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Editorial

Preface to the thematic issue on modelling systemic change in coupled socio-environmental systems

One of the things that make coupled socio-environmental systems so challenging, and interesting, to study is how interconnected everything is. Interconnectedness cuts across scales, systems, and geographies, and is challenging to modellers of socio-environmental systems in part because of the very idea of a 'system' itself. As soon as a system is defined, boundaries are created, both between the concepts and entities that are represented and those that are not, and between the ways in which those representations are done and the alternative approaches that were rejected. Interconnectedness means these boundaries are transgressed: there is no isolation. As Robin (2014) puts it, rewording the popular quotation of the 17th Century English mystic John Donne's *Devotions upon Emergent Occasions*, "No island is an island." For inhabitants of low-lying Pacific islands, experiencing the consequences of rising sea levels due to anthropogenic climate change they made relatively little contribution to, that assertion has a special significance.

Systemic change is a fundamental change to the structure of a system – the way it is described, which in a simulation model will be done using a formal language. The interconnectedness among systems is one obvious cause of such fundamental change, through exogenous disturbances to one system by another, as in the example with islands above. However, internal dynamics within a system itself can endogenously cause restructuring. Restructuring can occur through processes such as evolution, learning, adaptation, and amplification of minor changes though internal system feedbacks (which is itself an interconnectedness among elements of the system).

Disturbances to and evolution and adaptation of socio-environmental systems should perhaps be seen as the rule rather than the exception. Not all such processes necessarily lead to the kind of restructuring that is entailed in the concept of systemic change. Nevertheless, clearly systemic change should be something that is expected in socio-environmental systems, rather than, as so often seems to be the case, a "surprise". As such, modelling systemic change would ideally be more routine in the social/environmental arena, especially now, when so many of the environmental resources human societies depend on are being associated with the word "peak". The concept of peak oil is already familiar, but even if this challenge is addressed, peak water (Gleick and Palaniappan, 2010) and peak phosphorus (Beardsley, 2011) are already being discussed as threats for future generations.

This thematic issue gathers together some of the latest work on modelling systemic change in coupled socio-environmental systems. It grew from a session at the Leipzig conference of the International Environmental Modelling and Software Society in 2012. Our goal was to collect together work reflecting on how model design could be aimed at representing the processes and consequences of systemic change, and potentially how these processes could be analysed and governed. We were particularly interested in the different ways systemic change is represented, whether (and if so, how) modelling systemic change has affected decisions about model boundary, and how (if at all) uncertainty has been handled. We were keen for the issue to include a variety of modelling approaches and case studies in different regions. The introductory article provides a more comprehensive overview of the contributions to this issue.

Besides the authors of the articles, the preparation of this thematic issue would not have been possible without the help of those in the scientific community who acted as reviewers. We thank them for their efforts.

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