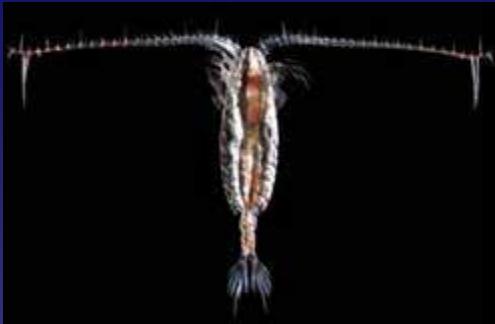


GLOBEC Northwest Atlantic Program



Calanus finmarchicus
Pseudocalanus spp.
+ other copepods



Cod and haddock
Eggs and larvae

Goal: To understand the processes controlling abundance of cod and haddock larvae and their copepod prey species as affected by climate change.



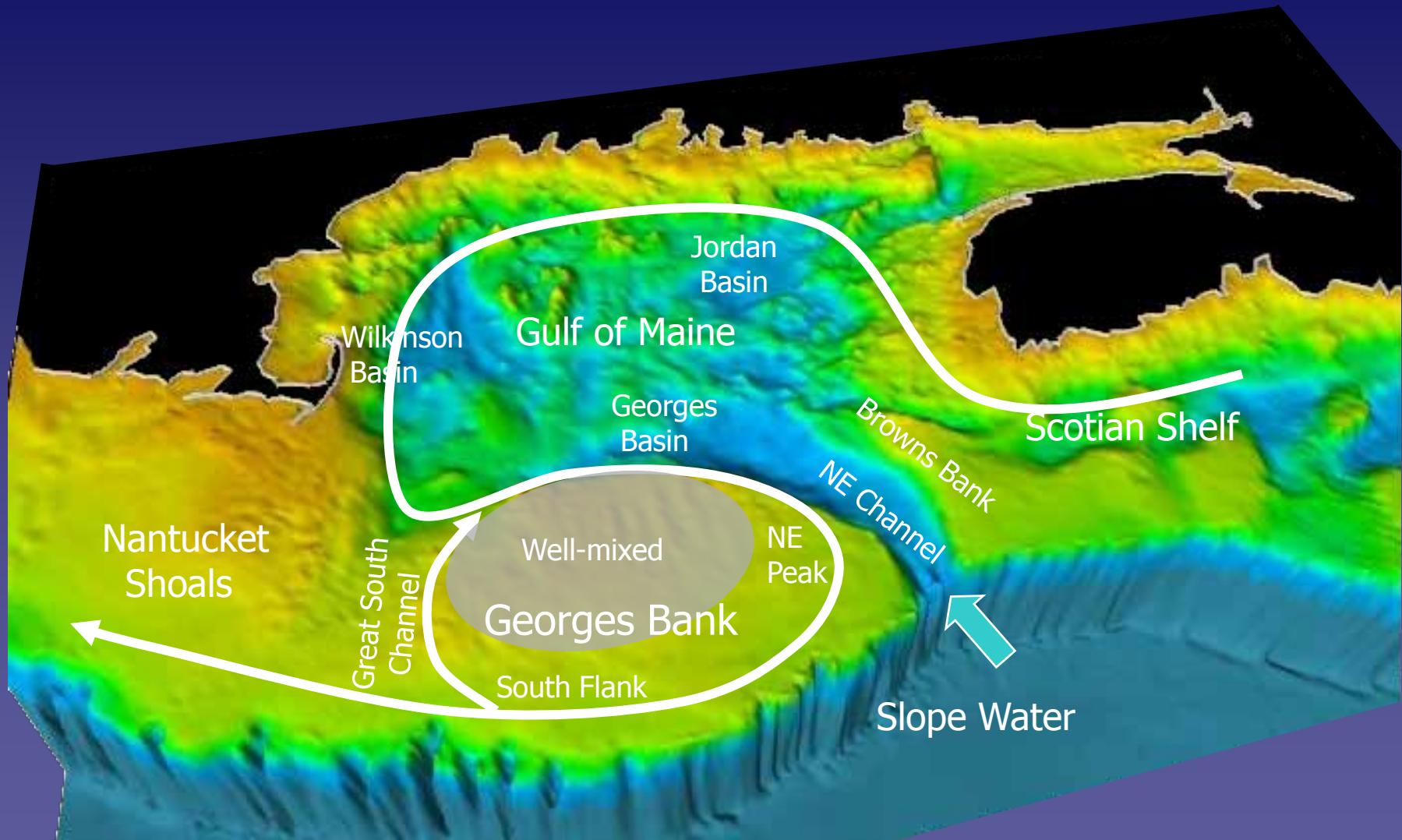
GLOBEC NWA Program

- **Larger Context:** To understand the fundamental mechanisms controlling abundance of key marine animal species by studying organismal and population level dynamics and their interactions with the physical environment across multiple scales.
- **Benefit:** A better understanding of how key species and ecosystem *components* are controlled by natural and human perturbations such as climate change, pollution, and over-exploitation.

GLOBEC was designed as a basic research program

US and International programs, 2600+ pubs, 26 spec vols

Gulf of Maine - Georges Bank Study Area

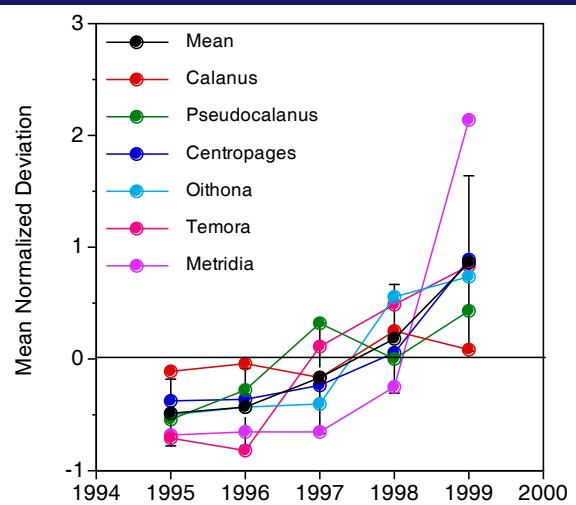


Program Elements:

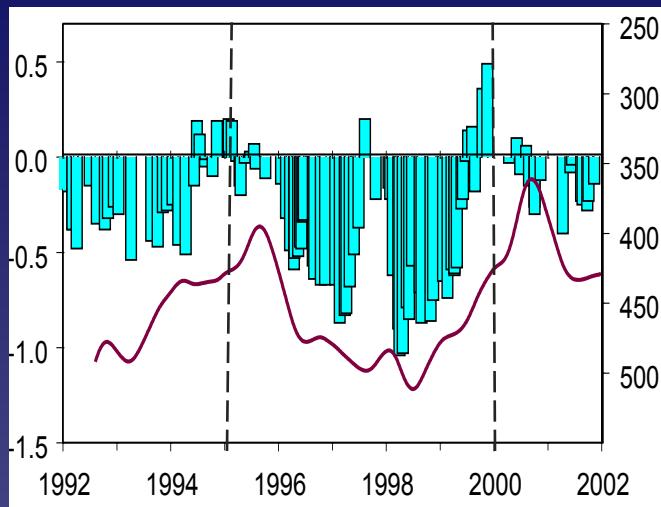
- Field sampling (1995-1999)
 - Broadscale - bank-wide, every year
 - Process - targeted, every other year
- On-going work: 1995-present
 - Modeling
 - Retrospective analysis
 - Satellite
 - Program/Data Management

Results: Broadscale

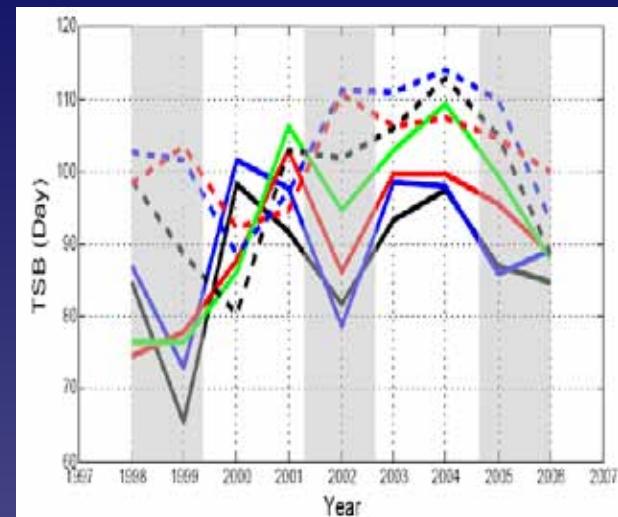
Copepods vs Year



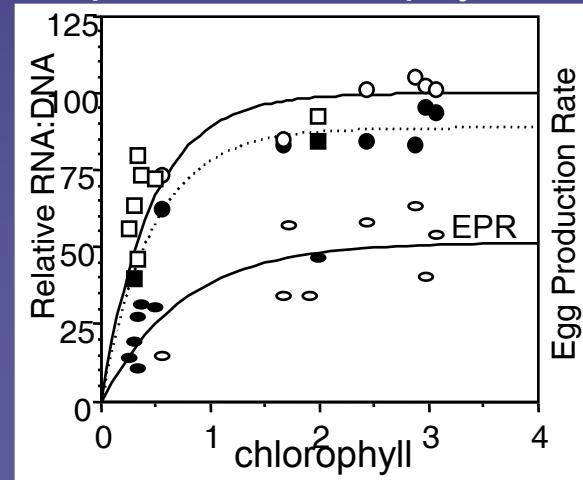
Salinity Anomaly



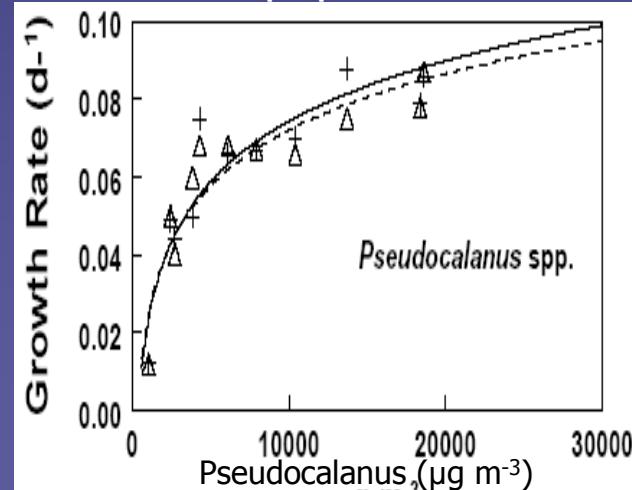
Time of Spring Bloom



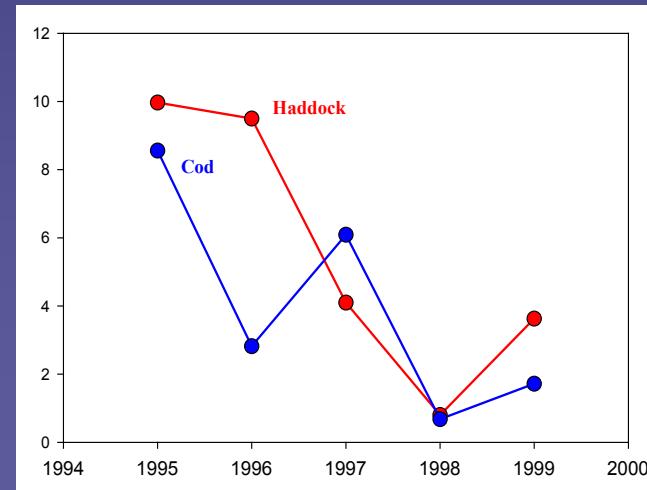
Copepod growth and egg prod. vs chlorophyll



Cod & Haddock Growth vs Copepods

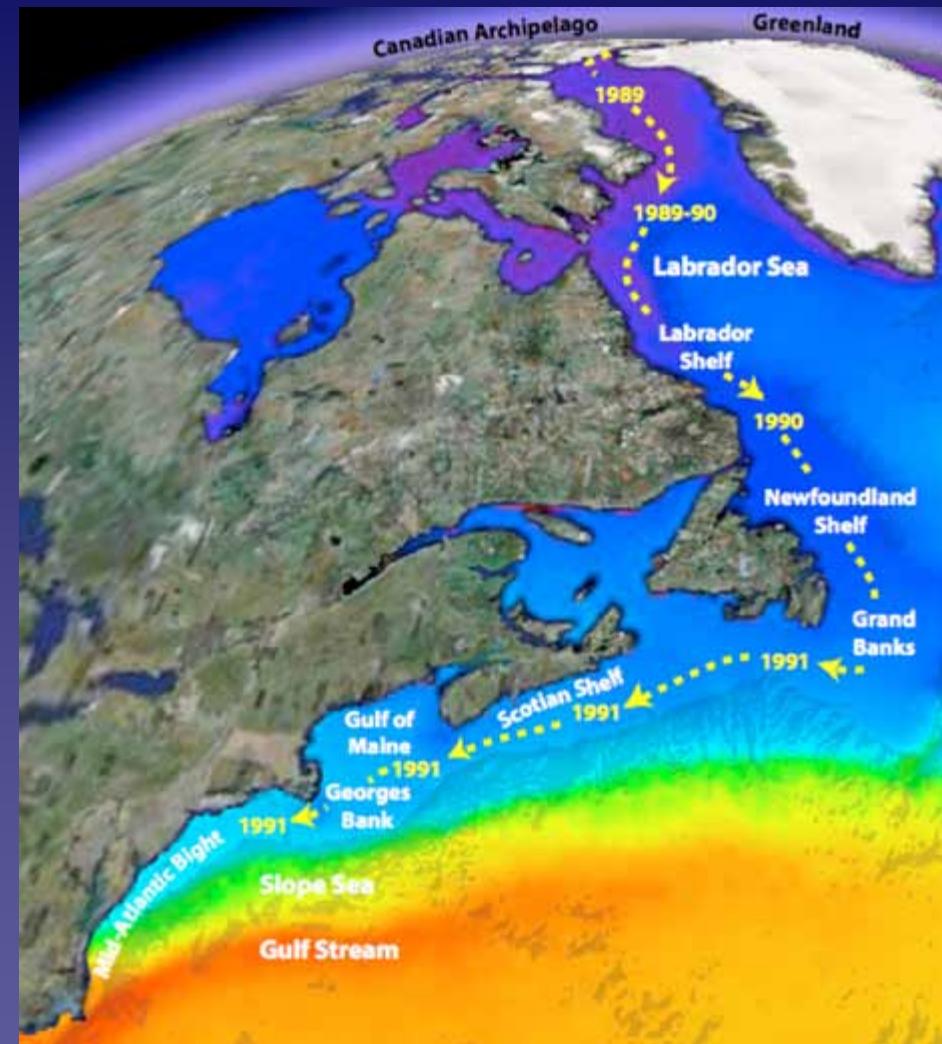


Cod & Haddock Mortality vs Year



1990s Freshening

Green & Pershing 2007 *Science*

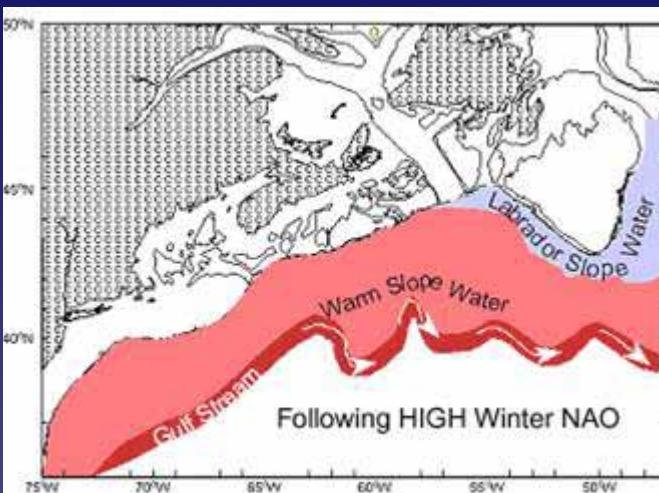
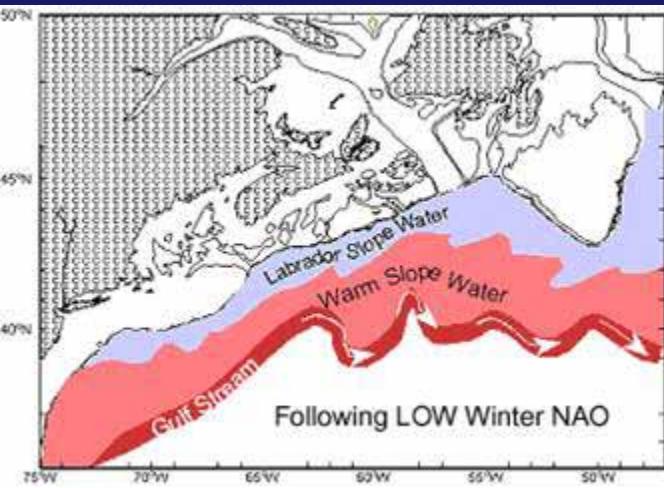


Freshwater in early 1990s
traced to Arctic

- AO+ winds strengthen Beaufort Gyre
- AO- winds release freshwater

North Atlantic Oscillation

Labrador Slope Water Intrusions Reduce Nutrients



Upwelling

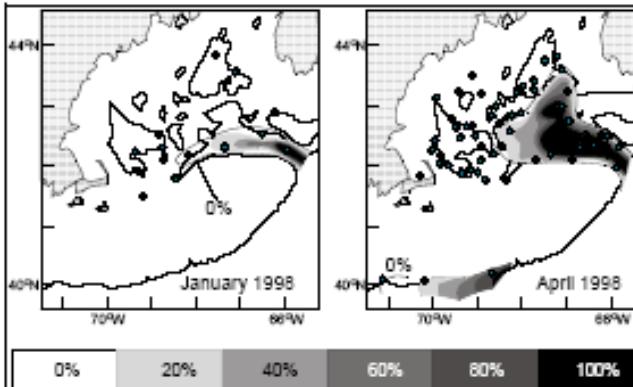
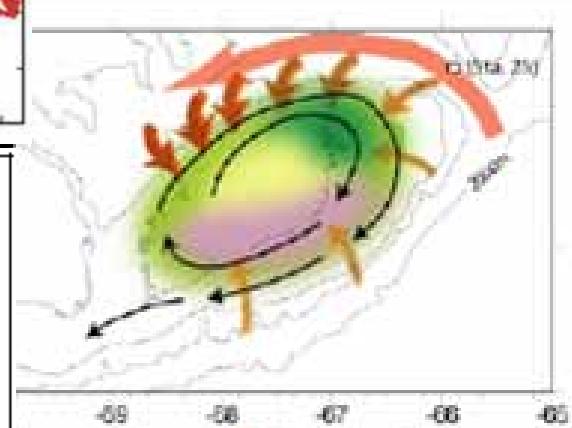


Fig. 5. Percent LSW in bottom water (150-200 m) in 1998. (Drinkwater et al, 2003)



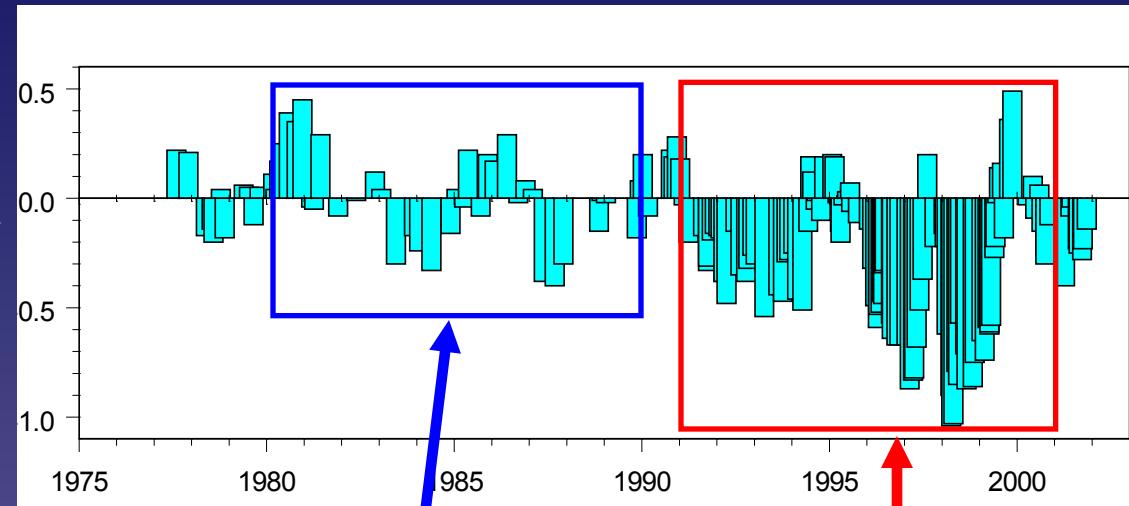
LSW= low nutrients; WSW has 50% higher nutrients

Changes in the Georges Bank ecosystem –

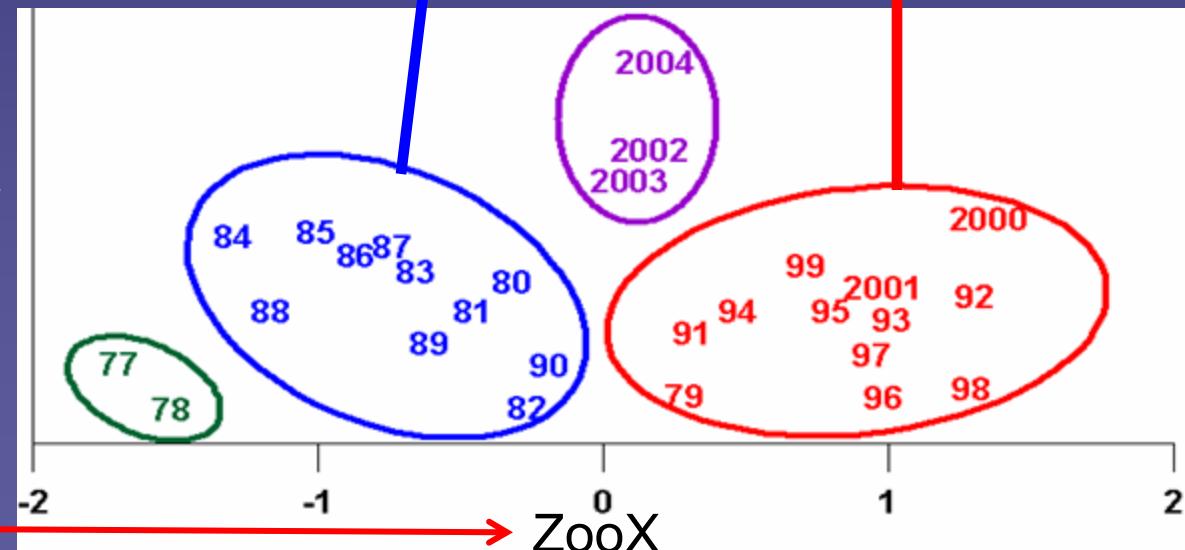
Change in zooplankton community structure

Favored smaller copepods during the 1990's

Georges Bank
salinity anomaly

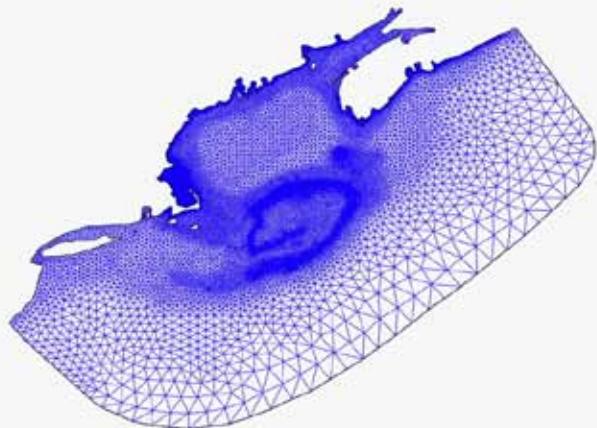


Multi-dimensional
Scaling analysis of
zooplankton community
(Kane, 2007)

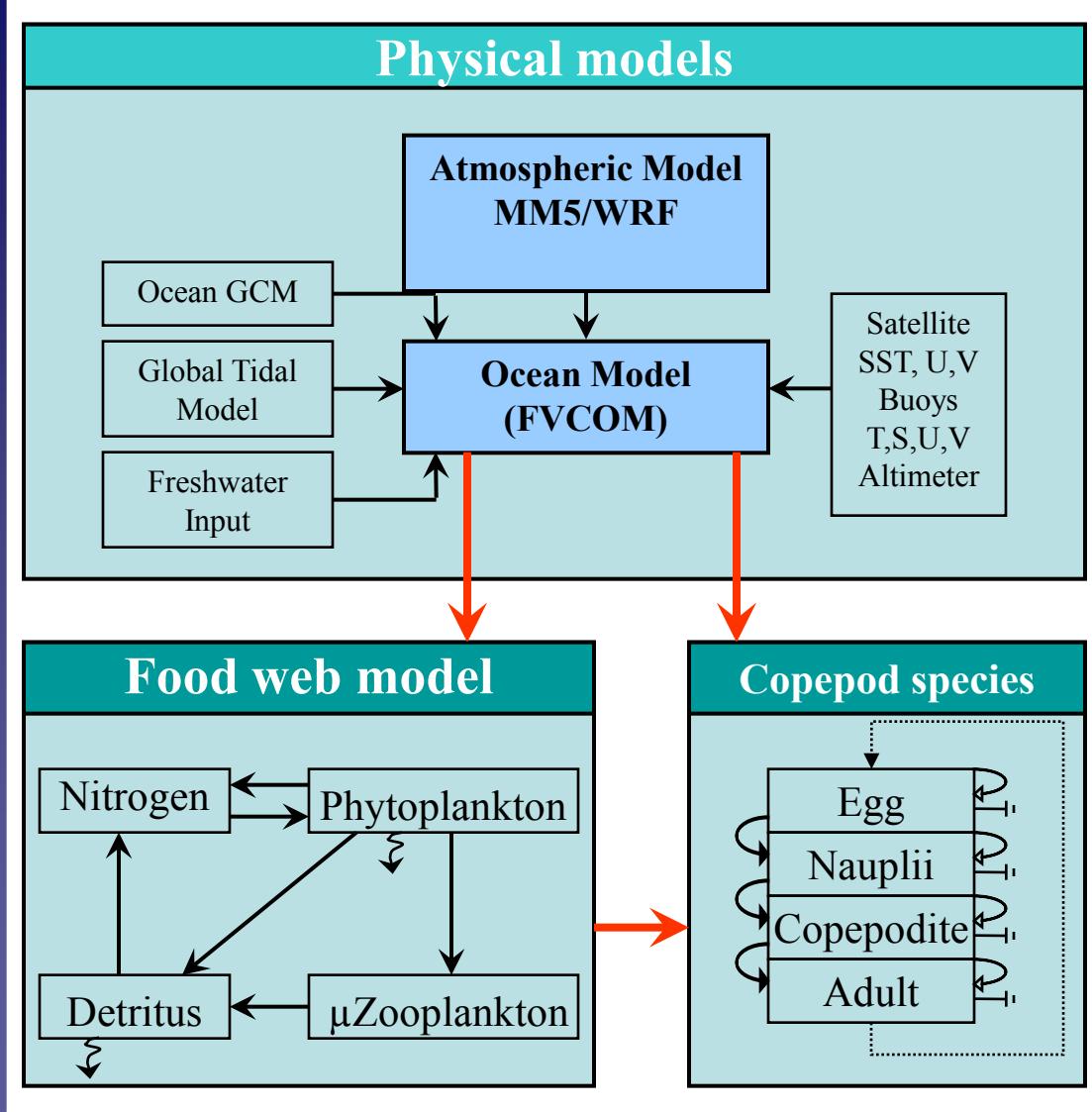


Model Framework

- Full 3-D coupling
- Food web model - NPZD
(Ji et al., 2008, JMS)
- Mean-age copepod model
(Hu et al., 2007, MEPS)



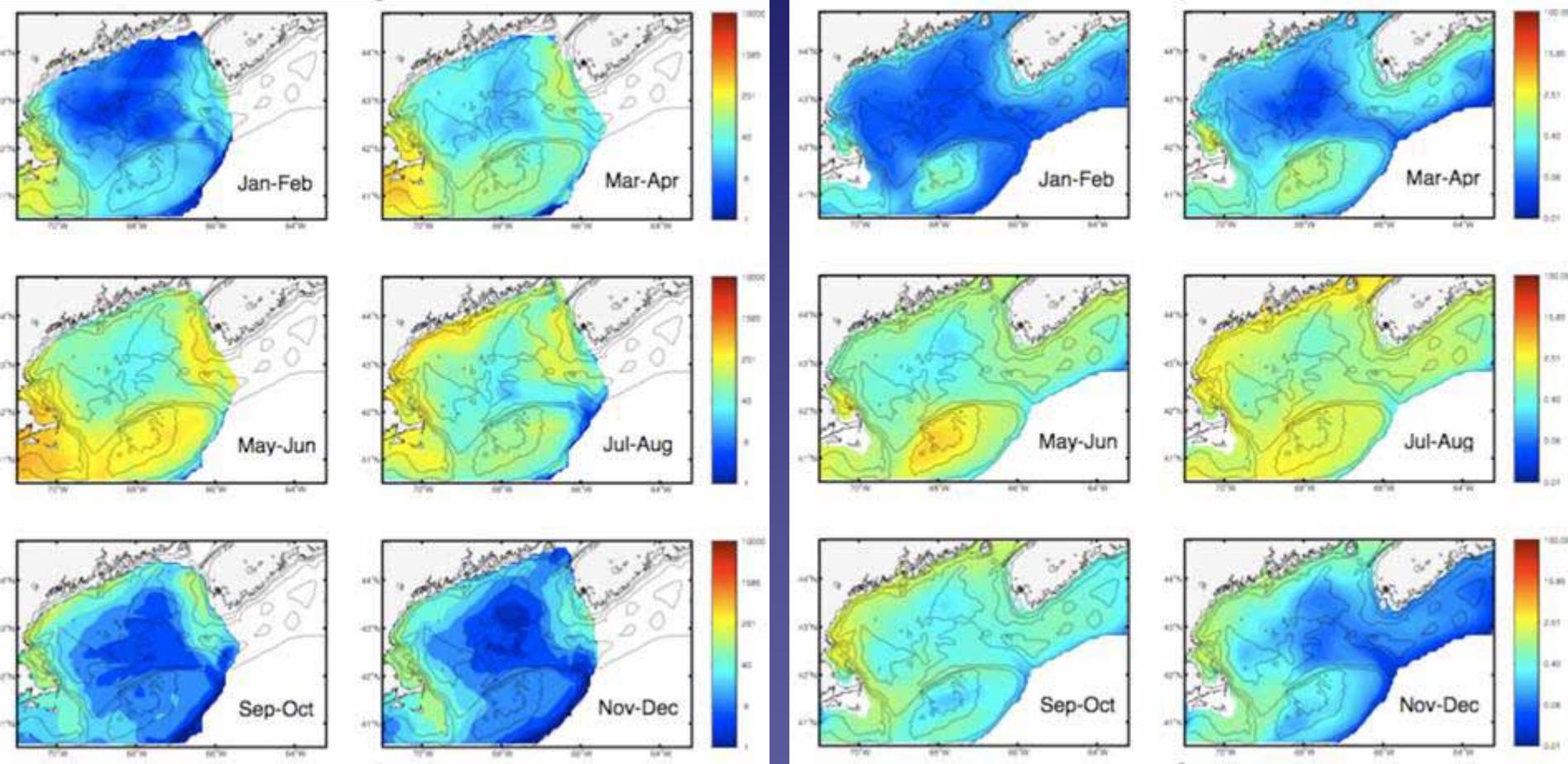
Model Grid

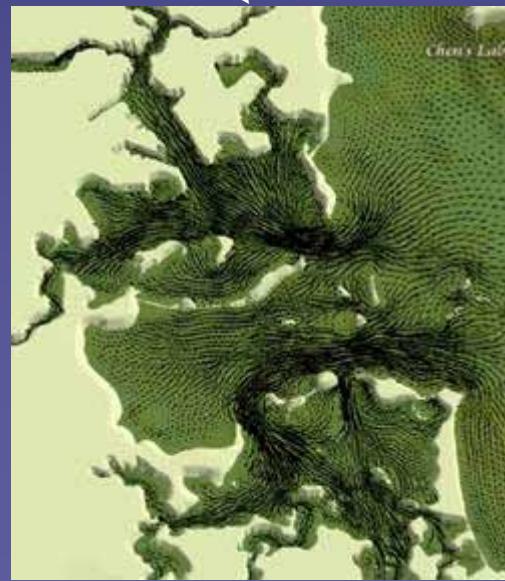
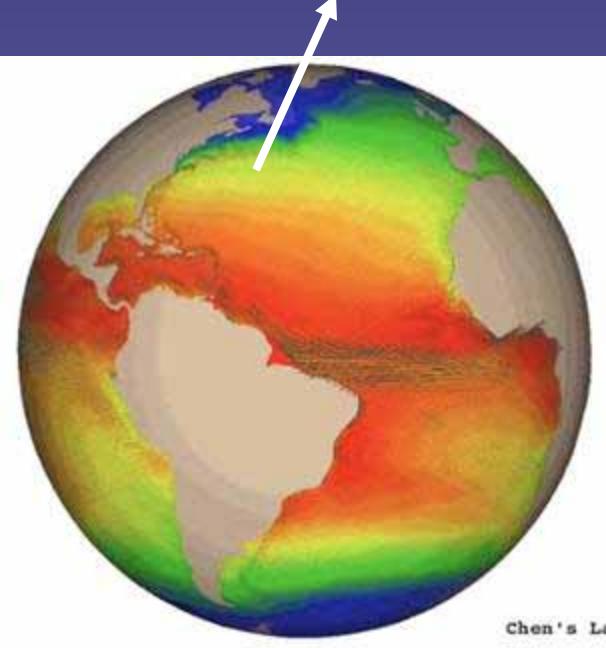
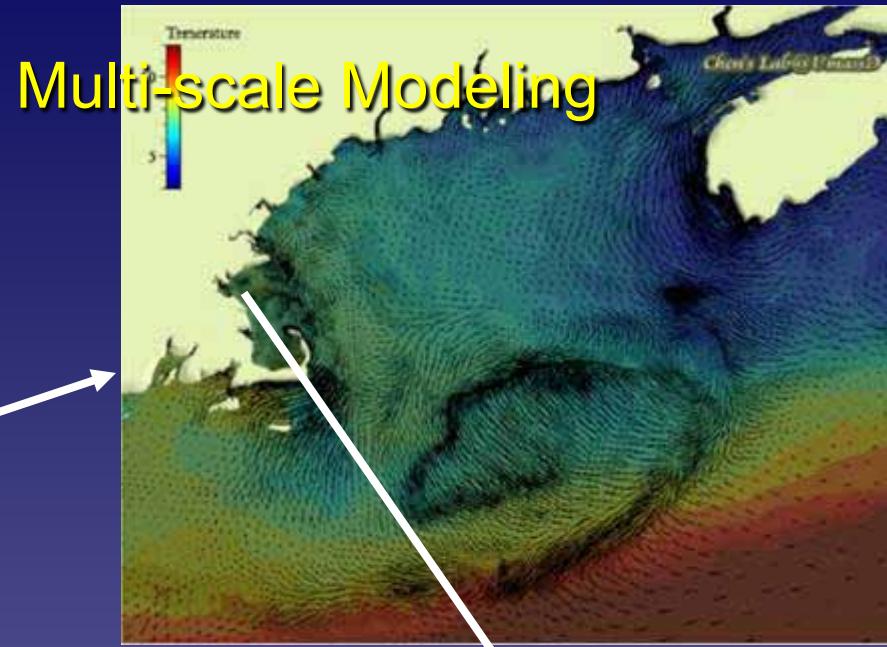
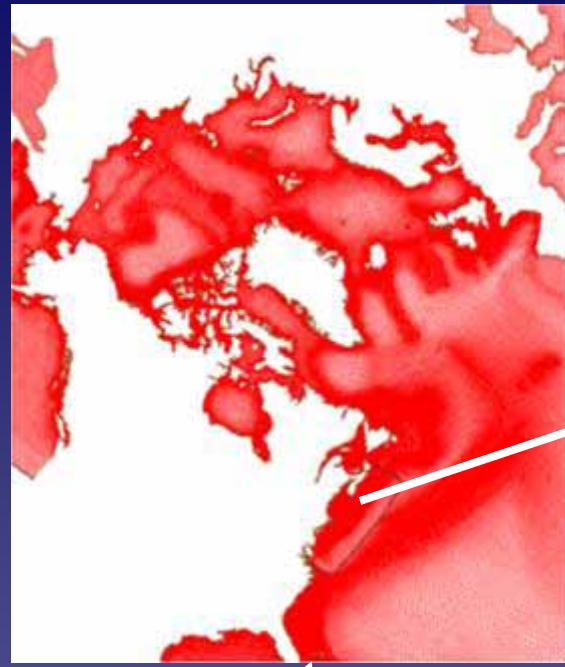


Pseudocalanus: Data vs Model

Observation (Climatology)

Model computed (1999)





Transitioning: Applications

- GLOBEC 3D models predict effects of local & remote forcing on:
 - Lower food web (NPZD)
 - Dominant copepod species
 - Cod/haddock larval survival
- Need to incorporate into adult fish stock assessment
- Use for other species: fish, scallops, lobsters

Many other applications

- red tides
- right whales
- pollution transport, watershed interface
- siting of outfalls, developments
- search and rescue
- storm/hurricane surge/run-up
- sea-level rise/inundation

Design of and integration with ocean observing systems for EBM

GLOBEC NW Atlantic Program – Management Perspective

David Mountain

in consultation with

David Preble and John Pappalardo
New England Fishery Management Council



GLOBEC's management focus:

Support Ecosystem-Based Management

This ‘transition-to-application’ has not happened

Reasons:

- 1) Direct interaction with management interests not part of the Implementation Plan**
- 2) Fishery management largely single-species oriented**
 - ‘Ecosystem’ and ‘environmental conditions’ had little direct role in stock assessment or management processes
 - EBM was a concept, but not an operational reality.

EBM is becoming a reality

NEFMC will be developing an Ecosystem Management Plan

Time for transition of research results to management is NOW

Some results have been applied:

Circulation models and particle tracking

- Drift of dead whales ("...one whale or 2?...")
- Evaluating MPA's

Other regional GLOBEC programs

- Ecosystem changes and Salmon closure
- Indices in SAFE reports

Relationship of Research and Management



Management needs guide Research goals

- Research provides new capabilities,
supporting new management approaches
- “...going where we haven’t been before...”
- Requires flexibility and communication

Lessons Learned – Advice for New Programs

- 1) Implementation Plan should include section on ‘transition –to-application’**
 - at least in general: users, applications, process to get there**
- 2) Have regular meetings (e.g., annually) with management interests**
For fishery management - both Councils and NMFS scientists
- 3) Separate Transition phase of the program, with dedicated funding**
 - Separate research and transition**
 - Don’t compromise research to meet operational constraints**
 - May require modest additional ‘directed research’**

(The above applies to marine science education, too)

Lessons Learned – Advice for New Programs

Research is this hard



Transition is this hard

