Compression wood has a minor effect on the climate signal in tree-ring stable isotope records of montane Norway spruce

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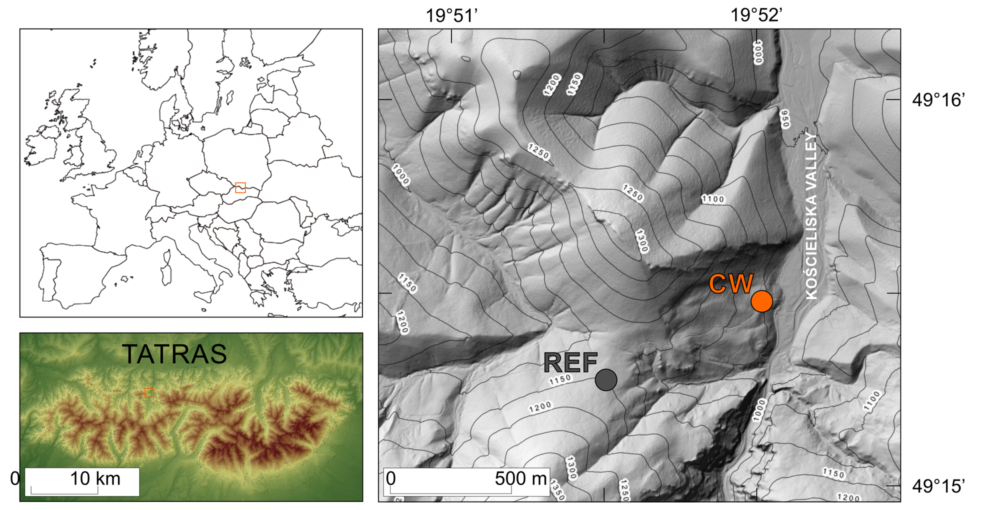
INTRODUCTION

Compression wood (CW) is a type of reaction wood that occurs in coniferous species. Its main role is to increase the mechanical strength and regain the vertical orientation of a leaning stem. The anatomical structure of CW is characterized by (i) rounded tracheids causing intercellular spaces, (ii) a thickened secondary wall (S2 layer) showing helical cavities and (iii) a lack of a tertiary cell wall (S3 layer). CW is a proxy used to reconstruct the frequency and intensity of mass movements, however, in dendroclimatological studies, CW is thought to bias the strength of the climate signal in tree-ring parameters.

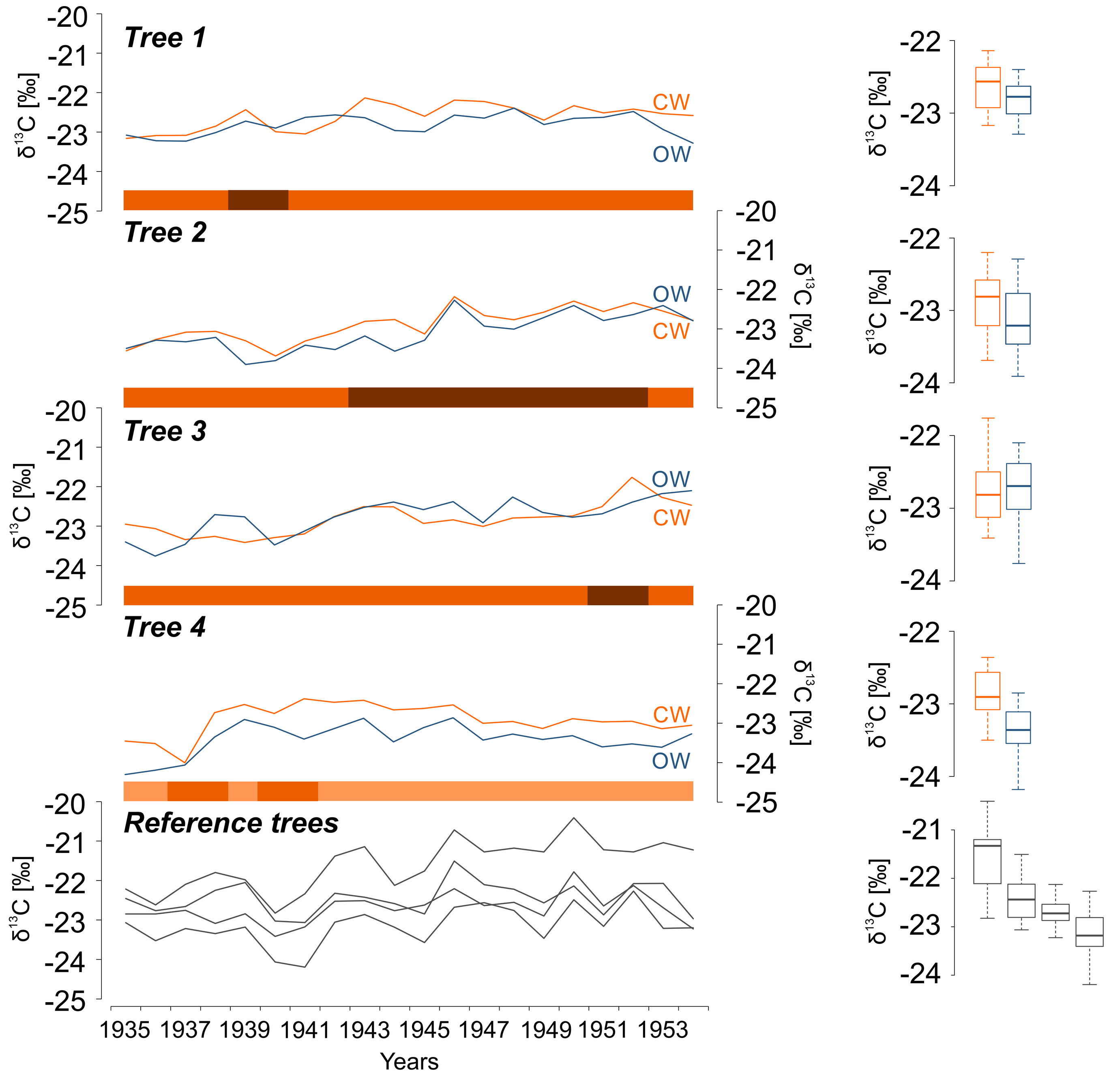
The aims of the study were to: (1) test for differences in the means and year-to-year variations of δ13C and δ18O values in tree-ring cellulose of CW, opposite wood (OW) and wood from undisturbed reference trees (REF), (2) assess whether the strength of the climatic signal in δ13C and δ18O chronologies is affected by CW.

MATERIALS & METHODS

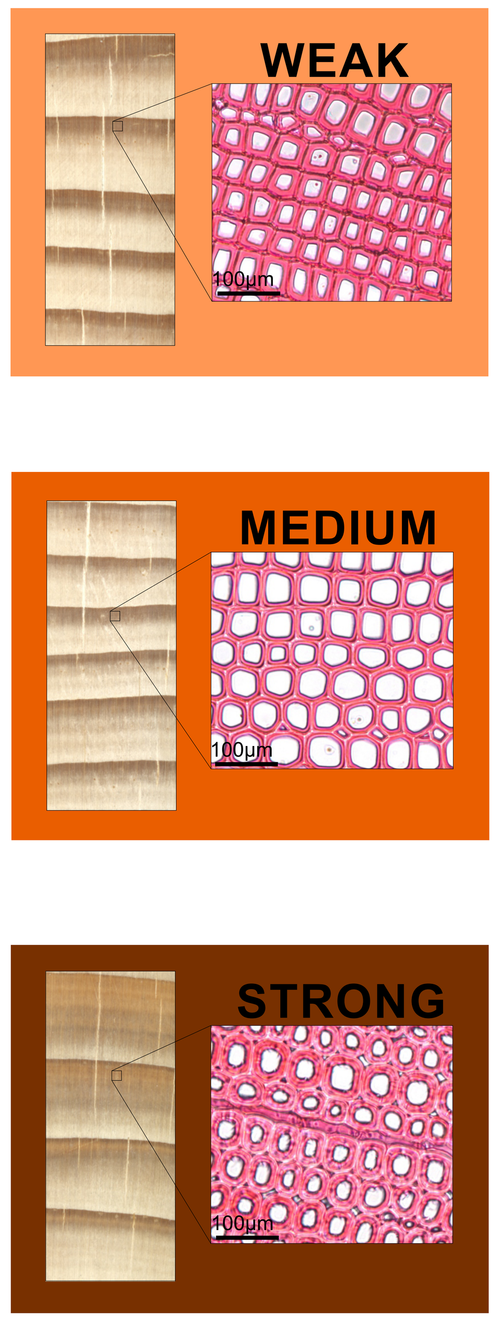
Four trees growing in the montane zone of the Western Tatra Mountains, Poland, were selected, and two radii per tree were taken, one with compression wood (CW) and one from the opposite side of the trunk (OW). Four reference trees (REF) without compression wood were sampled from the same valley, however, from a slightly different location. All analyses were performed for the period 1935-1954 with CW present in all trees.



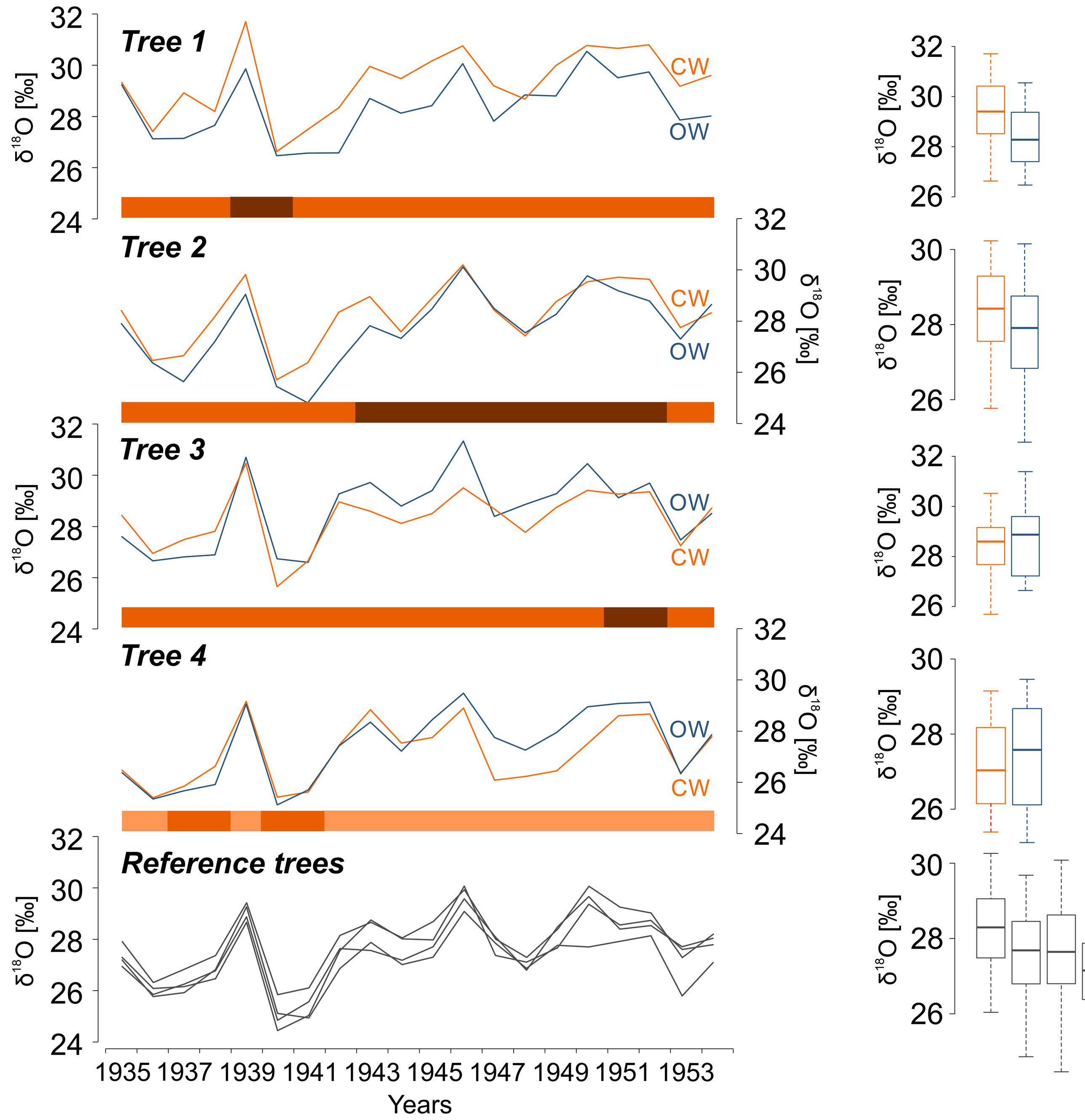
δ13C of single trees and occurence of CW



CW classes

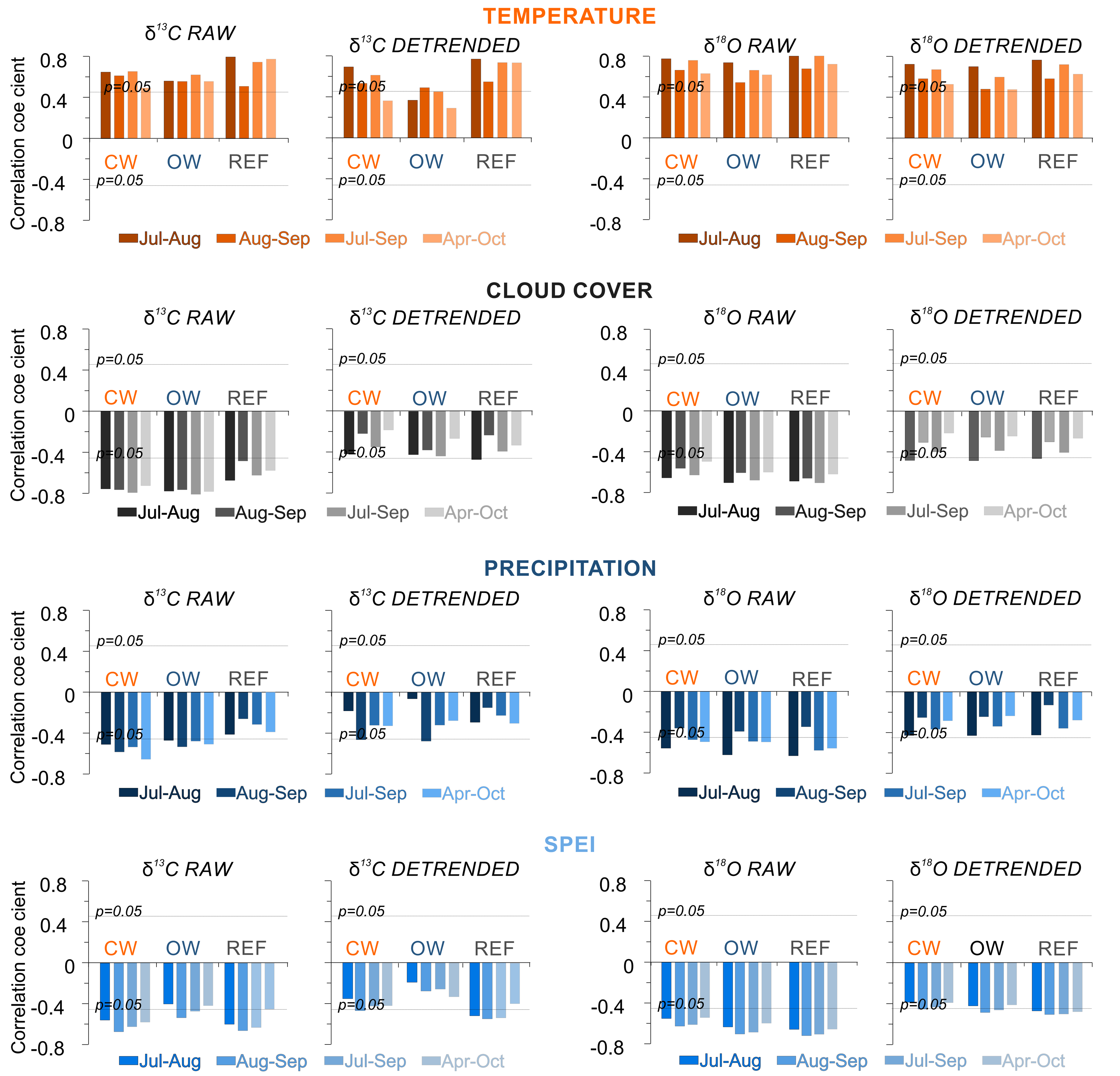


δ18O of single trees and occurence of CW

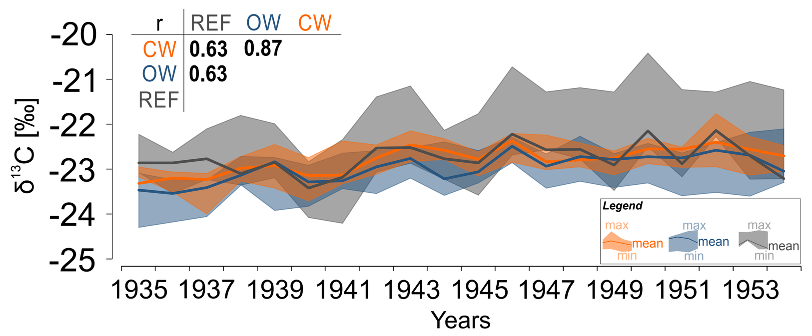


Climate signals

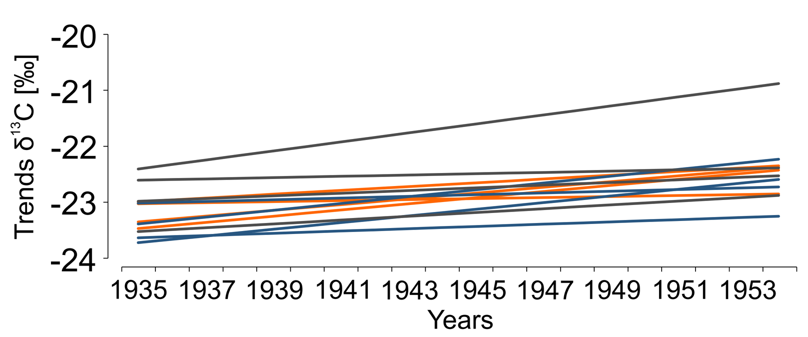
δ13C chronologies / δ18O chronologies



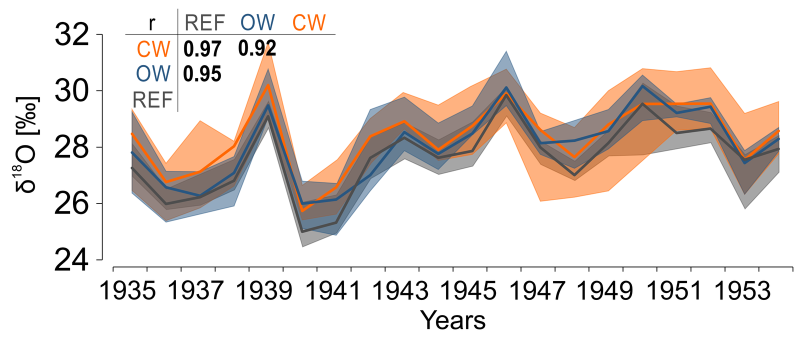
δ13C chronologies



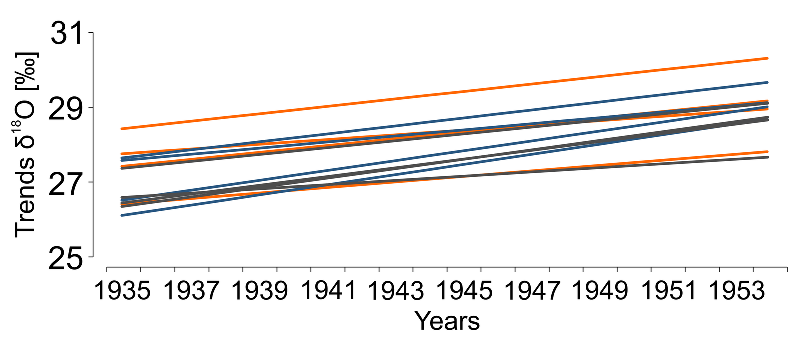
δ13C trends



δ18O chronologies



δ18O trends



CONCLUSIONS

1. The occurrence of compression wood of variyng intensity has little influence on $\delta^{13}C$ and $\delta^{18}O$ values. CW, OW and REF isotope chronologies exhibit high similarity. This is in contrast to TRW chronologies containing CW (*Janecka et al.* 2016).
2. The relationship between climate parameters, $\delta^{13}C$ and $\delta^{18}O$ records are generally consistent across radii with and without CW and in comparison to an independent reference dataset. We found a strong positive relationship to summer temperature, negative to precipitation, cloud cover and SPEI of the same periods.
3. The samples from trees affected by geomorphological processes that cause CW formation can be used to reconstruct the past intensity and frequency of these processes and also contribute to climatological research.

See details: Janecka K., Kaczka R. J., Gärtner H., Harvey J. E., Treydte K. (2020). Compression wood has a minor effect on the climate signal in tree-ring stable isotope records of montane Norway spruce. Tree Physiology. doi.org/10.1093/treephys/tpaa038