

Prof. Vipul Silwal

Mailing Address

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Indian Institute of Technology Roorkee
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Education

PhD in Geophysics 2012-2018
University of Alaska Fairbanks, USA
Thesis: Earthquake source mechanisms and three-dimensional wavefield simulations in Alaska
Advisor: Dr. Carl Tape

Integrated BS and MS, Exploration Geophysics 2007-2012
Indian Institute of Technology (IIT), Kharagpur, India
Thesis: Moment Tensor Inversion in Alaska using Body and Surface Waves
Advisor: Dr. William Mohanty and Dr. Carl Tape

Experience

Assistant Professor
Department of Earth Sciences
Indian Institute of Technology Roorkee June 2019 - present

Research Associate, Indian Institute of Technology Hyderabad Mar 2019 - May 2019

- Initiating and formalizing steps for seismicity and tectonic study in Himalayas
- Installation and maintenance of HPC resources
- Meshing and three-dimensional simulations in northwestern Himalayas

Research Assistant, University of Alaska Fairbanks 2012-2018

- Moment tensor inversion of earthquakes using FWI
- Microseismicity analysis
- Uncertainty analysis using probabilistic approach.
- 3D Wavefield simulations in Alaska.
- Preparing a reference velocity model of Alaska for tomographic inversion.

Field Technician, Alaska Earthquake Center Summer 2012, 2013

- Installation and maintenance of seismic stations in Alaska.

Research Assistant, IIT Kharagpur 2011-2012

- Computation of green's function and synthetic seismograms.
- Gained experience on working in a collaborative environment and version controlled setup.

Research Intern, University of Tromsø, Norway Summer 2010

- Seismicity analysis of Hakon Mosbey Mud Volcano (Barents Sea).
- Offshore field trip in Barents Sea and Svalbard for sedimentary coring and seismic reflection survey.

Sponsored/ Research Projects

1. Geological and Geophysical investigation of Mines in Rudraprayag, (2023). Geocoin Global Pvt. Ltd., 9.60 Lakhs.
2. Ultrasonic Seismic imaging application to Sandalwood trees, Dharampal Satyapal associates, (2023). Dharmapal Satayapal Ltd., 40 Lakhs.
3. Moment tensor inversion and three-dimensional wavefield simulation in Himalayas, (2020), IITR-FIG, 18 Lakhs.
4. Seismic imaging of central Himalayas using spectral element method, (2021). DST-SERB, 21 Lakhs.

5. Bihar 1934 and Uttarkashi 1991 earthquake scenario multi-state risk preparedness, (2022). NDMA, 128.40 Lakhs.
6. Development of low-cost geophone sensors, (2022). iHUB-IITR, 6 Lakhs.

Publications

1. S. P. Singh and **V. Silwal**, 2023, Enhanced crustal and intermediate seismicity in the Hindu Kush- Pamir Region revealed by Attentive Deep Learning Model, *Artificial Intelligence in Geosciences*. vol 4, pp 150-163.
2. **V. Silwal**, P. Kumar, R. Mahanta, V. Maurya, M. L. Sharma, Kamal, A. Ammani, (2023) Near Real-Time Detection And Moment Tensor Inversion of May 11, 2022 Dharchula Earthquake. *GeoHazards*, pp. 515-525.
3. **V. Silwal**, C. Tape, and A. Lomax, 2018, Crustal earthquakes in the Cook Inlet and Susitna regions, southern Alaska, *Tectonophysics*, Vol. 745, doi: 10.1016/j.tecto.2018.08.013.
4. Alvizuri, C., **V. Silwal**, L. Krischer, and C. Tape, 2018, Estimation of full moment tensors including uncertainties for earthquakes, volcanic events and nuclear explosions, *Journal of Geophysical Research: Solid Earth.*, Vol. 123, doi: 10.1029/2017JB015325.
5. Tape, C., S. Holtkamp, **V. Silwal**, Y. Kaneko, J. Hawthorne, J. P. Ampuero, N. Ruppert, K. Smith, and M. E. West, 2018, Earthquake nucleation and fault slip complexity in the lower crust of central Alaska, *Nature Geoscience*, 11, doi: 10.1038/s41561-018-0144-2.
6. Tape, C., A. Lomax, **V. Silwal**, J. D. Agnew and B. Brettschneider, 2017, The 1904 Ms 7.3 Earthquake in Central Alaska, *Bulletin of the Seismological Society of America*, Vol. 107, No. 3, pp. 1147-1174, June 2017, doi: 10.1785/0120160178.
7. **V. Silwal** and C. Tape, 2016, Seismic moment tensors and estimated uncertainties in southern Alaska, *Journal of Geophysical Research: Solid Earth.*, v. 121, doi: 10.1002/2015JB012588.
8. C. Tape, **V. Silwal**, C. Ji, L. Keyson, M.E. West, and N. Ruppert, 2015, Transtensional tectonics of the Minto Flats fault zone and Nenana basin, central Alaska, *Bulletin of the Seismological Society of America*, Vol. 105, No. 4, pp. 2081-2100, August 2015, doi: 10.1785/0120150055.
9. C. Tape, M. West, **V. Silwal**, and N. Ruppert, 2013, Earthquake nucleation and triggering on an optimally oriented fault, *Earth and Planetary Science Letters*, v. 363, p. 231- 241. doi: 10.1016/j.epsl.2012.11.060.
10. D. Trivedi, K. Devi, I. Buynevich, P. Srinivasan, K. Ravisankar, **V. Silwal**, D. Sengupta, and R. R. Nair., 2012, Interpretation of Dune Genesis from the Sedimentological Data and Ground Penetrating Radar (GPR) Signatures: A case study from Ashirmata Dune Field, Mandvi Beach, Gujarat, India, *International Journal of Geosciences*, 2012, 3, 772-779, doi: 10.4236/ijg.2012.34078.

Reports/ Catalogs

2. Mahanta, R., V. Silwal, 2024, Processing local seismological waveform datasets for moment tensor inversion using mtuq. Zenodo. <https://doi.org/10.5281/zenodo.10499910>
3. V. Silwal. Seismic moment tensor catalog for crustal earthquakes in the Cook Inlet and Susitna region of southern Alaska, 2018. ScholarWorks@UA at <http://hdl.handle.net/11122/8383>: descriptor file, text file of catalog, figures with waveform fits, and input weight files.
4. A. Lomax, **V. Silwal**, and C. Tape. Hypocenter estimation for 14 earthquakes in south-central Alaska (1929-1975), 2018. ScholarWorks@UA at <http://hdl.handle.net/11122/8380>: descriptor file and zipped set of text files for each earthquake.
5. **V. Silwal**. Seismic moment tensors for six events in the Minto Flats fault zone, 2012-2016, 2018. ScholarWorks@UA at <http://hdl.handle.net/11122/8253>: descriptor file, text file of catalog, figures with waveform fits, and input weight files.
6. C. Tape, **V. Silwal**, and S. Holtkamp. Step-response signals recorded during earthquakes in Alaska, 2017. ScholarWorks@UA at <http://hdl.handle.net/11122/7947> (last accessed 2017-10-27).
7. **V. Silwal**. Seismic moment tensor catalog for Minto Flats fault zone (2000-2014), 2015. ScholarWorks@UA at <http://hdl.handle.net/11122/6267> (last accessed 2016-01-22): descriptor file, text file of catalog, composite figures of waveform fits and depth searches.

8. **V. Silwal**. Seismic moment tensor catalog for southern Alaska, 2015. ScholarWorks@UA at <http://hdl.handle.net/11122/6025> (last accessed 2016-01-22): descriptor file, text file of catalog, figures with waveform fits, depth searches, and uncertainty analyses.

Conferences/ Abstracts

1. S. P. Singh, **V. Silwal**, Repopulating Earthquake Catalog in the Hindu Kush-Pamir Region using Attentive Deep Learning Model , AGU Fall Meeting Abstracts 2021.
2. A Kharita, **V. Silwal**, SPEAQ-A Python Toolbox for Assessing Station Performance After an Event, AGU Fall Meeting Abstracts 2021, S25E-0291
3. **V. Silwal**, R Mahanta Moment tensor solutions and 3D wavefield simulation in Garhwal Himalayas, AGU Fall Meeting Abstracts 2021, S55E-0197
4. R Modrak, C Tape, CR Alvizuri, **V. Silwal**, J Thurin, M Cleveland, Force and moment tensor uncertainty quantification with 1D and 3D Earth models, AGU Fall Meeting Abstracts 2020, S045-0004
5. B. Chow, Y. Kaneko, **V. Silwal**, and C. Tape. Adjoint tomography of the Hikurangi subduction zone and New Zealands North Island. 2018. Abstract T51I-0282 presented at 2018 Fall Meeting, AGU, Washington, D.C., 10-14 Dec.
6. R. Modrak, **V. Silwal**, C. Alvuzuri, and C. Tape. Moment tensor inversion and uncertainty quantification using mtuq, instaseis, obspy and pymc. 2018. Abstract S53E-0458 presented at 2018 Fall Meeting, AGU, Washington, D.C., 10-14 Dec.
7. C. Tape, S. Holtkamp, **V. Silwal**, J. Hawthorne, Y. Kaneko, J. P. Ampuero, C. Ji, N. Ruppert, K. Smith, and M. E. West. Earthquake nucleation and fault slip complexity in the lower crust of central Alaska. 2018. Abstract T43B-03 presented at 2018 Fall Meeting, AGU, Washington, D.C., 10-14 Dec.
8. C. Tape, C. Alvizuri, **V. Silwal**, and W. Tape. Uncertainties for seismic moment tensors and applications to nuclear explosions, volcanic events, and earthquakes. 2017. Abstract S44B-01 presented at 2017 Fall Meeting, AGU, New Orleans, La., 11-15 Dec.
9. C. Alvizuri, **V. Silwal**, L. Krischer, and C. Tape. Estimation of full moment tensors, including uncertainties, for earthquakes, volcanic events, and nuclear explosions. 2017. Abstract T2.3-P8 presented at the CTBT Science and Technology Conference 2017, Vienna, Austria.
10. **V. Silwal**, C. Tape, and E. Casarotti. Wavefield simulations of earthquakes in Alaska for tomographic inversion. 2017. Abstract S51D-0619 presented at 2017 Fall Meeting, AGU, New Orleans, La., 11-15 Dec.
11. **V. Silwal** and C. Tape. Crustal earthquakes in the Cook Inlet and Susitna regions, southern Alaska. 2017. Abstract presented at 2017 EarthScope National Meeting, Anchorage, Alaska, May 16-18.
12. J. C. Purba, **V. Silwal**, and C. Tape. A 10-Year Catalog (2007-2016) of Seismic Moment Tensors in Southern Alaska. 2017. Abstract presented at 2017 EarthScope National Meeting, Anchorage, Alaska, May 16-18.
13. C. Tape, S., Holtkamp, **V. Silwal**, J. Hawthorne, Y. Kaneko, J. P. Ampuero, N. Ruppert, K. Smith, and M. E. West. Slow-to-fast earthquake nucleation in the lower crust of central Alaska. 2017. Abstract presented at 2017 EarthScope National Meeting, Anchorage, Alaska, May 16-18.
14. C. Tape, **V. Silwal**, and S. Holtkamp. An unwanted long-period step response: examples from Alaska earthquakes. 2017. Abstract presented at 2017 EarthScope National Meeting, Anchorage, Alaska, May 16-18.
15. C. Tape, A. Lomax, **V. Silwal**, J. D. Agnew, and B. Brettschneider. The Ms7.3 earthquake of August 27, 1904 in central Alaska. 2017. Abstract presented at 2017 EarthScope National Meeting, Anchorage, Alaska, May 16-18.
16. C. Alvizuri, **V. Silwal**, L. Krischer, and C. Tape. Estimation of full moment tensors, including uncertainties, for earthquakes, volcanic events, and nuclear tests. 2016. Abstract S31A-2701 presented at 2016 Fall Meeting, AGU, San Francisco, Calif., 12-16 Dec.

17. **V. Silwal** and C. Tape. Wavefield simulations of earthquakes in southern Alaska for tomographic inversion. 2016. Poster presented at 2016 CIG All Hands Meeting, Davis, Calif., 20-22 June.
18. C. Alvizuri, **V. Silwal**, and C. Tape. Estimation of full moment tensors with uncertainties. 2016. Poster presented at 2016 CIG All Hands Meeting, Davis, Calif., 20-22 June.
19. **V. Silwal** and C. Tape. Wavefield simulations of earthquakes in southern Alaska for tomographic inversion. 2016. Abstract presented at 2016 IRIS Workshop, Vancouver, Wash., 8-10 June.
20. C. Alvizuri, **V. Silwal**, and C. Tape. Estimation of full moment tensors with uncertainties. 2016. Abstract presented at 2016 IRIS Workshop, Vancouver, Wash., 8-10 June.
21. **V. Silwal** and C. Tape. Seismic moment tensors and estimated uncertainties in southern Alaska subduction zone. 2016. Abstract presented at 9th Biennial Workshop on Japan-Kamchatka-Alaska Subduction Processes, Fairbanks, Alaska, May 31 to June 3, 2016.
22. **V. Silwal** and C. Tape. Seismic moment tensors and estimated uncertainties in southern Alaska. 2016. Abstract presented at 2016 Alaska Geological Society Technical Conference, Fairbanks, Alaska, April 22.
23. C. Tape and **V. Silwal**. Earthquake source studies and seismic imaging in Alaska. 2015. Abstract T42B-05 presented at 2015 Fall Meeting, AGU, San Francisco, Calif., 14-18 Dec.
24. C. Tape, **V. Silwal**, C. Ji, L. Hutchinson, M. West, and N. Ruppert. Transtensional tectonics of the Minto Flats fault zone and Nenana basin, central Alaska. 2015. Abstract presented at the 2015 SSA Annual Meeting, Pasadena, California, April 21-23.
25. S. G. Holtkamp, N. A. Ruppert, **V. Silwal**, D. Christensen, and C. Nye. Recurring Swarms of Deep Long Period Earthquakes in the Denali Volcanic Gap Suggest a Continuation of Volcanic Processes in the Absence of Active Volcanism. 2014. Abstract presented at the 2014 AGU Annual Meeting, San Francisco, California, Dec 15-19.
26. **V. Silwal** and C. Tape. Seismic moment tensors in southern Alaska derived from body waves and surface waves. 2014. Abstract presented at the 2014 SSA Annual Meeting, Anchorage, Alaska, April 30 - May 2.
27. L. Keyson, **V. Silwal**, M. West, and C. Tape. Earthquakes of the Minto Flats seismic zone, central Alaska. 2014. Abstract presented at the 2014 SSA Annual Meeting, Anchorage, Alaska, April 30 - May 2.
28. **V. Silwal** and C. Tape. Seismic moment tensor inversion with posterior samples and uncertainties. 2013. Abstract S51A-2311 presented at 2013 Fall Meeting, AGU, San Francisco, Calif., 9-13 Dec.
29. **V. Silwal** and C. Tape. Seismic moment tensor inversion: Sampling the posterior probability distribution. 2013. Abstract presented at the 2013 CIG-QUEST-IRIS Workshop on Seismic Imaging of Structure and Source, July 14-17, 2013, Fairbanks, Alaska, USA.
30. C. Tape, M. West, **V. Silwal**, and N. Ruppert. Earthquake nucleation and triggering on an optimally oriented fault. 2013. Abstract presented at the 2013 CIG-QUEST-IRIS Workshop on Seismic Imaging of Structure and Source, July 14-17, 2013, Fairbanks, Alaska, USA.
31. C. Tape and **V. Silwal**. A three-dimensional seismic velocity reference model for Alaska. 2013. Abstract presented at 2013 EarthScope National Meeting, Raleigh, North Carolina, May 12-15.
32. C. Tape, M. West, **V. Silwal**, and N. Ruppert. Earthquake nucleation and triggering on an optimally oriented fault. 2013. Abstract presented at 2013 EarthScope National Meeting, Raleigh, North Carolina, May 12-15.
33. C. Alvizuri, C. Tape, **V. Silwal**, D. Christensen, M. West, and S. McNutt. Mecanismos focales de ondas P en el volcan Uturuncu. 2013. Poster presented at Workshop Centenario del Observatorio San Calixto, La Paz, Bolivia, April 29 to May 1.

34. J. Mienert, S. Buenz, B. Ferre, G. Dutta, and **V. Silwal**. Long-Term Seismological Observations of Eruptions of the Hakon Mosby Mud Volcano at the Barents-Sea Continental Margin (ESONET-LOOME Demonstration Mission). 2011. Poster presented at EGU General Assembly, Vienna, Austria, April 3-8.

Teaching

At IITR,

Teaching Faculty,

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| Numerical modeling in Geophysics (ESN-421) | Autumn 2019-2022 |
| Geophysical inversion (ESN-422) | Fall 2020-2023 |
| Numerical techniques and Computer Programming (ESN-510) | Autumn 2019-2022 |
| Seminar (ESN-599) | Fall 2021 |

Student mentoring

Rinku Mahanta, PhD
 Vikas Kumar, PhD
 Shubham Mishra, intern (*now at IIT Bombay*)
 Angel Swastik Duggal, Project JRF
 Sneha Bhuyan, intern

At University of Alaska

Teaching Assistant, Introductory Physics (Physics 211) Spring 2015

Student mentoring

QingPing Yu, undergraduate, UAF.
 Joshua Purba, undergraduate, UAF. (*now at University of Calgary*)

Awards

1. Brian R. Zelanka Scholarship for Best Graduate Student 2018
2. Earthscope National Meeting Scholarship 2017
3. Best student poster at Alaska Geological Society Conference 2016
4. Geophysical Society of Alaska scholarship 2015
5. SEG scholarship 2014
6. IRIS travel grant for IRIS Workshop 2014
7. INSPIRE scholarship by the Department of Science & Technology, India 2007-2012

Computer Skills

Languages: Python, C, Fortran, Perl, Latex, Shell scripting
Software: MATLAB, Obspy, SPECFEM3D, GEOCUBIT, GMT, SAC
Platforms: Linux, Mac, Windows, CPU cluster, GPU cluster

Other Activities

1. Seismology Seminar coordinator at Geophysical Institute, UAF 2013-2014
2. TOTAL Well Log Analysis Course 2011
3. Schlumberger PETREL Seismic Visualization and Interpretation Course 2010
4. Mentor, SEG and SPG IIT Roorkee student chapter 2020-ongoing

Research Statement

I am interested in theoretical and computational aspects of seismology. Seismology is a data-rich science with tremendous opportunities for understanding source processes and Earth structure. To pursue this I perform forward modeling of wave propagation through a media representative of Earth structure. The misfit between the synthetic thus generated and the observed data is then minimized using different approaches. The inversion technique and the applied minimization depends on many factors, such as theory underneath, linear or non-linear problem, dimensionality of the problem, and computational resources available. The uncertainty in the solution is also an integral part. For source inversion I have tried to quantify the uncertainty using Bayesian approach. These earthquake sources are the priori for the tomographic inversion. With the recent advances in high performance computing people have been able to carry out adjoint tomography at both regional and global scale. Similar effort is undergoing by us to better understand structure of Alaska and Himalayas.