

# LIST OF PROJECT PUBLICATIONS

## Journal Papers

Allaerts, D., C. Draxl, E. Quon, and M. Churchfield, 2020: Large-eddy simulation of a diurnal cycle driven by assimilation of mesoscale time-height profiles, *Boundary Layer Meteorology*, **176**, 329-348. DOI: 10.1007/s10546-020-00538-5

Allaerts, D., E. Quon, and M. Churchfield 2022: Using observational mean flow data to drive large-eddy simulations of a diurnal cycle at the SWiFT site, under submission to *Wind Energy: NAWEA/WindTech Special Issue*.

Arthur, R. S., J. D. Mirocha, and K. A. Lundquist, 2018: Using a canopy model framework to improve large-eddy simulations of the atmospheric boundary layer in the Weather Research and Forecasting model, *Mon.-Wea. Rev.*, **147**(1), 31-52, <https://doi.org/10.1175/MWR-D-18-0204.1>

Arthur, R. S., T. W. Juliano, B. Adler, R. Krishnamurthy, J. K. Lundquist, B. Kosović, and P. A. Jiménez, 2022: Improved representation of horizontal variability and turbulence in mesoscale simulations of an extended cold-air pool event, *J. Appl. Meteor. Climatol.*, **61**, 685–707. <https://doi.org/10.1175/JAMC-D-21-0138.1>.

Draxl, C., Allaerts, D., Quon, E., and Churchfield, M., “Coupling mesoscale momentum and temperature budget components to large-eddy simulations for wind energy applications”, *Boundary Layer Meteorology*, **179**(1), 73-98. 10.1007/s10546-020-00584-z

Eghdami, E., A. P. Barros, P. A. Jiménez, T. W. Juliano, and B. Kosović, 2022: Diagnosis of second-order turbulent properties of the surface layer for three-dimensional flow based on the Mellor and Yamada model, *Mon. Wea. Rev.*, **150**, 1003–1021. <https://doi.org/10.1175/MWR-D-21-0101.1>.

Haupt, S.E., B. Kosovic, W. Shaw, L. Berg, M. Churchfield, J. Cline, C. Draxl, B. Ennis, E. Koo, R. Kotamarthi, L. Mazzaro, J. Mirocha, P. Moriarty, D. Munoz-Esparza, E. Quon, R.K. Rai, M. Robinson, G. Sever, 2019: On Bridging a Modeling Scale Gap: Mesoscale to Microscale Coupling for Wind Energy, *Bulletin of the American Meteorological Society*, Dec. 2019, 2533-2549. <https://journals.ametsoc.org/doi/full/10.1175/BAMS-D-18-003>

Hawbecker, P. and Churchfield, M., 2021. Evaluating Terrain as a Turbulence Generation Method. *Energies*, **14**(21), 6858 (1-26). <https://doi.org/10.3390/en14216858>

Juliano, T.W., B. Kosović, P.A. Jimenez, M. Eghdami, S.E. Haupt, and A. Martilli, 2022: “Gray Zone” Simulations using a Three-Dimensional Planetary Boundary Layer Parameterization in the Weather Research and Forecasting Model, *Monthly Weather Review*, **150**(7), 1585-1619. <https://doi.org/10.1175/MWR-D-21-0164.1>.

McCandless, D.J. Gagne, T.C., B. Kosovic, S.E. Haupt, B. Yang, C. Becker, and J. Schreck, 2022: Machine Learning for Improving Surface Layer Flux Estimates, *Boundary Layer Meteorology*, in press.

Mazzaro, L.J., E. Koo, D. Munoz-Esparza, J.K. Lundquist, and R.R. Linn, 2019: Random Force Perturbations: A New Extension of the Cell Perturbation Method for Turbulence Generation in Multiscale Atmospheric Boundary Layer Simulations. *J. Adv. Model. Earth Syst.*, **11**, 2311–2329. <https://doi.org/10.1029/2019MS001608>.

Mazzaro, L. J., D. Munoz-Esparza, J. K. Lundquist, and R. R. Linn, 2017: Nested mesoscale-to-LES modeling of the atmospheric boundary layer in the presence of under-resolved convective structures, *J. Adv. Model. Earth Syst.*, **9**, 1795–1810. doi:10.1002/2017MS000912.

Mirocha, J.D., M.J. Churchfield, D. Munoz-Esparza, R. Rai, Y. Feng, B. Kosovic, S.E. Haupt, B. Brown, B.L. Ennis, C. Draxl, J.S. Rodrigo, W.J. Shaw, L.K. Berg, P. Moriarty, R. Linn, R.V. Kotamarthi, R. Balakrishnan, J. Cline, M. Robinson, and S. Ananthan, 2017: Large-Eddy Simulation sensitivities to variations of configuration and forcing parameters in canonical boundary layer flows for wind energy applications, *Wind Energy Sci.*, **3**, 589-613, <https://doi.org/10.5194/wes-3-589-2018>

Muñoz-Esparza, D., J. K. Lundquist, J. A. Sauer, B. Kosovic', and R. R. Linn, 2017: Coupled mesoscale-LES modeling of a diurnal cycle during the CWEX-13 field campaign: From weather to boundary-layer eddies, *J. Adv. Model. Earth Syst.*, **9**, 1572–1594. doi:10.1002/2017MS000960.

Muñoz-Esparza, D. and Kosović, B., 2018a: Generation of Inflow Turbulence in Large-Eddy Simulations of Nonneutral Atmospheric Boundary Layers with the Cell Perturbation Method. *Mon. Wea. Rev.*, **146**(6), 1889-1909.

Muñoz-Esparza, D., Sharman, R., Sauer, J. and Kosović, B., 2018b: Toward Low-Level Turbulence Forecasting at Eddy-Resolving Scales. *Geophysical Research Letters*, **45**(16), 8655-8664.

Quon, E. W., 2022: Measurement-Driven Large-Eddy Simulations of a Wind Turbine Array during a Wake Steering Field Campaign. Under submission to *Wind Energy Science*.

Rai, R.K., L.K. Berg, B. Kosovic, S.E. Haupt, J.D. Mirocha, B. Ennis, and C. Draxl, 2019: Evaluation of the Impact of Horizontal Grid Spacing in Terra Incognita on Coupled Mesoscale-microscale Simulations using the WRF Framework, *Monthly Wea. Rev.*, **147**, 1007-1027. <https://journals.ametsoc.org/doi/abs/10.1175/MWR-D-18-0282.1>.

Rai, R.K., L.K. Berg, M. Pekour, W.J. Shaw, B. Kosovic, J.D. Mirocha, B.L. Ennis, 2017: Spatio-temporal variability of turbulence kinetic energy budgets in the convective boundary layer over both simple and complex terrain. *J. Appl. Meteor. and Climatol.*, **56**(12), 3285-3302. doi:10.1175/JAMC-D-17-0124.1

Rai, R.K., L.K. Berg, B. Kosovic, J.D. Mirocha, M.S. Pekour, and W.J. Shaw, 2016: Comparison of measured and numerically simulated turbulence statistics in a convective boundary layer over complex terrain. *Bound.-Layer Meteor.*, **163**, 69-98.

Rodrigo, J. S., M. Churchfield, and B. Kosovic, 2016: Atmospheric boundary layer modeling based on mesoscale tendencies and data assimilation at microscale, *Wind Energy Science* doi:10.5194/wes-2016-26.

Simon, J. S., B. Zhou, J. D. Mirocha and F. K. Chow, 2019: Explicit filtering and reconstruction to reduce grid dependence in convective boundary layer simulations using WRF-LES, *Mon.-Wea. Rev.*, 147(5), 1805-1821, <https://doi.org/10.1175/MWR-D-18-0205.1>

Theodin, R., E. Quon, M. Churchfield, and P. Veers, 2022: Investigations of Correlation and Coherence in Turbulence from a Large-Eddy Simulation, *Wind Energ. Sci. Discuss.* [preprint] in review, <https://doi.org/10.5194/wes-2022-71>

## Peer-reviewed Conference Papers

**Chatterjee, T.**, J. Li, S. Yellapantula, B. Jayaraman and E. Quon, 2022: Wind farm response to mesoscale-driven coastal low level jets: a multiscale large eddy simulation study. *J. Phys.: Conf. Ser.*, **2265**, 022064, doi:[10.1088/1742-6596/2265/2/022004](https://doi.org/10.1088/1742-6596/2265/2/022004).

**Haupt, S.E.**, L. Berg, M. Churchfield, B. Kosovic, W. Shaw, J. Mirocha, 2019: Mesoscale to Microscale Coupling for Wind Energy Applications: Addressing the Challenges, *J. Physics Conference Series* (2020) 012076 **1452**, NAWEA/WindTech Conference, Amherst, MA, October 15, 2019. doi:10.1088/1742-6596/1452/1/012076

**Jayaraman, B.**, E. Quon, J. Li, and T. Chatterjee, 2022: Structure of Offshore Low-Level Jet Turbulence and Implications to Mesoscale-to-Microscale Coupling. *J. Phys.: Conf. Ser.*, **2265**, 022064, doi:[10.1088/1742-6596/2265/2/022064](https://doi.org/10.1088/1742-6596/2265/2/022064).

Kosovic, B., P. Jimenez, **T.W. Juliano**, A. Martilli, M. Eghdami, A.P. Barros, and S.E. Haupt, 2019: Three-Dimensional Planetary Boundary Layer Parameterization for High-Resolution Mesoscale Simulations, *J. Physics Conference Series* (2020) **1452** 012080, NAWEA/WindTech Conference, Amherst, MA. doi:10.1088/1742-6596/1452/1/012080

**Quon, E. W.**, A. S. Ghate, and S. K. Lele, 2018: Enrichment methods for inflow turbulence generation in the atmospheric boundary layer. *J. Phys.: Conf. Ser.*, **1037**, 072054, doi:[10.1088/1742-6596/1037/7/072054](https://doi.org/10.1088/1742-6596/1037/7/072054).

**Rai, R.K.**, Berg, L.K., Newsom, R., Kaul, C.M., Mirocha, J.D., Choukulkar, A., Brewer, A., Pichugina, Y. and Banta, R., 2019. Characterization of turbulence under different stability conditions using lidar scanning data. *J. Physics: Conference Series* (2020) 012085 **1452**, NAWEA/WindTech Conference, Amherst, MA.

## Conference Presentations: (presenter in **Bold**)

**Allaerts, D.**, C. Draxl, and M. Churchfield, “Large-eddy simulations of a diurnal cycle driven by mesoscale and observational profile assimilation, American Physical Society Division of Fluid Dynamics Meeting, Nov. 18-20, 2018, Atlanta, Georgia.

**Allaerts, D.**, C. Draxl, E. Quon, and M. Churchfield, “Evaluation of internal forcing techniques for mesoscale-to-microscale coupling”, 2019 Wind Energy Science Conference, June 16-20, 2019, Cork, Ireland.

Arthur, R.S., J.D. Mirocha, N. Marjanovic, B. D. Hirth, J. L. Schroeder, and **F. K. Chow**, 2019: Multi-scale simulations of wind farm performance with complex terrain and weather events, NAWEA/WINDTECH, Amherst, MA, October 14-16.

**Churchfield, M.**, D. Allaerts, P. Hawbecker, and E. Quon, “Treatment of Gravity Waves in Wind Energy Atmospheric Large-Eddy Simulation“, June 16-20, 2019, Cork, Ireland.

Cline, J.W., **W. J. Shaw** and S.E. Haupt, 2018: Meteorology Research in DOE’s Atmosphere to Electrons (A2e) Program, Ninth Conference on Weather, Climate, and the New Energy Economy, AMS Annual Meeting, January 8, 2018.

**Cline, J.**, S.E. Haupt, and W. Shaw, 2017: Meteorology Research in DOE’s Atmosphere to Electrons (A2e) Program, WindTech International Conference on Future Technologies in Wind Energy, Boulder, Co, October 24.

**Connolly, A.**, W. H. M. Wendels, L. van Veen, L., J. M. T. Neher, B. Geurts, J. D, Mirocha, and F. K. Chow, 2020: Development of fine scale structures in large eddy simulations over complex terrain, 19th Conference on Mountain Meteorology Virtual Meeting, 15 July, 2020.

**Dettling, S.M.**, D. J. Gagne, S.E. Haupt, T. Brummet, B. Kosovic, and P. Hawbecker, 2022: Downscaling from Mesoscale to Microscale in Complex Terrain Using a Generative Adversarial Network, 21<sup>st</sup> Conference on Artificial Intelligence for Environmental Science, AMS Annual Meeting, Virtual, Jan. 25, 2022.

**Dettling, S.**, B. Kosovic, D.J. Gagne, and S.E. Haupt, 2021: Machine-Learning Model for Surface Layer Parameterization at the Air-Sea Interface, AMS Annual Meeting, Virtual, Jan. 12.

**Draxl, C.**, Churchfield, M., Rodrigo, J. S., 2017: Coupling the Mesoscale to the Microscale Using Momentum Budget Components, North American Wind Energy Symposium, Ames, USA, September 2017.

**Draxl, C.**, Churchfield, M., Rodrigo, J. S., 2017: Coupling the Mesoscale to the Microscale Using Momentum Budget Components, AMS Annual Meeting, Seattle, USA, January 2017.

**Haupt, S.E.**, B. Kosovic, S. Dettling, P. Hawbecker, T. Juliano, T. Brummet, A. Decastro, D.J. Gagne, C. Kaul, L. Berg, R. Rai, J. Lee, W. Shaw, J. Mirocha, W. Lassman, M. Churchfield, E. Quon, R. Thedin, S. Davis, M. Robinson, 2022: Advances in Mesoscale to microscale coupling for Wind Energy Applications, 13<sup>th</sup> Conference on Weather, Climate, and the New Energy Economy, AMS Annual Meeting, Jan. 26, Virtual.

**Haupt, S.E.**, B. Kosovic, S. Dettling, P. Hawbecker, T. Brummet, and D.J. Gagne, 2021: Recent Progress in Mesoscale to Microscale Coupling: Offshore and Complex Terrain Advances. AGU Annual Meeting, Dec. 16, 2021, New Orleans, LA.

**Haupt, S.E.**, S. Dettling, T. Brummet, A. DeCastro, P. Hawbecker, D.J. Gagne, B. Kosovic, 2021: Using Deep Learning to Downscale from Mesoscale to Microscale in Complex Terrain, 3<sup>rd</sup> NOAA Workshop on Leveraging AI in Environmental Science, Virtual, Sept. 15. Highlighted Talk.

**Haupt, S.E.**, 2021: Meteorology Research to Enable Offshore Wind Energy, AMS Washington Forum, Virtual, April 29.

**Haupt, S.E.**, 2021: Machine Learning for Weather and Climate in Energy Applications at NCAR, InterMET Webinar on Applications of Machine Learning, Virtual, Feb. 24.

**Haupt, S.E.**, B. Kosovic, L. Berg, W. Shaw, J. Mirocha, M. Churchfield, 2020: Mesoscale to Microscale Coupling for Wind Energy, 11<sup>th</sup> Conference on Weather, Climate, & the New Energy Economy, AMS Annual Meeting, Boston, MA, Jan. 14.

**Haupt, S.E.**, L. Berg, M. Churchfield, B. Kosovic, W. Shaw, J. Mirocha, 2019: Mesoscale to Microscale Coupling for Wind Energy Applications: Addressing the Challenges, NAWEA/WindTech Conference, Amherst, MA,

**Haupt, S.E.**, 2019: Advances in Mesoscale to Microscale Coupling for Wind Energy Applications, 6th International Conference on Energy and Meteorology, Lyngby, Denmark, June 25, 2019.

**Haupt, S.E.**, 2019: Mesoscale to Microscale Coupling for Wind Energy Applications, Energy Systems Integration Group Meteorology & Market Design for Grid Services Workshop, Denver, CO, June 5, 2019.

**Haupt, S.E.**, B. Kosovic, W. Shaw, L. Berg, R. Rai, J. Mirocha, M. Churchfield, C. Draxl, M. Robinson, 2018: Recent Advances in Mesoscale to Microscale Coupling, AMS Conference on Boundary Layers and Turbulence, Oklahoma City, OK, June 14, 2018.

**Haupt, S.E.**, 2018: Progress in Mesoscale to Microscale Coupling: Modeling Nonstationary Conditions in Flat and Complex Terrain, International Conference on Energy & Meteorology, Shanghai, China, May 22, 40 min. lecture.

**Haupt, S.E.**, 2018: Meteorology, Climate, and the Electric Sector – Forecasting for an Integrated Energy System, ESIG Forecasting Workshop, St. Paul, MN, June 19, 2018 (Invited Panel talk).

**Haupt, S.E.**, L. Berg, M. Churchfield, J. Cline, J. Mirocha, B. Kosovic, C. Draxl, R. Rai, R. Kostmarthi, M. Robinson, W. Shaw, 2017: The US DOE A2e Mesoscale to Microscale Coupling Project: Nonstationary Modeling Techniques and Assessment, International Conference on Energy and Meteorology, Bari, Italy, June 28.

Haupt, S.E., **J. Cline**, W. Shaw, L. Berg, M. Churchfield, J. Mirocha, B. Kosovic, C. Draxl, R. Rai, R. Kostmarthi, 2017: The US DOE A2e Mesoscale to Microscale Coupling Project: Nonstationary Modeling Techniques and Assessment, European Geophysical Union, Vienna, Austria, April 26.

**Haupt, S.E.**, W. Shaw, B. Kosovic, 2016: The DOE A2e Mesoscale to Microscale Coupling Project, AMS Symposium on Boundary Layers and Turbulence, Salt Lake City, UT, June 20.

**Haupt, S.E.**, 2016: Meteorology Models Enabling Wind Energy, Wyoming Renewable Energy Summit, Laramie, WY, June 13. Invited Keynote.

**Haupt, S.E.**, W. Shaw, and B. Kosovic, 2015: Meso- to Microscale Coupling Project, WindTech Workshop, London, Ontario, Canada, October 19.

**Hawbecker, P.**, W. Lassman, J. Mirocha, R.K. Rai, R. Thedin, M. Churchfield, S.E. Haupt, and C. Kaul, 2022: Offshore Sensitivities across Scales: A NYSERDA Case Study, 13<sup>th</sup> Conference on Weather, Climate, and the New Energy Economy, AMS Annual Meeting, Jan. 25, Virtual.

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

**Juliano, T.**, B. Kosovic, P.A. Jimenez, M. Eghdami, S.E. Haupt, and A. Martilli, 2022: Advantages of a Three-Dimensional Planetary Boundary Layer Parameterization for the Weather Research and Forecasting Model, 31<sup>st</sup> Conference on Weather Analysis and Forecasting, AMS Annual Meeting, Jan. 25, 2022. Virtual.

**Juliano, T.W.**, P. Jimenez-Munoz, B. Kosovic, and S.E. Haupt, 2020: Wind Energy Forecasting Using a Three-Dimensional Planetary Boundary Layer Parameterization. 100th American Meteorological Society Annual Meeting, Jan. 14.

**Juliano, T.**, P.A. Jimenez, B. Kosovic, S. Haupt, M. Eghdami, and A.P. Barros, 2021: Grey Zone Simulations over the Columbia River Gorge using a Three-Dimensional Planetary Boundary Layer Parameterization, AMS Annual Meeting, Virtual, Jan. 11.

**Kosovic, B.,** P.A. Jimenez, T. Juliano, M. Eghdami, and S.E. Haupt, 2021: Analysis of Horizontal Shear and Mixing at Gray Zone Length Scales using Filtered Large-Eddy Simulation of a Flow over Complex Terrain, AMS Annual Meeting, Virtual, Jan. 11.

**Kosovic, B.,** T.C. McCandless, D.J. Gagne, T. Brumett, and S.E. Haupt, 2020: Machine Learning Models for replacing Monin Obukhov Similarity Theory Based Surface Layer Parameterization, 100th American Meteorological Society Annual Meeting, Jan. 14.

Kosovic, B., P. Jimenez, **T.W. Juliano**, A. Martilli, M. Eghdami, A.P. Barros, and S.E. Haupt, 2019: Three-Dimensional Planetary Boundary Layer Parameterization for High-Resolution Mesoscale Simulations, NAWEA/WindTech Conference, Amherst, MA.

**Kosovic, B.,** J.D. Mirocha, M.J. Churchfield, D. Munoz-Esparza, R.K. Rai, Y. Feng, S.E. Haupt, B. Brown, B.L. Ennis, C. Draxl, J. Sanz Rodrigo, W. J. Shaw, L.K. Berg, P. Moriarty, R. Linn, R. V. Kotamarthi, 2017: Assessment of Large-eddy Simulations of the Atmospheric Boundary Layer for Wind Energy Applications, WindTech International Conference on Future Technologies in Wind Energy, Boulder, Co, October 25.

**Kaul, C. M.,** S. Ananthan, M. J. Churchfield, J. D. Mirocha, L. K. Berg, R. Rai, 2019: Large-eddy simulations of idealized atmospheric boundary layers using Nalu-Wind, NAWEA/WINDTECH, Amherst, MA, October 14-16, 2019

**Mirocha, J.D.,** S.E. Haupt, et al, 2019: Toward the integration of atmosphere and wind plant physics and simulation techniques: An overview of the DOE's Mesoscale-Microscale Coupling project, Meteorology and Climate - Modeling for Air Quality Conference, UC Davis, Davis, CA, Sept. 11.

**Mirocha, J.D.** and S.E. Haupt, 2018: The U.S. DOE Mesoscale to Microscale Coupling Project: Extending Boundary Layer Flow Simulation to Complex Environments, Ninth Conference on Weather, Climate, and the New Energy Economy, AMS Annual Meeting, January 8, 2018.

**Mirocha, J.D.,** R.K. Rai, M.J. Churchfield, Y. Feng, C. Draxl, J. Sanz Rodrigo, B.L. Ennis, B. Kosović, and S.E. Haupt, 2017: An investigation of online and offline mesoscale-microscale coupling techniques during unsteady meteorological conditions, WindTech International Conference on Future Technologies in Wind Energy, Boulder, Co, October 25.

**Quon, E.,** M. Debnath, C. Ivanov, P. Doubrawa, and M. Churchfield, "Measurement-Driven Large-Eddy Simulation of a Wind Turbine Array during a Wake Steering Field Campaign", 2021 Wind Energy Science Conference, May 25–28, 2021, Hannover, Germany.

**Quon, E.,** J. Li, S. Yellapantula, M. Churchfield, and M. Optis, "Mesoscale-to-microscale coupled simulations of low-level jets along US North Atlantic Coastline", 2021 Wind Energy Science Conference, May 25–28, 2021, Hannover, Germany.

**Rai, R. K.**, L. K. Berg, G. G. Medina, C. Kaul, J. Lee, Z. Yang, 2022: Coupling of Sea Wave Surface Roughness into Coupled Mesoscale–Microscale Simulations in the North Sea Using the WRF Framework, 13th Conference on Weather, Climate, and the New Energy Economy, AMS Annual Meeting, Remote, Jan. 25.

**Rai, R. K.**, L. K. Berg, G. G. Medina, C. Kaul, Z. Yang, 2021: Improving the Simulation of Offshore Winds in the WRF Model Using Sea State Variables from Wave Models, 12th Conference on Weather, Climate, and the New Energy Economy, AMS Annual Meeting, Remote, Jan. 12.

**Rai, R.**, L. K. Berg, C. Kaul, J. Mirocha, A. Choukulkar, WA Brewer, Y. Pichugina, R. Banta, 2019: Characterization of turbulence under different stability conditions using lidar scanning data near the WFIP 2 Physics site, NAWEA/WINDTECH, Amherst, MA, October 14-16, 2019

**Rai, R.**, L. K. Berg, C. Kaul, R. Newsom, J. Mirocha, A. Choukulkar, WA Brewer, Y. Pichugina, R. Banta, 2020: Characterization of Surface-Layer Turbulence Using Scanning Lidar Data at the WFIP-2 Site, 11th Conference on Weather, Climate, and the New Energy Economy, AMS Annual Meeting, Boston, MA, Jan. 14.

**Rai, R.**, L. K. Berg, R. Newsom, J. Mirocha, 2019: Simulating Scanning Lidar Data Using Spatiotemporally Resolved LES Data, Tenth Conference on Weather, Climate, and the New Energy Economy, AMS Annual Meeting, Phoenix, AZ, Jan. 9.

**Rai, R.**, L. K. Berg, B. Kravitz, B. Kosovic, J. D. Mirocha, B. Ennis, and S. E. Haupt, 2019: Improving Simulation of Turbulence in WRF-LES of Stable Condition Using Velocity Fluctuations, Tenth Conference on Weather, Climate, and the New Energy Economy, AMS Annual Meeting, Phoenix, AZ, Jan. 8.

**Rai R. K.**, L. K. Berg, B. Kosovic, J.D. Mirocha, B. Kravitz, 2018: Generation of Turbulent Inflow Boundary Conditions for WRF LES, 23rd Symposium on Boundary Layers and Turbulence, AMS Meeting, Oklahoma City, Ok, June 14.

**Rai, R.K.**, L.K. Berg, B. Kosovic, J.D. Mirocha, S.E. Haupt, B.L. Ennis, and C. Draxl, 2017: Evaluation of the Impact on Terra Incognita for Mesoscale and Microscale WRF Simulations, WindTech International Conference on Future Technologies in Wind Energy, Boulder, Co, October 25.

**Rai, R.K.**, L.K. Berg, B. Kosovic, J.D. Mirocha, M. Pekour, B. Ennis, and W. J. Shaw, 2017: Examination of the Spatio-temporal Variability of the Terms of the Turbulent Kinetic Energy Budget over a Complex Terrain in the Convective Boundary Layer: A Tool for Parameterization Development, American Meteorological Society Meeting, Seattle, WA, January 24.



**Sever, G.,** R.V. Kotamarthi, Y. Feng, 2017: A turbulence library for asynchronous coupling of meso and microscale models, WindTech - International Conference on Future Technologies in Wind Energy, Boulder, CO, October 25, 2017.

**Wise, A. J. M. T.** Neher, R. S. Arthur, J. D. Mirocha, F. K. Chow, and J. K. Lundquist, 2020: Multi-scale modeling of a wind turbine wake over complex terrain in different atmospheric stability regimes, 19th Conference on Mountain Meteorology Virtual Meeting, 15 July, 2020.

## Team Reports

Haupt, S.E., C. Kaul, R. King, A. Glaws, M. Churchfield, S. Dettling, T. Brummet, B. Kosovic, D.J. Gagne, P. Hawbecker, J. Lee, R. Rai, J. Mirocha, Z. Wu. R.S. Arthur, 2021: FY21 Report of the MMC Team on Machine Learning Approaches to Estimate Microscale Processes from Mesoscale Input. DOE A2e MMC & OWAC Team, 2021: Results of Industry & Government Roundtable on Atmospheric Research Needs for Renewable Energy.

Haupt, S.E., R Arthur, L. Berg, M. Churchfield, A. DeCastro, S. Dettling, C., Draxl, D.J. Gagne, P. Hawbecker, P. Jimenez, A. Jonko, T. Juliano, C. Kaul,, B. Kosovic, W Lassman, M Kumar, T.C. McCandless, J. Mirocha, E. Quon, R. Rai, W. Shaw, R Thedin, 2020: FY20 Report of the Atmosphere to Electrons Land-Based Mesoscale to Microscale Coupling Project: Pacific Northwest Laboratory Report PNNL-30841, 104 pp.

Haupt, S.E., L. Berg, M. Churchfield, A. DeCastro, C. Draxl, D.J. Gagne, P. Hawbecker, P. Jimenez, A. Jonko, T. Juliano, C. Kaul,, B. Kosovic, J. Mirocha, E. Quon, R. Rai, W. Shaw, 2020: Outcomes of the DOE Workshop on Atmospheric Challenges for the Wind Energy Industry: Pacific Northwest Laboratory Report PNNL-30828, 37 pp.

Haupt, S.E., D. Allaerts, L. Berg, M. Churchfield, A. DeCastro, C., Draxyl, D.J. Gagne, P. Hawbecker, P. Jimenez, A. Jonko, T. Juliano, C. Kaul,, B. Kosovic, RT.C. McCandless, J. Mirocha, D. Munoz-Esparza, E. Quon, R. Rai, J. Sauer, W.Shaw, 2019: FY19 Report of the Atmosphere to Electrons Mesoscale to Microscale Coupling Project: Pacific Northwest Laboratory Report PNNL-29603, 127 pp. <https://doi.org/10.2172/1735568>

Haupt, S.E., D. Allaerts, L. Berg, M. Churchfield, A. DeCastro, C., Draxyl, E. Koo, B. Kosovic, R. Kotamarthi, B. Kravitz, L. Mazzaro, J. Mirocha, E. Quon, R. Rai, J. Sauer, G. Sever, W. Shaw, 2019: FY18 Report of the Atmosphere to Electrons Mesoscale to Microscale Coupling Project:, Pacific Northwest Laboratory Report PNNL-28259, 124 pp.

Haupt, S.E., A. Anderson, L. Berg, B. Brown, M. Churchfield, C., Draxyl, C. Kalb, E. Koo, B. Kosovic, R. Kotamarthi, L. Mazzaro, J. Mirocha, E. Quon, R. Rai, G. Sever, 2018: Third Year Report of the Atmosphere to Electrons Mesoscale to Microscale Coupling Project:, Pacific Northwest Laboratory Report PNNL-XXXXX, 137 pp.

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