

SEBASTIAN STEINIG

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EDUCATION AND EMPLOYMENT

Senior Research Associate

since Apr 2023

School of Geographical Sciences, University of Bristol, Bristol, UK

- Research Co-Investigator on NERC project: "PaleoGradPhan – Paleoclimate meridional and zonal Gradients in the Phanerozoic" - PI: Prof. Dan Lunt
- combining geochemical reconstructions with new paleoclimate modelling to constrain and better understand large-scale climate gradients over the last 500 million years
- creation of best-estimate product and web application of past temperature gradients as new reference data

Lecturer in Physical Geography (0.5 FTE)

Sep 2022 - Aug 2023

School of Geographical Sciences, University of Bristol, Bristol, UK

- co-developed and co-delivered new MSc unit "Introduction to Scientific Computing" for the new "Environmental Modelling and Data Analysis" and "Geographic Data Science and Spatial Analytics" MSc programmes
- designed and delivered 18 hours of computer-based lectures and practicals to introduce students with a wide range of previous coding experience to Python for scientific computing and geographic data analysis

Research Associate

Sep 2019 - Mar 2023

School of Geographical Sciences, University of Bristol, Bristol, UK

- part of the NERC-funded SWEET project ("Super-Warm Early Eocene Temperatures and climate: understanding the response of the Earth to high CO₂ through integrated modelling and data"; www.deepmip.org/sweet) - PI: Prof. Dan Lunt
- role involved configuring, running and analysing UK climate models of different complexities (HadCM3/UKESM) to better understand early Eocene warmth
- coordinated the development of the international DeepMIP model database and web application to streamline paleoclimate model data sharing and analysis
- developed the "climatearchive.org" platform for visualising, analysing and sharing climate model data online to make it more accessible across disciplines and for non-experts

PhD in Geosciences

Dec 2015 - Aug 2019

Christian-Albrechts-University, Kiel, Germany

and GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany

- applied a suite of models of different complexity: a global climate model (NEMO/ECHAM), intermediate complexity (UVic) and biogeochemical box modelling to better understand past greenhouse climates
- generated and analysed a large ensemble of paleoclimate GCM simulations to quantify the influence of initial and boundary conditions on the Cretaceous climate system
- used large compilations of geochemical proxy data to constrain the model results and to identify systematic offsets in available temperature reconstructions
- *Thesis: Evolving ocean basins in the Early Cretaceous greenhouse climate: A model-proxy synthesis of circulation, surface temperatures and carbon burial*
Honors: with the highest distinction (*summa cum laude*); Supervisors: Martin Frank and Sascha Flögel

PUBLICATIONS

Journal Articles (published)

- [1] F. D. Kelemen, **S. Steinig**, A. De Boer, J. Zhu, W.-L. Chan, I. Niezgodzki, D. K. Hutchinson, G. Knorr, A. Abe-Ouchi, and B. Ahrens. “Meridional Heat Transport in the DeepMIP Eocene Ensemble: Non-CO₂ and CO₂ Effects”. en. In: *Paleoceanography and Paleoclimatology* 38.8 (2023). DOI: 10.1029/2022PA004607.
- [2] M. J. Cramwinckel, N. J. Burls, A. A. Fahad, S. Knapp, C. K. West, T. Reichgelt, D. R. Greenwood, W.-L. Chan, Y. Donnadieu, D. K. Hutchinson, A. M. De Boer, J.-B. Ladant, P. A. Morozova, I. Niezgodzki, G. Knorr, **S. Steinig**, Z. Zhang, J. Zhu, R. Feng, D. J. Lunt, A. Abe-Ouchi, and G. N. Inglis. “Global and Zonal-Mean Hydrological Response to Early Eocene Warmth”. en. In: *Paleoceanography and Paleoclimatology* 38.6 (2023). DOI: 10.1029/2022PA004542. (Visited on 07/14/2023).
- [3] B. Goudsmit-Harzevoort, A. Lansu, M. L. J. Baatsen, A. S. von der Heydt, N. J. de Winter, Y. Zhang, A. Abe-Ouchi, A. de Boer, W.-L. Chan, Y. Donnadieu, D. K. Hutchinson, G. Knorr, J.-B. Ladant, P. Morozova, I. Niezgodzki, **S. Steinig**, A. Tripathi, Z. Zhang, J. Zhu, and M. Ziegler. “The Relationship Between the Global Mean Deep-Sea and Surface Temperature During the Early Eocene”. In: *Paleoceanography and Paleoclimatology* 38.3 (2023). DOI: 10.1029/2022PA004532.
- [4] A. J. McGlannan, A. Bonar, L. Pfeifer, **S. Steinig**, P. Valdes, S. Adams, D. Duarte, B. Milad, A. Cullen, and G. S. Soreghan. “An eolian dust origin for clastic fines of Devonian-Mississippian mudrocks of the greater North American midcontinent”. In: *Journal of Sedimentary Research* 92.12 (2022), pp. 1186–1206. DOI: 10.2110/jsr.2022.013.
- [5] Z. Zhang, Z. Zhang, Z. He, N. Tan, Z. Guo, J. Zhu, **S. Steinig**, Y. Donnadieu, J.-B. Ladant, W.-L. Chan, A. Abe-Ouchi, I. Niezgodzki, G. Knorr, D. K. Hutchinson, and A. M. de Boer. “Impact of Mountains in Southern China on the Eocene Climates of East Asia”. In: *Journal of Geophysical Research: Atmospheres* 127.17 (2022). DOI: <https://doi.org/10.1029/2022JD036510>.
- [6] T. Reichgelt, D. R. Greenwood, **S. Steinig**, J. G. Conran, D. K. Hutchinson, D. J. Lunt, L. J. Scriven, and J. Zhu. “Plant Proxy Evidence for High Rainfall and Productivity in the Eocene of Australia”. In: *Paleoceanography and Paleoclimatology* 37 (2022). DOI: 10.1029/2022PA004418.
- [7] I. Niezgodzki, G. Knorr, G. Lohmann, D. J. Lunt, C. J. Poulsen, **S. Steinig**, J. Zhu, A. de Boer, W.-L. Chan, Y. Donnadieu, D. K. Hutchinson, J.-B. Ladant, and P. Morozova. “Simulation of Arctic sea ice within the DeepMIP Eocene ensemble: Thresholds, seasonality and factors controlling sea ice development”. In: *Global and Planetary Change* 214 (2022), p. 103848. DOI: 10.1016/j.gloplacha.2022.103848.
- [8] C. J. R. Williams, D. J. Lunt, U. Salzmann, T. Reichgelt, G. N. Inglis, D. R. Greenwood, W.-L. Chan, A. Abe-Ouchi, Y. Donnadieu, D. K. Hutchinson, A. M. Boer, J.-B. Ladant, P. A. Morozova, I. Niezgodzki, G. Knorr, **S. Steinig**, Z. Zhang, J. Zhu, M. Huber, and B. L. Otto-Bliesner. “African Hydroclimate During the Early Eocene From the DeepMIP Simulations”. In: *Paleoceanography and Paleoclimatology* 37 (2022). DOI: 10.1029/2022PA004419.
- [9] Y. Zhang, A. M. de Boer, D. J. Lunt, D. K. Hutchinson, P. Ross, T. van de Flierdt, P. Sexton, H. K. Coxall, **S. Steinig**, J.-B. Ladant, J. Zhu, Y. Donnadieu, Z. Zhang, W.-L. Chan, I. Abe-Ouchi, Ayako and Niezgodzki, G. Lohmann, G. Knorr, C. J. Poulsen, and M. Huber. “Early Eocene Ocean Meridional Overturning Circulation: The Roles of Atmospheric Forcing and Strait Geometry”. In: *Paleoceanography and Paleoclimatology* 37 (2022). DOI: <https://doi.org/10.1029/2021PA004329>.

- [10] L. Cavalheiro, T. Wagner, **S. Steinig**, C. Bottini, W. Dummann, O. Esegbue, G. Gambacorta, V. Giraldo-Gómez, A. Farnsworth, S. Flögel, P. Hofmann, D. J. Lunt, J. Rethemeyer, S. Torricelli, and E. Erba. “Impact of global cooling on Early Cretaceous high pCO₂ world during the Weissert Event”. In: *Nature Communications* 12.1 (2021), p. 5411. DOI: 10.1038/s41467-021-25706-0.
- [11] W. Dummann, **S. Steinig**, P. Hofmann, M. Lenz, S. Kusch, S. Flögel, J. O. Herrle, C. Hallmann, J. Rethemeyer, H. U. Kasper, and T. Wagner. “Driving mechanisms of organic carbon burial in the Early Cretaceous South Atlantic Cape Basin (DSDP Site 361)”. In: *Climate of the Past* 17.1 (2021), pp. 469–490. DOI: 10.5194/cp-17-469-2021.
- [12] D. J. Lunt, F. Bragg, W.-L. Chan, D. K. Hutchinson, J.-B. Ladant, P. Morozova, I. Niezgodzki, **S. Steinig**, Z. Zhang, J. Zhu, A. Abe-Ouchi, E. Anagnostou, A. M. de Boer, H. K. Coxall, Y. Donnadieu, G. Foster, G. N. Inglis, G. Knorr, P. M. Langebroek, C. H. Lear, G. Lohmann, C. J. Poulsen, P. Sepulchre, J. E. Tierney, P. J. Valdes, E. M. Volodin, T. Dunkley Jones, C. J. Hollis, M. Huber, and B. L. Otto-Bliesner. “DeepMIP: model intercomparison of early Eocene climatic optimum (EECO) large-scale climate features and comparison with proxy data”. In: *Climate of the Past* 17.1 (2021), pp. 203–227. DOI: 10.5194/cp-17-203-2021.
- [13] G. N. Inglis, F. Bragg, N. J. Burls, M. J. Cramwinckel, D. Evans, G. L. Foster, M. Huber, D. J. Lunt, N. Siler, **S. Steinig**, J. E. Tierney, R. Wilkinson, E. Anagnostou, A. M. de Boer, T. Dunkley Jones, K. M. Edgar, C. J. Hollis, D. K. Hutchinson, and R. D. Pancost. “Global mean surface temperature and climate sensitivity of the early Eocene Climatic Optimum (EECO), Paleocene–Eocene Thermal Maximum (PETM), and latest Paleocene”. In: *Climate of the Past* 16.5 (2020), pp. 1953–1968. DOI: 10.5194/cp-16-1953-2020.
- [14] **S. Steinig**, W. Dummann, W. Park, M. Latif, S. Kusch, P. Hofmann, and S. Flögel. “Evidence for a regional warm bias in the Early Cretaceous *TEX*₈₆ record”. In: *Earth and Planetary Science Letters* 539 (2020), p. 116184. DOI: 10.1016/j.epsl.2020.116184.
- [15] W. Dummann, **S. Steinig**, P. Hofmann, S. Flögel, A. Osborne, M. Frank, J. Herrle, L. Bretschneider, R. Sheward, and T. Wagner. “The impact of Early Cretaceous gateway evolution on ocean circulation and organic carbon burial in the emerging South Atlantic and Southern Ocean basins”. In: *Earth and Planetary Science Letters* 530 (2020), p. 115890. DOI: 10.1016/j.epsl.2019.115890.
- [16] K. Wallmann, S. Flögel, F. Scholz, A. W. Dale, T. P. Kemena, **S. Steinig**, and W. Kuhnt. “Periodic changes in the Cretaceous ocean and climate caused by marine redox see-saw”. In: *Nature Geoscience* 12.6 (2019), pp. 456–461. DOI: 10.1038/s41561-019-0359-x.
- [17] **S. Steinig**, J. Harlaß, W. Park, and M. Latif. “Sahel rainfall strength and onset improvements due to more realistic Atlantic cold tongue development in a climate model”. In: *Scientific Reports* 8.1 (2018), p. 2569. DOI: 10.1038/s41598-018-20904-1.

Journal Articles (under review)

- [18] **S. Steinig**, A. Abe-Ouchi, A. de Boer, W.-L. Chan, Y. Donnadieu, G. Hutchinson David K. Knorr, J.-B. Ladant, P. Morozova, I. Niezgodzki, C. Poulsen, E. Volodin, Z. Zhang, J. Zhu, D. Evans, G. Inglis, A. N. Meckler, and D. J. Lunt. “The DeepMIP-Eocene model database and interactive web application versions 1.0”. In: *Scientific Data* (submitted).
- [19] **S. Steinig**, W. Dummann, P. Hofmann, M. Frank, W. Park, J. O. Herrle, and S. Wagner Thomas Flögel. “Controls on Early Cretaceous South Atlantic Ocean circulation and carbon burial - a climate model-proxy synthesis”. In: *Climate of the Past* (submitted). DOI: 10.5194/egusphere-2023-2732.

Journal Articles (in preparation)

- [20] **S. Steinig**, J. Zhu, R. Feng, W.-L. Chan, D. K. Hutchinson, J.-B. Ladant, I. Niezgodzki, Z. Zhang, and D. J. Lunt. “Clouds drive nonlinear Eocene surface warming in the DeepMIP ensemble”. In: *Journal of Geophysical Research: Atmospheres* (in prep).
- [21] **S. Steinig**, C. J. R. Williams, A. A. Sellar, and D. J. Lunt. “Constraints on HadGEM3 climate sensitivity from the early Eocene”. In: *Journal of Advances in Modeling Earth Systems* (in prep).

- [22] **S. Steinig**, T. Alexander, P. J. Valdes, and D. J. Lunt. “Climatearchive.org: An interactive platform for visualising and sharing climate data”. In: *Environmental Modelling & Software* (in prep).

FUNDING AND AWARDS

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| NERC Standard Grant (£785,000 as Research Co-Investigator) <i>Project:</i> PaleoGradPhan – Paleoclimate meridional and zonal Gradients in the Phanerozoic | 2022 |
| Winner of JGI Beauty of Data Competition (£100) Competition to find the best University of Bristol data visualisations and new ways of communicating data. Awarded for the entry ‘Wheel of Time Weather Globe’. | 2022 |
| Jean Golding Institute Seed Corn Funding (£5,000 as PI) <i>Project:</i> Earth’s climate at your fingertips: connecting multidisciplinary environmental sciences and the public through interactive data exploration (climatearchive.org) For collaboration with University of Bristol Research IT on consultancy basis. | 2021 |
| School of Geographical Sciences, University of Bristol (£2,200 as PI) & Cabot Institute for the Environment, University of Bristol (£2,200 as PI) For research time and travel expenses to prepare and showcase a future warming visualisation (climatearchive.org/cop26) at COP26 in Glasgow as part of the Universities Network Public Engagement Subgroup exhibition stand. | 2021 |
| SHUG Faculty Award (3,000 €) Best PhD dissertation in the Faculty of Mathematics and Natural Sciences (out of ~140). | 2020 |
| Prof. Dr. Werner Petersen Award (2,500 €) For an outstanding PhD dissertation at GEOMAR, Kiel, Germany. | 2019 |

SEMINARS AND CONFERENCE TALKS

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| Meteorological Colloquium by the Universities of Frankfurt and Mainz, Germany (invited seminar) | Dec 2022 |
| EGU General Assembly, Vienna, Austria (solicited talk) | May 2022 |
| Bristol DataViz Interest Group, University of Bristol, UK (invited online talk) | Mar 2022 |
| Institute of Geosciences, University of Frankfurt, Germany (invited seminar) | Dec 2021 |
| Celebrating 30 years of PMIP (invited online talk) | Dec 2021 |
| PhanTASTIC Fall Meeting (invited online talk) | Sep 2021 |
| 6th DeepMIP Meeting (invited online talk) | Sep 2020 |
| PREFACE International Conference on Ocean, Climate and Ecosystems, Lanzarote, Spain (talk) | Apr 2018 |
| IODP/ICDP Kolloquium, Bochum, Germany (talk) | Apr 2018 |
| GSA Annual Meeting, Seattle, Washington, USA (talk) | Oct 2017 |

FIRST-AUTHOR CONFERENCE POSTER PRESENTATIONS

14th International Conference on Paleoceanography, Bergen, Norway (2022)
EGU General Assembly, Vienna, Austria (2018, 2020, 2021)
IODP/ICDP Gemany, annual colloquium (2016, 2018, 2019)
Fourth International Conference on Earth System Modelling, Hamburg, Germany (2017)

TEACHING AND STUDENT SUPERVISION

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| MSc unit ”Introduction to Scientific Computing” School of Geographical Sciences, University of Bristol, Bristol, UK | 2022 |
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- I designed the structure of this completely new unit, created and delivered material for six of the twelve 3-hour long combined lectures and computer practicals, and designed and marked a new assessment on geospatial data analysis in Jupyter notebooks
- I used Python as an example to introduce basic concepts in scientific computing and geospatial data analysis to students from physical and human geography domains

I have also supervised the following students:

- Co-Supervisor of NERC PhD Phoebe Ross, "Deep Ocean Circulation during Super Warm Early Eocene Temperatures"
- Co-Supervisor of Cabot MScR Andy Lyford, "Modelling polar amplification"
- Supervisor of visiting MSc students Akina Renard and Willem Nicolas from France, 5 months research placement to trial computer science methods for the climatearchive.org platform

I further worked with groups of 2nd year BSc Computer Science students during two 6-month Software Product Engineering courses between 2021 and 2023. My role involved introducing them to fundamentals of climate modelling to allow them to develop academic software at the interface between computer and climate sciences.

OUTREACH ACTIVITIES

- **Horizons: Histories and Futures of Migration, Germanisches Nationalmuseum, Nuremberg, Germany:** Invited custom exhibition installation to visualise future climate change scenarios and links to human migration (tinyurl.com/Horizons-Migration). Germany's largest museum of cultural history with ~430,000 visitors each year. On display from 30th March - 10th September 2023.
- **Cabot Institute for the Environment Research Showcase, Bristol, UK:** Invited exhibition display of the climatearchive.org platform.
- **Understanding Climate, Senckenberg Museum, Frankfurt, Germany:** Invited custom exhibition installation of my climatearchive.org platform to let visitors explore past and future climate change and science (tinyurl.com/Understanding-Climate). Second-largest natural history museum in Germany with ~400,000 visitors each year. On display from 21st October 2022 - 16th July 2023.
- **Bristol Data & AI Showcase 2022, Bristol, UK:** Invited exhibition display of my work on climate data accessibility and sharing (<https://tinyurl.com/JGI-showcase>).
- **"Festival of Tomorrow" 2022, Swindon, UK:** Two-day exhibition stall showcasing palaeoclimate research and invited panel discussion: "Global warming - Back to The Future!"
- **COP26, Glasgow, UK:** Selected exhibition stall in the public Green Zone showcasing the climatearchive.org platform as part of the Universities Network Public Engagement Subgroup.
- **Media interviews:** including online blogs (tinyurl.com/ask-a-scientist) and BBC's 'Science in Action' (www.bbc.co.uk/programmes/w3ct1l4k) about my research and outreach activities
- **Online Articles:** Multiple co-authored pieces in "The Conversation UK" using science-fiction and fantasy novels to explain climate science basics to a broader audience (theconversation.com/profiles/sebastian-steinig-1282910).

OTHER RELEVANT EXPERIENCE

- **Organisation of NextGEN@Helmholtz conference** Jul 2017
Part of the core team of PhD students organising a three-day conference for more than 140 early career scientists from across 18 different Helmholtz centres with an overall budget of 30,000 €.

- **Participation in research cruise M135** Feb 2017 – Apr 2017
Water mass and geological sampling within the oxygen minimum zone off Peru onboard German RV Meteor.
- **Palaeoceanographic internship Cardiff University, Cardiff, UK** Aug 2012 – Sep 2012
I worked for two months with Ian Hall and Margit Simon on the generation of high-resolution palaeoceanographic records from the Agulhas region in the Palaeoclimate and Climate Systems Research in the School of Earth and Ocean Sciences.