

Multi-scale Integrated Modelling of Ecosystem Services (MIMES)

Workshop held on August 16, 2013

Overview presentation can be found at: <http://www.ifs.org.nz/mimes/mimes-workshop-2/>

This workshop was organised to demonstrate to end-users the capability of MIMES to integrate existing models, model outputs and databases into an organising framework to connect ecosystem services supply and demand across landscapes and overtime. MIMES provides a unifying approach, a thinking space, and a design tool to enable spatially dynamic scenario modelling. MIMES is not a 'product' but an 'open source' accounting framework that can be used to show how the supply and demand for ecosystem services link the economy and the environment. MIMES integration capacity is a way to overcome problems associated with being data rich but information poor. How we put data together is becoming important as data becomes more accessible and the ability to generate data grows in scale (big data).

In New Zealand, the incentive for MIMES development has been the Integrated Freshwater Solutions Project (www.ifs.org.nz). Stakeholders involved in the Mediated Modelling workshops wanted a more spatially oriented representation of the causes of water degradation in the Manawatu catchment.

MIMES is based on systems thinking and systems dynamics so the future is not a linear projection of the past but a function of feedbacks and time lags in the interlinked system.

Summary of Discussion on Friday August 16th

MIMES capability

MIMES has the potential to address multi-scales and incorporate the market sector as well as other groups not in the market-place e.g. iwi, conservationists, recreationists. MIMES is a tool to explore different pathways to reach a desired vision. Back-casting provides a way to understand the driving forces and explore transition pathways through 'what-if' scenarios.

MIMES captures feedbacks using stocks and flows framework. Effects are calculated and different scenarios can be stored and analysed. As such it provides scope for adaptive management as projected effects come into play.

Model use

The view that models need the ability to build in new information as it is generated was voiced in the workshop. MIMES provides a flexible platform for integration and is in essence an open source library of modelling modules available to custom design a particular model. Models can be constructed of catchments, coastal zones and combination thereof at different scales..

Very detailed models covering expert subject areas, are not useful if individuals with different views and expertise do not have the means to communicate these contributions to each other—The role of a framework like MIMES is to solve the operability between these various views rather than improve on the expert models.

Classification of ecosystem services

The point was made that there needs to be a common language for ecosystem services to enable

comparability. A 2012 paper written by Amanda M. Nahlik, Mary E. Kentula, M. Siobhan Fennessy, and Dixon H. Landers on this issue titled “Where is the consensus? A proposed foundation for moving ecosystem service concepts into practice” is attached.

MIMES uses the de Groot et al, 2002 classifications of ecosystem services. The nine ecosystem services used for the Manawatu catchment study were inferred from the stakeholders at the Integrated Freshwater Solutions workshops. The objective of a MIMES management approach is to highlight the benefits derived from ecosystem services through the gap between biophysical supply of ecosystem services and human demand for ecosystem services.

MIMES is managed using matrix tables which allows combinations of data bases and flexibility. However, like with every model, with every additional layer of complexity there are trade-offs with flexibility and usability. MIMES distinguishes between ecosystem services functions (e.g. carbon storage, flood water storage) and services (e.g. reduction in GHG, reduction in downstream flood risk).

Scaling

The scale at which MIMES-Manawatu can be run is determined by the layer polygons and how they are linked. The Manawatu features 49 sub-catchments.

For MIMES the ability to scale up and down is important – which is why it is referred to as multi-scale. Multi-scale covers location (e.g. local, regional, national, global); time (e.g. day, year, decade) and social institutions (e.g. citizens, government, economic sectors). The question was asked about whether it was best to start at national scale and work down rather than up-scaling regional case studies. It was felt there needed to be good data for both the regional and national scale.

Scaling by tenure base is not done with MIMES. AgriBase is one way to get data but it is expensive and difficult to get. It may be possible to add the land valuation database as a layer. It is difficult to scale data up or down for model use. See attached journal article by Ausseil et al (2013) ‘Assessment of multiple ecosystem services in New Zealand at the catchment scale’. In addition, the dynamics change at each level of scale and this is why a flexible ‘multi-scale’ dynamic approach is important.

Water

Hydrology models can project water supply and it is possible to quantify water use on an aggregated product basis. However, for water there is currently a disconnect between sectors as water supply and demand does not take place in isolation but is determined by economic, social and cultural impacts. MIMES Manawatu puts water modelling into a dynamic framework that incorporates time-lags and feedbacks from economic, social and cultural drivers.

Economics

The economics in MIMES are determined by:

- Demographic co-efficient
- Demographics: population effects
- Demographics: built capital

Allowing subsidies in MIMES is a way see the trade-offs for the different demographic groups between natural and built capital in the landscape. Generally it is better to get a balance within the

system than depend on external subsidies as this makes the system reliant on outside solutions. MIMES is about how to build resilience within the system.

Current Applications of MIMES

- Science in Action (Environmental Protection Agency)
- Integrated land and coastal systems. In Massachusetts MIMES is being used for the Ocean's Act which manages based on ecosystem services rather than stock levels
<http://www.seaplan.org/project/mimes/>
- Tulalip Tribes – bring all their biophysical models together
- <http://www.afordablefutures.com/>

Robustness

One of the key properties of systems thinking is counter-intuitive relationships. Therefore, any model used needs to be shown to be robust. Robustness was seen to be particularly important when considering trade-offs. Another view expressed was that while a robust assessment would be welcomed decisions are being made without this and all we need is something better than what we currently have.

Scenarios

A question was posed about the ability of MIMES to explore new solutions using artificial intelligence rather than run-out set stakeholder-driven scenarios for the best solution. It was explained that MIMES is not an optimisation model as 'optimal' depends very much on the lens you look through. With MIMES people are part of the system as they are making decisions. MIMES is about creating an environment where multiple situations can be considered and multiple combinations of solutions can be generated. Sensitivity analysis on which variables have the most impact is possible but has not been done for the Manawatu catchment case study.

MIMES Potential

MIMES could be used for:

1. Showing how impacts are assessed over an entire system and communicate this back to end-users and consumers.
2. Showing interlinkages in the primary sector. Primary industries are part of the environmental problem and there is a need to shift to where they are part of the solution. A robust way of moving forward is needed that tell solution oriented narratives. For example, bees are being moved out of regions to maintain their health as there are no suitable food sources. Manuka could be used for riparian planting to provide this.
3. Promoting supply chain resilience. The previous globalisation model was about who could supply things the cheapest. Now security of supply is a big issue.
4. Analysing where money is best spent by councils using the 'money sliders' on the interface.
5. Analysing whether NZ should be attracting investment from overseas or instead be investing off-shore
6. Education - for this it was felt MIMES does not need to be too precise. As an educational tool MIMES can be used to show the consequences of present actions on ecosystem services overtime. Ecosystem services have some buffering capacity but this is diminishing.
7. An organising principle bringing databases and thinking together. This concept is how MIMES is to be used by the US EPA.

8. Mediation sessions pre court hearings to get agreement. For policy and regulation MIMES outputs would need to stand-up in the environment court.
9. Showing the complexity of issues and providing opportunities for dialogue. It was noted councils have to make decisions on resource use every day and can't be paralysed by too much or too little information.
10. Linking terrestrial, coastal and marine ecosystems and services.
A national ecosystem services assessment. EERNZ to look at how MIMES compare with the work of Ian Basement's used in the UK National Ecosystem Assessment.

MIMES SWOT Analysis based on 3 small groups during the workshop

<p>Strengths</p> <ol style="list-style-type: none"> 1. Systems thinking 2. Ability to map dynamics not just integration 3. Multi-disciplinary – can reach different stakeholders, politicians 4. Handles complexity and has flexibility. MIMES is a framework that can be transported elsewhere e.g. Civil engineers could use for road decisions 5. Can continuously inform adaptive management 6. Can handle cumulative effects 7. Multi-scale 8. Spatial 9. Facilitates collaborative processes and stakeholder engagement 10. Integration functionality – can handle cultural, spiritual, recreation 	<p>Weaknesses</p> <ol style="list-style-type: none"> 1. Science-policy divide. Policy does not always align with science 2. Ranking outputs - looking at multiple objectives and multiple outputs still makes decision-making hard to do 3. Complex and lacks focus – many audiences and outcomes 4. Data complexity and set-up 5. Needs commercial software to develop (is also a strength) 6. Time-consuming to set up matrices 7. Visual interface (this needs more development to make user friendly) 8. Robustness 9. Limitations - not explicit on where weaknesses are in model 10. What is the added value compared to the expense and outcomes generated 11. Transparency – lack of ability to track what is happening
<p>Opportunities</p> <ol style="list-style-type: none"> 1. Prioritisation/coordination of spending across council 2. Flexibility – is a framework rather than a model so can add in a new model if needed 3. Documentation and meta data can show what the process is 4. Scenarios and storytelling 5. Scaling – a national scale could provide NZ with consistency 6. Compatibility with multi criteria decision making (MCDM) 7. Raises awareness of ecosystem services 8. Distinguishes between ecosystem functions and ecosystem services 9. Forecasting tool 10. Make interface more user friendly 	<p>Threats</p> <ol style="list-style-type: none"> 1. Need to be able to explain how system works without confusing people 2. Lack of resources 3. Not having all the sectors needed to explain the true dynamics covered 4. Used as a decision tool not as a decision support tool 5. Inappropriate interpretations of outputs 6. Input data not satisfactory at scale being used – mismatch/appropriateness of scale 7. Perceptions of media and media criticism 8. Expert disagreement about which model to use 9. Lack of capability and expertise 10. Utilitarianism of ecosystem services

<p>11. Good decision support tool</p> <p>12. Benefits to different demographics shown</p> <p>13. Communication tool –true cost/benefit analysis of an action</p>	
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Possible way forward for Ecosystem Services Modelling in New Zealand

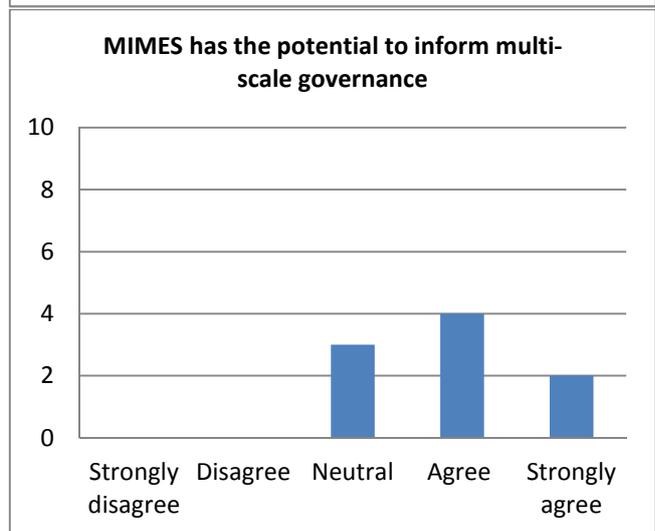
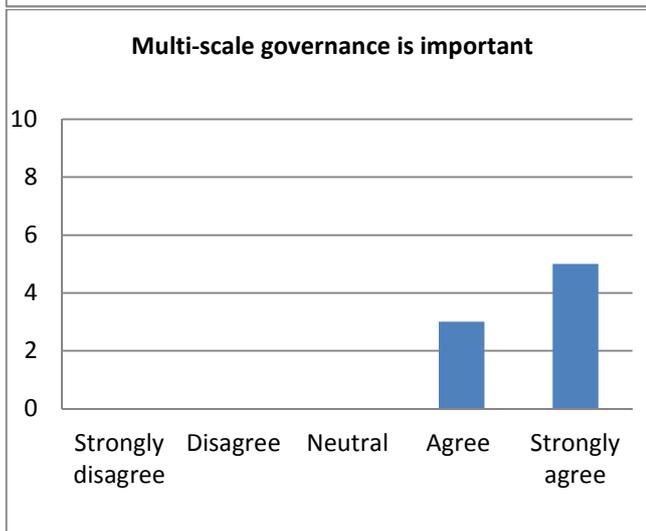
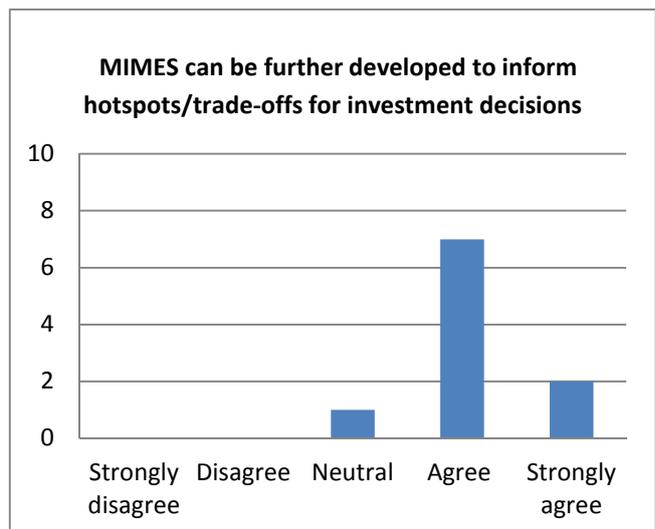
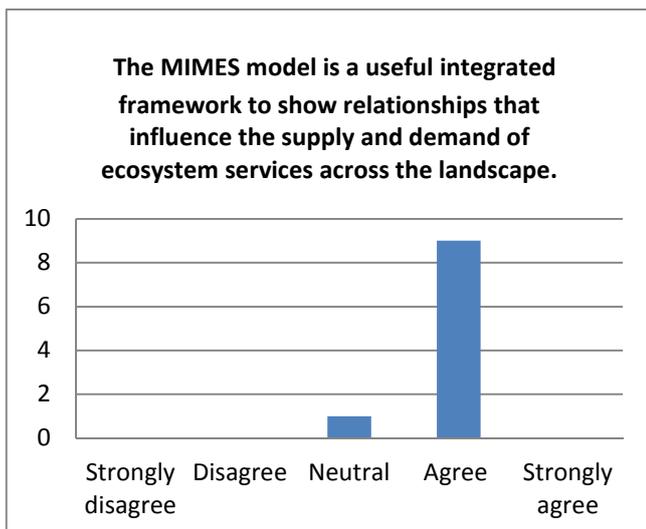
Establish a Centre for Excellence and work to increase familiarity with systems models. The procedure used to promote Life Cycle Assessment may be good to follow. A skill shortage in the Life Cycle Assessment area was identified and a Chair was established at Massey University to address this. The NZ Life Cycle Association was established to provide links with international groups and training workshops.

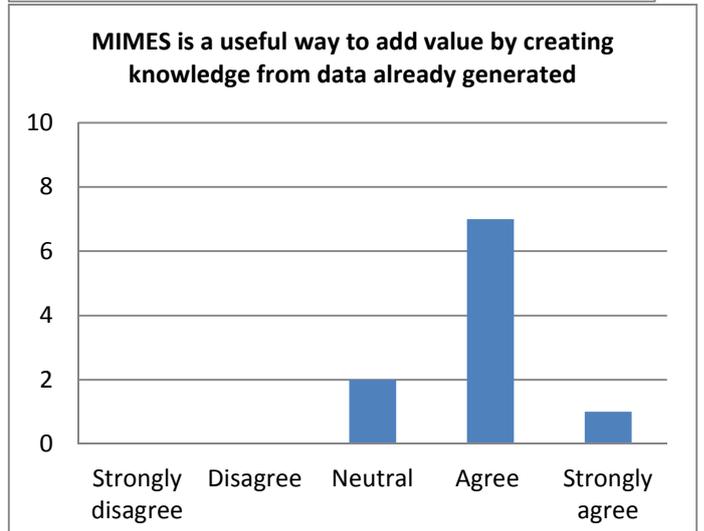
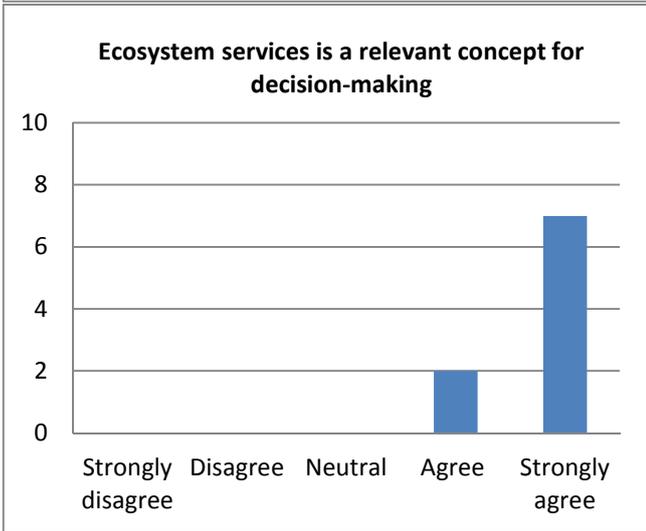
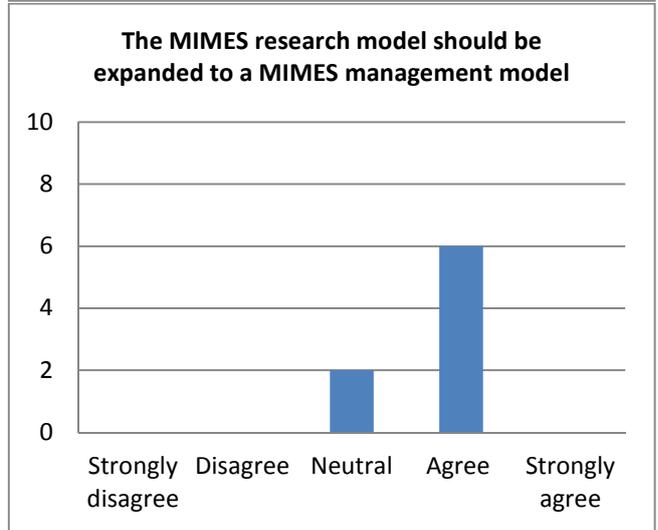
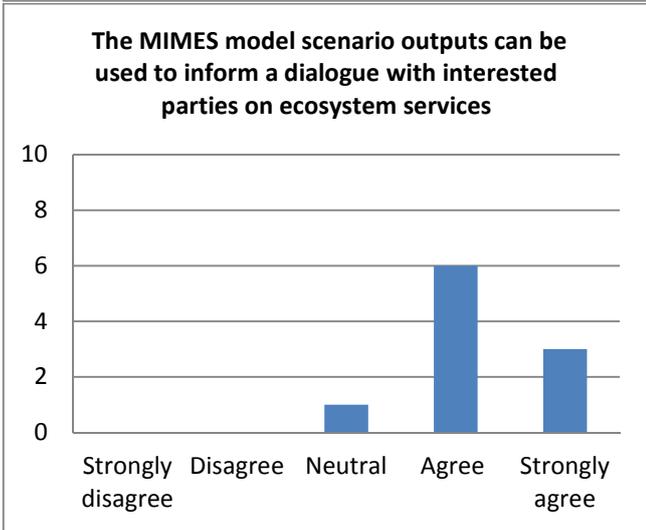
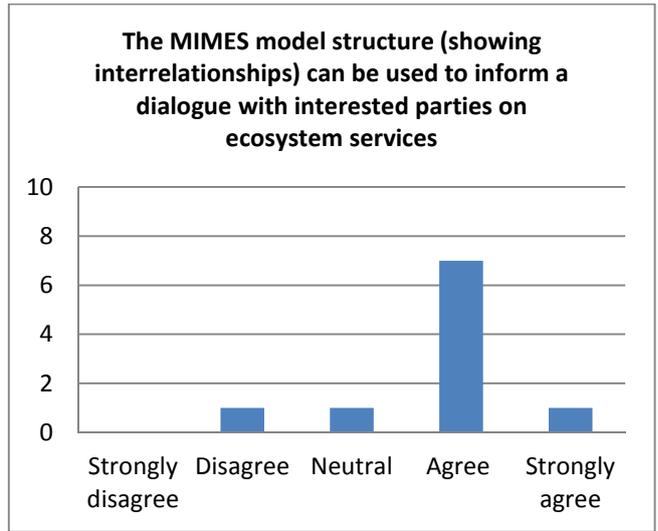
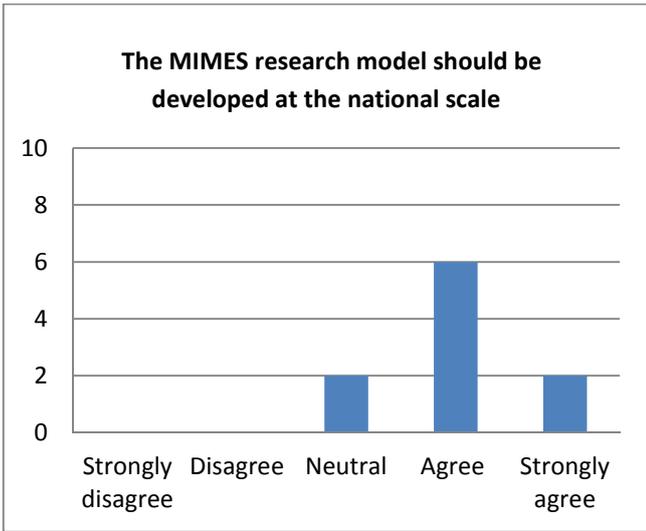
Other

Directory link for decision support tools available for use in New Zealand

<http://tools.envirolink.govt.nz/>

Survey responses from potential end-users at the workshop (10 completed)





**The MIMES workshop on 16 August was
useful to me.**

