

# BASIN: Basin-scale Analysis, Synthesis, and INtegration



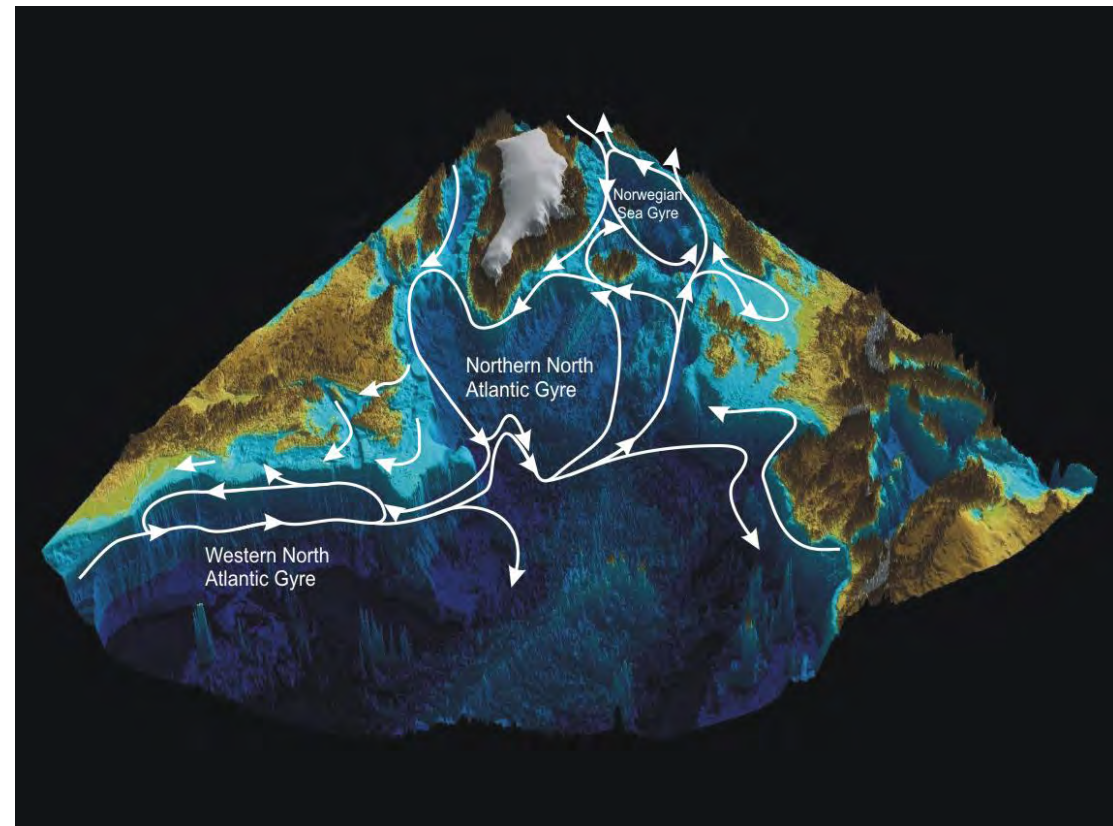
BASIN is an initiative to develop a joint EU/North American ocean ecosystem research program.

More generally, it and others are initiatives that we need on the way to understanding *“Climate Change Effects on Fish & Fisheries”*

**Cisco Werner**  
Rutgers University

**Peter Wiebe**  
Woods Hole Oceanographic Institution

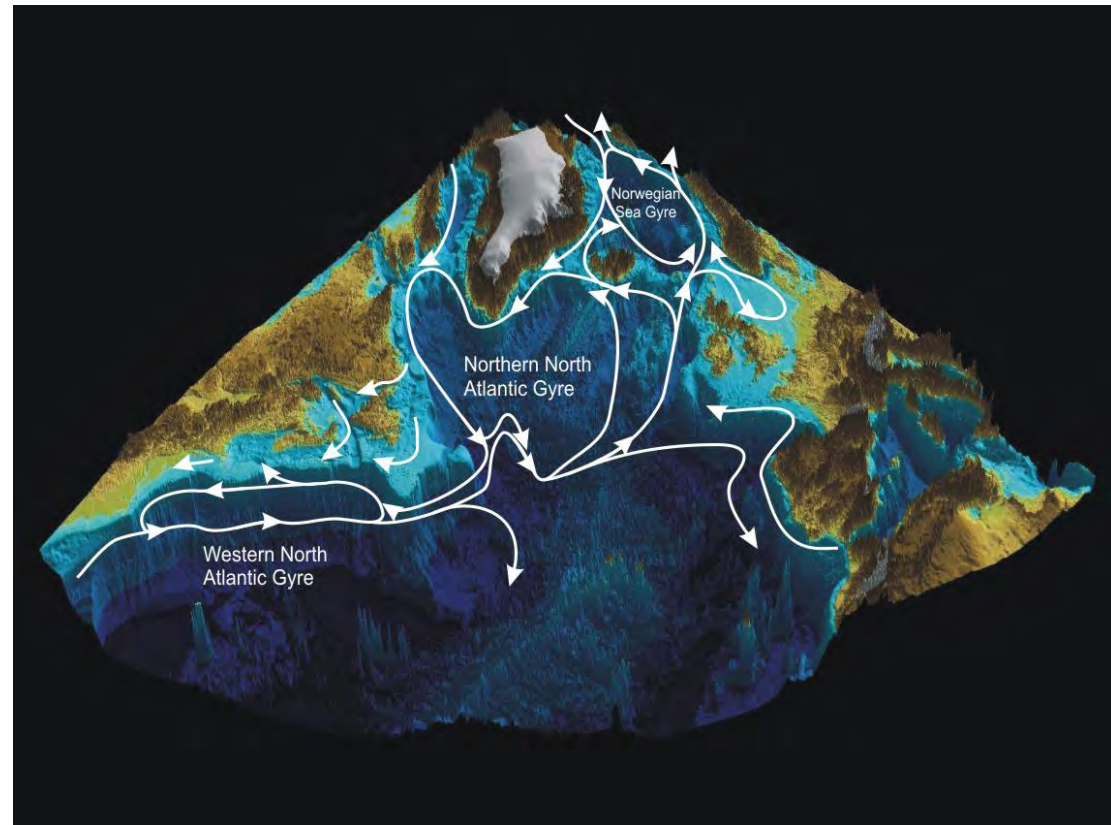
**Jon Hare**  
NOAA, National Marine Fisheries Service



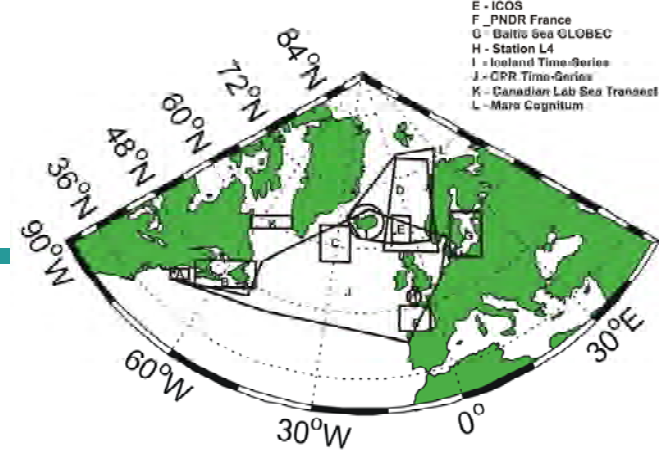
# BASIN aim

To understand and simulate the population structure and dynamics of broadly distributed and trophically important plankton and fish species in the North Atlantic ocean (including shelves) to resolve the impacts of climate variability on marine ecosystems, and thereby contribute to ocean management.

A basin-scale analysis through synthesis of observations and modeling is needed to develop ***a fundamentally new understanding of marine ecosystem dynamics.***

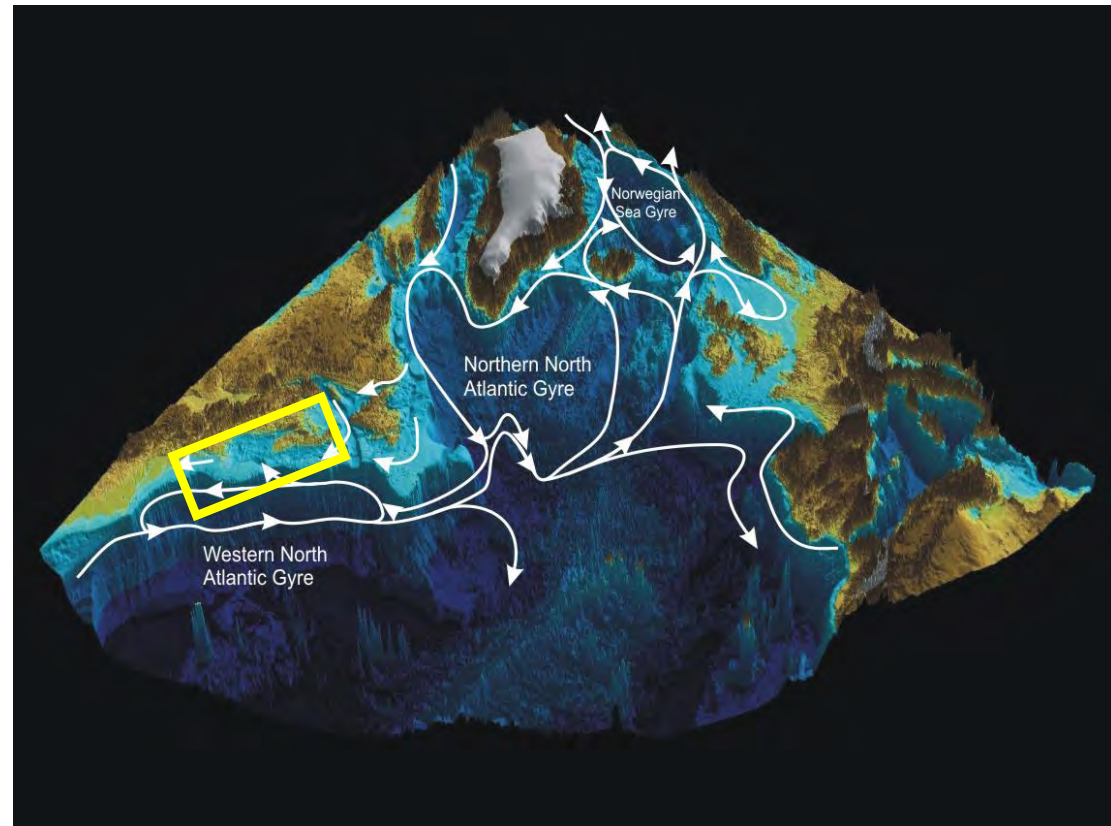


# BASIN: an outgrowth of the 1990's regional approaches

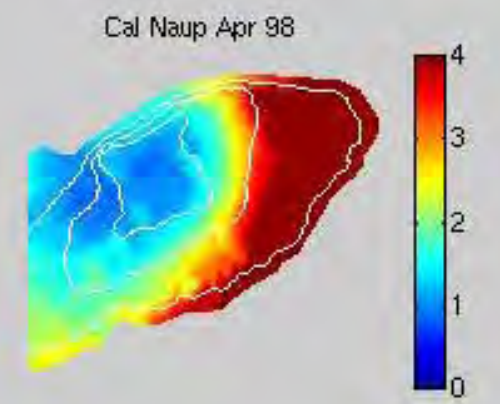
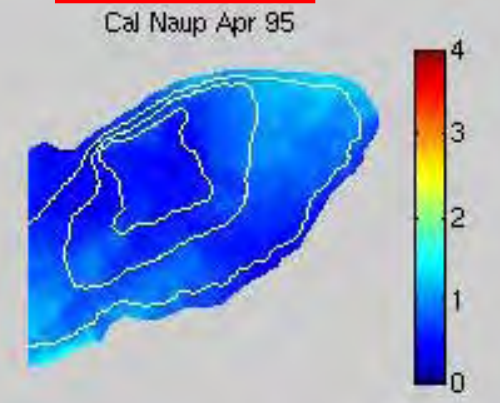
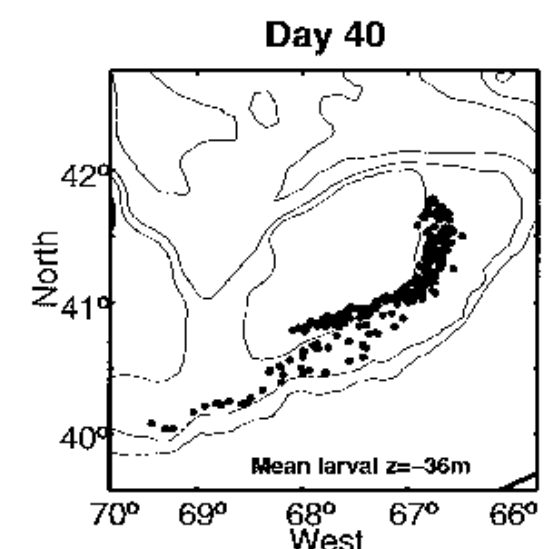
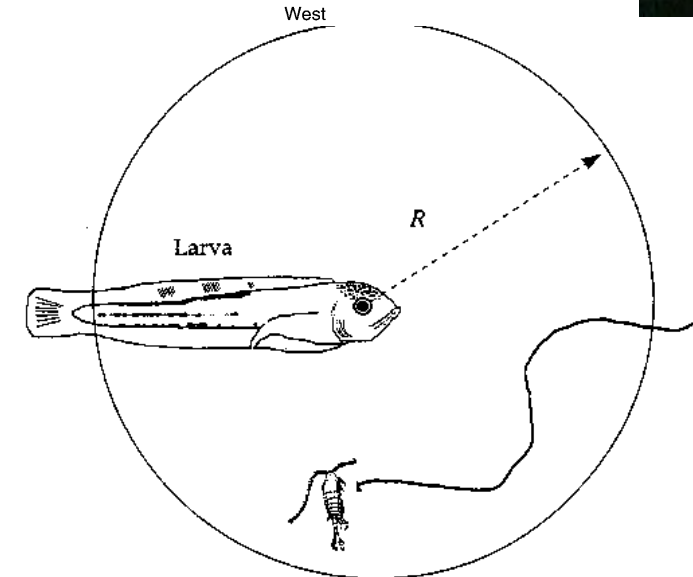
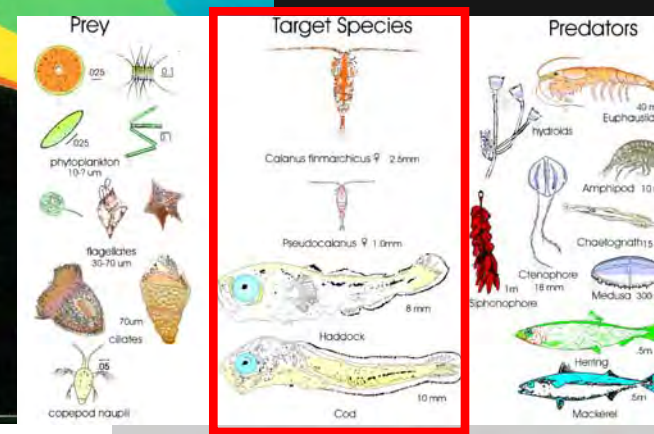
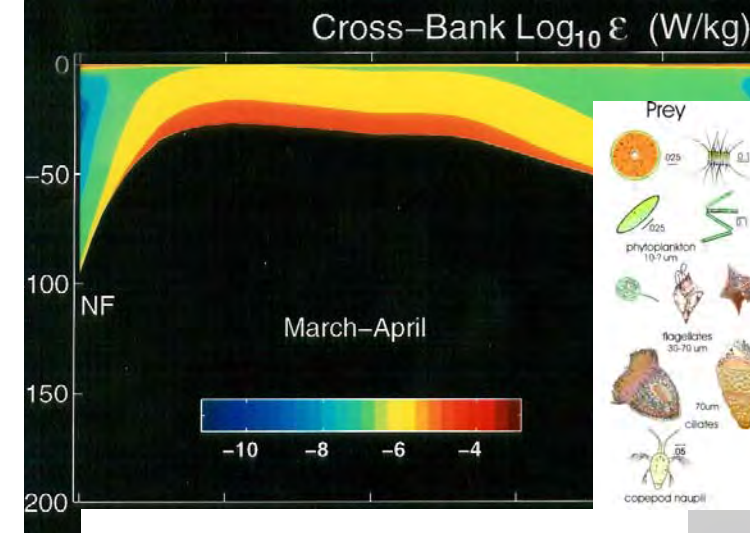
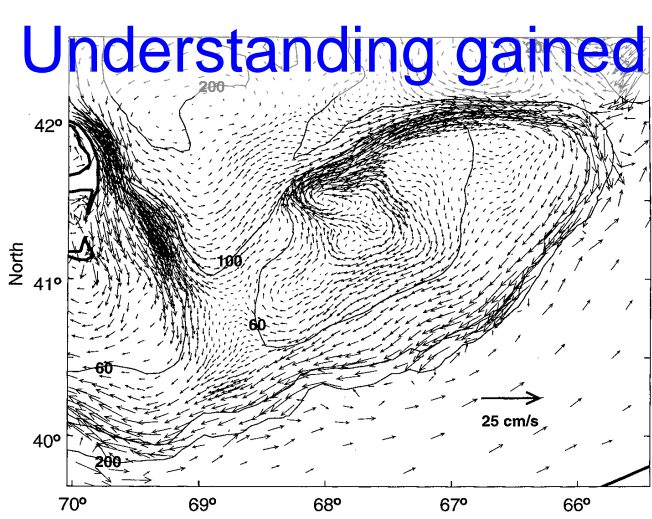


## Rationale:

- Understanding complex marine ecosystems *requires simplification (regional programs)*.
- Focus on *target species* and their dominant prey, with emphasis on individual organisms, population dynamics, and interactions with the **physical environment**, especially *as it relates to global climate change*.

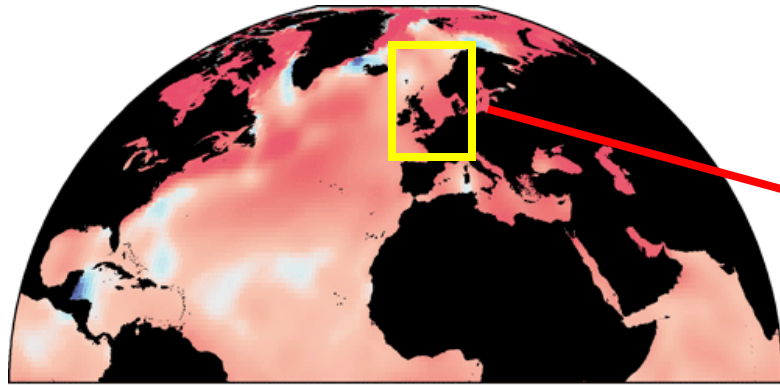


# Understanding gained



Significant steps were made, but results were still regional in scope, and uncoupled from large-scale forcing, management & human/economic dimensions.

# But, we recognize long-term & large scale changes, such as increases in North Atlantic SST and shifts in biogeography

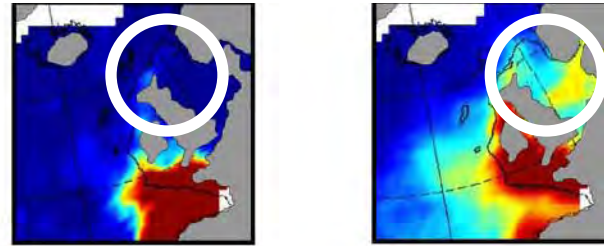


Change of SST in the North Atlantic and European marginal seas (between 1978 and 2002).

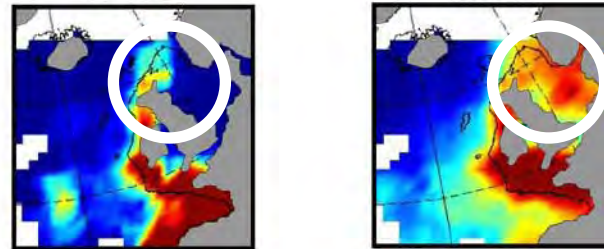
Based on the GISST data set of the British Hadley Centre. Source: PIK, based on Hadley Centre, 2003

Warm-temperate Temperate spp.

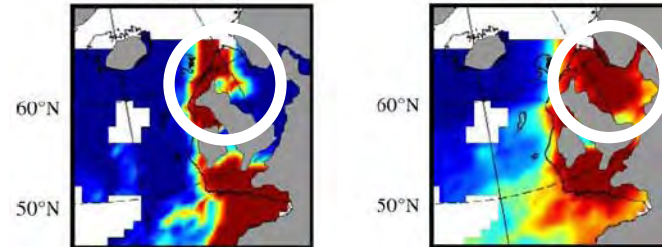
1958-1981



1982-1999



2000-2002



0.00 0.02 0.04 0.06 0.08 0.10

Mean number of species per CPR sample

0.0 0.2 0.4 0.6 0.8 1.0

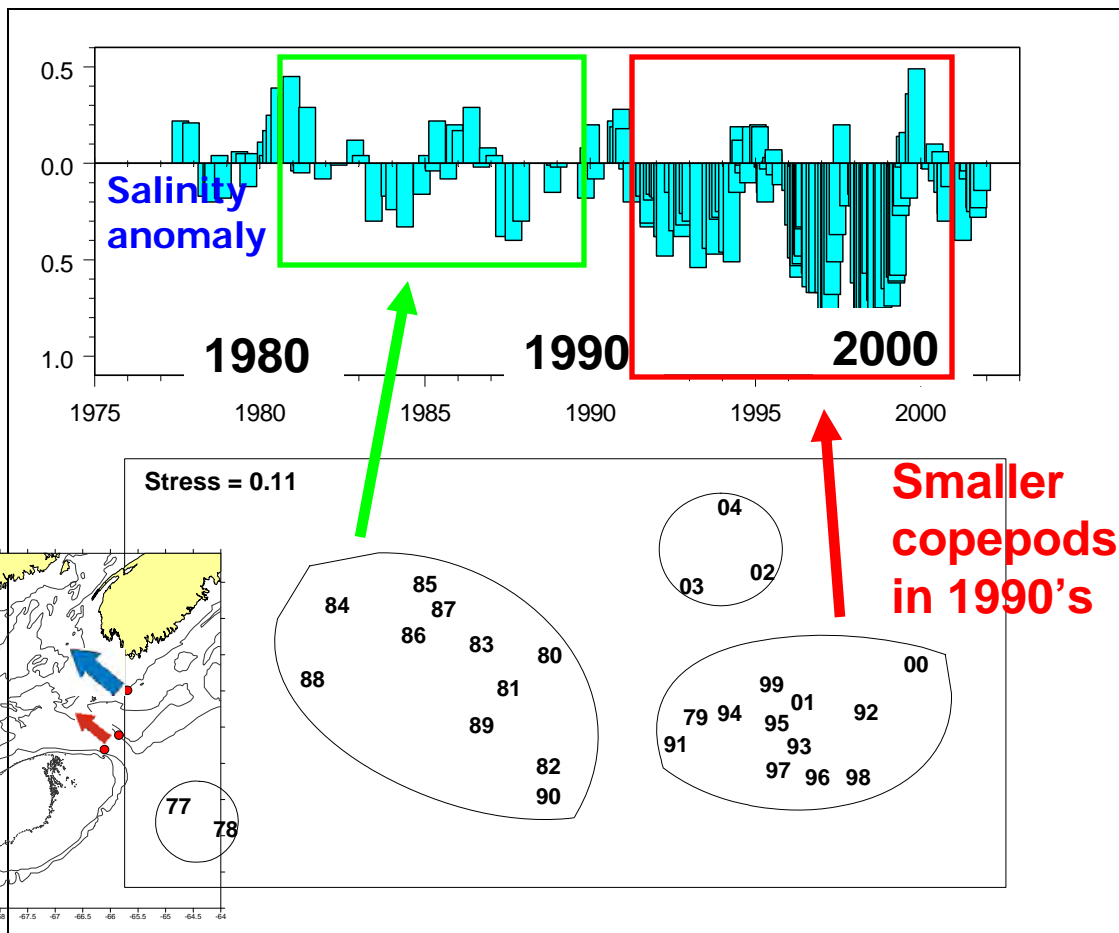
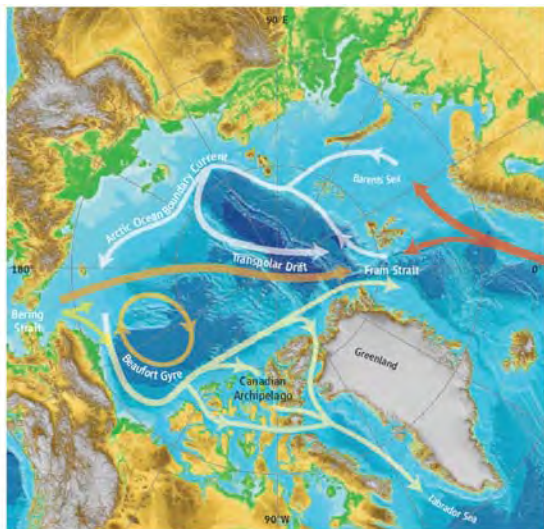
Warm-water species have extended their distribution northwards by more than 10° of latitude.

(Beaugrand, 2002)

# Northwest Atlantic region (advective effects):

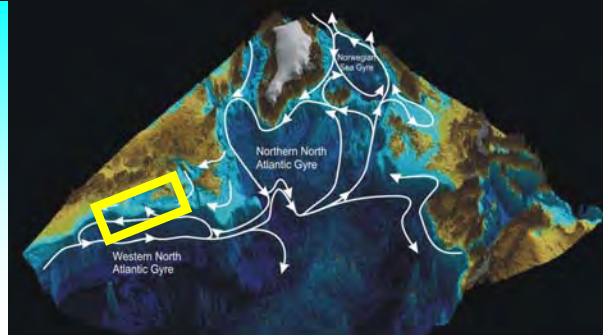
1. salinity change in 1990's has been large, and
2. change in zooplankton community structure

## Gulf of Maine / Georges Bank

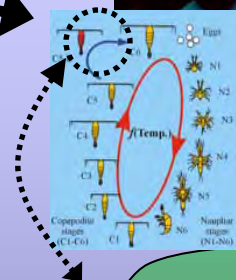
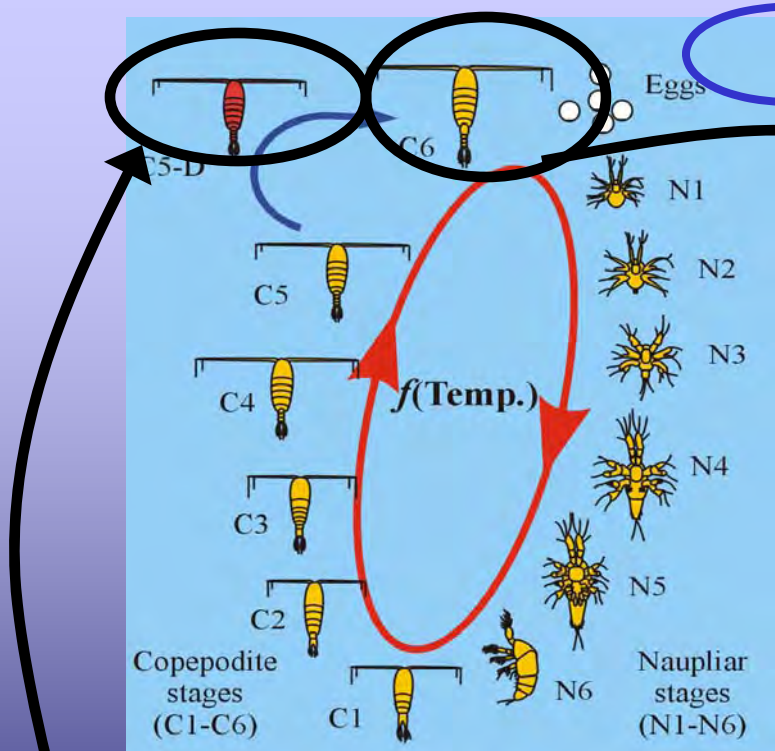


(Mountain, 2003)

# NORTH ATLANTIC OCEAN



## SHELF SEAS



Climate forcing of ocean circulation

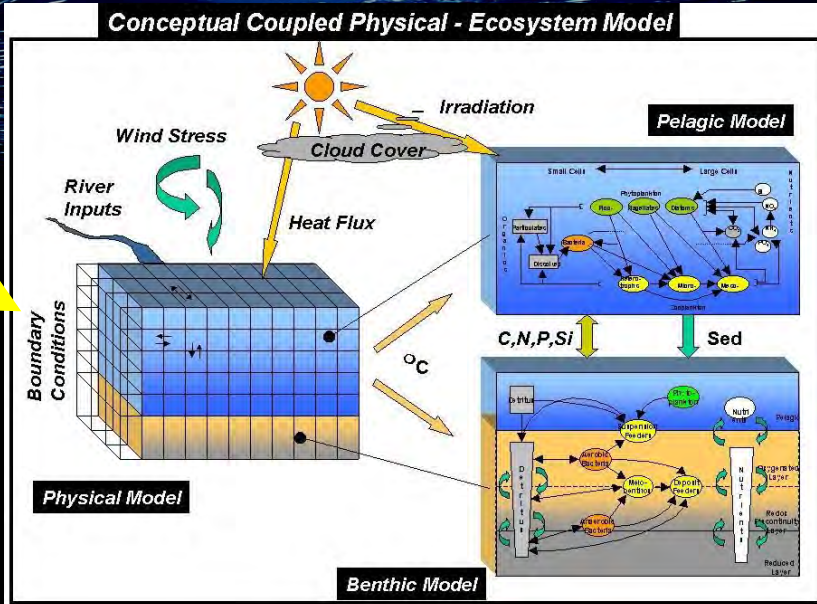
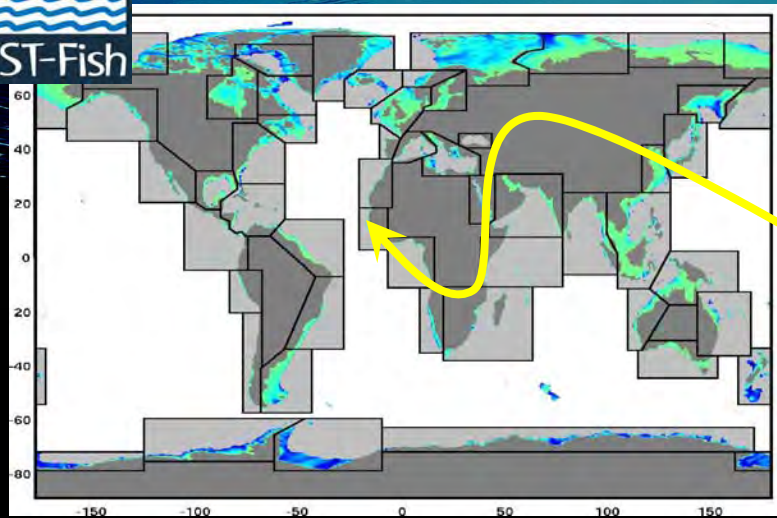
We need new basin-scale approaches for:

- Connectivity
- Shelf-ocean coupling
- Biogeochemistry (C)
- Ecosystem approaches to management

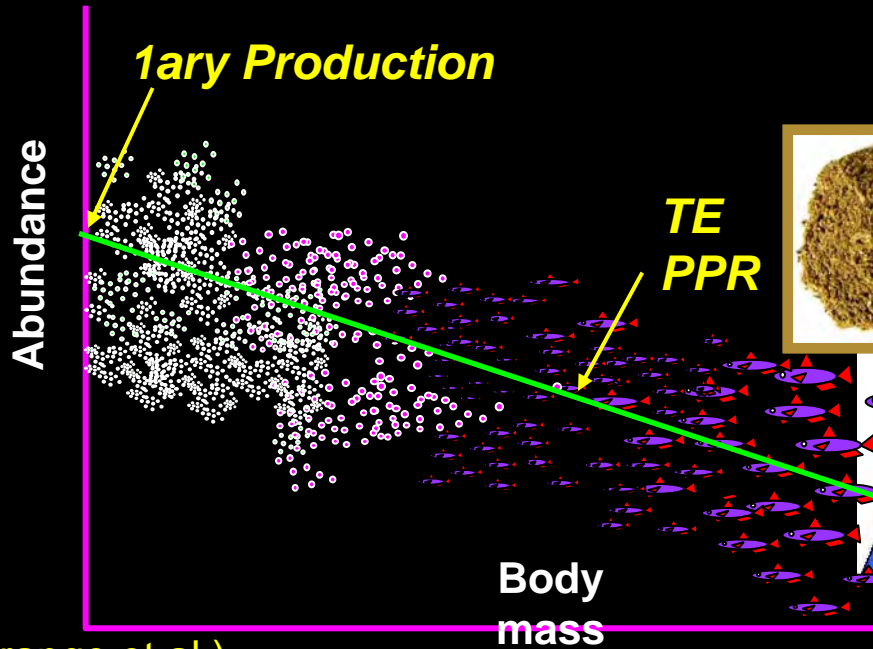


# Climate Change forcing scenarios and global markets

Model pelagic/ benthic dynamics as driven by regional hydrodynamics



Couple the shelf seas to the global ocean



Bio-economic models



(Barange et al.)





**GLOBEC**

**BASIN/FUTURE**

**QUEST-Fish**

**Earth System Models**

**BASIN** ... simulate the population structure and dynamics of ... marine ecosystems in the North Atlantic ... links to climate variability ... ocean management.

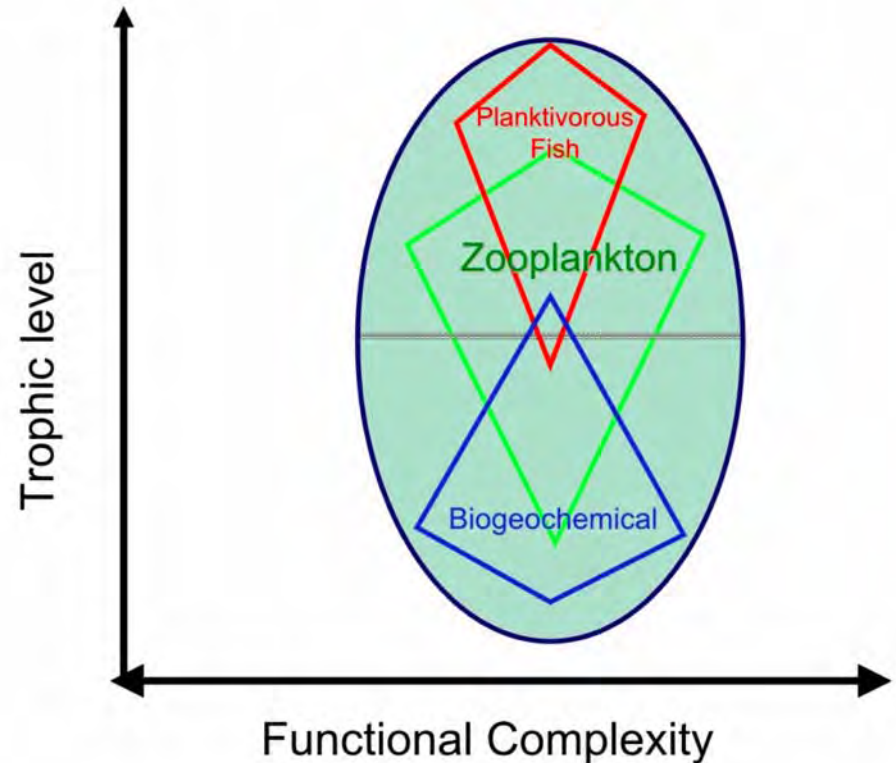
**FUTURE<sup>(\*)</sup>** ... understand how marine ecosystems in the North Pacific respond to climate change and human activities ... forecast ...communicate to ... governments, stakeholders and the public.

**(\*)FUTURE: Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Ecosystems**

# BASIN's modeling elements (integration across models):



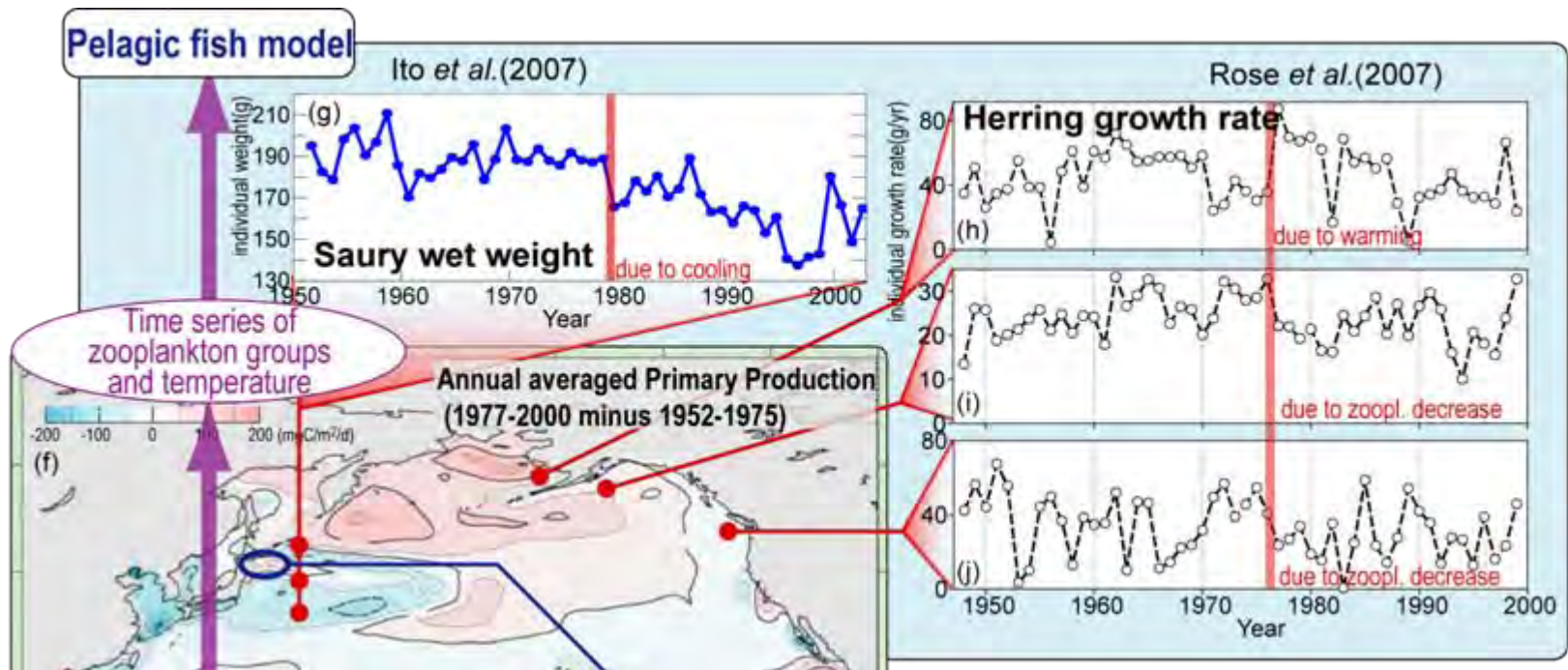
- Integration across trophic levels through the development of a suite of models that capture the relevant ecosystem and biogeochemical dynamics;
- development of a common framework (as in ESMF\*) to maximize model interoperability;



\*ESMF: Earth System Modeling Framework

# BASIN's modeling elements (need for retrospective analysis):

- establishment of an Ecological Model Intercomparison (ECOMIP) project;
- a 50-year ecological hindcast and analysis effort using data-assimilative models;

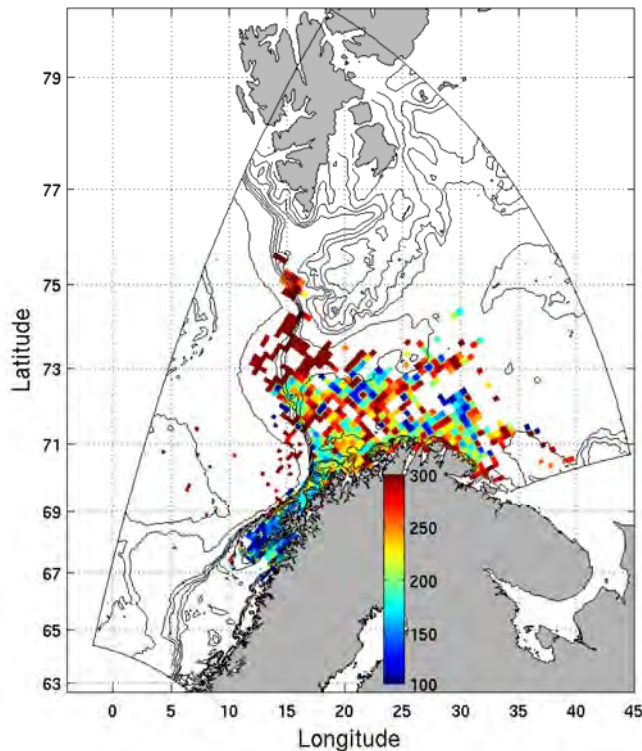


(Yamanaka et al.)

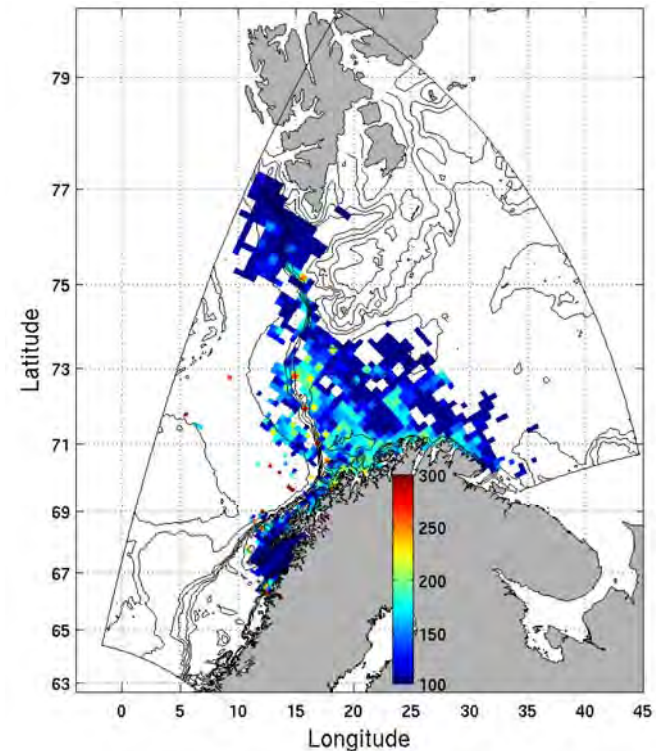
# BASIN's modeling elements (scenario development):



- Future scenarios including responses of the ocean with respect to temperature, salinity, currents, etc., that drive models of ocean biology and biogeochemistry



**Ctrl run**

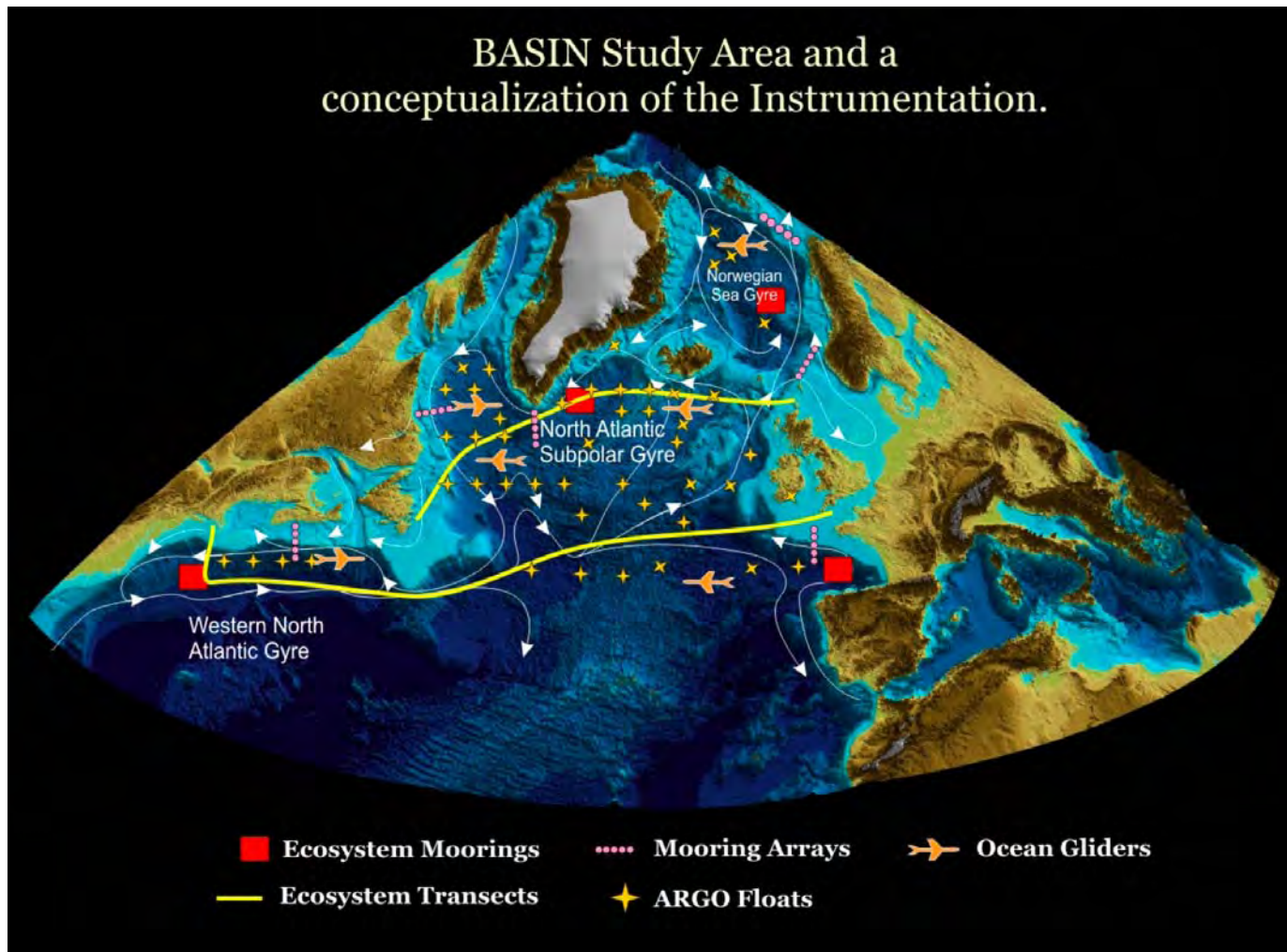


**+50 run**

# BASIN's modeling elements (model-obs-data fusion):



- Observing System Simulation Experiments (OSSEs) to optimize the design of field sampling and long-term monitoring across the basin.



# (10 year) Program Elements

---

## Data

Assembly  
Integration  
Analysis  
Synthesis

## Modeling

Coupled phys/bio  
Hindcasts  
Forecasts  
OSSEs\*



## New Data

Biota  
Distribution  
Abundance  
Process  
Biogeochemistry

## Management

Focus on science  
for ecosystem approaches  
to fisheries

\*Observation System Simulation Experiments

# Programmatic challenges:



- Development of joint proposals?
- How will they be evaluated and funded?

Presently:

**On EU side:** One proposal with ~25 institutions will (likely) be funded.

Funding 4 yrs, €14M total:

€7M with and additional €7M in institutional match

**On the US side:** new proposals to NSF/NOAA linked to EU project.

Submissions this summer (Workshop in June, 2010).

**On the Canadian side:** contributing existing programs

# Needs



- Move from regional to basin-scale studies
  - 10 year programs: BASIN & FUTURE
- “Walk before we start running”:
  - Systematic & collaborative modeling, laboratory and observational activities
  - Field program and sustained observations (through OSSEs) to collect data to:
    - Parameterize models
    - Provide evaluation
    - Estimate/reduce uncertainty
- Integrate research results with scientific advice to improve ocean resource management
- Resolve international program & funding structures



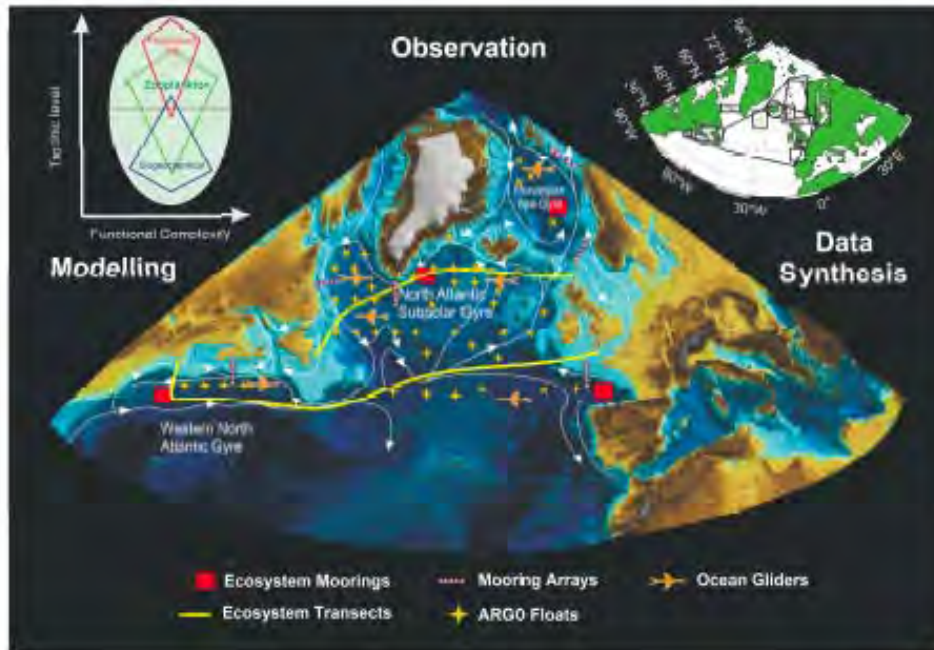


<http://www.globec.org/structure/multinational/basin/basin.htm>

## BASIN: Basin-scale Analysis, Synthesis, and INtegration

An international programme to resolve the impact of climatic processes on ecosystems of the North Atlantic basin and shelf seas

## Science Plan and Implementation Strategy



**Acknowledgments:** Support for BASIN workshops was provided by NSF, NOAA, the European Union EUR-OCEANS Network of Excellence, the EU Sixth Framework Program (Specific Support Actions), DFO and NSERC (Canada).





GLOBEC

**BASIN/FUTURE**

QUEST.FISH

Earth System Models

**BASIN**'s aims are to understand and simulate the population structure and dynamics of broadly distributed and trophically important plankton and fish species in the North Atlantic ocean to resolve the impacts of climate variability on marine ecosystems, and thereby contribute to ocean management.

**FUTURE**<sup>(\*)</sup> is an integrative Scientific Program undertaken by the member nations and affiliates of PICES to understand how marine ecosystems in the North Pacific respond to climate change and human activities, to forecast ecosystem status based on a contemporary understanding of how nature functions, and to communicate new insights to its members, governments, stakeholders and the public.

<sup>(\*)</sup>**FUTURE**: **F**orecasting and **U**nderstanding **T**rends, **U**ncertainty and **R**esponses of North Pacific **E**cosystems

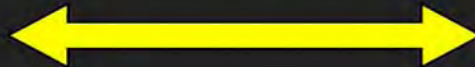
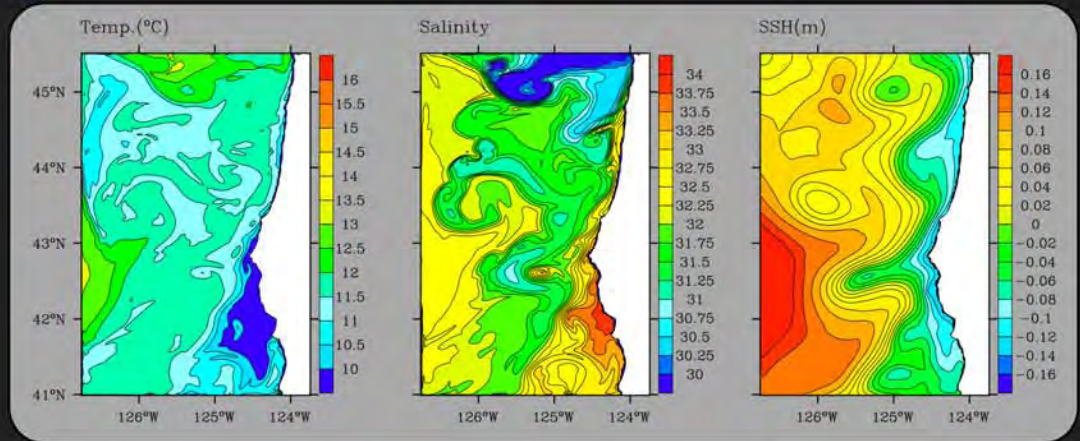
NCAR-CCSM Global Climate Model



Dynamical two-way downscaling

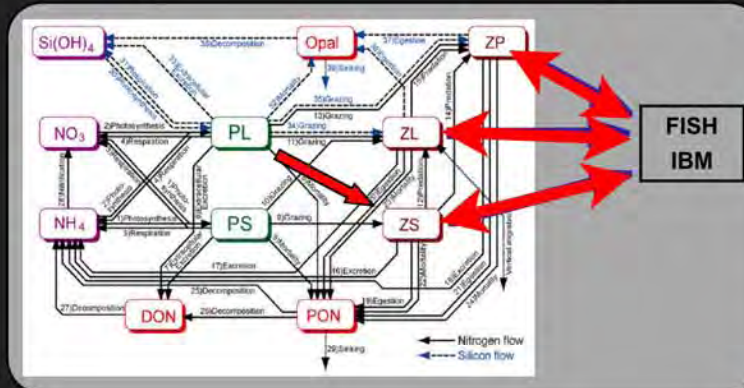


ROMS regional ocean model



Tightly coupled to lower and upper trophic level models

NEMURO NPZD and Individual Based Model



# Need for basin-scale North Atlantic studies



- Connectivity in the North Atlantic is determined by the large-scale gyres that span the basin.
- Basin-scale forcing impacts biogeography and ecosystem structure and function both locally and across the entire region.
- The North Atlantic system is a key ocean basin globally for the sequestration of carbon.
- The ecosystem approach to management of widely distributed fish and other key species requires a basin-scale approach.