

Dr. Jobst Heitzig – short CV

(September 2025)

Summary

Dr. Jobst Heitzig is a Senior Researcher at the Potsdam Institute for Climate Impact Research since 2010 and leads its Working Group on *Behavioural Game Theory and Interacting Agents*. He holds a PhD in mathematics from Hannover University and has worked as a scientific officer with the German National Statistical Office, as a data warehouse analyst with the German Development Bank KfW, and as a freelance statistical software trainer with SAS. He was a project lead of an EIT Climate-KIC project on Power Grid Stability (SWIPO), co-speaker of the flagship project *copan – coevolutionary pathways*, and has organized several interdisciplinary international workshops and conferences. He has published on game theory, complex networks theory, dynamical systems theory, environmental economics, social choice, statistical methods, general topology, confidentiality protection, combinatorics, and environmental ethics, and has edited three special issues for the journal EPJ ST. He has supervised a number of master's and PhD theses.

Current position

2010–	Senior Researcher, <i>Potsdam Institute for Climate Impact Research</i> , Research Department <i>Complexity Science</i> .
2025–	Leader, Working Group on <i>Behavioural Game Theory and Interacting Agents (BeGa)</i> .
2019–2024	Co-leader, FutureLab on <i>Game Theory and Networks of Interacting Agents (GaNe)</i> .
2013–2018	Co-speaker, flagship project <i>copan – coevolutionary pathways</i> .

Previous work experience

2007–2009	IT Systems Analyst, <i>KfW Bankengruppe (German Development Bank)</i> . Data warehousing, internal IT consulting, software development.
2002–2007	Scientific Officer, <i>German National Statistical Office</i> . Development of methods for statistical privacy protection, trainer for statistical software.

Education

2002	PhD in Mathematics, Leibniz-Universität Hannover, grade “ausgezeichnet”
1995	Pre-diploma in Physics, Leibniz-Universität Hannover

Current research interests

- Mechanisms for cooperation (coalition formation, conditional commitments, group decision methods)
- Learning and equilibrium selection in games (types of equilibria, dynamics, convergence, realism, heuristics)
- Multi-level governance (multi-level games and networks)
- Modelling interacting social dynamics on adaptive networks (belief formation, opinion dynamics, norm emergence, identity formation) with applications to ethical investment and consumption
- Formalization of responsibility and agency in multi-agent situations with uncertainty
- Conceptual models of global long-term nature-society coevolution
- Dynamical systems theory of sustainable management and transient behaviour
- Using machine learning methods safely in our research, and making AI safer in general

Publications

ISI journal articles (published / in press / accepted / under minor revision)

2025

- Marquardt J, Pfeiffer F, Blum M, Daw T, Akowuge Dugasseh F, Heitzig J, Hysing E, Brandt Jensen IH, Kulha K, Langkjær F, Lindvall D, Nasiritousi N, Schlosberg D, Toikka A, Tønder L (2025) Reconciling democracy and sustainability: three political challenges and the role of democratic innovations. In production at *Sustainability: Science, Practice and Policy*. doi:10.1080/15487733.2025.2504239
- Bechthold M, Barfuss W, Butz A, Breier J, Constantino S, Heitzig J et al. (2025) Social norms and groups structure safe operating spaces in renewable resource use in a social-ecological multi-layer network model. *Earth System Dynamics* 16(4):1365–1390. doi:10.5194/esd-16-1365-2025
- Smith EK*, Wiedermann M*, Donges JF, Heitzig J, Winkelmann R (2025) A global threshold model of enabling conditions for social tipping in pro-climate change behaviours – the role of sea-level rise anticipation and climate change concern. *Earth System Dynamics* 16(2):545–564. doi:10.5194/esd-16-545-2025. Preprint: <https://doi.org/10.5194/egusphere-2023-1622> *shared lead authorship
- Nagel S, Heitzig J, Schöll E (2025) Macroscopic stochastic model for economic cycle dynamics. *Physical Review Letters* 134(4). doi:10.1103/PhysRevLett.134.047402. Preprint: arXiv:2312.16708

2024

- Dima S*, Fischer S*, Heitzig J*, Oliver J* (2024) Non-maximizing policies that fulfill multi-criterion aspirations in expectation. In: Freeman, R., Mattei, N. (eds) *Algorithmic Decision Theory. ADT 2024*. Lecture Notes in Computer Science, vol 15248. Springer, Cham. doi:10.1007/978-3-031-73903-3_8. arXiv:2408.04385 *equal contributions, authors listed alphabetically
- Jacobs B, Heitzig J (2024) Should we vote in non-deterministic elections? *Philosophies* 9 (4):107. doi:10.3390/philosophies9040107
- Conitzer V, Freedman R, Heitzig J, Holliday WH, Jacobs BM, Lambert N, Mossé M, Pacuit E, Russell S, Schoelkopf H, Tewolde E, Zwicker WS (2024) Social Choice for AI Ethics and Safety. In: *Proceedings of the 41st International Conference on Machine Learning (ICML), Vienna, Germany*. Publisher: PMLR. Preprint: arXiv:2404.10271
- Heitzig J, Simmons FW, Constantino S (2024) Fair democratic decisions via non-deterministic proportional consensus. *Social Choice & Welfare*. doi:10.1007/s00355-024-01524-3. Preprint: ssrn.com/abstract=3751225
- Pawluczuk Ł, Heitzig J (2024) Boundary objects as a credible way of thinking about integrated human-Earth models. *GAIA* 33/1:137–141. doi:10.14512/gaia.33.1.4
- Schunck F, Wiedermann M, Heitzig J, Donges JD (2024) A dynamic network model of societal complexity and resilience inspired by Tainter's theory of collapse. *Entropy* 2024:26,98. doi:10.3390/e26020098. arXiv:2102.06698.
- Lücke M, Winkelmann S, Heitzig J, Molkenthin N, Koltai P (2024) Learning Interpretable Collective Variables for Spreading Processes on Networks. *Physical Review E* 109:L022301.

Before 2024

- Lücke M, Heitzig J, Koltai P, Molkenthin N, Winkelmann S (2023) Large population limits of Markov processes on random networks. *Stochastic Processes and their Applications* 166:104220. doi:10.1016/j.spa.2023.09.007. arXiv:2210.02934
- Anderies JM, Barfuss W, Donges JF, Fetzer I, Heitzig J, Rockström J (2023) A modeling framework for World-Earth system resilience: exploring social inequality and Earth system tipping points. *Environmental Research Letters* 18:095001. doi:10.1088/1748-9326/ace91d. arXiv:2204.04471
- Bien S, Schultz P, Heitzig J, Donges JF (2023) Resilience basins of complex systems: An application to prosumer impacts on power grids. *Chaos* 33:063148. doi:10.1063/5.0120891. arXiv:2108.09474

- Terzopoulou Z, Keijzer MA, Sreedurga G, [Heitzig J](#) (2023) The Rule–Tool–User Nexus in Digital Collective Decisions. *Proceedings of the 2023 International Conference on Autonomous Agents and Multiagent Systems (AAMAS23)*: 1792-1796.
- Hiller S, Israel J, [Heitzig J](#) (2022) An Axiomatic Approach to Formalized Responsibility Ascription. In: Aydoğan, R., Criado, N., Lang, J., Sanchez-Anguix, V., Serramia, M. (eds) PRIMA 2022: Principles and Practice of Multi-Agent Systems. PRIMA 2022. *Lecture Notes in Computer Science*, vol 13753. Springer, Cham. doi:10.1007/978-3-031-21203-1_26. arXiv:2111.06711
- Tamberg LA, [Heitzig J](#), Donges JF (2022) A modeler's guide to studying the resilience of social-technical-environmental systems *Environmental Research Letters* 17(5): 055005. doi:10.1088/1748-9326/ac60d9. arXiv:2007.05769
- Winkelmann R* / Donges JF* / Smith EK* / Milkoreit M*, Eder C, [Heitzig J](#), Katsanidou A, Wiedermann M, Wunderling N, Lenton TM (2022) Social tipping processes towards climate action: a conceptual framework. *Ecological Economics* 192:107242. doi:10.1016/j.ecolecon.2021.107242, arXiv:2010.04488. *shared first authorship
- Ansari S, Brzoska L, [Heitzig J](#), Lentz H, Fritzscheier J, Moosavi MR (2021) A temporal network model for livestock trade systems. *Frontiers in Veterinary Science*. doi:10.3389/fvets.2021.766547
- Donges JF, Lochner J, Kitzmann N, [Heitzig J](#), Lehmann S, Wiedermann M, Vollmer J (2021) Dose-response functions and surrogate models for exploring social contagion in the Copenhagen Networks. *EPJ ST*. doi:10.1140/epjs/s11734-021-00279-7. arXiv:2103.09496
- Kittel T, Müller-Hansen F, Koch R, [Heitzig J](#), Deffuant G, Mathias JD, Kurths J (2021) From lakes and glades to viability algorithms: automatic classification of system states according to the Topology of Sustainable Management. *EPJ ST*. doi: 10.1140/epjs/s11734-021-00262-2. arXiv:1706.04542
- Helfmann L, [Heitzig J](#), Koltai P, Kurths J, Schütte C (2021) Statistical analysis of tipping pathways in agent-based models. *EPJ ST*. doi:10.1140/epjs/s11734-021-00191-0. arXiv:2103.02883
- Asano YM, Kolb JJ, Farmer JD, [Heitzig J](#) (2021) Emergent inequality and business cycles in a simple behavioral macroeconomic model. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* 118 (27):e2025721118. doi:10.1073/pnas.2025721118. SSRN:3415472
- Ansari S, Anvari M, Pfeffer O, Molkenhain N, Hellmann F, [Heitzig J](#), Kurths J (2021) Moving the epidemic tipping point through topologically targeted social distancing. *EPJ ST*. doi:10.1140/epjs/s11734-021-00138-5. arXiv:2102.09997
- Donges JF, Lucht W, Cornell S, [Heitzig J](#), Barfuss W, Lade S, Schlüter M (2021) Taxonomies for structuring models for World-Earth systems analysis of the Anthropocene: subsystems, their interactions and social-ecological feedback loops. *Earth System Dynamics* 12:1115–1137. doi:10.5194/esd-12-1115-2021
- Müller PM, [Heitzig J](#), Kurths J, Lüdge K, Wiedermann M (2021) Anticipation-induced social tipping – can the environment be stabilised by social dynamics? *EPJ ST*. doi:10.1140/epjs/s11734-021-00011-5 arXiv:2012.01977
- Wunderling N, Krönke J, Wohlfarth V, Kohler J, [Heitzig J](#), Staal A, Willner S, Winkelmann R, Donges JF (2021) Modelling nonlinear dynamics of interacting tipping elements on complex networks: the PyCascades package. *EPJ ST*. doi:10.1140/epjs/s11734-021-00155-4. arXiv:2011.02031
- Wiedermann M, Smith KE, [Heitzig J](#), Donges JF (2020) A network-based microfoundation of Granovetter's threshold model for social tipping. *Scientific Reports* 10:11202. arXiv:1911.04126
- Kolb JJ, Müller-Hansen F, [Heitzig J](#), Kurths J (2020) Macroscopic approximation methods for the analysis of adaptive networked agent-based models: Example of a two-sector investment model. *Physical Review E* 102:042311. arXiv:1909.13758
- Mathias JD, Debeljak M, Deffuant G, Diemer A, Donges J, Gladych G, [Heitzig J](#), Holtz G, Obergassel W, Pellaud F, Sánchez A, Trajanov A, Videira N (2020) Grounding social foundations for Integrated Assessment Models of climate change: policy-makers need models with social assessment for developing efficient climate policies. *Earth's Future* 8(7):e2020EF001573

- Heitzig J* / Donges JF*, Barfuss W, Kassel JA, Kittel T, Kolb JJ, Kolster T, Müller-Hansen F, Otto IM, Wiedermann M, Zimmerer KB, Lucht W (2020) Earth system modeling with endogenous and dynamic human societies: the copan:CORE open World-Earth modeling framework. *Earth System Dynamics* 11:395–413. doi:10.5194/esd-11-395-2020 * shared first authorship
- Strnad FM, Barfuss W, Donges JF, Heitzig J (2019) Deep reinforcement learning in World-Earth system models to discover sustainable management strategies. *Chaos* 29:123122. doi:10.1063/1.5124673. arXiv:1908.05567
- Wienand JF, Eidmann D, Kremers J, Heitzig J, Hellmann F, Kurths J (2019) Impact of Network Topology on the Stability of DC Power Grids. *Chaos* 29:113109. doi:10.1063/1.5110348. arXiv:1905.06429
- Müller-Hansen F, Heitzig J, Donges JF, Cardoso M, Dalla-Nora E, Andrade P, Kurths J, Thonicke K (2019) Can intensification of cattle ranching reduce deforestation in the Amazon? Insights from an agent-based social-ecological model. *Ecological Economics* 159: 198–211. doi:10.1016/j.ecolecon.2018.12.025
- Krämer KH, Donner R, Heitzig J, Marwan N (2018) Recurrence threshold selection for obtaining robust recurrence characteristics in different embedding dimensions. *Chaos* 28:085720. doi:10.1063/1.5024914. arXiv:1802.01605
- Heitzig J, Barfuss W, Donges JF (2018) A thought experiment on sustainable management of the Earth system. *Sustainability* 10(6):1947. doi:10.3390/su10061947
- Heitzig J, Kornek U (2018) Bottom-up linking of carbon markets: farsightedness, delayed cap coordination and reversibility. *Nature Climate Change* 8:204–209. doi:10.1038/s41558-018-0079-z
- Müller-Hansen F, Schlüter M, Mäs M, Donges JF, Kolb JJ, Thonicke K, Heitzig J (2017) Towards representing human behavior and decision making in Earth system models – an overview of techniques and approaches. *Earth System Dynamics* 8:977–1007. doi:10.5194/esd-8-977-2017
- Goswami B, Boers N, Rheinwalt A, Marwan N, Heitzig J, Breitenbach SFM, Kurths J (2017) Abrupt transitions in time series with uncertainties. Accepted for *Nature Communications*
- Donges JF, Winkelmann R, Cornell SE, Lucht W, Dyke JG, Rockström J, Heitzig J, Schellnhuber HJ (2017) Closing the loop: reconnecting human dynamics to Earth system science. *The Anthropocene Review* 4(2):151–157. doi:10.1177/2053019617725537
- Kittel T, Heitzig J, Webster K, Kurths J (2017) Timing of transients: quantifying reaching times and transient behavior in complex systems. *New J. Phys.* 19:083005. arXiv:1611.07565
- Nitzbon J, Heitzig J, Parltitz U (2017) Sustainability, collapse and oscillations of global climate, population and economy in a simple World-Earth model. *Environmental Research Letters* 12:074020. doi:10.1088/1748-9326/aa7581
- Müller-Hansen F, Cardoso MF, Dalla-Nora EL, Donges JF, Heitzig J, Kurths J, Thonicke K (2017) A matrix clustering method to explore patterns of land-cover transitions in satellite-derived maps of the Brazilian Amazon. *Nonlin. Processes Geophys.* 24:113–123
- Nitzbon J, Schultz P, Heitzig J, Kurths J, Hellmann F (2017) Deciphering the imprint of topology on nonlinear dynamical network stability. *New J. Phys.* 19:033029. doi:10.1088/1367-2630/aa6321. arXiv:1612.03654
- Schultz P, Menck PJ, Heitzig J, Kurths J (2016) Potentials and limits to basin stability estimation. *New J. Phys.* 19:023005. doi:10.1088/1367-2630/aa5a7b. arxiv:1603.01844
- Hellmann F, Schultz P, Grabow C, Heitzig J, Kurths J (2016) Survivability of deterministic dynamical systems. *Scientific Reports* 6:29654. doi:10.1038/srep29654
- Plietzsch A, Schultz P, Heitzig J, Kurths J (2016) Local vs global redundancy – tradeoffs between resilience against cascading failures and frequency stability, In: Heitzig J, Graff Zivin J, Abarbanel HDI, Kocarev L, Kurths J (eds.) Health, Energy & Extreme Events in a Changing Climate, *EPJ Special Topics* 225(3):551–568. doi:10.1140/epjst/e2015-50137-4
- Heitzig J, Kittel T, Donges J, Molkenthin N (2016) Topology of sustainable management of dynamical systems with desirable states: from defining planetary boundaries to safe operating spaces in the Earth

System. *Earth System Dynamics* 7, 21–50. doi:10.5194/esd-7-21-2016

- Donges JF, [Heitzig J](#), Beronov B, Wiedermann M, Runge J, Yi Q, Tupikina L, Stolbova V, Donner RV, Marwan N, Dijkstra, HA (2015) Unified functional network and nonlinear time series analysis for complex systems science: The pyunicorn package. *Chaos* 25:113101. doi:10.1063/1.4934554. Also at <http://arxiv.org/abs/1507.01571>
- Auer S, [Heitzig J](#), Kornek U, Schöll E, Kurths J (2015) The dynamics of coalition formation on complex networks. *Scientific Reports* 5:13386. doi:10.1038/srep13386
- Rheinwalt A, Goswami B, Boers N, [Heitzig J](#), Marwan N, Krishnan R, Kurths J (2015) Teleconnections in climate networks: a network of networks approach to investigate the influence of sea surface temperature variability on monsoon systems. *Proc Climate Informatics Workshop*, Boulder, USA, pp 23–33. doi:10.1007/978-3-319-17220-0_3
- Wiedermann M, Donges JF, [Heitzig J](#), Lucht W, Kurths J (2015) Macroscopic description of complex adaptive networks co-evolving with dynamic node states. *Physical Review E* 91, 052801. doi:10.1103/PhysRevE.91.052801
- Goswami B, [Heitzig J](#), Rehfeld K, Marwan N, Ambili A, Prasad S, Kurths J (2014) Estimation of sedimentary proxy records together with associated uncertainty. *Nonlinear Processes in Geophysics* 21, 1093–1111. doi:10.5194/npg-21-1093-2014
- Schultz P, [Heitzig J](#), Kurths J (2014) Detours around basin stability in power networks. *New Journal of Physics* 16:125001. doi:10.1088/1367-2630/16/12/125001
- Schultz P, [Heitzig J](#), Kurths J (2014) A random growth model for power grids and other spatially embedded infrastructure networks. *EPJ ST Resilient Power Grids and Extreme Events* 223(12):2593–2610. doi:10.1140/epjst/e2014-02279-6
- Menck PJ, [Heitzig J](#), Kurths J, Schellnhuber HJ (2014) How dead ends undermine power grid stability. *Nature Communications* 5:3969. doi:10.1038/ncomms4969
- Schmidt RC, [Heitzig J](#) (2013) Carbon leakage: grandfathering as an incentive device to avert relocation. *Journal of Environmental Economics and Management (JEEM)* 67(2):209–223. doi:10.1016/j.jeem.2013.12.004
- [Heitzig J](#) (2013) Moving Taylor Bayesian regression for nonparametric multidimensional function estimation with possibly correlated errors. *SIAM Journal on Scientific Computation* 35(4):A1928–A1950. doi:10.1137/12087846X
- Wiedermann M, Donges JF, [Heitzig J](#), Kurths J (2013) Node-weighted interacting network measures improve the representation of real-world complex systems. *Europhysics Letters* 102:28007. doi:10.1209/0295-5075/102/28007
- Menck PJ, [Heitzig J](#), Marwan N, Kurths J (2013) How basin stability complements the linear-stability paradigm. *Nature Physics* 9:89–92. doi:10.1038/nphys2516
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- Donges JF, [Heitzig J](#), Donner RV, Kurths J (2012) Analytical framework for recurrence network analysis of time series. *Physical Review E* 85:046105. doi:10.1103/PhysRevE.85.046105
- [Heitzig J](#), Donges JF, Zou Y, Marwan N, Kurths J (2012) Node-weighted measures for complex networks with spatially embedded, sampled, or differently sized nodes. *The European Physical Journal B* 85(1):38.

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- Donner RV, Heitzig J, Donges JF, Zou Y, Marwan N, Kurths J (2011) The geometry of chaotic dynamics – a complex network perspective. *The European Physical Journal B* 84(4):653–672. doi:10.1140/epjb/e2011-10899-1
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- Rehfeld K, Marwan N, Heitzig J, Kurths J (2011) Comparison of correlation analysis techniques for irregularly sampled time series. *Nonlinear Processes in Geophysics* 18:389–404. doi:10.5194/npg-18-389-2011
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Non-ISI journal articles / books / chapters / proceedings / editorials

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- Müller-Hansen F, Schlüter M, Mäs M, Hegselmann R, Donges JF, Kolb JJ, Thonicke K, Heitzig J (2017) How to represent human behavior and decision making in Earth system models? A guide to techniques and approaches. *Earth System Dynamics Discussions*. doi:10.5194/esd-2017-18
- Heitzig J, Graff Zivin J, Abarbanel HDI, Kocarev L, Kurths J (2016) Editorial, In: Heitzig J, Graff Zivin J, Abarbanel HDI, Kocarev L, Kurths J (eds.) Health, Energy & Extreme Events in a Changing Climate, *EPJ Special Topics* 225(3):423–427. doi:10.1140/epjst/e2016-60093-5
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Heitzig J (2006) The “jackknife” method: confidentiality protection for complex statistical analyses. In *Monographs of Official Statistics*, eds. Muñoz PD, Brünger H (European Communities, Luxembourg), 325–332

Heitzig J (2004) Protection of confidential data when publishing correlation matrices. In *Proceedings in Computational Statistics (16th COMPSTAT Symposium)*, ed. Antoch J (Springer, Heidelberg), 1163–1170

Conference papers / preprints / submitted / in preparation / under discussion

Heitzig J (2025) Provision of public goods via unilateral but mutually conditional commitments — mechanism, equilibria, and learning. Submitted to *International Journal of Game Theory*. SSRN:3449004

Schwarz L, Breier J, Prawitz H, Bechthold M, von Bloh W, Constantino SM, Gerten D, Heitzig J, Hotz R, John L, Müller C, Rockström J, Donges JF (2025) From Farm to Planet: The InSEEDS World-Earth Model for Simulating Transitions to Regenerative Agriculture. Submitted to *Earth System Dynamics*.

Heitzig J, Potham R (2025) Model-Based Soft Maximization of Suitable Metrics of Long-Term Human Power. Submitted to *AAAI*. arXiv:2508.00159

Lowe R, Edelman J, Tan ZX, Klingefjord O, Hain E, Wang V, Sarkar A, Bakker MA, Barez F, Franklin M, Haupt A, Heitzig J, Holliday WH, Jara-Ettinger J, Kasirzadeh A, Kearns RO, Kirkpatrick JR, Koh A, Lehman J, Levine S, Revel M, Vendrov I (2025) Full-Stack Alignment: Co-Aligning AI and Institutions with Thicker Models of Value. Accepted at *ICML 2025 Workshop MoFa*. Also submitted to *AIES-25*.

Smith EK, Kitzmann N, Milkoreit M, Winkelmann R, Crépin AS, Eder C, Harring N, Heitzig J, Katsanidou A, Lenton T, Mauelshagen F, Minor K, Otto I, Rezai A, Scheffran J, Stadelmann-Steffen I, van der Ploeg F, Wunderling N, Donges J (2025) Criticality and critical agency in societal tipping processes towards sustainability. Submitted to *PNAS*.

Goll D, Heitzig J, Barfuss W (2025) Deterministic Model of Incremental Multi-Agent Boltzmann Q-Learning: Transient Cooperation, Metastability, and Oscillations. Submitted to *Journal of Physics: Complexity*. arXiv:2501.00160

Venegas-Pineda LG, Jardón-Kojakhmetov H, Engel M, Heitzig J, Cenk Eser M, Ming C (2024) Strategic control for a Boltzmann like decision-making model. Submitted to *Communications in Nonlinear Science and Numerical Simulation*. arXiv:2405.10915

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