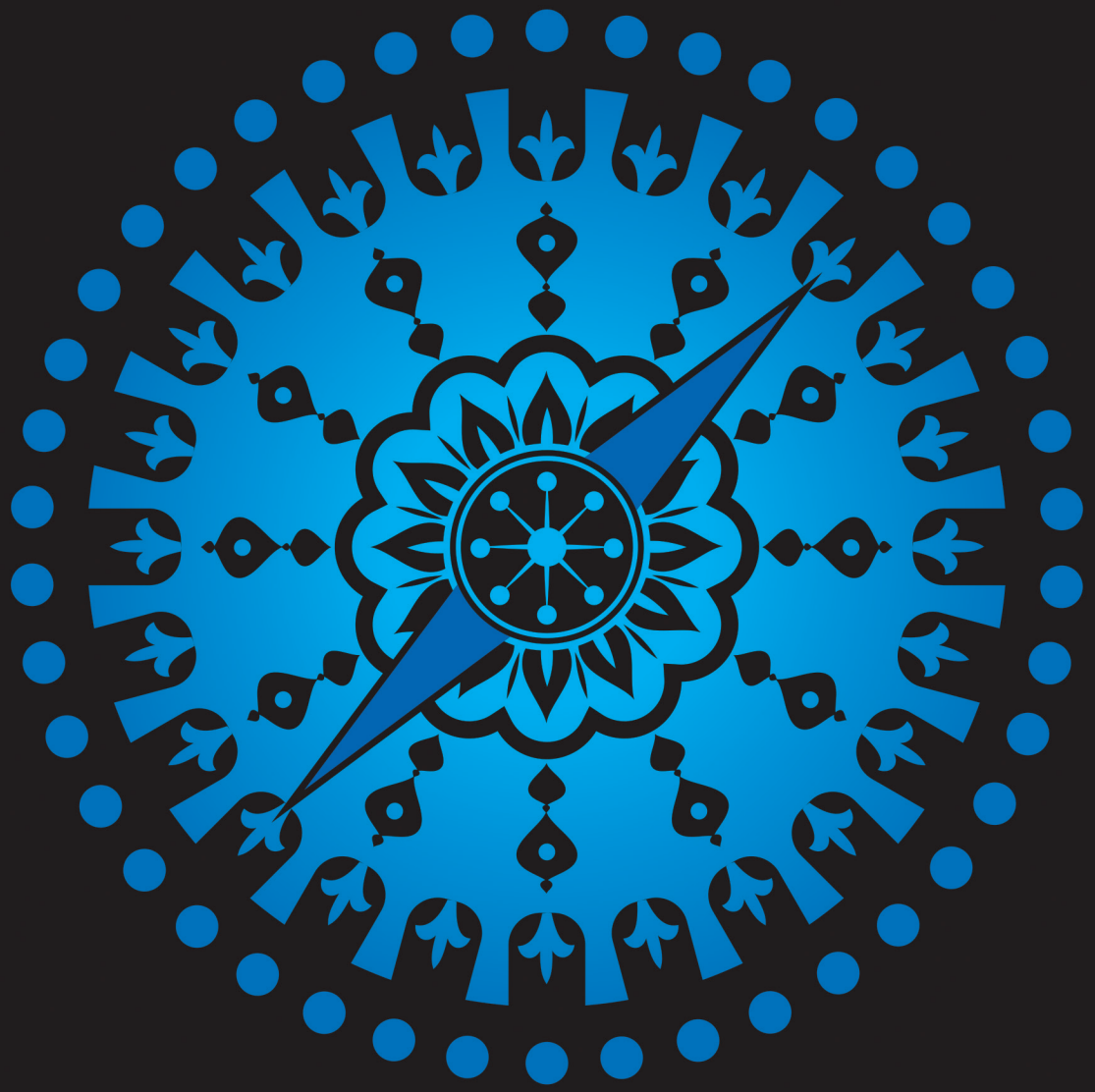
PROGRAM AND ABSTRACTS



pages goa 2013

2ND YOUNG SCIENTISTS MEETING
THE PAST: A COMPASS FOR FUTURE EARTH

11 - 12 FEBRUARY

PAGES
PAST GLOBAL CHANGES

THE PAST: A COMPASS FOR FUTURE EARTH

PAST GLOBAL CHANGES

2nd YOUNG SCIENTISTS MEETING

Goa, India — 11 - 12 February 2013

Contents:

Welcome on behalf of the local organizers

Welcome to PAGES Goa 2013!

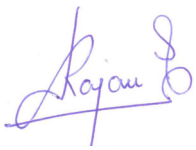
The National Centre for Antarctic and Ocean Research, an autonomous research centre under the Ministry of Earth Sciences (Government of India) warmly welcomes the young palaeo researchers to Goa.

India is endowed with unique geomorphologic systems like the Himalayas, desert, large and small rivers, lakes of all dimensions in various climatic domains (ranging from humid to hyper arid) and surrounded by the distinctive Indian Ocean. These settings along with substantive historical and pre-historic records make India an ideal laboratory to test hypotheses relating to human-climate-environment interaction and better inform the future planning strategies. The changing climate and its visible strain on ecological and environmental systems in this part of the world necessitate an integrated approach in understanding the past, present and future of the monsoon systems and their global interactions.

We sincerely hope that the 2nd Young Scientist Meeting and the 4th PAGES Open Science Meeting, happening for the first time in Indian subcontinent, would provide ample opportunities for scientist networking and developing new research collaborations. I wish to place on record the generous funding we have received from the Ministry of Earth Sciences, Government of India, which helped us to support large number of young scientists, internationally.

I am confident that Goa with its magnificent beaches, rich cultural heritage, delectable cuisine and wonderful people will provide an ideal locale for a relaxed yet scientifically intense workshop. I look forward to an excellent meeting that would enhance the scientific knowhow on global change and would lead to tangible scientific outputs.

I wish you a fruitful meeting and a pleasant stay in Goa!



S. Rajan

Chairman, Local Organizing Committee

Welcome on behalf of PAGES

Welcome to PAGES 2nd Young Scientists Meeting!

PAGES serves the Global Change community by supporting science aimed at understanding the Earth's past climate and environment, with the ultimate goal of assisting future projections. Having become a mature scientific organization, PAGES had grown to recognize the need to nurture our young scientists to ensure that research on past, present, and future global change continues to thrive and evolve.

The YSM is intended to provide you with a platform for interdisciplinary scientific exchange and discussion of your research. It should also provide you with tips and ideas, which we hope will be helpful in the future. You have the chance to provide feedback on the infrastructure of the scientific world, such as organizations like PAGES, publishers, data centers, etc., and hence to actively shape a part of your scientific environment. Finally, we hope that you will make new or strengthen existing contacts with fellow scientists across geographical and scientific borders, and establish ties that last a whole career.

The 1st YSM four years ago in Corvallis, USA was a definitive success, based on the positive feedback, rich output, continued engagement of participants, and emulation of the concept by sister organizations. Accordingly, this year's program is again based on the successful concept outlined above. However, some aspects have evolved since the 1st YSM. A major innovation is that (still) young attendees of the 1st YSM are now forming an essential part of the program committee (page 7) and thus shaped actively the program of this 2nd YSM. This has extended the involvement of early-career scientists now to all stages of the meeting.

Involvement and engagement is what we hope to get also from you - not only now, but also in the mid term and throughout your hopefully thriving careers. We hope that the YSM will inspire you to engage in international collaboration, community service and international science coordination, be it through PAGES or other Global Change organizations.

Several of the organizations most relevant to you, such as APN, START, IGBP, IAS and others are co-sponsoring this meeting (page 6). We would like to take this opportunity to sincerely thank them for their generous support, which allows us to assemble this truly international group of early-career scientists here in Goa. Most of all we thank our hosts from the National Centre for Antarctic and Ocean Research for setting us up for meeting here at this wonderful place.

We wish everyone a productive and inspiring meeting!

Thorsten Kiefer and Lucien von Gunten

PAGES Executive Director and Science Officer

Hubertus Fischer and Alan Mix

PAGES Co-Chairs

YSM Sponsors

Main Sponsors:

MoES, Ministry of Earth Sciences, India
www.dod.nic.in

NCAOR, National Centre for Antarctic and Ocean Research, Goa, India
www.ncaor.gov.in

NSF, National Science Foundation, USA
www.nsf.gov

SNSF, Swiss National Science Foundation, Switzerland
www.snf.ch

Other Sponsors:

APN, Asia-Pacific Network for Global Change Research
www.apn-gcr.org

START, System for Analysis, Research and Training
www.start.org

IGBP, International Geosphere-Biosphere Programme, Brazil Regional Office
www.inpe.br/igbp/

NOAA, National Oceanic and Atmospheric Administration, USA
www.noaa.gov

NIOT, National Institute of Ocean Technology, India
www.niot.res.in

INCOIS, Indian National Centre for Ocean Information Services, India
www.incois.gov.in

IITM, Indian Institute of Tropical Meteorology, India
www.tropmet.res.in

OCCR, Oeschger Centre for Climate Change Research, University of Bern, Switzerland
www.oeschger.unibe.ch

IAS, International Association of Sedimentologists
www.sedimentologists.org

YSM Committees and Organizers

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Alberto Reyes, *University of Wisconsin-Madison, USA (participant 1st YSM)*
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Lucien von Gunten, *Science Officer*
Saadia Iqbal, *Science Communicator*
Barbara Gerber, *Conference Coordinator*

MEETING PROGRAM

SUNDAY, 10 FEBRUARY

18:00:19:30 Ice breaker at the Zaiyo-Zuiyo lawns, International Centre Goa

MONDAY, 11 FEBRUARY

09:00-09:30 Welcome

09:30-10:00 Keynote Talk - Alan Mix: "Paleoscience - review and preview"

10:00-11:00 Oral Session

YSM06 Proxy Development, Calibration and Validation

Chair: Denis-Didier Rousseau

Reconstructing Plio-Pleistocene Intermediate Water Temperatures Using Mg/Ca of Infaunal Foraminifera (Uvigerina peregrina)
Aurora Elmore, Erin McClymont, Harry Elderfield, Sev Kender, Benjamin Petrick

Holocene Climate in Western Mongolia from an Altai Ice Core
Pierre-Alain Herren, Anja Eichler, Horst Machguth, Leonhard Tobler, Alexander Zapf, Margit Schwikowski, Tatyana Papina

Reconstructing the past millennium of hydrologic variability in the Western Tropical Pacific using the hydrogen isotopes of lipid biomarkers
Julie Richey, Julian Sachs

Climatic signal in tree-ring width chronologies of European Russia: spatial change and perspectives for paleoclimatic reconstructions
Vladimir Matskovsky

11:00-11:30 Morning Break

11:30-12:30 Poster Sessions

YSM06 Proxy Development, Calibration and Validation

Chair: Denis-Didier Rousseau

YSM06-01 *A multiproxy examination of the toarcian oceanic anoxic event, Arroyo Lapa, (North and South) Neuquen Basin, Argentina*
Aisha Al Suwaidi, François Baudin, Susana Damborenea, Stephen Hesselbo, Hugh Jenkyns, Miguel Manceñido, Richard Pancost, Alberto Riccardi, Chris Siebert

YSM06-02 *Abrupt changes in the strength of the Indian Summer Monsoon during late glacial to Holocene evidenced by episodic increases in Ayeyarwady outflow to the Andaman Sea*
Sijinkumar A.V., B.N. Nath

YSM06-03 *Developing a chrysophyte-based cold-season temperature transfer function and a calibration-in-time model to reconstruct environmental variables in Polish lakes*
Iván Hernández-Almeida, Christian Kamenik, Wojciech Tylmann, Martin Grosjean

YSM06-04 *Developing and validating diatom-based water chemistry models for Ugandan crater lakes: assessing the advantages and disadvantages of regional vs. pan-African calibration datasets*
Keely Mills, David B. Ryves

YSM06-05 *Development and application of Australian lacustrine ostracod-based transfer functions*
Chris Gouramanis, Stuart Halse, Patrick De Deckker, Daniel Wilkins

YSM06-06 *End-member modelling – a way to better understand grain size proxies in marine and terrestrial sediment archives*
Elisabeth Dietze, Boris Biskaborn, Andreas Borchers, Michael Dietze, Stephan Opitz, Janneke IJmker

YSM06-07 *Paleorainfall variations in Southern India during the past 3154 years: Evidence from Pookot Lake record*
Sandeep K, Shankar R, Warrier A K, Weijian Z, Xuefeng Lu

YSM06-08 *Recent accumulation rate and impurity seasonality derived from NEEM firn cores*
Gideon Gfeller, Matthias Bigler, Daiana Leuenberger, Olivia Mini, Hubertus Fischer

YSM06-09 *Robust grain size end-members inferred from Quaternary lacustrine sediments across the Tibetan Plateau*
Elisabeth Dietze, Bernhard Diekmann, Torsten Haberzettl, Karoline Henkel, Christian Herb, Thomas Kasper, Weilin Zhang

YSM06-10 *Spectral biases in climate proxies and reconstructions of the last millennium*
Jörg Franke, David Frank, Christoph Raible, Jan Esper, Stefan Brönnimann

YSM06-11 *Testing the tree-ring parameter Blue Intensity, a new inexpensive path towards robust low-frequency reconstructions of late Holocene summer temperatures?*
Jesper Björklund, Hans Linderholm

YSM06-12 *The missing ocean - Generation of high resolution records of sea surface temperature for the Common Era*
Jeff Salacup, Timothy Herbert, Warren Prell

YSM06-13 *Triple water vapor isotopic ($H_2^{18}O$, $HD^{16}O$, $H_2^{17}O$) measurements above the Greenland Ice Sheet and importance for interpretation of ice cores*
Hans Christian Steen-Larsen, Renato Winkler, Frederic Prié, Amaelle Landais, Valérie Masson-Delmotte, Camille Risi, Barbara Stenni

YSM06-14 *You are what you eat: Differences in the chemical composition of organic-walled dinoflagellate resting cysts and its implications for preservation*
Kara Bogus, Kenneth Neil Mertens, Johan Lauwaert, Ian C. Harding, Henk Vrielinck, Karin Zonneveld, Gerard J.M.Versteegh

YSM07 Modeling

Chair: Pascale Braconnot

YSM07-01 *Evaluation of historical climate simulation with High-resolution global atmospheric model*
Sumin Woo, Jai-Ho Oh, Kyoung-Min Lee

YSM07-02 *Influence of the tropical hydrologic cycle on Atlantic meridional overturning at the end of the last interglacial*
Benjamin Blazey, Matthias Prange, Andrè Paul, Aline Govin

MEETING PROGRAM

YSM07-03 *Meeting the challenge of global high resolution paleoclimate modelling*
Paul Spence

YSM07-04 *On the role of sea ice at the onset of the Little Ice Age*
Flavio Lehner, Andreas Born, Christoph C. Raible, Thomas F. Stocker

YSM07-05 *Modelling the influence of evolving vegetation on past greenhouse climates*
Claire Loptson, Dan Lunt

YSM07-06 *Projected 21st Century Decline Snow Cover Overlying the Arctic Sea Ice and Implications for the Sea Ice and Arctic Climate in CESM/CCSM*
Benjamin Blazey

YSM07-07 *The Tropical Pacific climate response to the changing forcing over the last glacial cycle*
William Roberts, Paul Valdes

YSM07-08 *What is the influence of Tibetan Plateau on the Asian summer monsoon? Barrier versus heating effect*
Guangshan Chen, Zhengyu Liu, John Kutzbach

12:30-13:30 Oral Session

YSM02 Regional Climate Dynamics
Chair: Olga Solomina

Sub-centennial Holocene fluctuations of Atlantic water inflow and sea ice distribution in the western Barents Sea, European Arctic
Sarah Berben, Katrine Husum, Patricia Cabedo Sanz, Simon Belt

Sahel megadrought during Heinrich Stadial 1: Evidence for a three-phase evolution of the low- andmid-level West African wind system
Ilham Bouimetarhan, Matthias Prange, Enno Schefuß, Lydie Dupont, Jörg Lippold, Stefan Mulitza, Karin Zonneveld

Precession forcing of fire activity in subtropical southern Africa over the past 170,000 years
Anne-Laure Daniau, Maria Fernanda Sánchez Goñi, Philippe Martinez, Dunia H. Urrego, Viviane Bout-Roumazeilles, Stéphanie Desprat, Jennifer Marlon

Regional monsoon dynamics from small but complex paleoclimate networks
Kira Rehfeld, Bedartha Goswami, Nora Molkenthin, Franziska Lechleitner, Sebastian F.M. Breitenbach, OlaKwiecien, Norbert Marwan, Jürgen Kurths

13:30-15:00 Lunch

15:00-16:00 Oral Sessions

YSM02 Regional Climate Dynamics (continued)
Chair: Ines Hessler

Fluctuations in the Indonesian-Australian Monsoon: New insights from the Flores stalagmite record
Nick Scroxton, Linda Ayliffe, Mike Gagan, John Hellstrom, Wahyoe Hantoro, Hamdi Rifai, Bambang Suwargardi

History of terrestrial precipitation in the Amazon basin (South America) during the last 240 ka
Aline Govin, Janis Ahrens, David Heslop, Matthias Zabel, Stefan Mulitza, Cristiano M. Chiessi

YSM07 Modeling
Chair: Pascale Braconnot

Unraveling groundwater and surface water interaction in Central Kenya Rift lakes: Implications for Paleohydrology
Lydia A. Olaka, Andreas Musolff, Ulrich Kniess

Integrated climate-proxy modeling using the isotope-enabled SPEEDY-IER with a focus on tropical climate
Sylvia Dee, David Noone, Julien Emile-Geay, Nikolaus Buenning

16:00-16:30 Afternoon Break

16:30-17:15 The Art of Reviewing
Alicia Newton, Denis-Didier Rousseau and Chris Turney. Moderation: Alberto Reyes

17:15-17:45 The Art of Sharing Data
David Anderson

17:45-18:45 Breakout Groups

19:00-21:00 Boat Dinner

MEETING PROGRAM

TUESDAY, 12 FEBRUARY

09:00-10:00 Reporting from Breakout Groups

10:00-11:00 Oral Sessions

YSM01 Climate Forcings
Chair: Michael Schulz

Diatom based sea-ice reconstruction over the past 95,000 years in the Indian Ocean sector of Southern Ocean
Abhilash Nair, Rahul Mohan, M.C Manoj, Meloth Thamban

Mid- to Late Holocene temperature and salinity changes in the Southwestern Atlantic
Renata H. Nagai, Cristiano M. Chiessi, Silvia H.M. Sousa, Henning Kuhnert, Stefan Mulitza, Michel M. Mahiques

YSM04 Human-Climate-Ecosystem Interactions
Chair: Janet Wilmshurst

Regional integration of lake sediment and archaeological archives: Holocene climate variability and socio-evolutionary pathways in Cappadocia, central Anatolia
Samantha Allcock, Neil Roberts

The impact of environmental change on past human societies in the Central Peloponnese (Greece)
Ingmar Unkel, Helmut Brückner, Walter Dörfler, Christian Heymann, Oliver Nelle, Arndt Schimmelmann, HelenZagana

11:00-11:30 Morning Break

11:30-12:30 Poster Session

YSM02 Regional Climate Dynamics
Chair: Ines Hessler

YSM02-01 *A 12,000-Year-Long, Annually-Resolved Varve Record Spanning the Last Interglacial from Lake Bosumtwi, Southern Ghana*
Nicholas McKay, Jonathan Overpeck, Timothy Shanahan, John Peck, Clifford Heil, John King, Chris Scholz

YSM02-02 *A 65 ka Stalagmite Paleoclimate Record from Northern Venezuela: A Record of Caribbean Climate Change*
Julie B. Retrum, Luis A. González, R. Lawrence Edwards, Stacy M. Tincher, Hai Chang, F. Urbani

YSM02-03 *A pseudoproxy evaluation of four climate field reconstruction methods using improved emulations of real-world conditions*
Jianghao Wang, Julien Emile-Geay, Dominique Guillot, Jason E. Smerdon

YSM02-04 *Antarctic linkages to the deep water flow variability during the past 95000 years in the Indian sector ofthe Southern Ocean*
M C Manoj, Meloth Thamban, Rahul Mohan

YSM02-05 *Contrasting paleoceanographic conditions off western Sahel during Heinrich Stadial 1: A new concept for productivity development revealed by dinoflagellate cysts*
Ilham Bouimetarhan, Jeroen Groeneveld, Matthias Zabel, Lydie Dupont, Karin Zonneveld

YSM02-06 *Data and model perspectives on the Indian Ocean Zonal Mode over the past millennium*
Bronwen Konecky, James Russell, Mathias Vuille, Yongsong Huang

YSM02-07 *Deglaciation in the tropical Indian Ocean driven by interplay between the regional monsoon and global teleconnections*
Rajeev Saraswat, David Lea, Rajiv Nigam, Andreas Mackensen, Dinesh Naik

YSM02-08 *Does upstream Agulhas Current variability reflect inferred changes in Agulhas Leakage?*
Margit H. Simon, Ian R. Hall, Kristina L. Arthur, Ben Loveday, Frank J. C. Peeters, Stephen Barker, Martin Ziegler

YSM02-09 *Eastern Andean Patagonia (40º-51ºS) vegetation and climate variability during the Holocene related tosouthern westerlies fluctuations*
Gonzalo Sottile, M. Alejandra Marcos, Florencia Bamonte, Marcos Echeverría, M. Eugenia de Porras, MarcelaTonello, M. Virginia Mancini, M. Martha Bianchi

YSM02-10 *Genetic differentiation in the Patagonian-fueguian rodents* Abrothrix olivaceus *and* A. longipilis (Rodentia: Cricetidae) *associated to the major Pleistocene-Holocene climatic changes: Using molecular data to the global changing assessment*
Matias Mora

YSM02-11 *Hydrological and Climatological Changes in the Trondheimsfjord/Norway during the late Holocene inferred from Benthic Stable Isotopes and Dinocyst Assemblages*
G. Milzer, J. Giraudeau, S. Schmidt, J. Faust, J. Knies, F. Eynaud, C. Rühlemann

YSM02-12 *Incidence of the most important climatic perturbations of the late Pleistocene and early Holocene on the phylogeography and population genetics of the Talas's tuco-tuco* (Ctenomys talarum) *from the Argentinean Pampas*
Matias Mora

YSM02-13 *Late Holocene variations from Lake Rutundu, mount Kenya*
Christine Omuombo, Daniel Olago, Stephen Rucina, David Williamson

YSM02-14 *Late Holocene vegetation vis á vis climate dynamics from Hasila wetland, western Assam, NortheastIndia: Pollen and diatom record*
Swati Dixit, Samir Kumar Bera

YSM02-15 *Late Quaternary paleoceanography of the southwestern Indian Ocean*
Dinesh K. Naik, R. Saraswat, N. Khare, A.C. Pandey, A. Mackensen, R. Nigam

YSM02-16 *Late-Holocene climate variability in southern New Zealand: A multi-proxy study of laminated lake sediments from Lake Ohau to reconstruct regional climate* **Heidi Roop**, Marcus Vandergoes, Richard Levy, Gavin Dunbar, Sean Fitzsimons, Jamie Howarth, Bob Ditchburn, Gary Wilson, Jennifer Purdie

YSM02-17 *Mangrove and coastal environment changes during the Holocene in the Mahanadi Delta, India*
Shilpa Singh

YSM02-18 *Marine and terrestrial response of the Black Sea/Northern Anatolia region to rapid climatic variability during the marine isotope stage 3*
Lyudmila S. Shumilovskikh, Helge W. Arz, Hermann Behling

MEETING PROGRAM

YSM02-19 *New evidence of Holocene climate and atmospheric circulation variability, inferred from lacustrine stable isotope records from Gotland, southern Sweden*
Francesco Muschitiello, Dan Hammarlund, Barbara Wohlfarth

YSM02-20 *New Insights on Last Glacial Ice-sheet Dynamics and Retreat Deduced from Southeastern Weddell Sea Sediment*
Daniela Sprenk, Michael E. Weber, Gerhard Kuhn

YSM02-21 *Novel precipitation isotope records address a long-standing debate about East Asian cave oxygen isotope records*
Elizabeth Thomas, Steve Clemens, Tim Herbert, Yongsong Huang, Warren Prell, Jaap Sinninghe-Damsté, Youbin Sun

YSM02-22 *Permafrost and climate development in the northern Yukon since the LGM – East Beringia vs. Laurentide Ice*
Michael Fritz, Ulrike Herzschuh, Wayne Pollard, Hugues Lantuit

YSM02-23 *Reconstruction of late Quaternary climate changes as derived from a pollen record from Lahaul Himalaya, Himachal Pradesh, India*
Suman Rawat, A. K. Gupta, S. J. Sangode, N. R. Phadtare, H. C. Nainwal

YSM02-24 *Southern Westerlies postglacial dynamics at Central Chilean Patagonia (Rio Cisnes valley, 44°S)*
María Eugenia de Porras, Antonio Maldonado, Flavia Quintana, César Méndez, Omar Reyes

YSM02-25 *The late Pleistocene-Holocene climatic transition record in the alluvial sequences of central Argentina (33-38°S)*
Mehl Adriana, Zárate Marcelo

12:30-13:30 Oral Sessions

YSM05 Chronology
Chair: Alberto Reyes

U-Pb age model for an Early Pleistocene stalagmite from Corchia Cave (Italy)
Petra Bajo, Russell Drysdale, Jon Woodhead, John Hellstrom, Giovanni Zanchetta

YSM03 Global Earth-System Dynamics
Chair: Immaculate Ssemmanda

How did the late-glacial no-analog plant communities in eastern North America arise? Testing competing hypotheses through model-data comparison
Yao Liu, Simon Brewer, Stephen T. Jackson

The past relationship between temperature and sea level from proxy records and transient ice sheet modelling
Edward Gasson, Mark Siddall, Dan Lunt, David Pollard

Climate variability in West Antarctica over the last 60 thousand years and linkages to the tropics
Bradley Markle, Eric Steig, Spruce Schoenemann, Tyler J. Fudge, WAIS Divide Community Members, Ed Brook, Ken Taylor, Todd Sowers, Andtrew Schauer, Qinghua Ding, Cecilia Bitz, Emily Newsom

13:30-15:00 Lunch

15:00-16:00 Poster Sessions

YSM01 Climate Forcings
Chair: Michael Schulz

YSM01-01 *Concerted climatic and oceanic variability in tropical southeastern Africa (off Tanzania) over the past 19,000 years related to the latitudinal migration of the ITCZ: Evidence from palynology*
Ilham Bouimetarhan, Lydie Dupont, Karin Zonneveld

YSM01-02 *Detailed reconstructions of fluctuations of seven glaciers during the "Little Ice Age" in the Northern Caucasus Russian Federation*
Irina Bushueva

YSM01-03 *High resolution characterization of the Indian monsoon over the last glacial period from Bitoo Cave, northern India*
Gayatri Kathayat, Hai Cheng, Ashish Sinha, R. L. Edwards

YSM01-04 *High-resolution multi-proxy climatic reconstruction off Myanmar suggestive of climatic modulations due to solar forcing during the past ~489 years*
Rajani Panchang, Rajiv Nigam

YSM01-05 *Holocene carbon fluxes in the tropical peatlands of Southeast Asia: The contrasting roles of changingsea-level and climate*
René Dommain, Hans Joosten, Paul H. Glaser

YSM01-06 *Tracking carbon dynamics and climate forcing through Holocene peatland development by combining palaeoecological information and modern carbon flux measurements*
Paul Mathijssen, Minna Väliranta, Eerika Niemelä, Annalea Lohila, Juha-Pekka Tuovinen

YSM03 Global Earth-System Dynamics
Chair: Immaculate Ssemmanda

YSM03-01 *Analysis of the South American monsoon for the mid-Holocene considering the results of seven different PMIP3-model outputs*
Luciana Prado, Ilana Wainer, Cristiano Chiessi

YSM03-02 *Glacier expansion during the Late Quaternary in the monsoon dominated Goriganga valley, Central Himalaya, India*
Sheikh Nawaz Ali, Rabiul Biswas, Anil Shukla, Navin Juyal

YSM03-03 *Holocene Atlantic bottom water inflow at the western Barents Sea margin, European Arctic*
Diane Groot, Steffen Aagaard-Sørensen, Katrine Husum

YSM03-04 *Increase proportion of Antarctic Intermediate Water off northern Chile (7°S) in glacial periods over the past million years*
Gema Martínez-Méndez, Dierk Hebbeln, Mahyar Mohtadi, Mieke Thierens,, Frank Lamy, Tim Freudenthal

YSM03-05 *Mid-Holocene variability of the East Asian monsoon based on bulk organic $\delta^{13}C$ and C/N records from the Pearl River estuary, southern China*
Fengling Yu, Yongqiang Zong, Jeremy M. Lloyd, Melanie J. Leng, Adam D. Switzer, Wyss W.-S. Yim, Guangqing Huang

MEETING PROGRAM

YSM03-06 *Norwegian Research School in Climate Dynamics (ResClim)*
Sarah Berben, Tore Furevik

YSM03-07 *Understanding the range of climates that can be simulated by perturbing uncertain climate parameters within their range of uncertainty for the early Eocene warm paleoclimate*
Navjit Sagoo, Paul Valdes, Rachel Flecker

YSM04 Human-Climate-Ecosystem Interactions
Chair: Janet Wilmshurst

YSM04-01 *Holocene vegetation, climate, and disturbance history from the subalpine ecozone of the Colorado Plateau, USA*
Jesse Morris, Andrea Brunelle, Mitchell Power

YSM04-02 *Lake Geneva sediments as archive for past environmental changes and human activity since the last 3000 years*
Katrina Kremer, Juan Pablo Corella, Stéphanie Girardclos

YSM04-03 *Late Holocene Hypolimnetic Anoxia in Lake Victoria at Napoleon Gulf as inferred from Geochemical Proxies*
Morgan Andama, Julius B. Lejju, Casim Umba Tolo, Grace Kagoro-Rugunda, Immaculate Ssemmanda, Janet Ayebare

YSM04-04 *Late Pleistocene to Holocene climate and seasonality in North Africa from $\delta^{18}O$, $\delta^{13}C$ and Mg/Ca analysis of marine and terrestrial mollusc shells (Haua Fteah, Libya)*
Amy Prendergast, Rhiannon Stevens, Tamsin O'Connell, Chris Hunt, Graeme Barker

YSM04-05 *Recent climate change in West Africa and adaptation strategies proposed by rural population*
Timothee Ourbak, Benoit Sarr

YSM04-06 *The Indian Monsoon anomaly at 4k; dynamical analogs and cultural implications*
Max Berkelhammer, Ashish Sinha

YSM05 Chronology
Chair: Alberto Reyes

YSM05-01 *Chronology of deposition of coastal Red dunes (Teri sands) in South India and its palaeoenvironmental implications*
Linto Alappat, P. Morthekai, A.Vidyasagar, S. Srinivasalu, D. V. Reddy, A.K. Singhvi

YSM05-02 *Dendrochronological studies in Nepal: Current status and future prospects*
Narayan Prasad Gaire, Dinesh Raj Bhuju

YSM05-03 *Intercontinental Ash: The correlation of the Alaskan White River Ash to the European AD 860B tephra*
Britta Jensen, Sean Pyne-O'Donnell, Gill Plunkett, Duane Froese, Paul Hughes, Jonathan Pilcher, Valerie Hall

16:00-16:30 Afternoon Break

16:30-17:15 **The Art of Communicating Science**
Gavin Schmidt

17:15-17:45 **Peer Feedback, Awards, and Closing**

18:00-19:30 OSM Welcome Reception

Monday, 11 February

09:30-10:00

Keynote Talk

Alan Mix

Alan Mix is Professor of Ocean Ecology and Biogeochemistry at the College of Earth, Ocean, and Atmospheric Sciences (COAS), Oregon State University, USA, and director of the Stable Isotope Laboratory at COAS. He is co-chair of the PAGES Scientific Steering Committee and serves on the Board of Advisors at the GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany, and MARUM at the University of Bremen, Germany. His areas of expertise are paleoceanography of surface and deep-ocean circulation using micropaleontological and geochemical tracers; planktonic foraminiferal ecology and paleoecology; and paleoclimatology from cave deposits. Professor Mix holds a PhD in Geology from Columbia University, USA.

A. Mix — Oregon State University, Corvallis, USA; mix@coas.oregonstate.edu

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16:30–17:15

The Art of Reviewing

Alicia Newton

Alicia Newton is Associate Editor at *Nature Geoscience*. A graduate of the University of South Carolina, her areas of research include Palaeozoic palaeontology and micropalaeontology, Quaternary climate and oceanographic change, and the development of palaeoceanographic proxies. She has also been active in secondary and undergraduate geoscience education practice and pedagogy. Alicia joined *Nature Geoscience* in July 2007.

A. Newton — Nature Publishing Group, London, UK; a.newton@nature.com

Denis-Didier Rousseau

Denis-Didier Rousseau is co-editor-in-chief of *Climate of the Past*, an open access and open review journal of the European Geosciences Union (EGU). He is also President of the EGU division "Climate: Past, Present, Future division". In France, he is Director of the Environmental Research and Teaching Institute at the École normale supérieure and Officer-in-charge of Paleoclimatology, Arctic research, and Open Access Publications at the National Institute for Earth Sciences and Astronomy of the National Center for Scientific Research (CNRS). Denis is a member of the PAGES Executive Committee and co-leader of the ADOM ("Dust") working group. He was elected as Member of the Academia Europaea for "leadership in continental paleoclimatology and major contributions to its methods and results."

D.-D. Rousseau — Ecole Normale Superieure, Paris, France; rousseau@lmd.ens.fr

Chris Turney

Chris Turney is the Asian and Australasian Regional Editor for the *Journal of Quaternary Science*. He is an Australian Research Council Laureate Fellow and Professor of Climate Change at the University of New South Wales, Australia. He is a member of the PAGES Scientific Steering Committee and co-leader of the PAGES 2k Network, and the Australian coordinator of INQUA's Oz INTIMATE program. Chris' areas of expertise include climate and environmental change; human evolution, migration and adaptation; and chronology. He has written two popular science books titled *Ice, Mud and Blood: Lessons from Climates Past* and *Bones, Rocks and Stars: the Science of When Things Happened.*

C. Turney — University of New South Wales, Sydney, Australia; c.turney@unsw.edu.au

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17:15–17:45

The Art of Data Sharing

David Anderson

David Anderson is the Director for the World Data Center for Paleoclimatology, Chief of the Paleoclimatology Branch of NOAA's National Climatic Data Center, and an Associate Professor Adjoint at the University of Colorado, USA. His research interests in paleoclimatology lie in the marine geologic record of the Asian monsoons and other aspects of tropical air-sea interaction, and in the ocean's role in regulating atmospheric carbon dioxide in the past and future. He has served on national and international advisory committees for paleoclimate research, ocean research, and data management issues, and has contributed to national reports on abrupt climate change and climate extremes. David received a Ph.D. in Geological Sciences from Brown University.

D. Anderson — World Data Center for Paleoclimatology, Boulder, USA; David.M.Anderson@noaa.gov

Tuesday, 12 February

16:30-17:15

The Art of Communicating Science

Gavin Schmidt

Gavin Schmidt, based at NASA's Goddard Institute for Space Studies (GISS), is a founding editor to the blog RealClimate.org which aims to provide context and background on climate science issues often missing in popular media coverage. In 2011 he was awarded the AGU Climate Communication Prize. Gavin is co-chair of the PAGES-CLIVAR Intersection Panel. His main research interest lies in understanding the variability of the climate, both its internal variability and the response to external forcing. At GISS, he is helping to develop the GISS ocean and coupled GCMs to improve the representation of the present day climate while investigating their response to external forcing. He holds a PhD from the University College London.

G. Schmidt — NASA Goddard Institute for Space Studies, New York, USA; Gavin.A.Schmidt@nasa.gov

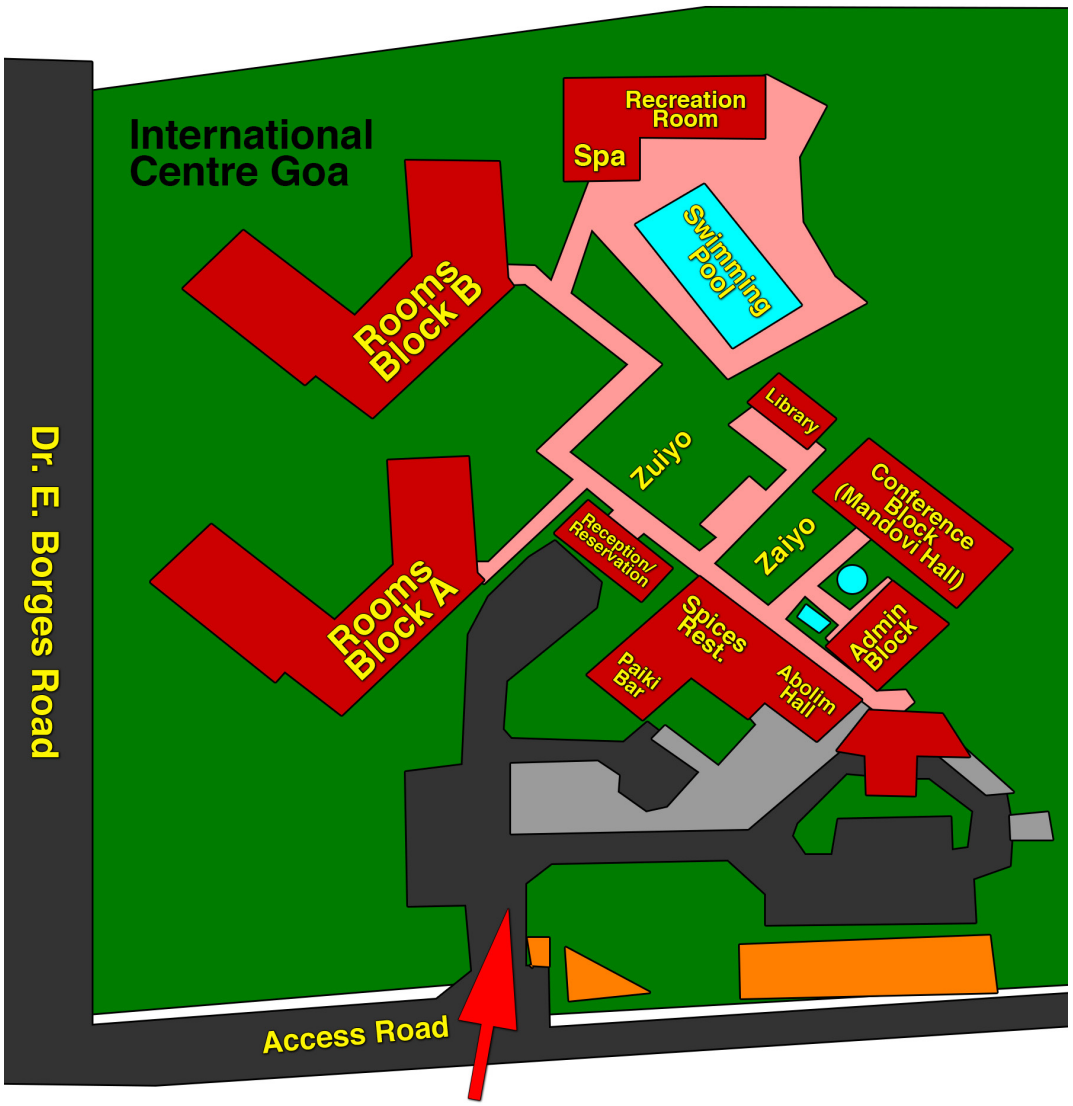
General Information and Social Activities

Local Transports
For the time of the YSM, transport is only arranged between the Cidade de Goa and the YSM venue (International Centre Goa, ICG). If you chose to stay elsewhere please arrange your own transport.

Venue
PAGES 2nd YSM will be held at the International Centre Goa, Dona Paula. All halls and outdoor venues are centrally located.

Internet Access
Free WiFi is available at the rooms and halls. WiFi access details will be provided while you check in at the front desk.

Conference Office
Conference office will be at the Business Centre opposite the *Mandovi* hall in the Conference Block.



Map 1: Meeting venue - International Centre Goa (www.pages-osm.org/ysm/goa-info/venue)

General Information and Social Activities

Registration Desk
YSM Registration will be held at the *Sal* hall at 17.00 – 19.00 hrs on 10 February 2013. Any remaining registration will be attended at the Conference Office on 11 February 2013.

Lunch and Breaks
All lunch and tea/coffee breaks are arranged at SPICES restaurant.

Welcome Reception & Conference Dinner
A welcome ice breaker with buffet dinner will be held for YSM participants on 10 February 2013 at the *Zaiyo-Zuiyo* lawns starting from 18.00 hrs.

The conference dinner YSM participants and social event will be held at 19.00-21.00 hrs on 11 February 2013 onboard a vessel at Mandovi River and Arabian Sea. Free transport will be arranged between the International Centre Goa and the landing place at the Panaji jetty.

Oral presentations
All talks will be held at *Mandovi* hall. Speakers are kindly asked to upload their presentations **no later than 15 minutes before the start of their session block**. Mac and PC laptops will be made available to speakers. Presentation can be made using Powerpoint, Keynote or Adobe software.

Slots for the talks are 15-minutes (allowing for 12-minute long talks, 2 minutes for discussion and 1 minute for switchover).

Break-out sessions will be at *Mandovi*, *Zuari* and/or *Sal*.

Poster Sessions
Poster sessions will be at *Abolim* hall. All posters will be displayed almost for the entire duration of the YSM. Posters should be put up in the morning of the first day **on the board labeled with your poster number**. Presenters should be in attendance during their poster session. All posters must be removed by the afternoon coffee break of the second day. Any leftover poster after 16.30 hrs will be discarded by the organizers!

YSM01: Climate Forcings

Convenors: Alberto Reyes, Michael Schulz

Poster

Concerted climatic and oceanic variability in tropical southeastern Africa (off Tanzania) over the past 19000 years related to the latitudinal migration of the ITCZ: Evidence from palynology

Ilham Bouimetarhan[1], Lydie Dupont[2], Karin Zonneveld[1]

[1]MARUM-Center of Marine Environmental sciences, Department of Geosciences, University of Bremen, [2]MARUM-Center of Marine Environmental sciences, University of Bremen

Few is known about the mechanisms responsible of hydrological changes and vegetation development during the late Quaternary history of tropical Southern Africa due to the scarcity of continuous and detailed high-resolution paleorecords. Here, we present a combined study of pollen and organic dinoflagellate cyst (dinocysts) assemblages from core GeoB12624-1 (08°14.05'N, 39°45.16'E, ~ 655 m water depth) retrieved from the East African continental margin off Tanzania to reconstruct paleoenvironmental changes over the past 19 thousands years. Our palynological records show that tropical Southern Africa has experienced high climate variability during the studied time interval implying significant coeval changes in continental climate and vegetation that paralleled changes in oceanic conditions. The environment shows warm and wetter conditions characterized by the dominance of river plume affinity dinocysts and the expansion of the wetter deciduous woodland formations and mangrove trees during Heinrich Stadial 1 suggesting greater monsoonal humidity. This phase of high precipitation occurred when the ITCZ migrated to the south reflecting the potential influence of high-latitude conditions on the Southeastern tropical Africa. In contrast, the Younger Dryas period shows a trend towards drier conditions when the vegetation became dominated by savanna and shrubs and the marine phytoplankton by heterotrophic dinocysts indicating strong northwesterly winds.

Poster

Detailed reconstructions of fluctuations of seven glaciers during the "Little Ice Age" in the Northern Caucasus Russian Federation

Irina Bushueva[1]

[1]Institute of Geography, Russian Academy of Sciences, Moscow, Russian Federation

The main task of this work is the development of detailed reconstructions of mountain glaciers' fluctuations with precise spatial references in the Northern Caucasus and their analyses in terms of glacier length, area and volume changes. The studied glaciers (Alibek, Ullukam, Terskol, Kashkatash, Bezingi, Mijirgi, Tsey) are situated along the Bolshoy Caucasus Range from the very west (Teberda river basin) to the east (Tsey river basin). Basing on instrumental data (since the middle of 20th century), remote sensing images (CORONA, Geoeye, Cartosat, IRS, ASTER, etc.), aerial photos of 1950s-1980s, maps (since 1887), old photographs, as well as proxy data (historical descriptions, lichenometry, dendrochronology, ^{14}C, 10Be), we reconstructed 15-20 positions of the glaciers tongues for each glacier and produced high resolution maps showing spatial variations of the glaciers since their maximum in the middle 17th or first half of 19th century. For Alibek glacier six former front positions and elevan moraines were photo-identified and dated. We obtained the carbon dating of intermorainal peat-bog (103%), moraine dating based on isotopes of ^{10}Be (1900±12) and determined minimum age of most distant moraine according to dendrochronological analysis of trees (*Abies nordmanniana*), growing on its surface (more than 200 years,). At that time (1895) the glacier was 290 m longer than today, its surface was 0.31 km^2 larger (5.94 km^2 in 1895, 5.63 km^2 in 2008). We calculated glaciers' length and area changes, using different methods (GLIMS) and analyzed advantages and disadvantages of each method in case of their application for Caucasian glaciers. Based on our measurements we evaluated changes of equilibrium line altitude and volume. Volume changes have been reconstructed using the model offered by Lüthi et al. (2010). The results of this study are important for verification of other reconstructions with the lower spatial and temporal resolutions, they provide additional points for the growth curve of lichens in the Central Caucasus, which is poorly fixed at the moment, and are important contributions to the global paleoclimatic reconstructions, where Caucasus is strongly underrepresented.

Talk

Diatom based sea-ice reconstruction over the past 95,000 years in the Indian Ocean sector of Southern Ocean

Abhilash Nair[1], Rahul Mohan[1], M.C Manoj[1], Meloth Thamban[1]

[1]National Centre for Antarctic and Ocean Research, Headland Sada, Vasco-da-Gama, Goa 403 804, India

A detailed investigation of the marine core SK 200/22a was undertaken to display the migration of Antarctic sea-ice extent in the Indian sector of Southern Ocean over the past 95,000 years. The core retrieved from sea-ice free zone near the Sub-Antarctic front (SAF) region of the Indian sector of Southern Ocean revealed ≥ 3% of the seasonal winter sea-ice indicator *Fragilariopsis curta* in the fossilized diatom assemblages. Additionally, the *Eucampia* Index showed similar temporal variations in the winter sea-ice extent. The temporal distribution of these sea-ice proxies at the core site indicate that the equatorward extent of Antarctic winter sea-ice significantly enhanced during the marine isotopic stages (MIS) 2, MIS4 as well as the late MIS 3. Comparison with the ice rafted debris

(IRD) record reveals that the major IRD events within the MIS 2 and MIS4 significantly lagged the seasonal winter sea ice extent, with enhanced ice rafting occurring at the terminations of sea-ice extent. Our study suggests that during glacial intervals, the Antarctic winter sea-ice was extended till the present sea-ice free SAF zone of the Indian sector of Southern Ocean, and subsequently retreated with the onset of inter-glacial period. The observed lag between the sea ice extent and IRD events at the core site also support that while the IRD records were dominantly controlled by the ice sheet dynamics and ocean currents, the deglacial sea surface warming seems to have influenced the equatorward extent of seasonal sea-ice.

Poster

High resolution characterization of the Indian monsoon over the last glacial period from Bitoo Cave, northern India

Gayatri Kathayat[1], Hai Cheng[1,2], Ashish Sinha[3], R. L. Edwards[2]

[1]Institute of Global Environmental Change, Xi'an Jiaotong University, Xi'an 710049, China , [2]Department of Earth Sciences, University of Minnesota, Minneapolis, MN 55455, USA, [3]Department of Earth Science, California State University Dominguez Hills, Carson, CA 90747, USA

The Indian summer monsoon (ISM) is one of largest components of the global climate system, transporting large amounts of moisture and heat northward across the Indian Ocean into India, southeastern China, and as far as northeastern China and Japan. Thus far, the longer-term climate history of the ISM has been primarily inferred from either coarsely resolved Arabian Sea sediments or from speleothem records from marginal locations in Arabian Peninsula. Here we present new high-resolution and absolute-dated $\delta^{18}O$ records from Bitoo Cave (30047'25"N, 77076'35"E, and ca. 3000 msl) that characterize the detail monsoon variability during the last glacial period. The Bitto cave is located on the southern slope of northwestern Himalayas with about 80% of annual precipitation falling between June and September. Several lines of evidences, including modern observation and model simulation, show that the $\delta^{18}O$ of precipitation in this region is primarily inversely correlated with the overall ISM intensity.
The Bitoo Cave $\delta^{18}O$ records are characterized by large amplitude fluctuations over the last glacial period on both orbital (~ 80) and millennial timescales (~ 2-30). The orbital variation broadly tracks Northern Hemisphere (NH) summer insolation without notable temporal lags, consistent with the East Asian monsoon (EAM) variability as documented from Chinese speleothem records. This observation strongly supports the notion that on orbital time scale, changes in ISM and EAM are predominantly driven by NH summer insolation. In particular, the Bitoo Cave record provides evidence for a relatively strong ISM period between 60 and 30 ka ago (MIS 3) - a time of larger global ice volume. This scenario is also consistent with the stronger EAM during this period as inferred from Hulu and Dongge cave records from China and with a number of simulation studies that indicate that increased summer solar radiation appears to be most effective in strengthening monsoons. Superimposed on the orbital scale variability, the Bitto speleothem records are also characterized by a series of millennial-length events that can be one-to-one correlated within age uncertainties to Greenland Interstadials 1 to 25 (or Chinese Interstadials A.1 to A.25) and Heinrich events 1 to 6, thus demonstrating a strong link between NH high latitude climate and low latitude monsoonal climate. A detailed comparison of the Bitoo records with Southern Hemisphere high-latitude temperature changes, documented by both sea surface temperature (SST) and Antarctic ice core records, does not appear to confirm a dominant role of Southern Hemisphere impact on the ISM through the increased cross-equatorial pressure gradient.

Poster

High-resolution multi-proxy climatic reconstruction off Myanmar suggestive of climatic modulations due to solar forcing during the past ~489 years

Rajani Panchang[1,2], Rajiv Nigam[1]

[1]National Institute of Oceanography, Dona Paula, Goa, India, [2]Agharkar Research Institute, Pune, India

A 1.78 m long sediment core was obtained at 37 m water depth on the Ayeyarwaddy Delta front, off Myanmar during the Indo-Myanmar Joint Oceanographic studies in the year 2002. The data set generated offers a resolution of ~4 years since 1513 to 1676 AD and since then ~8 years resolution unto Present. Detailed foraminiferal investigations were carried out on this core. The abundance as well as reproductive behaviour of a particular benthic foraminiferal species, Asterorotalia trispinosa indicate two significant climatic conditions in the study area since 1513 AD; a dry climate prior to 1650 AD and warm and wet climate since 1650 to present. Since 1650, 3 major freshwater pulses are recorded in the core at 1675, 1750 and 1850 AD. The oxygen isotopic ratios, Mg/Ca and Sr/Ca values as well as the pteropod and testate amoeba abundances also support these inferences. Major freshwater pulses reflected within the core at ~1675, 1765 and 1850 AD occur at an interval of 90 and 85 years respectively. However, the data set also shows several smaller fluctuations, especially in the older part of the core. The downcore data for Mean Proloculus Size (MPS) indicative of the sensitive reproductive behaviour in foraminifera was analyzed to identify cyclicity in events using the software Redfit 3.8. The MPS data revealed a ~93-year clyclicity at a 90% level of reliability. 90-year cycles are well within the purview of the Gleissberg Cycle. Variations in the radius of the sun are believed to modulate these cycles at a periodicity of 80 (±10) years vis. the 'Gleissberg Cycle'. Thus, the events seen in the core could be suggestive of solar forcing. Such 90-year cyclicities have been well documented in high-resolution climatic records, especially in those representing the past 500 years.
The records in the core under study seem to account for the period of cooling called the Little Ice Age i.e. ~16th

to the mid 19th century. It is worth exploring if this phenomenon affected the present study area in any way. Though there is no agreed consensus on an agreed date of its beginning, it is believed that it ended at ~1850 AD after which warming began. It is also agreed that there were three sunspot minima beginning at ~1650, 1770 and 1850 AD, each separated by slight warming intervals. The three fresh water pulses recorded at ~1675, 1765 and 1950 AD in the current data set data collected on the shelf off Myanmar seem to be in response to warming events associated with the Little Ice Age.
There is much speculation over the causes of the significant climatic fluctuations within the past 500 years (increased volcanic activity, sunspot activity, ENSO and change in ocean circulation patterns, etc). Researchers trying to understand the climate dynamics within this period stress upon the need for reporting high resolution and calibrated proxy records from different parts of the globe. The present work is an attempt to report such data and comparable global phenomena and ascertain the causes of these high amplitude climatic events reported here.

Poster

Holocene carbon fluxes in the tropical peatlands of Southeast Asia: The contrasting roles of changing sea-level and climate

René Dommain[1], Hans Joosten[1], Paul H. Glaser[2]

[1]Institute of Botany and Landscape Ecology, University of Greifswald, Germany, [2]Department of Earth Sciences, University of Minnesota, Minneapolis, USA

Tropical wetlands play a significant role in the global carbon cycle because they are believed to represent one of the largest natural sources of atmospheric methane. Tropical wetlands also comprise an important terrestrial carbon reservoir sequestering a large mass of atmospheric carbon dioxide in their organic soils. Changes in the extent of these wetlands have been invoked to explain Pleistocene and Holocene fluctuations in atmospheric CH_4 and CO_2 concentrations. However, the timing of tropical wetland initiation and its spatial expansion during the Late Quaternary have not been quantified based on stratigraphic evidence. Here we provide the first estimates of the Holocene spatio-temporal expansion of peatlands in Southeast Asia – one of the largest tropical wetland regions – using new and available radiocarbon-dated peat profiles. We also establish the temporal sequence of peatland initiation for Peninsular Malaysia, Sumatra and Borneo based on a collation of basal dates including newly dated cores from our field site in Borneo. In addition, we reconstruct Holocene rates of carbon sequestration and methane fluxes for this region. After deglaciation, the first peatlands of Southeast Asia formed in southern Borneo driven by the intensification of the Asian monsoon and by rapid flooding of the Sunda Shelf. However, this peatland region was too small to explain the abrupt increase of atmospheric CH_4 that occurred at the onset of the Holocene. Other tropical wetland sources most likely in northern Africa and continental southern Asia likely contributed to this rise in CH_4. The slower rate of sea-level rise after 8000 BP appears to have driven the formation of peatlands in the coastal areas of maritime Southeast Asia. The maximum rate of peatland initiation in Southeast Asia occurred between 6000 and 5000 BP when sea-level on the Sunda Shelf reached its Holocene highstand and Borneo experienced its wettest climatic phase. Significantly, this peak in peatland formation occurred nearly synchronously with the Holocene minimum in atmospheric CH_4 concentrations, implying that Southeast Asian peatlands were not an important CH_4 source at this time. Falling sea-levels after 5000 BP allowed for constant spread of coastal peatlands onto newly exposed land. These peatlands show the highest long-term rates of carbon accumulation of over 70 g C m^2 yr^1. Over 15 million ha of peatland formed in Peninsular Malaysia, Sumatra and Borneo over the Holocene and peat carbon sequestration of this region approached ca. 9 Tg C yr^1 by ~1000 BP. However, higher El Niño frequency and intensity during the past 4000 years substantially affected the peatlands of southern Borneo, which largely stopped sequestering carbon in response to higher drought stress. The areal expansion of peatlands during the Late Holocene contributed to the observed constant increase in atmospheric CH_4 concentrations over the last 3000 years, but was too small to account for the overall rise of ca. 100 ppbv CH_4 from Mid-Holocene to pre-industrial concentrations. Therefore, sea-level changes evidently exert greater control on changes in CH_4 emissions from Southeast Asian peatlands than does the often-inferred changes in precipitation related to Holocene shifts in the mean position of the Intertropical Convergence Zone.

Talk

Mid- to Late Holocene temperature and salinity changes in the Southwestern Atlantic

Renata H. Nagai[1], Cristiano M. Chiessi[2], Silvia H.M. Sousa[1], Henning Kuhnert[3], Stefan Mulitza[3], Michel M. Mahiques[1]

[1]Instituto Oceanográfico, University of São Paulo, Brazil, [2]Escola de Artes e Ciências Humanas, University of São Paulo, Brazil, [3]MARUM Institute, University of Bremen, Germany

Most of the paleoclimatic reconstructions from SE South America point to Mid- and Late Holocene climatic changes derived from orbital timescale insolation changes. Other modes of climatic variability are commonly overlooked. Here we present the stacked record of two marine sedimentary records collected in the SE Brazilian continental margin that highlight millennial timescale changes in oceanographic conditions. We measured Mg/Ca ratios and stable oxygen and carbon composition from planktonic foraminifera (*G.ruber* (pink)), from cores collected in the middle shelf of the SE Brazilian continental margin. The SE Brazilian shelf is under high hydrodynamic conditions related to the meandering pattern and eddy formation corridor of the Brazil Current (BC) which leads to warm and oligotrophic waters. However, during summer, the balance between the BC strength and prevailing NE winds promote the penetration of the South Atlantic Central Water (SACW) into the shelf, enhancing primary productivity with the input of colder,

less saline and nutrient-rich waters. Our data presents two negative temperature incursions between 5.5 and 4.5 kyr and from 2.8 kyr towards the Present, accompanied by lower salinities and enhancement primary productivity characteristic of SACW shelf penetration. We propose that these changes are a result of the strengthening of NE winds pattern as a consequence of stronger South Atlantic High system related to the occurrence of higher frequency and intensification of El-Niño like events throughout the Holocene.

Poster

Tracking carbon dynamics and climate forcing through Holocene peatland development by combining palaeoecological information and modern carbon flux measurements

Paul Mathijssen[1], Minna Väliranta[1], Eerika Niemelä[1], Annalea Lohila[2], Juha-Pekka Tuovinen[2]

[1]Environmental Change Research Unit, Department of Environmental Sciences, University of Helsinki, Helsinki, Finland, [2]Climate Change Research, Finnish Meteorological Institute, Helsinki, Finland

High latitude peatlands act as a huge reservoir of carbon, containing ca. 475 Pg of organic carbon. Pristine mires are generally regarded as long-term sinks for atmospheric carbon, because of the slow decomposition rate of organic matter under water-logged conditions. However, due to anaerobic decomposition processes, these ecosystems release methane (CH_4) to the atmosphere. Seen over a 100-year period, CH_4 has an atmospheric warming effect 25 times larger than that of carbon dioxide (CO_2). In order to better understand the role of northern mires in future global carbon budget, it is important to understand past mechanisms: how different types of mires have responded to climate changes before. Predictive models need profound background data and relevant parameters. In terms of modeling the climate-biosphere interactions, peatlands have proved to be a complicated environment where autogenic and allogenic forcing factors operate in tandem. Palaeoecological approach may provide means to understand past, present and future peatland dynamics and subsequent changes in carbon accumulation and emission patterns. In this project, by taking into account vertical and horizontal growth patterns, we establish robust three-dimensional chronologies for four peatlands in Finland to quantify carbon accumulations. Our ultimate aim is to produce Holocene-scale radiative forcing reconstructions by using the established relationships between the wetland type, vegetation composition and greenhouse gas fluxes and an existing radiative forcing model.
The first radiative forcing reconstruction experiment performed in a northern Finnish aapa mire showed that ca. 2000 years after the mire initiation the radiative forcing pattern changed from positive to negative. The result suggests that despite relatively high methane emissions minerotrophic fens can act as a climate cooling agent if the examination time-window covers the whole Holocene.

YSM02: Regional Climate Dynamics

Convenors: Ines Hessler, Liping Zhou, Olga Solomina

Poster

A 12,000-Year-Long, Annually-Resolved Varve Record Spanning the Last Interglacial from Lake Bosumtwi, Southern Ghana

Nicholas McKay[1], Jonathan Overpeck[1,2,3], Timothy Shanahan[4], John Peck[5], Clifford Heil[6], John King[6], Chris Scholz[7]

[1]Department of Geosciences, University of Arizona, [2]Department of Atmospheric Science, University of Arizona, [3]Institute of the Environment, University of Arizona, [4]Jackson School of Geosciences, University of Texas at Austin, [5]Department of Geology and Environmental Science, University of Akron, [6]Graduate School of Oceanography, University of Rhode Island , [7]Department of Earth and Environmental Sciences, Syracuse University

The impact of continued global warming on the likelihood of severe drought in sub-Saharan West Africa remains uncertain, as climate models generally do not simulate realistic climate dynamics in the region and have inconsistent projections for the future. The Last Interglacial period (LIG), occurring between 128 and 116 thousand years ago, is a partial analog for future warming because at its peak, global temperatures were slightly higher, and this warming was accentuated in Northern Hemisphere terrestrial summer temperatures. Here we present a new, annually-resolved, 12,100-year-long varve record for the LIG from Lake Bosumtwi in southern Ghana (6.5°N, 1.4°W). The abundance of terrigenous elements in the sediment, varve thickness, and the isotope geochemistry and mineralogy of authigenic carbonates in the sediment are all sensitive to changes in lake level, and record a dynamic history of hydrologic variability in the region. The LIG lake highstand was lower and shorter-lived than the the prolonged highstand in the early Holocene, and unlike the Holocene, the lake never overflowed during LIG. The overall drier conditions during the LIG are most likely driven by amplified precessional forcing during the interval, resulting in a northward shift in the rainbelt. The LIG, like the Holocene, had two distinct millennial-scale moist intervals, from 125 - 123 and 121 – 120 ka. In both the LIG and the Holocene, these peaks occurred during times of precession-driven insolation maxima in July and October, corresponding to the two rainy seasons in the modern climatology. This suggests that, at least during interglacials, prolonged wet conditions occur at the lake when rainy season insolation is highest. Over the course of the LIG, lake level generally tracked sea surface temperatures (SST) in Gulf of Guinea, including an abrupt drop in lake level that lasted about 500 years ca. 118 ka, corresponding to cooling in the Gulf of Guinea and much of the North Atlantic during the interval. The timing and duration of the event are comparable to the Late Eemian Aridity Pulse (LEAP) that is observed at several European sites, and has been interpreted to result from abrupt cooling in the North Atlantic, and possibly a reduction of Atlantic meridional overturning circulation. This scenario would likely result in drought in West Africa, so the aridity ca. 118 ka is the first indication that the LEAP occurred in Africa as well as Europe. The occurrence of quasiperiodic variability at multidecadal to centennial timescales is consistent with the hypothesis that slowly varying changes in Atlantic SST structure (e.g., the Atlantic Multidecadal Oscillation) drives long term hydrologic variability in the region. The periodicities vary over the course of the record, further implicating the role of ocean circulation.

Poster

A 65 ka Stalagmite Paleoclimate Record from Northern Venezuela: A Record of Caribbean Climate Change

Julie B. Retrum[1], Luis A. González[2], R. Lawrence Edwards[1], Stacy M. Tincher[3], Hai Chang[1], F. Urbani[4]

[1]Department of Earth Sciences, University of Minnesota, Minneapolis, Minnesota, USA, [2]Department of Geology, University of Kansas, Lawrence, Kansas, USA, [3]Encana Oil & Gas (USA) Inc., Denver, Colorado, USA, [4]Departamento de Geologia, Universidad Central de Venezuela, Escuela de Geologia, Minas, y Geofisica, Caracas, Venezuela

Three stalagmites collected from Cueva Zarraga in the Falcón mountains of northwestern Venezuelan were analyzed to determine local paleoclimatic history and help examine climate change in the Caribbean. Stalagmites ages were determined by U/Th disequilibrium and show a nearly complete Holocene record for two stalagmites. A third stalagmite has a record of ~ 65 ka, but has a significant period of non-deposition lasting from the Last Glacial Maximum at 19,820 ± 149 cal yr BP to start of the Holocene at 10,408 ± 78 cal yr BP. A brief resumption of stalagmite growth at 15,409 ± 747 cal yr BP possibly represents the Bølling-Allerød interstadial. Carbon and oxygen isotopes show a major depletion shift from the last glacial period into the Holocene, suggesting warmer and wetter conditions during the Holocene. While tempting to attribute $\delta^{13}C$ depletion to decrease of the C4 plant contribution, there is no evidence that the area experienced major vegetation changes. We attribute the $\delta^{13}C$ depletion to enhanced recycling of soil CO_2 resulting from canopy effects. The late Pleistocene record shows multiple short-term $\delta^{18}O$ enrichment events that likely correspond to Heinrich events 2 through 5. In the early Holocene, the $\delta^{18}O$ record shows a depletion trend from ~11,600, coming out of the Younger Dryas, to 8,000 cal yr BP before reaching the Holocene Thermal Maximum. A prominent $\delta^{18}O$ enrichment event is recorded in all the stalagmites that correspond to the 8200 cal yr BP event. Other short-term $\delta^{18}O$ enrichment events likely correspond to Bond events 1, 2, 5, and 6.
Today, Cueva Zarraga is at the northern extent of the Inter-Tropical Convergence Zone (ITCZ) and has two rainy seasons. The cooler and drier conditions of the last glacial period suggest a southern displacement of the ITCZ also suggested by Brazilian speleothem records that show anticorrelative trends to Cueva Zarraga. The Cariaco Basin and Cueva Zarraga records show very similar trends, except the timing of the Holocene Thermal Maximum. The Cariaco Basin Ti concentration record suggests that

the Holocene Thermal Maximum starts at ~10,000 cal yr BP, while the Cueva Zarraga record suggest a start ~2,000 cal yr BP later, suggesting there is a lag between the erosion leading to the increase in Ti delivery and isotopic composition of precipitation. The close proximity of Cueva Zarraga to Cariaco Basin may allow for a high resolution tropical terrestrial and oceanic climatic response comparison.

Poster

A pseudoproxy evaluation of four climate field reconstruction methods using improved emulations of real-world conditions

Jianghao Wang[1], Julien Emile-Geay[1], Dominique Guillot[1], Jason E. Smerdon[2]

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Multiple climate field reconstruction (CFR) techniques have been proposed in recent years to reconstruct global or hemispheric climate variability during the Common Era (the last 2000 years). Many studies have assessed the performance of these different techniques with synthetic data in pseudoproxy experiments (PPEs), but these experiments have been idealized by their choice of spatiotemporal coverage and the noise models applied to the pseudoproxy series. Here we present a pseudoproxy network based on more realistic characteristics to better discriminate between proposed CFR techniques. The network mimics the Mann et al. [2008] (hereinafter M08) proxy network and is constructed from the model output from the NCAR CCSM1.4 simulation (850-1999 CE). We adopt a spatiotemporal pseudoproxy pattern that reflects the loss of spatial sampling back in time in the M08 network and employ signal-to-noise (Gaussian white noise) ratios (SNR) that are empirically derived from correlations between each unscreened M08 proxy and the HadCRUT3v temperature field. This updated pseudoproxy construction is used to evaluate the spatiotemporal performance of four CFR techniques: (1) RegEM TTLS with fixed truncation, (2) GraphEM, (3) CCA, and (4) the Mann et al. [2009] implementation of RegEM TTLS.
We find that overall GraphEM produces more robust estimates of the temperature field at low SNR levels than other schemes and better preserves spatial information (i.e. the skill is collocated with pseudoproxies). Reconstructions with all CFR techniques tend to exhibit a warm bias (i.e. they underestimate volcanic cooling episodes) as well as underestimating the climate variability in the early half of the last millennium. Contrary to expectations, the skill does not decrease monotonically back in time, and varies substantially from century to century, even when proxy availability is time-invariant. We find that the high-amplitude climate events, which have more coherent spatial expressions than other fluctuations, get more easily resolved by the proxy network. This suggests that reconstruction skill is not only affected by the proxy availability, but is also a function of the type and amplitude of climate variations (e.g. external forcings such as volcanic eruptions).

Poster

Antarctic linkages to the deep water flow variability during the past 95000 years in the Indian sector of the Southern Ocean

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Palaeoceanographic reconstruction based on high-resolution benthic (Cibicidoides wuellerstorfi) stable isotope, mean sortable silt (mSS) and magnetic grain size records in a sediment core (SK200/22a) from the Sub-Antarctic regime of the Indian sector of Southern Ocean depict the variations in global influence of Circumpolar Deep Water (CDW) and the southward spreading of the North Atlantic Deep Water (NADW). Interestingly, the marine isotopic stage (MIS) 1 and MIS2 are characterized by near constant variations in S-S values, negating any significant changes in the flow during these periods. The MIS 2 - MIS 5 periods were characterized by a general increase in mSS value with specific increases at around 91-88 kaBP, 80-78 kaBP, 73-72 kaBP, 56-52 kaBP and between 40-37 kaBP, supporting a strengthening of bottom-current activity that triggered winnowing at these periods. The mSS records are supported by the low $\delta^{13}C$ values of C. wuellerstorfi during the glacials and some parts of MIS3 and MIS 5, confirming older nutrient-rich and poorly ventilated southern sourced deep waters at these periods. The core site is within the influence of ACC-CDW current, where it merges with NADW, apparently restricting the southward transport of northern source deep waters during these periods. The termination I is marked by decrease in flow speed and an increase in the C. wuellerstorfi $\delta^{13}C$ values. Comparison of mSS and C. wuellerstorfi $\delta^{13}C$ record with the Antarctic ice core records reveal that pulses of reduced bottom water flow of CDW/NADW are synchronous with the Antarctic warming Events (A1-A7). Accordingly, the Antarctic warming events are co-eval with a weaker bottom flow that transported finer magnetic grain size, which seem to be particularly sensitive to fluctuations of the CDW/NADW variations. The decreased flow speed during the Antarctic warm events may be due to the lower production rate of southern-sourced water or reduced density, leading to reduced geostrophic flow. During the cold phases of the Antarctic climate, enhanced southern westerly wind transport caused increased sea-ice export leading to increase in density of southern-sourced water, supporting a direct Antarctic linkage on the past changes in deep flow vigour in the study region.

Poster

Contrasting paleoceanographic conditions off western Sahel during Heinrich Stadial 1: A new concept for productivity development revealed by dinoflagellate cysts.

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A number of studies using marine sediment cores off NW Africa have suggested large changes in marine productivity during glacial periods, with abrupt variations related to the last deglaciation. However, most of these records derive from regions extending from the southern boundary of the Sahara to the Moroccan margin (between ~21°N and 34°N) where perennial upwelling prevails. Furthermore high resolution records are still lacking to define hydrographic and productivity variations during the last deglaciation, especially during Heinrich Stadial 1 (HS1) a period of vigorous atmospheric circulation and extreme aridity over the western Sahel. In the present study, the productivity record off NW Africa is extended to the continental slope off Northern Senegal at ~15°N covering the period from ~20 to 12 kyr BP, with special focus on HS1. We provide a multiproxy investigation by integrating organic-walled dinoflagellate cyst (dinocyst) associations to infer past changes in productivity with pollen/spores and Ti/Ca records to describe variations in past wind intensity and land aridity/humidity. We couple these qualitative data with quantitative information on past hydrography and productivity changes from carbon isotopes and Mg/Ca of foraminifers based temperature records to investigate the marine productivity response to past rapid climate change with emphasis on the cold extreme HS1. Using terrestrial and marine proxies from the same marine material enable the reconstruction of concerted changes in both terrestrial and oceanic conditions which offers the opportunity to establish direct land-sea correlations. Both quantitative and qualitative data suggest an internal complexity pattern where productivity dynamics are less straightforward within Heinrich Stadial 1 considered previously as an interval of high productivity as a whole.

Poster

Data and model perspectives on the Indian Ocean Zonal Mode over the past millennium

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The Indian Ocean Zonal Mode (IOZM) is a coupled oceanic-atmospheric phenomenon that strongly impacts precipitation patterns in the Indian Ocean region. On interannual timescales, modern observations have linked the IOZM with variations in the Indian, Asian, and Australasian monsoons and with the El Niño Southern Oscillation (ENSO), although exact mechanisms remain unclear. On multi-decadal to orbital timescales, an "IOZM-like" pattern has often been invoked to explain spatial patterns in precipitation in East Africa, Indonesia, Australia, and India. However, the relevance of an IOZM-like mode to regional rainfall during the past millennium has yet to be confirmed from high-resolution proxy records, and the mechanisms linking the IOZM to monsoon and ENSO-like variations on paleoclimate timescales remain elusive.
The δD and $\delta^{18}O$ of precipitation in East Africa and Indonesia have been shown to reflect the IOZM and other regional convective processes, suggesting that continental proxy reconstructions using stable H and O isotopes may track the IOZM. In this study, we assess the role of the IOZM in rainfall variations in the Indian Ocean region over the past millennium using (1) a synthesis of 1-2 kyr continental proxy reconstructions from East Africa and western Indonesia, and (2) an isotope-enabled atmospheric general circulation model experiment from 1870-2003 by the Stable Water Isotope INtercomparison Group (SWING). We present recent reconstructions from lake sediments based on the δD of terrestrial plant wax compounds, which reflects the δD of precipitation. Our data reveal an intensification of the Australasian monsoon over the past millennium, bringing progressively wetter conditions and D-depleted waxes to western Indonesia starting around 950 C.E. while overall wet conditions persisted in easternmost East Africa until the end of the 19th century. Superimposed on these long-term trends are a series of pronounced, multi-decadal to centennial scale isotopic excursions that appear zonally asymmetric and possibly "IOZM-like." The zonal asymmetry is most pronounced beginning around 1400 C.E., with the onset of Little Ice Age cool conditions recorded in sea surface temperature (SST) reconstructions from the Northern Hemisphere and the Indo-Pacific Warm Pool (IPWP).
We interpret these results in light of the SWING experiment and of 20th century precipitation observations. We find that significant multi-decadal isotopic variability is associated with the IOZM in both East Africa and Indonesia; however, this relationship is non-stationary. Multi-decadal periods of weaker and stronger correlation between the IOZM and isotopes of precipitation are coherent across both sides of the Indian Ocean, suggesting that another process, possibly ENSO or connections to local and remote SSTs, may modulate the strength of the relationships between the IOZM, precipitation, and precipitation isotopes. We investigate potential mechanisms for these variations and use these findings to assess whether an IOZM-like mode may have been present during the Little Ice Age or other periods during the past millennium, and discuss the implications of our results for reconstructions and simulations of past and future climate.

Poster

Deglaciation in the tropical Indian Ocean driven by interplay between the regional monsoon and global teleconnections

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High resolution climate records of the ice age terminations from monsoon-dominated regions reveal the interplay of regional and global driving forces. Speleothem records from Chinese caves indicate that glacial terminations were interrupted by prominent weak monsoon intervals (WMI), lasting a few thousand years. Deglacial WMIs are interpreted as the result of cold temperature anomalies generated by sea ice feedbacks in the North Atlantic, most prominently during Heinrich Events. Recent modelling results suggest, however, that WMIs reflect changes in the intensity of the Indian rather than the East Asian monsoon. Here we use foraminiferal trace element (Mg/Ca and Ba/Ca) and stable isotope records from a sediment core off the Malabar coast in the southeastern Arabian Sea with centennial-scale resolution to test this hypothesis and to constrain the nature and timing of deglacial climate change in the tropical Indian Ocean. The Malabar records indicate that deglacial warming started at 18.6±0.6 kyr BP, within error of the onset of warming at other tropical sites as well as in Antarctica and the Southern Ocean and with a lead over atmospheric CO_2 of 1.0±0.6 kyr. The Malabar deglacial SST record is unique in character and different from other tropical climate records. Deglacial warming occurred in two steps separated by an interval of stable SST between 15.9 and 13.5 kyr BP. The Ba/Ca record, which is a measure of riverine runoff, indicates that the last ice age termination was marked by a prominent weak Indian Monsoon interval interrupted by an intense monsoon phase, as seen in speleothem records and predicted by modelling. The deglacial tropical monsoon intensification coincides with northern high latitude warming, suggesting dominant control of northern high latitude ice-sheets on tropical monsoon.

Poster

Does upstream Agulhas Current variability reflect inferred changes in Agulhas Leakage?

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The inter-basin exchange of Indian Ocean waters into the South Atlantic via the Agulhas Leakage (AL) is considered a modulator of Atlantic Meridional Overturning Circulation (AMOC). Paleoceanographic studies show that increased inputs of saline and relatively warm Agulhas Current waters are associated with late Pleistocene deglaciations. This implies that this transfer of water masses may effectively regulate the buoyancy of the (South) Atlantic Ocean, and consequently the strength of the Atlantic Meridional overturning. Recent studies suggest that the variability in the latitudinal position of the subtropical front (STF) in the Southern Ocean, act as a gatekeeper for the Agulhas retroflection and its migration is potentially modulating the amount of Agulhas leakage reaching the South Atlantic over glacial-interglacial timescales with consequences for the AMOC.
While paleoceanographic investigations have been crucial in highlighting the important role of the AL for the climate system on orbital timescales, studies identifying trigger mechanisms of AL on shorter timescales are scarce. Furthermore, reconstructions elucidating forcing mechanism connecting the Agulhas Leakage with the upstream dynamics of the current are still limited due to a lack of climate records extracted from the main trajectory of the current itself.
Our findings from a sediment core located in the main flow of the Agulhas Current (CD154 17-17K), in the SW Indian Ocean, provide new insight into the long-standing debate about what ultimately drives variability of the AL on orbital to millennial timescales.
We constructed a 100-kyr high–resolution multi-proxy record from a sediment core located in the main flow of the Agulhas Current (CD154 17-17K), offshore Eastern Cape Province and show that this record exhibits a high variability in upper ocean temperatures, salinity and foraminiferal assemblages on glacial-interglacial and millennial timescales. We argue that this upstream AC variability is linked to changes in the strength of the subtropical gyre leading to a modification of the Agulhas Return Current circulation and thus impacting the upstream AC water mass properties. These reconstructions are in agreement with numerical model simulations, which demonstrate that the vigour of the subtropical gyre is modified by intensified and/or shifted Southern Hemisphere westerlies leading to a modification of upstream Agulhas Current dynamics.
Upstream AC variability could potentially control some of the variability further downstream in the Agulhas Leakage. Therefore, our reconstructions shed new light on the temperature/salinity variability reported in the Cape Basin area and its interpretation in terms of varying leakage, implying that the records of AL at the Agulhas Bank are potentially a result of temperature/salinity shifts of the Agulhas Current as a whole.

Poster

Eastern Andean Patagonia (40º-51ºS) vegetation and climate variability during the Holocene related to southern westerlies fluctuations

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The integration of the scarce eastern side of the Andes Patagonian peat, lake and caves records offer the opportunity to get a better understanding of a regional palaeoenvironmental synthesis. The selected fossil records implied in this study are located between 40-43°S in western (WNP), central (CNP) and eastern north of Patagonia (ENP) and between 49°-51°S in western (WSP) and central (CSP) south of Patagonia. Since the early Holocene northern and southern records shows similar patterns, displacing forest and grass steppe communities eastwards and showing high fire activity. This vegetation shifts may have been forced by weaker westerlies allowing humid air masses to reach eastward. During the middle Holocene WNP registered short humid periods inferred by eastern expansion of the forest communities and low fire activity meanwhile in CNP and ENP xeric steppe communities dominate with low fire activity suggesting arid conditions by an intensification of westerly belt. This westerlies behavior is inferred in WSP by the development of dense forest and arid shrubs steppes and low fire activity. Between 3000-2000yrs BP, north and south reconstructions suggest wetter conditions possibly associated to an equatorial displacement and weakening of the westerly belt. Since the 2000 to 500yrs BP there is a similar trend from wetter to arid conditions inferred by northern and southern sequences. After the medieval warm period (last 500yrs BP) the ENP shows palynological and charcoal evidences of wetter conditions than the previous period meanwhile the WSP presents short periods of wetter conditions inferred also by glaciological records.

Talk

Fluctuations in the Indonesian-Australian Monsoon: New insights from the Flores stalagmite record

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The extension of the Flores paleomonsoon record beyond 50kyr reveals not only a new paleomonsoon record, but also new mechanisms on the influencing factors of the movement and strength of the Inter-Tropical Convergence Zone (ITCZ) and associated rainfall over the Indonesian maritime continent. Our new stable isotope record shows fluctuations in the intensity of the Flores paleomonsoon on multiple timescales: glacial/interglacial, orbital and millennial.

At both millennial and orbital timescales the new $\delta^{18}O$ record shows negative-correlation with the Chinese Hulu-Dongge speleothem record, detailing movement of the ITCZ. These latitudinal shifts show close correspondence with Heinrich Events and other Northern hemisphere glacial fluctuations. Additionally, on longer timescales, precessional changes in solar insolation exert a strong control on $\delta^{18}O$. Other positive correlations between the two records highlight potential changes in the overall strength of the monsoon. Events that appear in only one record may be indicative of more local processes and/or changes in source moisture composition, moisture trajectories or kinetics.

Often overlooked, the carbon isotope record ($\delta^{13}C$) provides a record of changes in the vegetation on Flores. i.e. The ecosystem response to the changing climatic signal seen in $\delta^{18}O$. Varying degrees of correspondence between the $\delta^{18}O$ and $\delta^{13}C$ reveal which $\delta^{18}O$ excursions are likely to be the true result of changing rainfall intensity, as well as highlighting potential leads and lags in the system.

Our results highlight the importance of regional context in interpreting stalagmite records. This is due to the complex interactions of multiple factors that all contribute towards the stable isotope signature in speleothems, which, in the tropics, are often simply interpreted as changes in rainfall intensity.

Poster

Genetic differentiation in the Patagonian-fueguian rodents Abrothrix olivaceus and A. longipilis (Rodentia: Cricetidae) associated to the major Pleistocene-Holocene climatic changes: Using molecular data to the global changing assessment.

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The biogeographic consequences of climate change have attracted considerable attention. Particularly, the "refugial debate" centers on the possible retraction of habitats to limited areas that might have functioned as refuges for many related species, especially during glaciations of the Quaternary. One prediction of such scenarios is that populations must have experienced substantial growth accompanying climatic amelioration and the occupation of newly expanded habitats. An increasing number of phylogeographical studies in Patagonia have laid a framework for testing hypotheses concerning the

impact of shifting environmental conditions on changes in the distributional ranges of the species, particularly for small mammals. Many specialists' rodent species might allow us to know how the climatic changes have limited the contraction and expansion of their populations. Assessing the phylogeographic patterns on rodent's species, I show how the response to dramatic fluctuations in climate during the late Pleistocene-Holocene has direct implications for predicting the impact of current climate change. In order to overcome this goal I combined information derived from genetic markers and demographic studies of two species of sigmodontine Patagonian rodents, Abrothrix olivaceus and Abrothrix longipilis, which have highly extended distributional ranges into Patagonia. We used nuclear DNA sequence data of the entire intron-7 of β-fibrinogen (FGB-680bp), a partial fragment of the intron-2 of alcohol dehydrogenase (ADH1-630bp), and the entire intron of T-Complex Protein (TCP10-800bp) of 130 individuals of each species from 15-20 different populations distributed across four Argentinean provinces and two Chilean regions in Patagonia. Our goal is to supplement inferences based on mtDNA to interpret the patterns of genetic structure of these species and understand the role of glacial cycles in shaping geographical genetic variation. Our main finding is that phylogeographic genetic subdivision in A. olivaceus is weaker than in A. longipilis, which shows a stronger phylogeographical signal, most probably in agreement with the hypothesis of differentiation in isolation during Pleistocene-Holocene climatic events. While A. longipilis seems to be at equilibrium between mutation and genetic drift, A. olivaceus seems to have suffered recent historical population range expansions. All intron data supported the idea of two sites as centers of population range expansions for A. olivaceus. On the other hand, A. longipilis showed distinctive ecological characteristics that appear to have limited reductions of their populations at glacial times, possibly because of its association with the Patagonian steppe (which may have expanded at glacial phases, as a result of changes in sea level). I address the value of linking population genetic inferences in these high-latitude rodent's species with the main climatic changes observed during the Pleistocene-Holocene in Patagonia.

Talk

History of terrestrial precipitation in the Amazon basin (South America) during the last 240 ka

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With the Earth's largest rainforest and highest river flow, the Amazon basin plays a key role in the global hydrologic cycle. Over the last decades, there are signs of a changing water cycle in the eastern and southern regions of the basin linked to deforestation, land use and climate change. Anthropogenic impacts do not yet seem to surpass the magnitude of natural variability of the hydrologic cycle, but model projections suggest that the basin nears a tipping point. The lack of detailed information on past natural precipitation variations and the mechanisms behind them makes assessments of modern and future changes difficult. Of the small number of records documenting lowland South American paleoclimate, most are short (i.e. < 25 ka) or discontinuous.

Here we present a 240 ka history of precipitation changes in northern South America that resolves both orbital and millennial-scale variability. Located near Barbados, the marine sediment core GeoB3938-1 (12.26°N, 58.33°W, 1972 m water-depth) receives terrigenous material from nearby rivers. We analyzed the intensities of major elements every 1 cm by X-ray Fluorescence core scanning. We also measured the major element concentrations of 35 powdered bulk sediment samples. Using a log-ratio regression approach, we derived high-resolution calibrated proportions of the elements Ca, Fe, Al, Si, Ti and K. Calibrated data indicate that the terrigenous material at our core site mainly originates from the Orinoco and Amazon Rivers and that the input of Saharan dust blown across the Atlantic Ocean is negligible over the last 240 ka.

We applied endmember unmixing analyses to the calibrated elemental dataset and reconstructed past changes in the relative proportions of the marine, Amazon and Orinoco endmembers. The proportion of Amazon material (normalized to the sum of both terrigenous components, i.e. independent of marine variations) shows changes on two different time scales.

(1) During the last 240 ka, decreased (increased) proportions of Amazon material occur during periods of low (high) boreal summer insolation. A southerly position of the Intertropical Convergence Zone (ITCZ) and intensified trade winds during these periods, strengthen the North Equatorial Counter Current and North Brazil Current retroflection. This results in a reduced amount of Amazon water transported northwestwards by the North Brazil Current and hence decreased proportions of Amazon material at our study site.

(2) The relationship with insolation weakens during glacial times and is overprinted by millennial-scale variability. Increased input of Amazon material occurs during most of the Heinrich Stadials (HS) in the last 65 ka. This result supports wet conditions controlled by the North Atlantic cooling and southward shift of the ITCZ position, as documented by existing records from South America. The large decrease in Amazon material recorded at the study site during HS3, however, suggests a more complex spatial response of South American precipitation to HS climate change.

Poster

Hydrological and Climatological Changes in the Trondheimsfjord/Norway during the late Holocene inferred from Benthic Stable Isotopes and Dinocyst Assemblages

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Fjords are semi-enclosed basins surrounded by continental bedrock and are characterized by high sedimentation rates of several mm/yr. The hydrology of Norwegian fjords is linked to the North Atlantic Current (NAC) and the Norwegian Coastal Current (NCC), two major northward flowing sea surface/intermediate depth currents. The comparison of instrumental records from the Norwegian Sea and the Trondheimsfjord suggests that changes of bottom water temperature and salinity in the fjord are related to the NAC variability. Variations in primary productivity and salinity of the surface and intermediate water masses as well as the sedimentary budget in the fjord are driven to a high extent by variabilities in river input and precipitation in the hinterland. We test the use of dinocyst assemblages and stable isotope ratios of benthic foraminifera as proxies of surface/intermediate and bottom water conditions in the Trondheimsfjord, respectively. The calibration of these two proxies against modern and recent (past 60 years) hydrological conditions is based on 60 surface sediment samples that are evenly distributed in the fjord and three multi-cores recovered from locations along the fjord's axis. The chronology of the multi-cores is based on ^{210}Pb and ^{137}Cs measurements. Regardless of the locations of the surface sediment samples with respect to the river mouths, the modern benthic δ^{18}O ratios and dinocyst assemblages show continuous gradients from the fjord's entrance toward the innermost basin. Our multi-core time series suggest that the relative influence of the bottom water temperature and salinity on the oxygen isotope signature varies according to the distance of the core location to the fjord entrance and stratification patterns. The dinocyst assemblages clearly record changes of the surface water characteristics and nutrient delivery due to river input. Since the benthic δ^{13}C ratios across the fjord vary according to the fjord's topography and the associated changes in flow speed of bottom waters (winnowing effect), we assume that temporal variations in the carbon isotope ratios at a given location are mainly recording changes in the flux of marine organic matter at the water-sediment interface as well as variable inputs of terrigenous organic matter through rivers. We use this information to reconstruct the paleohydrology and paleoenvironmental conditions in the Trondheimsfjord from a piston-core which covers the last 3175 years. This late Holocene record shows an abrupt shift from lighter to heavier δ^{18}O ratios at 1200 years BP and high amplitude variations from 1000 to 2100 cal. yr BP. This variability is discussed in view of other evidences for changes in surface water physico-chemical and productivity changes as indicated by the down-core distribution of benthic δ^{13}C ratios and dinocyst assemblages.

Poster

Incidence of the most important climatic perturbations of the late Pleistocene and early Holocene on the phylogeography and population genetics of the Talas's tuco-tuco (Ctenomys talarum) from the Argentinean Pampas.

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We examined the phylogeography of the South American subterranean rodent Ctenomys talarum (Talas's tuco-tucos) using mitochondrial DNA (mtDNA) control region (D-loop) sequences. This species is an herbivorous rodent endemic to the Province of Buenos Aires, Argentina, that lives in natural grasslands in coastal sand dune habitats and in some fragmented inland populations. Currently, this species has changed from Least Concern to Vulnerable by IUCN, considering its highly habitat fragmentation and population declining in the last decade. In this study, we 1) assessed the genetic relationship among populations of C. talarum across the entire distributional range of this species, 2) analyzed how the geological history of the habitat has affected the genetic structure and demographic history of these populations, and 3) used powerful statistical tools in phylogeography and paleoclimatology to evaluate in what way the Pleistocene and Holocene climatic changes had affected the effective population sizes in this species. Pairwise FST values showed significant differentiation among all populations studied. A complex network of haplotypes in conjunction with the AMOVA results showed high genetic subdivision and a strong phylogeographic pattern among populations of C. talarum. The overall pattern was similar to that expected under the isolation-by-distance model, suggesting equilibrium between gene flow and local genetic drift. Major geographic barriers (e.g. rivers and unsuitable habitat) in the area, in conjunction with population isolation, appeared to be associated with strong genetic differentiation among the different geographical groups. Local mismatch distributions and tests of neutrality suggest contrasting histories for different groups of populations; while some populations appeared to be characterized by demographic stability and no significant departures from neutrality, others showed departures from strict neutrality consistent with a recent demographic expansion. Finally, a close association seems to exist between the major climatic changes that occurred during the Late Pleistocene and Holocene in the central region of Argentina and the main historical demographic changes inferred from C. talarum. Bayesian Skyline Plots (BSP) showed a constant population size from mid-late Pleistocene to early Holocene; effective population sizes seem to have remained constant until an increase in population size approximately 8,000 years BP. This overall change in historical effective population size coincides with this important geological event of sand dune formation and a cycle of climatic amelioration in Argentinean Pampas. Current populations of C. talarum appear to be relicts of a more extended historical distribution along the Argentinean pampas. These

historical extinctions, however, have not erased the signature of long-term stability and geographic structure of this species along the coastal and inland distribution ranges.

Poster

Late Holocene variations from Lake Rutundu, mount Kenya

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Records of the mountainous records from the Kenyan highlands have been obtained from low-resolution sampling records with specific interest in the Quaternary climate changes. In this study, high resolution records from multi-proxy geochemical and palaeoecological account from Lake Rutundu located on the NE flank of Mt. Kenya at 3078 masl was used to reconstruct changes in the environment. The analysis was carried out on a short sediment core of 1 m that covers the late Holocene period from 2000 yrs to present. Measurements of Stable carbon-isotope ratios, total organic carbon and sediment properties present a continuous palaeo-environmental change record. The pollen data show that grasses are major constituents of the late Holocene to modern day vegetation transition. This study offers new insights into processes that may have operated in the millennial scales during the late Holocene.

Poster

Late Holocene vegetation vis á vis climate dynamics from Hasila wetland, western Assam, Northeast India: Pollen and diatom record

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Pollen and diatom observation of a 1.5 m deep sedimentary profile cored from Hasila wetland of Goalpara District, western Assam, Northeast India has revealed climate vis-à-vis vegetation succession since Late Holocene supported by contemporary pollen/ vegetation relationship in and around the wetland which could be employed as background information for the palaeoclimate studies. Enrichment of tropical mixed deciduous forest elements like *Syzygium cumini*, *Shorea robusta, Dillenia pentagyna* and *Acacia catechu* along with fair value of planktonic diatoms indicate warm and humid climatic regime during 3,570-1,950 cal years BP. Subsequently during 1,950-570 cal years BP, increased warm and humid climatic regime persisted as evidenced by relative increment in proliferation of Sal and its associates indicating final settlement of tropical mixed deciduous forest. Consistent frequency of planktonic diatoms along with high percentage of Impatiens and Myriophyllum signify high monsoonal condition corresponding to that of Medieval Warm Period (Anderson et al., 2002). The swamp level along with pastoral practice relatively improved during this phase, thus, attributable to increased SW monsoon. However, from 570 cal year BP onwards gradual deterioration of mixed deciduous forest occurred as evidenced by sudden decline in Sal and its associates along with relative increment in benthic diatom assemblage under warm and relatively drier climate. Drastic increment in *Melastoma*, *Ziziphus* and *Areca* implying forest clearance at this phase. The occurrence of degraded pollen-spore along with adequate fungal remains especially *Xylaria, Diplodia, Nigrospora, Cookeina* and Microthyriaceous fruiting body is suggestive of aerobic microbial digenesis of rich organic debris during sedimentation.

Poster

Late Quaternary paleoceanography of the southwestern Indian Ocean

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Temporal variation in planktic foraminiferal abundance, stable isotopic ratio ($\delta^{18}O$) and trace metal ratio (Mg/Ca) of *Globigerina bulloides* have been used to infer Late Quaternary history of the southwestern Indian Ocean around Agulhas Retroflection Current. The high relative abundance of *G. bulloides* during marine isotopic stages 4 and 3, as compared to the early Holocene, is interpreted as the time of increased availability of nutrients as a result of enhanced upwelling. The seawater temperature as estimated from Mg/Ca composition of *G. bulloides* during this time interval was warmer than MIS 2 and comparable with early Holocene. The $\delta^{18}O$ *G. bulloides* during MIS5 through 3 was depleted than that during early Holocene, suggesting saltier condition during the last glacial period. The presence of warm and saltier water at the core site during the glacial period suggests increased transport of warm water by the Agulhas Retroflection Current. Just prior to last glacial maximum, a sharp increase in *G. bulloides* abundance coupled with equally significant increase in the relative abundance of warm water indicator *Neogloboquadrina pachyderma* dextral, suggests warm waters with high amount of nutrients. This increase in N. pachyderma dextral abundance is, however, not supported by *G. bulloides* Mg/Ca, suggesting that the warming was more pronounced in and most likely confined to the sub-surface waters, confirming the model studies wherein it is found that the non-breaking surface wave–induced mixing in the Southern Ocean can reduce sea surface temperature and increase subsurface temperature of the upper ocean. The last glacial maximum is marked by a significant drop in *G. bulloides* abundance, indicating decreased nutrient availability. The lowest Mg/Ca *G. bulloides* seawater temperature (6.5°C) during

MIS 2 (at 21.2 kyr BP) was ~3°C cooler than that during the average early Holocene Mg/Ca SST (9.4°C). The lowest LGM Mg/Ca SST, however, was ~8°C lower than the average spring SST near the core-site, suggesting northward shift of subtropical front.

Poster

Late-Holocene climate variability in southern New Zealand: A multi-proxy study of laminated lake sediments from Lake Ohau to reconstruct regional climate

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Driving this research is the need to improve our understanding of synoptic climate systems that influence climate in southern New Zealand and to document changes in the intensity of these systems beyond the historical record. Year-to-year variability in New Zealand's climate (e.g. temperature and precipitation) is influenced by climatological patterns originating in both the tropics (El-Niño-Southern Oscillation, Interdecadal Pacific Oscillation) and the Antarctic (Southern Annular Mode). Currently, very few highly resolved climate reconstructions exist in mid-latitudes of the Southern Hemisphere. The identification of annually laminated sediments in Lake Ohau, Mackenzie Basin, New Zealand (44.234°S, 169.854°E) offers a unique opportunity to investigate changes in regional hydrology and climate, and by extension also explore connections to large-scale climate patterns. Importantly, Lake Ohau is situated east of and in the lee of the Southern Alps, rendering the region characteristically dry and sensitive to small fluctuations in precipitation and temperature.
Short cores (<6 meters) from Lake Ohau contain layered sedimentary couplets, which ^{137}Cs and ^{210}Pb analyses suggest represent annual accumulation of terrigenous sediment at an average rate of 0.5 cm a^{-1}. Core imaging (RGB, L*), density, and magnetic susceptibility data were acquired using a Geotek multi-sensor core logger. Presented here is an initial assessment of couplet characteristics based on thin-sections, grain size analysis, and the GeoTek output. Initial correlation with records of lake inflow (1924-2012), and local precipitation and temperature (1910-2012) will also be presented. These results will provide the foundation for reconstructing the longer ~1,200 year record. Future work may result in the collection of a 100+ m core, allowing for a highly resolved climate record dating to 17,000 years before present. Ultimately, this annually resolved late Holocene climate record from the Southern Hemisphere mid-latitudes will be critical for testing our understanding of the behavior of large-scale climate patterns and can be used to inform regional and global climate modeling studies.

Poster

Mangrove and coastal environment changes during the Holocene in the Mahanadi Delta, India

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Mangrove vegetation is an important component of the coastal ecosystem. The palynological studies of mangrove sediments reveal not only the past extent of mangroves but also changes of environmental conditions over time, hence they form very good archives for paleoclimatic records. The Chilka Lagoon is the largest open lagoon of Asia, declared as a Ramsar site under the convention on "Wetlands of International Importance". The pollen records and radiocarbon dates obtained from two sediment cores of the Chilka Lagoon, Mahanadi Delta, were used for reconstructing the history of mangroves in relation to climatic changes and relative sea-level fluctuations during the Holocene. Pollen and chrono-stratigraphic data indicate that diversification of mangroves at the study site took place between 8,842 to 5,134 yrs B.P. This development of mangrove dominated vegetation was due to sea-level rise followed by stabilization of marine-freshwater environment, which provided conducive environment for the optimum development of mangrove forests. After 5,134 yrs B.P., the rich mangrove vegetation started deteriorating as indicated by the poor frequencies of core mangrove pollen, probably due to changes in sea-level. An intertidal environment reappeared for a short span of time around 2,526 to 2,203 yrs B.P., resulting in the rejuvenation of the mangroves due to relative rise in sea-level, balanced influx of fresh water and warm and moist conditions. Around 2,203 yrs B.P., the deterioration of mangroves took place as a result of change in climate towards more aridity, relative sea-level fall, which was further accelerated by anthropogenic activities. The present study reveals the existence of mangroves in the area in the recent past and such investigations would also be helpful in the regeneration and restoration of mangroves around the Chilka Lagoon.

Poster

Marine and terrestrial response of the Black Sea/Northern Anatolia region to rapid climatic variability during the marine isotope stage 3

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Recent studies on SE Black Sea sediments demonstrate a powerful potential of these archives for palaeoenvironmental and palaeoclimatic reconstructions in Northern Anatolia and the Black Sea region during the

last two interglacials and Terminations I and II. Here we present the first high-resolution pollen and dinoflagellate cysts (dinocyst) records from the SE Black Sea core 25-GC1, covering the marine isotope stage (MIS) 3. In comparison to oxygen isotopes and ice-rafted debris (IRD) records from the same archive provides a better understanding of the environmental dynamics in Northern Anatolia/Black Sea region. Age-control of the time series is based on radiocarbon and tephra dates with additional tuning of the proxy records to the GICC05 time scale of the North Greenland Ice Core Project oxygen isotopes.
During the MIS 3, general cold/arid conditions in Northern Anatolia are indicated by our pollen records. The pollen spectra are dominated by *Artemisia*, Chenopodiaceae and Poaceae, suggesting dominance of steppe vegetation in Northern Anatolia. Relatively low arboreal pollen percentages reveal arid conditions during this time, whilst stable occurrence of *Fagus*, *Carpinus betulus*, Ostrya-type, *Tilia*,*Corylus* etc. indicate the existence of small euxinian forest refugia on the adjacent land. In the Black Sea, dinocysts assemblages consist of two dominant species *Pyxidinopsis psilata* and *Spiniferites cruciformis*, indicating sea-surface salinity from 0 to 12. For SSS ~12 speak occasional appearance of *Lingulodinium machaerophorum* and *Operculodinium centrocarpum* during ~63-25 ka BP. However, stable increase in concentration of freshwater algae Pediastrum and Botryococcus indicates stable freshening of surface layer of the Black Sea from 63 ka towards 25 ka BP.
High-resolution records from 25-GC1 demonstrate unstable climate conditions during the MIS 3, characterized by general cool/arid conditions with several alternating warm and cold intervals. These oscillations, known as Dansgaard-Oeschger events (D/O), are clearly reflected by e.g. oxygen isotopes, dinocysts concentrations, pollen, and IRD. Warm D/O interstadials are indicated by high dinocyst concentrations revealing enhanced primary productivity in the Black Sea. Increases in pine and oak pollen percentages during the interstadials suggest an increased temperature and/or precipitation on land. Interestingly, pollen of euxinian vegetation do not increase during the interstadials, what is likely explained by too cold and dry conditions and/or too short time for spreading of euxinian vegetation. D/O stadials are characterized by low dinocyst concentrations and high percentages of steppe pollen (*Artemisia*, Chenopodiaceae, Poaceae). Higher percentages of spores of mycorrhizal fungi *Glomus* also indicate increased soil erosion on land during these intervals. Extreme winter cooling during stadials is indicated by the high amount of IRD, transported by coastal ice to the core site. Based on our records from 25-GC1, impacts of Heinrich events in Northern Anatolia/Black Sea region were similar to those associated with other D/O stadials.
In general, multi-proxy analysis on core 25-GC1 demonstrate a high sensitivity and clear response of marine and terrestrial ecosystems of Northern Anatolia/ Black Sea region to abrupt climate changes in Northern hemisphere during MIS 3.

Poster

New evidence of Holocene climate and atmospheric circulation variability, inferred from lacustrine stable isotope records from Gotland, southern Sweden

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Isotopic analyses of lacustrine carbonates have become a routine technique in paleolimnology and are nowadays a powerful tool for reconstruction of past climate variability, providing local to regional evidence of changes in effective moisture and precipitation seasonality. Several studies from northern and central Sweden have demonstrated a close correlation between Holocene wet/dry periods and the North Atlantic atmospheric system, such as changes in air mass trajectories and the North Atlantic Oscillation modes. The few corresponding records that exist from the southern Baltic region, however, likely depict local dynamics rather than regional. We analyzed the oxygen ($\delta^{18}O$) and carbon ($\delta^{13}C$) isotope composition of lacustrine carbonates (Chara sp. and *Bithynia tentaculata*) from a lake sediment sequence (Lake Bjärsträsk) on the island of Gotland, southern Sweden. Our new seasonally-resolved isotopic records show a significant consistency with existing regional climatic reconstructions and suggest a previously not recognized linkage between climate variability in the southern Baltic region and the Siberian High pressure system at the centennial to millennial scale, and hence to large-scale circulation dynamics. Furthermore, by comparing our data to the modern climatology of southern Sweden and to Holocene regional- and global-scale climate records, we explore potential couplings of Mid- and Late-Holocene extreme summer climate conditions in northwestern Europe to orbital forcing and low-latitude atmospheric circulation dynamics. Specifically, we discuss the relationship between long-term changes in the position of the North Atlantic subtropical front and the frequency of summer blocking anticyclones over southern Sweden. Therefore, we also tentatively outline the spatial structure of predominant modes of atmospheric variability over the North Atlantic sector throughout the Holocene.

Poster

New Insights on Last Glacial Ice-sheet Dynamics and Retreat Deduced from Southeastern Weddell Sea Sediment

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Ice-sheets are very sensible to climatic, especially temperature changes. In particular, the transition from the

Last Glacial to the recent Interglacial is of main interest for scientists to predict future climate changes. The timing of the final East Antarctic Ice Sheet (EAIS) retreat at the end of the Last Glacial is still only partially understood. Deep-sea sediments from the Antarctic continental margin, SE Weddell Sea, can help to reconstruct glacial ice-sheet dynamics. The cores (e.g., PS1791-2, PS1795-2) originate from up to 300m high and up to 100 km long sediment ridges located on a terrace of the continental slope in 2500-3000 m water depth, with a channel running SE of each ridge. During the Last Glacial Maximum (LGM) when the grounded EAIS margin advanced to the shelf break, coastal polynyas formed, which were enhanced by intensified katabatic winds. This led to more sea-ice formation, which induced brine rejection. The produced dense, high salinity water masses sank down the continental slope, reworked sediments and drained as contour currents into the channels and deposited material on the ridges. These sediments are fine-grained siliciclastic varves related to seasonal velocity changes of the contour current during the LGM. The silty layers are interpreted as overspill sediments, deposited on the ridges during glacial winter, because of intensified thermohaline convection, induced by enhanced sea-ice formation. Clayey layers were accumulated during reduced thermohaline convection in the glacial summer, due to less sea-ice formation. These sediment varves are interrupted by bioturbated sediments, which were deposited during open-water conditions with less thermohaline convection, requiring an ice-sheet retreat. We used the BMPix and PEAK tools for automated varve counting and to gain more information about the thickness differences between the individual varves and their deposition time frame. In addition to that spectral analysis on the thickness variability of the varves through time reveals that sunspot cycles, e.g., the Gleissberg cycle (period near 87 yrs), are preserved in the sediment. Furthermore, sediment component analysis, mainly to identify ash layers, and physical dating methods (e. g., AMS^{14}C, ^{40}Ar/^{39}Ar on ashes) lead to the identification of chronostratigraphic marker horizons, which can help to correlate the sediment cores among each other and even with EDML ice core. This allows for a better understanding of the glacial ice-sheet dynamics during Marine Isotopic Stage 3. Also, the stratigraphic evidence from the sediment ridges can be used to evaluate the timing of the final ice-sheet retreat and potential asynchronies between the East and West Antarctic Ice Sheets.

Poster

Novel precipitation isotope records address a long-standing debate about East Asian cave oxygen isotope records

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Chinese speleothem oxygen isotopes ($\delta^{18}O_{cave}$) are well-dated, high-resolution proxies for $\delta^{18}O$ of precipitation. Although $\delta^{18}O_{cave}$ is widely interpreted as a proxy for Asian Summer Monsoon (ASM) strength, less than 50% of annual precipitation in the cave region falls during the ASM season (June, July, August). Furthermore, the phasing of $\delta^{18}O_{cave}$ relative to orbital precession, an important driver of monsoon dynamics, is different than a suite of 18 independent summer monsoon records from throughout Asia. The interpretation of $\delta^{18}O_{cave}$ as a summer monsoon proxy has therefore been a subject of debate in recent years. To inform current interpretations of existing monsoon proxies and to improve our understanding of East Asian precipitation seasonality, we generate independent precipitation isotope records for southern and central China. We analyze leaf wax hydrogen isotopes (δ^2H_{wax}) and surface temperature records at millennial-resolution from 50-350 ka, an interval during which $\delta^{18}O_{cave}$ contains the greatest variability at the precession band. δ^2H_{wax} reflects the δ^2H of precipitation that falls during the growing season, especially in regions with little groundwater input. At Weinan (34°24'N, 109°35'E), on the southern Chinese Loess Plateau, soils are well drained and plants grow during the warm summer season, with rainfall mainly from the ASM. δ^2H_{wax} at Weinan therefore records δ^2H of summer precipitation. Terrestrial leaf waxes at ODP Site 1146 in the northern South China Sea (19°27.40'N, 116°16.37'E) are derived from the Pearl River, which drains subtropical southeastern China, where plants grow year-round. δ^2H_{wax} at Site 1146 therefore reflects annually integrated precipitation isotopes, similar to $\delta^{18}O_{cave}$. We use a radiometric chronology independent of orbital tuning at Site 1146 and tune mean grain size at Weinan, which varies in phase with ice volume, to Site 1146 benthic foraminifera $\delta^{18}O$.

We use the modern spatial relationship between precipitation δ^2H and surface temperature to remove the effects of condensation temperature on δ^2H_{wax} at both study sites. The resulting $\delta^2H_{wax\text{-}T}$ records contain information regarding precipitation source area and transport distance, both important indicators of monsoon precipitation. These seasonally distinct $\delta^2H_{wax\text{-}T}$ records provide insight into current interpretations of existing $\delta^{18}O_{cave}$ and inform our understanding of precipitation seasonality in East Asia.

Poster

Permafrost and climate development in the northern Yukon since the LGM – East Beringia vs. Laurentide Ice.

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The northern Yukon Territory was only partly glaciated during the Last Glacial Maximum, whereas large parts remained ice-free. Unglaciated Beringia provided a

glacial refugium for high-latitude flora and fauna and a migration corridor for species and early men between east Siberia and the Mackenzie River. Despite its apparently outstanding position for the understanding of the regional landscape and climate development, the late Quaternary climate history at its easternmost margin is largely unknown and relies on few records.
Multi-proxy analyses on permafrost deposits, ground ice and lake sediments have been applied to reconstruct landscape and vegetation history, as well as summer temperature and precipitation changes. The interdisciplinary approach uses geophysical, sedimentological, geochemical and palynological analysis together with multivariate statistics to get a comprehensive understanding of the climatic and environmental history in the close proximity to the Laurentide Ice Sheet (LIS).
Ice-thrust sets up to 180 m above sea level have incorporated remnants of Laurentide ice, which today become exposed due to coastal erosion. Strongly negative $\delta^{18}O$ values of late Wisconsin ice wedges indicate colder-than-modern winter temperatures and probably reduced snow depths.
Herb-dominated tundra persisted until ~14.7 cal ka BP with mean July air temperatures ≤5°C colder than today. Temperatures rapidly increased during the Bølling/Allerød interstadial towards modern conditions, favoring establishment of Betula-Salix shrub tundra. Pollen-inferred temperature reconstructions recorded a pronounced Younger Dryas (YD) cold reversal in east Beringia that had not been inferred distant to the North Atlantic and Pacific oceans, so far. Summer temperatures during the YD dropped by ~1.5°C and repressed shrub growth in favor of dry and cold-adapted herb communities. Pollen assemblages show little evidence of an early Holocene Thermal Maximum, probably due to a moisture-limited spread of thermophile plants.
Basal dates on peat and ice-wedge cast deposits suggest that until 11.4 cal ka BP bioproductivity was inhibited due to continuous harsh climate conditions. The late glacial–Holocene transition was marked by higher-than-modern temperatures that led to permafrost degradation beginning no later than 11.2 cal ka BP and caused a regional thaw unconformity. Thaw lakes developed as a result of extensive thermokarst. Thermokarst evolved into ice-wedge casts and started to fill with lacustrine deposits, which were subsequently covered by rapidly accumulating peat during the Holocene Thermal Maximum. A rising permafrost table, reduced peat accumulation, and extensive ice-wedge growth resulted from climate cooling starting in the middle Holocene.
Northern Yukon Holocene moisture availability increased in response to a retreating Laurentide Ice Sheet, postglacial sea level rise, and decreasing summer insolation that in turn led to establishment of Alnus-Betula shrub tundra from ~5 cal ka BP until present, and conversion of a continental into a coastal-maritime climate near the Beaufort Sea.
The reconstruction of climate and landscape dynamics in the western Arctic and in east Beringia may contribute to unravelling the cross-linkages and feedback mechanisms between ice sheet, ocean, and permafrost since the late Wisconsin.

Talk

Precession forcing of fire activity in subtropical southern Africa over the past 170,000 years

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Subtropical southern Africa is dominated today by grass fires that are controlled by marked rainfall seasonality. This seasonality consists of wet austral summers during which fuel accumulates, and dry winters that increase fuel flammability. Under global warming scenarios, fire is projected to intensify in this region due to an increase in temperature and winter dryness. However, the strong dependence of fire on fuel build-up, and thus precipitation, greatly increases the uncertainty of such projections. To address the question of whether fire increases in the subtropics of southern Africa during periods of global warming, a continuous record of biomass burning covering several past warm periods is needed from the region. Here, we show that precession-driven rainfall seasonality is likely the main driver of fire activity over the last two climatic cycles in southern Africa. Our results are based on a reconstruction of biomass burning changes from a marine sediment core off Namibia between 170,000-30,000 years ago. During periods of precession maxima and high northern-hemisphere ice volume, fire activity increased in southern Africa. This pattern is attributed to an increase in summer rainfall and fuel accumulation led by a shift of the Intertropical Convergence Zone poleward. If correct, a decline in wildfires over the forthcoming millennia would be expected, owing to the ongoing decrease in the precession index and resulting increase in summer dryness. In addition to the natural trend, human-induced landscape fragmentation would accelerate fire reduction.

Poster

Reconstruction of late Quaternary climate changes as derived from a pollen record from Lahaul Himalaya, Himachal Pradesh, India

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The Himalaya and the Tibetan Plateau play a crucial role in driving changes in the distribution and intensity of the Indian Summer Monsoon (ISM) rain. Small scale variation in the distribution and intensity of the monsoon can have a pronounced effect on the hydrological and

socio-economic conditions of the South Asian region. The Lahaul Himalaya is situated in the rain shadow zone immediately north of the east-west oriented Rohtang Range, which restrains the entry of the ISM. The weather record of the nearest station at Koksar (977 m altitude, 32.40°N and 77.20°E, WMO station # 42065.1) located at the base of the Rohtang Pass in the downstream area of Chandra River, reveals ~1000 mm annual precipitation mainly as winter snow. However, the occasional spill over of ISM during July to September contributes around 100 mm rainfall during the increased strength of ISM in northern India and significantly controls the subsistence of Chandra Tal meadow. Whereas, the major precipitation (>800 mm) as a winter snow, occurs due to Westerly disturbances during December to early March. The centennial to millennial scale climate records since the late Pliestocene peat deposit of Lahaul valley are significantly important for reconstruction of ISM variability in the NW Himalaya and understanding the spatio- temporal distribution of ISM in the South Asian region. Pollen record of an AMS radiocarbon dated lacustrine to peat sediment situated between the Chandra Lake and left bank of Chandra River in Lahaul, Himachal Pradesh provides an undisturbed and continuous account of vegetation vis-à-vis climate record which helps to understand ISM variability in centennial to millennial scale during the last ~13,000 cal yrs BP. On the basis of changes in relative proportion of the recovered pollen percentages and pollen concentrations derived from local, regional and extra-regional, the Chandra peat profile suggests numerous transitions of ISM from strong to weak, as well as three prominent warm and wet period and five major cold-dry events recorded during the last ~13,000 cal yrs BP.

Talk

Regional monsoon dynamics from small but complex paleoclimate networks

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Understanding the timing, extent and mechanisms underlying climate transitions in the past is of great importance to assess future climate change. Paleoclimate research, both in modeling and in data analysis, has given important clues as to how the mean state of climate system parameters, like temperature or precipitation, has changed. The regional extent of these changes, and their relation to each other, remains more difficult to pinpoint, however, due to limited data availability and model restrictions.
Relevance of individual paleoclimate-proxy time series needs to be assessed by cross-checking with other datasets. However, visual comparison of climate-proxy time series is insufficient to robustly detect similarities, differences, lags or leads. Heterogeneous growth or accumulation rates often lead to irregular temporal sampling, even if only one dataset is concerned. Therefore, computing correlation values is difficult because standard methods require coeval observation times, and sampling-dependent bias effects may occur. Paleoclimate networks offer new tools to assess and visualize the spatial coherence of past climate variability as recorded in paleoclimate proxy data. The climate network approach is based on complex systems theory, where (here: Earth) system dynamics are extracted from observed time series and investigated in a spatio-temporal context. Paleoclimate networks are adapted to spatial and temporal inhomogeneous sampling. They are based on adapted linear and nonlinear association measures that are more efficient than interpolation-based measures in the presence of inter-sampling time variability. We show how time uncertainties can be incorporated in the analysis and to what extent causality or directionalities can be inferred.
We reconstruct Holocene Asian Summer monsoon dynamics from paleoclimate data and investigate spatial structures and dependences. We observe a strong influence of the Indian Summer Monsoon (ISM) on the East Asian Summer Monsoon (EASM) during the Medieval Warm Period. During the cold Little Ice Age, the ISM circulation seems to have been weaker and did not extend as far east into the EASM realm. The network structure we observe for the most recent period of warming potentially indicates an ongoing transition towards a stronger ISM penetration into China. We investigate ISM strength further back in time and evaluate how ISM-EASM interactions varied during the last deglaciation. The robustness of our results are evaluated using a semi-empirical dynamical fluid model.

Talk

Sahel megadrought during Heinrich Stadial 1: Evidence for a three-phase evolution of the low- and mid-level West African wind system

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Millennial-scale dry events in the Northern Hemisphere monsoon regions during the last glacial period are commonly attributed to southward shifts of the Intertropical Convergence Zone (ITCZ) associated with an intensification of the northeasterly (NE) trade wind system during intervals of reduced Atlantic meridional overturning circulation (AMOC). Through the use of high-resolution last deglaciation pollen records from the continental slope off Senegal, our data show that one of the longest and most extreme droughts in the western

Sahel history, which occurred during the North Atlantic Heinrich Stadial 1 (HS1), displayed a succession of three major phases. These phases progressed from an interval of maximum pollen representation of Saharan elements between ~19 and 17.4 kyr BP indicating the onset of aridity and intensified NE trade winds, followed by a millennial interlude of reduced input of Saharan pollen and increased input of Sahelian pollen, to a final phase between ~16.2 and 15 kyr BP that was characterized by a second maximum of Saharan pollen abundances. This change in the pollen assemblage indicates a mid-HS1 interlude of NE trade wind relaxation, occurring between two distinct trade wind maxima, along with an intensified mid-tropospheric African Easterly Jet (AEJ) indicating a substantial change in West African atmospheric processes. The pollen data thus suggest that although the NE trades have weakened, the Sahel drought remained severe during this time interval. Therefore, a simple strengthening of trade winds and a southward shift of the West African monsoon trough alone cannot fully explain millennial-scale Sahel droughts during periods of AMOC weakening. Instead, we suggest that an intensification of the AEJ is needed to explain the persistence of the drought during HS1. Simulations with the Community Climate System Model indicate that an intensified AEJ during periods of reduced AMOC affected the North African climate by enhancing moisture divergence over the West African realm, thereby extending the Sahel drought for about 4000 years.

Poster

Southern Westerlies postglacial dynamics at Central Chilean Patagonia (Rio Cisnes valley, 44°S)

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Central Chilean Patagonia (44-49°S, South America) is a key area to reconstruct past Southern Westerlies SW) dynamics through the last glacial-interglacial cycle since its position within their maximal zonal flow and the presence of appropriate terrestrial paleoclimate records. An interdisciplinary project including geomorphology, pollen and fire records since 19kyr BP has been carried out along the Río Cisnes valley (RCv, 44°S) to trace past environmental changes related to SW dynamics. The upper RCv was free of ice by 19kyr BP but the presence of a Late Glacial moraine in the middle RCv points out that the valley was under glacial influence until 13kyr BP. Major vegetation changes were recorded from the Late Glacial to the early Holocene when grass-shrub steppes were replaced by the Nothofagus forest-steppe ecotone in the upper RCv and the deciduous Nothofagus forest in the middle RCv. High fire frequencies associated to the Nothofagus forest development were recorded in RCv around 12.5-8.5kyr BP. A maximum development of the Nothofagus forests along the RCv was recorded during the mid-Holocene whereas high pollen assemblage variability and high fire occurrence characterized the late-Holocene. Climatic changes in RCv were mostly associated to past SW major changes previously recorded along Patagonia from the Late Glacial to the mid-Holocene. During the Late Holocene, a high record variability emerges throughout Central Chilean Patagonia probably related to (1) low magnitude SW changes probably associated to ENSO and/or SAM or (2) the complex relationships between vegetation, fire and human occupations during the last 3kyr.

Talk

Sub-centennial Holocene fluctuations of Atlantic water inflow and sea ice distribution in the western Barents Sea, European Arctic

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The North Atlantic Current (NAC) brings warm and saline water into the Arctic: this inflow is balanced by the outflow of cold surface water and by the formation of deep water to the south, which is part of the Atlantic Meridional Overturning Circulation (AMOC). Changes of the AMOC can greatly affect the global ocean circulation and climate, especially at high latitudes where the inflow of warm water, heat exchange and its effect on sea ice formation is essential for environment and society. Hence, it is crucial to establish the natural range of oceanographic fluctuations within this area. Here we investigate a continuous high resolution record from the Kveithola Through, western Barents Sea, in order to elucidate the past variability of the Atlantic Water flow and sea ice distribution throughout the Holocene.
The age model is based on nine AMS C^{14} dates, and shows sediment accumulation rates up to 0.034 mm/yr, enabling a sub-centennial resolution. Planktic foraminifera and stable isotopes were analysed. In addition, the sea ice biomarker IP_{25} is measured in order to establish a reconstruction of temporal changes in sea ice cover. Finally, Mg/Ca ratios will be presented in order to further quantify the surface water mass properties as SST and SSS.
The planktic foraminiferal stable isotopes show warming at ca. 10 000 cal yr BP followed by a cooling from ca. 8 000 cal yr BP until present day conditions. This long-term cooling correlates to the decreasing June insolation at 70° N following the orbital forcing. The planktic foraminiferal fauna has two dominating species: the polar *N. pachyderma* (sin) and the sub-polar *T. quinqueloba*. The early Holocene is dominated by *N. pachyderma* (sin), while throughout the mid and late Holocene *T. quinqueloba* dominates the fauna with values up to 75% possibly reflecting a high nutrient availability close the sea ice margin. The sea ice indicator IP_{25} shows that the core site is influenced by sea ice in the early Holocene.

From ca. 8 500 to 2 500 cal yr BP the sea ice gradually decreases. After this time the IP_{25} record increases suggest a returned appearance of sea ice although in a smaller extent than during the early Holocene.

Poster

The late Pleistocene-Holocene climatic transition record in the alluvial sequences of central Argentina (33-38°S)

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Alluvial records of central Argentina (33-38° S) have been the focus of detailed sedimentological, stratigraphical and geochronological studies along a west-east climatic transect encompassing the Andean piedmont, the central Pampas and the eastern Pampas of Buenos Aires province, from arid (200 mm/yr mean annual rainfall) to humid (900 mm/yr mean annual rainfall) dominant climatic conditions. The results obtained permitted to infer paleoenvironmental conditions during the late Pleistocene -Holocene climatic transition.
At the Andean piedmont between 33-34°S, located in the South American Arid Diagonal, the Late Pleistocene -Holocene alluvial record is composed of sandy and silty deposits accumulated by braided streams in alluvial fan environments punctuated by episodes of volcanic eruptions and the formation of limnic levels. Aeolian process dominated the piedmont during the Last Glacial Maximum and the Late Glacial contributing with fine sediments. A soil stability interval followed documented by a conspicuous paleosoil (12-10 cal yrs BP) developed in a floodplain environment. The early Holocene alluvial deposits record a higher frequency of flooding events and the development of relative more abundant limnic levels reflecting higher organic production in the alluvial environments or higher organic matter inputs to them.
The late Pleistocene -Holocene transition in the central Pampas and the eastern Pampas of Buenos Aries province is also recorded by sandy silt fluvial facies with paleosoil developed on top. In the central Pampas this paleosoil was dated in 11.601-12249 and 11.592-12.400 cal yrs BP. Paludal-like aggradation dominated during the early Holocene.
Although analyzed alluvial sequences are located in a west-east climatic transect, they show a quasi synchronic behavior during the late Pleistocene -Holocene climatic transition. Paleosoil development indicates a climatic amelioration after arid-cold Late Glacial Maximum and Late Glacial conditions; in turns early Holocene records greater vegetation productivity in the fluvial basins. The conditions reflected across the west-east transect during the early Holocene -Andean piedmont more frequent flooding events and paludal-like environments of the Pampas- might have been linked with summer rains influenced by the South Atlantic anticyclonic center favoured by a southward displacement of the South Pacific anticyclonic center as it has been suggested by many authors.

YSM03:Global Earth-System Dynamics

Convenors: Thorsten Kiefer, Immaculate Ssemmanda

Poster

Analysis of the South American monsoon for the mid-Holocene considering the results of seven different PMIP3-model outputs

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Here we present a comparison between a multiproxy data compilation and paleoclimate model simulations for eastern South America (i.e., 0°-40°S; 10°-60°W) during the mid-Holocene (7,000 – 5,000 years Before Present). To avoid model-specific biases we averaged the output from seven mid-Holocene simulated mean precipitation fields from the fifth phase of the Coupled Model Intercomparison Project (CMIP5) and third phase of Palaeoclimate Modeling Intercomparison Project (PMIP3). The model outputs analyzed correspond to the experiments of the IPSL-CM5 (Institut Pierre-Simon Laplace – Coupled Model version 5, France), MIROC-ESM (Model for Interdisciplinary Research on Climate – Earth System Model, Japan), NCAR-CCSM4 (National Center for Atmospheric Research Coupled Climate Model version 4, USA), CNRM-CM5 (Centre National de Recherches Météorologiques – Coupled Model version 5, France), FGOALS-s2 (Flexible Global Ocean-Atmosphere-Land System Model, China), HadGEM2-CC (Hadley Centre Global Environment Model version 2, Carbon Cycle configuration), and HadGEM2-ES (Hadley Centre Global Environment Model version 2, Earth System configuration). CO_2 values were the same for both mid-Holocene and Pre-industrial simulations for all models. Mid-Holocene annual precipitation anomalies were calculated by subtracting the Pre-industrial values from the mid-Holocene annual climatology.
Results are compared with proxy data obtained from a compilation derived from 83 published studies, which includes pollen assemblages, stable isotope analyses in foraminifers and speleothems, soil geochemistry, lake sediments, physico-chemical soil analyses and relative abundance of species. Proxy data were semiqualitatively classified according to their age model and sampling resolution.
When compared to modern conditions proxy data point to a drier Southern Brazil and South Atlantic Convergence Zone (SACZ), but a wetter/similar to present Northeastern Brazil. This suggests a weaker South American Monsoon (SAM) during the mid-Holocene if compared to the modern strength of the SAM. The analyzed model simulations indicate a similar pattern, with a southward shift of the Intertropical Convergence Zone during mid-Holocene, related to a weaker South Atlantic Subtropical High, and negative annual precipitation anomalies over the SACZ area. Nevertheless, regional differences between the analyzed models were clearly detected. The model ensemble precipitation mean field show a good fit with the multiproxy compilation, whereas the best fit was provided by the FGOALS-s2 individual simulation.

Talk

Climate variability in West Antarctica over the last 60 thousand years and linkages to the tropics

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Drilling of the West Antarctic Ice Sheet (WAIS) Divide ice core was completed this year, reaching a depth of 3400 m. Annual layers are detectable to at least ~30,000 years, and a preliminary timescale is in good agreement with Greenland ice core and speleothem timescales. We present the complete stable water isotope (δD, $\delta^{18}O$, d_{excess}) climate record from WAIS Divide with resolution better than 25 years per sample to 30 ka and better than 50 years per sample through the bottom of the core at 62 ka. Stable water isotopes are well-established proxies of past site temperature ($\delta^{18}O$, δD) and moisture source and transport (d_{excess}) changes. The WAIS Divide record represents the highest resolution climate record ever recovered form the Southern Hemisphere that spans the Last Glacial period and transition to the Holocene.
Deglacial warming at the West Antarctic site is shown to commence at least 1000 years earlier than previously recognized from Antarctic records. We use an objective statistical approach to identify periods of significant change in the δ^{18O} and dexcess records and highlight an apparent abrupt warming event near the beginning of Antarctic wide deglaciation. The Antarctic Cold Reversal is strongly expressed in the WAIS record and a pronounced increase in accumulation is observed near the end of the Younger Dryas (~11.7 ka). Antarctic Isotope Maximum (AIM) events, which have been related to the Northern Hemisphere (NH) Dansgaard-Oeschger (DO) events, are well resolved in the WAIS Divide record. In particular, the AIM 2 event is clearly expressed as in other Pacific and Atlantic sector cores but notably absent in Indo-Pacific cores, suggesting strong regional climate variability in Antarctica during the Last Glacial Maximum.
The $\delta^{18}O$ record and timescale reinforce the known out-of-phase relationship between Northern and Southern Hemisphere (SH) temperature during DO/AIM events, the "bi-polar seesaw" explained through ocean heat transport. In contrast, preliminary analysis of the d_{excess} record suggests a different, more in-phase relationship with NH temperature and methane during some millennial scale climate events. A pronounced step-change in the WAIS dexcess record appears to be associated with the most recent abrupt NH event at 8.2 ka, though lagging by ~ a century. While the 8.2 ka event is absent or ambiguous

in other Antarctic ice cores, the change in WAIS Divide dexcess is the most distinctive feature of the Holocene record. Similarities and differences to other Antarctic dexcess records are addressed.
The timing of changes in d_{excess} may point to changes in atmospheric circulation or the meridional temperature gradient during rapid climate change events. One hypothesis is that changes in tropical climate may directly influence atmospheric circulation near West Antarctica through known atmospheric teleconnections in the Pacific. We explore these inter-hemispheric relationships through coupled global climate model experiments using CESM1 and ECHAM. We examine the influence of freshwater hosing events in the North Atlantic and in the Southern Ocean, for which there is emerging evidence of iceberg discharge during the deglacial transition.

Poster

Glacier expansion during the Late Quaternary in the monsoon dominated Goriganga valley, Central Himalaya, India

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The Himalaya and Tibetan plateau have considerable influence on global and regional climate and may have played key role in the onset of the Quaternary glaciation. The elevated topography paved the way for glaciers, and records of past glaciation that are preserved in the region which can be used to reconstruct the past climate variability. The limited chronometric studies in central Himalaya have suggested that Central Himalaya, glacier dynamic is intimately associated with the temporal changes of monsoon-driven moisture regime
In order to test the above hypothesis, we have used detailed field stratigraphy and optical chronology of the relict moraine succession in the upper Goriganga valley to ascertain the timing and magnitude of various glacial events. Based on the stratigraphic position of moraines, morphology and the degree of vegetation cover a total of four glacial events of decreasing magnitude have been identified and are termed as Stage-I (oldest and longest) to Stage-IV (youngest and smallest).
Stage-I glaciations which is dominated by calc-silicate lithology is represented by the presence of 12.5 km long discontinuous diamictite ridge which terminates at Rilkot (~3177 m). The crystalline lithology dominated Stage-II glaciation is represented by relatively sharp crested lateral moraines that terminates around Martoli village (~3240 m). The Stage-III and IV glacial events lie proximal to the present day glacier and terminate at 3640 m and 3740 m respectively.
Stage-II moraines were found to contain ice contact sediment and have been dated to 22±1, 25±2, 22±2 and 21±2 respectively at different locations. These ages broadly correspond to the Last Glacial Maximum (LGM). This would imply that stratigraphically older Stage-I glaciations pre dates the LGM whereas the Stage-III and IV have been attributed to Holocene.
Multiple ages corresponding to the LGM are obtained for the first time from the monsoon dominated Central Himalaya on moraines that show reasonable extent of valley glaciers during the LGM. Considering that the insolation driven southwest summer monsoon was weaker during the LGM, hence the only source of moisture could be the enhanced mid-latitude westerlies. Our observations are contrary to the suggestion that central Himalayan glaciers were less extensive during the LGM due to the weak summer monsoon. However, considering that the longest Stage-I glaciations pre date the LGM whereas the Stage-III and IV glaciations post date the LGM, our study suggests that the glacier expansion in the Central Himalaya was modulated by the changing intensities of both the summer monsoon and mid-latitude westerlies.

Poster

Holocene Atlantic bottom water inflow at the western Barents Sea margin, European Arctic

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The northward flow of warm and saline Atlantic Water forms an integral part of the Atlantic meridional overturning circulation (AMOC). Variability in the AMOC can affect the convective formation of deep water in the Nordic Seas and thereby the global ocean circulation. Additionally, variations in the inflow of Atlantic Water govern the ecological conditions at higher latitudes. Hence, it is crucial to establish the natural range of oceanographic fluctuations.
Here we investigate a high resolution record from the western Barents Sea margin to elucidate any changes in the flow of Atlantic Water into the Arctic Ocean during the Holocene. Benthic foraminiferal assemblages and $\delta^{18}O$ values (*Cassidulina neoteretis*) indicate rapid bottom water warming at the start of the Holocene with a replacement of the cold water species *E. excavatum f. clavata* by species such as *C. neoteretis* and *Cassidulina reniforme*, associated with cooled Atlantic Water. From ca. ± 10.000 to 2.000 cal. yr. BP. the foraminiferal assemblage indicates stable conditions while the $\delta^{18}O$ record shows a cooling trend that can be correlated with summer insolation at this latitude following orbital forcing. The bottom water properties will furthermore be investigated using Mg/Ca ratios measured on C. neoteretis. Opposite to the stable foraminiferal assemblages, there are two large lithological changes. Around 8000 and 1500 cal. yr. BP. both the grain size and the foraminiferal productivity increase, indicating an increase in bottom current strength and more favorable living conditions. This change probably represents an amplified, regional, inflow of Atlantic Water into the Barents Sea.

Talk

How did the late-glacial no-analog plant communities in eastern North America arise? Testing competing hypotheses through model-data comparison

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Dynamic Global Vegetation Models (DGVMs) provide a mechanistic link between past environments and observed vegetation proxies (e.g. pollen), and can therefore be used to identify processes and mechanisms of past ecosystem changes. By comparing model simulations of past vegetation and actual fossil pollen records at 5 sites (Crystal Lake, IL, Appleman Lake, IN, Silver Lake, OH, Anderson Pond, TN, Cupola Pond, MO) in eastern North America, we tested competing hypotheses concerning the drivers of the no-analog plant communities during the last deglaciation.

We parameterized a DGVM, the Lund-Potsdam-Jena General Ecosystem Simulator (LPJ-GUESS) model, with selected key taxa from the late-glacial period using published data. We forced LPJ-GUESS with climate output from the SynTraCE-21 project (a transient climate simulation), downscaled to sites. Simulated plant biomass was converted into pollen composition (accounting for taxon-specific pollen productivity and dispersal ability) to compare with fossil pollen records.

Major competing hypotheses of the control of the no-analog plant communities include: (1) unique environmental conditions and gradients (e.g., different-from-modern temperature seasonality), (2) lower-than-present atmospheric CO_2 concentration, and (3) biotic top-down control. We designed simulation experiments of different environmental drivers and their combinations to evaluate the first two hypotheses.

The simulation results show that climate appears to be a major driver for the no-analog vegetation, giving rise to novel plant assemblages at multiple sites during the late-glacial period. Vegetation composition is also sensitive to inter-annual climate variability. Atmospheric CO_2 concentration had little effect on vegetation composition. The no-analog plant communities developed at different times at different sites, and with different plant composition. We are currently analyzing spatiotemporal patterns of the simulated no-analog vegetation.

Our study provides a general framework for testing ecological hypothesis over long time scales and similar applications. We acknowledge uncertainties arising from climate drivers, vegetation-model parameters, initial conditions, model process error, and other sources in our model-data comparison. Currently we are testing the relative importance of these sources of uncertainty by conducting (1) climate sensitivity runs, (2) ensemble runs to incorporate parameter uncertainties, (3) simulations with different initial conditions (states after the spin-up), and (4) simulations with other process-based vegetation models.

Poster

Increase proportion of Antarctic Intermediate Water off northern Chile (27°S) in glacial periods over the past million years

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While in the past the variability in the production of North Atlantic Deep Water was seen as the major trigger of rapid ocean circulation and climate change, processes occurring in the tropics as well as at high austral latitudes are now viewed as equally important. In addition, efforts are made towards the understanding of the role of intermediate water-mass changes in the global ocean circulation and climate. Among the intermediate water masses, Antarctic Intermediate Water (AAIW) is of particular importance. Of all it has the largest extension, forming at the Antarctic Convergence Zone and spreading as far north as 20°N. Moreover, AAIW plays an important role in the oceanic sinking of CO_2 and in rapid global-scale oceanic overturning processes. Besides, it provides a link transporting signals resulting from processes occurring at high austral latitudes to the rest of the oceans through the so-called 'ocean tunnel'. However, at present, few paleoceanographic reconstructions of the characteristics, strength and variability of intermediate waters on glacial-interglacial time scales exist, partially due to the lack of long, high-resolution sediment sequences at intermediate depths. With this contribution we aid to fill in this gap and increase our knowledge about changes in the distribution of the AAIW.

Here we present benthic stable isotope data from the long sediment core GeoB15016 (56 meters composite depth). GeoB15016 was recovered with the sea floor drill rig MARUM-MeBo at 956 m water depth, off northern Chile (27°29,48´S, 71°07,58´W). The sediments at this site presently are deposited at the lower boundary between AAIW and Pacific Deep Water (PDW), allowing long-term paleoceanographic reconstructions (orbital to sub-orbital time scales) in an area sensitive to AAIW variability.

The GeoB15016 composite record covers the time interval from 965 to 80 ka. In this interval, the benthic $\delta^{18}O$ and $\delta^{13}C$ records display orbital modulation. The benthic $\delta^{13}C$ record reveals a strong influence of PDW during interglacial periods (MIS 25 to 5) at the study site. This is indicated by the overlap in $\delta^{13}C$ values between our intermediate-depth site and deeper records in both the SE and equatorial Pacific. During glacial periods (MIS 26 to 6) the $\delta^{13}C$ records diverge, with the Geo15016 intermediate water record displaying higher $\delta^{13}C$ values. This suggests i) a shift in the mixing ratio between AAIW and PDW, with stronger influence of the more $\delta^{13}C$-enriched AAIW during glacials; or ii) changes in the properties of either water mass between glacial to interglacial conditions; or iii) a combination of both. A shift in water-mass mixing ratio could be related to a lowering of the boundary between AAIW and PDW due to global sea level change, but also to

an increased production of the glacial equivalent of AAIW. We favour and discuss in our presentation the last option.

Poster

Mid-Holocene variability of the East Asian monsoon based on bulk organic $\delta^{13}C$ and C/N records from the Pearl River estuary, southern China

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Understanding the mid-Holocene dynamics of the East Asian monsoon (EAM) is integral to improving models of the Holocene development of the global climate system. Here we reconstruct the mid-Holocene EAM history from the Pearl River estuary, southern China, using bulk organic carbon isotopes ($\delta^{13}C$), total carbon to total nitrogen (C/N) ratios and total organic carbon (TOC) concentration.. Sedimentary $\delta^{13}C$, C/N and TOC are potentially good indicators of changes in monsoonal precipitation strength. Sediments buried during a period of high precipitation exhibit a high proportion of terrigenous material, and have low $\delta^{13}C$ and high C/N, and vice versa during a period of low precipitation. Results suggest a general decreasing trend in monsoonal precipitation from 6650 to 2150 cal yr BP due to the weakening northern hemisphere insolation most likely related to the current precession circle. Superimposed on this trend are apparent dry-wet oscillations at centennial to millennial timescales most likely in response to solar activity. Mismatches between our $\delta^{13}C$ record and results from the Dongge Cave in southern China at millennial-timescales may indicate that the $\delta^{13}C$ from the Pearl River estuary reveals changes in precipitation over a broader area than the $\delta^{18}O$ from Dongge Cave.

Poster

Norwegian Research School in Climate Dynamics (ResClim)

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Northwest Europe owes its mild climate to the northward transports of heat associated with the North Atlantic storm tracks and the North Atlantic Currents. Further, it is characterized by strong annual and decadal variability, making it particularly challenging to separate anthropogenic climate changes from natural variability. Particularly strong changes in our local climate have been observed for the last couple of decades. At present we do not know to which extent this is related to anthropogenic forcing, or if the next decades will show further amplification or a return to more normal conditions. Yet the success of all future political measures will strongly depend on the right input data from the climate community, making it more than ever before important to train future generations in the complex dynamics of the climate system. Related to this complexity is the need for collaboration between scientists of various skills, whether they have their expertise in the atmosphere, ocean, sea ice, biogeochemical cycling, or in climate modelling, and a need for scientists to be able to communicate to non-scientist to a much larger extent than before. Hence the Norwegian Research School in Climate Dynamics (ResClim) was officially launched on March 13, 2009 by the rector of the University of Bergen.
Here, we would like to present an overview of the organization, its aim and objectives. ResClim is a project with 10 national partners and 7 international collaborators and is lead from the Geophysical Institute at the University of Bergen, Norway. The aim of the school is to give PhD candidates in-depth knowledge in their specific study field within climate research, trans-disciplinary knowledge in the dynamics of the entire climate system, insight into the political and societal impacts of climate change, and the necessary skills to play an active role in appropriately predicting, mitigating, and adapting to climatic and environmental change. As the school's participants encompass different disciplinary backgrounds and cultures with varying degrees of experience, ResClim provides a range of unique activities that students can integrate into their own training programme so as to accommodate specific requirements with personal interests. The activities include all kinds of courses such as intensive courses, specialized workshops, specialized and/or more generalized summer schools, outreach activities; an annual short symposium on climate change as well as an annual all-staff meeting. Finally, ResClim also provides financial support for shorter research stays and research facilities.

Talk

The past relationship between temperature and sea level from proxy records and transient ice sheet modelling

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Various forms for the past relationship between temperature and sea level have been suggested from modeling studies and syntheses of proxy data. We present results from transient ice sheet modeling of the onset of Antarctic glaciation at the Eocene-Oligocene transition. In addition we simulate the formation and retreat of the Northern Hemisphere ice sheets between the last interglacial and present.
The computational expense of running GCMs and the long

response times of ice sheets means that GCMs cannot currently be directly coupled to ice sheet models for very long simulations. This has led to steady-state simulations being performed with a constant climate forcing and no feedbacks from the ice sheets. We use a matrix of GCM solutions to force an ice sheet model, which allows feedbacks from the ice sheets on the climate system to be approximated. We have validated this approach against a suite of GCM simulations between the last interglacial and present.
The results of these simulations are presented as plots of temperature against sea level and compared with similar plots compiled from proxy records of deep sea temperature, surface temperature, ice volume and sea level. Both sources of evidence suggest that the relationship between temperature and sea level is not constant, but that there are periods when sea level is less sensitive to temperature fluctuations, whilst also suggesting the presence of large thresholds in the Earth's climate system.

Poster

Understanding the range of climates that can be simulated by perturbing uncertain climate parameters within their range of uncertainty for the early Eocene warm paleoclimate.

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Geological proxy data for the early Eocene, ~55 million years ago (Ma), indicates extensive global warmth with reduced seasonality in both the Polar Regions and continental interiors. Estimates of CO_2 levels during the early Eocene are on par with those predicted in the near future and thus the early Eocene has become an increasingly relevant area of palaeoclimate research. However, the modern generation of climate models has not satisfactorily replicated the temperature distribution inferred from the geological proxy data. This significant discrepancy between proxy data and climate models has highlighted short-comings in both the models and the proxy data. Reducing this model-data mismatch will improve our understanding of processes important in warm climates.
Our work investigates the role of climate model uncertainty in this problem. We aim to answer the question, 'are modern climate models capable of simulating the temperature distribution inferred from early Eocene proxy data?' We attempt to answer this question by perturbing a set of 10 uncertain parameters within our climate model FAMOUS (Fast Met Office/UK Universities Simulator).
We perturb the uncertain parameters simultaneously, in order to maximise the parameter space covered, and independently, to understand the specific impacts on climate. We use 560 ppm CO_2 in all our simulations which is at the lower estimate of early Eocene CO_2 concentrations. We compare our results to published proxy data.
From over 100 initial simulations only 17 simulations are successful. Of these 17, 2 different parameter sets produce promising early Eocene climates which match the proxy data well (and have negligible sea ice, warm Polar Regions and a reduced pole to equator gradient). Both simulations converge to a similar climate which is distinct from the remaining simulations and show similarities in seasonal cloud cover and similar behaviour in oceanic and atmospheric circulation.
Our results indicate that within the bounds of uncertain parameter values, it is possible to improve early Eocene climates with FAMOUS. Changes in the physical properties and behaviour of clouds are similar in both simulations which match the proxy data well. This emphasises the importance of clouds in warm climates. There are compelling arguments for different cloud behaviour and properties in the past and these results may be applicable to other palaeoclimates.

YSM04: Human-Climate-Ecosystem Interactions

Convenors: Fatima Abrantes, Janet Wilmshurst

Poster

Holocene vegetation, climate, and disturbance history from the subalpine ecozone of the Colorado Plateau, USA

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In the southwestern United States, recent and historically unprecedented forest disturbances, including wildfire and native bark beetle outbreaks, emphasize a pressing need to better understand long-term climate-ecosystem dynamics in this region. Here we present sedimentary pollen, macrofossil, and charcoal records from six lakes located in the Colorado Plateau region of Utah. Over the last ca. 10,000 years, subalpine forests were dominated by spruce (*Picea engelmannii*) with pine (*Pinus flexilis*) and fir (*Abies lasiocarpa*) co-dominant during the early and late Holocene, respectively. Fire regimes during the Holocene exhibit considerable variability. In the southern portion of the study area, fire was most frequent during the early and mid-Holocene while in the north fire was most frequent in the mid-Holocene. Fire was infrequent throughout the region during the late Holocene until the arrival of Euro-American settlers in the mid-19th Century. Our records suggest that prior to the arrival of settlers, insolation-driven changes to the intensity and frequency of El Niño/Southern Oscillation and the North American Monsoon controlled vegetation and forest disturbance dynamics. The results of this work improve the understanding of the long-term climate-ecosystem dynamics in this region from secular climate variations as well as from recent anthropogenic modifications to the environment.

Poster

Lake Geneva sediments as archive for past environmental changes and human activity since the last 3000 years

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Lake sediments are excellent archives of past climate and environmental changes and record regional variations as well as rapid and extreme events.
Lake Geneva (Switzerland-France), the largest peri-alpine lake, with a maximal water depth of 309 m, is part of the Rhone river system and was formed during the Pleistocene by glacial erosion. Our study focuses on the deepest part of the lake basin, where sedimentation is mainly controlled by fluviatil input from the Rhone and Dranse rivers. These two river systems are sensitive to regional climate variations in the alpine realm and to human activity that affect the discharge regime and sediment input into the lake.
In Lake Geneva, high resolution seismic reflection profiles reveal two distinct units in the late Holocene sedimentation history. The first unit (Unit 1) consists of a succession of five large lens-shaped seismic sub-units, characterized by transparent/chaotic seismic facies with irregular lower boundaries, interpreted as mass-movement deposits. These sub-units interbed with parallel, continuous and strong amplitude reflections, interpreted as the 'background' lake sediment. The second unit (Unit 2) consists of 5 m of 'background' seismic facies with parallel geometry, varying at dm scale between chaotic/transparent and continuous, high amplitude reflections, which is interpreted as alternating turbidite and hemipelagic layers, respectively. Thus, deep Lake Geneva sediment is mainly composed of hemipelagic deposits intercalating with turbidite layers, which are interpreted as floods- and mass movement-related deposits.
Four 7- to 12-m long sediment cores were retrieved with a modified Kullenberg system from the deepest part of Lake Geneva. These cored sediment intervals cover the last 3000 years period, as dated with four Radiocarbon ages of plant remains. Major element composition analysis was performed with X-ray fluorescence using an Avaatech core scanner at cm resolution. Magnetic susceptibility and density were measured by Geotek Multisensor Core Logger at 0.5 cm resolution.
The resulting sediment record can be interpreted as proxy of clastic variations of the inflowing rivers and due to climate variations, such as the Medieval Warm Period (MWP) and the Little Ice Age (LIA), punctuated by extreme events such as floods. However, these signals are certainly also overprinted by human activity during the last 3000 years, and particularly during last centuries with river regulation and dam building on the Rhone river.

Poster

Late Holocene Hypolimnetic Anoxia in Lake Victoria at Napoleon Gulf as inferred from Geochemical Proxies

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Lake Victoria has undergone major changes during the past three decades, 1960s to 1990s. Primary productivity of the lake appears to have risen to about 2 to 3-fold. A consequence of this increased phytobiomass production has been increased deoxygenation of the deep water. Sedimentary Fe/Mn and Total Nitrogen (TN) determined using XRF and CNS analysers respectively and AMS radiocarbon dating have provided evidence of hypolimnetic anoxia and eutrophication from nitrate input into Lake Victoria at Napoleon Gulf in Jinja for the last 4,186 years to present. The results showed that hypolimnetic anoxia at Napoleon Gulf has been relatively high ca. 4186 to 1684 yr. BP possibly due to natural causes and low between ca. 1684 to 1029 yr. BP. Anoxia drastically increased from ca. 1029 to 370 yr. BP with levels becoming relatively very high from ca. 370 yr. BP to present. This may be attributed to eutrophication from high input of nitrates possibly associated with increased anthropogenic activities towards the most recent years as there was a positive correlation between Fe/Mn and TN ($r = 0.616$, $p = 0.025$, $n = 13$) and high TN values towards the most recent years.

Poster

Late Pleistocene to Holocene climate and seasonality in North Africa from $\delta^{18}O$, $\delta^{13}C$ and Mg/Ca analysis of marine and terrestrial mollusc shells (Haua Fteah, Libya)

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The Haua Fteah cave in Libya contains one of the longest and most complete sequences of human occupation in North Africa. This rich archaeological assemblage occurs in tandem with abundant material for paleoenvironmental reconstruction. In this study, stable isotope and element ratio analyses of the archaeological mollusc assemblage from the Haua Fteah have allowed the reconstruction of paired marine and terrestrial climate records that extend from c.120,000 to c.5000 years ago. These analyses have been interpreted with reference to analogue studies on modern marine and terrestrial molluscs from Libya. In the marine topshell Osilinus turbinatus, $\delta^{18}O$ and Mg/Ca ratios record fluctuations in sea surface temperature. In the terrestrial mollusc Helix melanostoma, $\delta^{18}O$ varies according to the water ingested by the animal as the shell grows, which in turn is linked to water and air temperature at the moment of precipitation whilst $\delta^{13}C$ provides a proxy for palaeovegetation patterns and water stress. Intrashell stable isotope series from these shells record snapshots of sub-seasonal climatic variations covering rapid and profound climatic fluctuations from MIS 5 to MIS 1. This high-resolution climatic framework coupled with the well-dated record of cultural change, allows an examination of human-environment interactions during critical periods of late Pleistocene to Holocene climate change in a region of North Africa with comparatively few climate records.

Poster

Paleoenvironmental perspective on the complex dynamics of socio-ecological systems

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Understanding the coupled socio-ecological systems from an evolutionary perspective is crucial to move toward a sustainable development trajectory. Long-term ecosystem service records and evidence-based analysis provides us an opportunity to track trends, spot critical issues, and identity priorities. Here we demonstrate how paleoenvironmental records together with socioeconomic records can provide important multi-decadal perspective on ecosystem services studies. More than 50 different paleoenvironmental proxy records can be mapped on to a wide range of ecosystem services categories and sub-categories. Our results from the lower Yangtze River Basin show clear regulating services variation during the last century, especially the abrupt decline since early 1980s, which suggest the current environment is under a critical transition period. In the case of water purification, there is strong evidence that a catastrophic threshold has been transgressed within the last two decades. Trade-off patterns between provisioning services and regulating services indicate that the intensive agriculture and regional land management practices are critically unsustainable.

Poster

Recent climate change in West Africa and adaptation strategies proposed by rural population

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Climate in Sahel region of West Africa is of crucial importance for the mainly rural population, (83% of the agriculture is rain fed). The main objective of this work is to understand farmers' perception of climate change and their adaptation strategies. By interviewing 2459 farmers on their perceptions of climate change over the past 30 years, and compare it to historical climate data (rare in this part of the world compared to other regions), we show that peasants have a rather good perception of past climate variability. A designed methodology offers the

opportunity understand their vulnerability and to propose adaptation solution. Climate risks are classified and both temperature increase and precipitation variability are classified over the whole study sites as the first major risks, even if risks related to precipitation patterns (such as drought, shortening of the crop season etc are noted as more important overall).
This work is done by a compilation of 2459 interviews, done by 14 master students of the Regional Center AGRHYMET in Niamey, Niger, a technical institution of the Permanent Interstate Committee for drought control in Sahel and spans 10 countries over West Africa (Benin, Burkina Faso, Cape Verde, Chad, Guinea, Mali, Mauritania, Niger, Senegal, Togo). This study is one of the first one based on such a large number of people interviewed, the variety of localities (agro-ecological and socio economic differences between, for example herders form Niger to agriculture form Togo), which is, at the end, targeted to concrete propositions of operational projects to be achieved by field actors e.g. Mainstreaming Climate Change in the Communal Investment Plan of Diofior (Senegal), or Adaptation and restocking poultry flock in Tondikiwindi municipality (Niger).

Talk

Regional integration of lake sediment and archaeological archives: Holocene climate variability and socio-evolutionary pathways in Cappadocia, central Anatolia.

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Collaborative studies between Quaternary scientists and archaeologists increasingly provide new and informative discussions about the nature and timing of cultural change and links with variation in the natural world (particularly climate). In the Eastern Mediterranean region, human occupation has been extensive throughout the Holocene period and climatic change has repeatedly been acknowledged in the area as a fundamental component in the rise and fall of these cultures; commonly linking climate perturbations to societal collapse. The contemporaneity of changes in culture and climate however has been poorly demonstrated and palaeo-climate records have often been collected from regions distant from the human record.
Varved sediment data collected from Nar crater-lake and archaeological archives from the same region, Cappadocia (Turkey) allow these chronological discrepancies and problems with spatially variable data sets to be addressed. Recovery of an annually laminated sequence from Nar Lake provides a fine temporal detail and a well dated record of Holocene climate variability which is highly suited for studies into human/climate relationships. Variations in the frequency and amplitude of Holocene climate are demonstrated from differences in the chemical composition of varve deposits from ITRAX XRF core scanning and other sedimentary techniques. The detail of these temporally constrained records are correlated alongside settlement histories and culture change profiles to 1) gauge their development side by side; 2) investigate the sensitivity or resilience of past people to unstable climates; 3) identify when cultures were ill-prepared and fail to initiate effective management strategies during times of stress and vulnerability created by climate variability.
ITRAX scans document a shift from a predominately stable system (high authigenic Ca & Sr) to one exhibiting much higher annual variability, including clastic in-wash events, characterised by peaks in Fe, Ti, Si, K and Rb. These high detrital components indicate strong erosion input into the lake which is related, in part, to the impact of increasing human occupation and catchment use. Increased catchment sediment supply is particularly prevalent between 8800-7840 varve years (vy) B.P. and 2600-0 vy B.P. Both periods coincide with the growth of Neolithic populations and the development of obsidian 'factories' on near-by Nenezi Dağ, and the establishment of Phrygian, Persian, Hellenistic-Roman, and Byzantine rule respectively. The former may also have been influenced by volcanic activity. Less variable conditions and reduced detrital input between 7840 and ~6200 vy B.P. occurred during times when archaeological survey data suggests less intensive human occupation of central Anatolia. The Nar lake geochemical record thus records both natural (e.g. climatic) and human-induced processes, with the balance between them changing over time.

Poster

Sedimentary records in subaqueous delta response to decline sediment load from Changjiang River: evidence based on $^{210}Pb_{ex}$, ^{137}Cs and $^{239+240}Pu$

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Continental margins are well known to act as sinks for sediment and chemicals in the landscape. The East China Sea (ECS) is the most important marginal sea in the western Pacific as it is the interface between the world's largest continent (Asia-Europe) and the Pacific Ocean. Changjiang River is the largest river in Asia, and is the largest single source of sediment to the continental shelf of the ECS. Deposition of clastic sediment occurs predominantly in close proximity to estuary, resulting in discharging large quantities of sediment from Changjiang River. However, the quantity of material exported by the river is subjected to decrease substantially as a consequence of extensive anthropogenic activities within the river catchment as well as climate changes. Therefore, ten sediment cores collected from the subaqueous delta of Changjiang estuary were subjected to elucidate the sedimentary dynamics in subaqueous delta response to decline in sediment discharges. Sediment accumulation rates, determined using the isotope ^{210}Pb as well as validated through ^{137}Cs and $^{239+240}Pu$, indicate that the

subaqueous delta of Changjiang estuary is also rapidly accumulating system, with average rate 4.33 g/cm^{2}yr. Sediments on subaqueous delta are also an important sink for sediment discharges. However, as a result of decline of sediment loads, sediment process of subaqueous delta could experience change, and have non-steady-state mechanism, indicated by down-core changes in $^{210}Pb_{ex}$ profiles. The results demonstrate the decrease in sediment load has triggered erosion of delta over past decade. In addition, this study confirms that radionuclides $^{210}Pb_{ex}$, ^{137}Cs and $^{239+240}Pu$ are useful tracers to determine sediment deposition times and can provide valuable information on sedimentary processes in the marine environment.

Talk

The impact of environmental change on past human societies in the Central Peloponnese (Greece)

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Sediment cores from inland lakes typically express a more constant sedimentation rate and thus provide a more continuous palaeoenvironmental archive than alluvial or near-coastal sediment archives. The central Peloponnese has been lacking detailed palaeoenvironmental reconstructions, although a direct comparison of sedimentary and other geoarchives of climate and environmental changes against the rich archaeological and historical records of ancient Greek societies may shed new light on human-environmental interactions.
In 2010 we recovered four sediment cores from a former lake bed in the valley of Asea near Tripolis. Especially the 8 m long core Asea-1, covering the entire Holocene, has the potential to provide a detailed palaeoenvironmental reconstruction. In the same year, we also retrieved a 15.5 m long core (STY-1) at the center of Lake Stymphalia, the only remaining natural lake on the central Peloponnese and only 30 km west of the ancient city of Mycene.
Our initial work focuses on sedimentological and geochemical proxies of the last 8 ka. High-resolution AMS-^{14}C dating and Bayesian age-depth-modeling was used to establish time series of climatic and environmental variables. We attempt to correlate our records from the Peloponnese with (1) other Mediterranean and global patterns of Holocene climate change, and (2) with archaeological and historical information for this region. While there is a profound archaeological record of cultural changes in mainland Greece covering the last 4200 years BP (back to ca. 2200 cal BC), there is still a lack in linking this record with natural archives recording climatic and environmental changes, which might have influenced the cultural development. Going into more detail, we focus on the balance between sustainability and exploitation, trying to answer questions like: How did the different ancient cultures manage their water resources? How sustainable was their agricultural land use?
So far, our geochemical analyses of sediments from Lake Stymphalia have shown that the water supply in the region fluctuated over time in response to changing climate. The Rb/Sr ratio as a proxy for changes between dry/warm and wet/cold conditions indicates pronounced wet phases around 6800, 4000–3700, 3500–3000 and 500–200 cal BP, partially corresponding to known phases of rapid climate change. The geochemical data mentioned here are the starting point for a more detailed and comprehensive environmental reconstruction of the central Peloponnese.

Poster

The Indian Monsoon anomaly at 4k; dynamical analogs and cultural implications

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Widespread evidence from a number of locations throughout the Northern Hemisphere indicates the presence of a spatially expansive climate anomaly at 4,100 years BP. The climate anomalies appear within dating uncertainty of a number of major cultural changes across North Africa, the Middle East and South Asia including the de-urbanization of the expansive Indus Valley and Harappan societies of India. While climate change has long been considered a plausible explanation for the cultural changes at this time, there has hitherto been no strong evidence of changes in Indian Monsoon precipitation during this period. Furthermore, significant reductions in the flow of the major rivers of the region associated with reduced winter snowpack, significantly predate the cultural changes and therefore cannot plausibly be causally related. In this paper, a new ultra-high resolution stalagmite record from Northeast India is presented that shows the Indian Summer Monsoon experienced an excursion at 4,100 years BP whose magnitude and duration exceeds anything experienced during the entire Holocene. We present this record and discuss caveats associated with quantitatively interpreting water isotope records from India. In order to forward an understanding of the dynamics that lead to the weakened monsoon during this period, we present satellite isotope retrievals and a series of water tagging experiments with a general circulation model during recent monsoon droughts. These two tools used in conjunction shed light on how the monsoon moisture budget shifts during droughts and how these changes become manifest in regional isotope proxy records. The discussion of modern monsoon dynamics focuses on the large monsoon drought of 2009, which was the fifth largest of the instrumental period and one that serves as a powerful modern analog to the monsoon changes at 4,100 years BP.

YSM05: Chronology

Convenors: Alberto Reyes, Chris Turney

Poster

Chronology of deposition of coastal Red dunes (Teri sands) in South India and its palaeoenvironmental implications

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Red sand dunes occur in the coastal plains of Tamil Nadu in the south coast of India between the co-ordinates of 8°00′ to 9°30′ N; 77°18′ to 79° 00′ E. While most of the dunes in east and west coast of India are white and show much younger age of deposition (middle to late Holocene), the red dune sands found to have deposited since Late Pleistocene. Sections were excavated (5-12m) reaching up to the palaeo-surface as a part of a detailed investigation and samples were collected for optically stimulated luminescence dating, geochemistry, grain size and magnetic susceptibility measurements. The objectives of this study were, i) to find the onset of dune accumulation using OSL dating ii) dosimetric aspects of dune reddening and iii) changes in weathering index and geochemical proxies to constrain the humid intervals. Two representative sections (Muttom; 8°07′56″ N; 77°19′84″E and Kachanavilai, KCV-1; 8°33′51.9N; 78°00′43.0″E) from different morphological settings from east and west coast will be presented. At Muttom a 12m section comprised of partly consolidated sand at the base transiting to thin (~1m) loose sand at the top were studied. The dunes on this elevated promontory overlooking to the low lying coastal plain has the potential to preserve multiple periods of stacked records as the wind is flowing from a high energy environment to declining environment. The contact zone with bedrock over which the sand was deposited was highly weathered and deep gullies were formed in the dunes. OSL ages for the upper 5m of the section indicated sand aggradations between 18 ka to 9 ka and the loose aeolian unit at the top had an age of 0.7± 0.1ka. Bleaching experiments were carried out to check the pretext of attenuation of light due to the red coating on the sand grains, leads to incomplete bleaching of re-worked sands, on the loose, un-consolidated upper part of the deposits. It was observed that the sun lamp could bleach the luminescence signals to a near background level with in 10m of exposure on non-treated sample. The OSL ages of the upper part of the samples in Muttom section corresponds with periods of gradual strengthening of monsoon with intermittent dry intervals. This shows that the dune record preserved here is representative of a transition period from highly active dune to dormant, where the wind was still active and enhanced moisture from SW monsoon on the sand helped in weathering and soil formation led to vegetation growth and stability.

Sections at KCV-1 represents a relict surface with a ~4m thick sand resting on the underlying lateritic bedrock. The upper part of the section comprised of indurated red sand with nodular calcrete and topographically, it occurs as a relict mount. The preliminary ages (9-6 ka and 4-3 ka) for the upper part of the sands in the area indicates that the area had abundant sand through out the Holocene possibly from both the fluvial and littoral sources. OSL ages, grain size, geochemistry and magnetic susceptibility results of these sections will be presented

Poster

Dendrochronological studies in Nepal: Current status and future prospects

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For to its diverse topography coupled with climatic variation and unique biodiversity, Nepal poses high potential for dendrochronological study. The first tree ring research in the country was carried out in 1970s, and shows a steady progress till date with only 53 tree ring studies reported that include published and unpublished research reports, thesis and journal articles. Studies have covered some 15 tree species such as Abies spectabilis, Betula utilis, Cedrus deodara, Juniperus spp, Picea smithiana, Pinus roxburghii, P. wallichiana and Tsuga dumosa. The most favored tree for the study has been Abies spectabilis and the most widely used parameter for analysis has been the ring width. The longest chronology for Nepal was build from Tsuga dumosa with 1,141 years that extended from 856 AD to 1996 AD. On climatic reconstruction, three studies were found that covered temperature from 1546 AD to 1991 AD. Interestingly a drought reconstruction of 223 years ranging 1778 AD to 2000 AD has also been reported. Past studies have covered areas like dendroclimatology, dendroecology, dendroarchaeology and stable isotopes in dendrochronology. By geographic coverage, 22 districts out of 75 in the country have been covered, and they are mostly from high altitudes. Recently, several new chronologies have been developed but with incomplete climatic reconstructions. Dendroecological studies carried out in high altitudes recent years have revealed an upward shift of treeline, especially that of A. spectabilis in east, central and western Nepal Himalaya. There exists a potential of application tree ring study in wider aspects including dendrohydrology, geomorphology and glaciology with large spatial coverage of the country. When analyzed by participation, 51% of the total studies till date were carried out by Nepali researchers, 28% by foreign researchers and 21% in joint endeavors. Hence, Nepal offers a great prospect for tree ring study specifically in context of climate change today.

Poster

Intercontinental Ash: The correlation of the Alaskan White River Ash to the European AD 860B tephra

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The presence of a volcanic ash (tephra) across a landscape provides a valuable isochronous marker horizon in diverse depositional settings. The correlation of widely distributed tephra beds has been identified by several large-scale, multidisciplinary projects (e.g. INTIMATE, RESET, PRECIP) as the only method that can decipher timing of rapid climate change events with shifts in, for example, archaeological, faunal and floral records. Here we present the correlation of the Alaskan White River Ash, eastern lobe (WRE), to the AD 860B tephra, first identified in Ireland, via major-element geochemistry and coincident age-determinations. WRE is present across the North American continent and in northeast Pacific marine cores. AD 860B has been located across northern Europe and in NGRIP, but a source was never determined until now. The correlation of these two tephra beds illustrates the viability of ultra-distal correlations, and the comparison of the diverse archives in which the tephra are found. Additionally, multiple Alaskan tephra beds produced by eruptions as large, or larger, than that which produced WRE, offer the possibility of additional North American tephra beds being present at an intercontinental scale. Many of these beds are beyond radiocarbon in age, such as the Old Crow tephra (124 ± 10 ka), an important marine isotope stage 5e marker horizon, presenting opportunities for correlations well into the Pleistocene.

Talk

U-Pb age model for an Early Pleistocene stalagmite from Corchia Cave (Italy)

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Speleothems are well-established archives of palaeoenvironmental change. The proxy data that underpin their utility in this regard are numerous and derived from the study of the physical (growth rate and growth intervals, petrography) and chemical (stable isotopes, trace elements, fluid inclusions) properties of speleothem calcite. The major strength of speleothems when compared to other palaeoclimate archives, however, is that they can be accurately and precisely dated using the U-series decay scheme, allowing palaeoclimate series to be fixed in absolute time.

Virtually all speleothem-based palaeoclimate studies up until now have been confined to the Middle to Late Quaternary period because of the time constraints imposed by the practical upper limit of the U-Th dating method, i.e.~500 ka. Although recent advances in U-series isotopic measurements continue to push this boundary, the age of many speleothems clearly exceeds the U-Th limit. The possibility of probing the many important but unanswered questions in palaeoclimatology (and other fields, such as palaeoanthropology) using such older speleothems has traditionally been considered rather remote. However, the recent refinement of the U-Pb dating method for speleothems has opened up new research opportunities in this field. An important goal in this new frontier is to produce palaeoclimate records underpinned by accurate, robust age models and minimised age uncertainties, which together will increase the range of palaeoclimate questions that can be addressed by the speleothem community.

Here we present the first high-resolution U-Pb chronology of a single speleothem. Our main goal was to investigate the level of age-model precision that is achievable by applying high-resolution U-Pb dating comparable to that performed in studies of younger (U-Th dated) speleothems.

The stalagmite (CC8) comes from Corchia Cave in Italy. Speleothems from this cave have already yielded useful palaeoclimate information for the latter part of the Quaternary. Their characteristics, such as high concentrations of uranium, low concentrations of common lead and thorium, and relatively well-constrained initial uranium-series disequilibria make them ideal candidates for successful U-Pb dating.

The stalagmite grew during the Middle Pleistocene Transition, an interval during which the period of glacial-interglacial cycles apparently shifted from 40,000 yr to 100,000 yr cycles. We focused largely on the periods encompassing three glacial terminations (TX, XI and XII). Using a combination of Tera-Wasserburg isochron and common-Pb-corrected age approaches, coupled with Bayesian Monte Carlo age modelling, our results show that 95% age-model uncertainties of a few thousand years are possible. Such levels of age-model uncertainties imply that palaeoclimate time series derived from speleothems of this age can be used to test hypotheses of orbital forcing.

YSM06: Proxy Development, Calibration and Validation

Convenors: Caroline Cleroux, Denis-Didier Rousseau

Poster

A multiproxy examination of the toarcian oceanic anoxic event, Arroyo Lapa, (North and South) Neuquen Basin, Argentina

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The Toarcian, Early Jurassic, Oceanic Anoxic Event (T-OAE: ~183 Ma) was characterized by globally synchronous deposition of sediments rich in organic carbon (black shales), and is associated with an abrupt negative carbon isotope excursion, disrupting a positive carbon-isotope excursion during the *tenuicostatum–serpentinum* ammonite Zone boundary. These disturbances are recorded in bulk sedimentary organic matter, carbonate and fossil wood, the latter recording the isotopic composition of the atmosphere. The T-OAE has been extensively studied in Northern and Southern Europe and new studies from the southern hemisphere have provided chemostratigraphic evidence for the global imprint of the event. Here we present new geochemical data from the Neuquén Basin, Argentina: bulk-sediment $\delta^{13}C$ values fall to -32.5‰ and $\delta^{13}C$ values from fossil wood fall to -30.7 ‰, isotopic ratios that are comparable to those identified in Europe for the T-OAE. Hydrogen Index (HI) data for the T-OAE in Argentina give values ranging from 12 to 425 mg HC/ g TOC, indicating a mixture of terrestrial and marine organic components. Pristane/Phytane ratios and pyrite framboid distribution data indicative of anoxic conditions occur at some levels, and new $\delta^{98/95}Mo$ data, with values ranging from ~ -0.2 to 0.78 ‰, which contrast with previously published molybdenum-isotope values from T-OAE black shales of northern Europe.

Poster

Abrupt changes in the strength of the Indian Summer Monsoon during late glacial to Holocene evidenced by episodic increases in Ayeyarwady outflow to the Andaman Sea

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Paleoclimatic records from the Andaman Sea are rare and limited to oxygen isotopic and magnetic properties. We used the downcore variation of a low salinity dwelling planktic foraminifer Neogloboquadrina dutertrei as a proxy for tracking salinity changes associated with Ayeyarwady River outflow into the Andaman Sea. Age controls of the cores are based on accelerator mass spectrometry (AMS) dates on mixed planktic foraminifera. Annually, a huge amount of fresh water reaches the Andaman Sea from the Ayeyarwady catchment with the most of outflow occurring during the summer to late fall. As a result of a fresh water influx, salinity reduces to a minimum value during July to August. Reconstruction of late Quaternary salinity changes would give inferences on the Ayeyarwady outflow which in turn is governed by the strength of the Indian summer monsoon. The comparison of downcore variation of *N. dutertrei* and earlier record of $\delta^{18}O$ seawater ($\delta^{18}O_{sw}$) matches exceptionally well and supports the former to use as a salinity proxy. The high abundance of N. dutertrei during early Holocene and Bølling/Allerød (BA) suggest low salinity, wet climate and freshened Andaman Sea surface water driven by enhanced Ayeyarwady outflow resultant of strengthened summer monsoon. The lower abundance of N. dutertrei during deglacial, Younger Dryas (YD) and mid- to late-Holocene suggests reduced Ayeyarwady outflow and direct precipitation as a result of weakening of summer monsoon. Last glacial maximum (LGM) was characterised by similar or slightly reduced Ayeyarwady outflow and summer monsoon than present. The comparison of temporal variation of N. dutertrei of north and south Andaman cores suggest highest Ayeyarwady outflow has occurred during early Holocene as a result of enhanced summer monsoon. These results corroborate earlier findings of substantial hydrologic changes in the Indian monsoon system during the last deglaciation - Holocene and consistent with the Mg/Ca-SST and oxygen isotope based summer monsoon reconstruction.

Talk

Climatic signal in tree-ring width chronologies of European Russia: spatial change and perspectives for paleoclimatic reconstructions

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European part of Russia, especially its central part, is still poorly studied in terms of dendroclimatology. In this study we analyzed the climatic response of 55 tree-ring width chronologies of living pines (*Pinus sylvestris*), spruces (*Picea abies, Picea obovata*) and larches (*Larix sibirica*) in European Russia. For this analysis we used two periods (AD 1950-1990 and AD 1901-1990) and 20 different meteorological parameters calculated from the following archives: daily and monthly data from more than 150 meteorological stations, CRU TS 3.0 gridded data and 20th Century Reanalysis. Also we analyzed growth response to the main teleconnection indexes (NAO, EA, EAWR, SCAND, POLAR), Palmer Drought Severity Index and

CPC Soil Moisture. Mapping the results of the analyses has allowed us to identify the most important climatic parameters which influence the radial growth of conifer trees in the northern and central parts of European Russia. It is obvious that all conifers growing to the north of 60°N react positively to summer temperature (minimum, maximum, mean temperatures of the warm season and individual months). To the south, at the latitude of 54°-56° N the signal is changing and the ring width depends on the combination of two parameters – warmth and humidity (drought index PDSI, precipitation, relative humidity of vegetation season). This border coincides with the modern border of broadleaved and boreal forests. Climatic parameters that form "pointer years" were also defined for all the chronologies of living trees. Currently we are in progress of constructing and updating six long chronologies that contain samples from archaeological and architectural wood. Two of them – "Vologda region" (60°N 39°E; 1085-2009 AD) and "Solovki islands" (65°N 36°E; 1187-2008 AD) chronologies – are already suitable for paleoclimatic analysis. "Solovki islands" chronology showed the highest correlations with the reconstruction of summer temperatures for Kola Peninsula and total solar irradiance reconstruction, while "Vologda region" chronology better correlates with the reconstruction of Northern Hemisphere annual temperature. Comparison of "pointer years" in the chronologies with historical data about extreme climatic events showed that 25% of all the events fall into "pointer years", and vice versa, 33% of negative pointer years fall into historical data. All these results demonstrate good paleoclimatic potential of tree ring width chronologies in European Russia.

Poster

Developing a chrysophyte-based cold-season temperature transfer function and a calibration-in-time model to reconstruct environmental variables in Polish lakes

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Transfer Functions based on modern training sets (calibration-in-space) are well established and powerful tools in quantitative paleolimnology when they are applied to subfossil assemblages to quantitatively reconstruct environmental variables such as temperature. However it is increasingly recognized that the selection of lakes and the design of the Transfer Function is most critical and may bias the results.
Here we show how we selected 50 lakes out of a data base with physical and chemical parameters of 2913 lakes in northern Poland to develop a Training Set for quantitative environment/proxy relationships and, ultimately to reconstruct quantitative seasonally resolved temperatures from multiple biological and inorganic lake sediment proxies. In this context, Poland in unique in three aspects: (i) Poland is one of the most important sites to study European temperatures since it explains up to 86% of the variance of winter temperatures; (ii) several lakes in Poland contain continuous Holocene-long annually laminated sediment sequences that allow for chronologically highly accurate climate reconstructions, and (iii) an inventory of 2913 Polish lakes exist in a data base of physical (longitude, latitude, altitude, morphology and water depth, temperature etc.) and chemical (electric conductivity, pH, nutrients, major anions and cations) parameters. With this data base multiple environmental gradients can be assessed in the multi-parameter space. The ultimate goal of the Transfer Function is to reconstruct seasonally resolved temperatures and precipitation from Chrysophyte stomatocysts, chironomids, diatoms, BSi, total organic carbon (TOC), N and stable C and O isotopes in Lake Żabińskie in NE Poland (54°07'54.5"N; 21°59'01.1"E; 40.1 ha and 43.5 m depth) for the past 1000 years (Project CLIMPOL: 'Climate of northern Poland during the last 1000 years: Constraining the future with the past'). However, the Training Set was designed in a way that the 50 chosen lakes are representative (mean and variance for environmental variables) for most of the lakes in lowland Poland. Using univariate and multivariate outlier detection techniques, we removed lakes that showed extreme values (morphology, physical and chemical parameters), and/or lakes close to big cities and the coast. From the remaining 1247 lakes we selected 50 lakes for the final training set using stratified balanced sampling with ten equidistant blocks along longitude (in Poland a proxy for the temperature gradient) and environmental variables (pH, log10-transformed surface area, lake volume, maximum and mean depth, shore-line development, exposure, conductivity, chemical oxygen demand, calcium, sulphate and chloride). The 50 selected lakes are all below 250 m.a.s.l. and span a MAT range of 6-8.5°C and precipitation range between 550-650 mm yr^{-1}. These 50 lakes were equipped with sediment traps and thermistors, and are monitored quarterly for physical and chemical properties of the water column.
Besides developing transfer function for calibration-in-space, we also aim to obtain quantitative climate reconstructions by calibrating biogeochemical proxies from Lake Żabińskie (BSi, TOC and N) to meteorological data (temperature and/or precipitation) covering the last century (calibration-in-time) using inverse linear regression, although its applicability will be further tested on longer temporal scales.

Poster

Developing and validating diatom-based water chemistry models for Ugandan crater lakes: assessing the advantages and disadvantages of regional vs. pan-African calibration datasets

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Diatom surface sediment samples and corresponding water chemistry were collected from 56 lakes across

a natural conductivity gradient in western Uganda to explore factors affecting diatom distribution. Although a training set exists for Eastern Africa (European Diatom Database Initiative), the African-wide calibration set, which was both geographically and limnologically diverse, provided poor-analogue matching for the crater lakes of western Uganda. As a result a regional training set was developed from these lakes to test the hypothesis that this approach, by providing more appropriate and closer analogues, can improve the accuracy of palaeo-conductivity reconstructions, and so environmental inferences in these lake systems compared to larger training sets. Canonical correspondence analysis (CCA) and partial CCA was used to explore the water chemistry and diatom distribution data; conductivity accounted for a significant, independent portion of this variation. The regional training set performed well, with an r^2 of 0.74 and prediction errors, estimated using jack-knifing, were low (0.256 $\log_{10}$ units). The comparison of conductivity reconstructions using the Ugandan crater lake training set and the East Africa training set (EDDI) highlighted a number of differences in the optima of key diatom taxa, which lead to differences in reconstructed values and could lead to misinterpretation of the fossil record. Transfer functions are best judged by how useful, rather than how accurate, they are. In this instance, the development of a Ugandan crater lake model is more useful for such lakes than the larger, but heterogeneous, EDDI models. The transfer function developed from the crater lakes improves on the regional EDDI models that have been widely, and often uncritically, applied across a range of lake types in eastern Africa. The EDDI training set does remain useful however, especially for larger lakes, and there is scope for its application to be refined applying models to planktonic taxa only (for example). We argue that the development of more regionally and limnologically specific models may provide the appropriate key to unlock the archives of eastern African crater lakes. These lakes house under exploited records of palaeoenvironmental information, but their value is being increasingly recognised to explore and answer key questions of regional and local-scale changes over the Holocene at high temporal resolution.
This research highlights issues of how far transfer functions based on continental-scale lake datasets such as the EDDI pan-African models should be used and the benefits that may be obtained from regional training sets.

Poster

Development and application of Australian lacustrine ostracod-based transfer functions

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Transfer functions are a commonly used technique for deciphering changes in palaeoenvironmental variables from fossil sequences. The technique is derived from the knowledge that an extant species is adapted to the characteristics of the environments in which it lives. Thus, finding this species within a fossil record implies that similar environmental conditions existed at this time. This can be further refined if a number of fossil species are present with known overlapping environmental tolerances. Environmental change can be deciphered from the fossil record where faunal variability is recorded. Here we present the development and calibration of a salinity-based transfer function using extant ostracod species from athalassic waterbodies in Australia, and its application to a Holocene fossil ostracod sequence recovered from Rottnest Island, Western Australia. Over 120 ostracod species and water chemistry data from over 1500 sites were collated from published and unpublished records from across Australia. The Non-metric Multidimensional Scaling (NMDS) technique was employed to examine the environmental variables of significance, and the principle axis of variation in Australian ostracod species distributions is salinity. From this training dataset, we then applied the Modern Analogue Technique (MAT) to a 7.4 ka fossil ostracod sequence from Barker Swamp on Rottnest Island, Western Australia. It is clear from the reconstruction that significant variations in salinity have occurred through time and that these variations coincide with other proxy records from the same swamp.

Poster

End-member modelling – a way to better understand grain size proxies in marine and terrestrial sediment archives

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Key proxies in sedimentary archives of terrestrial and marine origin are derived from detrital grain size distributions, precisely measured by laser particle size analysers with often more than 80 grain size classes. Although grain size distributions contain a lot of information on past sedimentary processes and depositional environments, research typically neglects the complete distribution and uses only integrated measures of moments instead (i.e. mean sand/silt/clay content, sorting, skewness, kurtosis). These are biased, when applied to multi-modal distributions, which form when sediments of different sources and sorted by different transport processes are mixed in the final depocentre. To decipher the genetic fingerprints of sources and transport processes, grain size distributions need to be unmixed. Principles of eigenspace analysis and several scaling procedures that account for the compositional data structure are integrated in an end-member modelling algorithm (EMMA), which aims to reduce redundancy in the large grain size datasets producing only a limited

number of meaningful end-member distributions. Their contribution to each sample in space and time as well as associated uncertainties can be quantified allowing a more robust separation of signals and noise.
Here we present the potential range of EMMA applications considering a variety of questions and settings. Lacustrine and aeolian sediment end-members from the north-eastern Tibetan Plateau allow the reconstruction of past water level changes and wind directions in a heterogeneous lake catchment. EMMA applied to lacustrine sediments of a Northern Siberian thermokarst lake reveals several processes related to permafrost degradation, fluvial and aeolian sediment input. One end-member even shows a high correlation with diatom valve concentrations suggesting a potential, quick way to determine diatom abundance in lake sediments. In soil-sediment sequences below stone pavements of the Mojave Desert, USA, grain size end-members allow deciphering aeolian sediment sources, bedrock disintegration and pedogenetic overprint. Marine sediments from Burton Basin, East Antarctica, contain end-members that represent ice-rafted debris and bottom water current activities.
These examples demonstrate the variety of depositional environments to which the algorithm can be applied. Altogether, EMMA is a robust method for better understanding sedimentation processes. With increasing data set sizes, EMMA will become more important to identify dominant signals in sediments.

Talk

Holocene Climate in Western Mongolia from an Altai Ice Core

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During summer 2009 a 72 m surface-to-bedrock ice core was collected on Tsambagarav glacier in the Mongolian Altai (4'100 m asl, 48°39.338'N, 90°50.826'E). This for the region typical flat-top type glacier has ideal properties for preserving climate information: 1) Low ice temperatures from -14 to -12.5°C preventing post-depositional artifacts due to melt water percolation and 2) a flat bedrock topography at the drill site ensuring an undisturbed chronology. The upper two-thirds of the ice core contain 200 years of climate information with annual resolution, dated by three independent approaches, i.e. annual layer counting, identifying horizons, and ^{210}Pb dating. The lower third was dated with a novel radiocarbon method, revealing strong thinning of the annual layers and a basal ice age of approximately 6'000 years before present (BP). We interpret the basal ice age as indicative of ice-free conditions at 4'100 m asl prior to 6'000 years BP. This age marks the onset of the Neoglaciation at the end of the Holocene Climate Optimum. Since most glaciers in the Mongolian Altai have comparable or lower elevation we conclude that they are not remnants of the Last Glacial Maximum but were formed during the second part of the Holocene. The ice core-derived accumulation suggests significant changes in the precipitation pattern of the last 6'000 years. During formation of the glacier wetter conditions than presently prevailed, followed by a long dry period from 5'000 years BP until 250 years ago.
To test whether the ice core stable isotope parameter $\delta^{18}O$ is suitable as temperature proxy a correlation analysis with instrumental data from Khovd weather station was performed. The highest correlation was obtained for the 5-year averaged $\delta^{18}O$ record and the months June-July-August. The reconstructed JJA temperatures from Tsambagarav show strong centennial fluctuations. The Little Ice Age cooling seems to be less pronounced compared to Mar-Nov ice core derived temperatures from the 350 km distant Belukha glacier in the Siberian Altai.

Poster

Paleorainfall variations in Southern India during the past 3154 years: Evidence from Pookot Lake record

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There are apprehensions about changing climate, particularly against the backdrop of global warming and extreme climatic events reported from many parts of the world. As India's agriculture and economy are strongly dependent on the summer monsoon, it is imperative to generate high-resolution paleorainfall records during the Late Holocene. Environmental magnetic analysis of two AMS C-14 dated sediment cores from Pookot Lake (Wayanad district, Kerala, Southern India), provide a continuous high-resolution record of monsoon for the past 3154 years. A range of magnetic parameters (Xlf, Xfd, Xarm, IRMs at different fields) were determined and interparametric ratios were calculated. A positive correlation was documented between magnetic parameters and Vythiri Station (near to the lake) rainfall data. There were significant variations in rainfall with periods of higher rainfall indicated by high magnetic susceptibility (Xlf) values and vice versa. The periods ~ 3154-2435, ~ 2189-2143, ~ 1486-1406, ~ 1069-715 and ~ 647-559 cal. years B.P. are characterized by relatively high rainfall whereas during the periods ~ 2435-2189, ~ 2143-1486, ~ 1406-1069, ~ 715-647 and ~ 559-350 cal. years B.P. rainfall was relatively low. From 350 to 200 cal. years B.P., rainfall exhibited an increasing trend. From 200 cal. years B.P. to the present, it was steady albeit with high-amplitude fluctuations. It appears that monsoonal rainfall in the region is influenced by the Sun, with periods of higher sunspot activity and Total Solar Irradiance characterized by higher rainfall (= high Xlf) and

vice versa. On a longer time scale, insolation also seems to have had an influence on rainfall, with periods of high insolation typified by high rainfall (= high XIf) and vice versa. The rainfall in the region exhibits periodicities of 469 years, 209-134 years, 14.3 years, 10 years, 8.5 years, 8.1 years, 7.8 years, 21.6 years, 17.1 years and 11.5-11.9 years, many of which have a solar origin. This was substantiated by cross spectral analysis between XIf and Group sunspot numbers, annual sunspot numbers as well as reconstructed sunspot numbers. High coherencies are obtained for many of the afore-mentioned periods which are attributed to solar origin. The Pookot Lake XIf record has faithfully recorded the global climatic events like the Little Ice Age (LIA) and the Medieval Warm Period (MWP). Rainfall was relatively low during LIA (559-350 cal. years B.P.) and relatively high during MWP (1069-715 cal. years B.P.). This was further substantiated by wavelet analysis of the XIf data. But it was not consistently high during the entire span of MWP. LIA appears to have been short-lived in the region and its termination could have been anywhere in the range of 350-200 cal. years B.P. as rainfall exhibits an increasing trend during this period. The Pookot Lake XIf record exhibits similarities with other continental and marine palaeoclimatic records in the region.

Poster

Recent accumulation rate and impurity seasonality derived from NEEM firn cores

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Chemical ice core measurements reveal information related to climate and atmospheric processes. However, they often also contain noise introduced by glaciological processes, arising from the movement of surface snow by wind driven erosion and re-deposition.
To separate the climate signal from glaciological noise, five 12 m long shallow firn cores, arranged in a square of 10 m side length and one in the centre, have been drilled close to the NEEM camp in Greenland during the field season 2011. They have been analysed with a Continuous Flow Analysis (CFA) system in high depth resolution. Among others, calcium, sodium, ammonium, nitrate, electrolytic conductivity, dust particle numbers, and hydrogen peroxide have been measured. These data allow for a very precise dating using common peak patterns in all firn cores and assuming hydrogen peroxide maxima occurring at summer solstice and minima in midwinter. The time period from 2008 back to the year 1989 is covered by all five cores. A very good covariance of the measured concentrations is found between the five cores. For the mean accumulation rate in the time period between 2008 and 1989 we find 26 cm (water equivalent) a^{-1}.
Due to a lack of information, in many firn and ice core studies a constant intra-annual snow accumulation distribution is assumed. However, spares snow height measurements at NEEM and the nearby site "Humboldt" together with model results point to the fact that winter to summer accumulation ratio is about 1:2. Using such an accumulation distribution we can come up with improved constraints on the seasonality of the measured chemical species. Dust particle numbers and calcium concentration peak distinctively in February, shortly after sodium showing its maximum in December. On the other hand, peaks are less pronounced for nitrate with a maximum in April and ammonium with a broad maximum from May to July. Although there are multiple peaks within one year, ammonium shows a very distinctive decreasing flank in August.
In order to understand the seasonality of the measured aerosols monthly statistics of five days back-trajectories using the HYSPLIT model have been derived, providing information about the origins of the air masses which arrive at the NEEM camp. Together with the seasonal cycles of environmental boundary conditions (such as temperature/precipitation in potential source regions, sea ice extent) and the analysis of typical weather patterns, this helps to constrain potential source regions for the different aerosols.

Talk

Reconstructing Plio-Pleistocene Intermediate Water Temperatures Using Mg/Ca of Infaunal Foraminifera (Uvigerina peregrina)

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The reconstruction of past surface, intermediate and deep-water temperatures is critical for our understanding of feedbacks within the ocean-climate system. Proxies for determining the paleotemperature of interior water masses have many caveats including the 'Carbonate Ion Effect' on the Magnesium to Calcium ratio (Mg/Ca) of benthic foraminifera. Recent studies have demonstrated that the shallow-infaunal species, Uvigerina peregrina, co-precipitates Mg independent of carbonate saturation state, affording the use of $Mg/Ca_{Uvigerina}$ for Quaternary paleotemperature reconstructions (Elderfield et al., 2010). Herein, we present the first record of intermediate water temperatures for critical time-periods during the Pliocene and Pleistocene, including the Mid-Pleistocene Transition (MPT), from a sediment core in the Southwest Pacific (DSDP site 593; 40°30'S, 167°41'E, 1068m water depth), within the core of modern Antarctic Intermediate Water (AAIW). By comparing $Mg/Ca_{Uvigerina}$, $Mg/Ca_{Cibicidoides}$, and $\delta^{18}O_{Cibicidoides}$, a multi-proxy approach helps to further demonstrate the utility of Mg/CaUvigerina as a paleotemperature proxy, without effects of carbonate ion. We then examine the changing structure of the interior Southern Ocean through the Plio-Pleistocene by comparing our new intermediate-water paleotemperature estimates with sea surface paleotemperature estimates generated using the alkenone-derived U^{K}_{37}' index from the same site, as well as deep-water paleotemperature

estimates from a proximal site, ODP site 1123 (3290m water depth). Intermediate water temperature reconstruction is particularly important since intermediate waters, including AAIW, are proposed to be a main driver in high-low latitude teleconnections. However, quantitative information about how intermediate waters evolved through the Plio-Pleistocene remains scarce. The production strength and depth of intermediate water formation in the Southern Ocean is directly tied to the location of the Sub-Antarctic Front (SAF). DSDP site 593 lies just north of the modern SAF, and its location is presumed to oscillate between north and south of the front according to the orbitally-timed latitudinal migration of the SAF. Consideration of changes to the SAF is made possible through comparison of Southwest Pacific sea surface temperature record with a high-resolution sea surface temperature record from the South Atlantic (ODP site 1087; 31°28'S, 15°19'E, 1374m water depth), which also lies just north of the modern SAF.

Talk

Reconstructing the past millennium of hydrologic variability in the Western Tropical Pacific using the hydrogen isotopes of lipid biomarkers

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Global changes in precipitation patterns are potentially one of the most important impacts in a warming climate. Understanding the changes in spatial and temporal patterns of natural hydrologic variability over the past millennium is imperative to making accurate predictions of future changes in hydroclimate. In this study we present a proxy reconstruction of rainfall variability over the past millennium from a marine lake in Palau. Palau is located in the Western Pacific Warm Pool, which is a primary source of heat and moisture to the extratropics. Past changes in Palau's hydroclimate may indicate fundamental changes in El Niño-Southern Oscillation or shifts in the mean position of the Intertropical Convergence Zone. We use the novel proxy technique of compound-specific hydrogen isotope analysis to reconstruct rainfall in this study. This approach is based on the fact that the hydrogen isotopic ratio (δD) of membrane lipids of aquatic algae reflects the δD of lake surface water. The δD of the lake surface water, in turn, varies as a function of the amount of rainfall. We observe several large (ca. 40‰) shifts in the δD of dinosterol in Palau over the course of the past millennium. There is a shift to dryer conditions in Palau ca. 1600-1800 A.D., which is consistent with a southward shift in the mean position of the ITCZ observed in other records spanning the tropical Pacific Ocean during this period. Another shift to dry conditions occurs ca. 1350-1500 A.D. Both of these dry periods correspond to archeological evidence of abandonment of settlements and/or increased fortifications in Palau. Positive correlation with two additional records of hydroclimatic variability from the Indonesia indicate that the Palau δDdinosterol record is representative of broad scale regional shifts in precipitation.

Poster

Robust grain size end-members inferred from Quaternary lacustrine sediments across the Tibetan Plateau

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The detrital grain size composition of sediments can be explained by different transport processes, each of them sorting sediments in a characteristic way. Transport processes are typically linked to distinct environmental, mainly hydrological variations, although tectonic and in more recent time scales, anthropogenic influence can significantly alter them. Lake basins act as final sediment sinks, where sediments that were sorted by different processes get mixed. Hence, lacustrine sediments often show multi-modal grain-size distributions. Then, descriptive grain size analysis as for example the method of moments (i.e. mean, sorting, kurtosis) lead to misinterpretations. The new end-member modelling analysis (EMMA) allows a mathematical unmixing of grain size compositions to geoscientifically-interpretable end-members and quantifying their contributions to each sample in space and time using principals of eigenspace analysis and a series of scaling procedures.
In this study detrital grain size distributions from lakes of different sizes and catchment configurations across the Tibetan Plateau are analysed using EMMA. The most robust end-members are determined by a variety of similarly-likely model runs. Their relation provides valuable and quantitative information on past sediment transport processes and, hence, on past hydrological variations for different times throughout the Quaternary. Lake sediments from the northern, north-eastern, and southern Tibetan Plateau are discussed, including Late Quaternary sediments from Lakes Donggi Cona, Nam Co, Tangra Yum Co and Pleistocene lake sediments from the Qaidam basin. The study also assesses the value of EMMA as a method to reconstruct lake level changes independent of time scale and resolution of the respective lake sediment archive.

Poster

Spectral biases in climate proxies and reconstructions of the last millennium

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External forcing and internal dynamics result in sub-daily to multi-centennial climate system variability. Climate variables can behave differently in certain frequency ranges, e.g low-frequency temperature variability caused by fluctuations in solar activity may not cause coherent low-frequency precipitation changes. Hence, time series can correlate stronger and weaker in distinct frequency ranges. Nevertheless, many state-of-the-art reconstructions methods routinely use hydroclimatic proxies to reconstruct temperature, possibly blurring differences in the variability continuum of temperature and precipitation prior to the instrumental period. To determine if the true variance across all frequency bands is properly captured in the pre-industrial period, we estimate the variability continuum in instrumental observations, the 20th century reanalysis, multiple simulations for the last millennium, annually resolved proxy records of at least 500 years in length and spatially resolved climate reconstructions.
We find that while an ensemble of different general circulation models represents patterns captured in instrumental measurements, such as land-ocean contrasts and enhanced low-frequency variability in the tropics, proxy data do not. The observed tendencies for strong inter-annual fluctuations in precipitation are not reflected in hydroclimatic proxy records. Likewise, temperature-sensitive proxies overestimate the ratio of low to high-frequency variability. These spectral biases in the proxy records appear to propagate into multi-proxy climate reconstruction of temperature and precipitation for which we observe an overestimation of low-frequency variability. We will present why attention to a proper representation of the high to low frequency spectrum in proxy records, coupled with an improved process understanding of how climatic signals are recorded, is needed to reduce uncertainties in future climate reconstruction efforts.

Poster

Testing the tree-ring parameter Blue Intensity, a new inexpensive path towards robust low-frequency reconstructions of late Holocene summer temperatures?

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Trees growing in the outskirts of their ecological niche, where climate conditions prevent further expansion, usually exhibit growth patterns dominated by variations in climate. Tree-rings from trees in such areas acquire similar annually resolved growth patterns. By piecing the climate induced fingerprints of living trees, where every ring is absolutely dated in time, with the similar fingerprint in dead-wood, tree-ring records can reach quite far back in time, at best >7000 years in Fennoscandian forests. In reconstructing climate variability of the late Holocene, especially the last thousand years, the most favored proxy has been tree-ring data. On annual scale the skill of tree-rings as climate proxy is undisputed. The debate about tree-rings' as climate proxy regards its capacity to provide information about how paleoclimate has varied over centuries and over millennia.
The tree-ring parameter maximum density (MXD) has proved competent to provide growing season temperature reconstructions with skill both on annual and multicentennial scale. MXD analyzed with x-ray densitometry, measures how dense the annual late wood is. In regions where growth is limited by growing season temperature, a denser late wood means warmer summers. MXD often yields superior signal strength compared to the more inexpensive tree-ring width (TRW) parameter. But studies have also shown that numerous chronologies (TRW or MXD) over larger areas are superior to single chronologies, and give more robust climate reconstructions.
A more inexpensive alternative to MXD is Blue Intensity (BI). With BI the wood pieces are scanned and the blue light reflectance is measured, presumably related to amount of lignin in the wood. Low blue light reflectance values are associated with dense wood. The parameter minimum blue intensity and MXD have roughly an inverse relationship. The BI method has been shown to provide equivalent annual scale information to those produced with x-ray densitometry. However the quality of the multicentennial scale information has yet to be investigated.
Here we present a new, well replicated, millennium long Scots pine (*Pinus Sylvestris*) chronology from northern fennoscandia. Both MXD and BI measurements were undertaken from the same cores to evaluate BI as a new way of providing high quality multicentennial paleoclimate information. The climate response of each chronology will be investigated, and compared. If the year-to-year variability in both records is driven by the same climate forcing, it is safe to assume that the low-frequency variability should in fact also be similar for both proxies. Furthermore, both chronologies will be compared to existing long MXD chronologies from the Fennoscandian region to make sure that robust results are achieved.
Preliminary results show that careful removal of movable compounds in the wood and thorough preparation of the sample surface before scanning is critical to retain un-biased climate-related low-frequency variation. Furthermore, preliminary analyses show that if these criteria are met, BI cannot be separated in skill ($p<0.05$) from MXD, to reconstruct multi-centennial scale Fennoscandian summer temperatures, and probably elsewhere too. Implications from these results yield that, with BI, paleoclimate information for the last thousand years can be made more robust with less money.

Poster

The missing ocean - Generation of high resolution records of sea surface temperature for the Common Era.

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Of the twelve high resolution compilations of climate composited to produce the IPCCs most current understanding of climate over the past 2000 years (the Common Era), three contain 'limited coverage' of the oceanic realm and the others contain 'none or very few'. This is due in large part to low sedimentation rates encountered in the open ocean which limit the resolution of an environmental reconstruction. Our understanding of the climate system over this period is therefore largely dependent on terrestrial data, and furthermore based primarily on tree rings. Given the importance of the ocean to both local and global heat budgets, a better understanding of the ocean's role in climate change over the Common Era is sorely lacking and inclusion of more marine based records into the IPCC composites should be of primary concern.
To that end we investigated the utility of the Uk'37 sea surface temperature (SST) proxy, based on organic compounds called alkenones produced by haptophyte algae, in a high sediment-rate archive, the estuary Narragansett Bay. We developed a new understanding of how the proxy is being produced in the water, and then recorded in the sediments, by producing a multi-year-long, monthly to sub-weekly resolved time-series of water column Uk'37. Comparison with instrumental SST suggests that while important and informative seasonal inconsistencies exist, especially during alkenone blooms, the integrated Uk'37 signal produced in the water column reflects mean annual instrumental SST, and also closely matches values seen in modern sediments.
A subset of samples were analyzed for haptophyte-specific 18S ribosomal RNA (rRNA) to understand the composition of the alkenone-producing community during times of instrumental-Uk'37 coherency and incoherency, alike. So far, the only alkenone-producing species detected in Narragansett Bay, E.huxleyi and G.oceanica - which dominate open-ocean production and form the foundation of the Uk'37-SST calibration – were detected in the high salinity lower-Bay during the spring bloom of 2010. A second 'brackish' alkenone-producing population is suspected on the basis of high contributions of the C37:4 alkenone in the low-salinity upper Bay.
We used our improved understanding of Uk'37 to generate three sediment core histories of local-to-regional climate change spanning the past ~1500 years. The average resolution of the records, sampled every two centimeters, is approximately decadal, an order of magnitude finer than even highly-resolved open-ocean reconstructions. The reconstructions show strong inter-core coherence of centennial-to-decadal variability, and structure consistent with the Medieval Warm Period, the Little Ice Age, and 20th century warming. This work supports the careful but expanded application of the Uk'37 SST proxy in other high-salinity estuaries in an effort to provide the scientific community (e.g. IPCC) with a more robust understanding of oceanic-climate dynamics and variability over the Common Era.

Poster

Triple water vapor isotopic ($H_2{}^{18}O$, $HD^{16}O$, $H_2{}^{17}O$) measurements above the Greenland Ice Sheet and importance for interpretation of ice cores

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Water stable isotopes from ice cores provide highly resolved, well-dated climate information. The archived climate signal is however an integrated signal of the precipitation isotopic composition, which itself is controlled by variations in moisture origin and condensation history. Therefore, in order to correctly interpret ice core isotope records it is of great importance to understand the underlying physical processes of the atmospheric hydrological cycle.
Novel triple water stable isotope measurements ($H_2{}^{18}O$, $HD^{16}O$, $H_2{}^{17}O$) revealing both d-excess and ^{17}O-excess have been carried out on both vapor and snow samples with the aim at improving our understanding of the atmospheric processes affecting ice core isotopic records. This has shed new light on both the super saturation during snow crystal formation and source region conditions. We have therefore for the last four summer seasons since 2009 measured the isotopic composition of the water vapor in continuous mode on top of the Greenland Ice Sheet as part of the NEEM deep ice core-drilling project.
By comparing the observed variability of the in-situ water vapor isotopic composition with general circulation models equipped with isotopic modules we have been able to both validate and point to weaknesses in the modeled isotopic values. We find that the general circulation model (LMDZiso) used here captures reasonably well both variations in absolute humidity and vapor isotope composition. However comparing the observed and modeled d-excess reveals very poor correlation. We understand this as indications for the general circulation model (LMDZiso) having a correct representation of the large-scale atmospheric circulation but having poor sub-grid physics performance especially related to the simulation of relative humidity in the Arctic Ocean boundary layer.
We use back trajectory analysis to relate the origin of the water vapor to its isotopic fingerprint, in particular for the d-excess and ^{17}O-excess. This leads us to identify Arctic and North Atlantic origin respectively. By combining the d-excess and ^{17}O-excess we are able to show the effect of multiple sources along the trajectory of the air masses. Using in-situ water vapor isotopic monitoring in the Arctic is shown to be important tools to enhance our

understanding of physical processes in the atmosphere and to better evaluate the performance of general circulation models, which can be used to both understand paleo-climate variations and predict future climate.

Poster

You are what you eat: Differences in the chemical composition of organic-walled dinoflagellate resting cysts and its implications for preservation

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Organic matter-based paleoproxies are important tools for our understanding of past climate changes and the global carbon cycle. As such, they represent important links between organisms, the environment, and the sedimentary record. However, many organic matter-based proxies suffer from selective preservation, so that the sedimentary record can be thought of as incomplete. The factors responsible for selective preservation are only partially understood, specifically in regards to some of the organic microfossil groups, such as the resting cysts of dinoflagellates (dinocysts). Very little is known regarding the chemical structure of dinocysts, in particular, the compounds comprising the dinocyst macromolecule, called dinosporin. However, it is thought that differences in its composition may explain why some species are better preserved in the sedimentary record. Therefore, a more precise understanding of dinosporin chemistry can provide new information regarding the preservation of dinocysts and organic matter in general, which, in turn, will allow for more accurate interpretations of the signals derived from the sediment record. In this study, we analyzed the cyst wall chemistry of various extant dinoflagellate lineages using micro-Fourier transform infrared spectroscopy (FTIR). Based on the presence of characteristic functional groups, two inherently different dinosporin compositions are suggested, which roughly correspond to the dinocysts produced by either photoautotrophic or heterotrophic dinoflagellates. Both dinocyst wall chemistries exhibit a carbohydrate-based composition, but the autotrophic dinosporin appears more similar to a cellulose-like glucan, while the heterotrophic dinosporin is suggestive of a chitin-like glycan. The variations likely reflect the different life strategies of these two cyst-producing dinoflagellate groups, something that could be developed as a paleoecological proxy by inferring the past nutritional strategies of extinct taxa. These results constitute the first demonstration of differences in dinosporin composition between these dinoflagellate groups and provide evidence that differences in preservation potential may be related to dinocyst wall chemistry.

YSM07: Modeling

Convenors: Steven Phipps, Pascale Braconnot

Poster

Evaluation of historical climate simulation with High-resolution global atmospheric model

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Climate simulations with high-resolution (40-km mesh) atmospheric general circulation model (GCM) have been used for regional detail climate response to observed CO_2, sulfate and other greenhouse gas during the historical period. For this long-term climate simulation, we have adopted operational global numerical weather prediction model (GME) of German Weather Service (Deutscher Wetterdienst). It is based on uniform icosahedral-hexagonal grid so it has several advantages to simulate at high spatial resolution relative to spectral methods.
So in this study, we have performed GME in high-resolution (40km) and 40 layers using AMIP observed sea surface temperature and sea ice concentration and have reproduced the global climate simulation for historical period (1979~2009). From the results in AGCM, we have analyzed the performance of simulating the past climate in global distribution with observed data like CPC Merged Analysis of precipitation (CMAP), Global Precipitation Climatology Project (GPCP), ERA40 reanalysis dataset. Although seasonal mean precipitation in JJA shows the tropical biases of the so-called double-ITCZ problem, it can reflect the trend of precipitation generally in DJF. And seasonal surface air temperature is also simulated well with the observation. Especially, it is able to capture accurately the response of regional climate changes, it can provide the detailed precipitation pattern for the estimation in the East Asia summer monsoon.

Poster

Influence of the tropical hydrologic cycle on Atlantic meridional overturning at the end of the last interglacial

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In this study, we examine the state of the Atlantic thermohaline circulation at the end of the last interglacial (129ka to 116 ka). More specifically, we consider the effect of tropical precipitation changes on modulating the salinity of the North Atlantic, and the persistence of the thermohaline circulation during the formation of continental Northern Hemisphere ice sheets. We utilize a combination of tropical precipitation reconstructions and modeling scenarios to investigate the teleconnection between the tropics and North Atlantic. The tropical rainfall records derive from marine sediment core transects from the South American and African margins in the tropical Atlantic. The rainfall reconstructions are translated into forcing fields for general circulation model experiments using the Community Climate System Model (CCSM). In this study, we report the results of two primary sets of model experiments. In the first we compare paleoclimate simulations of the last interglacial using CCSM to the sediment core based reconstructions. Second, we report the results of an ensemble of sensitivity experiments in which we investigate the role of modeled and reconstructed tropical precipitation changes on the North Atlantic salinity and deep water formation. More specifically, we report how modifications to the precipitation the ocean receives in the tropics propagate to the North Atlantic and in turn impact the deep water formation. The work will continue with an investigation of the role a persistent thermohaline circulation has on the formation of Northern Hemisphere ice sheets.

Talk

Integrated climate-proxy modeling using the isotope-enabled SPEEDY-IER with a focus on tropical climate

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Water isotope records lend insight into past climatic and hydroclimate conditions and can help identify the isotopic signature accompanying abrupt climate change events. Such signatures may be caused by changes in the hydrological cycle and the resulting variations in precipitation amount, evaporation, origin and composition, as well as changes in circulation. However, it is usually not possible to isolate the causes of isotopic excursions in proxy records without an isotope-enabled general circulation model (GCM). Currently, there are few efficient isotope-enabled models that are fit for tropical paleoclimate studies.
We address the need for a fast, realistic, isotope-enabled model suitable for paleoclimate integrations with the efficient atmospheric GCM, 'SPEEDY' (Simplified Parameterizations, primitivE-Equation Dynamics). Our new model (SPEEDY-IER) provides physically-consistent realizations of tropical climate and isotopic excursions in proxies at a fraction of the computational cost of IPCC-class GCMs, and allows for long simulations comparable in scale to proxy archives. Isotopic physics have been incorporated into SPEEDY. Stable water isotopologues $H2^{18}O$, HDO, and H_2O are included as tracers and advected within all stages of the hydrologic cycle with appropriate equilibrium or kinetic fractionation during phase changes. Changes to SPEEDY-IER are carried out systematically, allowing us to quantify the influence of each physical process and yielding insight into the main causes of isotope variability. We investigate the effect of equilibrium

and kinetic fractionation, advection, isotopic exchange during rainfall, and the addition of a 2-bucket soil moisture model on the modeled isotope values, comparing them to GNIP data and the SWING2 model database. Despite the atmospheric model's simplified physics, SPEEDY-IER captures the observed range of isotope variability. Modeled annual average values as reproduced by SPEEDY-IER are consistent within a ~3 permil range with GNIP and SWING2 values across the tropics and subtropics and within a ~5 permil range over the poles. SPEEDY-IER is used to explore relationships between climate variability and proxy records. To further bridge the gap between coupled AGCMs and observational proxy archives, SPEEDY-IER is coupled to forward process models of coral aragonite and tropical tree-ring $\delta^{18}O$. This enables us to simulate the atmospheric response and subsequent isotopic signal induced by a range of tropical sea surface temperature anomalies (both idealized and realistic), and how this signal is expressed in the proxy records. Implications for climate reconstructions are then discussed.

Poster

Meeting the challenge of global high resolution paleoclimate modelling.

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Given the dominant role of the Ocean in Earth's energy budget, large-scale paleoclimate events are often hypothetically linked to changes in the global ocean circulation. In turn, General Circulation Models (GCMs) have been widely used to evaluate the Ocean's ability to drive and respond to paleoclimate change. However, to date almost all paleoclimate GCM simulations are limited to coarse resolution models that fail to resolve mesoscale features that are known to dominate the oceanic kinetic energy budget. Inaccuracies in the representation of mesoscale ocean features, such as coastal boundary currents and eddies, can severely limit a GCMs ability to simulate the ocean circulation and it's related climate feedbacks. This study will outline both the need for high resolution paleoclimate simulations and the physical challenges associated with it. In particular, we address the following: Where and why are mesoscale ocean features important for the modeling of paleoclimate events? How strongly does model resolution influence the deep and near surface ocean circulation? What are some of the implications of high resolution ocean modeling for biogeochemistry cycles? How is Access-OEP being used to meet the challenge of high resolution paleoclimate modeling?

Poster

On the role of sea ice at the onset of the Little Ice Age

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The transition from the Medieval Climate Anomaly (MCA) to the Little Ice Age (LIA) is believed to have been driven by an interplay of external forcing and internal variability. While the global signal seems to have been dominated by solar irradiance, the understanding of mechanisms shaping the climate on continental scale is less robust. A recent reconstruction proposes that a shift from a persistent positive to a more negative North Atlantic Oscillation (NAO), orchestrated by tropical sea surface temperatures and atmospheric teleconnection, dominated the North Atlantic-European region during the transition phase. There remain doubts with this particular reconstruction and new results from models and proxies suggest an alternative mechanism in which the atmosphere is not the leading component: forced by a sequence of volcanic eruptions and decreasing solar irradiance the Arctic sea ice expands substantially at the beginning of the LIA. The excess of sea ice is exported to the northern North Atlantic where it melts, thereby weakening convection. As a consequence, northward heat transport is reduced, reinforcing the expanded sea ice cover and the cooling of the Northern Hemisphere. Using transient "all-forcing" simulations as well as sensitivity experiments with artificial sea ice growth, we are able to show that indeed many aspects of reconstructed temperature anomalies of the MCA-LIA transition can be explained by changes in sea ice and ocean heat transport. Artificial sea ice growth experiments in coupled models are a novelty, providing the opportunity to study dynamical changes in sea ice and heat transport after a perturbation. Preliminary results of these experiments point towards the Labrador and Barents Sea being key regions in a complex feedback loop that determines much of Europe's climate during the onset of the LIA. Support for this mechanism comes from proxies of Scandinavian land temperature, glaciers, and ocean heat transport.

Poster

Modelling the influence of evolving vegetation on past greenhouse climates

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The warmest climates of the past 65 million years occurred during the early Eocene (56-48 Ma) . Atmospheric CO_2 levels for this time period have a large uncertainty associated with them, but were possibly as high as 2000 to 3000 ppm. Current modeling efforts have had great difficulty in replicating the shallow latitudinal

temperature gradient indicated by proxy data for this time period. This is partly due to the fact that the specific mechanisms that cause this shallow temperature gradient are unknown or not fully understood so cannot be accounted for. Another contributing factor could be that not all climate feedbacks are included in these models. Vegetation feedbacks have been shown to be especially important so by including a more accurate representation of vegetation in the climate model, the model-data discrepancies may be reduced.
A fully coupled atmosphere-ocean GCM, HadCM3L, coupled to a dynamic global vegetation model (TRIFFID), was used to simulate Eocene climate at CO_2 concentrations of 560ppm and 1020ppm. This allows simulations with vegetation-climate interactions to be compared to simulations with static vegetation, but also to see how predicted vegetation changes with atmospheric CO_2. The effects of removing C_4 grasses from the dynamic vegetation model were also investigated, as they did not evolve until the Oligocene. This had an important effect on the coverage of other PFTs and therefore the climate.
The global mean annual temperature was higher when interactive vegetation was present compared to the simulations with static vegetation, increasing from 17.7 degrees C to 18.4 degrees C at 560 ppm and 21.7 degrees C to 23.3 degrees C at 1020 ppm. The latitudinal temperature gradient also became shallower, making it more consistent with proxy data. Climate sensitivity is higher with dynamic vegetation, so temperatures consistent with data can be reached at lower (and more plausible) CO_2 levels than some previous studies. Vegetation cover predicted by TRIFFID matches reasonably well with fossil evidence, especially at higher atmospheric CO_2. For example, TRIFFID predicts broadleaf trees growing on most of Antarctica, which is in agreement with fossils found on Antarctica.
These results demonstrate that by including a dynamic vegetation component in climate simulations, the discrepancy between model results and data can be reduced. In addition, although TRIFFID was designed for modern day vegetation, it can still produce a reasonable representation of vegetation in paleoclimate simulations.

Poster

Projected 21st Century Decline Snow Cover Overlying the Arctic Sea Ice and Implications for the Sea Ice and Arctic Climate in CESM/ CCSM

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In this study, we examine the causes of the projected decline in 21st century snow cover overlying the sea ice in the Arctic Ocean in a General Circulation Model (GCM). While this decline is observed in multiple Representative Concentration Pathway (RCP) scenarios, this study uses an ensemble of Community Earth System Model (CESM) / Community Climate System Model (CCSM) simulations for the high emissions RCP 8.5 scenario. Despite increases in total precipitation in the Arctic basin, the snow cover on the sea ice is projected to decrease year round over the course of the 21st century. While accelerated springtime melt is projected, the primary mechanism leading to this decline is the absence of autumn ice cover. As a result, early snow events are not accumulated; resulting in reduced snow cover year round. The decline of snow cover results enhances two competing mechanisms which impact the energy balance of the Arctic sea ice. First, the reduced snow thickness during the winter months results in enhanced transport of energy through the sea ice, which enables increased winter ice growth. The annually averaged effect of this increased energy loss by the ice exceeds the globally averaged 8.5 W/m^2 increase prescribed for this scenario. However, the reduced snow results in earlier spring loss of the snow cover. This process produces a lower sea ice surface albedo, which results in increased short wave absorbtion. As a result, the loss of spring and summer snow cover results in an increased energy flux to this ice. The magnitude of these effects, while large, is very similar, indicating the need for a careful treatment of snow cover on sea ice in GCMs, including the validation of snow cover and a careful treatment of the effects of snow cover.

Poster

The Tropical Pacific climate response to the changing forcing over the last glacial cycle

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The response of the tropical Pacific to orbital forcing is poorly understood. This is the result of the relative complexity of modelling the tropical climate which requires full complexity global models. Such full complexity models do not, however, lend themselves to long integrations over orbital time scales due to the vast computer resources needed. Studies have shown how the mean state and interannual variability of ENSO vary with changes in orbital forcing but the results are conflicting and the models used have serious short comings. We shall present results from a full complexity GCM, HadCM3, which contains all the processes that could change the mean state and interannual variability (ENSO) on long and short timescales and therefore overcomes the flaws in previous studies.
We shall show results from a suite of model simulations, run as a series of snapshots over the last 120 thousand years that not only vary the orbital forcing but also the greenhouse gas forcing and the presence of Northern Hemisphere ice sheets. These are varied in three sets of simulations that vary the orbital forcing alone, the orbital and greenhouse gas forcing and all the forcings together. With these three sets of experiments we can unravel how the tropical Pacific climate varies over the glacial cycle. We shall show that changing the orbital forcing causes the annual mean temperature and ENSO to vary and both are paced on precessional timescales. Although this is in agreement with previous studies we do not find that the previously proposed mechanism is responsible for the change in the full complexity model. We find that the effect of greenhouse gases on the annual mean

temperature dwarves the effect of orbital variations but that ENSO variability is unaffected by the mean state change, and is once again paced by the precessional cycle. The presence of ice sheets has little impact on the annual mean temperature in the tropics but causes a dramatic increase in the variability of ENSO.

Talk

Unraveling groundwater and surface water interaction in Central Kenya Rift lakes: Implications for Paleohydrology

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Groundwater is increasingly becoming an important resource for rural communities especially in arid and semiarid regions. Knowledge of the occurrence and state of this resource is important for sustainable management. For along time groundwater and surface water budget estimations and response to climate changes have been treated separately. However, aquifers surrounding lakes can modify how lake levels and solute balance respond to climate changes. Understanding ground and surface water connection is important to reconstruct paleohydrologic conditions and inform on future changes linked with climate changes.
Lakes in the East Africa Rift have been intensively studied to better understand the influence of climate change on hydrological systems. The exceptional sensitivity of these rift lakes, however, is both a challenge and an opportunity when trying to reconstruct past climate changes from changes in the hydrological budget of lake basins on timescales of 100 to 104 years. The regional comparisons of these studies results however, are riddled with heterogeneity of response in magnitude and time within the region. Groundwater is an important component in the hydrology of these closed lakes and has not been considered much in the Paleo-hydrologic reconstructions. In this study, we reconstruct groundwater dynamics since the Holocene within the Central Kenya rift basins of lakes Naivasha and Nakuru by combining tracer methods of chemical, isotopic and noble gasses approaches (Major Anions and Cations, ^{3}H-^{3}He, ^{4}He, ^{14}C) with a simple numerical model using a linear decay approach. Water samples from wells, springs and lake in the catchment are analysed to determine the flow, age and origin of the groundwater in the study area. Paleoclimatic parameters such as airmass origins and rainfall intensity can be deduced from these.
The study is on-going and we plan to present the reconstruction of the recorded climate history, groundwater flow pathways and connectivity to the lakes additionally modern recharge rates and flow paths in the unsaturated zone. Further we'll attempt to provide important quantitative l foundations for sustainable management of these resources

Poster

What is the influence of Tibetan Plateau on the Asian summer monsoon? Barrier versus heating effect

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The Tibetan Plateau plays critically roles in the evolution and variability of the Asian monsoon system. In spite of advances in our understanding of this complex interaction, the effects of Tibetan Plateau on the Asian monsoon system remain hotly debated. Traditionally, The Tibetan Plateau is considered as a heating source, which drives the Asian summer monsoon system. A new hypothesis is recently proposed, suggesting that the Tibetan Plateau acts as a barrier posed by the mountains at the southern edge of the plateau, separating the moist warmer air over the South Asia from the dry colder air over the north Eurasia, such that the moist warmer air is favourable for deep convection.
To further study the influence of the Tibetan Plateau on the Asian summer monsoon, a set of four experiments is performed with a state-of-the-art fully coupled global model to test the responses of the Asian monsoon to the total Tibetan Plateau uplift, the southern barrier, the sensible heating on the slope of the barrier. Based on these simulations, we find that the plateau affects the South Asian monsoon mainly through its southern flank, consistent with previous studies. However, our experiments show that the southern flank affects the South Asian monsoon by producing a concentrated "candle" heating on the southern edge of the plateau rather than by increasing deep convection to the south of the plateau. Our experiments reveal that this "candle" heating is mainly (about 55% of the total) driven by sensible heating on the south slope of the plateau. The source of the remaining (about 45% of the total) diabatic heating is further explored.
Although the main chunk of Tibetan Plateau (except the south barrier) has limited impacts on the South Asian monsoon, it significantly influences the East Asian monsoon. An eastward-extended rain belt is found over East Asia in the case when the main chunk of Tibetan Plateau is present. The mechanism of this eastward-extended rain belt requires further study. Our preliminary results indicate that the surface heating on the Tibetan Plateau may cause the eastward-extended rain belt.

Presenting Author Index

MEETING PROGRAM

SUNDAY, 10 FEBRUARY

18:00-19:30	Ice breaker

MONDAY, 11 FEBRUARY

09:00-09:30	**Welcome**
09:30-10:00	**Keynote Talk - Alan Mix: "Paleoscience - review and preview"**
10:00-11:00	**Oral Session YSM06**
	Morning Break
11:30-12:30	**Poster Sessions YSM06 and YSM07**
12:30-13:30	**Oral Session YSM02**
	Lunch
15:00-16:00	**Oral Sessions YSM02 (continued) and YSM07**
	Afternoon Break
16:30-17:15	**The Art of Reviewing**
17:15-17:45	**The Art of Sharing Data**
17:45-18:45	**Breakout Groups**
19:00-21:00	Boat Dinner

TUESDAY, 12 FEBRUARY

09:00-10:00	**Reporting from Breakout Groups**
10:00-11:00	**Oral Sessions YSM01 and YSM04**
	Morning Break
11:30-12:30	**Poster Session YSM02**
12:30-13:30	**Oral Sessions YSM05 and YSM03**
	Lunch
15:00-16:00	**Poster Sessions YSM01, YSM03, YSM04 and YSM05**
	Afternoon Break
16:30-17:15	**The Art of Communicating Science**
17:15-17:45	**Peer Feedback, Awards, and Closing**
18:00-19:30	OSM Welcome Reception