MANAGING THE INCONCEIVABLE: PARTICIPATORY ASSESSMENTS OF IMPACTS AND RESPONSES TO EXTREME CLIMATE CHANGE

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Abstract

A comprehensive understanding of the implications of extreme climate change requires an in-depth exploration of the perceptions and reactions of the affected stakeholder groups and the lay public. The project on "Atlantic sea level rise: Adaptation to imaginable worst-case climate change" (Atlantis) has studied one such case, the collapse of the West Antarctic Ice Sheet and a subsequent 5-6 meter sea-level rise. Possible methods are presented for assessing the societal consequences of impacts and adaptation options in selected European regions by involving representatives of pertinent stakeholders. Results of a comprehensive review of participatory integrated assessment methods with a view to their applicability in climate impact studies are summarized including Simulation-Gaming techniques, the Policy Exercise method, and the Focus Group technique. Succinct presentations of these three methods are provided together with short summaries of relevant earlier applications to gain insights into the possible design options. Building on these

insights, four basic versions of design procedures suitable for use in the Atlantis project are presented. They draw on design elements of several methods and combine them to fit the characteristics and fulfill the needs of addressing the problem of extreme sea-level rise. The selected participatory techniques and the procedure designs might well be useful in other studies assessing climate change impacts and exploring adaptation options.

1. Introduction

An increasing number of studies attempt to detect discernable impacts of anthropogenic climate change on individual species and entire ecosystems (Parmesan and Yohe, 2003; Root et al, 2003). Yet the more widespread and more severe impacts are expected to emerge in several decades. Although the majority of people tend to believe that anthropogenic climate change and its impacts represent a real risk (see Kempton, 1991; Dunlap et al., 1993; McDaniels et al., 1996; Krosnick et al., 1998; Berrens et al., 2004), for the lay public and for most policymakers the long-term nature of climate change and even its easily conceivable impacts on crops and shorelines belong to the realm of distant future: somewhat hazy, a little mystical, very uncertain, and by all means far from the tangible reality of present-day problems and concerns on the social and political agendas. Lay perceptions of large-scale, systemic changes (such as the collapse of the thermohaline circulation, changes in the El Nino Southern Oscillation, or shifts in monsoon patterns) vary across the domains of science, fiction, and science fiction. Extreme sea-level rise (ESLR) as a result of the collapse of the West Antarctic Ice Sheet is one of the most intensively researched areas among the systemic changes. Its key feature from the perspective of public perception and management is that even when it is detected early, it is impossible to stop. In this respect, it is similar to an asteroid detected to be on collision course with the Earth. Even if there are precursors of the event, they can only provide limited and belated information once the ice sheet disintegration process starts.

Research on the social perception of such risks is almost non-existent. A closely related field, natural hazard risk assessments focuses on immediate and direct hazards that originate in natural systems and processes (see Petak and Atkisson, 1982, for example). Disaster research in anthropology addresses both natural and man-made hazards (Hoffman and Oliver-Smith, 2002). Yet it is also preoccupied with short-term and direct events and provides post-event interpretations and analyses of observed behavior or declared perceptions. Kasperson et al. (this issue) provide a review of available literature on extreme sea-level rise.

The main objective of the project on "Atlantic sea-level rise: Adaptation to imaginable worst-case climate change" (hence the Atlantis project) is to delve into the question of how present-day predecessors of future generations possibly facing ESLR perceive and deal with this risk. The principal approach is participatory assessment in which representatives of key stakeholder groups and the lay public process relevant region-specific information on the geophysical and socioeconomic trends and events. This paper presents the methodological foundations of these stakeholder discourses carried out in three regions of Western Europe: the Rhone delta in France, the Thames estuary in

England, and the Rhine delta which constitutes the larger part of the Netherlands. These studies partly rely on global impact estimates (Nicholls et al., this issue) and provide some empirical checks for assessing the implications of such catastrophic risks for climate change mitigation (Guillerminet and Tol, this issue).

Developing the suitable method is not straightforward. Although the root of the problem is the same (extreme sea-level rise), the investigated regions are rather different in terms of magnitudes and characteristics of the implications. In the Rhone basin, a relatively small but unique area is affected. The Thames region involves the historic financial and cultural metropolis of London. In the Netherlands, a large area of the country and numerous historic centers are at stake. The historical-cultural contexts differ as well. Living below sea-level has been part of the national identity in the Netherlands for centuries. The occasional floods in the past and the Thames barrier to protect London against them have created some awareness about sea-level-related risks and possible technological fixes, albeit at a much smaller scale. Finally, the problem of extensive flood risk has manifested itself in sporadic events in the Rhone/Camargue area, but the threat of permanent inundation is new.

Given the geographical, economic, and socio-cultural differences among these regions, the right balance is sought in the methodological development between the specificity of operational design and the flexibility of implementation. This feature has two implications for the present paper. First, it requires a presentation of the foundations of the techniques that were used to produce the results presented in the three regional papers

(Poumadere et al., Lonsdale et al., Olsthoorn et al.) in this issue. Second, it makes this methodology paper interesting and relevant to others who consider using participatory techniques in climate impact studies.

Section 2 discusses key issues of using participatory approaches in climate impact and climate policy studies. This is followed by short summaries of three methods that provide the foundations for the procedure designs developed for use in the Atlantis regional case studies. Four such designs are sketched in Section 4, followed by implementation issues in Section 5. The main lessons are summarized in the closing section, while concise overviews of the three participatory methods, examples of their relevant applications, and their potential use in climate policy studies are provided in the Appendix.

2. Participatory techniques in climate policy studies

In addition to modeling and expert panels, participatory integrated assessments have been proposed as a useful approach to synthesizing scientific knowledge for policymaking (Tol and Vellinga, 1998). A simple sketch of the key components of participatory assessments and their linkages is presented in Figure 1. The process is driven by the objectives of the organizers or the client who commissions the project. This determines the nature and the amount of scientific and expert knowledge as well as the policy, stakeholder, or lay interests to be combined in the exercise. The participatory techniques provide the tools and procedures for integrating those inputs and producing the required results that can be of rather different nature.

< Figure 1 here >

It is important to note that, in addition to serving the objectives of the organizers, the exercise should also provide something valuable to the participants. Public service and generosity are good but self-interest works even better when it comes to requesting time and intellectual commitment of busy people. This was particularly challenging task in the ESLR case in which there is little direct link between today and the very long-term, low-probability risk addressed.

Participatory techniques are often argued for but rarely used in environmental assessments. In climate change, for example, perhaps the most contentious issue is to resolve the question raised by Article 2 of the Framework Convention on Climate Change: what might constitute a dangerous anthropogenic interference with the climate system. It has been repeatedly emphasized that this involves social choices based on ethical principles, value judgments, risk perceptions, and risk preferences. Moss (1995) emphasizes the need for regular interactions between the scientific and policy communities in order to solve the Article 2 puzzle. This suggests the utilization of the techniques reported here.

Participatory techniques have been used in several projects to analyze different aspects of climate change mitigation. Parson (1996) experimented with policy exercises to explore unresolved questions of international climate policy: how to define and negotiate national emission-abatement obligations, how to design adequate procedures and institutions, and how to sustain their effectiveness over time. The Dutch project on ‘Climate Options for the Long Term’ (COOL) involved so-called ‘dialogues between research and society’ at the national, European, and global level (Berk et al., 2002) to look into the distant future and consider drastic reductions of greenhouse gas emissions by 2050. Toth et al. (1998) conducted a policy exercise involving representatives of the European venture capital sector, dynamic small technology development companies, and the European Commission to explore public policy needs and private opportunities for fostering investments in carbon-free technologies to help accomplish the commitments under the Kyoto Protocol. This exercise was yet another demonstration that it is possible to engage ‘serious’ business people into a participatory exercise on issues of their interest.

The situation is quite different on the impact side. Assessments of gradual climate change impacts and the literature reporting their results are dominated by the large and ever growing field of biophysical impact studies. The number of studies looking into the economic and social implications is much lower albeit increasing. Serious adaptation studies assessing the options, costs, and benefits of coping strategies are few and stakeholder involvement in them is a rare exception. There is an apparent gap between national research programs and government documents providing information about climate change impacts on the one hand, and the regional policymakers who are supposed to use this information and undertake appropriate action on the other. A well-documented example is reported for the United

Kingdom by Demeritt and Langdon (2004). This suggests that such climate impact studies could benefit from a closer involvement of regional stakeholders.

In comparison to gradual climate change, assessments of extreme change are lagging behind. There are some efforts to investigate their biophysical impacts, a few projects explore their economic and social implications, but the Atlantis project is likely to be the first one to take a systematic look into the adaptation options in specific regions. At the first glance, response options to extreme sea-level rise (ESLR) appear to be simple. One would either choose to protect an area by coastal defense works or retreat from the prospective inundated area. Yet reality is more complex. The affected areas are extremely diverse in terms of geography and geomorphology, historical heritage, current population and economic density, cultural affection, etc. A proper assessment of the potential losses from such events therefore requires an in-depth exploration of these issues by involving representatives of different stakeholder groups affected by them.

Methods of participatory integrated assessment (PIA) can do just that. They involve public policymakers and private stakeholders and make them part of the assessment process. Techniques based on the joint work of scientists, experts, and stakeholders have been demonstrated to lead to better assessments because they combine the latest expert information with first-hand policy experience in the affected society. Over the past 15 years, PIAs have been used only sporadically in climate impact studies to complement model-based analyses and expert assessments. This experience has nonetheless shown that even for tangible, medium-term (next few decades) impact studies, it is important to provide substantive strategic linkages to the present in order to engage senior policymakers. Other important prerequisites for successful exercises include a competent and trustworthy organizing team, solid high-quality scientific input, and the prospects for productive interaction procedures. The next section presents the methodological foundations to provide the last item.

3. Methodological foundations and applications in climate studies

A diverse set of participatory methods have been developed and applied for a broad range of purposes from research to corporate strategies, from education to policy development. The potential of some of these techniques in environmental assessment has been increasingly recognized and utilized in the last two decades. Toth and Hizsnyik (2004a) present a targeted review of relevant participatory assessment methods. Based on that survey, this section takes a closer look at a small sample of methods with a view to their applicability in climate impact assessment, particularly in studies of extreme climate change.
Three methods were found to be particularly relevant and promising for climate change studies

Simulation-gaming techniques involve suitable, problem-oriented combinations of a game, a simulation, and the reality to create a situation in which participants engage into playing pre-assigned or voluntarily chosen roles. Depending on the nature and objectives of the gaming exercise, these roles can be rather realistic or entirely abstract, but they determine the objectives, constraints, and general strategies of the players and the corresponding decisions they make in the course of the game. Interactions among the players are regulated by a set of rules enforced by the game operator. Rules tend to be few and flexible in strategic exploratory games that are good candidates for use in climate policy assessment.

Interestingly, no application of simulation-gaming in climate impact projects has been reported in the literature. The reason may well be that, even in the sporadic cases when impact studies involve stakeholders, gaming is thought to be too 'flippant' to use in investigating serious issues.

The Policy Exercise is a hybrid method drawing on several earlier techniques (free-form games, operational games, participatory modelling workshops) and featuring innovative design elements as well. It was explicitly developed to provide a science-policy interface that is less rigid than policy modelling but better structured and more systematic than a traditional assessment panel. Policy exercises combine expert reviews and policy interviews in the preparations phase, scenarios and group interaction techniques at the workshops, policy analysis and evaluation methods in the synthesis phase. They proved to be particularly useful to address poorly structured problems involving considerable uncertainties and potentially large stakes, including climate change impact and adaptation assessments.

The first application of the Policy Exercise technique to study climate change impacts and adaptation happened some 15 years ago. Toth (1992a) reports about a series of exercises in the context of a UNEP project to explore adaptation options and strategies dealing with impacts of global climate change in Southeast Asia. The exercises involved senior national-level policy makers (deputy minister and state secretary level) and senior analysts who developed and evaluated policy responses under different climate change and impact scenarios. One reason of the success was that the climate impacts and adaptation strategies were linked to long-term development goals and implementation plans in the key climate-sensitive sectors in these countries. The project also demonstrates the possibility of transferring participatory techniques such as the Policy Exercise method across different cultures, but special characteristics of the target culture need to be observed and appropriate modifications in the method have to be made (see Toth, 1992b).

The Focus Group technique originates in small-group interaction processes widely used in applied social sciences. It involves a carefully designed, well-prepared, and closely monitored social process to obtain information about the participants' perceptions, beliefs, and attitudes related to a relatively simple, clearly defined issue. A discussion leader or moderator introduces topics related to the main subject of the group meeting and facilitates the group discussion to secure the maximum information yield from the participants. The most widespread applications of the method are in consumer research (to test planned new products or services) and in politics (to test campaign topics and policy initiatives). The Focus Group technique can be used as part of a feasibility study to clarify objectives and expectations in preparation for a more ambitious participatory project that would involve gaming or a policy exercise. But its more common application is to gather information about public perceptions and attitudes concerning climate change, impacts and policy preferences in a more systematic manner than traditional survey questionnaires or interviews.

The authors are not aware of Focus Group applications to study regional climate change impacts. The Round Table sessions conducted in the Canadian MacKenzie Basin Impact Study (Cohen, 1997) used some Focus Group design elements to provide fora for stakeholders to respond to the impact assessments and to consider response options. The project on 'Urban Lifestyles, Sustainability, and Integrated Environmental Assessment' (Kasemir et al., 2003) made extensive use of focus groups but the scope was much broader than regional impacts: they addressed global impacts and mitigation issues as well.

Different participatory methods imply different kinds of information flows between the organizers and the participants. Free-form games and Policy Exercises are characterized by a balanced exchange of information in a joint exploration process. Operational games, especially teaching-training games, intend to convey information from the game developers (or the clients behind them) to the players. In contrast, focus groups are mainly used to extract from the participants the maximum amount of information that is of interest for the organizer/client.

The biggest weakness of all participatory techniques is the difficulty of attaining replicable results. They are not considered "scientific" because they tend to generate too much unsystematic information for post-workshop analysis and provide few effective means for analysis. Data collection, measurement and analysis are difficult during the course of a workshop session because they might disrupt the momentum and bias the outcomes. Nevertheless, the potential value of these techniques has been demonstrated. Thorough design and skillful facilitation can diminish the possible distortions emerging from these features. The next section presents four different designs to show how.

4. Possible applications and design options for assessing extreme climate change

The diversity of the small selection of participatory frameworks discussed in the previous section demonstrates that ample possibilities exist to assemble individual and well-proven tools into specially designed procedures. This should be implemented according to the analytical or practical requirements of any particular climate impact assessment project, in this case extreme sea-level rise (ESLR) in the Atlantis study, so that the product can fulfill the needs of the targeted user communities.

4.1 Exploring response strategies to cope with ESLR by stakeholders

The basic procedures and many design elements adopted in the Atlantis stakeholder discourses stem from the Policy Exercise method. In addition, two fields in Simulation-

Gaming have been identified as interesting and relevant sources: free-form games and operational games. The scenario-based Policy Exercises and free-form games provide the most promising framework to elaborate the risk-strategy-achievement dynamics of the ESLR management process. Such exercises are excellent albeit relatively simple tools to involve selected representatives of the stakeholder community. In these processes, participants face different scenarios and propose strategies to manage the ESLR problem in their region. The repeated cycles of policy moves, evaluations with the help of experts, then revised scenarios enhance the assessment significantly. The Atlantis designs also incorporate elements of operational games.

This section draws on Toth and Hizsnyik (2004b) and presents sketches of four pilot designs that are suitable for use in the stakeholder interaction process to assess and respond to extreme climate change. Some of these designs draw directly on scenario types used in policy exercises or gaming arrangements presented in the previous section. All sketches have been modified in order to make them suitable for the problem characteristics of ESLR. The designs presented below focus on the personal interaction phase. However, there are many steps and activities before and after the workshop that are the same or very similar in all four cases.

The preparations phase includes interviews with would-be participants, the development of scenarios that outline both the sea-level-rise components and the background socioeconomic development patterns. Other activities include the development of role descriptions, and the rules and procedures for the interactions at the workshop. In order to capture all useful and relevant information from the process, the logistics for documentation and evaluation should also be prepared.

The workshop phase itself has four main steps. In the first step, participants introduce themselves and get a short *briefing* about the objectives, procedures and assignments in the course of the workshop. The *scenario session(s)* can follow one of the four designs presented below, their variants or some modified procedures. The scenario processing is followed by the *debriefing* step in which participants reflect on, interpret, explore, and further analyze the most critical events and outcomes of the scenario sessions. This is strictly the content-related assessment of the scenario work. The final step is the *evaluation* in which participants have the opportunity to critique the process itself starting from the quality and usefulness of the input material they received before the workshop to the effectiveness of the interaction phase at the workshop.

The final, post-workshop phase of the process is the documentation, analysis, reporting, and publication of the results.

4.2 Design A: Ticking clock

This procedure is intended to imitate the temporal constraints involved in ESLR management to draw attention to the geophysical (sea-level rise) and socioeconomic (largely institutional) inertia, the temporal dimension of the adaptation process (long construction or evacuation times), the pressure to undertake appropriate decisions and actions in time. At the beginning of the session, a simulation clock is started and the progress of the real workshop time translates into the progress of simulated calendar years in the scenario time.

The scenario session can be conceived as a simulation of the activities of a Regional Management Board that is given the responsibility to prepare plans and undertake actions to cope with the ESLR problem in the region. The scenario session could run as depicted in Table I.

< Table I here >

The relationship between the session clock and the scenario calendar is somewhat tilted in order to leave sufficient time for participants to get used to the scenario situation. The steps highlighted in the table designate proximate milestones only. The session itself is a continuous interaction among participants on the Regional Managements Board and between them and the Control team. The latter evaluates the plans and actions undertaken by the board and provides new information about the changing sea-level conditions and other relevant events in the region. The "ticking clock" design can be an effective simulation tool to emphasize the importance of timely actions in the ESLR management. Institutional changes and infrastructure building involved in some response options are likely to take a long time therefore the failure to initiate them on time might foreclose the use of these options altogether. Nevertheless, this process might put a lot of pressure on the participants, especially those who have less experience in participating in such processes.

4.3 Design B: Backcasting

The Backcasting session starts with a scenario presenting the impacts of ESLR in 2130 when the process will have been completed. How big is the area that will be inundated and what kind of assets known to be there at present will be affected. Participants are asked to imagine themselves to be in 2030 when the first reports about the plausibility of ESLR become available. This means that a "connecting scenario" is needed that elaborates the "future history" (from the participants "real-life" perspectives) of the region between 2003 and 2030.

The first task for the participants is to agree on the basic strategy: total retreat, partial retreat, full protection, or something else. The implication of this strategy should be fixed for the year 2130. The backcasting process involves an in-depth clarification of the preconditions and the previous steps that would ensure the successful implementation and completion of the strategy by 2100. What are the previous steps? Who should undertake them? By when? How -- in terms of funding, technologies, institutional changes, etc.? In subsequent rounds participants regress all the way back to 2030 when the first serious warning about ESLR was issued. The length of the time steps in the backcasting process can be fixed (for example, participants list actions to be completed by 2100, 2070, 2045) or it could emerge from the time required to implement the strategies and actions recommended by the participants.

Since the number of options to respond to the ESLR risk is rather limited, a variant of the Backcasting design might involve a series of shorter sessions in which participants explicitly deal with one particular option in an inverse scenario processing mode. One session could look at the timing and the relationships of the necessary actions to protect the region by dikes, whereas another session could outline the process minimizing the economic, environmental, and social losses of retreat.

4.4 Design C: Classic

This design resembles the most widely used procedure in policy exercises and war-gaming. Participants are presented with the original scenario outlining the information about socioeconomic development and the regional specifics for the year 2030. The scenario also contains the mock then-best available projections about the magnitude and timing of ESLR. In the first move, participants develop strategies and put in place the necessary actions for the first 20 years of the time horizon until 2050. The Control team evaluates the submitted moves. The evaluation includes a thorough assessment of the plans and actions initiated by the participants to undertake preparations for managing the fast sea-level-rise problem. The Control team may also provide new information that is imitated to have become available between 2030 and 2050 about improved scientific knowledge and other features of the original sea-level-rise scenario. All information is included in an updated situation for the year 2050 and the new scenario for the subsequent decades.

Participants start working with the new scenario from the year 2050 on. They learn about the results and effectiveness of their actions undertaken in the previous period. Based on these results and the new information, they develop new plans and actions for the period 2050 through 2070. These initiatives are submitted as the second move to the Control team. The Control team undertakes the same assessment as in round one and produces an updated scenario for the year 2070. This updated scenario serves as the starting point for participants in the third round in which plans and actions are developed and implemented for the following 30-year period until 2100. The same steps are repeated once again: Control team assessment and update for 2100, participants' strategy development for the period 2100-2130 as the last move in the game. Once this move is submitted, the Control team makes an evaluation and produces the final state of the world at the end of the scenario horizon.

A condensed version of the above design would cover the scenario horizon in three steps: first move for the period 2030-2050 with first update for 2050. This is followed by a 30-year step covering strategies up to 2080 with the second update commencing in 2080. The third and final round would then cover the 50-year period between 2080 and 2130. This seems like an enormous planning horizon, but – due to the nature of the ESLR problem – the key strategic choices will have to be made in the decades shortly after 2030.

An important part of the classic design is branch exploration. After completing the scenario process, participants and members of the Control team revisit the scenario and identify points at which they considered several options seriously. The list of these crucial decision points is then prioritized according to the extent to which an alternative decision taken at that point would have led to a different sequence of events for the remaining part of the scenario horizon. Depending on the time available, participants process the first 3 to 6 branch points in terms of the feasibility and effectiveness of the alternative actions, the expected outcomes, and the characteristics of the new situation with a view to subsequent decisions in the ESLR management process.

4.5 Design D: Over and over again

The basic idea behind this design is that the most crucial choices in managing the ESLR problem will need to be made in the initial years/decades. Two extreme options – full protection of the affected region by dikes versus the total retreat behind the safe elevation contours after ESLR – require two totally different sets of social, economic, technological, and infrastructure measures. Switching from the implementation path of one strategy to the other would be very difficult and extremely costly. The costs of "changing one's mind" increase exponentially with the passage of time and the amount of investments undertaken. Therefore, a thorough in-depth exploration of the first decision period might be useful.

Design D starts with an initial scenario for 2030. Its content is similar to the scenario in the Classic design: description of the history leading up to 2030 outlining general socioeconomic development and the regional situation, together with the ESLR projection. The task for the participants is to develop a strategy and implementation plan for the next 20-25 years from the perspective of 2030. The Control team does the assessment, provides feedback, and requests clarification about unclear items. Alternative strategies within the same scenario frame are explored in subsequent rounds.

Round 2 takes the same initial scenario for 2030 but participants can now also rely on the additional information provided by the Control team in response to their first move. Thus they are in a better position to develop improved strategic plans and implementation action for the same period between 2030 and 2050-2055. The submission of this move is also followed by the Control team's evaluation providing additional feedback and requesting further clarification. The third and final round gives participants one more chance to develop further enhanced strategies and implementation plans for the same time horizon. This is followed by the final evaluation by the Control team.

A variant of the design D scenario starts with participants divided into pre-assigned clusters of 3-5 people. The assignment can be based on stakeholder groups, professional background or some other criteria. The task for these small groups is the same as in the base case: develop strategies and implementation plans for the next 20-25 years. The small groups present their moves in a plenary, critique and discuss each other's proposals and identify unresolved questions. In this variant, the plenary session fulfils the role of the Control team or a Control team could also provide an evaluation of the moves submitted by the different teams.

Based on the assessment of the suggested moves in the first round and the list of open questions identified in the plenary discussion, participants may rearrange themselves into a different set of small groups for the second round. Ideally, they agree on the tasks for the subgroups (i.e., what part of the general strategy should each group develop), but this need not be the case. The restructured small groups either work on key aspects of the generally accepted response strategy or they search for new general strategic responses. In either case, the next plenary involves group presentations, discussion and assessment of the various ideas and strategic recommendations, and identification of additional unresolved questions. Depending whether this variant is played with or without a Control team, additional information and evaluation could also emerge. The plenary session is followed by a third round. Once again, the starting point is the same original scenario for 2030 but the group discussions are enhanced by the results of the previous two rounds in terms of pros and cons of different strategic options, and the lessons learned about the economic and social costs of them as well as about the technological and infrastructural implications.

5. Deliberation and the Atlantis implementations

For any application of the participatory techniques in climate impact studies, an important question is to determine how to call the stakeholder interaction. This depends to a large extent on the culture and the socio-linguistic connotations of different words. In some countries, game and gaming still sound somewhat unserious. The word simulation may have other misleading connotations in some languages. Other candidates are strategic exercise, future practicing, sea level rise task force. The choice of the name is proposed to be left to the case study team implementing the exercise.

Whichever of the designs A—D is selected, it is important to note a few general points. A key to any successful stakeholder process is the promise to and a clear agreement with the participants that none of them will be quoted in an identifiable manner outside the meeting room.

Another important design element is the clarification of the participants' role in the exercise. Since the main reason for involving representatives of various stakeholder groups is their interest and expertise in diverse implications of ESLR and its management, it is practical to assign a role to each participant closely resembling his or her day-to-day or professional activities. One possibility is to tell participants that they are playing the successor in their own current position in the year 2030. In order to design and operate the interaction process, participants should be asked in the pre-interviews about their responsibilities, objectives within their own organizations, their performance criteria and other issues relevant for their roles in the exercise.

Most designs of stakeholder workshops involve a Control team of experts who are able to assess the facts and implications of the moves submitted by participants. The problem is that these experts could also well be used in the strategy teams. Depending on the specific characteristics and the availability of experts in different regions, the distribution of participants between strategy teams and the Control team should be given thorough consideration.

In such stakeholder exercises, identifying and engaging a senior, generally respected person from the region as the Chair of the exercise turned out to be rather useful in the past. The Chairperson can provide both the enticement and some kind of "guarantee" for the participants that the exercise is a serious venture and worth their time.

The role of the facilitator is crucial in any participatory assessment. This is especially true in policy exercises and war-gaming. Facilitation can make the difference between success and failure when the exercise involves participants with none or limited experience in these kinds of group interactions. The nature of the ESLR problem requires a relatively flexible facilitation, yet one that keeps the process on track. The choice of the facilitator should be made in time especially if there are some preparations required.

There are additional choices to be made in preparing the stakeholder interactions. A technical one is to arrange documenting the session for the analysis phase. This can take the form of video and/or audio recording but in some cultures this may be disturbing to some participants. If participants express unease about video or audio recording of the session, fast-typing note-takers should be arranged.

The previous subsections demonstrate the diversity of framing and design opportunities of the participatory assessment techniques to arrive at designs and procedures that best serve the objectives of a given impact assessment. Yet a word of caution is in order. One should be careful when mixing the design elements and other features of different techniques in order to preserve methodological consistence. An inadequately mixed procedure can easily fall apart to the frustration of participants and organizers alike. In contrast, well-designed and at least meta-tested procedures provide a stimulating and productive working environment and produce results to the satisfaction of all, as was the case in the three regional case studies of the Atlantis project.

The Atlantis exercises used the procedural elements of the four workshop designs presented in this section. The regional teams reformulated the designs according to the special biophysical and sociopolitical cultures characterizing the regions. As a result, the regional case studies followed rather different procedures. The Rhone study (Poumadere et al., this issue) was largely based on the Policy Exercise method, albeit without Control team. The workshop used “canned” scenarios and the versions were adopted depending on how the discussion was unfolding at the branching points. This required meticulous preparations. The exercise was an important vehicle to get people talking and produced good material for subsequent analysis.

The Dutch session (Olsthoorn et al., this issue) was also a simplified policy exercise without Control team but it involved elements of the Focus Group technique as well. Little introductory explanation was needed because participants were experienced workshoppers. The moderator explained the objective (scenario writing) and they just launched into it. Even the scenario branch analysis evolved spontaneously.

The Thames workshop (Lonsdale et al., this issue) was organized as a free-form game with role-playing and scenario processing. This was the most formal exercise with clearly defined rules and procedures. A participant-selected Control team evaluated and updated the scenarios.

It is not clear whether the three case studies differ because the countries, the affected regions, and the magnitude of the impacts are so different or because the regional study teams have different disciplinary and methodological backgrounds. It is clear that the chosen designs worked in all three cases. It is also remarkable that the findings are rather similar. Moreover, all regions found a strong contrast between the perceptions and views expressed in one-on-one interviews prior to the workshop and the outcomes of the group discussions at the workshops. The information flow, the group dynamics, and the main foci of the group elaborations differed across the regions, but each provided relevant insights into the problem and lessons about the applicability of participatory techniques to address low probability – high consequence risks and about their usefulness for studying the social perception of and reaction to such risks.

6. Summary and conclusions

Participatory assessment methods are an underutilized resource in climate impact assessment. Sporadic examples of their applications over the past 15 years proved to be useful complements to impact modeling and expert assessments of gradual climate change. This paper has presented the methodological foundations of applying participatory techniques for exploring the perceptions and implications of extreme climate change. These results can be easily adopted to study the same problem (extreme climate change) in other regions as well as other extreme climate impacts in the affected areas, like the consequences of the collapse of the thermohaline circulation in the North Atlantic region or the effects of and responses to shifts of the South Asian monsoon system in the Indian subcontinent.

Four designs are outlined as the most promising options to address regional implications of extreme sea-level rise. The "Ticking clock" process emphasizes inertia, irreversibility, and long lead times in the management process. "Backcasting" helps chart the adaptation strategy by specifying the temporal sequence of measures moving backwards in time. The "Classic" design imitates the decision process through a series of steps of updated scenarios that incorporate implications of earlier decisions as well as new information. Finally, the "Over and over again" design focuses on the importance of the decisions made in the initial decades and involves several iterations over the same time period to allow participants benefit from the feedback received on earlier moves.

The applications of participatory techniques to help relevant policymakers and stakeholders engage into a serious assessment of a remote and low-probability environmental risk proved to be successful. The flexibility of these techniques and the possibility to combine design elements of several techniques in a methodologically consistent manner were helpful. The results indicate that participatory techniques can usefully complement formal methods of risk analysis and they are also valuable in exploring the risk perceptions and risk attitudes of key stakeholder groups if their delegates at the workshop correctly represent the wider community.

The paper has shown that participatory integrated assessments can provide demonstrable contribution to climate impact assessments: foster learning about the perceptions of those affected and exploring benefits and costs, pros and cons of different adaptation strategies to reduce negative and to benefit from positive impacts of changing climate, gradual and abrupt change alike. Accordingly, the paper is not only relevant for the Atlantis study presented in this special issue. It serves the broader community by presenting designs that could be adopted in future climate impact and adaptation studies to explore the implications and identify the responses and their implementation in both gradually evolving impacts as well as extreme climate change.

Appendix. Short summaries of selected participatory techniques

This Appendix presents three participatory methods that have proven to be or are likely to be particularly useful in climate impact and climate policy assessments.

Simulation-gaming techniques (SG)

SG techniques involve a combination of some elements of a game, a simulation, and the reality. The crucial element stemming from gaming is that participants are typically playing some pre-assigned or voluntarily selected roles and they make decisions pertinent to those roles under a set of rules that define the boundaries of the game. Roles can be defined across a broad range from very realistic (close to the players' everyday functions) to completely abstract/symbolic. Similarly, rules of the game that regulate interactions among players and their decision-making could range from rigid and predetermined rules to more or less flexible arrangements that may also evolve in the course of the game.

Simulation-gaming techniques have been used for a large variety of practical management problems in business and public policy, as well as for research purposes primarily in social science (Shubik, 1975; Duke and Greenblat, 1979; Horn and Cleaves, 1980; Greenblat and Duke, 1981). Some applications involve complex private sector or public policy decisions like siting a research laboratory of a large multinational pharmaceutical company or reforming the health care system of a country. Free-form games driven by a minimum set of rules and an initial scenario have been intensively used for over half a century to test military strategies in different conflict situations (see Brewer and Shubik, 1979). More recently, this technique has also spread to strategic planning and forecasting in corporate and public policy arenas. Operational games draw on a rich collection of procedural designs, playing situations, role characteristics and paraphernalia to construct an artificial social situation. The game enhances selected features of the reality that were identified as relevant factors in shaping actors' behavior and social processes in reality. Under the guidance of the game operator, players can act in a single, relatively large group or in several smaller teams. The relationship among the smaller groups can be cooperative, competitive, or neutral. Scoring (e.g., gaining or losing points) usually serves as an important motivator in the course of the game, but winning or losing becomes a secondary issue in the end when insights gained from playing the game are shared and conclusions are drawn collectively.

In climate impact assessment, free-form games are good candidates for strategy exploration in the presence of considerable stakes and large uncertainties. In its simplest form, information on the relevant risks collated in one or more scenarios could be processed by a group of stakeholders who are assisted by experts. More elaborate free-form games might involve sophisticated scenarios, impact models, and other assessment tools to evaluate the full implications of the selected strategies. Operational games are good candidates for education and training programs on climate change and impacts.

Getting closer to the ESLR problem as a crisis situation, the paper by Quanjel et al. (1998) on CRISISLAB, a simulation to evaluate and improve crisis management is of special relevance. The simulation intends to alleviate the problem that many management exercises lack realistic interaction, objective measurement of performance, structured feedback, and the building of shared mental models. Andriessen (1995) takes a harsh-winter case as the subject of a policy simulation to study crisis management by developing and applying crisis scenarios. A full-day exercise with representatives of four responsible ministries proved to be very useful in increasing crisis awareness, demonstrating the need for coordination, and improving the robustness of crisis management. Schulein (1989) looks at crisis gaming for research and training whereby the focus is on making complex decisions in a short time period, based on incomplete and/or unreliable data. The task is to control an organization in times of crises in a supervisor-controlled (mostly hostile) environment. An extra dimension is added by allowing the players to define the management structure they will play in to allow the comparison of different structures. Clearly the nature of the ESLR crisis differs from the characteristics of organizational and management crises. Yet these and many other crisis games provide a suit of ideas and design elements that can be adopted in climate-related exercises.

The Policy Exercise (PE) method

A Policy Exercise (Brewer, 1986; Toth, 1988a,b) is a flexibly structured process designed as an interface between scientists, experts, and policymakers. Its objective is to synthesize and assess knowledge accumulated in several relevant fields of science for policy purposes in the light of complex practical management problems. It is carried out in one or more periods of joint work involving scientists, policymakers, and a support staff. A period consists of three phases (preparations, workshop, evaluation) and can be repeated several times. Core activities in the process include scenario writing ("future histories", sometimes emphasizing non-conventional, surprise-rich but still plausible futures) and scenario analyses via the interactive formulation and testing of alternative policies that respond to challenges in the scenario. These scenario-based activities take place in an organizational setting reflecting the institutional features of the addressed issues. Throughout the exercise, a wide variety of hard (mathematical and computer models) and soft methods are used.

Principal participants in a PE are leading scientists from disciplines of critical importance to the subject and representatives of major actors, influential policy makers, and stakeholders from the policy side. In the first phase, a series of plausible future development scenarios are prepared together with all necessary background "technical" documents. Scenarios provide a special framework in which issues from various fields affecting the problem are integrated and bounded, and in which specific policy options are tested during an interactive session at the workshop. From the technical point of view, these sessions represent a mixture of a scenario-based free-form gaming exercise ("war-game", see above), an operational gaming session, and a modeling workshop as developed in the so-called Adaptive Environmental Assessment and Management approach. However, these techniques are not part of the PE approach.

A basic feature of the PE concept is that participants from the policy side are involved from the very beginning of the preparations. Several ways have been devised to learn about their opinions, attitudes, and perception of the problem. These include an active correspondence by mail or e-mail throughout the preparations phase, telephone interviews and detailed personal pre-interviews conducted by the organizer team with would-be participants. They also contribute to the formulation and writing of the scenarios and technical documents this way. Participants' input is also critical in the evaluation phase when their feedback and comments on the draft synthesis report and other documents are essential. The product of a PE is not necessarily new scientific knowledge or a series of explicit policy recommendations, but rather a new, better structured view of the problem in the minds of the participants. The exercise also produces statements concerning priorities for research to fill gaps of knowledge, institutional changes that are needed to better cope with the problems, technological initiatives that are necessary, and monitoring and early warning systems that could ease some of the problems in the future.

The substantive centerpiece of a Policy Exercise is scenario development and analysis. Six basic scenario types and associated interactive scenario processing sessions were originally developed (Toth, 1988a,b). These archetypes are as follows:

Type 1: future scenario revised based on proposed policies

Type 2: future evolution unfolds as a result of proposed policies

Type 3: managing future crisis situations

Type 4: backcasting – avoiding future crisis situations

Type 5: managing the future – injecting policies at several future time points

Type 6: managing the future in "real time" simulation with a running "scenario clock"

In the applications over the past 15 years, different combinations and variants of these archetypes have been designed, tested, and used. The designs developed for the ESLR project and presented in this paper also originate in these archetypes.

The first, and as of today the most prominent, field of application for Policy Exercises has been environmental and natural resource management issues. Duinker et al. (1993) adopted policy exercises in a study of Europe's forest sector. This exercise brought together senior executives of forestry and forest product companies from many European countries. The exercise processed a series of environmental (forest dieback) and economic (European demand for forest products in the context of global trade) scenarios to explore robust company strategies as well as European- and national-scale policy interventions.

Ever since its inception, an increasing use of the PE method to address global change issues can be observed (see Klabbers et al., 1995; 1996; Toth, 1995; Mermet, 1992) together with a wide range of public policy problems beyond environment (Joldersma et al., 1995; Wenzler et al., 1995). For example, Klabbers et al. (1995) report a PE application in the domain of climate policy with the focus on managing the organized complexity through gaming. They observe that government and industry policy makers and individual consumers base their response to the climate change issue on the balance between three types of considerations: perceived risks of climate change, socio-economic and technological feasibility of response options, and ethical aspects of an equitable distribution of responsibilities among different social actors. Especially in industrialized countries, they are overwhelmed by a profusion of complex and sometimes contradictory information from the scientific community. The exercise presented by Klabbers et al. (1995) responds to the policy makers' request to the scientific community to gather usable information about the risks and response options related to climate change.

The Focus Group technique (FGT)

The FGT is based on a well-prepared and monitored social process that draws on small-group techniques used in applied social science research (see Krueger, 1988) and in political decision-making (see Stewart et al., 1994). FG sessions are group interviews in which a discussion leader (moderator) facilitates the conversation process and a small group discusses the issues raised by the discussion leader. The most frequently used format of the FGT involves six to eight participants, the moderator, and assistant(s), if necessary. The moderator should be an experienced specialist in small-group techniques who can direct the discussions so that they best serve the interest of the client. FG sessions can vary between rather rigid, questionnaire-like information acquisition at the one extreme and a freely flowing, brainstorming-like discussion at the other. The precise format within this spectrum is determined by the client, the objectives, the time frame, and the number and character of the participants. The responsibility for implementing the agreed design rests with the facilitator. This is not an easy task even with well-specified questions and thoroughly thought-through session procedures.

In recent decades, environmental organizations have become important actors among the numerous other interest and pressure groups that try to influence the governments' environmental policies directly or through industrial, energy, transport and other policies indirectly. Public opinion surveys or formal referenda are increasingly recognized instruments in shaping the final decisions on local environmental issues (e.g., on siting potentially harmful or risky industrial plants, waste disposal facilities; on projects involving major transformation of the landscape) or about national environmental policies (e.g., on utilizing or abandoning nuclear power). The FGT is frequently used as a tool for soliciting public opinion on these issues.

Global and continental-scale environmental problems pose profoundly new challenges for democratic decision-making. While new techniques (like PEs) have been devised and applied to provide fora for interactions between scientists and policymakers, citizen involvement has been lagging so far. This is not particularly surprising if we consider the fact that the scales, complexities, and uncertainties involved in these issues make it virtually impossible even for curious and motivated lay people to arrive at an informed judgment on these problems. In addition to being a pure discussion/debate activity, the FGT may also combine computer models with the monitored social process. This allows participants to express their judgments on products and services (existing or planned) to help future providers or even complex issues like public (e.g., environmental) policies in a form that provides useful information for policymakers. An example of such effort is the Georgia Basin Futures Project (Tansey et al, 2002; Carmichael et al., 2004) in which an integrated assessment model is combined with focus-group-type interactions to help the general public to identify desirable futures for the region.

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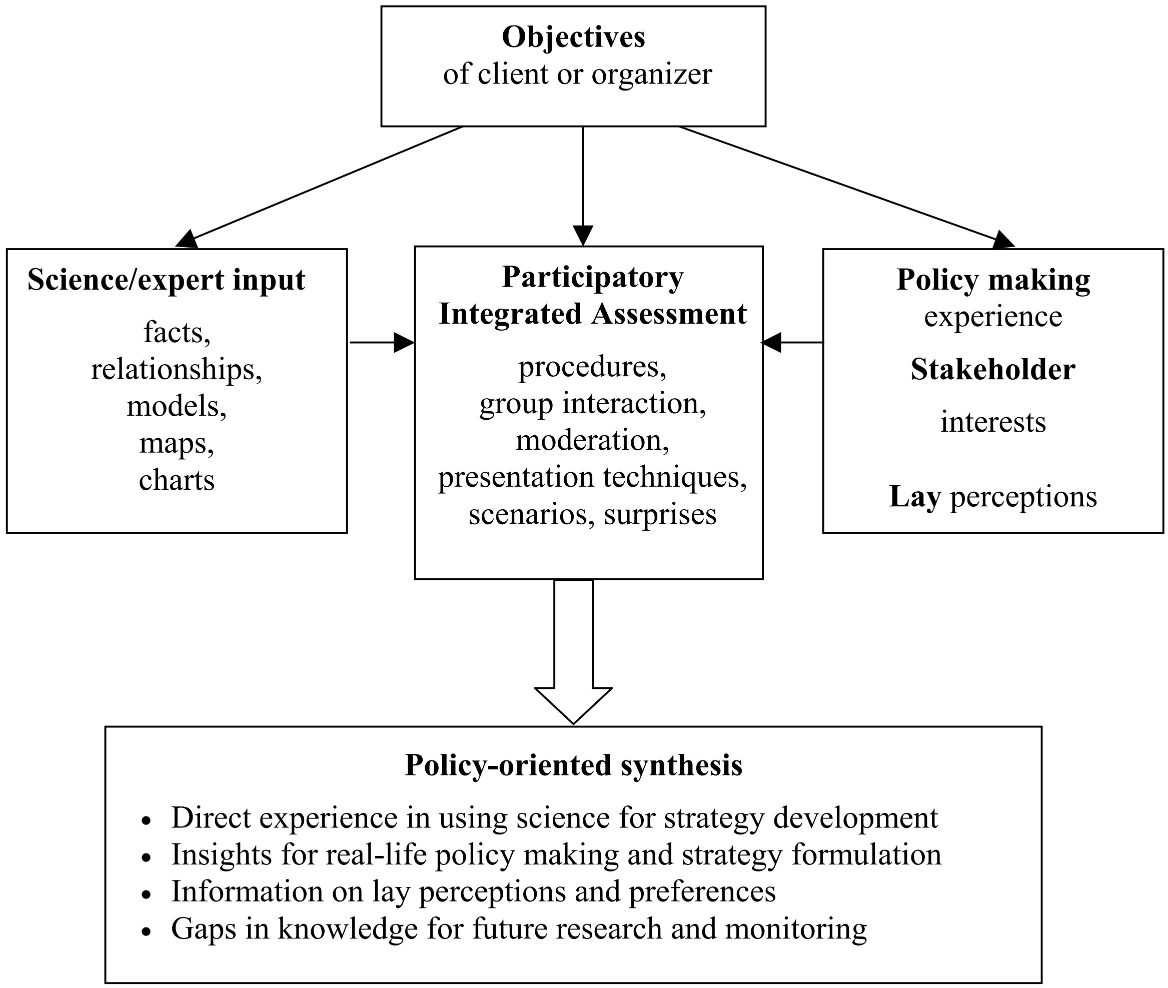

Figure 1: The general structure of participatory integrated assessments

Table I
Example of the Ticking Clock design

Real time (minutes)	Scenario time (year)	Events	Tasks
Start	2030	First news, committee established	Prepare Action Plan (AP) until 2035
60	2035	Submit AP1, receive new info	Prepare AP2 until 2045
90	2045	Submit AP2, receive new info	Prepare AP3 until 2055
120	2055	Submit AP3, receive new info	Prepare AP4 until 2070
150	2070	Submit AP4, receive new info	Prepare final AP until 2100
180	2100	Submit final AP	

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