



Human Social Dynamics Program

# Integrating Socio-Ecological Sciences Through a Community Modeling Framework

**Planning and Organizing Workshop at Arizona State University**

**March 1-3, 2007**

## **WORKSHOP VISION AND GOALS**

Agent Based Models (ABMs) have recently emerged as a promising tool to study the dynamics of coupled human and natural systems. While ABMs are much discussed and are rapidly becoming perceived as a requirement for cutting edge research centering on human-environmental interactions, most social and natural scientists still have a limited awareness of their potential, and the experimental nature of most ABM platforms prevents them from being readily accessible to researchers. Furthermore, a lack of standards has inhibited the exchange of modeling expertise and cumulative model building among different research teams, and there has been little effort at systematically addressing problems of validation and verification in modeling algorithms and results. In this workshop we will address these issues and accelerate the regular integration of ABMs for research in social-natural dynamics by initiating a broad, communitywide agenda involving active researchers ranging from content experts in the social sciences, ecology, conservation biology and GIS, to computer scientists and mathematicians. We aim to establish a Community Modeling Framework for Social-Ecological research (CMFS), following successful examples of community frameworks for cybertool development in other research domains. The workshop will be followed by a proof of concept pilot project, comprising a new collaborative, scientific network to initiate the CMFS. The pilot project will establish a modeling archive and component library for jump starting new research using ABM, a collaboration server (CVS) for improving usability and usefulness of ABM for social-ecological research, a testbed of standard data for developing model evaluation protocols, proposed best practices for model dissemination and frameworks for model interchange, and a training program in ABM aimed at social and natural scientists. A lot of small initiatives on components of the perspective described above are on their way in different locations. We hope that the workshop will establish a consortium, a central place, to derive the information at a central place.

# Integrating Socio-Ecological Sciences Through a Community Modeling Framework

## AGENDA

February 28

*Participants arrive*

*Social hour*

March 1

*Continental breakfast*

*Welcome and introduction: context, overview, and goals*

*Coffee break*

*Archiving model components*

It is not necessary to reinvent the wheel in modern times, but this is what happening among scholars who model social-ecological systems. Many (though not all) models of complex human-environmental interaction involve similar agents: farmer, fisher, family, household, large herbivore, crop plant, etc. Can we establish an archive of standardized ABM 'components' (e.g. Java classes) that can be used, modified, and reused in multiple research projects? What formats would best serve such an archive? How can these components be made accessible to researchers with varying skill levels that seek to develop socio-ecological models? How can researcher credit, intellectual property, and community accessibility be balanced?

*Lunch*

*Standard protocol for ABMs*

It is essential that there be commonly agreed on protocols for description and presentation to evaluate the quality and scientific contribution of modeling oriented research. Standardized protocols are especially important for simulating complex phenomena which are difficult to characterize and where relevant methods are not yet widely understood. Such protocols can help establish the credibility of modeling results, offer a framework for replication and verification, and provide a 'ruler' against which journals can measure submitted manuscripts. Can we begin to define such a standardized protocol? How and where should this protocol be promoted and applied? What are the potentials and challenges of working with an initial set of journals to field test such a protocol?

*Tea time*

*ABM platforms and interfaces*

Developing usable simulations in current ABM platforms generally require experienced programming background. It would be helpful if future platforms have user interfaces that can be manipulated more directly by practicing scientists. This will make it easier for scientists to experiment with and evaluate the potential for ABM to address a broad array of issues in human-environmental interactions. However, ABMs must still retain more flexibility than is available in most software GUI's. What developments in ABM platforms would make them more accessible in this way? Can interfaces be designed to accommodate a range nonprogrammer end users and those who wish to change the underlying code? Can we establish a cooperative network and development environment to envision and create next generation interfaces?

# Integrating Socio-Ecological Sciences Through a Community Modeling Framework

March 2

*Continental breakfast*

*GIS and ABM integration*

GIS and ABM technologies have followed similar but largely independent paths for introduction and use in the social and natural sciences. They also utilize very different underlying software architecture and model structure. Yet there is a clear need for tighter integration between agent based simulation platforms and spatial technologies, represented by GIS that is especially critical for modeling human decisions and their recursive environmental consequences at landscape scales. What are the current developments in integrating GIS and ABM? What are the challenges and potentials for dynamic interaction or even model composability among these different classes of models. In particular, how can issues of timing, scaling, and information flow be addressed? How can functional integration between multi-agent and geospatial modeling tool kits be facilitated?

*Coffee break*

*Testbed for social-ecological ABMs*

It would be helpful to establish a testbed of social-ecological data to be used for evaluating models and establishing evaluation protocols in a controlled and replicable environment. It is useful to have both carefully structured 'artificially' generated data sets and real world data collected during social-ecological research. The artificial data, with systematically defined and known population parameters, serve for assessing the behavior of software code and for developing quantitative evaluation protocols; the realworld data serve to compare the efficacy of alternative modeling algorithms for answering research questions. Given the diversity of models and model objectives, even within socio-ecological research, is such a testbed realistically feasible? How could it be structured, described, and formatted?

*Lunch*

*Model library*

When model analyses are published, the results are generally difficult to replicate. And if a researcher hopes to build on existing models, they are generally not easily accessible. Therefore, it would be helpful to establish a model library, where scholars publish key ABM models, along with model documentation and source code, when they publish a paper. How should we establish a library of published models to serve as record of prior research and guides for future work? What formats would best serve such a library? How would published models be made accessible? How can researcher credit, intellectual property, and community accessibility be balanced? Could a model library also benefit publication of results? If so, should we couple a model code library with publication protocols in a field test with a set of journals?

*Training in ABM methodology*

Agent-based methodology is generally not taught in regular university courses. We propose to initiate a training program to jumpstart the use of ABM by established scholars and students. This could involve complementary online tutorials, packaged course materials, summer schools, and intensive training workshops. What are the major skills gaps we are likely to face in our community? What are the possibilities for students and scholars to derive training and how can this be improved? Which of these venues are most effective for which audience?

*Tea time*

## **Integrating Socio-Ecological Sciences Through a Community Modeling Framework**

### *Introduction to a community framework*

We propose to establish a community modeling framework for social-ecological science. This will serve as a cooperative, multi-institutional and multidisciplinary organization to carry out the components of a program to promote the regular use of agent-based modeling in social-ecological research, and guide this program into the future. What would such a consortium look like? How can member institutions benefit from such an organization and cooperatively develop new opportunities for socio-ecological research? How can management and organizational responsibilities best be shared to ensure long term continuity?

### *Group dinner*

### **March 3**

#### *Continental breakfast*

#### *Organizational charter*

This will be a working session to plan a mission statement, governing body, organizational structure, working groups, and best practices guidelines.

#### *Coffee break*

#### *Creating a consortium*

- Election of a governing body (Steering Committee) to manage the pilot project
- Assignment of responsibilities for producing a report. This will include a copy of the preliminary charter and procedures guide. It will be published with NSF and an abbreviated version will be submitted for publication (e.g. to JASSS or other relevant journal)
- Establishment of a timeline for report and pilot project

#### *Lunch*

#### *Adjournment*