure the transdisciplinary process of involving stakeholders in simulation modeling and how to know when such a process can be labeled as transformative. There is a proliferation of approaches for this across disciplines, of which this article identifies Group Model Building, Companion Modeling, Challenge-and-Reconstruct Learning, and generic environmental modeling as the most prominent. This article systematically reviews relevant theories, terminology, principles, and methodologies across these four approaches to build a framework that can facilitate further learning. The article also provides a typology of approaches to modeling with stakeholders. It distinguishes transformative approaches that involve stakeholders from representative, instrumental and nominal forms. It is based on an extensive literature review, supported by twenty-three semi-structured interviews with participatory and non-participatory modelers. The article brings order into

the abundance of conceptions of transformation, the role of simulation models in transformative change processes, the role of participation of stakeholders, and what type of approaches to modeling with stakeholders are befitting in the development of policy pathways.

Aquifer Thermal Energy Storage (ATES) smart grids: Large-scale seasonal energy storage as a distributed energy management solution

Rostampour, V., Jaxa-Rozen, M., Bloemendal, M., Kwakkel, J., & Keviczky, T. (2019). Aquifer Thermal Energy Storage (ATES) smart grids: Large-scale seasonal energy storage as a distributed energy management solution. Applied energy, 242, 624-639.

Aquifer Thermal Energy Storage (ATES) is a building technology used to seasonally store thermal energy in the subsurface, which can reduce the energy use of larger buildings by more than half. The spatial layout of ATES systems is a key aspect for the technology, as thermal interactions between neighboring systems can degrade system performance. In light of this issue, current planning policies for ATES aim to avoid thermal interactions; however, under such policies, some urban areas already lack space for the further development of ATES, limiting achievable energy savings. We show how information exchange between ATES systems can support the dynamic management of thermal interactions, so that a significantly denser layout can be applied to increase energy savings in a given area without affecting system performance. To illustrate this approach, we simulate a distributed control framework across a range of scenarios for spatial planning and ATES operation in the city center of Utrecht, in The Netherlands. The results indicate that the dynamic management of thermal interactions can improve specific greenhouse gas savings by up to 40% per unit of allocated subsurface volume, for an equivalent level of ATES economic performance. However, taking advantage of this approach will require revised spatial planning policies to allow a denser development of ATES in urban areas.

Thank you for reading the newsletter of the Society for Decision Making Under Deep Uncertainty!

This newsletter is brought to you by volunteers of the Society's Communications & Outreach Team (Antonia Hadjimichael and Mrinalini Cariappa). You can contribute to this newsletter and to our website by suggesting content to website@deepuncertainty.org.