Poster

Two-thousand-year climate reconstruction of the Altai region with annual time resolution and the search of natural cycles with length from 3 to 1,000 years

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The purpose of the study is to find the natural cycles of different periodicity (from 3-10 years to several hundred years) in trace element composition and lithological properties of sediments lake Teletskoe (Altai region) in the time interval of the last two millennia.
Sediment cores up to 230 cm were selected in 2002, 2004 and 2010 using gravity tube in the deep basin (326 m) of the lake Teletskoye. There also were selected blocks of the upper layers of undisturbed sediment with box-corer. In the laboratory, the cores were cut into two halves. One part was used for the sampling with step of 5 mm. These samples were used for measure humidity, isotopic analysis, the determination of total carbon, loss of ignition, isotopic age determinations using ^{137}Cs, ^{210}Pb and ^{14}C. From the second half of the core samples were prepared for scanning microanalysis.
Scanning microanalysis using synchrotron radiation (μ-XRF) has been made on storage ring VEPP-3 in the Institute of Nuclear Physics SB RAS (Novosibirsk). Trace elements along the core was analyzed at excitation energies of 18 and 24 keV with step 100 microns. In each point was determined from 15 to 25 elements with a detection limit 0.5 ppm and X-ray density of the sample (XRD).
Time model was calculated according to the isotopic analyzes using ^{137}Cs, ^{210}Pb and ^{14}C.
For the analysis of non-stationary time process has been applied the empirical mode decomposition method with the application of the Hilbert-Huang conversion.
Were found natural cycles with periods: 3,5±0,3; 8,8±0,9; 18,8±2,0; 37,8±1,6; 86,0±10,2; 164±15; 346±30; 596±71; 993 years.

Talk

Shifting Winds over the North Sea: How Anglo-Dutch documentary evidence enables the reconstruction of changes in prevailing wind during the Little Ice Age, 1630-1700

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Climatic reconstructions that record the regional chronologies of the Medieval Climatic Optimum and the Little Ice Age traditionally consider changes in average seasonal temperature or precipitation. Past fluctuations in these meteorological expressions are readily visible in proxy data available from natural archives, yet regional variability in prevailing wind intensity or direction are not easily reflected in, for example, tree rings or ice cores. This paper introduces previously unexamined Anglo-Dutch ship logbooks, weather diaries, accounts and correspondence as quantifiable sources useful for the reconstruction of changes in past wind intensity and direction. Using documentary evidence, the paper argues the late-seventeenth century transition to the cooler climate of the Maunder Minimum in the North Sea region was accompanied by a shift in the patterns of prevailing wind. While Anglo-Dutch observers described an abundance of westerlies in the middle of the seventeenth century, easterlies and high winds were recorded with greater frequency in subsequent decades.

Poster

Garabashi glacier (Central Caucasus) mass balance reconstructions inferred from tree-rings

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Tree-ring data was successfully used for glacier mass balance change.The exploration whether tree-ring data can be effectually applied for the mass balance reconstruction in Caucasus was the main goal of this research. Tree-ring width and maximum density chronologies of pine (*Pinus sylvestris* L.) at seven high-elevation sites in Northern Caucasus were explored for this purpose. As well as in other places of the temperate zone tree- ring width has complex climate signal controlled both temperature and precipitation. Tree-ring maximum density in Caucasus has a clear climate response to summer temperatures and allowed the reconstruction of April-September temperatures since 1800s. Instrumental mass balance records of Garabashi glacier started at 1983s. It is well known that Caucasus glaciers intensively retreat in the last decades and according to instrumental data mass balance variations are mostly controlled by the ablation, i.e. summer temperature variations. Maximum density chronology has statistically significant correlation with mass balance due to summer temperature sensitivity and great input of ablation to total mass balance variations. To include in our reconstruction different climatically sensitive parameters, stepwise multiple regression model was used. The strongest relation ($r = 0.88$; $p < 0.05$) between 2 ring-width and 1 maximum density chronologies was identified. Cross-validation test ($r = 0.79$; $p < 0.05$) confirmed model adequacy and it allowed to reconstruct Garabashi glacier mass balance for 1800-2005. The reconstruction length threshold by Expressed Population Signal (>0.85) values counted for chronologies. Reconstructed and instrumental mass balance values coincide well except the most recent period in 2000s, when the reconstructed mass balance slightly underestimated the real values.

However even in this period it remained negative as well as the instrumental records. The bias can be explained by the weak sensitivity of the chronologies to winter precipitation (i.e. accumulation). The tree-ring based mass balance reconstruction was compared with one based on meteorological data (since 1905s). Both reconstructions have good interannual agreement ($r = 0.53$; $p<0.05$) particularly for the period between 1975 and 2005. According to the reconstruction two distinct periods of positive mass balance occurred in 1830s and 1860s. They agree well with early historical data and the tree-ring of moraines of Kashkatash glacier in Central Caucasus.

Poster

Sea ice, biological production and nutrient cycling reconstructed at an unprecedented time resolution in the Adélie Basin, East Antarctica, for the last 2,000 years

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Antarctic sea ice impacts on the ocean-atmosphere heat and gas fluxes, the formation of deep and intermediate waters, the nutrient distribution and primary productivity, the so-called 'biological carbon pump', one of the most active in the global ocean. In this study, we explore the link between sea ice dynamic, biological production and nutrient cycling during the late Holocene (the last 2,000 yrs) in the AdÉlie Basin, East Antarctica, from the well-dated sediments of the Ocean Drilling Program (ODP) Site U1357. This archive, composed from ~32 meters of seasonal to annual laminated diatomaceous sequences, allows reconstructions at an unprecedented time resolution (5-10 yrs). Our study combines records of diatom census counts and diatom-specific biomarkers (a ratio (D/T) of di- and tri-unsaturated Highly Branched Isoprenoid lipids (HBI)) as indicators of sea ice and biological production changes, XRF data as markers for terrigenous inputs and bulk nitrogen isotopes (d15N) and d15N on chlorins as proxies for reconstructing nitrogen cycle.
The diatom and HBI records reveal five distinct periods. From 0 to 350 yrs AD, decreasing occurrences of sea ice-related diatom species (e.g. Fragilariopsis curta + F. cylindrus) together with low D/T values and increasing open ocean diatom species (large centrics, Chaetoceros Resting Spores (CRS)) document a progressive decline of sea ice presence during the year (> 9 months per year) with spring melting occurring earlier in the year and autumn sea ice formation appearing later. In contrast, between 350 and 750 yrs AD, high production of open ocean diatom species and low low D/T values and sea ice related species indicate a short duration of sea ice cover (< ~8 months per year). From 750 to 1400 yrs AD, a prolonged seasonal sea ice (> ~10 months per year) is illustrated by a pronounced increase of sea ice-associated diatom species and high D/T values. Between ~1400 and 1850 yrs AD, seasonal sea ice strongly declines (<~7 months per year) as a result of early spring melting (increasing CRS production) and late autumn waxing (high occurrences of Thalassiosira antarctica). Longer growing seasons promoted a substantial development of phytoplankton communities (especially large centric diatoms) that conducted to lower D/T values.
Consistent with diatom and HBI reconstructions, XRF data show higher Fe/Al and Zr/Al ratios values during inferred warmer periods and lower ratio values during inferred cooler and icier periods, thus supporting a strong impact of the sea ice seasonal cycle on glacial runoffs.
The link between sea ice conditions, biological production and nutrient cycling is still being explored and we will discuss its relationship by combining all the cited records cited above with the $d^{15}N$ records that we are currently generated.
Based on our results, we find that sea ice dynamic and associated diatom production in the AdÉlie Basin revealed an opposite climatic trend than that identified in the Northern Hemisphere for the last 2000 years. The 'Little Ice Age' (1400-1850 yrs AD) or the 'Dark Ages' (400-750 yrs AD) corresponded to warmer climate conditions in the AdÉlie Basin, while the 'Roman Warm Period' (0-350 yrs AD) or the 'Medieval Warm Period' (900-1200 yrs AD) were associated to colder conditions. We therefore emphasize that Northern and Southern Hemisphere climate evolved in anti-phase seesaw pattern during the late Holocene.

Poster

Multi-annual variability of the Peruvian Oxygen Minimum Zone across the last millenium

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There is evidence that pelagic oxygen minimum zones (OMZ) have expanded and intensified for at least 50 years, probably as a response of global warming. However, it is essential to document the OMZ evolution beyond the historical record to better assess the relative contributions of natural and anthropogenic forcings. Such records from the Peruvian margin have been studied but only a few ones focus on both variability and mean state of nutrient cycle and upwelling intensity in the OMZ.
We here analyzed three trigger cores containing faintly laminated sediments from the Peruvian shelf, along a North-South transect, from 11°S to 15°S within the OMZ. Non-destructive measurements (X-ray radiography and X-ray fluorescence core-scanning) were first realized to better identify individual layers. A combination of ^{210}Pb based estimates of accumulation rates and ^{14}C analysis on calcitic foraminifera or organic matter will provide the age model for the cores. We analyzed diatom assemblages, bulk $\delta^{15}N$, total nitrogen, organic carbon and alkenone contents as well as alkenone-based sea surface