# A taste of the YSM proceedings issue

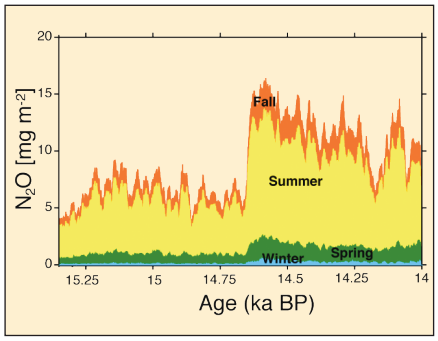
**The following articles are excerpts from the proceedings special issue of PAGES 1st Young Scientists Meeting (July 2009), which are published in the open-access online journal *IOP Conference Series: Earth and Environmental Science*. For full articles visit the online proceedings special issue at http://iopscience.iop.org/1755-1315/9/1**

## Terrestrial $N_2O/NO_x$ emissions during abrupt climate change

Mirjam Pfeiffer and Jed O. Kaplan

http://iopscience.iop.org/1755-1315/9/1/012001

$N_2O$ emitted by the terrestrial biosphere during abrupt climate change events could have amplified externally forced warming. In order to quantify the magnitude of change in emissions for the abrupt warming that occurred at the transition from Oldest Dryas to Bølling during the last deglaciation at a local scale, we combine high-resolution multiproxy records obtained from the Gerzensee site in Switzerland with a modeling approach using the ARVE-DGVM and a novel scheme for process-based simulations of terrestrial $N_2O$ and $NO_x$ emissions.




*Simulated change in seasonal $N_2O$ emissions during the Oldest Dryas/Bølling transition at Gerzensee, Switzerland.*

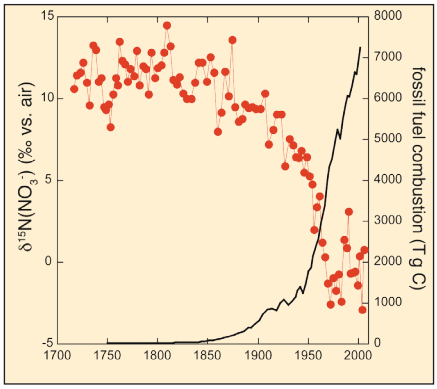
We apply a prescribed vegetation change derived from the pollen record as well as temperature and precipitation reconstructions derived from $\delta^{18}O$ values in lake carbonates as model drivers. Our results show a pronounced increase in mean annual $N_2O$ and $NO_x$ emissions for the time of the transition, with highest amounts generally being emitted during summer. While summertime emissions tend to be limited by soil moisture, temperature controls emissions during winter. For the time between 14.67 and 14.62 cal ka BP, our simulated $N_2O$ emissions show rates of increase as high as 1% per year, indicating that local reactions of emissions to changing climate could have been considerably faster than the atmospheric concentration changes observed in polar ice.

## Isotopes of nitrate: A proxy for changes in sources

Meredith G. Hastings

http://iopscience.iop.org/1755-1315/9/1/012002

The nitrogen isotopic composition of nitrate has been suggested to contain information about the sources of nitrate. However, it has been difficult to prove this directly for several reasons: many records are a combination of nitrogen signals, not atmospheric nitrate deposition alone; after the nitrate is deposited, processing (biological, chemical, physical) can alter the original signal; and/or the isotopic signatures of nitrate sources are not well quantified. Atmospheric nitrate is the major sink of nitrogen oxides that are released into the atmosphere by both natural and man-made sources including lightning, soils, forest fires and fossil fuel combustion.




*$\delta^{15}N$ of nitrate (**red circles**) from Greenland ice and estimates of fossil fuel combustion (**black line**; http://cdiac.ornl.gov/trends/emis/tre_glob.html) (modified from Hastings et al., Science, 2009).*

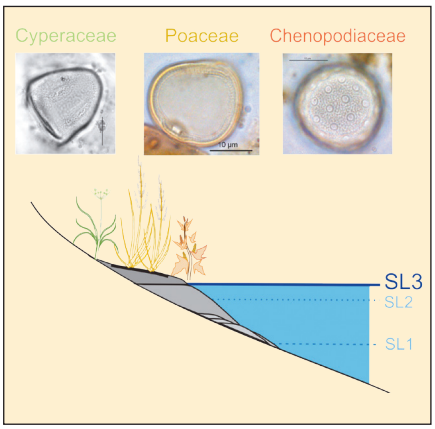
Results from a Greenland ice core show a clear change in the nitrogen isotopic composition of atmospheric nitrate ($\delta^{15}N$) over the last 300 years, which is coherent with the rise in fossil fuel combustion, a major source of nitrogen oxides in the modern environment. There are several processes that can modify the isotopic signals captured in polar ice, however, we would not expect any of these processes to have changed significantly over the last 300 years. These results suggest an intriguing possibility that ice core records may reveal how natural sources of nitrate (lightning, biomass burning, biogenic processes in soils) have varied over time and how these variations in the atmosphere and biosphere are connected to changes in climate.

## Past coastal vegetation reveals millennial changes in sea level

Catalina González and Lydie M. Dupont

http://iopscience.iop.org/1755-1315/9/1/012003

A Cariaco Basin pollen record shows the development of tropical coastal vegetation during Marine Isotope Stage 3 and gives insight into the timing of sea-level changes during Heinrich meltwater events. Rapid and abrupt expansions of salt marsh vegetation in northernmost South America were associated with the North Atlantic cold stadials encompassing Heinrich events. Intervals of salt marsh expansion have an internal plant community structure, which consists of a recurrent alternation of three different plant types. According to these observational results, soil development and salinity gradients




*The alternation of different plant types provides independent evidence of changes in salinity and soil height, and thus allows for past sea level reconstructions.*

are the main factors determining plant succession patterns, which are ultimately linked to regional sea-level and hydrological changes. Based on the interpretation of ecological preferences of individual plant types, we examined two contrasting interpretations of the pollen data, and

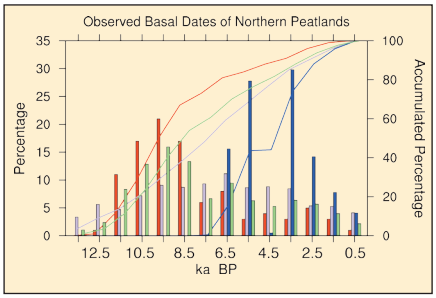
concluded that during the onset of Heinrich events, sea-level might have risen synchronously with temperature changes over Antarctica.

## Have northern peatlands changed the Holocene global carbon cycle?

Yi Wang, N.T. Roulet, S. Frolking, L.A. Mysak, X. Liu and Z. Jin

http://iopscience.iop.org/1755-1315/9/1/012004

Because the estimated present-day carbon storage of Northern Peatlands (NP) is about 300-500 petagram, and the NP has been subject to a slow but persistent growth over the Holocene epoch, it is desirable to include the NP in studies of Holocene carbon cycle dynamics. Here we use an Earth System Model of Intermediate Complexity to study the first-order effect of NP on global carbon cycle dynamics in the Holocene. We prescribe the reconstructed NP growth based on data obtained from numerous sites (located in Western Siberia, North America, and Finland) where peat accumulation records have been developed. Using an inverse method, we demonstrate that the long-term debates over potential source and/or sink of terrestrial ecosystem in the Holocene are clarified, and our results suggest that the primary carbon source for the changes (sinks) of atmospheric and terrestrial carbon is the ocean, presumably, due to the deep ocean sedimentation pump (the so-called alkalinity pump). This paper complements the study of Wang et al. (2009, Climate of the Past) by sensitivity tests using modified boundary conditions. Our paper does not consider the factors of anthropogenic land use and land cover change in the Holocene.



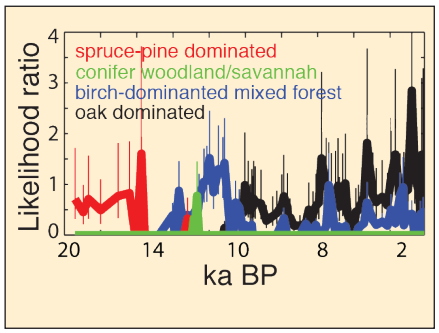

*The observed basal date frequency of the NP for Western Siberia (**red**), North America (**purple**), Finland (**blue**), and total (**green**). Notice that the solid curves correspond to accumulative percentages of the observed basal date frequency with the same colour coding (right Y-axis).*

## Ecosystem antiquity and turnover in eastern North America

Yao Liu, S.T. Jackson, S. Brewer and J.W. Williams

http://iopscience.iop.org/1755-1315/9/1/012005

We explored formal approaches to identifying and interpreting the antiquity and turnover of terrestrial ecosystems in eastern North America using pollen records. To assess ecosystem transitions with uncertainty, we applied cluster analyses, receiver-operating characteristic (ROC) analyses, and likelihood estimation of




*Likelihood of analogs to modern "pollen-ecosystems" for Tannersville Bog (Pennsylvania, USA) since the Last Glacial Maximum. Vertical bars show 50% confidence intervals.*

ecosystem analog in a simple Bayesian model. These approaches provide better presentation and interpretation of the evolving nature of ecosystem transitions. Antiquity and turnover were assessed for 479 fossil pollen sites across eastern North America. Results of analyses on a pollen sequence from Tannersville Bog provide an illustration. We mapped antiquities for four ecosystems of eastern North America defined by their pollen assemblages. Approaches discussed in this study provided a vehicle for addressing further questions such as: What are the spatial and temporal patterns of emergence of specific ecosystems? Does ecosystem emergence occur simultaneously or time-transgressively? How are these processes governed by Holocene climate dynamics?

## Water availability from tree-rings in South-Central Chile

Rocio Urrutia, A. Lara, M.P. Peña and D.A. Christie

http://iopscience.iop.org/1755-1315/9/1/012006

Based on reports of decreasing trends in precipitation over the last decades in South-Central Chile and an increasing demand for water, water availability can be considered a main limitation for the future development of the region. This fact is further aggravated by projected climatic scenarios that simulate warmer and drier regional climate towards the end of this century. This issue makes the study of past water availability crucial to understand what is going to occur with this resource in the future. This paper compares two water availability reconstructions in the Valdivian rainforest ecoregion. The tree-ring reconstructions cover the last three centuries and correspond to precipitation in the northerly region and to streamflow in the southern region. Both reconstructions differ especially in their multidecadal variability, but match at higher frequency variations, such as at the bidecadal, decadal and annual scale. The decadal and bidecadal similarities between both regional reconstructions might be partially explained by common cyclic solar forcing, while the sub-decadal regional differences might reflect the differential effects of ENSO events at both locations and the stronger influence of the Antarctic Oscillation (AAO) on the southern region. The current and projected increasing trend in the AAO could further enhance the observed decreasing streamflow in the southern area.

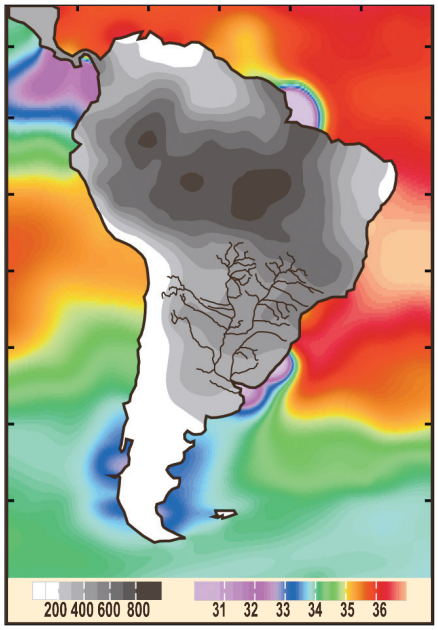
Austrocedrus chilensis, *the tree-species used in the water availability reconstructions from Chile.*

## Four proxies, one story: Precipitation in South America

Cristiano M. Chiessi, S. Mulitza, J. Pätzold and G. Wefer

http://iopscience.iop.org/1755-1315/9/1/012007

Southeastern South America is not only the most densely populated region on the continent but also a region that shows intensive agriculture, large-scale hydropower generation, and a rapidly growing demand for industrial and urban water supply—all activities that strongly rely on precipitation. Instrumental records in-




*Map of S. America showing Southern Hemisphere summer (main rainy season in southeastern S. America) precipitation (**gray shading**, mm season$^{-1}$), sea surface salinity (**color shading**, practical salinity units, psu), and the main drainages in southeastern S. America.*

dicate marked changes in precipitation during the last decades raising concerns about potential negative impacts of future droughts and floods. But regional instrumental records are not long enough to allow detrending natural and anthropogenic components of precipitation variability, which are necessary to fully understand multidecadal climate oscillations. To accomplish this, one must rely on a comprehensive understanding of the natural variability of the climate system on a regional level. We explored how different proxies (i.e., stalagmite oxygen isotopic composition, pollen %, charcoal accumulation rates, and bulk sediment elemental ratios) record Holocene precipitation variability over southeastern South America. We found generally a good agreement between the different records both on orbital and centennial timescales. Dry mid Holocene, and wet late Holocene, Younger Dryas and a period between ~9.4 and 8.12 cal ka BP seem to be pervasive features. Moreover, we show how proxy-specific sensitivity can greatly improve past precipitation reconstructions and our understanding of natural climate variability.

## A North Atlantic diatom tale of Heinrich Event 1

**Isabelle M. Gil, L.D. Keigwin and F.G. Abrantes**

http://iopscience.iop.org/1755-1315/9/1/012008

Heinrich event 1 (H1) is a climate event resulting from the release of a huge volume of sea ice and icebergs into the North Atlantic from the Northern Hemisphere ice sheets. High-resolution diatom records from the Bermuda Rise (BR) and the Laurentian Fan (LF) reveal its impacts on North Atlantic surface circulation and its timing. The event is composed of three phases: The first two correspond to major pulses of Ice Rafted Debris (IRD) and the third phase relates to its immediate aftermath. At both sites, diatom abundances start to rise at 16.8 ka. This increase is marked by diatoms related to cold environments over the LF and brackish and fresh water diatom species over the BR. This last record implies icebergs migration to subtropical latitudes and nutrient-rich meltwater. During the second phase, both sites record maximum diatom abundances when sea-ice conditions are dominant over the LF and brackish-fresh water diatom contributions culminate over the BR. The last phase witnesses the persistence of low salinity water over the LF, while a decrease towards the disappearance of diatoms occurs over the BR. The disturbances induced by H1 appear to end ~14.6 ka over the BR, while over the LF, the high diatom production persists until 14.1 ka and the salinity anomaly until 13.8 ka.

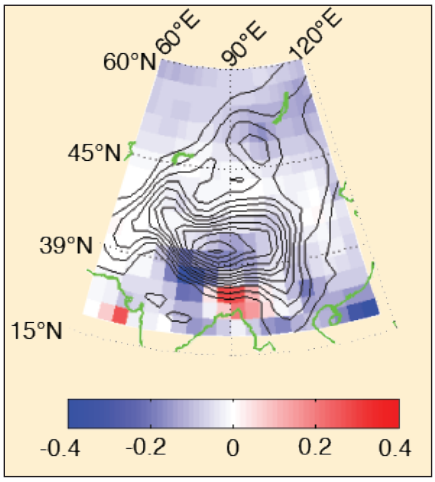
*Drifting icebergs in the North Atlantic. Photo from http://www.morguefile.com/*

## Spatial patterns in Central Asian climate and glaciers

**Summer Rupper and Michele Koppes**

http://iopscience.iop.org/1755-1315/9/1/012009

Chronologic and geomorphologic studies of past glacial advances suggest that glacier response to climate change during the global last glacial maximum (LGM) was highly variable across Central Asia. This study focuses on reconciling the record of Central Asian glacier changes with the pattern of climate change around the region and testing the sensitivity of glaciers to changes in LGM boundary conditions. In particular, a suite of general circulation model simulations (GCMs) and a glacier equilibrium line altitude (ELA) model are compared to reconstructed glacier advances from geomorphic data and used to test the sensitivity of Central Asian glaciers to simulated climate changes at the LGM. Results highlight temperature changes as being the most important influence on glacier ELA changes during the LGM. Additionally, temperature changes are relatively consistent across the suite of GCMs, with the exception of the southern Himalaya. Further research will necessarily need to focus on detailed analysis of the inter-model differences in temperature in the southern Himalaya and acquiring additional paleoclimate proxies in the region in order to further constrain the GCMs.



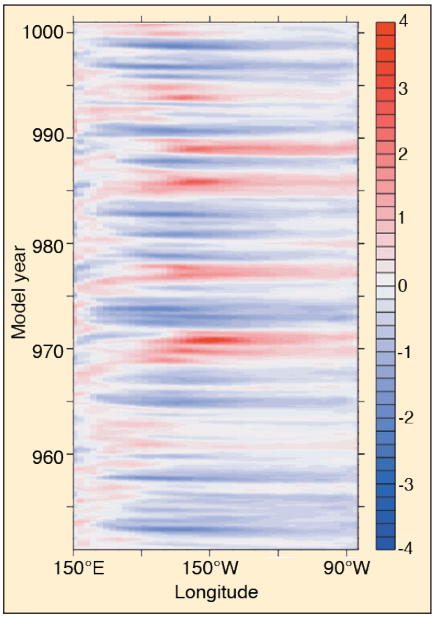

*Change in mean annual precipitation (m yr$^{-1}$) for 21 ka minus 0 ka, averaged across twelve GCM simulations.*

## Using past climates to explore El Niño dynamics

**Steven J. Phipps and Jaclyn N. Brown**

http://iopscience.iop.org/1755-1315/9/1/012010

The paleoclimate record shows that there was an increase in the frequency and magnitude of El Niño events during the




*Sea surface temperature anomalies (°C) at the equator show the propagation of simulated El Niño events within the model.*

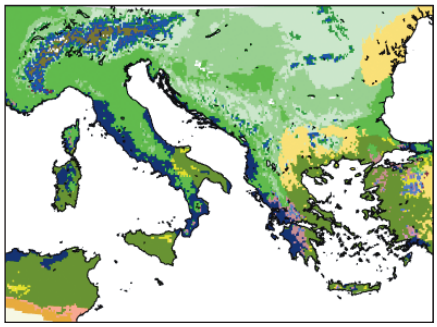
Holocene. Exploring these changes, using both data and models, provides a means of understanding El Niño dynamics. We therefore use a climate system model to explore the role of the Earth's orbital geometry in driving changes in El Niño variability over the past 8 ka. In the early Holocene, we find that increased insolation over the Asian landmass results in an intensification of the Asian summer monsoon system. This causes a strengthening of the Walker Circulation over the Pacific Ocean, leading to an amplification of the easterly trade winds in the central and western Pacific. The stronger trade winds represent a barrier to the eastward propagation of westerly wind bursts, therefore inhibiting the onset of El Niño events. We find that orbitally driven insolation changes are able to explain changes in El Niño variability over the past 8 ka. The stability of the background state of the tropical Pacific has decreased over this period, creating conditions more favorable for the development of El Niño events.

## Holocene Mediterranean vegetation change: Links to land use?

**Pamela M. Collins, J.O. Kaplan and B.A.S. Davis**

http://iopscience.iop.org/1755-1315/9/1/012011

The circum-Mediterranean region experiences a strongly seasonal climate with rainy winters and intense summertime drought, steep topography, and a multi-millennial history of intensive human land use, all of which make its soils vulnerable to erosion. Indeed, historical and stratigraphic records document severe and long-term soil erosion in several locations in the Mediterranean. Additionally, a forest-to-scrub transition in Mediterranean vegetation occurred between the mid-Holocene (6 ka BP) and the present. Our study contributes to the open debate on the causes of this shift in vegetation cover by asking the question: Could human-induced soil erosion have altered the land's capacity to support different vegetation types? We test the sensitivity of large-scale vegetation patterns to changes in soil physical properties such as depth, content of coarse fragments, and organic matter content, using the Mediterranean region as a case study. We find that while simulated biomes are sensitive to changes in some soil physical properties at some locations, threshold values for soil change to affect vegetation are very high. Additional work is planned to analyze the role that other soil physical properties and climate change could have played in influencing Holocene land cover change in the Mediterranean and to improve model representations of relevant processes.



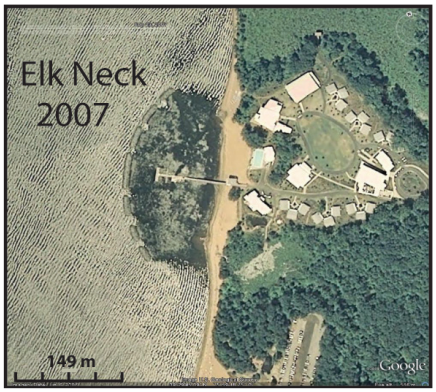
*Modeled potential natural vegetation. How might this picture change if the land had never been farmed or deforested?*

## Nearshore sedimentation in Chesapeake Bay

**Cindy M. Palinkas, E.W. Koch and N. Barth**

http://iopscience.iop.org/1755-1315/9/1/012012

Sediment characteristics, especially grain size and organic content, in nearshore Chesapeake Bay environments show significant temporal and spatial variability. This can impact benthic organisms, particularly submersed aquatic vegetation (SAV), which are important components of the ecosystem. In order to better understand how these changes are reflected in the stratigraphic record, the radiochemical and textural properties of sediment at four sites are examined. Fine and organic material are observed to increase at some nearshore locations, whereas others have experienced a shift toward lower-organic, coarser sediments. These changes are likely related to local variations in sedimentary processes. Other, more recent, perturbations are due to breakwater construction, which can trap fine and organic material in the protected area. Accumulation rates inshore of the breakwater are ~2-4 times higher than in adjacent exposed locations and this change is coincident with breakwater construction. Thus, because sedimentary processes vary according to physical setting, local trends must be discerned to determine whether a given site may be suitable for SAV restoration.




*Breakwaters reduce inshore physical energy (**wavy lines**), increasing fine sediment accumulation that can negatively affect submersed aquatic vegetation (**dark patches**).*

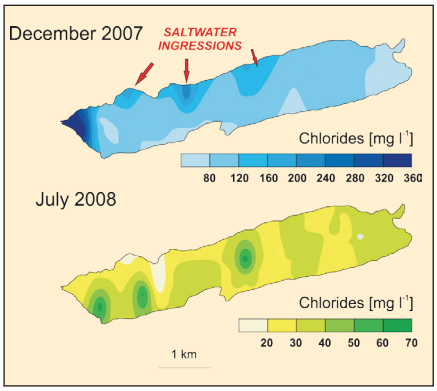
## Sea level rise intensifies saltwater ingressions to coastal lakes

**Michał Woszczyk, W. Spychalski, M. Lutyńska and R. Cieśliński**

http://iopscience.iop.org/1755-1315/9/1/012013

The Baltic Sea level along the Polish coast has risen since at least the mid 19th century and during the last few decades an accelerated rate was observed. The rise in mean sea level was accompanied by an increase in the frequency of storm surges, which in turn, are one of the main driving forces for saltwater ingressions to freshwater coastal lakes and groundwater aquifers.

From hydrochemical research of coastal Lake Sarbsko it emerges that seawater can be pumped into the lake beneath the sand barrier during winter storm surges when a gradient in hydrostatic pressure develops between the seaward and landward sides of the beach barrier. The evidence comes from increased pore water salinity in the lake at sites located along the barrier head when the sea level is at its yearly maximum (Figure). On the other hand, distinctly decreased storm activity during summer months resulted in a significant drop in pore water salinity. Moreover, a paleoecological study of a lake sediment core taken in the salt-water affected section of Lake Sarbsko revealed that in the last few decades, the intensity of saline groundwater supply to the lake has distinctly increased.




*Distribution of chlorides in pore waters from the 5-cm top-layer of surface sediments of Lake Sarbsko.*

## Mid-late Holocene environments of Agua Buena, Argentina

Diego Navarro, A. Mehl, M.A. Zarate and M.M. Paez

http://iopscience.iop.org/1755-1315/9/1/012014

In southern South America the acquisition of high-quality Holocene paleoclimate data is a priority due to the paucity of complete, continuous and well-dated records. We report preliminary results from a combined sedimentological and palynological study of an alluvial fan sequence and laterally connected sedimentary deposits at Agua Buena, east of the Andes. The main geomorphological units of the area were identified and mapped based


***a**) Atuel river upper basin landscape and **b**) one of the stratigraphic profiles analized.*

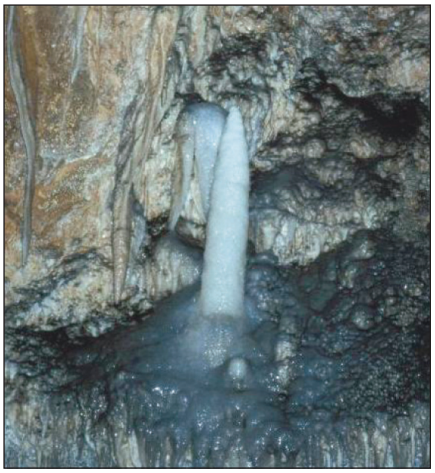
on satellite image analysis and multiple field surveys. The sedimentological and pollen results allowed us to reconstruct the development of some environments. The Agua Buena record corresponds to the distal facies of a large alluvial fan that has been active since ca. 4.1 ka. Organic-rich levels were formed during the development of wetlands ("vegas") dominated by Cyperaceae, Juncaceae and Poaceae. These highly productive environments with almost permanent water saturation were important between 4.1 and 2.8 cal ka BP, indicating relatively stable conditions. After 2.8 cal ka BP, the organic content was comparatively lower with increasing sedimentation rates that are indicative of higher fluvial discharges. This information is fundamental to interpret pollen and charcoal records in the area and to evaluate their representativeness and potential to reconstruct past local and regional vegetation.

## $^{230}$Th/U-dating of a very young, low U stalagmite from Cuba

Claudia Fensterer, D. Scholz, D. Hoffmann, A. Mangini and J.M. Pajón

http://iopscience.iop.org/1755-1315/9/1/012015

A key aspect of unraveling past climate variability, identifying potential forcing mechanisms and quantifying and predicting future climate change is the accurate determination of the timing of the changes. This is especially important in order to obtain information about the phasing of climate change and about the links between climate changes in different regions. Speleothems can be accurately and precisely dated using uranium (U)-



*Dated stalagmite "Cuba Grande" (720 mm long) inside the cave in western Cuba. Photo: Paolo Terzan*

series disequilibrium methods and, thus, provide an important archive for high-resolution climate reconstructions. However, dating of very young samples with low uranium content is difficult, especially since site-specific detrital contamination may have a significant influence on the ages obtained for such samples. We have dated a late Holocene stalagmite from Cuba using two different mass spectrometric methods (TIMS and MC-ICPMS). The stalagmite grew within the last 1.4 ka and has extremely low $^{230}$Thorium (Th) concentrations (between 0.01 and 0.06 pg/g). The effect of potential contamination by detrital initial $^{230}$Th is large. Using an age model based on the $^{230}$Th/U ages determined on samples with low or negligible $^{232}$Th concentration, we find that the ($^{238}$U/$^{232}$Th) activity ratio of the detrital phase is an order of magnitude larger than the usually applied bulk earth value indicating the importance of an accurately determined correction factor.

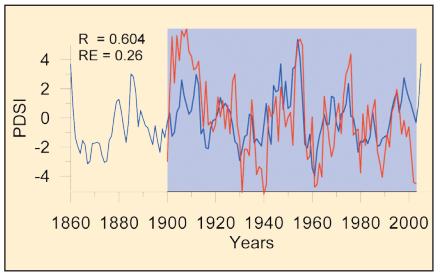
This project is part of the DFG Program INTERDYNAMIK.

## *Quercus macrocarpa* – providing multiple proxies in the Prairies

Jessica R. Vanstone and D.J. Sauchyn

http://iopscience.iop.org/1755-1315/9/1/012016

Comparisons between patterns of annual layers of *Quercus* tree-rings and climate records suggest that these parameters may serve as potential climate proxies, where-




*Latewood reconstruction of Palmer Drought Severity Index (**blue line**) compared to observed (**red line**) from near Estevan (Saskatchewan) for the period 1860 - 2005. **Blue shading** represents the calibration period.*

by climatic factors influence the size and density of vessels within the ring, either by acting as a limiting factor for growth or through fine tuning of the wood structure to environmental (water) conditions. This study assesses the potential of *Q. macrocarpa* to provide multiple dendroclimatic proxies for the Canadian Prairies, by investigating growth responses of annual, early- and late-wood widths to regional climate variability. Results indicate that ring width chronologies from southeastern Saskatchewan capture regional signals related to moisture and drought conditions. Correlations suggest that latewood widths are more representative of annual ring-widths, than are earlywood widths, and are the best proxy of seasonal fluctuations in climate. Regression models that include latewood widths were thus able to account for more variance in the Palmer Drought Severity Index (PDSI) than when annual ring-widths were used as the only proxy. This study demonstrates that *Q. macrocarpa* can provide multiple dendroclimatic proxies for investigating large scale climatic fluctuations at annual and sub-annual timescales and is novel in terms of sub-annual analysis of tree-rings in a region that previously lacked dendrochronological research.

## Teberda River runoff variability based on tree rings

Vladimir V. Matskovsky, E.A. Dolgova and O.N. Solomina

http://iopscience.iop.org/1755-1315/9/1/012017

We use seven tree-ring chronologies from high elevation sites to reconstruct Teberda River (Northern Caucasus, Russia) runoff for May, July and August. Teberda River is 60 km long with the watershed surface equal to 1080 km$^2$, the mean watershed altitude is 2210 m. 56% of Teberda River's runoff is provided by snow and ice melt. Six chronologies were developed from *Pinus sylvestris* and one from *Abies nordmanniana*. We used principal component regression and all possible combinations of seven predictors were tried to get the best

result on the cross-validation. Although we didn't create annually resolved quantitative reconstructions of Teberda River runoff because of insufficient correlation between tree growth and hydrological parameters, our smoothed reconstruction of May, July and August runoff can tell much about low-frequency variations of these parameters. Two of three reconstructions showed high wavelet coherence with instrumental data on decadal timescales and were analyzed for spectrum stability. Minima of moving trends at the end of the reconstructions along with weakening of decadal cycles may be a marker of significant change of Teberda River hydrological regime during the second half of the 20th century.

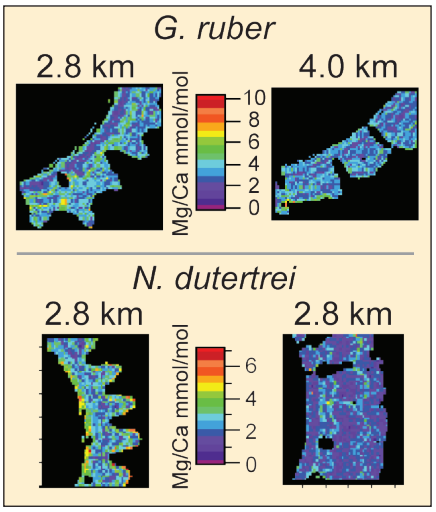
*The view of Teberda River from the Mt. Khatipara timberline.*

## Variability of the Mg/Ca ratio in planktonic foraminifers

Jennifer Fehrenbacher and Pamela Martin

http://iopscience.iop.org/1755-1315/9/1/012018

The Magnesium/Calcium (Mg/Ca) ratio in planktonic foraminifers is a well-established and widely used proxy for reconstructing sea surface and thermocline temperatures in the past. The proxy is complicated by dissolution on the sea floor, which results in an underestimation of past temperatures. Though the dissolution effect is well documented, questions remain in understanding how dissolution alters shell Mg/Ca variability. How does dissolution lower the Mg/Ca ratio? Is there preferential dissolution of higher Mg calcite? We sought to answer some of these questions by generating electron microprobe images of core top samples of planktonic foraminifera obtained from shallow and deep cores from the western tropical Atlantic. Both cores are bathed in North Atlantic Deep Water and dissolution is driven by depth (e.g., the pressure effect on calcite). We assume deeper core samples experienced more intense dissolution. Mg/Ca ratio image maps were generated for two species widely used in temperature reconstructions, *G. ruber* and *N. dutertrei*. Images and histograms of the Mg/Ca ratio of *G. ruber* reveal a preferential decrease in high Mg/Ca calcite. Preliminary results of *N. dutertrei* suggest the variability within this species is dependent upon the surface crystallinity, thus, determining the effect of dissolution on *N. dutertrei* was difficult to ascertain.



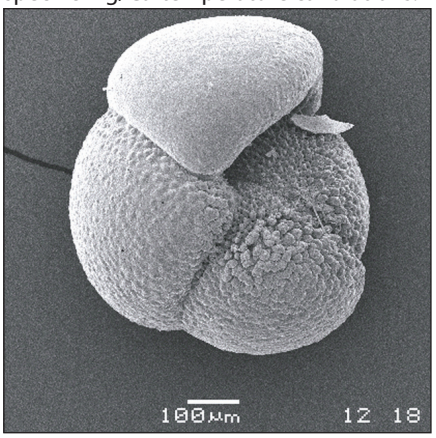

*Sample electron microprobe Mg/Ca image maps of* G. ruber *from a shallow and deep core and* N. dutertrei *both from the shallow core. The* G. ruber *images highlight the variable nature of the Mg/Ca ratio within this species and how dissolution alters its variability. The* N. dutertrei *images reveal the complex Mg/Ca variability of this species, which may be dependent on shell surface morphology/crystallinity.*

## *G. inflata* Mg/Ca calibrations and temperature reconstructions for Termination I

Elizabeth J. Farmer, M.R. Chapman and J.E. Andrews

http://iopscience.iop.org/1755-1315/9/1/012019

Mg/Ca ratios from planktonic foraminifers are now widely used as a proxy for ocean temperature. Paired Mg/Ca and $\delta^{18}O$ analyses from a range of species with different depth habitats allow a profile of water column properties to be built up for a specific location over time. However, Mg incorporation varies significantly between species and locations and such detailed multi-species reconstructions require accurate species-specific, and even region-specific Mg/Ca-temperature calibrations.




*Scanning electron microscope image of the thermocline-dwelling planktonic foraminifer* G. inflata.

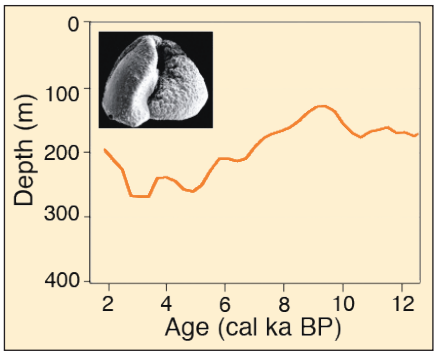
We present preliminary results based on a new Mg/Ca calibration (Mg/Ca = $0.92e^{0.039T}$) for the thermocline-dwelling foraminifer *Globorotalia inflata*, derived using a suite of North Atlantic coretops. We compare the performance of this new calibration with existing ones, using the downcore Mg/Ca record from core SU90-03 (40°N, 32°W) over the Holocene and the larger climatic shift of Termination I. The new calibration successfully reconstructs present day conditions at the core site and appears to better estimate the cooler temperatures at the lower limit of *G. inflata*'s temperature range. There are significant differences between the calibrations, highlighting how calibration choice affects both absolute temperatures and the amplitude of events, particularly over large-scale climatic transitions. This has major implications for errors associated with the reconstruction of seawater $\delta^{18}O$/paleosalinity and surface temperature gradients based on Mg/Ca records from multiple foraminiferal species.

## *G. truncatulinoides* depth migration over the Holocene

Caroline Cléroux and Jean Lynch-Stieglitz

http://iopscience.iop.org/1755-1315/9/1/012020

By comparing the oxygen isotopic composition ($\delta^{18}O$) of surface dwelling and benthic foraminifers from cores along a depth transect to *G. truncatulinoides* $\delta^{18}O$ in one of the deeper cores, we calculated the calcification depth of this species over the past 12 ka in the Florida Straits. A significantly different calcification depth between 8-10 ka and the late Holocene has been found and the signal is observed in two other locations over the western North Atlantic American continental margin. The cause of this migration is unknown and is a hitch to the assumption that deep-dwelling foraminifera calcify at constant depth level. We now present new Mg/Ca ratio and stable isotopic measurements on *G. truncatulinoides* and *G. crassaformis*




*Picture and calcification depth of* G. truncatulinoides *in the Florida Strait for the last 12 ka.*

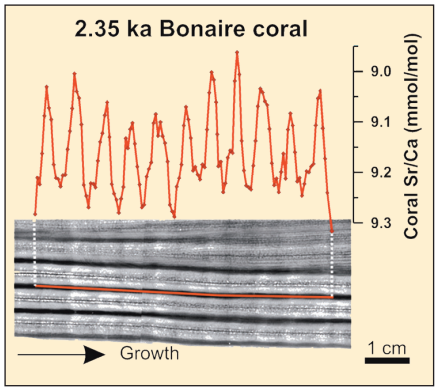
and a preliminary interpretation to understand the cause of the migration of *G. truncatulinoides*. We show that subsurface temperature and salinity did not change significantly suggesting that they are not the cause of the migration. However, carbon isotopic data ($\delta^{13}C$) seem to indicate changes in nutrients and/or productivity and provide the best hypothesis for the observed calcification depth change.

## Monthly Holocene temperature variability from Caribbean corals

**Cyril Giry, T. Felis, S. Scheffers and C. Fensterer**

http://iopscience.iop.org/1755-1315/9/1/012021

As new high-resolution paleoclimate records emerge from various archives, it becomes progressively evident that fluctuations in Holocene tropical climate were larger than previously considered. While orbitally-induced insolation changes control sea surface temperature (SST) variations on millennial timescales, the tropical Atlantic Ocean exhibits prominent




*Monthly-resolved Sr/Ca record of a fossil* Diploria strigosa *coral from Bonaire. The sampling transect along the dense thecal wall is indicated on the X-radiograph (**red line**).*

interannual to interdecadal SST variability that modulates the strength of the trade winds and influences the distribution and intensity of rainfall over the surrounding landmasses. We used Strontium/Calcium (Sr/Ca) variations in annually-banded fossil corals (*Diploria strigosa*) from coastal deposits on Bonaire (Southern Caribbean Sea) to reconstruct seasonal and interannual to interdecadal SST variability at monthly resolution.

A 40-year-long monthly-resolved coral Sr/Ca record from 2.35 ka BP (U-series dating) exhibits clear seasonal cycles and pronounced interannual variability at periods of 6-7 years. Our investigations reveal that the Sr/Ca SST proxy is not influenced by diagenetic alteration of the skeleton or skeletal growth rate. As tropical Atlantic SST variability on these timescales is influenced by the competing influence of natural modes of ocean/atmosphere variability, longer records of multiple fossil corals will provide estimates on the range of seasonal and interannual to interdecadal SST variability in the Southern Caribbean Sea during key periods of the Holocene.

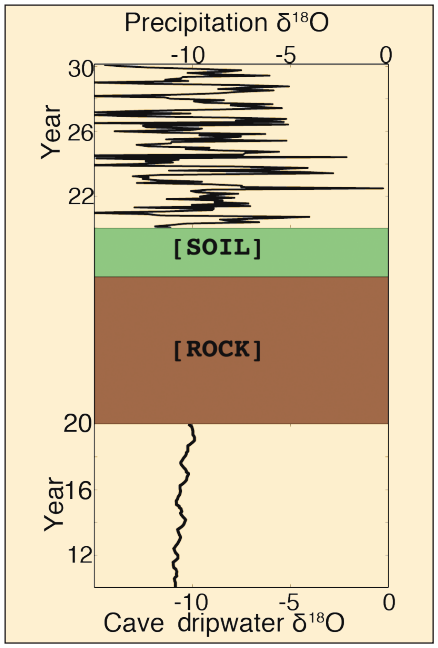
This project is part of the DFG Program INTERDYNAMIK.

## Forward modeling cave dripwater isotopes

**Sarah A Truebe, T.R. Ault and J.E. Cole**

http://iopscience.iop.org/1755-1315/9/1/012021

Speleothem oxygen isotope records from arid regions are often interpreted as indicators of the total amount and/or seasonal balance of precipitation. We address the possible influence of in situ processes such as groundwater storage and mixing




*Precipitation $\delta^{18}O$ input (**top**) and model output dripwater $\delta^{18}O$ (**bottom**). Although our idealized precipitation input has no statistically significant variance on timescales longer than the seasonal cycle, model-simulated subsurface storage and mixing can generate substantial decadal to multi-decadal variability.*

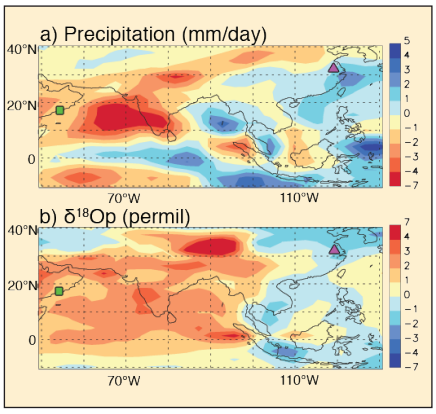
on speleothem $\delta^{18}O$ values by simulating surface-to-cave moisture flux with a two-layer soil/rock model. Observations indicate that dripwater $\delta^{18}O$ values are most comparable to winter precipitation values. However, using modern climate data to drive our model, we show that seasonality and duration of the regional summer monsoon can affect how much summer precipitation reaches the cave. We then use randomly generated data with the same statistical distribution as actual climate data to drive our model. When graphed as frequency spectra, these "model" $\delta^{18}O$ series exhibit a high degree of variance at decadal to multidecadal frequencies, despite being driven by synthetic data that includes only a seasonal cycle. This suggests that some background level of variance in speleothem $\delta^{18}O$ records could be due to nonclimatic processes, such as subsurface water storage and mixing. Interpreting climatic vs nonclimatic controls on speleothem $\delta^{18}O$ variability could be achieved by replicating records from different caves or from monitoring modern cave systems to understand the influence of in situ processes.

## Speleothem $\delta^{18}O$ and paleoprecipitation in Asia

**Jung-Eun Lee and Abigail L. Swann**

http://iopscience.iop.org/1755-1315/9/1/012021

Oxygen isotope measurements from speleothems have been used to infer past hydrological cycles because the isotopic composition of precipitation is observed to decrease with increasing precipitation rates over low latitude coastal and island stations (the "amount effect"). Here, we show that local precipitation amount can be inferred from the differences in oxygen isotopic composition if the measurement site is in a subtropical coastal region where water vapor is transported directly from the ocean. Our work indicates that sites further inland may not be suitable for studying the changes in local precipitation amount but still reflect the combined changes of precipitation amount and changes in vapor transport pattern. We have shown that Hulu Cave is a reasonable site to interpret precipitation from oxygen isotopes in precipitation ($\delta^{18}O_p$): the estimated precipitation difference between present-day and the Last Glacial Maximum (LGM) from the measured $\delta^{18}O_p$ difference (1~2‰) would be 0.8-2.2 mm/day (drier during the LGM) assuming our model simulates evapotranspiration reasonably well at this site.




*The differences in (**a**) precipitation and (**b**) $\delta^{18}O_p$ between the LGM and present. The triangle and square denote the location of the Hulu Cave and Qunf Cave, respectively.*