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Can extant taxa give clues for paleoenvironmental reconstruction? Examples from diffuse and semi-ring-porous species.



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Wood anatomical variability in ring-porous species has been successfully employed in the past few years to extract the climate (temperature, precipitation) and environmental signals from tree rings. However, very little is known about the ability of diffuse- and semi-ring-porous species to record environmental signals in their xylem cells although they could be abundant in fossil wood assemblage (fig.1).

Wood anatomical response to environmental parameters was assessed in *Alnus glutinosa*, *Fagus sylvatica* and *Prunus avium* through the analysis of wood anatomical differences of approximately 750 growth rings of the three species sampled along a geographic gradient from north Spain to north France and Czech Republic (Fig 2).

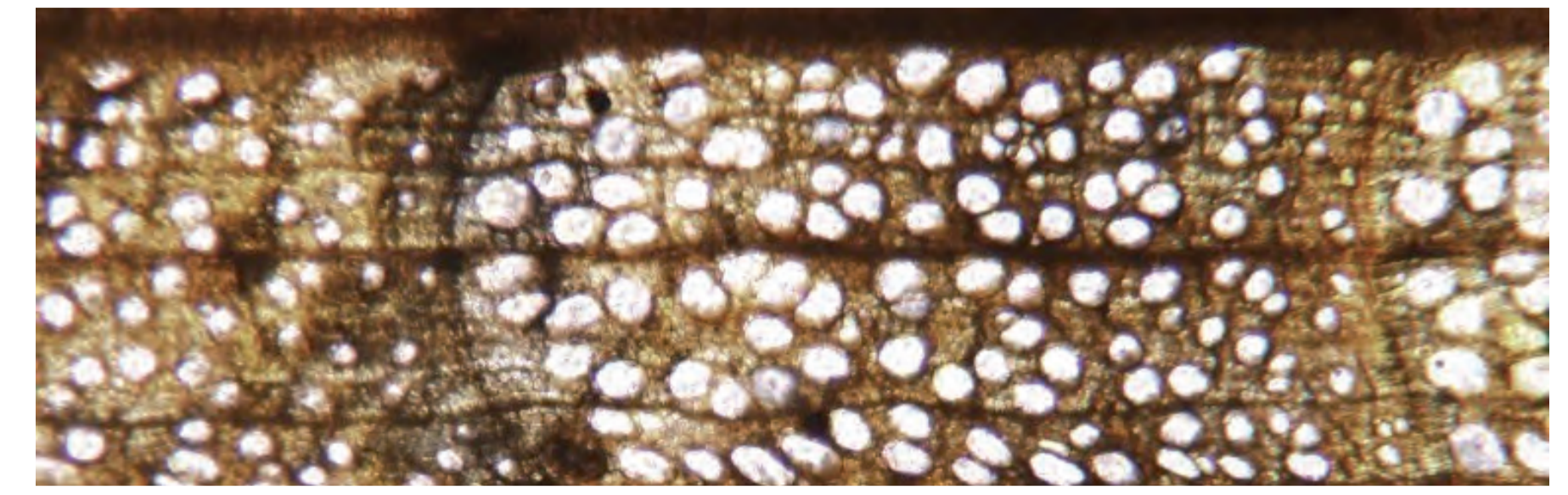


fig. 1 *Fagus mansii* - Middle Miocene Wood Flora of Vantage, Washington (source E. Wheeler, Insidewood database).

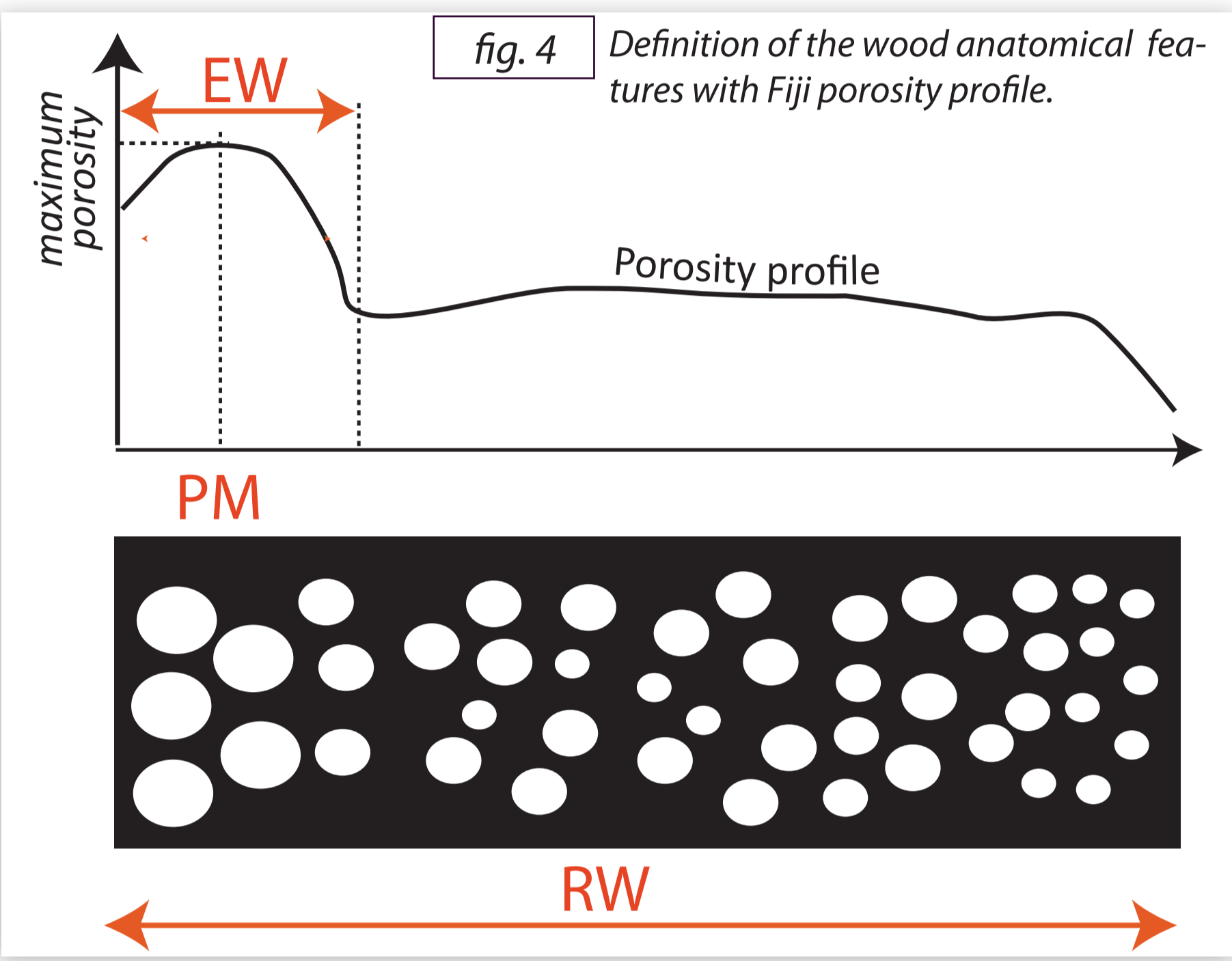
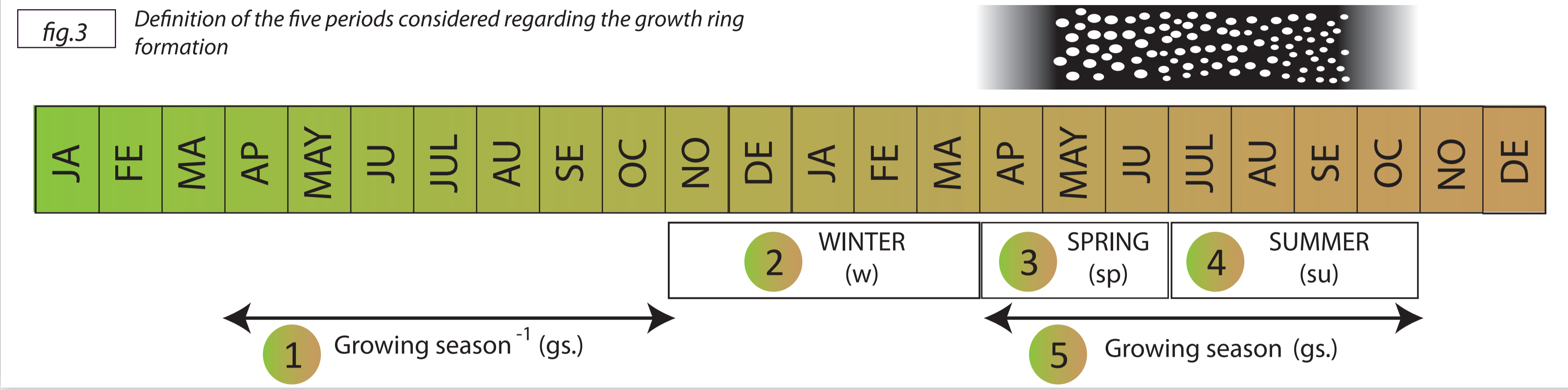


Image analysis (Fiji software) was used to measure diverse classical and original wood anatomical features listed below:

- growth ring width RW
- earlywood width (only for *P. avium*, fig. 4) EW
- porosity index PI
(i.e. relative area occupied by vessel, fig. 4)
- mean vessel area MVA
- maximal porosity (fig. 4) PM
- vessel density VD
- maximal vessel area MXVA
- circularity CIR
(i.e. $4\pi \times (\text{area}/\text{perimeter}^2)$). The value vary from 0 to 1.
A value closed to 1 indicates a perfect circle.

Each growth ring was considered individually. For all years of growth ring formation, five periods were defined (fig. 3). The total amount of precipitation (P), the mean temperatures (T) and the water availability (W; defined as P-2T) were calculated. We added to these parameters, the total amount of precipitation (defined as soil reserve, SR) from January of the year preceding the growth ring formation to march of the year of the growth ring formation, the mean of the coldest temperatures (CT) for the winter and the spring period, the mean of the hottest temperatures (HT) for the spring and the summer period. We also took into account the diameter of the sampled trees (TD) and the altitude (AL), latitude (LA) and longitude (LO) of the sampling areas.

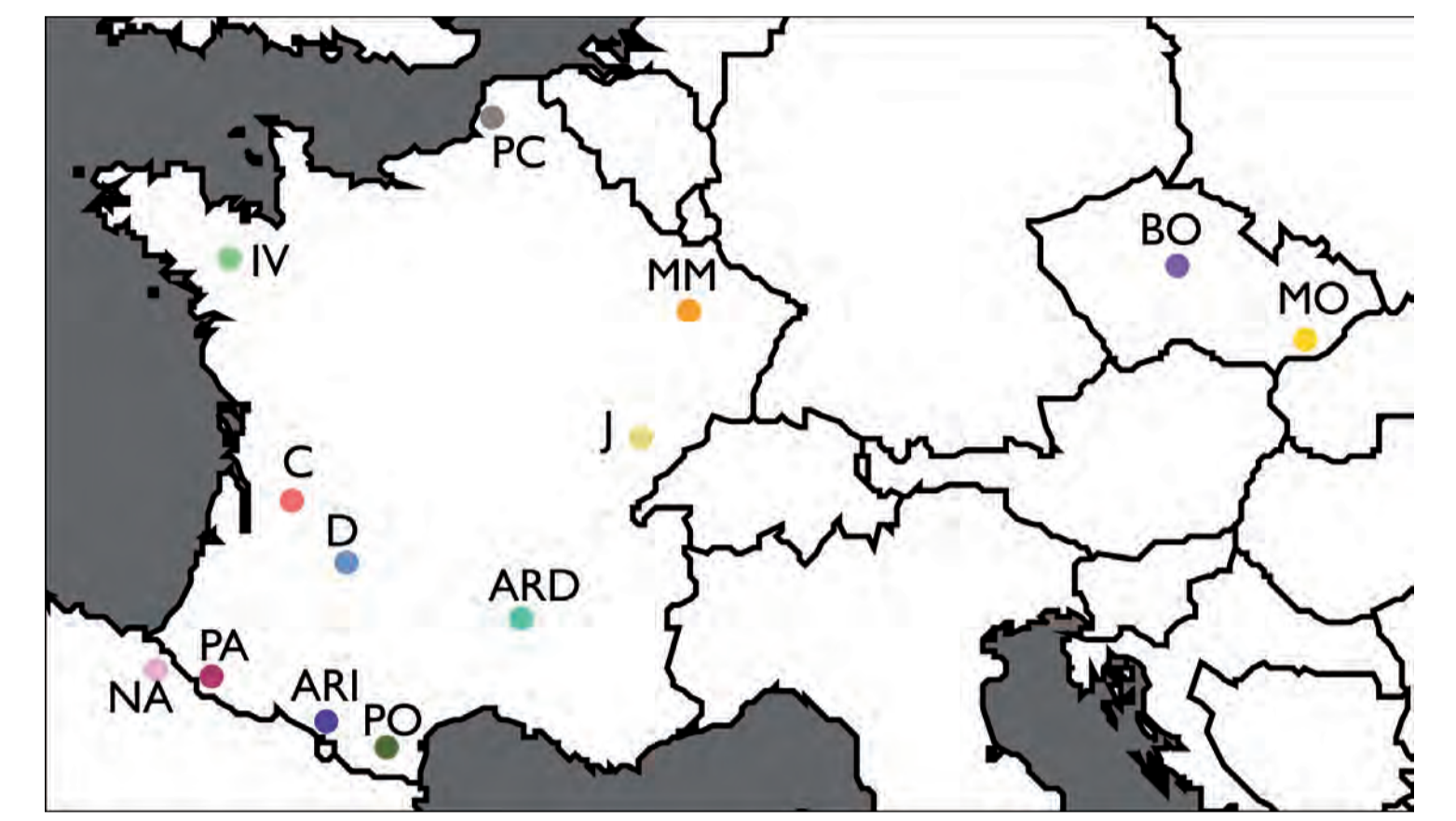


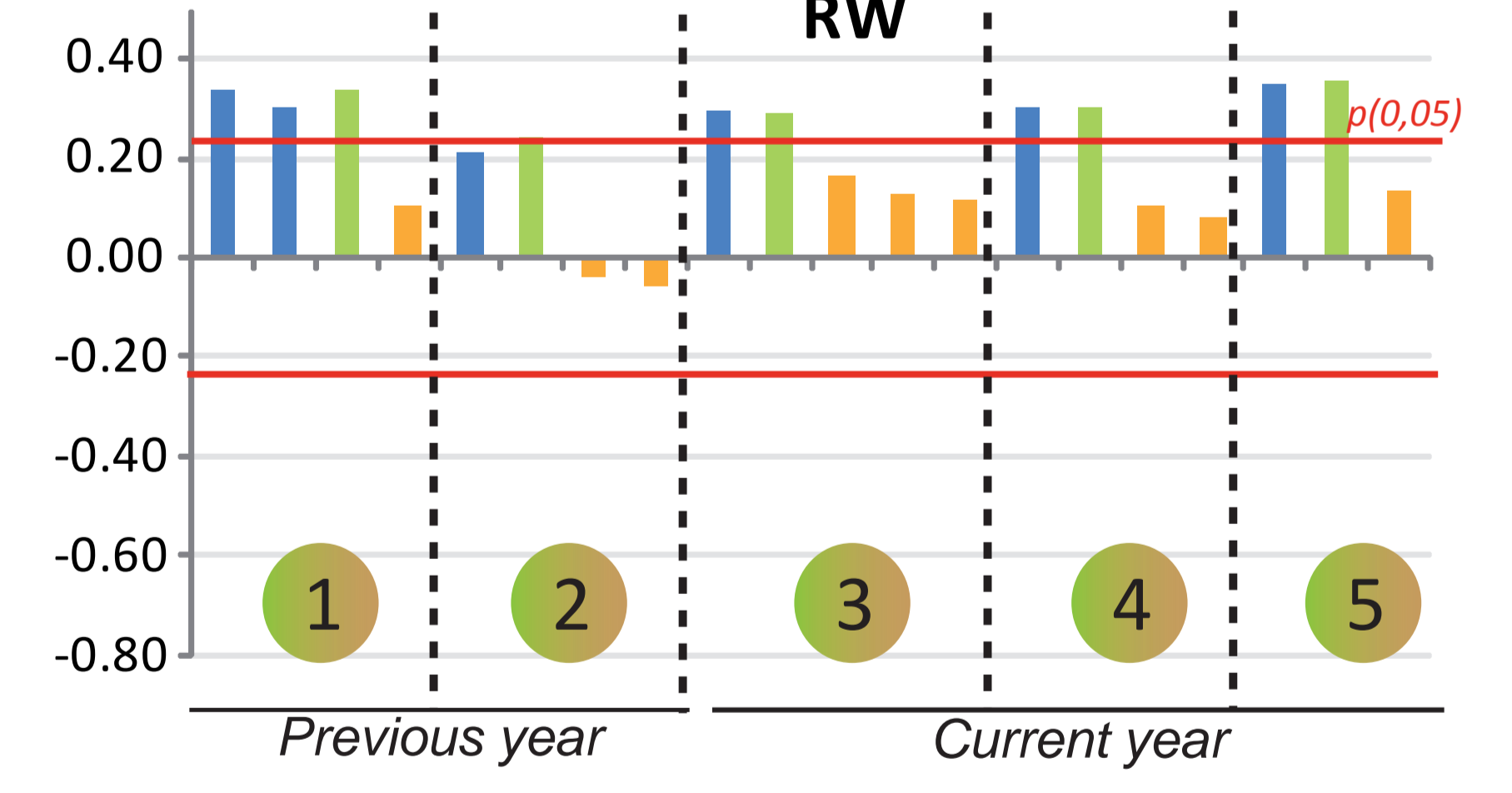
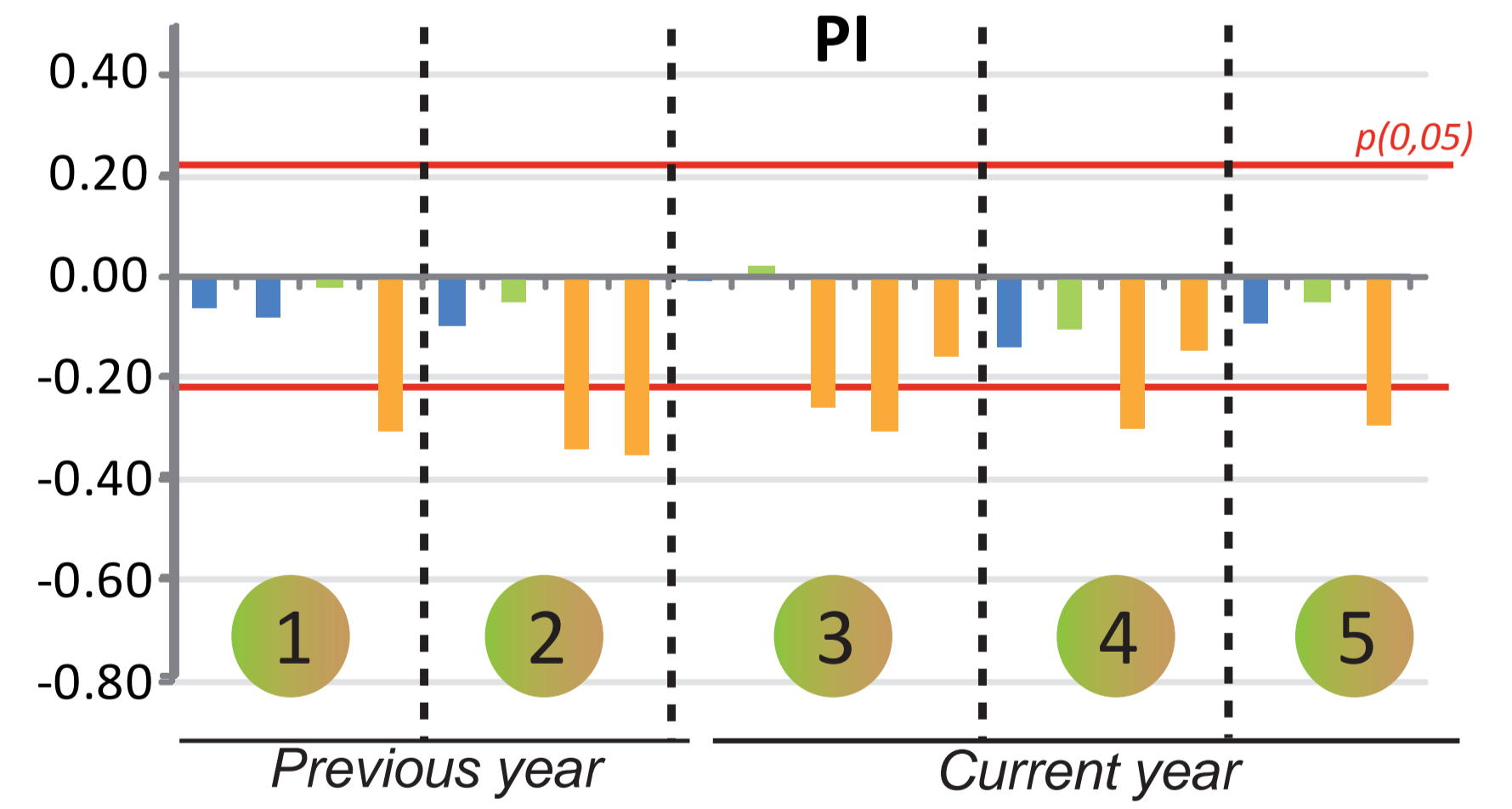
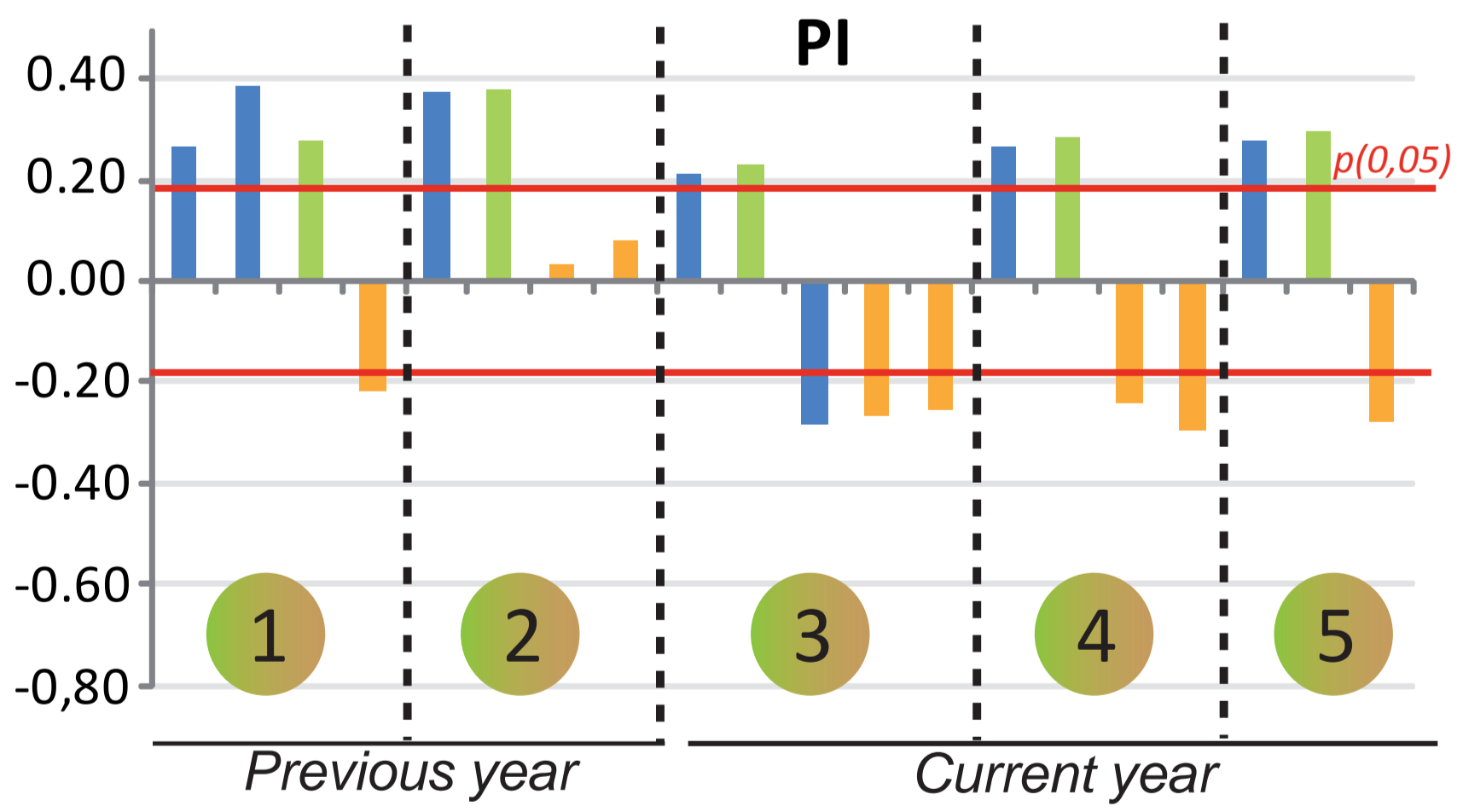
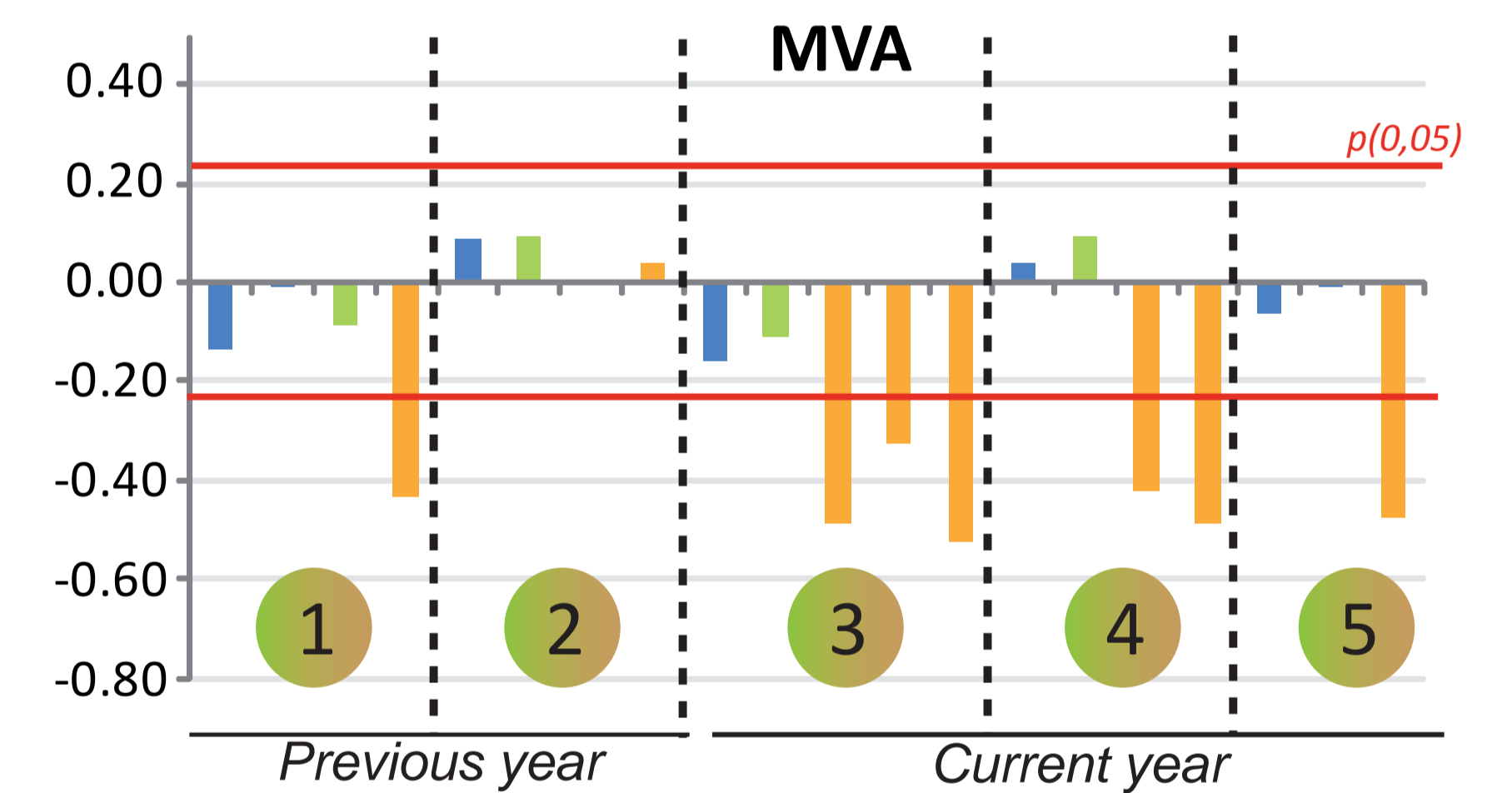
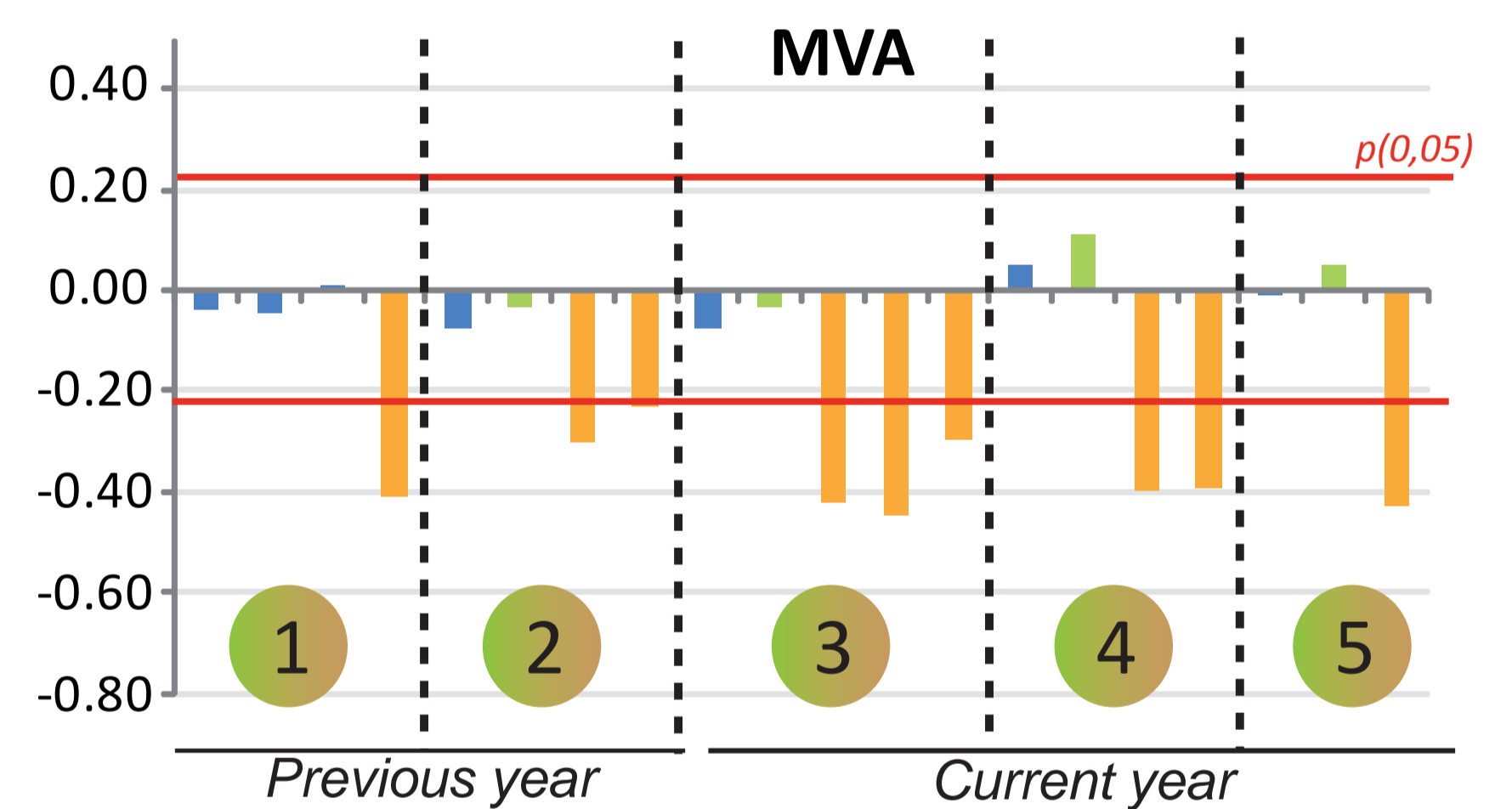
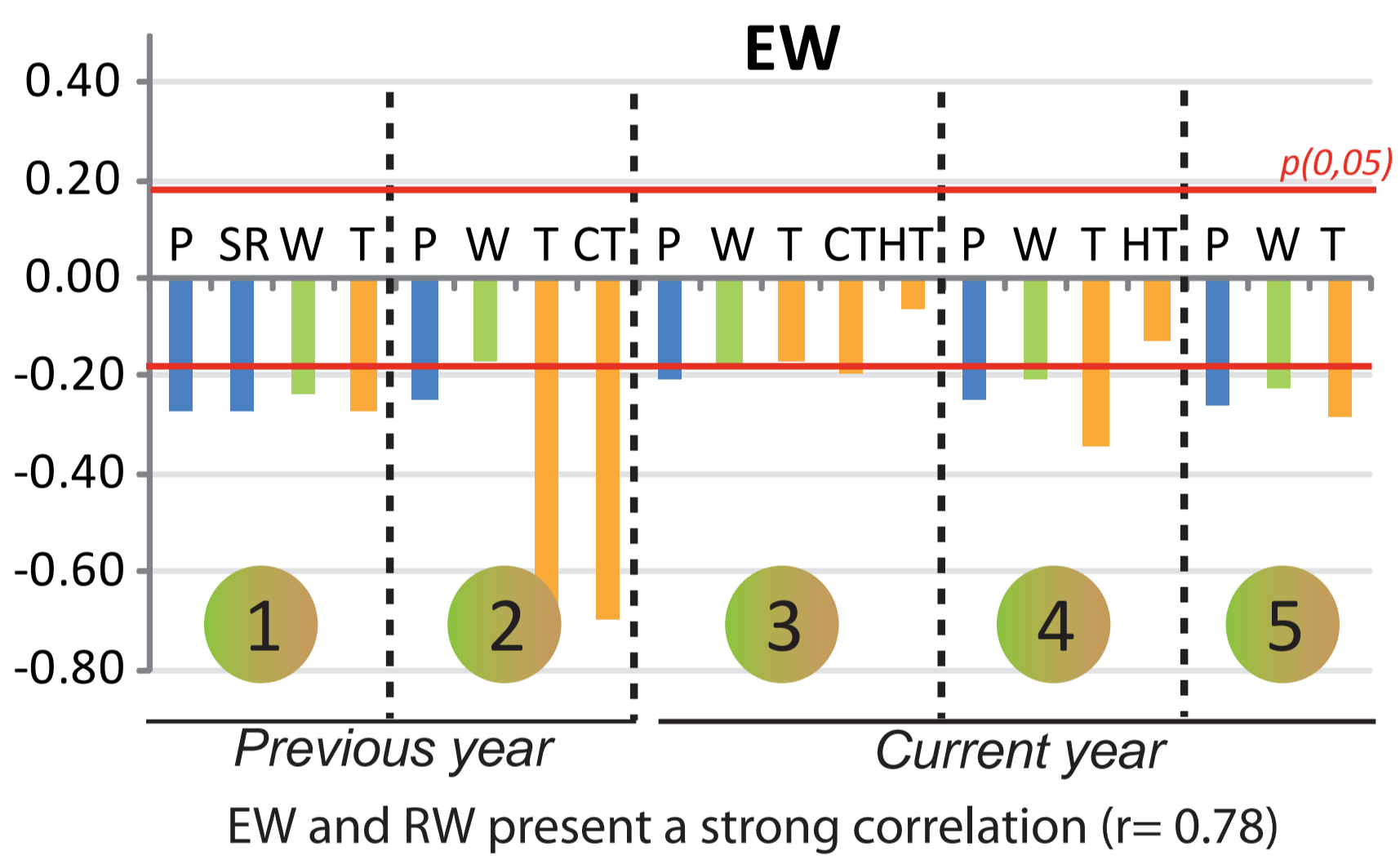
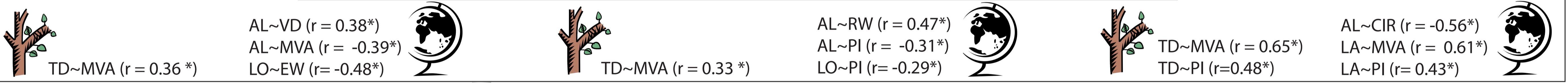
fig. 2 Map of the different sampling localities in France, Spain and Czech Republic.

SEMI RING-POROUS *Prunus avium* L.

DIFFUSE POROUS *Alnus glutinosa* L.

Fagus sylvatica L.

Pearson correlation coefficient between wood anatomical features and biological and geographic parameters



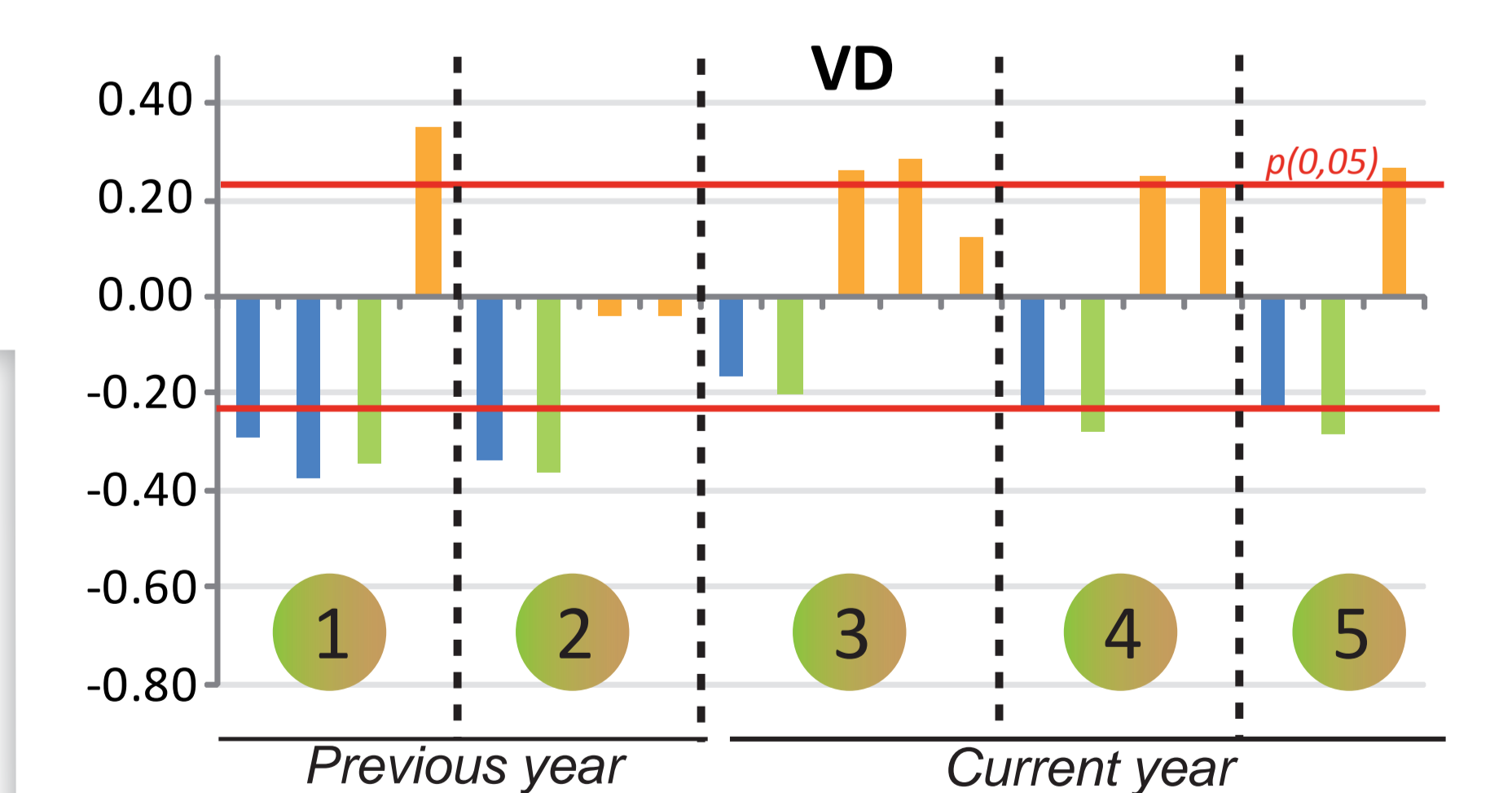
PI, MVA and MXVA present strong correlation between each other
No effect of meteorological parameter on VD and PM



Pearson correlation coefficient between wood anatomical features and meteorological parameters

- ➔ PRESENCE OF A LINK BETWEEN WOOD STRUCTURE AND ENVIRONMENT. As in ring-porous species, semi ring-porous and diffuse porous species show significant correlation (sometimes weak) with meteorological parameters (both temperatures and precipitation)
- ➔ PRESENCE OF A "NOISE EFFECT". Others environmental parameters than meteorological ones affect wood anatomy. Their consideration into dendroecological studies would allow a better understanding of these structures. One other major constraint in dendroecological studies is the existence of auto-correlation between numerous environmental parameters.
- ➔ SIMILAR OR DIFFERENT RESPONSES ? Although, two species can present a similar response to one meteorological parameter (MVA in *F. sylvatica* and *A. glutinosa*), they also can present different pattern (EW/RW and RW in *P. avium* and *F. sylvatica*). Moreover some species seem to be more sensitive than other ones (*F. sylvatica* vs *A. glutinosa*) (distribution ?)

MVA, PI and MXVA present strong correlation between each other



Despite the existence of numerous distortions as false rings and narrow rings expressing respectively dominated and senescent states of the sampled trees, statistical analyses allowed us, to envisage meteorological and global climate "answer scenarios" for each of the studied species. These last results can be used in the future for the re-examination of fossil wood material, in an attempt of palaeoclimatic and palaeoenvironmental reconstruction.

To be continued ...