Geophysical Research Abstracts
Vol. 16, EGU2014-3589, 2014
EGU General Assembly 2014

A climate simulation of the first millennium AD using a comprehensive Earth System Model

Sebastian Wagner and Eduardo Zorita
Helmholtz-Zentrum Geesthacht, Institute for Coastal Research, Geesthacht, Germany (sebastian.wagner@hzg.de)

Investigations of past climate using fully coupled comprehensive Earth System Models are restricted by the large computational costs of these simulations. Here we present first results from an on-going simulation with the MPI-ESM-P starting in year 100 BC. The simulation is forced with changes in orbital forcing and long-term solar variations augmented by a synthetic 11-year cycle including an interactive ozone cycle.
For the first time also changes in volcanic activity are implemented based on the reconstruction method by Crowley and Unterman (2012). The basis of the extended volcanic forcing in terms of aerosol optical depth and effective radius are new sulfate estimations from ice cores from Greenland (NEEM) and Antarctica (WAIS) presented by Sigl et al. (2013). Because the NEEM record only reaches back as far as 79 AD, the time until 100 BC was filled by earlier information contained in the Dye 3 and GRIP record (Clausen et al., 1997). Compared to the 2nd millennium AD, the first millennium does however show a considerably reduced amount of large explosive tropical eruptions.
On hemispheric and global scale the large outbreaks around the years 530 and 740 AD are well reflected as negative temperature anomalies. The 79 AD Vesuvius eruption does not however produce a pronounced hemispheric signal. The amount of sulphate ejected into the stratosphere may have been too low for a sustained hemispheric-scale cooling. The large eruption of 530 AD (so called ‘mystic cloud’) is however well reflected within the temperature evolution and is more pronounced over the northern hemisphere during summertime.
On longer, multi-centennial, time scales, global temperatures show a slight decrease. This decrease is more pronounced over the NH hemisphere during JJA and is caused by the decline in the TOA short wave incoming radiation. Over the extratropical SH changes in orbital forcing are not reflected in temperature trends as clearly as over the NH due to the larger oceanic and ice-covered areas.
Future investigations will concentrate on the analyses of additional modes of variability, such as the AO and AAO, and ENSO as well as changes in ocean circulation, for instance related to the variability of the North Atlantic.