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A new perspective on permafrost boundaries in France during the Last Glacial Maximum

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During the Last Glacial Maximum (LGM), a very cold and dry period around 26.5–19 kyr BP, permafrost was widespread across Europe. In this work, we explore the possible benefit of using regional climate model data to improve the permafrost representation in France, decipher how the atmospheric circulation affects the permafrost boundaries in the models, and test the role of ground thermal contraction cracking in wedge development during the LGM. With these aims, criteria for possible thermal contraction cracking of the ground are applied to climate model data for the first time. Our results show that the permafrost extent and ground cracking regions deviate from proxy evidence when the simulated large-scale circulation in both global and regional climate models favours prevailing westerly winds. A colder and, with regard to proxy data, more realistic version of the LGM climate is achieved given more frequent easterly winds conditions. Given the appropriate forcing, an added value of the regional climate model simulation can be achieved in representing permafrost and ground thermal contraction cracking. Furthermore, the model data provide evidence that thermal contraction cracking occurred in Europe during the LGM in a wide latitudinal band south of the probable permafrost border, in agreement with field data analysis. This enables the reconsideration of the role of sand-wedge casts to identify past permafrost regions.