

# WOLFRAM BARFUSS

Argelander Professor

Transdisciplinary Research Area Sustainable Futures at the Center for Development Research (ZEF)  
University of Bonn, Genscherallee 3, 53113 Bonn, Germany

✉ wbarfuss@uni-bonn.de 🏠 wbarfuss.github.io 📞 +49-228-73-1835

## EXPERIENCE

---

*Argelander Assistant Professor* (Tenure-Track), University of Bonn, of Integrated System Modeling for Sustainability Transitions Feb 23 →

*Research Scientist*, University of Tübingen, Tübingen AI Center Apr 21 - Jan 23

*Research Fellow*, University of Leeds, School of Mathematics May 20 - Mar 21

*Research Scientist*, Max Planck Institute for Mathematics in the Sciences Leipzig Aug 19 - Sep 20

*Research Scientist*, Potsdam Institute for Climate Impact Research (PIK) Jun 15 - Jul 19

*Visiting Researcher*, Stockholm Resilience Center (SRC), Stockholm University Oct 16 - Nov 16

*Visiting Researcher*, University College London, Department of Computer Science Sep 13 - Mar 14

## ADDITIONAL AFFILIATIONS

---

Member, Cluster of Excellence PhenoRob, Uni Bonn Sep 23 →

Member, Center for Earth System Observation and Computational Analysis (CESOC) Sep 23 →

Member, Transdisciplinary Research Area Individual & Societies, Uni Bonn Sep 23 →

Member, Transdisciplinary Research Area Modeling, Uni Bonn Mar 23 →

Member, Earth Resilience and Sustainability Initiative (PIK-PU-SRC) Aug 19 →

Guest researcher, Potsdam Institute for Climate Impact Research Aug 19 →

Guest researcher, Princeton University (PU) Jan 20 - Dec 22

## EDUCATION

---

Ph.D. in Theoretical Physics, Humboldt University Berlin - *summa cum laude* Jul 19  
Thesis: *Learning dynamics and decision paradigms in social-ecological dilemmas*

M.Sc. in Physics, University of Erlangen-Nuremberg - *with distinction* (1.07 | 1.0) May 15  
Electives: Philosophy & Economics

B.Sc. in Physics, University of Erlangen-Nuremberg - *very good* (1.43 | 1.0) Sep 13  
Electives: Computer Science & Complex Systems

## PUBLICATIONS

---

A modeling framework for World-Earth System resilience: Exploring social inequality and earth system tipping points *by* Anderies JM, [Barfuss W](#), Donges JF, Fetzer I, Heitzig J, Rockström J (2023) in *Environ. Res. Lett.* 18 095001

Perspectives on adaptive dynamical systems *by* Sawicki J, Berner R, Loos SAM, Anvari M, Bader R, [Barfuss W](#), Botta N, Brede N, Franović I, Gauthier DJ, Goldt S, Hajizadeh A, Hövel P, Karin O, Lorenz-Spreen P, Miehl C, Mölter J, Olmi S, Schöll E, Seif A, Tass PA, Volpe G, Yanchuk S, Kurths J (2023) in *Chaos*, 33, 071501

Intrinsic fluctuations of reinforcement learning promote cooperation *by* [Barfuss W](#) & Meylahn (2023) in *Sci. Rep.* 13, 1309

Modeling the effects of environmental and perceptual uncertainty using deterministic reinforcement learning dynamics with partial observability *by* [Barfuss W](#) & Mann RP (2022) in *Phys. Rev. E* 105, 3, 034409

Dynamical systems as a level of cognitive analysis of multi-agent learning *by* [Barfuss W](#) (2022) in *Neural Computing & Applications* 34, 1653–1671

Taxonomies for structuring models for World-Earth system analysis of the Anthropocene: subsystems, their interactions and social-ecological feedback loops *by* Donges JF, Lucht W, Cornell SE, Heitzig J, [Barfuss W](#), Lade SJ, Schlüter M (2021) in *Earth Syst. Dyn.* 12, 1115–1137

Stewardship of global collective behavior *by* Bak-Coleman J, Alfano M, Barfuss W, Bergstrom C, Centeno MA, Couzin ID, Donges JF, Galesic M, Gersick AS, Jacquet J, Kao A, Gersick A, Moran RE, Romanczuk P, Rubenstein DI, Tombak KJ, Van Bavel JJ, Weber EU (2021) in *Proc. Natl. Acad. Sci.* 118(27), e2025764118

Towards a unified treatment of the dynamics of collective learning *by* Barfuss W (2021) in *AAAI Spring Symposium 2020/21: Challenges & Opportunities for Multiagent Reinforcement Learning*

Caring for the future can turn tragedy into comedy for long-term collective action under risk of collapse *by* Barfuss W, Donges JF, Vasconcelos VV, Kurths J, Levin SA (2020) in *Proc. Natl. Acad. Sci.* 117(23), 12915-12922

Reinforcement learning dynamics in the infinite memory limit *by* Barfuss W (2020) in *Proc. of the 19th International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*

Earth system modeling with complex dynamic human societies: the copan:CORE World-Earth modeling framework *by* Donges JF, Heitzig J, Barfuss W, Wiedermann M, Kassel JA, Kittel T, Kolb JJ, Kolster T, Müller-Hansen F, Otto IM, Zimmerer KB, Lucht W (2020) in *Earth Syst. Dyn.* 11, 395-413

Deep reinforcement learning in World-Earth system models to discover sustainable management strategies *by* Strnad FM, Barfuss W, Donges JF, Heitzig J (2019) *Chaos* 29, 123122

The physics of governance networks: critical transitions in contagion dynamics on multilayer adaptive networks with application to the sustainable use of renewable resources *by* Geier F, Barfuss W, Wiedermann M, Kurths J, Donges JF (2019) in *Eur. Phys. J. Spec. Top.*, 228 11, 2357-2369

Geometric effects in random assemblies of ellipses *by* Lovric J, Kaliman S, Barfuss W, Schröder-Turk GE, Smith AS (2019) in *Soft Matter*, 15, 8566-8577

Learning dynamics and decision paradigms in social-ecological dilemmas *by* Barfuss W (2019), *PhD Thesis, Humboldt-University of Berlin*

Deterministic limit of temporal difference reinforcement learning for stochastic games *by* Barfuss W, Donges JF, Kurths J (2019) in *Phys. Rev. E* 99, 043305 (*Editor's Suggestion*)

When optimization for governing human-environment tipping elements is neither sustainable nor safe *by* Barfuss W, Donges JF, Lade SJ, Kurths J (2018) in *Nat. Commun.* 9, 2354

A thought experiment on sustainable management of the Earth system *by* Heitzig J, Barfuss W, Donges JF (2018) in *Sustainability* 10(6), 1947

From math to metaphors and back again. Social-ecological resilience from a multi-agent environment perspective *by* Donges JF, Barfuss W (2017) in *GAIA* 26(S1), 182-190

Sustainable use of renewable resources in a stylized social-ecological network model under heterogeneous resource distribution *by* Barfuss W, Donges JF, Wiedermann M, Lucht W (2017) in *Earth Syst. Dyn.* 8, 255-264

Parsimonious modeling with Information Filtering Networks *by* Barfuss W, Massara GP, Di Matteo T, Aste T (2016) in *Phys. Rev. E* 94, 062306

## PRESENTATIONS

---

2023: AI4ABM Seminar(V); NDA, Potsdam; ZEF, Bonn; TRA Sustainable Future, Bonn; Cooperative AI Retreat, London; Berkeley MARL Seminar(V); ECEM, Leipzig; Sustainable AI Lab, Bonn; CESOC Seminar(V); Lamarr Institute(V); Tchumatchenko Group, Bonn; Hasenauer Group, Bonn

2022: Cooperative AI Seminar(V); Uni Leeds(V); SIAM Life Science Mini Symposium(V); MPI for Evolutionary Biology; Université Libre de Bruxelles; Adaptivity in nonlinear dynamical systems Workshop(V), Amsterdam Cooperation Colloquium(V); Adaptive and Learning Agents AAMAS Workshop(V); Collective Learning across Scales ICLR Workshop(V); Royal Society Meeting on Collective Knowledge(V)

2021: Uni Leeds(V); Uni Tübingen(V); Uni Graz(V); Uni Konstanz(V); Dartmouth College(V); Dutch Institute for Emergent Phenomena(V); Learning, Evolution & Games (LEG) Conference(V); COMARL AAAI Spring Symposium(V)

2020: MPI for Human Cognitive and Brain Sciences; Free University of Berlin; MPI for Evolutionary Biology; Potsdam Institute for Climate Impact Research(V); ERSI Workshop(V); Collective Intelligence Conference(V);

AAMAS(V); Adaptive and Learning Agents (ALA) Workshop(V); Optimization and Learning in Multiagent Systems Workshop(V)

2019: MPI for Mathematics in the Sciences; Institute for Cross-Disciplinary Physics and Complex Systems (IFISC); International workshop on complex systems and networks, Berlin; AI, People & Planet Workshop, New York City; Uni Bayreuth; KOSMOS Conference, Berlin

2018: Helmholtz Centre for Environmental Research (UFZ); DPG Spring Meeting, Berlin

2017: Uni Oxford, DPG Spring Meeting, Dresden; Resilience2017 Conference, Stockholm;

2016: EGU Vienna; Perspectives in Nonlinear Dynamics, Berlin; CCS Amsterdam

2015: DPG Spring Meeting, Berlin

2014: SigmaPhi, Rhodes

## TEACHING

---

### Supervision

Ph.D. supervision: C. Bergerot (co-supervision)

3 MSc Thesis, 3 Internships

### Courses

*Complex System Modeling of Human-Environment Interactions*, Uni Bonn 2023

*Economics on Sustainability*, Uni Bonn 2023

### Lectures

*Sustainability as a Complex System*, Uni Bonn 2024

*World-Earth Resilience and Transformation Pathways*, ZEF, Uni Bonn 2023

*Agent Based Modeling*, Department of Economics, Humboldt-University Berlin 2016, 2018

*Multi-agent systems*, Department of Physics, Humboldt-University Berlin 2016, 2018

### Outreach

Panelist on *Time for utopias*, koellektiv, Cologne 2023

Discussion on *System modeling between utopia and dystopia*, IAKM 2023

Pubic lecture on *Sustainably Intelligent or Intelligently Sustainable?*, Tübingen 2021

High school lecture on *Cooperative AI*, Rutesheim 2021

Interview in Perspective Daily on the work *Stewardship of global collective behavior* 2021

## SERVICE

---

### Committees

Steering Committee of the TRA Sustainable Futures, Uni Bonn 2023 →

Tübingen AI Center Coordination Group 2021-2022

Heinrich-Böll Foundation scholarship selection committee 2015-2017

Ph.D. representative, Potsdam Institute for Climate Impact Research 2016-2017

Student representative, University Council & Academic Senate, Uni Erlangen-Nuremberg 2012-2013

### Peer review

**Journals:** Anthropocene Review, Applied Mathematics and Computation, Applied Sciences, Chaos, Computational and Applied Mathematics, Discover Sustainability, Earth System Dynamics, Ecological Modelling, Ecology & Society, European Physics Letters, iScience, Nature Communications, Nature Sustainability, Neural Computing and Applications, Physica A, Physical Review E, Physical Review Letters, Physical Review Research, Physical Review X Life, PLOS Computational Biology, PLOS Sustainability and Transformation, Proceedings of the National Academy of Sciences, Royal Society Interface

**Conferences & Workshops:** Adaptive and Learning Agents (ALA) Workshop at AAMAS, AI for Earth Sciences Workshop at ICLR and NeuIPS, Evolutionary Dynamics in social, cooperative and hybrid AI (EDAI) Workshop at ECAI, International Conference on Autonomous Agents and Multiagent Systems (AAMAS)

**Funding:** Cooperative AI Foundation, European Research Council (ERC), Swiss National Science Foundation

**FUNDING TRANSPARENCY.** I have received direct funding for my work from the Cooperative AI Foundation (2022,2024→), the Heinrich-Böll Foundation (2015-2018), Wilhelm & Else Heraeus Foundation (2015-2018) and the Leonardo-Kolleg, Uni Erlangen-Nuremberg (2012 - 2015).