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Impact of climate variability on terrestrial environment in Western Europe between 45 and 9 kyr cal. BP: vegetation dynamics recorded by the Bergsee Lake (Black Forest, Germany).

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Between 9 and 45 kyr cal. BP, two great transitions lead the global climate system to evolve from the Last-Glacial period (115-14.7 kyr cal. BP), to two successive warmer periods, the Late-Glacial Interstadial (14.7-11.7 kyr cal. BP) and the Holocene (11.7-0 kyr cal. BP). δ^{18}O variations recorded in Greenland ice cores (GRIP NGRIP) revealed high frequency climate variability within the Last Glacial. These reference isotopic records highlighted a succession of centennial-to-millennial warm/cold events, the so-called Greenland Interstadials (GI) and Greenland Stadials (GS). The number continental records about the period 14.7-0 kyr cal. BP is substantial. This allowed to understand the vegetation dynamics in response to climate changes this period at the North-Atlantic scale. However, sequences covering the glacial period (beyond 20 kyr cal.BP) remain rare, because of hiatuses mostly due to local glaciers. Therefore, sedimentary continuous records of vegetation dynamics are still needed to better understand climate changes during the Last Glacial in Western Europe (Heiri et al. 2014). Here we present a new high-resolution pollen record from Lake Bergsee ($47°34'20''$N, $7°56'11''$E, 382 m a.s.l). This lake is located south of Black Forest and north of the Alps, beyond the zone of glaciers maximal extension. Therefore it could have recorded the whole last climatic cycle, i.e. 120-0 kyr cal. BP. In 2013, a 29 m long core was extracted from the Bergsee. According to the depth-age model based on 14C AMS dating and the Laacher See Tephra (LST), the record spans continuously at least the last 45 kyrs. The first series of pollen analysis, focused on the 45-9 kyr cal. BP time window, allows us to reconstruct a precise, faithful and continuous vegetation history at the centennial scale. This high temporal resolution enabled to assess the response of vegetation to secular climate events (e.g. GI-4 = 200 yrs). First, our results show that vegetation responded to climate changes at millennial/pluri-millennial scale. The well-known afforestation of the Late-Glacial interstadial and the Holocene (with pine and hazel-dominated forests respectively) are recorded. Our results also reveal a three-phase sequence in the Last-Glacial. The persistence of very cold conditions between 24 and 30 kyr cal. BP favored a drastic steppe grassland. In contrast, trees proportion increased during the two other periods (14.7-24 and 30-45 kyr cal. BP) in correlation with a relative favorable climate. Second, the respons of vegetation to centennial scale climatic events is characterized by the successive rapid establishment of two different landscapes. GS are dominated by steppic taxa (*Artemisia*, *Helianthemum*), whereas more or less complete ecological successions *Juniperus-Betula-Pinus* seem to occur for most GIs when edaphic conditions became more favorable. Therefore, we suggest a global forcing defined by the strong impact of the climate variability on vegetation changes. We also propose the contribution of local characteristics (latitude, topography) which favored flora migration and long distance pollen inputs from refuge areas.

Heiri O., Koinig K.A., Spötl C., Barrett S, Brauer A., Drescher-Schneider R., Gaar D., Ivy-Ochs S., Kerschner H., Luetscher M., Moran A., Nicolussi K., Preusser F., Schmidt R., Schoeneich P., Schwörer C., Sprafke T., Terhorst B., Tinner W. -2014- "Palaeoclimate records 60-8 ka in the Austrian and Swiss Alps and their forelands", Quaternary Science Review, 106 : 186-205.