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Editorial

INTRODUCTION

From 12 to 19 July 2000, the European Forum on Integrated Environmental Assessment (EFIEA) hosted a Policy Workshop on Scaling Issues in Integrated Assessment in the town of Mechelen, close to Maastricht in the Netherlands. This was the second of the so-called ''Matrix'' workshops, which addressed specific methodological topics relevant to Integrated Environmental Assessment in the context of policy-relevant issues. In each workshop, a group of approximately 50–60 participants, including EFIEA-members and other scholars, were brought together to explore theoretical and methodological issues and to share practical experiences. The first Matrix workshop was held in July 1999 in Baden close to Vienna, where the focus was on uncertainty. In the second workshop, the focus of this volume, the emphasis was on the issue of scaling in Integrated Environmental Assessment. Thus, it is commonly referred to as the EFIEA Scaling Workshop.

SETTING THE STAGE

The issue of scale, both in time, space and quantity, is of fundamental importance in the field of Integrated Assessment. By definition Integrated Assessment deals with complex issues that operate at multiple scale levels. Within the natural sciences the scale-problem has already played an important role for some time. For many social scientists the scale issue is a relatively new area of concern, although its importance is increasingly recognized.

Insights from both the social and natural sciences are of crucial importance in understanding the complex relationships between humans and the natural environment. There is a growing need for interdisciplinary approaches to scaling issues: approaches that combine insights from both the natural and social sciences. These interdisciplinary approaches can pave the way for a more common understanding of the role of scale in many current societal problems.

To date, no grand 'scale theories' or standard procedures have been developed that allow integrated assessors to deal with different and multiple spatial scales, and with the short and long term in an appropriate and qualified manner in their assessment endeavors. The aim of the workshop therefore was to address this observed need and to take a significant step towards the development of heuristics, procedures and tools to address spatial and temporal scale issues.

The workshop focused on various aspects of scales in Integrated Assessment with respect to data/indicators, models and scenarios. For each of these topics, the available theories and practical methods were screened for their contribution to Integrated Assessment. The workshop format combined lectures on topical issues around scale with more applied work sessions. Ten speakers, well known in the field of integrated assessment and modeling, prepared and presented papers during morning sessions. Building on these presentations, afternoon works sessions focused on topical issues related to several key themes: cross-scale interactions; up and downscaling (including aggregation and disaggregation), scaling and modeling, scaling and scenarios, and scaling and indicators/data. Based on these sessions, scaling concepts were clarified and further refined, and a research agenda was developed for subsequent explorations in scale management.

This double issue of Integrated Assessment represent the key tangible output of the Scaling Workshop. In addition to the ten papers prepared and later refined by the key speakers, three other papers prepared by participants at the workshop are also included here. These papers reflect the wide range of topics that were addressed during this meeting. They point to a number of unresolved issues in the field of IA and point towards important areas for further research. Unfortunately, as the attendees will certainly attest, they cannot fully capture the breadth and depth of these discussions, along with the enthusiasm of the participants.

OVERVIEW OF THE PAPERS

Wilbanks sets the stage by indicating why scale matters in pursuing integrated assessments (IAs). Driving forces of environmental change come from and interact across different scales. He raises the issue of agency and structure, i.e., the ability of individuals and groups to take action, but always under constraints. He further discusses operational issues of incorporating micro- and macro-scale information and perspectives in Integrated Assessment Models (IAMs). Finally, he lays out several key challenges related to data availability, upscaling, downscaling, integration, and cross-scale dynamics, all of which appear in other papers.

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Stehr and von Storch point out the different approaches the social and physical sciences have take to addressing scale issues. Within the social sciences, debates have focused on macro-micro and agent-structure issues. The physical sciences provide a clearer hierarchical structure in the form of a cascade of spatial (and temporal) scales. The key element they address, though, is the often missing link between the analytical and practical capacity of knowledge. ''The distinction between analytical and practical is particularly relevant to actors who have to deal with and convert scientific knowledge claims into practical action. Thus, choices of scale not only affect what can or will be analyzed but also what can or will be done.

Dowlatabadi offers us a personal journey. Most significantly he draws in the importance of scale with respect to human cognitive processes – perception and awareness, and human social organization and the associated ability to act. Similar to Stehr and von Storch, these are seen to differ fundamentally from the usual physical dimensions. He draws upon insights into the scale of participation required versus that actually seen for climate policies – mitigation, adaptation, and geo-engineering. He also talks about meeting energy needs.

Evans et al. go further in exploring in more detail the role of scale in various social sciences. Unfortunately, but perhaps to be expected, they do not find a grand solution or even a consensus on either approaches or even definitions. They do point to common areas of concern, however. Also they nicely summarize what could be the holy grail of IAMs – ''spatially explicit models that elegantly handle dynamic relationships and human decision making.''

Jaeger and Tol point to the need for economic analyses to more deeply address laws and patterns that govern economic processes at different spatial, temporal, and institutional scales. This goes beyond what has been done before in the areas of micro- vs. macro- and short-run vs. long-run analyses. They point, for example, to the key role of increasing returns to scale.

Van der Veen and Otter also focus on the issue of scale in economics, but approach it from a different angle. Focusing more specifically on regional economics, they emphasize the difficulties in understanding spatial resolution and human behavior in a uniform construct. Like Jaeger and Tol, they also note the somewhat arbitrary divisions between micro-, meso-, and macroeconomics.

Downing et al. take us into the practical issues of scale in terms of upscaling and downscaling in studies of the impacts of climate change and variability on agriculture in Europe. They show us that there is still much to learn in this area and how current practices can introduce additional uncertainties.

Schneider and Root propose a more general strategy for bridging gaps related to scale, in particular geographical scale. In their approach, Strategic Cyclical Scaling, ''large-scale associations are used to focus small-scale investigation in order to develop valid causal mechanisms generating the large-scale relationships.'' This is somewhat different from traditional upscaling or downscaling, which attempt to bring either the higher or lower scale directly into the model. Most significant is the requirement of ''the development and fostering of interdisciplinary teams, and eventually, interdisciplinary communities, capable of unbiased peer reviewing of cross-scale, cross-disciplinary analyses in which the bulk of the originality is in the integrative aspects, rather than advances in the subdisciplines that are coupled.''

Schnellnhuber et al. introduce us to the notion of Hazardous Functional Patters (HFPs) generating non-sustainable trajectories, or Syndromes, of the human nature system. They propose the use of Qualitative Differential Equations (QDEs) to analyze these. In relation to scale, these can help to bridge variability at the local scale and changes at the global or regional scale by identifying common patterns of behavior (or potential behavior) at a more intermediate, or functional scale. They also look at the issue of non-local interactions.

Pahl-Wostl brings us more directly to the question of scales other than the traditional ones of time and space. Focusing on the importance of individuals and organizations, she points to the need to pay attention to levels of social organization. From a methodological perspective, she argues for more attention to and use of agent-based and participatory methodologies.

Easterling and Kok take up the challenge of scale in the context of the theory of hierarchical systems. They start from the premise that the systems of interest for Integrated Assessment are inherently nested hierarchical systems, which are ''too complex for analytical solution and too structured and organized for pure statistical treatment.'' In doing so, they emphasize that this calls for going beyond the preoccupation with bottom-up aggregation and top-down disaggregation. Many relevant properties of a system are emergent, i.e., they are difficult if not impossible to construct or predict from the constituent parts. Similarly, behavior in system components may be constrained by processes operating at a higher scale, in ways that might not be apparent from top-down disaggregation. Thus, it is important for IAMs to try to embed hierarchical structures explicitly.

Giampietro also draws from hierarchy theory in his contribution. He emphasizes the importance of perspectives, i.e., how we interact with the system. Specifically, different perspectives, which include different choices of scale, reflect different reasons for analyzing, and can provide equally valid, but non-equivalent descriptions of, the same system. In many cases of IA, it will be necessary to adopt more than a single perspective to reflect both the general complexity of the issue and the different perspectives of different stakeholders.

Finally, Rotmans rounds off these two issues with a general reflection on the issue of scale in Integrated Assessment. He provides an overview of the challenges, both theoretical and practical, scale issues poses for the field. He also provides recommendations for moving forward even as a wide range of practitioners make initial tentative steps into what is in many cases unknown territory.

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