Pre-Open Meeting Workshop

In conjunction with the 6th Open Meeting of the Human Dimensions of Global Environmental Change Research Community

"Multi-Agent Modeling and Collaborative Planning – Method2Method Workshop"

Date: 8-9 October 2005

The 6th IHDP (http://www.ihdp.org/) Open Meeting will be held in Bonn, Germany from Oct. 9-13, 2005. On Saturday, October 8 and Sunday, October 9, we will conduct a problem-based workshop on linking data collection methods to multi-agent system models (MAS) and conceptualizing common model requirements for simulating land-use and land-cover change (LUCC).

Location:
Center for Development Research (ZEF) (www.zef.de)
Street: Walter-Flex-Straße 3
Zip code: D-53113
City: Bonn

Routemap:
http://www.zef.de/howtoreach.0.html

Workshop organizers:
Thomas Berger, Franz Gatzweiler, Marco Huigen, Dawn Parker, Derek T. Robinson, and Heidi Wittmer

1. INTRODUCTION

Scientists have developed a number methods and tools for modeling and planning human-environment interactions, each guided by their own set of disciplinary backgrounds and research paradigms. Examples are bio-economic modeling, survey methods based on common sampling frames, collective action research, role-playing games and participatory planning.

There is a need to create transparency among scientists in the field of human-environment interactions with respect to the variety in methods. Complex problems arise from environments characterized by turbulence and uncertainty, and are typically value-laden, open-ended, multidimensional, ambiguous, and unstable. The number of tools to address complex problems is multiplying. Sophisticated analytical methods and computer software make it possible to handle increasingly greater amounts of information, facilitating large-scale modeling and forecasting. Deeper scientific knowledge and technical expertise also continue to emerge from the disciplines. To achieve flexible solutions for the dynamic management of complex problems, beyond simply adding more variables or applying new information and tools to existing decision models and computer programs, we need to collectively determine:

What methods are available and suitable for adequately addressing complex issues at the interface of social and ecological systems via collaborative research and mutual learning?

Previous workshops and summer institutes on ABM for LUCC modeling have provided excellent learning experiences and outputs with the production of journal papers, special issues, and a LUCC Report 6. The proposed workshop will expand on our previous collaborations and provide an avenue for the development of novel ideas and a synthesis of ideas focused on steps and procedures for bringing data to empirical multi-agent models.

The outcome of the workshop are intended to be submitted to a suitable peer-reviewed journal, e.g. the *International Journal of Agricultural Sustainability* which has issued a call for papers on Participatory Research and Learning Approaches for Agriculture.

2. WORKSHOP

The workshop is a **1 ½ day event** with a problem-based format on Saturday and Sunday morning.

To encourage active participation and the exchange of ideas, the workshop is constrained to about 25 participants.

Lunch will be provided on Saturday Oct. 8, 2005.

2.1. Schedule

The workshop consists of four sessions.

Day	**Time**	Details
Oct. 8.	9.00am-9:30am	Workshop and participant introductions.
	9:30am-12.00pm	Session 1: Methodologies for Data collection for ABM
	12.00-1:30 pm	Lunch – Provided by the Workshop
	1:30-3:30pm	Session 2: Collective summary of Session 1
	4:00-6:00pm	Session 3: LUMPs
	7.00pm-?	Dinner
Oct. 9.	10.30am–12.00pm	Session 4: Mimosa and Integration framework
	12.30am-14.00pm	Session 5: Wrap it up

2.2. Sessions objectives and format

2.2.1. Session 1 (9.30 – 12.00)

Description

Usually, research questions are derived from a specific problem definition and then it is decided which technique or combination of techniques is most appropriate for analysing the problem. Although the organizers do not encourage tool-driven research (the proverbial 'hammer looking for a nail'), we are asking the participants to take their data collection methodology as a starting point and then evaluate the consequences for their research. We ask the participants to depart from the data gathering technique in order to explore what kinds of questions can be addressed and how this technique affects and reflects the agent based modelling.

As a good reference for the data gathering techniques a paper by Janssen et al. is included.

The case-background serves as a help to formulate possible research questions that could be addressed with the respective techniques.

The Case of Ethiopian Coffee Forests

The montane rainforests of SW Ethiopia are the birthplace of worldwide Coffea arabica gene pool. Wild Coffea arabica populations can be found amongst undisturbed afro-montane rainforest vegetation between 1000 and 2000 m asl. These forests are fragmented forest areas in hilly regions. The fragmentation is the result of settlement, the use of the forest for agricultural purposes and forest (eucalyptus) plantations. All land in Ethiopia belongs to the government, merely use rights are assigned to peasants. Much forest land of SW Ethiopia is officially gazetted and protected as National Forest Priority Area. The use of the forest resources within the NFPA, however, is usually tolerated by local governmental bodies. The forests are inhabited and used by people, some of them lived in the area since time memorable.. Apart from three forest islands (10,000 ha, 2,700 ha, and 9,000 ha) which are fenced and protected by guards, the remaining forests are inhabited and used by people. Of these two groups can be distinguished: the Forest people (Manja) and the Farmers (Kaffa). Former traditionally live within the forests, highly depend on its products (honey in particular) and are at times nomadic. The later also use the forest but derive a large proportion of their livelihood from agriculture (maize, enset (false banana), coffee gardens). Both groups collect coffee from the forest, which is their main source of cash income. Another group are the new settlers, who have been resettled by the government from other areas of the country. They live in close neighbourhood to the original inhabitants and are mainly into agriculture. However, the new settlers' agricultural practices are not adapted to the new environment, and their cultivation and forest utilization practices tend to be less adequate and sustainable than those of the Manja and Kaffa people.

Format

Groups of 4 – 5 people are formed to answer questions and discuss techniques for eliciting and coupling information from 1 of 5 empirical data gathering methods. The six methods have been defined as follows:

1. Structured theory-driven questionnaires (Household surveys)
2. Field Experiments
3. Laboratory Experiments
4. Companion Modeling
5. Participatory Observation

Objectives

Each break-out group is to focus on the use of a particular data collection methodology and structurally discuss its strengths and weaknesses with regard to scientific MAS applications.

To facilitate this process and ensure all groups maintain consistency for discussion, each break-out group should address predefined questions.

Included attachments

- Paper on data gathering techniques for ABM by Marco Jansen.
- Questionnaire (see next section) to be used in session 1

Questionnaire for session 1

The goal of the questionnaire is to understand what effects a data collecting methodology has on the choice of the ABM model and how this collection methodology is related to the research questions. If possible, try to phrase your answers with examples based on the case.

Research Questions

1. What type of research questions can you answer with your collection techniques? Try to formulate it in a general form (e.g. questions with a spatial or social focus, questions dealing with innovations and so on).
2. Give 2 or 3 typical examples based on the case.
3. What mechanisms driving LUCC are best captured by the method?

ABM-LUCC Models/Frameworks

4. Which agent based models are best for your collection techniques? (E.g. LUCITA, SLUDGE, ABLOOM?
5. Which agent based frameworks are best for your collection techniques? (E.g. RePast, SWARM, NetLogo, MameLuke)

General aspects of data collection techniques

6. How much time will it take to gather the data? Explain
7. How much data do you have to gather for a purposeful model (is the method data hungry? Explain
8. How easy is it to gather the data? Explain.
9. Where are the greatest costs incurred in your data collection technique (i.e. equipment, time, labour, training, etc.) and if possible give an indication of those costs. Please elaborate on the types of equipment, training, labour use, and use of time required.
10. Which types of data are unique to your approach (methodology and associated uncertainties and errors in the data)?
11. What are the pitfalls or limitations to your data gathering methodology?

Landscape

12. How do you identify and define the landscape with your collection techniques?
    a. Do you use an abstract or empirically-based representation?
    b. What is the smallest unit of spatial resolution observed and how does this relate to the spatial resolution represented in your model (i.e. is dis/aggregation required)? Also are other resolutions preferred (if yes, explain what is the constraint)?
13. How can you represent/capture the data required for the biophysical landscape with your collection techniques?
    a. Describe the process of data collection?
    b. What is the (maximal) extent and resolution you can cover with your approach?

c. Describe the conceptual linkages of your data collection approach to a GIS (i.e. is it possible? What intermediate steps and software are required?). Feel free to elaborate.
d. Is your approach suitable to deal with different scales? Explain.

Agents

14. How do you identify and define the agents with your collection techniques?
    a. Are they abstract or empirical based?
    b. Which (smallest) social unit of observation has most potential in your approach?
    c. Is there specific literature that you often refer to for this task?
15. How can you represent/capture the data required for the agents with your collection techniques?
    a. Describe the process of data collection?
    b. What is the (minima) social level you can cover with your approach?
    c. What types of decisional structures are most likely to appear in your approach? Describe such a type.
    d. How would you capture agent heterogeneity?
    e. How would you parameterize your agents?

Time

16. How do you identify and define the appropriate time scale in your collection techniques?
    a. Which (smallest) unit of time has most potential in your approach?
    b. Describe the process of retrieving the appropriate temporal scale with regards to your data collection.

Interaction agents with landscape

17. How do you identify and define the interactions with your agents and the landscape with your collection techniques?
18. Does your data collection technique identify decision strategies directly or are they indirectly identified (e.g. based on statistics (=inductive) or data fed into theoretical construct (=deductive))

Complementary data collection techniques

19. Which other data collection techniques are most complementary. List them from 1 to 4, where 1 is most and 4 is least complementary.

Stakeholder interaction

20. How easy is it for stakeholders to understand the models resulting from you data collection techniques and the resulted models?
21. How well does the gathered and modeled data represent the stakeholder perceptions?

2.2.2. Session 2 (1.30pm – 3.30pm)

Description

The outcomes of the first session are presented.

Format

In this plenary session each subgroup presents its findings.

Moderator = Heidi Wittmer

Objectives

Subgroups will document their results in a readable format so that we can elaborate strengths and weaknesses comparatively.

2.2.3. Session 3 (4.00pm – 6.00pm)

Description

The development of a complete model of LUCC is extensive and often beyond the time-frame and skill set available to most Ph.D. and Master students. To improve the efficiency of the modeling process we believe steps must be made to identify generalized but fundamental building blocks useful for a range of agent-based models in the LUCC field.

In previous workshops several agent-based land use research groups have indicated that identification of general agent-based structures for land use research (so-called Land Use Modeling Primitives or 'LUMPs') and setting up libraries for these LUMPs would be possible and helpful. In this session we will try to come to a clear description of what these LUMPs are and how we can make use of their generic structures in our modeling.

As part of a collaborative project with ESRI and Argonne National Laboratory (the developers of RePast) the SLUCE team at the University of Michigan has conducted research on primitives for MAS and for coupling MAS GIS. Attached is an abstract submitted to Agent2005 by the Michigan SLUCE team that provides one approach to the assessment of ABM primatives. In short, they assess three platforms for developing ABMs (NetLogo, RePast, Mobidyc) to qualitatively evaluate primitive types and uses. For example, much of NetLogo and a portion of its primitives are focused on GUI development for running and displaying models. In contrast the Mobidyc platform is similar to the MameLuke Framework but uses a complete GUI for stringing together ecological actions/behaviours/primitives.

Their idea of primitives in the attached abstract is focussed on the functionality of agents and agent modeling frameworks using primitives or building blocks. These are not necessarily LUMPs, which are specifically focused on LUCC issues, events, and behaviours. Examples of process primitives that may be useful for developing agent behaviours include:

1. rest/wait
2. move
3. change
4. decide/choose
5. measure
6. compare/evaluate
7. relationship – define a connection
8. influence (one directional)
9. interact/exchange (influence two directional)
10. destroy

Similar to the Mobidyc and MameLuke frameworks, the above primitives may be combined with logical operators in many ways to create behaviours or meta-primatives. For example:

interpret = measure + compare
react = interpret + move
learn = react + change

Furthermore, these process primitives may be used as generic algorithmic blueprints or schema that may be used to describe or develop an agents' action.

Another approach in defining LUMPs is to look at the functionalities commonly used in agent-based modeling systems for land use and generate libraries with key interaction primitives, like market mechanisms, information transfers, imitation behaviour. See the attached chapter by Parker (2005) for an example of this approach. Furthermore see the attached document by Robert Najilis.

Format

Derek T. Robinson a PhD of Michigan University will give an introduction on primitives (15 min.).

After the presentation we will have a short plenary discussion on LUMPs (25 min.).

Dawn Parker will moderate.

After the plenary discussion the subgroups of session 1 will break-out and discuss how they would like to use primitives, which primitives can be identified, how to link them with the model/problem they defined earlier that morning.

Objectives

The subgroups will present their findings on a poster.

Included attachments

- Abstract Michigan group
- Document by Robert Najilis
- Chapter 19 Parkers' book.

2.2.4. Session 4 (10.30am – 12.00pm)

Description

The LUMPs as defined in session 3 should be stored in publicly available libraries and then could be part of an integrated modeling framework. Besides LUMPs library components, such a framework should contain structures to link agent based models with other existing models. Furthermore, such a framework should contain structures that allow for knowledge representation transformations, in other words, a structure that allows stakeholder knowledge translations into scientific representations and vise versa.

Hence, often in more complex systems, agent based models need to get data from and to other models (e.g. hydrology models). There are smart ways of dealing with such coupling issues.

To set the discussion on such an integrated modeling framework, short presentations by Marco Huigen (University of Hohenheim) and Jean-Pierre Muller (CIRAD) will describe current research in this area and stimulate discussion. Marco's presentation will be on model coupling and integration issues and Jean Pierre will talk about MIMOSA, a platform for different knowledge representations.

Format

1. Brief presentations by Marco Huigen and Jean-Pierre Muller (20 minutes per presentation)
2. Plenary discussion (50 min.)

Objectives

The aim of this session is to set up a translation between the conceptual ideas on the primitives towards a practical-use of the primitives. Such a practical, generic implementation of LUMPs and integrated modeling would serve the ABM LUCC by:

1) Individual modelers could use it to communicate their model mechanisms and structures, perhaps by highlighting the parts that are active and/or the components that were implemented.
2) It would give us an underlying conceptual pattern to use in developing the set of software libraries for ABM/LUCC that we would like to. We could start by gathering available code and seeing which elements we already have covered.

1 & 2 would give us what we needed to write a grant proposal, and also to do a great overview paper that could be a workshop product. Perhaps as a workshop follow-up, we could send out a draft of the completed diagram, and have interested participants express their own models using it. Or that could be part of the grant proposal.

Session 5 (12.30am – 14.30pm)

Description

This session summarizes the discussed and achieved. Furthermore, it allows the floor for ideas on future collaboration.

Richard Aspinall will present his journal.

We will come up with ideas for joint publications and the lay out should be drafted.

Format

Plenary session

Moderator =?

Objectives

Wrap up the workshop.

2.3. Participants

In the table below the invited people that will participate are given.

	Last name	First Name	Email
1	Berger	Thomas	490e@uni-hohenheim.de
2	Huigen	Marco	Huigen@cml.leidenuniv.nl
3	Brown	Daniel	danbrown@umich.edu
4	Robinson	Derek	dtrobins@umich.edu
5	Promburom	Panomsak	panomsakp@yahoo.com
6	Castella	Jean-Christoph	j.castella@ird.fr
7	Becu	Nicolas	becu@uni-hohenheim.de
8	Van Oel	Pieter	P.R.vanOel@ctw.utwente.nl
9	Happe	Kathrin	happe@iamo.de
10	Damgaard	Martin	damgaard@iamo.de
11	Jungklaus	Oliver	jungklaus@iamo.de
12	Parker	Dawn	dparker3@gmu.edu
13	Aspinall	Richard	richard.aspinall@asu.edu
14	Schreinemachers	Pepijn	pepijn.schreinemachers@uni-bonn.de
15	Overmars	Koen	overmars@cml.leidenuniv.nl
16	Gatzweiler	Franz	fgatz@uni-bonn.de
17	Wittmer	Heidi	heidi.wittmer@ufz.de
18	Pahl-Wostl	Claudia	pahl@usf.uni-osnabrueck.de
19	Deadman	Peter	pjdeadma@fes.uwaterloo.ca
20	Schlueter	Maja	maja.schlueter@ufz.de
21	Volkmann	Jörg	j.volkmann@amberfoundation.com
22	Gotts	Nick	n.gotts@macaulay.ac.uk
23	Janssen	Marco	maajanss@indiana.edu

2.4. Requirements participants

We would like to ask the participants to write up a few paragraphs regarding their own strategies for bringing data to ABM models. Topics possibly to be included are:

- Briefly describe your research context and your main research questions.
- Which kind of ABM do you use, please shortly describe. (BDI, Heuristic, empirically informed/fitted ABMs and frameworks/libraries)?
- What data collection techniques have you used to bring data to your ABM model?
- Why did you select this data collection technique?
- What do you see as the strengths and weaknesses of your chosen strategy?When can results be expected?
- How are research/modeling goals communicated, visualized to stakeholders?
- Is IT an additional barrier or supportive of communication?
- Involvement of stakeholders in designing the model (participation)
- How are stakeholder's views inquired, recorded, integrated?
- To which extent can conflicting views and perceptions be recognized?
- Do stakeholders understand the purpose of assessment/model
- How is stakeholder's spatial knowledge integrated in the model?
- How does the method analyze ecological, social dynamics?
- How does the method deal with complexity (reductionistic or holistic)
- Which scales/levels do you address?
- How do processes on multiple scales communicate (in your gathered data)?
- How do processes on multiple levels communicate (in your gathered data)?
- How do processes on multiple scales communicate with the levels (in your gathered data)?

Furthermore, we would like to ask the participants to prepare some answers to the questions listed in Session 1.

We will compile the responses and distribute them. Please send your response document to Marco Huigen: mhuigen@uni-hohenheim.de