

Craig Steven Schwartz

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Curriculum Vitae
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PROFESSIONAL EXPERIENCE

The National Center for Atmospheric Research (NCAR), Boulder, CO
Mesoscale and Microscale Meteorology (MMM) Laboratory

- Project Scientist II, 2017-present
- Project Scientist I, 2016-2017
- Associate Scientist III, 2011-2016
- Associate Scientist II, 2009-2011

The University of Oklahoma and National Severe Storms Laboratory, Norman, OK

- Graduate Research Assistant, 2007-2009

The National Weather Service, Juneau, AK

- Summer hire, May-July 2007
- Worked operational shifts

The Storm Prediction Center and National Severe Storms Laboratory, Norman, OK

- NOAA Ernest F. Hollings Scholarship Internship, Summer 2006

The Ocean Prediction Center, Camp Springs, MD

- Summer internship, 2002

EDUCATION

The University of Maryland, College Park, MD

- Ph.D., Atmospheric and Oceanic Science, December 2021
- Dissertation: *An evaluation of convection-allowing ensemble forecast sensitivity to initial conditions*
- Dissertation Advisor: Jonathan Poterjoy

The University of Oklahoma, Norman, OK

- Master's of Science in Meteorology, May 2009
- Thesis: *An assessment of convection-allowing WRF-ARW configurations: Utility as next-day guidance and sensitivity to resolution and physical parameterizations*
- Thesis Advisor: John S. Kain

The Pennsylvania State University, University Park, PA

- Bachelor of Science in Meteorology, May 2007
- Bachelor of Music, Composition Option, with Honors, May 2007
- Graduated with Highest Distinction
- The Schreyer Honors College

The Kentucky Institute for International Studies

- Studied in Salzburg, Austria for five weeks, May-June 2005

TECHNICAL SKILLS

- WRFDA, GSI, DART data assimilation systems
- WRF and MPAS numerical weather prediction models
- Fortran, NCL, python programming languages
- Unix scripting (csh, bash, ksh)

UNIVERSITY TEACHING EXPERIENCE

- Guest lecturer, Department of Atmospheric & Oceanic Science, The University of Maryland, 2020 (synoptic meteorology)
- Teaching Assistant, School of Meteorology, The University of Oklahoma, 2009 (general meteorology course for majors)
- Teaching Assistant, Department of Meteorology, The Pennsylvania State University, 2006 (general meteorology course for non-majors)

HONORS AND AWARDS

American Meteorological Society (AMS)

- Editor's Award for *Weather and Forecasting*, 2015
- Graduate Fellowship, 2007-2008
- The District of Columbia Chapter of the AMS Scholarship Recipient, 2003

National Center for Atmospheric Research (NCAR)

- MMM Special Recognition Award, 2020
- MMM Special Recognition Award, 2018
- MMM Special Recognition Award, 2014

National Oceanic and Atmospheric Administration (NOAA)

- Ernest F. Hollings Scholarship, 2005-2007
- Best Student Presentation, NOAA/EPP Forth Education and Science Forum, Tallahassee, FL, 2006

The University of Oklahoma

- Yoshi Sasaki Award for Best M.S. Student Publication, 2009

Astronaut Scholarship Foundation

- Scholarship recipient, 2008 — awarded nationally to ~25 students

The Pennsylvania State University

- Meteorological Honors and Awards:
 - John A. Dutton Award in Atmospheric Dynamics, 2007
 - Dr. Joel and Peggy Myers Scholarship in Meteorology, 2006-2007
 - Charles and Anna Hosler Scholarship in Meteorology, 2004-2006
 - John and Elizabeth Holmes Teas Scholarship in Earth and Mineral Sciences, 2004-2006
- University Honors and Awards:
 - John W. White Graduate Fellowship, 2007
 - Evan Pugh (Senior) Scholar Award for Academic Achievement, 2006-2007
 - Evan Pugh (Junior) Scholar Award for Academic Achievement, 2005-2006
 - President Sparks Award for Academic Excellence, 2004-2005
 - President's Freshman Award for Academic Excellence, 2003-2004
 - Schreyer Honors College Academic Excellence Scholarship, 2003-2007
- Music Honors and Awards:
 - College of Arts and Architecture Creative Achievement Award, 2007
 - College of Arts and Architecture Alumni Scholarship, 2006-2007
 - College of Arts and Architecture Reuben and Gladys Golumbic Scholarship for Humanistic Achievement in the Arts, 2005
 - Eleanor Beene Memorial Scholarship in Music, 2004-2005
 - School of Music Scholarship, 2003-2007

COMMUNITY SERVICE

Journal Editorships and Peer review

- Associate Editor in Chief for *Advances in Atmospheric Sciences*, Jan. 1, 2020-present
- Associate Editor for *Weather and Forecasting*, Jan. 1, 2014-present
- Associate Editor for *Monthly Weather Review*, Jan. 1, 2016-present
- Reviewer for *Journal of Geophysical Research—Atmospheres*
- Reviewer for *Journal of Atmospheric Sciences*
- Reviewer for *Geoscientific Model Development*
- Reviewer for *Journal of Hydrometeorology*
- Reviewer for *Journal of Applied Meteorology and Climatology*
- Reviewer for *Quarterly Journal of the Royal Meteorological Society*
- Reviewer for *Theoretical and Applied Climatology*
- Reviewer for *Aerosol and Air Quality Research*
- Reviewer for *Atmospheric Research*

- Reviewer for the *Central European Journal of Geosciences*
- Reviewer for *Meteorology and Atmospheric Physics*
- Reviewer for *Remote Sensing*
- Reviewer for *Atmospheric Chemistry and Physics*
- Reviewer for *Journal of Meteorological Research*
- Reviewer for *International Journal of Remote Sensing*
- Reviewer for *Atmospheric Pollution Research*
- Reviewer for *Atmospheric Science Letters*
- Reviewer for *Journal of Environmental Management*
- Reviewer for *Atmospheric Environment*
- Reviewer for *Scientific Online Letters on the Atmosphere*
- Reviewer for *Meteorologische Zeitschrift*
- Reviewer for *Advances in Space Research*
- Reviewer for *Journal of Atmospheric and Solar-Terrestrial Physics*
- Reviewer for *Atmosphere*
- Reviewer for *Meteorological Applications*

Grant proposal review

- National Science Foundation
- University of Wisconsin–Milwaukee
- Austrian Science Fund
- United Arab Emirates University
- Poland National Science Centre

Conference Committees

- Program Committee for the 2022 AMS WAF/NWP conferences
- Organizing committee for the System for Integrated Modeling of the Atmosphere (SIMA) Community Workshop, Virtual conference, 2020
- Science committee for the 6th International Symposium on Data Assimilation, Munich, Germany, 2018

Internal UCAR/NCAR Service

- MMM Diversity and Inclusion Committee, 2017-present
- UCAR Awards Jury, 2016, 2017
- Various hiring committees

Field Projects and Experiments

- CONCH (Coordinated Observations of Northeast Colorado Hail), Boulder, CO, 2021: Forecaster
- Front Range Air Pollution and Photochemistry Experiment (FRAPPE), Boulder, CO, 2014: Forecaster
- Mesoscale Prediction Experiment (MPEX), Boulder, CO, 2013: Lead forecaster
- Deep Convective Clouds and Chemistry (DC3), Salina, KS, 2012: Lead forecaster

- Vortex2, 2009: Participant (mobile mesonets)
- NOAA Hazardous Weather Testbed Spring Experiment, 2008, 2009, 2018, 2019, 2020, 2021: Participant

Student Mentoring/Advising

- Austin Coleman (Texas Tech University; PhD committee)
- Paola Corrales (University of Buenos Aires; mentoring)
- Mouhamet Diallo (French Guiana University; mentoring)
- Thomas Gowan (University of Utah; mentoring)
- Marika Koukoula (University of Connecticut; PhD committee)
- Xiaoshi Qiao (Nanjing University of Information Science and Technology; mentoring)
- Malcolm Wilson (Cornell University; mentoring through NCAR's SOARS program)

Educational Outreach

- K–12 science fair judge:
 - GLOBE International Virtual Science Symposium, March 2018; April 2019, 2021
 - New Vista High School, Boulder, CO, April 2015, 2019, 2020
 - Eisenhower Elementary School, Boulder, CO, February 2015
 - Peak to Peak High School, Lafayette, CO, January 2011, 2012
 - Boulder Valley School District, Boulder, CO, February 2010, 2011, 2012, 2013, 2015, 2016, 2018, 2019, 2020, 2021; March 2017
 - Oklahoma Mesonet Science Fair, Norman, OK, March 2008, February 2009
- UCAR and NCAR:
 - Instructor for GSI Tutorial for Thailand Weather Forecasters, June 2017
 - WRF Data Assimilation Tutorial instructor, July 2011, 2012, 2013, 2014, 2017, 2019; August 2015, 2016; October 2017
 - “Super Science Saturday” volunteer, October 2009, 2011; November 2015, 2017, 2018
 - Judge for summer internship program’s poster session, July 2014, 2015, 2016, 2017
- American Meteorological Society:
 - Student conference presenter: “Conversations with Professionals”, 92nd Annual Meeting, January 2012
 - Judge for student conference poster session, 92nd Annual Meeting, January 2012
 - Judge for WAF/NWP conference student presentations, January 2020
- American Geophysical Union:
 - Judge for student posters, Annual Fall Meeting, December 2016, 2018, 2020

- University of Colorado:
 - Selection committee for Astronaut Scholarship Foundation nominees, February 2018, March 2019, 2020, 2021
- National Oceanic and Atmospheric Administration (NOAA):
 - Reviewer for Ernest F. Hollings Scholarship, February 2018, 2020

The Pennsylvania State University Campus Weather Service

- Penn State's Campus Weather Service is the largest student-run forecasting organization in the United States of America
- President, 2006-2007
- Shift leader, 2004-2007
- Forecaster and radio broadcaster, 2003-2007

PROFESSIONAL MEMBERSHIPS

American Meteorological Society
 American Geophysical Union

RESEARCH GRANTS

11. Adapting machine learning-based convective hazard guidance to use the HRRR/RRFS (Co-PI), National Oceanographic and Atmospheric Administration, Recommended for funding, \$575,846, 2021–2023.
10. Diagnosing synoptic progressiveness forecast errors within the UFS MRWA (Co-PI), National Oceanographic and Atmospheric Administration, Recommended for funding, \$552,819, 2021–2023.
9. A collaboration between NCAR and WindBorne (PI), WindBorne Systems, \$231,066, 2021–2022.
8. Using convective mode information for hazard prediction with convection-allowing models (Co-PI), National Oceanographic and Atmospheric Administration Award Number NA19OAR4590128, \$731,555, 2019–2022.
7. Enhanced tools for high-resolution ensemble development and verification (Co-PI), National Oceanographic and Atmospheric Administration Award Number NA19OAR4590232, \$571,997, 2019–2021.
6. Forecast System Development Activities Toward a Convective-scale HRRR Ensemble (Co-PI), National Oceanographic and Atmospheric Administration Award Number NA17OAR4590182, \$530,134, 2017–2019.
5. Use of NWP Models to Identify Convective Outflows for Fire Weather Forecasting (Co-PI), Joint Fire Science Program, \$344,397, 2017–2019.

4. Demonstration of a Rapid Update Convection-Permitting Ensemble Forecast System to Improve Flash Flood and Winter Weather Prediction (Co-PI), National Oceanographic and Atmospheric Administration Award Number NA17OAR4590122, \$293,080, 2017–2019.
3. Demonstration of a Rapid Update Convection-Permitting Ensemble Forecast System to Improve Hazardous Weather Prediction (Co-PI), National Oceanographic and Atmospheric Administration Award Number NA17OAR4590114, \$285,593, 2017–2019.
2. Resolution Dependence of Simulated Convective Storms in the Southeast United States (Co-PI), National Oceanographic and Atmospheric Administration Award Number NA15OAR4590238, \$206,685, 2015–2017.
1. Convection-Permitting Ensemble Forecast System for Prediction of Extreme Weather (Co-PI), National Oceanographic and Atmospheric Administration Award Number NA15OAR4590191, \$247,208, 2015–2017.

PEER-REVIEWED PUBLICATIONS

49. Koukoula, M., **C. S. Schwartz**, E. I. Nikolopoulos, and E. N. Anagnostou, 2021: Understanding the impact of soil moisture on precipitation under different climate and meteorological conditions: A numerical sensitivity study over the CONUS. *J. Geophys. Res. Atmos.*, In press, doi:10.1029/2021JD035096.
48. **Schwartz, C. S.**, J. Poterjoy, J. R. Carley, D. C. Dowell, G. S. Romine, and K. Ide, 2021: Comparing partial and continuously cycling ensemble Kalman filter data assimilation systems for convection-allowing ensemble forecast initialization. *Wea. Forecasting*, In press.
47. Koukoula, M., **C. S. Schwartz**, E. I. Nikolopoulos, and E. N. Anagnostou, 2021: Evaluation of soil state representation in the NCAR ensemble analysis system. *Journal of Hydrology*, **601**, 126617, doi:10.1016/j.jhydrol.2021.126617.
46. Bresch, J. F., J. G. Powers, **C. S. Schwartz**, R. A. Sobash, and J. L. Coen, 2021: Objective identification of thunderstorm gust fronts in numerical weather prediction models for fire weather forecasting. *International Journal of Wildland Fire*, **30**, 513–535, doi:10.1071/WF20059.
45. **Schwartz, C. S.**, G. S. Romine, and D. C. Dowell, 2021: Toward unifying short-term and next-day convection-allowing ensemble forecast systems with a continuously-cycling 3-km ensemble Kalman filter over the entire conterminous United States. *Wea. Forecasting*, **36**, 379–405, doi:10.1175/WAF-D-20-0110.1.
44. Sobash, R. A., G. S. Romine, and **C. S. Schwartz**, 2020: A comparison of neural-network and surrogate-severe probabilistic convective hazard guidance derived from a

- convection-allowing model. *Wea. Forecasting*, **35**, 1981–2000, doi:10.1175/WAF-D-20-0036.1.
43. Qiao, X., S. Wang, **C. S. Schwartz**, Z. Liu, and J. Min, 2020: A method for probability matching based on the ensemble maximum for quantitative precipitation forecasts. *Mon. Wea. Rev.*, **148**, 3379–3396, doi:10.1175/MWR-D-20-0003.1.
42. **Schwartz, C. S.**, M. Wong, G. S. Romine, R. A. Sobash, and K. R. Fossell, 2020: Initial conditions for convection-allowing ensembles over the conterminous United States. *Mon. Wea. Rev.*, **148**, 2645–2669, doi:10.1175/MWR-D-19-0401.1.
41. Choi, Y., S.-H. Chen, C.-C. Huang, K. Earl, C.-Y. Chen, **C. S. Schwartz**, and T. Matsui, 2020: Evaluating the impact of assimilating aerosol optical depth observations on dust forecasts over North Africa and the East Atlantic using different data assimilation methods. *Journal of Advances in Modeling Earth Systems*, **12**, e2019MS001890, doi:10.1029/2019MS001890.
40. **Schwartz, C. S.**, and R. A. Sobash, 2019: Revisiting sensitivity to horizontal grid spacing in convection-allowing models over the central and eastern United States. *Mon. Wea. Rev.*, **147**, 4411–4435, doi:10.1175/MWR-D-19-0115.1.
39. Yang, J., M. Astitha, and **C. S. Schwartz**, 2019: Assessment of storm wind speed prediction using gridded Bayesian regression applied to historical events with NCAR’s real-time ensemble forecast system. *J. Geophys. Res. Atmos.*, **124**, 9241–9261, doi:10.1029/2018JD029590.
38. Sobash, R. A., **C. S. Schwartz**, G. S. Romine, and M. L. Weisman, 2019: Next-day prediction of tornadoes using convection-allowing models with 1-km horizontal grid spacing. *Wea. Forecasting*, **34**, 1117–1135, doi:10.1175/WAF-D-19-0044.1.
37. **Schwartz, C. S.**, 2019: Medium-range convection-allowing ensemble forecasts with a variable-resolution global model. *Mon. Wea. Rev.*, **147**, 2997–3023, doi:10.1175/MWR-D-18-0452.1.
36. **Schwartz, C. S.**, G. S. Romine, R. A. Sobash, K. R. Fossell, and M. L. Weisman, 2019: NCAR’s real-time convection-allowing ensemble project. *Bull. Amer. Meteor. Soc.*, **100**, 321–343, doi:10.1175/BAMS-D-17-0297.1.
35. Gowan, T. M., W. J. Steenburgh, and **C. S. Schwartz**, 2018: Validation of mountain precipitation forecasts from the convection-permitting NCAR Ensemble and operational forecast systems over the Western United States. *Wea. Forecasting*, **33**, 739–765, doi:10.1175/WAF-D-17-0144.1.
34. Zhang, X., E. N. Anagnostou, and **C. S. Schwartz**, 2018: NWP-based adjustment of IMERG precipitation for flood-inducing complex terrain storms: Evaluation over CONUS. *Remote Sensing*, **10**, 642, doi:10.3390/rs10040642.

33. **Schwartz, C. S.**, and R. A. Sobash, 2017: Generating probabilistic forecasts from convection-allowing ensembles using neighborhood approaches: A review and recommendations. *Mon. Wea. Rev.*, **145**, 3397–3418, doi:10.1175/MWR-D-16-0400.1.
32. **Schwartz, C. S.**, G. S. Romine, K. R. Fossell, R. A. Sobash, and M. L. Weisman, 2017: Toward 1-km ensemble forecasts over large domains. *Mon. Wea. Rev.*, **145**, 2943–2969, doi:10.1175/MWR-D-16-0410.1.
31. Powers, J. G., J. B. Klemp, W. C. Skamarock, C. A. Davis, J. Dudhia, D. O. Gill, J. L. Coen, D. J. Gochis, R. Ahmadov, S. E. Peckham, G. A. Grell, J. Michalakes, S. Trahan, S. G. Benjamin, C. R. Alexander, G. J. DiMego, W. Wang, **C. S. Schwartz**, G. S. Romine, Z. Liu, C. Snyder, F. Chen, M. J. Barlage, W. Yu, and M. G. Duda, 2017: The Weather Research and Forecasting (WRF) Model: Overview, system efforts, and future directions. *Bull. Amer. Meteor. Soc.*, **98**, 1717–1737, doi:10.1175/BAMS-D-15-00308.1.
30. **Schwartz, C. S.**, 2017: A comparison of methods used to populate neighborhood-based contingency tables for high-resolution forecast verification. *Wea. Forecasting*, **32**, 733–741, doi:10.1175/WAF-D-16-0187.1.
29. Sobash, R. A., G. S. Romine, **C. S. Schwartz**, D. J. Gagne, and M. L. Weisman, 2016: Explicit forecasts of low-level rotation from convection-allowing models for next-day tornado prediction. *Wea. Forecasting*, **31**, 1591–1614, doi:10.1175/WAF-D-16-0073.1.
28. Romine, G. S., **C. S. Schwartz**, R. D. Torn, and M. L. Weisman, 2016: Impact of assimilating dropsonde observations from MPEX on ensemble forecasts of severe weather events. *Mon. Wea. Rev.*, **144**, 3799–3823, doi:10.1175/MWR-D-15-0407.1.
27. **Schwartz, C. S.**, 2016: Improving large-domain convection-allowing forecasts with high-resolution analyses and ensemble data assimilation. *Mon. Wea. Rev.*, **144**, 1777–1803, doi:10.1175/MWR-D-15-0286.1.
26. Sobash, R. A., **C. S. Schwartz**, G. S. Romine, K. R. Fossell, and M. L. Weisman, 2016: Severe weather prediction using storm surrogates from an ensemble forecasting system. *Wea. Forecasting*, **31**, 255–271, doi:10.1175/WAF-D-15-0138.1.
25. **Schwartz, C. S.**, G. S. Romine, R. A. Sobash, K. R. Fossell, and M. L. Weisman, 2015: NCAR’s experimental real-time convection-allowing ensemble prediction system. *Wea. Forecasting*, **30**, 1645–1654, doi:10.1175/WAF-D-15-0103.1.
24. **Schwartz, C. S.**, G. S. Romine, M. L. Weisman, R. A. Sobash, K. R. Fossell, K. W. Manning, and S. B. Trier, 2015: A real-time convection-allowing ensemble prediction system initialized by mesoscale ensemble Kalman filter analyses. *Wea. Forecasting*, **30**, 1158–1181, doi:10.1175/WAF-D-15-0013.1.
23. **Schwartz, C. S.**, Z. Liu, and X.-Y. Huang, 2015: Sensitivity of limited-area hybrid variational-ensemble analyses and forecasts to ensemble perturbation resolution. *Mon. Wea. Rev.*, **143**, 3454–3477, doi:10.1175/MWR-D-14-00259.1.

22. Newman, K. M., **C. S. Schwartz**, Z. Liu, H. Shao, and X.-Y. Huang, 2015: Evaluating forecast impact of assimilating Microwave Humidity Sensor (MHS) radiances with a regional ensemble Kalman filter data assimilation system. *Wea. Forecasting*, **30**, 964–983, doi:10.1175/WAF-D-14-00091.1.
21. Weisman, M. L., R. J. Trapp, G. S. Romine, C. Davis, R. Torn, M. Baldwin, L. Bosart, J. Brown, M. Coniglio, D. Dowell, A. C. Evans, T. J. Galarneau Jr., J. Haggerty, T. Hock, K. Manning, P. Roebber, P. Romashkin, R. Schumacher, **C. S. Schwartz**, R. Sobash, D. Stensrud, and S. Trier, 2015: The Mesoscale Predictability Experiment (MPEX). *Bull. Amer. Meteor. Soc.*, **96**, 2127–2149, doi:10.1175/BAMS-D-13-00281.1.
20. Romine, G. S., **C. S. Schwartz**, J. Berner, K. R. Fossell, C. S. Snyder, J. L. Anderson, and M. L. Weisman, 2014: Representing forecast error in a convection-permitting ensemble system. *Mon. Wea. Rev.*, **142**, 4519–4541, doi:10.1175/MWR-D-14-00100.1.
19. **Schwartz, C. S.**, G. S. Romine, K. R. Smith, and M. L. Weisman, 2014: Characterizing and optimizing precipitation forecasts from a convection-permitting ensemble initialized by a mesoscale ensemble Kalman filter. *Wea. Forecasting*, **29**, 1295–1318, doi:10.1175/WAF-D-13-00145.1.
18. Chen, D., Z. Liu, **C. S. Schwartz**, H.-C. Lin, J. D. Cetola, Y. Gu, and L. Xue, 2014: The impact of aerosol optical depth assimilation on aerosol forecasts and radiative effects during a wild fire event over the United States. *Geosci. Model Dev.*, **7**, 2709–2715, doi:10.5194/gmd-7-2709-2014.
17. Pagowski, M., Z. Liu, G. A. Grell, M. Hu, H.-C. Lin, and **C. S. Schwartz**, 2014: Implementation of aerosol assimilation in Gridpoint Statistical Interpolation (v. 3.2) and WRF-Chem (v. 3.4.1). *Geosci. Model Dev.*, **7**, 1621–1627, doi:10.5194/gmd-7-1621-2014.
16. **Schwartz, C. S.**, Z. Liu, H.-C. Lin, and J. D. Cetola, 2014: Assimilating aerosol observations with a “hybrid” variational-ensemble data assimilation system. *J. Geophys. Res. Atmos.*, **119**, doi:10.1002/2013JD020937.
15. **Schwartz, C. S.**, 2014: Reproducing the September 2013 record-breaking rainfall over the Colorado Front Range with high-resolution WRF model forecasts. *Wea. Forecasting*, **29**, 393–402, doi:10.1175/WAF-D-13-00136.1.
14. **Schwartz, C. S.**, and Z. Liu, 2014: Convection-permitting forecasts initialized with continuously-cycling limited-area 3DVAR, ensemble Kalman filter, and “hybrid” variational-ensemble data assimilation systems. *Mon. Wea. Rev.*, **142**, 716–738, doi:10.1175/MWR-D-13-00100.1.
13. Saide, P. E., G. R. Carmichael, Z. Liu, **C. S. Schwartz**, H.-C. Lin, A. M. da Silva, and E. Hyer, 2013: Aerosol optical depth assimilation for a size-resolved sectional model: impacts of observationally constrained, multi-wavelength and fine mode retrievals on regional scale analyses and forecasts. *Atmos. Chem. Phys.*, **13**, 10425–10444, doi:10.5194/acp-13-10425-2013.

12. **Schwartz, C. S.**, Z. Liu, X.-Y. Huang, Y.-H. Kuo, and C.-T. Fong, 2013: Comparing limited-area 3DVAR and hybrid variational-ensemble data assimilation methods for typhoon track forecasts: Sensitivity to outer loops and vortex relocation. *Mon. Wea. Rev.*, **141**, 4350–4372, doi:10.1175/MWR-D-13-00028.1.
11. Jiang, Z., Z. Liu, T. Wang, **C. S. Schwartz**, H.-C. Lin, and F. Jiang, 2013: Probing into the impact of 3DVAR assimilation of surface PM₁₀ observations over China using process analysis. *J. Geophys. Res.*, **118**, 6738–6749, doi:10.1002/jgrd.50495.
10. Romine, G. S., **C. S. Schwartz**, C. Snyder, J. L. Anderson, and M. L. Weisman, 2013: Model bias in a continuously cycled assimilation system and its influence on convection-permitting forecasts. *Mon. Wea. Rev.*, **141**, 1263–1284, doi:10.1175/MWR-D-12-00112.1.
9. **Schwartz, C. S.**, Z. Liu, H.-C. Lin, and S. A. McKeen, 2012: Simultaneous three-dimensional variational assimilation of surface fine particulate matter and MODIS aerosol optical depth. *J. Geophys. Res.*, **117**, D13202, doi:10.1029/2011JD017383.
8. Liu, Z., **C. S. Schwartz**, C. Snyder, and S.-Y. Ha, 2012: Impact of assimilating AMSU-A radiances on forecasts of 2008 Atlantic tropical cyclones initialized with a limited-area ensemble Kalman filter. *Mon. Wea. Rev.*, **140**, 4017–4034, doi:10.1175/MWR-D-12-00083.1.
7. **Schwartz, C. S.**, Z. Liu, Y. Chen, and X.-Y. Huang, 2012: Impact of assimilating microwave radiances with a limited-area ensemble data assimilation system on forecasts of typhoon Morakot. *Wea. Forecasting*, **27**, 424–437, doi:10.1175/WAF-D-11-00033.1.
6. Liu, Z., Q. Liu, H.-C. Lin, **C. S. Schwartz**, Y.-H. Lee, and T. Wang, 2011: Three-dimensional variational assimilation of MODIS aerosol optical depth: Implementation and application to a dust storm over East Asia. *J. Geophys. Res.*, **116**, D23206, doi:10.1029/2011JD016159.
5. Brooks, H. E., P. T. Marsh, A. M. Kowaleski, P. Groenemeijer, T. E. Thompson, **C. S. Schwartz**, C. M. Shafer, A. Kolodziej, N. Dahl, and D. Buckey, 2011: Evaluation of European Storm Forecast Experiment (ESTOFEX) forecasts. *Atmos. Res.*, **100**, 538–546, doi:10.1016/j.atmosres.2010.09.004.
4. Kain, J. S., M. Xue, M. C. Coniglio, S. J. Weiss, F. Kong, T. L. Jensen, B. G. Brown, J. Gao, K. Brewster, K. W. Thomas, Y. Wang, **C. S. Schwartz**, and J. J. Levit, 2010: Assessing advances in the assimilation of radar data and other mesoscale observations within a collaborative forecasting–research environment. *Wea. Forecasting*, **25**, 1510–1521, doi:10.1175/2010WAF2222405.1.
3. **Schwartz, C. S.**, J. S. Kain, S. J. Weiss, M. Xue, D. R. Bright, F. Kong, K. W. Thomas, J. J. Levit, M. C. Coniglio, and M. S. Wandishin, 2010: Toward improved convection-allowing ensembles: Model physics sensitivities and optimizing probabilistic guidance with small ensemble membership. *Wea. Forecasting*, **25**, 263–280, doi:10.1175/2009WAF2222267.1.

2. **Schwartz, C. S.**, J. S. Kain, S. J. Weiss, M. Xue, D. R. Bright, F. Kong, K. W. Thomas, J. J. Levit, and M. C. Coniglio, 2009: Next-day convection-allowing WRF model guidance: A second look at 2 vs. 4 km grid spacing. *Mon. Wea. Rev.*, **137**, 3351–3372, doi:10.1175/2009MWR2924.1.
1. Kain, J. S., S. J. Weiss, D. R. Bright, M. E. Baldwin, J. J. Levit, G. W. Carbin, **C. S. Schwartz**, M. L. Weisman, K. K. Droegemeier, D. B. Weber, and K. W. Thomas, 2008: Some practical considerations regarding horizontal resolution in the first generation of operational convection-allowing NWP. *Wea. Forecasting*, **23**, 931–952, doi:10.1175/WAF2007106.1.

NON-REFEREED PUBLICATIONS (IF FIRST AUTHOR, ALSO ORAL PRESENTATION)

12. Bresch, J. F., J. G. Powers, **C. S. Schwartz**, and J. L. Coen, 2019: Supporting fire weather forecasting through a tool to identify convective outflows in numerical weather prediction models. Proceedings, *6th Intl Fire Behavior and Fuels Conference*, Albuquerque, NM, The International Association of Wildland Fire, May 2019.
11. Descombes, G., T. D. Auligne, H.-C. Lin, D. Xu, **C. S. Schwartz**, and F. Vandenberghe, 2014: Multi-sensor Advection Diffusion nowCast (MADCast) for cloud analysis and short-term prediction. NCAR Technical Note NCAR/TN-509+STR, 21 pp, doi: 10.5065/D62V2D37.
10. **Schwartz, C. S.**, Z. Liu, X.-Y. Huang, and Y.-H. Kuo, 2014: A limited-area dual-resolution hybrid-variational ensemble data assimilation system for the WRF model. Preprints, *15th WRF Users' Workshop*, Boulder, CO, National Center for Atmospheric Research, 6A.3.
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8. **Schwartz, C. S.**, and Z. Liu, 2011: Assimilating satellite microwave radiance measurements over the Antarctic. Preprints, *12th WRF Users' Workshop*, Boulder, CO, National Center for Atmospheric Research, 7B.1.
7. Liu, Z., Q. Liu, H.-C. Lin, **C. S. Schwartz**, and Y.-H. Lee, 2011: Assimilating MODIS aerosol optical depth using WRF/Chem and GSI: Application to a Chinese dust storm. Preprints, *12th WRF Users' Workshop*, Boulder, CO, National Center for Atmospheric Research, 8A.4.
6. **Schwartz, C. S.**, Z. Liu, Y. Chen, and X.-Y. Huang, 2011: Satellite radiance data assimilation with a limited-area ensemble Kalman filter and 3D-Var analysis system. Preprints, *15th Symposium on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans and Land Surface*, Seattle, WA, Amer. Meteor. Soc., 5.5.

5. **Schwartz, C. S.**, Z. Liu, Y. Chen, and X.-Y. Huang, 2010: Studying typhoon Morakot with a coupled WRFDA-DART system. Preprints, *11th WRF Users' Workshop*, Boulder, CO, National Center for Atmospheric Research, 3A.11.
4. Kain, J. S., S. J. Weiss, M. C. Coniglio, M. Xue, F. Kong, M. L. Weisman, M. Pyle, R. A. Sobash, **C. S. Schwartz**, D. R. Bright, J. J. Levit, and G. W. Carbin, 2009: New developments in applied research for severe weather convection forecasting in the Hazardous Weather Testbed, Norman, OK, U.S.A. Preprints, *5th European Conference on Severe Storms*, Landshut, Germany, O05-20.
3. **Schwartz, C. S.**, J. S. Kain, S. J. Weiss, M. Xue, D. R. Bright, F. Kong, K. W. Thomas, J. J. Levit, M. C. Coniglio, and M. S. Wandishin, 2009: Optimizing probabilistic high resolution ensemble guidance for hydrologic prediction. Preprints, *23rd Conference on Hydrology*, Phoenix, AZ, Amer. Meteor. Soc., 9.4.
2. Kain, J. S., S. J. Weiss, S. R. Dembek, J. J. Levit, D. R. Bright, J. L. Case, M. C. Coniglio, A. R. Dean, R. A. Sobash, and **C. S. Schwartz**, 2008: Severe-weather forecast guidance from the first generation of large domain convection-allowing models: Challenges and opportunities. Preprints, *24th Conference on Severe Local Storms*, Savannah, GA, Amer. Meteor. Soc., 12.1.
1. **Schwartz, C. S.**, J. S. Kain, S. J. Weiss, M. Xue, D. R. Bright, F. Kong, K. W. Thomas, J. J. Levit, M. C. Coniglio, and M. S. Wandishin, 2008: Toward improved convection-allowing ensembles: Model physics sensitivities and optimizing probabilistic guidance with small ensemble membership. Preprints, *24th Conference on Severe Local Storms*, Savannah, GA, Amer. Meteor. Soc., 11A.5.

SELECTED FIRST-AUTHORED PRESENTATIONS

43. **Schwartz, C. S.**, J. Poterjoy, and G. S. Romine, 2021: Comparing convection-allowing ensemble forecasts initialized from partial and continuously cycling ensemble Kalman filter data assimilation systems. *25th Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface*, Virtual, American Meteorological Society, 10.2.
42. **Schwartz, C. S.**, G. S. Romine, and D. C. Dowell, 2020: Experiments with a continuously-cycling 3-km ensemble Kalman filter over the entire conterminous United States. *American Geophysical Union Fall Meeting*, Virtual, American Geophysical Union, A250-01.
41. **Schwartz, C. S.**, and R. A. Sobash, 2020: Precipitation forecast sensitivity to horizontal grid spacing in convection-allowing models over the central–eastern United States. *Northeast Regional Operational Workshop XXI*, Virtual, National Weather Service and University at Albany, Session B.

40. **Schwartz, C. S.**, G. Romine, R. Sobash, K. Fossell, and M. Weisman, 2020: Convection-allowing ensemble research at NCAR. *4th Convective Scale Modelling Workshop*, Boulder, CO, 10b. (invited)
39. **Schwartz, C. S.**, G. S. Romine, and J. Bresch, 2020: Experiments with a 3-km ensemble Kalman filter data assimilation system over the entire conterminous United States. *24th Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface*, Boston, MA, American Meteorological Society, 13.5.
38. **Schwartz, C. S.**, and R. A. Sobash, 2020: Revisiting sensitivity to horizontal grid spacing in convection-allowing models over the central-eastern United States using a large dataset. *30th Conference on Weather Analysis and Forecasting/26th Conference on Numerical Weather Prediction*, Boston, MA, American Meteorological Society, 8C.6.
37. **Schwartz, C. S.**, and R. A. Sobash, 2020: Convection-allowing medium-range severe weather guidance from a variable-resolution global ensemble. *Severe Local Storms Symposium*, Boston, MA, American Meteorological Society, 4.3.
36. **Schwartz, C. S.**, and R. A. Sobash, 2020: Clarifying applications of neighborhood approaches to high-resolution forecasts. *26th Conference on Probability and Statistics*, Boston, MA, American Meteorological Society, 2.3.
35. **Schwartz, C. S.**, 2019: Medium-range convection-allowing ensemble forecasts with a variable-resolution global model. *18th Conference on Mesoscale Processes*, Savannah, GA, American Meteorological Society, 4.5.
34. **Schwartz, C. S.**, and R. A. Sobash, 2019: Revisiting sensitivity to horizontal grid spacing in convection-allowing models over the central-eastern United States using a large dataset. *Joint WRF/MPAS Users' Workshop*, Boulder, CO, National Center for Atmospheric Research, 6.5.
33. **Schwartz, C. S.**, and R. A. Sobash, 2018: Global convection-allowing ensemble forecasts with MPAS. *Joint WRF/MPAS Users' Workshop*, Boulder, CO, National Center for Atmospheric Research, 10.5.
32. **Schwartz, C. S.**, G. S. Romine, R. A. Sobash, K. R. Fossell, and M. Wong, 2018: Evaluating the NCAR Ensemble's initialization approach. *29th Conference on Weather Analysis and Forecasting/25th Conference on Numerical Weather Prediction*, Denver, CO, American Meteorological Society, 15B.1.
31. **Schwartz, C. S.**, G. S. Romine, K. R. Fossell, R. A. Sobash, and M. L. Weisman, 2018: Recent progress in high-resolution ensemble development over the United States. *WRF-GRAPES workshop*. Boulder, CO, National Center for Atmospheric Research. (invited)
30. **Schwartz, C. S.**, G. S. Romine, and K. R. Fossell, 2018: How does covariance inflation impact EnKF-initialized convection-allowing ensemble forecasts? *6th International Symposium on Data Assimilation*, Munich, Germany, Ludwig-Maximilians University, 7.1.

29. **Schwartz, C. S.**, G. S. Romine, K. R. Fossell, R. A. Sobash, and M. L. Weisman, 2017: Comparing 3- and 1-km probabilistic forecasts from WRF model ensembles over the United States. *NCAS/NCAR WRF Tutorials and Workshop*, Durham, England.
28. **Schwartz, C. S.**, 2017: Ensemble forecast verification. *18th WRF Users' Workshop*, Boulder, CO, National Center for Atmospheric Research. (invited)
27. **Schwartz, C. S.**, G. S. Romine, K. R. Fossell, R. A. Sobash, and M. L. Weisman, 2017: Toward 1-km ensemble forecasts over large domains. *18th WRF Users' Workshop*, Boulder, CO, National Center for Atmospheric Research, 3.1.
26. **Schwartz, C. S.**, and R. A. Sobash, 2017: Generating probabilistic forecasts from convection-allowing ensembles using neighborhood approaches: A review and recommendations. *7th International Verification Methods Workshop*, Berlin, Germany, World Meteorological Organization, PROB ENS-5.
25. **Schwartz, C. S.**, G. S. Romine, R. A. Sobash, and K. R. Fossell, 2016: NCAR's experimental real-time convection-allowing ensemble prediction system. *American Geophysical Union Fall Meeting*, San Francisco, CA, American Geophysical Union, IN31F-02.
24. **Schwartz, C. S.**, G. S. Romine, R. A. Sobash, and K. R. Fossell, 2016: Toward operational convection-allowing ensembles over the United States. *Northeast Regional Operational Workshop XVII*, Albany, NY, National Weather Service and University at Albany, Session F.
23. **Schwartz, C. S.**, 2016: Can high-resolution ensemble forecasts improve wind flow modeling? *Wind Resource & Project Energy Assessment Conference 2016*, Minneapolis, MN, American Wind Energy Association. (invited)
22. **Schwartz, C. S.**, 2016: Ensemble forecast verification. "Ensemble prediction with the WRF model" *mini-tutorial*, Boulder, CO, National Center for Atmospheric Research. (invited)
21. **Schwartz, C. S.**, G. S. Romine, R. A. Sobash, and K. R. Fossell, 2016: An update on NCAR's experimental real-time convection-allowing ensemble prediction system. *17th WRF Users' Workshop*, Boulder, CO, National Center for Atmospheric Research, 9.4.
20. **Schwartz, C. S.**, G. S. Romine, R. A. Sobash, and K. R. Fossell, 2016: NCAR's experimental real-time convection-allowing ensemble prediction system. *Second annual NCAR Day of Networking and Discovery*, Boulder, CO.
19. **Schwartz, C. S.**, 2016: Toward unified convection-allowing analysis and forecast systems over large domains. *NCAR/MMM Seminar Series*, Boulder, CO. (invited)

18. **Schwartz, C. S.**, 2015: The future of weather forecasting: high-resolution ensembles. University of Connecticut, Department of Civil & Environmental Engineering, Storrs, CT. (invited)
17. **Schwartz, C. S.**, 2015: Practical applications of hybrid variational-ensemble data assimilation approaches. *IMAGe Theme of the Year—Frontiers in Ensemble Data Assimilation for Geoscience Applications*, Boulder, CO, National Center for Atmospheric Research. (invited)
16. **Schwartz, C. S.**, 2015: Toward large-domain high-resolution continuously cycling data assimilation systems. *16th WRF Users' Workshop*, Boulder, CO, National Center for Atmospheric Research, 4A.2.
15. **Schwartz, C. S.**, and Z. Liu, 2014: Convection-permitting forecasts initialized with continuously cycling limited-area 3DVAR, ensemble Kalman filter, and “hybrid” variational-ensemble data assimilation systems. *1st World Weather Open Science Conference*, Montreal, Quebec, World Meteorological Organization, SCI-PS103.02.
14. **Schwartz, C. S.**, 2014: Some best practices for WRFDA. *15th WRF Users' Workshop*, Boulder, CO, National Center for Atmospheric Research. (invited)
13. **Schwartz, C. S.**, and Z. Liu, 2013: Convection-permitting forecasts initialized with continuously cycling limited-area 3DVAR, ensemble Kalman filter, and “hybrid” variational-ensemble data assimilation systems. *15th Conference on Mesoscale Processes*, Portland, OR, Amer. Meteor. Soc., 9.6.
12. **Schwartz, C. S.**, Z. Liu, X.-Y. Huang, Y.-H. Kuo, and C.-T. Fong, 2013: Comparing limited-area 3DVAR and hybrid variational-ensemble data assimilation methods for typhoon track forecasts: Sensitivity to outer loops and vortex relocation. *14th WRF Users' Workshop*, Boulder, CO, National Center for Atmospheric Research, 5A.1.
11. **Schwartz, C. S.**, Z. Liu, and H.-C. Lin, 2013: Ensemble and variational data assimilation of surface particulate matter and MODIS aerosol optical depth. *17th Symposium on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans and Land Surface*, Austin, TX, Amer. Meteor. Soc., 3.3.
10. **Schwartz, C. S.**, and Z. Liu, 2013: Comparing variational, ensemble, and “hybrid” variational/ensemble data assimilation techniques for limited-area tropical cyclone forecasts. *17th Symposium on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans and Land Surface*, Austin, TX, Amer. Meteor. Soc., 11.2.
9. **Schwartz, C. S.**, Z. Liu, H.-C. Lin, and S. A. McKeen, 2012: Simultaneous Three-dimensional Variational Assimilation of Surface Fine Particulate Matter and MODIS Aerosol Optical Depth. *13th WRF Users' Workshop*, Boulder, CO, National Center for Atmospheric Research, 7.2.
8. **Schwartz, C. S.**, Z. Liu, C. Snyder, and S.-Y. Ha, 2012: Sensitivity of tropical cyclone forecasts to microwave radiance data assimilation with a limited-area ensemble Kalman

filter. *16th Symposium on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans and Land Surface*, New Orleans, LA, Amer. Meteor. Soc., 12.4.

7. **Schwartz, C. S.**, and Z. Liu, 2011: Assimilating satellite microwave radiance measurements over the Antarctic. *Workshop on Polar Simulations with the WRF Model*, Columbus, OH.
6. **Schwartz, C. S.**, M. L. Weisman, and W. Wang, 2011: When can high-resolution NWP model forecasts be trusted? Using error characteristics of the initial conditions to evaluate the likelihood of accurate forecasts. *24th Conference on Weather and Forecasting/20th Conference on Numerical Weather Prediction*, Seattle, WA, Amer. Meteor. Soc., 11B.1.
5. **Schwartz, C. S.**, 2010: Using error characteristics of the initial conditions to evaluate the likelihood of accurate forecasts. *Developmental Testbed Center Verification Workshop*, Boulder, CO. (invited)
4. **Schwartz, C. S.**, M. L. Weisman, and W. Wang, 2010: When can high-resolution NWP model forecasts be trusted? Using error characteristics of the initial conditions to evaluate the likelihood of accurate forecasts. *25th Conference on Severe Local Storms*, Denver, CO, Amer. Meteor. Soc., 13B.4.
3. **Schwartz, C. S.**, Z. Liu, Y. Chen, and X.-Y. Huang, 2010: Radiance data assimilation with an EnKF. *8th JCSDA Workshop on Satellite Data Assimilation*, Baltimore, MD.
2. **Schwartz, C. S.**, 2009: Verifying ensemble forecasts using a “neighborhood” approach. *Developmental Testbed Center Verification Workshop*, Boulder, CO.
1. **Schwartz, C. S.**, 2009: Assessing real-time convection-allowing WRF-ARW forecasts from research and operational perspectives: Lessons learned from the 2007 and 2008 NOAA Hazardous Weather Testbed Spring Experiments. *NCAR/MMM Seminar Series*, Boulder, CO.