

# BRIAN J. BUTTERWORTH

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## EDUCATION

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University at Albany, State University of New York	Atmospheric Science	Ph.D.	2016
University of Colorado, Boulder	Geography	M.A.	2011
University of Delaware	Environmental Science	B.S.	2007

## PROFESSIONAL EXPERIENCE

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<b>Research Associate</b> – University of Wisconsin – Madison Study: <i>Chequamegon Heterogeneous Ecosystem Energy-balance Study Enabled by a High-density Extensive Array of Detectors (CHEESEHEAD)</i>	2019 – present
<b>Postdoctoral Associate</b> – University of Calgary Studies: <i>Ship and tower-based eddy covariance measurements of carbon dioxide flux over sea ice in the Canadian Arctic</i>	2016 – 2019
<b>Graduate Researcher</b> – Atmospheric Sciences Research Center Dissertation: <i>Air-Sea Carbon Dioxide Exchange in the Southern Ocean and Antarctic Sea Ice Zone</i>	2012 – 2016
<b>Affiliate Faculty</b> – Metropolitan State University of Denver	2011 – 2012
<b>Geocoding Analyst</b> – University of Wisconsin – Madison Study: <i>Drinking Water Systems, Hydrology, and Childhood Gastrointestinal Illness in Central and Northern Wisconsin</i>	2011 – 2012
<b>Graduate Researcher</b> – University of Colorado, Boulder Thesis: <i>A Climatological Study of the Relationship between Alpine Treeline and Thermally-Driven Upslope Winds on Niwot Ridge, Colorado</i>	2008 – 2011
<b>Undergraduate Researcher</b> – University of Delaware Study: <i>Impact of the biological control agent <i>Rhinoncomimus latipes</i> on mile-a-minute weed, <i>Persicaria perfoliata</i>, in field cages</i>	2006

## PEER-REVIEWED PUBLICATIONS

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**Butterworth, B. J.**, and Coauthors, 2020: Connecting Land-Atmosphere Interactions to Surface Heterogeneity in CHEESEHEAD 2019. *Bulletin of the American Meteorological Society*, in review.

**Butterworth, B. J.**, and B. G. T. Else, 2018: Dried, closed-path eddy covariance method for measuring carbon dioxide flux over sea ice. *Atmospheric Measurement Techniques*, **11**, 6075–6090, <https://doi.org/10.5194/amt-11-6075-2018>.

**Butterworth, B. J.**, and S. D. Miller, 2016: Air-sea exchange of carbon dioxide in the Southern Ocean and Antarctic marginal ice zone. *Geophysical Research Letters*, **43**, 7223–7230, <https://doi.org/10.1002/2016GL069581>

**Butterworth, B. J.** and S. D. Miller, 2016: Automated Underway Eddy Covariance System for Air–Sea Momentum, Heat, and CO<sub>2</sub> Fluxes in the Southern Ocean. *Journal of Atmospheric and Oceanic Technology*, **33**, 635–652, <https://doi.org/10.1175/JTECH-D-15-0156.1>

Hough-Goldstein, J., M. Schiff, E. Lake and **B. Butterworth**, 2008: Impact of the biological control agent *Rhinoncomimus latipes* (Coleoptera : Curculionidae) on mile-a-minute weed, *Persicaria perfoliata*, in field cages. *Biological Control*, **46**, 417–423, <https://doi.org/10.1016/j.biocontrol.2008.04.001>

## OTHER PUBLICATIONS

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### Book Chapter:

Paleri, S., **B. J. Butterworth**, and A. R. Desai, 2020: Spatial Patterns and Scales. *Conceptual Boundary Layer Meteorology: The Air Near Here*, A.L. Hiscox and A.G. McCombs, Eds., Elsevier, submitted.

### White Paper:

Helbig, M., Gerken, T., Beamesderfer, E., Baldocchi, D. D., Banerjee, T., Biraud, S. C., Brunsell, N. A., Burns, S. P., **Butterworth, B. J.**, Chan, W. S., Desai, A. R., Fuentes, J. D., Hollinger, D. Y., Kljun, N., Mauder, M., Novick, K. A., Perkins, J. M., Rey-Sanchez, C., Scott, R. L., Seyednasrollah, B., Stoy, P. C., Sullivan, R. C., Vilà-Guerau de Arellano, J., Wharton, S., Yi, C., and Richardson, A. D.: White Paper: Understanding land-atmosphere interactions through tower-based flux and continuous atmospheric boundary layer measurements, AmeriFlux Management Project, Berkeley, CA, U.S.A., 47 pp., 2020.

## PUBLISHED DATASETS

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Miller, S. and **B. J. Butterworth**, (2016). Eddy covariance air-sea momentum, heat, and carbon dioxide fluxes in the Southern Ocean from the Nathaniel B. Palmer (cruise NBP1210). Integrated Earth Data Applications (IEDA). doi: <http://dx.doi.org/10.1594/IEDA/323564>.

Miller, S. and **B. J. Butterworth**, (2016). Eddy covariance air-sea momentum, heat, and carbon dioxide fluxes in the Southern Ocean from the Nathaniel B. Palmer (cruise NBP1402). Integrated Earth Data Applications (IEDA). doi: <http://dx.doi.org/10.1594/IEDA/323565>.

## PRESENTATIONS

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**Butterworth B. J.**, Desai, A., Paleri, S., Metzger, S., Durden, D., Florian, C., Mauder, M., Wanner, L., Sühling, M., and Xu, K., 2020: Using Spatial Eddy Covariance to Investigate Energy Balance Closure over a Heterogeneous Ecosystem, *A CHEESEHEAD virtual mini-session*, 17 June 2020. [Oral Presentation]

**Butterworth, B. J.**, Desai, A., Paleri, S., Metzger, S., Durden, D., Florian, C., Mauder, M., Wanner, L., Sühling, M., and Xu, K., 2020: Using Spatial Eddy Covariance to Investigate Energy Balance Closure over a Heterogeneous Ecosystem, *EGU General Assembly 2020, Online*, 4–8 May 2020, EGU2020-22480, <https://doi.org/10.5194/egusphere-egu2020-22480>. [Chat-based presentation]

**Butterworth, B. J.**, Desai, A. R., Metzger, S., and Paleri, S. 2019: Impact of the Spatial Distribution of Surface Fluxes on Energy Balance Closure over a Heterogeneous Ecosystem. *AGU Fall Meeting 2019*, B41K-2496. [Poster Presentation]

Desai, A.R., Reed, D.E., **Butterworth, B. J.**, Stoy, P.C., Taebel, Z. and Mineau, J., 2019: Inland water bodies as surface energy hotspots. *AGU Fall Meeting 2019*, B32B-02. [Oral Presentation]

Desai, A.R., **Butterworth, B. J.**, Wang, Z., Oncley, S. and Townsend, P.A., 2019: Can satellite greenhouse gas remote sensing capture regional spatial variability in fluxes, drivers, and atmospheric response?. *AGU Fall Meeting 2019*, A51E-03. [Oral Presentation]

Else, B., **Butterworth, B. J.**, Sims, R.P., Duke, P., Jones, S., Marriott, S. and Emingak, F., 2019. Seasonal Cycles of Air-Sea CO<sub>2</sub> Exchange in an Arctic Coastal System. *AGU Fall Meeting 2019*, B32B-06. [Oral Presentation]

Metzger, S., Durden, D., Paleri, S., Sühling, M., **Butterworth, B. J.**, Desai, A.R., Florian, C., Mauder, M., Plummer, D.M., Wang, Z. and Wanner, L., 2019: Numerical experiment design doubles scientific return of surface-atmosphere synthesis. *AGU Fall Meeting 2019*, B22D-01. [Oral Presentation]

**Butterworth, B. J.**, A. Desai, S. Oncley, W. Brown, S. Metzger, D. Durden, P. Townsend, E. Kruger, P. Stoy, G. Petty, M. Schwartz, E. Olson, H. Vogelmann, S. Paleri, K. Xu, and J. Mineau, 2019: Updates on the Chequamegon Heterogeneous Ecosystem Energy-balance Study Enabled by a High-density Extensive Array of Detectors. *Ameriflux Annual Meeting*, Boulder, Colorado. [Poster Presentation]

**Butterworth, B. J.**, 2019: Carbon Dioxide Exchange over Oceans and Sea Ice. *SAGE and CCR Spring Meeting*, Madison, Wisconsin. [Oral Presentation; Invited]

**Butterworth, B. J.**, B. Else, 2019: Annual Carbon Dioxide Flux over Seasonal Sea Ice in the Canadian Arctic. *Annual AOSS Community Poster Reception*, Madison, Wisconsin. [Poster]

**Butterworth, B. J.**, 2019: Air-Sea Carbon Dioxide Exchange in the Southern Ocean and Antarctic Sea Ice Zone. *UW-AOS Colloquium*, Madison, Wisconsin. [Oral Presentation; Invited]

Nomura, D., **B. J. Butterworth**, F. Deman, B. Delille, K. Campbell, E. Cimoli, M. Kiuchi, K. Suzuki, K. Yoshida, N. Kanna, Y. Kawaguchi, T. Hirawake, F. Fripiat, B. Else, J.-L. Tison, M. van Leeuwe, J. M. Rintala, L. A. Miller, K. Meiners, C. J. Mundy, H. Ikawa, and A. Ooki, 2018. Inter-calibration experiment for sea ice primary production in Saroma-ko Lagoon, Hokkaido, Japan, 1-9 March 2018. *Biogeochemical Exchange Processes at Sea Ice Interfaces (BEPSII) Meeting*, Davos, Switzerland. [Poster Presentation]

Duke, P., B. Else, L.A. Miller, H. Thomas, K. Juniper, and **B. J. Butterworth**, 2018. Estimating pCO<sub>2</sub> in Cambridge Bay Nunavut Using an Autonomous Sensor Platform. *POLAR2018*. Davos, Switzerland. [Poster Presentation]

**Butterworth, B. J.**, and B. Else (Presenter), 2017: Eddy Covariance Measurements of Greenhouse Gas Exchange in an Arctic Marine Environment. *ArcticNet 2017 Annual Scientific Meeting*, Winnipeg, Manitoba. [Poster Presentation]

Wohl, C., Else B. (Presenter), **B. J. Butterworth**, M. Ahmed, T. Papakyriakou, D. Capelle, J. Abbatt, D. Collins, A. Jones, W. Sturges, R. Beale, P. Nightingale, and M. Yang, 2017: Continuous Observations of a Suite of Volatile Organic Compounds in the Surface Ocean and Lower Atmosphere of the Canadian Arctic. *ArcticNet 2017 Annual Scientific Meeting*, Winnipeg, Manitoba. [Oral Presentation]

**Butterworth, B. J.**, and S.D. Miller, 2016: Air-Sea Exchange of Carbon Dioxide in the Antarctic Marginal Ice Zone. *ArcticNet 2016 Annual Scientific Meeting*, Winnipeg, Manitoba. [Oral Presentation]

Else, B., **B. J. Butterworth**, and S. Rysgaard, 2016: Oxygen, Salt, and Heat Exchange Measured at the Ice-Ocean Interface During the Ice Algae Bloom Period. *ArcticNet 2016 Annual Scientific Meeting*, Winnipeg, Manitoba. [Poster Presentation]

**Butterworth, B. J.**, and S.D. Miller, 2016: Air-Sea Exchange of Carbon Dioxide in the Southern Ocean and Antarctic Marginal Ice Zone. *Air-sea Gas Flux; Progress and Future Prospects Science Workshop*, IFREMER, Brest, France. [Oral Presentation]

Miller, S.D., and **B. J. Butterworth**, 2015: Automated underway eddy covariance system for air-sea momentum, heat and CO<sub>2</sub> fluxes in the Southern Ocean. *SOOS-WCRP-ESA Workshop on Southern Ocean Surface Fluxes*, Frascati, Italy. [Oral Presentation]

**Butterworth, B. J.**, and S.D. Miller, 2015: Air-Sea CO<sub>2</sub> Flux by Eddy Covariance in the Southern Ocean and Antarctic Sea Ice Zone. *7th International Symposium on Gas Transfer at Water Surfaces*, Seattle, WA. [Oral Presentation]

**Butterworth, B. J.**, and S.D. Miller, 2015: Unattended Measurements of High Latitude Air-sea CO<sub>2</sub> Exchange by Eddy Covariance, *19th Conference on Air-Sea Interaction*, Phoenix, AZ. [Oral Presentation]

**Butterworth, B. J.**, and S.D. Miller, 2014: Long-term Southern Ocean Air-sea CO<sub>2</sub> Flux by Eddy Covariance from an Ice Breaker. *Ocean Sciences Meeting*, Honolulu, HI. [Oral Presentation]

**Butterworth, B. J.**, and S.D. Miller, 2013: Air-sea Fluxes of CO<sub>2</sub> over the Southern Ocean. *6th International SOLAS Summer School*, Xiamen, China. [Oral and Poster Presentation]

## TEACHING EXPERIENCE

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### **Metropolitan State University of Denver**

Introduction to Physical Geography	2012 (2 classes)
Map Use	2012
Weather and Climate	2011

### **University of Colorado, Boulder**

Laboratory for Physical Geography I	2009 (3 classes), 2010 (2 classes), 2011 (3 classes)
Laboratory for Physical Geography II	2008 (3 classes), 2009 (3 classes), 2010 (3 classes)

## GRANTS

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Travel Grant – 2 <sup>nd</sup> International workshop of Air-Sea Gas Fluxes (France)	2016
Travel Grant – Surface Ocean Lower Atmosphere Study summer school (China)	2013
Travel Grant – University at Albany Graduate Student Association	2013
Adam Kolff Memorial Research Fellowship	2010

## HONORS & AWARDS

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Narayan R. Gokhale Distinguished Research Scholarship Award  
United States Antarctic Service Medal  
CU Boulder Geography Scholarship  
Outstanding Senior in Environmental Science Award – University of Delaware  
Member of Phi Beta Kappa – academic fraternity  
Member of Alpha Zeta – honors agricultural fraternity  
Honors Program at University of Delaware  
Tuition Scholarship – University of Delaware

## PROFESSIONAL ACTIVITIES

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Helped organize a workshop (funded by NEON) to train researchers to use cloud computing resources to process data from the CHEESEHEAD project	2019
Session Convener and Chair for AGU Meeting – B21C - Surface-Atmosphere Interactions: Advances in Analysis and Scaling of Surface-Atmosphere Fluxes	2019
AmeriFlux Early Career Workshop. <i>Ameriflux Annual Meeting</i> , Boulder Colorado.	2019

Session Chair for ArcticNet Science Meeting 2016 – Ocean-Sea-Ice-Atmosphere Interaction	2016
Surface Ocean Lower Atmosphere Study (SOLAS) summer school – Xiamen, China	2013

## OUTREACH ACTIVITIES

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Helped organize an open house event to illustrate the CHEESEHEAD project to the community of Park Falls, WI	2019
Park Falls Public Library – presentation on the scientific motivations for the CHEESEHEAD study to community of Park Falls, WI	2019
Sexual harassment training – helped organize a sexual harassment training for the participants of the CHEESEHEAD project	2019
Ark Community Charter School – presentation on the Southern Ocean gas exchange experiment to 3 <sup>rd</sup> grade class in Troy, NY	2014

## FIELD CAMPAIGNS

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Park Falls, Wisconsin (May – Oct): Managed field operations for the CHEESEHEAD19 field campaign to determine the influence of mesoscale atmospheric processes on the Earth's energy balance.	2019
Quebec City, QC (May 10 – 23): Installed eddy covariance system on board the CCGS Amundsen for the Summer 2018 Expedition. Sailed (May 17 – 21) as part of equipment testing cruise in the St. Lawrence Estuary.	2018
Hokkaido, Japan (Feb 27 – Mar 11): Deployed under-ice eddy covariance system for measuring O <sub>2</sub> fluxes in Saroma-ko Lagoon in Hokkaido, Japan as part of an international collaboration (SCOR Working Group 152 on Measuring Essential Climate Variables in Sea Ice) to compare methods for measuring biogeochemical properties of sea ice.	2018
Amundsen Leg 2a (Jul 5 – 14): Sailed aboard the research vessel CCGS Amundsen from Kuujjuarapik, Quebec to Iqaluit, Nunavut to take measurements of air-sea-ice gas exchange in Hudson Bay.	2017
Amundsen Leg 1 (May 22 – Jun 11): Sailed aboard the research vessel CCGS Amundsen as part of the BaySys project from Quebec City to St. Johns, Newfoundland. Installed eddy covariance system on the bow mast of the ship to collect measurements of air-sea-ice gas exchange of carbon dioxide and methane.	2017
Cambridge Bay, Nunavut (Apr. 21 – May 5): Traveled to Qikirtaajuk Island in Dease Strait to install an eddy covariance tower to collect long-term, continuous measurements of air-sea-ice carbon dioxide flux.	2017

Cranberry Lake, New York (Aug. 11 – 22): Lake-atmosphere gas exchange, collaboration between ASRC, SUNY ESF, Columbia University.	2014
Research Vessel Ice Breaker (RVIB) Nathaniel B. Palmer (June 22 – 29): Equipment repairs and 6-day cruise from Punta Arenas to Valparaiso, Chile	2013
RVIB Nathaniel B. Palmer (Nov. 19 – 26): Equipment repair, Punta Arenas, Chile	2013
RVIB Nathaniel B. Palmer (Dec. 20, 2012 – Feb. 12, 2013): Installed and maintained EC system aboard a 40-day cruise from Punta Arenas, Chile to McMurdo Station, Antarctica	2012
Niwot Ridge, Colorado (August): Collaboration with Daniel Wolfe (NOAA) investigating boundary-layer development on Niwot Ridge using tether sonde.	2010
National Center for Atmospheric Research (August): Bio-hydro-atmosphere interactions of Energy, Aerosols, Carbon, H <sub>2</sub> O, Organics & Nitrogen (BEACHON) study – Weather balloon releases to investigate troposphere over Hayman fire burn site.	2010
Niwot Ridge, Colorado (summer) – Installed EC equipment and an array (3km x 4km) of temperature probes on Niwot Ridge to investigate the interaction between the local meteorology and vegetation patterns.	2009
White Clay Creek State Park, Delaware (summer) – Tested the effectiveness of using host-specific weevil as a biological control agent for invasive mile-a-minute weed.	2006

## JOURNAL REVIEWER

Limnology and Oceanography Methods	2020
Forests	2020
Ocean Science	2019
Atmospheric Measurement Techniques	2018
Atmospheric Measurement Techniques	2016

## ADVISORS

Postdoctoral – Dr. Ankur R. Desai	University of Wisconsin – Madison, Atmospheric Sci.
Postdoctoral – Dr. Brent G. T. Else	University of Calgary, Geography
Ph.D. – Dr. Scott D. Miller	University at Albany, SUNY, Atmospheric Science
Master's – Dr. Peter D. Blanken	University of Colorado, Boulder, Geography