Andrea Schumacher

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EDUCATION

2005	M.S. in ATMOSPHERIC SCIENCE, Colorado State University, Fort Collins, CO
	Thesis: A Vortical Hot Tower Approach to Tropical Cyclogenesis
2000	B.A. in MATHEMATICS/CHEMISTRY, New College of Florida, Sarasota, FL
	Thesis: Optimal Transitional Labelings of Graphs: A Polarization Approach

PROFESSIONAL EXPERIENCE

2021-present	RESEARCH ASSOCIATE IV, Tropical Cyclones/Training/Societal Impacts, Cooperative Institute for Research in the Atmosphere (CIRA)
2020-present	RESEARCHER, Risk Communication, National Center for Atmospheric Research (NCAR), Microscale and Mesoscale Meteorology (MMM) Laboratory
2019-2020	GOES-R SATELLITE TRAINING LIAISON, CIRA
2015-2019	GOES-R SATELLITE LIAISON TO THE NATIONAL HURRICANE CENTER, CIRA
2015-2018	TROPICAL CYCLONE GROUP TECHNICAL LEAD, CIRA
2012-2021	RESEARCH ASSOCIATE III, Tropical Cyclones/Training, CIRA
2006-2012	RESEARCH ASSOCIATE II, Tropical Cyclones, CIRA
2001-2004	GRADUATE RESEARCH ASSISTANT, Colorado State University
2002-2004	GRADUATE TEACHING ASSISTANT, Atmospheric Dynamics I, Colorado State University

FORECAST PRODUCTS AND DATASETS DEVELOPED

- TROPICAL CYCLONE FORMATION PROBABILITY (TCFP) PRODUCT (co-developer, version operational 2012-2022) [https://www.ssd.noaa.gov/PS/TROP/TCFP/index.html]
- TROPICAL CYCLONE GENESIS INDEX (TCGI) (co-developer) [https://rammb.cira.colostate.edu/projects/tc_genesis/index_2020.asp]
- STORMWINDMODEL (co-developer) [https://cran.r-project.org/web/packages/stormwindmodel/index.html]
- HURRICANEEXPOSURE (co-developer) [https://cran.r-project.org/web/packages/hurricaneexposure/index.html]
- HURRICANE EVACUATION ORDER DATABASE (developer) [https://github.com/abschu11/us_hurricane_evacuation_orders]

FUNDED RESEARCH GRANTS AND CONTRACTS

2021-2023 "Unification and Improvements to Guidance for National Weather Service Tropical Cyclone Wind and Storm Surge Hazard Products." PI: **A. Schumacher**, co-PI: K. Musgrave. Funded by NOAA-OAR-Joint Technology Transfer Initiative (JTTI) [$353K]

2018-2020 "Using dynamically-based probabilistic forecast systems to improve the National Hurricane Center wind speed probability products." PI: **A. Schumacher**, co-PI K. Musgrave. Funded by NOAA Research to Operations (R2O) Hurricane Forecast Improvement Project (HFIP) [$200K]

2016-2017 "Tropical Cyclone Forecast Aid Improvements." PIs: **A. Schumacher**, K. Musgrave, J. Knaff, and C. Sampson. Funded by DOD/Joint Typhoon Warning Center (Contract). [$315]

2015-2017 "Improvements to Operational Statistical Tropical Cyclone Intensity Forecast Models." PIs: G. Chirokova and **A. Schumacher**, NOAA Partner: J. Knaff. Funded by NOAA Joint Hurricane Testbed (JHT). [$167K]

2015-2017 "Improvement to the Tropical Cyclone Genesis Index (TCGI)." PI: J. Dunion, co-PIs: J. Kaplan and **A. Schumacher**. Funded by NOAA Joint Hurricane Testbed (JHT). [$84K]

2014-2015 "CIRA Support to Monte Carlo Model-based Wind Arrival and Departure Estimates." PI: **A. Schumacher**, NOAA Partner: M. DeMaria. Funded by Hurricane Sandy Supplemental Funding for NOAA [$93K]

2013-2015 "Upgrades to the Operational Monte Carlo Wind Speed Probability Program." PI: **A. Schumacher**, NOAA Partner: M. DeMaria. Funded by NOAA Joint Hurricane Testbed (JHT). [$86K]

2013-2015 "Guidance on Intensity Guidance." PI: D. Nolan, co-PI: **A. Schumacher**, NOAA Partner: M. DeMaria. Funded by NOAA Joint Hurricane Testbed (JHT). [$152K]

2012-2013 "New Statistical-Dynamical Intensity Forecast Models for the Indian Ocean and Southern Hemisphere." PI: **A. Schumacher**, NOAA Partners: M. DeMaria and J. Knaff. Funded by DOD/Joint Typhoon Warning Center [$96K]

2012-2013 "CIRA Support for Transition of Tropical Cyclone Forecast Products." PI: **A. Schumacher**, NOAA Partners: M. DeMaria and J. Knaff. Funded by The NESDIS Center for Satellite Applications and Research and GOES-Product Systems Development and Implementation (PSDI) program. [$90K]

2011-2013 "Development of a Probabilistic Tropical Cyclone Prediction Scheme." PI: J. Dunion, co-PIs: J. Kaplan, **A. Schumacher**, and J. Cossuth [$190K]

PUBLICATIONS – REFEREED

Submitted/In Review

1. J.L. Demuth, R.E. Morss, G. Wong-Parodi, **A. Schumacher**, H. Walpole, and N. Herbert, In Review: Longitudinal Studies of Risk Perceptions and Behavioral Responses for Natural Hazards. *Handbook of Risk, Crisis, and Disaster Communication*, B.F. Liu and A. Mehta (Eds.), Informa UK Limited.

2. C. Earl-Spurr, **A. Schumacher**, C. Arthur, T. Arulalan, I. Cauravouvinaka, M. DeMaria, J. Kepert, and M. Sharma, In Review: Forecasting Tropical Cyclone Wind Hazards and Impacts: Summary from the Tenth International Workshop on Tropical Cyclones (IWTC-10). Submitted to *Tropical Cyclone Research and Review.*

Accepted

1. McGovern, A., D.J. Gagne II, C.D. Wirz, I. Ebert-Uphoff, A. Bostrom, Y. Rao, **A. Schumacher**, M. Flora, R. Chase, A. Mamalakis, M. McGraw, R. Lagerquist, R.J. Redmon, and T. Peterson: Trustworthy

Artificial Intelligence for Environmental Sciences: An Innovative Approach for Summer School. Accepted by *Bull. Amer. Meteor.*

Published

1. Anderson, G. B., **A. Schumacher**, J. M. Done, and J. Hurrell, 2022: Projecting the impacts of a changing climate: Tropical cyclones & flooding. *Current Environmental Health Reports*, 9(2), 244-262, https://doi.org/10.1007/s40572-022-00340-0.
2. Anderson, G. B., **A. Schumacher**, and J. M. Done, 2022: Exposure assessment for tropical cyclone epidemiology. Current *Environmental Health Reports*, 9(1), https://doi.org/10.1007/s40572-022-00333-z.
3. Nethery, R. C., N. Katz-Christy, M. Kioumourtzoglou, R. M. Parks, **A. Schumacher**, and G. B. Anderson, 2021: Integrated causal-predictive machine learning models for tropical cyclone epidemiology, *Biostatistics*, https://doi.org/10.1093/biostatistics/kxab047.
4. Anderson G. B., J. Ferreri, M. Al-Hamdan, W. Crosson, **A. Schumacher**, S. Guikema, S. Quiring, D. Eddelbuettel, M. Yan, and R. D. Peng, 2020: Assessing United States county-level exposure for research on tropical cyclones and human health. *Environmental Health Perspectives*. 128(10), https://doi.org/10.1289/EHP6976.
5. Yan, M., A. Wilson, S. Magzamen, F. Dominici, Y. Yang, M. Al-Hamdan, W. Crosson, **A. Schumacher**, S. Guikema, R. Peng, and G. B. Anderson, 2020: Tropical cyclone exposures and risks of emergency Medicare hospital admission for cardiorespiratory diseases in 175 United States counties, 1999–2010. *Epidemiology*. 32(3), 315-326, https://doi.org/10.1097/EDE.0000000000001337.
6. Bhatia, K. T., D. S. Nolan, M. DeMaria, and **A. B. Schumacher**, 2017: Improving Tropical Cyclone Intensity Forecasts with PRIME, *Wea. Forecasting*, 32(4), 1353-1377.
7. Sampson, C. R., J. A. Hansen, P. A. Wittmann, J. A. Knaff, and **A. B. Schumacher**, 2016: Wave Probabilities Consistent with Official Tropical Cyclone Forecasts. *Wea. Forecasting*, 31, 2035-2045.
8. Quiring, S. M., **A. B. Schumacher**, and S. Guikema, 2014: Incorporating Hurricane Forecast Uncertainty into a Decision-Support Application for Power Outage Modeling. *Bull. Amer. Meteor. Soc.*, 95(1), 47-58.
9. DeMaria, M., J. A. Knaff, M. J., Brennan, D. B. Brown, R. D. Knabb, R. T. DeMaria, **A. B. Schumacher**, C. A. Lauer, D. P. Roberts, C. R. Sampson, P. Santos, D. Sharp, and K. A. Winters, 2013: Improvements to the Operational Tropical Cyclone Wind Speed Probability Model. *Wea. Forecasting*, 28, 586-602.
10. Sampson, C. R., **A. B. Schumacher**, J. A. Knaff, M. DeMaria, E. M. Fukada, C. A. Sisko, D. P. Roberts, K. A. Winters and H. M. Wilson, 2012: Objective Guidance for Use in Setting Tropical Cyclone Conditions of Readiness. *Wea. Forecasting*, 27, 1052–1060.
11. Quiring, S., **A. Schumacher**, C. Labosier, and L. Zhu, 2011: Variations in mean annual tropical cyclone size in the Atlantic, *J. Geophys. Res.*, 116, D09114, doi:10.1029/2010JD015011.
12. Schumacher, R. S., D. T. Lindsey, **A. B. Schumacher**, J. Braun, S. D. Miller, J. L. Demuth, 2010: Multidisciplinary Analysis of an Unusual Tornado: Meteorology, Climatology, and the Communication and Interpretation of Warnings. *Wea. Forecasting*, 25, 1412–1429.
13. Rappaport, E. N., J. L. Franklin, **A. B. Schumacher**, M. DeMaria, L. K. Shay, and E. J. Gibney, 2010: Tropical cyclone intensity change before U.S. Gulf coast land fall. *Wea. Forecasting*, 25, 1380-1396.
14. Sherman-Morris, K., **A. Schumacher**, S. Drobot and K. McNeal, 2010: Hurricane Preparedness and Response among Pet Care Providers along the Gulf Coast: An Investigation of Hurricanes Gustav and Ike. *International Journal of Mass Emergencies and Disasters,* 28 (3).
15. **Schumacher, A. B.**, M. DeMaria, and J. A. Knaff, 2009: Objective Estimation of the 24-h Probability of Tropical Cyclone Formation. *Wea. Forecasting*, 24, 456–471.
16. Knaff, J. A., T. A. Cram, **A. B. Schumacher**, J. P. Kossin and M. DeMaria, 2008: Objective identification of annular hurricanes. *Wea. Forecasting*, 23, 17-28.

17. Montgomery, M. T., M. E. Nicholls, T. A. Cram and **A. B. Saunders**. 2006: A Vortical Hot Tower Route to Tropical Cyclogenesis. *J. Atmos. Sci.*, 63, 355–386.

PUBLICATIONS - NON-REFEREED

C. Earl-Spurr, **A. Schumacher**, C. Arthur, T. Arulalan, I. Cauravouvinaka, M. DeMaria, J. Kepert, and M. Sharma, 2022: Report Topic 5.2 – Forecasting Hazards and Impacts – Wind, 10th International Workshop on Tropical Cyclones (IWTC-10). Available from https://community.wmo.int/en/iwtc-10-reports.

J.L. Demuth, R.E. Morss, G. Wong-Parodi, **A. Schumacher**, N. Herbert, H. Walpole, 2022: Longitudinal Studies of Risk Perceptions and Behavioral Responses for Natural Hazards. *Report to NOAA*.

Anderson G. B., **A. Schumacher**, S. Guikema, S. Quiring, J. Ferreri, A. Staid, M. Guo, L. Ming, and L. Zhu, 2020: `stormwindmodel`: Model tropical cyclone wind speeds. Version 0.1.4 [Software]. Available from: https://cran.r-project.org/web/packages/stormwindmodel/index.html.

Anderson G. B., M. Yan, J. Ferreri, W. Crosson, M. Al-Hamdan, **A. Schumacher**, and D. Eddelbuettel, 2020: `hurricaneexposure`: Explore and Map County-Level Hurricane Exposure in the United States. Version 0.1.1 [Software]. Available from: https://cran.r-project.org/web/packages/hurricaneexposure/index.html.

Anderson G. B., **A. Schumacher**, W. Crosson, M. Al-Hamdan, M. Yan, J. Ferreri, Z. Chen, S. Quiring, and S. Guikema, 2020: `hurricaneexposuredata`: Data Characterizing Exposure to Hurricanes in United States Counties. Version 0.1.0 [Software]. Available from: https://github.com/geanders/hurricaneexposuredata.

Dunion, J., J. Kaplan, and **A. Schumacher**, 2019: Improvement to the Tropical Cyclone Genesis Index (TCGI). *Final Report to the NOAA Joint Hurricane Testbed*, https://www.nhc.noaa.gov/jht/15-17reports/Dunion_201_Schumacher_202_progress_reportFINAL_rev030619.pdf.

Chirokova, G. and **A. Schumacher**, 2019: Improvements to Operational Statistical Tropical Cyclone Intensity Forecast Models. *Final Report to the NOAA Joint Hurricane Testbed*, https://www.nhc.noaa.gov/jht/15-17reports/Chirokova_204_progress_reportFINAL_112918.pdf.

Schumacher, A., 2016: Upgrades to the Operational Monte Carlo Wind Speed Probability Program, *Final Report to the NOAA Joint Hurricane Testbed*, https://www.nhc.noaa.gov/jht/13-15reports/Final_Schumacher_JHT15.pdf.

Dunion, J., J. Kaplan, **A. Schumacher**, and J. Cossuth, 2013: Development of a Probabilistic Tropical Cyclone Genesis Prediction Scheme. *Final Report to the NOAA Joint Hurricane Testbed*, https://www.nhc.noaa.gov/jht/11-13reports/Final_Dunion_JHT13.pdf.

Schumacher, A. B., K. Sherman-Morris, K. McNeal, and S. Drobot, 2008: Pet Care Professionals' Preparedness for, Response to, and Utilization of Resources during Hurricane Gustav. *Quick Response Report #QR210*, https://hazards.colorado.edu/uploads/quick_report/morris_2008.pdf.

Schumacher, A. B., 2008: After WAS*IS Ecstasy, The Laundry: One Atmospheric Scientist's Experience. *Weather and Society Watch*, Vol. 2.2, January 2008, pp. 7, http://www.sip.ucar.edu/news/pdf/WSW_January_2008.pdf.

PRESENTATIONS – INVITED

Schumacher, A.B., J. Demuth, R. Morss, G. Wong-Parodi, J. Alland, D. Smith, N. Herbert, and H. Walpole, 2022: Risk Communication, Perceptions, and Responses to Tropical Cyclones Laura and Marco 2020. *Southern Region Science Circle – Forecaster Applications Chat*, Virtual, 11 August 2022.

Schumacher, A. B., 2021: Using hurricane data for health impacts research. International Society for Environmental Epidemiologists – N. American Chapter (ISEE-NAC) Workshop on Climate Change, Hurricanes, and Health. Virtual (https://www.youtube.com/watch?v=Lr8DcDfi7XI), 14 April 2021.

Schumacher, A. B., 2017: GOES-16 Capabilities & the 2017 Hurricane Season. *Denver/Boulder Chapter of the American Meteorological Society Seminar*, NCAR Mesa Lab, Boulder, CO, 7 December 2017.

Schumacher, A. B., 2017 (Recorded): GOES-16 Applications for Hurricane Forecasting. *WMO RA-IV Hurricane Committee - 39 Meeting*, San Jose, Costa Rica, 23 March 2017.

Schumacher, A. B. and E. Dagg, 2015: An examination of situation-specific hurricane forecast uncertainty statements in NHC Tropical Cyclone Discussions. *National Hurricane Center Science Seminar*, Miami, FL, 12 November 2015.

Schumacher, A. B. and M. DeMaria, 2015: Applications of GOES-R and JPSS at the National Hurricane Center, *GOES-R Science Seminar*, 31 March 2015 (remote).

Schumacher, A. B., 2008: Hurricane Research in the Rockies: Recent Research to Operations Activities at CIRA. *Weekly Hurricane Seminar Series*, National Hurricane Center, Miami, FL, October 2008.

CONFERENCE PAPERS AND PRESENTATIONS (LAST 2 YEARS)

Schumacher, A.B., M. DeMaria, A. Brammer, K. Musgrave, P. Santos, Z. Rosen, M. Long, and W. Hogsett, 2023: Taking steps to unify and improve NWS TC wind forecast products. *2023 Tropical Cyclone Operations and Research Forum / Interdepartmental Hurricane Conference*, Miami, FL, 7-9 March 2023.

Schumacher, A.B., J. Demuth, R. Morss, G. Wong-Parodi, N. Herbert, H. Walpole, J. Alland, D. Smith, 2023: "Wait, the forecast changed?": Longitudinal panel surveys of the public. *2023 Tropical Cyclone Operations and Research Forum / Interdepartmental Hurricane Conference*, Miami, FL, 7-9 March 2023.

Schumacher, A.B., K. Musgrave, O. Ostwald, and M. Niznik, 2023: A New Evacuation Database for Societal Impacts Research. *103rd AMS Annual Meeting*, Denver, CO, 8-12 January 2023.

Schumacher, A.B. and coauthors, 2023: Unifying NWS Wind Products. *103rd AMS Annual Meeting*, Denver, CO, 8-12 January 2023.

Schumacher, A.B., K. Musgrave, M. DeMaria, A. Brammer, P. Santos Jr., Z. Rosen, M. Long, L. Lu, and O. Ostwald, 2022: Unification and Improvements to Guidance for National Weather Service Tropical Cyclone Wind and Storm Surge Hazard Products. *6th Conference on Weather Warnings and Communications*, Milwaukee, WI, 15-17 June 2022.

Schumacher, A.B. and coauthors, 2022: Longitudinal Analysis of Hurricanes Laura and Marco. Part I: Public Perceptions of Exposure to Hurricane Forecasts and Warnings, *102nd AMS Annual Meeting*, virtual, 26 January 2022.

TEACHING AND EDUCATIONAL OUTREACH

Instructor, Trustworthy Artificial Intelligence for Environmental Science (TAI4ES) Virtual Summer School, 27-30 June 2022.

Instructor, Risk Communication for Trustworthy AI: Six-part Virtual Tutorial, 24 May – 21 June 2022.

SOARS Mentor, NCAR, 2021-2022.

Summer REU Mentor, CSU Dept of Atmospheric Science, summer 2021.

Schumacher, A. B. K. Musgrave, and C. Slocum, 2020: AMS Short Course: From GOES-R and JPSS Satellite Data to Disaster Response: Every Decision Counts – Tropical Cyclones, *100th AMS Annual Meeting*, Boston, MA, 12 January 2020.

Schumacher, A. B. and M. Folmer, 2018: GOES-R Series Workshop: Tropical Applications for Users. *33rd Conference on Hurricanes and Tropical Meteorology*, Ponte Vedra, FL, 16-20 April 2018.

Schumacher, A. B. and M. Folmer, 2018: AMS Short Course: GOES-R Series: Products and User Applications – Tropical Cyclones, *98th AMS Annual Meeting*, Austin, TX, 7 January 2018.

Schumacher, A. B. and M. Folmer, 2017: NHC GOES-R Supplemental Training Workshop. National Hurricane Center, Miami, FL, 16 February 2017.

Schumacher, A. B., 2017: GOES-16 Tropical Applications. *GOES-R Series Faculty Virtual Course*: Tropical Cyclones, 6 September 2017, Online presentation (https://www.meted.ucar.edu/training_module.php?id=1311#.WnCuu6inF9N)

Schumacher, A. B. and G. Chirokova, 2017: AMS Short Course: JPSS Products and User Applications – Tropical Cyclones, *97th AMS Annual Meeting,* Seattle, WA, 22 January 2017.

Schumacher, A. B. and M. DeMaria, 2011: Tropical Cyclone Applications of Satellite Data, *COMET Faculty Course*, CIRA, Fort Collins, CO, 10 August 2011.

AWARDS AND HONORS

- Outstanding Achievement Award - Meteorology, National Hurricane Conference (2019)
- Leadership Award, Louisiana Emergency Preparedness Association (2019)
- Governor's Award for High Impact Research (Team Member), CO-LABS (2012)
- Research Initiative Award, Cooperative Institute for Research in the Atmosphere (2012)
- Research Initiative Award, Cooperative Institute for Research in the Atmosphere (2008)
- AMS Industry/Government Graduate Fellowship, American Meteorological Society (2001-2002)
- 3F Fellowship, Colorado State University Dept. of Atmospheric Science (2001-2002)

PROFESSIONAL DEVELOPMENT

- Visiting Scientist Program, National Hurricane Center, Miami, FL, 6-10 October 2008.
- Advanced Weather and Society Integrated Studies (WAS*IS) Workshop in conjunction with the NOAA Hazardous Weather Testbed's Experimental Warning Program (EWP) in Norman, OK, 15-17 September 2008.
- Weather and Society Integrated Studies (WAS*IS) Workshop at the National Center for Research in the Atmosphere (NCAR) in Boulder, CO, 12-20 July 2007.

CERTIFICATIONS

- UCAR Researchers Involved in Human Subjects Research (CITI Program), expires 8/2023
- CSU Human Subjects Protection Training (CITI Program), refresher completed 6/20/2022
- Colorado State University Pride Resource Center Safe Zone Network (Training 5/27/22)

PROFESSIONAL SERVICE

- Rapporteur, Forecasting TC Wind Hazards and Impacts, 10th International Workshop on Tropical Cyclones (IWTC-10, 2022)
- American Meteorological Society Local Chapter Affairs Executive Committee (2016-2019)

- Fort Collins Atmospheric Scientists (FORTCAST, AMS Local Chapter) Executive Board (2015-2016)
- Search Committee Chair, Colorado State University (2006-present)
- AMS Hurricanes and Tropical Meteorology Conference Organizing Committee (2015-2016)
- Reviewer for Journal of Applied Meteorology and Climatology, Remote Sensing of the Environment, Weather and Forecasting, Monthly Weather Review, IEEE Transactions on Geoscience and Remote Sensing, Atmospheric Research, and JGR-Atmospheres

PROFESSIONAL MEMBERSHIPS

- Society for Risk Analysis (since 2020)
- American Meteorological Society (since 2001)
- American Geophysical Union (since 2023)
- Weather and Society Integrated Studies (WAS*IS) Fellow (since 2007)

COMPUTER SKILLS

- Operating Systems: Linux, Windows, Mac
- Scripting languages: Perl, Bash
- Programming: FORTRAN, R, Python, IDL
- Visualization: GrADS, R, QGIS
- Statistical Analysis: FORTRAN IMSL, R, Atlas.ti, SPSS