

# Norman Julius Steinert

Senior Researcher

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## Profile

I am a physical climate scientist, currently working at the CICERO Center for International Research in Oslo, Norway. My research investigates climate change mitigation scenarios and Earth system reversibility, and the role of tipping points in shaping long-term Earth system responses to climate change. This work focuses on self-amplifying climate feedbacks and their implications for climate mitigation scenarios. By combining Earth system models with reduced-complexity climate emulators, my research advances the understanding of climate feedbacks, their potential irreversibility under overshoot, and the risks they pose to achieving climate stabilization. Another major strand of my research focuses on the role of the land surface in the Earth system, with an emphasis on land-climate interactions, terrestrial carbon cycle dynamics, including permafrost-carbon release and high-latitude ecosystem stability under climate change.

## Education

PhD in Physics, “Cum Laude”, Complutense University of Madrid, <i>Madrid, Spain</i>	Oct 2017 – Dec 2021
Master of Science in Meteorology, Free University of Berlin, <i>Berlin, Germany</i>	Oct 2013 – Jul 2017
Bachelor of Science in Meteorology, Free University of Berlin, <i>Berlin, Germany</i>	Oct 2010 - Sept 2013

## Career experience

Senior Researcher, CICERO – Center for International Climate Research, Oslo, Norway	Jan 2024 – present
Parental leave	June 2024 – Sept 2024
Postdoc, NORCE - Norwegian Research Centre, <i>Bergen, Norway</i>	Jan 2022 – Dec 2023
Research assistant, Global forecasters - CIEMAT, <i>Madrid, Spain</i>	Jun 2017 – Sept 2017
Intern, Reuniwatt, <i>Saint-Pierre, La Reunion, France</i>	Oct 2016 – Apr 2017
Student assistant, Max Planck Institute for Meteorology, <i>Hamburg, Germany</i>	Mar 2015 – Sept 2016
Intern, Alfred-Wegener-Institute, <i>Bremerhaven, Germany</i>	Feb 2014 – Apr 2014
Student assistant, FUB - Institute for Meteorology, <i>Berlin, Germany</i>	Nov 2013 – Jan 2015
Intern, ETH - Institute for Atmospheric and Climate Science, <i>Zurich, Switzerland</i>	Jul 2012 – Sept 2012
Student assistant, German Research Center for Geosciences, <i>Potsdam, Germany</i>	Jun 2012 – Nov 2013

## Research mobility

Research stay, *3 months, 2025*, Potsdam Institute for Climate Impact Research, Potsdam, Germany

Research stay, *4 months, 2023*, UK Met Office and University of Exeter, Exeter, UK

Research stay, *1 months, 2021*, Utrecht University, *Utrecht, The Netherlands*

Research stay, *3 months, 2020-2021*, Max Planck Institute for Meteorology, *Hamburg, Germany*

## Visiting Scientist positions

*Jan 2025 – present*, Potsdam Institute for Climate Impact Research, Potsdam, Germany

## Project funding

- **NAVIGATE**

Navigating the uncharted territory of the Anthropocene climate

WP co-lead, task lead (2.3/10 million NOK)

Norwegian Research Council, Norway, 2025-2028

- **Towards2020 Seed Funding Project**

GRAFITE (Global pRojections And Feedback Interactions in Tipping point Emulators)

Project lead (0.5 million NOK)

CICERO Center for International Climate Research, Oslo, Norway, 2024

- **Fast Track Initiative Seed Funding Project**

LICORICE (Effects of climate-driven Land-surface Integrity Changes in permafrost Regions on northward expanding agriculture)

Project lead (0.5 million NOK)

Bjerknes Centre for Climate Research, Bergen, Norway, 2023

## Awards and Grants

- **'Seal of Excellence'** for non-funded MSCA Postdoctoral Fellowship 2025 due to budget constraints

*The European Commission, Feb 2026*

- **Best PYRN ECS Poster Presentation Award:** Runner-up

*EUCOP6 European Conference on Permafrost, Puigcerdà, Spain, June 2023*

- **PhD Thesis Award**, Spanish National Research Council - most relevant theses in 2021

*Spanish National Research Council (CSIC), Madrid, Spain, February 2023*

- **RCN Researcher Mobility Grant**

*Research Council of Norway, NORCE Norwegian Research Centre, Bergen, Norway, December 2022*

- **Utrecht Network Young Researchers Grant**

*Utrecht Network, April 2021*

- **Top 3 presentations at PhDay Physics Complutense 2019**  
*Complutense University Madrid, Spain, November 2019*
- **ERASMUS Scholarship Grant**  
*Reuniwatt, La Reunion, France, September 2016 – April 2017*
- **Ernst-Reuter-Gesellschaft Travel Grant**  
*Free University of Berlin, Germany, August 2016*

## ■ Media and outreach

- Lars Ursin, 06 Apr 2026, “Tåler vi at 1,5-gradersmålet ryker?”, *Energi og Klima*.
- CICERO News article, 02 Feb 2026, “Global warming must peak below 2°C to limit tipping point risks”, *CICERO*.
- NRK “The Daily News”, 13 Oct 2025, NRK1 TV Norway.
- CICERO News article, 13 Oct 2025, “New report confirms world reaches first climate tipping point”, *CICERO*.
- Jesse Steinmetz, 29 May 2025, “2 billion people could face chaotic and 'irreversible' shift in rainfall patterns if warming continues”, *Live Science*.
- Daniel Bardsley, 12 February 2025, “Climate change impact will continue beyond 2100 even if targets are met, study says”, *The National*.
- CICEROdagen 2024, 25 April 2024, “En samtale om vippepunkter”, *CICERO*.
- Volker Mrasek, 20 June 2023, “Forscher modellieren zu erwartende Treibhausgasemissionen”, *Deutschlandfunk*.

## 👥 Leadership and professional activities

- Member of advisory board for the Carbon Dioxide Removal Model Intercomparison Project Phase 2 (CDRMIP2), *2025-present*
- Member of the coordinating team for Reduced Complexity Model Intercomparison Project Phase 3 (RCMIP3), *2025-present*
- Land-Processes lead of the WCRP TCRE and ZEC assessment, *2025-present*
- Domain co-lead TIPMIP permafrost domain, *2024-present*
- Section co-lead in Global Tipping Points Reports 2023 & 2025, *2023 & 2025*
- Student Mentorship, *Freie Universität Berlin, 2011-2013*

## Code and software development

Experienced in code development using collaborative software best practices, releasing version-controlled open-source software. Experienced user of python, R, FORTRAN, bash, HTML, Git, HPC, LaTeX and Unix systems. Experience in handling and processing large climate and observational datasets (netcdf4, hdf5). Code and software developments include:

- PerCX Simple permafrost carbon response model: primary development. (*Steinert et al., 2025, ESD*); <https://github.com/normansteinert/PerCX.git>
- METEOR multi-timescale regional climate emulator: co-development. (*Sandstad et al., 2025, GMD*); <https://github.com/benmsanderson/METEOR.git>
- PRIME spatially resolving pattern-scaling emulator: co-development. (*Mathison et al., 2025, GMD*)

## Supervision

Ulrike Mühlhaus, PhD thesis, 2026—present, Goethe University Frankfurt, Germany

Franziska Hasenburg, Master's thesis, 2026, Johannes Gutenberg University Mainz, Germany

Ulrike Mühlhaus, Masters's thesis, 2025, PIK, Germany

Callum Christie, Master's project, 2023, University of Exeter , UK

Nagore Meabe Yanguas, Master's thesis, 2023, Complutense University of Madrid, Spain

Alejandro Campos Saz, Master's thesis, 2022, Complutense University of Madrid, Spain

Francisco Javier Pérez Pérez, Master's thesis, 2021, Complutense University of Madrid, Spain

Mentoring-program, 2011-2014, Free University of Berlin, Germany

## Organization of Meetings

EGU General Assembly 2026, Session co-convener: The Climate Model Hierarchy: Bridging simulation, understanding and application, 2026, *Vienna, Austria*

EGU General Assembly 2026, Session co-convener: Towards net zero and beyond: Carbon Budgets, Overshoot, Climate (Ir)reversibility, and Carbon Removal, 2026, *Vienna, Austria*

EGU General Assembly 2026, Session co-convener: Permafrost-climate-feedbacks: past, present and future, 2026, *Vienna, Austria*

EGU General Assembly 2025, Session co-convener: Towards net zero and beyond: remaining carbon budgets, negative emissions, mitigation pathways and implications for policy, 2025, *Vienna, Austria*

EGU General Assembly 2025, Session co-convener: Statistical and physical emulator for climate impacts, 2025, *Vienna, Austria*

EGU General Assembly 2024, Session co-convener: Towards a net-zero world and beyond: remaining carbon budgets, ambitious mitigation pathways with or without temperature overshoot, and implications for policy, 2024, Vienna, Austria

EUCOP6 - 6<sup>th</sup> European Conference on Permafrost, Session convener: “Modeling of permafrost-climate feedbacks in future scenarios”, 2023, Puigcerdà, Spain.

## Publications

### Peer-reviewed journal articles (by date)

#### Accepted/In review

- Sanderson, B. M., M. Sandstad, M. Dewey, [N. J. Steinert](#), J. Fjeldså: *METEORv1.6: Spatial climate variability and integrated impact emulation*.  
**In review [preprint]**
- [Steinert, N. J.](#), K. Zickfeld, B. M. Sanderson, C. D. Koven, N. Mengis, P. Rethmeier, J. Schwinger: *Key features of the climate response to overshoot*.  
**In review**
- Sanderson, B. M., M. Sandstad, A. Romero-Prieto, S. Jenkins, C. Koven, G. Peters, R. Séfèrian, A. H. MacDougall, A. Seshadri, V. Brovkin, J. Dunne, A. L. S. Swann, T. Koenigk, R. A. Fisher, D. Hohn, T. Ilyina, C. D. Jones, H. Li, P. Lawrence, S. Liddicoat, N. Mengis, A. Romanou, L. T. Sentman, C. Smith, [N. J. Steinert](#), J. Tjiputra, T. Ziehn: *Decomposition of the Zero Emissions Commitment into thermal warming pipeline and carbon buffering components*.  
**In review [preprint]**
- Marvel, K., C. Jones, V. Cooper, [N. J. Steinert](#): *How to use CMIP data in climate assessments*  
**In review**
- Swann, A. L. S., C. D. Koven, C. Proistosescu, R. A. Fisher, B. M. Sanderson, V. Brovkin, T. Hajima, C. D. Jones, N. Y. Kiang, D. M. Lawrence, S. Liddicoat, H. Liddy, A. Romanou, R. Séfèrian, L. T. Sentman, [N. J. Steinert](#), J. Tjiputra, T. Ziehn: *Land carbon response to positive, zero, and negative CO<sub>2</sub> emissions across Earth system models*.  
**In review [preprint]**
- Mühlhaus, R., [N. J. Steinert](#), J. Rockström, N. Wunderling: *Observationally constrained climate sensitivity implies high climate tipping risk*.  
**In review [preprint]**
- Sanderson, B. M., S. Baur, C.-F. Schleussner, G. Peters, S. Mittal, M. Sandstad, S. Kalbekken, C. Smith, S. Fuss, B. van Ruijven, R. Fisher, J. Rogelj, R. Séfèrian, B. Samset, [N. J. Steinert](#), L. Terray, J. Fuglestedt: *Robust assessment of Solar Radiation Modification risks and uncertainties must include shocks and societal feedbacks*.  
**In review [preprint]**
- Varney, R. M., D. Hooke, [N. J. Steinert](#), T. L. Smallman, C. Mathison, and E. J. Burke: *Northern high latitudes could become a net carbon source below 2°C global warming*.  
**In review [preprint]**

- Romero-Prieto, A., M. Sandstad, B. M. Sanderson, Z. R. J. Nicholls, [N. J. Steinert](#), T. Gasser, C. Mathison, J. Kikstra, T. J. Aubry, and C. Smith: *Reduced Complexity Model Intercomparison Project Phase 3: Experimental protocol for coordinated constraining and evaluation of Reduced-Complexity Models*.  
**In review [preprint]**
- Kug, J.-S., Y. Shin, J.-H. Oh, C. Liu, S.-W. Yeh, J. Schwinger, K. Zickfeld, S.-I. An, S.-W. Son, S.-K. Min, H. Lee, [N. Steinert](#): *Climate Change Hysteresis and Irreversibility*.  
**In review**
- Winkelmann, R., ..., [N. J. Steinert](#), ..., et al.: *The Tipping Points Modelling Intercomparison Project (TIPMIP): Assessing tipping point risks in the Earth system*.  
**In review [preprint]**
- [Steinert, N. J.](#), G. Munday, M. Sandstad, B. M. Sanderson, N. Wunderling: *Permafrost carbon-climate feedback amplifies Earth system tipping risks*.  
**Accepted in Environmental Research Letters**
- [Steinert, N. J.](#), J. Schwinger, E. Burke, B. Zhu, T. Gasser, G. Munday, C. Mathison, S.-W. Park, H. Lee: *Permafrost carbon release scales linearly with overshoot warming mediated by AMOC tipping*.  
**Accepted in Nature Communications**

## 2026

- Ritchie\*, P. D. L., [N. J. Steinert](#)\*, J. F. Abrams, H. Alkhayuon, C. W. Arnscheidt, N. Bochow, R. R. Chapman, J. Clarke, D. P. Dennis, J. F. Donges, B. M. Flores, J. Garbe, A. Högner, C. Huntingford, T. M. Lenton, J. Lohmann, K. Lux-Gottschalk, M. Milkoreit, T. Möller, P. Pearce-Kelly, L. Pereira, C. Quinn, C.-F. Schleussner, S. M. Stuenzi, D. Swingedouw, L. N. Van der Laan, K. Zickfeld, N. Wunderling\*: *The implications of overshooting 1.5°C on Earth system tipping elements - a review*, 21, 043001. \*These authors share the first authorship.  
**Environmental Research Letters**

## 2025

- García-Pereira, F., J. F. González-Rouco, N. Meabe-Yanguas, P. de Vrese, [N. J. Steinert](#), J. Jungclaus, S. Lorenz: *Permafrost sensitivity to soil hydro-thermodynamics in historical and scenario simulations with the MPI-ESM*.  
**The Cryosphere**
- Sandstad, M., [N. J. Steinert](#), S. Baur, B. M. Sanderson: *METEORv1.0.1: A novel framework for emulating multi-timescale regional climate responses*.  
**Geoscientific Model Development**
- [Steinert, N. J.](#), and B. M. Sanderson: *Normalizing the permafrost carbon feedback contribution to the Transient Climate Response to cumulative Emissions and the Zero Emissions Commitment*, 16, 1711–1721, (2025).  
**Earth System Dynamics**
- Sanderson, B., ... [N. J. Steinert](#), ..., et al.: *flat10MIP: An emissions-driven experiment to diagnose the climate response to positive, zero, and negative CO<sub>2</sub> emissions*, 18, 5699–5724, (2025).  
**Geoscientific Model Development**
- [Steinert, N. J.](#), J. Schwinger, R. Chadwick, J.-S. Kug, H. Lee: *Irreversible land water availability changes from a potential ITCZ shift during temperature overshoot*, 13 (5), e2024EF005787, (2025).  
**Earth's Future**

- Munday, G., C. D. Jones, N. J. Steinert, C. Mathison, E. Burke, C. Smith, C. Huntingford, R. Varney: *Risks of unavoidable impacts on forests at 1.5°C with and without overshoot*, 15, 650–655, (2025).

#### **Nature Climate Change**

- Samantaray\*, A., K., N. J. Steinert\*, P. Mooney: *Plant and soil characteristics as key predictors for future agricultural drought*, 20, 054059, (2025). \*These authors share the first authorship.

#### **Environmental Research Letters**

- Mathison, C. T., E. Burke, E. Kovacs, G. Munday, C. Jones, C. Smith, C. Huntingford, A. Wiltshire, N. J. Steinert, L. Gohar, R. Varney: *A rapid application emissions-to-impacts tool for scenario assessment: Probabilistic Regional Impacts from Model patterns and Emissions (PRIME)*, 18, 1785-1808, (2025).

#### **Geoscientific Model Development**

- Park, S-W., J.-S. Kug, H. Lee, N. J. Steinert, S.-I. An, S. Jongsoo: *Potential intensification of permafrost carbon feedback under net-zero and negative emissions*. 11, eadn8819, (2025).

#### **Science Advances**

## **2024**

- Schleussner, C.-F., G. Ganti, Q. Lejeune, B. Zhu, P. Pfliegerer, R. Prütz, P. Ciais, T. L. Frölicher, S. Fuss, T. Gasser, M. J. Gidden, C. M. Kropf, F. Lacroix, R. Lamboll, R. Martyr, F. Maussion, J. W. McCaughey, M. Meinshausen, M. Mengel, Z. Nicholls, Y. Quilcaille, B. Sanderson, S. I. Seneviratne, J. Sillmann, C. J. Smith, N. J. Steinert, E. Theokritoff, R. Warren, J. Price, J. Rogelj: *Overconfidence in climate overshoot*, 634, 366-373 (2024).

#### **Nature**

- Nitzbon, J., T. Schneider von Deimling, M. Aliyeva, S. E. Chadburn, G. Grossea, S. Laboor, H. Lee, G. Lohmann, N. J. Steinert, S. M. Stuenzi, M. Werner, S. Westermann, and M. Langer: *No respite from permafrost-thaw impacts in absence of a global tipping point*, 14, 573-585 (2024).

#### **Nature Climate Change**

- Steinert, N. J., F. J. Cuesta-Valero, F. García-Pereira, P. de Vrese, C. Melo-Aguilar, E. García-Bustamante, J. H. Jungclaus, J. F. González-Rouco: *Underestimated land heat uptake alters the global energy distribution in CMIP6 climate models*, 51(10), e2023GL107613, (2024).

#### **Geophysical Research Letters**

- García-Pereira, F., J. F. González-Rouco, C. Melo-Aguilar, N. J. Steinert, E. García-Bustamante, P. de Vrese, Johann Jungclaus, Stephan Lorenz, Stefan Hagemann, F. J. Cuesta-Valero, A. García-García and H. Beltrami: *First comprehensive assessment of industrial era land heat uptake from multiple sources*, 15, 547-564, (2024).

#### **Earth System Dynamics**

- Bustamante, M., ..., N. J. Steinert, ..., et al.: *Ten New Insights in Climate Science 2023/2024*, 7, e19, 1-30, (2024).

#### **Global Sustainability**

- Wunderling, N., ... N. J. Steinert, ..., et al.: *Climate tipping point interactions and cascades: A review*, 15(1), 41–74, (2024).

#### **Earth System Dynamics**

- García-Pereira, F., J. F. González-Rouco, T. Schmid, C. Melo-Aguilar, C. Vegas-Cañas, N. J. Steinert, P. J. Roldán-Gómez, F. J. Cuesta-Valero, A. García-García, H. Beltrami, and P. de Vrese: *Thermodynamic and hydrological drivers of the subsurface thermal regime in Central Spain*, 10(1), 1–21, (2024).

#### **SOIL**

### **2023**

- Steinert, N. J., M. V. Debolskiy, E. J. Burke, F. García-Pereira, and H. Lee: *Evaluating permafrost definitions for global permafrost area estimates in CMIP6 climate models*, 19(1), 014033, (2023).

#### **Environmental Research Letters**

- de Vrese, P., G. Georgievski, J. F. Gonzalez Rouco, D. Notz, T. Stacke, N. J. Steinert, S. Wilkenskjeld, and V. Brovkin: *Representation of soil hydrology in permafrost regions may explain large part of inter-model spread in simulated Arctic and subarctic climate*, 17(5), 2095–2118, (2023).

#### **The Cryosphere**

### **2022**

- Schwinger, J., A. Asaadi, N. J. Steinert, H. Lee: *Emit now, mitigate later? Earth system reversibility under overshoots of different magnitude and duration*, 13, 1641–1665, (2022).

#### **Earth System Dynamics**

- Martin, M., ... N. J. Steinert, ..., et al.: *Ten new insights in climate science 2022*, 5, e20, 1–20, (2022).

#### **Global Sustainability.**

- Melo-Aguilar, C. A., J. F., González-Rouco, N. J., Steinert, H., Beltrami, F., Cuesta-Valero, A., García-García, F., García-Pereira, E., García-Bustamante, P. Roldán-Gómez, T. Schmid and J. Navarro: *Near-surface soil thermal regime and land–air temperature coupling: a case study over Spain.*, 2022.

#### **International Journal of Climatology**

### **2021**

- González-Rouco, J. F., Steinert, N. J., García-Bustamante, E., Hagemann, S., De-Vrese, P., Jungclaus, J. H., Lorenz, S. J, Melo-Aguilar, C., and: *Increasing the depth of a Land Surface Model: Part I: Impacts on the Subsurface Thermal Regime and Energy Storage*, 22(12), 3211-3230, (2021).

#### **Journal of Hydrometeorology**

- Steinert, N. J., González-Rouco, J. F., De-Vrese, P., García-Bustamante, E., Hagemann, S., Melo-Aguilar, C., Jungclaus, J. H., and Lorenz, S. J.: *Increasing the depth of a Land Surface Model: Part II: Temperature Sensitivity to Improved Subsurface Thermodynamics and Associated Permafrost Response*, 22(12), 3231-3254, (2021).

#### Journal of Hydrometeorology

- Steinert, N. J., González-Rouco, J. F., García-Bustamante, E., Melo-Aguilar, C., García-Pereira, F., and Alexeev, V.: *Agreement of Analytical and Simulation-Based Estimates of the Required Land Depth in Climate Models*, 48(20), e2021GRL094273, (2021).

#### Geophysical Research Letters

### 2018--2020

- Melo-Aguilar, C., González-Rouco, J. F., García-Bustamante, E., Steinert, N., Jungclaus, J. H., Navarro, J., and Roldán-Gómez, P. J.: *Methodological and physical biases in global to subcontinental borehole temperature reconstructions: an assessment from a pseudo-proxy perspective*, 16, 453–474, (2020)

#### Climate of the Past

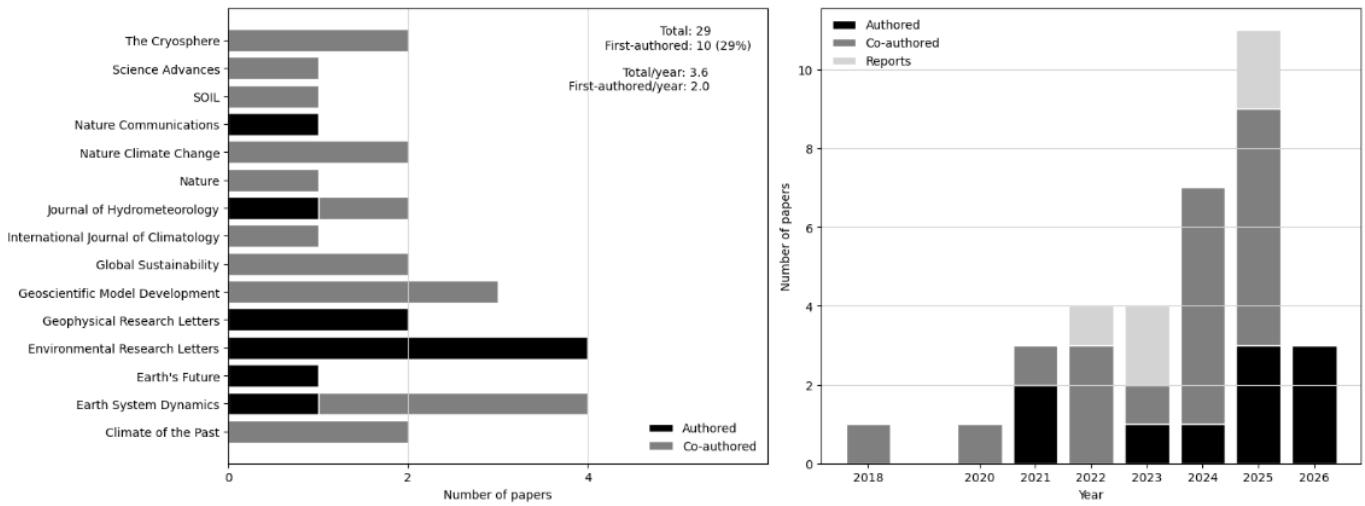
- Melo-Aguilar, C., González-Rouco, J. F., García-Bustamante, E., Navarro-Montesinos, J., and Steinert, N.: *Influence of radiative forcing factors on ground–air temperature coupling during the last millennium: implications for borehole climatology*, 14, 1583–1606, (2018).

#### Climate of the Past

### Reports

- Lenton, T. M., Milkoreit, M., Willcock, S., Abrams, J.F., Armstrong, McKay, D.I., Buxton, J.E., Donges, J.F., Loriani, S., Wunderling, N., Alkemade, F., Barrett, M., Constantino, S., Powell, T., Smith, S.R., Boulton, C. A., Pinho, P., Dijkstra, H.A. Pearce-Kelly, P., Roman-Cuesta, R.M., Dennis, D. (eds), (2025), ***Global Tipping Points Report 2025***. University of Exeter, Exeter, UK.
- Planetary Boundaries Science (2025). ***Planetary Health Check 2025***. Potsdam Institute for Climate Impact Research, Potsdam, Germany.
- T. M. Lenton, D.I. Armstrong McKay, S. Loriani, J.F. Abrams, S.J. Lade, J.F. Donges, M. Milkoreit, T. Powell, S.R. Smith, C. Zimm, J.E. Buxton, E. Bailey, L. Laybourn, A. Ghadiali, J.G. Dyke (eds) (2023), ***Global Tipping Points Report 2023***. University of Exeter, Exeter, UK.
- Future Earth, The Earth League, WCRP (2023), ***10 New Insights in Climate Science 2023/2024***. Stockholm
- Future Earth, The Earth League, WCRP (2022), ***10 New Insights in Climate Science 2022***. Stockholm

## Statistics (Published/ in press, including scientific reports)



Publication statistics: First-authored (black), co-authored (gray) and scientific report (light gray) publications per scientific peer-reviewed journal (left) and per year (right). Per-year statistics are calculated from the year of first publication in the respective classification.

## 🗨 Languages

- German (Native)



- Spanish (Intermediate)



English (Advanced)



Norwegian (Elementary)

