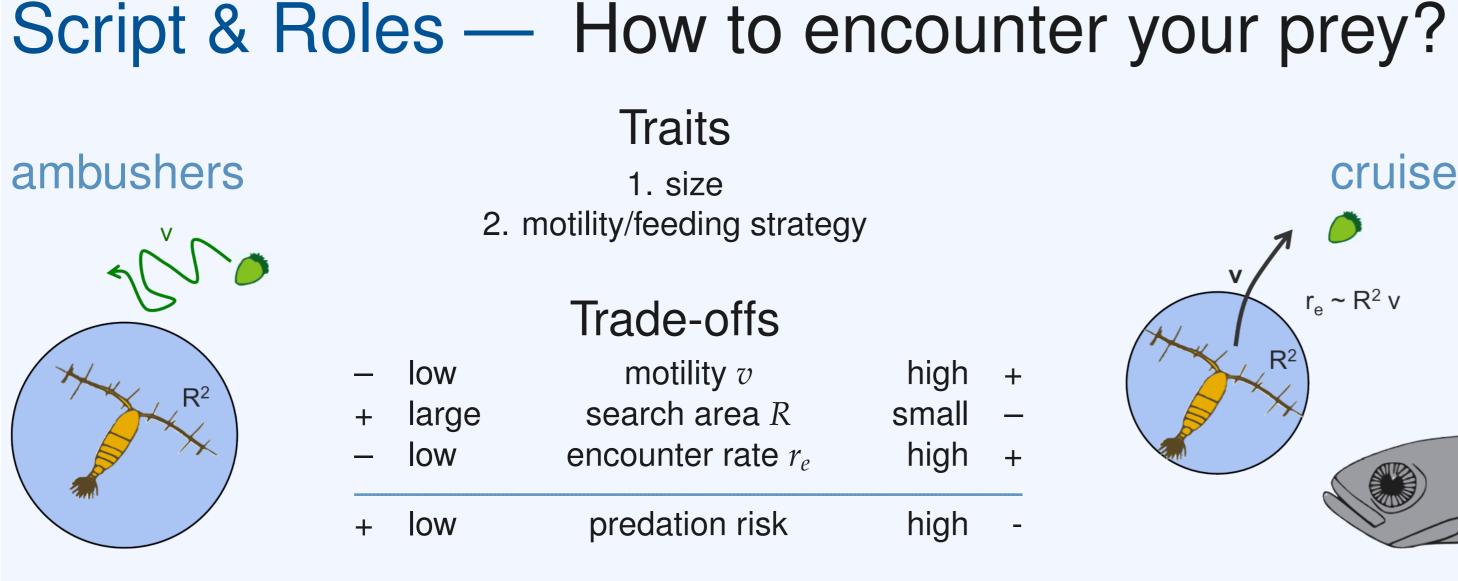
Ambushers vs. Cruisers — A plankton drama in 3D **Technical University** of Denmark

Institute of Technology

PML Plymouth Marine

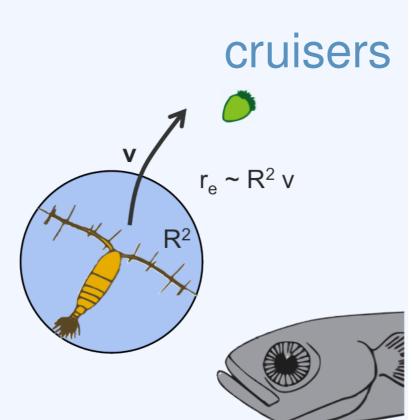
AEF Prowe, KH Andersen, T Kiørboe, AW Visser – DTU Aqua, Charlottenlund, Denmark

S Dutkiewicz, M Follows — MIT, Cambridge, USA A Atkinson, C Widdicombe — PML, Plymouth, UK



The motive — why this model?

• zooplankton feeding models currently employed in 3D global models are oversimplified • 1 step more complex: plankton functional type (PFT) architecture \Rightarrow applicable in existing frameworks



Cast — encounter model

A Hickman — Univ Southhampton, UK

J Sharples — Univ. Liverpool, UK

The actors — state variables

The phytoplankton

e.g. flagellates small, motile small, non-motile e.g. coccoliths, small diatoms large, motile e.g. dinoflagellates large, non-motile e.g. Large diatoms

The zooplankton

- small, non-motile microzoo ambushers, e.g. some ciliates
- small, motile microzoo cruisers, e.g. dinoflagellates
- large, non-motile mesozoo ambushers, e.g. Oithona
- large, motile mesozoo cruisers, e.g. Calanus

• encounter rates: search area, predator/prey motility - functions of size



Southampton UNIVERSITY OF LIVERPOOL

primary cv

---> cv (escape)

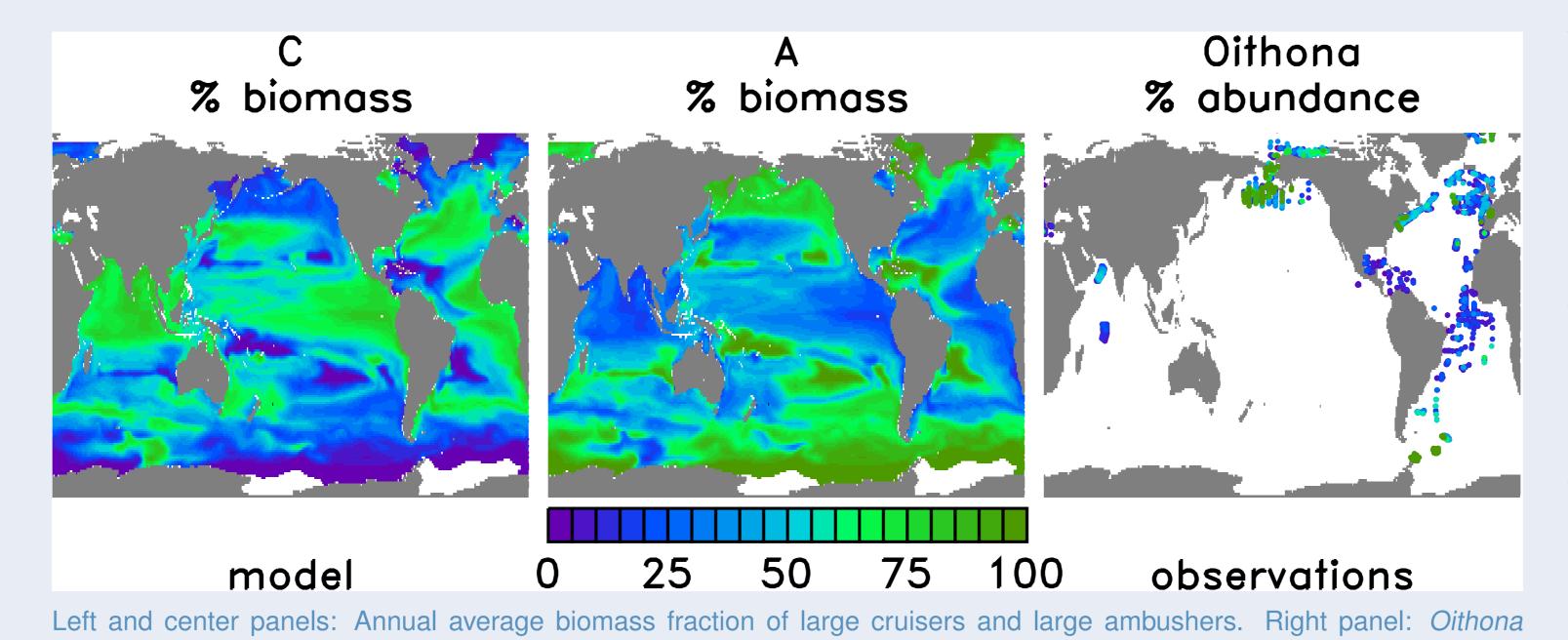
 \rightarrow primary hv

--- → hv (escape)

The stage — global biogeographies

The global model • encounter rate model • coupled to 3D MITgcm (T, S, advection, mixing, 1° grid) • nutrients: P, N, Fe • fixed plankton stoichiometry nutrient- & light-limited phyto growth

- temperature dependent phyto growth, feeding, remineralization
- 10 year offline simulations



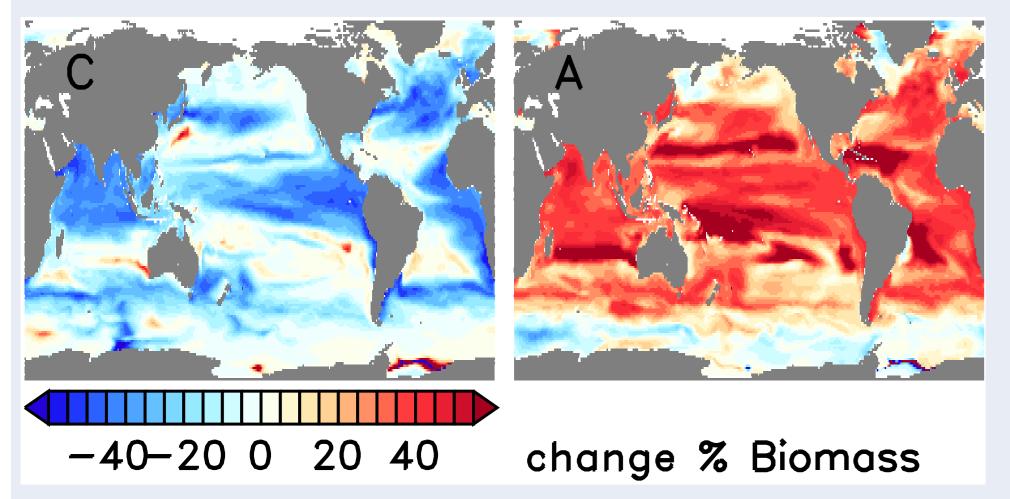
with S Dutkiewicz & M Follows

What we want ... • feeding strategy biogeography • mechanistically emerging food web • trophic efficiency & productivity • generate hypotheses in 3D

What we don't want ...

- a plankton community with specific species, e.g. Thalassiosira and Calanus
- What we think about ...
- switiching between / adaptive strategies
- life stages for large zoo
- many PFTs with randomly assigned trait values constrained by model trade-offs

Parameter sensitivity

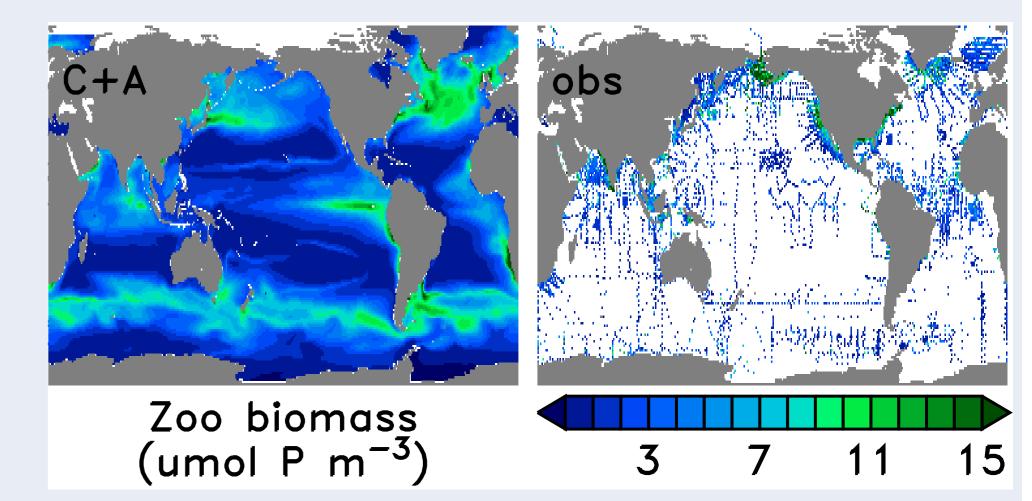


Make-up

sp. abundance fraction of total copepods at all stations where Oithona sp. was identified. Data: NMFS-COPEPOD global

- high sensitivity to parameters (absolute/relative to other PFTs) • scarcity of global data
 - satellite PP: high uncertainties

Model assessment



Not well constrained parameters, e.g. higher mortality rate for C relative to A, considerably affects i.a. the fraction of total biomass for both feeding strategies.

• some mesozoo biomass: MAREDAT, COPEPOD databases little microzoo biomass

model PFT predictions

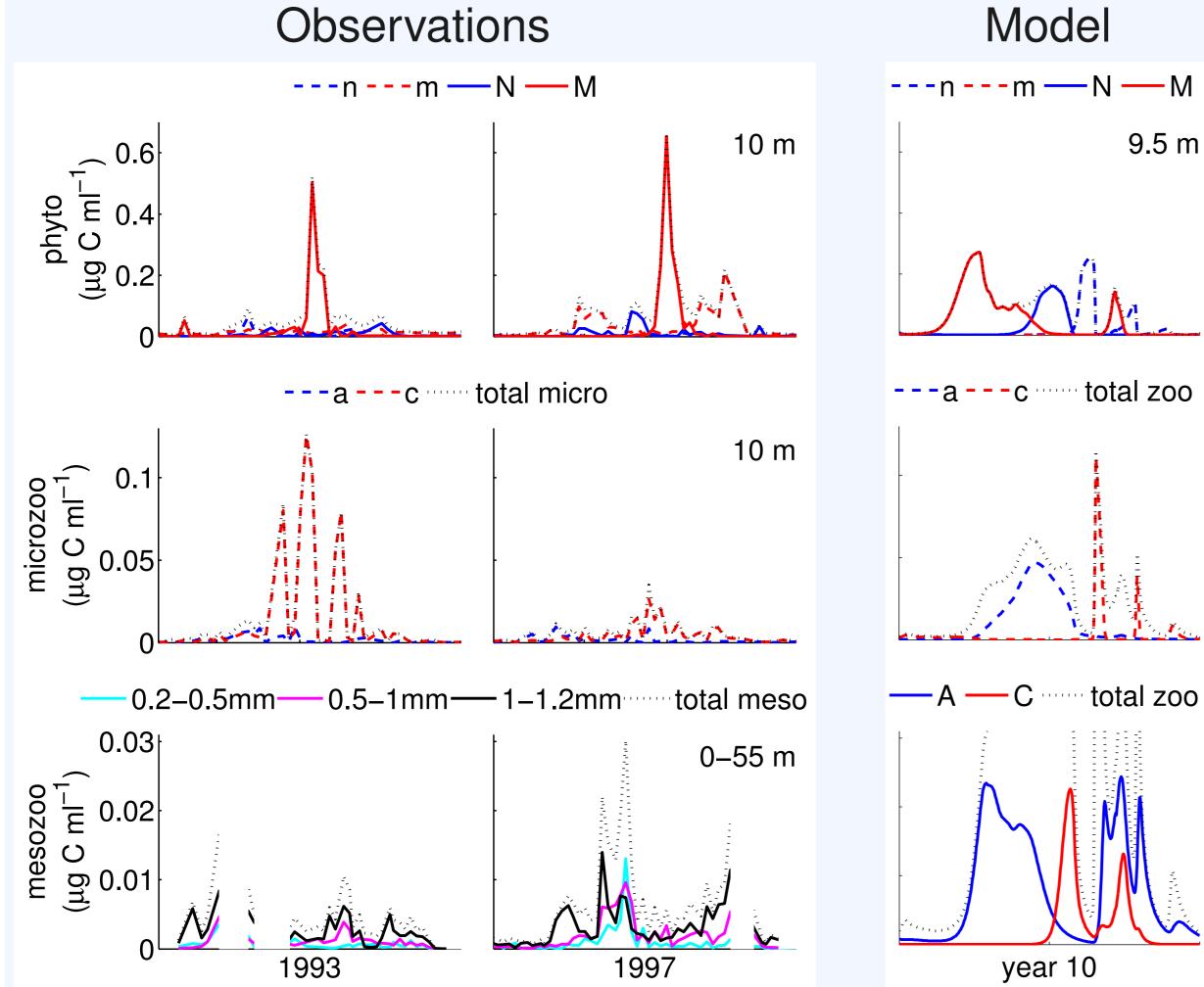
plankton database ">http://www.st.nfms.noaa.gov/plankton> (May 2013).

• sufficient taxonomic resolution at most for copepods \Rightarrow little feeding strategy information

so ... how to assess?

Validation options: total large cruiser and ambusher biomass compared to mesozooplankton biomass observations. Data: MAREDAT 2012.

Backstage — 1D seasonal succession assessment



with A Hickman, A Atkinson, J Sharples, C Widdicombe

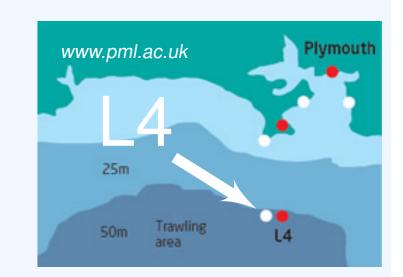
The scene — setup

• station L4, Western English Channel Observatory • 1D online simulations: encounter model & MITgcm • temperature/mixing forcing: S2P3 shelf model (Sharples et al. 2006) • generic shelf sea meteorological forcing (for now)

The props — observations @ L4

• phyto-/microzooplankton abundance/biomass, taxonomic resolution

mesozooplankton abundance, taxonomic resolution



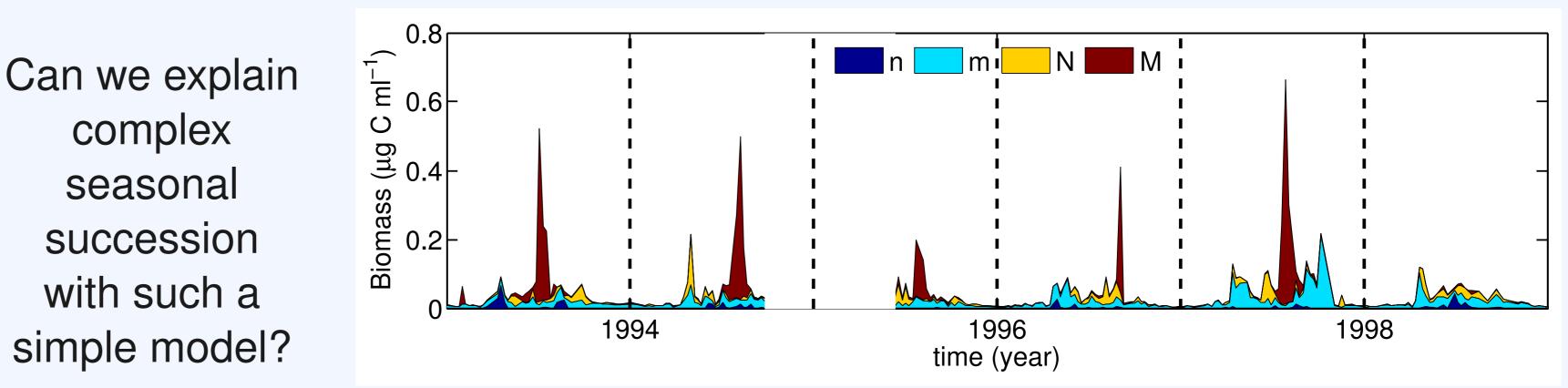
- mesozooplankton biomass, 3 size classes • nutrients, physical parameters from buoy
- weakly stratifying water column (55 m depth)

Interannual variability

total zoo

Observed biomass in 1993/1997 grouped according to model PFTs for phytoplankton (top), microzooplankton (mid), and in 3 size classes for mesozooplankton (bottom).

Corresponding simulated model PFTs in year 10 after initialization.



High interannual variability in observed phytoplankton biomass grouped according to model PFTs. Data: Western Channel Observatory http://www.westernchannelobservatory.org.uk, obtained through the British Oceanographic Data Centre.

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Centre for Ocean Life A VRK Centre of Excellence www.oceanlifecentre.dk

