Process oriented analyses to better infer precipitation changes in West Africa

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
The representation of future precipitation changes in West Africa show little agreement between model simulations. In addition, PMIP mid-Holocene simulation underestimate the northward extend of the monsoon rain. Here we propose a convective regime sorted analyses to estimate the relative part of the changes in boreal summer precipitation resulting from changes in large scale pattern or more local thermodynamically factors. For this we consider three periods: Last Glacial Maximum (LGM), mid-Holocene (MH) and abrupt4xCO2 (4X). The first part of the analyses shows that there is more analogy between model results when using this classification, compared to ensemble model mean. It tells us that part of the model spread in the change in total precipitation results from differences in the relative effect of large scale versus more local thermodynamics. Model agreement is however dependent on the analyses period, the largest agreement being found for the changes in the distribution of the convective regimes. In order to show detailed regional changes in WAM precipitation, an attempt is made to modify the precipitation regime of the ERA-interim reanalysis data by the changes of regimes from model results, and to apply a correction on precipitation that takes into account the information gained from the distribution and the efficiency of precipitation of the different convective regimes. For 4X and LGM it is however difficult fully assess regional changes given the regional spread of the results.

Comparing simulations of last millennium AMOC with reconstructions

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
The Atlantic meridional overturning circulation has large amplitude variations on decadal timescales. Although models show this variability, a quantitative evaluation of it is hard because of a lack of observational records. Recent developments in paleoceanography now allow us to estimate the temporal behaviour of the AMOC over the last millennium. Here we will present three recent reconstructions (Rahmstorf et al, 2015; Thornalley et al, submitted). Here these are compared with the output of the PMIP3 past1000 simulations and the CESM last millennium ensemble. We explore the relevant approaches to perform such a data-model comparison. From a logistical viewpoint, this analysis will highlight the importance of both extending the past1000 simulations through the historical period and uploading the msftmyz diagnostic to the Earth System Grid.

The PMIP Paleovariability Working Group and NCAR's Climate Variability Diagnostics Package

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
The Paleovariability working group aims to foster and facilitate research into looking at how climate variability changed in the past. The majority of its focus so far has been on ENSO. Partly this is due to ENSO's global dominance at interannual timescales. But we feel that this is also partly down to the effort required to download and compute standard climate variability indices from the PMIP simulations. However substantial effort has recently been expended in developing a software stack to automate Earth System Model validation (ESMval; Eyring et al, 2015). Like PMIP's own benchmarking activity, this has predominantly been focused on analysing the mean state of the climate. Nonetheless, significant progress has been made towards the standardised and routine calculation of multiple modes of climate variability (Phillips et al, 2014). On behalf of the Paleovariability working group, University College London is undertaking the computation of these modes and diagnostics. The intention of this effort is to (a) provide a first look at variability in PMIP4 (b) permit quick assessment of the potential of future research studies (c) provide pre-computed time series/patterns to allow studies to compare to climate variability, without needing to the download simulation data itself. Here we would like to demonstrate the utility of this effort, by showing results of the diagnostic package from PMIP3 simulations.

East Asian summer monsoon dynamics in the past and future warmer climates: mid-Pliocene and RCP4.5 scenario comparison perspective

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)

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Abstract:

In this study, moisture budget analysis and moist static energy (MSE) are applied to investigate the drivers and mechanisms of East Asian summer monsoon (EASM) precipitation in the mid-Pliocene and RCP4.5 scenario. The enhancement of EASM precipitation is a common feature in both warmer climates. By diagnosing moisture budget analysis, it was found that thermodynamic component contributes more than dynamical contribution to EASM precipitation in both warmer climates, which essentially represents the increasing response of EASM precipitation to the past and future warming. MSE is used to reveal the dynamical mechanism responsible for the EASM precipitation enhancement. One mechanism identified by MSE is zonal thermal contrast enhancement and the other is stationary meridional velocity. The former can affect EASM precipitation via strengthening of large-scale circulation associated moisture transport into EASM domain. while the latter can exert EASM precipitation through modulating the local physical processes associated with moisture convergence in mid-Pliocene and divergence in RCP4.5 scenario, which is possible reason to explain why projected EASM precipitation with higher than mid-Pliocene CO_2 level but precipitation increase less than mid-Pliocene. Nevertheless, mid-Pliocene offers an analogue to understand the EASM dynamics in the future scenario.

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2012: Observational analysis and numerical simulation of the interannual variability of the boreal winter Hadley circulation over the recent 30 years. Sci China Earth Sci, 55, 1–15, doi: 10.1007/s11430-012-4497-x.

A comparison of the Arctic warming mechanism between the mid-Holocene and the future

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:

There remain substantial uncertainties in the future projections of Arctic climate change. Schmidt et al. (2013) advocated potential of constraining the uncertainties by making use of both paleoclimate simulations and archives. Indeed, they found a statistical correlation in sea ice changes between the mid-Holocene (MH) and the future with respect to the modern period. It was unclear, however, why such a relation emerges and what the mechanism behind the relation is. We conducted a surface energy balance analysis on 10 CMIP5/PMIP3 atmosphere-ocean general circulation models for climate changes under MH forcing and future RCP4.5 scenario forcing. We found that many common dominant processes that amplify the Arctic warming from late autumn to winter exist between the two periods, despite of the completely different external forcing (insolation vs. GHGs). We also quantified the contribution of individual processes to the inter-model variance of the surface temperature changes. The controlling term varies with seasons, and the details will be presented. Based on the understanding of Arctic warming mechanism from this study, we conclude that paleo-archive recording the Arctic warming at the MH must contain the useful information relevant to the future Arctic climate change.

large-scale Climate And VegetatIon Changes OveR the last Deglaciation (CLAVICHORD)

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
The last deglaciation (from 21,000 to 9,000 years ago), during which the huge ice sheets over the North America and Scandinavia melted, is a period of tremendous climate and environmental changes. These changes are documented by physically based paleoenvironmental indicators (such as oxygen or carbon isotopes in ice cores and marine cores) and by biologically based data (such as paleo-vegetation). This study aims, for this period of the last deglaciation, at 1) building a comprehensive documentation of climate changes over terrestrial areas from widely available pollen data, 2) assessing the impact of both climate and atmospheric CO_2 changes on vegetation change, and 3) investigating the changes in large-scale atmosphere circulation and the hydrological cycle responsible for these surface climate and vegetation changes. This study will provide new benchmarking data for understanding environmental changes and evaluating climate models that are used for climate projections. Then, these results will contribute to quantifying the range of possible changes in these circulations in the future. Here, we develop pollen/biome-based global climate reconstructions with an inverse (equilibrium) vegetation modeling approach over the last deglaciation. The approach is implemented by searching for a set of climate values which, when input to a vegetation model, simulates vegetation that is consistent with the paleovegetation reconstructed from fossil pollen data. The approach allows us to avoid both no-analog and wrong-analog problems and to assess the potential bias in reconstructions that may result from varying atmospheric CO_2 concentrations.

Reconstructing the East African rainfall and Indian Ocean sea surface temperatures over the last centuries using data assimilation

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
The relationship between the East African rainfall and Indian Ocean sea-surface temperatures (SSTs) is well established. The potential interest of this covariance to improve reconstructions of both variables over the last centuries is examined here. This is achieved through an off-line method of data assimilation based on a particle filter, using hydroclimate-related records at four East African sites (Lake Naivasha, Lake Challa, Lake Malawi and Lake Masoko) and SSTs-related records at 12 oceanic sites spread over the Indian Ocean to constrain the Last Millennium Ensemble of simulations performed by CESM1. Skillful reconstructions of the Indian SSTs and of the East African rainfall can be obtained based on the assimilation of only one of these variables, when assimilating pseudo-proxy data deduced from the model CESM1. The skill of these reconstructions increases with the number of particles selected in the particle filter, although the improvement becomes modest beyond 99 particles. When considering a more realistic framework, the skill of the reconstructions is strongly deteriorated because of the model biases and the uncertainties of the real proxy-based reconstructions. However, it is still possible to obtain a skillful reconstruction of the whole Indian Ocean SSTs based only on the assimilation of the the 12 SST-related proxy records selected, as far as a local calibration is applied at all individual sites. This underlines once more the critical role of an adequate integration of the signal inferred from proxy records into the climate models for reconstructions based on data assimilation.

Orbital modulation of ENSO seasonal phase locking

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
Modern El Niño-Southern Oscillation (ENSO) events are characterized by their phase locking of variability to the seasonal cycle and tend to peak at the end of calendar year. However, in an idealized CCSM3 simulation of the climate of the last 300 thousand years, ENSO seasonal phase locking is shifted periodically following the precessional forcing: ENSO tends to peak in boreal winter when perihelion is near vernal equinox, but peak in boreal summer when perihelion ranges between autumnal equinox and winter solstice. The mechanism for the change of ENSO's phase locking is proposed to be caused by the change of seasonality of the growth rate, or the intensity of ocean-atmosphere feedbacks, of ENSO. It is found that the December peak of 'winter ENSO' is caused by the continuous growth of ENSO anomaly from June to November, while the June peak of 'summer ENSO' appears to be caused jointly by the seasonal shift of positive growth rate in spring and relatively stronger stochastic noise in the first half of the year. Furthermore, the change of the seasonal cycle of feedbacks is contributed predominantly by that of the Ekman upwelling feedback (EK) with the thermodynamic damping playing a secondary role. The summer peak of ENSO is proposed to be caused by the following mechanism. A perihelion in the late fall to early winter forces spring cooling of SST in the eastern equatorial Pacific (EEP) due to reduced insolation, which, reinforced by an oceanic process, leads to weakened thermodynamic damping. The EEP thus becomes more sensitive and favors the growth of the eastern Pacific-like ENSO (opposing to the central Pacific-like ENSO). This generates more uniform basin-wide wind response (quantified as a component of EK), in turn, increased instability in spring, ultimately benefiting the subsequent summer ENSO peak.

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The calendar effect in PMIP4 time-slice and transient simulations: overall impact and strategies for data analysis

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
The "calendar effect" is the common expression for the impact that the known changes in the length of months or seasons over time, related to changes in the eccentricity of Earth's orbit and precession, have on summarization of model output. Even if daily data are available, the calendar effect must still be considered when summarizing data by months or seasons, or when calculating climatic indices such as the temperature of the warmest or coldest month—values that are required for comparisons with paleoclimatic observations. The impact arises not only from the changing length of months or seasons, but more importantly, from advancement or delay in the starting and ending dates of months or seasons relative to the solstices. The impact of the calendar effect is large and spatially variable, and can produce apparent spatial patterns that might otherwise be interpreted as evidence of, for example, high-latitude amplification of temperature changes, continental/marine temperature contrasts, or variations in strength of the global monsoon. Calendar effects must also be considered in the analysis of transient climate-model simulations (even if data are available on the daily time step). Time series of data aggregated using a fixed modern calendar as opposed to an appropriately changing one can differ not only in the shape of long-term trends, but also in the timing of Holocene "thermal maxima" by several thousand years, depending on the time of year. There are a number of approaches for adjusting monthly data that were averaged using present-day calendar definitions to a "paleo calendar". A simple one involves a) determining the appropriate fixed-angular month lengths for a paleo experiment (e.g., Kutzbach and Gallimore, 1988, JGR 98:803-821), b) interpolating the data to a daily time step using a mean-preserving interpolation method (e.g., Epstein, 1991, J. Climate 4:365-368) or using archived daily data directly, and then c) averaging or accumulating the interpolated daily data using the appropriate paleo month starting and ending days (i.e., month lengths). We present examples of the calendar effect and discuss their implications for interpretation of paleoclimate data.

PaCMEDy - Palaeoclimate Constraints on Monsoon Evolution and Dynamics

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
PaCMEDy aims to identify emerging constraints on monsoon evolution and dynamics, linking modelling of past climates to future projections. The evaluation of the variability and the strength of monsoons in palaeoclimate simulations through past records provides the opportunity to assess the credibility of future climate projections. The project will use annually-resolved palaeoenvironmental records of past 6000 years from corals, molluscs, speleothems and tree rings, together with global climate-model transient (from mid-to-late Holocene) and high resolution simulations of Indian, African and South-American monsoons to provide a better understanding of the monsoon dynamics. The project will also use forward models, including models of terrestrial productivity, tree growth and speleothem development to relate simulated climate changes more directly to observations. PaCMEDy is organised around four themes: (1) the impact of external forcing and extratropical climates on intertropical convergence and the hydrological cycle in the tropics; (2) characterization of interannual to multidecadal monsoon variability to determine the extent to which the stochastic component is modulated by external forcing or changes in mean climate; (3) the influence of local (vegetation, dust) and remote factors on the duration, intensity and pattern of the Indian, African and South American monsoons; and (4) the identification of paleo-constraints that can be used to assess the reliability of future monsoon evolution. The poster will present the objectives of the project and a synthesis of the results obtained during the first year.

The role of vegetation change upon polar amplification in warm climate by feedback analysis

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
Past warm periods are induced by both higher atmospheric CO2 concentration and the change of Earth's orbit through different temporal and spatial pattern of downward shortwave radiation. Previous studies revealed that vegetation change in high latitude (e.g. from tundra to forest) in warm climate strengthens a polar amplification. This is due to lower vegetation albedo of forest than tundra, snow-albedo feedback caused by early snow melt due to forest coverage and ocean heat release in autumn and winter. To reveal the mechanisms of orbit-induced warming case (6ka) and CO2-induced warming cases (2xCO2 and 4xCO2), we apply a feedback analysis method (Yoshimori et al. 2014) on several climate simulations by a GCM with vegetation feedback. We also discuss the difference of feedback mechanisms in the orbit induced case and CO2-induced case, especially focusing on interseasonal warming mechanisms caused by vegetation feedback in the high latitude and its contribution to the polar amplification.

Proxy system modeling and data assimilation in paleoclimatology

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
Optimally using data assimilation techniques to combine paleoclimate observations and model results requires addressing several challenges. First, the variables measured in environmental archives collected in the field (such as tree ring width or pollen assemblage) are often not directly simulated by climate or Earth system models and may be a complex and nonlinear function of several environmental factors. An objective comparison between the measured variables and simulation results may be improved by modeling the mechanisms by which a paleoclimatic archive is imprinted with an environmental signal, i.e., by using a "proxy system model". Second, specific data assimilation techniques are needed to handle sparse data, represent temporal averaging, spatial downscaling and chronological uncertainty. In this framework, the goal of the new PAGES working group on Data Assimilation and Proxy System modeling (DAPS; http://pastglobalchanges.org/ini/wg/daps/intro) is to stimulate the application of proxy system models and data assimilation in paleoclimatology. Among the initiatives proposed at the first DAPS meeting in Louvain la Neuve, Belgium, were "proxy system model intercomparison projects" for important paleoclimatic archives and observations, which will lead to improved assessments of proxy system model uncertainty; and application of data assimilation methods to construct a last century product, whose skill and error characteristics may be examined relative to historical and modern reanalyses within the data assimilation framework. These efforts will benefit from close collaboration with the PMIP4 initiative.

WCRP Assessment on Climate Sensitivity - the paleo angle.

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
The aims of the WCRP Assessment on Climate Sensitivity are: to make a thorough assessment of climate sensitivity; to clarify the nature and limitations of key evidence; to assess the likelihood of very low or high climate sensitivity and provide robust 5-95% confidence ranges for it; and to highlight future research directions most likely to yield stronger constraints. Towards these goals, a review paper is currently in progress, to be submitted for publication in 2018. As part of this we hope to make available some simple code to allow the community to reproduce, test and build on the results. There are three groups involved, focussing on: process modelling/present day constraints; the Historical Record; and the Paleoclimate Record; plus a subgroup focussing on synthesising the different lines of evidence. Here we will overview progress to date, particularly highlighting the constraints on climate sensitivity from the paleoclimate record.

The PMIP Past to Future (P2F) Working Group

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
The Past to Future working group provides a focus for scientists interested in using paleoclimate information to improve predictions of climate change. The group website (https://wiki.lsce.ipsl.fr/pmip3/doku.php/pmip3:wg:p2f:index) contains information for those interested in learning about this area of research, with an outline of common methodologies, suggested targets for research, information on how to find model output and paleoclimate observations, and summaries of relevant papers over recent years. There is also a subgroup focussed on the Last Glacial Maximum which aims to keep track of model experiments which segregate the different forcings for that climate interval, with the aim of diagnosing the effect of the different feedbacks. As well as overviewing these activities, we will show some highlights of recent research in the P2F area.

Assessing reconstructions of temperature changes over the past millennium in Antarctica using pseudo-proxy experiments and data assimilation

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)

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Abstract:

Reconstructions of temperature changes in Antarctica over the past millennia are still relatively uncertain. This can have several origins: 1) The number of high resolution ice cores is small, in particular on the Antarctic Plateau; 2) The instrumental records are too short to adequately calibrate the reconstructions and test the methodologies; 3) The link between isotope records measured in the ice core and local climate are usually complex and dependent on the spatial and time scales investigated. In order to estimate the potential biases of the standard reconstruction methods, their skills are first assessed in a pseudo-proxy framework. To do so, the surface temperature and stable oxygen isotopes results of a long simulation of an isotope-enabled model are sampled at the same temporal and spatial resolution as the real data synthesized by the working group Antarctica2K. This provides temperature series covering the last decades corresponding to instrumental data and isotopes values over the last centuries at the locations where ice core data are available. Those pseudo-data are used to make reconstructions of temperature over the last millennium using standard statistical methods that can then be compared to the simulated temperature to evaluate the performance of each of these methods. In a second step, using the same pseudo-proxy framework, a data assimilation method based on a particle filtering is applied and the resulting reconstructions of temperature changes are compared to the ones of the statistical methods. Finally, the data assimilation implementation method tested and improved in this idealized framework is applied to the real data and the results compared to available reconstructions based on statistical methods.

Experiments for ensemble-based joint state-parameter estimation in past climate reconstructions

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
Within model-data comparison under a data assimilation (DA) perspective in paleoclimate we may have two main objectives: a) to conduct climate field reconstructions (CFR), and b) to constrain (or calibrate) the model parameters with the alternative/additional goal of improving model projections of future climates. One can well approach the problem of CFR for past climates without explicitly accounting for parameter estimation, and in fact this has allowed the use of the so-called offline (possibly multi-model) DA approaches for CFR in recent studies. However, in general, for long-term past climate reanalyses, inaccurate parameters in the climate model have a predominant role in the growth of prediction errors. Although DA is most often used for state estimation, combining observational data with model predictions to produce an updated model state that most accurately approximates the true system state whilst keeping the model parameters fixed, it is also possible to use DA techniques for the joint state-parameter estimation problem. Unfortunately, it is not possible, in general, to use offline approaches for this, as the background ensemble has not been explicitly designed with the joint estimation problem in mind. This leads to the problem that one needs to resort to new paleo-simulations if we want to attempt both (a,b) goals, with the attached computing cost. Here we explore some ensemble strategies for the joint state-parameter estimation problem with a synthetic study using the global Community Earth System Model (CESM v2.1) and MARGO-like sparse pseudo-proxy SST observations.

Improving coupled vegetation dynamics in an Earth System model with palaeo-environment evaluation

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
Paleoclimate simulations are usually performed using coupled general circulation models or Earth System models that have released to the academic community. This can often mean that the performance of a given model for a given palaeo-epoch does not have much influence on the development of that model, and does not therefore influence decisions about model structure, parameterisations or tuning. Here we report work on palaeoclimate simulations of the last glacial maximum and mid-Holocene that have been performed in parallel with the development of the United Kingdom Earth System Model (UKESM). This model will form a major part of the UK's contribution to CMIP6 and is being developed jointly by the UK Met Office and UK academic community. We present the first palaeoclimate simulations with the UK Met Office's Global Atmosphere model version 7 (GA7) in an Earth System configuration that includes dynamic vegetation, aerosols and chemistry. GA7 is a 3D semi-Lagrangian, non-hydrostatic, fully compressible general circulation model with a horizontal resolution of 1.875x1.25 degrees and with 85 vertical levels, 35 of which are in the stratosphere. GA7 includes a prognostic rather than diagnostic cloud scheme, and a new dynamical core which has improved the simulation of climate variability. A size-resolving aerosol scheme allows for a more realistic simulation of the indirect aerosol-cloud interactions. The land surface scheme (JULES) uses 9 natural plant functional types and simulates vegetation interactively using an updated version of TRIFFID. In comparison with the most recent pollen-based LGM vegetation reconstructions for northern Eurasia, GA7 significantly overestimates bare soil coverage. Results from a parallel 100-member perturbed parameter ensemble of land surface-only LGM simulations together with a statistical emulator, allow us to identify underlying reasons for this bias and to make suitable parameter changes that lead to improved vegetation coverage, thereby potentially improving the fully coupled Earth System model. Together with previous work using an older version of the UK Met Office Earth System model (HadGEM2-ES), vegetation coverage in mid- to high-latitudes at the LGM appears to provide effective bounds on the temperature dependence of vegetation productivity, and the associated surface feedbacks from snow cover.

Spatial paleoclimate reconstructions using model simulations and proxy data

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:
The German research programme "Our way to Europe" (CRC 806) studies the history of the Modern Man in an interdisciplinary framework by using geoscientific and archaeological methods. One aim of the climatological group is the spatial climate reconstruction for Europe by including all available proxy and model data. This contribution looks at the comparison between model simulations, which are taken from the PMIP3 database, and statistical climate reconstructions based on pollen data. The aim is to optimize the model data by including the probabilistic information of the occurring taxa. This concept will be presented and discussed. For the Mid-Holocene (6 ka BP), especially summer temperatures change clearly when assimilating the PMIP3 multi-model ensemble to the observed pollen data. In this case, the original PMIP3 simulated temperature data are increased through the inclusion of the paleo pollen data. This happens especially over land. The added value can be detected by the predominantly positive Brier skill scores.

Pre-monsoon precipitation inferred from Himalayan Birch from the Central Himalaya

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:

Based on Himalayan birch collected from the Sagarmtha National park and Langtang National park of central Nepal, we developed 460-year chronology, currently this is the longest chronology of this species from High Asia. Himalayan birch showed strong and direct relationship with spring (March-May) precipitation thus, used to reconstruct spring precipitation back to 1552AD. This is the first precipitation reconstruction using this species. The reconstruction captured 37% of the variance in the calibration model over the period 1960-2009. Reconstruction (2011-1552) shows annual, multiannual to decadal variation. The year 1999, 1813 and 1954 respectively experienced the driest spring where as 1775, 1557 and 1988. The reconstructed series showed AD1811- 1821 and 1995-2005 are the driest decades where as AD 1926-1936 and 1640-1650 the wettest in the whole reconstruction (1552-2011). The most interesting feature of this reconstruction is a decrease in precipitation between 1 to 5 years following the eruption of volcanic eruption depending upon the strength of the volcano. The MTM spectral analysis showed significant spectral peaks at 3.4, 3.6, 3.9, 26.2, 30, 42.7, 53.8 years. The reconstructed precipitation also showed significant correlation with the Kathmandu precipitation and other larger-scale regional indices used to represent the South Asian monsoon rainfall. Thus, the result here indicates a great potential to extend the tree-ring series in length using Himalayan birch that could provide high-resolution palaeoclimatic records that span the last several centuries and fill the gaps from the data scare region of central Himalaya.

Proxy data "Pollen" assimilation to reconstruct climate for Holocene (10kyr BP) in the Euro-Mediterranean region

Session: Cross-cutting Group 2 (Paleovar, Past to future, Data assimilation)
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Abstract:

The Mediterranean area is a hotspot of climatic change and during the Holocene, it has known important climatic changes which has deeply influenced its socio-economic development. We present a new approach to reconstruct these climatic changes, based on an off-line pollen data assimilation in the earth system model. Pollen data have been extracted from the European Pollen Database (286 sites). The earth system model, LOVECLIM, is run to simulate at a annual time-step the last 10kyr Holocene climate with appropriate boundary conditions and realistic forcing. To match data and model simulations, a simple downscaling scheme is used to the 10' resolution. Simulated climate variables (temperature, precipitation and sunshine) are averaged over an interval of 10 years and are used as the forcing parameters to a vegetation model, BIOME4, that calculates the equilibrium distribution of vegetation types and associated phenological, hydrological and biogeochemical properties. A canonical analysis is applied to optimise the correlation between the pollen aggregated plant functional types (pft) and the model simulated pfts. BIOME4 output, constrained with the pollen observations, are off-line coupled using a particle filter based data assimilation method. The observations are assimilated at every 100 year step using 1000 ensembles at each step. A Bayesian likelihood function provides the best particles taken from the 1000 candidates (10 yr model averages). The results are compared with previous reconstructions and are available for data-model comparison exercises.