

Curriculum Vitae

October 8, 2021

Eric C. Bruning

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Professional Positions

- September 2016 – present: Associate Professor, Texas Tech University, Dept. of Geosciences, Atmospheric Science Group
- June 2010 – August 2016: Assistant Professor, Texas Tech University, Dept. of Geosciences, Atmospheric Science Group
- June 2008 – May 2010: Research Associate, University of Maryland (Earth System Science Interdisciplinary Center and NOAA Cooperative Institute for Climate & Satellites), Postdoc sponsor: Steven J. Goodman
- May 2003 – May 2008: Graduate Research Assistant, W. David Rust, National Severe Storms Laboratory (NSSL)
- November 1999 – May 2003: Undergraduate Research Assistant, W. David Rust, NSSL

Education

- Ph.D. in Meteorology, *University of Oklahoma, May 2008*, “Charging Regions, Regions of Charge, and Storm Structure in a Partially Inverted Polarity Supercell Thunderstorm”, Advisors: Michael I. Biggerstaff and W. David Rust
- M.S. in Meteorology, *University of Oklahoma, December 2005*, “Electrical and Polarimetric Radar Observations of a Multicell Storm in TELEX”, Advisor: W. David Rust
- B.S. in Meteorology, *Summa Cum Laude*, Minor in Mathematics, *U. Oklahoma, May 2003*

Summary of Publications and Funding

39 peer reviewed publications (3 conditionally accepted).

h-index as of 12 Jan 2021: **23** (Google Scholar; 2166 citations), **19** (Scopus h-index; 1448 citations by 875 documents), **18** (Web of Science; 1,331 citations by 793 documents).

\$3.52M total grant funding since 2010; current: \$1.49M. A complete list including role in the award is provided at the end of this document.

Professional Awards

- 2018 American Geophysical Union Atmospheric and Space Electricity Section Early Career Award
- 2017 NASA Agency Honor Award, Group Achievement Award, GOES-R Team Member, “For excellence resulting in the successful GOES-R satellite launch, providing the nation’s foundation for the world’s highest quality weather monitoring and forecasting.”

Summary of Research Interests

The relationship of lightning and thunderstorm electricity to meteorological processes in thunderstorms, as characterized through remote sensing (radio and optical) and in-situ (balloon-borne electric field) observations. Primary topics include the multi-scale charge structure of thunderstorms, its organization by turbulence in thunderstorms, and electrification mechanisms. Related interests in cloud and precipitation

microphysics, weather radar, thunderstorm fluid dynamics and severe storm meteorology. Supporting work with high resolution electrified numerical simulations of thunderstorms. Developer of and contributor to open-source community scientific software.

Discovered that electrical energy in thunderstorms (its spatial frequency domain spectrum) is distributed like turbulence kinetic energy, including a Kolmogorov-like inertial range. Established key conceptual links between the mapped extent of lightning channels and the underlying kinematic and precipitation texture of thunderclouds. Developed methods for display and interpretation of lightning mapping data; these were adopted by operational weather agencies in the US and Europe. Highly collaborative in supporting advancement of lightning science at the meteorological interface.

Research Direction

Texas Tech University

Doctoral Students Supervised

- Jessica Dos Santos Souza, *TBD, cloud ice microphysics, thunderstorm electrification, and models of thunderstorm convection*, Geosciences, Atmospheric Science Group. (Jan 2021 - present).
- Vicente Salinas, *Examining Thunderstorm Kinematic Structures in which Lightning Initiates and How the Causal Electrostatics Are Generated*, Geosciences, Atmospheric Science Group. (May 2016 - Dec 2020).
- Vanna C. Chmielewski, *Understanding the surprising variation in storm charge structures on 4 June 2012 over West Texas*, Geosciences, Atmospheric Science Group. (May 2013 - August 2017).

Masters Students Supervised

- David PeQueen, *GLM Flash Data Trends during Tropical Cyclone Intensification Changes* (August 2019 - December 2021)
- Jessica Dos Santos Souza, *Assessing turbulence in different spots of lightning flash propagation* (January 2019 - Dec 2021)
- David Newbern, *Dynamical Processes Associated with Winter Lightning Events in Iowa* (August 2018 - December 2020)
- Cameron Nixon, *The GOES-16 Geostationary Lightning Mapper: Lightning Trends Within Tornadic Quasi-Linear Convective Systems* (August 2017 - December 2019)
- Kelley Murphy, *Assessing Lightning Risk In Vulnerable Outdoor Environments* (August 2016 - December 2018)
- Candace Wood, Atmospheric Science, Atmospheric Science Group, *Horizontal Channel Lengths of Cloud to Ground Lightning Flashes*, (October 2010 – May 2018; inherited from Prof. Kyle Wiens, my predecessor).
- Matthew Brothers, *Investigating the Relative Contribution of Charge Deposition in Organizing Charge within a Thunderstorm*, (June 2015 - August 2017).
- Samantha Berkseth, *Quantitative Analysis of the Turbulent Structure of Convection*, (August 2014 - Oct 2016).
- Vicente Salinas, *Quantification and geometrical evaluation of the electrostatics of lightning flashes*, (August 2014 - May 2016).
- Jennifer Daniel, *A Study of Inferred Charge Advection in Mesoscale Convective Systems on the South Plains Utilizing the West Texas Lightning Mapping Array*, (August 2010 - August 2016).

- Phillip J. Ware, Atmospheric Science, Atmospheric Science Group, *Thunderstorm Electrification and Kinematics as Seen Through Ensemble Lightning Flash Properties*, (August 2013 – August 2015).
- Camaron Plourde, Atmospheric Science, Atmospheric Science Group, *An Investigation of Lightning Behavior during the Quasi-Linear Convective System in northwest Texas on March 19, 2012*, (August 2011 – August 2013).
- Vanna Sullivan, Atmospheric Science, Atmospheric Science Group, *Variations of the Vertical Electric Field and Wind Speed on Days with Airborne Dust in Lubbock, Texas*, (August 2011 – May 2013).
- Natalie Gusack, Atmospheric Science, Atmospheric Science Group, *Using EFM and Soundings to Examine Variations in Thunderstorm Thermodynamics*, (August 2010 - August 2012).

Member of Doctoral Committees

- Alex Schueth, TBD, Tornado dynamics. Geosciences, Texas Tech University, Atmospheric Science Group (June 2020 - present).
- Jannick Fischer, TBD, Tornado dynamics. Geosciences, Texas Tech University, Atmospheric Science Group (June 2020 - present).
- Austin Coleman, TBD, Numerical weather prediction and ensemble sensitivity analysis. Geosciences, Texas Tech University, Atmospheric Science Group (June 2020 - present).
- Robert Gautreaux, TBD, Philosophy and effectiveness of communications in weather broadcast. Media and Communications, Texas Tech University (April 2020 - present).
- Milind Sharma, TBD, Lightning and polarimetry in severe storms. Atmospheric Science, Purdue University (Feb 2018 – present).
- Felix Erdmann, “Preparation for the use of MTG LI observations in short-term numerical weather prediction.” Ocean, Atmosphere, and Climate, University of Toulouse and Centre National de Recherches Météorologiques (July 2020 – December 2020).
- Aaron Hill, “Demonstration of Ensemble Sensitivity-based Targeted Observing for Convective-Scale Applications: Perfect-model Experiments,” Geosciences, Texas Tech University, Atmospheric Science Group (June 2015 – August 2019).
- William Scott Gunter, “High-resolution Full-scale Observations of Thunderstorm Outflow Winds,” Geosciences, Texas Tech University, Atmospheric Science Group (January 2012 – May 2015).
- Anthony Reinhart, “Verification of Numerically Simulated Supercell Cold Pools using Data Assimilation,” Geosciences, Texas Tech University, Atmospheric Science Group (January 2011 - August 2016).

Professional Society Memberships

- American Meteorological Society
- American Geophysical Union

Professional Service

Current

- University Corporation for Atmospheric Research, Unidata Strategic Advisory Committee, Member, October 2021 - present.

- EUMETSAT Meteosat Third Generation Lightning Imager Mission Advisory Group, Member, November 2018 - present.
- NOAA VORTEX-SE Scientific Steering Committee, Member, January 2018 - present.
- GOES-R Geostationary Lightning Mapper - Science Team (2008–present)

Previous

- University Corporation for Atmospheric Research, Unidata Users Committee, Member, August 2018 - October 2021.
- Member, World Meteorological Organization (WMO) Commission for Climatology (CCL) ad-hoc Weather and Climate Extremes evaluation committee for lightning extremes, June 2019 - August 2020.
- American Meteorological Society, Chair, Scientific and Technological Activities Commission, Atmospheric Electricity Committee, January 2016 - January 2018.
- NASA Global Hydrology Resource Center, User Working Group steering committee, September 2014 - September 2017.
- American Meteorological Society, Member, Scientific and Technological Activities Commission, Atmospheric Electricity Committee, January 2012 - December 2015.
- Instructor, AMS Short Course: *Climate Data Access, Use, And Tools*, 2010 Annual Mtg.
- EUMETSAT Lightning Imager Science Team (2009-2010) and Science Review Panel (2011, 2013)
- Reviewer, Journal of Geophysical Research, Geophysical Research Letters (American Geophysical Union); Bulletin of the American Meteorological Society, Journal of Atmospheric Science, Journal of Atmospheric and Oceanic Technology, Weather and Forecasting (American Meteorological Society) journals; Atmospheric Research (Elsevier); Boundary Layer Meteorology (Springer). Grant reviewer for NSF, NOAA, German Research Foundation, Israeli Science Foundation, Swiss Science Foundation.

Exhibitions

- *Marcando el Relámpago (Marking the Lightning)*, Museum of Texas Tech University, Lubbock, TX. September 30, 2017 – January 28, 2018, artist Tina Fuentes; catalogue. Funded by NSF CAREER award. <https://www.depts.ttu.edu/museumttu/exhibitions/2017/Marcando.php>
- *Marcando el Relámpago (Marking the Lightning)*, South Texas College, McAllen, TX. August 27, 2018 – October 17, 2018, artist Tina Fuentes. <https://library.southtexascollege.edu/marcando-el-relampago/>

Formal Publications

- Salinas, V., E. C. Bruning, E. R. Mansell, and M. D. Brothers, 2021b: Modeling the electrical energy discharged by lightning flashes using capacitors for application with lightning datasets. *J. Atmos. Sci.*, in press
- Brune, W. H., and Coauthors, 2021: Extreme oxidant amounts produced by lightning in storm clouds. *Science*, **372** (6543), 711–715, doi: 10.1126/science.abg0492
- Duran, P., and Coauthors, 2021b: Changes in inner-core lightning characteristics as Hurricane Dorian (2019) reached peak intensity. *Geophys. Res. Lett.*, **48** (8), e2020GL092067, doi: 10.1029/2020GL092067

- Murphy, K., E. C. Bruning, J. Vanos, K. Ardon-Dryer, and C. J. Schultz, 2021b: Assessing lightning risk in outdoor vulnerable environments. *Weather, Climate, and Society*, **13** (3), 571–589, doi: 10.1175/WCAS-D-20-0021.1
- Sharma, M., R. Tanamachi, E. Bruning, and K. Calhoun, 2021a: Polarimetric and electrical structure of the 19 May 2013 Edmond-Carney, Oklahoma tornadic supercell. *Mon. Wea. Rev.*, early release, doi: 10.1175/MWR-D-20-0280.1
- Lavigne, T., C. Liu, J. Hill, and E. Bruning, 2021: Observations from the One Year Electric Field Study-North Slope of Alaska (OYES-NSA) field campaign, and their implications for observing the distribution of global electrified cloud activity. *Journal of Atmospheric and Solar-Terrestrial Physics*, **214**, 105–128, doi: 10.1016/j.jastp.2020.105528
- Peterson, M. J., and Coauthors, 2020: New WMO megaflash lightning extremes for flash distance (709 km) and duration (16.73 seconds) recorded from space. *Geophys. Res. Lett.*, **47** (16), e2020GL088888, doi: 10.1029/2020GL088888
- Bruning, E. C., and Coauthors, 2019d: Meteorological imagery for the Geostationary Lightning Mapper. *J. Geophys. Res.*, **124** (24), 14 285–14 309, doi: 10.1029/2019JD030874
- Jensen, M., and Coauthors, 2019: Tracking Aerosol Convection Interactions Experiment (TRACER) Science Plan. Tech. Rep. DOE/SC-ARM-19-017, U.S. Department of Energy Office of Science
- Lyons, W. A., E. C. Bruning, T. A. Warner, D. R. MacGorman, S. Edgington, C. Tillier, and J. Mlynarczyk, 2020: Megaflashes: Just how long can a lightning discharge get? *Bulletin of the American Meteorological Society*, **101** (1), E73–E86, doi: 10.1175/BAMS-D-19-0033.1
- Rudlosky, S. D., S. J. Goodman, K. S. Virts, and E. C. Bruning, 2019b: Initial Geostationary Lightning Mapper observations. *Geophys. Res. Lett.*, **46** (2), 1097–1104, doi: 10.1029/2018GL081052
- Brothers, M. D., E. C. Bruning, and E. R. Mansell, 2018: Investigating the relative contributions of charge deposition and turbulence in organizing charge within a thunderstorm. *J. Atmos. Sci.*, **75** (9), 3265–3284, doi: 10.1175/JAS-D-18-0007.1
- Chmielewski, V. C., E. C. Bruning, and B. C. Ancell, 2018b: Variations of thunderstorm charge structures in West Texas on 4 June 2012. *J. Geophys. Res.*, **123** (17), 9502–9523, doi: 10.1029/2018jd029006
- Weiss, S. A., D. R. MacGorman, E. C. Bruning, and V. C. Chmielewski, 2018b: Two methods for correcting range-dependent bias of Lightning Mapping Arrays. *J. Atmos. Oceanic Tech.*, **35**, 1273–1282, doi: 10.1175/JTECH-D-17-0213.1
- Schultz, C. J., T. J. Lang, E. C. Bruning, K. M. Calhoun, S. Harkema, and N. Curtis, 2018: Characteristics of lightning within electrified snowfall events using Lightning Mapping Arrays. *J. Geophys. Res.*, **123**, 2347–2367, doi: 10.1002/2017JD027821
- Gunter, W. S., J. L. Schroeder, C. C. Weiss, and E. C. Bruning, 2017: Surface measurements of the 5 June 2013 damaging thunderstorm wind event near Pep, Texas. *Wind and Structures*, **24** (2), 185–204
- Chmielewski, V. C., and E. C. Bruning, 2016: Lightning mapping array flash detection performance with variable receiver thresholds. *J. Geophys. Res. Atmos.*, **121** (14), 8600–8614, doi: 10.1002/2016jd025159
- Fuchs, B. R., E. C. Bruning, S. A. Rutledge, L. D. Carey, P. R. Krehbiel, and W. Rison, 2016: Climatological analyses of LMA data with an open-source lightning flash-clustering algorithm. *J. Geophys. Res. Atmos.*, **121** (14), 8625–8648, doi: 10.1002/2015JD024663
- Lyu, F., and Coauthors, 2016: Ground detection of terrestrial gamma ray flashes from distant radio signals. *Geophysical Research Letters*, **43** (16), 8728–8734, doi: 10.1002/2016gl070154, URL <http://dx.doi.org/10.1002/2016GL070154>
- Pollack, I. B., and Coauthors, 2016: Airborne quantification of upper tropospheric NO_x production from lightning in deep convective storms over the United States Great Plains. *J. Geophys. Res. Atmos.*, **121** (4), 2002–2028, doi: 10.1002/2015JD023941
- Bruning, E. C., and R. J. Thomas, 2015: Lightning channel length and flash energy determined from moments of the flash area distribution. *J. Geophys. Res.*, **120** (17), 8925–8940, doi: 10.1002/2015JD023766
- Barth, M., and Coauthors, 2015: The Deep Convective Clouds and Chemistry (DC3) field campaign. *Bulletin of the American Meteorological Society*, **96**, 1281–1309, doi: 10.1175/BAMS-D-13-00290.1
- Behnke, S. A., and E. C. Bruning, 2015: Changes to the turbulent kinematics of a volcanic plume inferred from lightning data. *Geophys. Res. Lett.*, **42** (10), 4232–4239, doi: 10.1002/2015GL064199

- Fuchs, B. R., S. A. Rutledge, E. C. Bruning, J. Pierce, T. J. Lang, D. R. MacGorman, P. R. Krehbiel, and W. Rison, 2015: Environmental controls on storm intensity and charge structure in various regions of the United States. *J. Geophys. Res.*, **120** (13), 6575–6596, doi: 10.1002/2015JD023271
- Bruning, E. C., S. A. Weiss, and K. M. Calhoun, 2014: Continuous variability in thunderstorm primary electrification and an evaluation of inverted-polarity terminology. *Atmos. Res.*, **135–136**, 274–284, doi: 10.1016/j.atmosres.2012.10.009
- Bruning, E. C., and D. R. MacGorman, 2013: Theory and observations of controls on lightning flash size spectra. *J. Atmos. Sci.*, **70** (12), 4012–4029, doi: 10.1175/JAS-D-12-0289.1
- Lu, G., and Coauthors, 2013: Coordinated observations of sprites and in-cloud lightning flash structure. *J. Geophys. Res.*, **118** (12), 6607–6632, doi: 10.1002/jgrd.50459
- Emersic, C., P. L. Heinselman, D. R. MacGorman, and E. C. Bruning, 2011: Lightning activity in a hail-producing storm observed with phased-array radar. *Mon. Wea. Rev.*, **139** (6), 1809–1825, doi: 10.1175/2010MWR3574.1
- Bruning, E. C., W. D. Rust, D. R. MacGorman, M. I. Biggerstaff, and T. J. Schuur, 2010: Formation of charge structures in a supercell. *Mon. Wea. Rev.*, **138** (10), 3740–3761, doi: 10.1175/2010MWR3160.1
- Mansell, E. R., C. L. Ziegler, and E. C. Bruning, 2010: Simulated electrification of a small thunderstorm with two-moment bulk microphysics. *J. Atmos. Sci.*, **67** (1), 171–194, doi: 10.1175/2009JAS2965.1
- MacGorman, D. R., and Coauthors, 2008: TELEX: The Thunderstorm Electrification and Lightning Experiment. *Bull. Amer. Met. Soc.*, **89** (7), 997–1013
- Weiss, S. A., W. D. Rust, D. R. MacGorman, E. C. Bruning, and P. R. Krehbiel, 2008: Evolving complex electrical structure of the STEPS 25 June 2000 multicell storm. *Mon. Wea. Rev.*, **136** (2), 741–756
- Stolzenburg, M., T. C. Marshall, W. D. Rust, E. C. Bruning, D. R. MacGorman, and T. Hamlin, 2007: Electric field values observed near lightning flash initiations. *Geophys. Res. Lett.*, **34**, doi: 10.1029/2006GL028777
- Bruning, E. C., W. D. Rust, T. J. Schuur, D. R. MacGorman, P. R. Krehbiel, and W. Rison, 2007: Electrical and polarimetric radar observations of a multicell storm in TELEX. *Mon. Wea. Rev.*, **135** (7), 2525–2544, doi: 10.1175/MWR3421.1
- Rust, W. D., and Coauthors, 2005: Inverted-polarity electrical structures in thunderstorms in the Severe Thunderstorm Electrification and Precipitation Study. *Atmos. Res.*, **76**, 247–271
- MacGorman, D. R., W. D. Rust, P. R. Krehbiel, W. Rison, E. C. Bruning, and K. Wiens, 2005: The electrical structure of two supercell storms during STEPS. *Month. Wea. Rev.*, **133**, 2583–2607

Publications in peer review

- Ardon-Dryer, K., V. Chmielewski, E. C. Bruning, and X. Xueting, 2021: Changes of electric field, aerosol, and wind covariance in different blowing dust days in West Texas. *Aeolian Res.*, accepted pending minor revisions
- Boggs, L., and Coauthors, 2021b: Novel radio and optical measurements reveal the electrical structure of gigantic jets. *Science Advances*, in review
- Salinas, V., E. C. Bruning, and E. R. Mansell, 2021a: Examining the kinematic structures within which lightning flashes are initiated using a cloud-resolving model. *J. Atmos. Sci.*, accepted with minor revisions
- Souza, J. C. S., and E. C. Bruning, 2021b: Assessment of turbulence intensity in different spots of lightning flash propagation. *Geophys. Res. Lett.*, accepted pending minor revisions; preprint available at 10.1002/essoar.10506201.1

Recent Talks and Conference Presentations

- Barber, C. A., M. L. Larsen, E. Bruning, and B. Hirth, 2021: Preliminary analysis of bulk rain variables acquired from laser precipitation monitors mounted at different heights on a vertical tower. *21st Symposium on Meteorological Observation and Instrumentation*, 10-15 January 2021
- Boggs, L., T. Neubert, A. Nag, and E. Bruning, 2021a: Optical and radio emissions of a possible blue starter observed by ASIM and the West Texas LMA. *Abstracts, EGU General Assembly*, EGU21-13649

- Bruning, E. C., D. PeQueen, S. A. Weiss, and J. Jordan, 2021c: Multi-sensor comparison of lightning datasets in West Texas. *Preprints, 10th Conf. on the Meteorological Applications of Lightning Data*, 10-15 January 2021
- Duran, P., C. J. Schultz, E. Bruning, S. N. Stevenson, R. Allen, N. Johnson, and D. PeQueen, 2021a: Changes in inner-core lightning characteristics as Hurricane Dorian (2019) reached peak intensity. *Fourth Special Symposium on Tropical Meteorology and Tropical Cyclones*, 10-15 January 2021
- Lybrand, S., C. J. Schultz, P. Meyer, R. Allen, K. M. Calhoun, and E. C. Bruning, 2021: A case study validation of the geostationary lightning mapper infrared rgb product. *Preprints, 10th Conf. on the Meteorological Applications of Lightning Data*, 10-15 January 2021
- Murphy, K., E. C. Bruning, and C. J. Schultz, 2021a: A spatiotemporal lightning risk assessment using lightning mapping data. *Preprints, 10th Conf. on the Meteorological Applications of Lightning Data*, 10-15 January 2021
- PeQueen, D., E. C. Bruning, and S. N. Stevenson, 2021: Glm flash data trends in tropical cyclone intensification changes. *Preprints, 10th Conf. on the Meteorological Applications of Lightning Data*, 10-15 January 2021
- Salinas, V., and E. C. Bruning, 2021: Identifying the representative kinematics in which lightning flash initiations occur and their influence on the associated microphysics and electrostatics. *Preprints, 10th Conf. on the Meteorological Applications of Lightning Data*, 10-15 January 2021
- Sharma, M., R. Tanamachi, D. T. Dawson II, Y. Jung, E. R. Mansell, E. C. Bruning, and K. Thomas, 2021c: Investigating the coupling of supercell dynamics and microphysics through lightning and cold pools. *Preprints, 10th Conf. on the Meteorological Applications of Lightning Data*, 10-15 January 2021
- Sharma, M., R. Tanamachi, E. C. Bruning, and K. M. Calhoun, 2021b: Polarimetric and electrical structure of the 19 may 2013 edmond–carney, oklahoma, tornadic supercell. *Preprints, 10th Conf. on the Meteorological Applications of Lightning Data*, 10-15 January 2021
- Souza, J., and E. Bruning, 2021a: Analysis of lightning flash properties relative to turbulence in thunderstorms. *Preprints, 10th Conf. on the Meteorological Applications of Lightning Data*, 10-15 January 2021
- Welty, T., E. C. Bruning, C. C. Weiss, and J. McDonald, 2021: Using lightning’s microphysical link to better understand storm conditions and processes. *Preprints, 10th Conf. on the Meteorological Applications of Lightning Data*, 10-15 January 2021
- Bruning, E. C., 2020: What would it take to predict lightning? *Proc. Fourth Texas Weather Conference*, 24–25 September 2020, URL <https://youtu.be/TC0IwzWxW8I>
- Bruning, E. C., D. PeQueen, S. A. Weiss, and J. Jordan, 2020: Multi-sensor comparison of lightning datasets in West Texas. *Eos Trans. AGU, Fall Meet. Suppl.*, AE007-05
- Calhoun, K. M., E. C. Bruning, C. J. Schultz, and T. C. Meyer, 2020: GLM use, feedback, and development in the Hazardous Weather Testbed. *Preprints, 16th Annual Symposium on New Generation Operational Environmental Satellite Systems*, Paper 6.1, AMS Annual Meeting, Boston, MA, USA
- Duran, P., C. J. Schultz, R. Allen, E. Bruning, S. N. Stevenson, and D. PeQueen, 2020: Using GLM flash density, flash area, and flash energy to diagnose tropical cyclone structure and intensification. *Proc. JPSS/GOES-R Proving Ground / Risk Reduction Summit*, College Park, MD; United States, URL <https://ntrs.nasa.gov/search.jsp?R=20200001351>
- Jensen, M., and Coauthors, 2020a: Tracking Aerosol Convection interactions Experiment (TRACER): An upcoming field campaign. *Preprints, 12th Symposium on Aerosol - Cloud - Climate Interactions*, Paper 10.5, AMS Annual Meeting, Boston, MA, USA
- Jensen, M., and Coauthors, 2020b: Tracking Aerosol Convection interactions Experiment (TRACER): An upcoming field campaign. *Eos Trans. AGU, Fall Meet. Suppl.*, A045-05
- PeQueen, D., and E. C. Bruning, 2020: Diagnosing intensification changes of tropical cyclones using glm flash data. *Proc. Fourth Texas Weather Conference*, 24–25 September 2020, URL <https://youtu.be/TC0IwzWxW8I>
- Salinas, V., and E. C. Bruning, 2020: Investigating the influence of thunderstorm kinematics on local increases in electric fields and charge preceding lightning flash initiations. *Proc. Fourth Texas Weather Conference*, 24–25 September 2020, URL <https://youtu.be/TC0IwzWxW8I>
- Souza, J. C. S., and E. C. Bruning, 2020: Flash propagation relative to radar-estimated turbulence during the KtAl experiment. *Proc. Fourth Texas Weather Conference*, 24–25 September 2020, URL

- <https://youtu.be/TC0IwzWxW8I>
- Welty, T., and E. C. Bruning, 2020: Using lightning's microphysical link to better understand storm conditions and processes. *Proc. Fourth Texas Weather Conference*, 24–25 September 2020, URL <https://youtu.be/TC0IwzWxW8I>
- Williams, J., E. C. Bruning, E. R. Mansell, and K. Ardon-Dryer, 2020: Effects of ice nuclei particle parameterization on cloud formation and electrification using the COMMAS model. *Preprints, 12th Symposium on Aerosol - Cloud - Climate Interactions*, Paper 1431, AMS Annual Meeting, Boston, MA, USA
- Bruning, E. C., V. Salinas, and L. Schielicke, 2019a: Concerning the coupling of fluid flows to thunderstorm electrostatics and lightning. *Preprints, 22nd Conference on Atmospheric and Oceanic Fluid Dynamics*, Poster 2, Portland, ME, USA
- Bruning, E. C., 2019c: When you wish upon a star: Early Career Scientist perspectives on the future of Beyond Earth sciences. *Eos Trans. AGU, Fall Meet. Suppl.*, U34A (invited panelist)
- Bruning, E. C., C. J. Schultz, and K. M. Calhoun, 2019b: Quantification of lightning flash characteristics using meteorological imagery from the Geostationary Lightning Mapper. *Eos Trans. AGU, Fall Meet. Suppl.*, AE24A–03
- Bruning, E. C., C. E. Tillier, S. F. Edgington, J. K. Zajic, S. D. Rudlosky, K. M. Calhoun, C. M. Gravelle, and M. Foster, 2019c: Design and implementation of GLM gridded imagery for operations and research. *Preprints, Ninth Conference on the Meteorological Application of Lightning Data*, Paper TJ21.1, Phoenix, AZ
- Calhoun, K. M., T. C. Meyer, E. C. Bruning, C. J. Schultz, G. T. Stano, P. A. Campbell, J. K. Zajic, and S. D. Rudlosky, 2019: Operational use, analysis, and applications of Geostationary Lightning Mapper data in the Hazardous Weather Testbed. *Preprints, 15th Annual Symposium on New Generation Operational Environmental Satellite Systems*, Paper TJ14.1, Phoenix, AZ
- Lyons, W. A., and Coauthors, 2019: Documenting a 400+ km long mesoscale lightning flash in an MCS trailing stratiform region using GLM, NLDN, and OKLMA data. *Preprints, Ninth Conference on the Meteorological Application of Lightning Data*, Paper TJ20.1, Phoenix, AZ
- Newbern, D., and E. C. Bruning, 2019: Winter lightning events in Iowa. *Eos Trans. AGU, Fall Meet. Suppl.*, AE11A–3196
- Nixon, C., and E. C. Bruning, 2019: The GOES-16 Geostationary Lightning Mapper: Using lightning trends operationally during tornadic storms in VORTEX-SE and other cases. *Preprints, Ninth Conf. on the Meteorological Applications of Lightning Data*, AMS Annual Meeting, Phoenix, AZ, Paper 7.1
- Rudlosky, S. D., E. Bruning, K. M. Calhoun, and C. J. Schultz, 2019a: Geostationary Lightning Mapper products. *Preprints, 2019 Joint Satellite Conference*, Paper 13A.1, Boston, MA, USA
- Salinas, V., E. C. Bruning, L. Schielicke, E. Mansell, and M. D. Brothers, 2019: Enhancement of electric fields and charge density by thunderstorm turbulence leading to flash initiation in simulated thunderstorms. *Eos Trans. AGU, Fall Meet. Suppl.*, AE24A–15
- Salinas, V., and E. C. Bruning, 2019: Observations of lightning flash characteristics in turbulent environments of thunderstorms. *Preprints, Ninth Conference on the Meteorological Application of Lightning Data*, Paper 2.2, Phoenix, AZ
- Schultz, C. J., L. D. Carey, N. Curtis, K. M. Calhoun, and E. C. Bruning, 2019: Characterization of optical energy output in thunderstorms to enhance severe thunderstorm identification. *Preprints, Ninth Conference on the Meteorological Application of Lightning Data*, Paper 7.4, Phoenix, AZ
- Sharma, M., R. Tanamachi, E. Bruning, K. M. Calhoun, H. B. Bluestein, J. B. Houser, J. C. Snyder, and Z. B. Wienhoff, 2019: Observational analysis of the electrical and kinematic structure of a tornadic supercell. *Preprints, Ninth Conference on the Meteorological Application of Lightning Data*, Paper 2.5, Phoenix, AZ
- Souza, J. C. S., and E. C. Bruning, 2019: Flash propagation relative to radar-estimated turbulence during the KTaL experiment. *Eos Trans. AGU, Fall Meet. Suppl.*, AE21B–3064
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Current and Pending Support

- Collaborative Research: Microphysical Illumination of Large Lightning Study; TTU PI Eric Bruning. Funding Agency: NSF. \$691,594, 0.5/1.0/1.0 months per year, 1 September 2021 - 31 August 2024. Program Manager: Nicholas Anderson, NSF AGS/PDM, (703) 292-4715, nanderso@nsf.gov. (pending, 100% of TTU effort, \$691,594). Indirect cost portion: \$208,753.
- Environmental and Storm-generated Controls in Modulating Quasi-linear Convective System Vertical Vorticity: Dynamics and Detection; TTU PI Christopher Weiss. Funding Agency: NOAA. \$1,589,283, 1.0/1.0/1.0 months per year, 1 September 2021 - 31 August 2024. Three subaward institutions. Program Manager: Bruce Gibbs, NOAA OAR, bruce.t.gibbs@noaa.gov, (301) 734-1134. (current, 50% of TTU effort, \$369,080). Indirect cost portion: \$261,160.
- Polarimetric radar & lightning analysis and high resolution simulations to support TRACER science goals; TTU PI Eric Bruning, Funding Agency: DOE via subaward from Columbia Univ. (Columbia PI Marcus van Lier-Walqui). \$269,569, 1.0/1.0/1.0 months per year, 1 August 2020-31 July 2023. Program Manager: Shaima Nasiri, DOE CESD/ASR, (301) 903-0207, Shaima.Nasiri@science.doe.gov. (current, 100% of TTU effort, \$269,569). Indirect cost portion: \$84,085.
- Collaborative Research: Experiment of Sea Breeze Convection, Aerosols, Precipitation and Environment (ESCAPE). PI: Eric Bruning, Funding Agency: NSF, \$157,644, 0.5/1.5/1.0 months per year, 1 January 2021 - 31 December 2023. Program Manager: NSF AGS/PDM, Nicholas Anderson, (703) 292-4715, nanderso@nsf.gov. (current, 100% of TTU effort, \$157,644). Indirect cost portion: \$50,780.
- TTU support for drop size distribution and rainfall profiles at the 200m tower. Subaward of “Collaborative Research to Explore the Spatial/Temporal Statistical-Physical Structures of Rain in the Vertical Plane,” AGS-2001490. TTU PI: Eric Bruning, Funding Agency: College of Charleston (original source: NSF), \$ 35,131 1 April 2020 – 31 March 2023, 0 months per year (current, 50% of TTU effort, \$ 17,566).
- Texas Tech University Support to GOES-R GLM Validation. PI: Eric Bruning, Funding Agency: NOAA/NASA-MSFC, \$463,947, 1.5/1.0/1.5 months per year, 1 September 2019 – 31 August 2022. Program Manager: Richard Blakeslee, NASA MSFC, (256) 961-7962, rich.blakeslee@nasa.gov. (current, 100% of TTU effort, \$463,947). Indirect cost portion: \$127,905.
- VORTEX-SE: Characterization of microphysical processes in potentially tornadic Southeast U.S. storms via polarimetric radar - disdrometer - lightning synthesis. PI: Eric Bruning, Funding Agency: NOAA, \$147,273, 1 September 2019 – 31 August 2022, 0/1 months per year. Program Manager: NOAA OAR/OWAQ, Kandis Boyd, (301) 734-1026, kandis.boyd@noaa.gov. (current, 50% of TTU effort, \$73,636). Indirect cost portion: \$44,617.
- Optimizing Geostationary Lightning Mapper Use in AWIPS. PI: Eric Bruning, Funding Agency: NOAA via U. Maryland CISES subcontract, \$211,742, 1 August 2019 – 31 July 2022, 0.5 / 0.5 months per year. Program Manager: Fernando Miralles-Wilhelm, U. Maryland CISES, (301) 405-0788, fwilhelm@umd.edu. (current, in no-cost extension, 100% of TTU effort, \$136,587) Indirect cost portion: \$41,780.

Previous awards

- VORTEX-SE: Establishing the Interdependence of Thermodynamic State, Lightning, and Low-Level Vorticity as a Foundation for Improved Forecaster Awareness of Southeast U.S. Storms. PI: Christopher Weiss, Funding Agency: NOAA, \$299,040, 1 September 2018 – 31 August 2021, 1/1 months per year. Program Manager: NOAA OAR/OWAQ, Kandis Boyd, (301) 734-1026, kandis.boyd@noaa.gov. (50% of TTU effort, \$149,520) Fully expended. Indirect cost portion: \$89,350.
- CAREER: Thunderstorm electrical energy structure, dissipation, and visualization. PI: Eric Bruning, Funding Agency: NSF, \$738,576, 0.25/1/1/1/1 months per year, 1 May 2014 – 30 April 2021. Program Manager: Nicholas Anderson, NSF AGS/PDM, (703) 292-4715, nanderso@nsf.gov. (100% of TTU effort, \$738,576). Fully expended. Indirect cost portion: \$214,246.
- Meteosat Third Generation Lightning Imager / Geostationary Lightning Mapper Intercomparison Study; TTU PI Eric Bruning, Funding Agency: National Meteorological Administration of Romania (original source: EUMETSAT). \$37,430.00, 1 semester teaching buyout, 15 December 2020 - 15 April 2021. Contact: Andrei Diamandi, NMA Romania and EUMETSAT NWC SAF Local Manager, diamandi@meteoromania.ro. Fully expended. (100% of TTU effort, \$37,430.00). Indirect cost portion: \$12,641.92.
- VORTEX-SE: Insights into the Structure and Predictability of Southeastern U.S. Tornadoic Storms Afforded by Intensive Observation and High-Resolution Numerical Modeling. PI: Christopher C. Weiss, Funding Agency: NOAA, \$149,754, 1 September 2017 – 31 August 2020, 0/0 months per year. Program Manager: NOAA OAR/OWAQ, Kandis Boyd, (301) 734-1026, kandis.boyd@noaa.gov. (33% of TTU effort, \$49,418). Fully expended. Indirect cost portion: \$45,758.
- Precipitation Drop Size Measurement on the TTU 200 m Tower. PI: Eric Bruning, Funding Agency: College of Charleston (original source: NSF), \$ 10,609 1 March 2019 – 31 March 2020, 0 months per year (current, 50% of TTU effort, \$ 5,304). Fully expended.
- Optimizing Geostationary Lightning Mapper Use in AWIPS. PI: Eric Bruning, Funding Agency: NOAA via U. Maryland CICS subcontract, \$61,895, 1 September 2018 – 30 June 2020, 1 month total (current, 100% of TTU effort, \$61,895). Fully expended.
- Cloud-ready Processing and Dissemination of GOES-16 Geostationary Lightning Mapper Gridded Imagery. PI: Eric Bruning, Funding Agency: Univ. Corp. Atmos. Res. / Unidata Equipment Award program, \$14,207, 1 May 2018 – 30 September 2019, 0 months per year (100% of TTU effort, \$14,207)
- VORTEX-SE: The Role and Predictability of Baroclinic and Terrain Influences in Southeastern U.S. Tornado Environments. PI: Christopher C. Weiss, Funding Agency: NOAA, \$249,835, 1 October 2016 – 30 September 2018, 0/1 months per year (33% of TTU effort, \$82,445)
- Texas Tech University Support to GOES-R GLM Validation. PI: Eric Bruning, Funding Agency: NOAA/NASA-MSFC, \$224,763, 1/1/1 months per year, 6 January 2016 – 1 September 2019 (100% of TTU effort, \$224,763)
- VORTEX-SE: Improving Understanding and Predictability of Tornadoic Storms in the Southeastern U.S. Using Intensive Observations and High-Resolution Modeling. PI: Christopher C. Weiss, Funding Agency: NOAA, \$249,942, 1 September 2015 – 31 August 2017, 1/1 month per year (33% of TTU effort, \$82,481)
- Collaborative Research: Thunderstorm Influences on Lightning and Atmospheric Chemistry in Oklahoma and North Texas during the Deep Convective Clouds and Chemistry (DC3) Project. PI: Eric Bruning, Funding Agency: NSF, \$271,732, 1/1/1/0/0 months per year, January 1 2012 – 31 December 2016 (100% of TTU effort, \$271,732)

- Texas Tech University Support to GOES-R GLM Validation. PI: Eric Bruning, Funding Agency: NOAA/NASA-MSFC, \$224,998, 2/2/1.75 months per year, 22 December 2011 – 22 December 2015 (100% of TTU effort, \$224,998)
- Establishment of a Joint Atmospheric Sciences- National Wind Institute Research Electronics Lab at Texas Tech University PI: Eric C. Bruning, Co-I: Jennifer K. Vanos, Funding Agency: Texas Tech University National Wind Institute Discovery Program, 2 weeks support, \$39,714.00, 1 May 2015 – 31 August 2015 (60% of TTU effort, \$23,828)
- Operational Trials of Total Lightning Data and Training at the NWS Lubbock Forecast Office. PI: Eric Bruning, Funding Agency: COMET/UCAR, \$14,934, 0 months per year, 1 May 2011 – 31 Aug 2013 (100% of TTU effort, \$14,934)
- *Risk Reduction Research for the GOES-R Geostationary Lightning Mapper*, PI: Phil Arkin, Funding Agency: NOAA, \$135,000, 1 month per year, 1 October 2010 – 30 September 2011 (100% of TTU effort, \$51,538)

Declined grant activity

- Consortium Proposal to Implement the WeST-M3 Infrastructure to Enable Convergent Research at the Weather-Social- Technology Interface; TTU PI John Schroeder; TTU Co-PIs Eric Bruning and Jennifer Henderson. Other institutions: Northwestern University, 2i2c and UC Berkeley, University of Houston, Arizona State University. Funding Agency: National Science Foundation, Mid-Scale Research Infrastructure program. \$19,999,000.00, 1 October 2021 – 30 September 2026. Preliminary proposal declined. (20% of TTU effort).
- Impact of boundary layer kinematics and aerosol physicochemical properties on convection initiation downwind of an urban hotspot (Houston) within the TRACER project; TTU PI Sandip Pal, Funding Agency: DOE. \$835,242 1.0/0.0/0.0 months per year, 1 August 2020-31 July 2023. Program Manager: Shaima Nasiri, DOE CESD/ASR, (301) 903-0207, Shaima.Nasiri@science.doe.gov. (pending, 10% of TTU effort, \$83,524). Indirect cost portion: \$263,805.
- Developing merged GLM products and applications from GOES 16 and 17: blending ground truth with storm characteristics to evaluate abilities and additional capabilities; TTU PI Eric Bruning, Funding Agency: NASA via subaward from U. Oklahoma (Oklahoma PI Vanna Chmielewski). \$297,057, 0.5/1.0/1.5 months per year, 1 Sep 2020-31 Aug 2023. Program Managers: Tsengdar Lee, NASA SMD/ESD, (202) 358-0860, tsengdar.lee@nasa.gov; Daniel T. Lindsey, NOAA GOES-R Program, (970) 491-8773, dan.lindsey@noaa.gov. (declined, 100% of TTU effort, \$297,057). Indirect cost portion: \$92,420.
- Using GLM Flash Density, Flash Area, and Flash Energy to Diagnose Tropical Cyclone Structure and Intensification; TTU PI Eric Bruning, Funding Agency: NASA, TTU subaward on proposal led by Patrick Duran (NASA-MSFC), \$98,722, 0.5/1.0/1.5 months per year, 1 Sep 2020-31 Aug 2023. Program Managers: Tsengdar Lee, NASA SMD/ESD, (202) 358-0860, tsengdar.lee@nasa.gov; Daniel T. Lindsey, NOAA GOES-R Program, (970) 491-8773, dan.lindsey@noaa.gov. (declined, 100% of TTU effort, \$98,722). Indirect cost portion: \$34,047.
- Collaborative Research: Study of Negative Lightning Leader Stepping. PI: Eric Bruning, Funding Agency: NSF, \$103,454 , 1 May 2018 – 30 April 2021, 0/1/1 months per year (declined, 100% of TTU effort, \$103,454)
- Augmentation of vertical and horizontal ozone profiles with miniature NO_x and CO sensors in Houston, TX. PI: Jennifer Vanos. Agency: Texas Air Quality Research Program, \$172,679, 0 months per year, 1 July 2016 – 31 August 2017 (declined)
- CC*DNI DIBBs: Enhance Unidata Data Facility with a Scalable Lightning Data Infrastructure and Geospatial Capabilities. PI: Guofeng Cao, Co-Is: Ryan May, Yong Chen, Eric Bruning. Funding Agency: NSF, \$1,380,219, \$662,749 is non-TTU. 1/1/1 months per year. Oct 1 2015 - Sep 30 2018. (declined)

- ROSES: Linking cloud-top evidence of updraft processes to near-ground rotation PI: Eric C. Bruning, Co-Is: Johannes M. L. Dahl and Christopher C. Weiss (TTU) Christopher J. Schultz (NASA-MSFC), Edward R. Mansell (NOAA/OAR/NSSL) Funding Agency: NASA, \$451,380, 1/1/1 months per year, 1 July 2015 - 30 June 2018 (declined)
- ThUnderstorms, Precipitation and Aerosol interactions (TUPA). PI:Emmanouil Anagnostou (UCONN), Funding Agency: DOE/NASA-MSFC, \$95,658, 1 month per year, 1 January 2014 – 31 December 2016 (declined)
- Hazards SEES Type 2: An Integrated Framework for Enhancing Community Resiliency to Severe Thunderstorms. PI: Daan Liang (Texas Tech U.), Funding Agency: NSF, \$2,999,763, 1 month per year, 1 January 2014 – 31 December 2017 (declined)