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References

Aktuell

Goldsmith 2017

Yonaton Goldsmith et al., *East Asian summer monsoon rainfall dominates Lake Dali lake area changes*, *Reply to Liu et al.* PNAS **114** (2017), E2989–E2990.

Yonaton Goldsmith, Wallace S. Broecker, Hai Xu, Pratigya J. Polissar, Peter deMenocal, Naomi Porat, Jianghu Lan, Peng Cheng, Weijian Zhou & Zhisheng An

The Early Holocene was 2,500 y long (11.5–9 ka), which requires ≈1,650 km3 of snowmelt water converted to ice (using a 9 % volume increase). The size of the Dali catchment area at elevations between 1,800 and 1,400 m is ≈550 km2. Thus, the pollen reconstruction requires the presence of a 3-km-thick glacier at the onset of the Holocene to sustain the hydrological balance. This number is most likely impossible.

Liu 2017

Jianbao Liu, Shengqian Chen, Jianhui Chen, Zhiping Zhang & Fahu Chen, *Chinese cave $\delta^{18}O$ records do not represent northern East Asian summer monsoon rainfall*. PNAS **114** (2017), E2987–E2988.

In fact, the level of Lake Dali was not controlled solely by monsoonal rainfall because it was also fed by snow/ice melt from the Da Hinggan Range. For example, previous studies have demonstrated that Lake Dali reached a highstand in the early Holocene as a result of snow/ice melt input rather than monsoonal rainfall, whereas the highest lake level occurred in the mid-Holocene, which indicates the strongest EASM rainfall.

Reese 2017

April Reese, *Blackouts cast Australia's green energy in dim light*. science **355** (2017), 1001–1002.

On 8 February, as South Australians sat down to dinner on a broiling summer evening, the lights went out. Instead of blaming the heat wave and heavy demand for air conditioning for the outage—the second in 6 months—conservative politicians took aim at South Australia's progressive Labor government and its ambitious renewable energy policy.

Last May, unable to compete with government-backed renewables, the state's lone remaining coal-fired power plant closed its doors, leaving the Pelican Point natural gas plant as South Australia's only instate fossil-fueled generator. Yet postmortems on both blackouts largely exonerated renewables. As for the 8 February incident, the Australian Energy Market Operator last month said that it underestimated how much power would be needed during peak demand that sweltering day. As winds ebbed, a natural gas plant on standby couldn't ramp up in time.

Segal 2017

Dvira Segal, *Probing the limits of heat flow*. science **355** (2017), 1125–1126.

Studies of atomic point contacts reveal the fundamental quantum of heat transport.

Anthropologie

Tobler 2017

Ray Tobler et al., *Aboriginal mitogenomes reveal 50,000 years of regionalism in Australia*. nature **544** (2017), 180–184.

n544-0180-Supplement1.pdf, n544-0180-Supplement2.xlsx

Ray Tobler, Adam Rohrlach, Julien Soubrier, Pere Bover, Bastien Llamas, Jonathan Tuke, Nigel Bean, Ali Abdullah-Highfold, Shane Agius, Amy O'Donoghue, Isabel O'Loughlin, Peter Sutton, Fran Zilio, Keryn Walshe, Alan N. Williams, Chris S. M. Turney, Matthew Williams, Stephen M. Richards, Robert J. Mitchell, Emma Kowal, John R. Stephen, Lesley Williams, Wolfgang Haak & Alan Cooper

Aboriginal Australians represent one of the longest continuous cultural complexes known. Archaeological evidence indicates that Australia and New Guinea were initially settled approximately 50 thousand years ago (ka); however, little is known about the processes underlying the enormous linguistic and phenotypic diversity within Australia. Here we report 111 mitochondrial genomes (mitogenomes) from historical Aboriginal Australian hair samples, whose origins enable us to reconstruct Australian phylogeographic history before European settlement. Marked geographic patterns and deep splits across the major mitochondrial haplogroups imply that the settlement of Australia comprised a single, rapid migration along the east and west coasts that reached southern Australia by 49–45 ka. After continent-wide colonization, strong regional patterns developed and these have survived despite substantial climatic and cultural change during the late Pleistocene and Holocene epochs. Remarkably, we find evidence for the continuous presence of populations in discrete geographic areas dating back to around 50 ka, in agreement with the notable Aboriginal Australian cultural attachment to their country.

Biologie

Snowdon 2017

Charles T. Snowdon, *Learning from monkey "talk"*. science **355** (2017), 1120–1122.

Nonhuman primates are capable of several key elements of human language.

Nonhuman primates do not talk, but we should not expect them to. Each species has its own adaptations for communication. Nevertheless, there is much about language evolution that we can learn from nonhuman primates, provided that we study a variety of species and consider the multiple components of speech and language.

Energie

Zhai 2017

Yao Zhai, Yaoguang Ma, Sabrina N. David, Dongliang Zhao, Runnan Lou, Gang Tan, Ronggui Yang & Xiaobo Yin, *Scalable-manufactured randomized glass-polymer hybrid metamaterial for daytime radiative cooling*. science **355** (2017), 1062–1066.

s355-1062-Supplement.pdf

Passive radiative cooling draws heat from surfaces and radiates it into space as infrared radiation to which the atmosphere is transparent. However, the energy

density mismatch between solar irradiance and the low infrared radiation flux from a near-ambient-temperature surface requires materials that strongly emit thermal energy and barely absorb sunlight. We embedded resonant polar dielectric microspheres randomly in a polymeric matrix, resulting in a metamaterial that is fully transparent to the solar spectrum while having an infrared emissivity greater than 0.93 across the atmospheric window. When backed with a silver coating, the metamaterial shows a noontime radiative cooling power of 93 watts per square meter under direct sunshine. More critically, we demonstrated high-throughput, economical roll-to-roll manufacturing of the metamaterial, which is vital for promoting radiative cooling as a viable energy technology.

Zhang 2017

Xiang Zhang, *Metamaterials for perpetual cooling at large scales.* science **355** (2017), 1023–1024.

A glass-polymer film can cool structures by radiating heat, even under direct sunlight.

Klima

Byrne 2014

B. Byrne & C. Goldblatt, *Radiative forcing at high concentrations of well-mixed greenhouse gases.* Geophysical Research Letters **41** (2014), 152–160.

Key Points:
- The IPCC expressions perform poorly at high GHG concentrations
- The new expressions provided perform much better at high GHG concentrations
- Forcings with latitude dependence are provided for forcing models

We present new calculations of radiative forcing at very high concentrations of CO2, CH4, and N2O, relevant to extreme anthropogenic climate change and paleoclimate studies. CO2 forcing is calculated over the range 100 ppmv to 50,000 ppmv, and the maximum forcing is 38.1 W m-2. CH4 and N2O forcings are calculated over the range 100 ppbv to 100 ppmv and give maximum forcings of 6.66 W m-2 and 22.3 W m-2. The sensitivity of our calculations to spatial averaging and tropopause definition is examined. We compare our results with the "simplified expressions" reported by Intergovernmental Panel on Climate Change (IPCC) and find significant differences at high greenhouse gas concentrations. We provide new simplified expressions which agree much better with the calculated forcings and suggest that these expressions be used in place of the IPCC expressions. Additionally, we provide meridionally resolved forcings which may be used to force simple and intermediate complexity climate models.

Foster 2017

Gavin L. Foster, Dana L. Royer & Daniel J. Lunt, *Future climate forcing potentially without precedent in the last 420 million years.* Nature Communications **8** (2017), 14845. DOI:10.1038/ncomms14845.

NatComm08-14845-Supplement1.pdf, NatComm08-14845-Supplement2.xlsx, NatComm08-14845-Supplement3.xlsx

The evolution of Earth's climate on geological timescales is largely driven by variations in the magnitude of total solar irradiance (TSI) and changes in the greenhouse gas content of the atmosphere. Here we show that the slow B50Wm.2

increase in TSI over the last B420 million years (an increase of B9Wm.2 of radiative forcing) was almost completely negated by a long-term decline in atmospheric CO2. This was likely due to the silicate weatheringnegative feedback and the expansion of land plants that together ensured Earth's long-term habitability. Humanity's fossil-fuel use, if unabated, risks taking us, by the middle of the twenty-first century, to values of CO2 not seen since the early Eocene (50 million years ago). If CO2 continues to rise further into the twenty-third century, then the associated large increase in radiative forcing, and how the Earth system would respond, would likely be without geological precedent in the last half a billion years.

Lacis 2010

Andrew A. Lacis, Gavin A. Schmidt, David Rind & Reto A. Ruedy, *Atmospheric CO_2, Principal Control Knob Governing Earth's Temperature*. science **330** (2010), 356–359.

s330-0356-Supplement.pdf

Ample physical evidence shows that carbon dioxide (CO2) is the single most important climate-relevant greenhouse gas in Earth's atmosphere. This is because CO2, like ozone, N2O, CH4, and chlorofluorocarbons, does not condense and precipitate from the atmosphere at current climate temperatures, whereas water vapor can and does. Noncondensing greenhouse gases, which account for 25 % of the total terrestrial greenhouse effect, thus serve to provide the stable temperature structure that sustains the current levels of atmospheric water vapor and clouds via feedback processes that account for the remaining 75 % of the greenhouse effect. Without the radiative forcing supplied by CO2 and the other noncondensing greenhouse gases, the terrestrial greenhouse would collapse, plunging the global climate into an icebound Earth state.

Liebrand 2017

Diederik Liebrand et al., *Evolution of the early Antarctic ice ages*. PNAS **114** (2017), 3867–3872.

Diederik Liebrand, Anouk T. M. de Bakker, Helen M. Beddow, Paul A. Wilson, Steven M. Bohaty, Gerben Ruessink, Heiko Pälike, Sietske J. Batenburg, Frederik J. Hilgen, David A. Hodell, Claire E. Huck, Dick Kroon, Isabella Raffi, Mischa J. M. Saes, Arnold E. van Dijk & Lucas J. Lourens

Understanding the stability of the early Antarctic ice cap in the geological past is of societal interest because present-day atmospheric CO2 concentrations have reached values comparable to those estimated for the Oligocene and the Early Miocene epochs. Here we analyze a new high-resolution deep-sea oxygen isotope (d18O) record from the South Atlantic Ocean spanning an interval between 30.1 My and 17.1 My ago. The record displays major oscillations in deep-sea temperature and Antarctic ice volume in response to the ≈110-ky eccentricity modulation of precession. Conservative minimum ice volume estimates show that waxing and waning of at least ≈85 to 110 % of the volume of the present East Antarctic Ice Sheet is required to explain many of the ≈110-ky cycles. Antarctic ice sheets were typically largest during repeated glacial cycles of the mid-Oligocene (≈28.0 My to ≈26.3 My ago) and across the Oligocene–Miocene Transition (≈23.0 My ago). However, the high-amplitude glacial–interglacial cycles of the mid-Oligocene are highly symmetrical, indicating a more direct response to eccentricity modulation of precession than their Early Miocene counterparts, which are distinctly asymmetrical—indicative of prolonged ice buildup and delayed, but rapid, glacial terminations. We hypothesize that the long-term transition to a warmer climate state with sawtooth-shaped glacial cycles in the Early Miocene was brought about

by subsidence and glacial erosion in West Antarctica during the Late Oligocene and/or a change in the variability of atmospheric CO2 levels on astronomical time scales that is not yet captured in existing proxy reconstructions.

Keywords: unipolar icehouse | early Antarctic ice sheet | OligoceneMiocene | glacialinterglacial cycle geometries | bispectral analysis

Significance: The Antarctic ice cap waxed and waned on astronomical time scales throughout the Oligo-Miocene time interval. We quantify geometries of Antarctic ice age cycles, as expressed in a new climate record from the South Atlantic Ocean, to track changing dynamics of the unipolar icehouse climate state. We document numerous ≈110-thousand-year-long oscillations between a near-fully glaciated and deglaciated Antarctica that transitioned from being symmetric in the Oligocene to asymmetric in the Miocene. We infer that distinctly asymmetric ice age cycles are not unique to the Late Pleistocene or to extremely large continental ice sheets. The patterns of long-term change in Antarctic climate interpreted from this record are not readily reconciled with existing CO2 records.

Klima Mathematik

Ludescher 2017

Josef Ludescher, Armin Bunde & Hans Joachim Schellnhuber, *Statistical significance of seasonal warming/cooling trends*. PNAS **114** (2017), E2998–E3003.

The question whether a seasonal climate trend (e.g., the increase of summer temperatures in Antarctica in the last decades) is of anthropogenic or natural origin is of great importance for mitigation and adaption measures alike. The conventional significance analysis assumes that (i) the seasonal climate trends can be quantified by linear regression, (ii) the different seasonal records can be treated as independent records, and (iii) the persistence in each of these seasonal records can be characterized by short-term memory described by an autoregressive process of first order. Here we show that assumption ii is not valid, due to strong intraannual correlations by which different seasons are correlated. We also show that, even in the absence of correlations, for Gaussian white noise, the conventional analysis leads to a strong overestimation of the significance of the seasonal trends, because multiple testing has not been taken into account. In addition, when the data exhibit long-term memory (which is the case in most climate records), assumption iii leads to a further overestimation of the trend significance. Combining Monte Carlo simulations with the Holm–Bonferroni method, we demonstrate how to obtain reliable estimates of the significance of the seasonal climate trends in long-term correlated records. For an illustration, we apply our method to representative temperature records from West Antarctica, which is one of the fastest-warming places on Earth and belongs to the crucial tipping elements in the Earth system.

Keywords: climate | long-term persistence | seasonal trends | statistical significance | multiple testing

Significance: The question whether a seasonal climatic trend (e.g., the increase of spring temperatures in Antarctica in the last decades) is of anthropogenic or natural origin is of great importance because seasonal climatic trends may considerably affect ecological systems, agricultural yields, and human societies. Previous studies assumed that the seasonal records can be treated as independent and are characterized by shortterm memory only. Here we show that both assumptions, which may lead to a considerable overestimation of the trend significance, do not apply to temperature data. Combining Monte Carlo simulations with the Holm–Bonferroni method, we demonstrate how to obtain reliable estimates of the statist-

ical significance of seasonal climatic trends and apply our method to representative atmospheric temperature records of Antarctica.

Kultur Amerika

Wade 2017

Lizzie Wade, *Unearthing Democracy's Roots*. science **355** (2017), 1114–1118.

In some ancient Mesoamerican societies, rulers shared power and ordinary people had a voice.

Most Mesoamerican cities were centered on a monumental core of pyramids and plazas. In Tlaxcallan, the plazas were scattered throughout every neighborhood, with no clear center or hierarchy. Rather than ruling from the heart of the city, as kings did, Fargher believes Tlaxcallan's senate likely met in a grand building he found standing alone 1 kilometer outside the city limits. This distributed layout is also a sign of shared political power, he says.

Collective societies tend to lay out their cities in standardized ways, with the largest ones even using grids, says Blanton, which ease navigation both for residents and for a government providing services. In the Indus capital of Mohenjo-daro in today's Pakistan, for example, the art depicts few individual people, and houses built with standard-sized bricks line regularly spaced city blocks. The strict urban plan incorporated wells and allowed thousands of people to use toilets connected to the world's first sewers.

Another common feature of collective societies is economic equality, which archaeologists can infer from comparing the goods of rich and poor people. In autocratic societies like the classical Maya, luxury goods such as intricately painted pottery and jade are only found in palaces and royal tombs. In contrast, in Tlaxcallan people of all classes seemed to have owned and used pottery with ornate, multicolor designs. "You can't tell rich people from poor people based on their stuff," Fargher says. Pool sees a similarly narrow wealth gap at Tres Zapotes. And in classical Athens, perhaps the most famous premodern democracy, "wealthy people lived in houses that were similar to the common people," Blanton says.

Methoden

West 2017

Julian G. West, *Fortune favors the well read*. science **355** (2017), 1090.

"You found that in what journal?" My adviser, sitting across the desk from me as we discussed my next research project, raised his eyebrows in surprise. We had recently finished my first project and realized that our methods had some limitations. We needed to redesign our experiments, so I had done a lot of thinking and reading and had collected some preliminary results on new approaches. And based on some surprising sources, I had come up with an unusual proposal for advancing past the obstacles we had encountered.