Towards a common framework for socio-ecological marginal seas research

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IMBER

futureearth coasts
land-ocean interactions in the coastal zone

Knowledge for sustainability in a changing climate

SKLEC-NIVA
Centre for Marine and Coastal Research

NIVA

State Administration of Foreign Experts Affairs
中华人民共和国国家外国专家局

SKLEC

河口海岸学国家重点实验室
State key Laboratory of Estuarine and Coastal Research

2.3 GRAND CHALLENGE III –IMPROVING AND ACHIEVING SUSTAINABLE OCEAN GOVERNANCE

Overarching Research Question

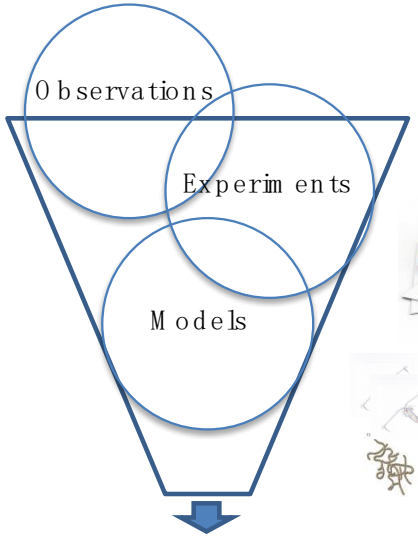
How can integrating research across the natural and social sciences and humanities improve our understanding and response to the impacts of global marine change in relation to the livelihood and well-being of coastal and maritime communities?

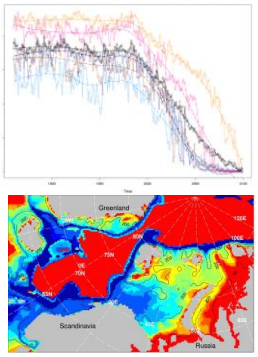
Future Earth Coasts

- to support the delivery of science-derived solutions that address global environmental and societal challenges, and designed to broaden global change science to promote a transition to sustainability.

  Equity | Justice | Resilience | Economic opportunity | Infrastructure development | Ecological management |

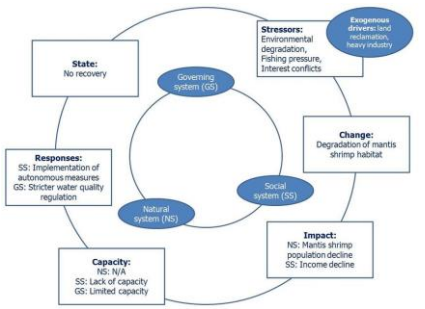
The traditional view for scientific provision for managing and optimising marginal seas services

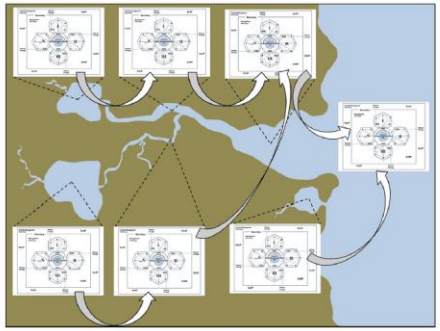




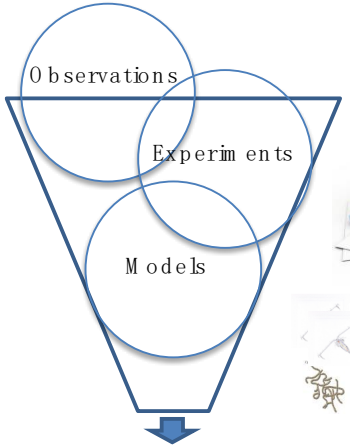
Ecosystem → Stressor database → Ecosystem Response → Projections → Stakeholders

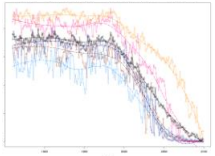
A strategy for managing and optimising marginal seas services

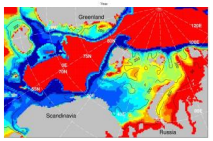




DAPSI-W(R)M IMBeR-ADApT





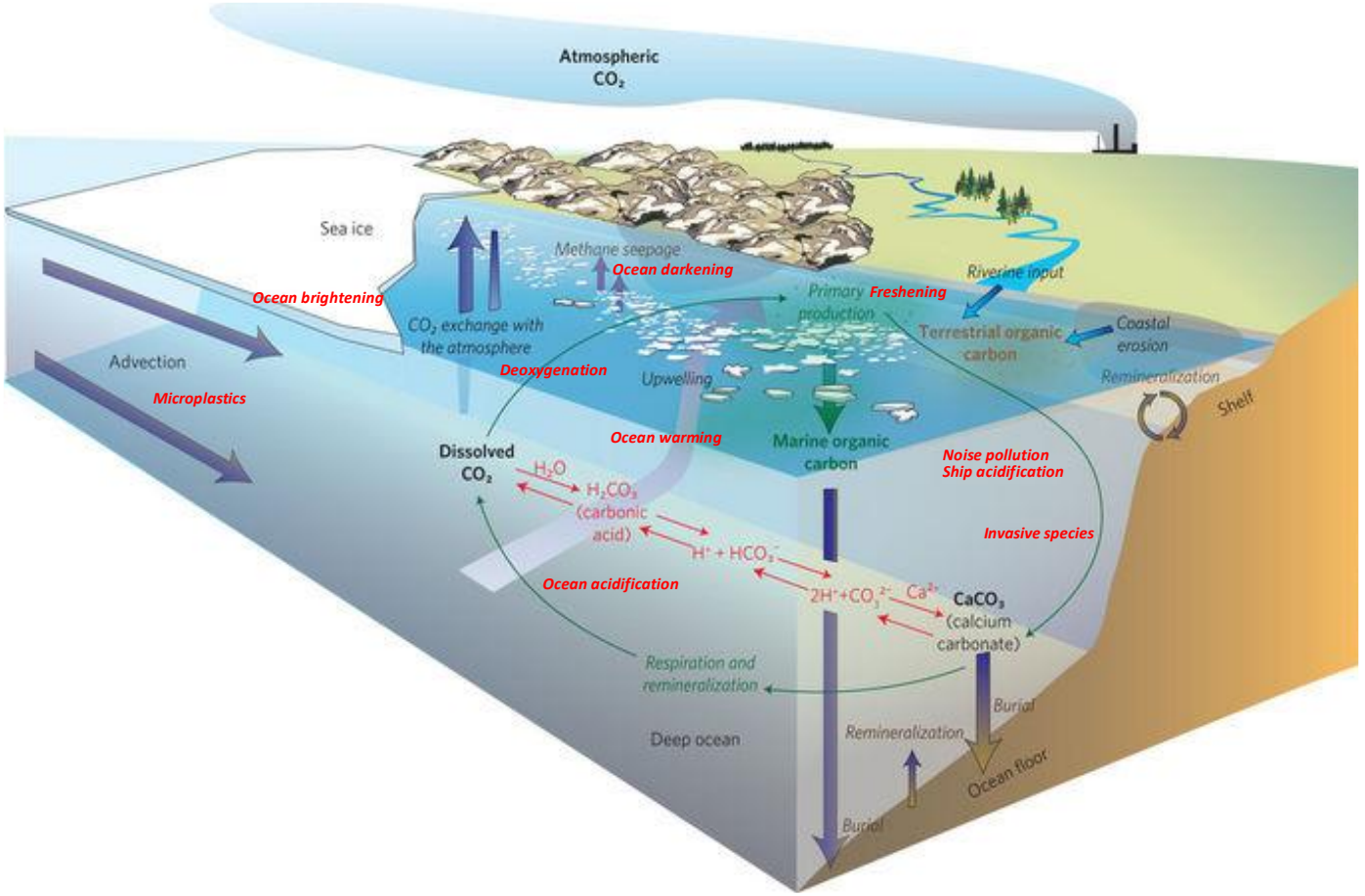


Stakeholders → Ecosystem service → Stressor database → Ecosystem Response → Projections → Stakeholders

Optimised boundary conditions

Arctic Case studies

The Arctic Ocean ecosystem is coming under increasing pressure from multiple stressors



Adapted from Bellerby et al., 2017. Nature Climate Change

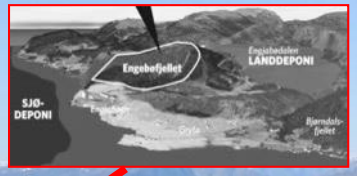
Studies of the beautiful Arctic fjords

Activities that impact the coastal system

Regulated by 14 laws managed by local, regional and national government agencies
How to achieve adaptive co-management?

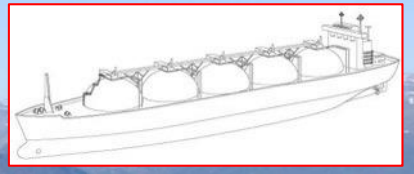
Hydro-electric power

Mining

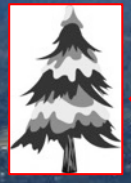


Fish farming

International shipping

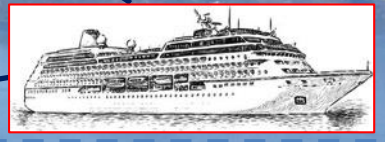


Agriculture pollution



Forestry

National Salmon fjords



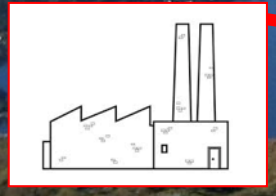
Cruise tourism

Marine protected areas

Municipal land-use planning

Leisure boating

Commercial fishery



Industry pollution

Leisure hunting and fishing

Kelp trawling

Sewage

Our starting point

How local stakeholders view the impacts of multistressors such as climate change, ocean acidification, jellyfish blooms and aquaculture

Identify the ecosystem services that are most relevant to local people

Stakeholder meetings

Stakeholder meetings

e.g. Fisherman, local government, tourist industry, tourists, local residents, local and regional government and NGOs

They provided local advice on ecosystem services, scales of process, local and national regulation...

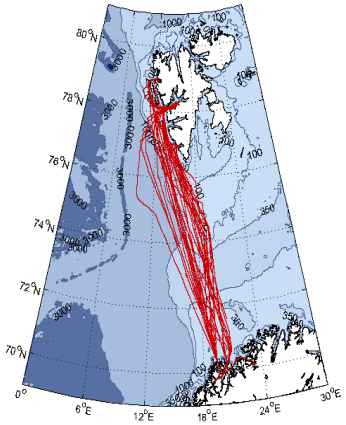
Local observations

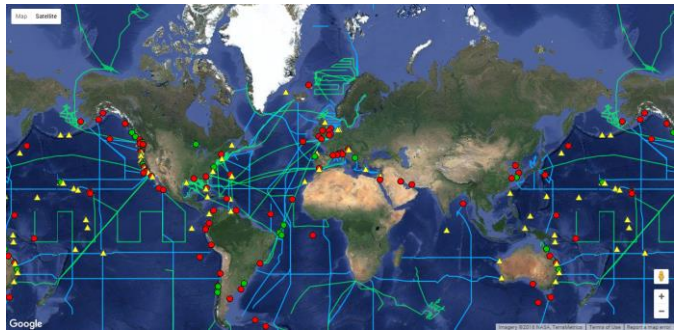
Community sampling

Dedicated cruises

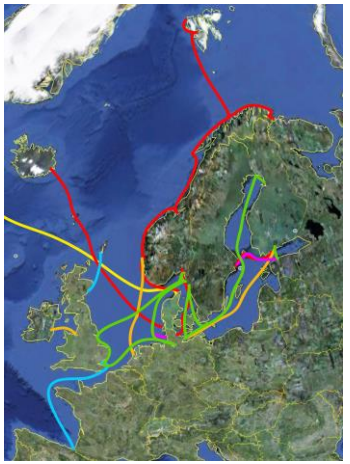
Monitoring and data archaeology

National network in coastal and open waters



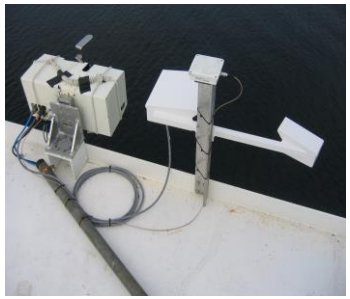


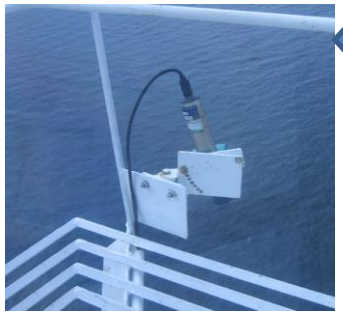
Part of the global (GOA-ON) and European Network (FerryBox, Copernicus)



High frequency measurements all year round

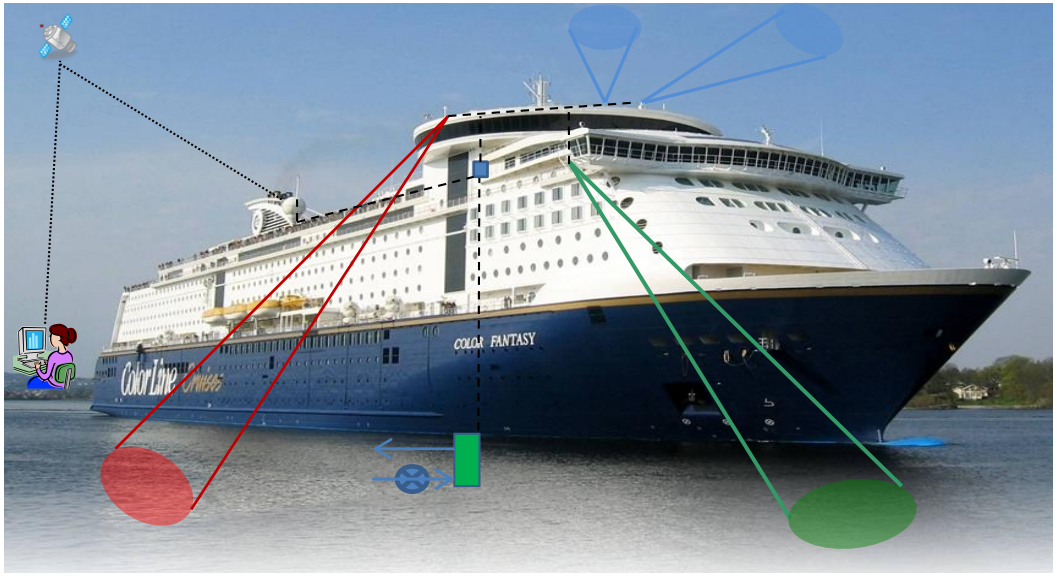
Multistressors from ships of opportunity





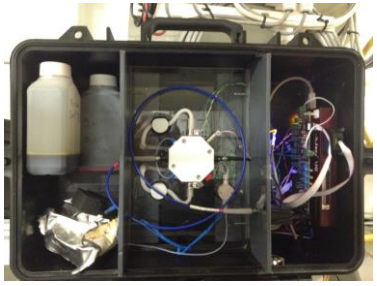
Deck sensors
SST radiomters
True wind and air pressure
Total radiation
Downwelling radiance
Ocean colour

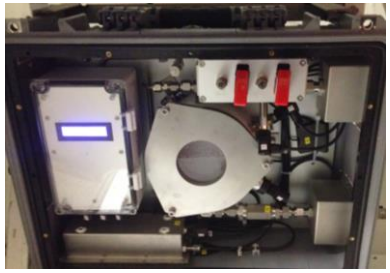
Water sensors
Temperature
Salinity
Oxygen
Chlorophyll-a fluor
Phycocyan. Fluor.
Particles
cDOM
Oil-fluor./PAH
pH and pCO_2

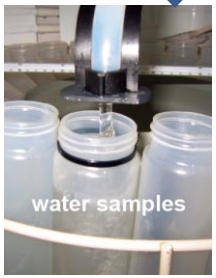


Water sampling
Chlorophyll-a, turbidity,
Nutrients, Part. C, N, P
Algae taxonomi e.g.

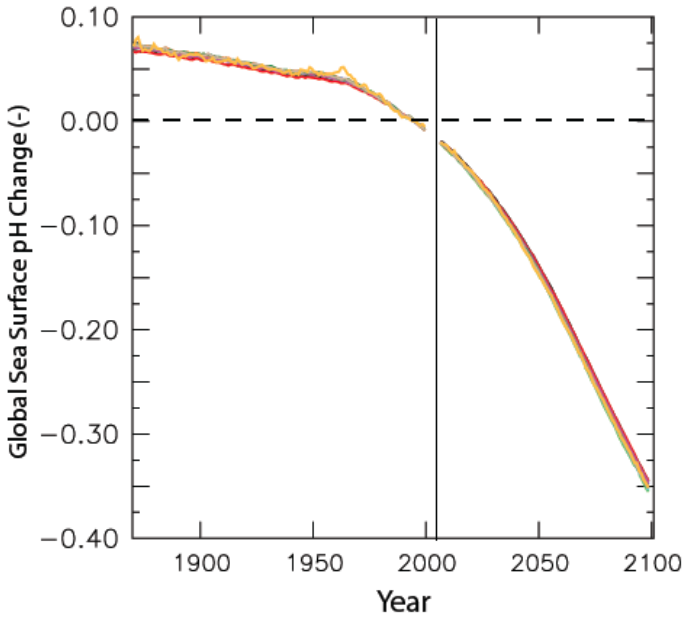
Passive sampling
Contaminants

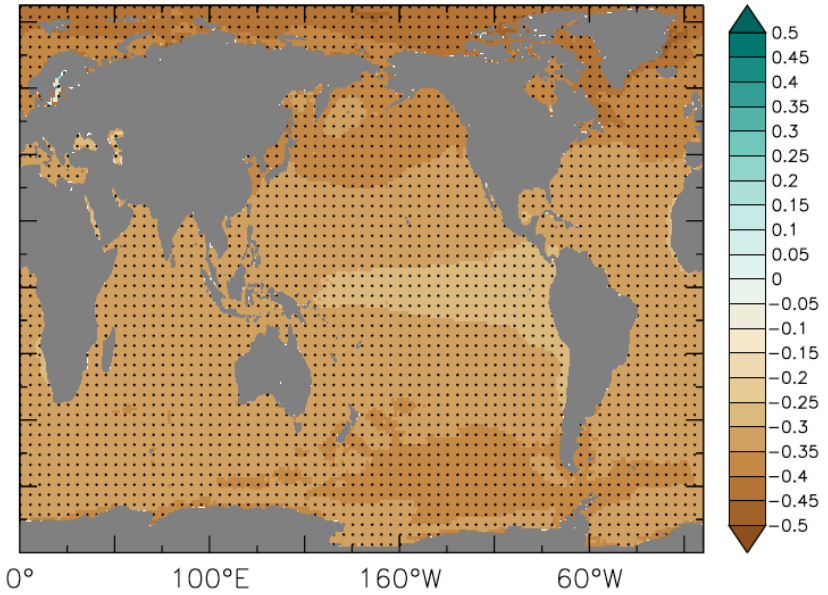






IPCC projections should not be driving marginal system research





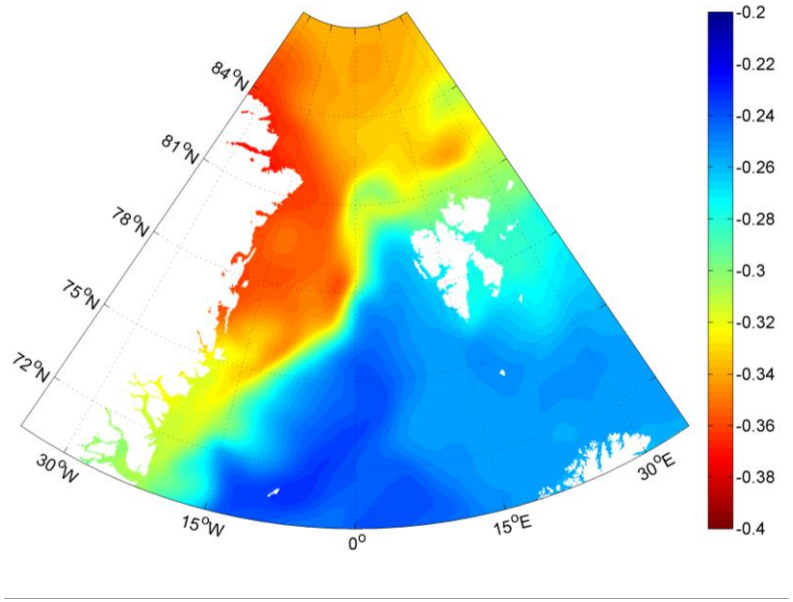
Bopp et al., 2013

Model agreement gives false confidence

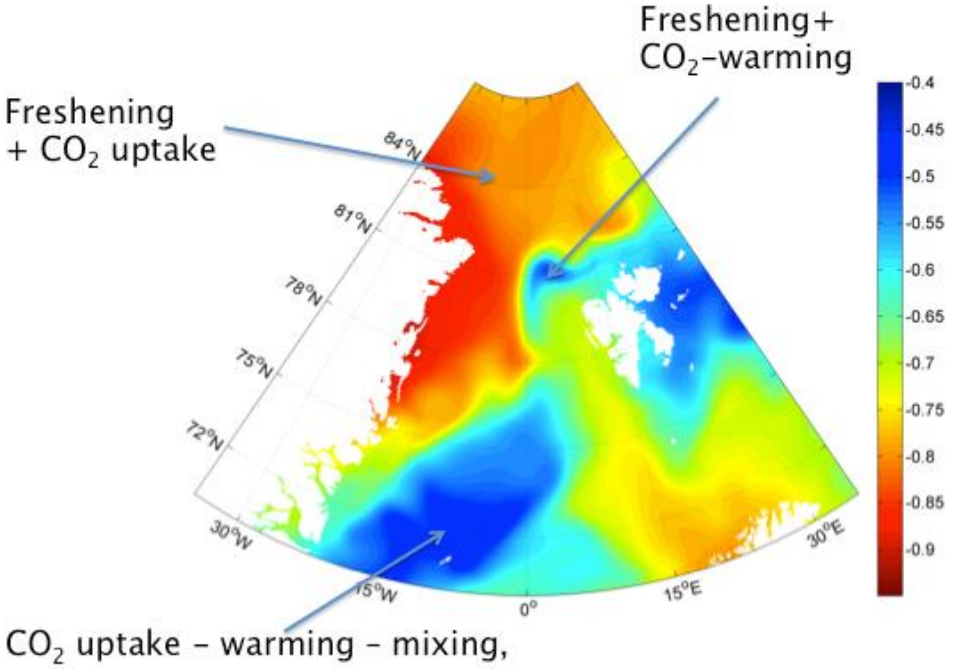
Moderately good basin scale representation

Not even downscaled climate models

pH change



Aragonite



Bellerby et al., 2013

A nested downscaled modelling approach

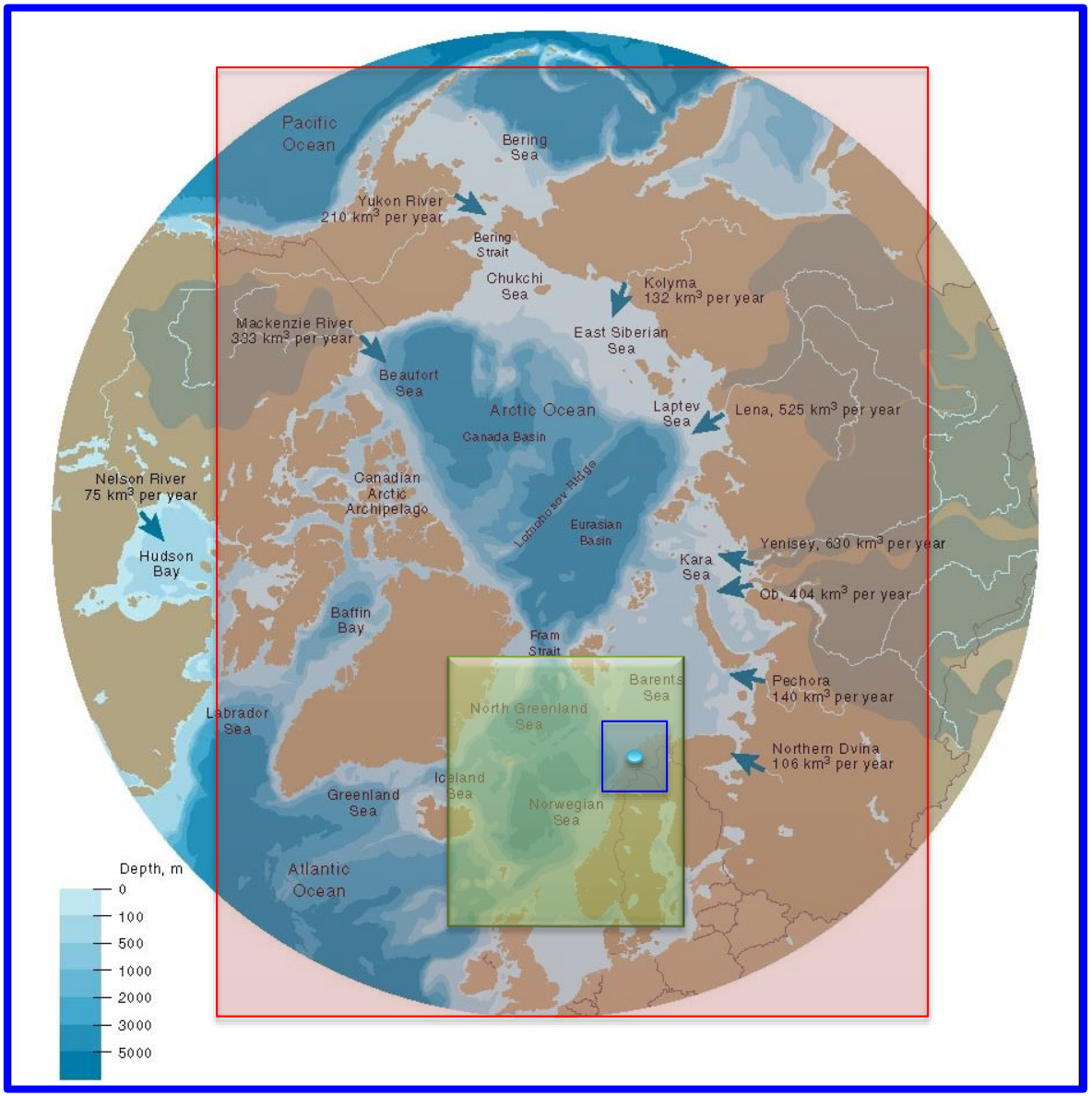
Model domains

NORESM

ROMS/ERSEM

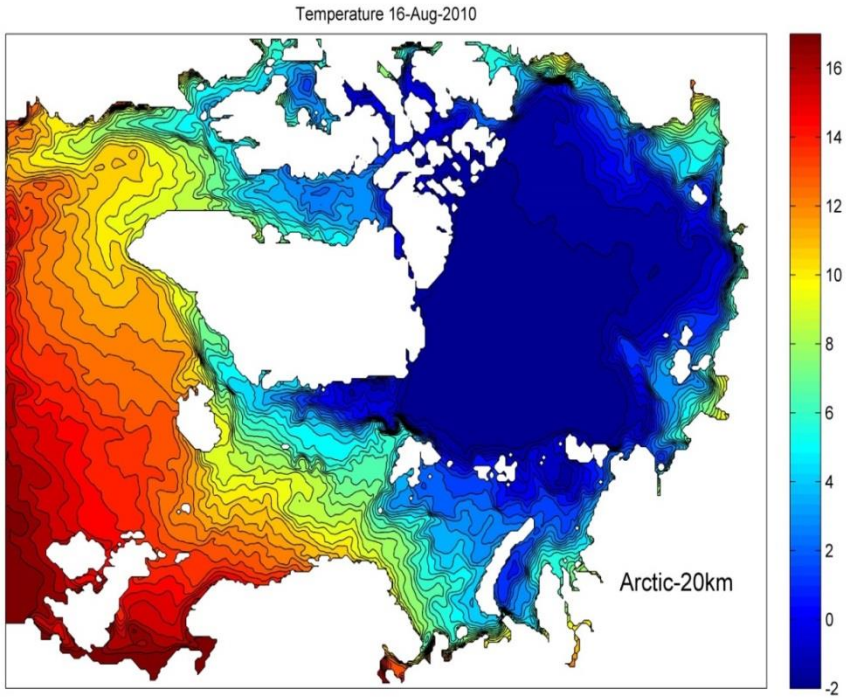
FVCOMM/ERSEM

BROM

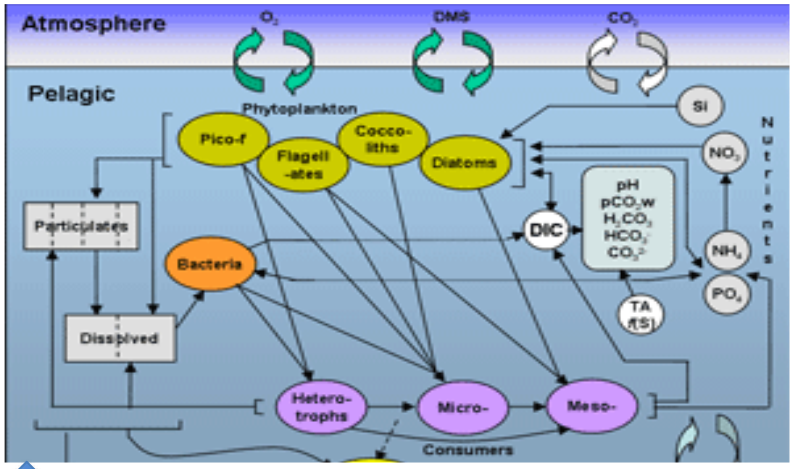


Model development and evaluation

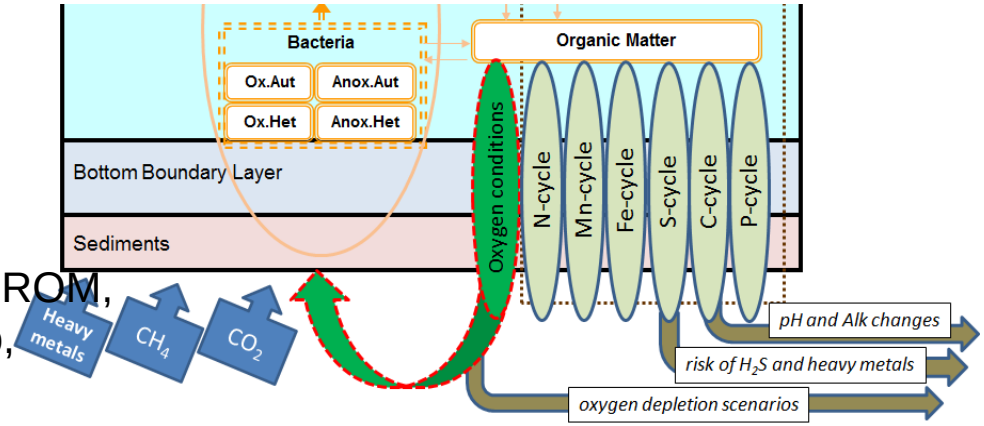
Regional Ocean Modelling System (ROMS)
+ sea ice model from Met. No.



European Regional Seas Ecosystem Model
(ERSEM, Butenschön et al., 2017)



Coupling via the Framework for Biogeochemical Modelling (FABM, Bruggeman and Bolding, 2014)

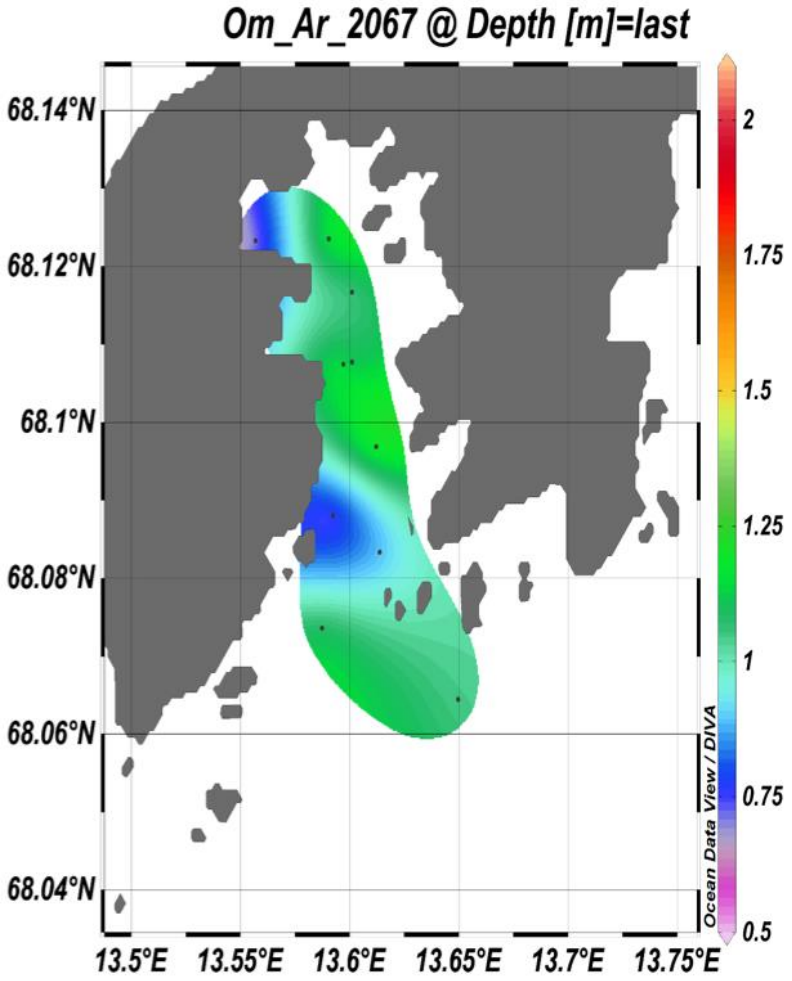


Benthic RedOx Model (BROM, Yakushev and Protsenko, 2014)

Now we have targetted stressor information downscaled to ecosystem services

- Seabed aragonite $CaCO_3$ saturation state below the fjord sill-depth for 2067

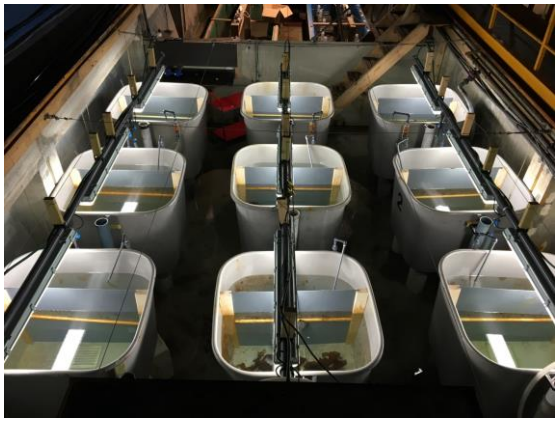
- Features are at the scale of the ecosystems and fishfarms

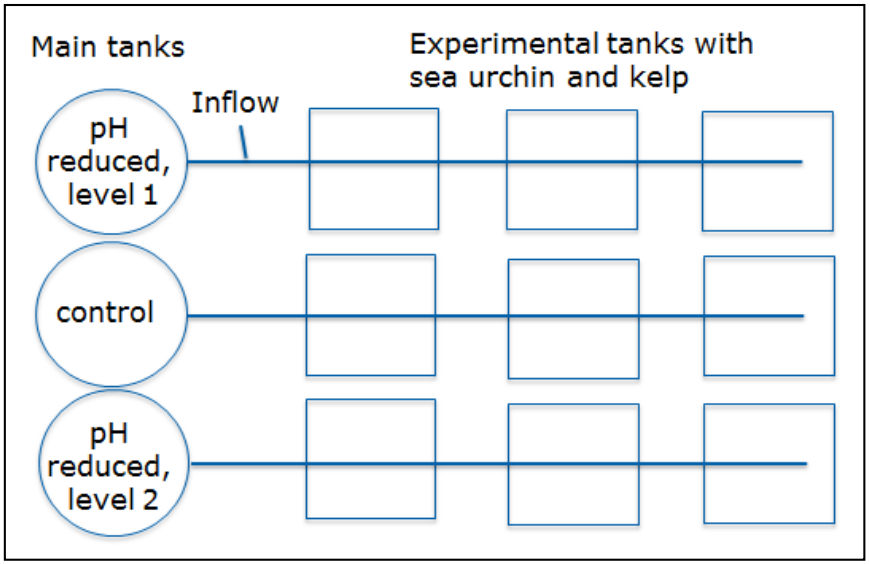


Sea urchin – seaweed interactions

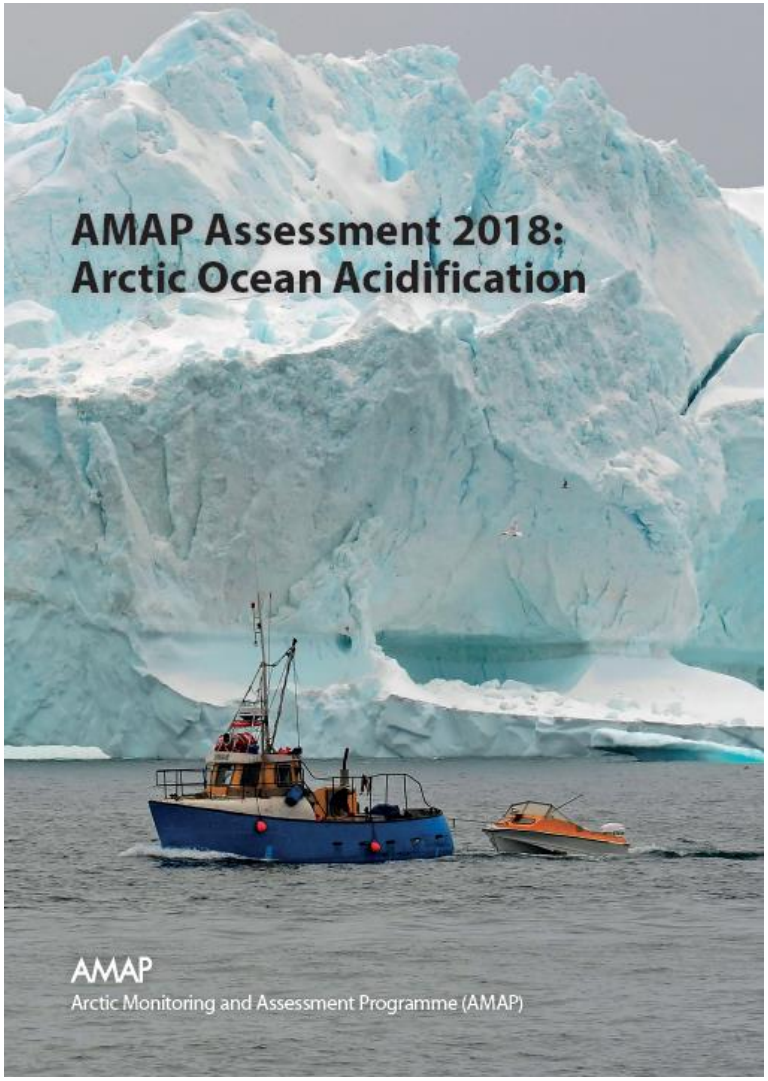
Ocean acidification - 2016

Plus freshwater, organic carbon – 2017





Results contributed to the new Arctic OA report



Contents

New Arctic OA report: socioeconomic change

Towards new Chinese case studies

Stakeholder discussions:

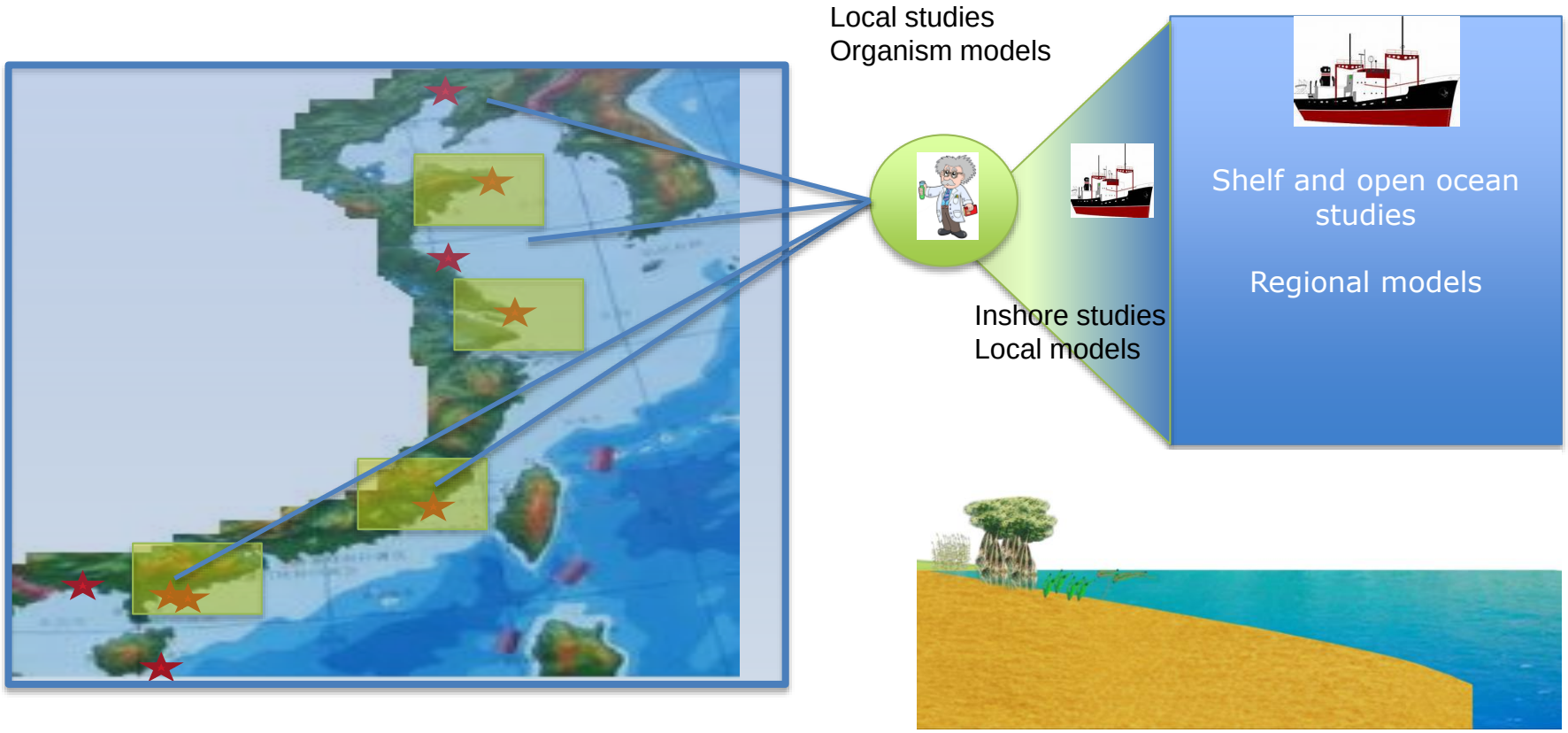
WORLD OCEAN COUNCIL®

The International Business Alliance for Corporate Ocean Responsibility

Local aquaculture

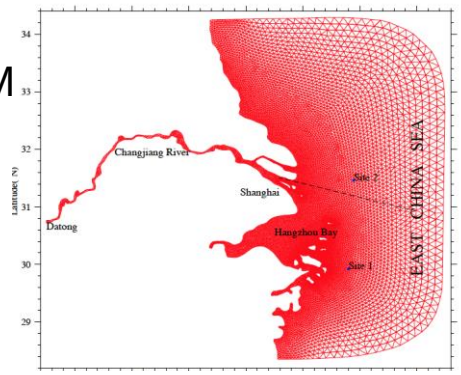
Local Shanghai administration marine managers

An integrated, interdisciplinary approach to understanding Chinese marginal systems

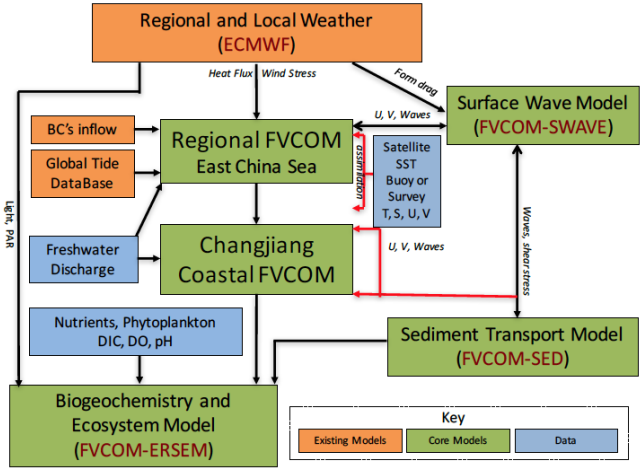


Model development and evaluation

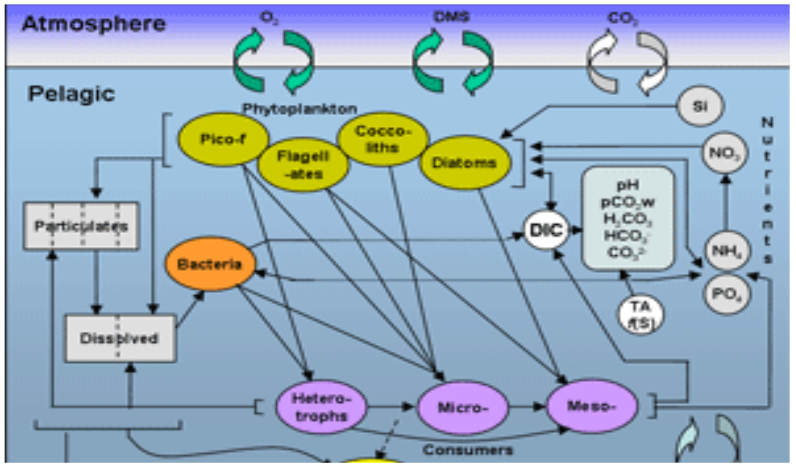
FVCOM



Coupling via the Framework for Biogeochemical Modelling (FABM, Bruggeman and Bolding, 2014)



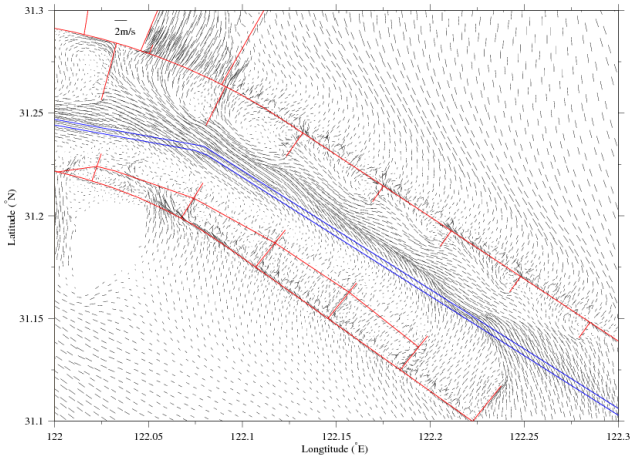
ERSEM

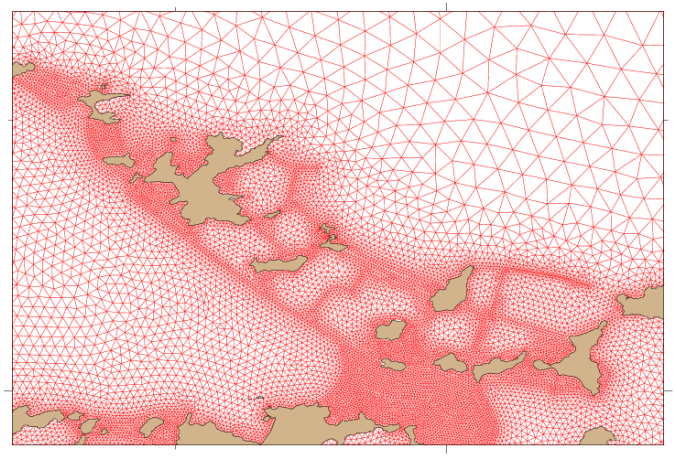


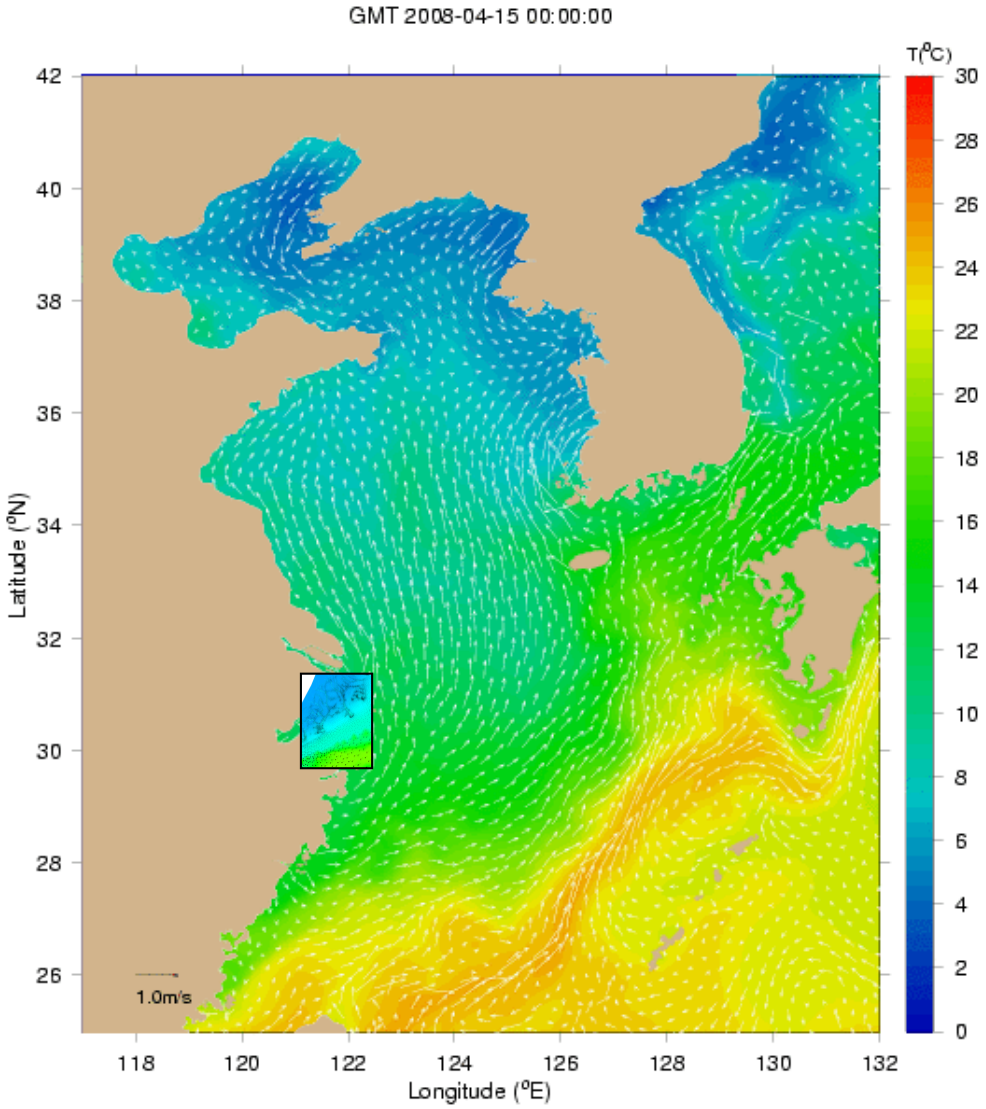
Jianzhong Ge[1*], Richard Bellerby[1,2], Ricardo Torres[3], Pingxing Ding[1], Changsheng Chen[4], Jie Liu[5], Fang Shen[1], Xiaodao Wei[1]

European Regional Seas Ecosystem Model (ERSEM, Butenschön et al., 2017)

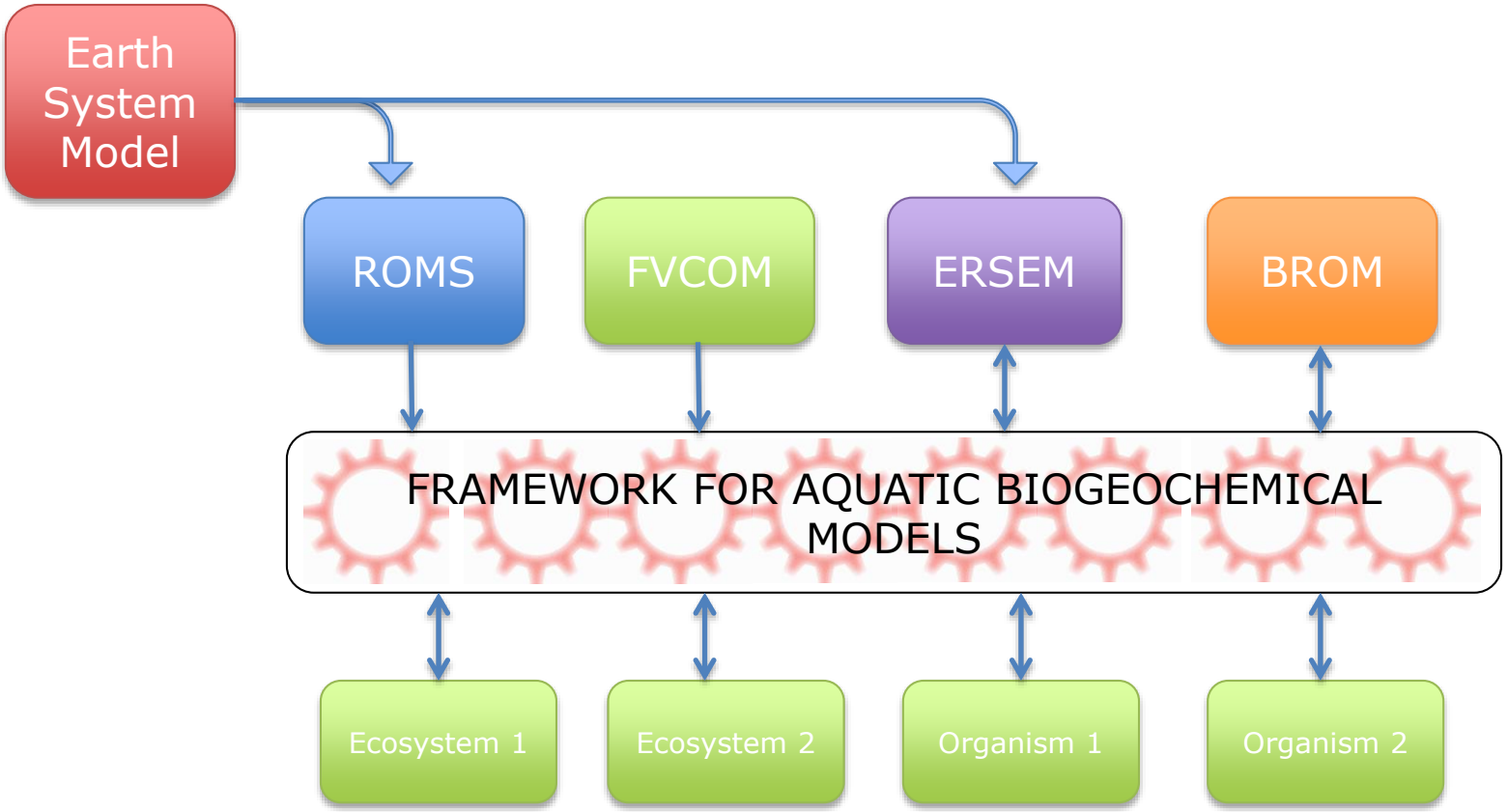
Developing downscaled multistressors to 12m horizontal for selected Chinese coastal systems



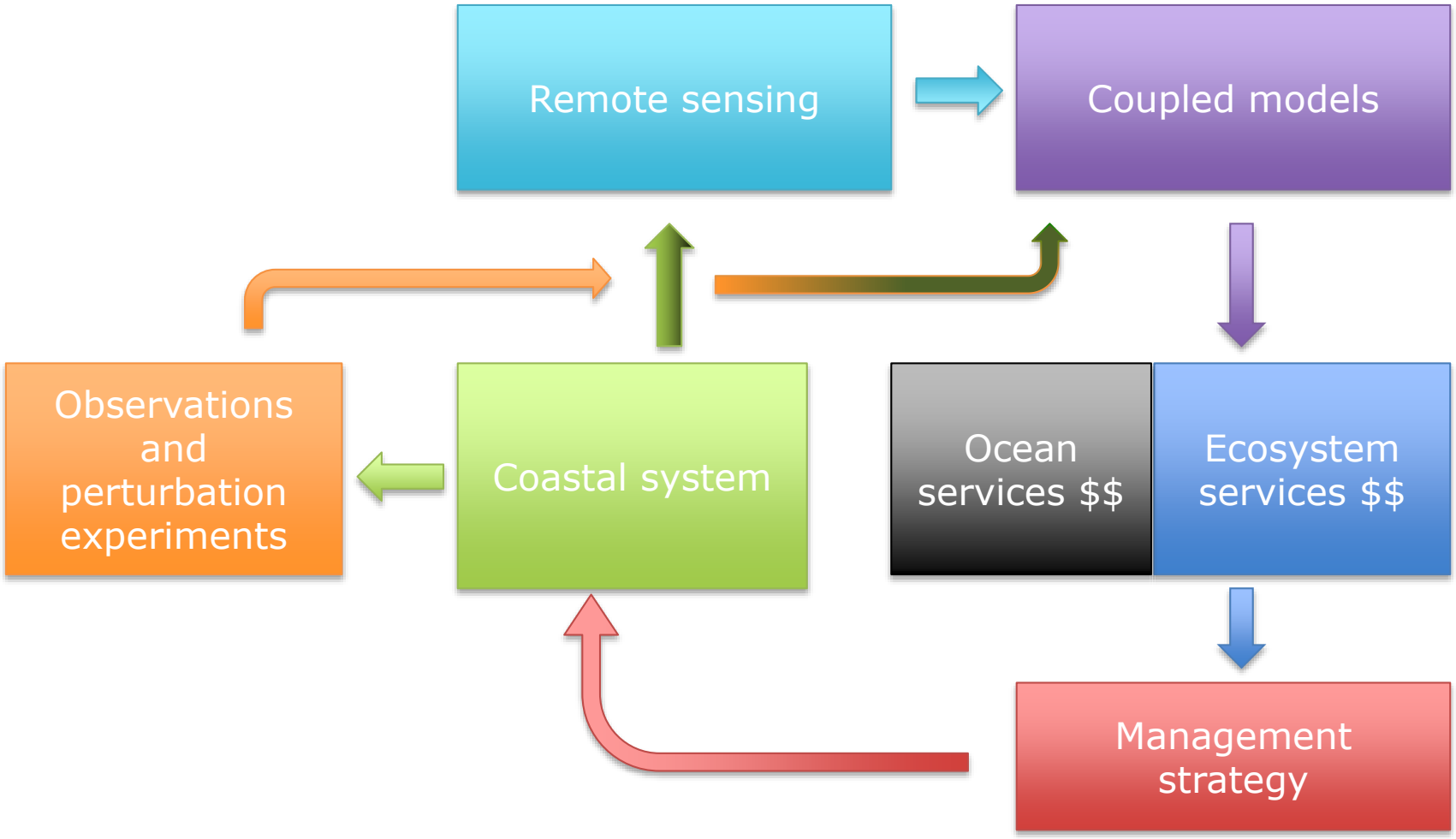




Coupled model family



An integrated coastal observatory



Summary

We need to improve our understanding of relevant drivers at relevant scales for relevant species towards relevant services.

This should be done in partnership with stakeholders – throughout all the project

Requires a renewed interdisciplinary approach

Together these will target our research efforts towards securing coastal productivity and sustainability

A new international working group to compare and contrast ocean services in Chinese and Arctic marginal seas + many more

Co-Chairs: **Prof. Richard Bellerby (SKLEC-NIVA, Shanghai/Bergen)**
Prof. Su Mei Liu (Ocean University of China, Qingdao)

- Identify key system services, stakeholders, regulatory institutions and process
- Identify recent historical and present variability in marginal seas services
- Couple environmental and ecological change to services
- Develop scenarios of future marginal seas services
- Optimise boundary conditions towards informed co-adaption to coastal change

IMBER

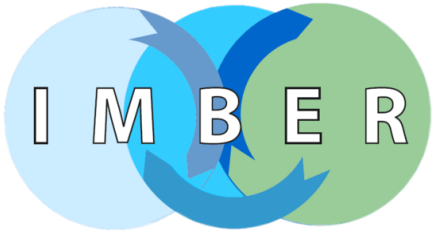
futureearth coasts
land-ocean interactions in the coastal zone

Continental Margins Working Group workshop – tomorrow and friday

This workshop has the ambition to:

«develop a framework for a common strategy towards our understanding of marginal social-ecological systems»

All are welcome!



Thank you

2.3 GRAND CHALLENGE III –IMPROVING AND ACHIEVING SUSTAINABLE OCEAN GOVERNANCE

Overarching Research Question

How can integrating research across the natural and social sciences and humanities improve our understanding and response to the impacts of global marine change in relation to the livelihood and well-being of coastal and maritime communities?

Related Research Questions

What are the trade-offs amongst the multiple demands on ocean resources and services?

How can IMBeR science best contribute to the provision and implementation of trade-off options for adaptation and mitigation?

How can IMBeR science contribute to the adaptation/adaptive capacity of communities to the cultural, social and ecological consequences of marine global change?

How can natural science, social science and humanities research be integrated into global change science so that it is useful to policy makers and the broader society?

IMBeR GRAND CHALLENGE III –IMPROVING AND ACHIEVING SUSTAINABLE OCEAN GOVERNANCE

The Challenge: To improve communication and understanding between IMBeR science, policy and society to achieve improved governance, adaptation to and mitigation of global change, and transitions towards ocean sustainability.

Stakeholder participation for co-production of knowledge