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25-year quasi-periodic climate teleconnections between northern and southern Europe via the North Atlantic Oscillation

S. Meyers and M. Pagani

Department of Geology and Geophysics, Yale University, New Haven, CT, USA (stephen.meyers@yale.edu)

The North Atlantic Oscillation (NAO) is the leading mode of atmospheric variability in the North Atlantic, influencing storm tracks across the Atlantic and creating a dipole pattern of precipitation from north to south in Western Europe. The identification of cyclic variation in the NAO would greatly enhance climate forecasting in these regions, however, its detection is constrained by the limited temporal and spatial extent of existing instrumental records. In this study, we apply tree-ring width series and advanced spectral methods to prospect for quasi-periodic climate signals in Western Europe that capture the dipole nature of the NAO. We identify a 25-year synchronization of NAO-induced precipitation between Scandinavia and the Mediterranean during the 17th-20th centuries. The amplitude of the 25-year beat is modulated by an ˜200 year cycle, with a minimum amplitude during the late Maunder Minimum. Comparison of our tree ring results with published Delta 14C data indicates that this amplitude minimum coincides with a maximum in Delta 14C, suggesting a solar influence on the intensity of the NAO within this 25-year band of quasi-periodic variability. Although some studies have credited climate forcing within this band to solar variability associated with the 22-year Hale cycle in magnetic polarity, there is no supporting evidence linking the Hale cycle and changes in the sun's radiative output. Alternatively, we propose that the 25-year cycle in the NAO arises from interference between the 18.6-year lunar nodal cycle and the 10.7-year Schwabe solar cycle. Such a relationship would influence the distribution of surface waters available for solar heating, ultimately impacting atmospheric moisture, pressure and temperature distributions.