Qinglei Cao

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RESEARCH INTERESTS

High-Performance Computing (HPC), Artificial Intelligence (AI), and Quantum Computing (QC): Task-Based Runtime Systems, Numerical Linear Algebra, Mixed-Precision Computing, Quantum Circuit Simulation, Large-Scale Machine Learning & Deep Learning, and Extreme-Scale Scientific Computing.

EDUCATION

The University of Tennessee, Knoxville (UTK), Computer Science — 2016-2022
PhD, High Performance Computing
Advisor: Dr. Jack Dongarra (Turing Award 2021)
Group Leader & Co-Advisor: Dr. George Bosilca

Ocean University of China (OUC), Computer Application Technology — 2013-2016
M.E., Image Processing & Parallel Computing

Hunan University (HNU), Information and Computational Science — 2005-2009
BS, Mathematics

PROFESSIONAL EXPERIENCE

Department of Computer Science, Saint Louis University (SLU) — St. Louis, MO
Assistant Professor — 2023-Present

Innovative Computer Laboratory (ICL), UTK — Knoxville, TN
Post-Doctoral Research Associate — 2023

Cerebras Systems, Inc. — Sunnyvale, CA
Member of Technical Staff — 2022-2023

Cerebras Systems, Inc. — Sunnyvale, CA
Summer Intern — 2021

Cadence Design Systems, Inc. — Austin, TX
Summer Intern — 2020

AWARDS & GRANTS

AWARDS

- Best Paper Runner-up Award, DRBSD — 2025
- TCSC SCALE Challenge Award (Finalist, 2 Entries) — 2025
- ACM Gordon Bell Prize for Climate Modelling — 2024
- ACM Gordon Bell Prize (Finalist) — 2024
- ACM Gordon Bell Prize (Finalist) — 2022
- SIAM Student Travel Award — 2021
- Best Paper Award, CLUSTER, IEEE — 2020
- Graduate Student Senate (GSS) Travel Awards, UTK — 2020

GRANTS

- POSE/NSF, Site-PI — 2025-2027
- CRII/OAC/NSF, Solo-PI — 2025-2027
- E3SM/ORNL/DOE, Sub-Award — 2024-2025

◇ COMPUTING RESOURCE ALLOCATIONS

- ☞ Frontier Supercomputer, Oak Ridge National Laboratory, US — 2022-Present
- ☞ Fugaku Supercomputer, RIKEN, Japan — 2021-Present
- ☞ Polaris Supercomputer, Argonne National Laboratory, US — 2025-Present
- ☞ Leonardo Supercomputer, EuroHPC/CINECA, Italy — 2024
- ☞ Alps Supercomputer, Swiss National Supercomputing Centre, Switzerland — 2024
- ☞ Summit Supercomputer, Oak Ridge National Laboratory, US — 2020-2024

PUBLICATIONS

◇ Conference Papers

1. Dawei Gao, Dali Wang, Zhuowei Gu, Qinglei Cao, Peter E. Thornton, Daniel Ricciuto, and Yunhe Feng. HELM: Restart-Compatible Trustworthy AI Emulation for Accelerating Long-Horizon Global Land Simulations. IEEE International Conference on Big Data, 2026
2. Zhuowei Gu, Aurelien Bouteiller, Joseph Schuchart, Thomas Herault and Qinglei Cao. Merging Parameterized Task Graphs in PaRSEC Through JDF Composition with LLM Assistance. Workshop on Asynchronous Many-Task Systems and Applications(WAMTA), 2026 [PDF]
3. Qiao Zhang, Rabab Alomairy, Dali Wang, Addison Thurston and Qinglei Cao. Leveraging PaRSEC for Task-Based Heterogeneous Computing in Python and Julia. Workshop on Asynchronous Many-Task Systems and Applications(WAMTA), 2026 [PDF]
4. Cory Gardner, Seyun Jeong, Oam Khatavkar, Aiden Moon, Qinglei Cao, and Tae-Hyuk Ahn. Evaluating Accuracy and Performance Tradeoffs in GPU Accelerated Single Cell RNA-seq Analysis. International Workshop on Distributed Runtime Systems for Scientific Big Data (DRBSD, **Best Paper Runner-up Award**), 2025 [PDF]
5. Rabab Alomairy, Sameh Abdulah, Qinglei Cao, David Keyes and Hatem Ltaief. Sustainably Modeling a Sustainable Future Climate. IEEE High Performance Extreme Computing Conference, 2025 [PDF]
6. Zhuowei Gu, Dali Wang, Dawei Gao, Yunhe Feng and Qinglei Cao. Flexible User-defined Domain Decomposition in Kilometer-Scale E3SM Land Model Simulation. International Conference on Computational Science (ICCS), 2025 [PDF]
7. Rabab Alomairy, Qinglei Cao, Hatem Ltaief and David Keyes. Scalable Low-Rank Solvers for Large-Scale 3D Mesh Deformation Using Global and Compact Support RBF Kernels. IEEE International Symposium on Cluster, Cloud, and Internet Computing (CCGRID, **TCSC SCALE Challenge Award, Finalist**), 2025
8. Dali Wang, Chen Wang, Qinglei Cao, Jayesh Krishna, Danqing Wu, Weijian Zheng, Peter Schwartz, Fengming Yuan, Kathryn Mohror and Peter Thornton. Scaling Ultrahigh-Resolution E3SM Land Model for Leadership-Class Supercomputers. IEEE International Symposium on Cluster, Cloud, and Internet Computing (CCGRID, **TCSC SCALE Challenge Award, Finalist**), 2025 [PDF]
9. Qiao Zhang, Rabab Alomairy, Dali Wang, Zhuowei Gu and Qinglei Cao. Leveraging Hardware-Aware Computation in Mixed-Precision Matrix Multiply: A Tile-Centric Approach. Workshop on Asynchronous Many-Task Systems and Applications (WAMTA), 2025 [PDF]
10. Aurelien Bouteiller, Qinglei Cao, Joseph Schuchart and Thomas Herault. Comparing and Contrasting User and Runtime Directed Data Placement Strategies for Owner-Compute, Multi-Accelerator Distributed Task Based Scheduling. Workshop on Asynchronous Many-Task Systems and Applications (WAMTA), 2025 [PDF]
11. Rabab Alomairy, Hatem Ltaief, Qinglei Cao and David Keyes. Analyzing Data Sparsity in Global and Compact Support Radial Basis Functions for 3D Unstructured Mesh Deformation. Workshop on Asynchronous Many-Task Systems and Applications (WAMTA), 2025 [PDF]

12. Rabab Alomairy, Qinglei Cao, Hatem Ltaief, David E. Keyes, and Alan Edelman. Scalable Hamming Distance Computation Using Accelerated Matrix Transformations. ISC High Performance, 2025 [PDF]

13. Sameh Abdulah, Allison H. Baker, George Bosilca, Qinglei Cao, Stefano Castruccio, Marc G. Genton, David E. Keyes, Zubair Khalid, Hatem Ltaief, Yan Song, Georgiy L. Stenchikov, and Ying Sun. Boosting Earth System Model Outputs And Saving PetaBytes in their Storage Using Exascale Climate Emulators. International Conference for High Performance Computing, Networking, Storage and Analysis (SC, **ACM Gordon Bell Prize for Climate Modelling**), 2024 [PDF]

14. Hatem Ltaief, Rabab Alomairy, Qinglei Cao, Jie Ren, Lotfi Slim, Thorsten Kurth, Benedikt Dorschner, Salim Bougouffa, Rached Abdelkhalek, and David E. Keyes. Toward Capturing Genetic Epistasis From Multivariate Genome-Wide Association Studies Using Mixed-Precision Kernel Ridge Regression. International Conference for High Performance Computing, Networking, Storage and Analysis (SC, **ACM Gordon Bell Prize, Finalist**), 2024 [PDF]

15. Shihui Song, Yafan Huang, Peng Jiang, Xiaodong Yu, Weijian Zheng, Sheng Di, Qinglei Cao, Yunhe Feng, Zhen Xie, and Franck Cappello. CereSZ: Enabling and Scaling Error-bounded Lossy Compression on Cerebras CS-2. International Symposium on High-Performance Parallel and Distributed Computing (HPDC), 2024 [PDF]

16. Kareem Shaik, Dali Wang, Weijian Zheng, Qinglei Cao, Heng Fan, Peter Schwartz, and Yunhe Feng. S3LLM : Large-Scale Scientific Software Understanding with LLMs using Source, Metadata, and Document. International Conference on Computational Science (ICCS), 2024 [PDF]

17. Qinglei Cao, Thomas Herault, Aurelien Bouteiller, Joseph Schuchart, and George Bosilca. Evaluating PaRSEC through Matrix Computations in Scientific Applications. Workshop on Asynchronous Many-Task Systems and Applications (WAMTA), 2024 [PDF]

18. Qinglei Cao, Sameh Abdulah, Hatem Ltaief, Marc G Genton, David E Keyes, and George Bosilca. Reducing Data Motion and Energy Consumption of Geospatial Modeling Applications Using Automated Precision Conversion. IEEE International Conference on Cluster Computing (CLUSTER), 2023 [PDF]

19. Qinglei Cao, Sameh Abdulah, Rabab Alomairy, Yu Pei, Pratik Nag, George Bosilca, Jack Dongarra, Marc G Genton, David E Keyes, Hatem Ltaief, and Ying Sun. Reshaping geostatistical modeling and prediction for extreme-scale environmental applications. International Conference for High Performance Computing, Networking, Storage and Analysis (SC, **ACM Gordon Bell Prize, Finalist**), 2022 [PDF]

20. Qinglei Cao, Rabab Alomairy, Yu Pei, George Bosilca, Hatem Ltaief, David Keyes, and Jack Dongarra. A framework to exploit data sparsity in tile low-rank Cholesky factorization. IEEE International Parallel & Distributed Processing Symposium (IPDPS), 2022 [PDF]

21. Qinglei Cao, Yu Pei, Kadir Akbudak, George Bosilca, Hatem Ltaief, David Keyes, and Jack Dongarra. Leveraging parsec runtime support to tackle challenging 3d data-sparse matrix problems. IEEE International Parallel and Distributed Processing Symposium (IPDPS), 2021 [PDF]

22. Yunhe Feng, Dong Zhong, Peng Sun, Weijian Zheng, Qinglei Cao, Xi Luo, and Zheng Lu. Micromobility in smart cities: A closer look at shared dockless e-scooters via big social data. IEEE International Conference on Communications (ICC), 2021 [PDF]

23. Qinglei Cao, George Bosilca, Wei Wu, Dong Zhong, Aurelien Bouteiller, and Jack Dongarra. Flexible data redistribution in a task-based runtime system. IEEE International Conference on Cluster Computing (CLUSTER), 2020 [PDF]

24. Qinglei Cao, Yu Pei, Kadir Akbudak, Aleksandr Mikhalev, George Bosilca, Hatem Ltaief, David Keyes, and Jack Dongarra. Extreme-scale task-based Cholesky factorization toward climate and weather prediction applications. ACM Platform for Advanced Scientific Computing Conference (PASC), 2020 [PDF]

25. Elliott Slaughter, Wei Wu, Yuankun Fu, Legend Brandenburg, Nicolai Garcia, Wilhem Kautz, Emily Marx, Kaleb S. Morris, Qinglei Cao, George Bosilca, Seema Mirchandaney, Wonchan Lee, Sean Treichler, Patrick McCormick, and Alex Aiken. Task bench: a parameterized benchmark for evaluating parallel runtime performance. IEEE/ACM International Conference for High Performance Computing, Networking, Storage and Analysis (SC), 2020 [PDF]

26. Xi Luo, Wei Wu, George Bosilca, Yu Pei, Qinglei Cao, Thananon Patinyasakdikul, Dong Zhong, and Jack Dongarra. Han: a hierarchical autotuned collective communication framework. IEEE International Conference on Cluster Computing (CLUSTER, **Best Paper**), 2020 [PDF]

27. Dong Zhong, Qinglei Cao, George Bosilca, and Jack Dongarra. Using advanced vector extensions AVX-512 for MPI reductions. ACM European MPI Users' Group Meeting (EuroMPI), 2020 [PDF]

28. Dong Zhong, Pavel Shamis, Qinglei Cao, George Bosilca, Shinji Sumimoto, Kenichi Miura, and Jack Dongarra. Using ARM scalable vector extension to optimize OpenMPI. IEEE/ACM International Symposium on Cluster, Cloud and Internet Computing (CCGRID), 2020 [PDF]

29. Yu Pei, Qinglei Cao, George Bosilca, Piotr Luszczek, Victor Eijkhout, and Jack Dongarra. Communication avoiding 2d stencil implementations over PaRSEC task-based runtime. IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW), 2020 [PDF]

30. Qinglei Cao, Yu Pei, Thomas Herault, Kadir Akbudak, Aleksandr Mikhalev, George Bosilca, Hatem Ltaief, David Keyes, and Jack Dongarra. Performance analysis of tile low-rank Cholesky factorization using parsec instrumentation tools. IEEE/ACM International Workshop on Programming and Performance Visualization Tools (ProTools at SC), 2019 [PDF]

◇ Journal Papers

1. Dali Wang, Chen Wang, Qinglei Cao, Peter Schwartz, Fengming Yuan, Daniel Ricciuto, Peter Thornton, Shih-Chieh Kao, Jayesh Krishna, and Weijian Zheng. Enabling Kilometer-Scale E3SM Land Model Simulation over North America: A New Integrated Framework Solution. International Journal of High Performance Computing Applications (IJHPCA), 2026 [PDF]

2. Dali Wang, Qian Gong, Zirui Liu, Xiao Wang, Qinglei Cao and Scott Klasky. Scalable foundation models for numerical simulations on HPC platforms. Frontiers, 2026 [PDF]

3. Qiao Zhang, Rabab Alomairy, Dali Wang, Zhuowei Gu, and Qinglei Cao. High-performance mixed-precision matrix multiplication via tile-centric design on modern architectures. SN Computer Science. Springer, 2026 [PDF]

4. Aurelien Bouteiller, Thomas Herault, Qinglei Cao, Joseph Schuchart, and George Bosilca. PaRSEC: Scalability, Flexibility, and Hybrid Architecture Support for Task-based Applications in ECP. International Journal of High Performance Computing Applications (IJHPCA), 2025 [PDF]

5. Wang, Dali, Peter Schwartz, Fengming Yuan, Franklin Eaglebarge, Danial Riccuito, Peter Thornton, Chris Layton, and Qinglei Cao. Portable Software Environment for Ultrahigh-Resolution ELM Development on GPUs. Journal of Computer and Communications, 2025 [PDF]

6. Sameh Abdulah, Qinglei Cao, Yu Pei, George Bosilca, Jack Dongarra, Marc G. Genton, David E. Keyes, Hatem Ltaief, and Ying Sun. Accelerating geostatistical modeling and prediction with mixed-precision computations: A high-productivity approach with parsec. IEEE Transactions on Parallel and Distributed Systems (TPDS), 2022 [PDF]

7. Dong Zhong, Qinglei Cao, George Bosilca, and Jack Dongarra. Using long vector extensions for MPI reductions. Parallel Computing (PARCO), 2021 [PDF]

8. Qinglei Cao, George Bosilca, Nuria Losada, Wei Wu, Dong Zhong, and Jack Dongarra. Evaluating data redistribution in parsec. IEEE Transactions on Parallel and Distributed Systems (TPDS), 2021 [PDF]

◇ Abstracts & Posters

1. Dali Wang, Peter E. Thornton, Daniel M. Ricciuto, Xiaojuan Yang, Xiao Wang, Dan Lu, Dawei Gao, Yunhe Feng, Qinglei Cao, Zhuowei Gu, Zirui Liu. Accelerating Earth System Simulations: Creating an AI-Powered Emulator for the E3SM Land Model. American Geophysical Union (AGU), 2025

2. Dali Wang, Peter Schwartz, Fengming Yuan, Daniel M. Ricciuto, Shih-Chieh Kao, Michele Thornton, Anthony Walker, Peter E. Thornton, Qinglei Cao, and Chen Wang. Kilometer-scale E3SM Land Model: Code Development, Deployment, Evaluation, and Applications. American Geophysical Union (AGU), 2024

3. Qinglei Cao, Yu Pei, Kadir Akbudak, Aleksandr Mikhalev, George Bosilca, Hatem Ltaief, David Keyes, and Jack Dongarra. Extreme-Scale Tile Low-Rank Cholesky Factorization Using the PaRSEC Task-Based Runtime. ACM Platform for Advanced Scientific Computing Conference (PASC), 2021

PROFESSIONAL ACTIVITIES

◇ Editorial Board/Guest Editor

- ☞ SN Computer Science 2025 - 2026
- ☞ Electronics, MDPI 2026
- ☞ American Journal of Computer Science and Technology 2023 - 2024

◇ Organizer

- ☞ Workshop on Fostering an Open-Source Runtime Eco-System for PaRSEC 2026
- ☞ Workshop on Asynchronous Many-Task Systems and Applications 2025

◇ Technical Program Chair

- ☞ Workshop on Accelerator Programming and Directives (WACCPD at SC) 2026
- ☞ Workshop on Asynchronous Many-Task Systems and Applications 2025

◇ Technical Program Committee

- ☞ International Conference on Supercomputing (ICS) 2027
- ☞ International Parallel & Distributed Processing Symposium (IPDPS) 2024, 2027
- ☞ SuperComputing Asia (SCA) 2027
- ☞ SuperComputing India (SCI) 2027
- ☞ Workshop on Asynchronous Many-Task Systems and Applications 2024, 2026, 2027
- ☞ Intl Conference for High Performance Computing, Networking, Storage and Analysis (SC) 2025, 2026
- ☞ International Supercomputing Conference (ISC) High Performance 2024, 2026
- ☞ Workshop on HPC on Heterogeneous Hardware 2022 - 2026
- ☞ Twelfth Workshop on Accelerator Programming and Directives (WACCPD) 2025
- ☞ International Conference on Parallel Processing (ICPP) 2024, 2025
- ☞ International Conference on Cluster Computing (CLUSTER, Poster) 2025
- ☞ Asynchronous Many-Task systems for Exascale (AMTE) 2025
- ☞ Association for the Advancement of Artificial Intelligence (AAAI) Undergraduate Consortium 2024
- ☞ Intl Conference for High Performance Computing, Networking, Storage and Analysis AD/AE (SC) 2021
- ☞ Intl Conference on Advances and Trends in Software Engineering (SOFTENG) 2021 - 2024

◇ Conference & Journal Reviewer

- ☞ ACM Transactions on Architecture and Code Optimization 2026
- ☞ IEEE Transactions on Parallel and Distributed Systems 2026
- ☞ ACM Transactions on Mathematical Software (TOMS) 2023, 2026
- ☞ Parallel Computing 2023
- ☞ Journal of Supercomputing 2023
- ☞ IEEE Transactions on Multimedia 2023
- ☞ International Conference on Emerging Information Security and Applications 2022

- ☞ Intl Conference for High Performance Computing, Networking, Storage and Analysis (SC) 2020, 2021
- ☞ PeerJ Computer Science 2021
- ☞ International Conference on Cluster Computing (CLUSTER) 2020
- ☞ International Conferences on High Performance Computing and Communications (HPCC) 2020, 2021

◇ **Miscellaneous**

- ☞ **Application Support for Student Cluster Competition (SCC) and IndySCC** at SC 2025
- ☞ Section Chair at SC 2025

TEACHING EXPERIENCE

◇ **Lecturer**

- ☞ CSCI 2510 Principles of Computing Systems Spring (2025, 2026), Fall (2025, 2026), SLU
- ☞ CSCI 4620/5620 Distributed Computing Spring (2024), Fall (2023 - 2026), SLU

◇ **Guest Lecturer**

- ☞ CSCE 5300 Introduction to Big Data and Data Science Spring (2023, 2025), Fall (2023), UNT
- ☞ CSCI 5090 Computer Science Colloquium Fall (2023, 2024), SLU

◇ **Teaching Assistant**

- ☞ COSC 594 Scientific Computing for Engineers Spring 2018, UTK
- ☞ COSC 361 Operating Systems Spring (2017), Fall (2016), UTK

PRESENTATIONS & TALKS

◇ **Talk**

- ☞ Stevens Institute of Technology 2025
- ☞ OLCF User Meeting 2025
- ☞ ICL 35th Anniversary Workshop 2025
- ☞ NVIDIA GTC (GPU Technology Conference) 2025
- ☞ SIAM Conference on Computational Science and Engineering 2025
- ☞ University of North Texas 2025
- ☞ Annual Workshop on Charm++ and Its Applications 2024
- ☞ Innovative Computer Laboratory (ICL) Lunch Talk 2019, 2020, 2021, 2022
- ☞ Joint Laboratory on Extreme Scale Computing Workshop (JLESC) 2021
- ☞ SIAM Conference on Computational Science and Engineering (CSE) 2021
- ☞ SIAM Conference on Parallel Processing for Scientific Computing (PP) 2020

◇ **Paper Presentation**

- ☞ Workshop on Asynchronous Many-Task Systems and Applications (WAMTA) 2024
- ☞ International Conference on Cluster Computing (CLUSTER) 2023
- ☞ International Parallel and Distributed Processing Symposium (IPDPS) 2021, 2022
- ☞ International Conference on Cluster Computing (CLUSTER) 2020
- ☞ Platform for Advanced Scientific Computing Conference (PASC) 2020
- ☞ International Workshop on Programming and Performance Visualization Tools (ProTools at SC) 2019

◇ **Poster**

☞ Joint Laboratory on Extreme Scale Computing Workshop (JLESC) 2020

☞ Platform for Advanced Scientific Computing Conference (PASC) 2020

❤ OPEN SOURCE CONTRIBUTIONS

◇ [**PaRSEC**]: Task-based runtime system, funded by Exascale Computing Project (ECP)

◇ [**DPLASMA**]: Leading implementation of a dense linear algebra package for distributed system

◇ [**HiCMA**]: Hierarchical math library of exploiting the data sparsity of the matrix operator

◇ [**ExaGeostat**]: Parallel high performance unified framework for computational geostatistics

MEDIA COVERAGE

◇ SC24 Gordon Bell Prizes Awarded [HPCwire]

◇ 2024 Gordon Bell Prizes Awarded at SC24 [ACM]

◇ Gordon Bell Prize for Climate Modelling Goes to Team for Exascale Emulator Breakthrough [HPCwire]

◇ Recipients of Prestigious Climate Modelling Prize Developed a Technique to Provide More Accurate and Detailed Climate Change Predictions [ACM]

◇ ACM Gordon Bell Prize for Climate Modelling [ACM]

◇ ACM Presents Winners of Gordon Bell Climate Modelling Prize [insideHPC]

◇ ORNL's Frontier Powers KAUST-Led Genome Study for Gordon Bell Prize Nomination [HPCwire]

◇ Bigger, Faster, Smarter Genetics Research [ORNL]

◇ Frontier Users' Exascale Climate Emulator Nominated for Gordon Bell Climate Prize [ORNL]

◇ Researchers Benchmark Nvidia's GH200 Supercomputing Chips [HPCwire]

◇ Gordon Bell Prize Finalists Develop Method for More Efficient Computing [AAAS Eurekalert][HLRS News]

◇ Inside the Gordon Bell Prize Finalist Projects [HPCwire]

◇ SC22 Unveils ACM Gordon Bell Prize Finalists [HPCwire]

◇ 2022 ACM Gordon Bell Prize Finalists Announced [Communications of the ACM]

◇ What's New in HPC Research: EXA2PRO, DQRA, and HiCMA-PaRSE Frameworks & More [HPCwire]

◇ KAUST Leverages Mixed Precision for Geospatial Data [HPCwire]

◇ Mixing Precision for Model Acceleration [Tech Xplore]

◇ Mixing It Up: Saudi Researchers Accelerate Environmental Models with Mixed Precision [Nvidia]

◇ 「富岳」を用いた3つの研究成果がゴードン・ベル賞ファイナリストに選出されました [RIKEN News]

Last updated: November 2, 2026