Geophysical Research Abstracts,
Vol. 11, EGU2009-4926, 2009
EGU General Assembly 2009

Climate evolution of the last six centuries as simulated by Bergen Climate Model: the role of natural forcing

O.H. Otterå (1,2), M. Bentsen (1,2), I. Bethke (1,2)

(1) G. C. Rieber Climate Institute, Nansen Environmental and Remote Sensing Center, Bergen, Norway (oddho@nersc.no),
(2) Bjerknes Centre for Climate Research, Bergen, Norway

Results from a simulation of the climate of the last 600 years with Bergen Climate Model (BCM) will be presented. The model has been driven with relevant forcings, both natural (solar variability and volcanic aerosols) and anthropogenic (greenhouse gases and tropospheric aerosols). A clear signature of large volcanic eruptions can be found in the simulated Northern Hemisphere (NH) temperature record. The model is able to simulate individual extreme events, such as the ÿear without a summerïn 1816. The coldest periods during the so called Little Ice Age (1400-1850) generally occur in periods with high volcanic activity and minima in solar activity, such as in the mid 15th, late 17th and early 19th centuries. The model is also able to simulate regional climate impacts, such as the well known winter warming over NH extratropical land after large tropical volcanic eruptions. This winter warming pattern, which is most evident over Europe and Eurasia in the model, is caused by an enhanced equator-to-pole temperature gradient in the stratosphere due to the aerosol heating in the tropics. This in turn leads to a strengthening of the polar vortex, which in turn induces a shift toward the high phase of the Arctic Oscillation (AO). In winter, this results in enhanced westerly advection of relatively warm oceanic air over the continents.

Instrumental sea surface temperature records in the North Atlantic Ocean are characterised by large multi-decadal variability known as the Atlantic Multidecadal Oscillation (AMO). The results of long unforced climate simulations showing multidecadal variations in the Atlantic thermohaline circulation, have led to the widespread, although not ubiquitous, view that the AMO is an internal mode of climate variability. Here we show that when forced with solar and volcanic variations the BCM simulates multidecadal variations in temperature similar to what can be found in observations. For instance, a clear early 20th century warming signal is evident, as well a subsequent cooling in the 1960's and 70's. In addition, there is a strong correlation between the incoming shortwave radiation and the SST over the North Atlantic Ocean on multidecadal time scales. Our results therefore points to a strong link between the applied natural forcing and the simulated AMO.