



Planetary waves modulate summer climate variability over Europe during the Common Era

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We investigate European summer climate variability and its tele-connections in reconstructions and model simulations covering the Common Era (CE). Simulations of summer temperature reproduce important features of recent reconstructions obtained by the EuroMed2k group of the PAGES2k framework. The model experiments have been carried out with the Max Planck Institute for Meteorology Earth System Model (MPI-ESM-P) and cover the pre-industrial millennium and (partly) the entire CE. Both in simulations and gridded field reconstructions, the first and second empirical orthogonal functions (EOF) of spatial variations are well separated. The principal component of the first EOF is an expression of a planetary-wave-like pattern that is prominent in the upper troposphere and that resembles the previously defined circumglobal wave train (CGT) pattern. The CGT mode of surface air temperature variability is accompanied by a zonally-oriented pattern in precipitation.

Composites of related sea surface temperature (SST) and ocean-atmosphere heat flux fields reveal prominent anomalies in the Gulf Stream region, which might modulate the Rossby waves. The SST patterns are related to changes in the large-scale ocean gyre and overturning circulation. We also investigate the influence of external drivers (volcanic eruptions, solar modulations).