

The relation between mental and computer models: some experiment in the management of natural resources

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I will address 3 closely related issues: a) what affects the decision makers' and stakeholders' understanding, acceptance, trust, and thus willingness to act upon the results of ecological models, b) how these cognitive processes can be incorporated into ecological models, c) what complex, self-referential processes arise from their relations. We will see that these interactions can lead to the emergence of causal processes with considerable impact in the real world. For each of these issues I will discuss the results we obtained from experiments run with decision makers and stakeholders related to fishery and marine conservation projects.

- a) Ecological modeling is increasingly used to support decision making as well as community consultation. In these settings, effective understanding of scientific results can be affected by barriers which have more to do with human cognition and psychology than the complexity of the problem at hand. For example, while for modellers model acceptance usually hinges on data accuracy, model reliability, and problem uncertainty, in a social context the acceptance of model results also depends on context, type of problem, implications of the model, characteristics of the audience and stakeholders, the charisma and reputation of the modeller, and much else. We report on a number of studies we carried out with local decision makers and stakeholders related to marine park and fishery management, as well as on our development of a survey tool specifically designed for environmental problems in which modelling is employed as a part of the decision making process.
- b) It follows that for some purposes ecological models may need to include social and decision making processes. While physical, biological and ecological knowledge is usually understood as external to the systems under study (our understanding of celestial mechanics does not affect the motion of the planets), this is not necessarily true for knowledge related to human behaviour. In a human and social context, the mental models used to represent a system (even 'wrong' mental models) can affect the system itself, via the human actions they induce. This self-referential process is very difficult to model but has strong impact on the real world as clearly showed in the recent financial crisis and climate change debate.
- c) Usually, ecological models are seen as virtual laboratories, where we can carry out experiments which would be impossible or too difficult to perform in the real world. How do we reconcile the apparent objectivity of such models with the subjectivity of the mental models people use to guide their behaviour, if these need to be incorporated in the numerical models? One possible avenue is to consider numerical models as formalisation of mental models. This brings numerical and mental models on the same level and allows us to compare them. Numerical models can circumvent the logical fallacies humans often display and can provide a check of the consistency of human decision making. We describe a number of experiments in which comparison between mental models and numerical models have been carried out and discuss the possible implications for communicating the results of ecological modelling. Also, viewing ecological models as formalised mental models implies that ecological models too can have a causal power in the real world. This leads to the emergence of yet another self-referential process since the results of a numerical model can affect the decision makers' mental models which in turn can affect the real world. We discuss an experiment we recently carried out by explicitly asking responders' to parameterise a numerical model and estimate the model results as well as their acceptance of the model.