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Climate of the Past

Late Glacial and Holocene changes in vegetation cover and climate in southern Siberia derived from a 15 kyr long pollen record from Lake Kotokel

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Abstract. In this study a radiocarbon-dated pollen record from Lake Kotokel (52°47′ N, 108°07′ E, 458 m a.s.l.) located in southern Siberia east of Lake Baikal was used to derive quantitative characteristics of regional vegetation and climate from about 15 kyr BP (1 kyr=1000 cal. yr) until today. Quantitative reconstruction of the late glacial vegetation and climate dynamics suggests that open steppe and tundra communities predominated in the study area prior to ca. 13.5 kyr BP and again during the Younger Dryas interval, between 12.8 and 11.6 kyr BP. The pollen-based climate reconstruction suggests lower-than-present mean January (~−38°C) and July (~12°C) temperatures and annual precipitation (~270–300 mm) values during these time intervals. Boreal woodland replaced the primarily open landscape around Kotokel three times at about 14.8–14.7 kyr BP, during the Allerød Interstadial between 13.3–12.8 kyr BP and with the onset of the Holocene interglacial between 11.5 and 10.5 kyr BP, presumably in response to a noticeable increase in precipitation, and in July and January temperatures. The maximal spread of the boreal forest (taiga) communities in the region is associated with a warmer and wetter-than-present climate (T_w~17–18°C, T_c~−19°C, P_{ann}~500–550 mm) that occurred ca. 10.8–7.3 kyr BP. During this time interval woody vegetation covered more than 50% of the area within a 21×21 km window around the lake. The pollen-based best modern analogue reconstruction suggests a decrease in woody cover percentages and in all climatic variables about 7–6.5 kyr BP. Our results demonstrate a gradual decrease in precipitation and mean January temperature towards their present-day values in the region around Lake Kotokel since that time.

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1 Introduction

The Lake Baikal region of northern Eurasia (Fig. 1) has experienced a boom of palaeoenvironmental studies during the past decade (e.g. Colman et al., 1996; BDP-Members, 1997, 1998, 2005; Grachev et al., 1997; Williams et al., 1997, 2001; Demske et al., 2005; Oberhänsli and Mackay, 2005; Tarasov et al., 2007a and references therein). A rising interest in Lake Baikal – the world's largest, deepest and oldest freshwater reservoir – is easy to understand. The lake bottom sediments contain detailed and well-preserved palaeoenvironmental archives, which provide an excellent opportunity for reconstructing the regional climate and environments (e.g. Bezrukova 1999; Bezrukova et al., 2005; Horiuchi et al., 2000; Khursevich et al., 2001; Prokopenko and Williams, 2004; Tarasov et al., 2005).

Objective reconstruction of the past climate is one of the priority tasks for scientists working in the field of past global changes and Earth's system modelling (PAGES: http://www.pages.unibe.ch/). Since the 1940s (e.g. Iversen, 1944) late Quaternary pollen records from the lake sediments have become a frequently used proxy providing palaeoclimatic information at local and large regional scales (e.g. Grichuk, 1969; Bartlein et al., 1984; Guiot et al., 1989; Nakagawa et