IDEAS: an Integrated Dynamic Environmental Assessment System

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IDEAS is a set of linked models for assisting stakeholders in planning catchment futures. From a future vision of the catchment, which may be articulated in a variety of ways, IDEAS may be used to assess the environmental and socio-economic impacts of the vision. Integration of environmental and socio-economic factors facilitates learning by stakeholders of the impact of their personal visions on other stakeholders.

IDEAS may be applied at a range of scales, from local through to regional. However, it has particular strength at the catchment scale where bio-physical processes have strong spatial interactions. For example, in the Motueka catchment, there is strong interaction between nitrogen export from agriculture and acquacultural productivity in Tasman bay. Moreover, at the catchment scale cumulative effects of land use on water quantity and quality assume great importance, and require careful consideration.

At the catchment scale, the spatial pattern of land use and management is important for environmental outcomes. For without knowledge of the spatial pattern, it is impossible to model spatial interactions. As such, land use and management maps are used as independent drivers held common by the suite of bio-physical models. This *land use common* unifies not only the bio-physical models, but also the socio-economic models where catchment visions articulated by stakeholders are expressed essentially in terms of land use.

Integration of biophysical with socio-economic models is difficult to achieve in a dynamic sense for stakeholders because bio-physical models at the catchment scale tend to be complex, requiring much input data and computer processing (Cao et al., 2005; Andrew and Dymond, 2006). Economic input-output models have historically incorporated environmental outcomes dynamically through the use of ecosystem service coefficients. These coefficients represent an environmental service performed per unit land area, or output, of a economic sector. At the national scale, these coefficients can be regarded as aspatial. However, at the catchment scale, the coefficients depend strongly on the spatial arrangement of land use. For example, the export of nitrogen from a dairy farm depends strongly on the proximity of cows to waterways.

To enable the dynamic use of ecosystem service coefficients in socio-economic models, we have created a lookup of coefficients from a range of landuse patterns spanning most possibilities. From the lookup, the socio-economic models need to access the appropriate

coefficients according to the catchment vision being assessed. It is this lookup which permits the the socio-economic models to run independently of the bio-physical models while still *taking into account the influence of spatial land use patterns* on environmental outcomes.

The socio-economic models comprise aspatial and spatial components. The aspatial component is called the Catchment Futures Model and is a economic input-output model coupled with a population growth model (Cole and Maxwell, 2005). It may be used in a temporal mode where yearly environmental and economic outcomes influence sector drivers for following years. The spatial component is Evoland (Bolte et al., 2006) from Oregon State University. It models individual actors on the landscape and how policy, and environmental and economic outcomes influence individual land use and management decisions. It may be used to assess the influence of policy and education of actors on future land use patterns.

A variety of catchment scenarios have been evaluated for socio-economic and environmental outcomes. These include (1) pre-human (2) present land use (3) present land use with best management practice (4) very intensive agriculture (5) very intensive agriculture with best management practice, and (6) present growth until 2020. While the socio-economic measures of scenario (4) may be satisfactory, the environmental measures indicate problems with high nitrogen concentration in river water and lack of water for irrigation. Indeed, the indicator of low flow (low flow – maximum allowable water take) implies that in times of drought the river could actually dry up. IDEAS does not provide a framework for conflict resolution, but through its integration it identifies focussed points of disagreement, on which further research and more detailed models, outside of the integrative framework, are often required. In future, climate change will be incorporated into catchment planning deliberation by modifying explicit climate variables in the bio-physical models.

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