

# Jack Broderick Muir

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## Education

10/2021	PhD (Geophysics), California Institute of Technology (Caltech), Pasadena CA
06/2019	MSc (Geophysics), California Institute of Technology (Caltech), Pasadena CA
12/2014	PhB (Science, Honours in Physics), Australian National University, Canberra ACT 1 <sup>st</sup> class honours with the University Medal

## Professional Positions

03/2022–Present	Marie Skłodowska-Curie Individual Fellow, University of Oxford, Oxford, UK
03/2022–Present	Junior Research Fellow, Wolfson College, University of Oxford, Oxford, UK
01/2021–02/2022	Visiting Researcher, Australian National University, Canberra ACT, Australia
06/2015–10/2021	Graduate Student Researcher, California Institute of Technology, Pasadena CA, USA
01/2012–01/2013	Intern Researcher, Australian Nuclear Science and Technology Organization, Lucas Heights NSW, Australia

## Currently Active Projects

TerraPINN: Toward fully physics based probabilistic seismic hazard assessment using physics informed neural networks

with: Tarje Nissen-Meyer (Oxford Earth Sciences)

Multiscale nonparametric inference of seismicity background rates using deep Gaussian processes

with: Zach Ross (Caltech Seismolab)

Semi-supervised learning via the eikonal equation

with: Ollie Dunbar (Caltech Climate Dynamics), Andrew Stuart (Caltech Applied Mathematics)

Joint inversion of the core-mantle boundary topography and lowermost mantle velocity structure with hierarchical Hamiltonian Monte Carlo  
with: Hrvoje Tkalčić (ANU Earth Sciences), Satoru Tanaka (JAMSTEC)

## Publications

In review	<i>Convection of the Earth's Inner Core</i> , H. Tkalčić et al.
04/2022	<i>Wavefield-based evaluation of DAS instrument response and array designs</i> , J.B. Muir & Z. Zhan, GJI, (2022) 229 (1): 21–34, <a href="https://doi.org/10.1093/gji/ggab439">https://doi.org/10.1093/gji/ggab439</a>
02/2022	<i>Parsimonious velocity inversion applied to the Los Angeles Basin, CA</i> , J.B. Muir et al., JGR: Solid Earth, (2022) 127 (2): e2021JB023103, <a href="https://doi.org/10.1029/2021JB023103">https://doi.org/10.1029/2021JB023103</a>
01/2022	<i>Sub-kilometer correlation between near-surface structure and ground motion measured with distributed acoustic sensing</i> , Y. Yang et al., GRL, (2022) 49 (1): e2021GL096503, <a href="https://doi.org/10.1029/2021GL096503">https://doi.org/10.1029/2021GL096503</a>
01/2022	<i>HypoSVI - Hypocentral Earthquake Location Analysis using Machine Learning based Stein Variational Gradient Descent</i> , J. Smith et al., GJI, (2022) 228 (1): 698–710, <a href="https://doi.org/10.1093/gji/ggab309">https://doi.org/10.1093/gji/ggab309</a>
10/2021	<i>Seismic Wavefield Reconstruction using a Preconditioned Wavelet-Curvelet Compressive Sensing Approach</i> , J.B. Muir & Z. Zhan, GJI, (2021) 227 (1): 303–315, <a href="https://doi.org/10.1093/gji/ggab222">https://doi.org/10.1093/gji/ggab222</a>
12/2020	<i>Probabilistic lowermost mantle P-Wave tomography from hierarchical Hamiltonian Monte Carlo and model parametrisation cross-validation</i> , J.B. Muir & H. Tkalčić, GJI, (2020) 223 (3): 1630–1643, <a href="https://doi.org/10.1093/gji/ggaa397">https://doi.org/10.1093/gji/ggaa397</a>
02/2020	<i>Geometric and level set tomography using ensemble Kalman inversion</i> J.B. Muir & V.C. Tsai, GJI (2020) 220 (2): 967–980, <a href="https://doi.org/10.1093/gji/ggz472">https://doi.org/10.1093/gji/ggz472</a>

- 01/2020 *Did Oldham Discover the Core After All? Handling Imprecise Historical Data with Hierarchical Bayesian Model Selection Methods*,  
J.B. Muir & V.C. Tsai, SRL (2020) 91 (3): 1377–1383, <https://doi.org/10.1785/0220190266>
- 09/2017 *Rayleigh Wave H/V via Noise Cross-Correlation in Southern California*,  
J.B. Muir & V.C. Tsai, BSSA (2017) 107 (5): 2021–2027, <https://doi.org/10.1785/0120170051>
- 12/2015 *Strong, Multi-Scale Heterogeneity in Earth's Lowermost Mantle*,  
H. Tkalčić et al. Sci. Rep. (2016) 5: 18416, <https://doi.org/10.1038/srep18416>
- 11/2015 *Spherical Harmonic Analysis in the Geosciences via Bayesian Inference*,  
J.B. Muir & H. Tkalčić, GJI (2015) 203 (2): 1164–1171, <https://doi.org/10.1093/gji/ggv361>
- 07/2012 *A single-probe-beam double-heterodyne polarimeter-interferometer for plasma Faraday rotation measurements*,  
J. Howard et al. JINST (2012) 7 P07009, <https://doi.org/10.1088/1748-0221/7/07/p07009>

## Funding Awarded

- 03/2022–10/2022 Alan Turing Institute Postdoctoral Enrichment Award  
2,000.00 GBP
- 03/2022–03/2024 *TerraPINN: Toward fully physics based probabilistic seismic hazard assessment using physics informed neural networks*  
Marie Skłodowska-Curie Actions Individual Fellowship  
Co-I Tarje Nissen-Meyer  
224,933.76 EUR
- 08/2020–07/2023 *Improving the Interpretability of Tomographic Images Using Geologically Motivated Parametrizations*  
National Science Foundation Award 2011079  
PI Victor C. Tsai, JBM wrote scientific justification of proposal  
255,859.00 USD

02/2020–03/2021	<i>Combining High-Resolution Local Models with the SCEC CVMS</i> Southern California Earthquake Center Award 20024 PI Robert W. Clayton, JBM wrote scientific justification of proposal 23,460.00 USD
06/2015–06/2018	Origin Energy Foundation / General Sir John Monash Scholarship 180,000.00 AUD

### **Honours and Awards**

02/2021	Marie Skłodowska-Curie Individual Fellowship
02/2015	General Sir John Monash Scholarship
12/2014	ANU University Medal in Physics
12/2014	Director of Science Education Commendation (ANU)
12/2014	Australian Society of Exploration Geophysicists ACT Branch Student Award
01/2014	ANU Dunbar Scholarship for Physics Honours
12/2013	Australian Meteorological and Oceanographic Society ACT Branch Student Award
12/2011,13	Dean's Science Commendation (ANU)
12/2010,11,13	ANU National Merit Scholarship

### **Invited Talks**

03/2022	Better seismic models of the Los Angeles Basin using geologically informed tomography, Weeks Lecture, University of Wisconsin-Madison
03/2022	Curvelet based wavefield reconstruction - theory and applications from regional tomography to DAS / nodal integration, University of Wisconsin-Madison
12/2021	Seismic Wavefield Reconstruction using a Preconditioned Wavelet-Curvelet Compressive Sensing Approach, American Geophysical Union Fall Meeting
12/2021	Wavefield Reconstruction-based evaluation of DAS instrument response and array design, American Geophysical Union Fall Meeting

09/2021	Preconditioned Compressive Sensing for Wavefield Reconstruction, Australian Society of Exploration Geophysicists
12/2020	Level-set imaging of the Los Angeles Basin using the Community Seismic Network, ETH Zürich
09/2020	Parsimoniously introducing high-resolution local updates into the SCEC CVMs using a level-set approach, Southern California Earthquake Center workshop on “Multi-scale seismic velocity models—Imaging and validation studies”
06/2020	Imaging the Los Angeles Basin using the July 5 2019 Mw 7.1 Ridgecrest Earthquake, Oxford University
01/2019	Geometric and Level Set Tomography using Ensemble Kalman Inversion, Australian National University
11/2017	Rayleigh Wave H/V via Noise Cross-Correlation in Southern California, Los Alamos National Laboratory

### **Conference Presentations**

09/2021	Parsimonious velocity inversion applied to the Los Angeles Basin, CA, SCEC annual meeting poster
07/2021	Bayesian Joint Inversion Implies a Complex Multiscale Lowermost Mantle Overlaying Simple Core-Mantle Boundary Topography, Goldschmidt Poster
03/2021	Level-set Imaging of the Los Angeles Basin using the Hierarchical Ensemble Kalman Sampling SSA virtual tomography meeting
12/2020	Level-set imaging of the Los Angeles Basin using the Community Seismic Network, AGU fall meeting talk
09/2020	A Level-Set Approach to Parsimoniously Updating the SCEC CVMs, SCEC annual meeting poster

12/2019	Wavefield Reconstruction and Surface Wave Tomography from LassoCV, AGU fall meeting talk
09/2019	Visualising the Ridgcrest Earthquakes using Wavefield Reconstruction, SCEC annual meeting poster
12/2018	Taming the tomographic null space using geometric and level set parameterizations of the Earth, AGU fall meeting talk
09/2018	Geometric and Level Set Tomography for Interface Detection in the Near Surface, SCEC annual meeting poster
12/2017	Wavefield Reconstruction using Compressive Sensing and Distributed Acoustic Sensing, AGU fall meeting poster
12/2016	Rayleigh Wave H/V via Noise Cross-Correlation in Southern California, AGU fall meeting talk
12/2015	Joint Bayesian Tomography of the Core-Mantle Boundary Topography and Lowermost Mantle Velocity, AGU fall meeting talk
12/2014	Spherical Harmonic Analysis via Bayesian Inference, AGU fall meeting poster
09/2013	Bayesian inference applied to the differential rotation of Earth's inner core, Australian Conference of Undergraduate Research poster
09/2012	A single-probe-beam double-heterodyne polarimeter-interferometer for plasma Faraday rotation measurements, Australian Conference of Undergraduate Research poster

## General Audience Publications

06/2021	<i>Interview,</i> The Scholars Podcast <a href="https://player.whooshkaa.com/episode?id=842498">https://player.whooshkaa.com/episode?id=842498</a>
05/2019	<i>Listening to the Heartbeat of our Planet,</i> Caltech Letters <a href="https://caltechletters.org/science/historical-seismology">https://caltechletters.org/science/historical-seismology</a>

## Teaching Assistantships

04–06/2020	Caltech Ge264 <i>Machine Learning in Geophysics</i>
04–06/2019	Caltech Ge111B <i>Field Geophysics B</i>
01–03/2018	Caltech Ge162 <i>Seismology</i>
01–03/2017	Caltech Ge111A <i>Field Geophysics A</i>

## Internships & Intensives

07/2019	Dr. Lucy Jones Center for Science and Society Science Activation Workshop
06/2018	Gene Golub SIAM Summer School: Inverse Problems
11/2014–01/2015	Student Internship in Geophysics Australian National University
11/2013–01/2014	Student Fellowship in Astrophysics Australian Astronomical Observatory (AAO)
01/2012–01/2013	Year in Industry Internship in Condensed Matter Physics Australian Nuclear Science and Technology Organisation (ANSTO)
11/2011–01/2012	Summer Internship in Optics Australian National University
07/2011	Winter School in Astronomy Australian National University

## Service Activities & Roles

Journal Reviews	GRL, JGR: Solid Earth, GJI, BSSA, PAAG
08/2018–Present	General Sir John Monash Foundation Reviewer
07/2016–07/2019	Caltech Graduate Student Council Steering Committee 07/2017–07/2019 Treasurer 07/2018–07/2019 Academics Chair 07/2017–07/2018
07/2015–12/2020	Caltech Graduate Honor Council
02–09/2014	Australasian Conference for Undergraduate Research (ACUR) — Planning Committee

## **Professional Memberships & Roles**

12/2016–Present    Seismological Society of America  
08/2014–Present    American Geophysical Union  
08/2014–Present    Australian Society of Exploration Geophysicists

## **References**

Dr Tarje Nissen-Meyer, Department of Earth Sciences, University of Oxford, Oxford, UK, tarje.nissen-meyer@earth.ox.ac.uk, +44-1865-282149

Prof. Hrvoje Tkalčić, Research School of Earth Sciences, Australian National University, Canberra, ACT Australia, hrvoje.tkalczic@anu.edu.au, +61-2-6125-3213

Dr Victor C. Tsai, Department of Earth and Planetary Sciences, Brown University, Providence, RI USA, victor\_tsai@brown.edu, +1-401-863-1190

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