

# Aaron Hill

## Curriculum Vitae

### Education

- 2019 **Ph.D., Geosciences, Texas Tech University.**  
Dissertation: Demonstration of ensemble sensitivity-based targeted observing for convective-scale applications: Perfect-model experiments
- 2014 **M.S., Atmospheric Sciences, Texas Tech University.**  
Thesis: Mesoscale data assimilation and ensemble sensitivity analysis towards improved predictability of dryline convection
- 2012 **B.S., Atmospheric Sciences, University of Washington.**  
Minor: Applied Mathematics

### Appointments

- 2022-present **Research Scientist II, Colorado State University.**
- 2021-2022 **Research Scientist I, Colorado State University.**
- 2019-2021 **Postdoctoral Research Fellow, Colorado State University.**  
Advisor: Dr. Russ Schumacher
- 2012 - 2019 **Graduate Research Assistant, Texas Tech University.**  
Advisors: Drs. Chris Weiss and Brian Ancell
- July - Sep 2018 **Graduate Student Visitor, Mesoscale and Microscale Meteorology Laboratory, National Center for Atmospheric Research.**  
Sponsor: Dr. Glen Romine
- 2011-2012 **Undergraduate Research Assistant, University of Washington.**  
Advisor: Dr. Robert Houze, Jr.

### Teaching

- 2022 **Guest Lecturer:** ATS 780A7: Machine Learning for the Atmospheric Sciences
- 2022 **Guest Lecturer:** ATS 641: Mesoscale Meteorology
- 2020 **Co-Instructor:** Department of Atmospheric Science Machine Learning Workshop, Colorado State University
- 2019 **Guest Lecturer:** ATMO 3316: Severe and Hazardous Weather
- 2015, 2017-2018 **Writing Tutor:** Graduate Student Writing Center, Texas Tech University
- 2016, 2017 **Instructor of Record:** ATMO 1300: Introduction to Atmospheric Science, Texas Tech University
- 2015 **Guest Lecturer:** ATMO 1300: Introduction to Atmospheric Science
- 2015 **Guest Speaker:** 6th Grade Science Class, Tahoka Middle School, Tahoka, TX
- 2014 **Guest Lecturer:** ATMO 2301: Weather, Climate, and Human Activities

### Mentoring

- 2022 Colorado State University Research Experiences for Undergraduates (REU) Program
- 2021-2022 PROMoting Geoscience Research, Education, and Success (PROGRESS) Program
- 2021-2022 ATS Department Mentoring Program

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## Funding Support

### Current

- 2021-2024 **Co-Investigator** (Co-PIs: Christopher Weiss, Daniel Dawson, Eric Bruning, Vanna Chmielewski, Matthew Kumjian, Russ Schumacher): "Environmental and Storm-generated Controls in Modulating Quasi-linear Convective System Vertical Vorticity: Dynamics and Detection", National Oceanic and Atmospheric Administration, \$135,065, 9/21-8/24.
- 2021-2023 **Co-Principal Investigator** (PI: Russ Schumacher): "Medium-range excessive rainfall forecasts with machine learning models", National Oceanic and Atmospheric Administration Joint Technology Transfer Initiative, ~\$338,000, 8/21-7/23
- 2020-2022 **Co-Principal Investigator** (PI: Russ Schumacher): "Generating calibrated forecast guidance for severe weather beyond day 1", National Oceanic and Atmospheric Administration Joint Technology Transfer Initiative, \$433,209, 9/20-8/22.

### Completed

- 2018-2019 **Doctoral Dissertation Completion Fellowship**: one year of salary (\$24,000), 9/1/18-8/31/19.
- 2017 **Student Travel Award**: 20th Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface, \$550, January 2017.

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## Refereed Publications

### Submitted

- 2022 **Hill, A. J.**, R. S. Schumacher, and I. Jirak, 2022: A new paradigm for medium-range severe weather forecasts: probabilistic random forest-based predictions. *Weather and Forecasting*, submitted.
- Cheeseman, Michael, B. Ford, Z. Rosen, E. Wendt, A. DesRosiers, **A. J. Hill**, C. L'Orange, C. Quinn, M. Long, S. H. Jathar, J. Volckens, and J. R. Pierce, 2022: Investigating sub-city gradients of air quality: lessons learned with low-cost PM2.5 and AOD monitors and machine learning. *Atmospheric Chemistry and Physics*, in review, <https://doi.org/10.5194/acp-2021-751>.

### Accepted

### Published

- 2021 **Hill, A. J.** and R. S. Schumacher, 2021: Forecasting excessive rainfall with random forests and a deterministic convection-allowing model. *Weather and Forecasting*, 36, 1693–1711, [doi.org/10.1175/WAF-D-21-0026.1](https://doi.org/10.1175/WAF-D-21-0026.1).
- Schumacher, R. S., **A. J. Hill**, M. Klein, J. Nelson, M. Erickson, S. M. Trojaniak, and G. R. Herman, 2021: From random forests to flood forecasts: A research to operations success story. *Bulletin of the American Meteorological Society*, 102, E1742–E1755, [doi:10.1175/BAMS-D-20-0186.1](https://doi.org/10.1175/BAMS-D-20-0186.1)
- Hill, A. J.**, C. C. Weiss, and D. C. Dowell, 2021: Influence of a portable near-surface observing network on experimental ensemble forecasts of deep convection hazards during VORTEX-SE. *Weather and Forecasting*, 36, 1141–1167, [doi.org/10.1175/WAF-D-20-0237.1](https://doi.org/10.1175/WAF-D-20-0237.1).
- 2020 **Hill, A. J.**, C. C. Weiss, and B. C. Ancell, 2020: Factors influencing ensemble sensitivity-based targeted observing prediction at convection-allowing resolutions. *Monthly Weather Review*, 148, 4497–4517, [doi:10.1175/MWR-D-20-0015.1](https://doi.org/10.1175/MWR-D-20-0015.1).
- Hill, A. J.**, G. R. Herman, and R. S. Schumacher, 2020: Forecasting severe weather with random forests. *Monthly Weather Review*, 148, 2136–2161, [doi:10.1175/MWR-D-19-0344.1](https://doi.org/10.1175/MWR-D-19-0344.1).
- 2016 **Hill, A. J.**, C. C. Weiss, and B. C. Ancell, 2016: Ensemble sensitivity analysis for mesoscale forecasts of dryline convection initiation. *Monthly Weather Review*, 144, 4161–4182. [doi:10.1175/MWR-D-15-0338.1](https://doi.org/10.1175/MWR-D-15-0338.1).
- 2014 Rasmussen, K. L., **A. J. Hill**, V. E. Toma, M. D. Zuluaga, P. J. Webster, and R. A. Houze, Jr., 2014: Multiscale analysis of three consecutive years of anomalous flooding in Pakistan. *Quart. J. Roy. Meteor. Soc.*, 141, 1259–1276. [doi:10.1002/qj.2433](https://doi.org/10.1002/qj.2433).

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## Presentations in Last Five Years

Full presentation list: [https://ahill1818.github.io/full\\_preslist.html](https://ahill1818.github.io/full_preslist.html)

\*Upcoming presentation

- 2022 \***Hill, A. J.**, R. S. Schumacher, and I. Jirak, 2022: Medium-range severe weather predictions with random forests. 30th Conference on Severe Local Storms, Santa Fe, NM.
- \*Mazurek, A., R. S. Schumacher, and **A. J. Hill**, 2022: Evaluating random forest-based predictions of tornadoes, wind, and hail at two- to three-day lead times. 30th Conference on Severe Local Storms, Santa Fe, NM.
- \*Schumacher R. S., **A. J. Hill**, and A. Mazurek, 2022: Probabilistic forecast guidance for severe convective storms using GEFS reforecasts and machine learning. 30th Conference on Severe Local Storms, Santa Fe, NM.
- (invited) Hill A. J.**, 2022: Generating probabilistic machine-learned forecasts for severe weather and excessive rainfall prediction. National Weather Service Central Region Headquarters, virtual.
- Schumacher R. S. and **A. J. Hill**, 2022: Updates and improvements to Colorado State University-Machine Learning Probabilities excessive rainfall forecasts. Hydrometeorological Testbed Flash Flood and Intense Rainfall Experiment, virtual.
- Hill, A. J.**, 2022: Probabilistic predictions of severe weather with machine learning. Columbia, SC Weather Forecast Office Severe Weather Workshop, virtual
- Cheeseman, M., B. Ford, Z. Rosen, E. Wendt, A. J. DesRosiers, **A. J. Hill**, C. L'Orange, C. Quinn, M. Long, S. H. Jathar, J. Volckens, and J. R. Pierce, 2022: Neighborhood scale variability of co-incident PM2.5 and AOD: Results from Citizen Enabled Aerosol Measurements for Satellites (CEAMS). 24th Conference on Atmospheric Chemistry, poster.
- Escobedo, J. A., R. S. Schumacher, and **A. J. Hill**, 2022: Colorado State University Machine Learning Probabilities day 1 probabilistic excessive rainfall forecasts: synoptic regimes of the best- and worst-performing forecasts. 21st Annual Student Conference, poster.
- Hill, A. J.** and R. S. Schumacher, 2022: Medium-range predictions of severe weather with machine learning. 31st Conference on Weather Analysis and Forecasting/27th Conference on Numerical Weather Prediction, J7.2.
- James, E. P., **A. J. Hill**, and R. S. Schumacher, 2022: A first guess day-one Excessive Rainfall Outlook based on a skill-weighted blend of random forest prediction systems, 21st Conference on Artificial Intelligence for Environmental Science, poster.
- Nielsen, E. R. and **A. J. Hill**, 2022: Exploring multi-hazard joint probability forecasts through the lens of tornadoes and flash floods. 19th Conference on Mesoscale Processes, J3.4.
- Schumacher, R. S., **A. J. Hill**, and I. L. Jirak, 2022: Probabilistic forecast guidance for severe convective storms using GEFS reforecasts and machine learning. 31st Conference on Weather Analysis and Forecasting/27th Conference on Numerical Weather Prediction, J7.4.
- 2021 **Hill, A. J.** and R. S. Schumacher, 2021: Medium-range forecasts of hazardous weather with machine learning. 3rd NOAA Workshop on Leverage AI in Environmental Sciences, virtual poster.
- Hill, A. J.**, R. S. Schumacher, and J. Escobedo, 2021: Extending predictions of hazardous weather into the medium-range with machine learning. 2nd Knowledge-Guided Machine Learning Workshop, poster, virtual poster.
- Hill, A. J.** and R. S. Schumacher, 2021: Advancing probabilistic prediction of high-impact weather using ensemble reforecasts and machine learning. National Weather Service AI Team, virtual.
- Hill, A. J.**, E. James, R. S. Schumacher, M. Klein, J. Nelson, and M. J. Erickson, 2021: CSU CAM-based first guess excessive rainfall outlook products. Hydrometeorological Testbed Flash Flood and Intense Rainfall Experiment, virtual.
- Schumacher, R. S. and **A. J. Hill**, 2021: Advancing probabilistic prediction of high-impact weather using ensemble reforecasts and machine learning. Unified Forecast System (UFS) Webinar Series, virtual.
- (invited) Hill, A. J.**, 2021: Learning from machines: High-impact weather forecasting with Artificial Intelligence. University of Florida Department of Geography, virtual interview.
- (invited) Hill, A. J.**, 2021: Learning from machines: improving high-impact weather forecasts with Artificial Intelligence. Northern Illinois University Department of Geographic and Atmospheric Sciences, virtual interview.
- Hill, A. J.** and R. S. Schumacher, 2021: Medium-range severe weather forecasts with random forests, 20th Conference on Artificial Intelligence for Environmental Science, 3.2, virtual.

- Hill, A. J.** and R. S. Schumacher, 2021: Short-term excessive rainfall forecasts using random forests and a deterministic convection-allowing model, 20th Conference on Artificial Intelligence for Environmental Science, joint 12.8, virtual.
- Schumacher, R. S., **A. J. Hill**, M. Klein, J. Nelson, M. J. Erickson, and G. R. Herman, 2021: From random forests to flood forecasts: A research to operations success story, 11th Conference on Transition of Research to Operations, 14.9, virtual.
- 2020 **Hill, A. J.** and R. S. Schumacher, 2020: Random-forest severe guidance from the GEFS. Storm Prediction Center Fall Forecaster Training, virtual.
- (invited) Hill, A. J.**, 2020: Machine learning for convection hazard forecasts. NWS Southern Region Science and Technology Services Division Science Circle, virtual.
- (invited) Hill, A. J.**, 2020: Forecasting our future: machine learning and AI for high-impact weather. National Weather Association Annual Meeting, virtual.
- Hill, A. J.**, R. S. Schumacher, M. Klein, J. Nelson, and M. Erickson, 2020: First-guess excessive rainfall outlooks from machine learning models. Hydrometeorological Testbed Flash Flood and Intensive Rainfall Experiment.
- (invited) Hill, A. J.**, 2020: Statistical tools for high-impact weather. Naval Postgraduate School, Monterey, CA, interview.
- Hill, A. J.** and R. S. Schumacher, 2020: Heavy precipitation and flash flood forecasts using random forests and convection-allowing models. 30th Conference on Weather and Forecasting / 26th Conference on Numerical Weather Prediction, Boston, MA., J71.2
- Hill, A. J.**, C. C. Weiss, and D. C. Dowell, 2020: Assimilating near-surface observations from a portable mesoscale network of StickNet platforms during VORTEX-SE with the High Resolution Rapid Refresh Ensemble. Severe Local Storms Symposium, Boston, MA., 950
- Hill, A. J.**, C. C. Weiss, and B. C. Ancell, 2020: Factors influencing ensemble sensitivity-based targeted observing predictions at convection-allowing resolutions. 24th Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface, Boston, MA., 10.4
- McDonald, J. M., C. C. Weiss, and **A. J. Hill**, 2020: Properties of cold pools observed during the VORTEX-SE: Meso18-19 field campaign. Severe Local Storms Symposium, Boston, MA., 946
- Schumacher, R. S., **A. J. Hill**, G. R. Herman, M. Erickson, B. Albright, M. Klein, and J. A. Nelson Jr., 2020: If a flood falls in a (random) forest, does it get counted? Advances and challenges in predicting excessive precipitation using machine learning. 30th Conference on Weather and Forecasting / 26th Conference on Numerical Weather Prediction, Boston, MA., J71.3
- 2019 Ancell, B. C., A. A. Coleman, and **A. J. Hill**, 2019: Ensemble sensitivity-based subsetting overview and evaluation activities at the 2018 NOAA HWT. European Geophysical Union General Assembly 2019, Vienna, Austria, EGU2019-2435.
- Weiss, C. C., E. C. Bruning, J. Dahl, and **A. J. Hill**, 2019: Texas Tech VORTEX-SE Activities. VORTEX-SE Workshop, Huntsville, AL.
- Ancell, B. C., A. A. Coleman, and **A. J. Hill**, 2019: Ensemble sensitivity-based subsetting overview and evaluation activities at the 2018 NOAA HWT. 23rd Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface, Phoenix, AZ, paper 2.3A.
- Weiss, C. C., D. C. Dowell, N. Yussouf, and **A. J. Hill**, 2019: Insights into mesoscale and storm-scale predictability gained through ensemble sensitivity analysis. 23rd Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface, Phoenix, AZ, paper 20.1.
- 2018 Ancell, B. C., A. A. Coleman, and **A. J. Hill**, 2018: Ensemble sensitivity-based subsetting overview and evaluation activities at the 2018 NOAA HWT. American Geophysical Union Fall Meeting, Washington, D.C.
- Ancell, B. C., A. A. Coleman, **A. J. Hill**, and C. C. Weiss, 2018: Ensemble sensitivity-based subsetting overview and evaluation activities at the 2018 NOAA HWT. 29th Conference on Severe Local Storms, Stowe, VT, paper 3A.4.
- Hill, A. J.**, C. C. Weiss, and B. C. Ancell, 2018: Towards improving forecasts of severe convection along the dryline through targeted observing with ensemble sensitivity analysis. 29th Conference on Severe Local Storms, Stowe, VT, paper 14.2.

**Hill, A. J., C. C. Weiss, and D. C. Dowell, 2018:** Exploring the utility of assimilating observations from a mesoscale network of StickNet platforms during VORTEX-SE with the High Resolution Rapid Refresh Ensemble. 29th Conference on Severe Local Storms, Stowe, VT, paper 74.

Weiss, C. C., D. C. Dowell, **A. J. Hill**, J. McDonald, E. C. Bruning, and J. Dahl, 2018: An update on VORTEX-SE activities at Texas Tech University. 29th Conference on Severe Local Storms, Stowe, VT, paper 3B.1.

**(invited) Hill, A. J., 2018:** The utility of ensemble-sensitivity analysis for targeted observing, ensemble subsetting, and investigating environmental controls on storm characteristics. Cooperative Institute for Research in the Atmosphere, Fort Collins, CO.

**Hill, A. J., C. C. Weiss, and B. C. Ancell, 2018:** Ensemble-sensitivity analysis based observation targeting experiments for mesoscale convection forecasts and factors influencing observation-impact prediction. 22nd Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface, Austin, TX, paper 613.

Weiss, C. C., D. C. Dowell, **A. J. Hill**, and N. Yussouf, 2018: Ensemble sensitivity analysis of controls on storm-scale vertical vorticity for two southeastern U.S. tornado events. 22nd Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface, Austin, TX, paper 610.

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## Honors and Awards

- 2019-2020 **WxChallenge Category 1** cumulative winner, runner-up in Cold Bay, AK and Cheyenne, WY
- 2017 **WxChallenge** final-four finalist in 2017 end-of-year tournament
- 2013 **TTU Geoscience Scholarship:** Awarded to graduate students nominated by their respective department
- 2012 **Jurica Fellowship:** Awarded to new, incoming graduate students nominated by their prospective department
- 2012 **Atmospheric Sciences Achievement Award:** Graduating seniors in the Department of Atmospheric Sciences (Washington) who have achieved a GPA of 3.5 or higher in degree courses
- 2012 **Phil Church Award:** Graduating senior in the Department of Atmospheric Sciences (Washington) with the most outstanding record of scholarship, leadership, and service
- 2010-2012 **Naval Weather Service Association Scholar:** Proven academic achievement and student community leadership

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## Leadership Activities and Service

- 2022 **Member:** AMS 30th Conference on Severe Local Storms Program Committee
- 2021-present **Staff Representative:** Department of Atmospheric Science, Colorado State University
- 2021-present **Member:** Research to Operations Nexus Meetup Planning Committee
- 2021-present **Associate Editor:** Artificial Intelligence for Earth Systems
- 2020-present **Associate Editor:** Monthly Weather Review
- 2019-present **Member:** AMS Scientific and Technological Activities Commission Committee on Weather Analysis and Forecasting  
5 yr Strategic Planning Subcommittee  
Social Media Subcommittee
- 2016-present **Reviewer for:** Weather and Forecasting, Monthly Weather Review, Journal of Atmospheric Sciences, Journal of Applied Meteorology and Climatology, Bulletin of the American Meteorological Society, JGR-Atmospheres, Geophysical Research Letters, Weather and Climate Dynamics, Meteorological Applications, Energies, and Journal of Operational Meteorology
- 2022 **Participant:** The 2nd Mind the Gap Workshop: Educating the Next Generation of Atmospheric Scientists for Careers in Industry
- 2020-2022 **Chair:** AMS 31st Conference on WAF/27th Conference on NWP Program Committee
- 2021 **Participant:** Implicit and Explicit Bias Workshop, Department of Atmospheric Science, Colorado State University
- 2019-2022 **Participant:** Hydrometeorological Testbed (NOAA) Flash Flooding and Intense Rainfall Experiment
- 2014, 2018, 2021, 2022 **Participant:** Hazardous Weather Testbed (NOAA) Spring Forecast Experiment

- 2021 **Contributor:** National Oceanic and Atmospheric Administration White Paper on exploring ways to increase the near-term operational utility of existing observations and analysis systems
- 2021 **Session Co-Chair:** Special Symposium on Global and Mesoscale Models: Updates and Center Overviews: Utilization and Development of Rapidly Updating Mesoscale Models for Impact-Based Decision Support Services, AMS Annual Meeting 2021
- 2019-2020 **Member:** AMS 30th Conference on WAF/26th Conference on NWP Program Committee, Conference Session Chair
- 2019 **Participant:** Workshop: Increasing Inclusivity in the Engineering Classroom
- 2013-2019 **Team Manager:** WxChallenge Competition, Texas Tech University
- 2017-2018 **Member:** AMS 29th Conference on WAF/25th Conference on NWP Program Committee
- 2017-2018 **Student Member:** Texas Tech University College of Arts and Sciences Committee on Academic Programs
- Rapporteur:** 2017 NOAA R2O meeting and 2018 AMS Community Meeting
- 2015-2016 **Member:** 15th AMS Student Conference Planning Committee  
Poster Session Subcommittee and Session Chair
- 2014-2015 **Member:** 14th AMS Student Conference Planning Committee
- 2013-2015 **Secretary:** American Meteorological Society Student Chapter, Texas Tech University
- 2013, 2014 **Reviewer:** Texas Tech University Undergraduate Research Conference
- 2012-2013 **President:** American Meteorological Society Student Chapter, Texas Tech University
- 2011-2012 **President:** American Meteorological Society Student Chapter, University of Washington

## Fieldwork Participation

- 2019 Targeted Observations by Radars and UAS of Supercells (**TORUS**): Assisted fieldwork operations and led numerous forecast discussions.
- 2013-2019 Deploying mobile radars for interceptions of outflow boundaries, tornadoes, and mesoscale convective systems for the Texas Tech University Severe Storm Research Group.
- 2018 National Robotics Initiative: Assisted fieldwork operations with two mobile Ka-band radars to support unmanned aircraft flights in and around supercell thunderstorms.
- 2017 Rivers of VORTicity in Supercells (**RiVorS**): Assisted fieldwork operations with a mobile Ka-band radar to observe vorticity rivers.
- 2016-2017 Verification of the Origins of Rotation in Tornadoes Experiment-Southeast (**VORTEX-SE**): Student technician responsible for: integrating solar panel hardware into the Texas Tech StickNet observing platforms, altering existing hardware and software, maintaining stationary observing sites, developing web display, and producing analysis graphics.
- 2014-2015 Air Force Office of Scientific Research (**AFOSR**) project: Assisted fieldwork operations with mobile Ka-band radars to adaptively sample baroclinic boundaries near supercells. Contributed to development of computer processing techniques and communications for real-time dual-doppler analyses.
- 2013 Assisted in the rebuilding of TTU StickNet data acquisition systems in support of the TTU Hurricane Research Team.

## Interviews and Other Publications

- 05/2022 The Conversation: "AI and machine learning are improving weather forecasts, but they won't replace human experts"
- 7/22/21 KUNC to discuss recent flash-flood producing storms in Colorado
- 9/24/18 Daily Toreador newspaper regarding severe storm research in the Texas Tech Atmospheric Sciences Group
- 2/24/17 Texas Tech University Communications for the VORTEX-SE 2017 field program
- 3/16/16 Alabama Public Radio for Texas Tech involvement with the VORTEX-SE field program
- 2/11/16 Texas Tech University Climate Science Center Videos for Science series
- 12/15 Texas Living Magazine (online) regarding Texas weather

## Professional Associations

- 2017-present American Geophysical Union

2012-present American Meteorological Society

## Technical Skills

\* indicates proficiency

Programming Languages: Python\*, shell\*, Fortran, NCL, LabVIEW, HTML/CSS/PHP/Javascript

Meteorological Software: WRF\*, DART\*