

ESTUARINE AND COASTAL WATERS ECOHYDROLOGY

Eric Wolanski, PhD, DSc, FTSE, FIE Aust

Australian Institute of Marine Science

I wish to thank

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- ...

-the Australian Institute of Marine Science

-the Universities of Guam and Hawaii

-the Palau International Coral Reef Center

-the College of Micronesia-FSM

-the Conservation Society of Pohnpei

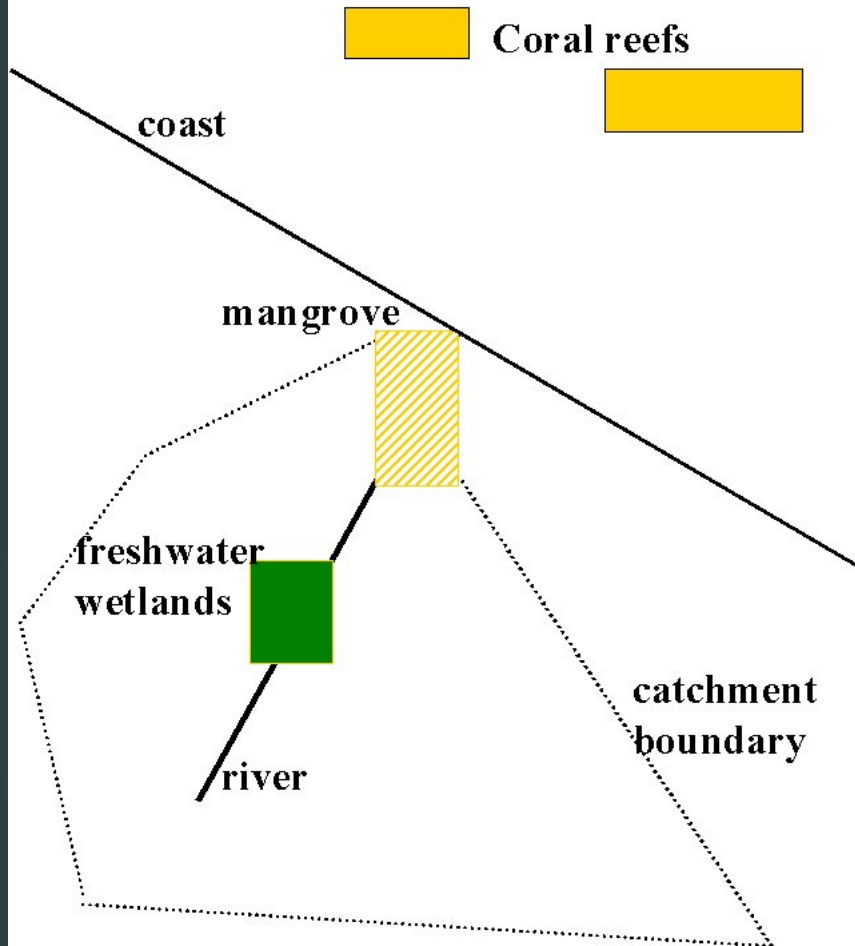
-UNESCO/ROSTE

-the University of Algarve

-the US-EPA STAR program (grant R 82-8008)

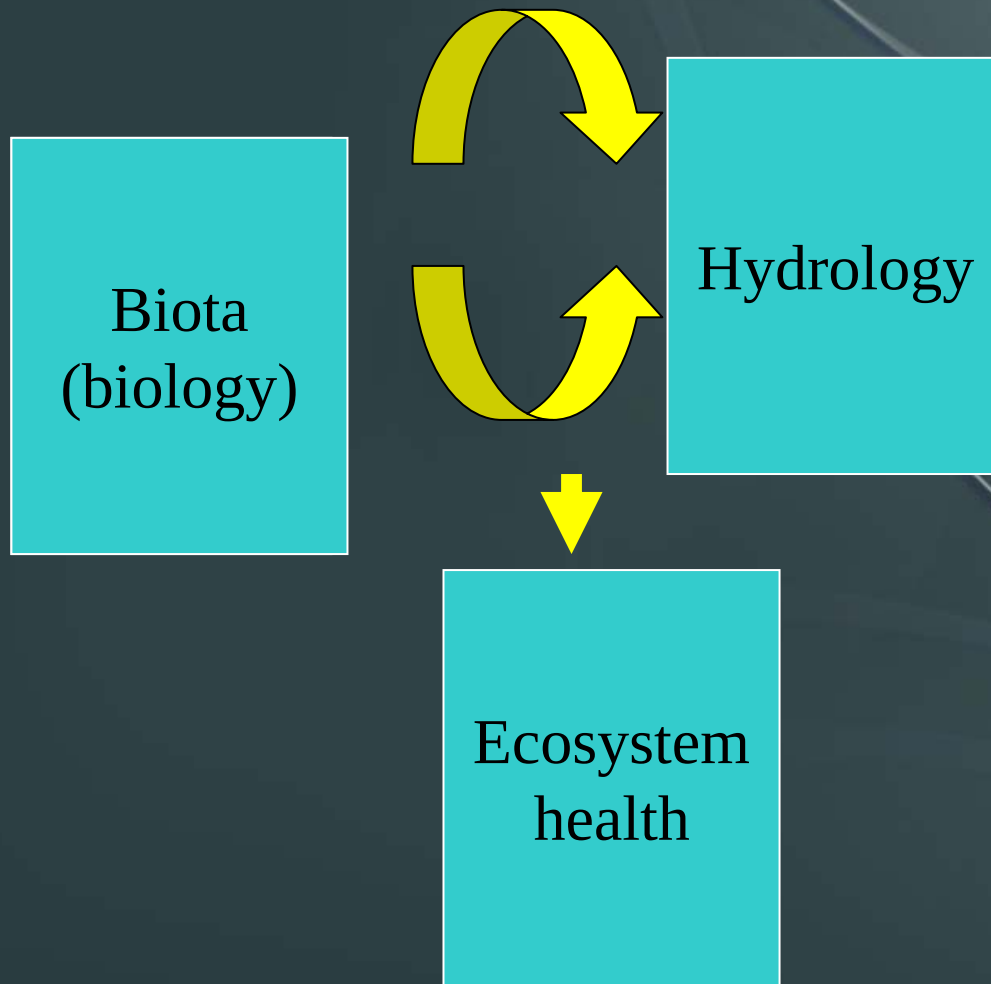
-the NOAA Coastal Oceans Program (grant NA16OP2920)

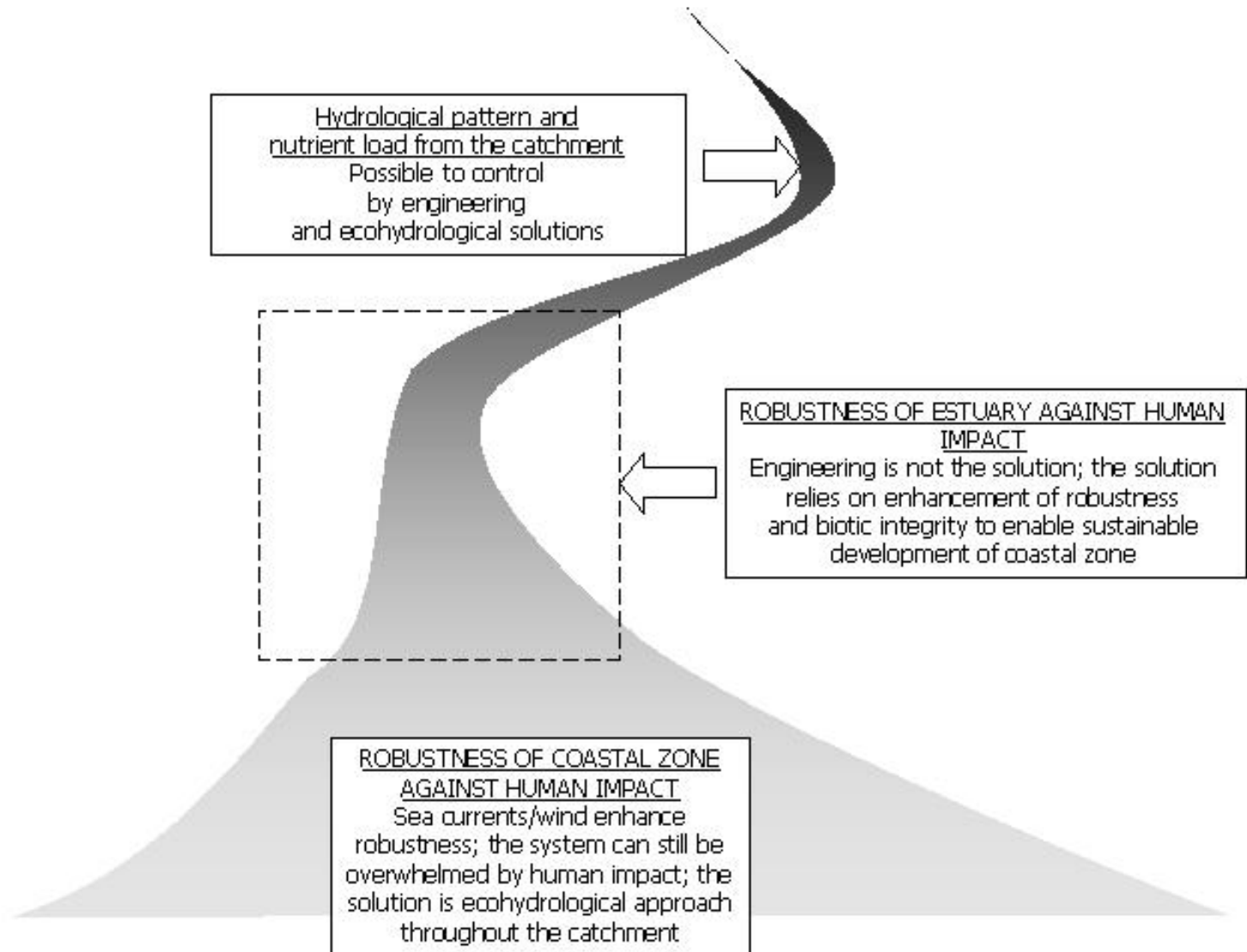
UNESCO – IHP ecohydrology program



Estuarine ecohydrology:

Wolanski, Boorman, Chicharo, Langlois, Lara, Plater, Uncles, Zalewski. 2004. *Wetlands Ecology and Management*, 12, 235-276.





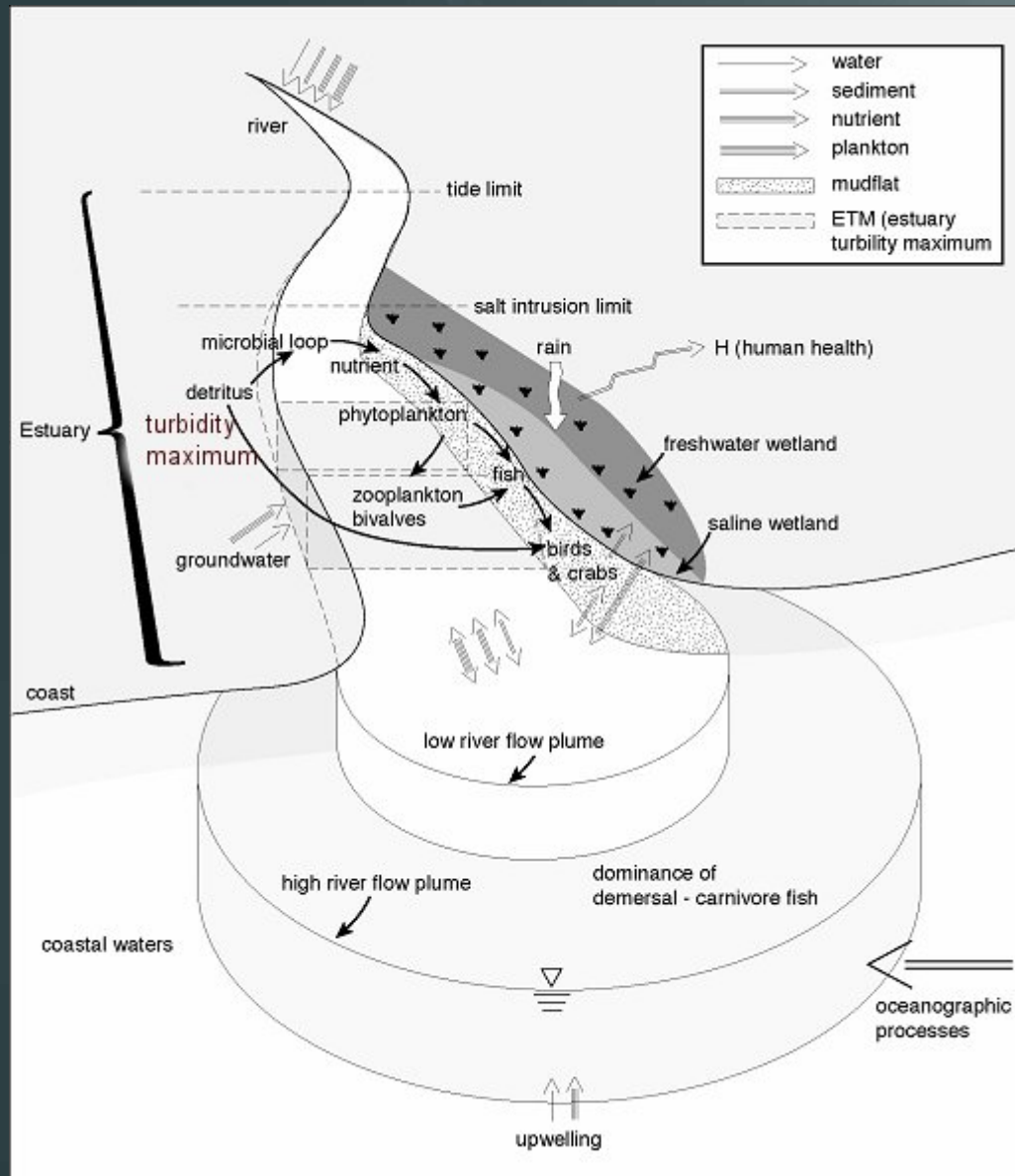
We are facing a serious issue:

- increasing degradation of estuarine water quality.**
- decreasing ecological services delivered by the estuary.**
- need to integrate land-use and water resources developments with estuarine ecological services to maintain 'quality of life'.**

We need an estuarine ecohydrology model to quantify

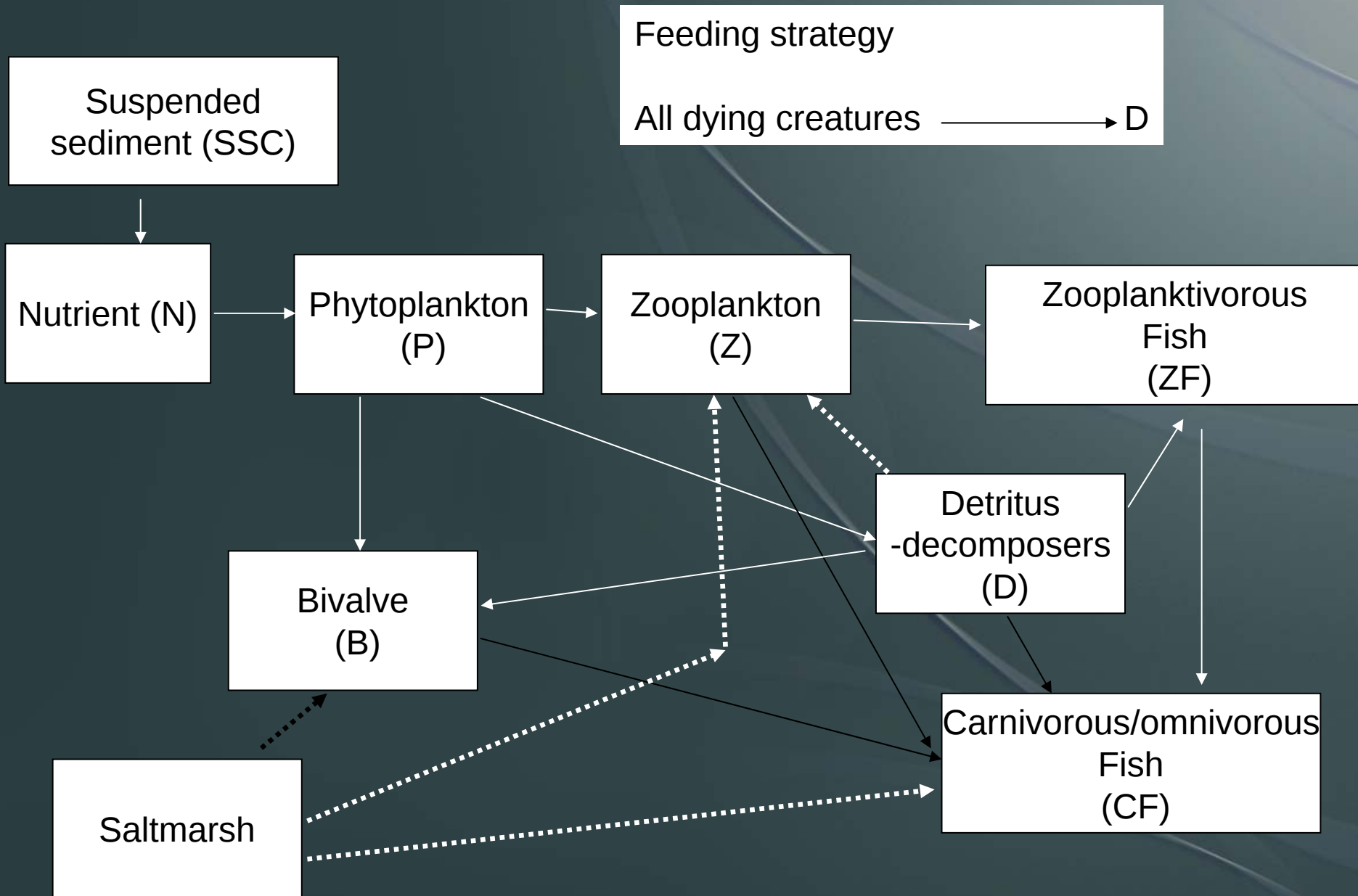
- causes and effects**
- the usefulness of remediation measures.**

Estuarine ecohydrology model

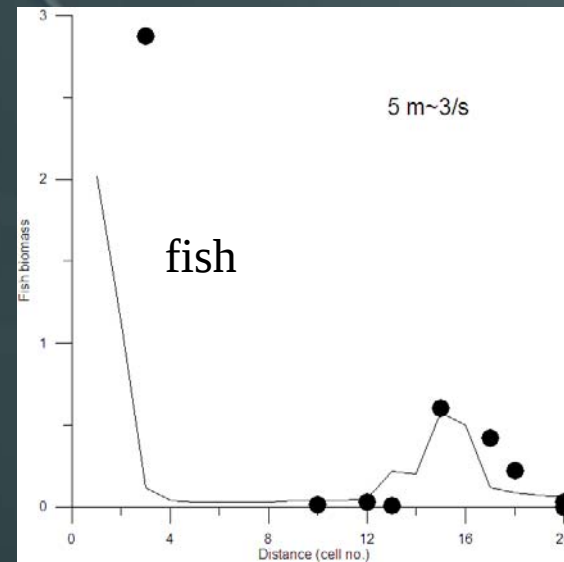
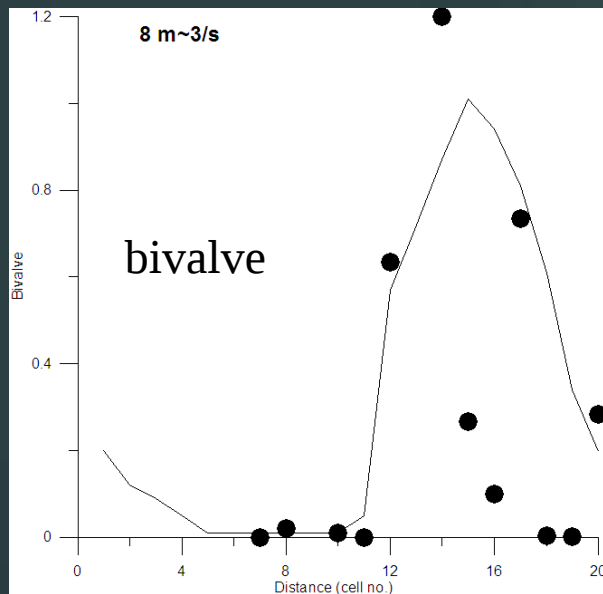
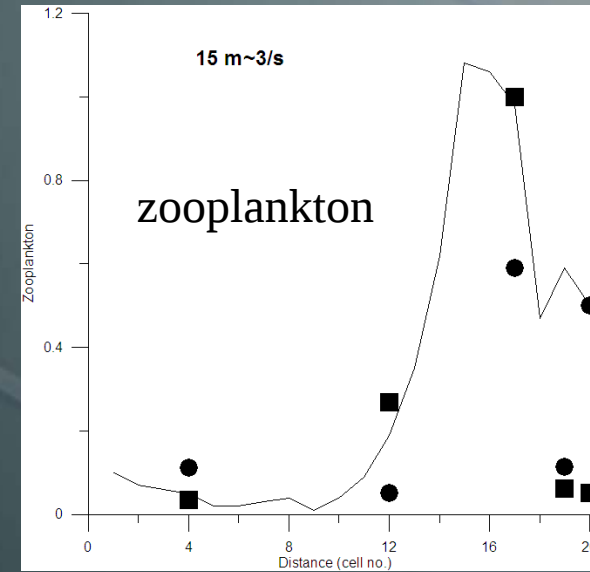
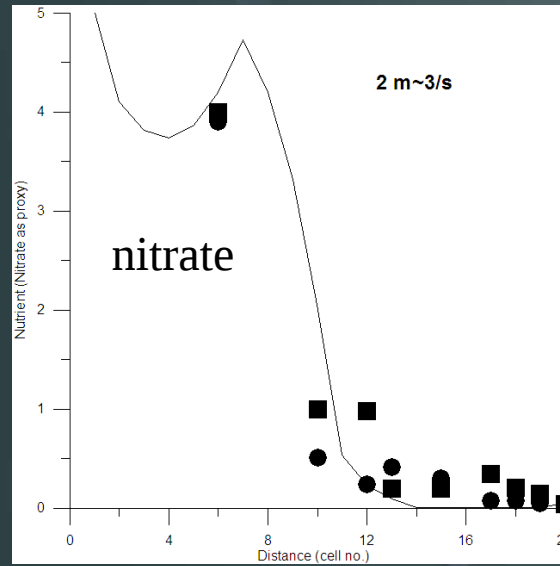
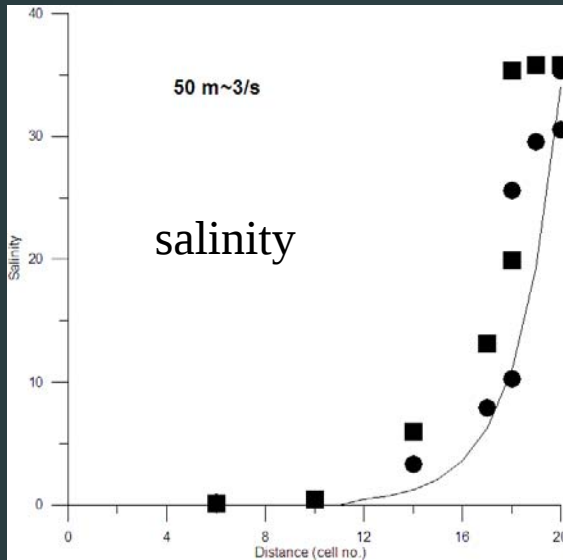


Case 1. Guadiana Estuary, Portugal - Spain



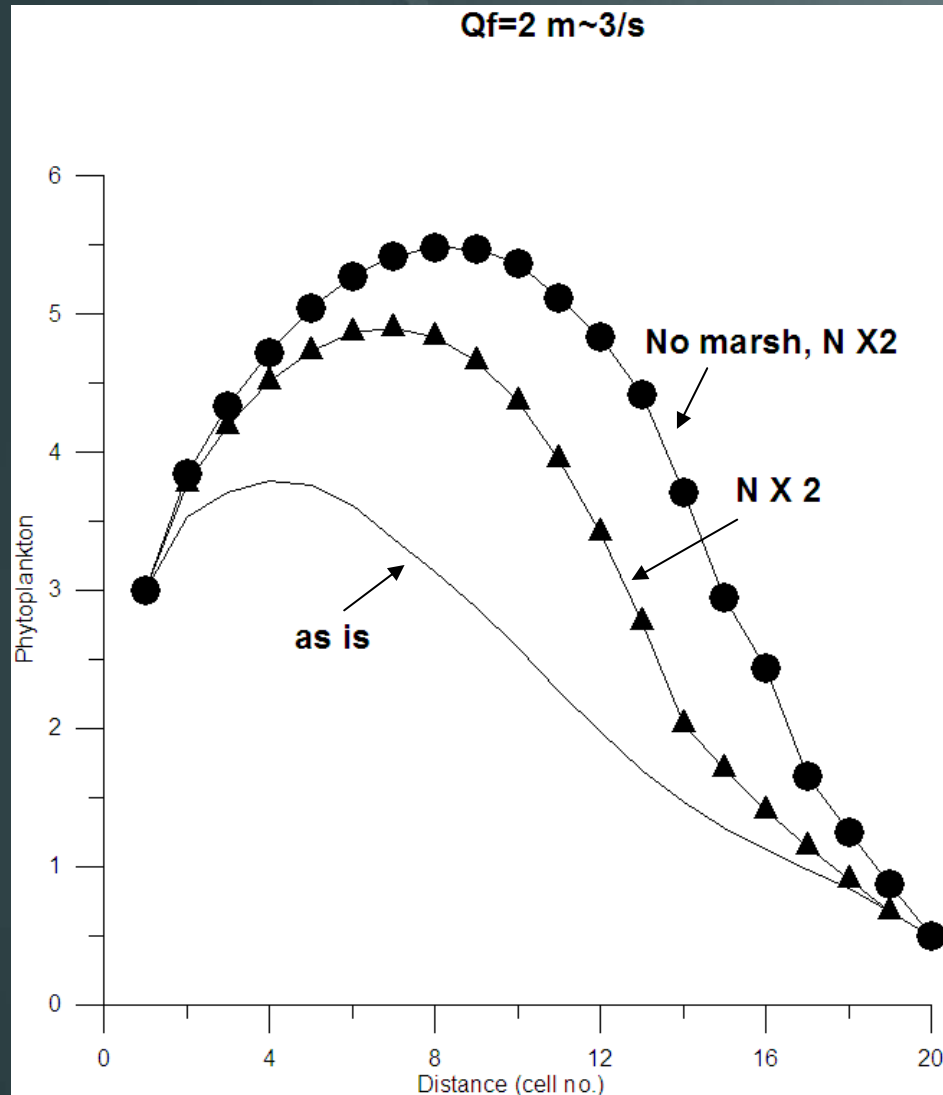


Model verification

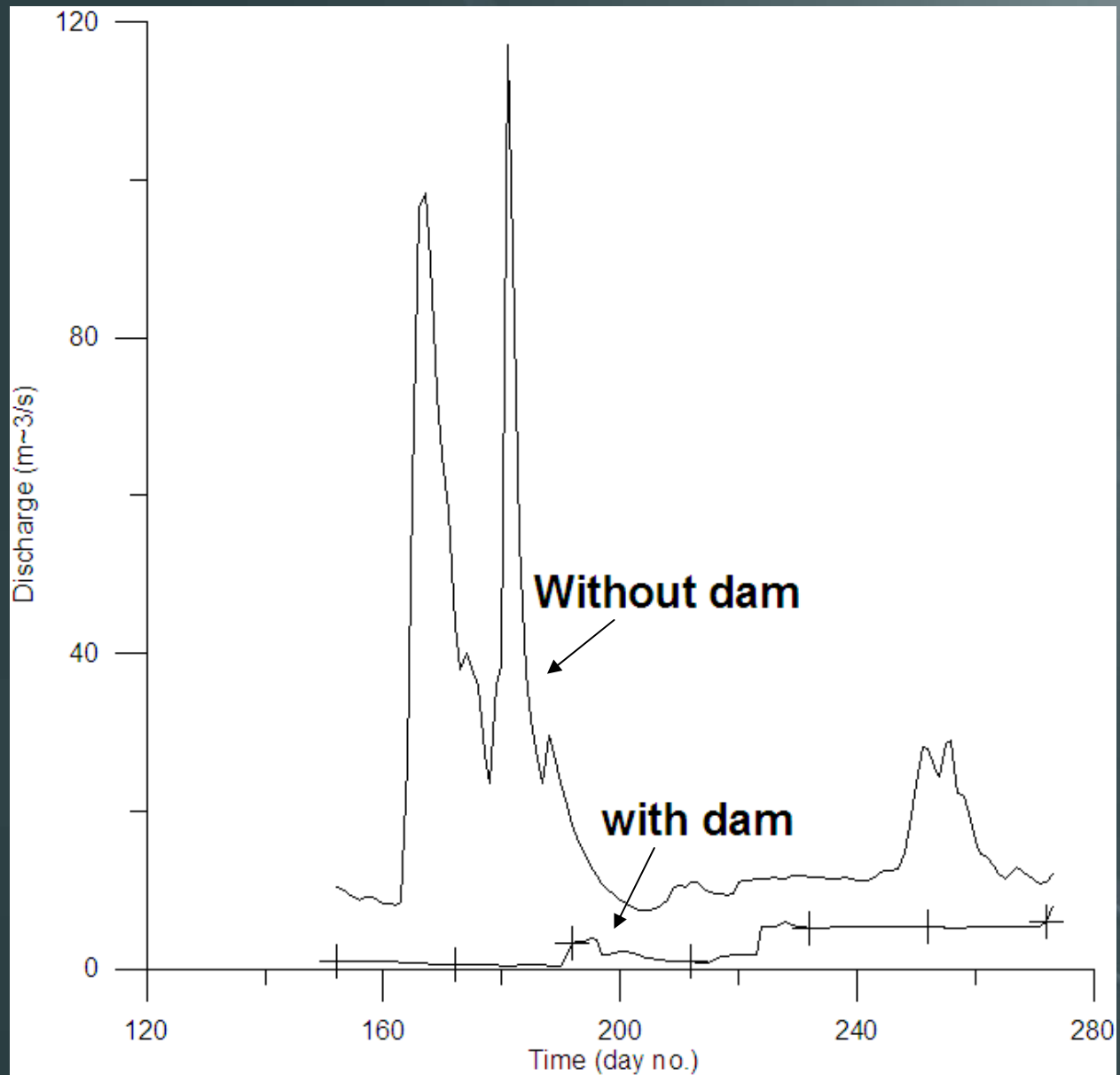


Two examples of a practical use of model:

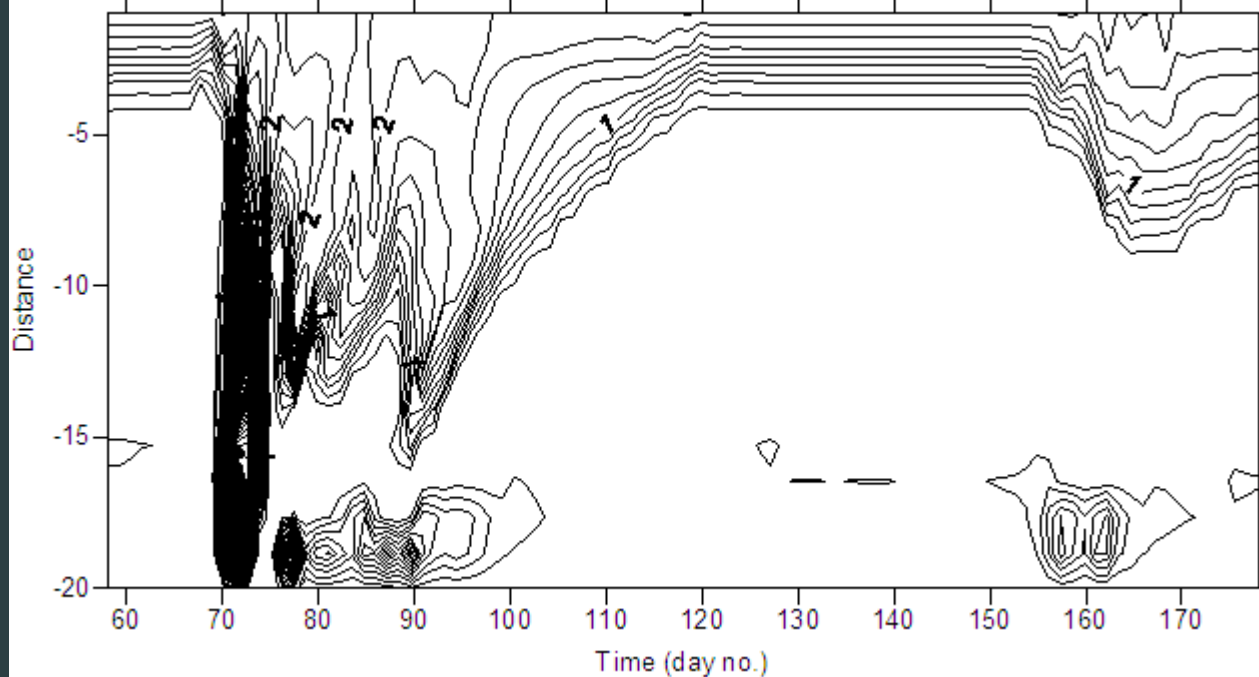
1. Predict the onset of eutrophication/toxic algae blooms from irrigation farming & removal of saltmarshes



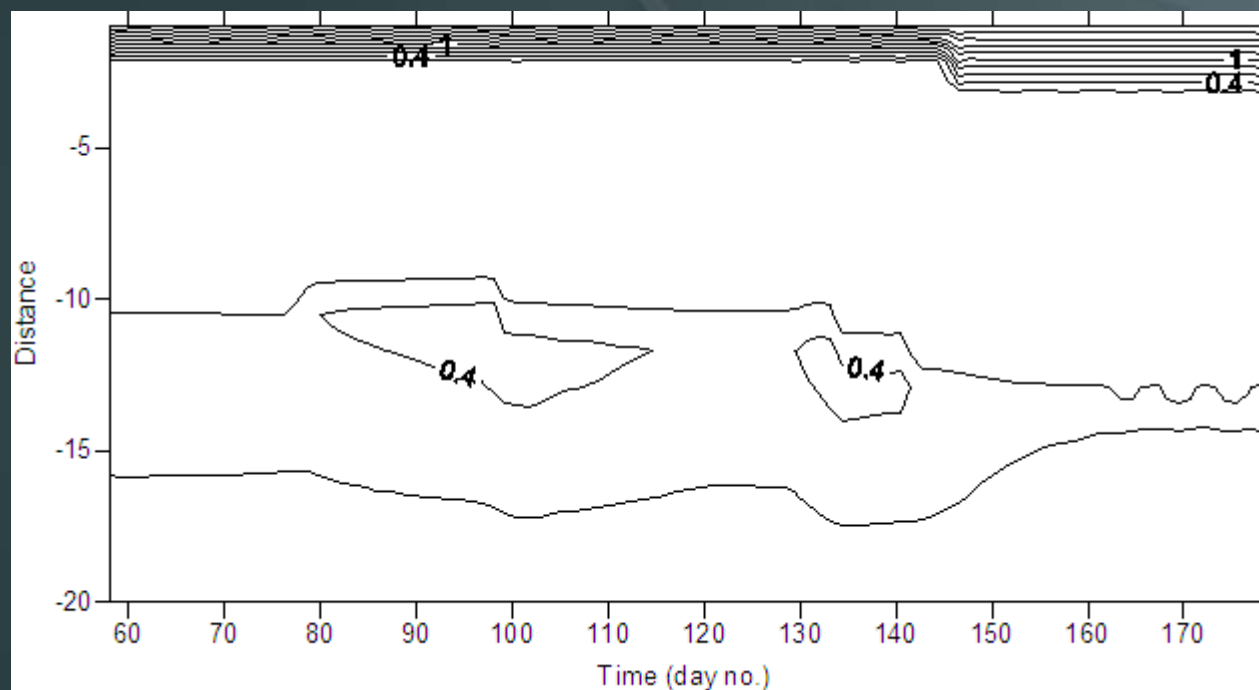
2. Influence of the Alqueve dam



Carnivorous/
omnivorous fish
(CF)



No dam



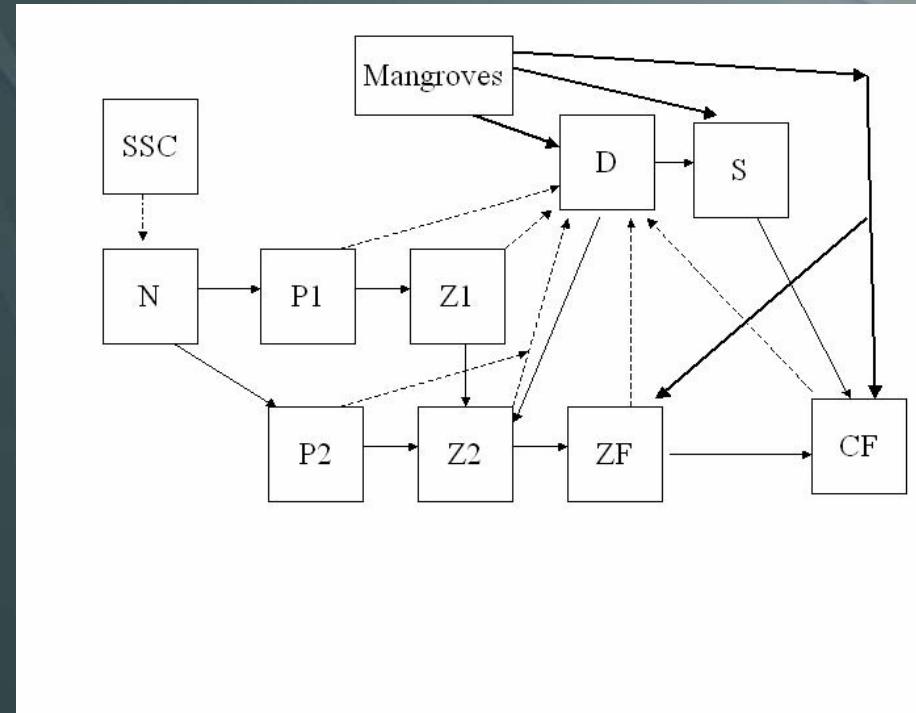
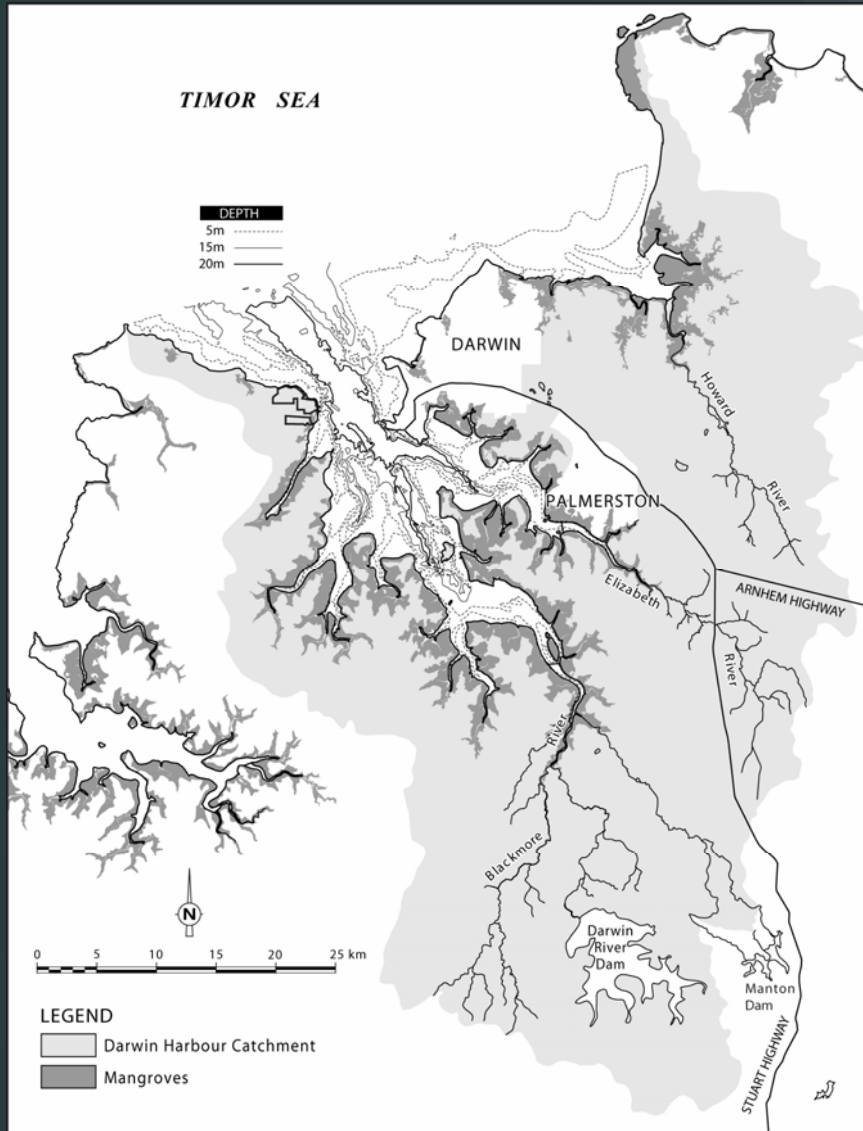
With
dam

-The model suggests that the Guadiana estuary biodiversity is degraded by the Alqueve dam.

-The model can be used to assess impacts of flow regulation and ecohydrology remediation measures (eg releasing water in freshets; using wetlands; ...).

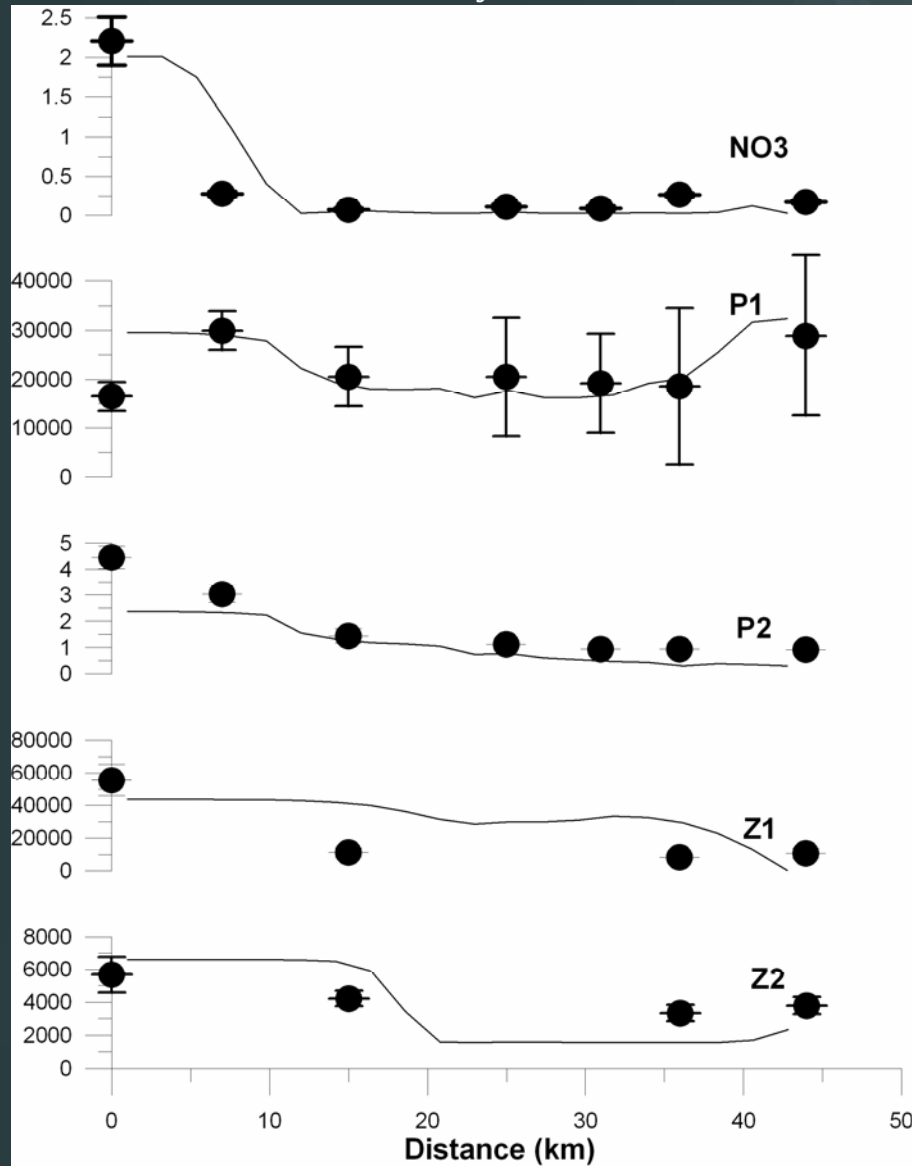
Case 2.

Darwin Harbour, Australia.

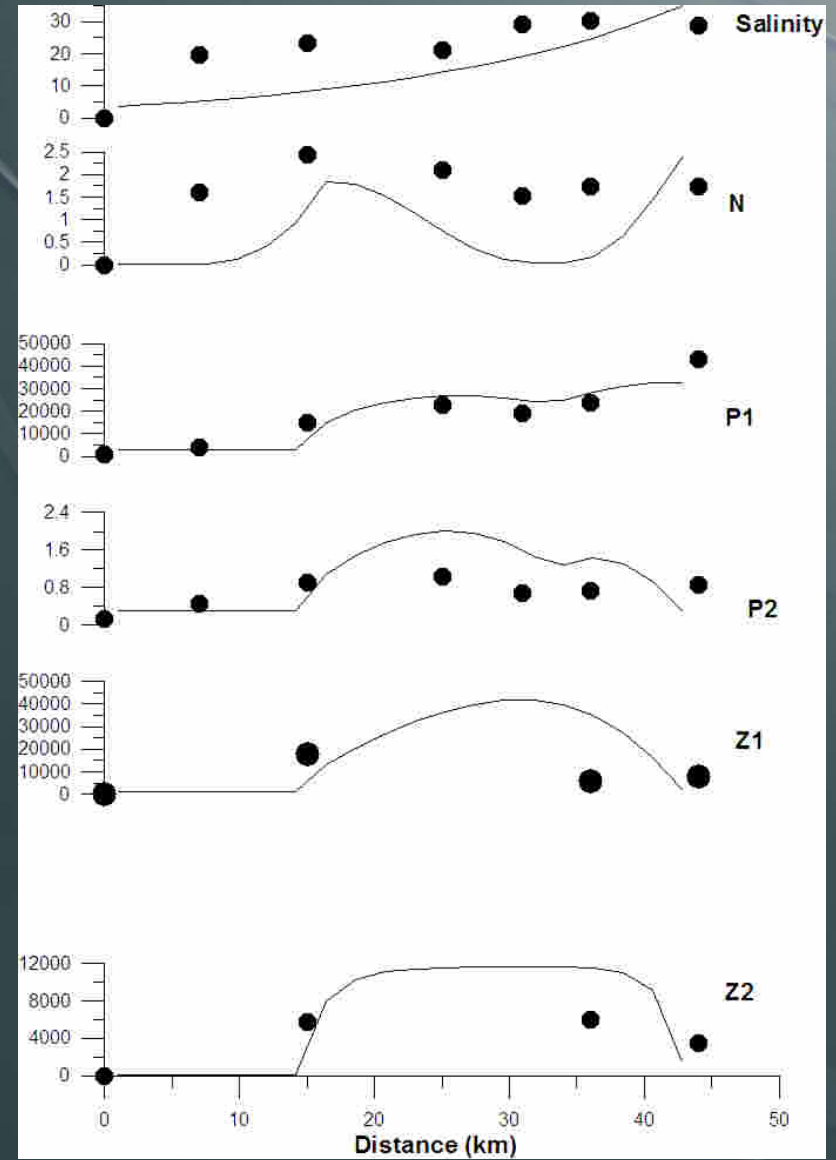


Model calibration

Dry season



Wet season



Provide a science-based predictive tool that can be used by
by managers of

- land-use
- water resources
- port activities
- fishing

to test realistically scenarios (eg clearing mangroves,
sewage discharges, dredging, spoil dumping...).

Case 3. The Great Barrier Reef and Micronesia.



The main threats:

- global warming
- overfishing/trawling

- agriculture

- cattle

- sugar cane and bananas

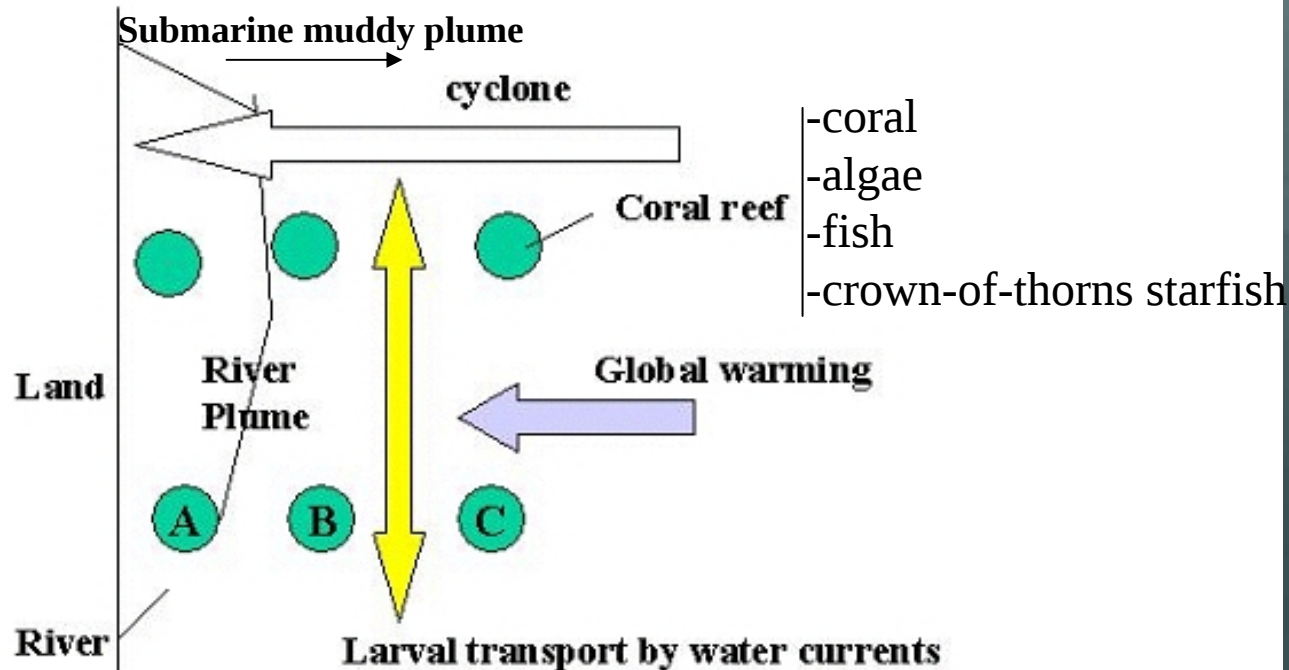


HOME reef ecohydrology model

Hydrology, oceanography, meteorology, ecology

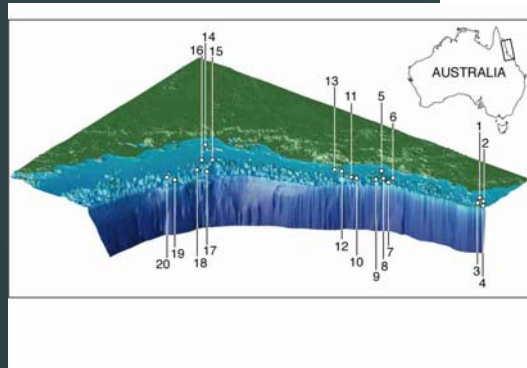
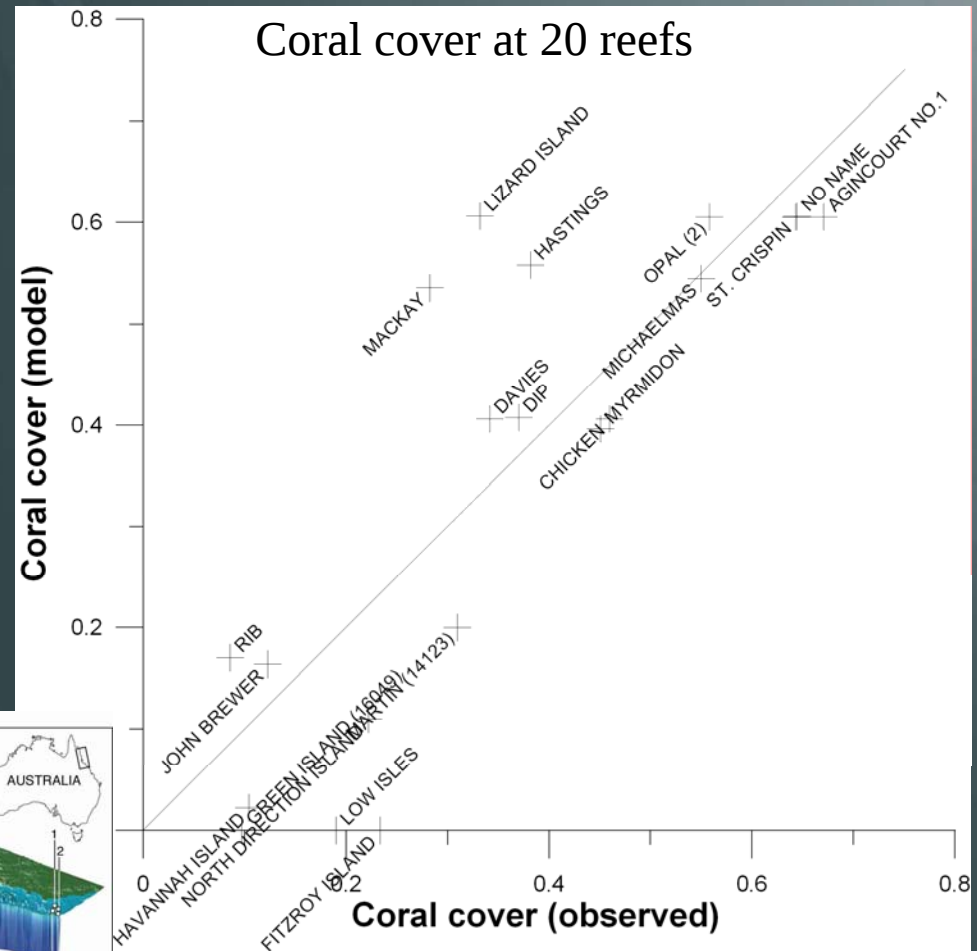
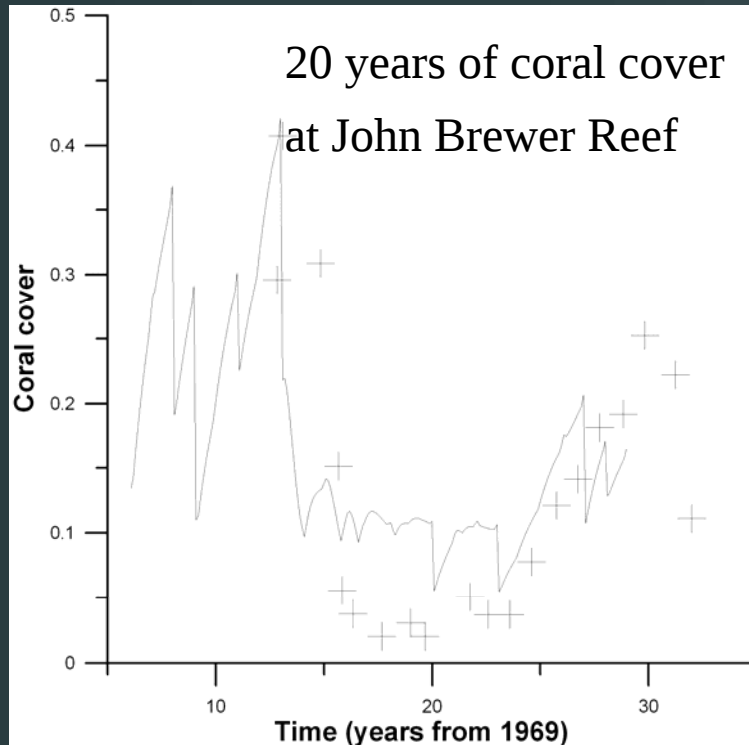
(Wolanski et al., JMS, 2004)

+ crown-of-thorns starfish + global warming)



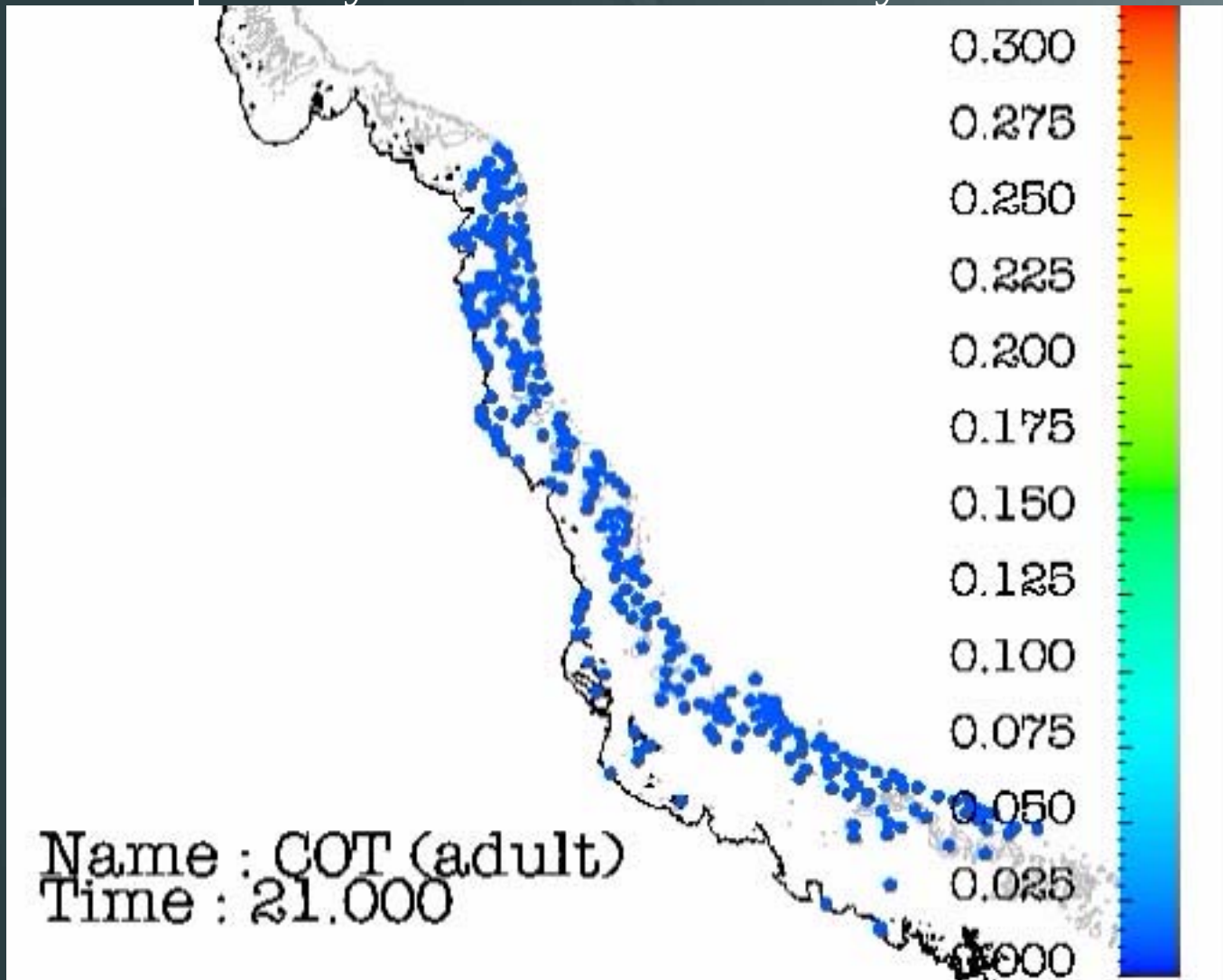
HOME Model verification in Great Barrier Reef

1. coral cover. 2. COTS



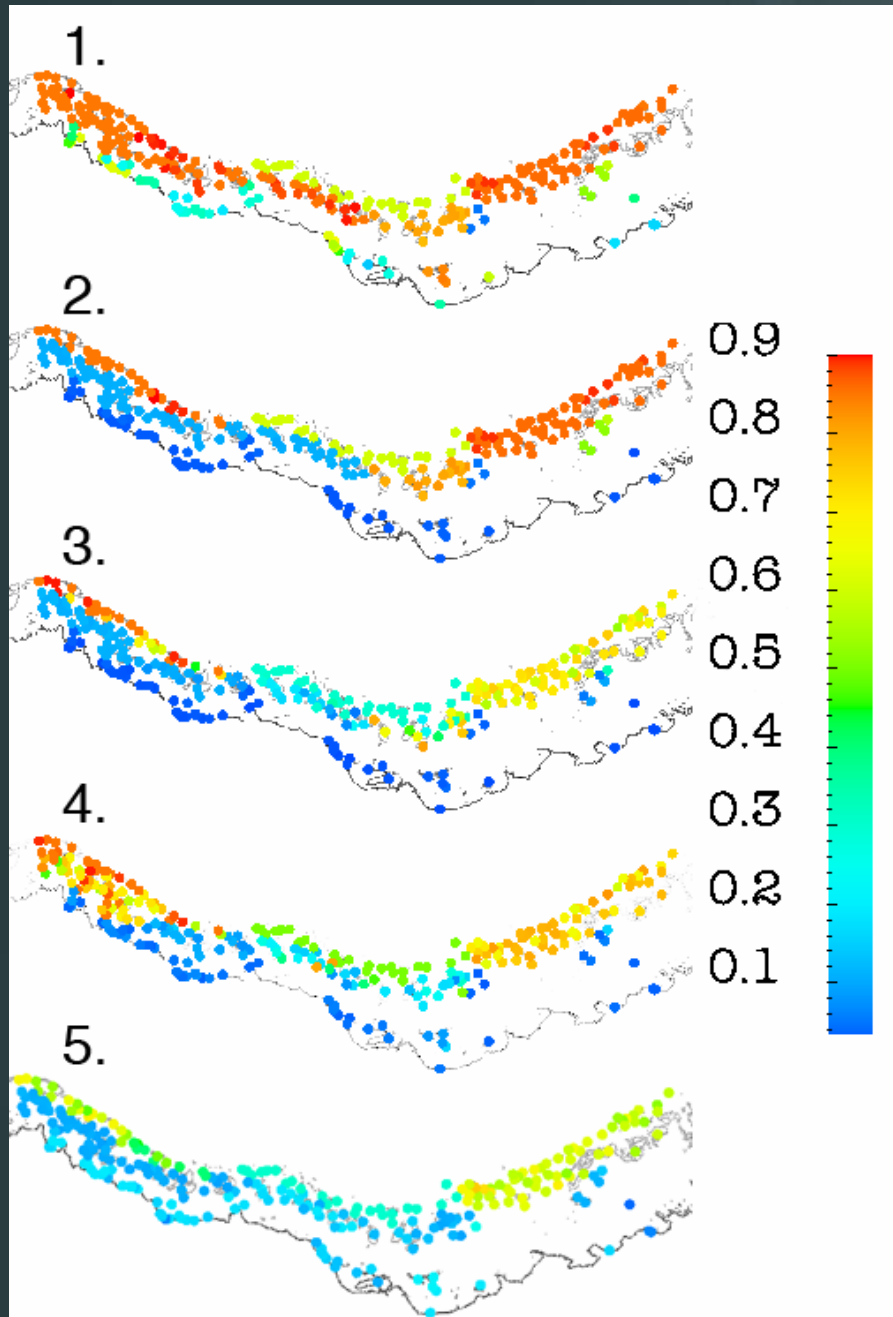
Model verification

3. Crown-of-thorns population dynamics -primary outbreaks – secondary outbreaks



The model suggests that there were no COTS outbreaks before European settlement.

Model prediction (coral cover)



Pre-colonisation

2050 & no global warming & present land-use practices

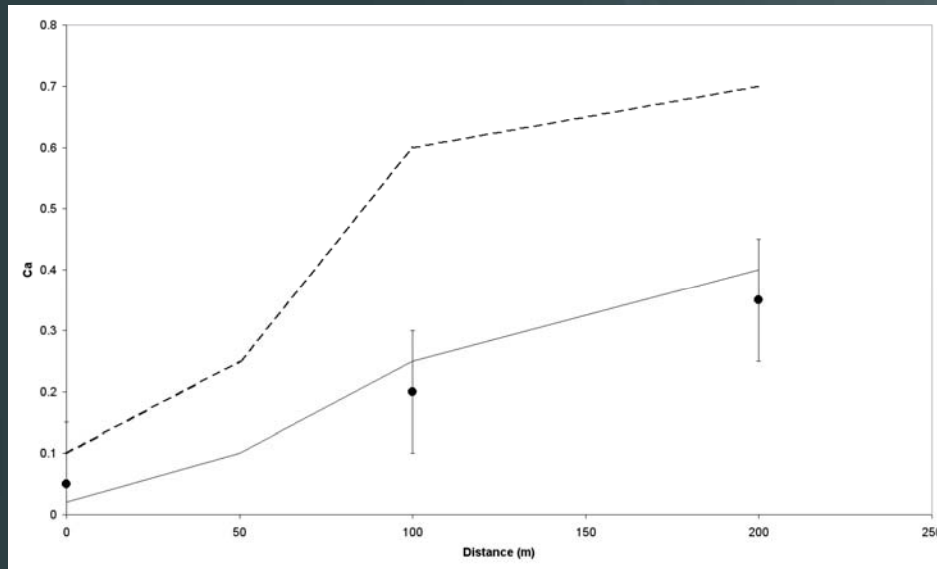
As # 2 with global warming (IPCC scenario A2)

As # 3 with improved land-use practices

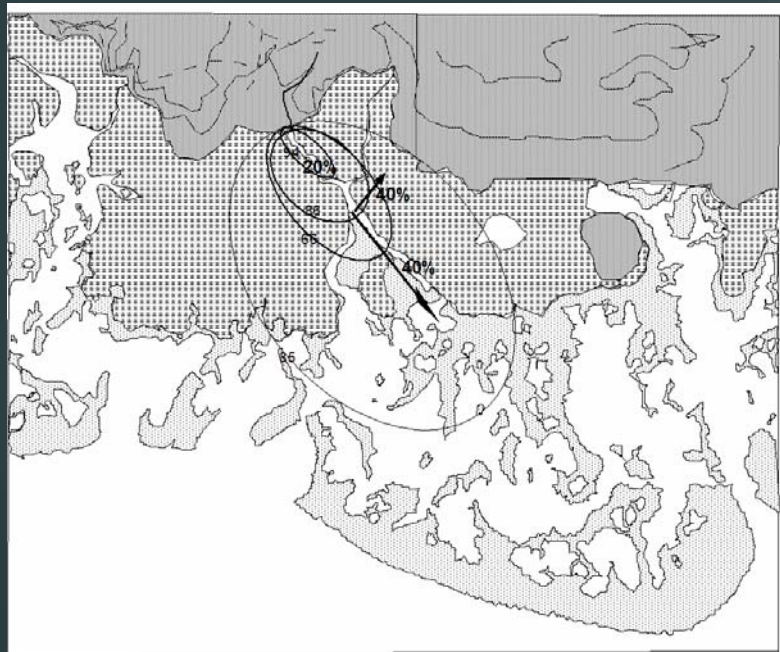
As # 4 in 2100

---- biological adaptation

Similar scenario modelling is underway in Guam, Palau and Pohnpei



Coral cover in Fouha Bay, Guam, with/without land use remediation.



Sedimentation plume (mg/cm²/d) in Enipein, Pohnpei, a degrading watershed and coral reef.

(Victor et al., in press)

Case 4. The environment in Asia Pacific harbours.

Wolanski, E. (2005). Springer.



In all cases, ecohydrology is ignored. There is no coordination between agencies. Environmental degradation is severe in all harbours north of Darwin. There is no case of ecologically sustainable development. Yet there are 100 million people who live along these waters and 600 million people drain their wastes in these waters!

The best tool that science can provide to enable ecologically sustainable development is to demonstrate how to use **ecohydrology**.