

EGU24-15834, updated on 20 May 2024

<https://doi.org/10.5194/egusphere-egu24-15834>

EGU General Assembly 2024

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Vegetation responses in East Asia to rapid climate changes: comparisons among the Younger Dryas event, the 8.2ka event, and the 4.2ka event

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Investigations of past biotic responses to rapid climate shifts are useful for developing biological scenarios that may result from future climate change. Vegetation responses to the Younger Dryas (YD) cold climatic reversal, the 8.2 ka cooling event, and the 4.2 ka event are of considerable interest. In this paper, we conduct model simulations of vegetation responses to these rapid climate changes over East Asia, and compare them with pollen-based vegetation records. Our aims were to investigate the vegetation responses to rapid climate changes with different magnitudes and to analyze dominant impact factors on vegetation in East Asia. Our results reveal that all major Plant Functional Types responded to the climate changes, but the magnitude, timing, and impact of their responses varied, with most changes in vegetation composition rather than vegetation type succession. In addition, it was found that after the abrupt cooling events the vegetation did not always recover to the state simulated before the perturbation, suggesting that different vegetation compositions may occur under similar climate conditions. Notably, there was a latitudinal gradient in the magnitude of these cold events in East Asia and in the resulting vegetation response, indicating a more pronounced vegetation responses to the severe cooling in the north and weaker responses to less cooling in the south. Changes in temperature exerted a major influence on the vegetation dynamics in the most high latitude regions, and changes in both temperature and precipitation were responsible for the vegetation changes at mid-to-high-latitudes. Vegetation compositions show a long-lasting effect of abrupt climate changes through eco-physiological and ecosystem demographic processes.