

*Dr. Steve Goldhaber*  
*Meteorologisk institutt*  
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#### S U M M A R Y

- Over 50 years of experience in scientific and technical programming.
  - Extensive experience (over 23 years) with HPC systems. Experienced in compiler design and implementation, inter-node communication, and program optimization.
  - Over 13 years working with and developing atmosphere and coupled climate models.
  - Able to design and engineer large projects (100,000+ lines). Experience working with very large code base systems (millions of lines).
  - Extensively experienced in embedded programming, network protocols, and Internet security protocols.
  - Excellent communication skills and customer relationships.
  - Team leadership experience.
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#### C U R R E N T E M P L O Y M E N T

**Meteorologisk institutt** 2023 - Present  
Oslo, Norway

- Research software engineer working with NorESM with a strong focus on development of the NorESM atmosphere component (CAM).

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#### O T H E R W O R K E X P E R I E N C E

**Centro Euro-Mediterraneo sui Cambiamenti Climatici** 2022 - 2023  
Bologna, Italy

- Visitor collaborating on improvements to CMCC climate model including using data assimilation.

**National Center for Atmospheric Research** 2012 - 2022  
Boulder, Colorado

- Software engineer in the Atmospheric Modeling & Predictability section in the Climate and Global Dynamics Laboratory.
- Architect and lead engineer on a project to design and implement a portable physics framework for NCAR atmosphere models ((CCPP). Collaborating with NOAA to achieve inter-agency portability.
- Supervising a small team of software engineers working on the Community Atmosphere Model (CAM) development and maintenance.
- Lead developer on project to incorporate the DART ensemble Kalman Filter as a component in CESM.
- Implemented a new coupling infrastructure between the lower atmosphere physics (troposphere, stratosphere) with models simulating the middle and upper atmosphere (e.g., ion transport, ionosphere dynamo).

- Implemented a new parallel decomposition method for atmospheric physics.
- Implemented infrastructure to support a quasi-3D cloud resolving model as a CAM physics package.
- Implemented a finite-volume physics grid in CAM allowing the CAM physics package to operate on a separate grid from the dynamical core.
- Implemented new coupling communications infrastructure to run a quasi-3D cloud resolving model inside CAM physics.
- Part of the team which implemented subcolumns in CAM.

**Tech-X Corporation**

2010 - 2012

Boulder, Colorado

Computer Scientist

- Re-implemented parallel I/O functionality for the Earth System Modeling Framework (ESMF).
- Implemented C++ bindings for the PIO parallel I/O library.
- Performance modeling and optimization in Synergia2 accelerator code from the Fermi National Accelerator Laboratory. Optimizing scalability and communication.

**Physics Department - University of Colorado**

2008 - 2010

Boulder, Colorado

- Postdoctoral Research Associate and Science Teaching Fellow with the Science Education Initiative and the Physics Education Research Group.
- Worked on analysis and reform of the upper-division undergraduate quantum mechanics course at CU.

**Peak to Peak Charter School**

2001 - 2008

Lafayette, Colorado

- Please see Teaching Experience

**Massively Parallel Technologies, Inc.**

2001 - 2002

Boulder, Colorado

- Staff Scientist. Investigated and implemented parallel algorithms (e.g., matrix multiply) for Massively Parallel's cluster technology. Specified improvements in communications architecture.

**Cisco Systems, Inc.**

2000 - 2001

Boulder, Colorado

- Technical Leader for IP security (IPsec) and Virtual Private Networking (VPN). Specified and wrote new system which allowed enhanced interoperability between the Cisco VPN 5000 concentrator series and other Cisco IPsec products. IPSec code (written at Compatible Systems) still in use by Cisco.

**Compatible Systems Corporation**

1993 - 2000

Boulder, Colorado

- Senior Software Engineer and VPN-systems architect. Designed and implemented a VPN system for Compatible Systems' multi-protocol networking devices. Implemented the IntraPort family of products which included client to LAN VPN. Oversaw several engineers who were maintaining and upgrading the VPN clients. Lead a project which implemented IKE, the main IPsec key-management protocol. This system allows companies and individuals to communicate securely over the Internet. It became the major product line for the company and led to acquisition by Cisco Systems. Designed several extensions to IKE (e.g., RADIUS and SecurID® authentication, MS networking configuration) which gives customers greater flexibility and control in designing their VPN systems.
- Designed and implemented CompatiView, a GUI application for managing Compatible Systems' devices over a network. CompatiView, a 100,000+ line C++ application (based on MFC), operated over IP or IPX on a Windows-based PC or over AppleTalk on a Macintosh.
- Designed and implemented a command-based management system for Compatible Systems' routers. CompatiView and this command-based system became the tools used to configure and monitor Compatible Systems devices.

**Thinking Machines Corporation**

1984 - 1993

Cambridge, Massachusetts

- Designed and implemented a Communication Compiler for the Connection Machine System (CM) which enabled programmers to significantly speed applications by pre-compiling static communication patterns.
- Developed an extension to the CM I/O system that allowed direct I/O from the CM to graphics workstations using the CM's proprietary high-speed I/O bus.
- Provided extensive pre-sales technical support. Implemented and optimized benchmark codes for the CM. Worked closely with the sales and technical marketing departments.
- Ported large application codes to the CM and optimized them. Examples include work on NCAR's General Circulation Atmospheric Model and a structural simulation program created by Professor Charbel Farhat at the University of Colorado. Provided post-sales technical support. Maintained a \$1 million parallel supercomputer.
- Member of the team that designed and implemented a compiler for a new C-based language (C\*) for the CM. Designed and implemented the compiler's code generator and intermediate representation. Developed an innovative tool that automatically produced the intermediate representation from its own specification document. Designed and implemented a tool to automatically produce the code-generation program from an input table.
- Project manager for a team which specified and implemented an innovative CAD tool for procedural design entry and logic simulation. This system was used for architectural and chip designs at Thinking Machines.

- Project leader supervising the development and completion of a state-of-the-art CAD software product which was successfully developed under a \$3 million, three-year contract. Designed and implemented a software tool capable of routing VLSI chip designs which contained both standard cells and hierarchically designed circuits. This system allowed integration of standard cells and custom blocks on the same chip.

### Higher Order Systems

1982 - 1984

Cambridge, Massachusetts

- Developed and maintained the graphics text editor for the AXES language. This editor was the main entry and debugging tool for program development with the Higher Order Software CASE system.
- Designed and managed the implementation of the user interface for the Higher Order Software CASE system. This interface contained a user-friendly file-management database, as well as an error and development tracking system.

### Kitt Peak National Observatory

1977 - 1978

Tucson, Arizona

- Studied the spectrum of the unusual object, IRC+10216, and developed a model which attempted to explain this spectrum.
- Developed an interactive system to pull useful information from raw spectroscopic data. This system replaced a batch-oriented data-reduction process and cut processing time from more than a week to one hour.

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## EDUCATION

### Massachusetts Institute of Technology

1975 - 1984

Cambridge, Massachusetts

- Ph.D. in Physics, 1984. Specialized in theoretical particle physics and relativistic quantum field theory. Thesis title: *The Self Energy of a Confined Quark*.
- BS in Physics, 1979. Performed undergraduate research in Astrophysics, Solid State Physics and Biophysics. Thesis title: *High Resolution Spectra of IRC+10216 at 2.5 and 5 Microns*.

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## PUBLICATIONS

- Pfister, Gabriele G and Eastham, Sebastian D and Arellano, Avelino F and Aumont, Bernard and Barsanti, Kelley C and Barth, Mary C and Conley, Andrew and Davis, Nicholas A and Emmons, Louisa K and Fast, Jerome D and Fiore, Arlene M and Gaubert, Benjamin and Goldhaber, Steve and Granier, Claire and Grell, Georg A and Guevara, Marc and Henze, Daven K and Hodzic, Alma and Liu, Xiaohong and Marsh, Daniel R and Orlando, John J and Plane, John M C and Polvani, Lorenzo M and Rosenlof, Karen H and Steiner, Allison L and Jacob, Daniel J and Brasseur, Guy P, *The Multi-Scale Infrastructure for chemistry and aerosols (MUSICA)*, in **Bull. Am. Meteorol. Soc.**, 101, #10, pp E1743–E1760.

- Toniazzo, T. and Bentsen, M. and Craig, C. and Eaton, B. E. and Edwards, J. and Goldhaber, S. and Jablonowski, C. and Lauritzen, P. H., *Enforcing conservation of axial angular momentum in the atmospheric general circulation model CAM6*, in **Geoscientific Model Development**, 13, #2, pp 685–705, 2020
- Herrington, Adam R. and Lauritzen, Peter H. and Reed, Kevin A. and Goldhaber, Steve and Eaton, Brian E., *Exploring a Lower-Resolution Physics Grid in CAM-SE-CSLAM*, in **Journal of Advances in Modeling Earth Systems**, 11, #7, pp 1894–1916, 2019.
- Herrington, Adam R., Lauritzen, Peter H., Taylor, Mark A., Goldhaber, Steve, Eaton, Brian E., Bacmeister, Julio T., Reed, Kevin A. and Ullrich, Paul A., *Physics–Dynamics Coupling with Element-Based High-Order Galerkin Methods: Quasi-Equal-Area Physics Grid*, in **Monthly Weather Review**, 147, #1, pp 69–84, 2019.
- Lauritzen, P. H., Nair, R. D., Herrington, A. R., Callaghan, P., Goldhaber, S., Dennis, J. M., Bacmeister, J. T., Eaton, B. E., Zarzycki, C. M., Taylor, Mark A., Ullrich, P. A., Dubos, T., Gettelman, A., Neale, R. B., Dobbins, B., Reed, K. A., Hannay, C., Medeiros, B., Benedict, J. J., and Tribbia, J. J., *NCAR Release of CAM-SE in CESM2.0: A Reformulation of the Spectral Element Dynamical Core in Dry-Mass Vertical Coordinates With Comprehensive Treatment of Condensates and Energy*, in **Journal of Advances in Modeling Earth Systems**, 10, #7, pp 1537–1570, 2018.
- Peter Hjort Lauritzen, Mark A. Taylor, James Overfelt, Paul A. Ullrich, Ramachandran D. Nair, Steve Goldhaber, and Rory Kelly, *CAM-SE-CSLAM: Consistent coupling of a conservative semi-Lagrangian finite-volume method with spectral-element dynamics*, in **Monthly Weather Review**, 145, #3, pp 833–855, 2017.
- Thayer-Calder, K., Gettelman, A., Craig, C., Goldhaber, S., Bogenschutz, P. A., Chen, C.-C., Morrison, H., Höft, J., Raut, E., Griffin, B. M., Weber, J. K., Larson, V. E., Wyant, M. C., Wang, M., Guo, Z., Ghan, S. J., *A unified parameterization of clouds and turbulence using CLUBB and subcolumns in the Community Atmosphere Model*, in **Geoscientific Model Development**, 8, #12, pp 3801–3821, 2015.
- Steve Goldhaber, Steven Pollock, Mike Dubson, Paul Beale and Katherine Perkins, *Transforming Upper-Division Quantum Mechanics: Learning Goals and Assessment*, in 2009 Physics Education Research Conference Proceedings, AIP, 2009, pp 145–148.
- M. Dubson, S. Goldhaber, S. Pollock, and K. Perkins, *Faculty Disagreement about the Teaching of Quantum Mechanics*, in 2009 Physics Education Research Conference Proceedings, AIP, 2009, pp 137–140.
- S.N. Goldhaber and R.L. Jaffe, *The Self-Energy of a Confined Massive Quark*, **Nucl. Phys.**, B277, 674, (1986).
- S. Goldhaber, T.H. Hansson, and R.L. Jaffe, *The Self-Energy of a Confined Quark*, **Phys. Lett.**, 131B, 445, (1983).

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 CONTRIBUTED TALKS

- Goldhaber, S., *Separating the physics and dynamics grids*, 19th Annual CESM Workshop, Breckenridge, CO, June 2014
  - Goldhaber, S., *Subcolumns in CAM*, CGD Research Reports, Boulder, CO, February 2014
  - Goldhaber, S., and C.A. Craig, *Subcolumns in CAM*, 18th Annual CESM Workshop, Breckenridge, CO, June 2013
  - Steve Goldhaber, Steven Pollock, Mike Dubson, Paul Beale and Katherine Perkins, *What are they learning in quantum mechanics? A conceptual post test for Quantum I*, American Association of Physics Teachers, National Meeting, Ann Arbor, MI, July 2009
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## CONTRIBUTED POSTERS

- Lauritzen, P.H., M.A. Taylor, S. Goldhaber, J. Bacmeister, and R.D. Nair, *Physics-dynamics coupling with Galerkin methods: Equal-area physics grid*, 19th Annual CESM Workshop, Breckenridge, CO, June 2014
  - Craig, C.A., S. Goldhaber, A. Gettelman, J. Bacmeister, and B.E. Eaton, *Subcolumns in CAM*, 18th Annual CESM Workshop, Breckenridge, CO, June 2013
  - Steve Goldhaber, Steven Pollock, Mike Dubson, Paul Beale and Katherine Perkins, *Transforming Upper-Division Quantum Mechanics: Learning Goals and Assessment*, 2009 Physics Education Research Conference, Ann Arbor, MI, July 2009.
  - Steve Goldhaber, Stephanie Chasteen, Steve Pollock, Mike Dubson, Ed Kinney, Oliver DeWolf, Paul Beale and Kathy Perkins, *Upper Division Transformations in Physics*, Four Corners Section of the American Physical Society: Annual Meeting, Colorado School of Mines, Golden, CO October 23-24, 2009 and STEM Education Symposium, Univ. of Colorado, August 31, 2009.
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## TEACHING EXPERIENCE

**National Center for Atmospheric Research** 2012 - Present  
Boulder, Colorado

- CSEG Coffee Talk: *Making the most of version control: SVN for CESM users, scientists, and developers*, National Center for Atmospheric Research, May 2014

**Peak to Peak Charter School** 2001 - 2008  
Lafayette, Colorado

- Member of the team which took the high school program from its inception through to its ranking as the 47<sup>th</sup> best high school in the nation<sup>1</sup>.
- Taught classes in high school physics (standard, honors and AP<sup>®</sup>Physics C).
- Developed AP<sup>®</sup>Physics C Mechanics and AP<sup>®</sup>Physics C Electricity and Magnetism courses.
- Developed and taught AP<sup>®</sup>Computer Science AB.

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<sup>1</sup>Kelly, Brian, Ed., "America's Best High Schools." U.S. News & World Report 10 Dec. 2007: 38 – 56.

- Created and taught new curricula for the high-school physics and honors physics classes. Introduced a digital textbook into the honors curriculum.
- Created a new high-school computer programming curriculum and taught the one-semester, introductory course. This curriculum involved creating a specialized educational tool (written in Java) that introduced students to the actions of a processor and a program at a basic level. Created and taught a two-semester high-school advanced programming curriculum.
- Redesigned the seventh and eighth-grade science curriculum to include an honors class in seventh grade while improving the sequence in order to provide a better transition between elementary school and high school.
- Helped plan and implement the curriculum for the middle and high school (July, 1999 – September 2001 when the secondary school opened).
- Founded (2003) and served as the adviser for the Peak to Peak chapter of the National Honor Society starting in 2003.
- Started a middle-school robotics club in the Spring of 2004. Started a high-school robotics club in the fall of 2004.

**Summit Middle School**

2000 - 2001

Boulder, Colorado

- Taught classes in Computer Programming and Applied Technology.
- Wrote and implemented a new curriculum for Applied Technology. This class enabled each student to learn about a range of modern technologies in a hands-on environment.
- Wrote and implemented a curriculum for the Introduction to Computer Programming class. This class introduced students to the basics of computer programming using the Forth language.
- Wrote and implemented a curriculum for the Advanced Programming class. This class introduced students to modern programming practices and object-oriented programming using the Java language.

**Compatible Systems Corporation**

1994 - 1999

Boulder, Colorado

- Gave several classes, attended by the entire company, introducing virtual private networking, IP security protocols and, the Internet Key Exchange Protocol.
- Served as a mentor to several new engineers and interns. Introduced them to networking, embedded programming, and virtual private networking technology.

**Thinking Machines Corporation**

1991 - 1993

Boulder, Colorado

- Taught courses at the University of Colorado (Boulder and Denver Campuses) on Connection Machine Architecture, CM Fortran and C\*. These lectures were attended by faculty as well as graduate and undergraduate students.

**Massachusetts Institute of Technology**

1980 - 1983

Cambridge, Massachusetts

- Teaching Assistant for Physics II (Electricity & Magnetism, 1982). Gave semi-weekly recitation sessions. Also held office hours and graded papers.
- Instructor in Junior Physics Laboratory (1980 - 1981). Introduced students to new experimental areas and techniques. Helped troubleshoot experiments in progress and guided students through the experimental process. Reviewed written reports and gave oral examinations (usually supervised by course instructor). Helped develop and construct new experimental stations.
- Teaching Assistant for Physics III, a sophomore-level course in vibrations and waves. (1983). Graded papers and held office hours to assist students.
- Member of the Undergraduate Curriculum Committee at MIT (1978 - 1980). Worked on reforms to the undergraduate physics curriculum which would help to attract and retain more physics majors. Worked on changes to freshman physics classes to better serve non-physics majors.

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**T E C H N I C A L   S K I L L S**

- **Computer Languages:** FORTRAN, Python, C, C++, LISP, Java, FORTH, PERL
- **Parallel Computing:** MPI, OpenMP
- **Operating Systems:** Unix, Mac OS X, Windows, Embedded
- **Network Protocols:** MPI, TCP/IP, IPSec, IKE, IPX, AppleTalk
- **Mathematics Software:** Mathematica<sup>®</sup>, Mathcad<sup>®</sup>
- **Web Technologies:** HTML, PHP, JavaScript, MySQL

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**O T H E R**

- Member, American Physical Society
- Member, American Geophysical Union
- Member, European Geosciences Union