Socio-ecological system dynamics modelling for sustainability assessment at the local scale

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Abstract: Modelling socio-ecological systems for sustainability assessment is complex. Often it is only performed at global or national scales, using integrated assessment models (IAMs). However, fostering sustainability at the local scale is critical for many interventions and extending the use of IAMs to this scale is necessary for operationalising sustainability. We co-designed a system dynamics IAM with a case-study community in Victoria. The community is a post-logging township in the Otways region, whose economy is currently undergoing transition to tourism and other activities, with some agriculture ongoing. The co-production of the IAM occurred with a diverse range of residents from the community. The model includes 12 sub-models for interacting systems in the community – these sub-models were Demographic, Land Use, Housing, Economy, Tourism, Biodiversity, Climate change, Inequality, Health and wellbeing, Telecommunications, Infrastructure, and Transport (Figure 1). The interactions between the sub-models were qualitatively characterised by members of the community, and quantified by the research team. A set of six sustainability scenarios was co-developed with the community, based on the shared socioeconomic pathway (SSP) framework but extended to the local scale; and adapted to a sustainability context by varying priority of sustainability dimensions (environment, society, or economy). These context-specific scenarios and their development is described in Szetey et al. (2021). The scenarios were simulated with the model, under appropriate representative concentration pathways (RCP) and uncertainty analysis using Morris elementary effects sampling performed. Initial results, with an RCP 4.5 scenario, indicate that the best outcome for sustainability with low uncertainty occurs from the scenario which prioritises environment and society but not economy (i.e., a low growth scenario). The scenario that prioritises all three sustainability dimensions demonstrates much greater uncertainty across all indicators. All scenarios with economy prioritised had higher uncertainty. This research helps understand possible pathways for local-scale sustainability, under different climate scenarios, and quantifies outcomes and uncertainty for each pathway. This form of modelling already exists for national and global scales, and this research seeks to extend it to the local, to enable local-scale sustainability.

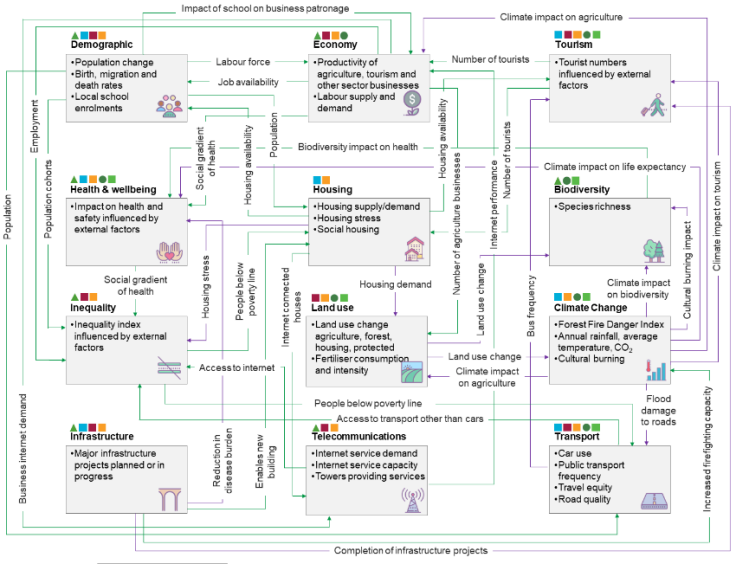

Figure 1. The interactions between the twelve sub-models

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