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TP5-P-10

Quantifying the similarity of globally distributed pollen records with paleo-climate networks

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Globally consistent natural evidence on past climate evolution is indispensable for climate model evaluations and forecasts. However, it has rarely been investigated quantitatively whether large sets of globally distributed pollen records with limited dating resolution can be statistically linked. This could facilitate the identification of global in contrast to regional climate change signals on millennial to orbital time scales. We consider a global set of time-irregular pollen records for a joint analysis of spatial similarity on different time scales during the last glacial. Making use of measures suitable for irregular time series and by application of a spatio-temporal stochastic model, we examine significant commonality between pollen records. We quantitatively assess the resulting paleo-climate networks while respecting the spatially heterogeneous and sparse proxy archive layout. The network configurations are compared to synthetic proxy networks, which mimic different real-world record impairments. We find strong commonalities of well resolved Chilean, North Pacific and European records on orbital to millennial time scales. They reveal partly inverted deglaciation signals for westward exposed coastal tree vegetation. Such signals are consistently observable for several mid-latitude records, probably indicating equatorward shifts of westerly circulation structures during the last glacial. Surrogate data suggests that a notable part of total records might be insufficiently resolved to detect statistically significant record similarity at least when classical correlation-based measures are utilised. We compare the results to temperature and precipitation signals in PMIP3 models.

TP5-P-11

The analysis of the salinity variations in the Sylt-Rømø Bight during annual cycle

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The Sylt-Rømø Bight is one of the largest tidal catchments in the Wadden Sea characterised by a chain of near shore islands, separated by tidal inlets. Since the beginning of the last century, two artificial causeways connect the mainland with the islands of Sylt and Rømø, thus creating a back barrier environment. This coastal lagoon exchanges almost 50% of its water volume with the open German Bight during each tidal cycle and thus the pelagic community is strongly triggered by both local and open water influence. Since the early seventies, the SYLT ROADS LTER pelagic time series have also included information about physical and hydro-chemical parameters in the Sylt-Rømø Bight. The measurements of those have been performed twice a week. The development of physical measures (e.g. salinity, SST) usually has well predicted character within the year. However, sometimes abrupt changes are monitored. The purpose of the current work is to explain such abrupt variations of the physical parameters, which might have fundamental impact on the composition of the pelagic communities. As a numerical solution, the FESOM-C model was used (Androsov et al., 2019). It solves three-dimensional primitive equations for the momentum, continuity, and density constituents, and uses the terrain following coordinate in the vertical. FESOM-coastal works on mixed unstructured meshes composed of triangles and quads, which combine geometrical flexibility and numerical efficiency.

TP5-P-12

Interannual to millennial scale variability of river Ammer floods and its relationship with solar forcing

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The relationship between observed and proxy river Ammer (southern Germany) and solar forcing is investigated. A composite analysis reveals that the observed river Ammer flood variability is related to large-scale extreme precipitation and temperature patterns. The upper level atmospheric circulation associated with floods, which resemble the synoptic scale Rossby wave breaking over Europe, is enhanced during low solar activity periods. Furthermore, a composite analysis reveals enhanced blocking activity in a region stretching from Greenland to western Russia during low solar irradiance summers. From the synoptic scale perspective, the observed out-of-phase relationship between solar forcing and river Ammer floods, as presented in previous studies, is related to blocking anomalies associated with solar forcing which favors upper level wave breaking over western Europe, a more unstable atmosphere and more floods. A singular spectrum analysis of a flood layer record from lake Ammer and a total solar irradiance reconstruction, going back in time to the mid-Holocene, reveals coherent variability at ~900 years and ~2,300 years. We argue that similar cycles should dominate the millennial scale variations of blocking activity in the east Europe-west Russia as well as the extreme precipitation and floods over central and west Europe.

TP5-P-13

Oxygen isotope curves from the end-Permian mass extinction interval – influence of global warming on ostracod diversity

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The end-Permian mass extinction event as the most severe biotic crises in Earth history is still a matter of debate regarding the responsibility of several environmental factors, such as ocean acidification, widespread marine anoxia and global temperature rise. In our study, we focus on the detailed reconstruction of a possibly global climate changes and its biological responses. For this purpose we analyse the ostracod diversity of the northwestern Iranian Aras Valley section as well as oxygen isotope values ($\delta^{18}O$) of ostracod shell calcite, which give a hint on the ancient ambient sea water temperature. This combination of geochemical and the palaeoecological approaches allows us to evaluate the role of temperature during the end-Permian mass extinction event. With the application of a new method – measuring the oxygen isotope proportion of ^{18}O and ^{16}O of ostracod shell calcite by application of SIMS technology – we are able to propose a detailed oxygen isotope curve. The data indicate a drastic temperature rise of nearly 10°C during the extinction interval. The comparison with other temperature reconstructions, which for example used conodont apatite, shows that ostracod shell calcite yields reliable results with similar trends. Ostracod diversity patterns show a restructuration of the community from low diverse assemblages in the pre-extinction phase to assemblages with higher diversity in the direct post-extinction phase. The extinction horizon itself is marked by a monospecific assemblage and a subsequent complete faunal turnover. The combination of these palaeontological results to the reconstructed temperature curve indicates a diversity drop, taking place during the initial phase of the temperature rise.

TP5-P-14

Semi-arid forest performance under future conditions: The role of increasing [CO_2] against dryer conditions

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Semi-arid forests have an important role in the global carbon (C) sink, but are assumed to be especially sensitive to projected climate change. In particular, forest trees growing under extremely dry conditions, such as the Yatir forest, a large Aleppo pine planation within the Negev desert. However, up to now we know little on the forest's sensitivity to expected future conditions, in particular the responses of increasing [CO_2] under hotter and drier conditions. Here, we applied a process-based ecosystem model (LandscapeDNDC), which was parameterised and initialised with species and site-specific data. The model was evaluated with ecosystem gas exchange observations (2010–2015) and forest inventory data. To study the responses of the pine plantation under predicted future conditions, we derived [CO_2], temperature, precipitation, relative humidity and radiation data from three climate model scenarios (based on CMIP5) for two major representative concentration pathways (RCP 8.5 and RCP 4.5) in daily resolution (1970–1999, 2010–2029 and 2070–2099 We used this data to run the LandscapeDNDC model and evaluated the effects of climate change scenarios with and without [CO_2] increase on GPP and tree stem growth responses. The climate models showed a clear trend in decreasing annual precipitation, while annual temperatures are predicted to increase strongly (4–6°C between 2000 and 2100 at RCP 8.5) at the forest site. This trend of hotter and drier conditions was reflected in reduced GPP and lower growth rates (lower stem volume). However, we found elevated [CO_2] to largely offset this decrease, resulting in slight or none reductions of GPP and tree stem biomass under predicted future conditions. We refer this strong [CO_2] sensitivity of the model to water savings caused by a larger water-use-efficiency (WUE) under increasing [CO_2], due to lower stomatal conductance (gs) at similar to higher C uptake.

TP5-P-15

Stratospheric influences on sub-seasonal predictability of European surface weather

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Surface weather variability on sub-seasonal timescales influences various socio-economic sectors such as the energy industry or agriculture. The state of the stratospheric polar vortex (SPV) is thought to be an important source of sub-seasonal predictability in winter, because long-lasting periods of positive or negative phases of the North Atlantic Oscillation (NAO) often follow anomalously strong or weak SPV states, respectively. However, only little is known on how this relationship ultimately affects the predictability of surface weather in different European regions. Here, we investigate the skill of sub-seasonal numerical forecasts of surface weather for individual European countries dependent on the state of the SPV. To this end, month-ahead forecasts of country-averaged 10 m wind, 2 m temperature, and precipitation from 20 years of ECMWF extended-range ensemble reforecasts provided by the Sub-seasonal to Seasonal (S2S) Prediction Project Database are verified. We generally find a substantial dependence of model skill on anomalous SPV states at forecast initial time and the subsequent respective NAO-like patterns throughout the forecast, but only for those countries that are particularly affected by the NAO-related anomalies. Forecasts initialised during the strongest SPV states have significantly enhanced skill compared to forecasts initialised during normal SPV states for most of these countries. In contrast, forecasts initialised during the weakest SPV states, which are mostly associated with sudden stratospheric warmings (SSWs), have a wide range of skill that is on average mostly lower than for the strongest SPV states and for specific countries even lower than for normal SPV states. To better understand