Paleoceanography

Supporting Information for

Millennial-scale Climate Variability Potentially Shaped the Early Interglacial Optimum in Southern Europe

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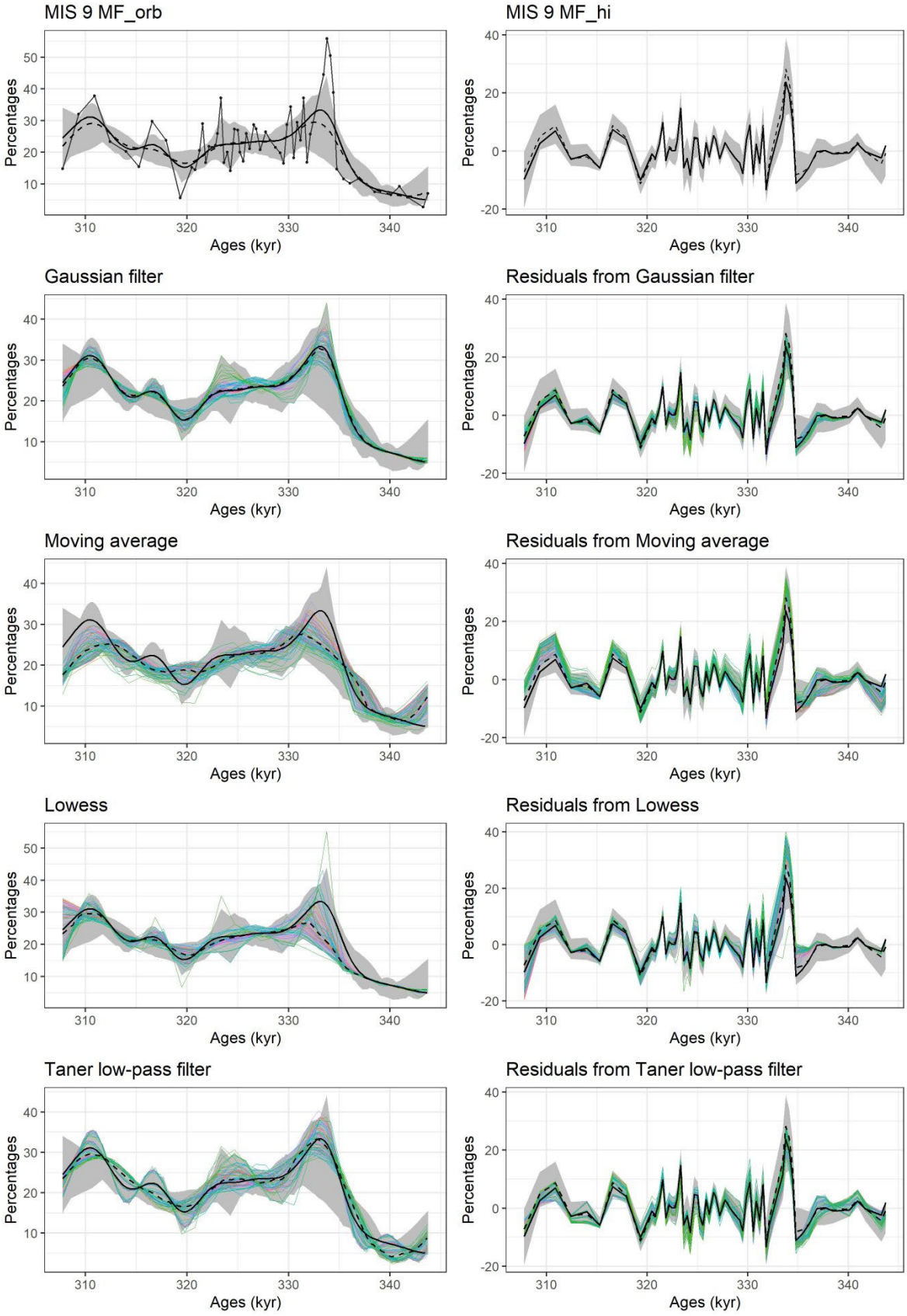

MIS 9 MF_orb
MIS 9 MF_hi
Gaussian filter
Residuals from Gaussian filter
Moving average
Residuals from Moving average
Lowess
Residuals from Lowess
Taner low-pass filter
Residuals from Taner low-pass filter
Percentages
Ages (kyr)

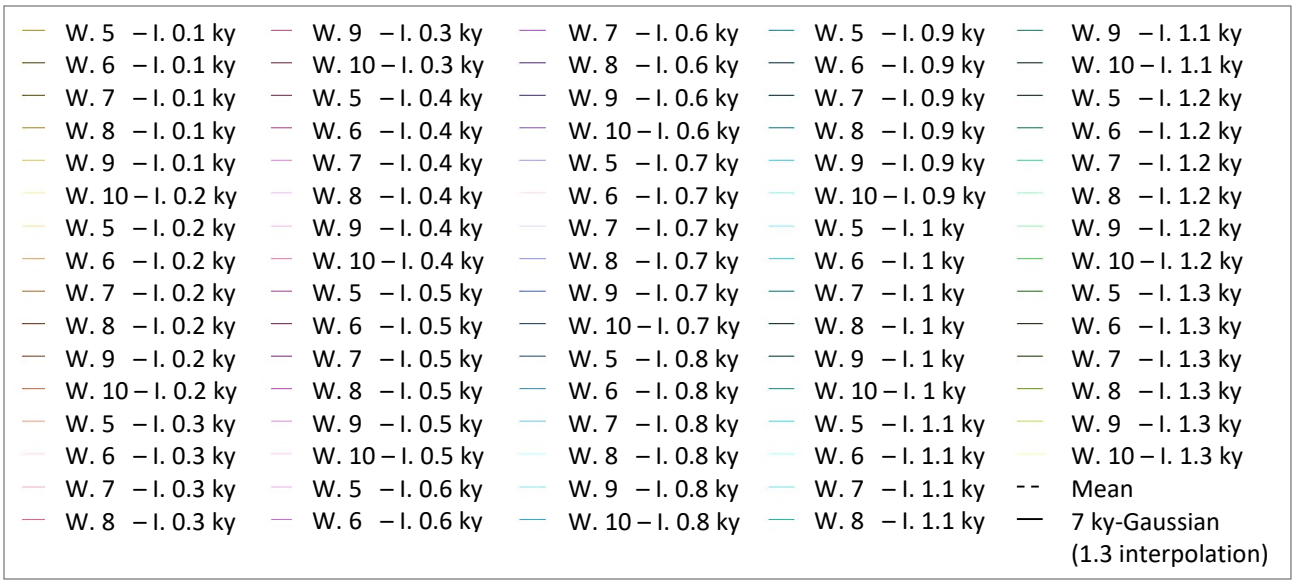
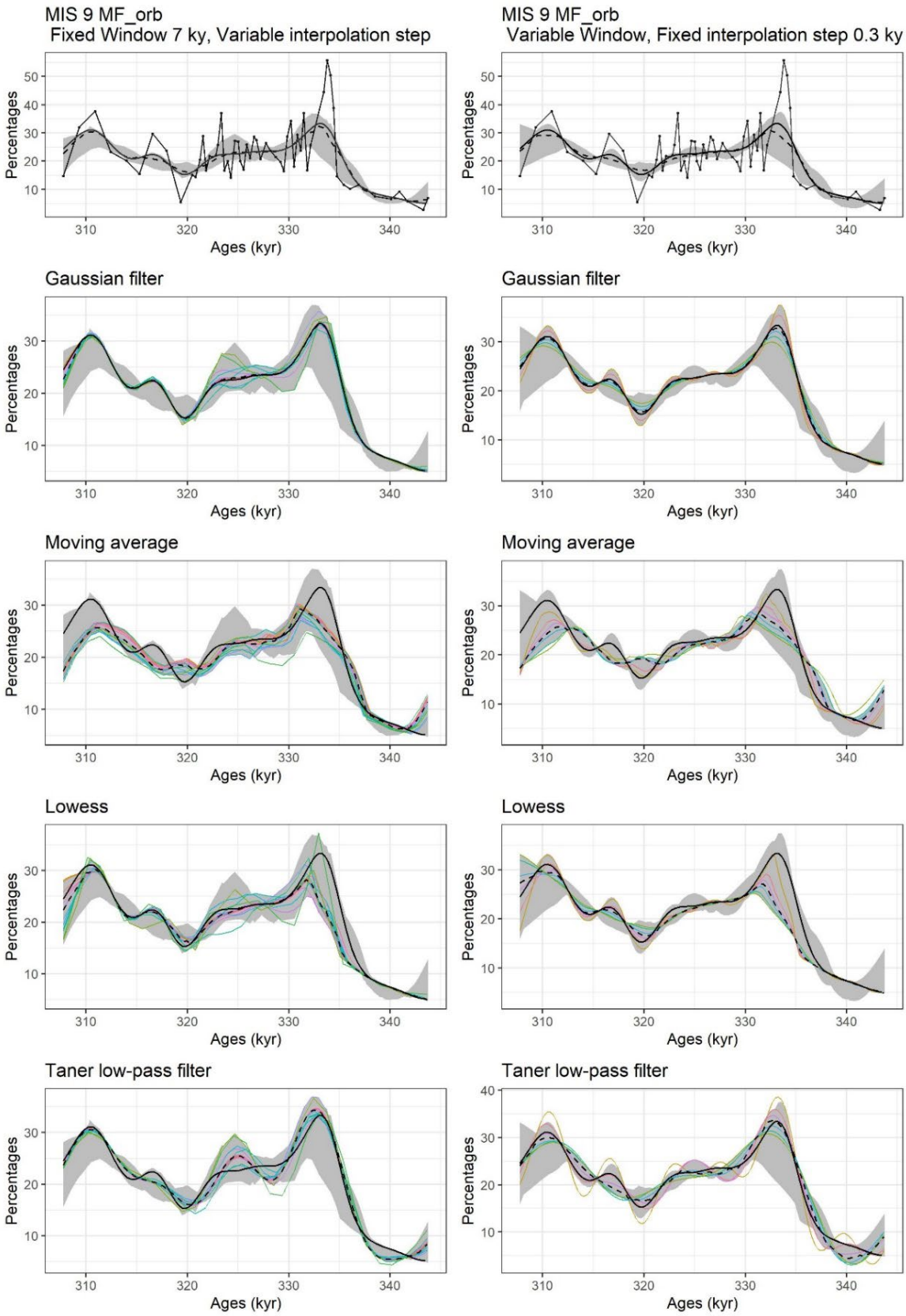


Figure S1: Sensitivity test to assess the influence of the interpolation step, windows and smoothing methods used to extract the residuals representing the millennial-scale variations.
Black curve with dots: raw MF percentages.
Black bold lines in all plots: MF_orb and MF_hi using a 7 ky Gaussian filter on interpolated data using a 0.3 ky step.
Grey area in all plots: global envelope of the smoothed data and residuals using variable filters (Gaussian, moving average, Lowess and Taner low-pass filter with windows varying from 5 to 10 ky and interpolation from 0.1 to 1.3 ky).
Colored lines: individual smoothing and residuals (cf. legends)
Dashed bold lines: Mean filter and residuals calculated from all results (in MF-orb and MF_hi upper plots) and for results obtained using the different methods.


MIS 9 MF_orb
Fixed Window 7 ky, Variable interpolation step
MIS 9 MF_orb
Variable Window, Fixed interpolation step 0.3 ky
Gaussian filter
Moving average
Lowess
Taner low-pass filter
Percentages
Ages (kyr)

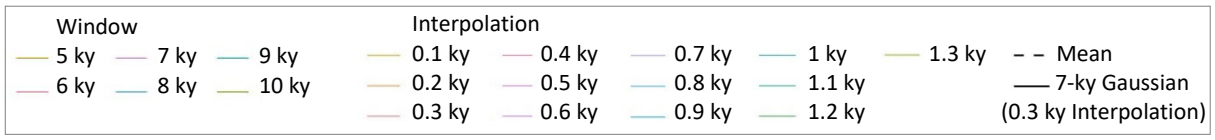
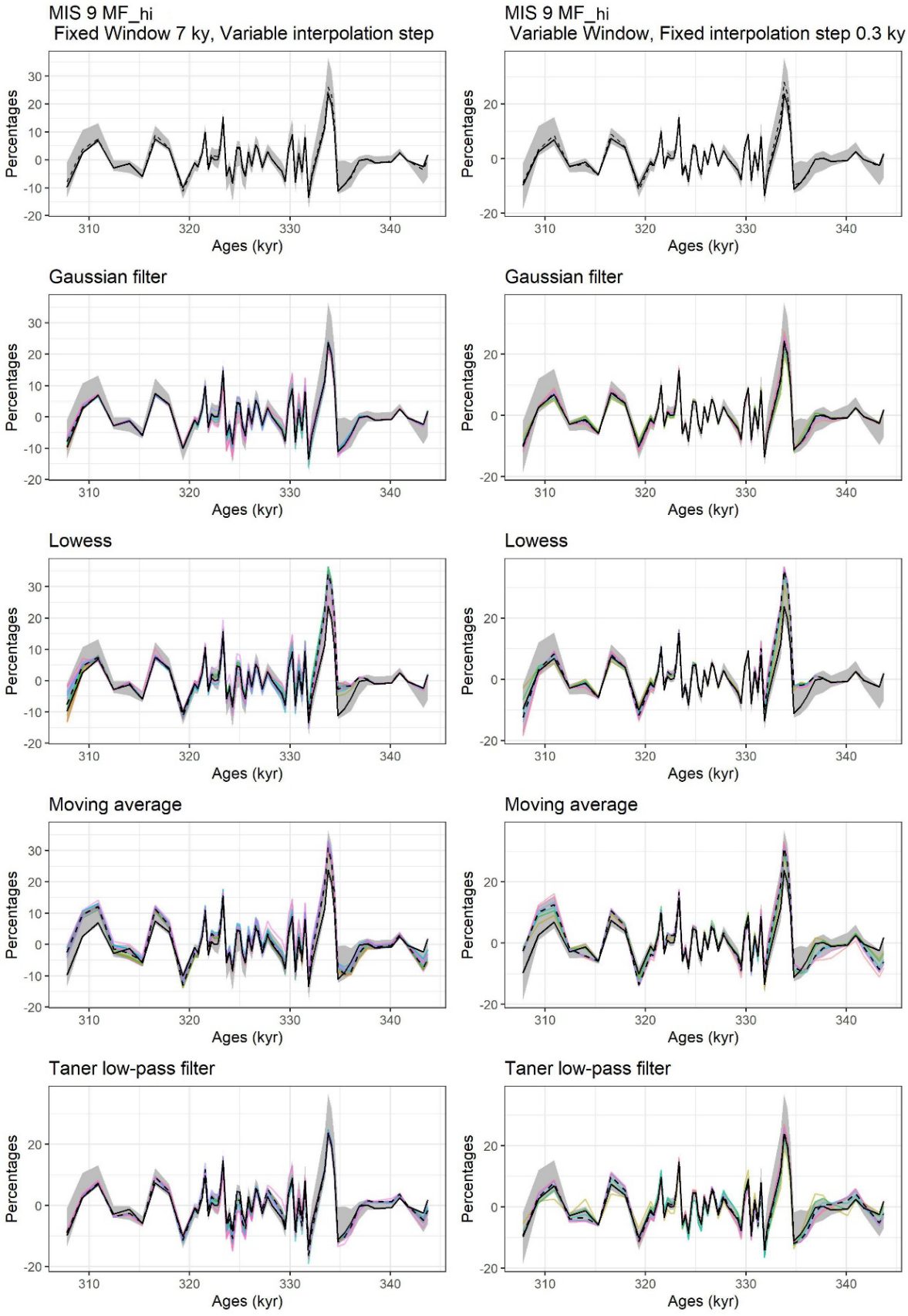


Figure S2: Sensitivity test to assess the influence of the interpolation step on the filters with fixed 7 ky window and of the window on data interpolated at 0.3 ky on the orbital component of the MF data.


MIS 9 MF_hi
Fixed Window 7 ky, Variable interpolation step
MIS 9 MF_hi
Variable Window, Fixed interpolation step 0.3 ky
Gaussian filter
Gaussian filter
Lowess
Lowess
Moving average
Moving average
Taner low-pass filter
Taner low-pass filter
Percentages
Ages (kyr)
310
320
330
340

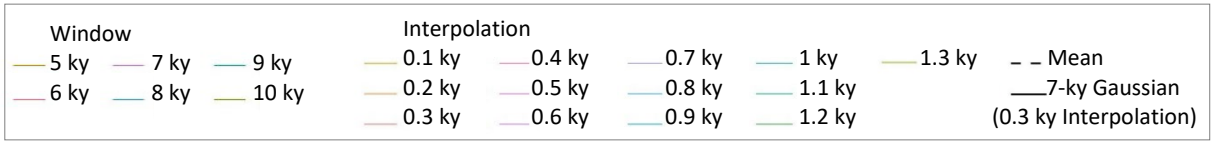


Figure S3: Sensitivity test to assess the influence of the interpolation step on the filters with fixed 7 ky window and of the window on data interpolated at 0.3 ky on the millennial components of the MF data.

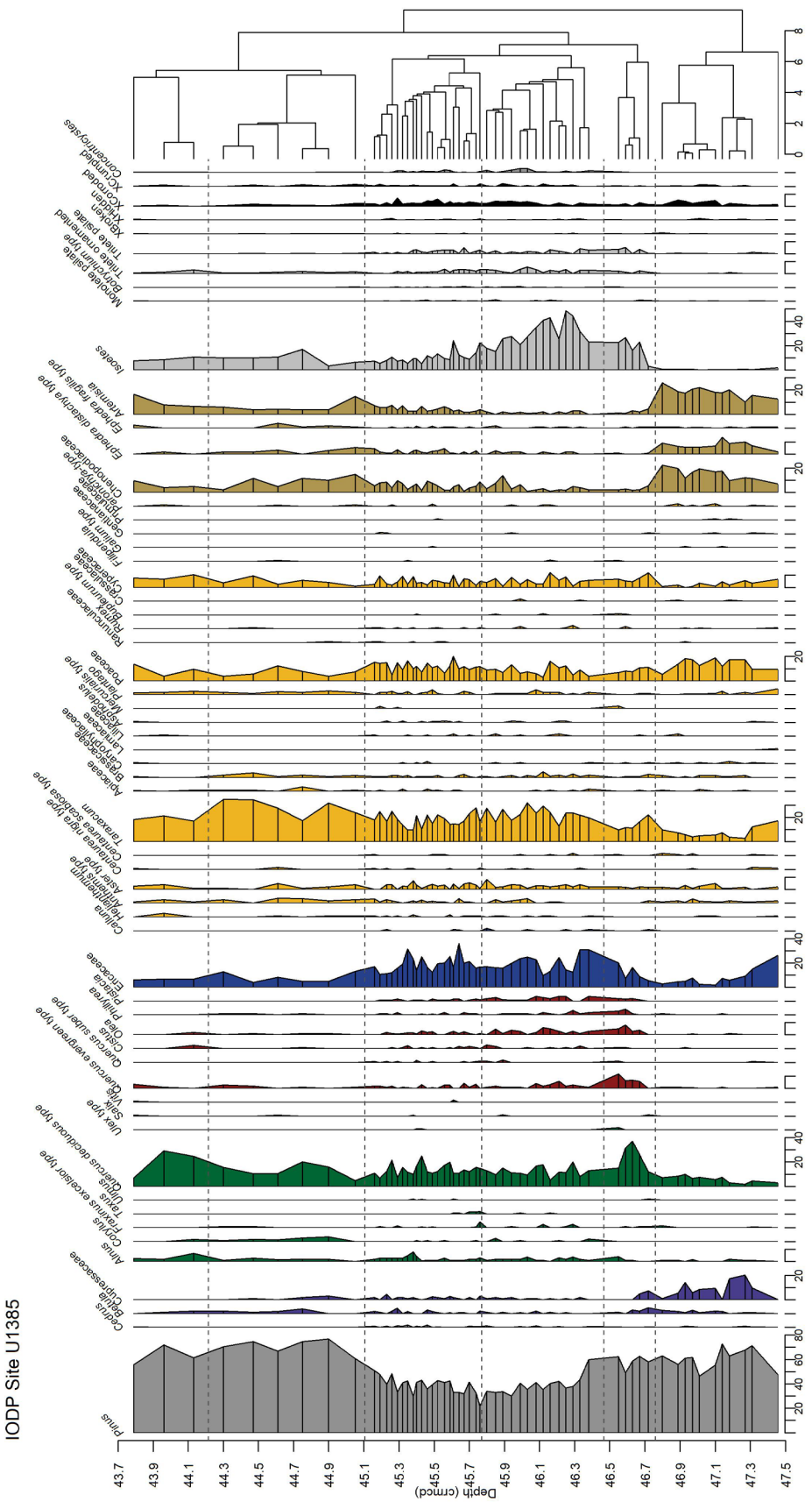

IODP Site U1385
Depth (cmcd)
43.7
43.9
44.1
44.3
44.5
44.7
44.9
45.1
45.3
45.5
45.7
45.9
46.1
46.3
46.5
46.7
46.9
47.1
47.3
47.5
Pinus
Cedrus
Betula
Ericaceae
Alnus
Corylus
Fraxinus excelsior type
Tilia
Quercus deciduous type
Ulex type
Salix
Viola
Quercus evergreen type
Quercus subgen Cerris
Quercus subgen Quercus
Philyrea
Phillyrea
Ericaceae
Cichorioideae
Helianthemum
Asteroideae
Centaurea nigra type
Centaurea scabiosa type
Taraxacum
Apiaceae
Brassicaceae
Caryophyllaceae
Lamiaceae
Lotus type
Medicago
Plantago
Poaceae
Ranunculaceae
Rumex
Scrophulariaceae
Cyperaceae
Filipendula
Geranium type
Geraniaceae
Papaveraceae
Rhamnus frangula type
Centaurea cyanus type
Centaureinae
Euphorbia dulcis type
Artemisia
Isoetes
Monolete psilate
Botryococcus
Tilia
Trilete ornamented
Trilete psilate
Xylodon
Xylodon
Xylodon

Figure S4. Pollen percentages diagram of the interval encompassing MIS 9e from IODP Site U1385. It shows the main pollen taxa only. Pollen zones were determined using constrained hierarchical clustering of the pollen percentage data. Clustering was performed using the CONISS method and implemented with the *chclust* function of the package *rioja* (Juggins, 2009) in the R environment (R Core Team, 2022). Only pollen taxa included in the main sum were selected to construct the Bray-Curtis distance matrix used for clustering analysis. The distance matrix was calculated using the R package *vegan* (Oksanen et al., 2022). The diagram was drawn with the *stratplot* function of the package *rioja*.

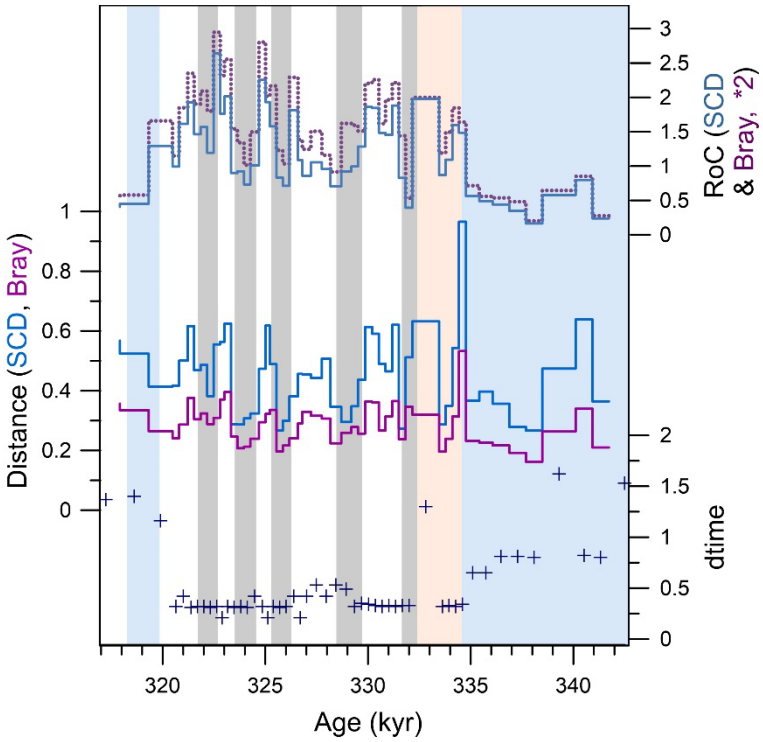


Figure S5: Sampling resolution, distance of the pollen assemblages and RoC for the MIS 9 pollen record from Site U1385.

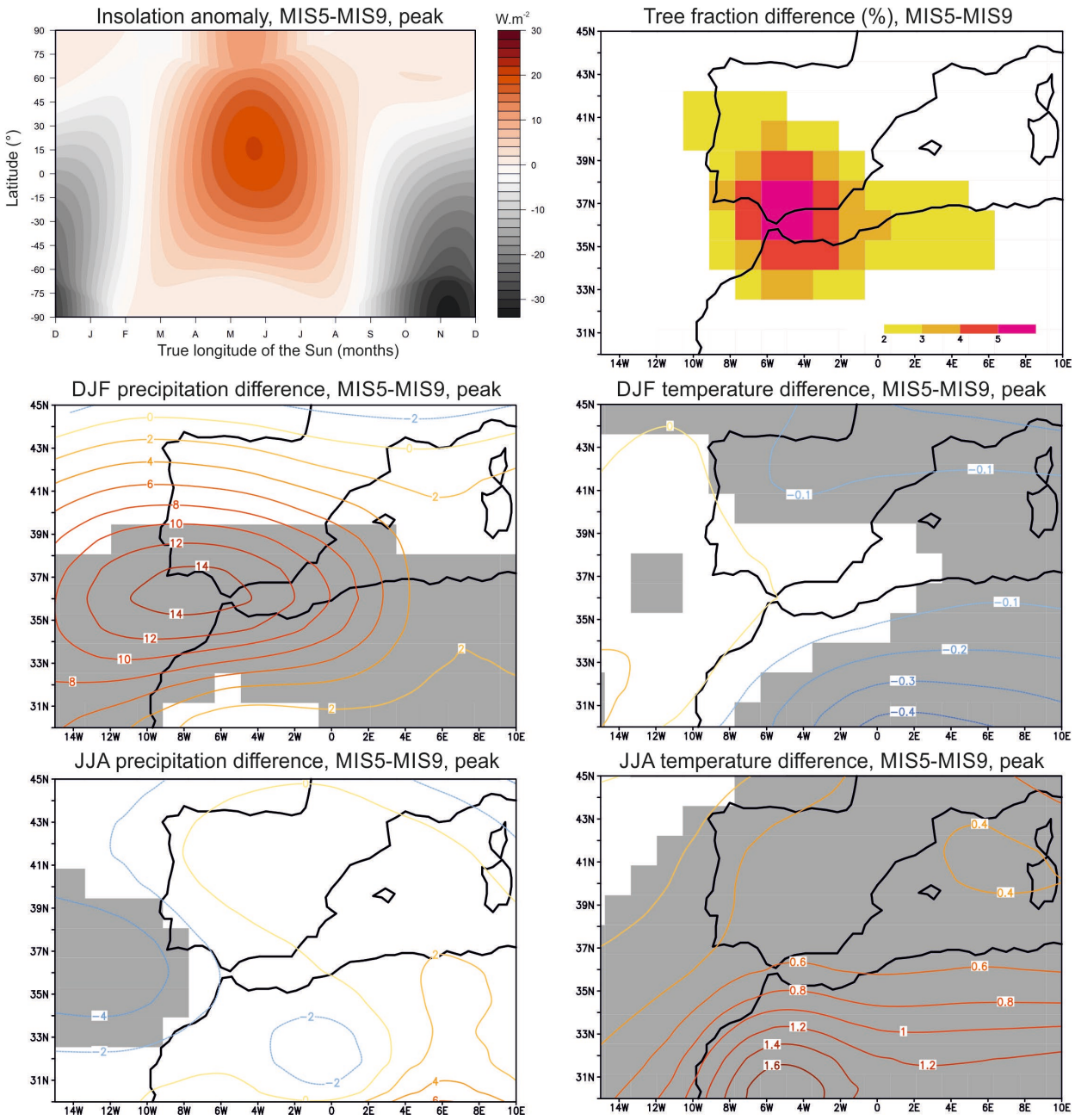


Figure S6. **Results of the LOVECLIM simulations presenting the differences in annual, JJA and DJF temperature (°C) and precipitation (cm.year^{-1}) between the MIS 5 and MIS 9 peak simulations** (cf. Yin & Berger, 2015). The grey shaded color indicates that difference is significant at more than 95% confidence level calculated using student t-test.