The Multi-Scale Integrated Model of Ecosystem Services MIMES

How it works

SEEA_EEA

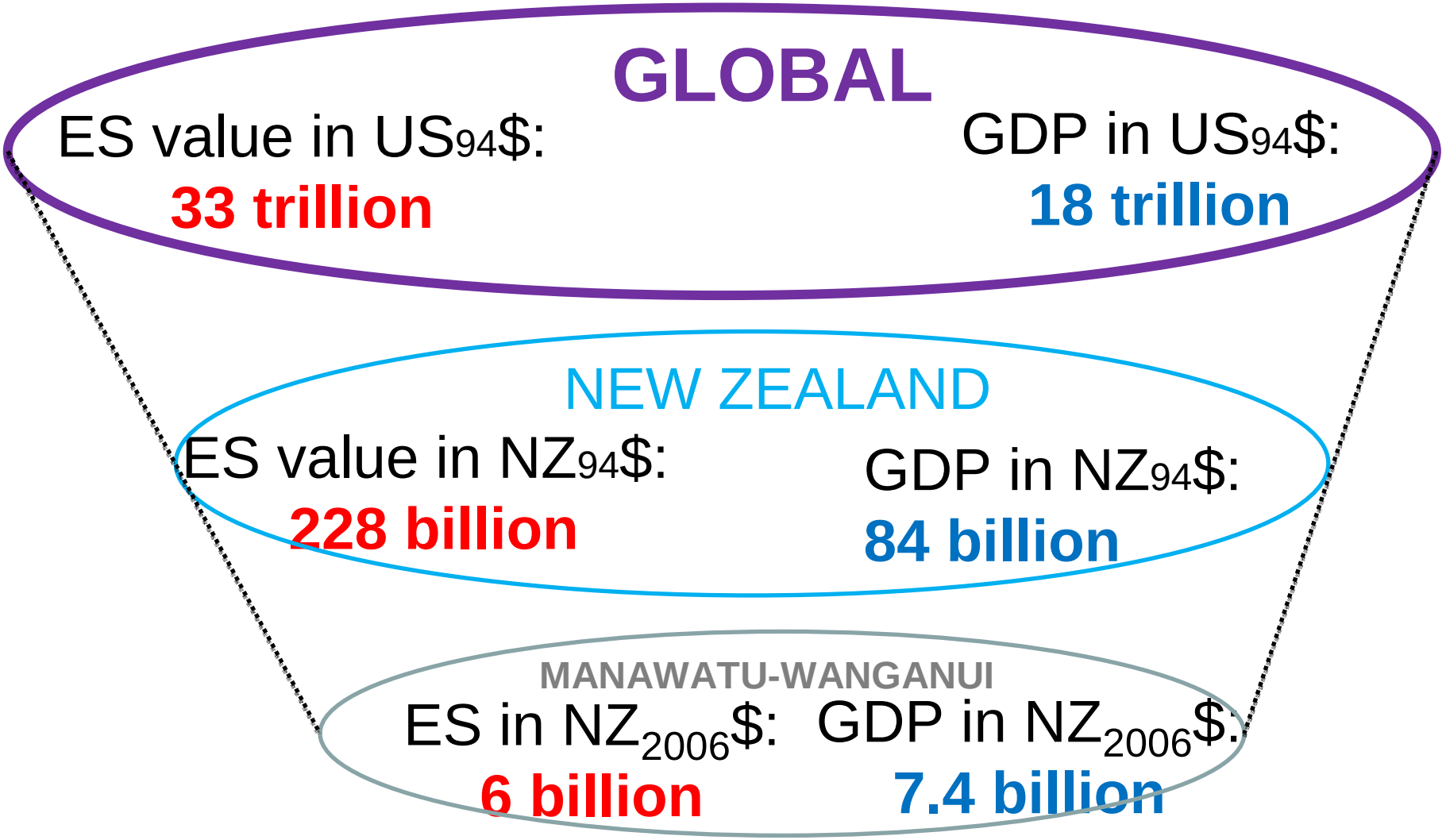
11-18-2013

Roelof M Boumans

Ecosystem Service Valuations

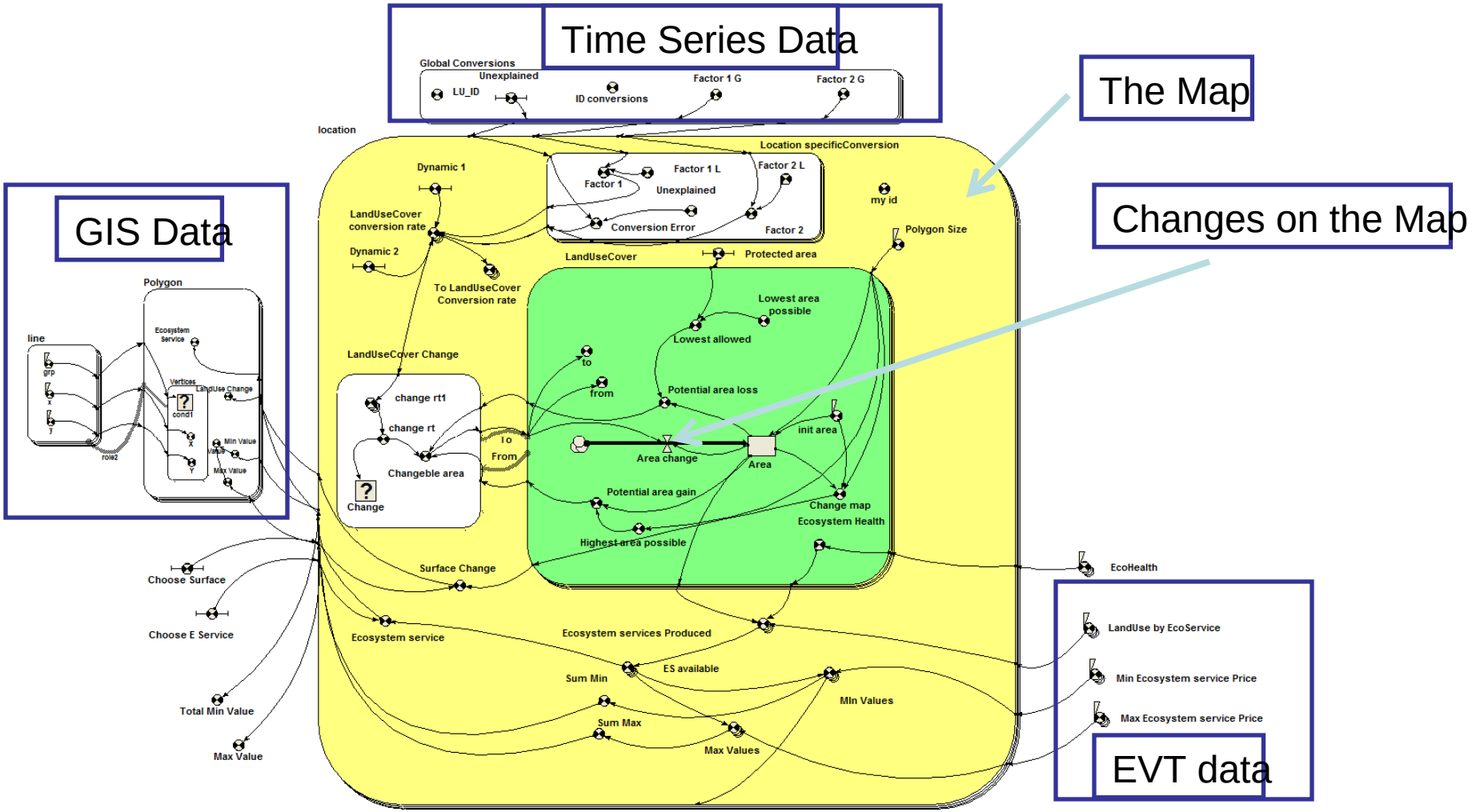
- Benefit Transfer Method
- Mediated Modelling (MM)
- Multi-scale Integrated Modelling of Ecosystem Services (MIMES)

Rapid Ecosystem Service Assessments

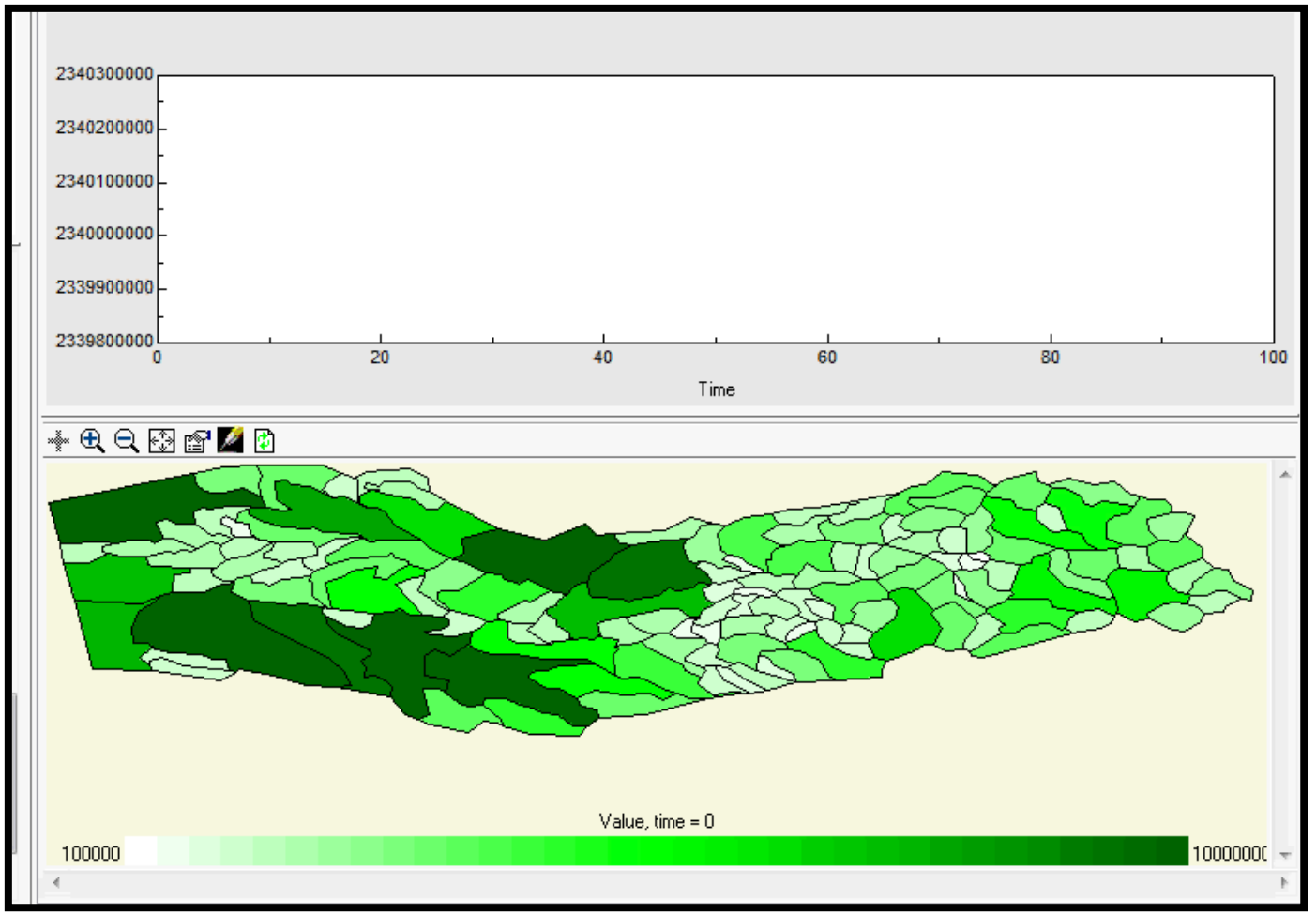


Sources: Costanza et al. 1997
Patterson and Cole 1999
van den Belt et al, 2009

Land Use Change in MIMES



Kamchatca Reforestation



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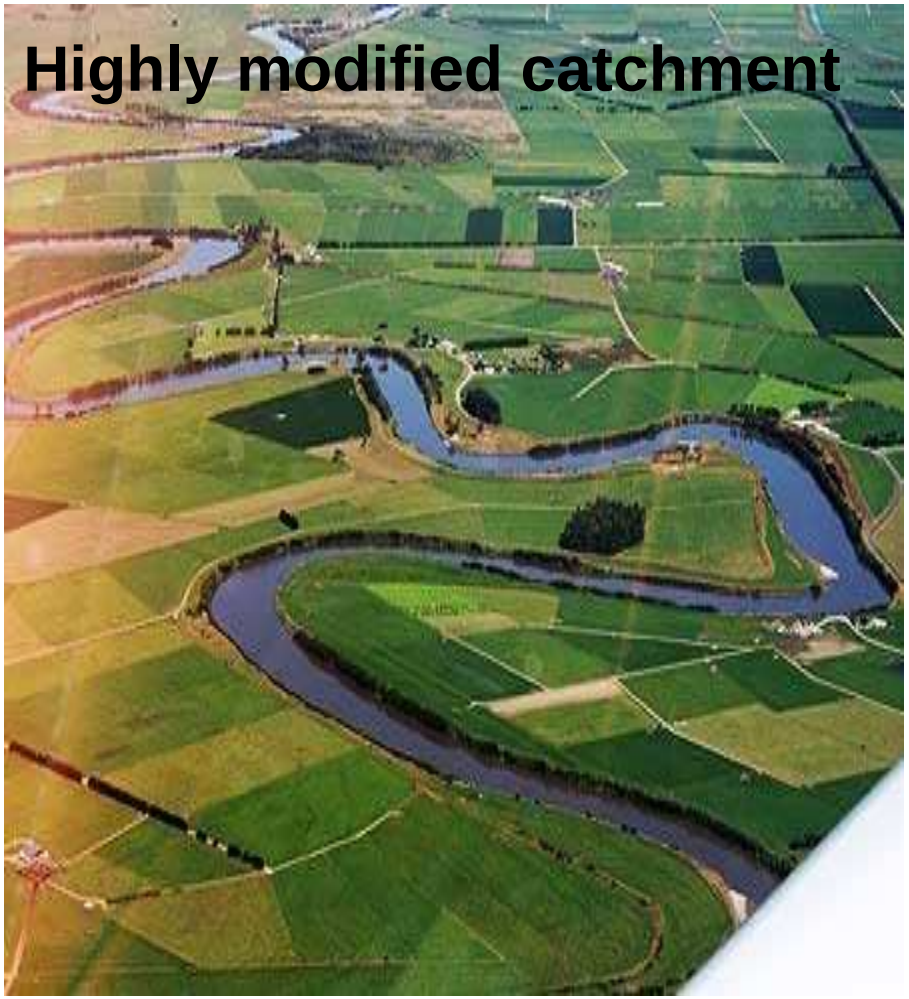
Mediated Modelling

‘Model building *with*, rather than *for*, people’

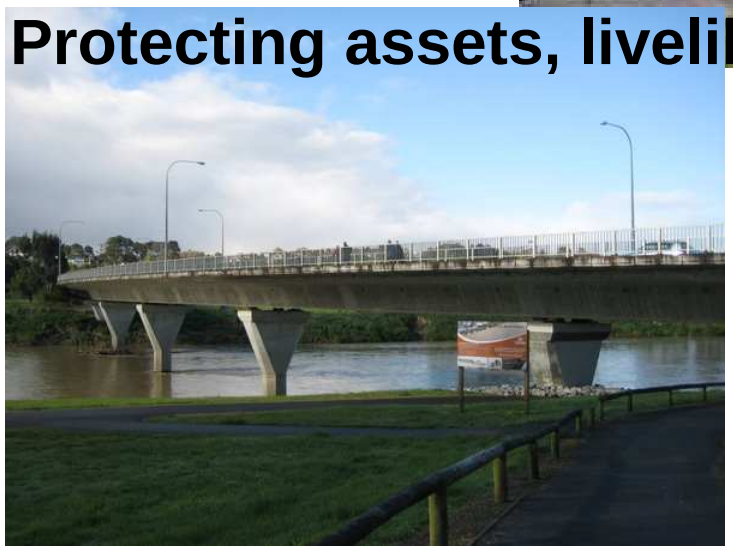
Auckland Mediated Modelling, Sustainable Pathways 2, 2012

The Manawatū River Catchment

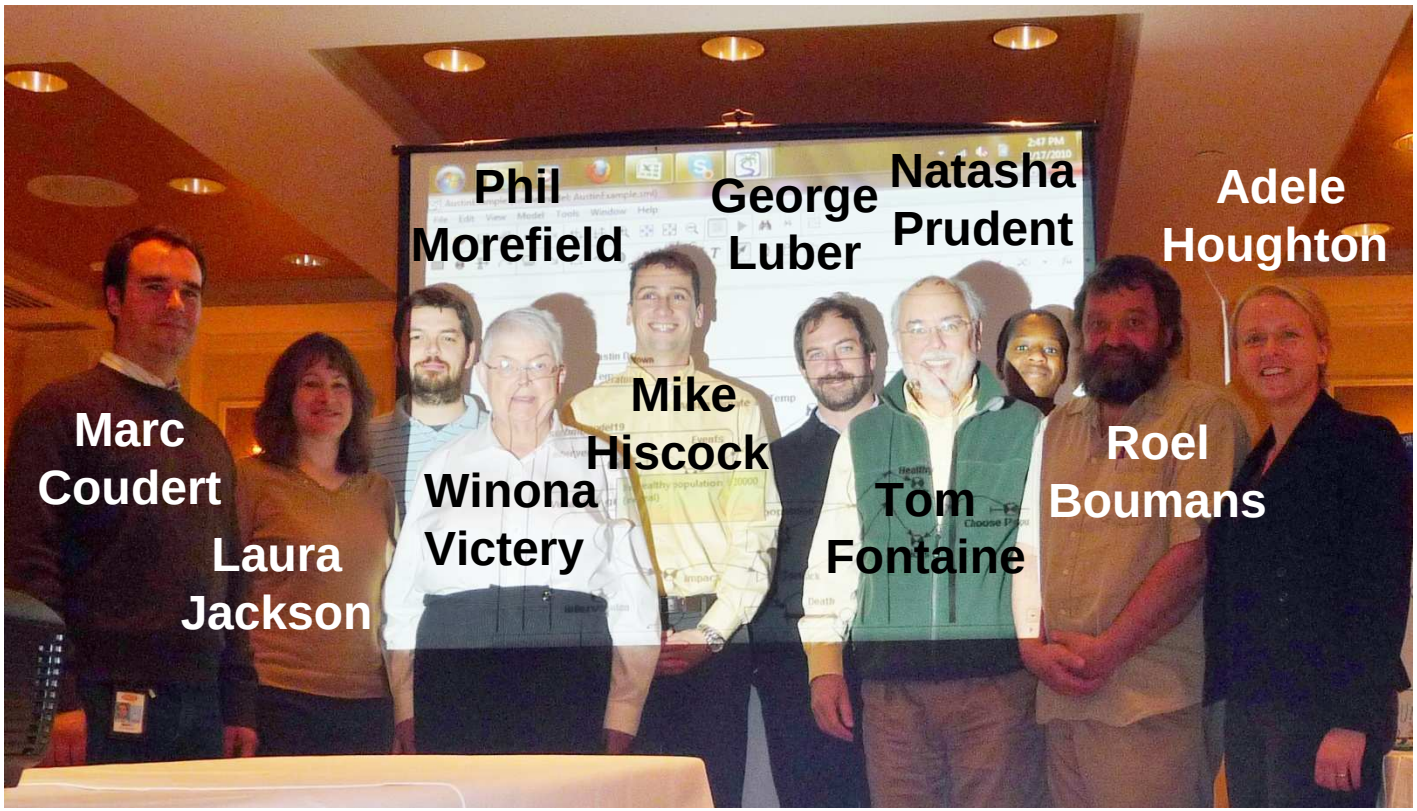


133,000 people
320,000 cows

Protecting assets, livelihoods



Participants: EPA, CDC, R6, R9, CDPH, NGO, Austin gov't



Plus:

Phil Gordon
Shannon Jones
Patrick Kelly
Kim Knowlton
Otis Latin
Ester Matthews
Mike McGeehin
Linda Rudolph
Richard Wade
Hal Zenick

The New York Times
SundayReview | The Opinion Pages

NEWS ANALYSIS

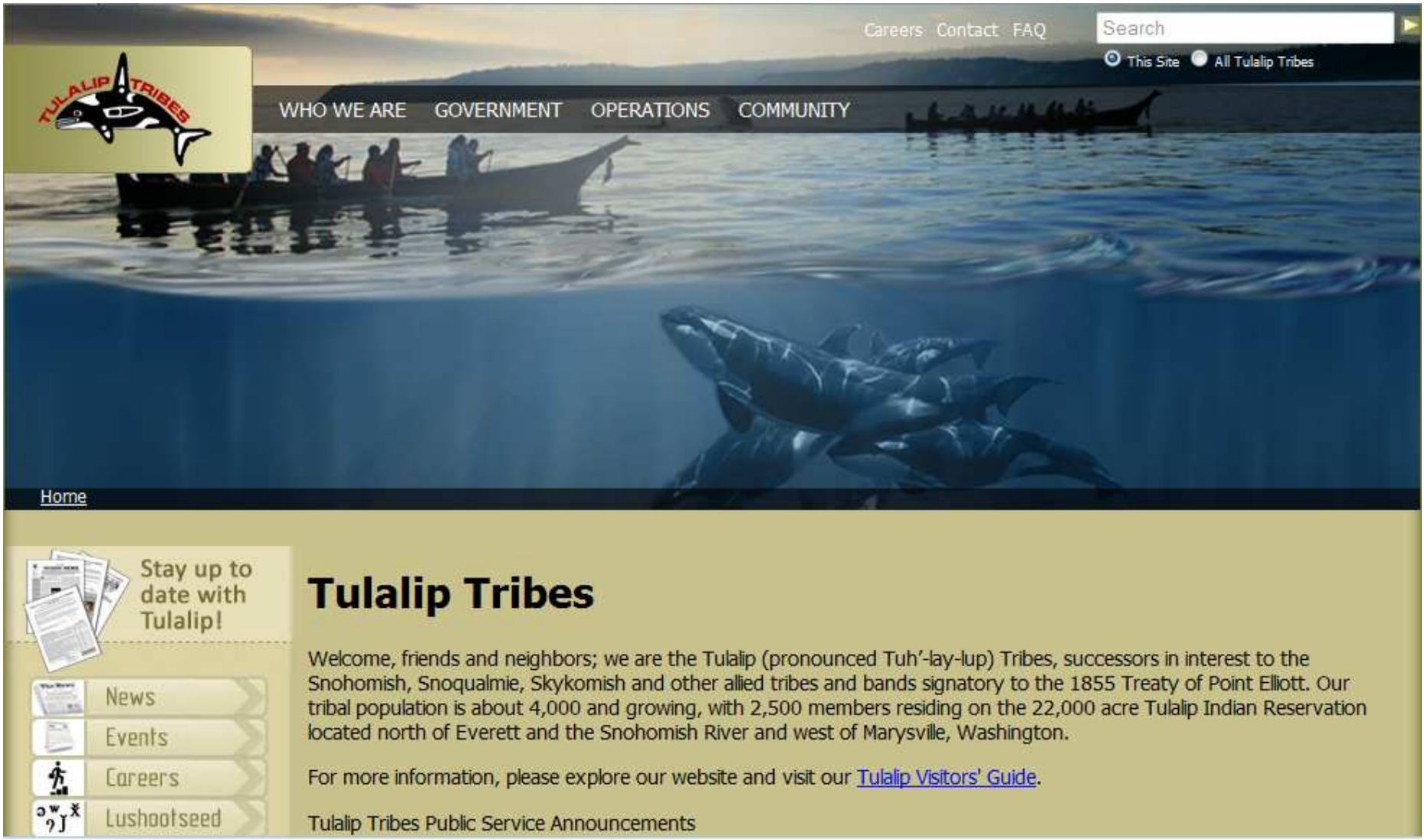
The Ecology of Disease

Olaf Hajek

By JIM ROBBINS
Published: July 14, 2012 | 76 Comments

Spatial Marine Modeling

NATIONAL SYSTEM of MARINE PROTECTED AREAS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TULALIP TRIBES
WHO WE ARE GOVERNMENT OPERATIONS COMMUNITY
Home
Stay up to date with Tulalip!
News
Events
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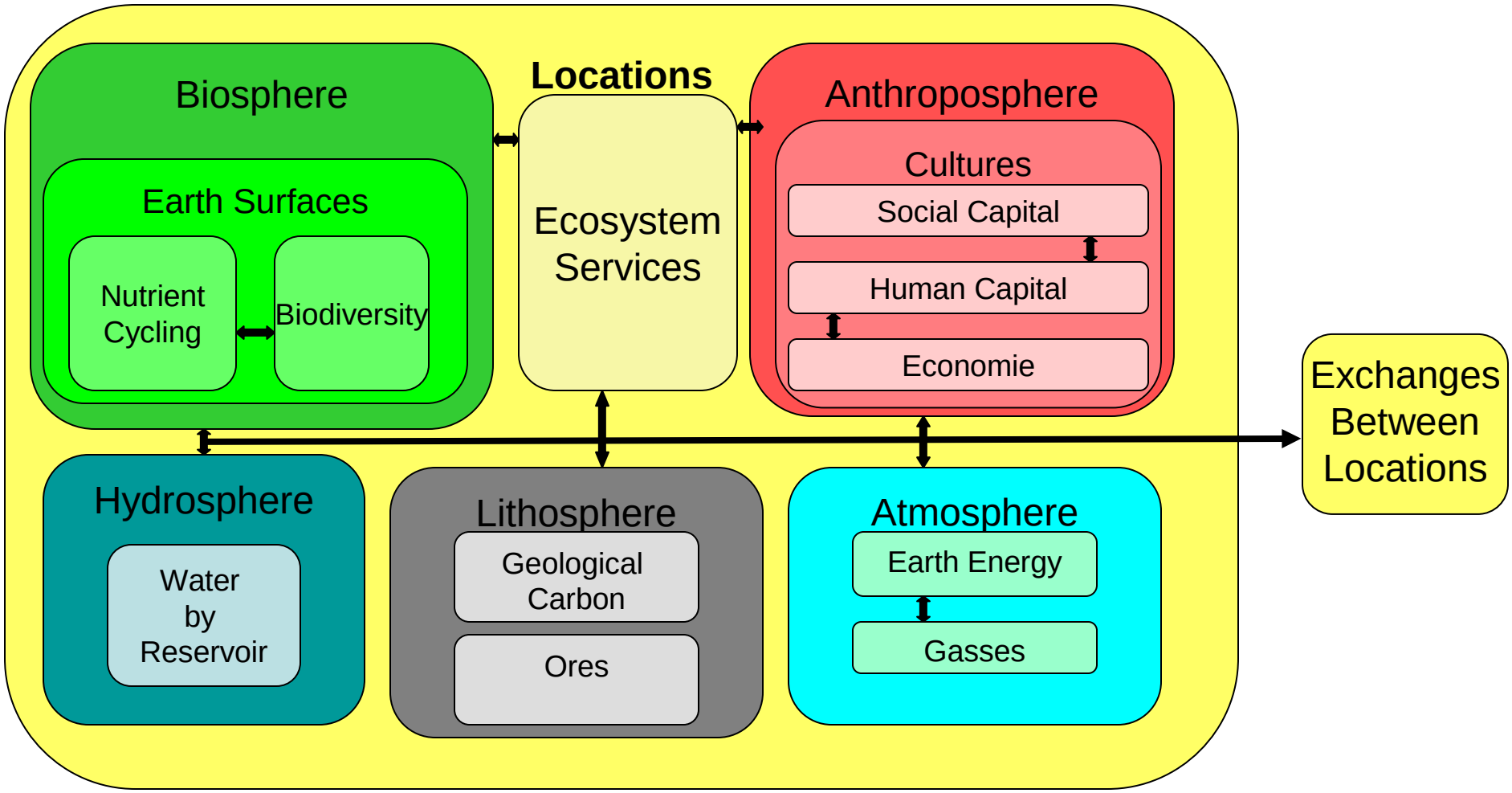
Tulalip Tribes
Welcome, friends and neighbors; we are the Tulalip (pronounced Tuh'-lay-lup) Tribes, successors in interest to the Snohomish, Snoqualmie, Skykomish and other allied tribes and bands signatory to the 1855 Treaty of Point Elliott. Our tribal population is about 4,000 and growing, with 2,500 members residing on the 22,000 acre Tulalip Indian Reservation located north of Everett and the Snohomish River and west of Marysville, Washington.
For more information, please explore our website and visit our Tulalip Visitors' Guide.
Tulalip Tribes Public Service Announcements

Ecosystem Service Valuations

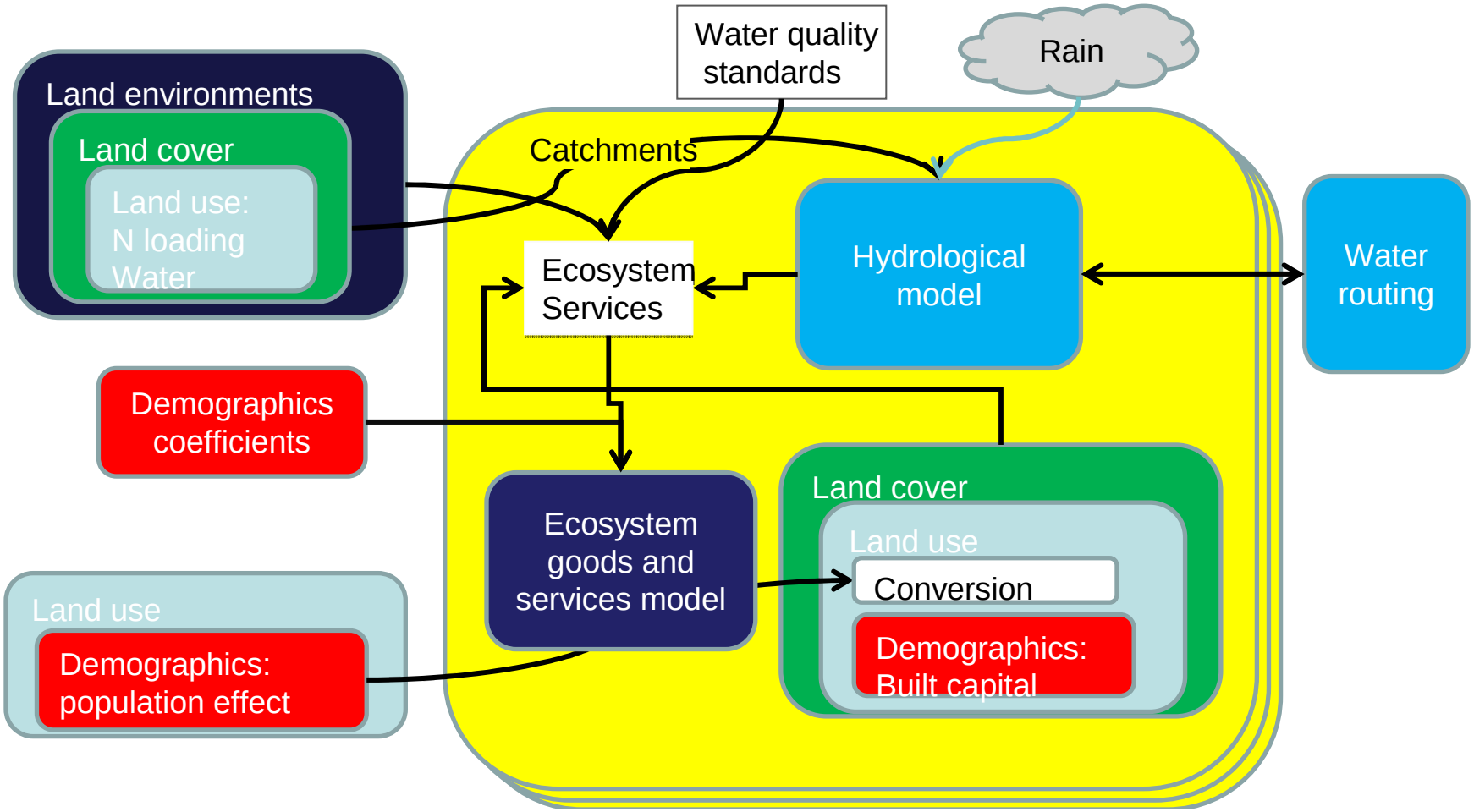
- Benefit Transfer Method
- Mediated Modelling (MM)
- Multi-scale Integrated Modelling of Ecosystem Services (MIMES)

- Building a MIMES Model
- Using a MIMES Model

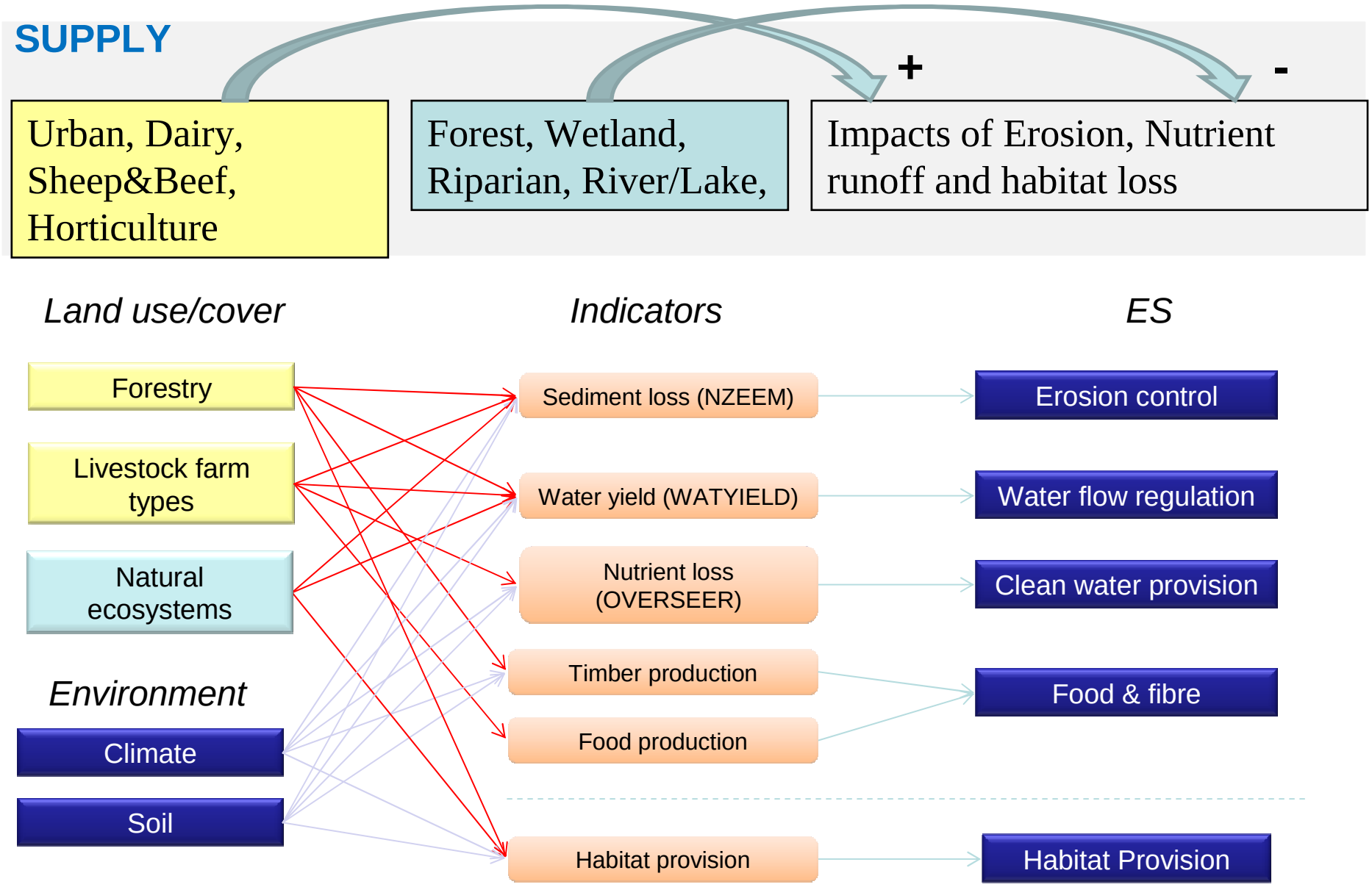
MIMES organization and Interaction Matrix



Manawatu MIMES
- Dynamic GIS-
Qualitative overview



GIS framework



Predicting Under Global Climate Change

GCC Scenarios --> GCC models	1%/year CO2 increase experiment to doubling	1%/year CO2 increase experiment to quadrupling	1%/year CO2 increase experiment to doubling	2xCO2 equilibrium experiment	550 ppm stabilization experiment	AMIP experiment	Climate of the 20th Century experiment	Committed climate change experiment	Pre-industrial control experiment	Present-day control experiment	Slab ocean control experiment	SRES A2 experiment
bccr bcm2				sresb1	sresa1b		20c3m	commit	picntrl			sresa2
cccma cgcm3 1	1pctto2x	1pctto4x	2xco2	sresb1	sresa1b		20c3m	commit	picntrl		slabcntl	sresa2
cccma cgcm3 1 t63			2xco2	sresb1	sresa1b		20c3m		picntrl		slabcntl	
cnrm cm3	1pctto2x	1pctto4x		sresb1	sresa1b	amip	20c3m	commit	picntrl			sresa2
csiro mk3	1pctto2x		2xco2	sresb1	sresa1b		20c3m	commit	picntrl		slabcntl	sresa2
csiro mk3 5	1pctto2x			sresb1	sresa1b		20c3m	commit	picntrl			sresa2
gfdl cm2	1pctto2x	1pctto4x	2xco2	sresb1	sresa1b		20c3m	commit	picntrl		slabcntl	sresa2
gfdl cm2 1	1pctto2x	1pctto4x		sresb1	sresa1b	amip	20c3m	commit	picntrl		slabcntl	sresa2
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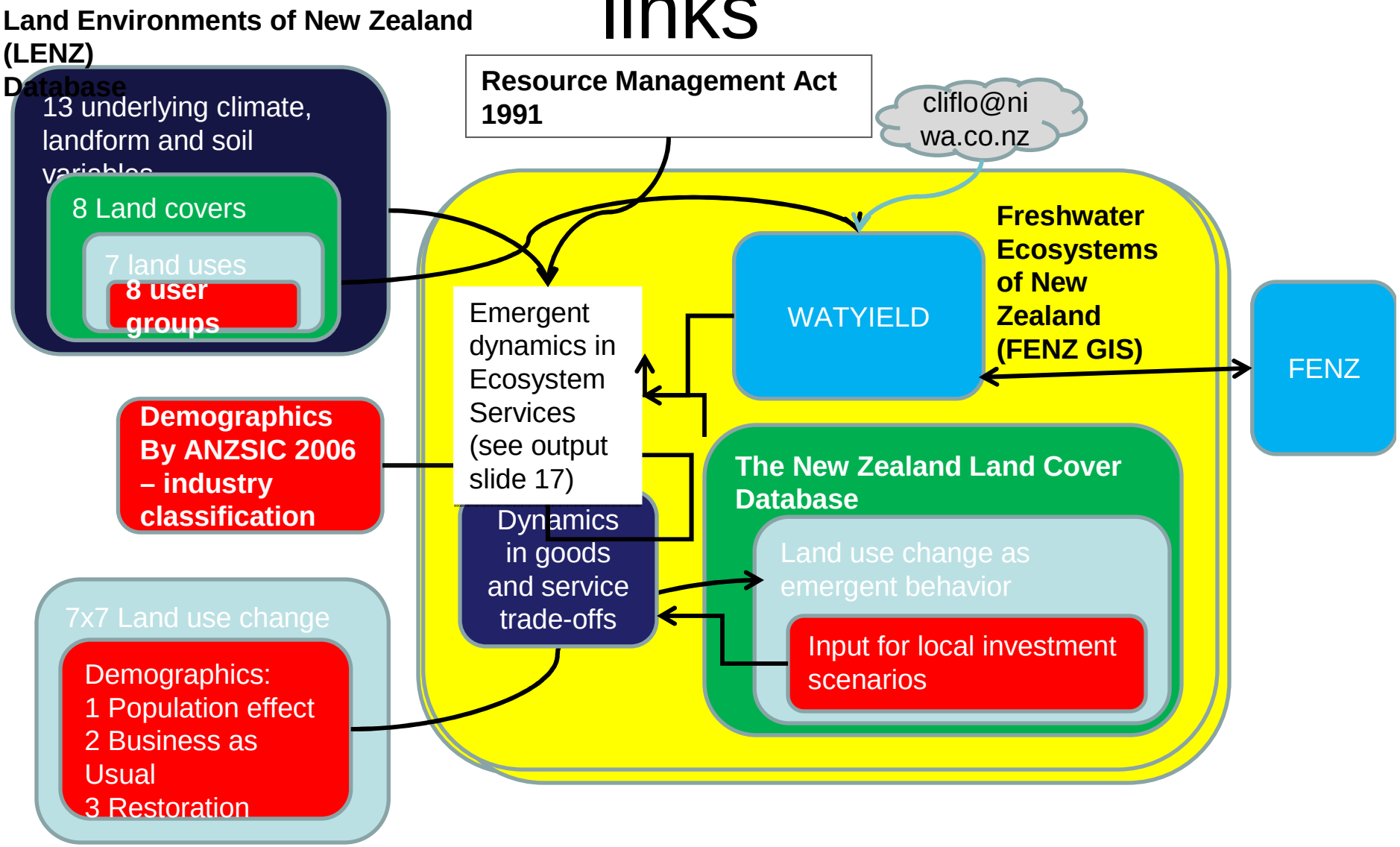
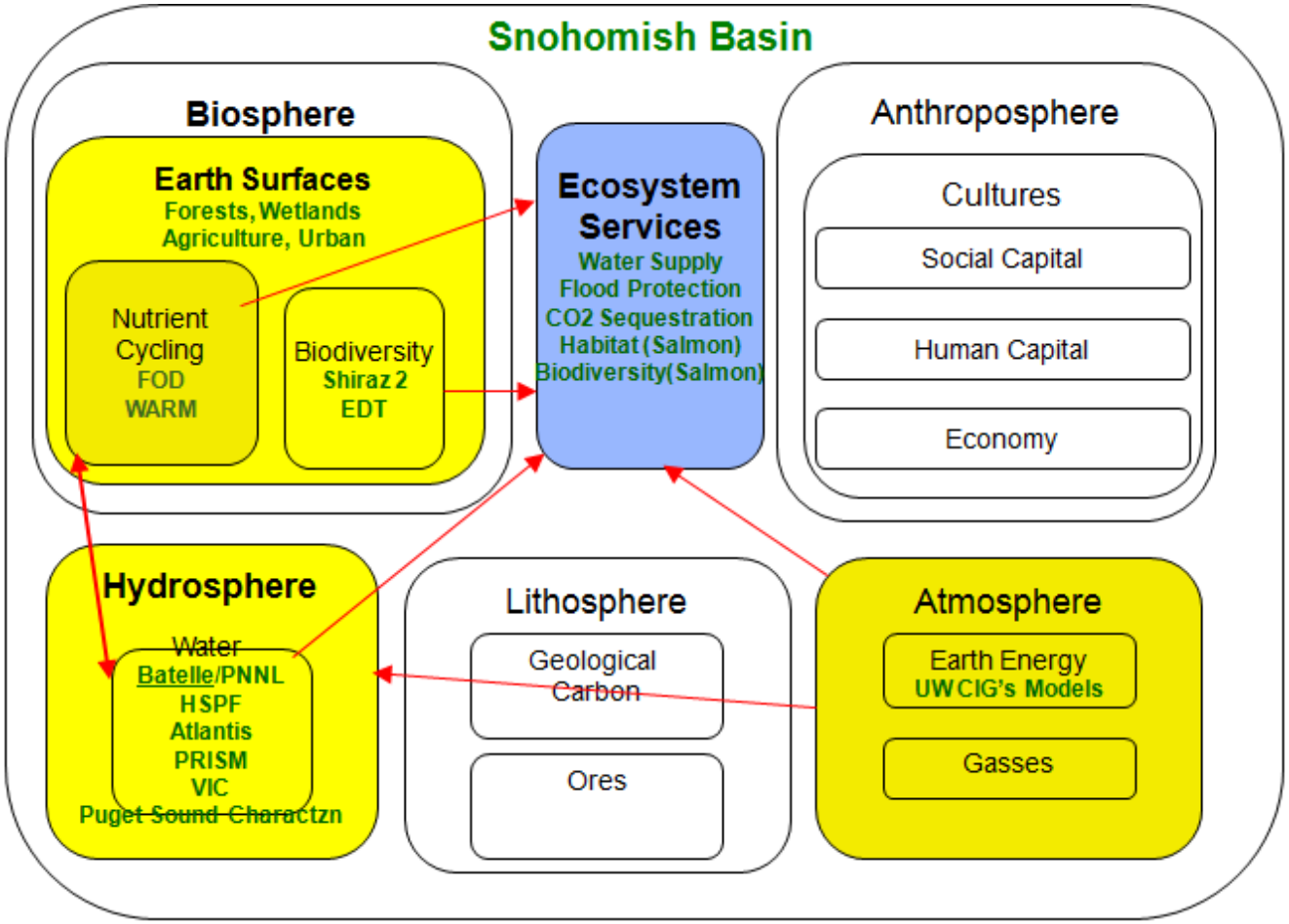
giss model e r	1pctto2x	1pctto4x	2xco2	sresb1	sresa1b	amip	20c3m	commit	picntrl		slabcntl	sresa2
iap fgoals1 0 g	1pctto2x			sresb1	sresa1b	amip	20c3m	commit	picntrl			
ingv echam4	1pctto2x	1pctto4x			sresa1b		20c3m		picntrl			sresa2
inmcm3	1pctto2x	1pctto4x	2xco2	sresb1	sresa1b	amip	20c3m	commit	picntrl		slabcntl	sresa2
ipsl cm4	1pctto2x	1pctto4x		sresb1	sresa1b	amip	20c3m	commit	picntrl	pdcntrl		sresa2
miroc3 2 hires	1pctto2x		2xco2	sresb1	sresa1b	amip	20c3m		picntrl		slabcntl	
miroc3 2 medres	1pctto2x	1pctto4x	2xco2	sresb1	sresa1b	amip	20c3m	commit	picntrl		slabcntl	sresa2
miub echo g	1pctto2x	1pctto4x		sresb1	sresa1b		20c3m	commit	picntrl	pdcntrl		sresa2
mpi echam5	1pctto2x	1pctto4x	2xco2	sresb1	sresa1b	amip	20c3m	commit	picntrl		slabcntl	sresa2
mri cgcm2 3 2a	1pctto2x	1pctto4x	2xco2	sresb1	sresa1b	amip	20c3m	commit	picntrl	pdcntrl	slabcntl	sresa2
ncar ccsm3	1pctto2x	1pctto4x	2xco2	sresb1	sresa1b	amip	20c3m	commit	picntrl	pdcntrl	slabcntl	sresa2
ncar pcm1	1pctto2x	1pctto4x	2xco2	sresb1	sresa1b	amip	20c3m	commit	picntrl	pdcntrl	slabcntl	sresa2
ukmo hadcm3	1pctto2x	1pctto4x	2xco2	sresb1	sresa1b		20c3m	commit	picntrl		slabcntl	sresa2
ukmo hadgem1		1pctto4x	2xco2		sresa1b	amip	20c3m		picntrl		slabcntl	sresa2

Manawatu MIMES – Data base links



Tulalip Tribe Scope of Work



Tulalip Tribe Scope of Work

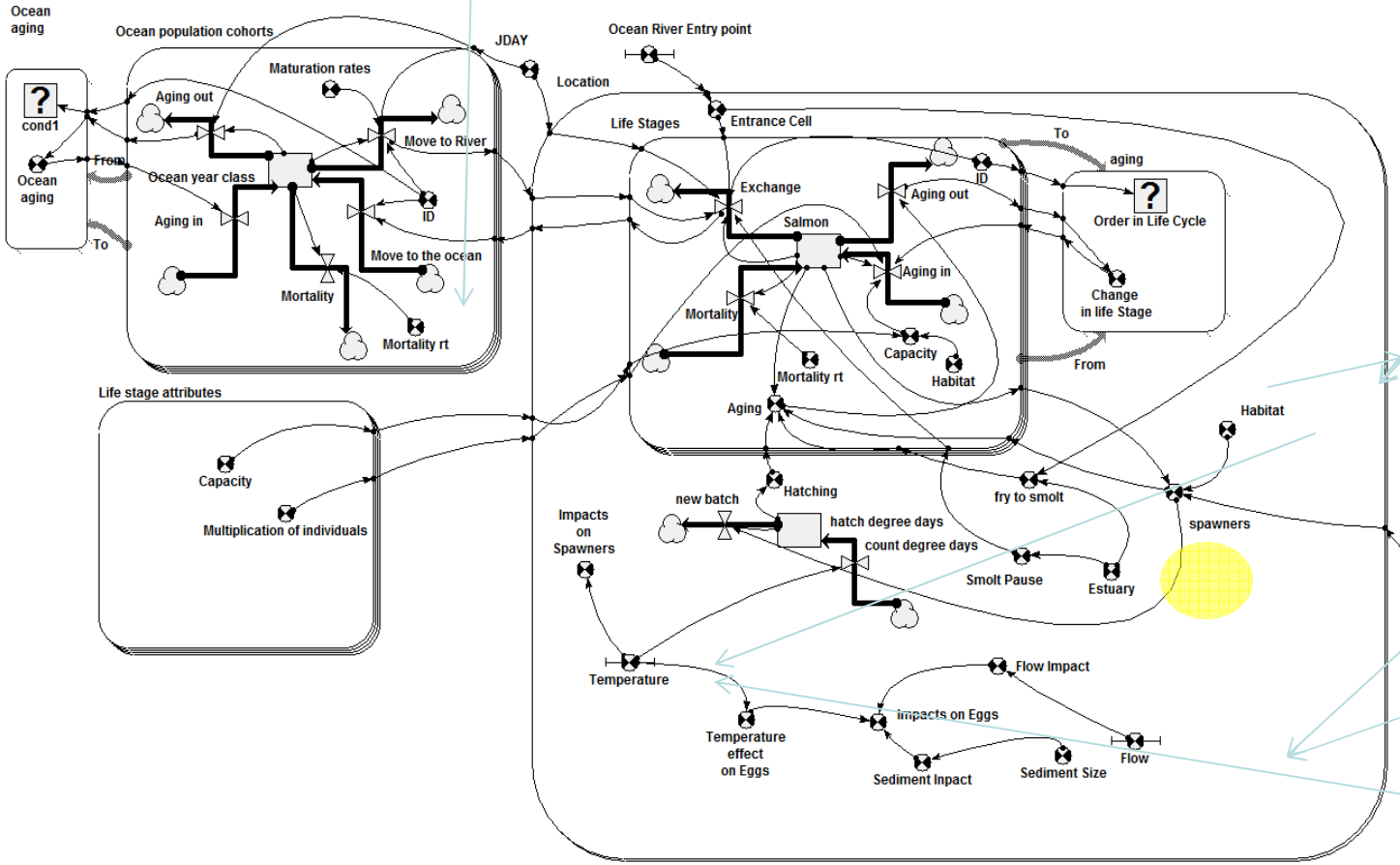
Current & historic land cover, land use, topography, elevation, soils

UrbanSim

LCCM

Potential Vegetation Model

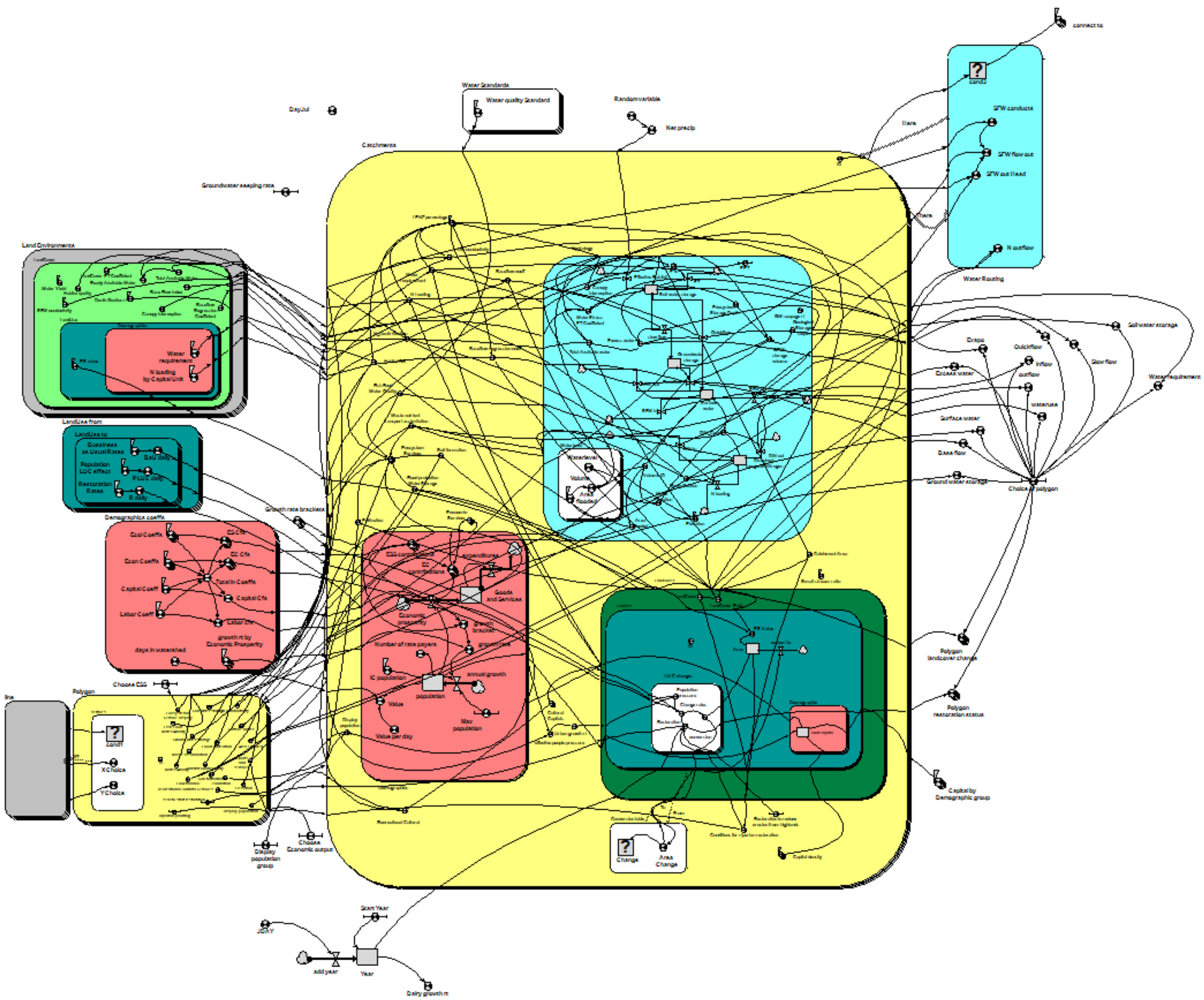
Atlantis or Ecopath with Ecosim



Puget Sound Watershed Characterization Project

HSPF or DHSVM or VIC

WRF-CCSM3 or WRF-ECAM5



connect to
cond
SFW conducts
SFW flow out
SFW out Nload
N outflow
Water Routing
Water Standards
Water quality Standard
Random variable
Net precip
DayJul
Catchments
Groundwater seeping rate
Land Environments
LandUse from
Demographics coeffs
Ecol Coeffs
Econ Coeffs
Capital Coeff
Labor Coeff
Total In Coeffs
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days in watershed
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Growth rate brackets
Choose ESS
Polygon
X Choice
Y Choice
Water requirement
N loading by Capital Unit
Waterlevel
Volume
Area flooded
Economic prosperity
Goods and Services
Number of rate payers
IC population
population
annual growth
Max population
Value
Value per day
Soil water storage
Drops
Quickflow
Excess water
Slow flow
Surface water
Base flow
Ground water storage
Choice of polygon
Polygon landcover change
Polygon restoration status
Capital by Demographic group
Capital density
Change
Area Change
Display population group
Choose Economic output
Start Year
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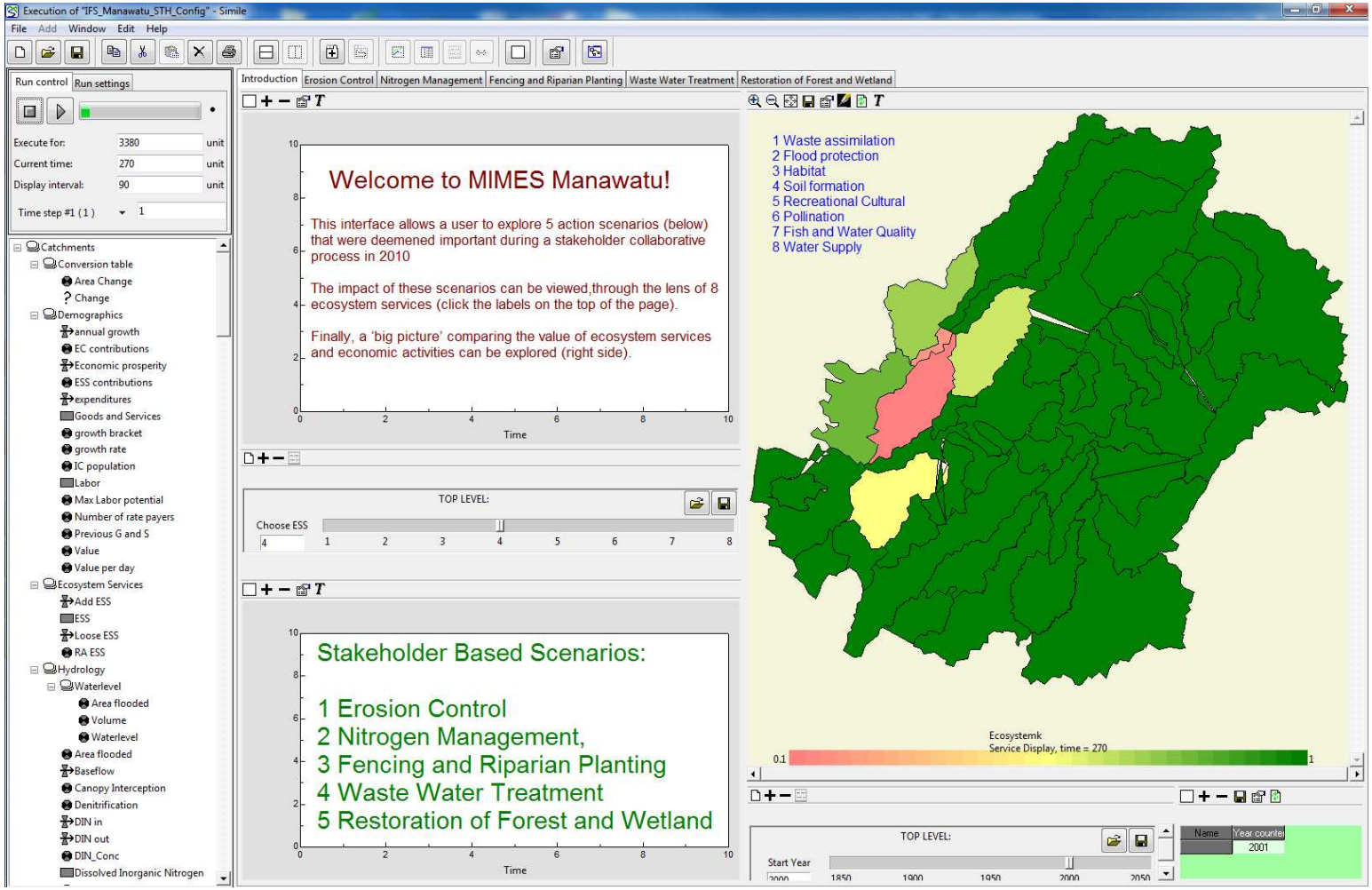
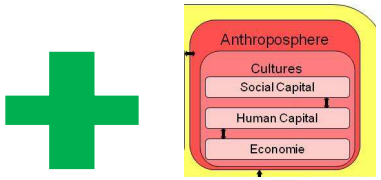
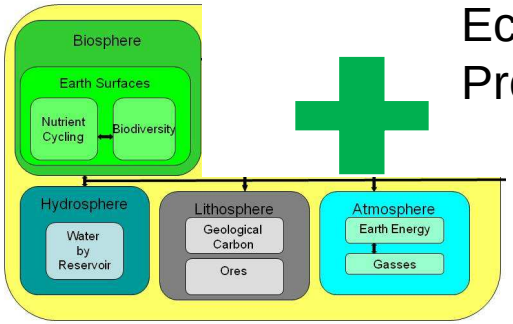
add year
Year
Daily growth rt

The Manuwatu MIMES User Interface for Scenario Modeling
The Introduction Page



Accounting Framework For Modeling Ecosystem Services

	Economic sector "Use"	Ecosystem "Use"
Economic Sector "Make"	 Macro Economics	 Ecosystem Impacts The "make" and "use" of disservices
Ecosystem "Make"	 Ecosystem Services	 Ecosystem Processes

Ontologies

Ecosystems

- **Coastal Ocean**
- **Cropland**
- **Desert**
- **Forest**
- **Grassland**
- **Lakes Rivers**
- **Ocean**
- **Rock Ice**
- **Tundra**
- **Urban**
- **Wetland**

Economic Sectors

- **Mining**
- **Forestry**
- **Fisheries**
- **Agriculture**
- **Manufacturing**
- **Tourism**
- **Research/Education**
- **Households**
- **Transportation In-Export**

Services

- **Aesthetics**
- **Biological regulation**
- **Climate regulation**
- **Cultural heritage**
- **Genetic**
- **Inorganic resources**
- **Natural Hazard Mitigation**
- **Navigational surface**
- **Organic resources**
- **Shelter**
- **Soil retention**
- **Spiritual Artistic Inspiration**
- **Waste absorption**
- **Water quality**
- **Water quantity**

Manawatu Land Use (ha) by Land Covers 1990

Land Use / Land Cover	Dairy	Cropping	Forestry	Sheep & Beef	Residential Industry Services	Conservation	Water Use
Urban					11468		
Pasture	50685			170106			
Cropping		6591					
Wetland						210	
Forest			8585			22665	
Shrub						63697	
Water							3092
Riparian						222	

Ecosystems perform Ecosystem Functions (estimated)

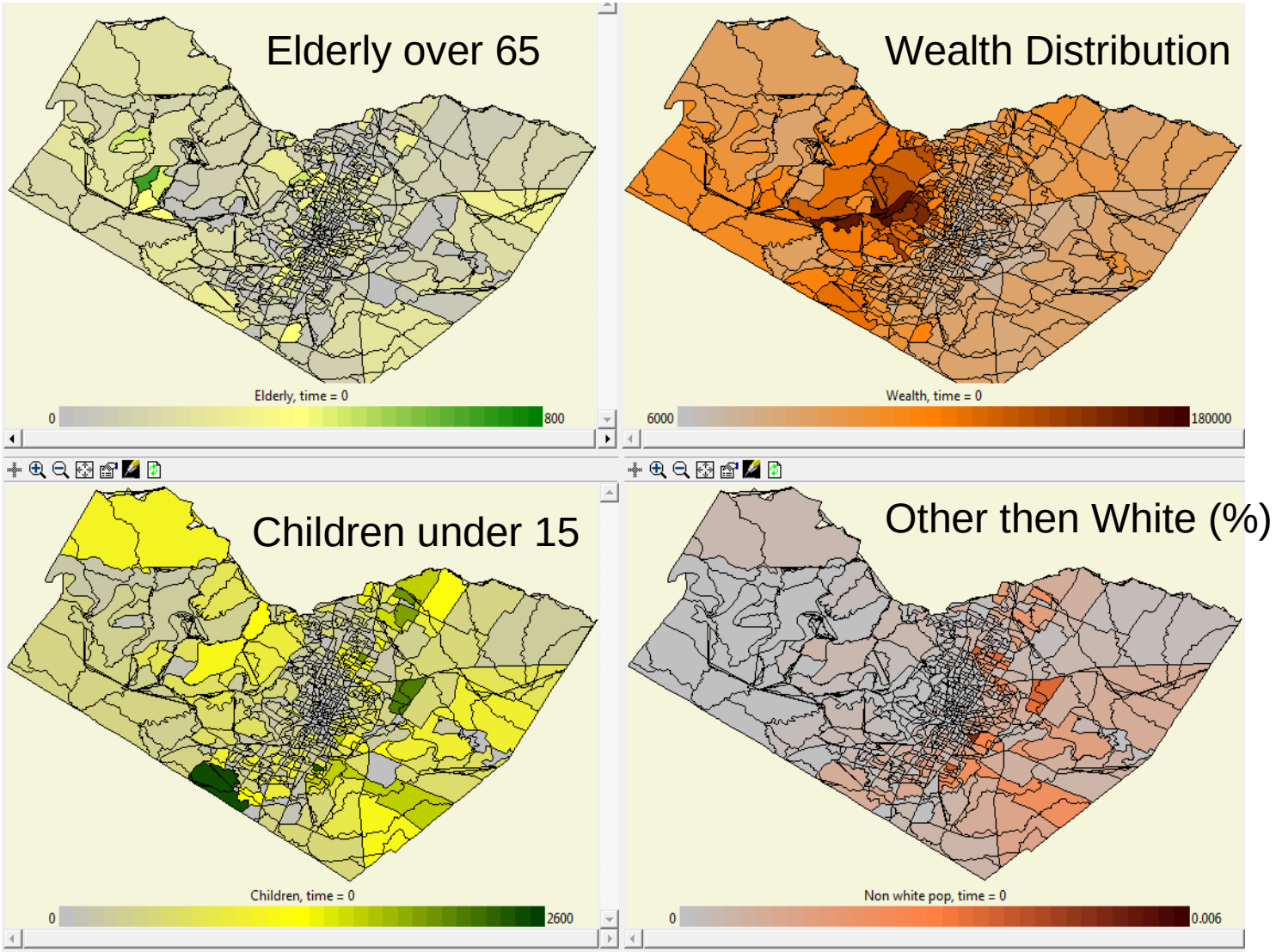
Ecosystem Functions / Land Cover or Ecosystems	De-nitrification	Water storage	Habitat conditions for wildlife	Habitat conditions for Soil organisms	Growing of Biomass	Buildings and Roads
Riparian	low	medium	high	medium	medium	
Cropping		low			high	low
Forest		medium	high	high	high	
Pasture		low		low	high	low
Shrub		low	medium	medium	low	
Urban						high
Water	low	high	high		low	
Wetland	high	high	high		low	

Ecosystem services needed for economic productivity

Demographic Groups / Ecosystems Services	Farmers	Recreationists	Foresters	Iwi	Urbanites	Conservationist	Industrialists	Services
Waste assimilation		high			high			
Flood protection	low	low			high		high	high
Habitat provisioning		medium	high	high		high		
Recreational Cultural		high		high	high			
Pollination	high		high					
Fish and Water Quality		high		high	mediu m	high		
Soil Formation	high		high					
Water Supply	high	medium					high	medium
Food provisioning	high			high	high			medium

The Social Fabric

2000 Census block group data



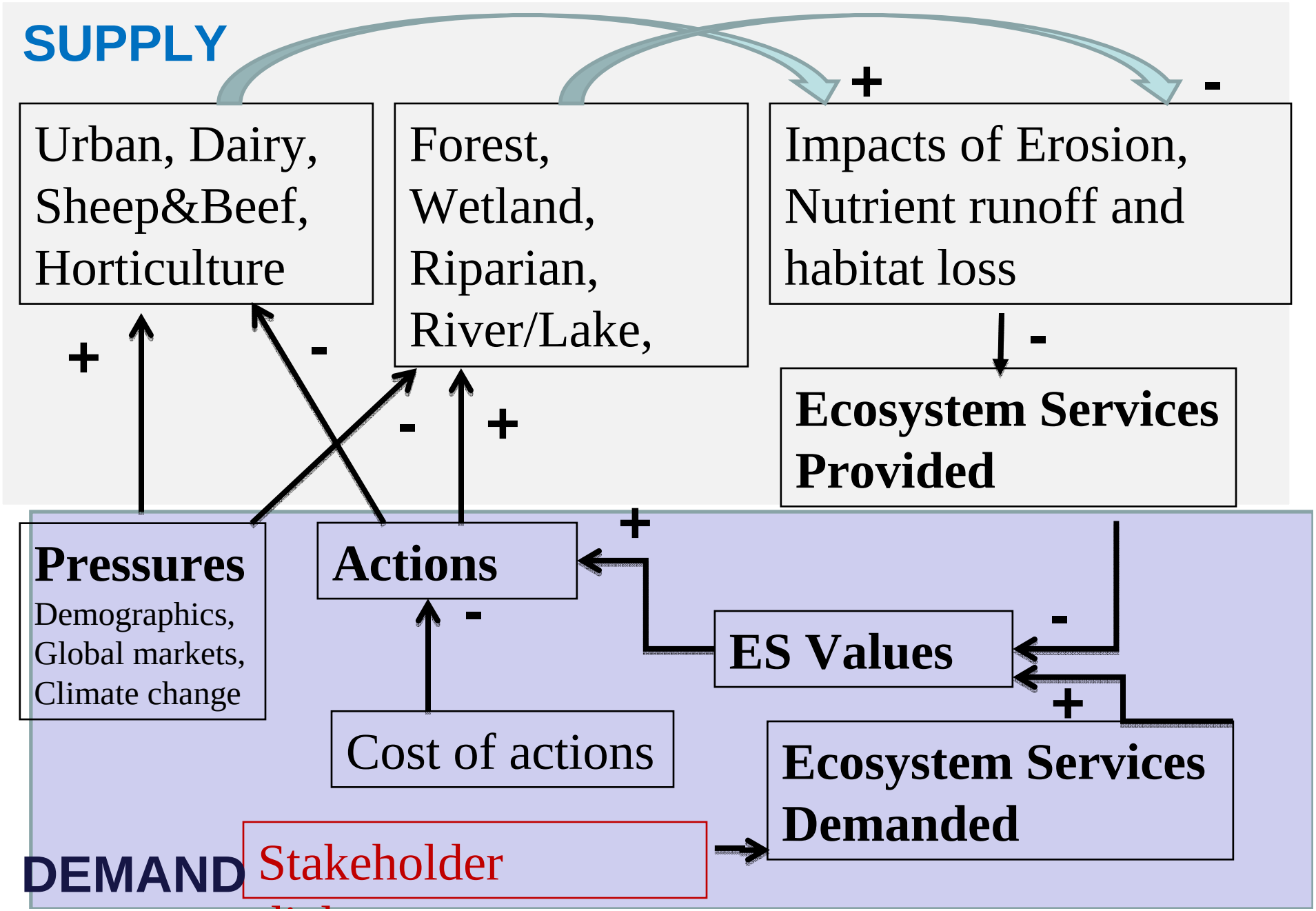
Economic sectors produce Environmental Externalities (estimated)

Impacts / Demographic Groups	Nitrogen Loading	Urbanization	Restoration	Erosion
Farmers	high			high
Recreationists		medium	low	
Foresters	low	low		high
Iwi				
Urbanites	high	high		
Conservationists			high	
Industrialists		high		
Services	high	high		

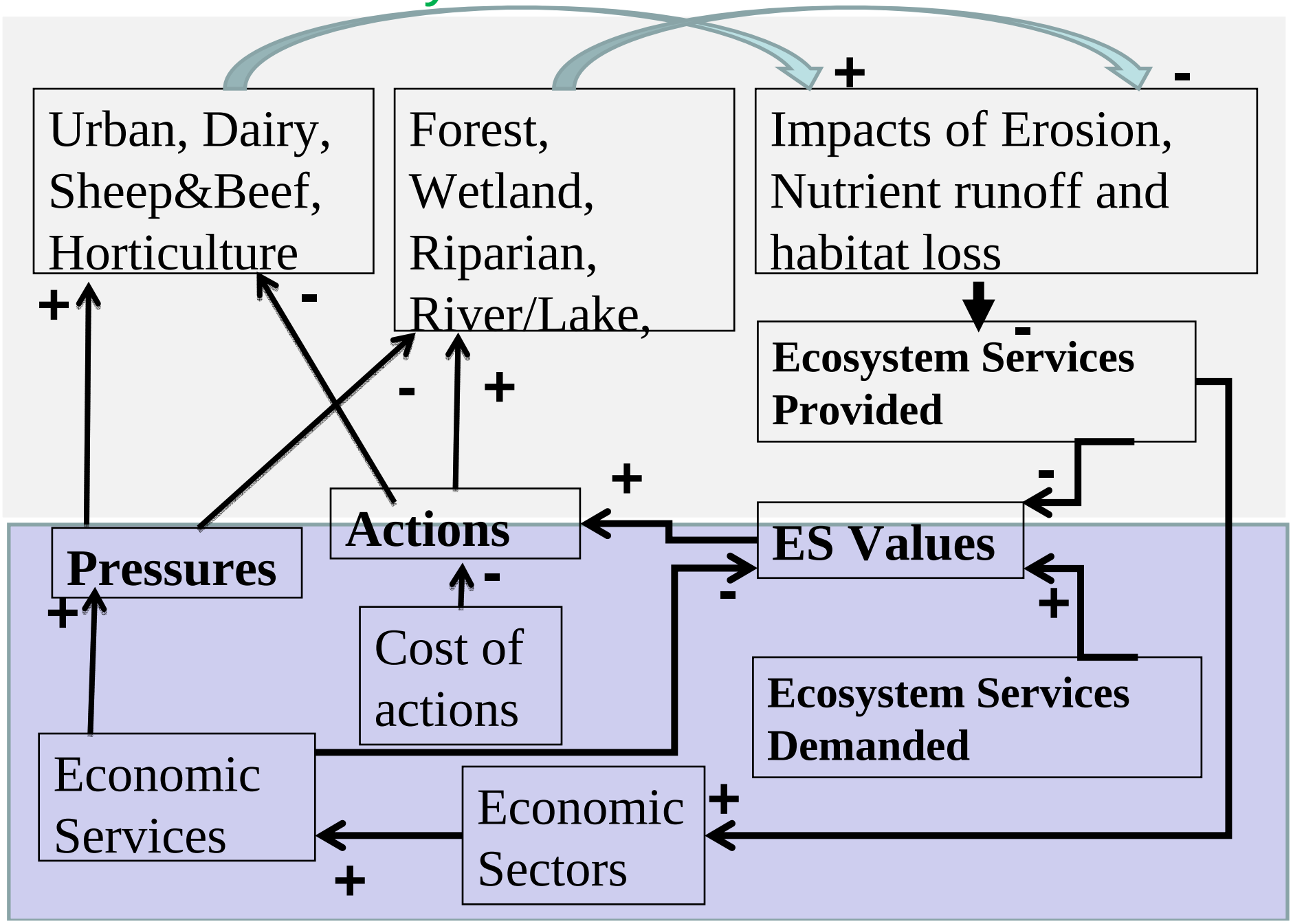
Externalities have impact on Ecosystems (estimated)

Land Covers Ecosystems / Impacts	Riparian	Cropping	Forest	Pasture	Shrub	Urban	Water	Wetland
Nitrogen Loading				high			loss of quality	
Urbanization		loss	loss		loss			loss
Restoration	gain	loss	gain	loss				gain
Erosion		loss of quality		loss			loss of quality	

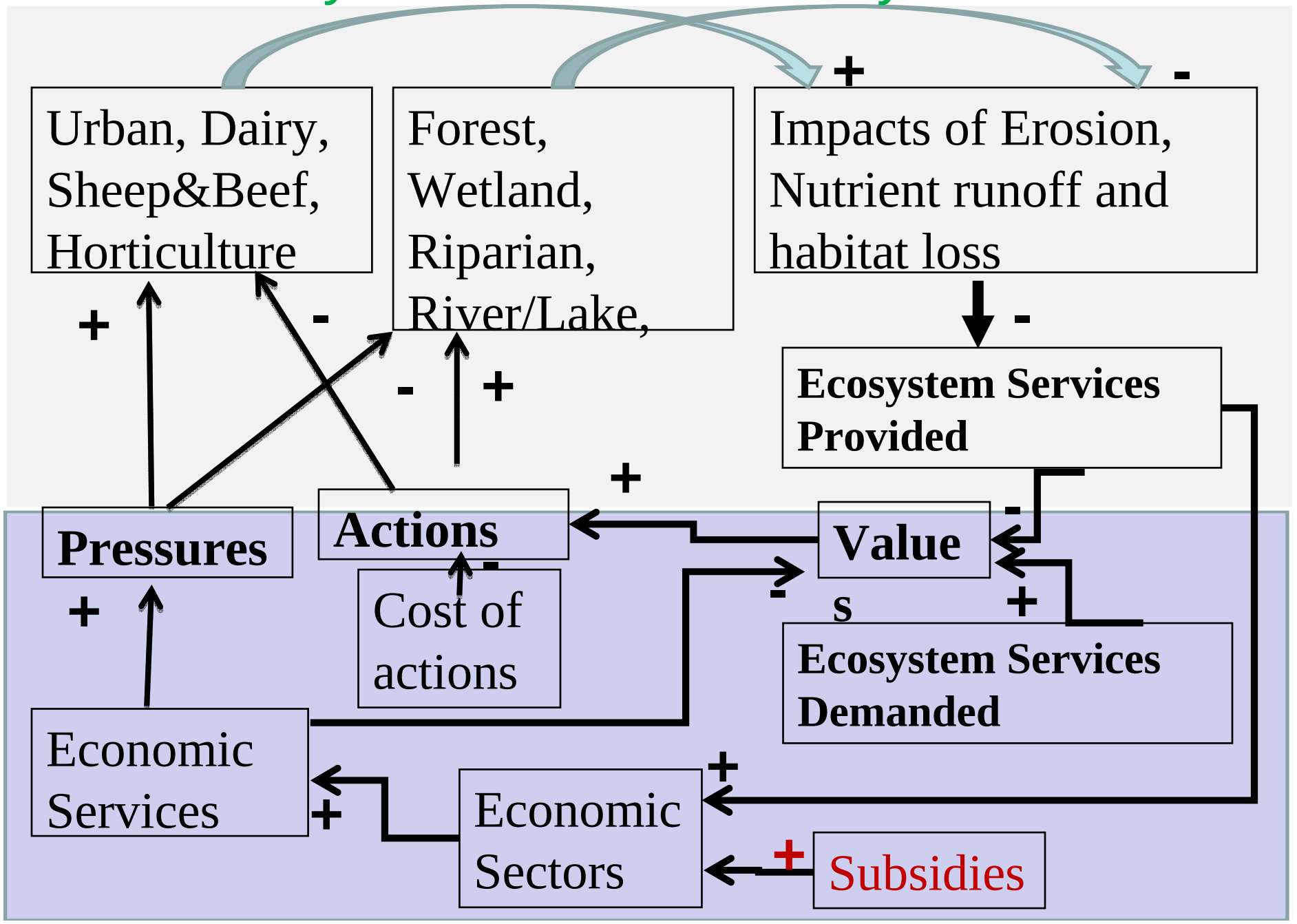
Causality within the sustainability loop



Causality for sustainable economies



Causality for non-sustainability Economies

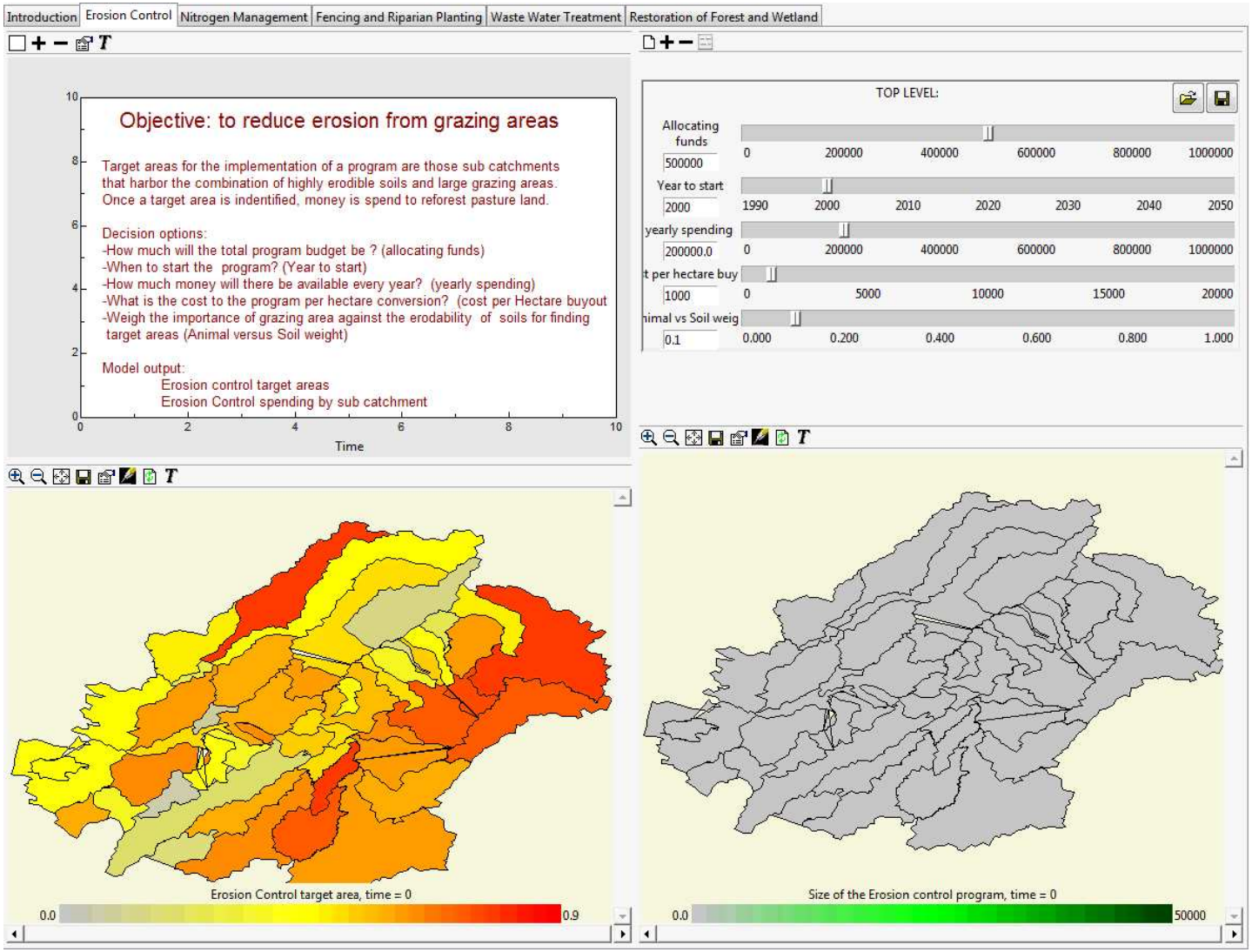


- Building a MIMES Model
- Using a MIMES Model

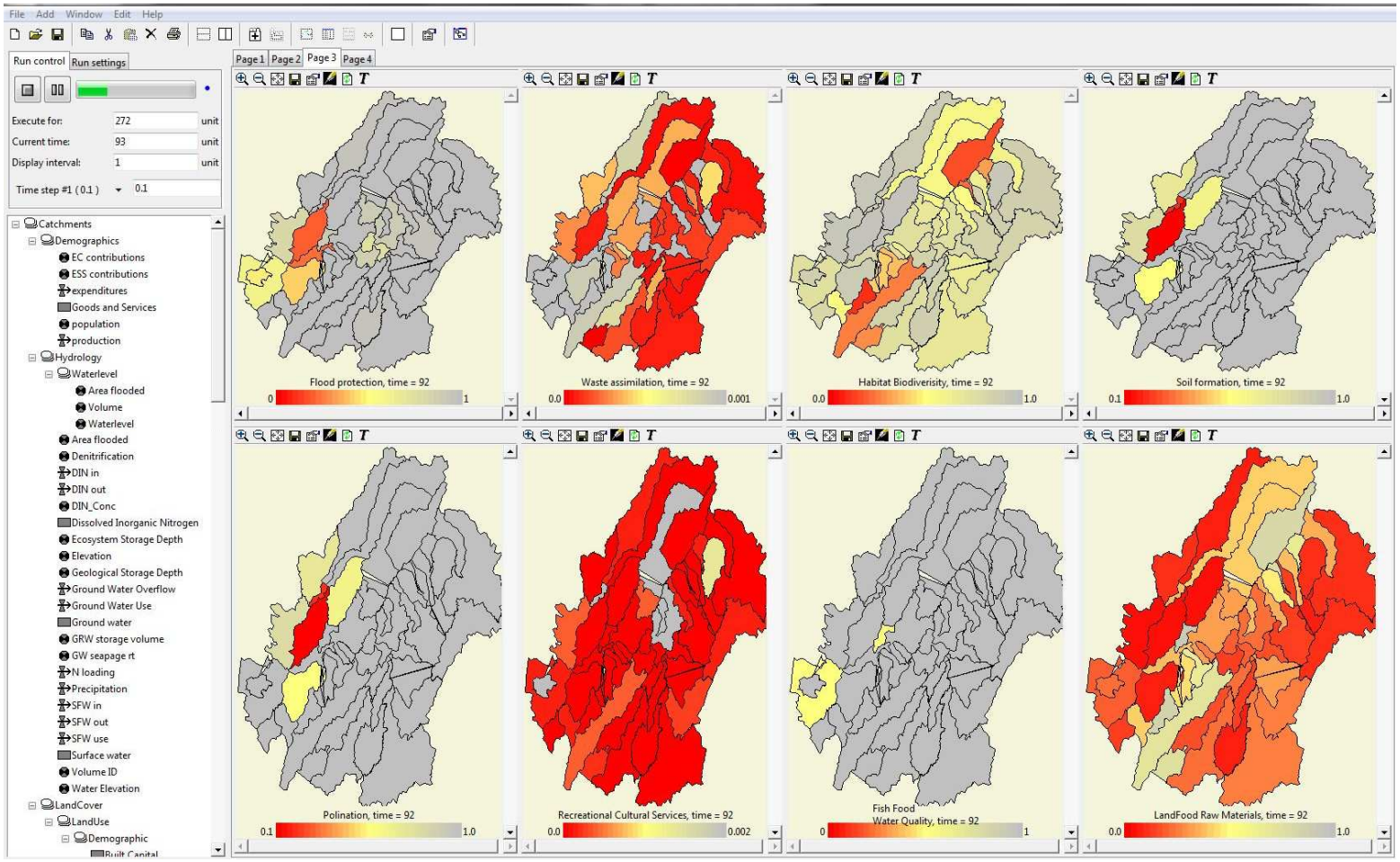
Scenario Modeling

- Aim is not to predict one exact picture of the future, but to present several alternative future developments.
- Scenarios consider potential developments and turning points.

The SLUI Scenario Run

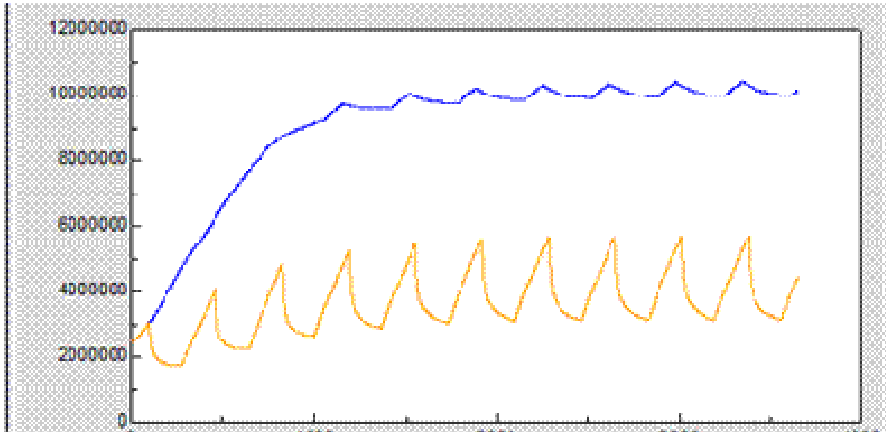


Emergent dynamics of Ecosystem Services

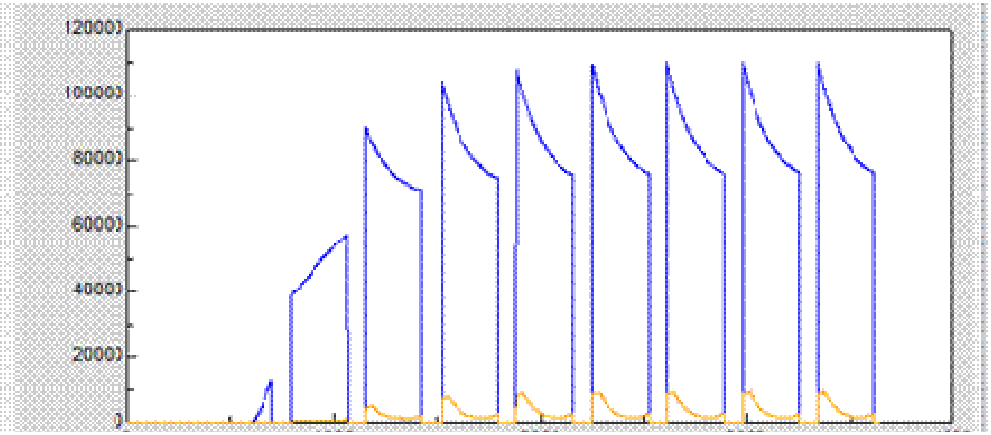


Scenario Analyses

Sand lance biomass



Humpback whale biomass

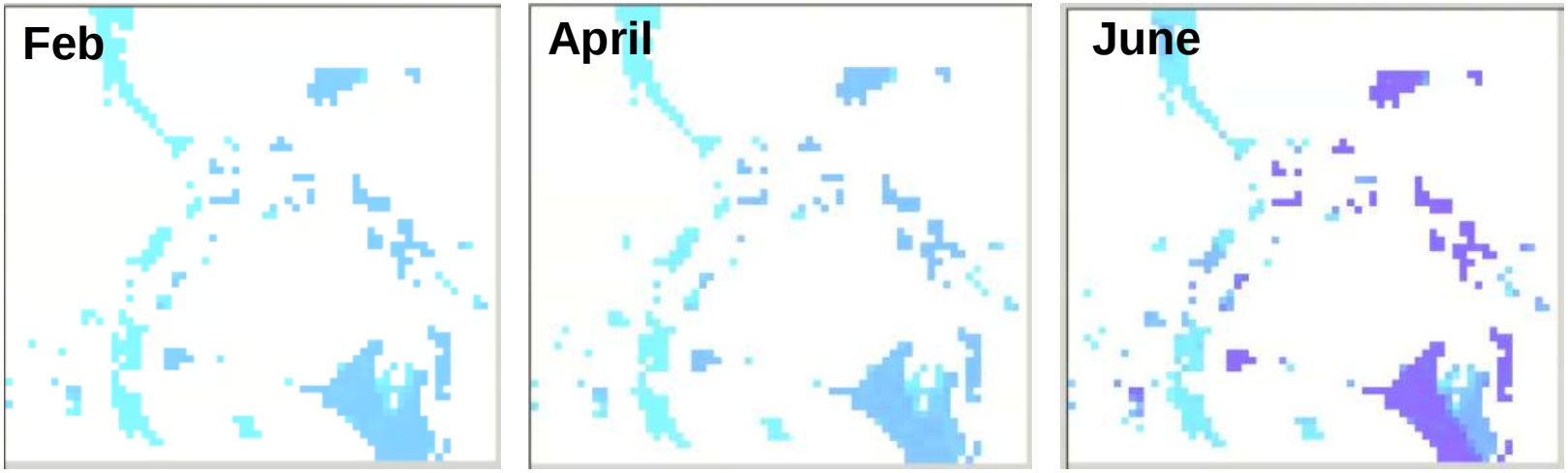


- Temporal and spatial tradeoff resulting in losses to whale watching revenues when SL fishing is allowed

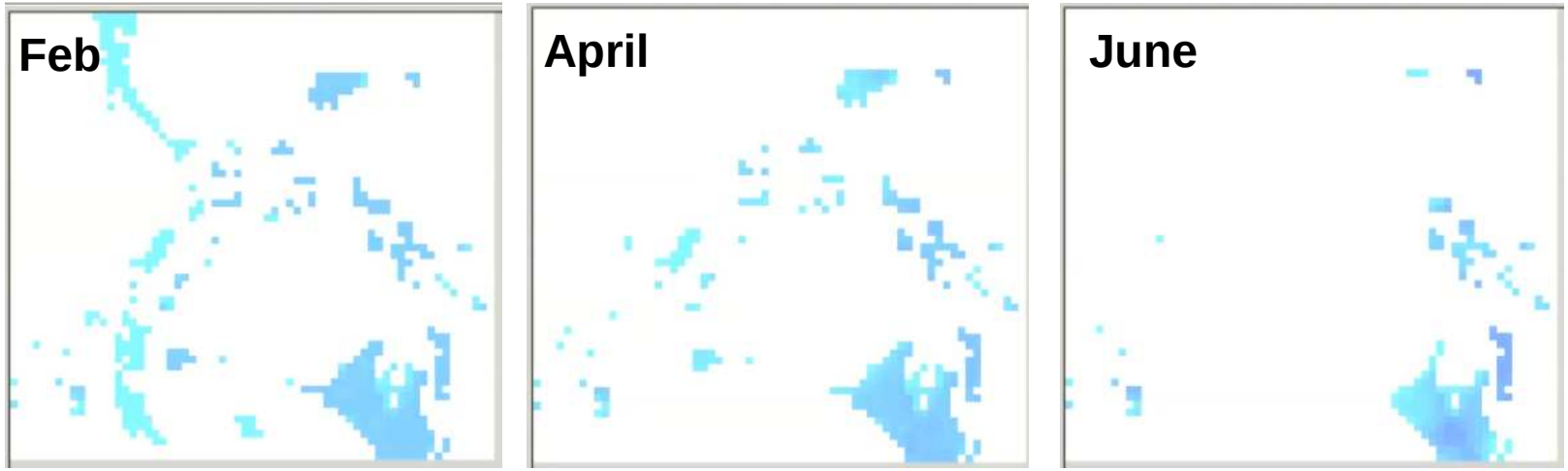
No sand lance fishing

Sand lance fishing

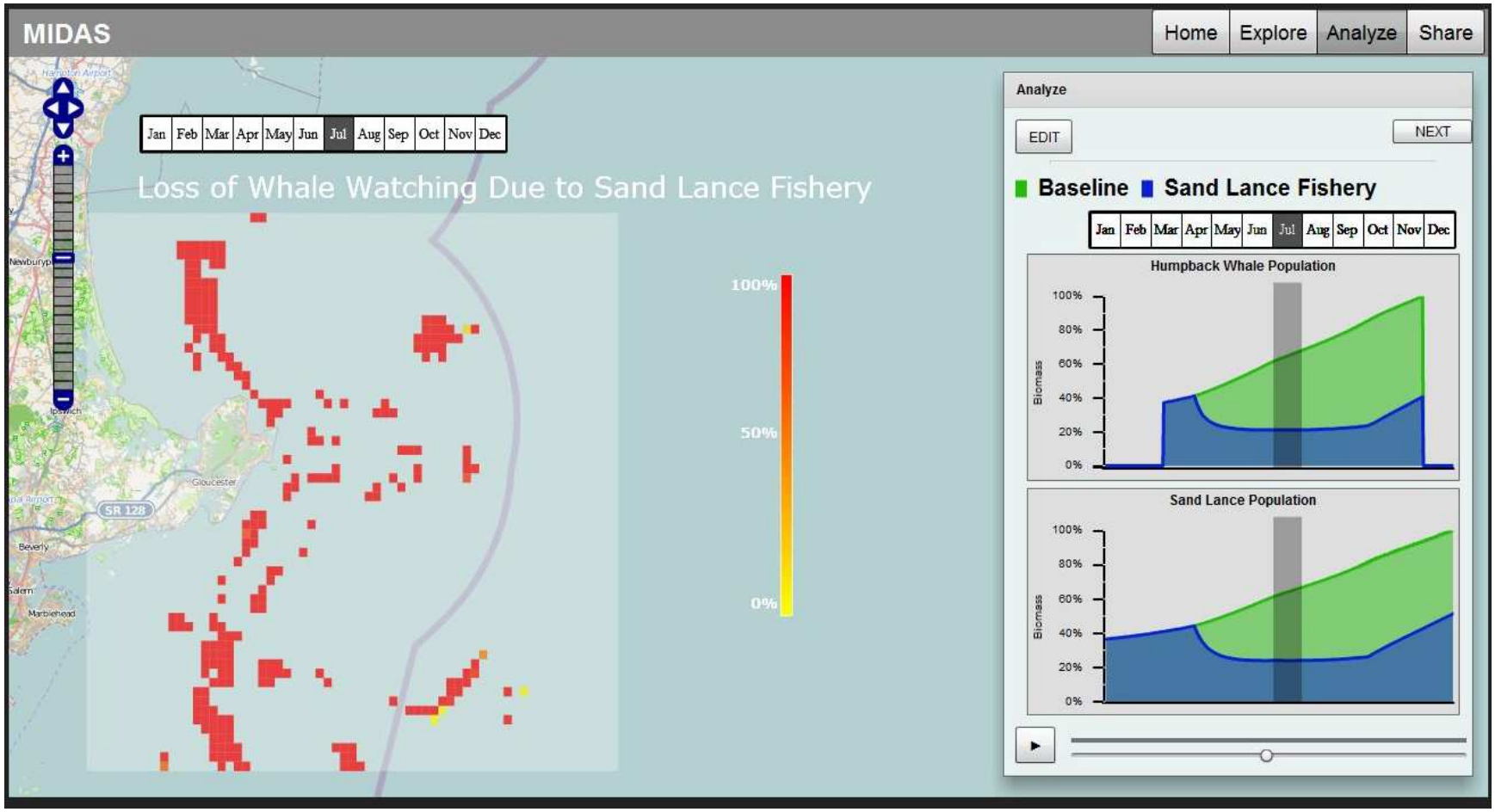
No sand lance fishing



Sand lance fishing turned on



MIDAS Promote collaborative spatial decision making to enhance understanding and education about marine resources



Any questions?