

Whyjay Zheng

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🌐 <http://whyjz.github.io/>

🎓 <https://scholar.google.com/citations?user=HJ64WwsAAAAJ>

Research Interests

I am interested in processes that shape a planet's surface and how remote sensing techniques help understand them better. My recent work focuses on glacier physics and cryospheric changes under the context of global warming. I am also keen to improve the efficiency and lower the threshold for conducting research in geoscience, which is essential since the data coming from remote sensing observations are getting larger and larger. I work with multiple science teams for processing high-resolution satellite data sets, such as optical, SAR, multi-spectral, and altimetry. We develop algorithms for fast, interactive, and robust Earth science workflows.

My background is in geophysics, planetary science, and remote sensing. My other non-glacier research projects include feature tracking of volcanic deformation, earthquake studies using InSAR, and the ice flexure model of Saturn's satellite Iapetus.

Current Projects

- 1 **Jupyter Meets the Earth** project: combines research use cases in geoscience with technical developments within the Jupyter and Pangeo ecosystems.
- 2 Developing and testing a physical framework of glacier perturbation due to changing bed conditions.
- 3 Interactive, reproducible, and scalable workflows for Earth Sciences, with a focus on cryosphere science (e.g., an easy and interactive glacier feature tracking workflow for mapping glacier speeds).
- 4 Glacier feature tracking comparison and developing guide of feature tracking based on user's needs for the research community.
- 5 Machine learning approaches in glacier elevation change over time: mapping glacier collapses and understanding their dynamics.

Education

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|-----------|---|
| Dec. 2020 | Cornell University . Ph.D. Geological Sciences
Advisor: Matthew Pritchard
<i>Investigating mass loss and changing ice dynamics of Arctic ice caps using remote sensing</i> |
| Jan. 2013 | National Taiwan University , M.Sc. Geosciences
Co-advisors: Wing-Huen Ip and Louis Suh-Yui Teng
<i>Elastic flexure model of Iapetus' equatorial ridge</i>
Class rank: 2 of 16 |
| Jun. 2010 | National Taiwan University , B.Sc. Geosciences
<i>Dean's Award</i> . Class rank: 1 of 28 |
| Jun. 2006 | Jianguo High School, Taipei, Taiwan
<i>Program for gifted students in math and science</i> |

Appointments

- Jan. 2021 – **Postdoctoral Scholar**
Department of Statistics, UC Berkeley
Supervisor: Fernando Pérez
Jupyter meets the Earth project team: advancing an open ecosystem that supports science by co-developing research and software, with a focus of cryosphere data.
- 2014 – 2015 **Full-time Research Assistant**
Institute of Oceanography, National Taiwan University
Supervisor: Emmy T. Y. Chang
Theme: GNSS time series analysis and ocean-bottom seismometer data analysis
(e.g., preliminary study of <https://doi.org/10.1029/2020EA001159>)
- 2013 – 2014 Served in the ROC Army, Matsu Islands, Taiwan

Professional Experience & Training

- 2020 ICESat-2 Hackweek, University of Washington, Jun. 8–18 (online program)
Project lead, *ICESat-2 data assimilation with raster format DEMs*
- 2018 International Summer School in Glaciology, Jun. 5–15, McCarthy, Alaska
Project: *Tidewater glacier cycle constrained by flowline topography*
- 2016 – 2020 Graduate Research Assistant, Cornell University (in summer)
Tectonic and magmatic processes during early-stage rifting: an integrated study of northern Lake Malawi, Africa
- 2010 – 2011 Graduate Research Assistant, National Taiwan University
Modeling the chronology of the marine terraces in Hengchun peninsula, Taiwan
- 2007 – 2008 Undergraduate lab intern, National Taiwan University
Geodesy & Remote Sensing Lab, Dept. of Geosciences

Teaching

- 2018 – 2020 Teaching Assistant at **Cornell University**
Have participated in various types of teaching scenarios, from a class of over 1000 students to field work with only few students.
EAS 1600: Environmental Physics (Aug.–Dec. 2020)
EAS 2500: Meteorological Observations and Instruments (Jan.–May 2020)
Lab instructor
EAS 1101: Climate and Energy: a 21st Century Earth Science Perspective (Aug.–Dec. 2019)
EAS 4370: Field Geophysics (Jan.–May 2019)
Field assistant
EAS 1560: Introductory Oceanography with Laboratory (Aug.–Dec. 2018)
Lab instructor (EAS/BIOEE 1560)
- 2010 – 2015 Teaching Assistant at **National Taiwan University**
Geo 1008: Introduction to Field Geology (II)
TA (Sep. 2010 – Jan. 2013, May 2014)
Course Coordinator (Aug. 2014 – Jan. 2015)
Ocean 5066: Seminar in Geophysics: General Aspects (Feb.–Jun. 2015)
Ocean 5001: Introduction to Marine Geology (Sep. 2014 – Jan. 2015)
- 2009 – 2011 Instructor of Magic Club, Dongshan High School, Taipei, Taiwan
- 2006 – 2013 Private tutor for math and science in high-school level

Honors, Awards, & Certification

- 2018 Arthur L. Bloom Fund for Geological Sciences Research and Education in the Pacific Region
Cornell University, 1,000 USD
- 2017 Wilderness first aid training (16 hours), Cornell Wilderness & Environmental Medicine
lapsed, last renewal 2017–2020
- 2013 **Overseas Ph.D. scholarship** (公費留學), Ministry of Education, Taiwan
141,000 USD for tuition and stipend. Used in 2015–2018.
- 2012 Poster presentation award, the Physical Society of ROC (Taiwan) Annual Meeting
- 2011 **Applied geotechnical technician** (應用地質技師)
Certified by Ministry of Examination, Taiwan
- 2007 Third prize, National Science Education Program, Taiwan
- 2005 First prize, National Earth Sciences Academic Competence Contest, Taiwan
(全國地球科學學科能力競賽一等獎)

Professional Services

Mentoring (undergraduate students)

- 2020 – Gerald Meyer, Hartwick College, USA
Research Experiences for Undergraduates (REU), NSF
Investigating brain terrain morphology on Mars
- 2019 – 2021 Leena Sen, Cornell University, USA
Undergraduate Honor Thesis
Satellite observations of glacier changes in Severnaya Zemlya, the Russian Arctic
- 2014 – 2015 Andy Chiu, National Central University, Taiwan
Undergraduate Research Program, National Taiwan University
Relocating the position of the ocean-bottom seismometers using airgun survey data

Software and Open Science

- 2021 Organized and presented at the workshop entitled “The Jupyter Landscape: a high-level map for (geo)scientists” at the 2021 EarthCube annual meeting.
Part of the workshop materials is published at <https://workflow.jupyterearth.org/>
- 2016 – Author of **GMT Tutorials**, an educational website with articles and gallery examples showing how to plot spatial data and make scientific figures using the free, open source Generic Mapping Tools (GMT) software and its Python version (PyGMT). Licensed under MIT and CC-BY 4.0 Licenses.
<http://gmt-tutorials.org/en/>, originally in Chinese (Taiwan) and partially translated into English
Github repository: <https://github.com/whyjz/GMT-tutorials>
- 2015 – **Lead developer** of the Cryosphere And Remote Sensing Toolkit (**CARST**) for processing high-resolution remote sensing data sets, including but not limited to optical images, SAR images, digital elevation models, and altimetry data. CARST is an open-source package and is constantly updated by its growing community.
Github repository: <https://github.com/whyjz/CARST>

Professional Services (continued)

- 2016 – Translator of the **QGIS Tutorials and Tips** website (English to Chinese (Taiwan)). QGIS is a free and open source Geographic Information System (GIS), and is commonly used within the geophysics and cryosphere community.
<https://www.qgistutorials.com/en/docs/introduction.html>

Professional Communities

- 2016 – 2017 Coordinator of the Earth & Atmos. Sciences Department Seminar, Cornell University
- 2014 Co-founder of the Geodesy Society of the ROC (Taiwan)
- Member of the following organizations:
 - AGU (2017–)
 - IACS (International Association of Cryospheric Sciences, 2018–)
 - AOGS (2011)
 - AAAS (2017–2019)
 - Reviewer of the following journals and book:
 - Journal of Glaciology
 - Remote Sensing of Environment
 - Encyclopedia of Planetary Landforms (ISBN 978-1-4614-3135-0)

Education and Outreach

Science Education and Outreach

- 2020 – 2021 Was selected for a short demo session entitled “Glacier Flow on Your Desk” at the Expanding Your Horizon program, Cornell University (a K-12 educational program that invites girl students to explore the STEM fields with connection to multiple universities).
The demo session was canceled in 2020 due to the COVID-19 pandemic. The 2021 demo is available at <https://www.youtube.com/watch?v=5-YKufHzx0U>
- 2018 – 2019 Made two videos introducing the research content (the collapse of Vavilov Ice Cap, Russia) to the general public. The total views have reached 300k on Youtube:
<https://youtu.be/jec47jxiuuA> and <https://youtu.be/WPfvUHFpRhk>
- 2016 Varna after-school program, Varna, New York
Designed scientific activities for people aged 4-11, e.g., making “glacier goo,” simulating volcano eruption using baking soda, etc.
- 2013 – **Columnist** at PanSci (泛科學), the largest science communication website in Taiwan. To date, I have written 17 short to mid-sized articles for the general public, providing latest research digest in Earth and planetary science. For the full list of my column posts, see
<https://pansci.asia/archives/author/whyj>, in Chinese (Taiwan)

Community Outreach

- 2019 **President** of Snee Graduate Organization (SGO), the graduate community in Earth & Atmospheric Sciences, Cornell University. During my term, SGO initiated many programs to facilitate inclusion, equity, and diversity in the Cornell and local Earth science community, including weekly tea time, Friday happy hour, and special seminars. SGO also contributed the formation of the Inclusion, Diversity, and Equity in Earth and Atmospheric Sciences (IDEEAS) working group in late 2019.

Education and Outreach (continued)

- 2018 – 2020 Staff member, Big Red Barn Graduate and Professional Student Center, Cornell University
 Co-hosted the weekly trivia night (2020)
- 2017 – 2018 Co-hosted the weekly International Coffee Hour at Cornell University

Research

Highlights

- Zheng, W., Pritchard, M. E., Willis, M. J. & Stearns, L. A. (2019). The possible transition from glacial surge to ice stream on Vavilov Icp. (Publication #2)
The paper analyzes the change of ice dynamics at Vavilov Ice Cap, Severnaya Zemlya, Russia, in 2017, several years after an initial surge phase. Remote sensing observations of shear margin development, glacier speeds, and Péclet number indicate possible ice stream formation. This paper adopts Péclet number and the glacier perturbation theory to quantify different stages during an unusual glacier surge. This novel and creative method provides insight about how a surge can break a cyclic mass balance by changing its ice dynamics. These analyses also show that an ice stream, which is capable of draining ice quickly over years, might develop from a short-term disruption of a glacier basin, posing a concern about underestimating sea level rise contribution. This paper has been covered by at least 8 media outlets including *Scientific American* and *Forbes*, and has been recognized as one of the most downloaded GRL papers during 2018–2019.
- Zheng, W., Pritchard, M. E., Willis, M. J., Tepes, P., Gourmelen, N., Benham, T. J. & Dowdeswell, J. A. (2018). Accelerating glacier mass loss on Franz Josef Land. (Publication #5)
This paper analyzes the high-resolution glacier elevation changes on Franz Josef Land (FJL) between 1953 and 2015, using data derived from satellite stereo imagery (WorldView and SPOT), radar altimetry (CryoSat-2), and a digitized cartographic map. For most glacier basins in FJL, the paper presents the first ever elevation change map during the 21st century. Our major findings include a doubled rate of ice mass loss from 2011 to 2015 compared to any previous time spans, and a SW-NE thinning-thickening pattern with variable local changes. The results also show that the shrinking ice cap uncovered at least one island during 2013–2016.
<https://news.cornell.edu/stories/2018/04/recent-russian-arctic-glacier-loss-doubles-previous-60-years>
- Zheng, W. (2020). The long-term instability of glacier dynamics due to a sudden change of basal lubrication. (Conference Proceedings #1)
In this study I present improved equations that relate the change of glacier flow to the change of bed friction. Two numbers in these equations (J_0 and Péclet number) depend on the glacier shape and speed, and determine the instability when basal lubrication occurs. These two numbers well correlate with the change of glacier speed in basins of Austfonna Ice Cap, Svalbard, during 1996 and 2018 as revealed by the ITMIX and ITS_LIVE data sets. For glaciers vulnerable to lubrication, the results indicate a possibility of prolonged glacier collapse, which discharges a massive amount of ice for a long time.
<https://agu.confex.com/agu/fm20/meetingapp.cgi/Paper/748560>

Peer-reviewed Journal Publications

- 1 Zheng, W., Oliva, S. J., Ebinger, C. & Pritchard, M. E. (2020). Aseismic Deformation During the 2014 Mw 5.2 Karonga Earthquake, Malawi, From Satellite Interferometry and Earthquake

Source Mechanisms. *Geophysical Research Letters*, 47(22), 1–12.
<https://doi.org/10.1029/2020GL090930>

- 2 **Zheng, W.**, Pritchard, M. E., Willis, M. J. & Stearns, L. A. (2019). The possible transition from glacial surge to ice stream on Vavilov Ice Cap. *Geophysical Research Letters*, 46.
<https://doi.org/10.1029/2019GL084948>
- 3 Gaherty, J. B., **Zheng, W.**, Shillington, D., Pritchard, M. E., Henderson, S. T., Chindandali, P. R., Mdala, H., Shuler, A., Lindsey, N., Oliva, S. J., Nooner, S., Scholz, C. A. & Schaff, D. (2019). Faulting processes during early-stage rifting: seismic and geodetic analysis of the 2009–2010 Northern Malawi earthquake sequence. *Geophysical Journal International*, 217, 1767–1782. <https://doi.org/10.1093/gji/ggz119>
- 4 Willis, M. J., **Zheng, W.**, Durkin, W. J., Pritchard, M. E., Ramage, J. M., Dowdeswell, J. A., Benham, T. J., Bassford, R. P., Stearns, L. A., Glazovsky, A. F., Macheret, Y. Y. & Porter, C. C. (2018). Massive destabilization of an Arctic ice cap. *Earth and Planetary Science Letters*, 502, 146–155. <https://doi.org/10.1016/j.epsl.2018.08.049>
- 5 **Zheng, W.**, Pritchard, M. E., Willis, M. J., Tepes, P., Gourmelen, N., Benham, T. J. & Dowdeswell, J. A. (2018). Accelerating glacier mass loss on Franz Josef Land, Russian Arctic. *Remote Sensing of Environment*, 211, 357–375. <https://doi.org/10.1016/j.rse.2018.04.004>

Other Publications

- 1 **Zheng, W.**, Durkin, W. J., Melkonian, A. K. & Pritchard, M. E. (2019). *Cryosphere And Remote Sensing Toolkit (CARST) v1.0.1*. Zenodo. <https://doi.org/10.5281/zenodo.3475693>
- 2 **Zheng, W.** (2013). *Elastic Flexure Model of Iapetus' Equatorial Ridge* (Master Thesis). National Taiwan University. <https://doi.org/10.6342/NTU.2013.02546>

Invited Talks

- 1 **Zheng, W.** (2021). *The demise of Arctic ice caps: from glacier surge to ice stream*. Berkeley Seismology Lab Seminar.
- 2 **Zheng, W.** (2020a). *How much is a glacier likely to collapse when bed conditions change?* Cornell Astronomy and Space Sciences, Planetary Lunch Seminar.

Other Conference Presentations

- 1 **Zheng, W.**, Grigsby, S., Sapienza, F., Taylor, J., Snow, T., Pérez, F. & Siegfried, M. Mapping ice flow velocity using an easy and interactive feature tracking workflow. In: *2021 EarthCube annual meeting (June 15–17)*. 2021. https://github.com/earthcube2021/ec21_zheng_etal
- 2 **Zheng, W.** The long-term instability of glacier dynamics due to a sudden change of basal lubrication. In: *2020 AGU fall meeting (December 7–11)*. 2020.
- 3 **Zheng, W.**, Delgado, F., Pritchard, M. E. & Reath, K. Laccolith evolution during and after the 2011–12 eruption of Cordon Caulle volcano, Chile, from satellite feature-tracking, elevation, and thermal observations. In: *2020 AGU fall meeting (December 7–11)*. 2020.
- 4 **Zheng, W.**, Delgado, F., Grandin, R. & Pritchard, M. E. Evidence for Episodic Magma Injection at Cordón Caulle Volcano (Southern Andes, Chile) During 2004–2019: New Insights from InSAR Time Series and Finite Element Models. In: *2019 AGU fall meeting (December 9–13)*. San Francisco, USA, 2019.
- 5 **Zheng, W.**, Pritchard, M. E., Gaherty, J. B., Henderson, S. T. & Shillington, D. Observations of the Karonga earthquake sequence in northern Lake Malawi (Nyasa) using InSAR, seismicity, and surface rupture, as constraints on rifting mechanisms. In: *2018 UNAVCO science workshop (March 27–29)*. Denver, USA, 2018.

- 6 **Zheng, W.**, Pritchard, M. E. & Willis, M. J. Measuring glacier changes and mass balance on the Russian Arctic using remote sensing datasets. In: *International summer school in glaciology (June 5-15)*. McCarthy, Alaska, USA, 2018.
- 7 **Zheng, W.**, Pritchard, M. E., Willis, M. J., Durkin, W. J. & Stearns, L. A. The evolution of a large glacier surge of Vavilov Ice Cap, Severnaya Zemlya, since 2013. In: *2018 AGU fall meeting (December 10-14)*. Washington, D.C., USA, 2018.
- 8 Pritchard, M., **Zheng, W.**, Henderson, S., Gaherty, J., Shillington, D., jaye Oliva, S., Ebinger, C., Nooner, S., Elliott, J., Saria, E., Ntmbila, D. & Chindandali, P. Rifting mechanisms constrained by InSAR, seismicity, GPS, and surface rupture from the Karonga earthquake sequence in northern Lake Malawi (Nyasa). In: *2017 AGU fall meeting (December 11-15)*. New Orleans, USA, 2017.
- 9 Willis, M. J., Pritchard, M. E., **Zheng, W.**, Durkin, W. J., Ramage, J. M., Dowdeswell, J. A., Benham, T. J. & Bassford, R. P. Rapid Thinning and Acceleration at the Cold-based Vavilov Ice Cap, Severnaya Zemlya, Russia. In: *47th Arctic workshop 2017 (March 23-25)*. Buffalo, New York, USA, 2017.
- 10 **Zheng, W.**, Pritchard, M. E. & Willis, M. J. Monitoring Land-ice Elevation Changes in Franz Josef Land Using Remote Sensing. In: *47th Arctic workshop 2017 (March 23-25)*. Buffalo, New York, USA, 2017.
- 11 Pritchard, M. E., Elliott, J., Durkin, W. J., **Zheng, W.**, Saria, E., Ntambila, D. & Chindandali, P. R. GPS and InSAR observations of ground deformation in the northern Malawi (Nyasa) rift from the SEGMeNT project. In: *2016 AGU fall meeting (December 12-16)*. San Francisco, USA, 2016.
- 12 Willis, M. J., **Zheng, W.**, Durkin, W. J., Pritchard, M. E., Ramage, J. M., Dowdeswell, J. A., Benham, T. J., Glazovsky, A. F., Macheret, Y. Y. & Porter, C. C. Rapid Collapse of the Vavilov Ice Cap, Russian High Arctic. In: *2016 AGU fall meeting (December 12-16)*. San Francisco, USA, 2016.
- 13 Willis, M. J., **Zheng, W.**, Pritchard, M. E., Melkonian, A. K., Morin, P., Porter, C., Howat, I. M., Noh, M. J. & Jeong, S. Ice Mass Changes in the Russian High Arctic from Repeat High Resolution Topography. In: *EGU general assembly 2016 (April 17-22)*. Vienna, Austria, 2016.
- 14 Chao, B. F., Chang, E. T.-Y. & **Zheng, W.** On possible physical sources of the common mode error (CME) "signal" in GPS solutions. In: *2015 Taiwan geosciences assembly (May 13-14)*. Taipei, Taiwan, 2015.
- 15 Willis, M. J., Pritchard, M. E. & **Zheng, W.** How can we Optimize Global Satellite Observations of Glacier Velocity and Elevation Changes? In: *2015 AGU fall meeting (December 14-18)*. San Francisco, USA, 2015.
- 16 Chang, E. T.-Y., Chao, B. F., Wu, T.-R., Lai, P.-Y. & **Zheng, W.** Examining the focal mechanism of the 2009 Samoa earthquakes by means of tsunami observation and simulation. In: *Geodynamics and Environment in East-Asia (GEEA) 7th France-Taiwan earth sciences symposium (November 12-18)*. Hualien, Taiwan, 2014.
- 17 **Zheng, W.**, Chang, E. T.-Y., Lai, P.-Y., Chao, B. F. & Wu, T.-R. Study of large earthquake by means of tsunami wave simulation – the 2009 Samoa earthquake. In: *Geodesy symposium 2014 (September 10-12)*. Nantou, Taiwan, 2014.
- 18 **Zheng, W.**, Ip, W.-H. & Teng, L. S. Elastic flexure model of Iapetus' equatorial ridge. In: *EGU general assembly 2012 (April 22-27)*. Vienna, Austria, 2012.
- 19 Huang, L.-C., Ip, W.-H., Zhu, M. & **Zheng, W.** Physical Characteristics of the River Valleys of the Hellas Basin on Mars. In: *AOGS 8th annual meeting (August 8-12)*. Taipei, Taiwan, 2011.

Funding

Unsuccessful Proposals

The following are proposals that were submitted but not awarded. I include these as they demonstrate collaborations and project ideas that have been initiated to the point of pursuing funding.

2020 Potentials and limits of glacier feature tracking: an intercomparison project for achieving velocity maps with high spatial and temporal resolution. *AGU Cryosphere Section Innovation Award*.

Team members: Will Kochtitzky (University of Ottawa), Maximillian Van Wyk (University of Minnesota), Shashank Bhushan (University of Washington), David Shean (University of Washington)

Postdoctoral Associate: Rapid transitions in glacier dynamics as revealed by satellite measurements of sub-annual elevation changes. *NASA Research Opportunities in Space and Earth Sciences 2020 (ROSES-2020). A.17 Cryosphere Science*.

PI: Matthew Pritchard (Cornell); Institution-PI: Alex Gardner (NASA-JPL); Collaborator: Indrani Das (LDEO)

2019 **Future Investigator:** Understanding fast ice-wasting mechanisms of marine-terminating ice caps in the Russian Arctic and Svalbard from multi-satellite observations. *Future Investigators in NASA Earth and Space Science and Technology (FINESST)-2019*.

PI: Matthew Pritchard (Cornell)

Skills

Coding	Python, PyQGIS, MATLAB, Shell scripting, Fortran
Software	Git, Jupyter, QGIS, ArcGIS, GMT, CorelDraw, Adobe Illustrator, Latex, NASA Ames Stereo Pipeline (ASP), InSAR Scientific Computing Environment (ISCE), Generic InSAR Analysis Toolbox (GIAN-T)
Professional Fields	Cryosphere studies, Planetary surface processing, Remote sensing, Geodynamics, Machine learning, Inverse problems
Languages	Mandarin Chinese (Traditional characters, native speaker), English (Professional working level), Spanish (Intermediate level), Taiwanese (Heritage speaker at intermediate level), Japanese (Beginner level with higher competency of reading)

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