L-ESV ASSIMILATIVE CAPACITY MODELS

ECASA STAKEHOLDER MEETING
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Paul Tett

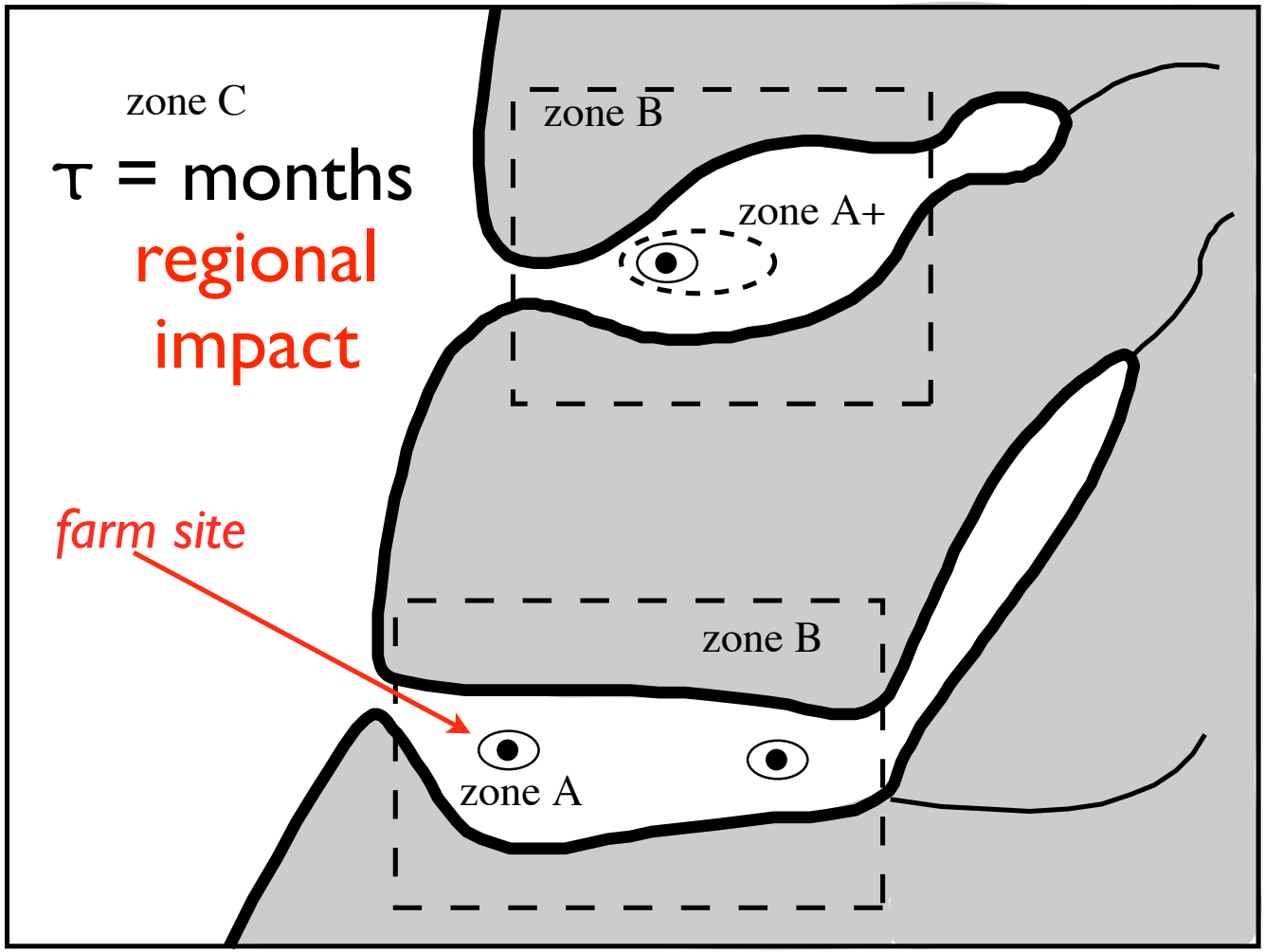
NAPIER UNIVERSITY
EDINBURGH

L-ESV

- B scale, pelagic impact (eutrophication, deoxygenation) of farm wastes (nutrients, organic matter) plus tracer option (for medicines etc)
- Because finfish-farming has a seasonal pattern and plankton are seasonal, simulates changes during a year
- Can be run with different waste loading scenarios to estimate an assimilative capacity
- Intended for water-body screening and management

Scales: spatial extent and timescale

(scale of ecosystem considered must be relevant to scale of industry and impact)



zone B scale - water body; eutrophication τ = days

zone A scale - local to farm; benthic impact τ = hours

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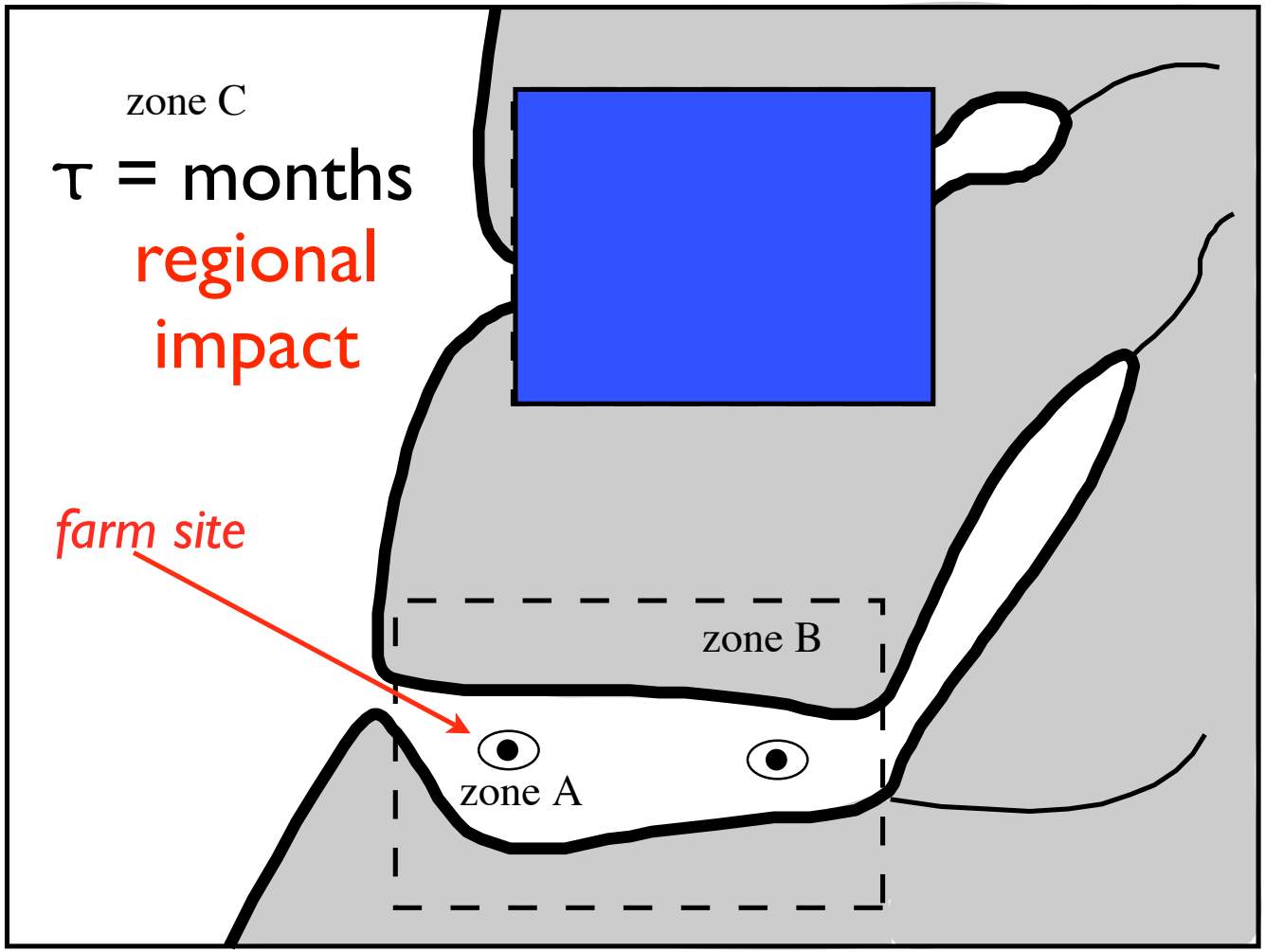

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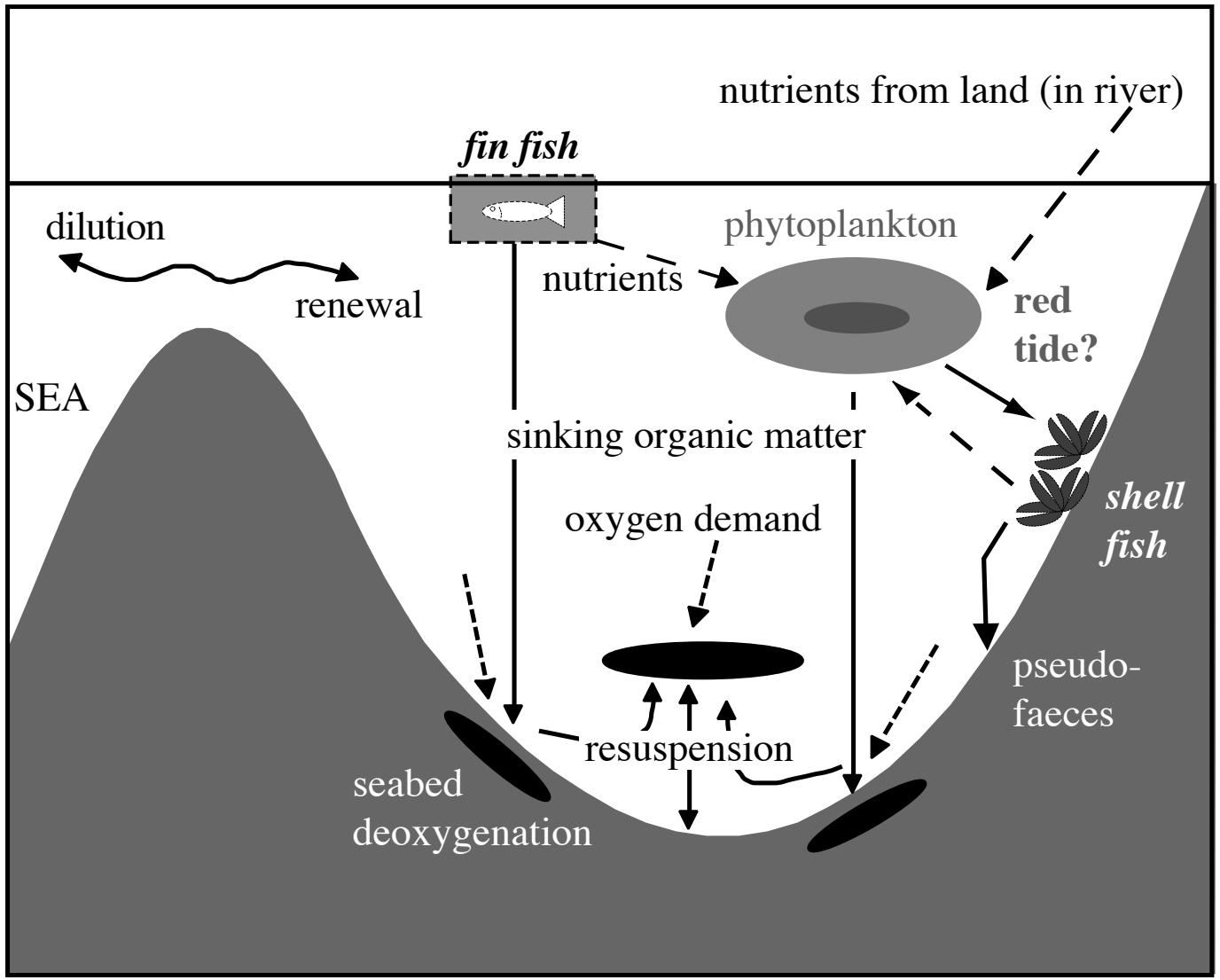
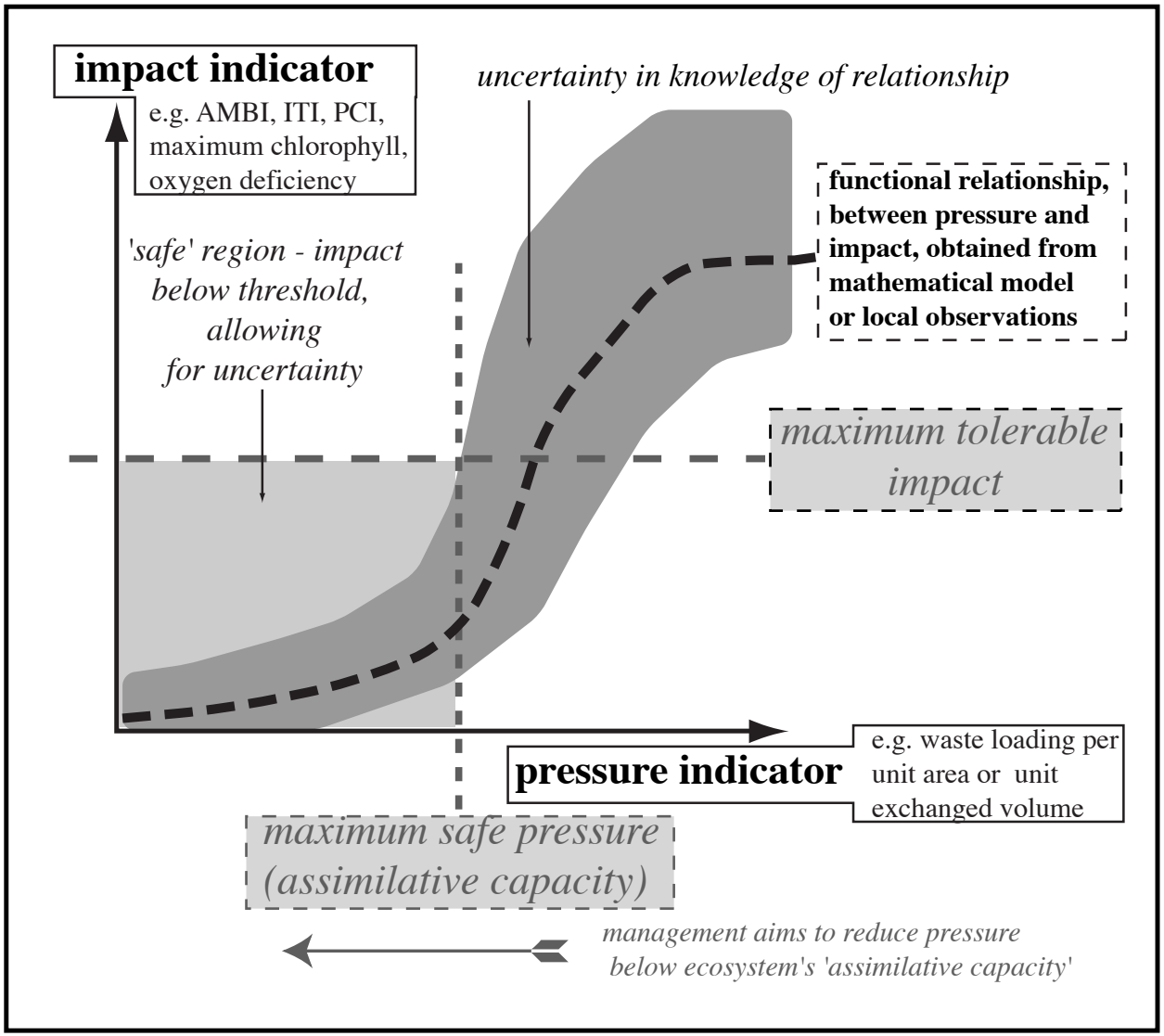
salmon
mussels

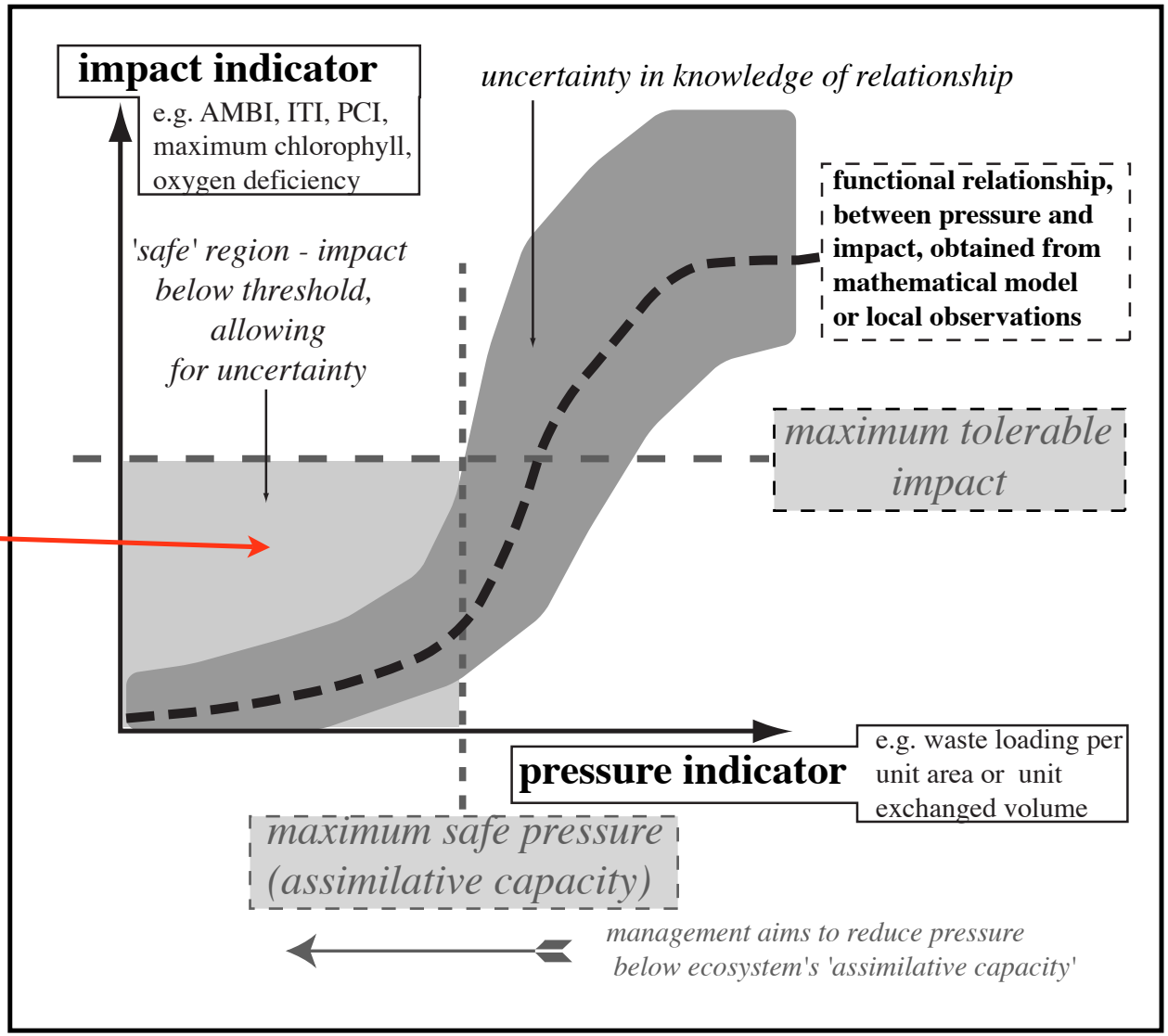
The environmental problems that can be investigated



Use to make a pressure-impact diagram for a water body



Use to make a pressure-impact diagram for a water body



Capacities

- assimilative capacity = capacity to accept, use, degrade or dilute wastes without breaching an EcoQS or EQS

  -- e.g. salmon production that can be consented for a given water body without causing eutrophication

- carrying capacity = capacity to maintain a stock of resource using organisms without breaching an EcoQS

  -- e.g. mussel stocking density and annual harvesting that can be supported without substantially depleting phytoplankton

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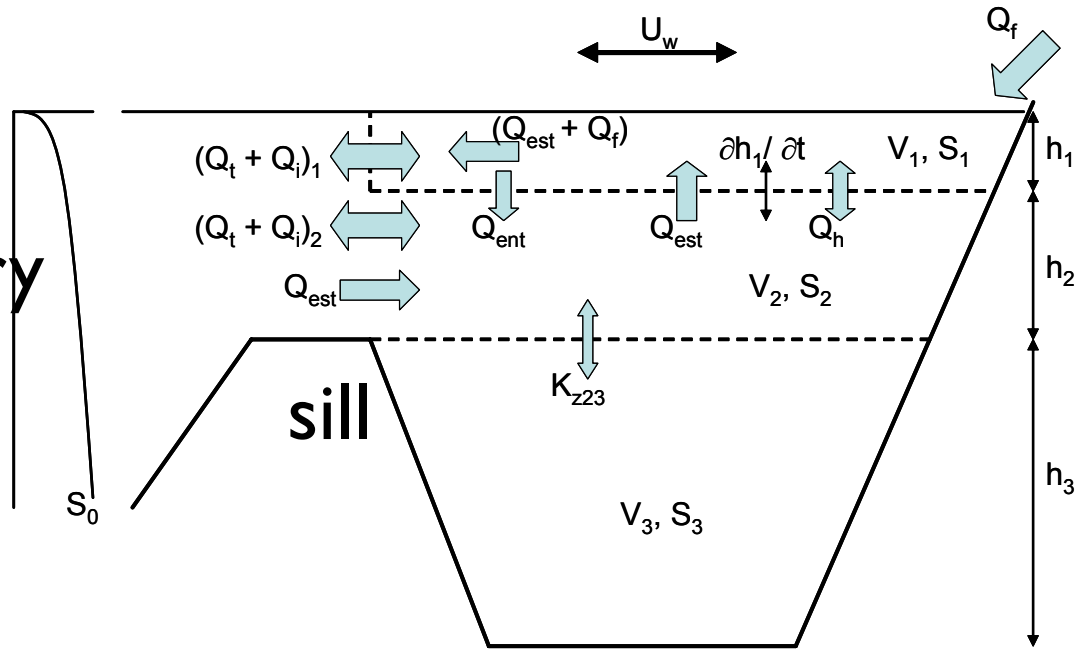
Assimilative capacity depends on

- rate at which water body exchanges with unpolluted sea: high flushing is good;
- layering of water column: stagnant deep water can become de-oxygenated;
- water transparency: turbid water retards phytoplankton growth and so allows more nutrients to be asimilated;
- grazing rates: zooplankton, benthos, cultivated shellfish, remove phytoplankton and so prevent eutrophication;
- boundary conditions: more risk if phytoplankton biomass or nutrients already high

Physical model - exchange in an RRE

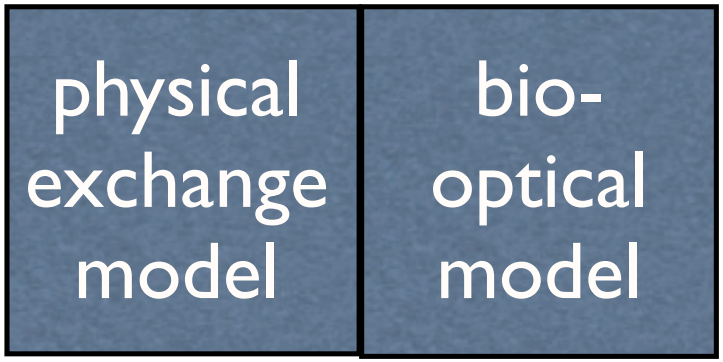
river inputs

sea-boundary conditions



3 layers in model ecosystem

Components of L-ESV model system



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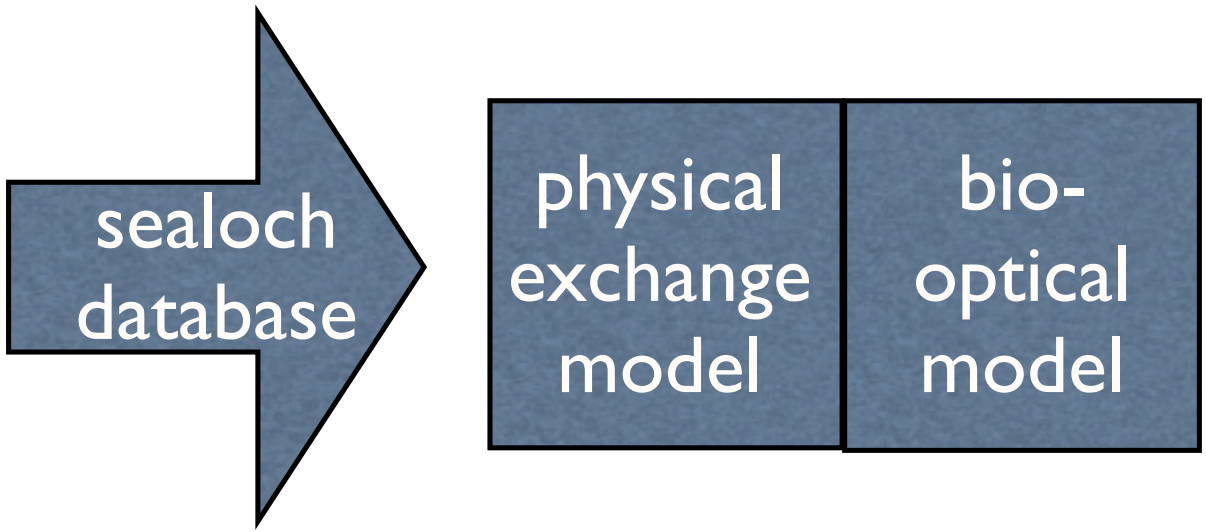

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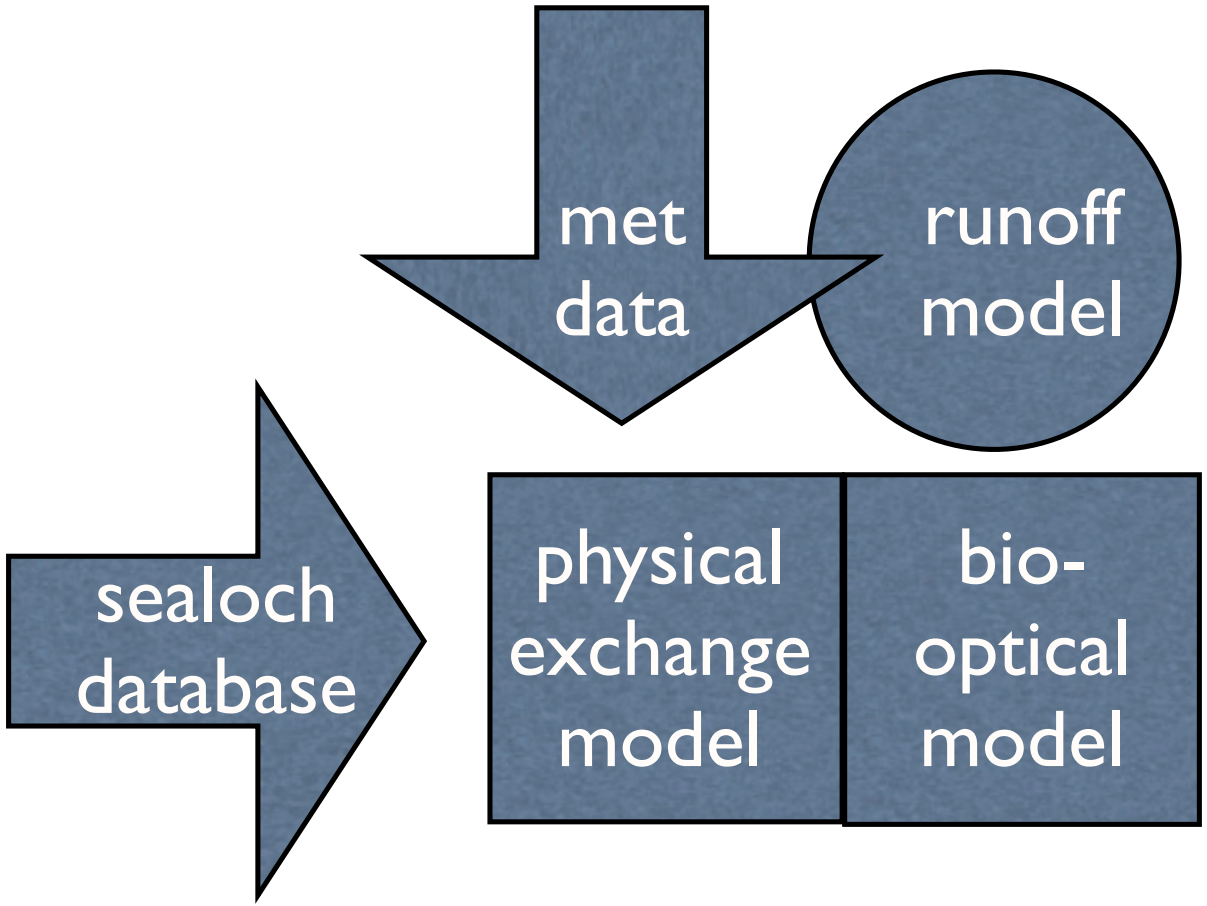

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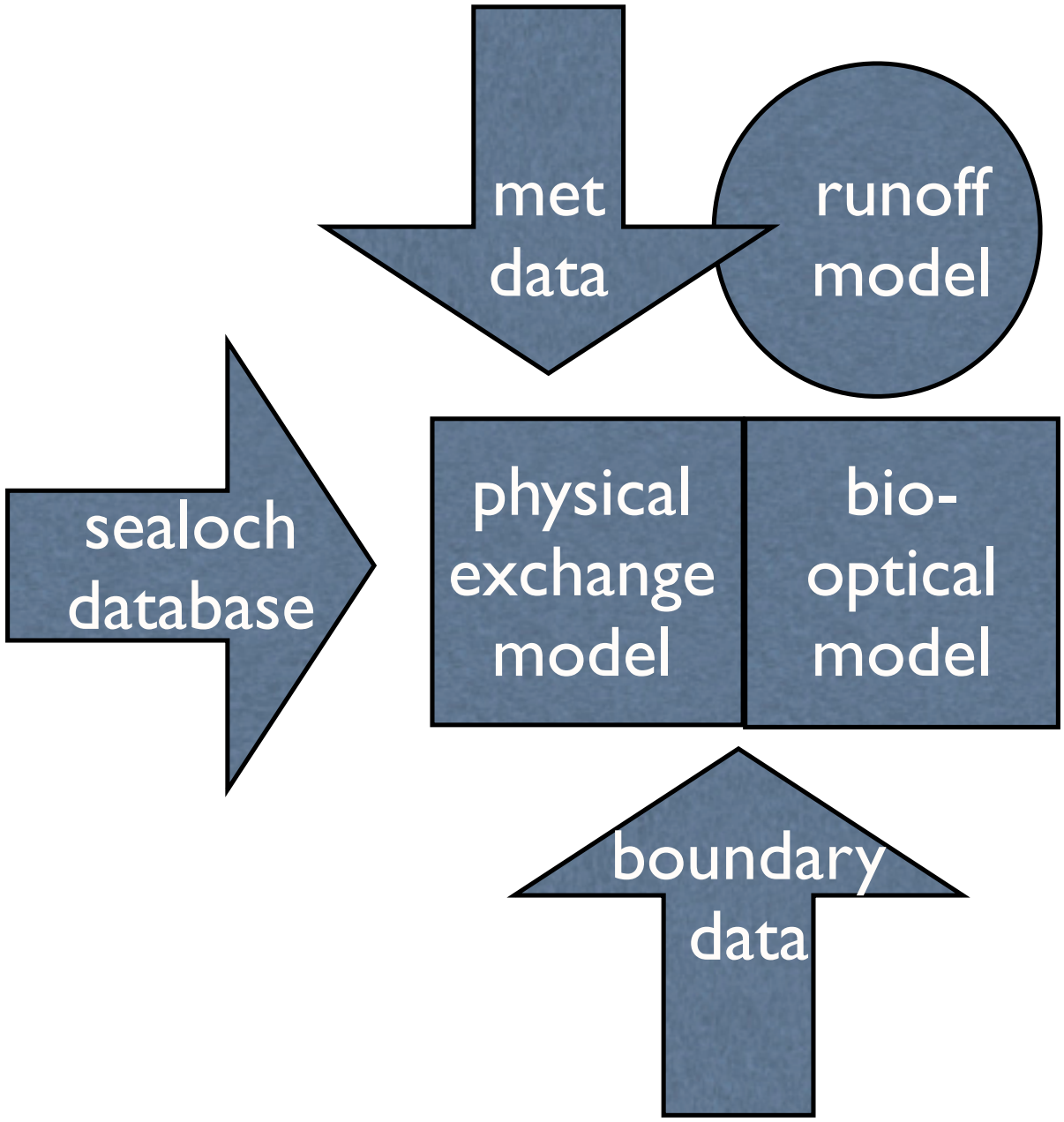

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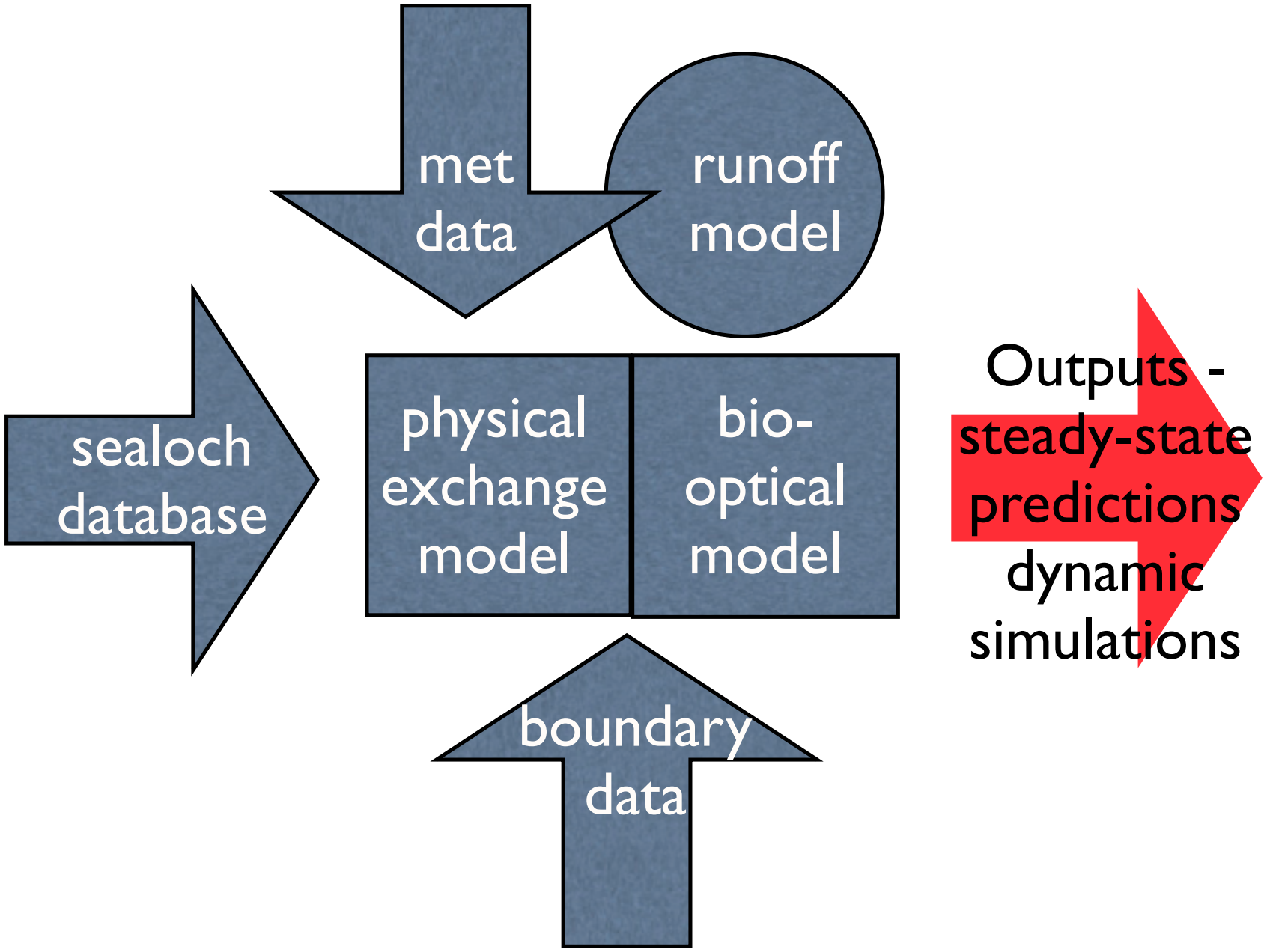
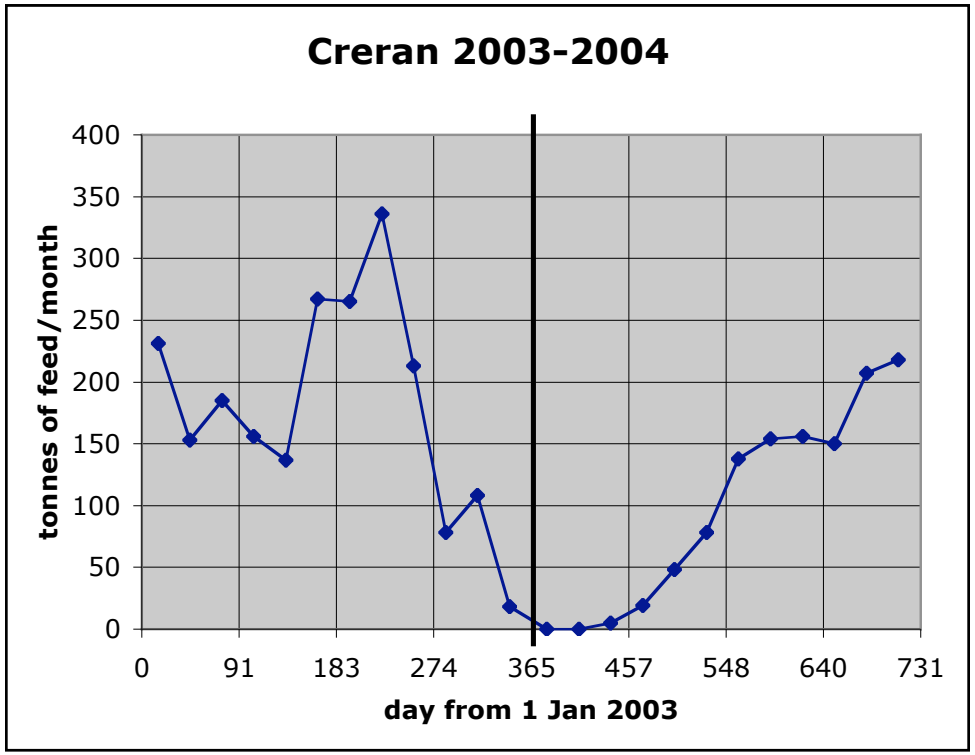


L-ESV mathematical model

- Equations for 'physics' - i.e. semi-dynamic water exchange between fjord and sea, and between layers in fjord - based on Stigebrandt FjordEnv model, adapted by Gillibrand & Inall (SAMS)
- Equations for 'biology' - i.e. how phytoplankton grow etc, derived from CSTT and PROWQM models by Portillo & Tett (NUE)
- Equations for 'fish' - i.e. converting feed into waste, taken from Black (2001); added background sea-bed fluxes from OAERRE

Feed data

end of 2002-3 cycle

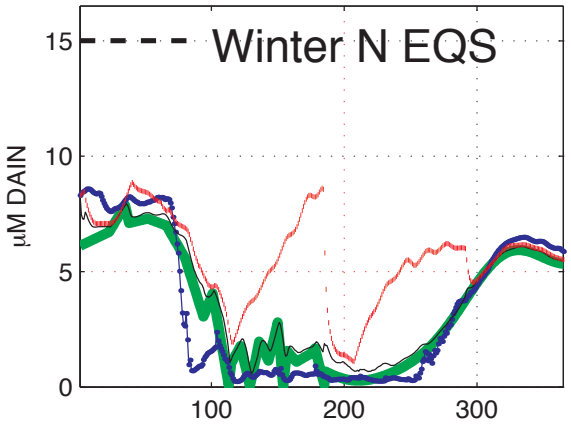


start of 2004-5 cycle

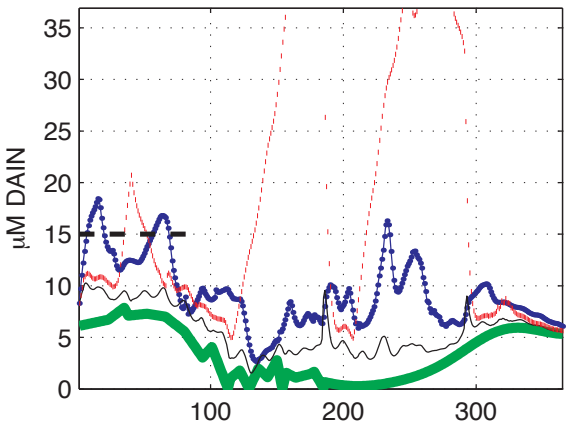
Results

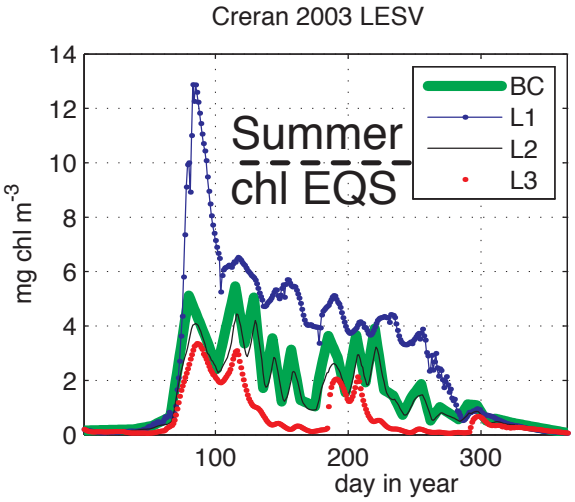
compare with EQS or with reference = BC

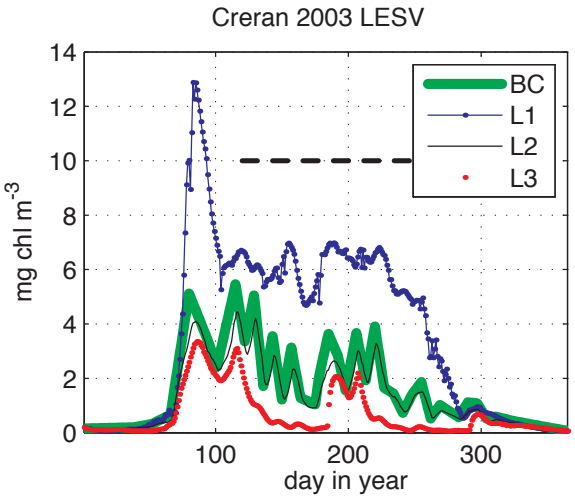
X1



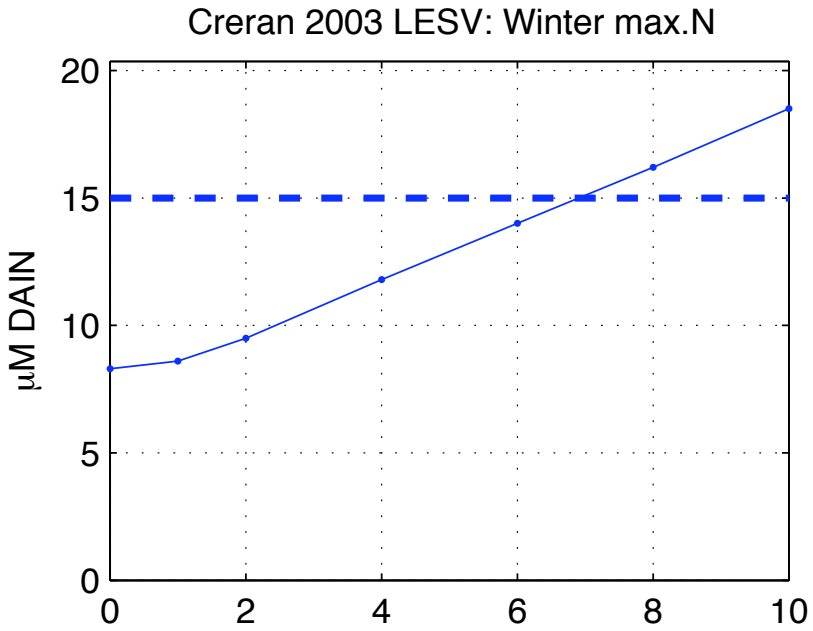
X1O

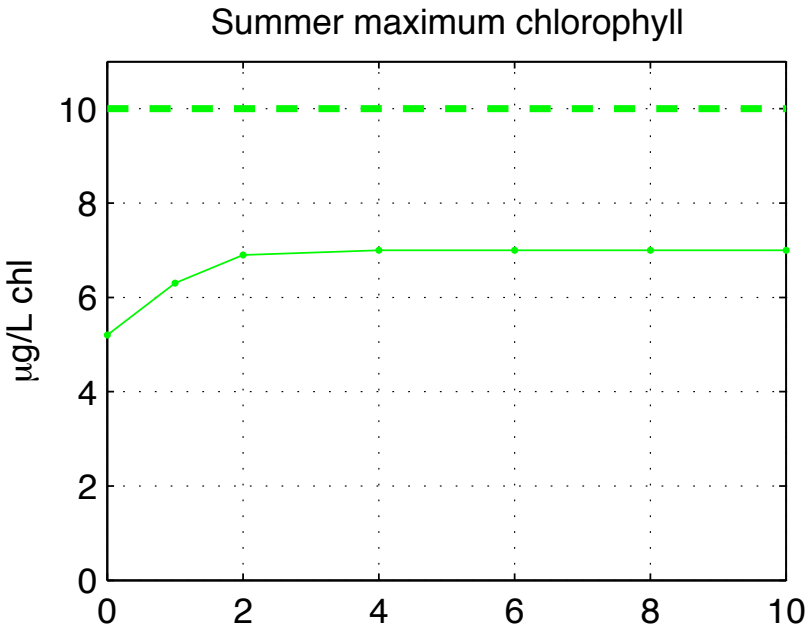




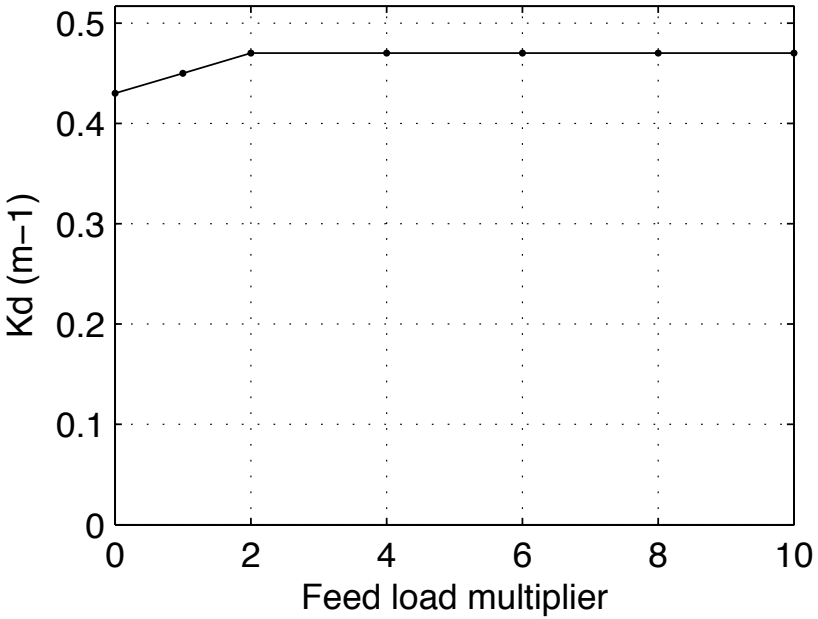


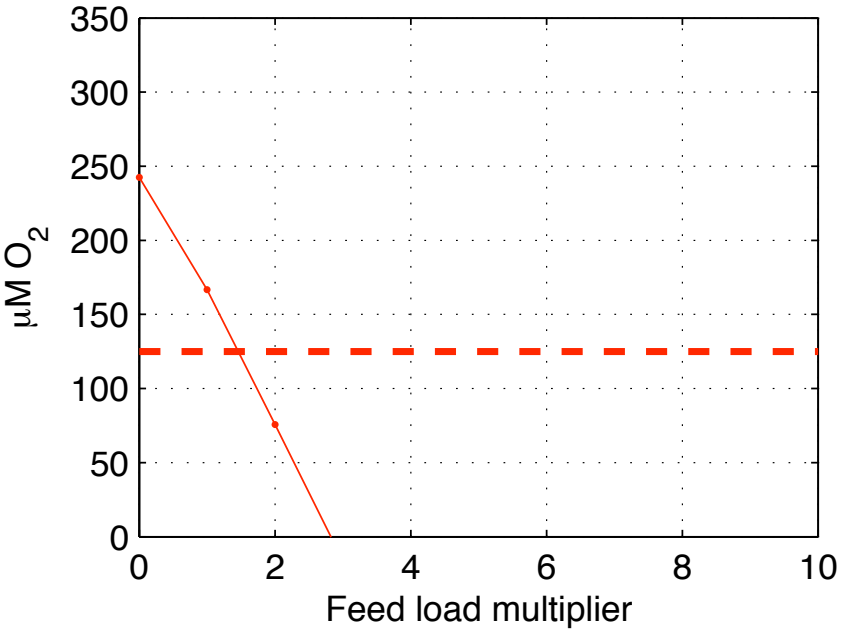
Use to make P-I diagram and hence estimate AC





pressure





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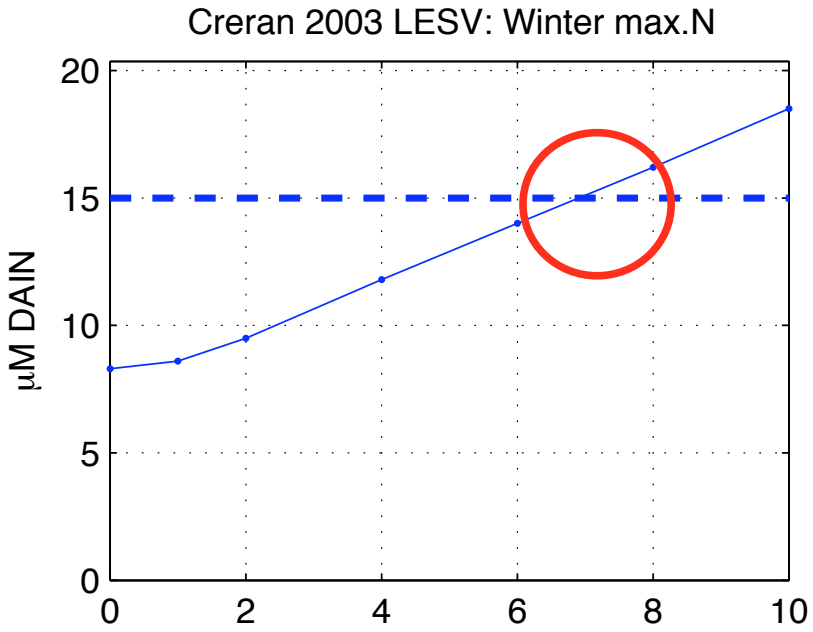

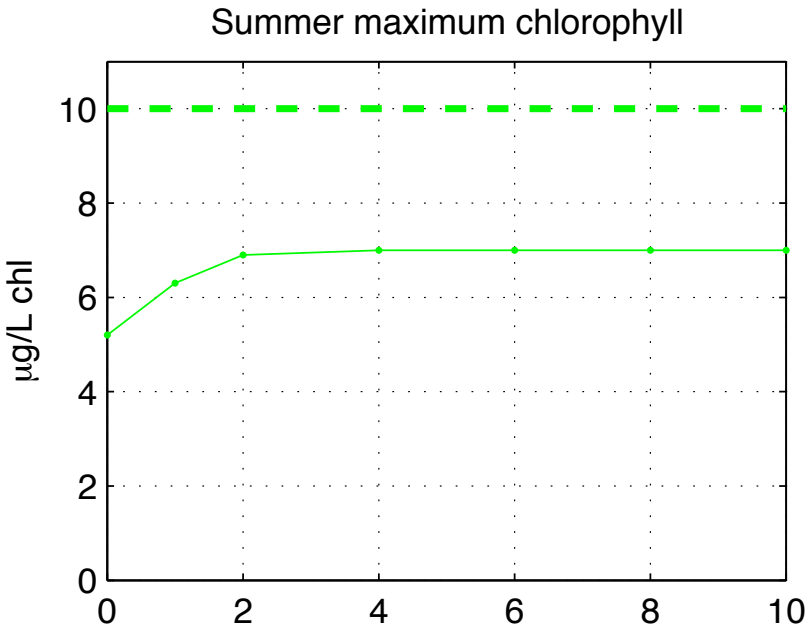

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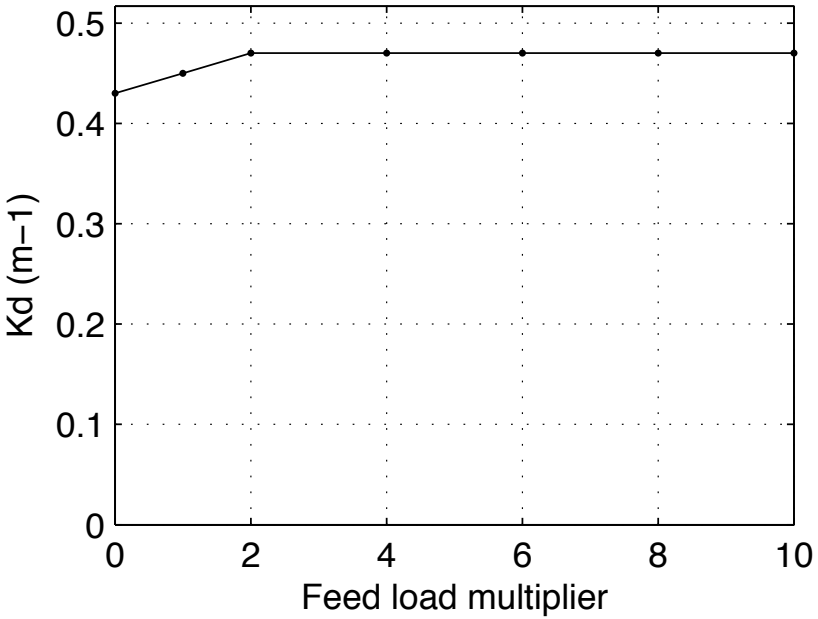

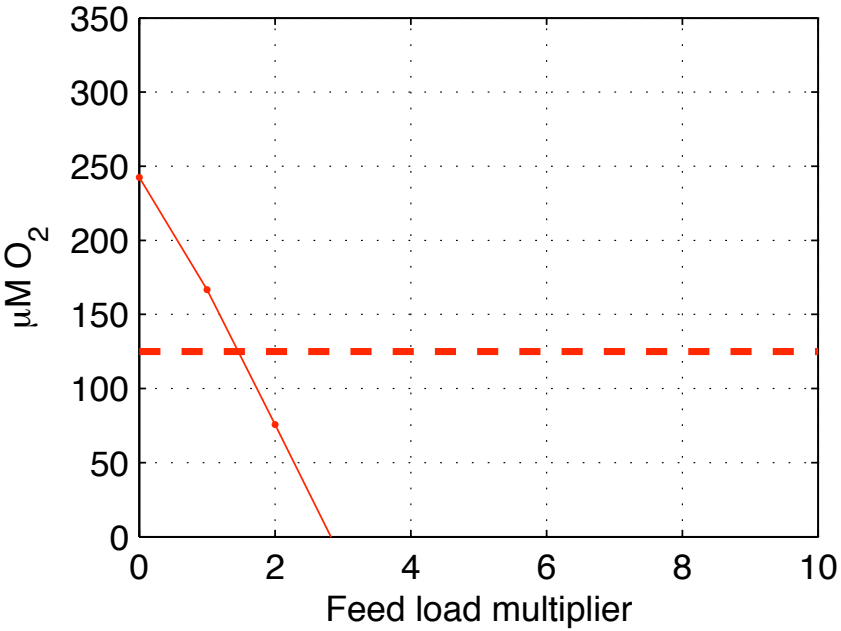

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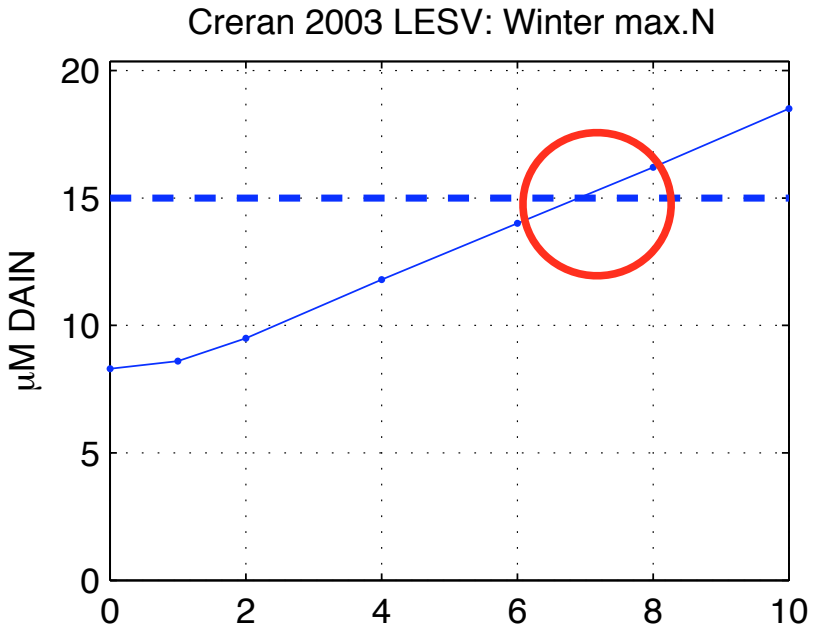

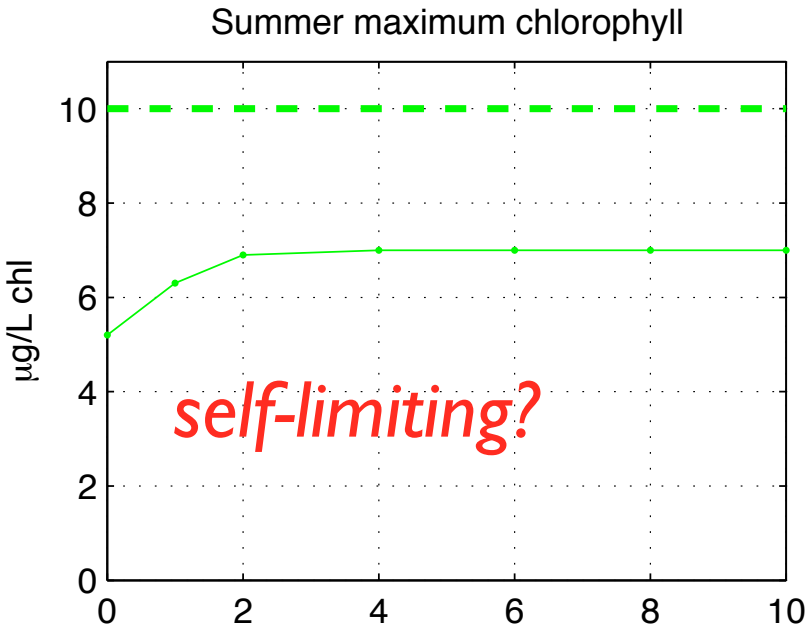

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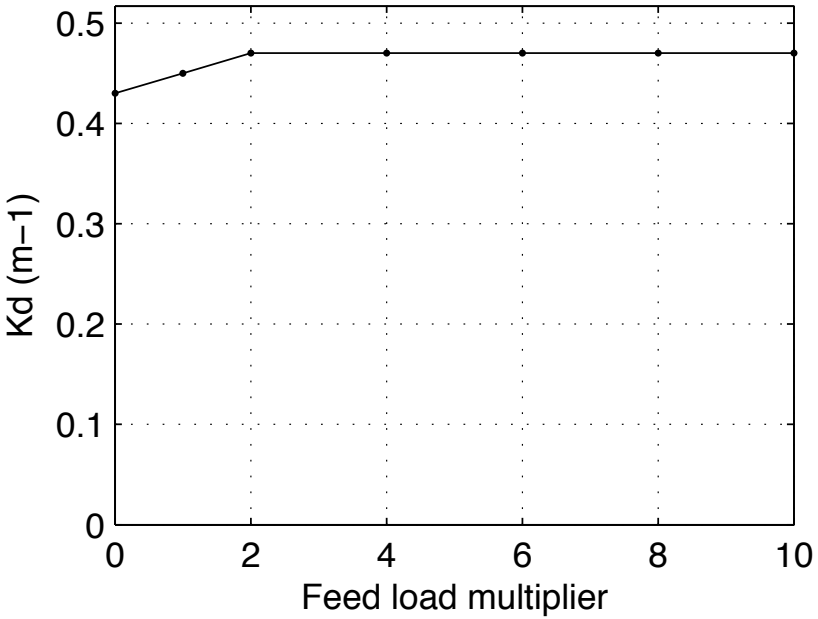

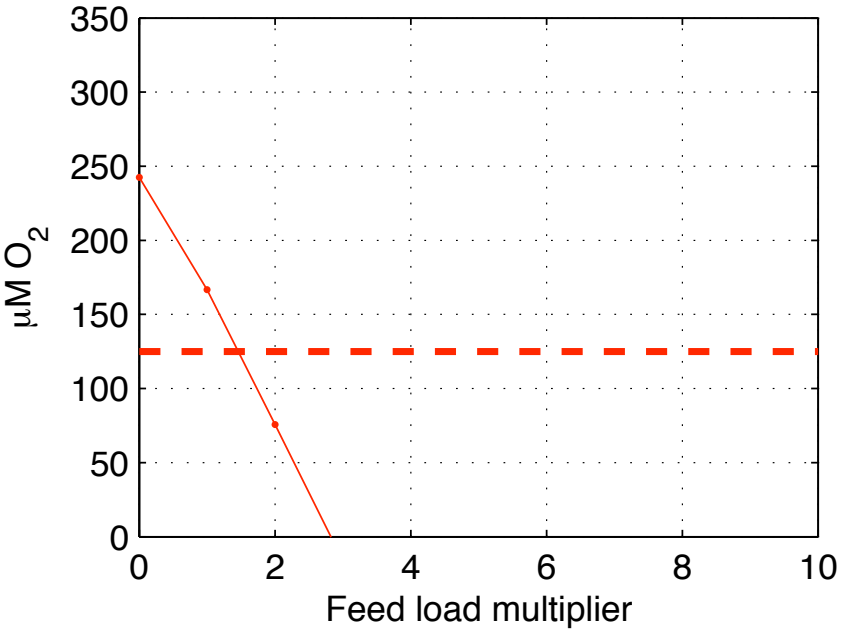

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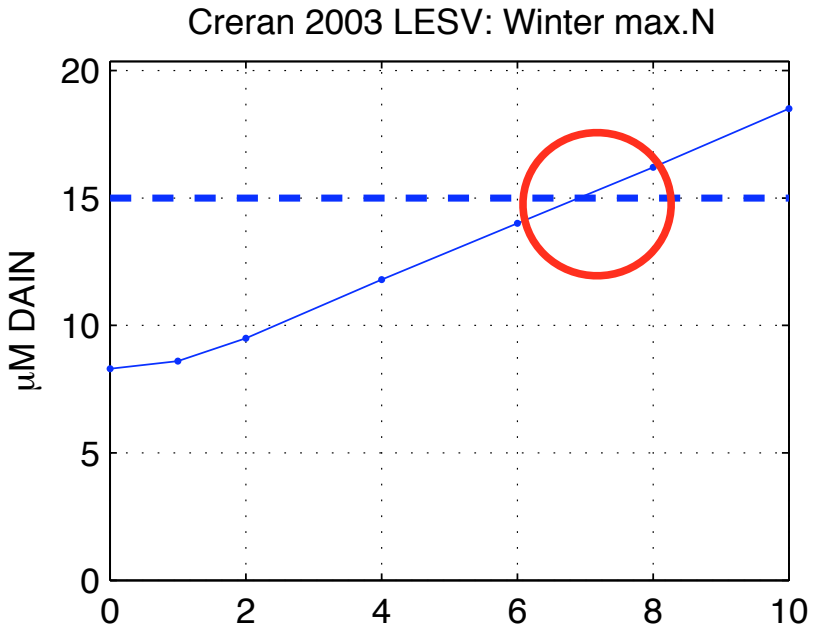

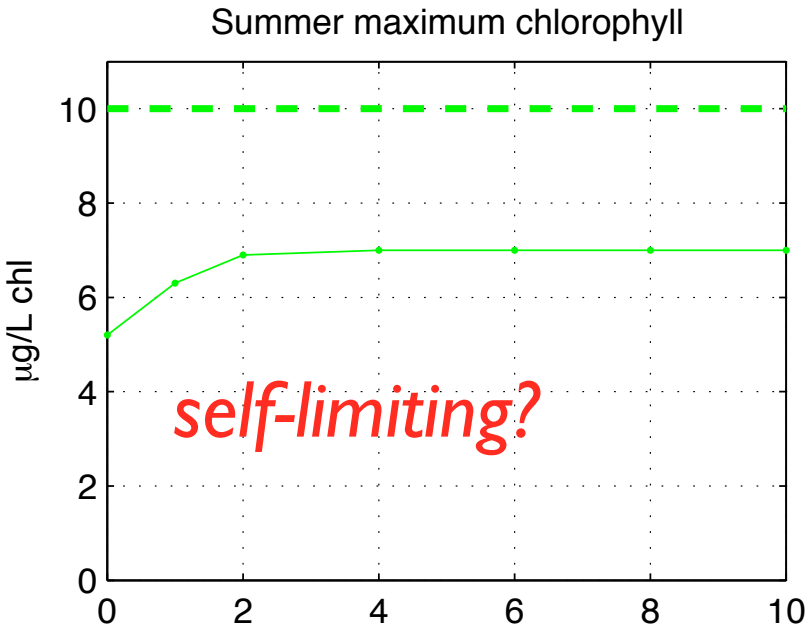

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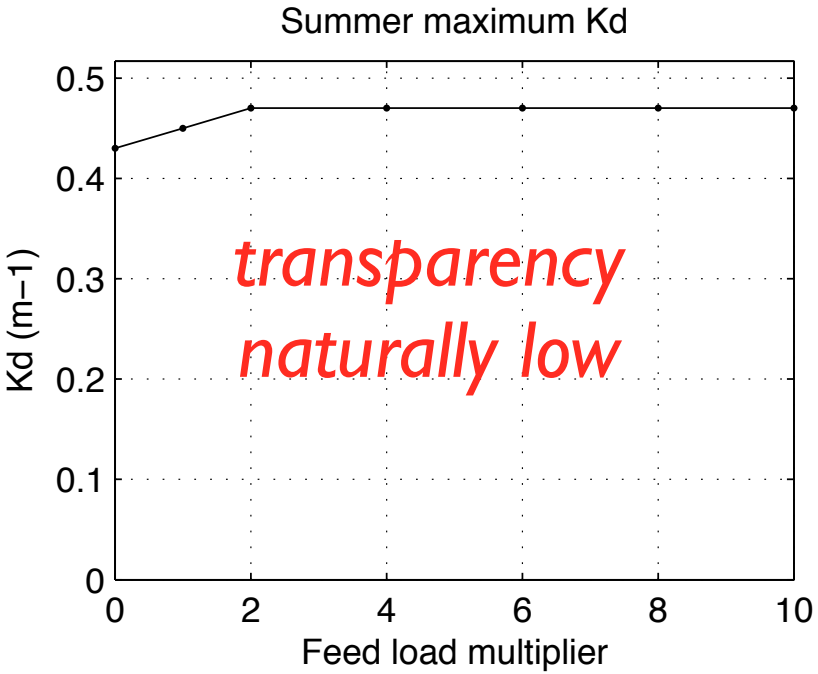

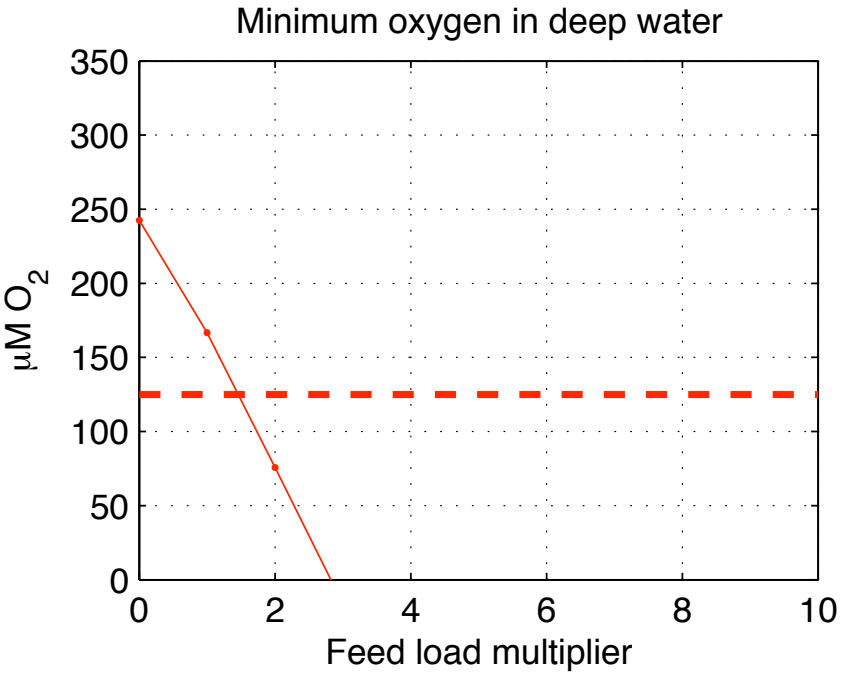

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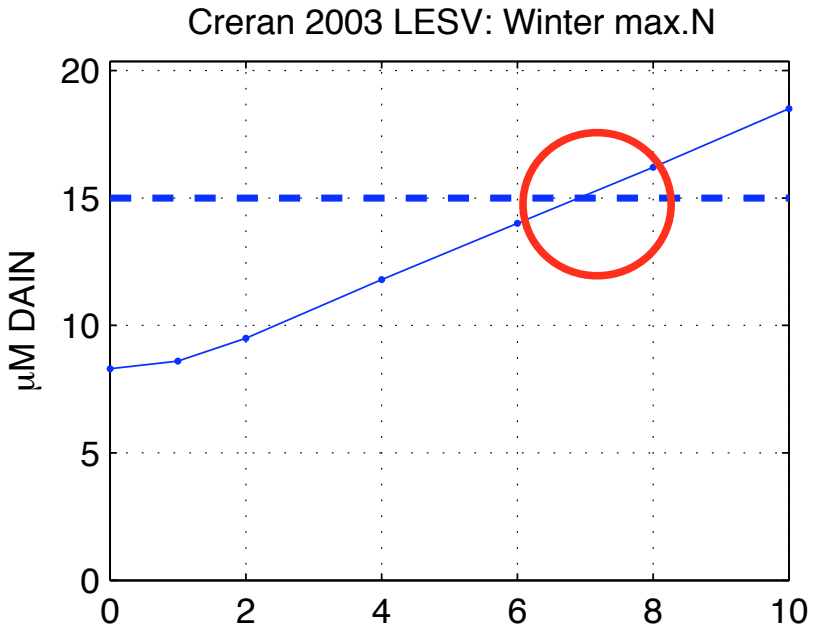

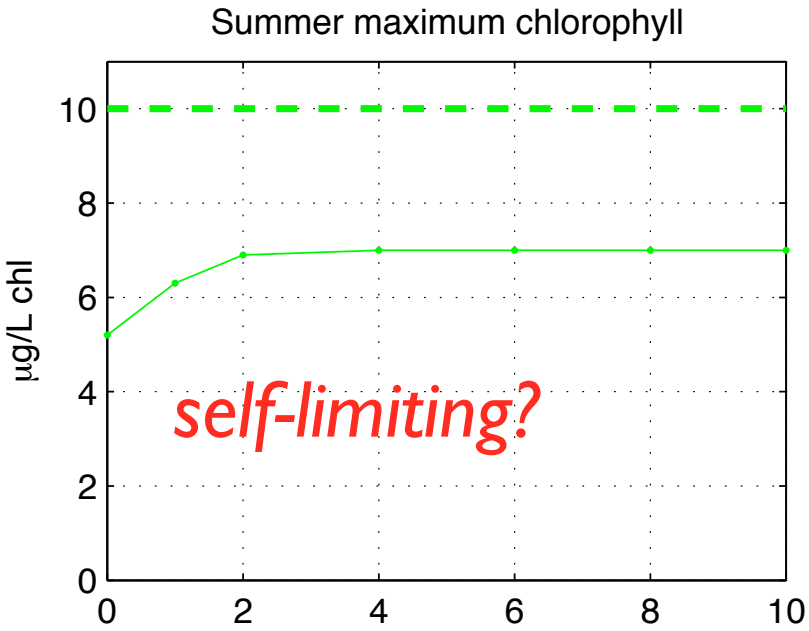

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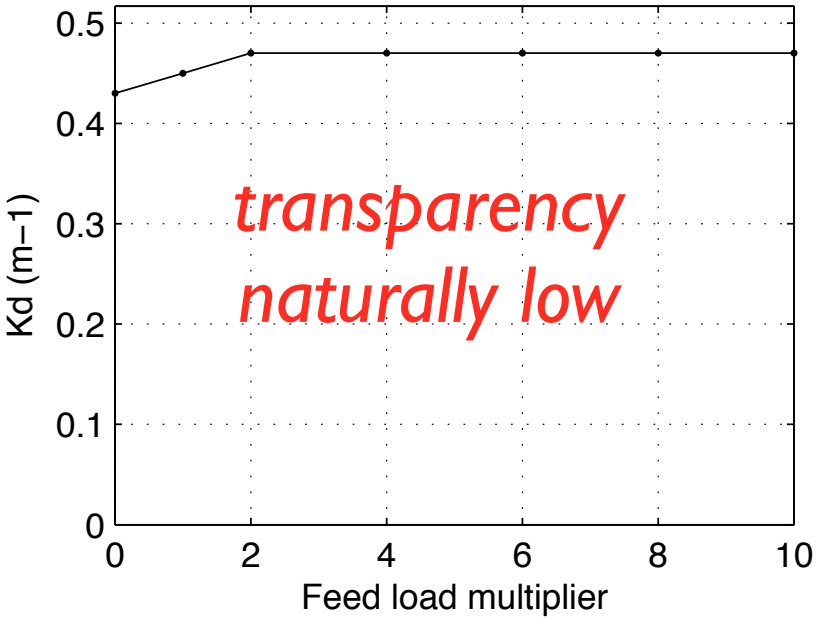

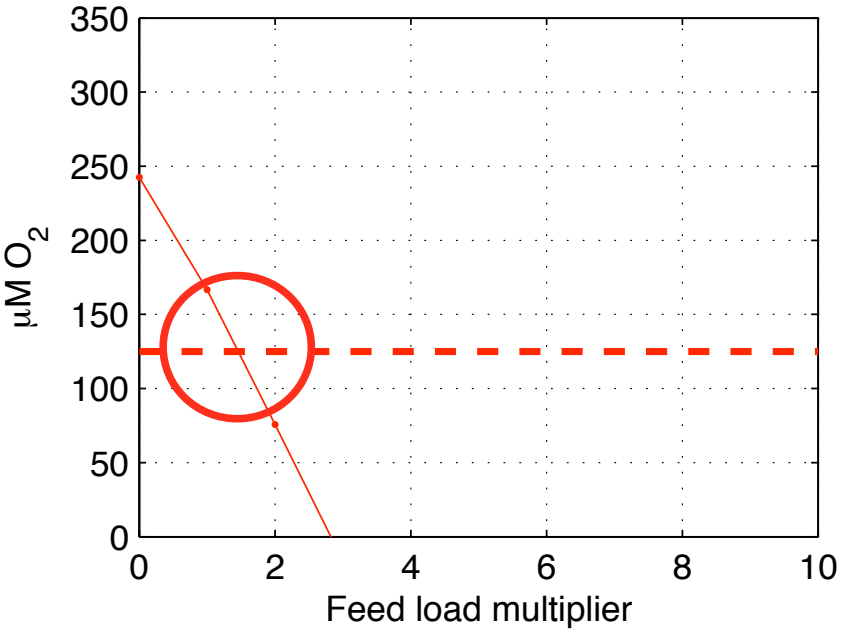

Status

- model system developed during ECASA (and with additional Scottish funding from SARF) by combining existing CSTT model concepts with FjordEnv
- numerical model contained in Matlab programme (the IP of SARF members, but we hope to make widely available)
- detailed documentation about to be available on the web (link from the toolbox)
- needs associated databases of water body shape etc, boundary conditions, meteorology, river flow -- creates difficulties at present for screening use

3 for 1 offer

3 for 1 offer

4 for 1: also includes a 'tracer' routine, allowing prediction of medicines dilution and decay