Mathilde **Marchandon**

Postdoctorant in Geophysics

Department of Earth and Environmental Sciences, LMU, Munich

marchandon@geophysik.uni-muenchen.de | https://mathildemarchandon.wixsite.com/mathildemarchandon

Earthquake deformation · Fault slip distribution · Off-fault deformation · Fault segmentation · Earthquake sequence · Optical correlation · InSAR · Joint-data inversion · earthquake cycle modeling · Dynamic rupture simulation

Research Experience

Postdoctoral researcher

LMU, Allemagne

Maternity leave 07/24-04/25

2022 -

What control the localization of coseismic deformation? Insights from dynamic rupture simulations

- 3D Dynamic rupture simulation accounting for off-fault plasticity
- Superviseur: Alice-Agnes Gabriel

Postdoctoral Researcher

ISTerre (UGA, France)

Maternity leave 07/21 - 03/22

2018 - 2021

How is deformation distributed and accommodated within strike-slip fault zones?

- Understanding the origin of the shallow slip deficit
- Measuring the 3D displacement field produced by earthquakes from stereoscopic optical images
- Fault slip modeling taking into account the topography and 3D variations in elastic properties
- Advisors: James Hollingsworth & Mathilde Radiguet

3D mesh of the South America subduction zone

- 3D meshing of the south america subduction zone to study the long-distance interactions between megathrust earthquakes — In the framework of Juliette Cresseaux's PhD
- Advisors: Anne Socquet & Mathilde Radiguet

Ph.D. in Geophysics

Géoazur (UCA, France)

Toward the understanding of seismic sequences: from spatial observation to numerical modeling.

2014 - 2018

- Measuring the 2D surface displacement field of historical and modern earthquakes using optical correlation
- Joint inversion of InSAR and optical data to estimate the geometry at depth and the slip distribution
- Modeling of the Coulomb stress changes during an earthquake sequence
- Seismic cycle simulation taking into account the co- and postseismic stress transfers between faults
- Advisors: Mathilde Vergnolle & Olivier Cavalié

Graduate student researcher

University of Montpellier

Slip distribution and stress variations throughout the seismic cycle along strike-slip faults

2014 - 6 months

- Development of an inversion code that automatically discretizes fault in size-variable triangular subfaults depending of the surface data coverage
- Modeling of the slip distribution during the different phases of the seismic cycle of an analog model of strike-slip fault
- Advisors: Rodolphe Cattin & Stéphane Dominguez

Graduate student researcher

University of Montpellier

Analysis of the seismic and inclinometric signals for the study of Mediterranean storms

2013 - 2 months

- Advisors: Frédéric Bouchon & Frédéric Bouchette

Education

Ph.D. in Geophysics

Valbonne, France

Géoazur, Université Côte d'Azur

2014-2018

M.Sc. in Earth Dynamic and Seismic Hazard

Montpellier, France

Université Montpellier 2

2012-2014

B.Sc. in Geoscience

Pau, France

Université de Pau et des Pays de l'Adour

2009 - 2012

Skills

Data processing	Optical correlation, DEM extraction, InSAR
Modeling	Joint data inversion, Coulomb stress transfer modeling, seismic cycle simulation, dynamic rupture modeling
Software	AMS Stereo Pipeline, COSI-Corr, Pylith, Trelis, SeisSol, SimModeler, GMT, ENVI, Qgis, Coulomb C3.3, Inkscape
Programming	Matlab, Python, Bash, Fortran, Latex
Operating system	Linux/Unix, Windows
Languages	French (native), English

Teaching

Teaching assistant — *LMU Munich*

Master degree level - 16h — *2022-2024*

- **New Directions in Seismology** Earthquake Geodesy

Teaching assistant — *Université Côte d'Azur*

Bachelor degree level - 224h — *2015-2018*

- **Stratigraphy and paleontology** Stratigraphic fossil description and identification
- **Sedimentary petrology** Sedimentary rock description and identification
- **Cartography** Constructing a geologic cross-section
- **Field trips** Cartography, Esterel volcanism, Arc de Castellane tectonic, Sedimentary petrology

Co-advising a reasearch internship — *Géoazur (UCA, France)*

Master degree level — *2015 - 2 months*

- Numerical modeling of the postseismic deformation of the 1997 Mw 7.2 Zirkuh earthquake

Outreach experience

2016	**Animation of a Geology outreach stand at the French Science day**	*Antibes, France*
2015	**Outreach of my PhD subject at the First Year PhD Student meeting of Géoazur**	*Géoazur*

Community tasks

-	**Reviewer for Earth and Planetery Science Letters, BSSA, Tecktonika, Seismica, Tectonics, Journal of Geodynamics, Seismological Research Letter, Journal of Geophysical Research: Solid Earth, Geophysical Research Letter, Geophysical Journal International, Nature communication**	
Nov 2019 - Jun 2021	**In charge of seminars of the Cycle team**	*ISTerre*
2018 - 2021	**Member of the eco-responsability team of ISTerre** Team in charge of reducing the carbon footprint of the laboratory	*ISTerre*
2018 - 2020	**Organizer of the weekly team coffee break**	*ISTerre*
2016	**Organizer of the First Year PhD Student meeting of the laboratory**	*Géoazur*
2009 - 2012	**Treasurer of the student association of Geology**	*University of Pau*

Grants awarded

2018 - 2020	**CNES (French spatial agency) postdoctoral fellow**
2014 - 2017	**French ministary of research and higher education fellow**

References

Alice-Agnes Gabriel algabriel@ucsd.edu · IGPP, Scripps Institution of Oceanography, San Diego, USA

James Hollingsworth james.hollingsworth@univ-grenoble-alpes.fr · ISTerre, Université Grenoble Alpes, France

Mathilde Vergnolle mathilde.vergnolle@geoazur.unice.fr · Géoazur, Université Côte d'Azur, France

Publications

Under review

T. Ulrich, X. Zou, **M. Marchandon**, N. Schliwa, F. Tan, A-A Gabriel, W. Fan, P. Shearer, Y. Fialko On Predictable aspects of the Mw 7.8 2025 Myanmar Earthquake

M. Marchandon,J. Hollingsowrth, L. Maubant, A. Socquet, E. Pathier, M. Radiguet and A.A. Gabriel, R. Subsurface Lithologic Controls on Off-Fault Deformation and Multi-Fault Slip During the 2016 Mw 6.5 Norcia Earthquake Revealed by Satellite Geodesy

J. Cresseaux, M. Radiguet, MP Doin, M. Moreno, F. Huiban, **M. Marchandon**, J. Baez, A. Tassara, A. Socquet. Constraints on the Lithospheric Structure and Rheology of the Northern Chile Forearc from modeling the Post-Seismic Deformation of the Mw8.1 Iquique Earthquake

T. Montagnon, J. Hollingsworth, E. Pathier, **M. Marchandon**, M. Dalla Mura, S. Giffard-Roisin. GeoFlowNet: Fast and Accurate Sub-pixel Displacement Estimation From Optical Satellite Images based on Deep Learning

Peer-reviewed

[16] Z. Yin, **M. Marchandon**, J. S. Haase, A.A. Gabriel, R. Douilly. (2025) 3D dynamic rupture modeling of the 2021 Haiti earthquake used to constrain stress conditions and fault system complexity, JGR: Solid Earth, 10.1029/2024JB030932

[15] **M. Marchandon**, A.A Gabriel, L. Chiaraluce, E. Tinti, E. Casarotti, J. Biemiller. (2025) Forecasting 3D Rupture Dynamics of the Alto Tiberina Low-Angle Normal Fault, Italy, Seismica, 10.26443/seismica.v4i2.1603

[14] M-H. Yen, E. Türker, T. Ulrich, **M. Marchandon**, A-A. Gabriel, F. Cotton. (2025) An analysis of directivity pulses using empirical data and dynamic rupture simulations of the 2023 Kahramanmaras earthquake doublet, accepted in Earthquake Spectra, DOI: 10.1177/87552930241305012

[13] T. Montagnon, S. Giffard-Roisin, M. D. Mura, **M. Marchandon**, J. Hollingsworth, E. Pathier. (2024) Sub-Pixel Displacement Estimation with Deep Learning: Application to Optical Satellite Images Containing Sharp Displacements, Journal of Geophysical Research: Machine Learning and Computation, 1, e2024JH000174. https://doi.org/10.1029/2024JH000174

[12] J. N. Hayek, **M. Marchandon**, D. Li, L. Pousse-Beltran, J. Hollingsworth, T. Li, A.-A. Gabriel. (2024) Non-typical supershear rupture: fault heterogeneity and segmentation govern unilateral supershear and cascading multi-fault rupture in the 2021 Mw 7.4 Maduo Earthquake, Geophysical Research Letter, 51, e2024GL110128. https://doi.org/10.1029/2024GL110128

[11] Montagnon T., Hollingsworth J., Pathier E., **Marchandon M.**, Dalla Mura M., (2024) Fast and Accurate Sub-Pixel Displacement Estimation from Optical Satellite Images Using a New Hyper-Realistic Earthquake Database and U-Net Architecture, IGARSS 2024-2024 IEEE International Geoscience and Remote Sensing Symposium

[10] Montagnon T., Hollingsworth J., Pathier E., **Marchandon M.**, Dalla Mura M., Giffard-Roisin S., (2023) A new deep-learning approach for the sub-pixel registration of satellite images containing sharp displacement discontinuities. IGARSS 2023-2023 IEEE International Geoscience and Remote Sensing Symposium, 2023/7/16

[9] AA. Gabriel, T. Ulrich, **M. Marchandon**, J. Biemiller, J. Rekoske. (2023) 3D Dynamic Rupture Modeling of the 6 February 2023, Kahramanmaraş, Turkey M w 7.8 and 7.7 Earthquake Doublet Using Early Observations. The Seismic Record, 3(4), 342-356.

[8] Z. Jia, Z. Jin, **M. Marchandon**, T. Ulrich, AA. Gabriel, W. Fan, P. Shearer, X. Zou, J. Rekoske, F. Bulut, A. Garagon, and Y. Fialko, (2023) The complex dynamics of the 2023 Kahramanmaraş, Turkey, Mw 7.8-7.7 earthquake doublet. Science, DOI:10.1126/science.adi0685.

[7] T. Montagnon, J. Hollingsworth, E. Pathier, **M. Marchandon**, M. D. Mura and S. Giffard-Roisin, (2022) Sub-pixel Optical Satellite Image Registration for Ground Deformation Using Deep Learning. 2022 IEEE International Conference on Image Processing (ICIP), 2022, pp. 2716-2720, doi: 10.1109/ICIP46576.2022.9897214.

[6] **Marchandon , M.**, Wright , T.J. and Hollingsworth , J. (2022). Remote Sensing of the Earthquake Deformation Cycle. In Surface Displacement Measurement from Remote Sensing Images (eds O. Cavalié and E. Trouvé).

[5] **Marchandon M.**, Hollingsworth J., Radiguet M. (2021) Origin of the Shallow Slip Deficit on a strike slip fault: influence of elastic structure, topography, data coverage, and noise. Earth and Planetary Science Letters 554, 116696.

[4] **Marchandon M.**, Vergnolle M, et Cavalié O. (2021) Fault interactions in a complex fault system: Insight from the NE Lut fault system. Geophysical Journal International 224(2), 1157–1173

[3] **Marchandon M.**, Vergnolle M ., Cavalié O., Sudhaus H., and Hollingsworth J. (2018) Earthquake sequence in the NE Lut, Iran: Observations from multiple space geodetic techniques. Geophysical Journal International 215(3), 1604-1621.

[2] **Marchandon M.**, Vergnolle M., Sudhaus H., and Cavalié O. (2018) Fault geometry at depth and slip distribution of the 1997 Mw 7.2 Zirkuh earthquake: contribution of near-field displacement data. Journal of Geophysical Research: Solid Earth, 123(2)

[1] Caniven Y., Dominguez S., Soliva R., Cattin R., Peyret M., **Marchandon M.**, Romano C., and Strak V. (2015). A new multi-layered visco-elasto-plastic experimental model to study strike-slip fault seismic cycle. Tectonics, 34(2), 232-364.

Communications

** indicates mentored students*

Conférences nationales et internationales

[29] A.A Gabriel, F. Gallovic, J Nicolas Hayek, J. Hollingsworth, D. Li, T. Li, **Marchandon M.**, J. Premus, L. Pousse-Beltran, N. Schliwa Deciphering the Unexpected: Unraveling Earthquake Complexity through Integrating Observations and Physics-Based Simulations Across Time Scales, AGU Fall Meeting, 2024, *Talk*

[28] Preca Trapani R.*, **Marchandon M.**, Gabriel A.A., Ulrich T., Wu B., Yen M-H, Cotton F., Do physic-based dynamic rupture models capture ground-motion variability? Insights from the 2023 Turkey earthquake sequence, Earthquake Physics and Induced Seismicity Workshop and Conferences, Lunteren, Pays-Bas, 2024, *Poster*

[27] Preca Trapani R.*, **Marchandon M.**, Gabriel A.A., Ulrich T., Yen M-H, Cotton F., Do physic-based dynamic rupture models capture ground-motion variability? Insights from the 2023 Turkey earthquake sequence, Numerical Modeling of Earthquake Motions: Waves and Ruptures Workshop, Smolenice, Slovakia, 2024, *Poster*

[26] Venisse N.*, DiToro G., **Marchandon M.**, Fondriest M., Faccenda M., Gabriel A.A., Fault damage zones in carbonates: formation, distribution and role in the seismic cycle (Italian Central Apenines), Numerical Modeling of Earthquake Motions: Waves and Ruptures Workshop, Smolenice, Slovakia, 2024, *Poster*

[25] Montagnon T., Giffard-Roisin S., Hollingsworth J., Pathier E., Dalla Mura M., **Marchandon M.**, A new deep-learning approach for the sub-pixel correlation of optical images in the near-field of earthquake ruptures, EGU, 2024, *Poster*

[24] **Marchandon M.**, Hollingsworth J., Gabriel A.A., Maubant L., Ulrich T., Socquet A., Pathier E., Radiguet M., Distribution and Accommodation of Deformation within Active Fault Zones: Insight from Geodetic Analysis & 3D Dynamic Rupture Simulations., AGU, 2023, *Invited talk*

[23] **Marchandon M.**, Marchandon M., Gabriel A.A., Chiaraluce L., Tinti E., Casarotti E., Biemiller J., Schliwa N., Rupture Forecasts for the Alto Tiberina Low-Angle Normal Fault, Italy, from Physic-Based 3D Dynamic Rupture Simulations. AGU, 2023, *Poster*

[22] Jia Z., Jin Z., **Marchandon M.**, Ulrich T. Gabriel A.A., Fan W., Shearer P.M., A unified view of the complex dynamics of the 2023 Kahramanmaraş, Turkey, Mw 7.8-7.7 earthquake doublet, AGU 2023, *Poster*

[21] J Hollingsworth, T Montagnon, E Pathier, **M Marchandon**, M Dalla Mura, Giffard-Roisin S. A new deep-learning approach for the sub-pixel correlation of optical images in the near-field of earthquake ruptures, AGU, 2023, *Poster*

[20] Giffard-Roisin S., Montagnon T., Pathier E., Dalla Mura M., **Marchandon M.**, Hollingsworth J., Can deep learning help understand and characterize earthquakes? An example with deep learning optical satellite image correlation. EGU, 2023, *Talk*

[19] Gabriel A.A., **Marchandon M.**, Ulrich T., Biemiller J., Geodetically and seismically informed rapid 3D dynamic rupture modeling of the Mw7.8 Kahramanmaraş earthquake, Turkey., EGU, 2023 *Poster*

[18] **Marchandon M.**, Gabriel A.A., Ulrich T., 3D Dynamic Rupture Simulation of the 2016 Mw 6.5 Norcia Earthquake Constrained by Multi-Data Geodetic Analysis, AGU, 2022, *Talk*

[17] Cresseaux J., Socquet A., Radiguet M., Doin M.P., Marsan D., **Marchandon M.**, Role of the Andean structure in the Post-Seismic Deformation Following the 2014 Mw 8.1 Iquique Earthquake in Chile: New insights from a Finite Element Model Constrained by GNSS, AGU, 2022, *Poster*

[16] Hayek J.N.*, Li D., **Marchandon M.**, Gabriel A.A., Pousse-Beltran L., Hollingswprth J., Unraveling the Dynamic Complexity of the 2021 Mw7.4 Maduo Earthquake., AGU, 2022, *Talk*

[15] **Marchandon M.**, Hollingsworth J., Maubant L., Socquet A., Gabriel A.A., Pathier E., Radiguet M., and Ulrich T., Distribution and accommodation of the deformation within active fault zones: insight from satellite geodesy, realistic fault slip modeling and dynamic rupture simulations applied to the 2016 Mw 6.5 Norcia earthquake. MDIS, 2022, *Poster*

[14] Cresseaux J., Socquet A., Radiguet M., Doin M.P., Marsan D., **M Marchandon**, Huiban F. , Molaro-Maqua R., Modelling the post-seismic deformations measured by GNSS and InSAR, following the 2014 Iquique earthquake, Chile, EGU, 2022, *Poster*

[13] Cresseaux. J, Socquet A., Radiguet M., Doin M-P., Marsan D., **Marchandon M.**, Molaro-Maqua R., Modelling of the post-seismic phase of the Iquique earthquake constrained by GNSS and InSAR observations, RST meeting, Lyon, France, 2021, *Talk*

[12] **Marchandon M.**, Hollingworth J., Radiguet M., How is deformation accommodated and distributed within active fault zones? Insights from satellite geodesy and realistic fault modeling, AGU fall meeting, San Francisco, USA, 2019, *Poster*

[11] **Marchandon M.**, Hollingworth J., Radiguet M., How is deformation accommodated and distributed within active fault zones? Insights from satellite geodesy and realistic fault modeling, CNES meeting, Toulouse, France, 2019, *Talk & Poster*

[10] **Marchandon M.**, Hollingworth J., Radiguet M., How is deformation accommodated and distributed within active fault zones? Insights from satellite geodesy and realistic fault modeling, MDIS meeting, Strasbourg, France, 2019, *Poster*

[9] **Marchandon M.**, Hollingworth J., Radiguet M., How is deformation accommodated and distributed within active fault zones? Insights from satellite geodesy and realistic fault modeling, Crustal Deformation Modeling Workshop, Goldon, USA, 2019, *Poster*

[8] **Marchandon M.**,Vergnolle M., and Cavalié O., Fault interactions and synchronization: Insight from the 1936-1997 NE Lut, Iran earthquake sequence, AGU fall meeting, Washington, USA, 2018, *Poster*

[7] **Marchandon M.**, Vergnolle M, and Cavalié O., Fault interactions and synchronization: Insight from the 1936-1997 NE Lut, Iran earthquake sequence, Wegener meeting, Grenoble, France, 2018, *Poster*

[6] Caniven Y., Dominguez S., Soliva R., Cattin R., Peyret M., **Marchandon M.**, Romano C., and Maerten F., A new multi-layered visco-elasto-plastic experimental model to study strike-slip fault seismic cycle., Geomod, Montpellier, France, 2016, *Poster*

[5] **Marchandon M.**, Vergnolle M, Sudhaus, H. and Cavalié O., Reassessment of the source model of the 1997 Mw 7.2 Zirkuh earthquake (North Eastern Iran), AGU fall meeting, San Francisco, USA, 2016, *Poster*

[4] **Marchandon M.**, Vergnolle M., Cavalié O., Sudhaus H., Hollingsworth, J., Earthquakes in the NE Lut, Iran: Observations from multiple space geodetic techniques, Wegener, Azores, Portugal, 2016, *Poster*

[3] **Marchandon M.**, Vergnolle M., Sudhaus H. and Cavalié O., Coseismic source model improvement inverting near-field geodetic data in addition to traditional far-field geodetic data, Wegener, Azores, Portugal, 2016, *Talk*

[2] **Marchandon M.**, VergnolleM., Cavalié O., Sudhaus H., Hollingsworth, J., First step to understand the NE Lut, Iran, earthquake sequence: observation of each earthquake deformation from multiple space geodetic techniques, TopoEurope, Antibes, France, 2015, *Poster*

[1] **Marchandon M.**, Vergnolle M, Sudhaus, H. , Cavalié O., and Hollingsworth J., Slip imagery at depth of the 1997 Zirkuh earthquake (Mw 7.2) from a joint inversion of InSAR, SAR, and optical correlation surface displacements, Second year PhD meeting of the EDSFA, University of Nice Sophia Antipolis, Nice, France, 2015, *Talk*

Seminars

[9] **Marchandon M.** Enhancing earthquake rupture understanding: bridging observations with dynamic rupture simulations, ISTerre, UGA, 2024, *Invited seminar*

[8] **Marchandon M.** Distribution and accommodation of deformation within active fault zones: Insight from satellite geodesy, realistic fault slip modeling and dynamic rupture simulations, Université de Nantes, 2024, *Invited seminar*

[7] **Marchandon M.** Distribution and accommodation of deformation within active fault zones: Insight from satellite geodesy, realistic fault slip modeling and dynamic rupture simulations, Géoazur, 2024, *Invited seminar*

[6] **Marchandon M.** Dynamic rupture modeling of the February 6, 2023, Kahramanmaraş, Turkey, Mw7.8 and Mw7.7 earthquake doublet, LMU Munich, 2024, *In-house seminar*

[5] **Marchandon M.** Distribution and accommodation of the deformation within active fault zones: Insight from satellite geodesy, realistic fault slip modeling and dynamic rupture simulations, IPGP, *Invited seminar*

[4] **Marchandon M.** Earthquake sequences and distribution of deformation within active fault zones: Insight from satellite geodesy and numerical modeling, LMU Munich, 2022, *In-house seminar*

[3] **Marchandon M.** Earthquake sequences and distribution of deformation within active fault zones: Insight from satellite geodesy and numerical modeling, ISTerre, 2020, *In-house seminar*

[2] **Marchandon M.** Toward the understanding of seismic sequences: From spatial observation to numerical modeling. Application to the NE Lut sequence (Iran), ISTerre, 2019, *In-house seminar*

[1] **Marchandon M.** Slip distribution and stress variations throughout the seismic cycle along strike-slip faults: insight from analog and numerical models. Géoazur, 2015, *In-house seminar*