PMIP publications for AR6

Chapter 1

- Shi, H., B. Wang, E. R. Cook, J. Liu, and F. Liu, 2018: Asian summer precipitation over the past 544 years reconstructed by merging tree rings and historical documentary records. J. Clim., 31, 7845-7861, https://doi.org/10.1175/JCLI-D-18-0003.1
    - The paper presents a new gridded Asian summer precipitation reconstruction (8.75°S-55.25°N, 61.25°-143.25°E) since AD 1470, and discussed the long-term variability modes of the past summer precipitation over Asian land.
- Wu, C. J.; Usoskin, I. G.; Krivova, N. et al., 2018: Solar activity over nine millennia: A consistent multi-proxy reconstruction, Astronomy & Astrophysics, Volume 615, id.A93, 13 pp., https://doi.org/10.1051/0004-6361/201731892
    - This paper describes the state-of-the-art method and the results of the first multi-isotope composite, which is used to reconstruct the solar activity over the Holocene.
- C.-J. Wu, N. A. Krivova et al., 2018, Solar total and spectral irradiance reconstruction over the last 9000 years, A&A, Forthcoming article, https://doi.org/10.1051/0004-6361/201832956
    - This paper describes the methods and the state-of-the-art results of solar irradiance reconstruction over the last 9000 years using a physics-based model. The reconstructed irradiance is recommended to serve as solar forcing in climate models.
- Otto-Bliesner, B.L. et al., 2017: The PMIP4 contribution to CMIP6 - Part 2: Two interglacials, Scientific objectives and experimental design of the PMIP4-CMIP6 Holocene and Last Interglacial simulations. Geoscientific Model Development, 10, 3979-4003, https://doi.org/10.5194/gmd-10-3979-2017
    - This paper describes the protocols for the mid-Holocene (6 ka) and Last Interglacial (127 ka) Tier 1 simulations, as well as numerous Tier 2 simulations to assess the sensitivities to prescribed vegetation, ice sheets, freshwater fluxes, and alternative states of orbital forcing. For the first time, the LIG is included for CMIP6 and PMIP4, allowing a multi-model assessment of this important period for testing our knowledge of climate-ice sheet interactions in warm climates.
- Kadow, C., S. Illing, I. Kröner, U. Ulbrich and U. Cubasch, 2017: Decadal climate predictions improved by ocean ensemble dispersion filtering. J. Adv. Model. Earth Syst. 9, doi 10.1002/2016M5000787
    - recent mode development and its performance improvements
- Zanchettin, D., Khodri, M., Timmreck, C., Toohey, M., Schmidt, A., Gerber, E. P., Hegerl, G., Robock, A., Pausata, F. S. R., Ball, W. T., Bauer, S. E., Bekki, S., Dhomse, S. S., LeGrande, A. N., Mann, G. W., Marshall, L., Mills, M., Marchand, M., Niemeier, U., Poulain, V., Rozanov, E., Rubino, A., Stenke, A., Tsigaridis, K., and Tummon, F.: The Model Intercomparison Project on the climatic response to Volcanic forcing (VolMIP): experimental design and forcing input data for CMIP6, Geosci. Model Dev., 9, 2701-2719, doi:10.5194/gmd-9-2701-2016, 2016, 10.5194/gmd-9-2701-2016, 2016
    - This paper presents the experimental design of the “Model Intercomparison Project on the climatic response to Volcanic forcing (VolMIP), which includes idealized experiments focused on the short-term atmospheric as well as long-term coupled response to volcanic forcing. The core idea of VolMIP is to constrain radiative forcing among the participating

models to focus on the climatic response, hence reference forcing dataare provided in terms of optical aerosol properties for a series of reference eruptions.

- Zanchettin, D., O. Bothe, H. F. Graf, S. J. Lorenz, J. Luterbacher, C. Timmreck, and J. H. Jungclaus (2013) Background conditions influence the decadal climate response to strong volcanic eruptions. J. Geophys. Res. Atm., 118(10): 4090-4106, doi:10.1002/jgrd.50229, 10.1002/jgrd.50229
    - This study illustrates how the decadal climate response to strong volcanic eruptions depends on the background climate state at the time of the eruption and on the presence and magnitude of additional external forcings acting at the same time. It demonstrates that background climate conditions are not merely a source of additive noise for post-eruption decadal climate variability but actively influence the mechanisms involved in the post-eruption decadal evolution.

- Fernández-Donado, L. et al, 2013. Large-scale temperature response to external forcing in simulations and reconstructions of the last millennium. Climate of the Past, 9 (1), pp. 393-421., https://doi.org/10.5194/cp-9-393-2013
    - This paper represents an extensive review of the state-of-the-art modelling and reconstructions effort for the last millennium (LM) previous to the coordinated approach within the CMIP5-PMIP3 community, as the basis of knowledge achieved prior the agreement of LM radiative forcings. Additionally, this work provides a quantitative framework to analyse the consistency between reconstructions and simulations in their response to external forcings and the respective role of the internal variability.

- Pavón-Carrasco, F.J. et al., 2018. Multi-centennial fluctuations of radionuclide production rates are modulated by the Earth's magnetic field. Scientific reports, 8(1), p.9820, https://doi.org/10.1038/s41598-018-28115-4
    - A revision of the standard accepted assumptions to reconstruct the solar activity during the Holocene is presented in this work. It is shown that not only the solar magnetic field but also the geomagnetic field has a relevant role for the timescales of interest. The latter suggests the need of reviewing how past solar forcing estimations are obtained, with relevant implications for the solar-climate relation as well as for the present and future generation of paleo simulations.

- Harrison, S. P., Bartlein, P. J., Izumi, K., Li, G., Annan, J., Hargreaves, J., et al. (2015). Evaluation of CMIP5 palaeo-simulations to improve climate projections. Nature Climate Change, 5(8), 735-743. , http://doi.org/10.1038/nclimate2649
    - Past climate changes provide a unique opportunity for out-of-sample evaluation of model performance. Palaeo-evaluation has shown that the large-scale changes seen in twenty-first-century projections, including enhanced land-sea temperature contrast, latitudinal amplification, changes in temperature seasonality and scaling of precipitation with temperature, are likely to be realistic.

- Schmidt, G. A., Annan, J. D., Bartlein, P. J., Cook, B. I., Guilyardi, E., Hargreaves, J. C., et al. (2014). Using palaeo-climate comparisons to constrain future projections in CMIP5. Climate of the Past, 10(1), 221-250. , http://doi.org/10.5194/cp-10-221-2014
    - Using palaeo-climate comparisons to constrain future projections!

Chapter 2

- Klein F., H. Goosse, D. Verschuren, N. Graham, 2016. Comparison of simulated and

reconstructed variations in East African hydroclimate over the last millennium. Climate of the Past Clim. Past, 12, 1499-1518 , https://doi.org/10.5194/cp-12-1499-2016
    - The paper shows the large role of natural variability in past precipitation changes in East Africa and discuss the role of Indian ocean SST.

- Shi, H., B. Wang, E. R. Cook, J. Liu, and F. Liu, 2018: Asian summer precipitation over the past 544 years reconstructed by merging tree rings and historical documentary records. J. Clim., 31, 7845-7861, https://doi.org/10.1175/JCLI-D-18-0003.1
    - The paper presents a new gridded Asian summer precipitation reconstruction (8.75°S-55.25°N, 61.25°-143.25°E) since AD 1470, and discussed the long-term variability modes of the past summer precipitation over Asian land.

- Shi, H., and B. Wang, 2018: How does the Asian summer precipitation-ENSO relationship change over the past 544 years? Clim. Dyn., https://doi.org/10.1007/s00382-018-4392-z
    - The paper presents the secular changes (centennial) of the Asian summer precipitation-ENSO relationship since AD 1470 and the possible causes. It also discussed the major modes of variability of the Asian summer rainfall on the interannual timescale.

- Fasullo, J.T., R. Tomas, S. Stevenson, B. Otto-Bliesner, E. Brady, E. Wahl, 2017: The amplifying influence of increased ocean stratification on a future year without a summer, Nature Communications, 8, 1236. doi:10.1038/s41467-017-01302-z, https://doi.org/10.1038/s41467-017-01302-z
    - CESM simulations of both the 1815 Tambora eruption and a hypothetical analogous future eruption are compared, the latter occurring in 2085 assuming a business-as-usual climate scenario. The 1815 eruption drove strong responses in both the ocean and cryosphere that were fundamental to driving the Year-Without-A-Summer. Through modulation of ocean stratification and near-surface winds, global warming contributes to an amplified surface climate response in CESM.

- Stevenson, S, J. Overpeck, J. T. Fasullo, S. Coats, L. Parsons, B. Otto-Bliesner, T. R. Ault, G. Loope, J. Cole, 2018: Climate Variability, Volcanic Forcing, and Last Millennium Climate Extremes, Journal of Climate, 31, 4309-4327., n/a
    - The Community Earth System Model (CESM) Last Millennium Ensemble to examine statistical associations between regional mega-events (megadroughts and megapluvials), coupled climate modes, forcing from major volcanic eruptions.

- Hood, L., S. Schimanke, Th. Spangehl, S. Bal, and U. Cubasch, 2013: The surface climate response to 11-yr solar forcing during northern winter: observational analyses and comparisons with GCM simulations. J. Climate, 26, 7489-7506., doi: http://dx.doi.org/10.1175/JCLI-D-12-00843.1
    - analysis of the natural climate response to the 11-year solar cycle

- 97. Langematz, U., A. Kubin, C. Brühl, A. J. G. Baumgaertner, U. Cubasch, and Th. Spangehl, 2013: Solar Effects on Chemistry and Climate Including Ocean Interactions. Chapter 29, Climate and Weather of the Sun-Earth System (CAWSES): Highlights from a Priority Program, Ed. F. J. Lübken, p 541-571. Springer, , DOI: 10.1007/978-94-007-4348-9_29.
    - Solar effects on natural variability

- Polanski, S., B. Fallah, D. J. Befort, S. Prasad and U. Cubasch, 2014: Regional moisture change over India during the past Millenium: A comparison of multi-proxy reconstructions and climate model simulations. Global and Planetary Change, 122, 176-185, , dx.doi.org.10.1016/J.gloplacha.2014.08.016
    - regional moisture variability during the past millennium over India

- Bürger, G. and U. Cubasch, 2015: The detectability of climate engineering. J. Geophys. Res. Atmos., 120, , doi:10.1002/2015JD023954
    - application of radiative forcing climate engineering
- Fallah, B., U. Cubasch, K. Prömmel, S. Sodoudi, 2015: A numerical model study on the behaviour of Asian summer monsoon and AMOC due to orographic forcing of Tibetan Plateau. Clim. Dyn, DOI 10.1007/s00382-015-2914-5.
    - link between AMOC and Asian summer monsoon
- Otto-Bliesner, B.L. et al., 2017: The PMIP4 contribution to CMIP6 - Part 2: Two interglacials, Scientific objectives and experimental design of the PMIP4-CMIP6 Holocene and Last Interglacial simulations. Geoscientific Model Development, 10, 3979-4003, doi:10.5194/cp-12-1645-2016
    - regional temperature evolution over Europe during the Holocene
- Babian, S., H. W. Rust, J. Grieger, K. Prömmel and U. Cubasch, 2016: Representation of the Antarctic Oscillation and related precipitation patterns in the MPI Earth System Model, Met. Zeitschrift, , DOI 10.1127/metz/2016/0661
    - Antarctic oscillation variability and modeled precipitation pattern
- Bal, S., S. Schimanke, T. Spangehl and U. Cubasch, 2017: Variable influence on the equatorial troposphere associated with SSW using ERA-interim. J. Earth. Sys. Sci., 126:19, DOI10.1007/sl2040-017-0802-6
    - Natural variability of SSW and tropical troposphere
- Babian, S., J. Grieger and U. Cubasch, 2018: A new index for the wintertime southern hemisphere split jet. Atmos. Chem. Phys., 18, 6749-6760, doi.org/10.5194/acp-18-6749-2018
    - improved description of southern hemisphere variability
- Wei Shang, Xuejuan Ren, Bo Huang, Ulrich Cubasch and Xiu-qun Yang, 2018: Subseasonal intensity variations of the South Asian high in relationship to diabatic heating: observation and CMIP5 models. Clim. Dyn, doi.org/10.1007/s00382-018-4266-4
    - Linking regional sub seasonal variability with diabetic heat sources
- Bo Huang, Ulrich Cubasch and Yan Li, 2018: East-Asian Summer Monsoon Representation in Re-Analysis Datasets. Atmosphere, 9, 235, , doi:10.3390/atmos9060235
    - Evaluation of the description of the regional variability in different re-analysis Dara sets
- Bal, S., S. Schimanke, T. Spangehl and U. Cubasch, 2018: Enhanced mean meridional circulation during the evolution of split type sudden stratospheric warming in observations and model simulations. J. Earth Syst. Sci. 127:68, doi 10.1007/s12040-018-0972-x
    - variability of SSWs and connection to meridional circulation
- Ohgaito, R., Abe-Ouchi, A., O'ishi, R., Takemura, T., Ito, A., Hajima, T., Watanabe, S., and Kawamiya, M.: Effect of high dust amount on surface temperature during the Last Glacial Maximum: a modelling study using MIROC-ESM, Clim. Past, 14, 1565-1581, https://doi.org/10.5194/cp-14-1565-2018, 2018, https://doi.org/10.5194/cp-14-1565-2018
    - Effect of aerosols on climate is major uncertainty for future projection.This paper discusses how the glaciogenic dust can affect the LGMclimate. A possibility of less cooling by high dust load surroundingof Antarctica is suggested.
- Chevalier, M., Brewer, S., Chase, B.M., 2017. Qualitative assessment of PMIP3 rainfall simulations across the eastern African monsoon domains during the mid-Holocene and the Last Glacial Maximum. Quat. Sci. Rev. 156, 107-120., 10.1016/j.quascirev.2016.11.028
    - The paper evaluates the simulated rainfall patterns in southeastern Africa during the mid-Holocene and the LGM.

- Zanchettin, D., Khodri, M., Timmreck, C., Toohey, M., Schmidt, A., Gerber, E. P., Hegerl, G., Robock, A., Pausata, F. S. R., Ball, W. T., Bauer, S. E., Bekki, S., Dhomse, S. S., LeGrande, A. N., Mann, G. W., Marshall, L., Mills, M., Marchand, M., Niemeier, U., Poulain, V., Rozanov, E., Rubino, A., Stenke, A., Tsigaridis, K., and Tummon, F.: The Model Intercomparison Project on the climatic response to Volcanic forcing (VolMIP): experimental design and forcing input data for CMIP6, Geosci. Model Dev., 9, 2701-2719, doi:10.5194/gmd-9-2701-2016, 2016, 10.5194/gmd-9-2701-2016, 2016
    - This paper presents the experimental design of the “Model Intercomparison Project on the climatic response to Volcanic forcing (VolMIP), which includes idealized experiments focused on the short-term atmospheric as well as long-term coupled response to volcanic forcing. The core idea of VolMIP is to constrain radiative forcing among the participating models to focus on the climatic response, hence reference forcing dataare provided in terms of optical aerosol properties for a series of reference eruptions.

- Zanchettin, D., O. Bothe, H. F. Graf, S. J. Lorenz, J. Luterbacher, C. Timmreck, and J. H. Jungclaus (2013) Background conditions influence the decadal climate response to strong volcanic eruptions. J. Geophys. Res. Atm., 118(10): 4090-4106, doi:10.1002/jgrd.50229, 10.1002/jgrd.50229
    - This study illustrates how the decadal climate response to strong volcanic eruptions depends on the background climate state at the time of the eruption and on the presence and magnitude of additional external forcings acting at the same time. It demonstrates that background climate conditions are not merely a source of additive noise for post-eruption decadal climate variability but actively influence the mechanisms involved in the post-eruption decadal evolution.

- Khodri M., Izumo T., Vialard J., Janicot S., Cassou C., Lengaigne M., Mignot J., Gastineau G., E. Guilyardi, Lebas N., Robock A. and M.J McPhaden, Tropical explosive volcanic eruptions can trigger El Niño by cooling tropical Africa, Nature Communications, 8, 778 (2017). , 10.1038/s41467-017-00755-6
    - This paper presents new evidences for a possible interference of volcanic forcing from tropical stratospheric eruptions on ENSO cycle and discusses the underlying physical processes. Targeted climate model simulations emphasize that Pinatubo-like eruptions tend to shorten La Niñas, lengthen El Niños and induce anomalous warming when occurring during neutral states. It also presents a new mechanisms suggesting that volcanically induced cooling in tropical Africa weakens the West African monsoon, and the resulting atmospheric Kelvin wave can drive equatorial westerly wind anomalies over the western Pacific. This wind anomaly is further amplified by air-sea interactions in the Pacific, favouring an El Niño-like response.

- Stoffel M, Khodri M., Corona C., Guillet S., Poulain V., Bekki S., Guiot J., Luckman B.H., Oppenheimer C., Lebas N., Beniston M.& Masson-Delmotte V., Reconciling reconstructions and simulations of volcanic cooling, Nature Geoscience, 8, 784-788 (2015), 10.1038/NGEO2526, 2015
    - The climatic impact of the largest volcanic events has been assessed in numerous modelling studies and tree-ring-based hemispheric temperature reconstructions. However, volcanic surface cooling derived from PMIP3 climate model simulations is systematically much stronger than the cooling seen in tree-ring-based proxies, suggesting that the proxies underestimate cooling; and/or the modelled forcing is unrealistically high. This paper present a new summer temperature reconstructions for the Northern Hemisphere from tree-ring width and maximum latewood density over the past 1,500 years in comparison to simulated climate effects of two large eruptions, in AD 1257 and 1815, using a climate model that accounts explicitly for self-limiting aerosol microphysical

processes. Results reveal for the first time an agreement between modelled and tree-ring based reconstruction of mean Northern Hemisphere extra-tropical summer cooling over land estimated between 0.8 to 1.3 degC for these eruptions. This reconciliation of proxy and model evidence paves the way to improved assessment of the role of both past and future volcanism in climate forcing.

- Schenk F., Väliranta M., Muschitiello F., Tarasov L., Heikkilä M., Björck S., Brandefelt J., Johansson A.V., Näslund J.O., Wohlfarth B. (2018): Warm summers during the Younger Dryas cold reversal. Nat. Communications 9:1634, https://doi.org/10.1038/s41467-018-04071-5
  - Very cold North Atlantic Ocean states in response to a weak AMOC cause persistent atmospheric blocking over Europe during summer. Proxy-model evidence suggests warmer and very dry conditions in response to a slowdown of the AMOC consistent with observations since the 1980s.

- Berman, AL., G. Silvestri, M. Rojas, M. Tonello, 2016: Accelerated greenhouse gases versus slow insolation forcing induced climate changes in southern South America since the Mid-Holocene. Climate Dynamics, 48(1-2): 387-404., 10.1007/s00382-016-3081-z
  - This paper describes past climates in South America combining multiproxyreconstructions and PMIP3 models to investigate the time evolution of regional climatic conditions from the Mid-Holocene (MH) to the present.

- Berman, AL., G. Silvestri, M. Tonello, 2016: Differences between Last Glacial Maximum and present-day temperature and precipitation in southern South America. Quaternary Science Reviews. 150: 221 - 233., https://doi.org/10.1016/j.quascirev.2016.08.025
  - This paper is the first analysis of differences between Last Glacial Maximum (LGM) and present climates in South America considering PMIP3 paleoclimatic models.

- Berman, AL., G. Silvestri, M. Tonello, 2018: On the differences between Last Glacial Maximum and Mid-Holocene climates in southern South America simulated by PMIP3 models. Quaternary Science Reviews, 185: 113-121., https://doi.org/10.1016/j.quascirev.2018.02.003
  - Differences between climate conditions during the Last Glacial Maximum and the Mid-Holocene in southern South America inferred from PMIP3 paleoclimatic simulations are described for the first time in this paper.

- Hakim, G. J., J. Emile-Geay, E. J. Steig, D. Noone, D. M. Anderson, R. Tardif, N. Steiger, and W. A. Perkins (2016), The last millennium climate reanalysis project: Framework and first results, Journal of Geophysical Research: Atmospheres, 121, 6745 - 6764, 10.1002/2016JD024751
  - Provides the first validated, global, multivariate reconstruction of climate fields based on a fusion of proxy and GCM runs.

- Ault, T. R., C. Deser, M. Newman, and J. Emile- Geay (2013), Characterizing decadal to centennial variability in the equatorial pacific during the last millennium, Geophysical Research Letters, 40, 3450-3456, 10.1002/grl.50647
  - Evaluates the ability of PMIP3-CMIP5 models to simulate tropical Pacific variability over the past millennium, as reconstructed from proxy data. The article identifies important disagreements between simulations and reconstructions: in the models, variability primarily reflects a thermodynamic response to reconstructed solar and volcanic activity, whereas in the reconstruction, variability arises from either internal climate processes, forced responses that differ from those in CCSM4, or non-climatic proxy processes that are not yet understood. These findings imply that the response of the tropical Pacific to future forcings may be even more uncertain than portrayed by CMIP5 because there are potentially important sources of century-scale variability that these models do not simulate.

- Lambert, F., J.-S. Kug, R. J. Park, N. Mahowald, G. Winckler, A. Abe-Ouchi, R. O'ishi, T. Takemura, and J.-H. Lee (2013), The role of mineral-dust aerosols in polar temperature amplification, Nat. Clim. Chang., 3(5), 487-491, 10.1038/nclimate1785
    - Impact of high atmospheric dust loads on polar temperature

- Lambert, F., A. Tagliabue, G. Shaffer, F. Lamy, G. Winckler, L. Farias, L. Gallardo, and R. De Pol-Holz (2015), Dust fluxes and iron fertilization in Holocene and Last Glacial Maximum climates, Geophys. Res. Lett., 42(14), 6014-6023, 10.1002/2015GL064250
    - Dust deposition fields for HOL and LGM climate, and associated CO2 drawdown through iron fertilization

- García-García A., Cuesta-Valero F.J., Beltrami H. and Smerdon J.E. (2016). Simulation of air and ground temperatures in PMIP3/CMIP5 last millennium simulations: implications for climate reconstructions from borehole temperature profiles. Environmental Research Letter, 11(4):044022., https://doi.org/10.1088/1748-9326/11/4/044022
    - This paper tests the methodology employed to reconstruct past ground surface temperature histories from borehole temperature profiles using simulations from the PMIP3/CMIP5 archives.

- Cuesta-Valero F.J., García-García A., Beltrami H. and Smerdon J.E. (2016). First Assessment of Continental Energy Storage in CMIP5 Simulations. Geophysical Research Letters, 43., https://doi.org/10.1002/2016GL068496
    - This paper assesses the ability of 30 CMIP5 models to reproduce the change in heat storage within the continental subsurface for the second half of the 20th century against estimates from borehole temperature profiles.

- Cuesta-Valero, F. J., García-García, A., Beltrami, H., Zorita, E., and Jaume-Santero, F.: Long-term Surface Temperature (LoST) Database as a complement for GCM preindustrial simulations, Clim. Past Discuss., 2018., https://doi.org/10.5194/cp-2018-133
    - A database containing long-term preindustrial absolute surface temperatures over North America is assembled and freely released for the use of the community. The long-term surface temperatures described here are estimated from geothermal data. These temperatures are useful for studying the stability of permafrost soils, as well as for evaluating the simulated preindustrial climatology, which may improve the estimated equilibrium climate sensitivity from climate models.

- Yan Qing, Wei Ting, and Zhang Zhongshi, 2017: Variations in large-scale tropical cyclone genesis factors over the western North Pacific in the PMIP3 last millennium simulations, Climate Dynamics, 48(3-4): 957-970., n/a
    - This paper examines the variation of tropical cyclone genesis during the last millennium

- 1. Charan Teja Tejavath, Ashok, K., Supriyo Chakraborty, and Ramesh Rengasamy, 2018: The Indian summer monsoon climate during the Last Millennium, as simulated by the PMIP3, passed discussion stage and under revision. Clim. Past Discuss., https://doi.org/10.5194/cp-2017-24, https://doi.org/10.5194/cp-2017-24
    - All the PMIP3 models analysed (eight) in this study clearly show a relatively wet Indian summer monsoon conditions during medivial warm period. Moreover, this is notwithstanding that all these models show a relatively high frquency of El Ninos during this period, and a significant negative correlation between the interannual signals of ENSO and area-averaged Indian summer monsoon rainfall. This is due to a slow (multi-decadal to centennial) shift in Walker circulation apparently associated with external forcing, which reduces the ENSO impacts, which reduces the El Nino-associated anomolous reduction in the rainfall in various regions of the Indian sub-continent. This is

the reason why the Indian summer monsoon was relatively wet within the last millenium.The results are relevant to the current day climate when the ENSO-monsoon relationship is weakening, and a shift in Walker circulation is recorded.

- 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, Clim. Past, 14, 1583-1606, 2018., https://doi.org/10.5194/cp-14-1583-2018
  - This paper assessed the long-term surface air temperature (SAT) and ground surface temperature (GST) coupling using simulations from the CESM-LME. It shows that this coupling can be impacted by long-term changes in the surface energy fluxes over the Last Millennium, due to the influence of anthropogenic external forcings, with potential implications for borehole-based temperature reconstructions.

- Fernández-Donado, L. et al, 2013. Large-scale temperature response to external forcing in simulations and reconstructions of the last millennium. Climate of the Past, 9 (1), pp. 393-421., https://doi.org/10.5194/cp-9-393-2013
  - This paper represents an extensive review of the state-of-the-art modelling and reconstructions effort for the last millennium (LM) previous to the coordinated approach within the CMIP5-PMIP3 community, as the basis of knowledge achieved prior the agreement of LM radiative forcings. Additionally, this work provides a quantitative framework to analyse the consistency between reconstructions and simulations in their response to external forcings and the respective role of the internal variability.

- Zhang, H. et al, 2018. East Asian warm season temperature variations over the past two millennia. Scientific reports, 8 (1), p.7702., https://doi.org/10.1038/s41598-018-26038-8
  - This work presents a spatially resolved warm-season temperature reconstruction for the last2k over the East Asian region showing the particular characteristics of climate variations during key periods of the last two thousand years and providing a comparison to PMIP3/CMIP5 climate model simulations.

- Pavón-Carrasco, F.J. et al., 2018. Multi-centennial fluctuations of radionuclide production rates are modulated by the Earth's magnetic field. Scientific reports, 8(1), p.9820, https://doi.org/10.1038/s41598-018-28115-4
  - A revision of the standard accepted assumptions to reconstruct the solar activity during the Holocene is presented in this work. It is shown that not only the solar magnetic field but also the geomagnetic field has a relevant role for the timescales of interest. The latter suggests the need of reviewing how past solar forcing estimations are obtained, with relevant implications for the solar-climate relation as well as for the present and future generation of paleo simulations.

- Lowry, D.P. and Morrill, C. 2018. Is the Last Glacial Maximum a reverse analog for future hydroclimate changes in the Americas? Climate Dynamics., 10.1007/s00382-018-4385-y
  - Future hydroclimate change is expected to generally follow a wet-get-wetter, dry-get-drier (WWDD) pattern, yet key uncertainties remain regionally and over land. We analyze 6 PMIP3 LGM simulations and show that, in some regions of North and South America, LGM hydroclimate changes could provide some insight into future changes in precipitation-evaporation.

- Loomis, S.E., Russell, J.M., Verschuren, D., Morrill, C., De Cort, G., Sinninghe Damste, J.S., Olago, D., Eggermont, H., Street-Perrott, F.A., Kelly, M.A. 2017. The tropical lapse rate steepened during the Last Glacial Maximum. Science Advances 3: e1600815., 10.1126/sciadv.1600815
  - A new 25,000-year temperature reconstruction from Mount Kenya, East Africa,

demonstrates that cooling during the Last Glacial Maximum was amplified with elevation. Comparison of our data with PMIP3 LGM simulations indicates that state-of-the-art models underestimate this lapse-rate change.

- Morrill, C., Lowry, D.P., Hoell, A. 2018. Thermodynamic and dynamic causes of pluvial conditions during the Last Glacial Maximum in Western North America. Geophysical Research Letters 45, 335-345., 10.1002/2017GL075807
  - We analyze 9 PMIP3 simulations to argue that wet conditions in western North America at LGM were caused by a combination of dynamic and thermodynamic factors. These same factors, working in the opposite direction, are projected to cause regional drying in western North America under increased greenhouse gas concentrations, indicating continuity from past to future in the mechanisms altering hydroclimate.

- Biasutti, M., Voigt, A., Boos, W. R., Braconnot, P., Hargreaves, J. C., Harrison, S. P., et al. (2018). Global energetics and local physics as drivers of past, present and future monsoons. Nature Geoscience, 11(6), 1-11. , http://doi.org/10.1038/s41561-018-0137-1
  - Global constraints on momentum and energy govern the variability of the rainfall belt in the intertropical convergence zone and the structure of the zonal mean tropical circulation.

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    - Changes in the Southern Annular Mode over the last millennium are reconstructed. The SAM is found to have undergone a progressive shift towards its positive phase since the fifteenth century, causing cooling of the main Antarctic continent at the same time that the Antarctic Peninsula has warmed. The positive trend in the SAM since ~AD 1940 is reproduced by multi-model climate simulations forced with rising greenhouse gas levels and later ozone depletion, and the long-term average SAM index is now at its highest level for at least the past 1,000 years.

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    - Here we present a global synthesis of sea surface temperatures for the Common Era (CE) derived from 57 individual marine reconstructions that meet strict quality control criteria. We observe a cooling trend from 1 to 1800 CE that is robust against explicit tests for potential biases in the reconstructions. Climate simulations using single and cumulative forcings suggest that the ocean surface cooling trend from 801 to 1800 CE is not primarily a response to orbital forcing but arises from a high frequency of explosive volcanism. Our results show that repeated clusters of volcanic eruptions can induce a net negative radiative forcing that results in a centennial and global scale cooling trend via a decline in mixed-layer oceanic heat content.

- Abram, N. J., H. V. McGregor, J. E. Tierney, M. N. Evans, N. P. McKay, D. S. Kaufman and the PAGES 2k Consortium (K. Thirumalai, B. Martrat, H. Goosse, S. J. Phipps, E. J. Steig, K. Halimeda Kilbourne, C. P. Saenger, J. Zinke, G. Leduc, J. A. Addison, P. Graham Mortyn, M.-S. Seidenkrantz, M.-A. Sicre, K. Selvaraj, H. L. Filipsson, R. Neukom, J. Gergis, M. A. J. Curran and L. von Gunten): Early onset of industrial-era warming across the oceans and continents, Nature, 536, 411-418, doi:10.1038/nature19082, 2016., 10.1038/nature19082
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change and that, in some regions, about 180 years of industrial-era warming has already caused surface temperatures to emerge above pre-industrial values, even when taking natural variability into account.

- Jungclaus, J. H., E. Bard, M. Baroni, P. Braconnot, J. Cao, L. P. Chini, T. Egorova, M. Evans, J. F. González-Rouco, H. Goosse, G. C. Hurtt, F. Joos, J. O. Kaplan, M. Khodri, K. K. Goldewijk, N. Krivova, A. N. LeGrande, S. J. Lorenz, J. Luterbacher, W. Man, A. C. Maycock, M. Meinshausen, A. Moberg, R. Muscheler, C. Nehrbass-Ahles, B. I. Otto-Bliesner, S. J. Phipps, J. Pongratz, E. Rozanov, G. A. Schmidt, H. Schmidt, W. Schmutz, A. Schurer, A. I. Shapiro, M. Sigl, J. E. Smerdon, S. K. Solanki, C. Timmreck, M. Toohey, I. G. Usoskin, S. Wagner, C.-J. Wu, K. L. Yeo, D. Zanchettin, Q. Zhang and E. Zorita: The PMIP4 contribution to CMIP6 - Part 3: The last millennium, scientific objective, and experimental design for the PMIP4 past1000 simulations, Geoscientific Model Development, 10, 4005-4033, doi:10.5194/gmd-10-4005-2017, 2017., 10.5194/gmd-10-4005-2017
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- PAGES Hydro2k Consortium (J. E. Smerdon, J. Luterbacher, S. J. Phipps, K. J. Anchukaitis, T. Ault, S. Coats, K. M. Cobb, B. I. Cook, C. Colose, T. Felis, A. Gallant, J. H. Jungclaus, B. Konecky, A. LeGrande, S. Lewis, A. S. Lopatka, W. Man, J. S. Mankin, J. T. Maxwell, B. L. Otto-Bliesner, J. W. Partin, D. Singh, N. J. Steiger, S. Stevenson, J. E. Tierney, D. Zanchettin, H. Zhang, A. R. Atwood, L. Andreu-Hayles, S. H. Baek, B. Buckley, E. R. Cook, R. D'Arrigo, S. G. Dee, M. L. Griffiths, C. Kulkarni, Y. Kushnir, F. Lehner, C. Leland, H. W. Linderholm, A. Okazaki, J. Palmer, E. Piovano, C. C. Raible, M. P. Rao, J. Scheff, G. A. Schmidt, R. Seager, M. Widmann, A. P. Williams and E. Xoplaki): Comparing proxy and model estimates of hydroclimate variability and change over the Common Era, Climate of the Past, 13, 1851-1900, doi:10.5194/cp-13-1851-2017, 2017., 10.5194/cp-13-1851-2017
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  - Simulations of five different periods have been designed to address the objectives of the sixth phase of the Coupled Model Intercomparison Project (CMIP6): the millennium prior to

the industrial epoch (CMIP6 name: past1000); the mid-Holocene, 6000 years ago (midHolocene); the Last Glacial Maximum, 21 000 years ago (lgm); the Last Interglacial, 127 000 years ago (lig127k); and the mid-Pliocene Warm Period, 3.2 million years ago (midPliocene-eoi400). This paper describes the motivation for the choice of these periods and the design of the numerical experiments and database requests, with a focus on their novel features compared to the experiments performed in previous phases of PMIP and CMIP. It also outlines the analysis plan that takes advantage of the comparisons of the results across periods and across CMIP6 in collaboration with other MIPs.

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Chapter 3

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    - Changes in the Southern Annular Mode over the last millennium are reconstructed. The SAM is found to have undergone a progressive shift towards its positive phase since the fifteenth century, causing cooling of the main Antarctic continent at the same time that the Antarctic Peninsula has warmed. The positive trend in the SAM since ~AD 1940 is reproduced by multi-model climate simulations forced with rising greenhouse gas levels and later ozone depletion, and the long-term average SAM index is now at its highest level for at least the past 1,000 years.

- McGregor, H. V., M. N. Evans, H. Goosse, G. Leduc, B. Martrat, J. A. Addison, P. G. Mortyn, D. W. Oppo, M.-S. Seidenkrantz, M.-A. Sicre, S. J. Phipps, K. Selveraj, K. Thirumalai, H. L. Filipsson and V. Ersek: Robust global ocean cooling trend for the pre-industrial Common Era, Nature Geoscience, 8, 671-677, doi:10.1038/NGEO2510, 2015., 10.1038/NGEO2510
    - Here we present a global synthesis of sea surface temperatures for the Common Era (CE) derived from 57 individual marine reconstructions that meet strict quality control criteria. We observe a cooling trend from 1 to 1800 CE that is robust against explicit tests for potential biases in the reconstructions. Climate simulations using single and cumulative forcings suggest that the ocean surface cooling trend from 801 to 1800 CE is not primarily a response to orbital forcing but arises from a high frequency of explosive volcanism. Our results show that repeated clusters of volcanic eruptions can induce a net negative radiative forcing that results in a centennial and global scale cooling trend via a decline in mixed-layer oceanic heat content.

- Abram, N. J., H. V. McGregor, J. E. Tierney, M. N. Evans, N. P. McKay, D. S. Kaufman and the PAGES 2k Consortium (K. Thirumalai, B. Martrat, H. Goosse, S. J. Phipps, E. J. Steig, K. Halimeda Kilbourne, C. P. Saenger, J. Zinke, G. Leduc, J. A. Addison, P. Graham Mortyn, M.-S. Seidenkrantz, M.-A. Sicre, K. Selvaraj, H. L. Filipsson, R. Neukom, J. Gergis, M. A. J. Curran and L. von Gunten): Early onset of industrial-era warming across the oceans and continents, Nature, 536, 411-418, doi:10.1038/nature19082, 2016., 10.1038/nature19082
    - Here we use post AD 1500 palaeoclimate records to show that sustained industrial-era warming of the tropical oceans first developed during the mid-nineteenth century and was nearly synchronous with Northern Hemisphere continental warming. The early onset of sustained, significant warming in palaeoclimate records and model simulations suggests that greenhouse forcing of industrial-era warming commenced as early as the mid-nineteenth century and included an enhanced equatorial ocean response mechanism. The development of Southern Hemisphere warming is delayed in reconstructions, but this apparent delay is not reproduced in climate simulations. Our findings imply that

instrumental records are too short to comprehensively assess anthropogenic climate change and that, in some regions, about 180 years of industrial-era warming has already caused surface temperatures to emerge above pre-industrial values, even when taking natural variability into account.

- Jungclaus, J. H., E. Bard, M. Baroni, P. Braconnot, J. Cao, L. P. Chini, T. Egorova, M. Evans, J. F. González-Rouco, H. Goosse, G. C. Hurtt, F. Joos, J. O. Kaplan, M. Khodri, K. K. Goldewijk, N. Krivova, A. N. LeGrande, S. J. Lorenz, J. Luterbacher, W. Man, A. C. Maycock, M. Meinshausen, A. Moberg, R. Muscheler, C. Nehrbass-Ahles, B. I. Otto-Bliesner, S. J. Phipps, J. Pongratz, E. Rozanov, G. A. Schmidt, H. Schmidt, W. Schmutz, A. Schurer, A. I. Shapiro, M. Sigl, J. E. Smerdon, S. K. Solanki, C. Timmreck, M. Toohey, I. G. Usoskin, S. Wagner, C.-J. Wu, K. L. Yeo, D. Zanchettin, Q. Zhang and E. Zorita: The PMIP4 contribution to CMIP6 - Part 3: The last millennium, scientific objective, and experimental design for the PMIP4 past1000 simulations, Geoscientific Model Development, 10, 4005-4033, doi:10.5194/gmd-10-4005-2017, 2017., 10.5194/gmd-10-4005-2017
  - This paper describes the motivation and the experimental set-ups for the PMIP4-CMIP6 past1000 simulations, and discusses the forcing agents orbital, solar, volcanic, and land use/land cover changes, and variations in greenhouse gas concentrations.

- PAGES Hydro2k Consortium (J. E. Smerdon, J. Luterbacher, S. J. Phipps, K. J. Anchukaitis, T. Ault, S. Coats, K. M. Cobb, B. I. Cook, C. Colose, T. Felis, A. Gallant, J. H. Jungclaus, B. Konecky, A. LeGrande, S. Lewis, A. S. Lopatka, W. Man, J. S. Mankin, J. T. Maxwell, B. L. Otto-Bliesner, J. W. Partin, D. Singh, N. J. Steiger, S. Stevenson, J. E. Tierney, D. Zanchettin, H. Zhang, A. R. Atwood, L. Andreu-Hayles, S. H. Baek, B. Buckley, E. R. Cook, R. D'Arrigo, S. G. Dee, M. L. Griffiths, C. Kulkarni, Y. Kushnir, F. Lehner, C. Leland, H. W. Linderholm, A. Okazaki, J. Palmer, E. Piovano, C. C. Raible, M. P. Rao, J. Scheff, G. A. Schmidt, R. Seager, M. Widmann, A. P. Williams and E. Xoplaki): Comparing proxy and model estimates of hydroclimate variability and change over the Common Era, Climate of the Past, 13, 1851-1900, doi:10.5194/cp-13-1851-2017, 2017., 10.5194/cp-13-1851-2017
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Chapter 4

- Sun, Y. et al.,2013:A comparative study of large-scale atmospheric circulation in the context of a future scenario (RCP4.5) and past warmth (mid-Pliocene), Climate of the Past, 9, 1613-1627., https://doi.org/10.5194/cp-9-1613-2013
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  - The climatic impact of the largest volcanic events has been assessed in numerous modelling studies and tree-ring-based hemispheric temperature reconstructions. However, volcanic surface cooling derived from PMIP3 climate model simulations is systematically much stronger than the cooling seen in tree-ring-based proxies, suggesting that the proxies underestimate cooling; and/or the modelled forcing is unrealistically high. This paper present a new summer temperature reconstructions for the Northern Hemisphere from tree-ring width and maximum latewood density over the past 1,500 years in comparison to simulated climate effects of two large eruptions, in AD 1257 and 1815, using a climate model that accounts explicitly for self-limiting aerosol microphysical processes. Results reveal for the first time an agreement between modelled and tree-ring based reconstruction of mean Northern Hemisphere extra-tropical summer cooling over land estimated between 0.8 to 1.3 degC for these eruptions. This reconciliation of proxy and model evidence paves the way to improved assessment of the role of both past and future volcanism in climate forcing.

- Sun, Y. et al., 2018:Quantifying East Asian summer monsoon dynamics in the ECP4.5 scenario with reference to the mid-Piacenzian warm period. Geophysical Research Letters , https://doi.org/10.1029/2018GL080061
  - A comparison of summer monsoon dynamics over East Asia for the mid-Piacenzian and the ECP4.5 scenario reveals both large-scale similarities and regional differences. a) Large-scale similarity in moisture transport under thermal control b) Regional differences in vertical motion regulated by moist static energy c) Negligible effect of slight topographic difference on regional precipitation

- Emile-Geay, J., K. M. Cobb, M. Carre, P. Braconnot, J. Leloup, Y. Zhou, S. P. Harrison, T. Correge,H. V. McGregor, M. Collins, R. Driscoll, M. Elliot, B. Schneider, and A. Tudhope (2016), Links betweentropical pacific seasonal, interannual and orbital variability during the holocene, Nature Geosci, 9(2),168-173, 10.1038/ngeo2608
  - This paper evaluates PMIP3 models and their ability to simulate the observed relationship between ENSO and the seasonal cycle on orbital scales. It reveals a fundamental discrepancy between models and observations that is critical to understanding the simulated ENSO response to future GHG emissions.

- Ault, T. R., C. Deser, M. Newman, and J. Emile- Geay (2013), Characterizing decadal to centennial variability in the equatorial pacific during the last millennium, Geophysical Research Letters, 40, 3450-3456, 10.1002/grl.50647
  - Evaluates the ability of PMIP3-CMIP5 models to simulate tropical Pacific variability over

the past millennium, as reconstructed from proxy data. The article identifies important disagreements between simulations and reconstructions: in the models, variability primarily reflects a thermodynamic response to reconstructed solar and volcanic activity, whereas in the reconstruction, variability arises from either internal climate processes, forced responses that differ from those in CCSM4, or non-climatic proxy processes that are not yet understood. These findings imply that the response of the tropical Pacific to future forcings may be even more uncertain than portrayed by CMIP5 because there are potentially important sources of century-scale variability that these models do not simulate.

- Lowry, D.P. and Morrill, C. 2018. Is the Last Glacial Maximum a reverse analog for future hydroclimate changes in the Americas? Climate Dynamics., 10.1007/s00382-018-4385-y
  - Future hydroclimate change is expected to generally follow a wet-get-wetter, dry-get-drier (WWDD) pattern, yet key uncertainties remain regionally and over land. We analyze 6 PMIP3 LGM simulations and show that, in some regions of North and South America, LGM hydroclimate changes could provide some insight into future changes in precipitation-evaporation.

- Loomis, S.E., Russell, J.M., Verschuren, D., Morrill, C., De Cort, G., Sinninghe Damste, J.S., Olago, D., Eggermont, H., Street-Perrott, F.A., Kelly, M.A. 2017. The tropical lapse rate steepened during the Last Glacial Maximum. Science Advances 3: e1600815., 10.1126/sciadv.1600815
  - A new 25,000-year temperature reconstruction from Mount Kenya, East Africa, demonstrates that cooling during the Last Glacial Maximum was amplified with elevation. Comparison of our data with PMIP3 LGM simulations indicates that state-of-the-art models underestimate this lapse-rate change.

- Morrill, C., Lowry, D.P., Hoell, A. 2018. Thermodynamic and dynamic causes of pluvial conditions during the Last Glacial Maximum in Western North America. Geophysical Research Letters 45, 335-345., 10.1002/2017GL075807
  - We analyze 9 PMIP3 simulations to argue that wet conditions in western North America at LGM were caused by a combination of dynamic and thermodynamic factors. These same factors, working in the opposite direction, are projected to cause regional drying in western North America under increased greenhouse gas concentrations, indicating continuity from past to future in the mechanisms altering hydroclimate.

- Biasutti, M., Voigt, A., Boos, W. R., Braconnot, P., Hargreaves, J. C., Harrison, S. P., et al. (2018). Global energetics and local physics as drivers of past, present and future monsoons. Nature Geoscience, 11(6), 1-11. , http://doi.org/10.1038/s41561-018-0137-1
  - Global constraints on momentum and energy govern the variability of the rainfall belt in the intertropical convergence zone and the structure of the zonal mean tropical circulation.

- Wang, B., Li, J., Cane, M.A., Liu, J., Webster, P.J., Xiang, B., Kim, H.M., Cao, J. and Ha, K.J., 2018. Toward Predicting Changes in the Land Monsoon Rainfall a Decade in Advance. Journal of Climate, 31(7), pp.2699-2714., 10.1175/JCLI-D-17-0521.1
  - This paper pointed out the sources of multidecadal predictability for the Northern Hemisphere land monsoon rainfall, which is closely related to the near-term predictability of the future climate.

- Xiang, B., Wang, B., Li, J., Zhao, M. and Lee, J.Y., 2014. Understanding the anthropogenically forced change of equatorial Pacific trade winds in coupled climate models. Journal of Climate, 27(22), pp.8510-8526., 10.1175/JCLI-D-14-00115.1
  - This paper discussed how and why anthropogenic forcing will change the trade winds.

- Lee, J.Y., Wang, B., Seo, K.H., Kug, J.S., Choi, Y.S., Kosaka, Y. and Ha, K.J., 2014. Future change of Northern Hemisphere summer tropical-extratropical teleconnection in CMIP5 models. Journal of Climate, 27(10), pp.3643-3664., 10.1175/JCLI-D-13-00261.1
    - The circumglobal teleconnection pattern is a dominant mode of the Northern Hemisphere summer circulation variability. This work documents its future change.

- Lee, J.Y. and Wang, B., 2014. Future change of global monsoon in the CMIP5. Climate Dynamics, 42(1-2), pp.101-119., 10.1007/s00382-012-1564-0
    - Global monsoon is a fundamental mode of global climate, and this work discusses its future change.

- Wang, B., Yim, S.Y., Lee, J.Y., Liu, J. and Ha, K.J., 2014. Future change of Asian-Australian monsoon under RCP 4.5 anthropogenic warming scenario. Climate dynamics, 42(1-2), pp.83-100., 10.1007/s00382-013-1769-x
    - The Asian-Australian monsoon is the most important mode of Earth climate system; this work discusses the projected future change of this system.

- Murakami, H., Wang, B., Li, T. and Kitoh, A., 2013. Projected increase in tropical cyclones near Hawaii. Nature Climate Change, 3(8), p.749., 10.1038/NCLIMATE1890
    - This paper discussed future change of the tropical cyclones in the central Pacific.

- Wang, B., Liu, J., Kim, H.J., Webster, P.J., Yim, S.Y. and Xiang, B., 2013. Northern Hemisphere summer monsoon intensified by mega-El Niño/southern oscillation and Atlantic multidecadal oscillation. Proceedings of the National Academy of Sciences, 110(14), pp.5347-5352., 10.1073/pnas.1219405110
    - This paper revealed the sources of predictability of decadal-multidecadal variation as well as the anthropogenic effects on recent change of the Northern Hemisphere summer monsoon, which is relevant to the near-term prediction of the future climate.

- Lu, Z., & Liu, Z. (2018). Orbital modulation of ENSO seasonal phase locking. Climate Dynamics., https://doi.org/10.1007/s00382-018-4382-1
    - This paper shows the mechanisms how the timing of El Nino-Southern Oscillation peaks was modulated by orbital forcing, and calls for further investigation in CMIP6 ensembles for the future change of this phenomenon.

- Abram, N. J., H. V. McGregor, J. E. Tierney, M. N. Evans, N. P. McKay, D. S. Kaufman and the PAGES 2k Consortium (K. Thirumalai, B. Martrat, H. Goosse, S. J. Phipps, E. J. Steig, K. Halimeda Kilbourne, C. P. Saenger, J. Zinke, G. Leduc, J. A. Addison, P. Graham Mortyn, M.-S. Seidenkrantz, M.-A. Sicre, K. Selvaraj, H. L. Filipsson, R. Neukom, J. Gergis, M. A. J. Curran and L. von Gunten): Early onset of industrial-era warming across the oceans and continents, Nature, 536, 411-418, doi:10.1038/nature19082, 2016., 10.1038/nature19082
    - Here we use post AD 1500 palaeoclimate records to show that sustained industrial-era warming of the tropical oceans first developed during the mid-nineteenth century and was nearly synchronous with Northern Hemisphere continental warming. The early onset of sustained, significant warming in palaeoclimate records and model simulations suggests that greenhouse forcing of industrial-era warming commenced as early as the mid-nineteenth century and included an enhanced equatorial ocean response mechanism. The development of Southern Hemisphere warming is delayed in reconstructions, but this apparent delay is not reproduced in climate simulations. Our findings imply that instrumental records are too short to comprehensively assess anthropogenic climate change and that, in some regions, about 180 years of industrial-era warming has already caused surface temperatures to emerge above pre-industrial values, even when taking natural variability into account.

Chapter 5

- Lu, Z., Miller, P. A., Zhang, Q., Zhang, Q., Wårlind, D., Nieradzik, L., & Smith, B. (2018). Dynamic Vegetation Simulations of the Mid-Holocene Green Sahara. Geophysical Research Letters, 45(16), 8294-8303., https://doi.org/10.1029/2018GL079195
    - This paper shows that the simulated vegetation composition in Sahara/Sahel, and in turn, atmosphere and vegetation feedbacks, depend on the correct representation of fire disturbance and soil texture in a humid environment.
- Gray, W.R., Rae, J.W.B, Wills, R.C.J., Shevenell, A.E., Taylor, B., Burke, A., Foster, G.L., Lear, C.H., 2018. Deglacial upwelling, productivity and CO2 outgassing in the North Pacific Ocean. Nature Geoscience 11, 340-344. , https://doi.org/10.1038/s41561-018-0108-6
    - This paper assess response of atmospheric circulations to LGM ice sheet forcing to understand controls on biogeochemistry of the North Pacific Ocean during last deglaciation. The paper suggests massive CO2 outgassing from the North Pacific during the last deglaciation was aided by a large increase in Ekman suction within the North Pacific with the presence of an ice sheet over North America.

Chapter 6

- Zanchettin, D., O. Bothe, H. F. Graf, S. J. Lorenz, J. Luterbacher, C. Timmreck, and J. H. Jungclaus (2013) Background conditions influence the decadal climate response to strong volcanic eruptions. J. Geophys. Res. Atm., 118(10): 4090-4106, doi:10.1002/jgrd.50229, 10.1002/jgrd.50229
    - This study illustrates how the decadal climate response to strong volcanic eruptions depends on the background climate state at the time of the eruption and on the presence and magnitude of additional external forcings acting at the same time. It demonstrates that background climate conditions are not merely a source of additive noise for post-eruption decadal climate variability but actively influence the mechanisms involved in the post-eruption decadal evolution.
- Khodri M., Izumo T., Vialard J., Janicot S., Cassou C., Lengaigne M., Mignot J., Gastineau G., E. Guilyardi, Lebas N., Robock A. and M.J McPhaden, Tropical explosive volcanic eruptions can trigger El Niño by cooling tropical Africa, Nature Communications, 8, 778 (2017). , 10.1038/s41467-017-00755-6
    - This paper presents new evidences for a possible interference of volcanic forcing from tropical stratospheric eruptions on ENSO cycle and discusses the underlying physical processes. Targeted climate model simulations emphasize that Pinatubo-like eruptions tend to shorten La Niñas, lengthen El Niños and induce anomalous warming when occurring during neutral states. It also presents a new mechanisms suggesting that volcanically induced cooling in tropical Africa weakens the West African monsoon, and the resulting atmospheric Kelvin wave can drive equatorial westerly wind anomalies over the western Pacific. This wind anomaly is further amplified by air-sea interactions in the Pacific, favouring an El Niño-like response.
- Stoffel M, Khodri M., Corona C., Guillet S., Poulain V., Bekki S., Guiot J., Luckman B.H., Oppenheimer C., Lebas N., Beniston M.& Masson-Delmotte V., Reconciling reconstructions and simulations of volcanic cooling, Nature Geoscience, 8, 784-788 (2015), 10.1038/NGEO2526, 2015
    - The climatic impact of the largest volcanic events has been assessed in numerous

modelling studies and tree-ring-based hemispheric temperature reconstructions. However, volcanic surface cooling derived from PMIP3 climate model simulations is systematically much stronger than the cooling seen in tree-ring-based proxies, suggesting that the proxies underestimate cooling; and/or the modelled forcing is unrealistically high. This paper present a new summer temperature reconstructions for the Northern Hemisphere from tree-ring width and maximum latewood density over the past 1,500 years in comparison to simulated climate effects of two large eruptions, in AD 1257 and 1815, using a climate model that accounts explicitly for self-limiting aerosol microphysical processes. Results reveal for the first time an agreement between modelled and tree-ring based reconstruction of mean Northern Hemisphere extra-tropical summer cooling over land estimated between 0.8 to 1.3 degC for these eruptions. This reconciliation of proxy and model evidence paves the way to improved assessment of the role of both past and future volcanism in climate forcing.

- Lambert, F., J.-S. Kug, R. J. Park, N. Mahowald, G. Winckler, A. Abe-Ouchi, R. O'ishi, T. Takemura, and J.-H. Lee (2013), The role of mineral-dust aerosols in polar temperature amplification, Nat. Clim. Chang., 3(5), 487-491, 10.1038/nclimate1785
  - Impact of high atmospheric dust loads on polar temperature

- Lambert, F., A. Tagliabue, G. Shaffer, F. Lamy, G. Winckler, L. Farias, L. Gallardo, and R. De Pol-Holz (2015), Dust fluxes and iron fertilization in Holocene and Last Glacial Maximum climates, Geophys. Res. Lett., 42(14), 6014-6023, 10.1002/2015GL064250
  - Dust deposition fields for HOL and LGM climate, and associated CO2 drawdown through iron fertilization

- Schurer, A. P., G. C. Hegerl, M. E. Mann, S. F. B. Tett and S. J. Phipps: Separating Forced from Chaotic Climate Variability over the Past Millennium, Journal of Climate, 26, 6954-6973, doi:10.1175/JCLI-D-12-00826.1, 2013., 10.1175/JCLI-D-12-00826.1
  - External forcings are found to contribute significantly towards long-term temperature variations over the last millennium, particularly from 1400 CE onwards. It is found that the recent observed 50- and 100-yr hemispheric temperature trends are substantially larger than estimates of the amplitude of internal climate variability.

- Abram, N. J., R. Mulvaney, F. Vimeux, S. J. Phipps, J. Turner and M. H. England: Evolution of the Southern Annular Mode during the past millennium, Nature Climate Change, 4, 564-569, doi:10.1038/NCLIMATE2235, 2014., 10.1038/NCLIMATE2235
  - Changes in the Southern Annular Mode over the last millennium are reconstructed. The SAM is found to have undergone a progressive shift towards its positive phase since the fifteenth century, causing cooling of the main Antarctic continent at the same time that the Antarctic Peninsula has warmed. The positive trend in the SAM since ~AD 1940 is reproduced by multi-model climate simulations forced with rising greenhouse gas levels and later ozone depletion, and the long-term average SAM index is now at its highest level for at least the past 1,000 years.

- Abram, N. J., H. V. McGregor, J. E. Tierney, M. N. Evans, N. P. McKay, D. S. Kaufman and the PAGES 2k Consortium (K. Thirumalai, B. Martrat, H. Goosse, S. J. Phipps, E. J. Steig, K. Halimeda Kilbourne, C. P. Saenger, J. Zinke, G. Leduc, J. A. Addison, P. Graham Mortyn, M.-S. Seidenkrantz, M.-A. Sicre, K. Selvaraj, H. L. Filipsson, R. Neukom, J. Gergis, M. A. J. Curran and L. von Gunten): Early onset of industrial-era warming across the oceans and continents, Nature, 536, 411-418, doi:10.1038/nature19082, 2016., 10.1038/nature19082
  - Here we use post AD 1500 palaeoclimate records to show that sustained industrial-era warming of the tropical oceans first developed during the mid-nineteenth century and was nearly synchronous with Northern Hemisphere continental warming. The early onset

of sustained, significant warming in palaeoclimate records and model simulations suggests that greenhouse forcing of industrial-era warming commenced as early as the mid-nineteenth century and included an enhanced equatorial ocean response mechanism. The development of Southern Hemisphere warming is delayed in reconstructions, but this apparent delay is not reproduced in climate simulations. Our findings imply that instrumental records are too short to comprehensively assess anthropogenic climate change and that, in some regions, about 180 years of industrial-era warming has already caused surface temperatures to emerge above pre-industrial values, even when taking natural variability into account.

- Jungclaus, J. H., E. Bard, M. Baroni, P. Braconnot, J. Cao, L. P. Chini, T. Egorova, M. Evans, J. F. González-Rouco, H. Goosse, G. C. Hurtt, F. Joos, J. O. Kaplan, M. Khodri, K. K. Goldewijk, N. Krivova, A. N. LeGrande, S. J. Lorenz, J. Luterbacher, W. Man, A. C. Maycock, M. Meinshausen, A. Moberg, R. Muscheler, C. Nehrbass-Ahles, B. I. Otto-Bliesner, S. J. Phipps, J. Pongratz, E. Rozanov, G. A. Schmidt, H. Schmidt, W. Schmutz, A. Schurer, A. I. Shapiro, M. Sigl, J. E. Smerdon, S. K. Solanki, C. Timmreck, M. Toohey, I. G. Usoskin, S. Wagner, C.-J. Wu, K. L. Yeo, D. Zanchettin, Q. Zhang and E. Zorita: The PMIP4 contribution to CMIP6 - Part 3: The last millennium, scientific objective, and experimental design for the PMIP4 past1000 simulations, Geoscientific Model Development, 10, 4005-4033, doi:10.5194/gmd-10-4005-2017, 2017., 10.5194/gmd-10-4005-2017
    - This paper describes the motivation and the experimental set-ups for the PMIP4-CMIP6 past1000 simulations, and discusses the forcing agents orbital, solar, volcanic, and land use/land cover changes, and variations in greenhouse gas concentrations.

- PAGES Hydro2k Consortium (J. E. Smerdon, J. Luterbacher, S. J. Phipps, K. J. Anchukaitis, T. Ault, S. Coats, K. M. Cobb, B. I. Cook, C. Colose, T. Felis, A. Gallant, J. H. Jungclaus, B. Konecky, A. LeGrande, S. Lewis, A. S. Lopatka, W. Man, J. S. Mankin, J. T. Maxwell, B. L. Otto-Bliesner, J. W. Partin, D. Singh, N. J. Steiger, S. Stevenson, J. E. Tierney, D. Zanchettin, H. Zhang, A. R. Atwood, L. Andreu-Hayles, S. H. Baek, B. Buckley, E. R. Cook, R. D'Arrigo, S. G. Dee, M. L. Griffiths, C. Kulkarni, Y. Kushnir, F. Lehner, C. Leland, H. W. Linderholm, A. Okazaki, J. Palmer, E. Piovano, C. C. Raible, M. P. Rao, J. Scheff, G. A. Schmidt, R. Seager, M. Widmann, A. P. Williams and E. Xoplaki): Comparing proxy and model estimates of hydroclimate variability and change over the Common Era, Climate of the Past, 13, 1851-1900, doi:10.5194/cp-13-1851-2017, 2017., 10.5194/cp-13-1851-2017
    - We review the principal proxy data available for hydroclimatic reconstructionsover the Common Era (CE) and highlight the contemporary understanding of how these proxies are interpreted as hydroclimate indicators. We also review the available last-millennium simulations from fully coupled climate models and discuss several outstanding challenges associated with simulating hydroclimate variability and change over the CE.

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    - Simulations of five different periods have been designed to address the objectives of the sixth phase of the Coupled Model Intercomparison Project (CMIP6): the millennium prior to the industrial epoch (CMIP6 name: past1000); the mid-Holocene, 6000 years ago (midHolocene); the Last Glacial Maximum, 21 000 years ago (lgm); the Last Interglacial, 127 000 years ago (lig127k); and the mid-Pliocene Warm Period, 3.2 million years ago

(midPliocene-eoi400). This paper describes the motivation for the choice of these periods and the design of the numerical experiments and database requests, with a focus on their novel features compared to the experiments performed in previous phases of PMIP and CMIP. It also outlines the analysis plan that takes advantage of the comparisons of the results across periods and across CMIP6 in collaboration with other MIPs.

Chapter 7

- de Boer, Bas, Haywood, Alan M., Dolan, Aisling M., Hunter, Stephen J., and Prescott, Caroline L., 2017. The Transient Response of Ice Volume to Orbital Forcing During the Warm Late Pliocene, Geophysical Research Letters, 44, 10,486–10,494., https://doi.org/10.1002/2017GL073535
  - The paper presents transient ice sheet predictions forced by multiple climate snapshots derived from HadCM3 set up with late Pliocene boundary conditions, forced with different orbital forcing scenarios. The results indicate that insolation forcing between the hemispheres was out of phase during MIS K1 and led to an asynchronous response of ice volume globally.
- Langebroek, P. M. and Nisancioglu, K. H., 2014: Simulating last interglacial climate with NorESM: role of insolation and greenhouse gases in the timing of peak warmth, Clim. Past, 10, 1305-1318. , https://doi.org/10.5194/cp-10-1305-2014
  - It shows the difference in impact of insolation versus greenhouse gas forcing on the (timing of peak) warmth during the last interglacial. Global simulations using the Norwegian Earth System Model, with a focus on explaining proxy records in the North Atlantic.
- Otto-Bliesner, B.L. et al., 2017: The PMIP4 contribution to CMIP6 - Part 2: Two interglacials, Scientific objectives and experimental design of the PMIP4-CMIP6 Holocene and Last Interglacial simulations. Geoscientific Model Development, 10, 3979-4003, https://doi.org/10.5194/gmd-10-3979-2017
  - This paper describes the protocols for the mid-Holocene (6 ka) and Last Interglacial (127 ka) Tier 1 simulations, as well as numerous Tier 2 simulations to assess the sensitivities to prescribed vegetation, ice sheets, freshwater fluxes, and alternative states of orbital forcing. For the first time, the LIG is included for CMIP6 and PMIP4, allowing a multi-model assessment of this important period for testing our knowledge of climate-ice sheet interactions in warm climates.
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  - CESM simulations of both the 1815 Tambora eruption and a hypothetical analogous future eruption are compared, the latter occurring in 2085 assuming a business-as-usual climate scenario. The 1815 eruption drove strong responses in both the ocean and cryosphere that were fundamental to driving the Year-Without-A-Summer. Through modulation of ocean stratification and near-surface winds, global warming contributes to an amplified surface climate response in CESM.
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    - Effect of aerosols on climate is major uncertainty for future projection.This paper discusses how the glaciogenic dust can affect the LGMclimate. A possibility of less cooling by high dust load surroundingof Antarctica is suggested.

- Zanchettin, D., Khodri, M., Timmreck, C., Toohey, M., Schmidt, A., Gerber, E. P., Hegerl, G., Robock, A., Pausata, F. S. R., Ball, W. T., Bauer, S. E., Bekki, S., Dhomse, S. S., LeGrande, A. N., Mann, G. W., Marshall, L., Mills, M., Marchand, M., Niemeier, U., Poulain, V., Rozanov, E., Rubino, A., Stenke, A., Tsigaridis, K., and Tummon, F.: The Model Intercomparison Project on the climatic response to Volcanic forcing (VolMIP): experimental design and forcing input data for CMIP6, Geosci. Model Dev., 9, 2701-2719, doi:10.5194/gmd-9-2701-2016, 2016, 10.5194/gmd-9-2701-2016, 2016
    - This paper presents the experimental design of the “Model Intercomparison Project on the climatic response to Volcanic forcing (VolMIP), which includes idealized experiments focused on the short-term atmospheric as well as long-term coupled response to volcanic forcing. The core idea of VolMIP is to constrain radiative forcing among the participating models to focus on the climatic response, hence reference forcing dataare provided in terms of optical aerosol properties for a series of reference eruptions.

- Zanchettin, D., O. Bothe, H. F. Graf, S. J. Lorenz, J. Luterbacher, C. Timmreck, and J. H. Jungclaus (2013) Background conditions influence the decadal climate response to strong volcanic eruptions. J. Geophys. Res. Atm., 118(10): 4090-4106, doi:10.1002/jgrd.50229, 10.1002/jgrd.50229
    - This study illustrates how the decadal climate response to strong volcanic eruptions depends on the background climate state at the time of the eruption and on the presence and magnitude of additional external forcings acting at the same time. It demonstrates that background climate conditions are not merely a source of additive noise for post-eruption decadal climate variability but actively influence the mechanisms involved in the post-eruption decadal evolution.

- Khodri M., Izumo T., Vialard J., Janicot S., Cassou C., Lengaigne M., Mignot J., Gastineau G., E. Guilyardi, Lebas N., Robock A. and M.J McPhaden, Tropical explosive volcanic eruptions can trigger El Niño by cooling tropical Africa, Nature Communications, 8, 778 (2017). , 10.1038/s41467-017-00755-6
    - This paper presents new evidences for a possible interference of volcanic forcing from tropical stratospheric eruptions on ENSO cycle and discusses the underlying physical processes. Targeted climate model simulations emphasize that Pinatubo-like eruptions tend to shorten La Niñas, lengthen El Niños and induce anomalous warming when occurring during neutral states. It also presents a new mechanisms suggesting that volcanically induced cooling in tropical Africa weakens the West African monsoon, and the resulting atmospheric Kelvin wave can drive equatorial westerly wind anomalies over the western Pacific. This wind anomaly is further amplified by air-sea interactions in the Pacific, favouring an El Niño-like response.

- Stoffel M, Khodri M., Corona C., Guillet S., Poulain V., Bekki S., Guiot J., Luckman B.H., Oppenheimer C., Lebas N., Beniston M.& Masson-Delmotte V., Reconciling reconstructions and simulations of volcanic cooling, Nature Geoscience, 8, 784-788 (2015), 10.1038/NGEO2526, 2015
    - The climatic impact of the largest volcanic events has been assessed in numerous modelling studies and tree-ring-based hemispheric temperature reconstructions. However, volcanic surface cooling derived from PMIP3 climate model simulations is systematically much stronger than the cooling seen in tree-ring-based proxies, suggesting that the proxies underestimate cooling; and/or the modelled forcing is unrealistically high.

This paper present a new summer temperature reconstructions for the Northern Hemisphere from tree-ring width and maximum latewood density over the past 1,500 years in comparison to simulated climate effects of two large eruptions, in AD 1257 and 1815, using a climate model that accounts explicitly for self-limiting aerosol microphysical processes. Results reveal for the first time an agreement between modelled and tree-ring based reconstruction of mean Northern Hemisphere extra-tropical summer cooling over land estimated between 0.8 to 1.3 degC for these eruptions. This reconciliation of proxy and model evidence paves the way to improved assessment of the role of both past and future volcanism in climate forcing.

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  - Very cold North Atlantic Ocean states in response to a weak AMOC cause persistent atmospheric blocking over Europe during summer. Proxy-model evidence suggests warmer and very dry conditions in response to a slowdown of the AMOC consistent with observations since the 1980s.

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SAM is found to have undergone a progressive shift towards its positive phase since the fifteenth century, causing cooling of the main Antarctic continent at the same time that the Antarctic Peninsula has warmed. The positive trend in the SAM since ~AD 1940 is reproduced by multi-model climate simulations forced with rising greenhouse gas levels and later ozone depletion, and the long-term average SAM index is now at its highest level for at least the past 1,000 years.

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    - The reconstructed Present Interglacial (PIG) and Last Interglacial (LIG) Northern Hemisphere mid-to-high latitude cooling compares well with multi-model, mean temperature trends for the warmest months and that these cooling trends reflect a linear response to the warmest-month insolation decrease over the interglacial intervals. The most notable exception is the strong LIG cooling trend reconstructed from Greenland ice cores that is not simulated by any of the models. A striking model-data mismatch is found for both the PIG and the LIG over large parts of the mid-to-high latitudes of the Southern Hemisphere where the data depicts negative temperature trends that are not in agreement with near zero trends in the simulations.

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    - Here we present a global synthesis of sea surface temperatures for the Common Era (CE) derived from 57 individual marine reconstructions that meet strict quality control criteria. We observe a cooling trend from 1 to 1800 CE that is robust against explicit tests for potential biases in the reconstructions. Climate simulations using single and cumulative forcings suggest that the ocean surface cooling trend from 801 to 1800 CE is not primarily a response to orbital forcing but arises from a high frequency of explosive volcanism. Our results show that repeated clusters of volcanic eruptions can induce a net negative radiative forcing that results in a centennial and global scale cooling trend via a decline in mixed-layer oceanic heat content.

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(midHolocene); the Last Glacial Maximum, 21 000 years ago (lgm); the Last Interglacial, 127 000 years ago (lig127k); and the mid-Pliocene Warm Period, 3.2 million years ago (midPliocene-eoi400). This paper describes the motivation for the choice of these periods and the design of the numerical experiments and database requests, with a focus on their novel features compared to the experiments performed in previous phases of PMIP and CMIP. It also outlines the analysis plan that takes advantage of the comparisons of the results across periods and across CMIP6 in collaboration with other MIPs.

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Chapter 8

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  - This paper describes the protocols for the mid-Holocene (6 ka) and Last Interglacial (127 ka) Tier 1 simulations, as well as numerous Tier 2 simulations to assess the sensitivities to prescribed vegetation, ice sheets, freshwater fluxes, and alternative states of orbital forcing. For the first time, the LIG is included for CMIP6 and PMIP4, allowing a multi-model

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    - This paper presents the experimental design of the “Model Intercomparison Project on the climatic response to Volcanic forcing (VolMIP), which includes idealized experiments focused on the short-term atmospheric as well as long-term coupled response to volcanic forcing. The core idea of VolMIP is to constrain radiative forcing among the participating models to focus on the climatic response, hence reference forcing dataare provided in terms of optical aerosol properties for a series of reference eruptions.

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    - This paper presents new evidences for a possible interference of volcanic forcing from tropical stratospheric eruptions on ENSO cycle and discusses the underlying physical processes. Targeted climate model simulations emphasize that Pinatubo-like eruptions tend to shorten La Niñas, lengthen El Niños and induce anomalous warming when occurring during neutral states. It also presents a new mechanisms suggesting that volcanically induced cooling in tropical Africa weakens the West African monsoon, and the resulting atmospheric Kelvin wave can drive equatorial westerly wind anomalies over the western Pacific. This wind anomaly is further amplified by air-sea interactions in the Pacific, favouring an El Niño-like response.

- Lora, J.M. (2018).Components and mechanisms of hydrologic cycle changes over North America at the Last Glacial Maximum. Journal of Climate 31, 7035-7051, https://doi.org/10.1175/JCLI-D-17-0544.1
    - This paper provides a full moisture budget analysis of North America during the LGM, which gives context for and a comparison point for similar analyses of future hydroclimate changes.

- Lora, J.M., J.L. Mitchell, and A.E. Tripati (2016). Abrupt reorganization of North Pacific and western North American climate during the last deglaciation, https://doi.org/10.1002/2016GL071244
    - This paper describes an abrupt reorganization of the circulation during the last

deglaciation that lead to hydroclimate changes in western North America observed in proxies.

- Lora, J.M., J.L. Mitchell, C. Risi, and A.E. Tripati (2017). North Pacific atmospheric rivers and their influence on North America at the Last Glacial Maximum. Geophysical Research Letters 44, 1051-1059, https://doi.org/10.1002/2016GL071541
    - This paper shows the strong impact that changes in climatological atmospheric river activity had on mid-latitude hydroclimate at the LGM, providing context for such future changes.

- Sun, Y. et al., 2018:Quantifying East Asian summer monsoon dynamics in the ECP4.5 scenario with reference to the mid-Piacenzian warm period. Geophysical Research Letters , https://doi.org/10.1029/2018GL080061
    - A comparison of summer monsoon dynamics over East Asia for the mid-Piacenzian and the ECP4.5 scenario reveals both large-scale similarities and regional differences. a) Large-scale similarity in moisture transport under thermal control b) Regional differences in vertical motion regulated by moist static energy c) Negligible effect of slight topographic difference on regional precipitation

- Yan Qing, Owen, L. A., Wang, H., & Zhang, Z. (2018). Climate constraints on glaciation over High-Mountain Asia during the last glacial maximum. Geophysical Research Letters, 45, 9024-9033., n/a
    - This paper addresses the questions on why there was not a large-scale ice sheet during LGM

- Yan Qing, Wei Ting, and Zhang Zhongshi, 2017: Variations in large-scale tropical cyclone genesis factors over the western North Pacific in the PMIP3 last millennium simulations, Climate Dynamics, 48(3-4): 957-970., n/a
    - This paper examines the variation of tropical cyclone genesis during the last millennium

- Lowry, D.P. and Morrill, C. 2018. Is the Last Glacial Maximum a reverse analog for future hydroclimate changes in the Americas? Climate Dynamics., 10.1007/s00382-018-4385-y
    - Future hydroclimate change is expected to generally follow a wet-get-wetter, dry-get-drier (WWDD) pattern, yet key uncertainties remain regionally and over land. We analyze 6 PMIP3 LGM simulations and show that, in some regions of North and South America, LGM hydroclimate changes could provide some insight into future changes in precipitation-evaporation.

- Morrill, C., Lowry, D.P., Hoell, A. 2018. Thermodynamic and dynamic causes of pluvial conditions during the Last Glacial Maximum in Western North America. Geophysical Research Letters 45, 335-345., 10.1002/2017GL075807
    - We analyze 9 PMIP3 simulations to argue that wet conditions in western North America at LGM were caused by a combination of dynamic and thermodynamic factors. These same factors, working in the opposite direction, are projected to cause regional drying in western North America under increased greenhouse gas concentrations, indicating continuity from past to future in the mechanisms altering hydroclimate.

- Zheng, W. P. and Braconnot, P. (2013). Characterization of Model Spread in PMIP2 Mid-Holocene Simulations of the African Monsoon. Journal of Climate. 26: 1192-1210., n/a
    - Using a classification of the monsoonal convective regimes fora subset of sevenPMIP mid Holocene simulations, this paper show that two categories of model can be defined based on their differences insimulating deep and moderate convective regimes in the PI simulations. Changes in precipitation at 6 ka are dominated by changes in the large-scale dynamics for most of the PMIP2 models and are characterized bya shift in the monsoonal

circulation toward deeper convective regimes. The results indicate that systematic model biases in simulating the radiation and heat fluxes could explain the damping of the meridional temperature gradient over West Africa and thereby the underestimation of precipitation in the Sahel-Sahara region.

- Marzin, C., Kallel, N., Kageyama, M., Duplessy, J. C. and Braconnot, P. (2013). Glacial fluctuations of the Indian monsoon and their relationship with North Atlantic climate: new data and modelling experiments. Climate of the Past. 9: 2135-2151, n/a
  - This study analyse the processes that can explain the relationship between the Indian monsoon and the North Atlantic climate under glacial conditions, by increasing the freshwater flux in the North Atlantic and reducing the intensity of the Atlantic meridional overturning circulation. It shows that reduced indian monsoon is associated to changes in the continental runoff and local hydrological cycle that are responsible for the changes in salinity of the Bay of Bengal in the model. Sensitivity experiments also highlight that the changes over the tropical Atlantic are essential in triggering perturbations of the subtropical jet over Eurasia that in turn affect the intensity of the Indian monsoon.

- Marzin, C., Braconnot, P. and Kageyama, M. (2013). Relative impacts of insolation changes, meltwater fluxes and ice sheets on African and Asian monsoons during the Holocene. Climate Dynamics. 41: 2267-2286., n/a
  - This paper analyse the teleconnection between the remnant northern hemisphere ice-sheet in the early Holocene and fresh water fluxes induced by ice sheet melting on the African and Indian monsoons. It shows that despite similarities in the response to these two factors in the Atlantic the teleconnections are different, mainly because of differences in the way the thermohaline circulation is affected.

- Luan, Y. H., et al. (2015). “Tropical Pacific mean state and ENSO changes: sensitivity to freshwater flux and remnant ice sheets at 9.5 ka BP.” Climate Dynamics 44(3-4): 661-678., n/a
  - Using as a reference a simulation of the early Holocene, the present study explores the relative contribution of ice-sheet and fresh water fluxes on themean climate state and ENSO variability in the tropical Pacific.The freshwater flux impact on ocean circulation and atmospheric feedbacks enhances ENSO amplitude. A feedback analysis suggests that it is due to the wind-thermocline feedback. The remnant ice sheett does not induce significant change in ENSO. Itexhibits a slight SST variability increase at the east coast and a reduction in the middle of the basin driven by the net. The freshwater flux forcing strengthens the amplitude of EP El Niño events. This mansucripts halp thus to unerstand the diversity of EL Niño event and the response of El Niño to external forcings.

- Saint-Lu, M., et al. (2015). “Changes in the ENSO/SPCZ relationship from past to future climates.” Earth and Planetary Science Letters 412: 18-24., n/a
  - This study considers a set of paleoclimate and future climate simulations. It shows that changes in the background tropical state largely control the mean SPCZ location. In contrast, changes in the background tropical state do not directly control the interannual variability of the SPCZ location. The relationship between ENSO and the SPCZ location varies from one climate to another. We thus demonstrate that the teleconnection mechanisms inferred from the modern climate cannot be directly extrapolated to other climates. This study therefore calls for a cautious interpretation of climate reconstructions from environmental indicators in the Southwest Pacific with regard to ENSO variations.

- Consequences of rapid ice-sheet melting on the Sahelian population vulnerability, D. Defrance, G. Ramstein, S. Charbit, M. Vrac, A.M. Famien, B. Sultan, D. Swingedouw, C. Dumas, F. Gemenne, J. Alvarez-Solas, J.-P. Vanderlinden, PNAS, 114 (25), 6533-6538, 2017, https://doi.org/10.1073/pnas.1619358114

    - This paper describes the impact of massive Greenland ice-sheet melting on the West Sahelian monsoon system (with consequences on agriculture and population)

- What drives LGM precipitation over the western Mediterranean? A stydy focused on the Iberian Peninsula and northern Morocco., P Beghin, S. Charbit, M. Kageyama, N. Combourieu-Nebout, C. Hatté, C. Dumas, J.-Y. Peterschmitt, Climate Dynamics, 46 (7-8), 2611-2631, 2016 , doi: 10.1007/s00382-015-2720-0, 2016
    - This paper describes how changes in the North Atlantic jet stream (due to the presence of the North American ice sheet) during the LGM influences the precipitation in the Iberian Peninsula and Northern Morocco. The paper is based on a model-data comparison.

- How might the North American ice sheet influence the northwestern European climate, P. Beghin, S. Charbit, C. Dumas, M. Kageyama, C. Ritz., Climate of the Past, 11, 1467-1490, 2015, https://doi.org/10.5194/cp-10-345-2014, 2014
    - Describes how the growth of the North American ice sheet during the last glacial cycle influences the Eurasian ice sheet through atmospheric teleconnections

- PAGES Hydro2k Consortium (J. E. Smerdon, J. Luterbacher, S. J. Phipps, K. J. Anchukaitis, T. Ault, S. Coats, K. M. Cobb, B. I. Cook, C. Colose, T. Felis, A. Gallant, J. H. Jungclaus, B. Konecky, A. LeGrande, S. Lewis, A. S. Lopatka, W. Man, J. S. Mankin, J. T. Maxwell, B. L. Otto-Bliesner, J. W. Partin, D. Singh, N. J. Steiger, S. Stevenson, J. E. Tierney, D. Zanchettin, H. Zhang, A. R. Atwood, L. Andreu-Hayles, S. H. Baek, B. Buckley, E. R. Cook, R. D'Arrigo, S. G. Dee, M. L. Griffiths, C. Kulkarni, Y. Kushnir, F. Lehner, C. Leland, H. W. Linderholm, A. Okazaki, J. Palmer, E. Piovano, C. C. Raible, M. P. Rao, J. Scheff, G. A. Schmidt, R. Seager, M. Widmann, A. P. Williams and E. Xoplaki): Comparing proxy and model estimates of hydroclimate variability and change over the Common Era, Climate of the Past, 13, 1851-1900, doi:10.5194/cp-13-1851-2017, 2017., 10.5194/cp-13-1851-2017
    - We review the principal proxy data available for hydroclimatic reconstructionsover the Common Era (CE) and highlight the contemporary understanding of how these proxies are interpreted as hydroclimate indicators. We also review the available last-millennium simulations from fully coupled climate models and discuss several outstanding challenges associated with simulating hydroclimate variability and change over the CE.

Chapter 9

- Koenig, S. J., Dolan, A. M., de Boer, B., Stone, E. J., Hill, D. J., DeConto, R. M., Abe-Ouchi, A., Lunt, D. J., Pollard, D., Quiquet, A., Saito, F., Savage, J., and van de Wal, R., 2015. Ice sheet model dependency of the simulated Greenland Ice Sheet in the mid-Pliocene, Clim. Past, 11, 369–381., https://doi.org/10.5194/cp-11-369-2015
    - This paper shows the first results of the Pliocene Ice Sheet modeling intercomparison Project for the Greenland ice sheets, how simulations of the GrIS depend on climate forcing and uncertainties in Pliocene ice-sheet predictions.

- de Boer, B., Dolan, A. M., Bernales, J., Gasson, E., Goelzer, H., Golledge, N. R., Sutter, J., Huybrechts, P., Lohmann, G., Rogozhina, I., Abe-Ouchi, A., Saito, F., and van de Wal, R. S. W., 2015. Simulating the Antarctic ice sheet in the late-Pliocene warm period: PLISMIP-ANT, an ice-sheet model intercomparison project, The Cryosphere, 9, 881–903., https://doi.org/10.5194/tc-9-881-2015
    - The results of the Pliocene Ice Sheet Modeling Intercomparison project for Antarctica. The paper demonstrates the uncertainties in ice-sheet model predictions for the Pliocene, depending on which ice-sheet model is used. Includes prediction of sea level.

- Dolan, Aisling M., de Boer, Bas, Bernales, Jorge, Hill, Daniel J., and Haywood, Alan M., 2018. High climate model dependency of Pliocene Antarctic ice-sheet predictions, Nature Communications, 9:2799., https://doi.org/10.1038/s41467-018-05179-4
    - Final PLISMIP paper. Using climatological forcing from 7 PlioMIP, AO-GCM simulations, for 3 ice-sheet models, the paper demonstrates the high dependency of Antarctic ice-sheet volume predictions on the climatemodel-based forcing used.

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    - The paper presents transient ice sheet predictions forced by multiple climate snapshots derived from HadCM3 set up with late Pliocene boundary conditions, forced with different orbital forcing scenarios. The results indicate that insolation forcing between the hemispheres was out of phase during MIS K1 and led to an asynchronous response of ice volume globally.

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    - It shows the difference in impact of insolation versus greenhouse gas forcing on the (timing of peak) warmth during the last interglacial. Global simulations using the Norwegian Earth System Model, with a focus on explaining proxy records in the North Atlantic.

- Otto-Bliesner, B.L. et al., 2017: The PMIP4 contribution to CMIP6 - Part 2: Two interglacials, Scientific objectives and experimental design of the PMIP4-CMIP6 Holocene and Last Interglacial simulations. Geoscientific Model Development, 10, 3979-4003, https://doi.org/10.5194/gmd-10-3979-2017
    - This paper describes the protocols for the mid-Holocene (6 ka) and Last Interglacial (127 ka) Tier 1 simulations, as well as numerous Tier 2 simulations to assess the sensitivities to prescribed vegetation, ice sheets, freshwater fluxes, and alternative states of orbital forcing. For the first time, the LIG is included for CMIP6 and PMIP4, allowing a multi-model assessment of this important period for testing our knowledge of climate-ice sheet interactions in warm climates.

- Capron, E., A. Govin, R. Feng, B.L. Otto-Bliesner, and E.W. Wolff, 2017: Critical evaluation of climate syntheses to benchmark CMIP6/PMIP4 127 ka Last Interglacial simulations in the high-latitude regions, n/a
    - This study provides a data-based regional temperature estimates across the Last Interglacial above the polar ice sheets and at the surface of the North Atlantic and Southern oceans. It highlights a strong polar amplification and land-sea contrast processes at play during this warm past time interval.

- Fasullo, J.T., R. Tomas, S. Stevenson, B. Otto-Bliesner, E. Brady, E. Wahl, 2017: The amplifying influence of increased ocean stratification on a future year without a summer, Nature Communications, 8, 1236. doi:10.1038/s41467-017-01302-z, https://doi.org/10.1038/s41467-017-01302-z
    - CESM simulations of both the 1815 Tambora eruption and a hypothetical analogous future eruption are compared, the latter occurring in 2085 assuming a business-as-usual climate scenario. The 1815 eruption drove strong responses in both the ocean and cryosphere that were fundamental to driving the Year-Without-A-Summer. Through modulation of ocean stratification and near-surface winds, global warming contributes to an amplified surface climate response in CESM.

- Zhu, J., Z.Y. Liu, E.C. Brady, B.L. Otto-Bliesner, S.A. Marcott, J. Zhang, A. Wang, D. Noone, R. Tomas, J. Nusbaumer, T. Wong, A. Jahn, and C. Tabor, 2017: Reduced ENSO variability at the LGM revealed by an isotope-enabled Earth system model. Geophysical Research Letters, 44, 6984-6992., n/a
    - Paleoclimate reconstructions and model simulations of ENSO strength at the Last Glacial Maximum (LGM; 21 ka B.P.) have led to contradicting conclusions. Using simulations from the water isotope-enabled Community Earth System Model (iCESM), this paper shows that the LGM ENSO is most likely weaker than the preindustrial and that ENSO reconstructions using the individual foraminifera analysis may reflect changes in the annual cycle instead of ENSO variability

- Zhu, J., Z.Y. Liu, E. Brady, B. Otto-Bliesner, J.X. Zhang, J. Nusbaumer, T.E. Wong, A. Jahn, and D. Noone, 2017: Investigating the direct meltwater effect in terrestrial oxygen-isotope paleoclimate records using an isotope-enabled Earth system model. Geophysical Research Letters, 44, 12501-12510., https://doi.org/10.1002/2017GL076253
    - Variations in terrestrial oxygen-isotope reconstructions from ice cores and speleothems have been primarily attributed to climatic changes of surface air temperature, precipitation amount, or atmospheric circulation. New modeling results with the water isotope-enabled CESM suggest important nuances for past climate interpretations of delta18O.

- Zanchettin, D., O. Bothe, H. F. Graf, S. J. Lorenz, J. Luterbacher, C. Timmreck, and J. H. Jungclaus (2013) Background conditions influence the decadal climate response to strong volcanic eruptions. J. Geophys. Res. Atm., 118(10): 4090-4106, doi:10.1002/jgrd.50229, 10.1002/jgrd.50229
    - This study illustrates how the decadal climate response to strong volcanic eruptions depends on the background climate state at the time of the eruption and on the presence and magnitude of additional external forcings acting at the same time. It demonstrates that background climate conditions are not merely a source of additive noise for post-eruption decadal climate variability but actively influence the mechanisms involved in the post-eruption decadal evolution.

- Yan Qing, Owen, L. A., Wang, H., & Zhang, Z. (2018). Climate constraints on glaciation over High-Mountain Asia during the last glacial maximum. Geophysical Research Letters, 45, 9024-9033., n/a
    - This paper addresses the questions on why there was not a large-scale ice sheet during LGM

- Yan Qing, Wei Ting, and Zhang Zhongshi, 2017: Variations in large-scale tropical cyclone genesis factors over the western North Pacific in the PMIP3 last millennium simulations, Climate Dynamics, 48(3-4): 957-970., n/a
    - This paper examines the variation of tropical cyclone genesis during the last millennium

- Harrison, S. P., Bartlein, P. J., Izumi, K., Li, G., Annan, J., Hargreaves, J., et al. (2015). Evaluation of CMIP5 palaeo-simulations to improve climate projections. Nature Climate Change, 5(8), 735-743. , http://doi.org/10.1038/nclimate2649
    - Past climate changes provide a unique opportunity for out-of-sample evaluation of model performance. Palaeo-evaluation has shown that the large-scale changes seen in twenty-first-century projections, including enhanced land-sea temperature contrast, latitudinal amplification, changes in temperature seasonality and scaling of precipitation with temperature, are likely to be realistic.

- Grunseich, G. and Wang, B., 2016. Arctic sea ice patterns driven by the Asian summer

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- Schmidt, G. A., Annan, J. D., Bartlein, P. J., Cook, B. I., Guilyardi, E., Hargreaves, J. C., et al. (2014). Using palaeo-climate comparisons to constrain future projections in CMIP5. Climate of the Past, 10(1), 221-250. , http://doi.org/10.5194/cp-10-221-2014
    - Using palaeo-climate comparisons to constrain future projections!

- Zheng, W. P. and Braconnot, P. (2013). Characterization of Model Spread in PMIP2 Mid-Holocene Simulations of the African Monsoon. Journal of Climate. 26: 1192-1210., n/a
    - Using a classification of the monsoonal convective regimes fora subset of sevenPMIP mid Holocene simulations, this paper show that two categories of model can be defined based on their differences insimulating deep and moderate convective regimes in the PI simulations. Changes in precipitation at 6 ka are dominated by changes in the large-scale dynamics for most of the PMIP2 models and are characterized bya shift in the monsoonal circulation toward deeper convective regimes. The results indicate that systematic model biases in simulating the radiation and heat fluxes could explain the damping of the meridional temperature gradient over West Africa and thereby the underestimation of precipitation in the Sahel-Sahara region.

- Marzin, C., Kallel, N., Kageyama, M., Duplessy, J. C. and Braconnot, P. (2013). Glacial fluctuations of the Indian monsoon and their relationship with North Atlantic climate: new data and modelling experiments. Climate of the Past. 9: 2135-2151, n/a
    - This study analyse the processes that can explain the relationship between the Indian monsoon and the North Atlantic climate under glacial conditions, by increasing the freshwater flux in the North Atlantic and reducing the intensity of the Atlantic meridional overturning circulation. It shows that reduced indian monsoon is associated to changes in the continental runoff and local hydrological cycle that are responsible for the changes in salinity of the Bay of Bengal in the model. Sensitivity experiments also highlight that the changes over the tropical Atlantic are essential in triggering perturbations of the subtropical jet over Eurasia that in turn affect the intensity of the Indian monsoon.

- Howell, F. W., Haywood, A. M., Otto-Bliesner, B. L., Bragg, F., Chan, W.-L., Chandler, M. A., Contoux, C., Kamae, Y., Abe-Ouchi, A., Rosenbloom, N. A., Stepanek, C. and Zhang, Z.: Arctic sea ice simulation in the PlioMIP ensemble, Clim. Past, 12, 749-767, doi:10.5194/cp-12-749-2016, 2016., 10.5194/cp-12-749-2016
    - This paper describes the response of Artic sea-ice to the Pliocene warm climate (PlioMIP1) into 8 general circulation models

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    - Examines the PMIP3 simulations of the Last Interglacial and finds that the models do not agree well with reconstructions. In particular, the models fail to replicate the reconstructed warming at high latitudes.

- Bakker, P., V. Masson-Delmotte, B. Martrat, S. Charbit, H. Renssen, M. Gröger, U. Krebs-Kanzow,

G. Lohman, D. J. Lunt, M. Pfeiffer, S. J. Phipps, M. Prange, S. P. Ritz, M. Schulz, B. Stenni, E. J. Stone and V. Varma: Temperature trends during the Present and Last Interglacial periods - a multi-model-data comparison, Quaternary Science Reviews, 99, 224-243, doi:10.1016/j.quascirev.2014.06.031, 2014., 10.1016/j.quascirev.2014.06.031

- The reconstructed Present Interglacial (PIG) and Last Interglacial (LIG) Northern Hemisphere mid-to-high latitude cooling compares well with multi-model, mean temperature trends for the warmest months and that these cooling trends reflect a linear response to the warmest-month insolation decrease over the interglacial intervals. The most notable exception is the strong LIG cooling trend reconstructed from Greenland ice cores that is not simulated by any of the models. A striking model-data mismatch is found for both the PIG and the LIG over large parts of the mid-to-high latitudes of the Southern Hemisphere where the data depicts negative temperature trends that are not in agreement with near zero trends in the simulations.

- McGregor, H. V., M. N. Evans, H. Goosse, G. Leduc, B. Martrat, J. A. Addison, P. G. Mortyn, D. W. Oppo, M.-S. Seidenkrantz, M.-A. Sicre, S. J. Phipps, K. Selveraj, K. Thirumalai, H. L. Filipsson and V. Ersek: Robust global ocean cooling trend for the pre-industrial Common Era, Nature Geoscience, 8, 671-677, doi:10.1038/NGEO2510, 2015., 10.1038/NGEO2510
  - Here we present a global synthesis of sea surface temperatures for the Common Era (CE) derived from 57 individual marine reconstructions that meet strict quality control criteria. We observe a cooling trend from 1 to 1800 CE that is robust against explicit tests for potential biases in the reconstructions. Climate simulations using single and cumulative forcings suggest that the ocean surface cooling trend from 801 to 1800 CE is not primarily a response to orbital forcing but arises from a high frequency of explosive volcanism. Our results show that repeated clusters of volcanic eruptions can induce a net negative radiative forcing that results in a centennial and global scale cooling trend via a decline in mixed-layer oceanic heat content.

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  - Shows that the PMIP2/PMIP3 models and proxies agree on the differences in climate state for 6 ka relative to 0 ka, when they are insolation driven. The largest uncertainty between the models and the proxies occurs over the Indo-Pacific Warm Pool (IPWP).

- Kageyama, M., P. Braconnot, S. P. Harrison, A. M. Haywood, J. H. Jungclaus, B. L. Otto-Bliesner, J.-Y. Peterschmitt, A. Abe-Ouchi, S. Albani, P. J. Bartlein, C. Brierley, M. Crucifix, A. Dolan, L. Fernandez-Donado, H. Fischer, P. O. Hopcroft, R. F. Ivanovic, F. Lambert, D. J. Lunt, N. M. Mahowald, W. R. Peltier, S. J. Phipps, D. M. Roche, G. A. Schmidt, L. Tarasov, P. J. Valdes, Q. Zhang and T. Zhou: The PMIP4 contribution to CMIP6 - Part 1: Overview and over-arching analysis plan, Geoscientific Model Development, 11, 1033-1057, doi:10.5194/gmd-11-1033-2018, 2018., 10.5194/gmd-11-1033-2018
  - Simulations of five different periods have been designed to address the objectives of the sixth phase of the Coupled Model Intercomparison Project (CMIP6): the millennium prior to the industrial epoch (CMIP6 name: past1000); the mid-Holocene, 6000 years ago (midHolocene); the Last Glacial Maximum, 21 000 years ago (lgm); the Last Interglacial, 127 000 years ago (lig127k); and the mid-Pliocene Warm Period, 3.2 million years ago (midPliocene-eoi400). This paper describes the motivation for the choice of these periods and the design of the numerical experiments and database requests, with a focus on their novel features compared to the experiments performed in previous phases of PMIP and

CMIP. It also outlines the analysis plan that takes advantage of the comparisons of the results across periods and across CMIP6 in collaboration with other MIPs.

- Meyer, H., Opel, T., Laepple, T., Dereviagin, A. Y., Hoffmann, K. and Werner, M.: Long-term winter warming trend in the Siberian Arctic during the mid- to late Holocene, Nature Geoscience, 8(2), 122-125, doi:10.1038/ngeo2349, 2015., 10.1038/ngeo2349
  - The paper presents a record of the oxygen isotope composition of permafrost ice wedges from the Siberian Arctic. In agreement with most PIMP3 models, the record shows a winter warming trend during the mid- to late Holocene, opposing the cooling seen in other proxy records.

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Chapter 10

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    - This paper presents the experimental design of the “Model Intercomparison Project on the climatic response to Volcanic forcing (VolMIP), which includes idealized experiments focused on the short-term atmospheric as well as long-term coupled response to volcanic forcing. The core idea of VolMIP is to constrain radiative forcing among the participating models to focus on the climatic response, hence reference forcing dataare provided in terms of optical aerosol properties for a series of reference eruptions.

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depends on the background climate state at the time of the eruption and on the presence and magnitude of additional external forcings acting at the same time. It demonstrates that background climate conditions are not merely a source of additive noise for post-eruption decadal climate variability but actively influence the mechanisms involved in the post-eruption decadal evolution.

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  - This paper presents new evidences for a possible interference of volcanic forcing from tropical stratospheric eruptions on ENSO cycle and discusses the underlying physical processes. Targeted climate model simulations emphasize that Pinatubo-like eruptions tend to shorten La Niñas, lengthen El Niños and induce anomalous warming when occurring during neutral states. It also presents a new mechanisms suggesting that volcanically induced cooling in tropical Africa weakens the West African monsoon, and the resulting atmospheric Kelvin wave can drive equatorial westerly wind anomalies over the western Pacific. This wind anomaly is further amplified by air-sea interactions in the Pacific, favouring an El Niño-like response.

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  - The climatic impact of the largest volcanic events has been assessed in numerous modelling studies and tree-ring-based hemispheric temperature reconstructions. However, volcanic surface cooling derived from PMIP3 climate model simulations is systematically much stronger than the cooling seen in tree-ring-based proxies, suggesting that the proxies underestimate cooling; and/or the modelled forcing is unrealistically high. This paper present a new summer temperature reconstructions for the Northern Hemisphere from tree-ring width and maximum latewood density over the past 1,500 years in comparison to simulated climate effects of two large eruptions, in AD 1257 and 1815, using a climate model that accounts explicitly for self-limiting aerosol microphysical processes. Results reveal for the first time an agreement between modelled and tree-ring based reconstruction of mean Northern Hemisphere extra-tropical summer cooling over land estimated between 0.8 to 1.3 degC for these eruptions. This reconciliation of proxy and model evidence paves the way to improved assessment of the role of both past and future volcanism in climate forcing.

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    - This paper evaluates PMIP3 models and their ability to simulate the observed relationship between ENSO and the seasonal cycle on orbital scales. It reveals a fundamental discrepancy between models and observations that is critical to understanding the simulated ENSO response to future GHG emissions.

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  - We review progress in model and proxy-based reconstruction of the surface temperature field of the Last Glacial Maximum. The magnitudes of the large-scale changes are increasingly well-constrained, with a recent model-data synthesis generating a value of 4 C, which suggests a moderate equilibrium climate sensitivity of about 2.5 C.

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  - This study analyse the processes that can explain the relationship between the Indian monsoon and the North Atlantic climate under glacial conditions, by increasing the freshwater flux in the North Atlantic and reducing the intensity of the Atlantic meridional overturning circulation. It shows that reduced indian monsoon is associated to changes in the continental runoff and local hydrological cycle that are responsible for the changes in salinity of the Bay of Bengal in the model. Sensitivity experiments also highlight that the changes over the tropical Atlantic are essential in triggering perturbations of the subtropical jet over Eurasia that in turn affect the intensity of the Indian monsoon.

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    - Using as a reference a simulation of the early Holocene, the present study explores the relative contribution of ice-sheet and fresh water fluxes on themean climate state and ENSO variability in the tropical Pacific.The freshwater flux impact on ocean circulation and atmospheric feedbacks enhances ENSO amplitude. A feedback analysis suggests that it is due to the wind-thermocline feedback. The remnant ice sheett does not induce significant change in ENSO. Itexhibits a slight SST variability increase at the east coast and a reduction in the middle of the basin driven by the net. The freshwater flux forcing strengthens the amplitude of EP El Niño events. This mansucripts halp thus to unerstand the diversity of EL Niño event and the response of El Niño to external forcings.

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    - This paper describes the changes in contribution between the White Nile and the Blue Nile river catchments during the mid-Holocene. By comparing regional proxy-records with the output from a global atmospheric model zoomed on Africa, we propose that the reduced contribution from the Blue Nile at 6 ka originated from both a higher White Nile runoff and a lower Blue Nile runoff.

- Lunt, D. J., A. Abe-Ouchi, P. Bakker, A. Berger, P. Braconnot, S. Charbit, N. Fischer, N. Herold, J. H. Jungclaus, V. C. Khon, U. Krebs-Kanzow, P. M. Langebroek, G. Lohmann, K. H. Nisancioglu, B. Otto-Bliesner, W. Park, M. Pfeiffer, S. J. Phipps, M. Prange, R. Rachmayani, H. Renssen, N. Rosenbloom, B. Schneider, E. J. Stone, K. Takahashi, W. Wei, Q. Yin and Z. S. Zhang: A multi-model assessment of last interglacial temperatures, Climate of the Past, 9, 699-717, doi:10.5194/cp-9-699-2013, 2013., 10.5194/cp-9-699-2013
    - Examines the PMIP3 simulations of the Last Interglacial and finds that the models do not agree well with reconstructions. In particular, the models fail to replicate the reconstructed warming at high latitudes.

- Bakker, P., V. Masson-Delmotte, B. Martrat, S. Charbit, H. Renssen, M. Gröger, U. Krebs-Kanzow, G. Lohman, D. J. Lunt, M. Pfeiffer, S. J. Phipps, M. Prange, S. P. Ritz, M. Schulz, B. Stenni, E. J. Stone and V. Varma: Temperature trends during the Present and Last Interglacial periods - a multi-model-data comparison, Quaternary Science Reviews, 99, 224-243, doi:10.1016/j.quascirev.2014.06.031, 2014., 10.1016/j.quascirev.2014.06.031
    - The reconstructed Present Interglacial (PIG) and Last Interglacial (LIG) Northern Hemisphere mid-to-high latitude cooling compares well with multi-model, mean temperature trends for the warmest months and that these cooling trends reflect a linear response to the warmest-month insolation decrease over the interglacial intervals. The most notable exception is the strong LIG cooling trend reconstructed from Greenland ice cores that is not simulated by any of the models. A striking model-data mismatch is found

for both the PIG and the LIG over large parts of the mid-to-high latitudes of the Southern Hemisphere where the data depicts negative temperature trends that are not in agreement with near zero trends in the simulations.

- Abram, N. J., H. V. McGregor, J. E. Tierney, M. N. Evans, N. P. McKay, D. S. Kaufman and the PAGES 2k Consortium (K. Thirumalai, B. Martrat, H. Goosse, S. J. Phipps, E. J. Steig, K. Halimeda Kilbourne, C. P. Saenger, J. Zinke, G. Leduc, J. A. Addison, P. Graham Mortyn, M.-S. Seidenkrantz, M.-A. Sicre, K. Selvaraj, H. L. Filipsson, R. Neukom, J. Gergis, M. A. J. Curran and L. von Gunten): Early onset of industrial-era warming across the oceans and continents, Nature, 536, 411-418, doi:10.1038/nature19082, 2016., 10.1038/nature19082
  - Here we use post AD 1500 palaeoclimate records to show that sustained industrial-era warming of the tropical oceans first developed during the mid-nineteenth century and was nearly synchronous with Northern Hemisphere continental warming. The early onset of sustained, significant warming in palaeoclimate records and model simulations suggests that greenhouse forcing of industrial-era warming commenced as early as the mid-nineteenth century and included an enhanced equatorial ocean response mechanism. The development of Southern Hemisphere warming is delayed in reconstructions, but this apparent delay is not reproduced in climate simulations. Our findings imply that instrumental records are too short to comprehensively assess anthropogenic climate change and that, in some regions, about 180 years of industrial-era warming has already caused surface temperatures to emerge above pre-industrial values, even when taking natural variability into account.

- Ackerley, D., J. Reeves, C. Barr, H. Bostock, K. Fitzsimmons, M.-S. Fletcher, C. Gouramanis, H. McGregor, S. Mooney, S. J. Phipps, J. Tibby and J. Tyler: Evaluation of PMIP2 and PMIP3 simulations of mid-Holocene climate in the Indo-Pacific, Australasian and Southern Ocean regions, Climate of the Past, 13, 1661-1684, doi:10.5194/cp-13-1661-2017, 2017., 10.5194/cp-13-1661-2017
  - Shows that the PMIP2/PMIP3 models and proxies agree on the differences in climate state for 6 ka relative to 0 ka, when they are insolation driven. The largest uncertainty between the models and the proxies occurs over the Indo-Pacific Warm Pool (IPWP).

- PAGES Hydro2k Consortium (J. E. Smerdon, J. Luterbacher, S. J. Phipps, K. J. Anchukaitis, T. Ault, S. Coats, K. M. Cobb, B. I. Cook, C. Colose, T. Felis, A. Gallant, J. H. Jungclaus, B. Konecky, A. LeGrande, S. Lewis, A. S. Lopatka, W. Man, J. S. Mankin, J. T. Maxwell, B. L. Otto-Bliesner, J. W. Partin, D. Singh, N. J. Steiger, S. Stevenson, J. E. Tierney, D. Zanchettin, H. Zhang, A. R. Atwood, L. Andreu-Hayles, S. H. Baek, B. Buckley, E. R. Cook, R. D'Arrigo, S. G. Dee, M. L. Griffiths, C. Kulkarni, Y. Kushnir, F. Lehner, C. Leland, H. W. Linderholm, A. Okazaki, J. Palmer, E. Piovano, C. C. Raible, M. P. Rao, J. Scheff, G. A. Schmidt, R. Seager, M. Widmann, A. P. Williams and E. Xoplaki): Comparing proxy and model estimates of hydroclimate variability and change over the Common Era, Climate of the Past, 13, 1851-1900, doi:10.5194/cp-13-1851-2017, 2017., 10.5194/cp-13-1851-2017
  - We review the principal proxy data available for hydroclimatic reconstructionsover the Common Era (CE) and highlight the contemporary understanding of how these proxies are interpreted as hydroclimate indicators. We also review the available last-millennium simulations from fully coupled climate models and discuss several outstanding challenges associated with simulating hydroclimate variability and change over the CE.

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from the Siberian Arctic. In agreement with most PIMP3 models, the record shows a winter warming trend during the mid- to late Holocene, opposing the cooling seen in other proxy records.

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Chapter 11

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