



2015 Workshop on “Environmental controls on marine nitrogen fixation”

Abstract:

Nitrogen fixation is essential for maintaining the marine fixed nitrogen (N) inventory that regulates oceanic productivity. Still, environmental controls of marine N₂ fixation are not well understood, making it difficult to reliably model how N₂ fixation operates today and how it has worked, and will work, under changed environmental conditions. Among the key factors believed to control nitrogen fixation are the inorganic N:P ratio of ambient waters, light, temperature, iron availability, and ambient levels of inorganic or organic phosphorus compounds. Yet, knowledge of the role of these and possibly other factors remains limited. To foster exchange of scientific questions, ideas and hypotheses and to initiate an open research agenda to better coordinate and fund future research on nitrogen fixation, experts working on various aspects of nitrogen fixation are invited to participate in a 1-day workshop in Granada, Spain, on 22 February 2015, from 9:30 am.

1 Overall objectives

Despite decades of dedicated work and much progress in our understanding of marine diazotrophs, their distribution and dynamics in the world ocean are still enigmatic. For example, it is still not fully resolved why high rates of N₂ fixation are observed in the N-rich North Atlantic, whereas directly measured rates of N₂ fixation are lower in the more N-depleted eastern tropical Pacific. It is similarly very unclear why diazotrophs abundance and activity is so sporadic in the yet oligotrophic, Mediterranean Sea. A number of hypotheses about factors controlling N₂ fixation have been put forward and include enhanced iron requirements, temperature limitations, and dissolved organic matter dynamics.

Numerical model studies aimed at testing these hypotheses have, until now, had mixed success in reproducing observed patterns of marine N₂ fixation. As molecular techniques bring new evidences for the existence of a wider variety of both nitrogen fixers and N₂ fixation strategies than previously thought, future global models may have to account for such diversity to be able to represent the above-mentioned, discrepancies in the observed, in situ rates. With marine N₂ fixation being a crucial player in setting the marine nitrogen budget and thus marine primary productivity, it is essential to understand the regulating mechanisms and their possible impact on the evolution of marine N₂ fixation in a changing environment.

Given the long-standing difficulty of developing a mechanistic picture of the controls on marine N₂ fixation, and given an improved coverage of field measurements and exciting new advances towards a better understanding of diazotrophs in the fields of microbiology, culture work and numerical modelling, we think that the time is right for a novel interdisciplinary effort to join expertise and ideas developed in various sub-disciplines in order to develop a coherent research strategy that brings together experts and expertise into an ambitious, international research programme aiming at a better understanding of marine diazotrophy.

This 1-day workshop aims at gathering relevant European and wider international expertise to discuss around the state of the art knowledge and identified caveats regarding the global nitrogen budgets and the regulation of nitrogen fixation across temporal and spatial scales. Beyond the scientific exchanges, we wish to initiate a working group on marine nitrogen fixation with a European perspective, towards developing an integrated Horizon2020 or similar large-scale collaborative proposal to decipher the environmental controls on marine nitrogen fixation.

2 Venue and Organization

The workshop will take place on Sunday 22 February 2015, from 9:30 – 17:00, in Seminario 3-4-5, First floor., at the [Granada Congress and Exhibition Centre](#) (*Palacios de Exposiciones y Congresos de Granada*). Participation is by invitation only. Refreshments will be provided. Organising team and contacts

- **Sophie Rabouille** - LOV (CNRS-UPMC), Villefranche sur Mer, France
email <srabouille@obs-vlfr.fr>; Tel.: +33(0)493 763 832.
- **Angela Landolfi** - GEOMAR, Kiel, Germany
email <alandolfi@geomar.de>; Tel.: +49 431 600-4283
- **Andreas Oschlies** - GEOMAR, Kiel, Germany
email <aoschlies@geomar.de>; Tel.: +49 431 600-1936

3 Preliminary program

This 1-day, round-table workshop will bring together marine scientists from different disciplines linking to biology, chemistry and physics, and combining expertise in culture and mesocosm studies, ecophysiology, microbiology, molecular biology, hydrography, remote sensing and numerical modeling from cell- to global scales. We plan to have short overview presentations on the current knowledge and open questions, all in plenary and followed by an open discussion about research priorities and strategies for collaborative efforts. The workshop will start from 9:30am. Overview presentations will cover the following issues:

- *Current estimates of global ocean N₂ fixation rates from observations and numerical models* - Angela Landolfi, GEOMAR, Kiel
- *What do we know about the global distribution of diazotrophs and the main groups/physiologies* - Jonathan Zehr, UCSC, USA
- *What do we know about limiting factors (light, iron, various phosphorus forms, temperature...)* - C. Mark Moore, University of Southampton, UK
- *How is N₂ fixation represented in cell-scale and global-scale models?* – Sophie Rabouille, LOV, France & Andreas Oschlies, GEOMAR, Germany

A general discussion session (structure to be finalized) will follow to address overarching questions. These include 1) Identify the major obstacles and challenges that limit our understanding of N₂ fixation 2) Discuss which are the multidisciplinary actions/strategies needed to make progress. Exchanges on possible ways of organizing efficient collaboration and attracting funding will end the 1-day workshop. A report will be written and iterated with all participants in the following weeks, with the aim to eventually use this for putting together a collaborative research proposal, e.g. in the Horizon2020 framework, in which non-EU partnerships are encouraged.