(SS08) Climatically-forced vegetation changes short-termed (a NECLIME symposium)

Date: August 24
Place: Room 5234 (oral)
Organizers: Andrea K. Kern & Torsten Utescher
Contact email address: andrea.kern@nhm-wien.ac.at
Purpose: Cenozoic studies around the globe allow us to draw substantial conclusions about Earth's evolution related to climatic changes. At the very best, proxy data based spatial reconstructions considering palaeovegetation or palaeoclimatic parameters can be compared with results obtained from adequate modeling studies which are highly useful to create an overall image. However, vegetation change caused by short-term climate variability usually remain concealed due to the delimited time resolution such studies permit.
Our symposium aims to discuss climate-vegetation interactions from decadal- to millennial-scale. This information is in great extent only supplied by high-frequency palynological analyses. Focusing on local vegetation dynamics climatic events and transitions can be deciphered and, if possible, compared with other geological and environmental proxy estimations. Besides, thematic priority lies on finding a potential climate-vegetation-equilibrium of fossil plant communities as well as up to what temporal extent, changes within the studied assemblage can be resolved. Only due to a deeper understanding of past short-term events, recent and future climate change and biotic response can be conceived.
We invite all contributions referring to high-resolving, quantitative vegetation and climate reconstructions in the Cenozoic.

Oral Presentation

Aug. 24 [PM2] Room: 5234

Chair: Andrea K. Kern

14:30-15:10 **[Keynote] Short-termed vegetation dynamics in the tropics: climate-forced and system-driven** SS08-O01 (195)

Henry Hooghiemstra, Mirella Groot, Raul Giovanni Bogota-Angel, Lucas Lourens, Juan Carlos Berrio, Erik Tuenter, Zaire Maria González-Carranza, Maria Isabel Vélez, Erik de Boer, Kenneth Frank Rijsdijk

15:10-15:30 **The vegetation change and fire record in the past 4000 years in Far East of Russia** SS08-O02 (598)

ShaoHua Yu, Zhuo Zheng, KangYou Huang, M.I. Skrypnikova

15:30-15:50 **Short-term landscape and climatic oscillation in the Holocene of Southern Primorye, Russian Far East** SS08-O03 (337)

Yury Mikishin, Tatiana Petrenko, Aleksandr Popov

Aug. 24 [PM3] Room: 5234

Chair: Torsten Utescher

16:20-16:40 **Cyclic vegetation changes during the Mid-Pleistocene climate transition around Osaka Bay, southwest Japan** SS08-O04 (241)

Ikuko Kitaba, Masayuki Hyodo, Shigehiro Katoh, David. L. Dettman, Hiroshi Sato

16:40-17:00 **Can vegetation changes be recorded on a decadal to centennial scale in the Late Miocene?** SS08-O05 (235)

Andrea K. Kern, Mathias Harzhauser, Ali Soliman, Werner E. Piller

17:00-17:20 **[General discussion]** SS08-O06

SS08-O01 (195)
Short-termed vegetation dynamics in the tropics: climate-forced and system-driven

Henry Hooghiemstra[1], Mirella Groot[1], Raul Giovanni Bogota-Angel[1,2], Lucas Lourens[3], Juan Carlos Berrio[4], Erik Tuenter[3], Zaire Maria González-Carranza[1], Maria Isabel Vélez[5], Erik de Boer[1], Kenneth Frank Rijsdijk[1]

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New high-resolution pollen records from tropical latitudes show a wealth of short-termed vegetation change. In the northern Andes we show obliquity and pCO_2-driven climate change in a new 284-kyr long record from the intra-Andean site Lake Fúquene. Glacial rates of temperature change vary from 2-3°C/100 yr, at Terminations up to 10°C/100 yr. Model studies show such high responsiveness during a full glacial-interglacial cycle is only explained when impact of green house gasses is included. From the Andean flank facing Western Amazonia we show a new record of Holocene climate change driven by trans-Amazonian moisture supply. Quasi-stable conditions lasted for maximally 200 to 600 yr evidencing that the low climate variability in Holocene ice-core records is not representative for the tropics. Both site studies show a dramatic difference in rate of temperature change across the last Termination. Multiple events of loss of the subpáramo biome in the region suggest climate change-driven migration rates may surpass biome migration capacity. Pollen records have high potential to improve understanding of processes involved in regional and temporarely extirpation of biota, as well as extinction. Regeneration capacity of the Andean subpáramo biome is compared with the species turn-over in a montane forest in Mauritius (Indian Ocean) after perturbation by the last Termination. After a long lasting ecological steady state during the last glacial, a cascade of short-lived forest associations developed finally into a next long lasting steady state during the Holocene. Tropical montane biomes are more vulnerable to climate perturbations as realized before but also show remarkable flexibility. Montane (Andes) and oceanic (Indian Ocean) island archipelagos are compared. Observations from the new and rapidly developing domain of 'high-resolution-paleoecology' are relevant for paleodata-model comparisons, conservation practice, as well as IPCC-related projections of the AD 2100 climate and environment.

Keywords: Dansgaard-Oeschger cycles, paleodata-model comparison, biome migration rates, rates of change, ecological change.

SS08-O02 (598)
The vegetation change and fire record in the past 4000 years in Far East of Russia

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The environment change in the Far East of Russia has enormous influenced the whole carbon cycle of the earth, as a high-latitude swamp in the world. In this paper, 64 samples had been selected in Amur 23 core to pollen analysis with the vegetation survey of the entire region, which were compared with 40 surface pollen samples in order to reconstruct the palaeoenvironment in the past 4000 years. In addition, the charcoal data had been quantitative analyzed and compared with pollen data to explore the material source of charcoals, the fire frequency and the extent of fire, and the human activities in this period could been deeply studied. The results showed that the palaeoenvironment in the Far East of Russia could be divided by four periods: the temperate broad –leaved forest indicating warm and wet climate during the 4000-3000 years ago, and most of charcoals came from the grass and less than 50μm, which showed most of the fire took placed in region. The fire frequency was not very high, nearly to 370 years/ time. In this period, the swamp has begun developing and the environment has been little effected by human beings. Dense, wet grass and broad- leaved trees dominated in the 3000-1500 years, which reflected the wet and warm climate, when the swamp had been developed fully. Especially, the human activities had been greatly intensified after 2000 years, showed by the increasing Gramineae pollen and reticular charcoals. Most of fire was locally of significantly higher frequency, achieved to 182 years/time, indicating the palaeoenvironment had been influenced by climate and human activities. During 1500-500 years, the increasing of Pinus demonstrated the climate became relatively cold and wet, and the fire frequency still increased, nearly to 165 years /time. At the same time, the swamp had been finished growth with intensifying human activities. Cold and dry conditions characterized the time after 500 years, when the swamp presented recession. The concentration of charcoal had been largely increased with the fire frequency reach to 125 years/time, which implied that the wet meadow began to degradation.

Keywords: Far East, pollen, charcoal, palaeoenvironment, human activities.

SS08-O03 (337)

Short-term landscape and climatic oscillation in the Holocene of Southern Primorye, Russian Far East

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Holocene vegetation and climate of Southern Primorye were reconstructed through integrated studies of sediments of accumulative terraces. We distinguished 29 pollen assemblages and corresponding them stages of vegetation and climate development. The warmest climate was registered in the end of Middle Atlantic Period (6600–7100 Cal. yr BP), middle of Late Atlantic (6000–6450 Cal. yr BP), Middle Subboreal Period (3650–4350 Cal. yr BP), middle of Late Subboreal Period (3100–3200 Cal. yr BP) and end of Early Subatlantic Period (1750–2200 Cal. yr BP). Pollen spectra are dominated by broad-leaved tree pollens with *Quercus* prevailing and a high content of *Juglans*, *Ulmus* and *Carpinus*. A high content of pollen of thermophilic hornbeam in pollen assemblages, exceeding the modern content by 7–10 times on average is indicative of development in Southern Primorye of vegetation similar to the currently existing vegetation in Korean Peninsula, 400–500 km south of Primorye. Mean yearly air temperatures were growing 5–7° on modern temperatures (10–12°C) and yearly precipitation rate was growing 1.5–2 times

(1100–1600 mm). A climate cooling down to a level, close to the present time, was registered in beginning of Preboreal Period, Middle Atlantic Period (7100–7350 Cal. yr BP), beginning of Late Atlantic Period (6450–6600 Cal. yr BP), end of Late Atlantic Period (5500–6000 Cal. yr BP), beginning of Middle Subboreal Period (4350–4750 Cal. yr BP), end of Middle Subboreal Period (3500–3700 Cal. yr BP), end of Late Subboreal Period (2650–2900 Cal. yr BP) and Middle Subatlantic Period (1400–1700 Cal. yr BP). The pollen assemblages of this age reflect a decreasing role of broad-leaved trees and spread of alder/birch trees and Korean pine. A more significant climate cooling was registered in the end of Preboreal Period, end of Boreal period (8900–9300 Cal. yr BP), Middle Atlantic Period (7350–7500 Cal. yr BP), Early Subboreal period (5000–5100 Cal. yr BP), beginning of Late Subboreal period (3200–3500 Cal. yr BP), beginning of Early Subatlantic Period (2500–2600 Cal. yr BP), beginning of Middle Subatlantic Period (1700–1750 Cal. yr BP) and Late Subatlantic Period (600–900 and 150–500 Cal. yr BP). In pollen assemblages, there is little pollen of broad-leaved trees, but much pollen of small-leaved and coniferous trees.

Keywords: pollen assemblage, broad-leaved forest, coniferous/broad-leaved forest, hornbeam, Korean pine.

SS08-O04 (241)

Cyclic vegetation changes during the Mid-Pleistocene climate transition around Osaka Bay, southwest Japan

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During the Mid-Pleistocene climate transition (MPT) from 1.25 to 0.7 Ma, the Quaternary climate system underwent large changes. The dominant climate cyclicity changed from ca. 41-kyr obliquity cycle to ca. 100-kyr eccentricity cycle, and the amplitude of variation increased. This caused a major change in the flora, e.g. several Tertiary plants disappeared around Osaka Bay, southwest Japan. Osaka Bay was also strongly affected by glacio-eustatic sea-level changes since the first marine incursion during marine oxygen isotope stage (MIS) 37 (1.25 Ma). Its depositional environment repeated the cycle of marine/fluvio-lacustrine phases associated with the interglacial/glacial cycle. We carried out multiproxy analysis of a 1,700-m core from Osaka Bay, focusing on the interglacials in the MPT to reveal the centennial to millennial scale variation in climate and sea-level, and discuss its influence on the flora. Diatom, sulfur and carbon isotope analyses reveal that the short-term high sea-level periods correspond to the single peak of precession cycle in MIS 31 and 25. In MIS 21 and 19 the sea-level highstand occurred just after the rapid postglacial sea-level rise, followed by a gradual decline in sea level accompanied by precession-related oscillations; a typical feature of the post-MPT interglacials with 100-kyr cyclicity. Inferred sea-level variation is supported by palynological marine/coastal vegetation proxies like the ratio of arboreal to herbaceous pollen, percentages of marine resting spore cysts or *Alnus* (main component of marsh forest). These marked cyclic changes are accompanied by significant vegetation changes. Before MIS 24, Taxodiaceae (*Cryptomeria* and *Metasequoia*) are dominant in the glacial periods. After MIS 22, however, it was replaced by Pineceae including sub-boreal taxa such as *Picea* and *Abies*, which probably grew in the cold-dry glacial climate. In the later interval *Metasequoia* nearly completely disappeared. On the other hand, forest components are very similar in every interglacial period. The interglacial vegetation is primarily characterized by deciduous broad-leaved forest, including *Fagus* or *Quercus* (*Lepidobalanus*). In interglacial periods, the proportion of *Quercus* (*Cyclobalanopsis*) fluctuated

with the precession cycle. The thermal maximum, shown by the highest proportion of *Quercus* (*Cyclobalanopsis*), occurred in phase with the sea-level highstand, with two exceptions. Therefore, vegetation cycles occurred in response to climate variation closely correlated with Milankovitch forcing, and the disappearance of *Metasequoia* might have been caused by cold glacial climates around the termination of MPT.

Keywords: Milankovitch cycle, cooling, disappearance of Tertiary plants, multiproxy analysis, Osaka Bay sediment.

SS08-O05 (235)

Can vegetation changes be recorded on a decadal to centennial scale in the Late Miocene?

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Resolving environmental changes on decadal to centennial scales is state-of-the-art within the Holocene. Outside the ^{14}C range it remains a challenge to provide a valid age control for deposits, which usually also lack signs of annual preservation. Nevertheless, new methods are needed to discuss short-termed environmental evolution and to detect their relation with paleoclimatic changes. Thus we studied two Austrian localities in a marginal position to a huge paleo-lake of slightly different Late Miocene age (~11.3 and ~10.5 Ma, respectively). Previous integrative stratigraphic studies revealed a good time frame, but a more precise age could be provided by astronomical tuning due to geophysical data. High resolution analyses were conducted on cores with sample resolution of 1 cm at both localities. To describe changes within and around the lake, a combination of different biotic and environmental proxies was applied, including pollen, dinoflagellates, ostracods, geophysics (gamma-radiation and magnetic susceptibility) and geochemistry (carbon and sulfur). The analyzed a 1-m-core sequence of the older locality covers a time span of less than 1400 years. Palynological data describe a high-frequently-changing marsh vegetation in a shallow embayment of the paleo-lake. Re-occurring algae blooms happened before a transgression, occurring within a few decades, disturbed the high nutrient surface waters. This deepening caused further a rapid dieback of the non-forested wetlands, followed by a re-establishment within less than 100 years. All these data can be linked to variations of the mean annual precipitation, while temperature remained stable. For the second example a longer core (6 m) was investigated in respect to geophysical properties and ostracod distribution. Statistical data processing suggested a link to solar cycles, which could enhance the former age-model. In the course of this study, palynological and geochemical samples were analyzed for a shorter core segment (1 m) representing a time span of app. 2000 years. These revealed synchronous alternations within the indicators for vegetation, surface water and bottom water conditions assume a common trigger. This may have rather controlled input into the lake than causing major changes within the lake environments or even climate. Presumably, these minor oscillations were caused by solar cycles, which in fact seem rather to control local weather patterns such as wind or rainfall and not climate. Thus, due to our Late Miocene high-resolution analyses we can show different forcing mechanism on climate even on a decadal scale.

Keywords: high-resolution-analysis, climate-vegetation-interaction, dinoflagellates, pollen, solar cycles.