EURO-BASIN
Integrated Modelling

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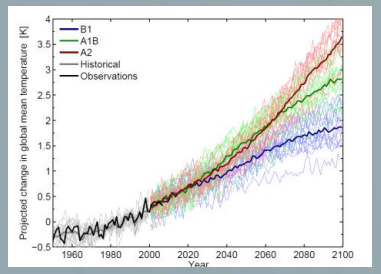
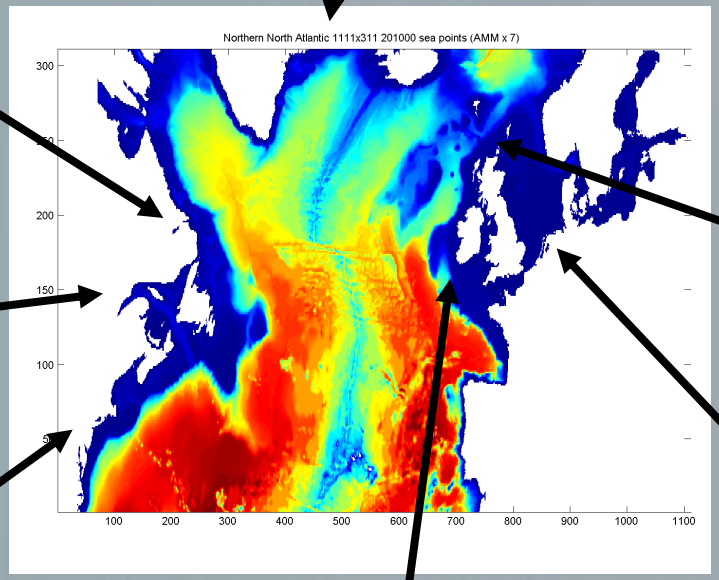
Rutgers June 2010

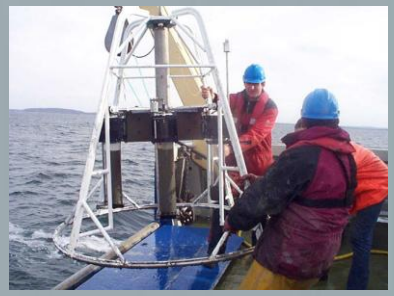
Challenges
North Atlantic Ocean Ecosystem Goods and Services

Climate



Biogeochemical Cycling





Basin Scale Connectivity

Ocean Acidification

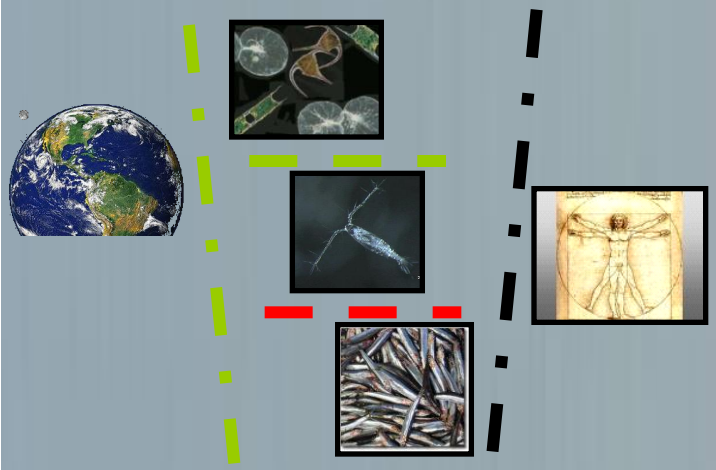
Observed changes In plankton distributions

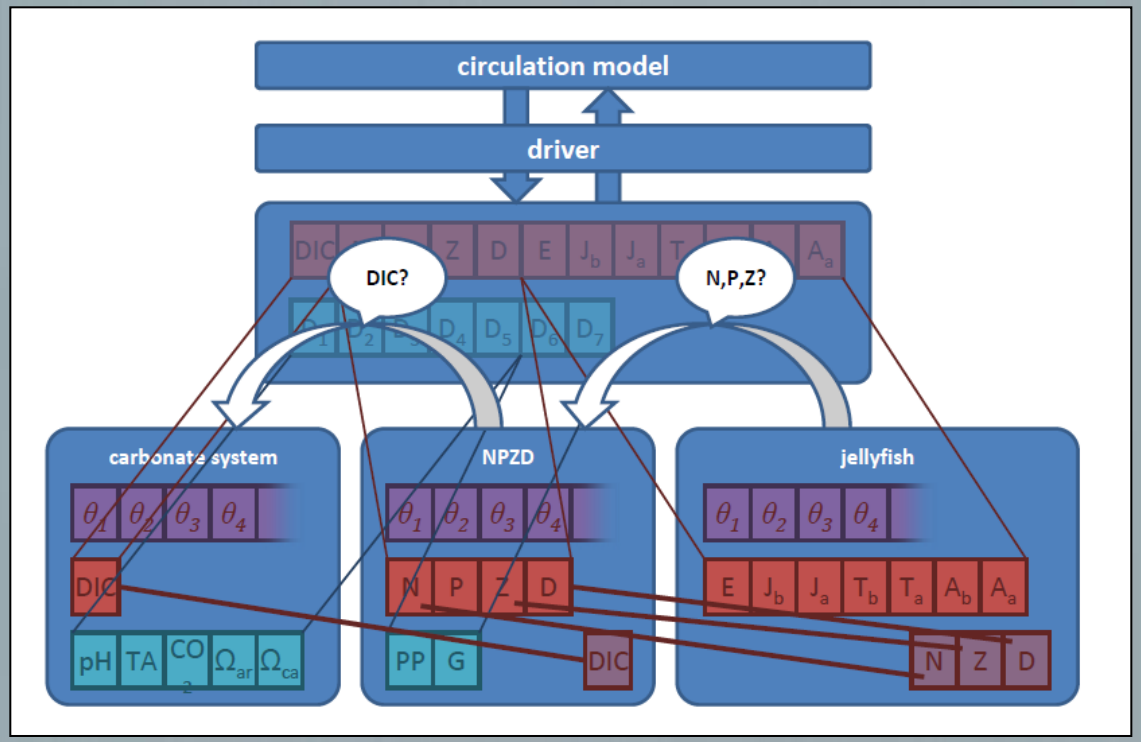
Observed reduction in CO_2 sink

Fisheries

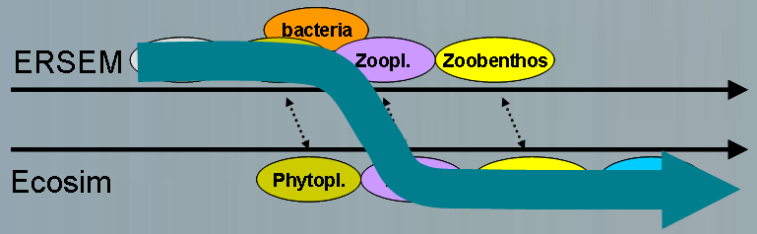
Eutrophication

Challenges: Coupled Models





Crossing the Boundaries: 2 way Couplers

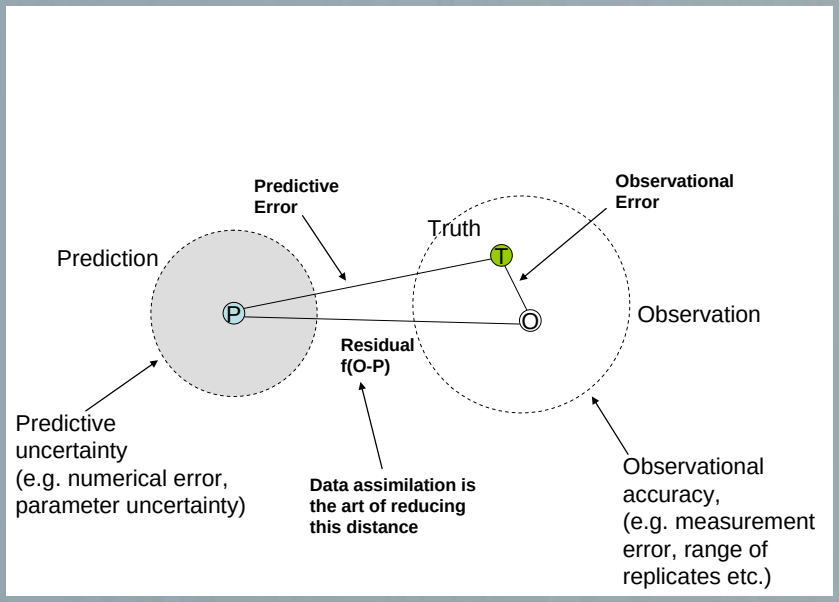


1960 Evaluated Hindcast 2000 Forecast…… 2050 2100

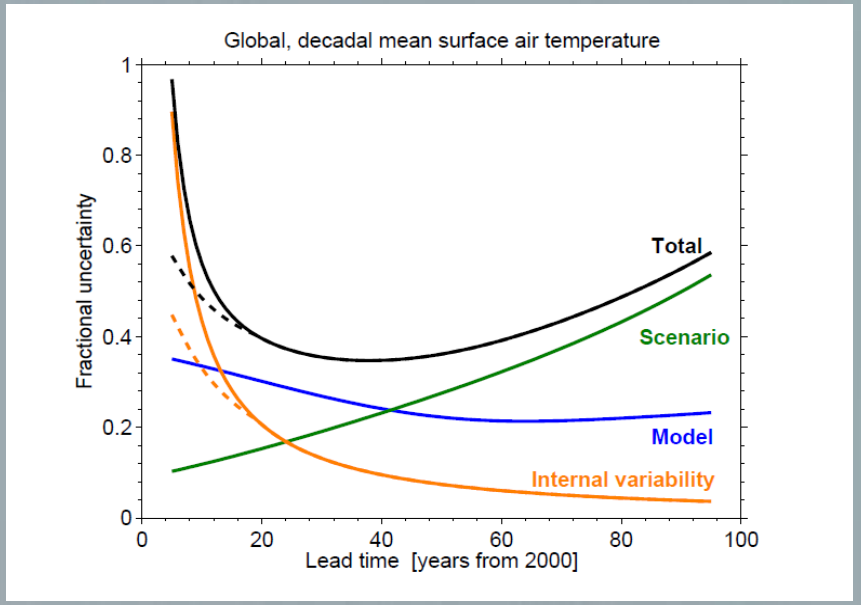
Challenges: How Good are the Simulations

If we are to use our simulations either for science or policy applications we need to understand and be able to articulate their quality.

Model Skill Assessment



Quantification of Uncertainty



Sources

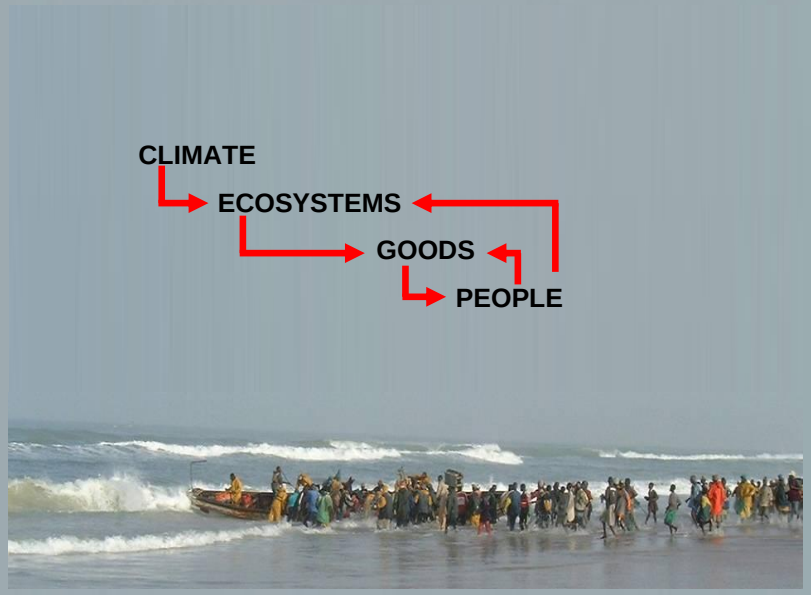
- *Scenario uncertainty*
- *Structural/parameter uncertainty*
- *Natural variability (attribution to global change)*

The Policy Challenge

Marine Ecosystem Evolution in a Changing Environment

Indicators of Good Environmental Status (GES)

1) ***Biological diversity***
2) ***Non-indigenous species***
3) ***Commercially exploited fish and shellfish***
4) ***Marine food webs***
5) ***Human-induced eutrophication***
6) *Sea floor integrity*
7) ***Hydrographical conditions***
8) ***Contaminants***
9) *Contaminants in fish and other seafood for human consumption*
10) *Marine litter*
11) *Introduction of energy including underwater noise*



+ Common Fisheries Policy
&
Maritime Strategy

1960 Evaluated Hindcast 2000 | Forecast…… 2050 2100

Overall Objective

- To describe, understand and predict the impact of climate change and variability and mans activity (fisheries) on marine ecosystem structure and function in the North Atlantic Ocean and shelf seas.

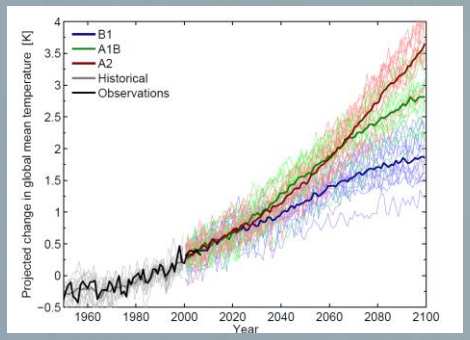
- Basin-scale modelling approach, simulating the response of marine ecosystems by considering four classes of experiment using coupled physical-biogeochemical-MTL models:

  – re-analysis forced simulations,
  – climate-scenario forced simulations,
  – top down control perturbation experiments and
  – a fully coupled end to end ecosystem model.

The integrative modelling objectives are:

- To simulate how changes in the climate induced changes in the hydrodynamics of the North Atlantic have impacted on ecosystem productivity, structure and function (T6.1)
- To understand and quantify the impact of key physical processes (meso-scale eddies, cross shelf exchanges and fluxes, winter convection) and their relative importance to the overall primary and secondary production and sequestration of carbon at the basin-scale (T6.2)
- To understand how bio geographic regions are maintained in the North Atlantic and how will they change with climate change (T6.3)
- To improve our understanding and quantify the basin-scale variability of the impact of top down (grazing) control on phytoplankton community composition and hence the sensitivity of biogeochemical cycling and the biological carbon pump?
- Are biogeochemical cycles in the North Atlantic sensitive to changes in fisheries management strategy?
- Contribute to an assembly of key species and ecosystem indicators for synthesis in WP8 Advancing Ocean Management.

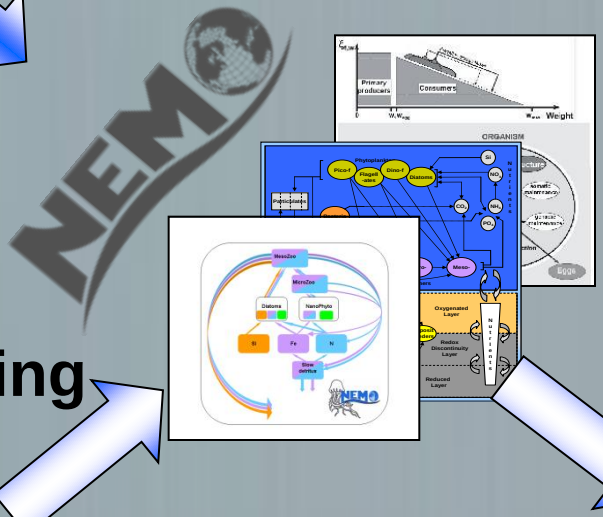
Building the Tools: Library of Coupled Models



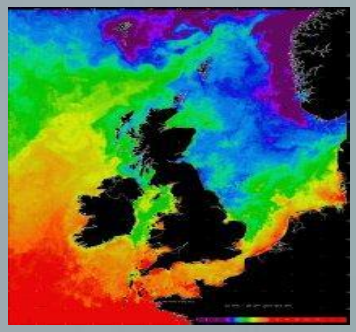
Climate Forcing

- Global
- Regional Downscale?

Ecosystem Modelling Framework



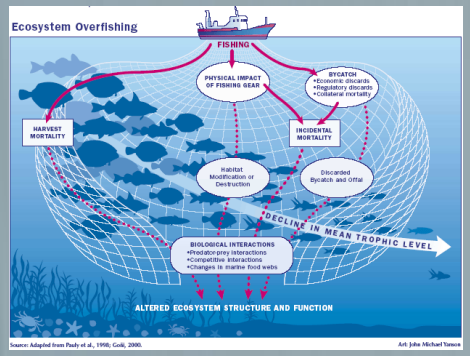
Observations



Skill Assessment

Anthropogenic Forcing

- Nutrient Loads
- Fishing pressure

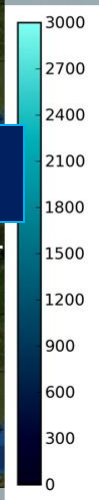


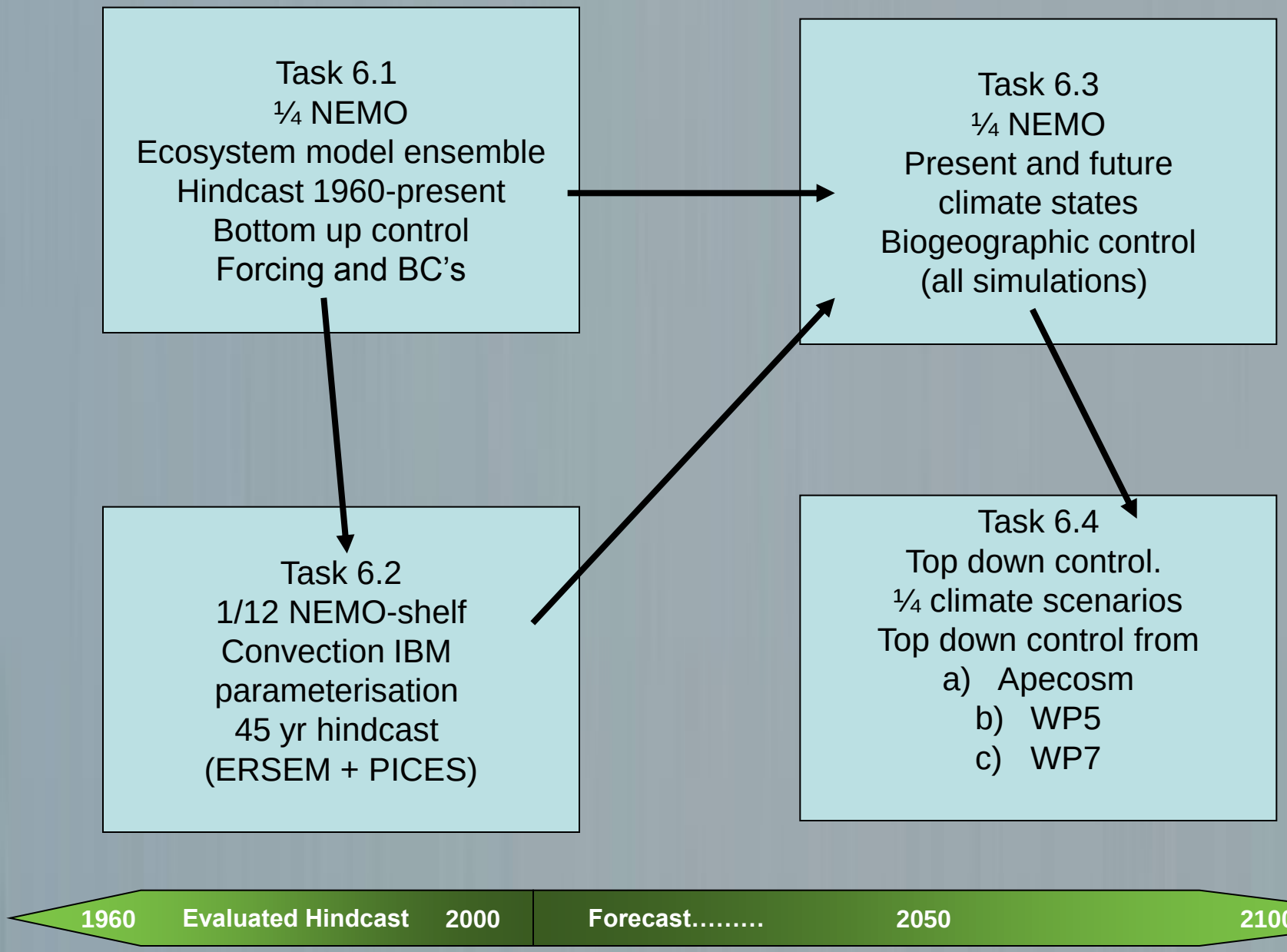
Quantification of Uncertainty

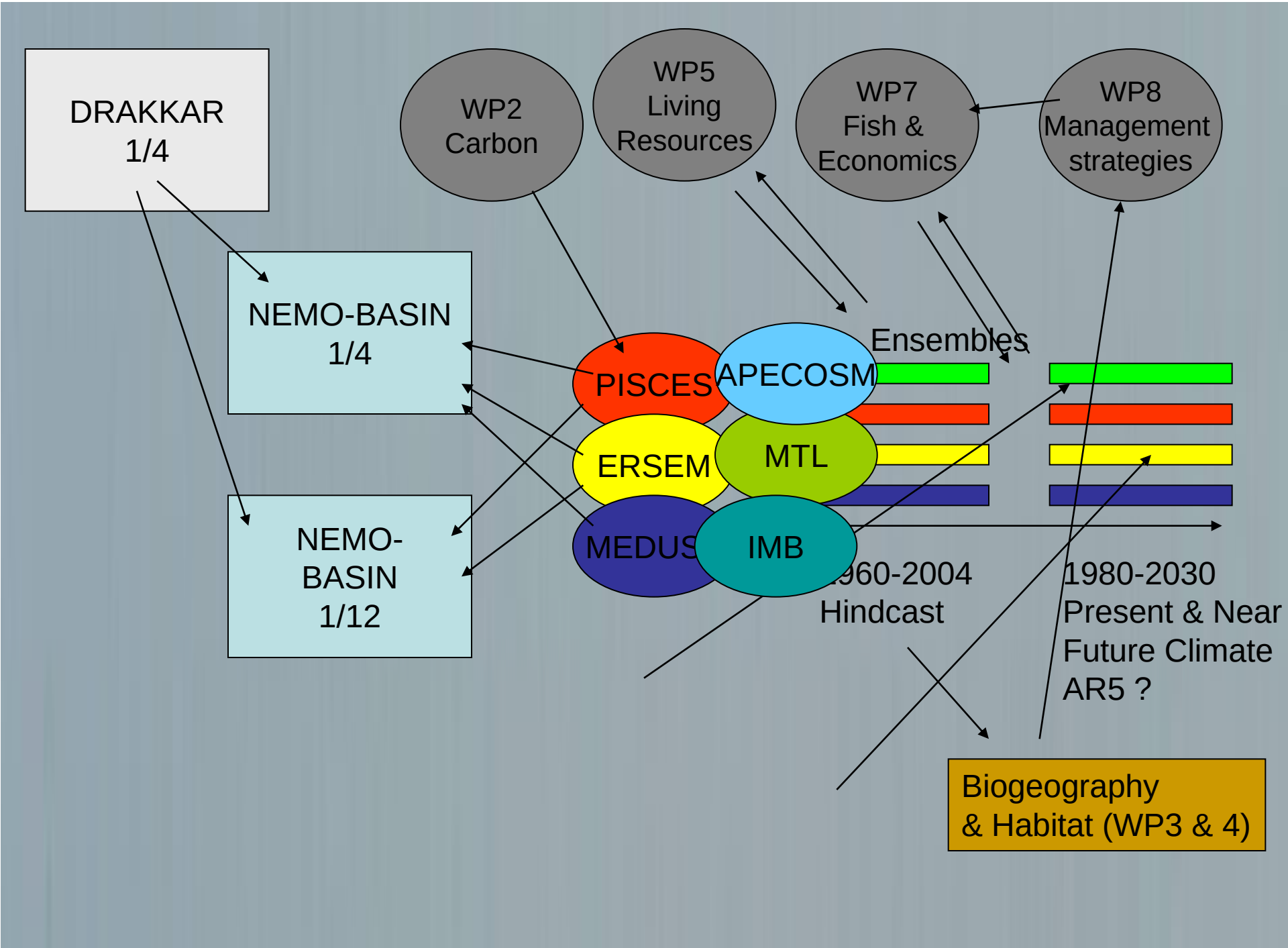
Ecosystem Structure &
Parameter
Physical scales
Forcing
Natural

Ensembles

Scenarios




Task 6.1
¼ NEMO
Ecosystem model ensemble
Hindcast 1960-present
Bottom up control
Forcing and BC's
Task 6.3
¼ NEMO
Present and future
climate states
Biogeographic control
(all simulations)
Task 6.2
1/12 NEMO-shelf
Convection IBM
parameterisation
45 yr hindcast
(ERSEM + PICES)
Task 6.4
Top down control.
¼ climate scenarios
Top down control from
a) Apecosm
b) WP5
c) WP7
1960
Evaluated Hindcast
2000
Forecast……
2050
2100


DRAKKAR
1/4
WP2
Carbon
WP5
Living
Resources
WP7
Fish &
Economics
WP8
Management
strategies
NEMO-BASIN
1/4
NEMO-
BASIN
1/12
PISCES
APECOSM
ERSEM
MTL
MEDUS
IMB
Ensembles
960-2004
Hindcast
1980-2030
Present & Near
Future Climate
AR5 ?
Biogeography
& Habitat (WP3 & 4)

The Partnership

- PML: Icarus Allen WP leader
  - ERSEM-NEMO, Model Uncertainty
- NOC-Southampton Tom Anderson
  - MEDUSA-NEMO
- NOC Liverpool Jason Holt
  - 1/12 NEMO shelf
- IUEM/CNRS: Laurent Memery / Olivier Aumont
  - PISCES-NEMO, APECOSM
- U Hamburg: Jan Backhaus
  - Convection IBM
- IMR Bergen: Geir Huse
  - copepod -IBM
- IMS-METU: Baris Salihoglu
  - 1/12 shelf, C export
- CLS Patrick Lehodey
  - MTL-Seapodym

~1.1M Euro EC contribution

Hooks

- Contribute to the ensemble
- Structural uncertainty
- Role of climate
- Controls on C export flux
- Top down control
- Processes behind bio-geographic shifts
- Predicting future states
- Feedbacks of mans activity on basin scale C budget
- Links to mid trophic levels

Advances in Marine Ecosystem Modelling Research III

- Call for abstracts
  - opens Sept 2010
  - Closes Jan 2011
- 26-29th June 2011 Plymouth
- BASIN modelling session?

Marine Ecosystem Change: a multiple driver problem requires ecosystem approach