

Hugh Morrison

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Professional Preparation

- 2003 Ph. D. The University of Colorado at Boulder, Astrophysical, Planetary, and Atmospheric Sciences, Thesis entitled ‘Single-column modeling of Arctic clouds: Development and evaluation of bulk microphysics parameterizations’, Advisor: Judith A. Curry
- 2000 M. S. The University of Colorado at Boulder, Astrophysical, Planetary, and Atmospheric Sciences
- 1997 B. S. Geography, The University of Minnesota

Appointments

- 2010 - Scientist II, Mesoscale and Microscale Meteorology Division, National Center for Atmospheric Research
- 2007-2010 Scientist I, Mesoscale and Microscale Meteorology Division, National Center for Atmospheric Research
- 2005-2007 Post-doctoral fellow, Advanced Study Program, National Center for Atmospheric Research
- 2005 Research Scientist, School of Earth and Atmospheric Sciences, Georgia Institute of Technology
- 2003-2005 Post-doctoral research associate, Department of Aerospace Engineering, University of Colorado at Boulder
- 1998-2003 Graduate research assistant, Program in Atmospheric and Oceanic Sciences, University of Colorado at Boulder

Honors and Awards

- 2012 Henry G. Houghton Award, American Meteorological Society
- 2011 Outstanding Scientific Paper Award for Solomon, Morrison, et al., published in *Mon. Wea. Rev.* (2009), NOAA OAR (Office of Oceanic and Atmospheric Research)
- 2010 NCAR Climate and Global Dynamics Division Special Recognition Award for papers published in *J. Climate*: Morrison and Gettelman (2008), Gettelman, Morrison, Ghan (2008)

- 2005-2007 National Center for Atmospheric Research Advanced Study Program Post-Doctoral Fellowship
1998-1999 University of Colorado Graduate School Fellowship
1997 National Council for Geographic Education/Association of American Geographers Award for Excellence of Scholarship

Professional Activities

- 2007 - Member, AMS Committee on Cloud Physics
2007 - Member, American Geophysical Union
2006 - 2011 Chair, GEWEX Cloud Systems Study (GCSS) Working Group on Polar Clouds (WG 5)
2006 - 2010 National Center for Atmospheric Research Early Career Scientist Association (ECSA) Steering Committee Member
2008 Co-chair, Seventh WMO Cloud Modeling Workshop, Cozumel, Mexico
2010 Member, Organizing Committee for the AMS 13th Conference on Cloud Physics
2011 - GEWEX Atmospheric System Study (GASS) Steering Committee Member
2011 - Co-chair, Physical Processes Working Group, Center for Multiscale Modeling of Atmospheric Processes
2012 - Associate Editor, *Monthly Weather Review*
2012 - Local organizer, First Pan-GASS Workshop, Boulder, CO

Refereed Publications

1. Morrison, H., M. D. Shupe, and J. A. Curry, 2003: Modeling clouds observed at SHEBA using a bulk microphysics parameterization implemented into a single-column model. *J. Geophys. Res.*, *108(D8)*, doi:10.1029/2002JD002229
2. Morrison, H., and J. O. Pinto, 2004: A new approach for obtaining advection profiles: Application to the SHEBA column. *Mon. Wea. Rev.*, *132*, 687-702.
3. Morrison, H., J. A. Curry, and V. I. Khvorostyanov, 2005: A new double-moment microphysics parameterization for application in cloud and climate models, Part I: Description. *J. Atmos. Sci.*, *62*, 1665-1677.
4. Morrison, H., J. A. Curry, M. D. Shupe, and P. Zuidema, 2005: A new double-moment microphysics parameterization for application in cloud and climate models, Part II: Single-column modeling of Arctic clouds. *J. Atmos. Sci.*, *62*, 1678-1693.
5. Morrison, H., M. D. Shupe, J. O. Pinto, and J. A. Curry, 2005: Possible roles of ice nucleation mode and ice nuclei depletion in the extended lifetime of Arctic mixed-phase clouds. *Geophys. Res. Lett.*, *32*, L18801, doi:10.1029/2005GL023614.

6. Morrison, H., and J. O. Pinto, 2005: Mesoscale modeling of springtime Arctic mixed-phase stratiform clouds using a new two-moment bulk microphysics scheme. *J. Atmos. Sci.*, *62*, 3683-3704.
7. Dethloff, K., A. Rinke, H. Morrison, W. Dorn, R. Gedes, W. Maslovski, V. Kattsov, M. A. Lange, K. Gorgen, and A. Lynch, 2005: Global impacts of Arctic climate processes, *EOS Transactions*, *86 (49)*, 511-512.
8. Morrison, H., and J. O. Pinto, 2006: Intercomparison of bulk microphysics schemes in mesoscale simulations of springtime Arctic mixed-phase stratiform clouds. *Mon. Wea. Rev.*, *134*, 1880-1900.
9. Khvorostyanov, V. I., H. Morrison, J. A. Curry, D. Baumgartner, and P. Lawson, 2006: High supersaturation and modes of ice nucleation in thin tropopause cirrus: Simulation of the 13 July 2002 Cirrus Regional Study of Tropical Anvils and Cirrus case. *J. Geophys. Res.*, *111(D02201)*, doi:10.1029/2004JD005235.
10. Morrison, H., and W. W. Grabowski, 2007: Comparison of bulk and bin warm rain microphysics models using a kinematic framework. *J. Atmos. Sci.*, *64*, 2839-2861.
11. Morrison, H., J. O. Pinto, J. A. Curry, and G. McFarquhar, 2008: Sensitivity of modeled arctic mixed-phase stratocumulus to cloud condensation and ice nuclei over regionally-varying surface conditions. *J. Geophys. Res.*, *113*, doi:10.1029/2007JD008729.
12. Morrison, H., and W. W. Grabowski, 2008: Modeling supersaturation and sub-grid scale mixing with two-moment warm bulk microphysics. *J. Atmos. Sci.*, *65*, 792-812.
13. Morrison, H., and W. W. Grabowski, 2008: A novel approach for representing ice microphysics in models: Description and tests using a kinematic framework. *J. Atmos. Sci.*, *65*, 1528-1548.
14. Luo, Y., K.-M. Xu, H. Morrison, and G. McFarquhar, 2008: Arctic mixed-phase clouds simulated by a cloud-resolving model: Comparison with ARM observations and sensitivity to microphysics parameterizations. *J. Atmos. Sci.*, *65*, 1285-1303.
15. Grabowski, W. W., and H. Morrison, 2008: Toward the mitigation of spurious cloud-edge supersaturation in cloud models. *Mon. Wea. Rev.*, *136*, 1224-1234.
16. Morrison, H., and A. Gettelman, 2008: A new two-moment bulk stratiform cloud microphysics scheme in the Community Atmosphere Model (CAM3), Part I: Description and numerical tests. *J. Climate*, *21*, 3642-3659.

17. Gettelman, A., H. Morrison, and S. J. Ghan, 2008: A new two-moment bulk stratiform cloud microphysics scheme in the Community Atmosphere Model (CAM3), Part II: Single-column and global model results. *J. Climate*, 21, 3660-3679.
18. Luo, Y., K.-M. Xu, H. Morrison, G. M. McFarquhar, Z. Wang, and G. Zhang, 2008: Multi-layer Arctic mixed-phase clouds simulated by a cloud-resolving model: Comparison with ARM observations and sensitivity experiments. *J. Geophys. Res.*, 113, doi:10.1029/2007JD009563.
19. Field, P. R., R. Wood, A. Gettelman, R. Neale, P. Rasch, and H. Morrison, 2008: Composite midlatitude cyclone comparison between CAM3 and satellite data. *J. Climate*, 21, 5887-5903.
20. Latham, J., P. Rasch, C.-C. Chen, L. Kettles, A. Gadian, A. Gettelman, H. Morrison, and S. Salter, 2008: Global temperature stabilization via controlled albedo enhancement of low-level maritime clouds. *Phil. Trans. of the Roy. Soc. A*, 366, 3969-3987.
21. Morrison, H., G. Thompson, and V. Tatarskii, 2009: Impact of cloud microphysics on the development of trailing stratiform precipitation in a simulated squall line: Comparison of one- and two-moment schemes. *Mon. Wea. Rev.*, 137, 991-1007.
22. Klein, S., R. McCoy, H. Morrison, and Coauthors, 2009: Intercomparison of model simulations of mixed-phase clouds observed during the ARM Mixed-Phase Arctic Cloud Experiment. Part I: Single-layer cloud, *Q. J. Roy. Meteor. Soc.*, 135, 979-1002.
23. Morrison, H., and Coauthors, 2009: Intercomparison of model simulations of mixed-phase clouds observed during the ARM Mixed-Phase Arctic Cloud Experiment. Part II: Multi-layer cloud, *Q. J. Roy. Meteor. Soc.*, 135, 1003-1019.
24. Solomon, A., H. Morrison, P. O. G. Persson, M. D. Shupe, and J.-W. Bao, 2009: Mesoscale simulations of polar clouds during MPACE, *Mon. Wea. Rev.*, 137, 3110-3128.
25. Slawinska, J., W. W. Grabowski, and H. Morrison, 2009: Impact of atmospheric aerosols on precipitation from deep organized convection: A prescribed-flow modeling study using double-moment bulk microphysics. *Q. J. Roy. Meteor. Soc.*, 135, 1906-1913.
26. Quaas, and Coauthors, 2009: Aerosol indirect effects - general circulation model intercomparison and evaluation with satellite data, *Atmos. Chem. Phys.*, 9, 8697-8717.

27. Morrison, H., and W. W. Grabowski, 2010: An improved representation of rimed snow and conversion to graupel in a multicomponent bin microphysics scheme. *J. Atmos. Sci.*, 67, 1337-1360.
28. Gettelman, A., X. Liu, S. J. Ghan, H. Morrison, S. Park, A. J. Conley, S. A. Klein, J. Boyle, D. L. Mitchell, and J.-L. F. Li, 2010: Global simulations of ice nucleation and ice supersaturation with an improved cloud scheme in the Community Atmosphere Model. *J. Geophys. Res.*, 115, D18216, doi:10.1029/2009JD013797.
29. Luo, Y., Y. Wang, H. Wang, Y. Zheng, and H. Morrison, 2010: Modeling convective-stratiform precipitation processes on a Meiyu front with the WRF model: Comparison with observations and sensitivity to cloud microphysics parameterizations. *J. Geophys. Res.*, 115, D18117, doi:10.1029/2010JD013873.
30. Salzmann, M., Y. Ming, J.-C. Golaz, P. A. Ginoux, H. Morrison, A. Gettelman, M. Kramer, and L. J. Donner, 2010: Two moment bulk stratiform cloud microphysics in the GFDL AM3 GCM: Description, evaluation, and sensitivity tests. *Atmos. Chem. Phys.*, 10, 8037-8064.
31. Grabowski, W. W., and H. Morrison, 2011: Indirect impact of atmospheric aerosols in idealized simulations of convective-radiative quasi-equilibrium. Part 2: Double-moment microphysics. *J. Climate*, 24, 1897-1912.
32. McFarquhar, G., and Coauthors, 2011: Indirect and Semi-Direct Aerosol Campaign (ISDAC): The Impact of Arctic Aerosols on Clouds. *Bull. Amer. Meteor. Soc.*, 92, 183-201.
33. Morrison, H., and J. A. Milbrandt, 2011: Comparison of two-moment bulk microphysics schemes in idealized supercell thunderstorm simulations. *Mon. Wea. Rev.*, 139, 1103-1130.
34. Morrison, H., P. Zuidema, G. McFarquhar, A. Bansemer, and A. J. Heysmfield, 2011: Snow microphysical observations in shallow mixed-phase and deep frontal Arctic cloud systems. *Q. J. Roy. Meteor. Soc.*, 137, 1589-1601, doi:10.1002/qj.840.
35. de Boer, G., H. Morrison, M. D. Shupe, and R. Hildner, 2011: Evidence of liquid dependent ice nucleation in high-latitude stratiform clouds from surface remote sensors. *Geophys. Res. Lett.*, 38, L01803, doi:10.1029/2010GL046016.
36. Wang, M., S. Ghan, R. Easter, M. Ovchinnikov, X. Liu, E. Kassianov, Y. Qian, W. Gustafson, V. E. Larson, D. P. Schanen, M. Khairoutdinov, and H. Morrison, 2011: The multi-scale aerosol-climate model PNNL-MMF: model description and evaluations. *Geosci. Mod. Dev.*, 4, 137-168, doi:10.5194/gmd-4-137-2011.
37. Wang, M., S. Ghan, M. Ovchinnikov, X. Liu, R. Easter, E. Kassianov, Y. Qian, and H. Morrison, 2011: Aerosol indirect effects in a multi-scale aerosol-climate model

- PNNL-MMF. *Atmos. Phys. Chem.*, 11, 5431-5455, doi:10.5194/acp-11-5431-2011.
38. Morrison, H., P. Zuidema, A. S. Ackerman, A. Avramov, G. de Boer, J. Fan, A. M. Fridlind, T. Hashino, J. Y. Harrington, Y. Luo, M. Ovchinnikov, and B. Shipway, 2011: Intercomparison of cloud model simulations of Arctic mixed-phase boundary layer clouds observed during SHEBA/FIRE-ACE. *J. Adv. Mod. Earth Systems*, Vol. 3, M06003, 23 pp., doi:[10.1029/2011MS000066](https://doi.org/10.1029/2011MS000066).
 39. Heymsfield, A., G. Thompson, H. Morrison, A. Bansemer, R. Rasmussen, Z. Wang, and D. Zhang, 2011: Formation and spread of aircraft-induced holes in clouds. *Science*, 333, No. 6038, 77-81, doi:10.1126/science.1202851.
 40. Morrison, H., and W. W. Grabowski, 2011: Cloud system-resolving model simulations of aerosol indirect effects on tropical deep convection and its thermodynamic environment. *Atmos. Chem. Phys.*, 11, 10503-10523, doi:10.5194/acp-11-10503-2011.
 41. Solomon, A., M. D. Shupe, P. O. G. Persson, and H. Morrison, 2011: Moisture and dynamical interactions maintaining decoupled Arctic mixed-phase stratocumulus in the presence of a humidity inversion. *Atmos. Chem. Phys.*, 11, 10127-10148, doi:10.5194/acp-11-10127-2011.
 42. Yang, Q., W. I. Gustafson Jr., Fast, J. D., Wang, H., Easter, R. C., Morrison, H., Lee, Y.-N., Chapman, E. G., Spak, S. N., and Mena-Carrasco, M. A., 2011: Assessing regional scale predictions of aerosols, marine stratocumulus, and their interactions during VOCALS-REx using WRF-Chem. *Atmos. Chem. Phys.*, 11, 11951-11975, doi:10.5194/acp-11-11951-2011.
 43. Bryan, G., and H. Morrison, 2012: Sensitivity of a simulated squall line to horizontal resolution and parameterization of microphysics. *Mon Wea. Rev.*, 140, 202-225.
 44. Fridlind, A. M., B. van Dierenhoven, A. S. Ackerman, A. Avramov, A. Mrowiec, H. Morrison, P. Zuidema, and M. D. Shupe, 2012: A FIRE-ACE/SHEBA case study of mixed-phase Arctic boundary-layer clouds: Entrainment rate limitations on rapid primary ice nucleation processes. *J. Atmos. Sci.*, 69, 365-389.
 45. Morrison, H., G. de Boer, G. Feingold, J. Harrington, M. Shupe, and K. Sulia, 2012: Self-organisation and resilience of Arctic mixed-phase clouds. *Nature Geoscience*, 5, 11-17, doi:10.1038/ngeo1332.
 46. Fan, J., L. R. Leung, Z. Li, H. Morrison, Y. Qian, Y. Zhou, and H. Chen, 2012: Aerosol impacts on clouds and precipitation in southeast China - Results from bin and bulk microphysics for the 2008 AMF-China field campaign. *J. Geophys. Res.*, 117, D00K36, doi:10.1029/2011JD016537.

47. Slawinska, J., W. W. Grabowski, H. Pawlowska, and H. Morrison, 2012: Droplet activation and mixing in large-eddy simulation of a shallow cumulus field. *J. Atmos. Sci.*, 69, 444-462.
48. van Weverberg, K., A. M. Vogelmann, H. Morrison, and J. A. Milbrandt, 2012: Sensitivity of idealized squall line simulations to the level of complexity used in two-moment bulk microphysics schemes. *Mon. Wea. Rev.*, 140, 1883-1907.
49. Fridlind, A. M., A. S. Ackerman, J.-P. Chaboureau, J. Fan, W. W. Grabowski, A. Hill, T. R. Jones, M. M. Khaiyer, G. Liu, P. Minnis, H. Morrison, L. Nguyen, S. Park, J. C. Petch, J.-P. Pinty, C. Schumacher, B. J. Shipway, A. C. Varble, X. Wu, S. Xie, and M. Zhang, 2012: A comparison of TWP-ICE observational data with cloud-resolving model results. *J. Geophys. Res.*, 117, D05204, doi:10.1029/2011JD016595.
50. Morrison, H., 2012: On the numerical treatment of hydrometeor sedimentation in bulk and hybrid bulk-bin schemes. *Mon. Wea. Rev.*, 140, 1572-1588.
51. Liu, X., R. C. Easter, S. J. Ghan, R. Zaveri, P. Rasch, X. Shi, J.-F. Lamarque, A. Gettelman, H. Morrison, F. Vitt, A. Conley, S. Park, R. Neale, C. Hannay, A. Ekman, P. Hess, W. Collins, M. Iacono, C. S. Bretherton, M. Flannar, D. Mitchell, 2012: Toward a minimal representation of aerosol direct and indirect effects: Model description and evaluation. *Geosci. Model Dev.*, 5, 709-739.
52. Morrison, H., S. Tessendorf, K. Ikeda, and G. Thompson, 2012: Sensitivity of a simulated mid-latitude squall line to parameterization of raindrop breakup. *Mon. Wea. Rev.*, 140, 2437-2460.
53. Wang, H., T. Auligne, and H. Morrison, 2012: The impact of microphysics scheme complexity on the propagation of initial perturbations. *Mon. Wea. Rev.*, 140, 2287-2296.
54. Wang, M., S. Ghan, X. Liu, T. L'Ecuyer, Kai Zhang, H. Morrison, M. Ovchinnikov, R. Easter, R. Marchand, D. Chand, Y. Qian, and J. E. Penner, 2012: Constraining cloud lifetime effects of aerosols using A-Train satellite observations. *Geophys. Res. Lett.*, 39, L15709, doi:10.1029/2012GL052204, 7 pp.
55. Morrison, H., 2012: On the robustness of aerosols effects on an idealized supercell storm simulated using a cloud system-resolving model. *Atmos. Chem. Phys.*, 12, 7689-7705, doi:10.5194/acp-12-7689-2012.
56. Harrington, J. Y., K. Sulia, and H. Morrison, 2012: A method for adaptive habit prediction in bulk microphysical models. Part I: Theoretical development. *J. Atmos. Sci.* (accepted)

57. Harrington, J. Y., K. Sulia, and H. Morrison, 2012: A method for adaptive habit prediction in bulk microphysical models. Part II: Parcel model corroboration. *J. Atmos. Sci.* (accepted)
58. Lebo, Z. J., H. Morrison, and J. H. Seinfeld, 2012: Are simulated aerosol effects on deep convective clouds strongly dependent on saturation adjustment? *Atmos. Chem. Phys.* (submitted)
59. Bogegnschutz, P. A., A. Gettelman, H. Morrison, V. E. Larson, D. P. Schanen, N. R. Meyer, and C. Craig, 2012: Unified parameterization of the planetary boundary layer and shallow convection with a higher-order turbulence closure in the Community Atmosphere Model: Single column experiments. *Geosci. Model Dev.* (submitted)
60. Yang, Q., W. I. Gustafson, Jr., J. D. Fast, H. Wang, R. C. Easter, M. Wang, S. J. Ghan, L. K. Berg, L. R. Leung, and H. Morrison, 2012: Impact of natural and anthropogenic aerosols on marine stratocumulus and precipitation in the Southeast Pacific: A regional modeling study using WRF-Chem. *Atmos. Chem. Phys.* (accepted)
61. Milbrandt, J. A., and H. Morrison, 2012: Predicting graupel density in a bulk microphysics scheme. *J. Atmos. Sci.* (in press)
62. Jarecka, D., W. W. Grabowski, H. Morrison, and H. Pawlowska, 2012: Homogeneity of the subgrid-scale turbulent mixing in a large-eddy simulations of shallow convection. *J. Atmos. Sci.* (submitted)