Gladstone Harbour Model

(GHHP Atlantis)

Gladstone Harbour Model Overview




- Model purpose
- General model overview
- Some preliminary results
- Questions

Gladstone Harbour Model Purpose




- The intended use of the Gladstone Harbour Model is to:

- *"provide a tool for integrating a wide range of environmental, social and economic information in a common framework to study and predict future changes in the ecosystem, because direct experimentation on the ecosystem is seldom possible, especially when the ecosystem considered is large and has open boundaries such as Gladstone Harbour."*

Gladstone Harbour Model Purpose




- The intended use of the Gladstone Harbour Model is to:

- *"provide a mechanism to 'road test' management strategies before implementing them in reality, allowing users to investigate the likely effectiveness and* [social, environment and financial] *cost of different management actions to maintain or restore the health of a system, in support of adaptive resource management."*

Gladstone Harbour Model

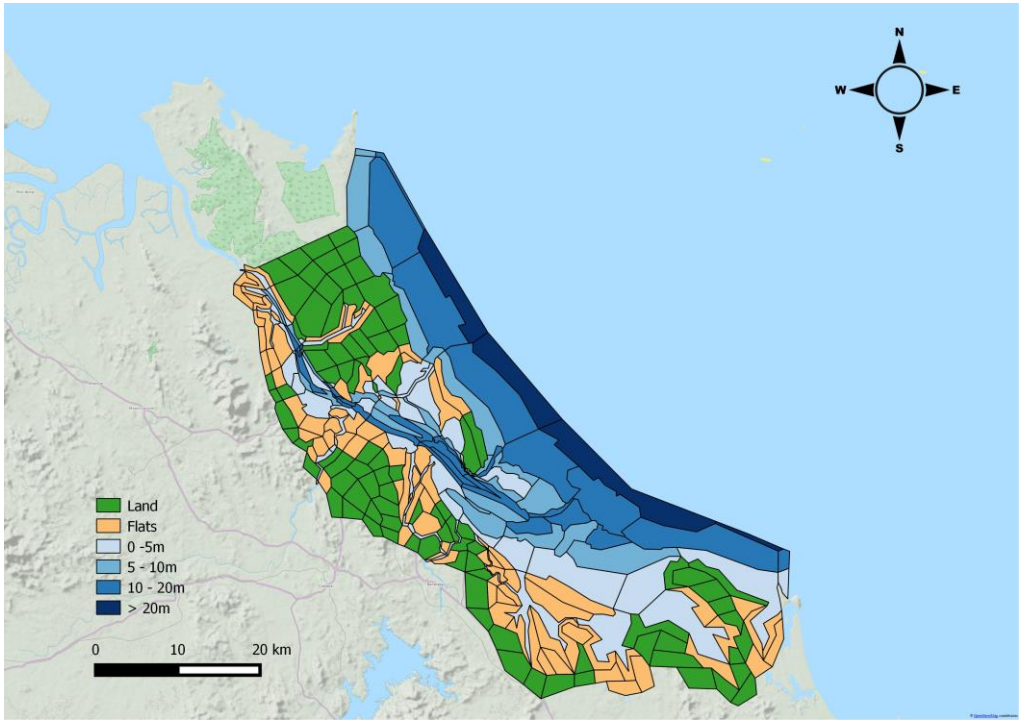
What is it?

Atlantis GHHP

- Developed by CSIRO—Atlantis is a system level model that is used as a scientific "Lego" set to build models that capture our best understanding of how a system is structured and how it functions.

Model World

Gladstone Harbour Model Domain



The model contains 305 boxes, 190 land boxes and 115 wet boxes:

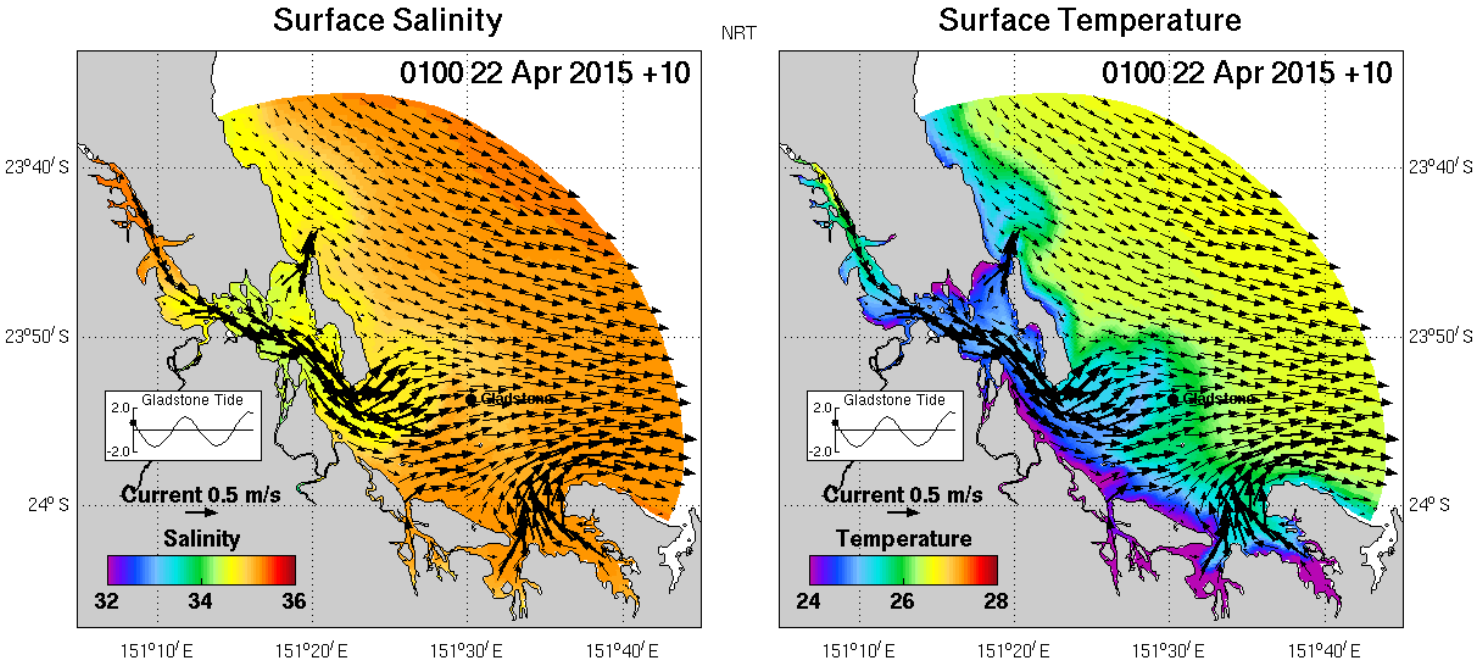
Harbour Boxes:
Based on available geomorphology of sediments and soils, water column properties; temperature, salinity, dissolved oxygen, major current patterns and distribution of habitats.

Land Boxes:
Simple land use and its influence on run-off and river flows are applied to each of the ‘land-cells’ within the grid.

3D Hydrodynamic Model

PORT CURTIS

NEAR REAL-TIME HYDRODYNAMIC MODELLING



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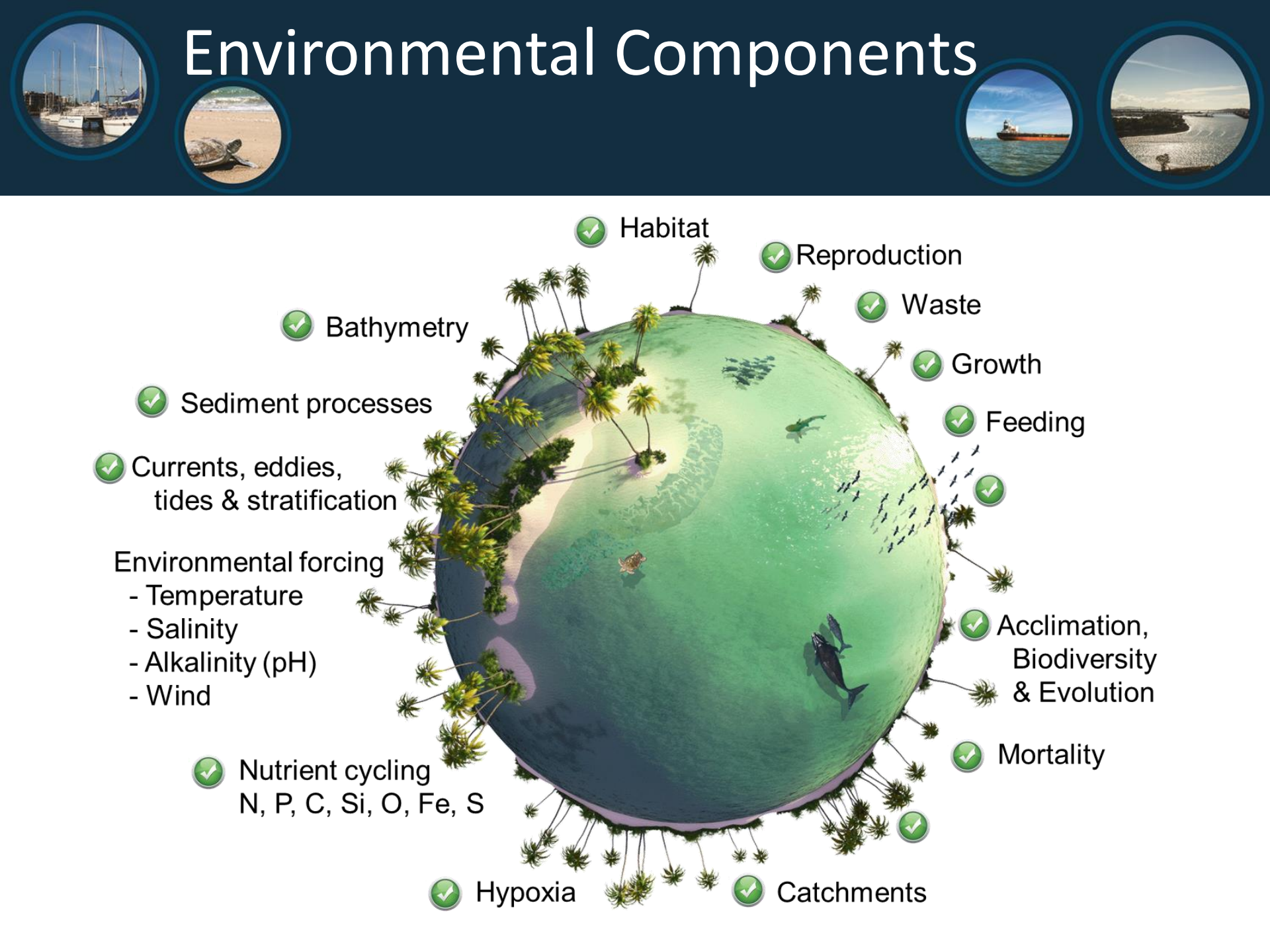
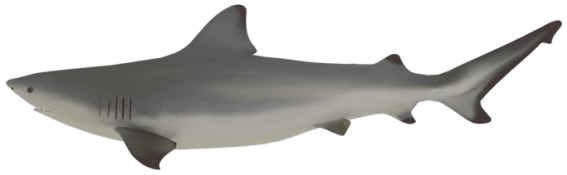
Environmental Components



Biological Components




- Plankton (3 phytoplankton groups and 2 zooplankton groups)
- Infauna (meiofauna and polychrates)
- Epifauna (bivalves, scallops, prawns, crabs, other invertebrates
- Seagrass (2 types *Zostera* and *Halophila*)
- Other marine habitats (coral, sponges, algae, microphytobenthos)
- Coastal habitats (mangrove, salt march, salt pans, mudflats)
- Fish (Barramundi, Bream, Mangrove Jack, 2 reef fish, 7 river harbour fish)
- Bull Shark, other demersal sharks and rays.
- Birds (e.g. herons, pied cormorants, plovers, oyster catchers, gulls, terns, pelicans)
- Marine mammals (dolphins, dugongs)
- Turtles (Green Turtle, Flat back Turtle)
- Nutrients and Detritus (N and Si…. P coming)



The Human Elements


- Social networks
- Attitudes
- Behaviour & decisions
- Monitoring
- Assessments
- Control Rules
- Regulation
- Economy
- Markets
- Trade
- Costs
- Revenue
- Investment
- Energy
- Agriculture
- Catchments
- Transport (& shipping)
- Tourism
- Fisheries (commercial & recreational)
- Land use
- Forestry
- Population
- Limits
- Governance
- Integration & feedbacks

The Human Elements




Main Human Elements	Additional Human Elements
Tourism	Simple perception (amenity index)
Fisheries	Simple health index
Agriculture	Skills, training and employment
Aquaculture	Population demographics
Mining	Simple housing demand model
Oil	Simple index of status cultural heritage sites
Energy generation	Simple recreational index
Heavy industry	
Shipping	
Services	
Urban and Community	

Fitting it all together




Atlantis / Seaview

Model runs are archived and can be accessed via the seaview website. Managers or other stakeholders have rapid access to a expanding library of potential management strategies and scenarios of interest.

Human Activities

These qualitative models synthesise the cause-and-effect relationships between human pressure and the environmental and ecological components of the Gladstone harbour region. These pressures include shipping and ports, heavy industry, mining, commercial fishing, recreational fishing, agriculture, tourism, retail and real estate.

Oceanographic

Climate and hydrology

This component of the model captures the water movements, surface temperature and salinity in the Gladstone Harbour region. The model runs in near real time and is connected to the eReefs model which provides oceanic conditions at the models boundary.

Biophysical

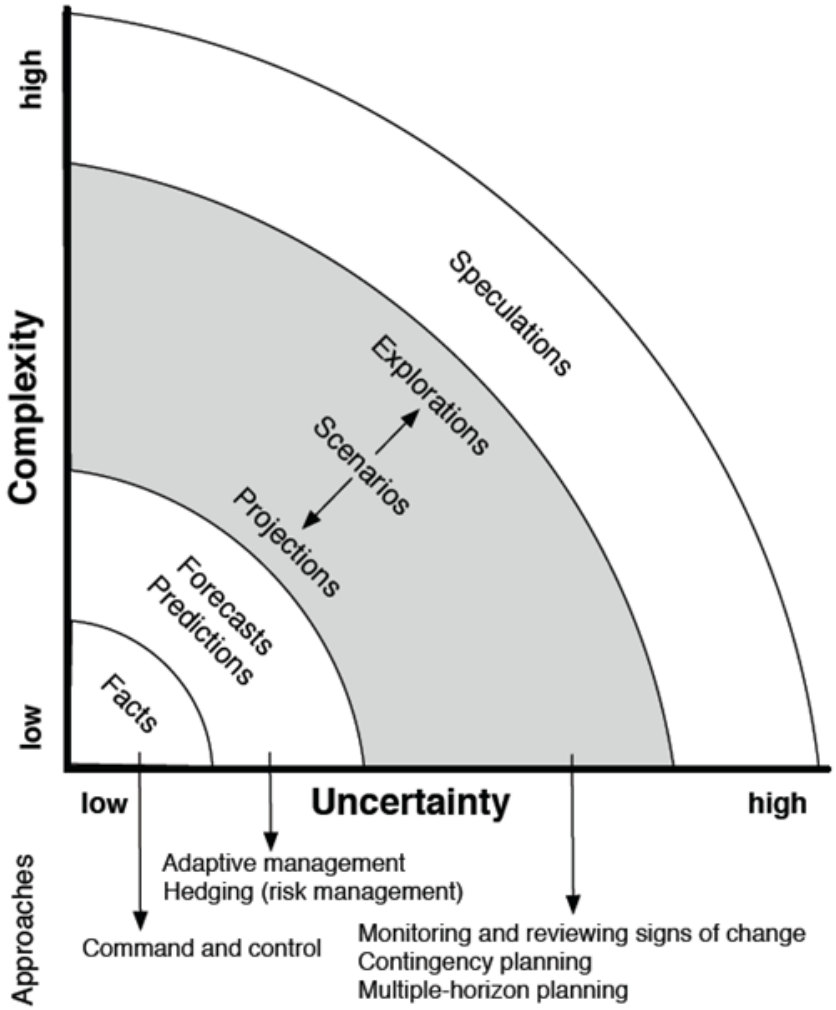
This module resolves nutrient flows through the system and its biota. It models a number of primary ecological processes including consumption, production, migration, predation, recruitment, habitat dependency and mortality.

Food Web

Biogeochemistry

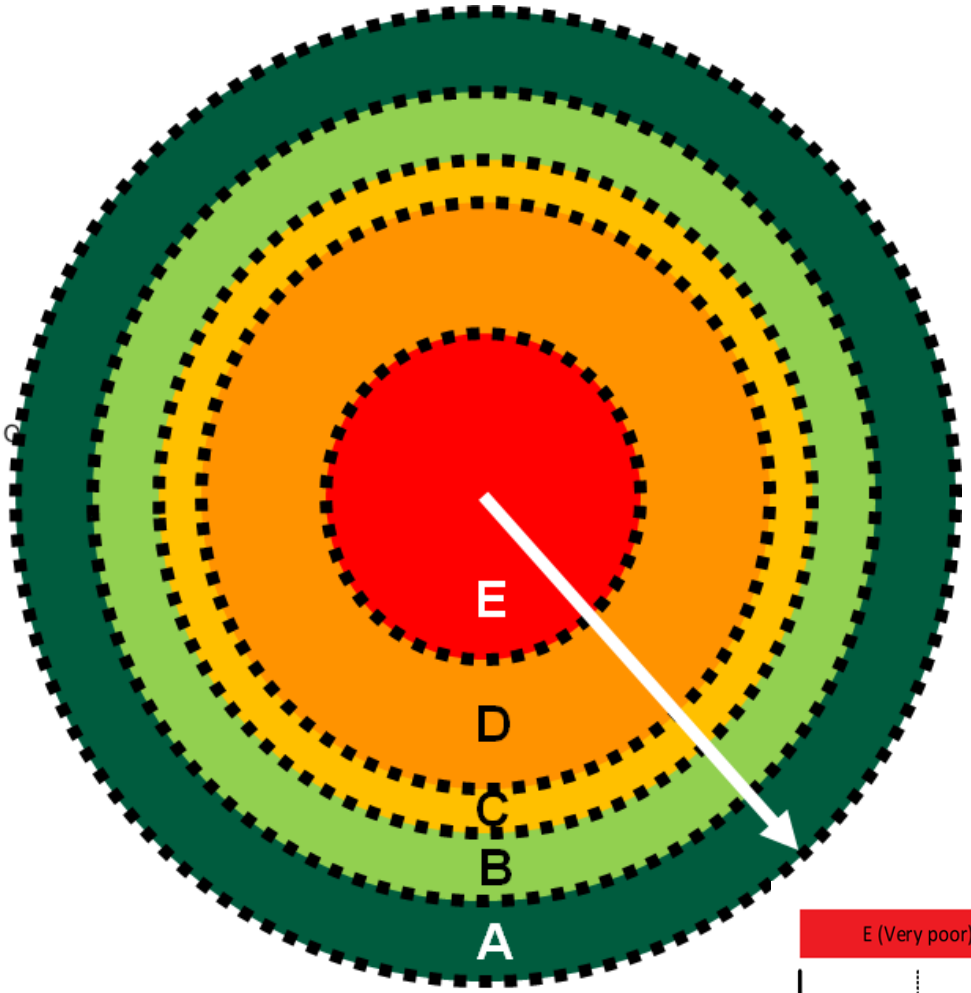
Habitats


Model Results Scenarios

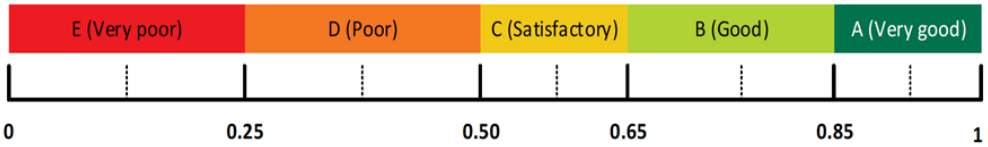



- Not as precise as projections or forecast
- Let you explore uncertain potential, but based on consistent foundations
- Important to understand the models are not crystal balls
- Ecosystems are highly complex and it is unlikely that a model can capture the full nuances of their function
- The model outputs should only ever be used as one source of information and not the only source

Scenario Results



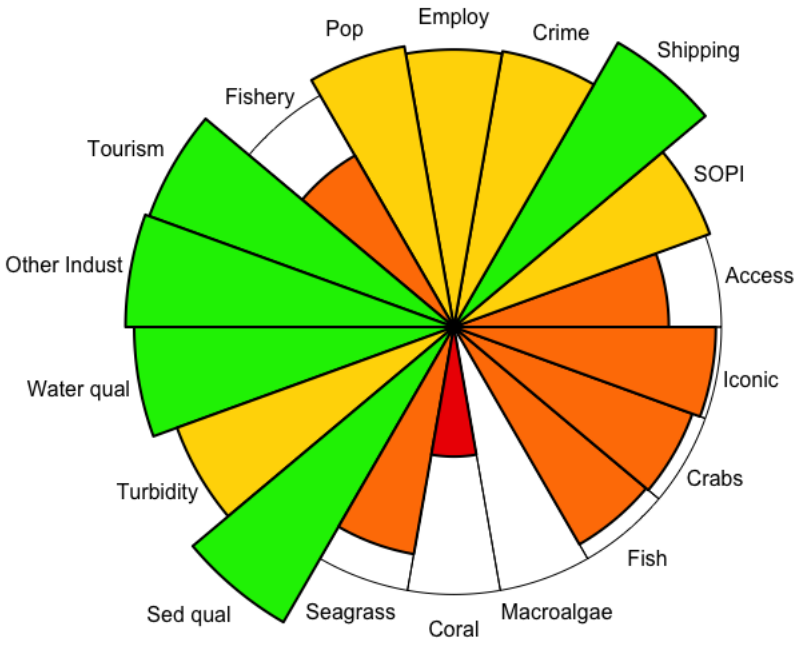
- Report card like
- Spatial
- Trend plots
- Visualisation of results
- Seaview website (Interactive library of existing model runs that allows comparisons of scenarios)
- Project reports



Report card like

Scenario Results Report Card Like

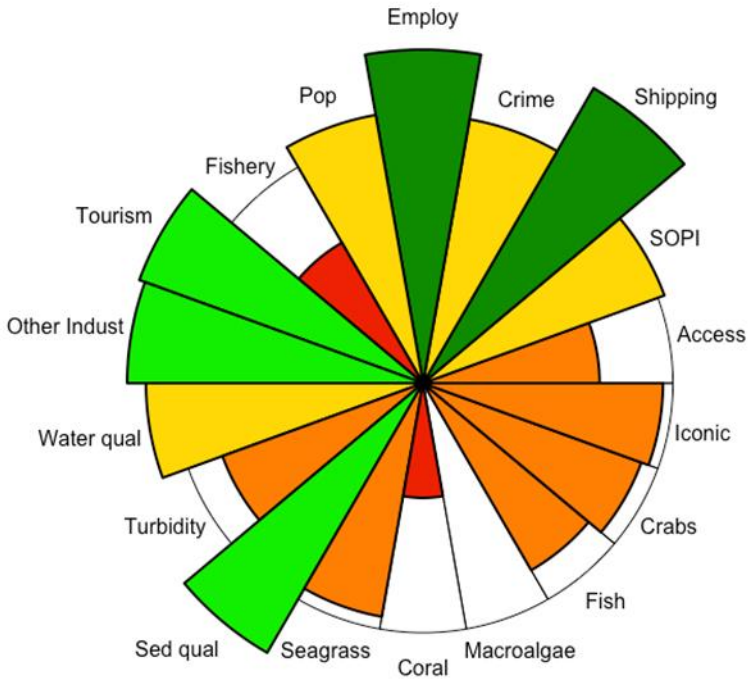
1: Current catchment and management (baseline)



- Good water quality
- Good sediment quality
- Good economic status
- Satisfactory demographics
- Poorer trophic and habitat

Scenario Results
Report Card Like

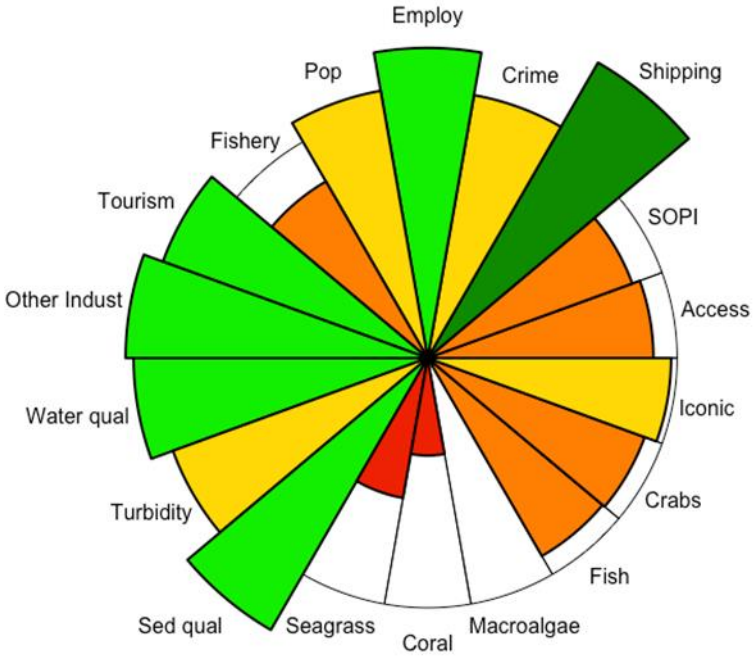
2: Flooding



- Flooding degrades water quality
- Trophic and habitat condition still poor
- Rebuilding has positive employment outcomes

Scenario Results
Report Card Like

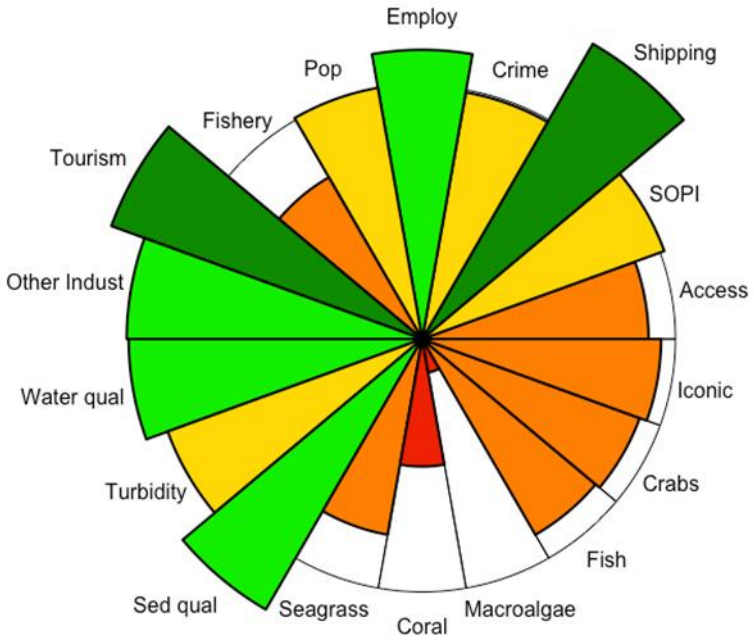
3: Strong climate effects



- Compounds flooding effects
- Degrades habitat
- Negative impact on ‘sense of place’

Scenario Results
Report Card Like

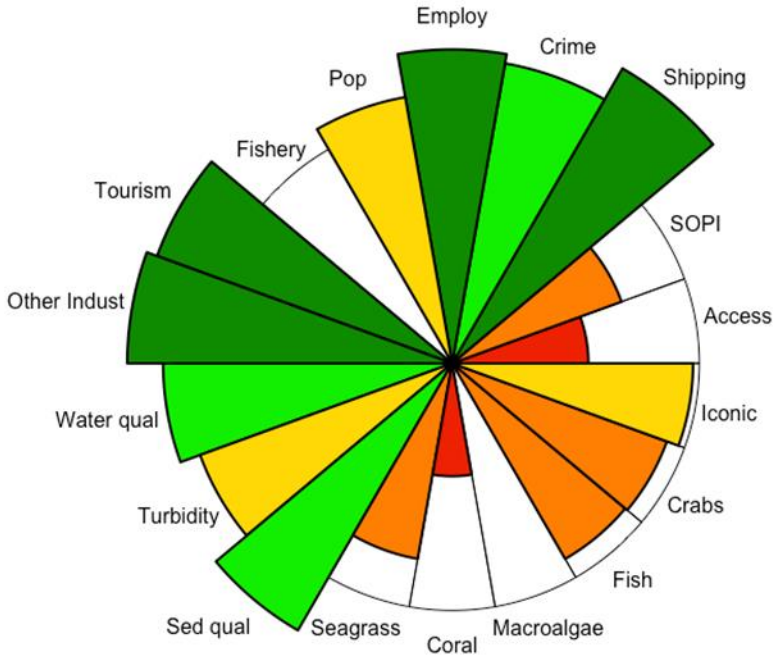
4: Reduced nutrient loads



- Improved water quality
- Ecosystem outcomes complex (owing to indirect effects)
- Improved recreational & tourism experiences

Scenario Results
Report Card Like

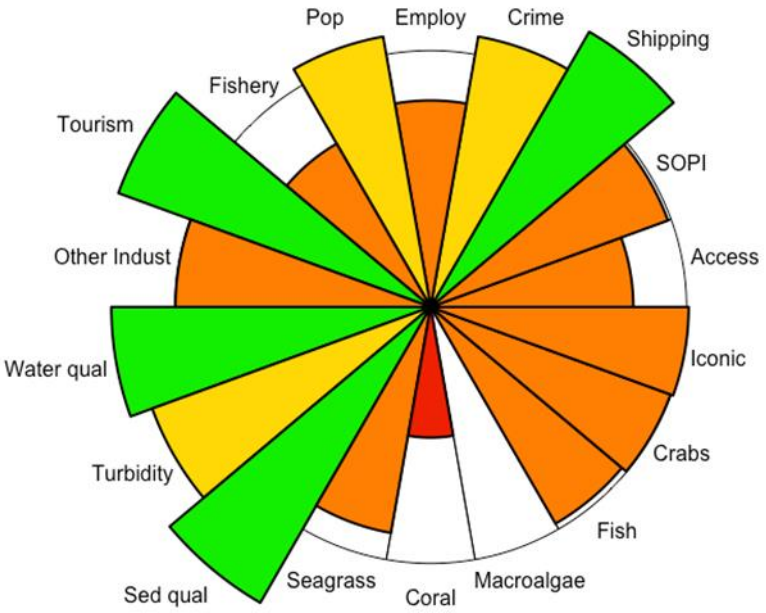
5: Rapid growth



- Improved economic scores
- Degrades ecosystem (even if water quality score does not change much)

Scenario Results
Report Card Like

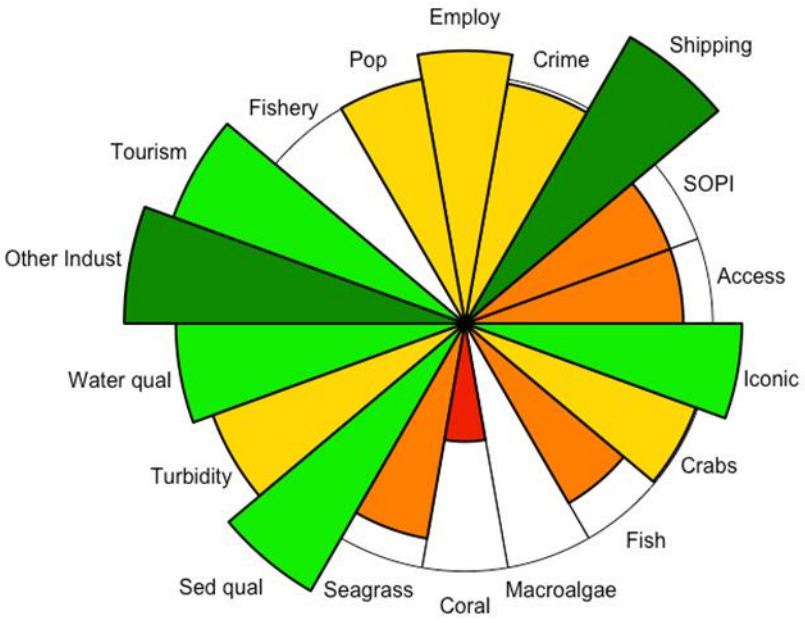
6: Slower growth or industrial decline



- Decline in economic indicators
- Decline in well being
- Decline in sense of place
- Little environmental change

Scenario Results Report Card Like

7: No commercial fishing

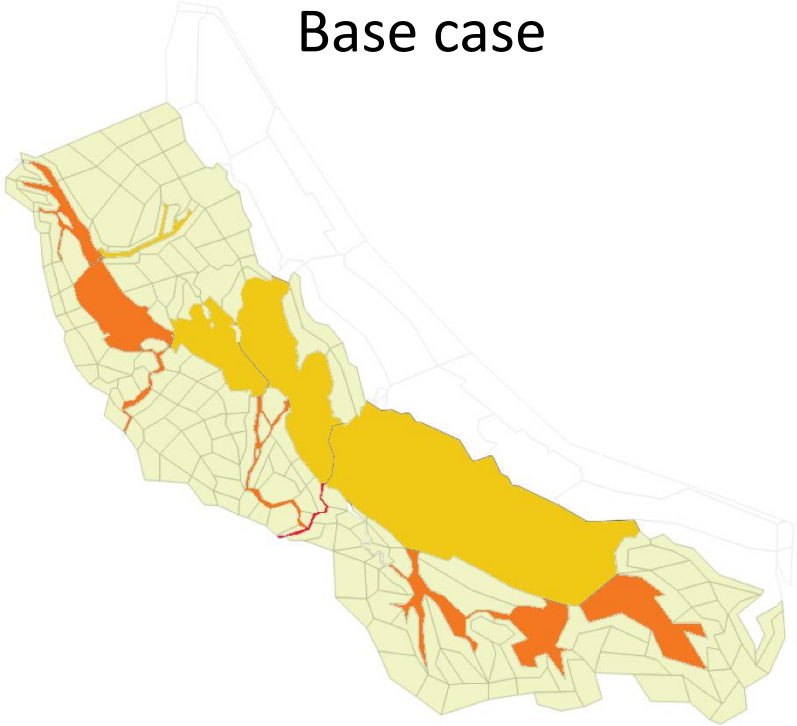


- Higher biomass of target species & some iconic species (if recreational fishing controlled)
- Little overall economic effect

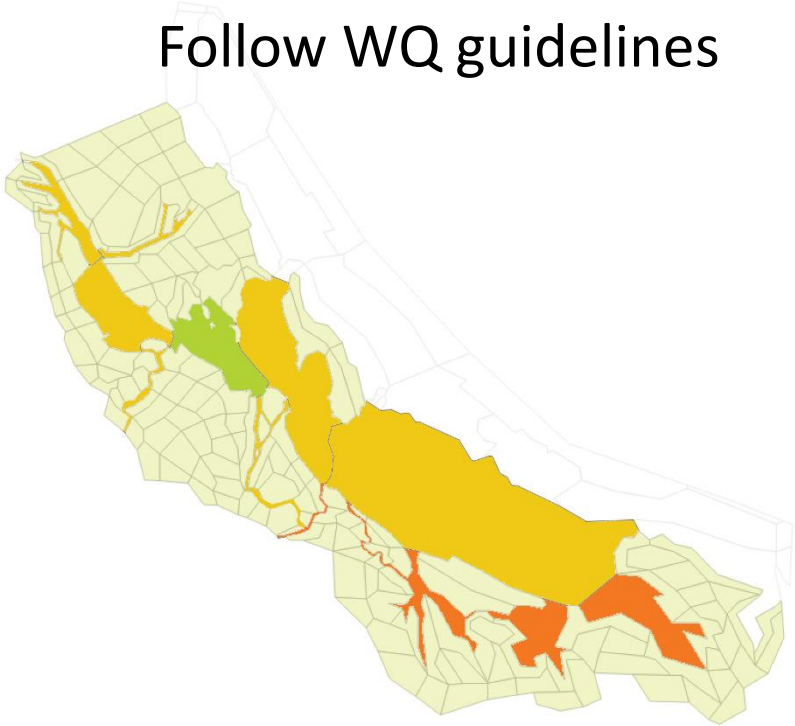
Spatial View Water Quality Scores

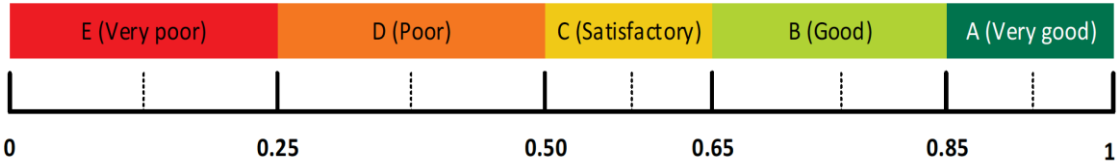
Spatial View Water Quality Scores

Base case



Follow WQ guidelines



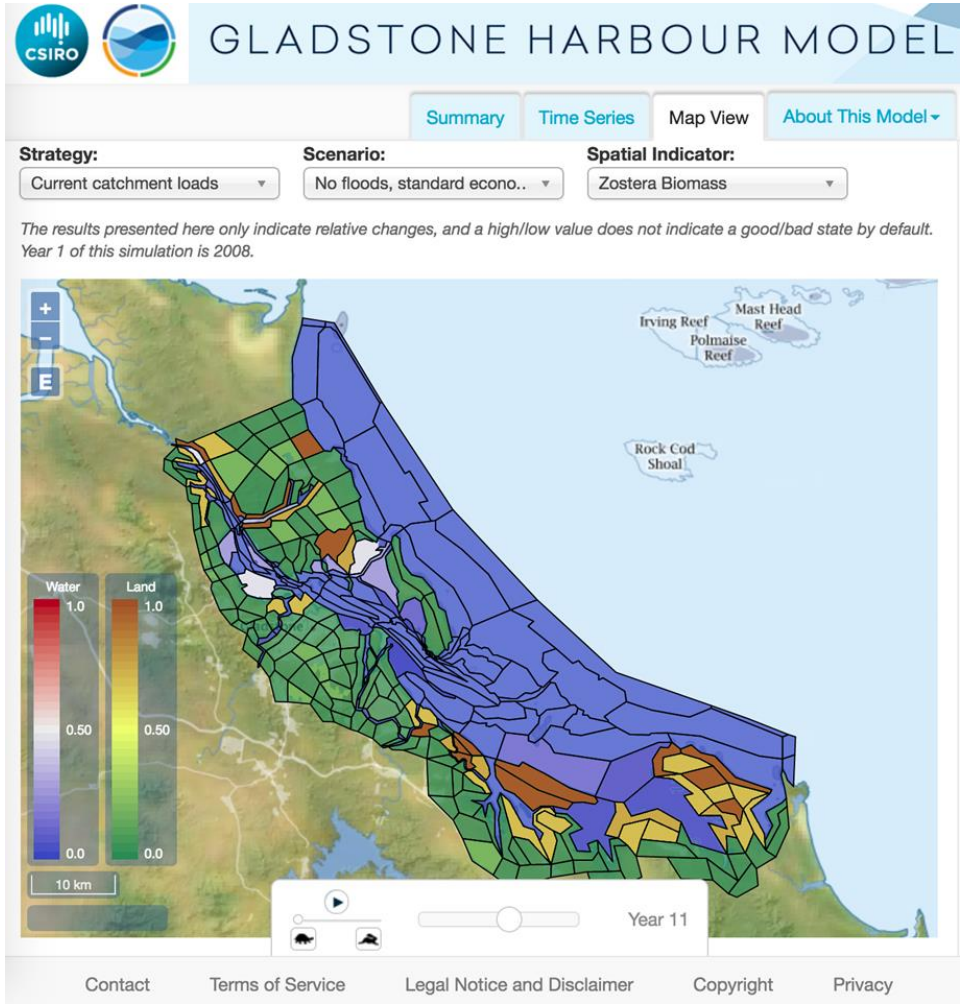


All zone WQ scores improved

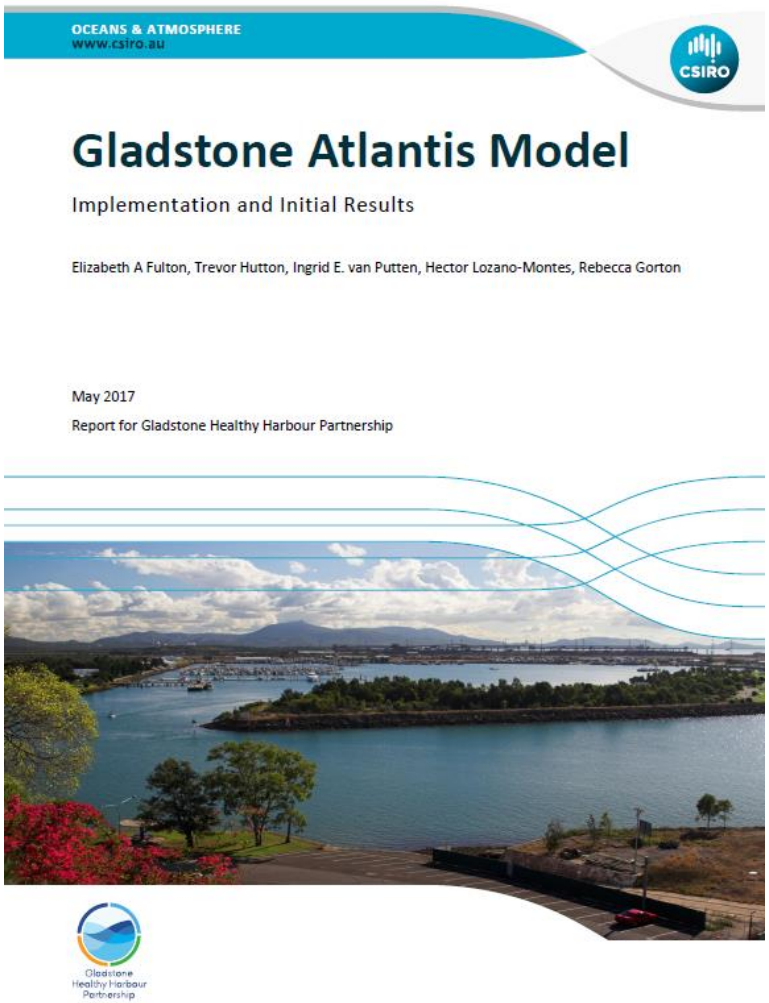
Scenario Results
Visualisation of Results

CSIRO Seaview site

(https://seaview.csiro.au/gladstone/index.html)



Acknowledgements



The Gladstone Atlantis Model and Seaview website were developed by CSIRO Oceans and Atmosphere, Hobart.

The project report can be viewed on the GHHP website:

Fulton EA, Hutton T, van Putten IE, Lozano-Montes H and Gorton R (2017) Gladstone Atlantis Model – Implementation and Initial Results. Report to the Gladstone Healthy Harbour Partnership. CSIRO, Australia.

https://dims.ghhp.org.au/repo/data/public/0be457

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