Because of the well-known contribution of the Atlantic Meridional Overturning Circulation (AMOC) to the mild climate of the Atlantic European region, understanding mechanisms leading to decadal AMOC variability are pre-requisite for developing decadal predictions. Using a wide range of statistical tools, the study therefore investigates the natural decadal variability of the AMOC and associated key variables in a new-coupled climate model CHIME (Coupled Hadley-Isopycnic Model Experiment), developed at the National Oceanography Centre, Southampton (UK). Power spectral analysis revealed an oscillation cycle of about 30 years. Convective activity in both Labrador Sea (LS) and Nordic Seas appear to be important factors in driving AMOC variability, although LS seems to have a more predominant role. The primary mode of AMOC variability is indeed associated with Labrador Sea Water variability on decadal timescale, and controlled by the northward advection of salinity anomalies originating from the tropical Atlantic about 15 years earlier. A secondary mode of variability is associated with Greenland Sea Water variability on inter-annual (or multi-decadal) timescale, associated with the North Atlantic Oscillation. Note that CHIME is as similar as possible to the widely used HadCM3 climate model with the important exception that the constant-depth ocean component of HadCM3 is replaced by the non-eddy permitting hybrid coordinate model HYCOM. Therefore, the results obtained with CHIME are evaluated alongside corresponding variability in the HadCM3 control simulation in order to investigate the dependence of simulated AMOC variability on ocean model type.