PROJECT TITLE: Climatic impacts of biodiversity in marine calcifying phytoplankton
DTP Research Theme(s): Living World, Changing Planet

Lead Institution: University of Bristol
Main Supervisor: Dr Fanny Monteiro, School of Geographical Sciences
Co-Supervisor: Prof Colin Brownlee and Glen Wheeler, Marine Biological Association (MBA)
Co-Supervisor: CASE partner – Marine Biological Association (MBA)

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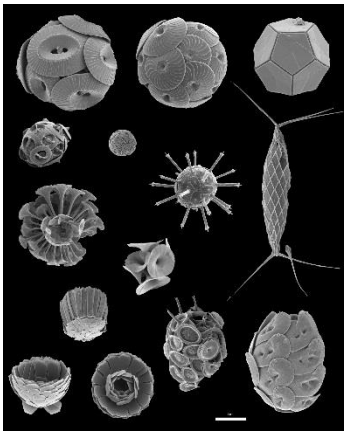

Image Caption: Diversity of marine calcifying phytoplankton (coccolithophores)

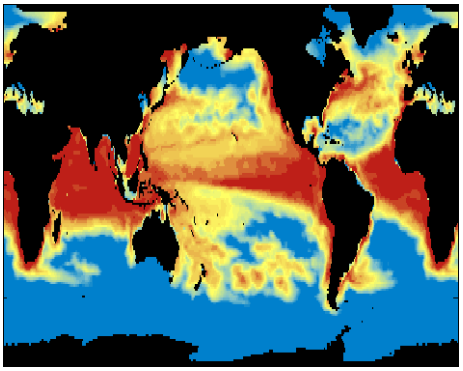

Image Caption: Distribution of coccolithophore *Emiliania huxleyi* in the DARWIN model

Project Background

Marine phytoplankton are key actors of the climate system, where they can strongly regulate the concentration of carbon dioxide and oxygen in the atmosphere. In particular calcifying marine phytoplankton coccolithophores play an important role in the carbon cycle as main contributor to ocean primary production and carbon pumps[1]. However, coccolithophores are potentially threatened by a changing ocean environment in which warming and ocean acidification may affect their ability to calcify and compete. Despite their significance and these potential threats, little is known about how coccolithophores will respond to climate change due to their diversity and the complexity of their interactions with other organisms and their environment.

Project Aims and Methods

The project will assess the impact of coccolithophore diversity on the carbon cycle for modern, future and past climates. It will evaluate the contribution of coccolithophore main types on the different carbon pumps mostly using computer modelling. While current models only account for the smallest and ominpresent coccolithophore Emiliania huxleyi, it is unclear if this type dominates carbon exports, especially since larger species tend to sink faster. What is then the contribution of larger coccolithophores on the biological and carbonate pumps today and how can it vary in the future and the past?

The student will use the innovative and successful marine ecosystem model DARWIN to represent the diversity of coccolithophores, in which plankton population self-assembles in response to the environment, resource competition and predefined physiological trade-offs2-4. The student will combine DARWIN with a variety of climate models (MITgcm, GENIE) to look at different climates. Opportunities to do laboratory experiments will also arise with our CASE partner MBA, where they will examine the physiological responses of different coccolithophore species to help parameterise the DARWIN model. Finally, this project will occur in synergy with our international NERC/NSF project which investigates coccolithophore calcification, and with which the student will closely interact.

Candidate

We seek a highly motivated and independent candidate interested in an interdisciplinary understanding of marine biology, ocean chemistry and climate. Candidates should have a degree in either Oceanography, Earth Sciences, Geophysics, Environmental Sciences, Geography, Biology, Chemistry, Physics or Mathematics.

Case Award Description

The student will spend at least three months working with CASE partner Marine Biological Association to gain insights into the physiology of different coccolithophores. The student will examine the physiological response (e.g. growth, calcification rates) of a range of coccolithophore species maintained at the Plymouth Culture Collection to changes in light, temperature and carbonate chemistry. These physiological parameters will be used to refine the DARWIN model so that it can be used to examine global responses of multiple coccolithophore species.

Training

The student will attend relevant DTP training courses such as "Programming", "Data analysis" and "Science communication". The student will learn how to use and develop climate models (from high-resolution ecosystem and physical modelling to Earth system modelling). Dr Monteiro will provide modelling support and the CASE partner training in experimental biology approaches. The student will spend one month at MIT to gain experience in running the DARWIN model and will have opportunity to participate in funded research cruises through an NSF-funded MBA-Bigelow collaboration. The student will develop expertise in marine ecology, ocean biogeochemistry and climate (future climate change and paleoclimate).

References / Reading List

1. Taylor, A.R., Brownlee, C., & Wheeler, G. (2017). Coccolithophore Cell Biology: Chalking Up Progress. Annual review of marine science, 9, 283-310.
2. Follows, M.J., S. Dutkiewicz, S. Grant and S.W. Chisholm (2007), Emergent biogeography of microbial communities in a model ocean, Science, 315, 1843-1846, doi: 10.1126/science.1138544
3. Barton, A.D., S. Dutkiewicz, G. Flierl, J. Bragg, and M.J. Follows (2010), Patterns of Diversity in Marine Phytoplankton, Science, 327, 1509 – 1511 doi: 10.1126/science.1184961
4. Monteiro, F.M., L.T. Bach, C. Brownlee, P. Bown, R.E.M. Rickaby, A.J. Poulton, T. Tyrrell, L. Beaufort, S. Dutkiewicz, S. Gibbs, M.A. Gutowska, R. Lee, U. Riebesell, J. Young and A. Ridgwell (2016), Why marine phytoplankton calcify, Science Advances, Vol. 2, no. 7, e1501822, doi: 10.1126/sciadv.1501822

Links

School webpage - http://www.bristol.ac.uk/geography/courses/postgraduate/
NERC GW4+ DTP Website: http://nercgw4plus.ac.uk/

Bristol NERC GW4+ DTP Prospectus:
http://www.bristol.ac.uk/study/postgraduate/2017/doctoral/phd-great-western-four-dtp/

Application deadline: 23.59 GMT, Sunday 7 January 2018

How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/

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