

# Marie Bocher

*Post-doctoral fellow in inverse geodynamics*

Schrennengasse 6  
8003 Zürich  
Switzerland  
☎ +41 767 273 546  
✉ [mariebocher@gmail.com](mailto:mariebocher@gmail.com)

## Profile

Topics: Data assimilation in geodynamics, Reconstruction of past mantle circulation, Global reconstructions of plate tectonics, Data assimilation for the seismic cycle.

keywords: Data Assimilation, Ensemble Kalman Filter, Mantle Convection, Seismic Cycle Models, Particle Filter, Plate Tectonics.

## Research Experience

- 10/17–12/19 **Post-doctoral Fellow**, *ETH Zürich*, Switzerland.
- State and parameter estimation in seismic cycle models. (Collaborations: Ylona Van Dinther, Casper Pranger, Femke Voessepoel, Shiran Levy)
  - Development of a particle filter for the automatic reconstruction of the past motion of tectonic plates (Collaboration: Michael Tetley)
  - Development of ensemble data assimilation methods for the reconstruction of mantle circulation. (Collaborations: Martina Ulvrova, Nicolas Coltice, Alexandre Janin)
- 01/17–06/17 **Post-doctoral Fellow**, *Université Claude Bernard Lyon 1*, France.
- Development of ensemble data assimilation methods for the reconstruction of mantle circulation.
- 09/13–11/16 **PhD in Geophysics**, *École Normale Supérieure de Lyon & Institut de Physique du Globe de Paris*, France.
- Supervisors: Nicolas Coltice & Alexandre Fournier  
Thesis title: Reconstruction of mantle circulation using sequential data assimilation.
- 01/13–08/13 **Master Internship**, *École Normale Supérieure de Lyon*, France.
- Supervisor: Nicolas Coltice  
Topic: Constraining the evolution of a convective system with data assimilation.
- 09/11–08/12 **Research Assistant**, *University of Sydney*, Australia.
- Supervisor: Patrice Rey  
Topic: 3D Numerical study of metamorphic core complexes.
- 05/11–07/11 **Master internship**, *ETH Zurich*, Suisse.
- Supervisor: Boris Kaus  
Topic: 2D modeling of three phase magma.

## Teaching Experience

- 04/19,04/18 **1h Short Course on Unconscious Bias**, *European Geophysical Union General Assembly*, Vienna, Austria.
- 03/19–07/19 **Co-supervision of a Master Student**, *ENS Paris-ETH Zurich*.
- Student: Alexandre Janin
  - Co-supervisor: Nicolas Coltice
  - Topic: Multivariate statistics of 3D mantle convection models.
- 05/18–08/18 **Co-supervision of a Master Student**, *TU Delft-ETH Zurich*.
- Student: Shiran Lévy
  - Co-supervisor: Femke Voessepel
  - Topic: Fault state estimation in subduction zones using a particle filter with time-lagged particle generation.

- 09/13–08/16 **Teaching Assistant**, *École Normale supérieure de Lyon*, France.
- 64h/year in front of students, for 3 years
  - level: from first year of bachelor to first year of Master
  - Topics: Mathematics and Computer Sciences for Earth Scientists, Geophysics, Seismology, General Earth Sciences.

## Other Responsibilities







- 11/18–now **Member of the working group for equality and diversity of the European Geoscience Union.**
- Provide suggestions and ideas on equality and diversity topics to the EGU council.
  - Organise meeting and sessions at the EGU General assembly.
- 07/18–now **Reviewer for:**
- Proceedings of the Royal Society A, International Journal for Numerical and Analytical Methods in Geomechanics, AGU Books.
- 04/17–now **Member of the *didthisreallyhappen?! group*.**
- An initiative aiming at bringing awareness of sexist behaviors in academia, using comics:
- Collection and processing of testimonies on sexism in academia
  - Communication on the project (oral presentations, posters, blog article..)
  - More information at [didthisreallyhappen.net](http://didthisreallyhappen.net)
- 11/16–06/17 **Co-organiser of the general seminar of the laboratory of geology of Lyon, France.**

## Education

- 09/12–07/13 **Master in Earth and Planetary Science -2nd year-**, *Ecole Normale Supérieure de Lyon*, France.
- Major in Geophysics and Geochemistry  
Magna Cum Laude
- 09/10–07/11 **Master in Earth and Planetary Science -1st year-**, *Ecole Normale Supérieure de Lyon*, France.
- Major in Geophysics and Geochemistry
- 09/09–07/10 **Bachelor in Earth and Planetary Sciences**, *Ecole Normale Supérieure de Lyon*, France.
- 09/06–07/09 **Preparatory School for French "Grandes Ecoles"**, *Lycée Henri IV*, Paris, France.
- 3-year intensive program preparing for the national competitive exam to enter top schools.  
Major in biology, chemistry, physics, mathematics and Earth sciences.

## Skills

Softwares  $\LaTeX$ , Beamer, Inkscape, Paraview, Gplates, Git, Slack.

Programing Python , Fortran 95 (+MPI) , Bash , C , Matlab , C++ 

Languages French (native speaker), English (fluent), German (intermediate).

## Scholarships & Funding

- ETH Zurich Postdoctoral Fellowship, 2 years salary + 20 000 CHF ( 18 000 EUR) research budget.
- 2 100 000 CPU hours obtained between 2013 and 2018, for 3 different projects, presented for my thesis.
- PhD scholarship, 3 years funded by the French ministry of higher education.
- “élève normalienne”, 4 years full education and cost of living funded by the French government (ca. 52 000 EUR).

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## Publications

- 2018 **M. Bocher**, A. Fournier, N. Coltice, *Ensemble Kalman filter for the reconstruction of the Earth's mantle circulation*, *Nonlin. Processes Geophys.*, 25, 99-123, <https://doi.org/10.5194/npg-25-99-2018>, 2018.
- 2017 P. Rey, L. Mondy, G. Duclaux, C. Teyssier, D.L. Whitney, **M. Bocher**, C. Prigent, *The origin of contractional structures in extensional gneiss domes: REPLY.*, *Geology*, 45.6.
- 2017 P. Rey, L. Mondy, G. Duclaux, C. Teyssier, D.L. Whitney, **M. Bocher**, C. Prigent, *The origin of contractional structures in extensional gneiss domes*, *Geology*, G38595-1.
- 2016 **M. Bocher**, *Reconstruction of Mantle Circulation Using Sequential Data Assimilation*, PhD Thesis, Université de Lyon.
- 2016 **M. Bocher**, N. Coltice, A. Fournier, P.J. Tackley, *A sequential data assimilation approach for the joint reconstruction of mantle convection and surface tectonics*, *Geophysical Journal International*, 204(1), 200-214.

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## Invited Talks

- 08/19 **M. Bocher**, *Data assimilation for geodynamics: current challenges and perspectives*, Geophysics Group Seminar, Mainz University, Germany.
- 05/19 **M. Bocher**, *Using data assimilation for the joint reconstruction of mantle circulation and surface tectonics.*, UKSEDI, University College London, United Kingdom.
- 11/18 **M. Bocher**, *Data assimilation for long-term geodynamics: combining physics and observations to reconstruct the history (and current state) of the solid Earth.*, Seminar of the Earth Science department of the École Normale Supérieure de Paris, France.
- 07/18 **M. Bocher**, *Ensemble assimilation of observations into geodynamical models.*, Seminar of the Department of Geoscience and Engineering, UT Delft, Netherlands.
- 03/18 **M. Bocher**, *Data assimilation for the reconstruction of the past dynamics of the Earth's mantle.*, Center for Space and Habitability (CSH) seminar, University of Bern, Switzerland.
- 04/17 **M. Bocher**, A. Fournier, N. Coltice, *Ensemble Assimilation of Geodynamic Observations Into Mantle Circulation Models*, European Geophysical Union General Assembly, Vienna, Austria.
- 01/17 **M. Bocher**, *Reconstruction of Mantle Circulation using Sequential Data Assimilation*, Computational Seismology Group Seminars, Department of Earth Sciences, ETH Zurich, Switzerland.
- 03/15 **M. Bocher**, C. Mallard, *Two complementary approaches to the study of the interaction between surface dynamics and mantle convection*, Geophysical Fluid Dynamics Group Seminar, Department of Earth Sciences, ETH Zurich, Switzerland.
- 04/15 **M. Bocher**, *A sequential data assimilation approach for the joint reconstruction of mantle convection and surface tectonics*, International workshop on theoretical aspects of ensemble data assimilation for the Earth system, Les Houches, France.

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## Presentations – Women in Science

- 09/19 **M. Bocher**, A. Adenis, M. Arnould, N. Coltice, M. Gérard, C. Mallard and M. Ulvrova, *Sexist bias in academia. Real-life examples and concrete solutions*, ResearchGate HQ, Berlin, Germany.
- 09/19 **M. Bocher**, A. Adenis, M. Arnould, N. Coltice, M. Gérard, C. Mallard and M. Ulvrova, *Feminist activism in academia: A grassroot initiative perspective*, I, Scientist, Berlin, Germany.
- 04/19 M. Ulvrova, A. Adenis, M. Arnould, **M. Bocher**, N. Coltice, M. Gérard and C. Mallard, *didthisreallyhappen.net: Promoting gender equality in academia through comic strips*, European Geophysical Union General Assembly, Vienna, Austria.

- 03/19 **M. Bocher**, A. Adenis, M. Arnould, N. Coltice, M. G rault, C. Mallard and M. Ulvrova, *didthisreallyhappen.net: project presentation and panel discussion*, Conference Is Science Equal?, International Doctoral Program of University of Strasbourg.
- 01/19 **M. Bocher**, *Interview on women in science*, Scientific radio show "CQFD", live broadcast on RTS 1, the french-speaking national swiss radio, Z rich, Switzerland.
- 12/18 M. G rault, A. Adenis, M. Arnould, **M. Bocher**, C. Mallard, N. Coltice and M. Ulvrova, *didthisreallyhappen.net: Fighting everyday sexism in academia, one comic strip at a time*, American Geophysical Union Fall meeting, Washington DC, USA.
- 11/18 M. Ulvrova, **M. Bocher**, *didthisreallyhappen.net, Promoting Equality In Science*, EqualiTea Meeting at the department of Earth sciences of the ETH Zurich, Switzerland.
- 04/18 A. Adenis, M. Arnould, **M. Bocher**, N. Coltice, M. G rault, C. Mallard, M. Ulvrova, *didthisreallyhappen.net: Fighting everyday sexism in academia, one comic strip at a time*, European Geophysical Union General Assembly, Vienna, Austria.
- 03/18 A. Adenis, **M. Bocher**, *Help us fight patriarchy, one comic strip at a time!*, EGU Geodynamics blog.
- 01/18 **M. Bocher**, *Panel discussion*, 1-day symposium "Sexes  gaux, sciences  gales", Universit  Claude Bernard Lyon 1, Lyon, France.
- 04/17 M. Arnould, **M. Bocher**, N. Coltice, M. G rault, C. Mallard, M. Ulvrova, *Beyond statistics: local solutions to the underrepresentation of women in Geophysics*, European Geophysical Union General Assembly, Vienna, Austria.
- 04/16 N. Coltice, **M. Bocher**, *Growing up as a feminine team through a European project*, European Geophysical Union General Assembly, Vienna, Austria.

## Other Presentations

- 12/19 **M. Bocher**, Y. Van Dinther, *Data assimilation for seismic cycles: estimation of mechanical parameters and stress.*, 2019 American Geophysical Union Fall meeting, San Francisco, USA.
- 08/19 **M. Bocher**, Y. Van Dinther, *Assimilation of observations into physical models of the seismic cycle at subduction thrusts.*, 2019 Ada Lovelace Workshop, Siena, Italy.
- 04/19 **M. Bocher**, M.G. Tetley, *Data assimilation for the time dependent reconstruction of continents*, European Geophysical Union General Assembly, Vienna, Austria.
- 04/19 M. Ulvrova, **M. Bocher**, *Effect of Model and its complexity on the joint reconstruction of mantle circulation and surface tectonics*, European Geophysical Union General Assembly, Vienna, Austria.
- 03/19 S. Levy, F. Voesspel, **M. Bocher**, Y. Van Dinther, *Data assimilation for state estimation of fault behavior*, 2019 SIAM Conference on Mathematical and Computational Issues in the Geosciences , Houston, Texas.
- 12/18 S. Levy, F. Vossepoel, **M. Bocher** and Y. van Dinther, *Fault State Estimation in Subduction Zones Using a Particle Filter with Time-Lagged Particle Generation*, American Geophysical Union Fall meeting, Washington DC, USA.
- 03/17 **M. Bocher**, N. Coltice, A. Fournier, *Application of the Ensemble Kalman Filter to the Reconstruction of Mantle Circulation*, Workshop on Emerging Applications of Data Assimilation in the Geosciences, Leiden, Netherland.
- 04/16 **M. Bocher**, N. Coltice, A. Fournier, P.J. Tackley, *Ensemble data assimilation for the reconstruction of mantle circulation*, European Geophysical Union General Assembly, Vienna, Austria.
- 12/15 **M. Bocher**, N. Coltice, A. Fournier and P. Tackley, *Reconstructing Mantle circulation and surface tectonics using Ensemble Data Assimilation*, American Geophysical Union, San Francisco, USA.

- 09/15 **M. Bocher**, N. Coltice, A. Fournier and P. Tackley, *Applying data assimilation to mantle circulation and surface tectonics: a proof of concept*, XIV International Workshop on Modelling of Mantle and Lithosphere Dynamics, Oleron, France.
- 04/15 N. Coltice, **M. Bocher**, A. Fournier and P. Tackley, *Blending geological observations and convection models to reconstruct mantle dynamics*, European Geophysical Union General Assembly, Vienna, Austria.
- 08/14 **M. Bocher**, N. Coltice, A. Fournier and P. Tackley, *A sequential data assimilation approach for the joint reconstruction of mantle convection and surface tectonics.*, 14th symposium of SEDI, Kanagawa, Japan.
- 06/11 **M. Bocher**, *Numerical modelling of magma, crystals and bubbles.*, Geophysical Fluid Dynamics Group Seminar, Department of Earth Sciences, ETH Zurich, Switzerland.