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The Central European heat-wave as recorded by chrysophyte stomatocyst assemblages in lake sediments

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'Golden algae' (classes Chrysophyceae and Synurophyceae) produce siliceous resting stages (stomatocysts) that are resistant, diverse and abundant in lake sediments. Stomatocyst assemblages have been shown to be proxies for dates of ice break-up and spring mixing, and thus for winter and/or spring climate. This study focused on their response to a well known climate extreme, the record-breaking heat-wave affecting Central Europe in 2003. We first examined stomatocyst sedimentation patterns from May 2001 to July 2005 using sequential sediment traps (Technicap) exposed in Lake Silvaplana, a Swiss Alpine lake that has been producing annually laminated sediments during the past ca. 3500 years. The analysis of sediment-trap samples, which covered periods of 20 – 32 days, revealed a distinct seasonality of stomatocyst types. Using cluster analysis, multidimensional scaling and the 'indicator-value approach', we classified thirteen stomatocyst types as either spring/summer ('warm') or autumn/winter ('cold') types ($P < 0.05$, adjusted for multiple testing). We then compared stomatocyst assemblages from surface sediments of Lake Silvaplana with the seasonal assemblages obtained from the previously described sediment-trap study. The sedimentary stomatocyst assemblages represented annual means and covered a similar period as the sediment-trap samples (AD 2001 – 2004). The sedimentary stomatocyst assemblages from AD 2001, 2002 and 2004 were dominated by autumn/winter ('cold') types. In 2003, when Central Europe was affected by the heat-wave, the assemblage showed a clear shift towards spring/summer ('warm') types. Even though this observation is based on only a single – yet extreme – event, it encourages the use of chrysophyte stomatocysts for reconstructing past climate.