

Dr. Jobst Heitzig – short CV

(December 2020)

Summary

Dr. Jobst Heitzig is a Senior Researcher at the Potsdam Institute for Climate Impact Research and co-leader of its FutureLab on *Game Theory and Networks of 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 two special issues for the journal EPJ ST. He has supervised a number of master's and PhD theses and is currently involved in the supervision of four PhD theses and one Postdoctoral Researcher.

Current position

2010– Senior Researcher, *Potsdam Institute for Climate Impact Research*,
Research Domain *Complexity Science*.
2019– Co-leader, FutureLab on *Game Theory and Networks of Interacting Agents (GaNe)*.
2013–2018 Co-speaker, flagship project *copan – coevolutionary pathways*.

Previous work experience

2007–2009 IT Systems Analyst, *KfW Bankengruppe (German Development Bank)*.
Data warehousing, internal IT consulting, software development.
2002–2007 Scientific Officer, *German National Statistical Office*.
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

Publications

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

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. Accepted for *Physical Review E*. arXiv:1909.13758
- Mathias JD, Debeljak M, Deffuant G, Diemer A, Donges J, Gladyskh 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](#), Parlitz 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.

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- 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 stzwischen südstern und herrmannplatzates. *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
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- Runge J, Heitzig J, Marwan N, Kurths J (2012) Quantifying causal coupling strength: a lag-specific measure for multivariate time series related to transfer entropy. *Physical Review E* 86:061121. doi:10.1103/PhysRevE.86.061121
- Runge J, Heitzig J, Petoukhov V, Kurths J (2012) Escaping the curse of dimensionality in estimating multivariate transfer entropy. *Physical Review Letters* 108:258701. doi:10.1103/PhysRevLett.108.258701

- Zou Y, [Heitzig J](#), Donner RV, Donges JF, Farmer JD, Meucci R, Euzzor S, Marwan N, Kurths J (2012) Power laws in recurrence networks from dynamical systems. *Europhysics Letters* 98:48001. doi:10.1209/0295-5075/98/48001
- 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. doi:10.1140/epjb/e2011-20678-7
- [Heitzig J](#), Simmons FW (2012, online first 2010) Some chance for consensus: voting methods for which consensus is an equilibrium. *Social Choice and Welfare* 38(1):43–57. doi:10.1007/s00355-010-0517-y
- 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
- [Heitzig J](#), Lessmann K, Zou Y (2011) Self-enforcing strategies to deter free-riding in the climate change mitigation game and other repeated public good games. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* 108:15739–15744. doi:10.1073/pnas.1106265108
- 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
- Erné M, [Heitzig J](#), Reinhold J (2002) On the number of distributive lattices. *Electronic Journal of Combinatorics* 9:1–23.
- [Heitzig J](#) (2002) Many familiar categories can be interpreted as categories of generalized metric spaces. *Applied Categorical Structures* 10:505–520
- [Heitzig J](#) (2002) Every finite system of T₁ uniformities comes from a single distance structure. *Applied General Topology* 3:65–76
- [Heitzig J](#), Reinhold J (2002) Counting finite lattices. *Algebra Universalis* 48:43–53
- [Heitzig J](#), Reinhold J (2000) The number of unlabeled orders on fourteen elements. *Order* 17:333–341

Non-ISI journal articles / books / chapters / proceedings / editorials

- 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
- Kurths J, [Heitzig J](#), Marwan N (2015) Approaching cooperation via complexity. *Global Cooperation and the Human Factor in International Relations*, 155–180
- [Heitzig J](#), Kittel T (2015) Topology of sustainable management of dynamical systems with desirable states. *Earth System Dynamics Discussions* 6:435–488. doi:10.5194/esdd-6-435-2015
- [Heitzig J](#), Fujiwara N, Aihara K, Kurths J (2014) Editorial: Interdisciplinary challenges in the study of power grid resilience and stability and their relation to extreme weather events. In: [Heitzig J](#), Fujiwara N, Aihara K, Kurths J (eds.) Resilient Power Grids and Extreme Events, *EPJ Special Topics* 223(12):2383–2386. doi:10.1140/epjst/e2014-02281-0
- [Heitzig J](#), Edenhofer O (2013) Cap, insure & compensate: domestic policies and the ratification of international environmental agreements. *SSRN Environmental Economics eJournal* 5(56). SSRN:2256875
- Zou Y, [Heitzig J](#), Small M, Kurths J (2013) Power laws of recurrence networks. In: Aschwanden M, Edvinsson U (eds) *Self-organized criticality systems*. Open Academic Press, in press

- Heitzig J (2012) Bottom-up strategic linking of carbon markets: which climate coalitions would farsighted players form? *SSRN Environmental Economics eJournal* 5(69), <http://ssrn.com/abstract=2274724>. doi:10.2139/ssrn.2274724
- Heitzig J (2011) Efficiency in face of externalities when binding hierarchical agreements are possible. *SSRN Game Theory & Bargaining Theory eJournal* 3(40), <http://ssrn.com/abstract=1815328>
- Heitzig J (2007) *Distance and topology – back to the roots of topology with a general concept of distance* (VDM Verlag, Saarbrücken)
- Heitzig J (2006) Using the jackknife method to produce safe plots of microdata. In *Privacy in Statistical Databases*, eds. Domingo-Ferrer J, Franconi L (Springer, Berlin, Heidelberg), 139–151
- 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

- Müller PM, Heitzig J, Kurths J, Lüdge K, Wiedermann M (2020) Anticipation-induced social tipping – can the environment be stabilised by social dynamics? Submitted to *EPJST*. arXiv:2012.01977
- Kittel T, Müller-Hansen F, Koch R, Heitzig J, Deffuant G, Mathias JD, Kurths J (2020) From lakes and glades to viability algorithms: automatic classification of system states according to the Topology of Sustainable Management. Submitted to *EPJST*. arXiv:1706.04542
- Wunderling N, Krönke J, Wohlfarth V, Kohler J, Heitzig J, Staal A, Willner S, Winkelmann R, Donges JF (2020) Modelling nonlinear dynamics of interacting tipping elements on complex networks: the PyCascades package. Submitted to *EPJST*. arXiv:2011.02031
- Winkelmann R* / Donges JF* / Smith EK* / Milkoreit M*, Eder C, Heitzig J, Katsanidou A, Wiedermann M, Wunderling N, Lenton TM (2020) Social tipping processes for sustainability: An analytical framework. Submitted to *WIREs Climate Change*. arXiv:2010.04488. *shared first authorship
- Tamberg LA, Heitzig J, Donges JF (2020) A guideline to modelling resilience of complex systems. Submitted to *Environmental Research Letters*. arXiv:2007.05769
- Ansari S, Brzoska L, Heitzig J, Lentz H, Fritzscheier J, Moosavi MR (2020) A temporal network model for livestock trade systems. In preparation for *Preventive Veterinary Medicine*.
- Heitzig J, Simmons FW (2020) Fair and efficient democratic decisions via non-deterministic proportional consensus. Submitted. arXiv:2006.06548
- Heitzig J (2020) Efficient non-cooperative provision of costly positive externalities via conditional commitments. Under review at *Journal of Public Economics*. SSRN:3449004
- Wiedermann M, Winkelmann R, Donges JF, Eder C, Heitzig J, Katsanidou A, Smith EK (2019) Domino Effects in the Earth System – the potential role of wanted tipping points. In review at *Global Sustainability*. arXiv:1911.10063
- Heitzig J, Hiller S (2020) Degrees of individual and groupwise backward and forward responsibility in extensive-form games with ambiguity, and their application to social choice problems. In revision. arXiv:2007.07352
- Ewers B, Donges JF, Heitzig J, Peterson S (2019) Divestment may burst the carbon bubble if investors’ beliefs tip to anticipating strong future climate policy. In revision. arXiv:1902.07481
- Heitzig J (2018) Social Choice with immunity from majority complaints and independence from Pareto-dominated alternatives. In preparation for *Social Choice and Welfare*
- Wiedermann M, Winkelmann R, Donges JF, Eder C, Heitzig J, Katsanidou A, Smith EK (2018) Can Antarctica tip climate policy? In revision

- Asano YM, Kolb JJ, Farmer JD, [Heitzig J](#) (2019) Emergent inequality and endogenous dynamics in a simple behavioral macroeconomic model. Revise and resubmit to *PNAS*. SSRN:3415472
- Donges JF, Lucht W, [Heitzig J](#), Cornell S, Lade S, Schlüter M (2018) Taxonomies for structuring models of the World-Earth system: subsystems, their interactions and coevolutionary feedback loops. *Earth System Dynamics Discussions*, doi:10.5194/esd-2018-27
- [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 (2017) Earth system modelling with complex dynamic human societies: the copan: CORE World-Earth modeling framework. *Earth System Dynamics Discussions*
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- Auer S, Roos C, [Heitzig J](#), Hellmann F, Kurths J (2017) The contribution of different electric vehicle control strategies to dynamical grid stability. arXiv:1708.03531
- [Heitzig J](#), Meyer-Ortmanns H (2017) Comparison of electricity market designs for stable decentralized power grids. arXiv:1704.04644
- Schultz P, Hellmann F, [Heitzig J](#), Kurths J (2016) A network of networks approach to interconnected power grids. arXiv:1701.06968
- Kittel T, Koch R, [Heitzig J](#), Deffuant G, Mathias J-D, Kurths J (2016) Operationalization of Topology of Sustainable Management to Estimate Qualitatively Different Regions in State Space. arXiv:1706.04542
- Arndt P, Donges JF, [Heitzig J](#) (2016) The Great Acceleration: timing a high-potential candidate for defining a safe and just Anthropocene. In preparation
- Böls K*, Donges JF*, Kittel T, [Heitzig J](#) (2016) Optimizing on the edge. In preparation
- Khotyakov M, Franke JG, [Heitzig J](#), Donner RV (2015) On the influence of dynamical noise on the dimension of a system's attractor. In preparation
- [Heitzig J](#) (2015) Efficient dynamic cartel formation via farsighted surplus sharing. In preparation
- [Heitzig J](#) (2002) A characterization of similarity maps between Euclidean spaces related to the Beckman-Quarles theorem. arXiv:math/0203233v1
- [Heitzig J](#) (2002) The asymptotic complexity of partial sorting – how to learn large posets by pairwise comparisons. arXiv:math/0205049v1
- [Heitzig J](#) (2002) Qualitative visualization of distance information. arXiv:math/0201298v1
- [Heitzig J](#) (2002) Social choice under incomplete, cyclic preferences: majority/minority-based rules, and blocks of alternatives. arXiv:math/0201285v1

* authors marked by asterisk share the first authorship

Media coverage of PNAS 2011 paper

- Dietz T, Zhao J (2011): Paths to climate cooperation. *Proceedings of the National Academy of Sciences of the United States of America* 108:15671–15672 (Commentary)
- Can game theory save the UN climate talks? *The Guardian Environment Blog*, 9/6/2011
- Climate change solution proposed by scientists incorporates game theory. *The Huffington Post*, 9/16/2011
- Klimasünder ausbremsen. *Potsdamer Neueste Nachrichten*, 8/31/2011
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- Study shows how a global CO₂ regime might prod laggard nations to reduce emissions. *ClimateWire*, 9/19/2011
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Spieltheoretiker untersuchen Klimaschutzverhandlungen. *DRadio Wissen*, 8/30/2011, radio feature

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