Robert Ladwig
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Homepage, Github, Gitlab, Google Scholar

I'M A HYDROLOGIST INTERESTED IN

(i) Water resources management, (ii) Aquatic ecosystem modeling, (iii) Knowledge-guided machine learning, (iv) Dissolved oxygen dynamics, (v) Climate change impact on lake mixing

PROFESSIONAL APPOINTMENTS

Postdoctoral Fellow since 2019
University of Wisconsin-Madison, Center for Limnology

- Aquatic ecosystem modeling of freshwater lakes in the US
- Dissolved oxygen depletion and stratification dynamics
- Technical development of open-source scientific lake modeling software
- Graduate level teaching
- Advisors: Assist. Prof. Hilary Dugan and Prof. Paul Hanson

Research Assistant 2015-2019
Leibniz-Institute of Freshwater Ecology and Inland Fisheries

- Field sampling, sediment column experiments, numerical modeling of lake systems, and multivariate statistical analysis of laboratory experiments
- Working group of Dr. Michael Hupfer 'Biogeochemical Processes in Sediments and Lake Management'

EDUCATION

Dr. rer. nat. (PhD) [magna cum laude] 2015-2019
Technische Universität Berlin and Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany

- Thesis: Adapting the water management to mitigate the impact of multiple stressors on an urban lake: Case study Lake Tegel, Germany
- Supervisors: Dr. Michael Hupfer and Prof. Dr.-Ing. Reinhard Hinkelmann
- Part of the Research Training Group 'Urban Water Interfaces' (DFG)

Master of Science in Hydrology [1.5] 2012-2015
Technische Universität Dresden, Germany

- Thesis: Optimal management of arid coastal aquifers with the use of density dependent groundwater flow modeling and artificial neural networks
- Supervisors: Dr. Jens Grundmann, Prof. Dr. Niels Schütze and JProf. Dr. Marc Walther

Bachelor of Science in BioGeoSciences [1.7] 2009-2012
Friedrich-Schiller University Jena, Germany

- Thesis: Spatiotemporal status of the heavy metal contamination in natural and contaminated test sites
- Supervisors: Prof. Dr. Kai Uwe Totsche and Dr. Dirk Merten

PEER-REVIEWED JOURNAL PAPERS

3. M. Hupfer, S. Jordan, C. Herzog, C. Ebeling, R. Ladwig, M. Rothe and J. Lewandowski (2019): "Chironomid larvae enhance phosphorus burial in lake sediments: Insights from long-term and short-term experiments", *Science of the Total Environment* **663**, 254-264.

2. R. Ladwig, E. Furusato, G. Kirillin, R. Hinkelmann and M. Hupfer (2018): "Climate Change Demands Adaptive Management of Urban Lakes: Model-Based Assessment of Management Scenarios for Lake Tegel (Berlin,Germany)", *Water* **10(2)**, 186.

1. R. Ladwig, L. Heinrich, G. Singer and M. Hupfer (2017): "Sediment core data reconstruct the management history and usage of a heavily modified urban lake in Berlin, Germany", *Environ Sci Pollut Res.* **24**, 25166-25178.

Submitted and Under Review

4. R. Woolway, A. Debolskiy, G. Golub, D. Mercado-Bettin, M. Perroud, V. Stepanenko, Z. Tan, L. Grant, R. Ladwig, J. Mesman, T. Moore, J. Schewe, T. Shatwell, I. Vanderkelen, R. Marce, D. Pierson, W. Thiery and E. Jennings (2020): "Phenological shifts in lake stratification under climate change", *submitted to Nature Climate Change* , .

3. R. Ladwig, P. Hanson, H. Dugan, C. Cayelan, Y. Zhang, L. Shu, C. Duffy and K. Cobourn (2020): "Lake thermal structure drives inter-annual variability in summer anoxia dynamics in a eutrophic lake over 37 years", *submitted to Hydrology and Earth System Sciences* , .

2. T. Moore*, J. Mesman*, R. Ladwig*, J. Feldbauer*, H. Dugan, F. Olsson, R. Pilla, J. Read, K. Rose, T. Shatwell and J. Venkiteswaran (-): "LakeEnsemblR v.1.0: A framework for ensemble modeling and environmental data processing of lake systems", *Will be submitted to Environmental Modelling and Software* , *Shared co-first authorships.

1. C. C. Barbosa, M. C. Caliijuri, A C. Alve dos Santos, R. Ladwig, L. F. A. de Oliveira and A. C. Sarmento (2020): "Future impact on water level and thermal regime of a multipurpose subtropical reservoir (Sao Paulo, Brazil) driven by climate change", *submitted to Science of the Total Environment* , .

In Prep.

5. R. Ladwig, L. Gao, J. Willard, N. Lottig, A. Appling, A. Delany, J. Stachelek, H. Dugan, S. Oliver, J. Read and P. Hanson (-): "Discovery of Causal Relationships in Lake Metabolism using a Bayesian Dissolved Oxygen Model", , .

4. T. Moore, R. Ladwig, S. Kelly (-): "Lake morphometry mediates lake stability response to impacts of climate change", *Will be submitted to Geophysical Research Letters* , .

3. T. Moore, D. Pierson, E. de Eyto, S. Kelly, R. Woolway, K. Bolding, J. Bruggeman, F. Clayer, M. Dillane, J. Feldbauer, G. Gal, J.-L. Guerrero, E. Jeppesen, R. Ladwig, J. Mesman, A. Nielsen, D. Trolle and E. Jennings (-): "Evaluation of global meteorological reanalyses as potential forcing datasets for one-dimensional hydrodynamic modeling", *Will be submitted to Hydrology and Earth System Sciences* , .

2. J. Feldbauer, T. Moore, J. Mesman, R. Ladwig, T. Berendonk and T. Petzoldt (-): "Model uncertainty of climate impact on thermal stratfication and ice cover duration for a German drinking water reservoir", , .

1. R. Ladwig, E. Matta, R. Hinkelmann and M. Hupfer (2020): "Numerical investigation of water exchange times and phytoplankton bloom formation in an urban lake after short-duration heavy rainfall events", *submitted to Environmental Modeling and Assessment* , .

FURTHER PUBLICATIONS AND PRESENTATIONS

19. What is driving oxygen depletion dynamics in lakes (and reservoirs, probably) over different time-scales?, Invited oral presentation, *Hydrobiological seminar at TU Dresden*, Virtual presentation 17.12.2020

18. Coupling Bayesian modeling of lake oxygen dynamics with machine learning to advance aquatic ecosystem understanding, Poster presentation, *AGU Fall Meeting 2020*, Virtual conference 01.-17.12.2020

17. What is driving oxygen depletion in lakes? Process-based modeling of long-term lake oxygen dynamics , Invited oral presentation, *CEREO/WRC seminar at Washington State University*, 04.11.2020

16. Two-layer Bayesian Dissolved Oxygen Model for Ecological Process Discovery, Poster presentation, *GLEON 21.5 All Hands' Meeting*, Virtual conference 19.-22.10.2020

15. LakeEnsemblR: An R package that facilitates ensemble modelling of lakes, Poster presentation, *GLEON 21.5 All Hands' Meeting*, Virtual conference 19.-22.10.2020

14. Ecological knowledge guides machine learning: (i) process-guided phosphorus modeling, (ii) Bayesian modeling of lake oxygen dynamics, Oral presentation, *Workshop on Knowledge Guided Machine Learning (KGML)*, Virtual Workshop,18.- 19.08.2020

13. LakeEnsemblR: An R package that facilitates 1D ensemble modeling of lakes, Oral presentation, *Incorporating Data Science and Open Science Techniques in Aquatic Research*, Virtual Summit, 23.-24.07.2020

12. New Features to the Trinity of GLM R-packages: glmtools, GLM3r and GRAPLEr, Poster presentation, *GLEON 21 All Hands' Meeting*, Huntsville, Canada, 04.-08.11.2019

11. What is driving the death zone of Lake Mendota?, Invited oral presentation, *Wisconsin Ecology 22nd Annual Fall Symposium*, Madison, USA, 15.10.2019

10. Simulating oxythermal habitats of fish in surrogate lake ecosystems, Oral presentation, *4th Science in the Northwoods Conference*, Woodruff, USA, 09.11.2019

9. Simulation of water exchange times for contaminant risk assessment in an urban lake using a depth-averaged 2D model, Conference paper, *E-proceedings of the 38th IAHR World Congress*, Panama City, Panama, 01.-06.09.2019

8. Adapting the water management to mitigate the impact of multiple stressors on an urban lake: Case study Lake Tegel, Germany , PhD thesis, Technische Universität Berlin, Berlin, Germany, 25.02.2019

7. How can we adapt urban lake management in times of climate change?, Invited oral presentation, *9th Water Research Horizon Conference*, Dresden, Germany, 03.-04.07.2018

6. From 1D to 2D: Impact of extreme weather events and climate change on the heavily stressed urban Lake Tegel in Berlin, Germany, Poster presentation, *EGU General Assembly*, Vienna, Austria, 09.-13.04.2018

5. Model-based assessment of urban water management strategies for a shallow dimictic lake, Poster presentation, *ELR2017NAGOA and ICLEE 8th Conference*, Nagoya, Japan, 22.-25.09.2017

4. Lake on life support: Evaluating urban lake management measures by using a coupled 1D-modeling approach, Oral presentation, *EGU General Assembly*, Vienna, Austria, 23.-28.04.2017

3. Abschlussbericht: Sedimentuntersuchungen am Tegeler See, Report, *on behalf of Berlin Senate Department for the Environment, Transport and Climate Protection*, Berlin, Germany, 2016

2. Qualitative Beurteilung von Bewirtschaftungsmaßnahmen im Sediment eines urbanen Sees mittels multivariater Statistik, Oral presentation (in German), *DGL Tagung Wien*, Vienna, Austria, 26.-30.09.2016

1. Urban Water Interfaces: Interfaces in Urban Surface Waters, Oral presentation, *6th German-Russian Week of the Young Researcher*, Moscow, Russia, 12.-16.09.2016

TEACHING EXPERIENCE

- Co-Instructor "Zoology 955: Seminar-Limnology - An introduction to lake modeling" at UW-Madison, Madison, USA, in 2019. Full-semester graduate student course, 11 students
- Lecturer of "GLM-AED2 lake modeling workshop". 05.11.2020, CEREO seminar at Washington State University,
- Organizer/Lecturer of "Process-based lake modeling in R using GLM (General Lake Model)". 14.10.2020, Virtual GLEON 21.5 All Hands' Meeting,
- Co-Lecturer of "Ensemble lake modelling with LakeEnsemblR". 15.10.2020, Virtual GLEON 21.5 All Hands' Meeting,
- Co-Lecturer of "GLM Workshop". 06.05.2020, Smart and Connected Communities and FCR Carbon Team - All-Hands Meeting,
- Co-Organizer/Lecturer of "Introduction to running, visualizing, and calibrating the General Lake Model (GLM)". 04.-08.11.2019, GLEON 21 All Hands' Meeting, Huntsville, Canada,
- Guest lecture about "Modeling of surface water systems" in the graduate course *Water Resource and Environmental Engineering 2017* at Saitama University, Saitama, Japan

(CO)-SUPERVISED STUDENTS

4. Aryan Adhlakha (undergraduate student, UW-Madison): Stochastic modeling of phytoplankton in process-based models

3. Lynette Gao (undergraduate student, UW-Madison): Lake anoxia modeling project, coupling with machine laarning algorithms

2. Simon Heimann (Master thesis, 2017-2018): Modellgestützte Analysen zum Einfluss des globalen Klimawandels auf die Temperatur- und Sauerstoffverhältnisse in geschichteten Seen (in German). Soils, Inland Waters, Contaminated Land (M.Sc.), Osnabrück University

1. Lena Heinrich (Master thesis, 2015-2016): Impact of management measures on sediment stratigraphy and phosphorus fixation in Lake Tegel (Berlin). Technical Environmental Protection (M.Sc.), Technische Universität Berlin

EXPERIENCE

Special research student (Visiting researcher) 09-11/2017
Saitama University, Japan
Research internship at working group of Assoc. Prof. Eiichi Furusato: field investigations and numerical modeling of reservoirs; ecological modeling of phytoplankton

Research assistant 05-07/2015
Technische Universität Dresden
Modeling and economic evaluation of groundwater management scenarios; correction and evaluation of written exams in the modules 'Hydrological Models' and 'Climatology and Hydrology'

Student assistant 11-12/2013
Institut für Wasser und Boden Dr. Uhlmann, Dresden
Data analysis, field work (e.g. stream gauging)

Internship 09-10/2013
Helmholtz-Centre for Environmental Research, Halle
Isotope analysis, chemical analysis, field sampling

Internship 03-04/2012
KOWUG Kommunale Wasser- und Umweltanalytik GmbH, Gera
Chemical analysis, sampling

Student assistant 08/11-02/12
Max-Planck Institute for Biogeochemistry, Jena
Technical work

Internship 07-08/2009
JENA-GEOS-Ingenieurbüro GmbH, Jena
Data analysis, field work (e.g. groundwater sampling)

PROJECT COLLABORATIONS

- ABI Development funded by National Science Foundation: Building advanced numerical simulation technology for the lake ecology community at UW-Madison, since 2019, *postdoctoral fellow in the project*
- Harnessing the Data Revolution funded by National Science Foundation: Knowledge Guided Machine Learning, since 2019, *postdoctoral fellow in the project*
- Collaborative Research funded by National Science Foundation: Consequences of changing oxygen availability for carbon cycling in freshwater ecosystems at UW-Madison, since 2019, *scientist in the project*
- Interdisciplinary Research Training Group 'Urban Water Interfaces' funded by Deutsche Forschungsgemeinschaft: joint project between Technische Universität Berlin and Leibniz-Institute of Freshwater Ecology and Inland Fisheries Berlin, 2015-2018, *doctoral student in the project*
- The Inter-Sectoral Impact Model Intercomparison Project (ISIMIP): community-driven climate-impacts modeling initiative, since 2019, *contact person for the GLM model in the Lakes team*

- Coupled Natural and Human system (CNH Lakes): research project that explores the relationships between human behavior and lake water quality, since 2019, *scientist in the project*
- Aquatic Ecosystem MOdeling Network Junior (AEMON-J): grass-roots network for early career researchers in aquatic ecosystem modeling, since 2019, *member of the team setting up the model wikipedia and LakeEnsemblR*
- Improving the lake Status from Eutrophy towards Oligotrophy (ISEO): joint project to investigate the impact of mixing patterns in North Italian Lake Iseo, 2018, *member of the IGB team*
- Yamagusuku Pond, Kumejima Island, Japan: application of artificial bubble plume mixing technique to improve pond water quality, 2017, *member of Saitama University team*

REVIEWER

- JGR Biogeosciences, Limnology and Oceanography, Hydrology and Earth System Sciences, Environmental Modelling & Software, Environmental Pollution, Inland Waters, Ecological Informatics, Limnologica, Heliyon, Water

SOCIETY MEMBERSHIPS

- Global Lake Ecological Observatory Network (GLEON)
- International Society of Limnology (SIL)
- Association for the Sciences of Limnology and Oceanography (ASLO)
- German Society for Limnology (DGL)
- American Geophysical Union (AGU)

OUTREACH AND SERVICE

- Interview about lake turnover and anoxia for the Clean Lakes Alliance
- Part of the UW-Madison Postdoctoral Research Symposium 2019 Planning Committee
- Since June 2019: part of the UW-Madison University Apartments Assembly, Vice Chair of Communications and Newsletters

COMPUTING

Selected software projects

LakeEnsemblR

R package that facilitates multi-model ensembles for lake thermodynamics, includes tools for calibration, sensitivity analysis and data visualization.

thermod

Simple two-layer water temperature model in R to teach students about heat fluxes, stratification dynamics and depletion of dissolved oxygen.

glmtools
: Overhaul and feature addition, e.g. calibration, of the tools suite for interacting with the General Lake Model (GLM) in R.

simpleAnoxia
: Simple two-layer dissolved oxygen model to simulate anoxia dynamics on the US continental scale using physics-guided machine learning.

GLM3r
: R package for basic GLM model running.

Experience

- Programming: R (6 years), MATLAB/Octave (8 years), Python (3 years)
- Modeling: GLM-AED2, open TELEMAC-Mascaret, OpenGeoSys, FLake, GOTM, Simstrat, MyLake, MODFLOW-2005, PCLake, PHREEQC, HEC-RAS, AKWA-M, Hydrus
- Misc.: Container (Docker), Unix, Git, LaTeX, Microsoft Office, ArcGIS, QGIS, Experience on High-Performance Computing (HLRN Germany, HTCondor), ParaView, Inkscape, FileZilla

LANGUAGES

- German (native)
- English (fluent, level C1)