Patrick Hawbecker
patrickhawbecker.com

EDUCATION

North Carolina State University Ph. D. in Atmospheric Science	August 2014 - December 2017 GPA: 3.72
Texas Tech University Masters of Atmospheric Science	September 2011 - May 2013 GPA: 3.75
The Ohio State University Bachelor of Science in Atmospheric Science Minor in Mathematics	September 2007 - June 2011 Overall GPA: 3. 639 Major GPA: 3. 954

WORK EXPERIENCE

Project Scientist I, August 2019 - Current
National Center for Atmospheric Research, Boulder, CO
Mesoscale-to-Microscale Coupling (MMC) Project

- Led a multi-lab study investigating offshore low-level jet sensitivity to sea surface temperatures across scales ranging from mesoscale to microscale.
- Performed mesoscale sensitivity simulations for several wind energy focused onshore and offshore case studies.
- Implemented a machine learning surface layer parameterization into the WRF model for both onshore and offshore surface layer parameterization and compared to the often-used Monin-Obukhov Similarity Theory.
- Analyzed terrain ruggedness metrics for the use in turbulence downscaling via a General Adversarial Network.
- Maintained several GitHub repositories consisting of numerical models, analysis codes, and case documentation.
- Organized a ReadTheDocs website to document the MMC project and serve as an end-of-project deliverable.
- Ran WRF simulations for the development of a machine learning Generative adversarial network that attempts to downscale mesoscale data to microscale.

US Army Test and Evaluation Command

- Developed a numerical model-based detection algorithm for water body (bay, lake, and sea) breezes in order to detect the Chesapeake Bay breeze from numerical weather prediction model output.
- Analyzed the sensitivity of the Chesapeake Bay breeze to water surface temperature using the WRF model with eight sea surface temperature products and a prognostic equation for diurnal water surface temperature changes.
- Ran a GPU-based large-eddy simulation (LES) model – FastEddy – to simulate turbulence within a forest canopy for the purposes of assessing the impact of turbulence on projectile motion.

Boundary Layer Reinvestment Project

- Conducted a mesoscale sensitivity study for a case day during the Perdigao field campaign to assess the best mesoscale setup to be used with nested LES simulations.
- Performed mesoscale-to-microscale WRF simulations for a 14-hour period during the Perdigao field campaign.

Vaisala Microburst

- Simulated idealized downburst-producing storms with the WRF model to be utilized as input to a radar simulator.

Postdoctoral Researcher, March 2018 – August 2019
National Renewable Energy Laboratory, Boulder, CO
Mesoscale-to-Microscale Coupling (MMC) Project

- Performed mesoscale model simulations with the Weather Research and Forecasting (WRF) model of high wind events over the Rocky Mountains as well as over the Wind Forecast Improvement Project (WFIP) 2 site.
- Tested several reanalysis data sets and model setups to perform sensitivity analysis of the resulting wind fields to the initial conditions and validated with observations from meteorological towers and various instruments.
- Conducted large-eddy simulations (LES) of flow over complex terrain with initial and boundary conditions provided by the WRF model and presented findings at the American Meteorology Society Annual Conference.
- Generated idealized terrain data from the Rocky Mountains in order to quantify the effectiveness of turbulence generation by terrain in large-eddy simulations.

- Enhanced a feature within the WRF model to output pseudo-tower data at a given location within idealized WRF simulations that is included in the WRFv4.1 release.

System Test Engineer, July 2013 – July 2014
ViaSat Inc., Carlsbad, CA
ViaSat Tests for NBN Co Satellite Ground Systems

- Generated and carried out test procedures required on hardware and software as specified by the customer.
- Developed automated scripts which communicate to, and gather data from, a Radisys ATCA chassis over a period of time to then be analyzed and displayed.
- Ran tests in formal and informal situations in front of quality assurance representatives and customers.

RESEARCH EXPERIENCE

Research Assistant, August 2014 – December 2017
North Carolina State University - Marine, Earth, and Atmospheric Science Department, Raleigh, NC
Full storm simulations of downburst-producing thunderstorms generated through convective heating

- Utilized Cloud Model 1 (CM1) to simulate downburst-producing thunderstorms based on varying the specified surface sensible heat flux as opposed to the common "warm bubble" approach
- Determine the dependence of the outflow wind strength and extent on the specified surface heating
- Analyzed the statistical variation in the shear exponent over conventional turbine rotor depths at hub height

Using Real Data Driven Mesoscale Models for Hub Height Wind Analysis During Ramp Events

- Used the WRF mesoscale driven by reanalysis data and applied forensic meteorology techniques to evaluate historic extreme wind ramp events and compared to observations such as radar, ASOS, and surface observations.
- Investigated the benefits of increasing domain resolution versus increasing the complexity of several numerical parameterization schemes (e.g. microphysical parameterization, boundary layer parameterization, etc.)
- Conducted preliminary simulations of nested LES within mesoscale models to analyze statistical and turbulent properties of the wind field at wind farm scales

Analyzing the impact of ambient turbulence on downburst wind fields at low-levels

- Simulated idealized downbursts through large-eddy simulation (LES) at high resolution in various planetary boundary layer regimes to determine the effects of ambient stability on the downburst wind field
- Compared the resolved turbulence simulations with the current state of the practice laminar simulations in order to emphasize the need for resolved turbulence in large-eddy, or cloud model simulations
- Collaborated with civil engineers at the University of Texas at Austin in order to quantify the impacts of downburst wind fields on wind turbines and their dependence on stability using the FAST model

Research Assistant, July 2011 – May 2013
Texas Tech University – Meteorology Department, Lubbock, TX
A Comparison of 1-Way and 2-Way Nesting in the WRF-LES Framework

- Used the Weather Research and Forecasting - Large-Eddy Simulation (WRF-LES) model to investigate the difference in numerical output between one-way and two-way nesting for numerical simulations of the atmospheric boundary layer
- Designed and ran experiments to optimize the setup of the simulations with regard to grid spacing, numerical damping and sub-grid scale schemes
- Revealed a warm bias and positive moisture bias within the nested LES domain which can have drastic effects on the two-way nesting output due to the feedback process.

Determining the Effect of Sub-Filter Scale (SFS) Topographic Information on WRF-LES Simulations

- Used high resolution and low resolution WRF-LES models to determine the effect of SFS information on the simulation accuracy
- Designed an experiment to determine, by spectral analysis techniques, whether or not topographic data within the SFS region of a model can result in numerically damped energy being transported upscale into fully resolvable scales of the model
- Through the investigation process, issues within the one-way nesting framework of the model were found and

research has been put on hold until one-way nesting technique has been perfected, or discredited

Research Assistant, July 2010 – June 2011

Ohio State University - Extreme Ice Survey (EIS), Byrd Polar Research Center, Columbus, OH

- Utilized a MatLab program to rectify images of glaciers in Greenland in order to display the glacier movements
- Displacements of the glaciers were calculated based on several years of hourly images during daylight from 2007 to 2011 in order to resolve the signal produced by the advancing and retreating of the glaciers

FIELD EXPERIENCE

- Deployed portable meteorological towers from Texas Tech, known as StickNet probes, in the path of various severe weather events, such as tornadic supercells, squall lines, and severe outflow boundaries
- Probes collected data of near surface winds, pressure, temperature, and dewpoint to be used as research data for various research projects at Texas Tech University
- Navigated and charted deployments for several severe weather events in the Texas/Oklahoma area
- Built, maintained, calibrated, and updated probes before and between deployments when necessary

RELEVANT SKILLS

Computer Skills: Programming Languages: Python (Numpy, Xarray, Pandas, TensorFlow), VAPOR, Unix, Fortran, MatLab, Octave, NCL, LabView and LoggerNet Datalogger Software, as well as, the programming and setup of various Campbell Scientific meteorological instruments. Proficient with Microsoft Excel, Word and PowerPoint, Eclipse, interpretation of MOS Data, pressure maps and other meteorological maps.

Language Skills: Intermediate Spanish

RESEARCH INTERESTS

Boundary layer meteorology and turbulence; fire meteorology; Machine Learning; Large-eddy simulations (LES) nested within mesoscale models; severe weather dynamics; wind power meteorology; coastal meteorology; instrumentation and observational data collection; ensemble modeling for uncertainty quantification; data assimilation

PUBLICATIONS AND PRESENTATIONS

Hawbecker, P., & Knievel, J. C. (2022). Simulating the Chesapeake Bay breeze: sensitivities to water surface temperature. Journal of Applied Meteorology and Climatology, Accepted.

Hawbecker, P., & Knievel, J. C. (2022). An algorithm for detecting the Chesapeake Bay breeze from mesoscale NWP model output. Journal of Applied Meteorology and Climatology, 61(1), 61-75.

Hawbecker, P., Lassman, W., Mirocha, J., Rai, R. K., Thedin, R., Churchfield, M., Haupt, S. E., Kaul, C.: Offshore Sensitivities across Scales: A NYSERDA Case Study, AMS 102nd Annual Meeting, 25 January 2022, Remote. Oral presentation.

Hawbecker, P., & Churchfield, M. (2021). Evaluating Terrain as a Turbulence Generation Method. Energies, 14(21), 6858.

Hawbecker, P. (2021). Mesoscale, Microscale, and Numerical Models. The Oxford Handbook of Non-Synoptic Wind Storms, 239.

Hawbecker, P., and Churchfield, M.: Mesoscale to Microscale Coupling for a Wind Ramp Case over Complex Terrain, 99th American Meteorology Society Annual Meeting, 8 January 2019, Phoenix, AZ. Oral presentation.

Hawbecker, P., Basu, S., and Manuel, L.: Investigating the impact of atmospheric stability on thunderstorm outflow winds and turbulence, Wind Energy. Sci. Discuss., https://doi.org/10.5194/wes-2017-45, 2018.

Hawbecker, P., Basu, S., and Manuel, L.: Realistic simulations of the July 1, 2011 severe wind event over the Buffalo Ridge Wind Farm, Wind Energy, http://onlinelibrary.wiley.com/doi/10.1002/we.2122/full, 2017.

Hawbecker, P., Basu, S., and Manuel, L.: Examining microburst scaling relationships through full-physics large eddy simulations, 22nd Symposium on Boundary Layers and Turbulence, 24 June 2016, Salt Lake City, UT. Oral presentation.

Hawbecker, P., Basu, S., and Manuel, L.: Realistic simulations of microbursts using the WRF model, 22nd Symposium on Boundary Layers and Turbulence, 20 June 2016, Salt Lake City, UT. Poster presentation.

Hawbecker, P., Basu, S., and Manuel, L.: Realistic simulations of the Buffalo Ridge microburst with the WRF model, 2016 Wind Energy Research Workshop, 16 March 2016, Lowell, MA. Oral presentation.

Hawbecker, P., Alapaty, K., Dudhia, J., Wang, W., Nolte, C.: Introducing global aerosol data to the microphysics-aware multi-scale Kain-Fritsch scheme, Community Modeling and Analysis System, 5 October 2015, Durham, NC. Oral presentation.

Hawbecker, P., Lu, N. Y., Basu, S., Kosovic, B., and Manuel, L.: Coupled mesoscale-LES modeling of a diurnal cycle with a nocturnal low-level jet: the Wangara case study, 27th Conference On Weather Analysis And Forecasting/23rd Conference On Numerical Weather Prediction, 3 July 2015, Chicago, IL. Oral presentation.

Hawbecker, P., Kang, S-L., Kosovic, B., and Hopson, T. Model Responses to Sub−Filter Scale (SFS) Topographic Information. 20th Symposium on Boundary Layers and Turbulence. Boston, MA

Hawbecker, P., Box, J.E., Balog, J.D., Ahn, Y., Benson, R.J. 2010. Greenland Outlet Glacier Dynamics from Extreme Ice Survey (EIS) Photogrammetry. American Geophysical Union, Fall Meeting, San Francisco, CA.

Debnath, M., Doubrawa, P., Optis, M., Hawbecker, P., & Bodini, N. (2021). Extreme wind shear events in US offshore wind energy areas and the role of induced stratification. Wind Energy Science, 6(4), 1043-1059.

Muñoz‐Esparza, D., Shin, H. H., Sauer, J. A., Steiner, M., Hawbecker, P., Boehnert, J., ... & Sharman, R. D. (2021). Efficient Graphics Processing Unit Modeling of Street‐Scale Weather Effects in Support of Aerial Operations in the Urban Environment. AGU Advances, 2(2), e2021AV000432.

Lu, N. Y., Manuel, L., Hawbecker, P., & Basu, S. (2021). A simulation study on risks to wind turbine arrays from thunderstorm downbursts in different atmospheric stability conditions. Energies, 14(17), 5407.

Haupt, S. E., Arthur, R., Decastro, A., Gagne, D. J., Jonko, A., Kosovic, B., ... & Thedin, R. (2020). FY 2020 Report of the Atmosphere to Electrons Land-Based Mesoscale-to-Microscale Coupling Project (No. PNNL-30841). Pacific Northwest National Lab.(PNNL), Richland, WA (United States).

Haupt, S. E., Berg, L. K., Decastro, A., Gagne, D. J., Jimenez, P., Juliano, T., ... & Rai, R. K. (2020). Outcomes of the DOE Workshop on Atmospheric Challenges for the Wind Energy Industry (No. PNNL-30828). Pacific Northwest National Lab.(PNNL), Richland, WA (United States); National Center for Atmospheric Research (NCAR), Boulder, CO (United States); Los Alamos National Lab.(LANL), Los Alamos, NM (United States); National Renewable Energy Lab.(NREL), Golden, CO (United States); Lawrence Livermore National Lab.(LLNL), Livermore, CA (United States).

Glotfelty, T., Alapaty, K., He, J., Hawbecker, P., Song, X., & Zhang, G. (2020). Studying Scale Dependency of Aerosol–Cloud Interactions Using Multiscale Cloud Formulations. Journal of the Atmospheric Sciences, 77(11), 3847-3868.

Haupt, S. E., Berg, L. K., Decastro, A., Gagne, D. J., Jimenez, P., Juliano, T., ... & Shaw, W. J. (2019). Report of the Atmosphere to Electrons Mesoscale-to-Microscale Coupling Project (FY2019) (No. PNNL-29603). Pacific Northwest National Lab.(PNNL), Richland, WA (United States); National Center for Atmospheric Research, Boulder, CO (United States); Lawrence Livermore National Lab.(LLNL), Livermore, CA (United States); National Renewable Energy Lab.(NREL), Golden, CO (United States); Los Alamos National Lab.(LANL), Los Alamos, NM (United States).

Glotfelty, T., K. Alapaty, J. He, P. Hawbecker, X. Song, and G. Zhang, 0: The Weather Research and Forecasting Model with Aerosol Cloud Interactions (WRF-ACI): Development, Evaluation, and Initial Application. Mon. Wea. Rev., 0, 2019.

ASSOCIATIONS AND ORGANIZATIONS

- American Meteorology Society (September 2011)
- Member of the AMS Ad Hoc Committee on Oceans, Coasts, and the Blue Economy (COCBE)
- Steering Committee Member of NCAR Early Career Scientist Assembly (ECSA)

HONORS & AWARDS

- Research Participation Program at the U.S. Environmental Protection Agency (May – October 2015)
- NCAR's Advanced Study Program – Graduate Student Visitor (June – September 2012)
- Recipient of the National Buckeye Plus Scholarship Fall 07 – June 2011
- Recipient of the Trustees Scholarship Fall 07 – June 2011