SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Analytical, Environmental and Geo- Chemistry

has the honor to invite you to the public defense of the Joint PhD thesis of

Xuefeng LI

to obtain the degree of Doctor of Sciences

Joint PhD with Université Libre de Bruxelles

Title of the PhD thesis:

Marine iron biogeochemistry under a changing climate: impact on the phytoplankton and the diazotroph communities

Promotors:
Prof. Marc Elskens
Prof. Lei Chou (ULB)

The defence will take place on
Thursday February 1 2018 at 10.00h

at the Université Libre de Bruxelles

Members of the jury:

Prof. Martine Leermakers (chairman)
Prof. Steeve Bonneville (secretary, ULB)
Prof. Em. Frank Dehairs (co-promotor)
Prof. Philippe Dubois (ULB)
Prof. Andrew Rees
(Plymouth Marine Laboratories, UK)
Prof. Koenraad Muylaert (KULeuven)

Curriculum vitae

Oct. 2012-Jan. 2018: PhD student, Joint supervision between **Université Libre de Bruxelles (ULB, Belgium) and Vrije Universiteit Brussel (VUB, Belgium)**; **Research project**: '*Marine Iron Biogeochemistry under a Changing Climate: Impact on the Phytoplankton and the Diazotroph Communities*'

2009-2012: Master's Degree in Environmental Science, **Nankai University**, Tianjin, China; **Research project**: '*Derivation of Ambient Water Quality Criteria for BTEX*'

2005-2009: Bachelor's Degree in Environmental Science, **Jilin University**, Changchun, China; **Research project**: '*Distribution and Ecological Risk Evaluation of Hg in Dustfall of Harbin*'

Abstract of the PhD research

Diatoms constitute a major group of phytoplankton, accounting for ~20% of the world's primary production. Biological dinitrogen (N_2) fixation by diazotrophic cyanobacteria has great biogeochemical implications in nitrogen (N) cycling. Iron (Fe) can be the limiting nutrient for phytoplankton growth and plays thus an essential role in governing the marine primary productivity. Meanwhile, oceanic systems are undergoing continuous modifications at varying rates and magnitudes as a result of changing climate. The objective of our research is to evaluate the effects of global climate change processes (changing dust deposition, ocean acidification and sea-surface warming) on phytoplankton growth, biological N_2 fixation, biogeochemical cycles, and the controlling role of Fe within these impacts.
Laboratory culture experiments using a marine diatom *Chaetoceros socialis* were conducted at two temperatures (13 and 18 ℃) and two carbon dioxide partial pressures (pCO_2, 400 and 800 µatm). The present study clearly highlights the effect of ocean acidification on enhancing the release of Fe upon dust deposition. Our results also confirm that while being a potential source of Fe, dust provides in addition a readily utilizable source of macronutrients such as phosphorus (P) and silicon (Si). However, elevated atmospheric CO_2 concentrations as well as increasing temperature may have an adverse impact on diatom growth, causing a decrease in cell size and possible further changes in phytoplankton biogeographic distribution and composition.
A better understanding of the major environmental (ocean acidification and warming) and nutrient (Fe, P and dust) controls governing N_2 fixation is highly required. Through three laboratory bioassays (+Fe, +P, +Dust) via incubation experiments performed on *Trichodesmium* IMS101, we found that addition of Fe, P or desert dust could stimulate the growth and N_2 fixation of *Trichodesmium* IMS101. In addition, during a field study in the North Atlantic Ocean using natural phytoplankton assemblages, N_2 fixation was remarkably stimulated through the addition of dissolved Fe under low temperature and depleted P conditions, highlighting the critical role of this trace element. Finally, semi-continuous dilution growth experiments were conducted on *Trichodesmium* IMS101 under future high pCO_2 and warming seawater conditions (800 µatm and 28 °C) and compared to the present-day situations (400 µatm and 24°C). The results indicate that higher pCO_2 and therefore ocean acidification may be beneficial for *Trichodesmium* growth and N_2 fixation. In contrast, ocean warming may not play an important role in *Trichodesmium* growth and N_2 fixation with a 4 °C increase from 24 °C to 28 °C.
The changing climate has thus a significant implication in ocean phytoplankton growth, cell size and primary productivity, phytoplankton distribution and community composition, and C, N, P, Si and Fe biogeochemical cycles in various ways.