

Jann Paul Mattern

Curriculum Vitae

Ocean Sciences Department
University of California Santa Cruz
Santa Cruz, CA, USA
✉ jmattern@ucsc.edu
paulmattern.org

Applied statistician with research interests focused on the development and implementation of statistical methods that combine large sets of observations with complex numerical models, including data assimilation, optimization and uncertainty analyses.

research

PhD thesis *Parameter, State and Uncertainty Estimation for 3-dimensional Biological Ocean Models* (advisors: Dr. Katja Fennel and Dr. Mike Dowd)

- data assimilation for complex, high-dimensional models and satellite observations using particle filter and statistical emulator techniques
- assessment of model uncertainty and sensitivity
- application of the methods to regional ROMS models for the Middle-Atlantic Bight and the Texas-Louisiana Shelf

MSc thesis *Ensemble-based data assimilation for a physical-biological ocean model near Bermuda* (advisors: Dr. Dirk Langemann, *Universität zu Lübeck*, Dr. Katja Fennel and Dr. Mike Dowd, *Dalhousie University*)

- implementation and comparison of the Ensemble Kalman Filter and a particle filter for a 1-dimensional ocean model and real-world observations

BSc thesis *Unterschriftsverifikation basierend auf lokal extrahierten Merkmalen temporaler Sequenzen* (*Verification of handwritten signatures based on locally extracted features of temporal sequences*; advisors: Dr. Thomas Martinetz and Dipl. Inf. Kai Labusch)

- development of a method to compare and classify handwritten signatures using sequence alignment and optimization techniques

academic work experience

since Sep 2017 Research Scientist, Ocean Sciences Department, *UC Santa Cruz*

2013 – 2017 Postdoctoral Fellow, Ocean Sciences Department, *UC Santa Cruz*
(advisor: Dr. Christopher A. Edwards)

2012 – 2013 Postdoctoral Fellow, Department of Oceanography, *Dalhousie University*
(advisor: Dr. Katja Fennel)

2008 – 2008 Research assistant, Department of Oceanography, *Dalhousie University*

2004 – 2007 Student assistant, Institute for Neuro- and Bioinformatics, *Universität zu Lübeck*

education

- 2009 – 2012 PhD program: Statistics (with emphasis on Oceanography)
Dalhousie University, Halifax, Canada
- 2007 – 2008 Visiting student, Department of Oceanography as part of the MSc program
Dalhousie University, Halifax, Canada
- 2005 – 2008 MSc program: Computational Life Sciences, *Universität zu Lübeck*, Lübeck, Germany
- 2002 – 2005 BSc program: Computational Life Sciences, *Universität zu Lübeck*, Lübeck, Germany

peer-reviewed publications

- K. Fennel, **J. P. Mattern**, S. Doney, L. Bopp, A. Moore, B. Wang and L. Yu (submitted to *Nature Primer*), Ocean Biogeochemical Modeling.
- J. P. Mattern** and C. A. Edwards (submitted to *PLOS ONE*), Ensemble optimal interpolation for adjoint-free biogeochemical data assimilation.
- J. P. Mattern**, K. Glauninger, G. L. Britten, J. Casey, S. Hyun, E. V. Armbrust, M. Follows, Z. Harchaoui and F. Ribalet (2022), A Bayesian approach to modeling phytoplankton population dynamics from size distribution time series, *PLOS Computational Biology*. doi: [10.1371/journal.pcbi.1009733](https://doi.org/10.1371/journal.pcbi.1009733)
- J. P. Mattern**, C. A. Edwards and C. N. Hill (2019), Dual number-based variational data assimilation – Constructing exact tangent linear and adjoint code from nonlinear model evaluations, *PLOS ONE*. doi: [10.1371/journal.pone.0223131](https://doi.org/10.1371/journal.pone.0223131)
- J. P. Mattern** and C. A. Edwards (2019), A simple difference quotient-based approximation for biogeochemical tangent linear and adjoint models, *Journal of Geophysical Research: Oceans*. doi: [10.1029/2018JC014283](https://doi.org/10.1029/2018JC014283)
- M. Irie, F. Hirose, T. Okada, **J. P. Mattern** and K. Fennel (2018), Modeling of nitrogen and phosphorus profiles in sediment of Osaka Bay, Japan with parameter optimization using the polynomial chaos expansion, *Coastal Engineering Journal*. doi: [10.1080/21664250.2018.1531814](https://doi.org/10.1080/21664250.2018.1531814).
- J. P. Mattern**, C. A. Edwards and A. M. Moore (2018), Improving variational data assimilation through background and observation error adjustments, *Monthly Weather Review*. doi: [10.1175/MWR-D-17-0263.1](https://doi.org/10.1175/MWR-D-17-0263.1)
- J. P. Mattern**, H. Song, C. A. Edwards, A. M. Moore and J. Fiechter (2017), Data assimilation of physical and chlorophyll observations in the California Current System using two biogeochemical models, *Ocean Modelling*. doi: [10.1016/j.ocemod.2016.12.002](https://doi.org/10.1016/j.ocemod.2016.12.002)
- J. P. Mattern** and C. A. Edwards (2017), Simple parameter estimation for complex models – testing evolutionary techniques on 3-dimensional biogeochemical ocean models, *Journal of Marine Systems*. doi: [10.1016/j.jmarsys.2016.10.012](https://doi.org/10.1016/j.jmarsys.2016.10.012).
- A. Kuhn, K. Fennel and **J. P. Mattern** (2015), Model investigations of the North Atlantic spring bloom initiation, *Progress in Oceanography*. doi: [10.1016/j.pocean.2015.07.004](https://doi.org/10.1016/j.pocean.2015.07.004)
- J. P. Mattern**, K. Fennel and M. Dowd (2014), Periodic time-dependent parameters improving forecasting abilities of biological ocean models, *Geophysical Research Letters*. doi: [10.1002/2014GL061178](https://doi.org/10.1002/2014GL061178)
- R. F. Wilson, K. Fennel and **J. P. Mattern** (2013), Simulating sediment-water exchange of nutrients and oxygen: A comparative assessment of models against mesocosm observations, *Continental Shelf Research*. doi: [10.1016/j.csr.2013.05.003](https://doi.org/10.1016/j.csr.2013.05.003)
- J. P. Mattern**, M. Dowd, and K. Fennel (2013), Particle Filter-based Data Assimilation for a 3-dimensional Biological Ocean Model and Satellite Observations, *Journal of Geophysical Research*. doi: [10.1002/jgrc.20213](https://doi.org/10.1002/jgrc.20213)
- J. P. Mattern**, K. Fennel, and M. Dowd (2013), Sensitivity and Uncertainty Analysis of Model Hypoxia Estimates for the Texas-Louisiana Shelf, *Journal of Geophysical Research*. doi: [10.1002/jgrc.20130](https://doi.org/10.1002/jgrc.20130)
- J. P. Mattern**, K. Fennel, and M. Dowd (2012), Estimating time-dependent parameters for a biological ocean model using an emulator approach, *Journal of Marine Systems*. doi: [10.1016/j.jmarsys.2012.01.015](https://doi.org/10.1016/j.jmarsys.2012.01.015)

- J. Hu, K. Fennel, **J. P. Mattern**, and J. Wilkin (2012), Data assimilation with a local Ensemble Kalman Filter applied to a three-dimensional biological model of the Middle Atlantic Bight, *Journal of Marine Systems*. doi: [10.1016/j.jmarsys.2011.11.016](https://doi.org/10.1016/j.jmarsys.2011.11.016)
- A. J. Hidy, J. C. Gosse, J. L. Pederson, **J. P. Mattern**, and R. C. Finkel (2010), A geologically constrained Monte Carlo approach to modeling exposure ages from profiles of cosmogenic nuclides: An example from Lees Ferry, Arizona, *Geochemistry Geophysics Geosystems*. doi: [10.1029/2010GC003084](https://doi.org/10.1029/2010GC003084)
- J. P. Mattern**, K. Fennel, and M. Dowd (2010), Introduction and Assessment of Measures for Quantitative Model-Data Comparison Using Satellite Images, *Remote Sensing*. doi: [10.3390/rs2030794](https://doi.org/10.3390/rs2030794)
- J. P. Mattern**, M. Dowd, and K. Fennel (2010), Sequential data assimilation applied to a physical-biological model for the Bermuda Atlantic time series station, *Journal of Marine Systems*. doi: [10.1016/j.jmarsys.2009.08.004](https://doi.org/10.1016/j.jmarsys.2009.08.004)

selected published abstracts

- J. P. Mattern** and C. A. Edwards (2022), A four-dimensional ensemble optimal interpolation approach for adjoint-free biogeochemical data assimilation. *2022 Ocean Sciences Meeting*, virtual. (oral presentation)
- J. P. Mattern**, C. A. Edwards and C. N. Hill (2020), Using dual numbers for automatic differentiation of complex functions – a simple way to create data assimilation code for coupled models. *2020 Ocean Sciences Meeting*, San Diego, CA, USA. (oral presentation)
- J. P. Mattern**, C. A. Edwards and C. N. Hill (2019), Two simple ways for creating model-independent biogeochemical tangent linear and adjoint code. *Ocean Predict '19*, Halifax, Canada. (oral presentation)
- J. P. Mattern**, C. A. Edwards, S. Dutkiewicz and O. Jahn (2018), Increasing the biological resolution of a regional ocean model for the California Current System. *2018 Eastern Pacific Ocean Conference*, Mt. Hood, OR, USA. (poster presentation)
- J. P. Mattern**, C. A. Edwards and A. M. Moore (2018), Error covariance tuning for data assimilation in biogeochemical ocean models. *2018 Ocean Sciences Meeting*, Portland, OR, USA. (oral presentation)
- J. P. Mattern**, H. Song, C. A. Edwards, A. M. Moore and J. Fiechter (2016), Comparison of Data Assimilation for Biogeochemical Ocean Models of Different Complexities. *2016 Ocean Sciences Meeting*, New Orleans, LA, USA. (oral presentation)
- J. P. Mattern**, K. Fennel, M. Dowd, C. A. Edwards, H. Song, A. M. Moore and J. Fiechter (2015), When Ocean Models meet Observations – Data Assimilation in Marine Ecosystem Models. *Scripps Institution of Oceanography*, La Jolla, CA, USA. (invited seminar talk)
- J. P. Mattern** and C. A. Edwards (2014), Optimization and Intercomparison of Biogeochemical Ocean Models of the US West Coast. *2014 Eastern Pacific Ocean Conference*, Mt. Hood, OR, USA. (oral presentation)
- J. P. Mattern**, K. Fennel, and M. Dowd (2013), Using Statistical Emulators for Parameter Estimation in a 3D BGC Model. *2013 Marine Biogeochemical Data Assimilation Symposium*, Hobart, Australia. (oral presentation)
- J. P. Mattern**, M. Dowd, and K. Fennel (2012), Particle Filter-based Data Assimilation for a 3D Biological Ocean Model and Satellite Observations. *2012 CMOS Congress*, Montréal, Canada. (oral presentation)
- J. P. Mattern**, K. Fennel, and M. Dowd (2012), Temporal and Spatial Dependence of Plankton Parameters in a Biological Ocean Model. *2012 Ocean Sciences Meeting*, Salt Lake City, UT, USA. (poster presentation)
- J. P. Mattern**, K. Fennel, and M. Dowd (2010), Satellite Data Assimilation for a 3D Physical-Biological Model using a Particle Filter. *2010 Ocean Sciences Meeting*, Portland, OR, USA. (poster presentation)

other professional activities

Member of the Computational Biogeochemical Modeling of Marine Ecosystems **CBIOMES** group.

Member of the Marine Ecosystem Analysis and Prediction Task Team (MEAP-TT) of the OceanPredict Initiative (formerly known as **GODAE-OceanView**).

Member of the University of California - CDPH (California Department of Public Health) Modeling Consortium for COVID-19 rapid analytic decision-making support, a group of modelers and researchers providing relevant analysis and insights to support pandemic-related decision making (since October 2021).

Volunteer with the County of Santa Cruz, California working on **modeling the outbreak of COVID-19** in the county (since April 2020).

Co-organizer of the "**Workshop on Bayesian Plankton Modeling**" held at the Massachusetts Institute of Technology in January 2020.

teaching experience Teaching graduate level course "Python programming for Ocean Scientists" consisting of 19 classes *UC Santa Cruz* (2017; 28.5 h total)

Teaching IAP class "Bayesian modeling of ecological systems using the "Stan" software package", *Massachusetts Institute of Technology* (2020; 4h total)

Teaching labs for "Marine Modelling", *Dalhousie University* (2008, 2010, 2011; 9h total)

Teaching class in "Multivariate Analysis", *Dalhousie University* (2011; 1.5h total)

Successfully completed the **2016 Professional Development Program**, that prepares scientists and engineers to be leaders in effective and inclusive education.

manuscript reviewer Biogeosciences (9 reviews), Frontiers in Marine Sciences (2 reviews), Geoscientific Model Development (2 reviews), Great Lakes Research (2 reviews), Hydrology and Earth System Sciences (2 reviews), Journal of Agricultural, Biological, and Environmental Statistics (1 review), Journal of Geophysical Research (7 reviews), Journal of Marine Systems (5 reviews), Monthly Weather Review (5 reviews), Ocean Modelling (15 reviews), Ocean Science Discussions (3 reviews), Remote Sensing Letters (2 reviews), Water (2 reviews)

computer/programming skills

advanced experience: Python, bash, Stan, Matlab

intermediate experience: Julia, FORTRAN, C++, Java, JavaScript