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Multi-scale adaptations and vulnerability transfer in an artificial society: From sugarscape to sugarscale

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Multi-scale adaptations and vulnerability transfer in an artificial society: From sugarscape to sugarscale.

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Abstract: In a context of global changes, coastal social-ecological systems are submitted to growing and combining pressures. To reduce their vulnerability, agents respond through adaptations that occurs at multiple scales (from individual to collective), leading to nested feedback loops with consequences that can be expected or not. Artificial societies are of great help to explore these complex and uncertain adaptation dynamics. Taking inspiration from Anderies et al. robustness framework, we modified Epstein and Axtell' Sugarscape model to integrate a multi-scale perspective and explore vulnerability transfers following adaptation processes. Harvesters (users) are evolving in a cell-environment composed of spice and sugar (resources) which is divided in 6 States (infrastructure providers). This environment is unequally submitted to two types of perturbations: a slowly increasing demographic pressure (exogenous drivers on users) and shocks on resources availability that simulate climatic extreme events (exogenous drivers on resource). Harvesters and States are responding by the implementation of adaptation strategies, respectively migration and opening or closing of the State borders (infrastructures). Vulnerability indicators were developed at several levels (individual, State and environment) to analyse consequences of adaptation, and more particularly vulnerability transfer across levels. We demonstrate a cumulating effect of perturbations, as well as mitigated effects of adaptation strategies. We discuss the outcome of developing multi-scales agent-based models to explore adaptation to global changes, moving from Sugarscape to Sugarscale. At this point, agents decision making are based on abstract Epstein and Axtell's Sugarscape model (based on welfare function defined in economics). The resulting model is to be used as a conceptual thought experiment that include main issues of coastal systems.

Keywords*: adaptation; agent-based modelling; global change; multi-scale approach; vulnerability.*