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# High-frequency cyclicity in varve thickness in a 3000-year record from the glacial lake Hvítárvatn, central Iceland

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A 3000 year long varve thickness record from Hvítárvatn (HVT), a glacial lake in central Iceland, is used to reconstruct activity of Langjökull and the two outlet glaciers that drain into the lake. During extended periods of cold summers the ice cap expands and consequent erosion delivers more sediment to the basin. The first-order trend of the varve thickness record is increased erosion through the Late Holocene, reaching a peak during the Little Ice Age (LIA). Superimposed on this trend are large inter-annual to decadal fluctuations in varve thickness that we suggest may reflect variability in climate parameters that influences the proportion of newly eroded sediment delivered to the lake each year.

In order to analyse if there is some regular high-frequency cyclicity in the last 3 ka of the varve thickness record from Hvítárvatn, spectral analysis was applied. Prior to the spectral analysis a non-linear long-term trend describing the change from relatively low sedimentation rate to higher and more variable sedimentation rates during the LIA, was filtered out. Singular Spectrum Analysis and the Multi-Taper Method were used to calculate a power spectrum. The results show that dominant variations in the varve thickness record are 100-85, 35, 13, 5 and 4-2 year cycles. Some of these cycles show similar variability to that of the North Atlantic Oscillation (NAO) and the North Atlantic Multidecadal Oscillation (NAMO). Wavelet Analysis was used to test whether the dominant frequencies of these cycles evolved through the 3ka record. However, in order to get more confident results the record was split into two parts, separating the high variance LIA portion from the more uniform older record. The dominant cycles are virtually continuous through the last 3ka, both before and during the Little Ice Age (1250-1900 AD) with minor changes in the length of the cycles. Although some of the cycles become stronger and more dominant during the LIA portion of the record. Furthermore, cycles that show similarities to known solar cycles do appear in the staple part (prior to the LIA), that do not exist in the LIA portion.

A correlation is found between the HVT varve thickness and both summer temperature and precipitation over the instrumental period going back $\sim$160 years. According to that result we indicate that the higher frequency variations on top of the long term trend do reflect conditions during the melting season. Relatively warm and/or wet summers do produce thicker varves.