

Seminar: “Measuring, reconstructing and modelling Earth's climate variability across spatial and temporal scales”

[Link to LSF](#)

Module: Bachelor (PSEM) / Master (MVSem)

Language: English (German optionally, tbd in first meeting)

Credit points: 3 / 6 ECTS for Bachelor / Master

Content: Student talks on the topic of climate variability on different time scales with joint discussions afterwards.

Time: Tuesdays, 16:15-18:00, exact dates below

Scope: The seminar includes the preparation of a talk for one of the topics listed below. Besides the oral presentation (30min), a hand out (max. 1 page) in case of Bachelor students or a written report (5 pages) for Master students should be provided. The seminar requires active participation in all sessions. Grades will be assigned according to the evaluation of the talk and, in case of MVSem, the written report.

Number of Participants: 12

Registration: is closed

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Lecturers: Dr. Kira Rehfeld & Beatrice Ellerhoff

The seminar will be held online: <https://heiconf.uni-heidelberg.de/cyfa-uvwf-dkx9-c7mh>

Dates & Topics

Date	Topic
03.11.2020	Introduction to climate variability across scales, discussion of seminar organization
10.11.2020	1. Climate variability - Mechanisms and Reconstruction
17.11.2020	2. Centennial to millennial variability
24.11.2020	3. Glacial-Interglacial changes
01.12.2020	4. Dansgaard-Oeschger events
08.12.2020	5. Human evolution and climate variability
15.12.2020	6. Climate variability in the Common Era from models and proxies
12.01.2021	7. Synoptic changes/ storm tracks
19.01.2021	8. Impact of climate variability on near-term policy choices and the value of information on the example of wind energy production
26.01.2021	9. The Concept of equilibrium climate sensitivity and its relevance to future climate
02.02.2021	10. Extreme events in a changing climate: Variability is more important than averages
09.02.2021	11. Global heating and its attribution
16.02.2021	12. tba

Literature

If you have problems accessing the literature via the university network (e.g. VPN), please contact beatrice.ellerhoff@iup.uni-heidelberg.de

In the scope of this seminar, it is important to focus on the main findings of the provided literature (often contained in the figures). An explanation of these main findings forms the basis for our discussions throughout the seminar. Questions can be additionally clarified in the personal meetings before the talk.

A short guide towards paper reading can be found here: <https://towardsdatascience.com/how-to-read-scientific-papers-df3afd454179>. It could be worthwhile developing your own strategy (e.g. marking with different colors, summarizing the key points in tables or mind maps) not only for this seminar but also for a Bachelor/Master thesis.

Background knowledge on paleoclimate science and environmental physics:

- Bradley, Raymond S.: Paleoclimatology: reconstructing climates of the Quaternary
- Roedel, Walter: Physik unserer Umwelt: die Atmosphäre

Seminar topics (please pick one):

1. Climate variability - Mechanisms and Reconstruction

- **Mitchell J. M.:** An overview of climatic variability and its causal mechanisms. Quaternary Research 6:481–493 (1976) doi:10.1016/0033-5894(76)90021-1
- **Snyder, C. W.:** Evolution of global temperature over the past two million years, Nature, 18(7624), 1–17, doi:10.1038/nature19798, 2016.

2. Centennial to millennial variability

- **Fraedrich, K., Blender, R. and Zhu, X.:** Continuum climate variability: long-term memory, extremes, and predictability, International Journal of Modern Physics B, 23(28), 5403–5416, 2009. Doi: <https://doi.org/10.1142/S0217979209063729>
- **Huybers, P. and Curry, W.:** Links between annual, Milankovitch and continuum temperature variability., Nature, 441(7091), 329–32, doi:10.1038/nature04745, 2006.
- *Ergänzend: Lovejoy, S. and Varotsos, C.: Scaling regimes and linear/nonlinear responses of last millennium climate to volcanic and solar forcings, Earth System Dynamics, 7(1), 133–150, doi:10.5194/esd-7-133-2016, 2016*

3. Glacial-Interglacial changes

- **Brook, E.J., Buizert, C.** Antarctic and global climate history viewed from ice cores. *Nature* 558, 200–208 (2018). <https://doi.org/10.1038/s41586-018-0172-5>
- **Ganopolski, A., Winkelmann, R. & Schellnhuber, H.:** Critical insolation–CO₂ relation for diagnosing past and future glacial inception. *Nature* 529, 200–203 (2016). <https://doi.org/10.1038/nature16494>
- *Ergänzend: Lisiecki, L. E., and Raymo, M. E. (2005), A Pliocene-Pleistocene stack of 57 globally distributed benthic $\delta^{18}O$ records, *Paleoceanography*, 20, PA1003, doi:10.1029/2004PA001071.*

4. Dansgaard–Oeschger events

- **Stocker, T. F. and Johnsen, S. J.:** A minimum thermodynamic model for the bipolar seesaw, *Paleoceanography*, 18, 1087, <https://doi.org/10.1029/2003PA000920>, 2003.
- **Buizert, C., et al:** Abrupt ice-age shifts in southern westerly winds and Antarctic climate forced from the north, *Nature*, 563, 681–685, <https://doi.org/10.1038/s41586-018-0727-5>, 2018
- *Ergänzend: Lohmann, J. and Ditlevsen, P. D.: Random and externally controlled occurrences of Dansgaard–Oeschger events, *Climate of the Past*, 14(5), 609–617, doi:10.5194/cp-14-609-2018, 2018.*

5. Human evolution and climate variability

- **Timmermann, A., Friedrich, T.** Late Pleistocene climate drivers of early human migration. *Nature* 538, 92–95 (2016). <https://doi.org/10.1038/nature19365>
- **Miikka Tallavaara, Miska Luoto, Natalia Korhonen, Heikki Järvinen, Heikki Seppä:** Human population dynamics in Europe over the LGM, *Proceedings of the National Academy of Sciences* Jun 2015, 201503784; DOI: 10.1073/pnas.1503784112
- **Gamble, Clive & Davies, William & Pettitt, Paul & Richards, Martin. (2004). *Climate Change and Evolving Human Diversity in Europe during the Last Glacial*.** Philosophical transactions of the Royal Society of London. Series B, Biological sciences. 359. 243–53; discussion 253. 10.1098/rstb.2003.1396.
- *Ergänzend: Viehberg, F., Just, J., Dean, J. R., Wagner, B., Franz, S. O., Klasen, N., ... Schäbitz, F. (2018). Environmental change during MIS4 and MIS 3 opened corridors in the Horn of Africa for Homo sapiens expansion. *Quaternary Science Reviews*. <https://doi.org/10.1016/j.quascirev.2018.09.008>*

6. Climate variability in the Common Era from models and proxies

- **Neukom, R., Barboza, L.A., Erb, M.P. et al.** Consistent multidecadal variability in global temperature reconstructions and simulations over the Common Era. *Nat. Geosci.* 12, 643–649 (2019). <https://doi.org/10.1038/s41561-019-0400-0>
- **Jungclaus, J. H. et al.:** Climate and carbon-cycle variability over the last millennium, *Clim. Past*, 6, 723–737, doi:[10.5194/cp-6-723-2010](https://doi.org/10.5194/cp-6-723-2010), 2010

7. Synoptic changes/ storm tracks

- **Tamarin-Brodsky, T. and Kaspi, Y.:** Enhanced poleward propagation of storms under climate change, *Nature Geoscience*, 10(12), 908–913, doi:10.1038/s41561-017-0001-8, 2017.
- **Lehmann, J., Coumou, D. & Frieler, K.:** Increased record-breaking precipitation events under global warming. *Climatic Change* **132**,501–515 (2015).
<https://doi.org/10.1007/s10584-015-1434-y>

8. Impact of climate variability on near-term policy choices and the value of information on the example of wind energy production

- **Lempert, R. J., Schlesinger, M. E., Bankes, S. C. and Andronova, N. G.:** The impacts of climate variability on near-term policy choices and the value of information, *Climatic Change*, 45(1), 129–161, doi:10.1023/A:1005697118423, 2000.
- **Gonzalez, P.L.M., Brayshaw, D.J. & Zappa, G.:** The contribution of North Atlantic atmospheric circulation shifts to future wind speed projections for wind power over Europe. *Clim Dyn* 53, 4095–4113 (2019). <https://doi.org/10.1007/s00382-019-04776-3>
- *Ergänzend: Zeng, Z., Ziegler, A.D., Searchinger, T. et al. A reversal in global terrestrial stilling and its implications for wind energy production. Nat. Clim. Chang. 9, 979–985 (2019). <https://doi.org/10.1038/s41558-019-0622-6>*

9. The Concept of equilibrium climate sensitivity and its relevance to future climate

- **Von Der Heydt, A. S., Köhler, P., Van De Wal, R. S. W. and Dijkstra, H. A.:** On the state dependency of fast feedback processes in (paleo) climate sensitivity, *Geophysical Research Letters*, 41(18), 6484–6492, doi:10.1002/2014GL061121, 2014.
- **Brown, P. T., Ming, Y., Li, W. and Hill, S. A.:** Change in the magnitude and mechanisms of global temperature variability with warming, *Nature Climate Change*, 7(10), 743–748, doi:10.1038/nclimate3381, 2017.
- *Ergänzend: Nijse, F. J. M. M., Cox, P. M., Huntingford, C. and Williamson, M. S.: Decadal global temperature variability increases strongly with climate sensitivity, Nature Climate Change, 9(August), 2–6, doi:10.1038/s41558-019-0527-4, 2019.*

10. Extreme events in a changing climate: Variability is more important than averages

- **Katz, R. W. and Brown, B. G.:** Extreme events in a changing climate: Variability is more important than averages, *Climatic Change*, 21(3), 289–302, doi:10.1007/BF00139728, 1992.
- **Fischer, E. M. and Schär, C.:** Future changes in daily summer temperature variability: Driving processes and role for temperature extremes, *Climate Dynamics*, 33(7–8), 917–935, doi:10.1007/s00382-008-0473-8, 2009.
- *Ergänzend: Sutton, R., Suckling, E. and Hawkins, E.: What does global mean temperature tell us about local climate?, Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 373(2054), doi:10.1098/rsta.2014.0426, 2015.*

11. Global heating and its attribution

- **Holmes, C. R., Woollings, T., Hawkins, E. and de Vries, H.:** Robust Future Changes in Temperature Variability under Greenhouse Gas Forcing and the Relationship with Thermal Advection, *Journal of Climate*, 29(6), 2221–2236, doi:10.1175/JCLI-D-14-00735.1, 2016.
- **Huber, M., Knutti, R.** Natural variability, radiative forcing and climate response in the recent hiatus reconciled. *Nature Geosci* 7, 651–656 (2014). <https://doi.org/10.1038/ngeo2228>
- *Ergänzend (Hintergrund):* Stott, P. A., Christidis, N., Otto, F. E. L., Sun, Y., Vanderlinden, J. P., van Oldenborgh, G. J., Vautard, R., von Storch, H., Walton, P., Yiou, P. and Zwiers, F. W.: *Attribution of extreme weather and climate-related events*, *Wiley Interdisciplinary Reviews: Climate Change*, 7(1), 23–41, doi:10.1002/wcc.380, 2016.