

Dr. Jobst Heitzig – short CV

(May 2018)

Summary

Dr. Jobst Heitzig is a Senior Researcher at the Potsdam Institute for Climate Impact Research and co-speaker of its flagship project *copan – coevolutionary pathways*. 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), and has published on dynamical systems theory, environmental economics, social choice, complex networks theory, game theory, statistical methods, general topology, confidentiality protection, and combinatorics. He has supervised a number of master's theses and is currently involved in the supervision of six PhD theses and one Postdoctoral Researcher.

Current position

2010– Senior Researcher, *Potsdam Institute for Climate Impact Research*,
Research Domain *Transdisciplinary Concepts & Methods*.
Co-Speaker of 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

- Conceptual models of global long-term nature-society coevolution (with the copan team)
- Dynamical systems theory of sustainable management and transient behaviour (with T. Kittel, J. Donges, K. Böltz and others)
- Modelling coalition formation on networks (with U. Kornek and S. Auer)
- Dynamical systems approaches to game equilibria and coalition formation (*collaborators sought!*)
- Consensus-finding, randomization and bargaining in group decision making (with F. Simmons, Portland Community College)
- Modelling divestment and related social tipping via agent-based models and adaptive networks (with B. Ewers, J. Kolb, J. Donges and others) Quantification of responsibility in multi-agent situations with uncertainty (with N. Botta)
- Stabilization of energy systems via demand-side management (with S. Auer, F. Hellmann and P. Schultz)
- Decentral conditional commitment mechanisms for forming bottom-up cooperation
- Information-theoretic identification and quantification of couplings in nonlinear multivariate data (with J. Runge)
- Bayesian inference for geo-archives (with B. Goswami) and spatial interpolation (with V. Stolbova, A. Rheinwald, B. Goswami)

- Multi-level models of climate policy (with O. Edenhofer)

Publications

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

- Heitzig J, Kornek U (2018) Bottom-up linking of carbon markets: farsightedness, delayed cap coordination and reversibility. *Nature Climate Change*, 2018, online first.
- 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. *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, Molkenhain 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
- 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), <http://ssrn.com/abstract=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

Heitzig J, Barfuss W, Donges JF (2018) A thought experiment on sustainable management of the Earth system. Submitted to *Sustainability*. Preprint doi:10.20944/preprints201805.0037.v1

- Müller-Hansen F, Heitzig F, Donges JF, Cardoso M, Dalla-Nora E, Andrade P, Kurths J, Thonicke K (2018) The dynamics of Amazon deforestation and cattle ranching intensification: insights from an agent-based social-ecological model. Submitted to *Ecological Economics*
- Krämer H, Donner R, Heitzig J, Marwan N (2018) Dimension-scalable recurrence threshold estimation. Revision under review.
- 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*
* shared first authorship
- Auer S, Roos C, Heitzig J, Hellmann F, Kurths J (2017) The contribution of different electric vehicle control strategies to dynamical grid stability. Submitted to *IEEE Sustainable Energy*. 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. Submitted to *Environmental Modelling and Software*. 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. Revision in preparation
- Donges JF, Lucht W, Heitzig J, Cornell S, Lade S, Schlüter M (2017) Taxonomies for structuring models of the World-Earth system: subsystems, their interactions and coevolutionary feedback loops. In preparation for *Earth System Dynamics*
- Ewers B, Donges JF, Heitzig J (2016) Will divestment burst the carbon bubble? In preparation for *Science*
- Heitzig J, Simmons FW (2015) Efficient democratic decisions via non-deterministic proportional consensus. In preparation for *Science*
- Bölts 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 for *Nonlinearity*
- Heitzig J (2015) Efficient non-cooperative provision of costly positive externalities via conditional commitments. In preparation for submission to *Econometrica*
- Heitzig J (2015) Efficient dynamic cartel formation via farsighted surplus sharing. In preparation for submission to *Econometrica*
- Heitzig J, Runge J, Kurths J (2015) Decomposing entropy and variance into driver contributions using concepts from bargaining theory. 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

Klimaschutz klappt – theoretisch. *Klimaretter.info*, 8/31/2011

Study shows how a global CO2 regime might prod laggard nations to reduce emissions. *ClimateWire*, 9/19/2011

Sustainability scientists suggest how countries can cooperate on climate. *ScienceDaily*, 9/12/2011

Spieltheoretiker untersuchen Klimaschutzverhandlungen. *DRadio Wissen*, 8/30/2011, radio feature

Spieltheorie: Grammatik menschlichen Verhaltens. *DRS2 Kontext*, 8/24/2011, radio feature