

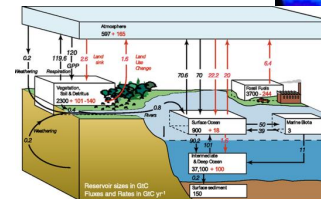
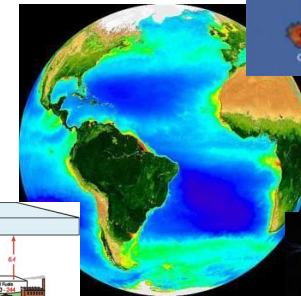
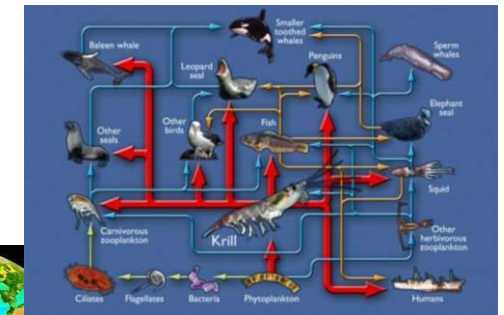
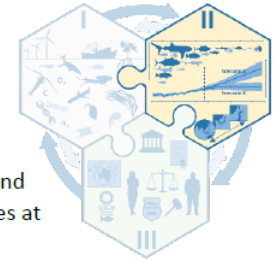
Innovation Challenge 3: To Advance Understanding of Ecological feedbacks in the Earth System

- Emerged from discussions at Future Oceans meeting in Bergen 2014
- Developed as part of the IMBeR Science Plan
- Developed as a GC2 related activity
- Led by Eugene Murphy and Lauren Bopp
- Report generated 2017 and discussed in detail at SSC meeting in Hobart in 2018
- Planned for an OSM session developed

Grand Challenge II

Improving scenarios, predictions and projections of future ocean-human systems at multiple scales

The Challenge: To incorporate understanding of the drivers and consequences of global change on marine ecosystems and human societies at multiple scales into models to project and predict future states.

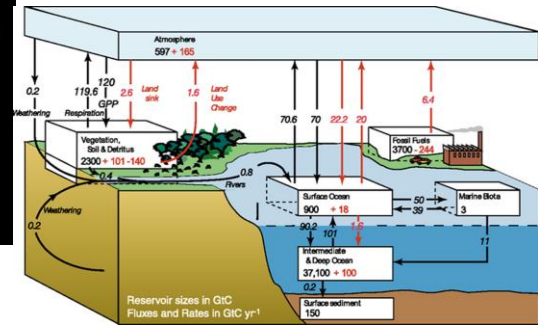


Innovation Challenge 3: To Advance Understanding of Ecological feedbacks in the Earth System



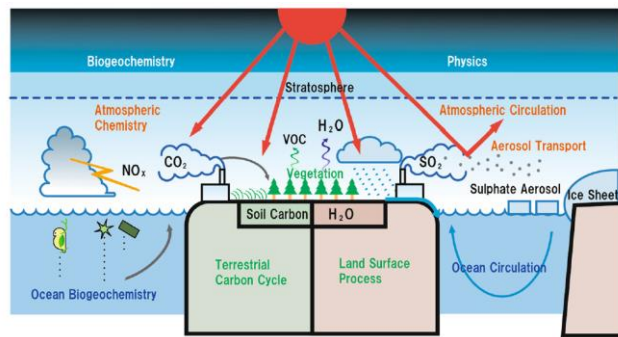
Innovation challenge 3

To advance understanding of ecological feedbacks in the earth system



How biological interactions influence climate processes and the impacts of change within ecosystems is poorly understood

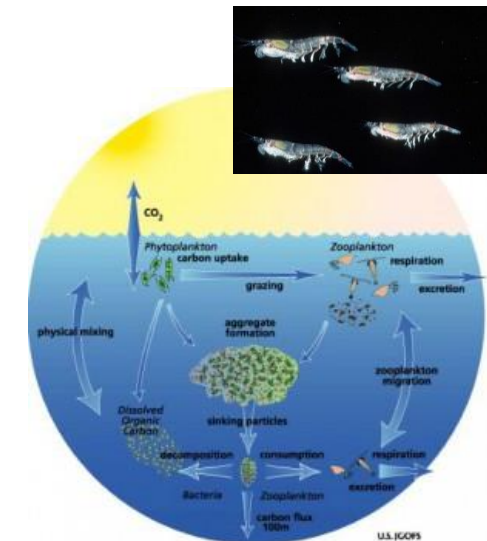
Capturing the role of biological processes in Earth System models remains to be done



Hajima et al. Progress in Earth and Planetary Science 2014, 1:29

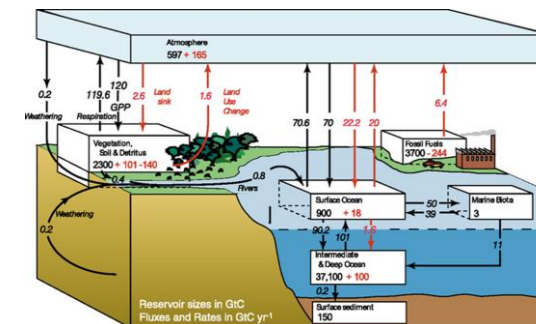
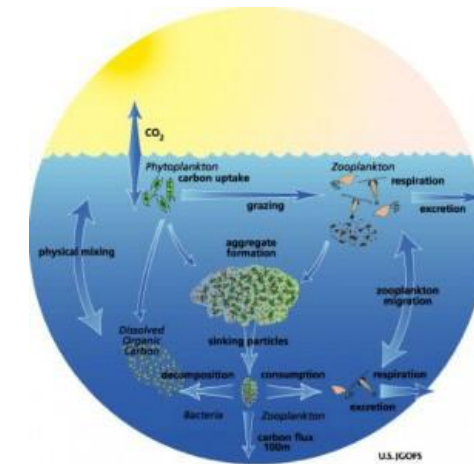


Building models with biology



Innovation Challenge 3: To Advance Understanding of Ecological feedbacks in the Earth System

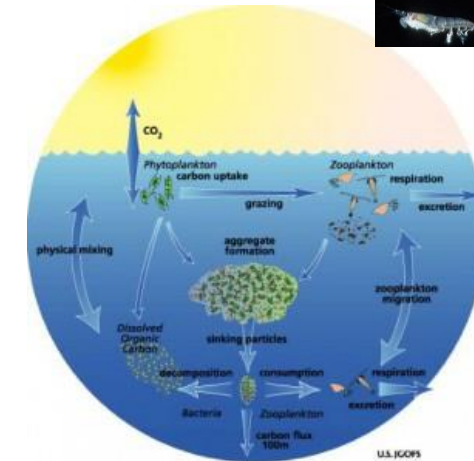
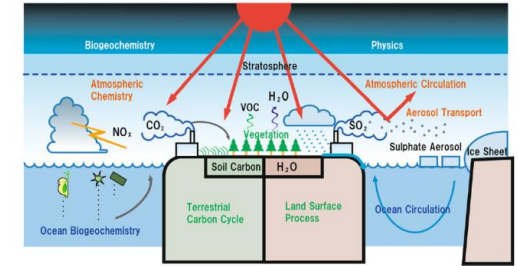
- Ecological processes are important in biophysical and biogeochemical processes.
- Ecological processes affect the development and stabilization of physical features of habitats.
- Ecological processes are also important in carbon budgets and greenhouse gases fluxes, thereby affecting future climate.
- The biological, physical and chemical processes are linked, thereby providing the potential for feedbacks.
- Understanding these dynamics and feedbacks at seasonal, interannual and decadal scales is important to interpreting and predicting, or projecting, marine ecological responses to global and local changes.
- This Innovation Challenge provides important inputs for Grand Challenge II that is focused on improving scenarios, predictions and projections of future states.



Innovation Challenge 3: To Advance Understanding of Ecological feedbacks in the Earth System

Priority Research Questions

- How do ocean ecosystem interactions with other components of the Earth System significantly affect climate processes and how are these interactions affected by change?
- What level of complexity is needed to represent these interactions and feedbacks?
- What approaches are needed for these interactions and feedbacks to be modelled and projected?
- How are ocean-human system interactions incorporated into Earth System models?





Conference session

Ecological feedbacks in the Earth System

Conveners: Lester Kwiatkowski, Charlotte Laufkötter, Andrew Yool, Laurent Bopp and Eugene Murphy

Session

A broader understanding of ecological feedbacks at seasonal, interannual and decadal scales is critical to interpreting and predicting, or projecting, marine ecological responses to global and local changes.

This session is aimed at advancing understanding of ecological feedbacks in the Earth System. We welcome reports of field, laboratory, data syntheses and modelling studies that address key research questions of this challenge:

- How do ocean ecosystem interactions with other components of the Earth System significantly affect climate processes and how are these interactions affected by change?
- What level of complexity is needed to represent these interactions and feedbacks?
- What approaches are needed for these interactions and feedbacks to be modelled and projected?
- How can ocean-human system interactions be incorporated into Earth System models?



Conference Schedule

SESSION 7: ECOLOGICAL FEEDBACKS IN THE EARTH SYSTEM

Room 7

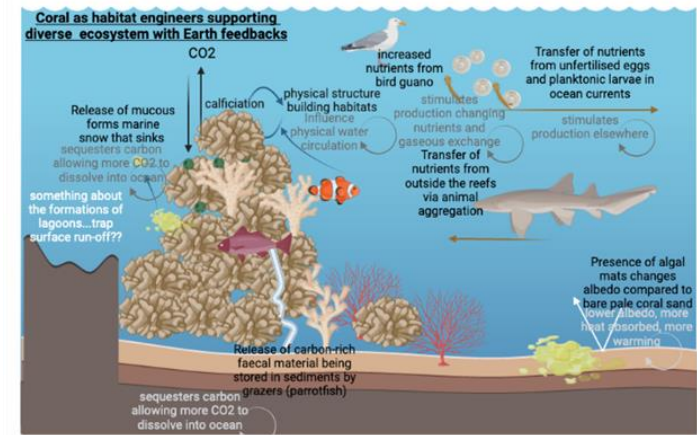
Tue 18 June	Time Block 1 of 3
11:00 - 11:30	Emma Cavan How does varying the metabolic response of organisms to warming influence global particulate organic carbon export?
11:30 - 11:50	Inga Hense Comparison of two model approaches for describing phytoplankton adaptation to temperature
11:50 - 12:10	Stanley Nmor Can diatoms thrive in low silicic conditions?
12:10 - 12:30	Rémy Asselot The relative importance of phytoplankton light absorption and ecosystem complexity for the climate system
Tue 18 June	Time Block 2 of 3
14:00 - 14:30	Wolfgang Koeve The bottleneck of marine ecological feedbacks on atmospheric pCO ₂

14:30 - 14:50	Leonardo Bertini The reversibility of anthropogenically-forced change in biogeochemical drivers in the North Atlantic. Can we still go back to pre-industrial levels?
14:50 - 15:10	Meike Vogt An observation-based, objective classification of plankton functional types for use in climate and Earth System models
15:10 - 15:30	Lester Kwiatkowski The impact of variable phytoplankton stoichiometry on projections of primary production, ocean carbon uptake and trophic cascades in the global ocean
Tue 18 June	Time Block 3 of 3
16:00 - 16:30	Daniele Bianchi The abundance and biogeochemical role of fish in the ocean
16:30 - 16:50	Ian Hatton The marine size-spectrum and human effects on oceanic systems
16:50 - 17:10	Kim Scherrer Integrating humans into a global model of the marine wild-capture fishery: small-scale fishing by coastal communities
17:10 - 17:30	Priscilla Le Mézo Human influence on the nutrient cycling by the global commercial fish community

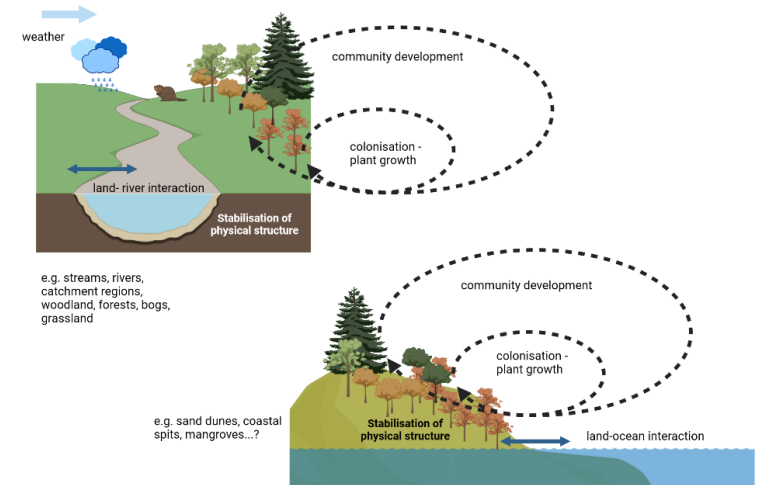
Ecological feedbacks in the Earth system

Paper in development following session

- Led by Eugene Murphy, Emma Cavan, Jess Williams
- Expanded to encompass marine and terrestrial processes
- Includes Laurent Bopp, Marion Gehlen, Lester Kwiatkowski, Charlotte Laufkötter and also Jess Melbourne-Thomas, Eileen Hofmann, Yadvindar Mahli, David Coomes + others
- Considering - feedbacks in ecosystems, ecological – abiotic feedbacks, ecological– climate feedbacks, scales of ecological feedbacks in the Earth system, implications and conclusions
- Draft is in circulation with co-authors – aim for submission in the next few months



Created in BioRender.com bio



Created in BioRender.com bio

Innovation Challenge 3: To Advance Understanding of Ecological feedbacks in the Earth System

- There have been some important individual pieces of work that continue to build the evidence base. These relate to carbon budgets, models studies, studies of individual species (e.g. krill in biogeochemical cycles).
- We have made progress and the community is active. There is a lot of interest but also major challenges. This is still a rapidly developing area but remains a topic that requires further development.
- There remains a role for IMBeR in developing syntheses and leading aspects of the development of these ideas because of the breadth of IMBeR science and expertise.
- It builds on GC2 modelling and projection activities – it can help improve projections and also potential consequences of policy decisions.
- There are important links with:
 - GC1 - need for improved understanding of processes and feedbacks across scales local-regional to global
 - GC3 – the importance of social-ecological feedbacks and their potential impacts in the Earth system is an increasing focus of interest and research. The potential secondary consequences of policy decisions and feedbacks between human activities and ecosystems is an increasing research focus.
- The Innovation Challenge may be most appropriately developed as a joint activity across the GCs led by GC2.
- It could contribute to IMBeR 3.0 as it requires an integration of scientific understanding and activity.
- The IMBeR community is in a strong position to take a leading role in developing analyses of ecological feedbacks and particularly the potential for feedback effects in social-ecological interactions that may be important in developing a sustainable ocean.



Thank you