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# Modelling Dynamic Social-ecological Systems: Towards an Integrated, Multiscale Approach

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**Abstract:**

Social-ecological systems (SES) consist of open, coupled, complex, interactive and non-linear dynamic processes that are inherently unpredictable. SES are a form of Complex Adaptive System (CAS) in which a dynamic network of many agents (which may represent species, people, organisations, nations, etc.) are acting independently and in parallel, constantly responding to their environment and what the other agents are doing. Hence, the causal drivers of SES behaviour tend to be highly dispersed and decentralized. An important characteristic of a CAS is that they can exhibit emergent behaviour and self-organisation, phenomena that cannot be predicted directly from the properties of their component parts. Self-organisation, the spontaneous configuration of spatial, temporal, spatio-temporal structures or functions in systems, has important implications for ecosystems management. In recent years, agent-based models (ABMs) enables simulation and investigation of complex SES and their emergent behaviour with a high level of detail; although the stochastic nature and potential combinations of parameters of such models, create large non-linear multidimensional “big data,” which are challenging to analyse. The MIRACLE (Mining Relationships Among variables in large datasets from CompLEx systems) project seeks to address some of these difficulties by investigating multiscale approaches for the selection of data and model reduction strategies. ‘Scale bridging' - the coupling of system elements that act at different spatial and temporal scales is an emerging strategy for modelling critical phenomena, such as tipping points, system regime shifts or collapse, which can help guide interventions in SES that may enhance adaptation to change and sustainability.

***Keywords**:* Complex systems; Scale bridging; Big data; Data reduction