

Paul A. Ullrich, Ph.D.

CONTACT INFORMATION

University of Michigan
Department of Atmospheric, Oceanic
and Space Sciences
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RESEARCH INTERESTS

Atmospheric dynamics, atmospheric modeling and dynamical cores, high-performance computing, planetary atmospheres, numerical methods, algorithms, computational fluid dynamics, adaptive mesh refinement

EDUCATION

University of Michigan, Ann Arbor, Michigan, USA

Ph.D, Atmospheric and Space Sciences / Scientific Computing, May 2011

- Advisor: Professor Christiane Jablonowski
- GPA: 8.860 / 9.000 ($A^+ = 9$, $A = 8$, ...)
- Start date: September 2007

M.Sci., Atmospheric and Space Sciences, May 2010

- Focus: Atmospheric dynamics, applied mathematics and scientific computing
- Obtained concurrently with Ph.D.

University of Waterloo, Waterloo, Ontario, Canada

M.Math., Applied Mathematics, August 2007

- Advisor: Professor John Wainwright
- Area of Study: Theoretical cosmology
- Start date: September 2005

B.Math., Double Major Applied Mathematics and Computer Science, August 2005

- Graduated with distinction – Deans' Honours List in Mathematics
- Co-operative education program

PROFESSIONAL EXPERIENCE

University of Michigan, Ann Arbor, Michigan, USA

Postdoctoral Research Fellow

May 2011 - Present

- Pursued research on the application of high-order numerical methods and adaptive mesh refinement to atmospheric science.

HONORS AND AWARDS

Invitations

- Invited participant of the Institute For Pure and Applied Mathematics (IPAM) 2010 Long Program Workshop on Numerical Hierarchies for Climate Modeling, April 12-16, 2010.
- Invited participant in the National Center of Atmospheric Science summer school on Numerical Techniques for Global Atmospheric Models, June 2008.

- National Center for Atmospheric Research (NCAR) Summer Internship in Parallel Computational Science (SIParCS) summer student internship (\$10,000), May - August 2008.

University of Michigan

- Proquest Distinguished Dissertation Award (Nominated), November 2011.
- American Geophysical Union Outstanding Student Paper Award, December 2010.
- Michigan Graduate Symposium Outstanding Ph.D. Student Research Award Nominee, November 2010.
- Rackham Predoctoral Fellowship, February 2010.
- Michigan Graduate Symposium (1st place poster presentation, 2nd place oral presentation), November 2008.
- College of Engineering Deans Fellowship, September 2007.

University of Waterloo

- Natural Sciences and Engineering Research Council of Canada (NSERC) Post-Graduate Scholarship Extension (\$17,500), September 2006.
- Ontario Graduate Scholarship (\$15,000), May 2005 (Declined by applicant – award could not be held alongside NSERC award)
- Natural Sciences and Engineering Research Council of Canada (NSERC) Post-Graduate Scholarship (Masters, \$17,500), April 2005.
- Canadian Computing Competition Bronze Medalist, May 2000.
- Sybase Scholarship for Computer Sciences (\$18,000), June 2000.

JOURNAL ARTICLES

Ullrich, P.A., C. Jablonowski and P.H. Lauritzen (2012) “A high-order ‘incremental-remap’-based semi-Lagrangian dynamical core.” *Journal of Computational Physics*. Submitted Feb. 2012.

Ullrich, P.A., Lauritzen, P.H. and Jablonowski, C. (2012) “Some considerations for high-order ‘incremental remap’-based transport schemes: edges, reconstructions and area integration.” *International Journal of Numerical Methods in Fluids*. In Review.

Ullrich, P.A. and Jablonowski, C. (2012) “MCore: A non-hydrostatic atmospheric dynamical core utilizing high-order finite-volume methods.” *Journal of Computational Physics*. Revised Jan. 2012.

Ullrich, P.A. and C. Jablonowski (2011) “Implicit-Explicit Runge-Kutta-Rosenbrock (IMEX-RKR) schemes for nonhydrostatic atmospheric models.” *Monthly Weather Review*. In Press, DOI: 10.1175/MWR-D-10-05073.1.

Ullrich, P.A. and C. Jablonowski (2011) “An analysis of finite-volume methods for smooth problems on refined grids.” *Journal of Computational Physics*, Vol. 230, 706–725, DOI: 10.1016/j.jcp.2010.10.014.

Ullrich, P.A., C. Jablonowski and B. van Leer (2010) “High-order finite-volume models for the shallow-water equations on the sphere.” *Journal of Computational Physics*, Vol. 229, 6104–6134, DOI: 10.1016/j.jcp.2010.04.044.

Lauritzen, P.H., R.D. Nair and P.A. Ullrich. (2010) “A conservative semi-Lagrangian multi-tracer transport scheme (CSLAM) on the cubed-sphere grid,” *Journal of Computational Physics*, Vol. 229, 1401–1424, DOI: 10.1016/j.jcp.2009.10.036.

Ullrich, P.A., P.H. Lauritzen and C. Jablonowski (2009) “Geometrically Exact Conservative Remapping (GECORE): Regular latitude-longitude and cubed-sphere grids.” *Monthly Weather Review*, 137, 1721–1741.

JOURNAL
ARTICLES IN
PREPARATION

Ullrich, P.A., T. Melvin, C. Jablonowski and A. Staniforth (2011) “A baroclinic wave test case for deep and shallow atmosphere dynamical cores.” *Quarterly Journal of the Royal Meteorological Society*. To be submitted.

Ullrich, P.A., J. Whitehead, C. Jablonowski and M.A. Taylor (2011) “A stability analysis of advection and diffusion in the Community Atmosphere Model Spectral Element (CAM-SE) model.” *Journal of Computational Physics*. To be submitted.

Lauritzen, P. H., Andronova, N., Bosler, P. A., Calhoun, D., Enomoto, T., Dong, L., Dubey, S., Guba, O., Hansen, A. B., Jablonowski, C., Juang, H.-M. H., Kaas, E., Kent, J., Muller, R., Penner, J. E., Prather, M. J., Reinert, D., Skamarock, W. C., Sorensen, B., Taylor, M. A., Ullrich, P. A. and White J. B. III, (2011): “A standard test case suite for 2D linear transport on the sphere: results from 17 state-of-the-art schemes.” *Geoscientific Model Development*. To be submitted early 2012.

BOOK CHAPTERS

Lauritzen, P.H., P.A. Ullrich and R.D. Nair (2011) “Atmospheric transport schemes: Desirable properties and a semi-Lagrangian view on finite-volume discretizations.” In *Numerical Techniques for Global Atmospheric Models*, Springer-Verlag: Heidelberg, pp. 185–250.

THESES

Ullrich, P.A. (2011) *Atmospheric Modeling with High-Order Finite-Volume Methods*, (Ph.D. Thesis) University of Michigan, Ann Arbor, Michigan, USA. 323pp.

Ullrich, P.A. (2007) *Exact and Perturbed Friedmann-Lemaitre Cosmologies*, (Master’s Thesis) University of Waterloo, Waterloo, Ontario, Canada. 169pp.

PATENTS

Mikkelsen, S., T. Mann, P. Ertl, L. O’Hagan, D. Sparkes and P. Ullrich (2005) *Electrochemical Assay for the Identification of Microorganisms*. European Patent CA2549658.

PUBLISHED
ABSTRACTS

Ullrich, P.A. and C. Jablonowski (2011) “MCore: A High-Order Finite-Volume Dynamical Core for Atmospheric General Circulation Models,” Abstract A11J-07 presented at 2011 Fall Meeting, American Geophysical Union, San Francisco, CA, December 5-9, 2011.

Ullrich, P.A. and C. Jablonowski (2010) “High-Order Finite-Volume Schemes for Simulating Atmospheric Flows,” Abstract A41G-07 presented at 2010 Fall Meeting, American Geophysical Union, San Francisco, CA, December 13-17.

Ullrich, P.A. and P.H. Lauritzen (2008) “GECORE: A New Geometrically Exact Remapping Scheme on the Sphere,” *Eos Trans. American Geophysical Union*, 89(53), Fall Meet. Suppl., Abstract A33A-0213.

PRESENTATIONS
(2009 ONWARD)

Ullrich, P. A. (2012) "New Approaches to Numerical Modeling of the Atmosphere." Invited presentation at the University of California Los Angeles, Los Angeles, California. February 15, 2012.

Ullrich, P. A. (2012) "New Approaches to Numerical Modeling of the Atmosphere." Invited presentation at the University of California Davis, Davis, California. January 17, 2012.

Ullrich, P. A. (2012) "New Approaches to Numerical Modeling of the Atmosphere." Invited presentation at the Lawrence Berkeley National Laboratory, Berkeley, California. January 13, 2012.

Ullrich, P. A. and Jablonowski, C. (2011) "MCore: Advances in high-order modeling of the global atmosphere." Presented at the American Geophysical Union Fall Meeting 2011, San Francisco, CA, USA, December 5-9, 2011.

Ullrich, P. A. (2011) "New Approaches to Numerical Modeling of the Atmosphere." Invited presentation at the University of Waterloo, Waterloo, Ontario, Canada. November 25, 2011.

Jablonowski, C., P. A. Ullrich and K. A. Reed (2011) "High-Order Methods and Non-hydrostatic Designs on Quasi-Uniform and Variable-Resolution Grids: Tackling the Numerical Challenges for Future-Generation GCMs," Invited presentation at the Global-to-Regional Climate Simulation Workshop, Santa Fe, NM, USA, August 3-5, 2011.

Jablonowski, C. and P. A. Ullrich (2011) "A High-Order Finite-Volume Scheme for the Dynamical Core of Weather and Climate Models." Invited presentation at the Scientific Discovery through Advanced Computing Program (SciDAC) Conference, Denver, CO, USA, July 10-14, 2011.

Ullrich, P. A. and Jablonowski, C. (2011) "MCore: A High-Order Finite-Volume Dynamical Core." Poster presentation at the 16th Annual Community Earth System Model (CESM) Workshop, Breckenridge, CO, USA, June 20-23, 2011.

Jablonowski, C., P. A. Ullrich and K. A. Reed (2011), "Tackling the numerical challenges of future-generation climate models: High-order methods, nonhydrostatic designs, variable-resolution and cubed-sphere grids, and how to test models." Institute for Mathematics and Its Applications (IMA), Invited presentation at the workshop 'Societally Relevant Computing', Minneapolis, MN, USA, April 11-15, 2011.

Ullrich, P. A. (2011) "High-Order Finite-Volume Methods for Atmospheric Transport." Presentation at the Workshop on Transport Schemes on the Sphere, Boulder, CO, USA, March 31, 2011.

Ullrich, P. A. (2011) "Towards the Next Generation of Climate Models." Presentation at the Society of Industrial and Applied Mathematics (SIAM) Conference of the Geosciences, Long Beach, CA, USA, March 24, 2011.

Jablonowski, C. and Ullrich, P.A. (2011) "A High-Order Finite-Volume Technique for Nonhydrostatic Dynamical Cores on (Adaptive) Cubed-Sphere Grids." Presentation at the National Centre for Atmospheric Science (NCAS) meeting, Boulder, CO, USA, March 7-9, 2011.

Ullrich, P. A. (2011) “Towards the Next Generation of Climate Models.” Invited presentation at the University of Michigan Seminar Series, Ann Arbor, MI, USA, January 10, 2011.

Ullrich, P. A. and C. Jablonowski (2010) “High-order finite-volume schemes for simulating atmospheric flows.” Presentation at the American Geophysical Union Fall Meeting 2010, San Francisco, CA, USA, December 13-17, 2010.

Ullrich, P. A. and C. Jablonowski (2010), “High-order finite-volume schemes for simulating atmospheric flows.” UM College of Engineering 2010 Engineering Graduate Symposium, Ann Arbor, MI, USA, November 12, 2010.

Ullrich, P.A. (2010) “A look at high-order finite-volume schemes for simulating atmospheric flows.” Presentation at the Workshop on Solutions to Partial Differential Equations on the Sphere, Potsdam, Germany, August 25, 2010.

Ullrich, P.A. (2010) “High-order finite-volume methods for geophysical flow problems,” Poster presentation at the National Science Foundation (NSF) Institute for Pure and Applied Mathematics (IPAM), Workshop II: Numerical Hierarchies for Climate Modeling, Los Angeles, CA, USA, April 16, 2010.

Jablonowski, C. and Ullrich, P.A. (2010) “An Analysis of Finite-Volume schemes: High-order Methods and Grid Reflections on Adaptive Grids,” Invited presentation at the NSF Institute for Pure and Applied Mathematics (IPAM), Workshop II: Numerical Hierarchies for Climate Modeling, Los Angeles, CA, USA, April 16, 2010.

Ullrich, P.A. (2010) “High-order finite-volume methods for geophysical flow problems,” Poster presentation at the Michigan Geophysical Union, Ann Arbor, MI, USA, March 26, 2010.

Ullrich, P.A. (2009) “Riemann-Solver Based Shallow-Water FV Models on the Sphere,” Poster presentation at the Engineering Graduate Symposium, Ann Arbor, MI, USA, November 13, 2009.

Ullrich, P.A. (2009) “Riemann-Solver Based Shallow-Water FV Models on the Sphere,” Invited talk at Field’s Workshop on Dynamics in Environmental and Geophysical Flows, Waterloo, Ontario, Canada, July 27-29, 2009.

Jablonowski, C. and P. A. Ullrich (2009), “Adaptive Mesh Refinement on the Sphere: Insights into computational grids, wave propagation and diffusion properties.” Invited presentation at the International Conference On Spectral and High Order Methods (ICOSAHOM) ‘09, Trondheim, Norway, June 22-26, 2009.

Ullrich, P.A. (2009) “GECORE: A Geometrically Exact Remapping Scheme on the Sphere.” Presentation at the Workshop on Solutions to Partial Differential Equations on the Sphere, Santa Fe, USA, April 27-30, 2009.

Jablonowski, C. and P. A. Ullrich (2009), “The Pros and Cons of Adaptive Meshes in Atmospheric Finite Volume Models.” Invited presentation at the Workshop on Multi-scale Modelling of the Atmosphere and Ocean, Reading, UK, March 25-26, 2009.

Ullrich, P.A. (2009) “GECORE: A Geometrically Exact Remapping Scheme on the Sphere.” Poster presentation at the Michigan Geophysical Union 2009, Ann Arbor, MI, USA, March 20, 2009.

TEACHING
EXPERIENCE

University of Michigan

Adjunct Lecturer

Sept. 2011 to Dec. 2011

AOSS 401 - Geophysical Fluid Dynamics

Primary instructor for this mixed undergraduate/graduate atmospheric dynamics course for 16 students.

Assistant Instructor

Sept. 2010 to Dec. 2010

AOSS 605 - The Art of Climate Modeling

Formulated and taught a series of six lectures on numerical methods for climate models under the advisement of Prof. Christiane Jablonowski.

Grader

Sept. 2008 to Dec. 2008

AOSS 551 - Fluid Dynamics

Duties included teaching tutorials, answering student questions and marking assignments.

Maple Instructor

Sept. 2008, 2009, 2010, 2011

Instructed students in the use of the software package Maple at a two hour tutorial session.

University of Waterloo

Teaching Assistant (TA)

Sept. 2005 to Aug. 2007

AM 341 / CM 271 Introduction to Computational Mathematics

AM 342 / CM 352 Computational Methods for Differential Equations

AM 452 / CM 452 Computational Methods for Partial Differential Equations

Duties included teaching tutorials, holding office hours for students, marking assignments and proctoring midterm and final examinations.

PROFESSIONAL
ACTIVITIES

Joint Summer School / Workshop Organizer

Workshop on the Intercomparison of Non-hydrostatic Dynamical Cores

Planned dates: July 30th to August 10th, 2012

Location: National Center for Atmospheric Research (NCAR)

Overview: The objectives of the summer school are to (1) teach a group of about 30 multi-disciplinary students how non-hydrostatic atmosphere models are designed and built, (2) invite about 10 dynamical core modeling groups to NCAR for a hands-on student-run intercomparison project, (3) establish new non-hydrostatic dynamical core and tropical cyclone test cases and (4) invite keynote speakers to NCAR to give lectures on modern numerical techniques, uncertainty quantification and physics-dynamics coupling. This workshop has been endorsed by the World Meteorological Organization (WMO) Working Group on Numerical Experimentation (WGNE).

SERVICE
CONTRIBUTIONS

Paper Reviewer

Journal of Computational Physics, published by Elsevier

Monthly Weather Review, published by the American Meteorological Society

Journal of Advances in Modeling Earth Systems, published by American Geophysical Union

Quarterly Journal of the Royal Meteorological Society, published by Wiley Blackwell

Session Chair

American Geophysical Union, San Francisco, CA. December 5-9, 2011.

Society Memberships

American Meteorological Society (AMS)

American Geophysical Union (AGU)

Society for Industrial and Applied Mathematics (SIAM)

INDUSTRIAL
EXPERIENCE

Maplesoft, Waterloo, Ontario, Canada

Mathematics Developer

Sept. 2004 to Dec. 2004

- Part of a team of four programmers developing an updated version of the statistics library for use within their flagship product.
- Developed approaches to statistics used in various papers and integrated them into the software.

RapidLabs Microsystems, Waterloo, Ontario, Canada

Senior Software Engineer

Jan. 2004 to Apr. 2004

- Led an initiative within this local start-up to develop a software system complementing their hardware system.
- Developed a statistical software technique for identifying microbial cultures.

Sonic Foundry Canada, Waterloo, Ontario, Canada

Software Engineer

Sept. 2001 to Aug. 2002

- Involved in the design and development of several software packages including Vegas Video and DVD Architect.
- Worked with a team of five members on image and video transformations.

Digital Tempest Productions, Kitchener, Ontario, Canada

CEO / Project Coordinator

June 2000 to June 2005

- Founded a software development company producing an open source and cross-platform functional library for C++.

TECHNICAL SKILLS

Programming: C, C++, Fortran, MPI, OpenMP, CUDA, OpenGL, PHP, UNIX shell scripting, SQL, CVS, SVN, XML / HTML, MATLAB, MAPLE, NCAR Command Language (NCL)

Applications: L^AT_EX, Microsoft Office, Microsoft Visual Studio .NET, and other common software for Windows, OS X, and Linux platforms

Operating Systems: Microsoft Windows, Apple OS X, Linux, Unix

EXPERTISE

Mathematics: Numerical methods, ordinary and partial differential equations, differential geometry, fluid and continuum dynamics, functional analysis, combinatorial theory, probability and statistics

Computer Science: Parallel computing, algorithms, software engineering, operating systems, artificial intelligence, databases

Atmospheric and space sciences: Atmospheric dynamics, radiative transfer, clouds and precipitation, planetary sciences, atmospheric chemistry

Languages: English, Mandarin