Geophysical Research Abstracts
Vol. 13, EGU2011-5919, 2011
EGU General Assembly 2011

On the implications of volcanic forcing to simulated near-decadal Northern Hemisphere winter climate variability during the last millennium

Davide Zanchettin (1), Claudia Timmreck (2), Angelo Rubino (3), Hans-F. Graf (4), Stephan Lorenz (1), Kirstin Krüger (5), and Johann H. Jungclaus (1)

(1) Max Planck Institute for Meteorology, Ocean in the Earth System Department, Hamburg, Germany, (2) Max Planck Institute for Meteorology, Atmosphere in the Earth System Department, Hamburg, Germany, (3) Ca' Foscari University, Environmental Sciences Department, Venice, Italy, (4) University of Cambridge, Centre for Atmospheric Science, Cambridge, United Kingdom, (5) Leibniz-Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany

The simulated near-decadal response of Northern Hemisphere (NH) winter climates to pre-industrial strong tropical volcanic eruptions (SVE) is inspected in an all-forcing ensemble of simulations covering the last millennium conducted with the ECHAM5/MPIOM Earth System Model developed at the Max Planck Institute for Meteorology (MPI-ESM). Up to 45 SVE (nine eruptions, each one with five realizations) producing a peak annual-average top-of-atmosphere radiative perturbation larger than -1.5 W/m2 are investigated in ensemble composite analysis. While post-eruption global and hemispheric winter anomalies of surface air temperature generally revert back to pre-eruption climatological values 4-6 winters after the event, longer-lasting significant repercussions of SVE can be found on NH regional winter climates. In particular, our simulations indicate that surface warming can persist over the Scandinavian/Western Russian region during the first two decades following the eruption, with peaking anomalies occurring around 10-12 years after a major event (delayed warming).

The delayed warming arises from major changes induced by SVE in the ocean/atmosphere coupled system, included internal processes pertaining to the multidecadal band of simulated variability. Particularly important is a strong signal amplification in the North Atlantic/Arctic region which entails, as a pivotal step, the establishment of a prolonged positive anomaly of the North Atlantic Oscillation. Volcanic-forced perturbations emerge therefore, in our simulations, as a candidate source of decadal and longer climate variability. Nonetheless, their modulation by background conditions, as well as possible interferences with the North Atlantic decadal-to-multidecadal intrinsic variability or interactions with remote potential sources of decadal variability certainly adds complexity to the interpretation of simulated climate variability as well as to the attribution of observed and reconstructed decadal and multidecadal regional climate variability.

In this contribution, pre-eruption conditions are investigated as a potentially relevant source for interferences affecting the post-eruption variability of the ocean/atmosphere coupled system in its specific aspects. It is discussed how different clusters of tropical SVE during the last millennium, such as those reconstructed for the 13th and 19th century, can yield remarkable peculiarities in the near-decadal regional climate response simulated by the MPI-ESM. In particular, it is suggested that the delayed warming is less likely to occur under a colder global climate.