

PAUL M. MARKOWSKI

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Professional Appointments

- 2018–present Associate Head of the Graduate Program in Meteorology and Atmospheric Science, Department of Meteorology and Atmospheric Science, Pennsylvania State University, University Park, Pennsylvania
- 2021–present Distinguished Professor, Department of Meteorology and Atmospheric Science, Pennsylvania State University, University Park, Pennsylvania
- 2013–2021 Professor, Department of Meteorology and Atmospheric Science, Pennsylvania State University, University Park, Pennsylvania
- 2007–2013 Associate Professor, Department of Meteorology and Atmospheric Science, Pennsylvania State University, University Park, Pennsylvania
- July, 2009–October, 2009 Visiting Scientist (sabbatical leave), Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany
- 2001–2007 Assistant Professor, Department of Meteorology and Atmospheric Science, Pennsylvania State University, University Park, Pennsylvania

Education

- Ph.D., 2000, University of Oklahoma (Meteorology)
- M.S., 1997, University of Oklahoma (Meteorology)
- B.S., 1996, Pennsylvania State University (Meteorology)

Honors and Awards

- Fellow, American Meteorological Society, 2019
- American Meteorological Society Clarence Leroy Meisinger Award, 2015 (for “advancing knowledge about the genesis of tornadoes through a rich mix of observations, theory, and numerical modeling”)
- National Weather Association T. Theodore Fujita Research Achievement Award, 2013 (for “incisive research directly applicable to operational forecasting which has allowed significant advances in our understanding of and forecasting tornadic and nontornadic thunderstorm environments”)

- Penn State University Office of Residence Life Award, 2013 (for “continuous efforts in aiding in the academic and personal development and wellbeing of first-year students” and “making a tremendous difference in the lives of first-year students”)
- Nikolai Dotzek Award (European Severe Storms Laboratory), 2011 (for “outstanding contributions to the science of severe storms”)
- Penn State University Alumni Achievement Award (Pennsylvania State University), 2010 (for “unraveling the mysteries of why and where tornadoes and severe storms will form, saving many human lives”)
- American Meteorological Society Editor’s Award (*Weather and Forecasting*), 2009 (for “his careful, exceptionally timely and critical review of manuscripts resulting in considerable improvement in its scientific quality, and thereby contributing significantly to the high standards of the journal”)
- NSF CAREER Award, 2007

Refereed Publications

† indicates students or research associates mentored by Paul Markowski

- Davies-Jones, R. P., and P. M. Markowski, 2021: Circulation around a constrained curve: An alternative analysis tool for diagnosing tornadogenesis in numerical supercell simulations. Submitted to the *Journal of Atmospheric Sciences*.
- Wang, A., Y. Pan, and P. Markowski, 2021: The influence of WENO schemes on large-eddy simulation of surface-layer turbulence. Submitted to the *Journal of Atmospheric Sciences*.
- Katona, B.,† and P.M. Markowski, 2021: Assessing the influence of complex terrain on severe convective environments in northeastern Alabama. Submitted to *Weather and Forecasting*.
- Wang, A.,† Y. Pan, and P. M. Markowski, 2020: The influence of turbulence memory on idealized tornado simulations. *Monthly Weather Review*, **148**, in press.
- Murdzek, S.,† P. Markowski, and Y. Richardson, 2020: Simultaneous dual-Doppler and mobile mesonet observations of streamwise vorticity currents in three supercells. *Monthly Weather Review*, **148**, in press.
- Steinkruger, D.,† P. Markowski, and G. Young, 2020: An artificially intelligent system for the automated issuance of tornado warnings in simulated convective storms. *Weather and Forecasting*, **35**, 1939–1965.
- Jiménez-Sánchez, G. J.,† P. Markowski, G. Young, and D. Stensrud, 2020: The Orinoco low-level jet: An investigation of its dynamical origins using the WRF model. *Journal of Geophysical Research–Atmospheres*, **125**, e2020JD032810.
- Markowski, P. M., 2020: What is the intrinsic predictability of tornadic supercell thunderstorms? *Monthly Weather Review*, **148**, 3157–3180.
- Kumjian, M. R., K. A. Bowley, Y. P. Richardson, P. M. Markowski, K. Lombardo, Z. J. Lebo, and P. Kollias, 2020: Snowflake selfies: A low-cost, high-impact approach toward student engagement in scientific research (with their smartphones). *Bulletin of the American Meteorological Society*, **101**, 917–935.

- Murdzek, S.,[†] P. Markowski, Y. Richardson, and R. Tanamachi, 2020: Processes preventing the development of a significant tornado in a Colorado supercell on 26 May 2010. *Monthly Weather Review*, **148**, 1753–1778.
- Jiménez-Sánchez, G. J.,[†] P. Markowski, V. Jewtoukoff, G. Young, and D. Stensrud, 2019: The Orinoco low-level jet: An investigation of its characteristics and evolution using the WRF model. *Journal of Geophysical Research–Atmospheres*, **124**, 10696–10711.
- Markowski, P. M., N. T. Lis,[†] D. D. Turner, T. R. Lee, and M. S. Buban, 2019: Observations of near-surface vertical wind profiles and vertical momentum fluxes from VORTEX-SE 2017: Comparisons to Monin–Obukhov similarity theory. *Monthly Weather Review*, **147**, 3811–3824.
- Colbert, M., D. J. Stensrud, P. M. Markowski, and Y. P. Richardson, 2019: Processes associated with convection initiation in the North American Mesoscale Forecast System, Version 3 (NAMv3). *Weather and Forecasting*, **34**, 683–700.
- Markowski, P. M., T. P. Hatlee,[†] and Y. P. Richardson, 2018: Tornadogenesis in the 12 May 2010 supercell thunderstorm intercepted by VORTEX2 near Clinton, Oklahoma. *Monthly Weather Review*, **146**, 3623–3650.
- Coffer, B. E., and P. M. Markowski, 2018: Comments on ‘The Regulation of Tornado Intensity by Updraft Width.’ *Journal of the Atmospheric Sciences*, **75**, 4049–4056.
- Geerts, B., D. J. Raymond, V. Grubisic, C. A. Davis, M. C. Barth, A. Detweiler, P. M. Klein, W.-C. Lee, P. M. Markowski, G. L. Mullendore, and J. A. Moore, 2018: Recommendations for in situ and remote sensing capabilities in atmospheric convection and turbulence. *Bulletin of the American Meteorological Society*, **99**, 2463–2470.
- Markowski, P. M., Y. P. Richardson, S. J. Richardson, and A. Petersson, 2018: Above-ground thermodynamic observations in convective storms from balloon-borne probes acting as pseudo-Lagrangian drifters. *Bulletin of the American Meteorological Society*, **99**, 711–724.
- Kahraman, A., M. Kadioglu, and P. M. Markowski, 2017: Severe convective storm environments in Turkey. *Monthly Weather Review*, **145**, 4711–4725.
- Zhu, L., Z. Meng, F. Zhang, and P. M. Markowski, 2017: The influence of sea- and land-breeze circulations on the diurnal variability of precipitation over a tropical island. *Atmospheric Chemistry and Physics*, **17**, 13213–13232.
- Rotunno, R., P. M. Markowski, and G. H. Bryan, 2017: ‘Near-ground’ vertical vorticity in supercell thunderstorm models. *Journal of the Atmospheric Sciences*, **74**, 1757–1766.
- Markowski, P. M., and Y. P. Richardson, 2017: Large sensitivity of near-surface vertical vorticity development to heat sink location in idealized simulations of supercell-like storms. *Journal of the Atmospheric Sciences*, **74**, 1095–1104.
- Markowski, P. M., 2016: An idealized numerical simulation investigation of the effects of surface drag on the development of near-surface vertical vorticity in supercell thunderstorms. *Journal of the Atmospheric Sciences*, **73**, 4349–4385.
- Katona, B.,[†] P. Markowski, C. Alexander, and S. Benjamin, 2016: The influence of topography on convective storm environments in the eastern United States as deduced from the HRRR. *Weather and Forecasting*, **31**, 1481–1490.

- Marquis, J., Y. Richardson, P. Markowski, J. Wurman, K. Kosiba, and P. Robinson, 2016: An investigation of the Goshen County, Wyoming, tornadic supercell of 5 June 2009 using EnKF assimilation of mobile mesonet and radar observations collected during VORTEX2. Part II: Mesocyclone-scale processes affecting tornado formation, maintenance, and decay. *Monthly Weather Review*, **144**, 3441–3463.
- Klees, A., Y. Richardson, P. Markowski, J. Wurman, K. Kosiba, and C. Weiss, 2016: Comparison of the tornadic and nontornadic supercells intercepted by VORTEX2 on 10 June 2010. *Monthly Weather Review*, **144**, 3201–3231.
- Markowski, P. M., and G. H. Bryan, 2016: LES of laminar flow in the PBL: A potential problem for convective storm simulations. *Monthly Weather Review*, **144**, 1841–1850.
- Nowotarski, C. J., and P. M. Markowski, 2016: Modifications to the near-storm environment induced by simulated supercell thunderstorms. *Monthly Weather Review*, **144**, 273–293.
- Kahraman, A., S. Tilev-Tanriover, M. Kadioglu, D. M. Schultz, and P. M. Markowski, 2016: Severe hail climatology of Turkey. *Monthly Weather Review*, **144**, 337–346.
- Weatherhead, B., B. Etherton, and P. Markowski, 2015: Weather verification papers requested. *Weather and Forecasting*, **30**, 1409–1410.
- Markowski, P., Y. Richardson, M. Kumjian, A. Anderson-Frey, G. Jimenez, B. Katona, A. Klees, R. Schrom, and D. Tobin, 2015: Comments on ‘Observations of Wall Cloud Formation in Supercell Thunderstorms during VORTEX2.’ *Monthly Weather Review*, **143**, 4278–4281.
- Weiss, C. C., D. C. Dowell, J. L. Schroeder, P. S. Skinner, A. E. Reinhart, P. M. Markowski, and Y. P. Richardson, 2015: A comparison of near-surface buoyancy and baroclinity in three supercells intercepted by VORTEX2. *Monthly Weather Review*, **143**, 2736–2753.
- Nowotarski, C. J.,[†] P. M. Markowski, Y. P. Richardson, and G. H. Bryan, 2015: Supercell low-level mesocyclones in simulations with a sheared convective boundary layer. *Monthly Weather Review*, **143**, 272–297.
- Markowski, P. M., Y. P. Richardson, and G. H. Bryan, 2014: The origins of vortex sheets in a simulated supercell thunderstorm. *Monthly Weather Review*, **142**, 3944–3954.
- Markowski, P. M., and Y. P. Richardson, 2014: What we know and don’t know about tornado formation. *Physics Today*, **67**, 26–31.
- Dahl, J., and P. Markowski, 2014: Comment on “Eliminating the major tornado threat in Tornado Alley.” *Int. J. Mod. Phys. B*, **28**, 1475004.
- Kahraman, A.,[†] and P. M. Markowski, 2014: A climatology of tornadoes in Turkey. *Monthly Weather Review*, **142**, 2345–2352.
- Schultz, D. M., Y. P. Richardson, P. M. Markowski, and C. A. Doswell III, 2014: Tornadoes in the central United States and the “clash of air masses.” *Bulletin of the American Meteorological Society*, **95**, 1704–1712.
- Nowotarski, C. J.,[†] P. M. Markowski, Y. P. Richardson, and G. H. Bryan, 2014: Properties of a simulated convective boundary layer in an idealized supercell thunderstorm environment. *Monthly Weather Review*, **142**, 3955–3976.

- Bluestein, H., R. Rauber, D. Burgess, B. Albrecht, S. Ellis, Y. Richardson, D. Jorgensen, S. Frasier, P. Chilson, R. Palmer, S. Yuter, W.-C. Lee, D. Dowell, P. Smith, P. Markowski, K. Friedrich, and T. Weckwerth, 2014: Radar in atmospheric sciences and related research: Current systems, emerging technology, and future needs. *Bulletin of the American Meteorological Society*, **95**, 1850–1861.
- Skinner, P. S., C. Weiss, M. French, H. Bluestein, P. Markowski, and Y. Richardson, 2014: VORTEX2 observations of a low-level mesocyclone with multiple internal rear-flank downdraft momentum surges in the 18 May 2010, Dumas, Texas supercell. *Monthly Weather Review*, **142**, 2935–2960.
- Marquis, J.,[†] Y. Richardson, P. Markowski, D. Dowell, J. Wurman, K. Kosiba, P. Robinson, and G. Romine, 2014: An investigation of the Goshen County, Wyoming, tornadic supercell of 5 June 2009 using EnKF assimilation of mobile radar data collected during VORTEX2. Part I: Experiment design and verification of the EnKF analyses. *Monthly Weather Review*, **142**, 530–554.
- Markowski, P. M., and Y. P. Richardson, 2014: The influence of environmental low-level shear and cold pools on tornadogenesis: Insights from idealized simulations. *Journal of the Atmospheric Sciences*, **71**, 243–275.
- Yuter, S. E., M. A. Miller, M. D. Parker, P. M. Markowski, Y. P. Richardson, H. E. Brooks, and J. M. Straka, 2013: Comment on “Why do tornados and hailstorms rest on weekends?” *Journal of Geophysical Research*, **118**, 1–7.
- Frame, J. W.,[†] and P. M. Markowski, 2013: The dynamical influences of anvil shading on simulated supercell thunderstorms. *Monthly Weather Review*, **141**, 2802–2820.
- Davies-Jones, R., and P. M. Markowski, 2013: Lifting of ambient air by density currents in sheared environments. *Journal of the Atmospheric Sciences*, **70**, 1204–1215.
- Oberthaler, A. J.,[†] and P. M. Markowski, 2013: A numerical simulation study of the effects of cloud shading on quasilinear convective systems. *Journal of the Atmospheric Sciences*, **70**, 767–793.
- Kosiba, K., J. Wurman, Y. Richardson, P. Markowski, P. Robinson, and J. Marquis, 2013: Genesis of the Goshen County, Wyoming, tornado (5 June 2009). *Monthly Weather Review*, **141**, 1157–1181.
- Markowski, P., Y. Richardson, J. Marquis, J. Wurman, K. Kosiba, P. Robinson, D. Dowell, E. Rasmussen, and R. Davies-Jones, 2012: The pretornadic phase of the Goshen County, Wyoming, supercell of 5 June 2009 intercepted by VORTEX2. Part I: Evolution of kinematic and surface thermodynamic fields. *Monthly Weather Review*, **140**, 2887–2915.
- Markowski, P., Y. Richardson, J. Marquis, R. Davies-Jones, J. Wurman, K. Kosiba, P. Robinson, E. Rasmussen, and D. Dowell, 2012: The pretornadic phase of the Goshen County, Wyoming, supercell of 5 June 2009 intercepted by VORTEX2. Part II: Intensification of low-level rotation. *Monthly Weather Review*, **140**, 2916–2938.
- Wurman, J., D. Dowell, Y. Richardson, P. Markowski, E. Rasmussen, D. Burgess, L. Wicker, and H. Bluestein, 2012: Verification of the Origins of Rotation in Tornadoes Experiment 2: VORTEX2. *Bulletin of the American Meteorological Society*, **93**, 1147–1170.
- Meng, Z., F. Zhang, P. Markowski, D. Wu, and K. Zhao, 2012: A modeling study on the development of a bowing structure and associated rear inflow within a squall line over South China. *Journal of the Atmospheric Sciences*, **69**, 1182–1207.
- Marquis, J., Y. Richardson, P. Markowski, D. Dowell, and J. Wurman, 2012: The maintenance of tornadoes observed with high-resolution mobile Doppler radars. *Monthly Weather Review*, **140**,

3–27.

- Green, B., F. Zhang, and P. Markowski, 2011: Miniature supercells in the landfalling outer rainbands of Hurricane Katrina (2005). *Weather and Forecasting*, **26**, 828–847.
- Nowotarski, C. J.,[†] P. M. Markowski, and Y. P. Richardson, 2011: The characteristics of numerically simulated supercell storms situated over statically stable boundary layers. *Monthly Weather Review*, **139**, 3139–3162.
- Markowski, P. M., and N. Dotzek, 2011: A numerical study of the effects of orography on supercells. *Atmospheric Research*, **100**, 457–478.
- Markowski, P. M., M. Majcen,[†] Y. P. Richardson, J. Marquis, and J. Wurman, 2011: Characteristics of the wind field in three nontornadic low-level mesocyclones observed by the Doppler On Wheels radars. *E. Journal of Severe Storms Meteor.*, **6** (3), 1–48.
- Wurman, J., K. Kosiba, P. Markowski, Y. Richardson, and D. Dowell, 2010: Finescale single- and dual-Doppler analysis of tornado intensification, maintenance, and dissipation in the Orleans, Nebraska, tornadic supercell. *Monthly Weather Review*, **138**, 4439–4455.
- Frame, J.,[†] and P. Markowski, 2010: Numerical simulations of radiative cooling beneath the anvils of supercell thunderstorms. *Monthly Weather Review*, **138**, 3024–3047.
- Markowski, P. M., and N. Dotzek, 2010: Comments on “Proposed Conceptual Taxonomy for Proper Identification and Classification of Tornado Events.” *Weather and Forecasting*, **25**, 338–340.
- James, R. P.,[†] and P. M. Markowski, 2010: A numerical investigation of the effects of dry air aloft on deep convection. *Monthly Weather Review*, **138**, 140–161.
- Byko, Z.,[†] P. Markowski, Y. Richardson, J. Wurman, and E. Adlerman, 2009: Descending reflectivity cores in supercell thunderstorms observed by mobile radars and in a high-resolution numerical simulation. *Weather and Forecasting*, **24**, 155–186.
- Markowski, P. M., and Y. P. Richardson, 2009: Tornadogenesis: Our current understanding, forecasting considerations, and questions to guide future research. *Atmospheric Research*, **93**, 3–10.
- Frame, J.,[†] J. L. Petters, P. Markowski, and J. Harrington, 2009: An application of the tilted pixel approximation to cumulonimbus environments. *Atmospheric Research*, **91**, 127–136.
- Frame, J.,[†] P. Markowski, Y. Richardson, J. Straka, and J. Wurman, 2009: Polarimetric and dual-Doppler radar observations of the Lipscomb County, Texas, supercell thunderstorm on 23 May 2002. *Monthly Weather Review*, **137**, 544–561.
- Marquis, J. M., Y. Richardson, J. Wurman, and P. M. Markowski, 2008: Single- and dual-Doppler analysis of a tornadic vortex and surrounding storm-scale flow in the Crowell, TX, supercell of 30 April 2000. *Monthly Weather Review*, **136**, 5017–5043.
- Majcen, M.,[†] P. Markowski, Y. Richardson, D. Dowell, and J. Wurman, 2008: Multi-pass objective analyses of radar data. *Journal of Atmospheric and Oceanic Technology*, **25**, 1845–1858.
- Markowski, P. M., J. M. Straka, E. N. Rasmussen, R. P. Davies-Jones, Y. Richardson, and J. Trapp, 2008: Vortex lines within low-level mesocyclones obtained from pseudo-dual-Doppler radar observations. *Monthly Weather Review*, **136**, 3513–3535.
- Richardson, Y., P. Markowski, J. Verlinde, and J. Wurman, 2008: Integrating classroom learning and

- research: The Pennsylvania Area Mobile Radar Experiment (PAMREX). *Bulletin of the American Meteorological Society*, **89**, 1097–1101.
- Markowski, P. M., 2008: A comparison of the midlevel kinematic characteristics of a pair of supercell thunderstorms observed by airborne Doppler radar. *Atmospheric Research*, **88**, 314–322.
- Straka, J. M., E. N. Rasmussen, R. P. Davies-Jones, and P. M. Markowski, 2007: An observational and idealized numerical examination of low-level counter-rotating vortices toward the rear flank of supercells. *Electronic Journal of Severe Storms Meteorology*, **2(8)**, 1–22.
- Markowski, P. M., and J. R. Stonitsch,[†] 2007: Reply to “Comments on Unusually long-duration, dual-Doppler radar observations of a front in a convective boundary layer.” *Monthly Weather Review*, **135**, 4240–4246.
- Stonitsch,[†] J. R., and P. M. Markowski, 2007: Unusually long-duration, dual-Doppler radar observations of a front in a convective boundary layer. *Monthly Weather Review*, **135**, 93–117.
- Markowski, P. M., and Y. Richardson, 2007: Observations of vertical wind shear heterogeneity in convective boundary layers. *Monthly Weather Review*, **135**, 843–861.
- Frame, J. W.,[†] and P. M. Markowski, 2006: Interactions between simulated squall lines and idealized terrain. *Monthly Weather Review*, **134**, 1919–1941.
- Shabbott, C. J.,[†] and P. M. Markowski, 2006: Surface in situ observations within the outflow of forward-flank downdrafts of supercell thunderstorms. *Monthly Weather Review*, **134**, 1422–1441.
- James, R. P.,[†] P. M. Markowski, and J. M. Fritsch, 2006: Bow echo sensitivity to low-level moisture. *Monthly Weather Review*, **134**, 950–964.
- Markowski, P. M., and Y. Richardson, 2006: On the classification of vertical wind shear as directional shear versus speed shear. *Weather and Forecasting*, **21**, 242–247.
- Markowski, P. M., C. Hannon,[†] and E. Rasmussen, 2006: Observations of convection initiation “failure” from the 12 June 2002 IHOP deployment. *Monthly Weather Review*, **134**, 375–405.
- Markowski, P. M., and C. Hannon,[†] 2006: Multiple-Doppler radar observations of the evolution of vorticity extrema in a convective boundary layer. *Monthly Weather Review*, **134**, 355–374.
- Markowski, P. M., and J. Harrington, 2005: A simulation of a supercell thunderstorm with emulated radiative cooling beneath the anvil. *Journal of the Atmospheric Sciences*, **62**, 2607–2617.
- James, R. P.,[†] J. M. Fritsch, and P. M. Markowski, 2005: Environmental distinctions between cellular and slabular convective lines. *Monthly Weather Review*, **133**, 2669–2691.
- Hoch, J.,[†] and P. M. Markowski, 2005: A climatology of springtime dryline position in the U.S. Great Plains region. *Journal of Climate*, **18**, 2132–2137.
- Doswell, C. A., III, and P. M. Markowski, 2004: Is buoyancy a relative quantity? *Monthly Weather Review*, **132**, 853–863.
- Markowski, P. M., C. Hannon,[†] J. Frame,[†] E. Lancaster,[†] A. Pietrycha,[†] R. Edwards, and R. Thompson, 2003: Characteristics of vertical wind profiles near supercells obtained from the Rapid Update Cycle. *Weather and Forecasting*, **18**, 1262–1272.
- Thompson, R., R. Edwards, J. Hart, K. Elmore, and P. Markowski, 2003: Close proximity soundings

- within supercell environments obtained from the Rapid Update Cycle. *Weather and Forecasting*, **18**, 1243–1261.
- Markowski, P. M., 2003: Comments on “Use of a mesoscale model to forecast severe weather associated with a cold front aloft.” *Weather and Forecasting*, **18**, 384–388.
- Markowski, P. M., J. M. Straka, and E. N. Rasmussen, 2003: Tornadogenesis resulting from the transport of circulation by a downdraft: Idealized numerical simulations. *Journal of the Atmospheric Sciences*, **60**, 795–823.
- Markowski, P. M., J. M. Straka, and E. N. Rasmussen, 2002: Direct surface thermodynamic observations within the rear-flank downdrafts of nontornadic and tornadic supercells. *Monthly Weather Review*, **130**, 1692–1721.
- Markowski, P. M., 2002: Hook echoes and rear-flank downdrafts: A review. *Monthly Weather Review*, **130**, 852–876.
- Markowski, P. M., 2002: Summary of mobile mesonet observations on 3 May 1999. *Weather and Forecasting*, **17**, 430–444.
- Markowski, P. M., and J. M. Straka, 2000: Some observations of rotating updrafts in a low-buoyancy, highly-sheared environment. *Monthly Weather Review*, **127**, 449–461.
- Rasmussen, E. N., S. J. Richardson, J. M. Straka, P. M. Markowski, and D. O. Blanchard, 2000: The association of significant tornadoes with a baroclinic boundary on 2 June 1995. *Monthly Weather Review*, **127**, 174–191.
- Shapiro, A., and P. M. Markowski, 1999: Dynamics of elevated vortices. *Journal of the Atmospheric Sciences*, **56**, 1101–1122.
- Markowski, P. M., E. N. Rasmussen, and J. M. Straka, 1998: Observations of low-level baroclinity generated by anvil shadows. *Monthly Weather Review*, **126**, 2942–2958.
- Markowski, P. M., J. M. Straka, E. N. Rasmussen, and D. O. Blanchard, 1998: Variability of storm-relative helicity during VORTEX. *Monthly Weather Review*, **126**, 2959–2971.
- Markowski, P. M., E. N. Rasmussen, and J. M. Straka, 1998: The occurrence of tornadoes in supercells interacting with boundaries during VORTEX-95. *Weather and Forecasting*, **13**, 852–859.
- Markowski, P. M., and D. J. Stensrud, 1998: Mean monthly diurnal cycles observed with PRE-STORM surface data. *Journal of Climate*, **11**, 2995–3009.

Books

- Markowski, P., and Y. Richardson, 2010: *Mesoscale Meteorology in Midlatitudes*. Wiley-Blackwell, 424 pp.

Book Chapters

- Markowski, P. M., 2006: An overview of atmospheric convection. *Atmospheric Convection: Research and Operational Forecasting Aspects*. Springer-Verlag, 1–6.
- Markowski, P. M., 2006: The concept of buoyancy and its application to deep moist convection. *Atmospheric Convection: Research and Operational Forecasting Aspects*. Springer-Verlag, 7–16.

- Markowski, P. M., 2006: Convective storm initiation and organization. *Atmospheric Convection: Research and Operational Forecasting Aspects*. Springer-Verlag, 17-22.
- Markowski, P. M., 2006: Pressure fluctuations associated with deep moist convection. *Atmospheric Convection: Research and Operational Forecasting Aspects*. Springer-Verlag, 23–28.
- Markowski, P. M., 2006: Supercell thunderstorms. *Atmospheric Convection: Research and Operational Forecasting Aspects*. Springer-Verlag, 29–44.
- Markowski, P. M., 2006: Tornadoes and tornadogenesis. *Atmospheric Convection: Research and Operational Forecasting Aspects*. Springer-Verlag, 45–56.

Other Publications

- Markowski, P., 1997: Tips for avoiding lightning on the golf course. *Golf Illustrated*, **3(2)**, 14–15.
- Markowski, P., and Y. Richardson, 2013: How to make a tornado. *Weatherwise*, July/August 2013, 12–19.
- Markowski, P., H. Brooks, Y. Richardson, R. J. Trapp, J. Allen, and N. Diffenbaugh, 2013: The *real* truth about tornadoes. Posted on *Live Science* on 2 December 2013 (<http://www.livescience.com/41632-the-truth-about-tornadoes.html>).
- Markowski, P., H. Brooks, Y. Richardson, R. J. Trapp, J. Allen, and N. Diffenbaugh, 2013: A closer look at tornadoes in a human-heated climate. Posted on the *New York Times* Opinion Page on 9 December 2013 (<http://dotearth.blogs.nytimes.com/2013/12/09/a-closer-look-at-tornadoes-and-global-warming>).

Invited Seminars

- “How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations, plus challenges for operational NWP,” NCEP Environmental Modeling Center, College Park, Maryland; 9/2019
- “How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations,” North Carolina State University, Raleigh, North Carolina; 3/2019
- “How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations,” *8th Annual Great Lakes Atmospheric Science Symposium* (keynote speaker), Oswego, New York; 10/2017.
- “How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations,” Department of Atmospheric Sciences, University of Utah, Salt Lake City, Utah; 11/2016.
- “What have we learned about severe storms from observations that we could not have learned from numerical simulations?”, Department of Geosciences, Texas Tech University, Lubbock, Texas; 10/2016.
- “Tornado formation: What we know and don’t know,” *Symposium on Advanced Assimilation and Uncertainty Quantification in Big Data Research for Weather, Climate and Earth System Monitoring and Prediction*, State College, Pennsylvania; 5/2016.
- “How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations,”

National Weather Association Severe Storms and Doppler Radar Conference (keynote speaker), Ankeny, Iowa; 4/2016.

"How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations," Department of Geological and Atmospheric Sciences, Iowa State University, Ames, Iowa; 4/2016.

"How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations," NASA Goddard Space Flight Center, Greenbelt, Maryland; 1/2016.

"The tornado outbreak of May 31, 1985: Looking back at one of Pennsylvania's deadliest weather events," State College NWS Severe Weather Media Workshop; 4/2015.

"The tornado outbreak of May 31, 1985: Looking back at one of Pennsylvania's deadliest weather events." Department of Meteorology, Penn State University; 2/2015.

"How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations," University of Alabama–Huntsville, Huntsville, Alabama; 2/2015.

"The making of a tornado," Virginia Air and Space Center, Hampton, Virginia; 9/2014.

"How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations," NASA Langley Research Center, Hampton, Virginia; 9/2014.

"How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations," *Severe Storms Special Symposium*, American Meteorological Society Annual Meeting, Atlanta, Georgia; 2/2014.

"How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations," Department of Atmospheric Sciences, University of Washington, Seattle, Washington; 1/2014.

"Storm chasing: What I've learned," Peter V. Hobbs Memorial Lecture, University of Washington, Seattle, Washington; 1/2014.

"How tornadoes develop: Ideas emerging from decades of theory, simulation, and field observations," *15th Conf. on Mesoscale Processes* (keynote speaker), American Meteorological Society, Portland, Oregon; 8/2013.

"How to make a tornado," Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, Boston, Massachusetts; 5/2013.

"Can a gust front tilt horizontal vortex lines to produce a tornado?," National Weather Service, State College, Pennsylvania; 4/2013.

"How tornadoes develop: Ideas emerging from decades of theory, simulation, and field observations," *Workshop on Severe Convection and Climate*, Columbia University (Lamont-Doherty Campus), Palisades, New York; 3/2013.

"Analysis of VORTEX2 data: Some interesting observations prior to tornadogenesis in the Goshen County, Wyoming, supercell of 5 June 2009," Webinar for National Weather Service Central Region; 3/2013.

"How to make a tornado," Fluid Dynamics Research Consortium, Penn State University, University Park, Pennsylvania; 1/2013.

"How to make a tornado," PSU Student Chapter of the AMS, Penn State University, University Park, Pennsylvania; 9/2012.

- "Tornadoes: What we can say (or can't say) about the future," *1st Annual Smeal Risk Management Symposium on Risk and Catastrophic Events* (keynote speaker), Smeal College of Business, Pennsylvania State University, University Park, Pennsylvania; 4/2012.
- "Discriminating between tornadic and nontornadic supercells," National Weather Service, State College, Pennsylvania; 4/2012.
- "How to make a tornado," Department of Atmospheric Sciences, Texas A&M University, College Station, Texas; 2/2012.
- "An overview of the Second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2)," Texas A&M Student Chapter of the AMS, College Station, Texas; 2/2012.
- "The Goshen County, Wyoming, supercell (5 June 2009) intercepted by VORTEX2: Interesting evolution leading up to tornadogenesis," School of Meteorology, University of Oklahoma, Norman, Oklahoma; 11/2011.
- "The Goshen County, Wyoming, supercell (5 June 2009) intercepted by VORTEX2: Interesting evolution leading up to tornadogenesis," Department of Meteorology, Pennsylvania State University, University Park, Pennsylvania; 11/2011.
- "Tornadoes, cookies, and crackers," Frank Talk, Department of Meteorology, Pennsylvania State University, University Park, Pennsylvania; 11/2011.
- "A sneak-preview of what scientists are learning from VORTEX2," National Weather Service, State College, Pennsylvania; 11/2011.
- "How to make a tornado," Department of Atmospheric Sciences, Colorado State University, Fort Collins, Colorado; 4/2011.
- "An overview of the Second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2)," *Minnesota Skywarn Workshop* (keynote speaker), Minneapolis, Minnesota; 4/2011.
- "Highlights from the Second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2)," Frank Talk, Department of Meteorology, Pennsylvania State University, University Park, Pennsylvania; 12/2010.
- "Convective storm structure and evolution," COMET (Cooperative Program for Meteorological Education and Training) Mesoscale Analysis and Prediction (COMAP) Course, Boulder, Colorado; 6/2010.
- "The effects of dry air aloft on convection," National Weather Service, State College, Pennsylvania; 4/2010.
- "What vortex lines might be telling us about tornadogenesis," Rosenstiel School of Marine and Atmospheric Sciences, University of Miami, Miami, Florida; 3/2010.
- "What vortex lines might be telling us about tornadogenesis," Department of Atmospheric and Oceanic Sciences, University of Wisconsin, Madison, Wisconsin; 11/2009.
- "The theoretical aspects of tornadogenesis," *College of Dupage Meteorology Department Severe Weather Conference*, Chicago, Illinois; 11/2009.
- "The Second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2)," *Chi Epsilon Pi Annual Awards Banquet* (presented jointly with Yvette Richardson), State College, Pennsylvania; 4/2009.

- "The Second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2)," *Public Forum at the American Meteorological Society Conference on Severe Local Storms* (presented jointly with Yvette Richardson and Erik Rasmussen), Savannah, Georgia; 10/2008.
- "What vortex lines might be telling us about tornadogenesis," School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, New York; 10/2008.
- "What vortex lines might be telling us about tornadogenesis," Stout Lecture, Department of Geosciences, University of Nebraska, Lincoln, Nebraska; 9/2008.
- "Tornadogenesis: Our current understanding and questions to guide future research," St. Louis Chapter of the American Meteorological Society and National Weather Association, St. Louis, Missouri; 9/2008.
- "The Second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2)," *National Academies Board on Atmospheric Sciences and Climate; Forum on Cutting Edge Research and Development in the Observation, Understanding, and Prediction of Severe Weather* (presented jointly with Yvette Richardson), Woods Hole, Massachusetts; 6/2008.
- "Convective storm structure and evolution," COMET (Cooperative Program for Meteorological Education and Training) Mesoscale Analysis and Prediction (COMAP) Course, Boulder, Colorado; 4/2008.
- "The nuts and bolts of tornadogenesis (at least as we think we understand it)," National Weather Service, State College, Pennsylvania; 4/2008.
- "Severe convective storms research at Penn State" (presented jointly with Yvette Richardson), National Weather Service, State College, Pennsylvania; 4/2008.
- "Severe convective storms research at Penn State" (presented jointly with Yvette Richardson), University of Oklahoma, Norman, Oklahoma; 3/2008.
- "The Second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2)," *National Weather Association Severe Storms and Doppler Radar Conference* (keynote speaker), Des Moines, Iowa; 3/2008.
- "Opportunities in severe storms research for physics students," North Carolina A & T University, Greensboro, North Carolina; 11/2007.
- "Convective storm structure and evolution," COMET (Cooperative Program for Meteorological Education and Training) Mesoscale Analysis and Prediction (COMAP) Course, Boulder, Colorado; 6/2007.
- "Tornado chasing: What I've learned," Earth and Mineral Sciences Interest House (Irvin Hall), University Park, Pennsylvania; 4/2007.
- "The initiation of deep, moist, convection (CI): A review of the obvious and consideration of the not-so-obvious aspects of CI," National Weather Service, State College, Pennsylvania; 4/2007.
- "Tornadogenesis: Our current understanding, operational considerations, and questions to guide future research," *Northern Plains Convective Workshop*, Grand Forks, North Dakota; 4/2007.
- "Tornado chasing and opportunities in atmospheric science," Villa Maria Academy (all-girls high school), Malvern, Pennsylvania; 1/2007.

- "The initiation of deep, moist, convection (CI): A review of the obvious and consideration of the not-so-obvious aspects of CI," *10th High Plains Severe Weather Conference* (keynote speaker), Dodge City, Kansas; 10/2006.
- "Thunderstorms and their associated severe weather," Department of Meteorology Summer Teachers Camp, University Park, Pennsylvania; 7/2006.
- "Tornadogenesis: What we know and don't know," National Weather Service, Philadelphia, Pennsylvania; 5/2006.
- "Tornado chasing: What I've learned," Earth and Mineral Sciences Interest House (Irvin Hall), University Park, Pennsylvania; 4/2006.
- "Tornadogenesis: What we know and don't know," National Weather Service, State College, Pennsylvania; 4/2006.
- "Tornadogenesis: What we know and don't know," *National Storm Chasers Convention*, Denver, Colorado; 2/2006.
- "Conditional symmetric instability (CSI): Is it possible for anyone to really grasp what this is?," National Weather Service, State College, Pennsylvania; 12/2005.
- "Advancing our understanding of tornadoes, their parent thunderstorms, and the larger-scale environment," *National Weather Association Severe Storms and Doppler Radar Conference* (keynote speaker), Des Moines, Iowa; 3/2005.
- "Thunderstorms and their associated severe weather," Department of Meteorology Summer Teachers Camp, University Park, Pennsylvania; 7/2004.
- "Tornadogenesis: Our current understanding," Stout Lecture, Department of Geosciences, University of Nebraska, Lincoln, Nebraska; 10/2003.
- "Thunderstorms and their associated severe weather," Department of Meteorology Summer Teachers Camp, University Park, Pennsylvania; 7/2003.
- "Tornadogenesis: Our current understanding," Kansas City Chapter of the American Meteorological Society, Kansas City, Missouri; 6/2003.
- "Tornadogenesis: Our current understanding," National Weather Service Central Region Headquarters, Kansas City, Missouri; 6/2003.
- "Forecasting severe storms," National Weather Service, State College, Pennsylvania; 4/2003.
- "The importance of rear-flank downdraft thermodynamic characteristics on tornadogenesis," *National Weather Association Severe Storms Conference* (keynote speaker), Des Moines, Iowa; 3/2003.
- "The latest in tornadogenesis research," *National Emergency Managers Severe Weather Workshop*, Norman, Oklahoma; 2/2003.
- "Tornado chasing: What I've learned," Department of Meteorology Weather Camp, University Park, Pennsylvania; 7/2002.
- "Thunderstorms and their associated severe weather," Department of Meteorology Summer Teachers Camp, University Park, Pennsylvania; 6/2002.
- "Tornadogenesis: Our current understanding," Research Experiences for Undergraduates program, National Severe Storms Laboratory; 6/2002.

- “Axisymmetric simulations of tornadogenesis resulting from the transport of circulation by downdrafts with varying thermodynamic characteristics,” National Severe Storms Laboratory, Norman, Oklahoma; 6/2002.
- “Maintenance of long-lived convective systems,” National Weather Service, State College, Pennsylvania; 4/2002.
- “Tornadogenesis: Our current understanding,” *College of Dupage Meteorology Department Severe Weather Conference*, Chicago, Illinois; 3/2002.
- “Tornado chasing: What I’ve learned,” Earth and Mineral Sciences Interest House (Irvin Hall), University Park, Pennsylvania; 2/2002.
- “Tornadogenesis: Our current understanding,” PSU Student Chapter of the AMS, University Park, Pennsylvania; 1/2002.
- “Surface thermodynamic characteristics of hook echoes and rear-flank downdrafts with implications for tornado genesis and maintenance,” High Plains Chapter of the National Weather Association, North Platte, Nebraska; 10/2001.
- “Surface thermodynamic characteristics of hook echoes and rear-flank downdrafts with implications for tornado genesis and maintenance,” Mesoscale and Microscale Meteorology (MMM) Division, National Center for Atmospheric Research, Boulder, Colorado; 5/2001.
- “Tornadogenesis ingredients: Lessons learned and new research,” National Weather Service, Springfield, Missouri; 4/2001.
- “Tornadogenesis ingredients: Lessons learned and new research,” National Weather Service, State College, Pennsylvania; 4/2001.
- “Surface thermodynamic characteristics of hook echoes and rear-flank downdrafts with implications for tornado genesis and maintenance,” Pennsylvania State University, University Park, Pennsylvania; 9/2000.
- “Surface thermodynamic characteristics of hook echoes and rear-flank downdrafts with implications for tornado genesis and maintenance,” University of Oklahoma, Norman, Oklahoma; 9/2000.
- “Mobile mesonet observations on 3 May 1999,” *National Symposium on the Great Plains Tornado Outbreak of 3 May 1999*, Oklahoma City, Oklahoma; 5/2000.
- “Variability of ‘environmental’ wind profiles and the role of boundaries during VORTEX,” *AMS Symposium on VORTEX: What We Have Learned—Where We Must Go*, Long Beach, California; 1/2000.
- “Some surface observations in hook echoes obtained by a mobile mesonet,” *AMS Symposium on VORTEX: What We Have Learned—Where We Must Go*, Long Beach, California; 1/2000.
- “Mobile mesonet observations on 3 May 1999,” Central Oklahoma Chapter of the AMS, Norman, Oklahoma; 9/1999.
- “Storm-relative helicity variability, low-level vorticity augmentation, and implications for tornado forecasting,” *NWS Southern Region Senior Forecaster Symposium*, Fort Worth, Texas; 7/1999.
- “Storm-relative helicity variability, low-level vorticity augmentation, and implications for tornado forecasting,” National Weather Service, Pleasant Hill, Missouri; 4/1999.

- “Storm-relative helicity variability, low-level vorticity augmentation, and implications for tornado forecasting,” National Weather Service, Norman, Oklahoma; 2/1999.
- “Boundaries and small-scale helicity variability during VORTEX, with implications for low-level mesocyclogenesis,” University of Oklahoma, Norman, Oklahoma; 4/1997.
- “A review of the origins of rotation in supercells and recent findings pertaining to tornadogenesis,” National Weather Service, State College, Pennsylvania; 4/1996.

Invited International Lectures

- “Forecasting severe convection II: Dynamics and prediction of severe thunderstorms” (week-long course), European Severe Storms Laboratory Training Center, Wiener Neustadt, Austria; 6/2018.
- “Discriminating between tornadic and nontornadic supercells,” European Severe Storms Laboratory Training Center, Wiener Neustadt, Austria; 6/2018.
- “How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations,” Department of Physics, University of Toronto, Toronto, Ontario; 11/2017.
- “How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations,” School of Earth, Atmospheric and Environmental Science, University of Manchester, Manchester, England; 8/2016.
- “How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations,” National Taiwan University, Taipei, Taiwan; 1/2016.
- “How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations,” National Taiwan Normal University, Taipei, Taiwan; 1/2016.
- “How to make a tornado: Ideas emerging from decades of theory, simulation, and field observations,” Chinese Culture University, Taipei, Taiwan; 1/2016.
- “How to make a tornado,” *Second China-U.S. Symposium on Meteorology: Severe Weather and Regional Climate Variability and Predictability*, Qingdao, China; 6/2013.
- “How to make a tornado,” *Conference on Mesoscale Convective Systems and High-Impact Weather in East Asia* (keynote presentation), Beijing, China; 3/2013.
- “Supercells and tornadoes: The past, present, and future roles of observations and models in advancing our understanding,” *6th European Conference on Severe Storms* (keynote presentation), Palma de Mallorca, Spain; 10/2011.
- “Organization of isolated, deep moist convection,” *Summer School on Convective Storms*, Nanjing University, Nanjing, China; 7/2011.
- “Supercell thunderstorms,” *Summer School on Convective Storms*, Nanjing University, Nanjing, China; 7/2011.
- “Tornadoes,” *Summer School on Convective Storms*, Nanjing University, Nanjing, China; 7/2011.
- “Tornado research: The latest inferences from models and observations, and future directions,” *Summer School on Convective Storms*, Nanjing University, Nanjing, China; 7/2011.

- “The Second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2),” Peking University, Beijing, China; 7/2011.
- “Tornadogenesis: New insights from field observations and idealized numerical simulations,” *International Workshop on Convective Storms*, Beijing, China; 7/2011.
- “What vortex lines might be telling us about tornadogenesis,” Department of Physical Sciences, University of Helsinki, Helsinki, Finland; 10/2009.
- “A short course on convective storms,” Finnish Meteorological Institute, Helsinki, Finland; 10/2009.
- “What vortex lines might be telling us about tornadogenesis,” Ludwig-Maximilians-Universität, Munich, Germany; 10/2009.
- “What vortex lines might be telling us about tornadogenesis,” Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany; 8/2009.
- “Tornadogenesis: Our current understanding, operational considerations, and questions to guide future research,” Japan Meteorological Agency, Tokyo, Japan; 1/2008.
- “The Second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2),” (presented jointly with J. Wurman) Japan Meteorological Agency, Tokyo, Japan; 1/2008.
- “Tornadogenesis: Our current understanding, operational considerations, and questions to guide future research,” *4th European Conference on Severe Storms* (keynote presentation), Trieste, Italy; 9/2007.
- “An overview of atmospheric convection,” Centre International Des Sciences Mecaniques, Udine, Italy; 7/2005.
- “The concept of buoyancy and its application to deep moist convection,” Centre International Des Sciences Mecaniques, Udine, Italy; 7/2005.
- “Convective storm initiation and organization,” Centre International Des Sciences Mecaniques, Udine, Italy; 7/2005.
- “Pressure fluctuations associated with deep moist convection,” Centre International Des Sciences Mecaniques, Udine, Italy; 7/2005.
- “Supercell thunderstorms,” Centre International Des Sciences Mecaniques, Udine, Italy; 7/2005.
- “Tornadoes and tornadogenesis,” Centre International Des Sciences Mecaniques, Udine, Italy; 7/2005.

Grants Awarded

- NOAA VORTEX-Southeast Award NA18OAR4590310, 9/1/2018–8/31/2021, \$299,994, “Using machine learning to improve warnings of nonclassical tornadic storms”
- NSF AGS-1821885, 9/1/2018–8/31/2021, \$1,168,436, “Improving our understanding of vorticity development in supercells through novel thermodynamic observations and an improved treatment of the near-surface layer in simulations”
- NOAA VORTEX-Southeast Award NA17OAR4590189, 9/1/2017–8/31/2019, \$178,176, “An investigation of the effects of complex topography on storm environments, near-surface wind profiles in and near storms, and tornado vulnerability in the southeastern U.S., using existing data and observations from the VORTEX-Southeast field campaign”

- NSF AGS-1536460, 9/1/2015–8/31/2019, \$899,955, “Improving our understanding of tornadic storms using VORTEX2 observations and idealized simulations”
- NOAA Research to Operations (R2O) Program Award NA15NWS4680012, 5/1/2015–4/30/2018, \$447,493, “Advancing storm-scale forecasts over nested domains for high-impact weather”
- NOAA Collaborative Science, Technology, and Applied Research (CSTAR) Program Award NA14NWS4680015, 5/1/2014–4/30/2019, \$375,000, “Improving warning decision support for convective storm events in the eastern United States”
- NSF AGS-1157646, 8/1/2012–7/31/2016, \$1,076,764, “Using the Second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX2) observations and idealized simulations to understand the lifecycle of tornadoes”
- NSF ATM-0644533, 4/19/2007–3/31/2013, \$747,592, “CAREER: A study of the radiative effects of cloud shadows on the dynamics of long-lived convective storms”
- NSF ATM-0801035, 6/1/2008–5/31/2012, \$964,389, “Collaborative Research: VORTEX2—Multi-scale and multi-platform study of tornadoes, supercell thunderstorms, and their environments”
- NSF ATM-0437512, 11/1/2004–10/31/2007, \$450,186, “Collaborative Research: Study of the genesis, evolution, structure, and dynamic climatology of tornadoes and their environments”
- College of Earth and Mineral Sciences (Deike Research Grant), 6/1/2002–5/31/2003, \$45,000, “The Pennsylvania Mobile Radar Experiment (PAMREX)”
- NSF ATM-0338661, 1/15/2004–1/14/2006, \$221,831, “Collaborative Research: Concentrating vorticity near the ground: Investigation of supercell rear-flank precipitation, vorticity generation, and transport processes”
- NSF ATM-021596, 1/1/2004–5/1/2005, \$482,978, “Studies of the internal structure and dynamics of convective weather systems”
- NSF ATM-010307, 1/15/2002–1/14/2005, \$221,289, “Collaborative Research: Measurement and analysis of the pre-convective boundary layer and convection initiation during the International H₂O Project (IHOP)”
- UCAR NA97WD0082, 8/1/2002–7/31/2004, \$73,242, “Bow echo development associated with the interaction of convection with complex terrain: Blending observations with idealized simulations”
- NSF ATM-021596, 4/14/2003–4/13/2004, \$6,000, “REU Supplement for Collaborative Research: Measurement and analysis of the pre-convective boundary layer and convection initiation during the International H₂O Project (IHOP)”
- College of Earth and Mineral Sciences (Wilson Research Initiation), 6/1/2002–5/31/2003, \$6741, “Kinematic differences between tornadic and nontornadic supercell thunderstorms in the middle troposphere”
- NSF ATM-021596, 2/25/2002–2/24/2003, \$19,500, “REU Supplement for Collaborative Research: Measurement and analysis of the pre-convective boundary layer and convection initiation during the International H₂O Project (IHOP)”

Academic Courses Taught

Introductory Meteorology (METEO 3)
Severe and Unusual Weather (METEO 5)
Synoptic Meteorology (METEO 411)
Mesoscale Meteorology (METEO 414)
Atmospheric Dynamics II (METEO 422)
Observing Meteorological Phenomena (METEO 471W)
Radar Observations and Analysis I (METEO 497D/597D)
Radar Observations and Analysis II (METEO 497D/597D)
Topics in Synoptic Meteorology (METEO 512)
Mesoscale Dynamics (METEO 529)
Atmospheric Convection (METEO 538)
First-Year Seminar in the Earth and Mineral Sciences (EMSC 100S)

Graduate Student Theses Supervised

Luke LeBel, Ph.D., anticipated graduation in 2025
Elissa Bartos, Ph.D., anticipated graduation in 2023
Dylan Steinkruger, Ph.D., anticipated graduation in 2022
Aaron Wang, Ph.D., anticipated graduation in 2022
Shawn Murdzek, Ph.D., anticipated graduation in 2022
Branden Katona, Ph.D., 2020 (Dissertation: "An Investigation of the Influence of Complex Terrain on Severe Storms and Their Environments")
Elissa Bartos, M.S., 2020 (Thesis: "Three-Dimensional Thermodynamic Observations in Supercell Thunderstorms from Swarms of Balloon-Borne Probes")(co-advised with Prof. Y. Richardson)
Dylan Steinkruger, M.S., 2020 (Thesis: "An Artificially Intelligent System for the Automated Issuance of Tornado Warnings in Simulated Convective Storms")(co-advised with Prof. G. Young)
Shawn Murdzek, M.S., 2019 (Thesis: "Processes Contributing to Tornadogenesis Failure in the 26 May 2010 Supercell near Prospect Valley, CO") (co-advised with Prof. Y. Richardson)
Giovanni Jiménez-Sánchez, Ph.D., 2018 (Dissertation: "The Orinoco Low-Level Jet")
Michael Colbert, M.S., 2017 (Thesis: "Exploring the Sensitivity of Convective Storm Characteristics and Dynamics to Grid Spacing in Convection-Allowing North American Mesoscale Forecast System Simulations")
Branden Katona, M.S., 2016 (Thesis: "Assessing the Influence of Topography on Convective Storm Environments Using High-resolution Operational Model Output")

- Chris Nowotarski, Ph.D., 2013 (Dissertation: "Simulating Supercell Thunderstorms in a Convective Boundary Layer: Effects on Storm and Boundary Layer Properties")
- Tim Hatlee, M.S., 2012 (Thesis: "The Pretornadic and Tornadogenesis Phases of the 12 May 2010 Supercell of Clinton, Oklahoma, Intercepted by VORTEX2") (co-advised with Prof. Y. Richardson)
- Andrew Oberthaler, M.S., 2011 (Thesis: "The Effect of Cloud Shading on Squall Lines: A Numerical Simulation Study")
- Chris Nowotarski, M.S., 2010 (Thesis: "The Characteristics of Numerically Simulated Supercell Storms Situated over Statically Stable Boundary Layers")
- Mario Majcen, Ph.D., 2009 (Dissertation: "A Conceptual Model of Nontornadic Supercells")
- Jeff Frame, Ph.D., 2008 (Dissertation: "The Dynamical Influences of Cloud Shading on Simulated Supercell Thunderstorms")
- Richard James, Ph.D., 2008 (Dissertation: "A Numerical Investigation of the Effects of Dry Air Aloft on Deep Convection")
- Zack Byko, M.S., 2007 (Thesis: "Examining Descending Reflectivity Cores Using High-Resolution Radar Data and a Numerical Simulation") (co-advised with Prof. Y. Richardson)
- Jeremy Ross, Ph.D., 2005 (Dissertation: "Reexamining Analog Forecasting Using NCEP/NCAR Re-analyses")
- John Stonitsch, M.S., 2005 (Thesis: "The Fine-Scale Structure and Evolution of Boundary Layer Wind and Thermodynamic Fields along a Front Observed during IHOP")
- Chris Shabbott, M.S., 2005 (Thesis: "Surface Thermodynamic Observations within the Forward-Flank Downdrafts of Tornadic and Nontornadic Supercells")
- Christina Hannon, M.S., 2003 (Thesis: "An Investigation of Convection Initiation 'Failure' on 12 June 2002 Using Mobile Doppler Radars")
- Jeff Frame, M.S., 2003 (Thesis: "The Interaction of Simulated Squall Lines with Idealized Terrain")

Research Associates Mentored

Valerian Jewtoukoff, 2016–2017

James Marquis, 2010–2014

Richard James, 2004

Departmental, College, and University Committee Service

Associate Head of the Graduate Program in Meteorology and Atmospheric Science, 7/2018–present

University Corporation for Atmospheric Research (UCAR) President's Advisory Committee on University Relations (PACUR), 10/2018–present

Men's Golf Team Faculty Partner, 8/2018–present

University Graduate Council, 8/2017–7/2019

Department of Meteorology and Atmospheric Science Graduate Academic Programs Committee, 6/2018–present

Schreyer Honors College Faculty Advisory Committee, 1/2017–5/2018

Department of Meteorology and Atmospheric Science Promotion and Tenure Committee, 7/2013–6/2015, 7/2017–6/2020 (chair from 7/2017–6/2018)

Department of Meteorology and Atmospheric Science Undergraduate Academic Programs Committee, 8/2001–6/2018 (chair from 10/2006–7/2008)

Department of Meteorology and Atmospheric Science Faculty Search Committees, 11/2002–6/2003, 10/2004–12/2006, 9/2007–4/2008 (chair), 11/2012–3/2013, 2/2013–10/2013, 1/2015–4/2015

Department of Meteorology and Atmospheric Science Colloquium Series organizer, 7/2011–7/2015

College of Earth and Mineral Sciences Museum and Art Gallery Advisory Board, 9/2008–12/2011

College of Earth and Mineral Sciences Faculty Performance Evaluation Committee, 2010

College of Earth and Mineral Sciences Faculty Advisory Committee, 10/2006–6/2009

College of Earth and Mineral Sciences Academy of Scholars Planning Committee, 10/2006–5/2007

College of Earth and Mineral Sciences Museum Exhibits Committee, 1/2005–12/2006

Department of Meteorology and Atmospheric Science Ad hoc General Education Committee (chair), 1/2004–1/2005

College of Earth and Mineral Sciences Museum Director Search Committee, 8/2003–1/2004

Department of Meteorology and Atmospheric Science Ad hoc Computers in the Curriculum Committee, 11/2002–12/2003 (co-chair)

College of Earth and Mineral Sciences Deike Renovation Task Force, 9/2002–5/2003

College of Earth and Mineral Sciences Facilities Task Force, 8/2002–9/2002

Scientific Society Memberships

American Meteorological Society, 1995–present

National Weather Association, 2011–present

External Service, Advisory Panels, and Other Activities

UCAR President's Advisory Committee on University Relations (PACUR), 10/2018–present

American Meteorological Society Atmospheric Research Awards Committee, 2017–2019

Taught week-long course (Forecasting Severe Convection II) at the European Severe Storms Laboratory Training Center in Wiener Neustadt, Austria, 6/2018

NCAR C-RITE Workshop Program Organizing Committee, 3/2017–1/2018

Chief Editor, *Weather and Forecasting*, 1/2012–10/2017

- VORTEX-Southeast Scientific Steering Committee, 3/2015–2/2017
- Invited Participant, NRC Workshop to Review NSF AGS Goals and Objectives, 4/2014
- National Football League Special Weather Adviser for Super Bowl XLVIII (1/2014–2/2014)
- Invited participant, NCEP/NSF Weather Ready Nation workshop, 4/2012
- Invited participant and panelist, NCEP/NSF Weather Ready Nation workshop, 12/2011
- Associate Editor, *Weather and Forecasting*, 1/2004–12/2011
- VORTEX2 Steering Committee, 9/2003–6/2011
- Associate Editor, *Monthly Weather Review*, 1/2006–12/2010
- National Science Foundation Observing Facilities Assessment Panel (OFAP), 10/2005–6/2010
- National Weather Service Quick Response Team (called on to survey violent tornado damage), 1/2003–12/2009
- Workshop co-convener, VORTEX2 Workshop at Penn State, 11/2009
- National Severe Storms Laboratory Review Panel (2/2009)
- 5th European Conf. on Severe Storms Program Committee, 10/2008–10/2009
- AMS 23rd Severe Local Storms Conference Program Committee, 10/2004–11/2006
- Program Chair, AMS Symposium on the Challenges of Severe Convective Storms, 2/2006
- AMS Scientific and Technological Activities Commission on Severe Local Storms, 1/2003–1/2006
- AMS 22nd Severe Local Storms Conference Program Committee, 1/2003–10/2004
- Workshop convener, VORTEX2 Workshop at Quartz Mountain, 9/2003
- Conference session chair
- AMS 28th Conf. on Severe Local Storms, Portland, Oregon; 11/2016
 - AMS 27th Conf. on Severe Local Storms, Madison, Wisconsin; 10/2014
 - 6th European Conf. on Severe Storms, Palma de Mallorca, Spain; 10/2011
 - AMS 25th Conf. on Severe Local Storms, Denver, Colorado; 10/2010
 - 5th European Conf. on Severe Storms, Landshut, Germany; 10/2009
 - AMS 24th Conf. on Severe Local Storms, Savannah, Georgia; 10/2008
 - 4th European Conf. on Severe Storms, Trieste, Italy; 9/2007
 - AMS 23rd Conf. on Severe Local Storms, St. Louis, Missouri; 11/2006
 - AMS Symposium on the Challenges of Severe Convective Storms, Atlanta, Georgia; 2/2006
 - AMS 22nd Conf. on Severe Local Storms, Hyannis, Massachusetts; 10/2004
 - AMS 21st Conf. on Severe Local Storms, San Antonio, Texas; 8/2002
 - AMS 20th Conf. on Severe Local Storms, Orlando, Florida; 9/2000
 - AMS Symposium on VORTEX, Long Beach, California; 1/2000
- Educational outreach
- Museum exhibit consultation for PSU Earth and Mineral Sciences Museum and State College Discovery Space Museum

- Delivered public lectures on tornadoes at the Whitaker Center (Harrisburg), 2012.
- Science adviser for NSF-funded IMAX film (Giant Screen Films), *Tornado Alley*, and accompanying educational materials, 2010–2011.
- Instructor for COMET (Cooperative Program for Meteorological Education and Training) Mesoscale Analysis and Prediction (COMAP) Course (enrollment comprises Science Operations Officers from the National Weather Service) hosted by the National Center for Atmospheric Research (NCAR), 6/2007, 4/2008, 6/2010
- Discussed opportunities in atmospheric science with students from underrepresented groups (Villa Maria Academy, an all-girls high school, 1/2007; NC A & T University, an HBU, 11/2007)
- Attracted funding and provided consultation for the construction of a tornado exhibit in the College of Earth and Mineral Sciences Museum at Penn State
- Instructor for high school teachers summer weather camp at Penn State University, 6/2002, 7/2003, 7/2004, 7/2006
- Instructor for middle and high school students weather camp at Penn State University, 7/2002
- Instructor and consultant for the *Passport to Knowledge* program for PBS, 3/2000–7/2001
- Reviewer of materials used for Virtual Institute for Satellite Integration Training (VISIT) courses, 10/2001
- Over 100 radio, television, newspaper, and magazine interviews given to local, national, and international media on severe storms and tornadoes since 1998, including *National Public Radio*, *Scientific American*, *ABC World News*, *NBC Nightly News*, *The Weather Channel*, *Discovery Channel*, *The Learning Channel*, *National Geographic*, *The Washington Post*, *Good Morning America*, *Agence France-Presse*, *Deutschlandfunk*, *The Philadelphia Inquirer*, *NBC Dateline*, *CBS 48 Hours*, the *BBC*, and *USA Today*