



Extremes in an ensemble of Maunder Minimum simulations: Cyclones, temperature, and precipitation

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The extremely hot European summer 2003 and the flooding event of the river Elbe in 2002 showed that the climate extremes had strong impacts on not only the environment, but also on the economy. Scenario simulations with increased atmospheric greenhouse-gas concentrations showed that the temperature variability may increase by up to 100 % in Europe. To place the recent extreme events in 2002 and 2003 and the projected changes in a longer-term context we estimate statistics of extreme events in the past utilizing a coupled general circulation model in a period which is characterized by a different climate state compared with today. The chosen "test period" in the last 500 years is the prolonged cold period, called the Maunder Minimum (MM).

To investigate the statistic of extreme events the comprehensive Community Climate System model from NCAR (National Center for Atmospheric Research, Boulder, USA) is used to simulate the present day climate conditions (fixed to 1990 AD conditions), the past climate with perpetual 1640 AD conditions, and an ensemble of 6 transient MM simulations from 1640-1715 AD with solar and volcanic forcing crudely represented by changing the total solar irradiance.

This set of simulations gives us the unique opportunity to analyze the behaviour of extremes. The focus is set to the cyclone activity and its relation to temperature and precipitation extremes. The comparison of the perpetual 1640 AD with 1990 AD simulations and with the ensemble of transient MM simulations illustrates the characteristics of extremes under different forcing conditions for colder than today's climate conditions.