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Temperature and stratification in the Irish Sea: analysis of a 489-year marine master chronology derived from growth increments in the shell of the clam Arctica islandica

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We demonstrate here that the growth increment variability in the shell of the long-lived bivalve mollusc Arctica islandica can potentially be used as a proxy for marine environmental change on multi-centennial timescales in the climatically important North Atlantic shelf seas. Crossdated chronologies of up to 489 years have been constructed using three different detrending techniques (negative exponential function, segment length dependent spline and regional curve standardization) designed to preserve low-frequency signals, and their characteristics compared. The strength of the common environmental signal expressed in the chronologies is fully comparable with equivalent statistics for tree-ring chronologies. The chronologies are compared with the 350-year Central England Temperature record and with seawater temperature records from stations close to the study site in the Irish Sea. Correlations are demonstrated between shell growth and (air and seawater) temperatures for the year of growth and for the previous year. Changes over time in low-frequency correlations with air temperatures and towards a deeper water origin for the shells in the chronology indicate that shell growth can be used to study stratification dynamics.