

Abstract

Annually laminated (varved) lake sediments constitutes excellent environmental archives, and have the potential to play an important role for understanding past seasonal climate with their inherent annual time resolution and within-year seasonal patterns.

We propose functional data analysis (FDA) methods to extract the relevant information with respect to climate reconstruction from the rich but complex information in the varves, including the shapes of the seasonal patterns, the varying varve thickness, and the non-linear sediment accumulation rates. In particular we analyse varved sediment from lake Kassjön in northern Sweden, covering the past 6400 years.

The properties of each varve reflect to a large extent weather conditions and internal biological processes in the lake the year that the varve was deposited. We present novel FDA methods to cluster the seasonal patterns of the varves (years) into homogeneous groups. The functional clustering methods addresses both the misalignment and the dependence of the curves (seasonal patterns). The resulting clusters of the Kassjön data and their time dynamics show great potential for seasonal climate interpretation, in particular for winter climate changes.