



## **Holocene simulations using a coupled climate model including the middle atmosphere**

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ProSECCO (Project on Solar Effects on Chemistry and Climate Including Ocean Interactions) aims at a better understanding of the influence of solar variability on climate. This study focuses on low-frequent solar variability during the late Holocene.

The coupled model ECHO-G (T30/L19-ECHAM4 atmosphere and T42/L20-HOPE-G ocean with equator refinement) is the most widely used GCM for long term paleo simulations. Here we use a middle atmosphere version of this model with 39 vertical levels and a changed source spectrum of the gravity wave parameterization (MA-ECHAM4). The model was tuned for long term climate simulations. Results are shown for present-day and pre-industrial conditions.

Transient simulations are performed covering the Maunder Minimum with prescribed changes in solar and volcanic activity and GHG-concentrations. The simulated global and regional changes in climate are assessed. Special emphasis is given to changes in ocean circulation, sea ice and large scale atmospheric circulation. Results are compared with other model studies and proxy based reconstructions. The effect of the middle atmosphere on the simulated climate of the Maunder Minimum is discussed.

One focus of the project is the investigation of the solar influence on climate with respect to longer time scales. Here, the model will be used for multi century simulations of selected Holocene episodes. These simulations will also include changes in orbital parameters.