Episodes of large unforced variability in European climate over the last millennium.

M. Gagen (1), E Zorita (2), D McCarroll (1), and the The Millennium project consortium. Team

(1) Swansea University, United Kingdom (m.h.gagen@swansea.ac.uk), (2) Institute for Coastal Research, HZG, Geesthacht, Germany (eduardo.zorita@hzg.de)

There are some indications of large multi-decadal excursions in temperature in European climate over the recent past that do not match the estimated external forcing. Characterisation of these episodes of large internal variability, in terms of their duration, amplitude and spatial structure is important for informing the effort to develop secure climate predictions and estimations of the possible future range of deviation from the forced response. Here we statistically analyse a set of annually resolved climate proxy composites, representative of temperature and hydro-climate in several seasons, covering Europe over the last millennium, and interpret them with the help of global climate simulations over the same period. Superposed to the forced response we find large amplitude continental-wide modes of temperature variation in both winter and summer seasons. European summer temperatures respond coherently to the external forcings throughout Europe. However, in addition to the forced response we find an unforced mode of variability which expresses as a north-south dipole in summer temperature anomalies. A very similar spatial structure also appears in the simulations and there it seems related to low frequency variations in the atmospheric circulation, also represented by a north-south dipole in the summer sea-level-pressure field. In wintertime, the quality and sparseness of temperature proxies yields a more blurred picture. The mode of internal winter temperature variability seems to be absent in a climate simulation, at least with the large amplitude displays by the proxy records.