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Impact of the 536/540 CE double volcanic eruption event on the 6th-7th century climate using model and proxy data

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The mid of the 6th century is an outstanding period and started with an unusual cold period that lasted several years to decades, due to the 536/540 CE double eruption event, with the strongest decadal volcanic forcing in the last 2000 years. Evidence from multiple tree ring records from the Alps to the Altai Mountains in Russia identified a centennial cooling lasting from 536 up to 660 CE. A previous Earth System Model (ESM) study with reconstructed volcanic forcing covering 535-550 CE like conditions already found that the double eruption led to a global decrease in temperature and an increase in Arctic sea-ice for at least a decade. However, the simulations were too short to fully investigate the multi-decadal cooling event and the atmospheric forcing from this double volcanic eruption alone may not be enough to sustain such a prolonged cooling. To better understand forced versus internal decadal climate variability in the first millennium we have performed mid 6th century ensemble simulations with the MPI-ESM1.2 for the 520-680 CE period. The ensemble consists of 10 realizations, which were branched of the MPI-ESM1.2 PMIP4 Past2k run, including the evolv2k volcanic forcing.

Here, we present results of this new set of the 6th-7th century MPI-ESM simulations in comparison to paleo-proxies. Summer surface temperatures are analyzed and compared with available tree-ring data, which fits very well for the entire 160 year period. As part of the VIKINGS project, special focus is placed on the impact of the 536/540 CE double volcanic eruption event on the surface climate in the Northern Hemisphere, in particular Scandinavia, Northern Europe and Siberia. The goal is to also compare the model data with new tree-ring and lake sediment proxies from southeastern Norway. Detailed comparison with proxy data will allow us to better understand the regional and seasonal climate variations of the 6th-7th century. Duration, strength and the possible mechanism for a long lasting volcanic induced cooling will be discussed.