Benoît Pasquier

Affiliation

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Research Interests

A fascinating consequence of the fluid nature of open-ocean ecosystems and nutrient cycles is that perturbations in one part of the ocean can influence biological production on the other side of the world. My focus has been on this interplay between the ocean's circulation and biology on the global scale.

During my PhD, I investigated fundamental scientific questions of global ocean biogeochemical cycles using cutting-edge mathematical tools. Specifically, I explored the teleconnections of the global biological pump by developing and using state-of-the-art inverse models of the phosphorus, silicon, and iron cycles. More recently, through my postdoctoral appointment, I have developed novel Green-function-based diagnostics to investigate the marine iron cycle with more detail than ever before. Lately, I have been developing the Algebraic Implicit Biogeochemical Elemental Cycling System (the AIBECS), a Julia package to provide an easy API to create global marine biogeochemistry models in just a few commands, which I believe could become both a great teaching medium and the ideal research tool for, e.g., offline parameter optimization.

There is a need to improve the current representation of biogeochemical processes in models of the ocean. There is also ample room to develop new tools that are simultaneously simple to use and understand, efficient and fast to run, and suitable for the novel diagnostics I have become familiar with. By providing clear quantitative answers, these tools help decipher complex global interactions of the oceanic nutrient cycles.

I am also an advocate for scientific openness, to facilitate collaboration, code review, and reproducibility.

Education

2013—2017 **PhD in Applied Mathematics** University of New South Wales, Sydney, Australia

Supervisor: **Mark Holzer**. Modeling and diagnosing ocean biogeochemical cycles.
Thesis title: *The Ocean's Global Iron, Phosphorus, and Silicon Cycles: Inverse Modelling and Novel Diagnostics.*

- Global Biogeochemical Cycles, Global Biological Pump
- Ecosystem Modeling & Biogenic Transport Modeling
- Green Functions Techniques (Path Densities, Flow Rates, Time Scales)
- Inverse Modeling (Newton's Method for Root Finding and Optimization)
- Iron Control on the Global Biological Pump
- Southern Ocean Nutrient Trapping

2010 **MSc in Environmental Science** University of New South Wales, Sydney, Australia

Study of the nature of environmental problems and the methodology of their evaluation and management.

- Geophysical Fluid Dynamics (taught by **Mark Holzer**)
- Oceanography (**Katrin Meissner**)
- Project Management, Environmental Risk Management

2007—2008 **MSc in Finance Mathematics** Paris Dauphine + ENSAE ParisTech, Paris, France

MASEF (Mathematics of Insurance, Economics and Finance), Finance specialty.

- Stochastic Calculus, Levy Processes with Jumps
- Stochastic Differential Equations
- Numerical Methods (Monte Carlo)

2004—2007 **MSc in Mathematics & Engineering** École Polytechnique, Palaiseau, France

Pure mathematics specialization.

- Algebra, Arithmetics, Numerical Methods
- Differential Topology, Relativity
- Physics, Biology

2001—2004 **Preparatory Classes** Lycée Masséna, Nice, France

French Preparatory Classes, mathematics specialty.

- Linear Algebra, Topology, Numerical Methods
- Mechanics, Electromagnetism, Thermodynamics

Professional Experience

Sep 17—Present **Postdoctoral Research Scholar** University of California, Irvine, CA, USA
Working on developing new tools and on improving global biogeochemistry models with **J. Keith Moore** and **François Primeau**.

Mar 17—Aug 17 **Casual Research Assistant** University of New South Wales, Sydney, Australia
Continuing PhD work with **Mark Holzer**.

Jun 16—Dec 16 **Mathematics Tutor** University of New South Wales, Sydney, Australia
Numerical Methods and Statistics, 2nd year.

May 11—Aug 12 **Proposal Engineer** Degrémont, Suez Environnement, Sydney, Australia
Managed tendering projects for Design, Construction, Maintenance and Operation contracts. Participated in business development, liaising with potential clients, advertising on company capabilities.

Jul 08—Jun 09 **Currency Trader Assistant** Société Générale Investment Banking, Paris, France
MASEF Internship, researched new detection and calculation techniques for high frequency data used in automated arbitrage. In particular, developed algorithms to evaluate unbiased stochastic moments in real-time.

Apr 07—Jul 07 **Mathematics Research Intern** École Polytechnique, Palaiseau, France
École Polytechnique Specialty (Mathematics) Internship at the Laurent Schwartz Mathematics Center under the direction of **Jean Lannes**. Calculated the Witt ring of quadratic forms defined on number fields, on the field of p-adic numbers, and on Dedekind rings such as the integers.

Sep 04—Feb 05 **IT Intern** Bioforce, Lyon, France
Bioforce provides training and careers advice in aid programmes and logistics. Developed an Access database to improve communication and management.

Other Skills

Scientific Programming

MATLAB / Julia	**Extensive use**
java / C++	**Competent**
Ruby / Python / Stan	**Little experience**

Languages

French	**First language**
English	**Fluent**
Italian	**Intermediate**
Japanese	**Novice**

Publications

[1] Perspective on Identifying and Characterizing the Processes Controlling Iron Speciation and Residence Time at the Atmosphere-Ocean Interface
Nicholas Meskhidze, Christoph Völker, Hind A. Al-Abadleh, Katherine Barbeau, Matthieu Bressac, Clifton Buck, Randelle M. Bundy, Peter Croot, Yan Feng, Akinori Ito, Anne M. Johansen, William M. Landing, Jingqiu Mao, Stelios Myriokefalitakis, Daniel Ohnemus, Benoît Pasquier, Ying Ye
Marine Chemistry, in preparation *(2019)* .

[2] Bayesian research synthesis models in geoscience: a case study of marine organic carbon fluxes
Gregory L. Britten, Yara Mohajerani, Louis Primeau, Murat Aydin, Catherine Garcia, Weilei Wang, Benoît Pasquier, Barry B. Cael, François W. Primeau
Geoscientific Model Development, in preparation *(2019)* .

[3] The F-1 algorithm for efficient computation of the Hessian matrix of an objective function defined implicitly by the solution of a steady-state problem
Benoît Pasquier, François Primeau
SIAM Journal on Scientific Computing, in preparation *(2019)* .

[4] Diatom physiology controls the response of the silicon cycle to iron fertilization: silicic-acid leakage or enhanced trapping
Mark Holzer, Benoît Pasquier, Timothy DeVries, Mark Brzezinski
Global Biogeochemical Cycles, in preparation *(2019)* .

[5] The number of past and future regenerations of iron in the ocean and its intrinsic fertilization efficiency
Benoît Pasquier, Mark Holzer
Biogeosciences *15.23 (2018) pp. 7177–7203* DOI: 10.5194/bg-15-7177-2018.

[6] Inverse-model estimates of the ocean's coupled phosphorus, silicon, and iron cycles
Benoît Pasquier, Mark Holzer
Biogeosciences *14.18 (2017) pp. 4125–4159* DOI: 10.5194/bg-14-4125-2017.

[7] The age of iron and iron source attribution in the ocean
Mark Holzer, Marina Frants, Benoît Pasquier
Global Biogeochemical Cycles *30.10 (2016) pp. 1454–1474* DOI: 10.1002/2016GB005418.

[8] The plumbing of the global biological pump: Efficiency control through leaks, pathways, and time scales
Benoît Pasquier, Mark Holzer
Journal of Geophysical Research: Oceans *121.8 (2016) pp. 6367–6388* DOI: 10.1002/2016JC011821.

Talks and Posters

[1] The number of past and future regenerations of iron in the ocean and its intrinsic fertilization efficiency
Benoît Pasquier, Mark Holzer
Michael Follows Group Meeting, 2019, Massacgussets Institue of Technology, USA.

[2] Developing a new, open-source, user-friendly, fast, modular, global marine biogeochemistry model (in Julia)
Benoît Pasquier
Sack-lunch seminar, 2019, Massacgussets Institue of Technology, USA.

[3] Offline parameter optimization for global marine biogeochemical models
Benoît Pasquier
François Primeau Group Meeting, 2018, University of California, Irvine, USA.

[4] Inverse-model estimates of the ocean's coupled phosphorus, silicon, and iron cycles.
Benoît Pasquier, Mark Holzer
Ocean Sciences Meeting, 2018, Portland, Oregon, USA.

[5] The efficiency of different iron sources in supporting the ocean's global biological pump
Benoît Pasquier, Mark Holzer
Half-baked seminar, Department of Earth System Science, 2017, University of California, Irvine, USA.

[6] Response of the biological pump to perturbations in the iron supply: Global teleconnections diagnosed using an inverse model of the coupled phosphorus-silicon-iron nutrient cycles
Benoît Pasquier, Mark Holzer
AMOS National Conference, 2017, Canberra, Australia.

[7] Exploring iron control on global productivity: "FePSi", an inverse model of the ocean's coupled phosphate, silicon and iron cycles
Benoît Pasquier, Mark Holzer
Postgrad Conference, 2016, Sydney, Australia.

[8] Iron control on global productivity: an efficient inverse model of the ocean's coupled phosphate, silicon, and iron cycles
Benoît Pasquier, Mark Holzer
Ocean Sciences Meeting, 2016, New Orleans, Louisiana, USA.

[9] An efficient inverse model of the ocean's coupled nutrient cycles
Benoît Pasquier, Mark Holzer
Postgrad Conference, 2015, Sydney, Australia.

[10] The plumbing of the global biological pump
Benoît Pasquier, Mark Holzer
AMOS National Conference, 2015, Brisbane, Australia.

[11] Plumbing of the biological pump
Benoît Pasquier, Mark Holzer
Postgrad Conference, 2014, Sydney, Australia.

Honors and Awards

2015 **Scolarship** — Cuomo Foundation, Monaco

2014 **Scolarship** — Frères Louis et Max Principale Foundation, Monaco

2014 - 2016 **Scolarship** — Monaco Government, Monaco
Higher studies scholarship

2013 **Scolarship** — Monaco Government, Monaco
H.S.H. The Prince Albert II Exceptional Scholarship

2013 - 2016 **Scolarship** — Monaco Scientific Centre, Monaco

2013 - 2016 **Tuition Fee Scholarship** — Graduate Research Shcool, UNSW, Sydney, Australia

2004 - 2008 **Scholarship** — Monaco Government, Monaco
Higher studies scholarship

References

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