

Dating Flanders - towards a Flemish tree-ring chronology of oak

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Introduction

Dendrochronological dating can be applied on wooden remnants from the largest part of the Holocene. It presupposes that absolutely dated average tree-ring chronologies are available as a standard against which undated tree-ring patterns from the same or similar species can be matched. In northwestern Europe, however, for certain periods and regions such chronologies have not yet been developed. We have observed this to be the case especially in (some) coastal regions.

This phenomenon is caused, among others, by the fact that dendrochronology in Europe was first introduced in regions with a moderately continental climate (i.e., Central Germany), and only later became an accepted method in regions where maritime influences prevail. This means that in the latter regions less time and capacity has been invested in dendrochronology. The result is what can be termed a dendrochronological 'knowledge gap' regarding some coastal areas in northwestern Europe.

One of the regions that is badly represented in the dendrochronological data set, is western Flanders (North Belgium;). In 1989, Hoffsummer laid the foundation for tree-ring dating in Walonie (southern Belgium). His published Meusse chronology, which spans the period from AD 672 to 1986, was constructed from oak that grew in the vicinity of Liege. The chronology is similar to Hollstein's Central-German chronology (1980), due to the fact that Hoffsummer used Hollstein's chronology as the main standard for dating the Liege material. The common signal in the tree-ring patterns that contributed to the Meusse chronology, therefore, most likely reflect a response to relatively 'continental' weather conditions and a somewhat marked topography, rendering the chronology less suitable for the dating of (archaeological) oak felled in the flat coastal (maritime) region to the West.

Past Dutch efforts to develop dendrochronology likewise were not focussed on Flanders. In 1995, Jansma published a variety of chronologies that represent both indigenous oak (3rd millennium BC to 6th century AD) and oak brought in from current Germany (4th to 18th century AD) and eastern Belgium (Wallonie, 14th to 15th century AD). However, a relatively short chronology produced by Jansma for western Flanders and the adjacent part of the Netherlands (the province of Zeeland; AD 824 - 1251) remained unpublished, because of its low replication. This means that also in Dutch dendrochronology western Belgium remained out of the picture.

The aim of the current study is to remedy this situation. Since a few years, we have been systematically investigating oak from archaeological excavations in western Flanders. These series are well-suited for the production of a regional master chronology that can be used as a standard for dating. By presenting this chronology here, we hope to lay the foundation for further dendrochronological work in this region.

Material

In 1995, the Belgian Institute of the Archaeological Heritage (IAP) and the Municipal Archaeological Service (SAD) of Brugge started extensive archaeological research on the site of a future housing project behind the former Bruges prison for women, *the Refuge*, at Sint-Andries, which is a province in West-Flanders (Belgium; Hollevoet and Hillewaert 1997/1998). In 1996, excavations began at Sint-Andries, Molendorp, where land for a future housing project was prepared for building. Both investigations revealed settlement traces from Pre-Roman, Roman and Early Medieval periods. Initially, these traces were dated mainly by pottery. However, timber used in several buildings and (stave) wells offered excellent opportunity for a more precise dating of the structures. Further material was derived from a medieval settlement near the village center of Varsenare (Jabbeke), and from Damme, Oudenaarde and several other sites mainly in West Flanders.

The Dutch data set was derived from the RING-archive. It includes material that was dated by Jansma at Amsterdam University between 1985 and 1991, by Hanraets at the National Service for Archaeological Heritage Management between 1989 and 1991, and by Hanraets and Jansma at the latter institute since 1991. Part of the material was published by Jansma (1995).

Methods

General

In January 1998, we were able to date tree-ring series from an early-medieval water well excavated in the municipality of Breda (province of Noord Brabant; AD 428 – 670). The reference chronology we used was the German ‘Ostfriesland’ chronology (Leuschner, unpublished data). We were then able to date wood from a medieval well at Sint Andries (Flanders) against the dated Breda chronology (AD 462-539). We produced a mean Breda/St. Andries chronology, which was subsequently used to date other finds from Flanders. Using cross-dating techniques, we selected those measurement series from the RING-archive that agree well with the Breda/St. Andries chronology. We used these together with material from Flanders as the basis for our new chronology.

Estimating the chronology signal

The strength of the common signal in a chronology is indicative of its suitability for dating wood from the region represented by the chronology. Jansma (1995) showed that the Estimated Population Signal (EPS), which is commonly used in dendrochronology to assess the signal strength, has some characteristics that make it less suitable for the estimation of a

chronology's signal. We therefore estimated the common signal of NLFlanders/1 by calculating the average running correlation between each individual measurement series and the average chronology of all other series in 50-year intervals, using COFECHA (Holmes 1984). Jansma (1995) has shown that, given sufficient replication, Dutch site chronologies of bog oaks are characterized by average correlations of about 0,5. We used this value as a rough threshold to discern between intervals with a sufficient (i.e. strong) and insufficient (i.e. weak) chronology signal.

We identified intervals where a weak chronology signal might be caused by low sample replication by straightforward comparison of the running correlation to changes of the number of individual tree-ring series included in the chronology. In this manner, we could discern between (a) intervals where a weak chronology signal in principle can be strengthened by inclusion of more dated time series, and (b) intervals where a weak signal is caused by other factors than sample depth and which therefore will not improve significantly when more series are added.

In order to assess the regionality of the chronology signal, we compared NLFlanders/1 to independent Belgian and German standard chronologies in the RING-archive, again using running correlation coefficients (50-year intervals).

Results and interpretation

The Dutch series that cross date well with the series from Flanders originate from excavations in different regions in the southeastern and eastern Netherlands (Fig. 1). The resulting average chronology, NLFlanders/1, runs from 218 BC to AD 1104 (Fig. 2). A separate Flanders chronology, comprised of the Flemish component of this data set, spans the intervals 218 BC to AD 208, AD 285 to 707 and AD 727 to 1051 (Fig. 2).

NLFlanders/1 has a low replication ($n < 10$) between 217 and 150 BC, AD 150-225 and AD 800-850 (Fig. 3). These are the intervals where a low internal correlation can be expected if replication plays a key role in the signal strength of these chronology intervals. However, between 217 and 150 BC the internal correlation in the chronology is higher than 0,5 (Fig. 4), meaning that the series in this interval have a strong common signal. This interval therefore does not need to be strengthened by including more series. The same holds for the interval AD 800 – 850. On the other hand, between AD 125 and 250 the average correlation in general remains below 0,5 (Fig. 4), meaning that in this interval replication indeed may be a factor of influence. If this is true, further inclusion of more dated series around this interval may well improve the reliability of this chronology interval.

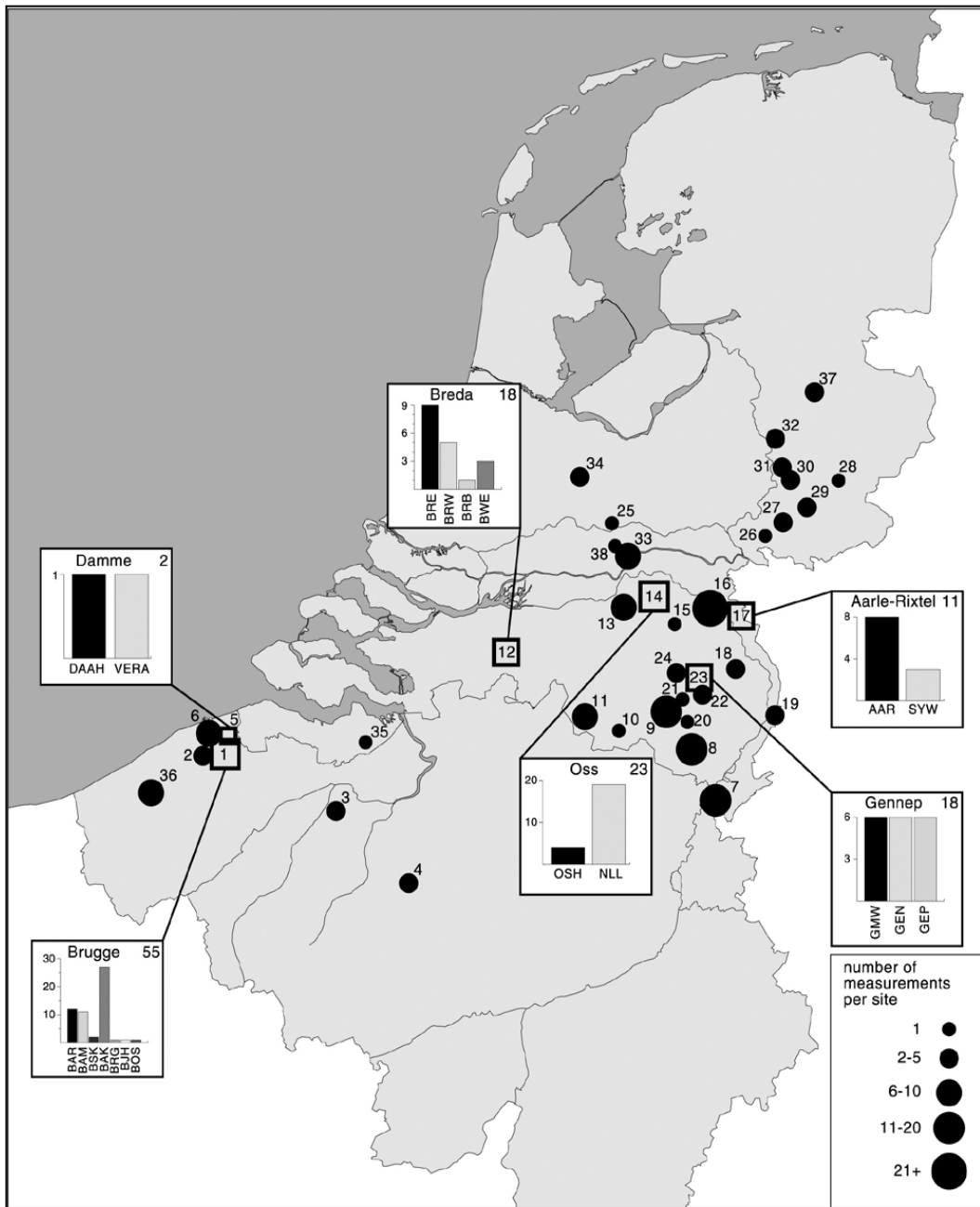


Figure 1: Map of archaeological sites represented by the NL/Flanders/1 chronology. 1 = Brugge; 2 = Jabbeke; 3 = Merelbeke; 4 = Elewijt; 5 = Damme; 6 = Oudenburg Roksem; 7 = Stevensweert; 8 = Nederweert; 9 = Geldrop; 10 = Bergeijk; 11 = Reussel; 12 = Breda; 13 = Empel; 14 = Oss; 15 = Uden; 16 = Cuyk; 17 = Gennep; 18 = Venray; 19 = Venlo; 20 = Someren; 21 = Mierlo; 22 = Helmond; 23 = Aarle-Rixtel, Strijp; 24 = Lieshout; 25 = Wijk bij Duurstede; 26 = Didam; 27 = Wehl-Hessenveld; 28 = Borculo; 29 = Zelhem; 30 = Warnsveld; 31 = Eme; 32 = Deventer; 33 = Tiel; 34 = Utrecht; 35 = Hulst; 36 = Kortemark; 37 = Heeten Raalte; 38 = Malburg.

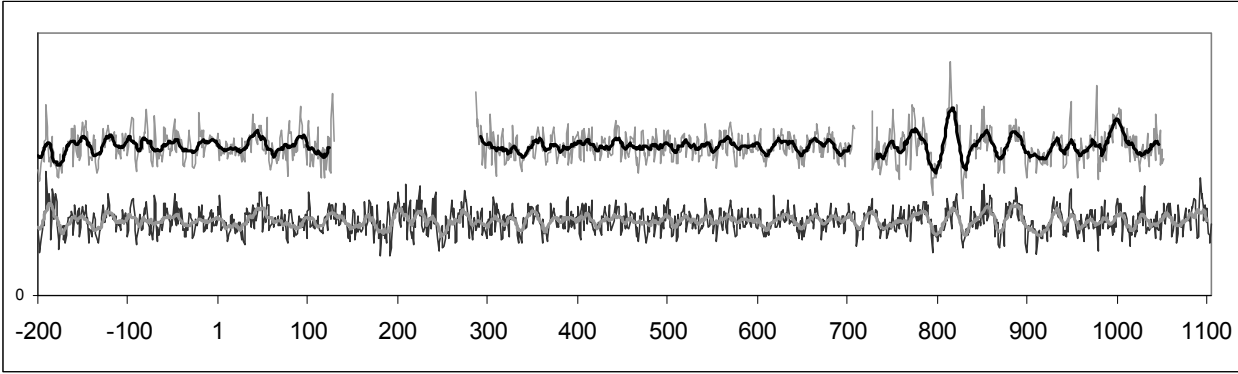


Figure 2: Average NLFlanders/1 (grey on black) and Flanders (black on grey) chronology

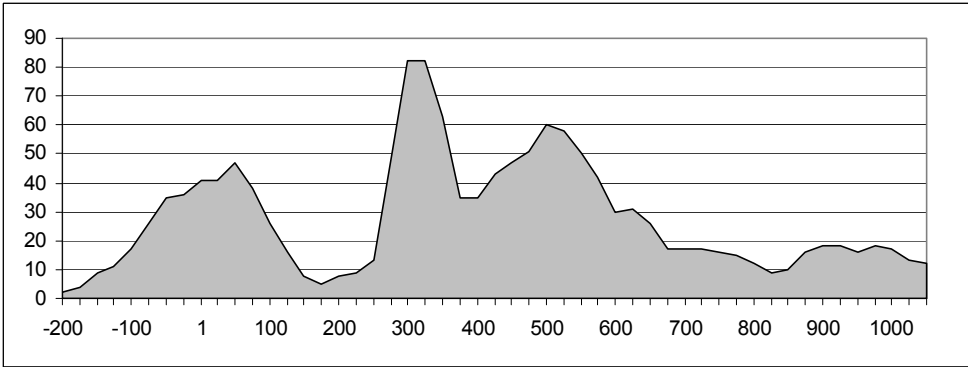


Figure 3: Replication of the NLFlanders/1 chronology. X-axis: years BC and AD; Y-axis: number of samples

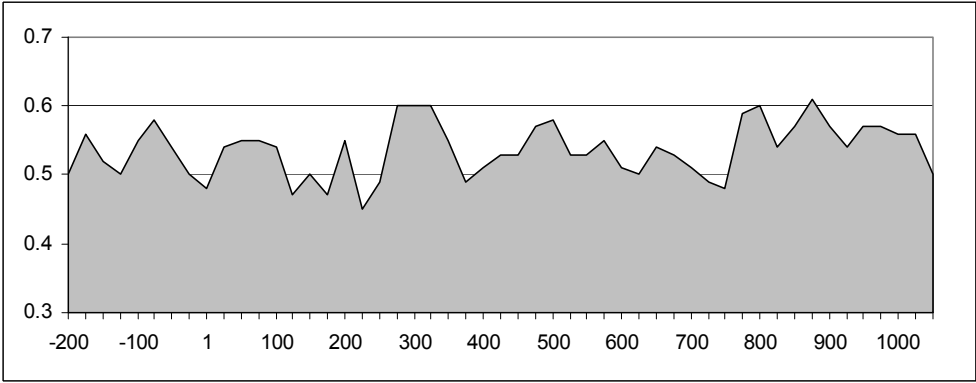


Figure 4: Internal correlation in the NLFlanders/1 chronology. X-axis: years BC and AD; Y-axis: average correlation per 50-year interval

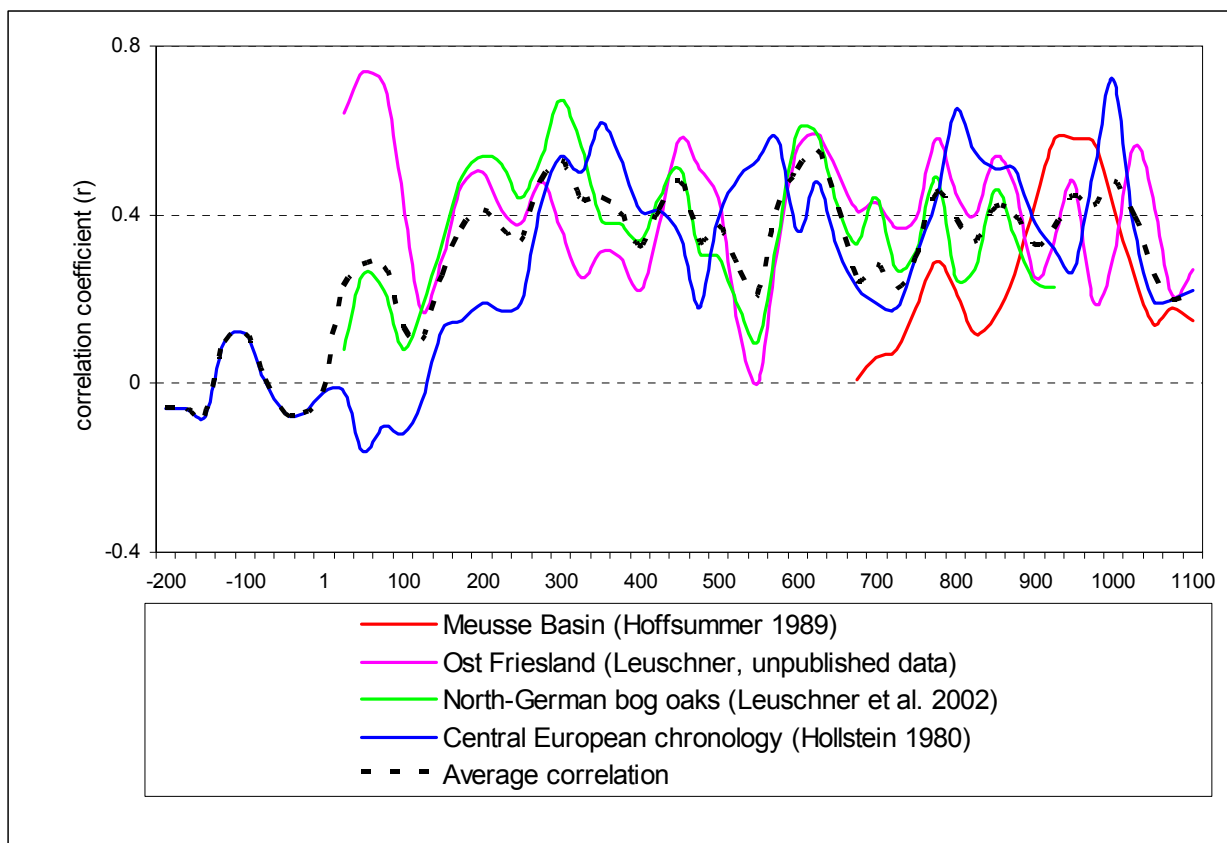


Figure 5: Running correlation with available master chronologies from Belgium and Germany

Between 218 BC and ca. AD 250, the average correlation between NLFlanders/1 and master chronologies from Germany is weak (Fig. 5). This is a consequence of the extremely weak correlation in this interval between NLFlanders/1 and Hollstein's Central European chronology (even negative correlations occur). Given the fact that the internal correlation in NLFlanders/1 is higher than 0,5 for most of this interval (Fig. 4), it is to be expected that NLFlanders/1 will prove useful for dating material from this interval that cannot be dated with the Hollstein chronology.

Most of the correlation series shown in Figure 5 dip to a minimum around AD 550 and AD 700 – 750. If climatic forcing played a role, these time intervals must have been characterized by a lack of predominant weather conditions over larger areas. However, for the period around AD 550 this conclusion is problematic, in view of the fact that around this time severe growth-reducing climatic factors, which may have been caused by a volcanic eruption or a meteor impact, influenced tree growth in larger parts of Europe (Baillie 1994). Other possible causes are (a) changing characteristics of the master chronologies themselves (i.e., lower replication, a different type of included material), and/or (b) increased felling activities in the relevant wood producing areas (which would have dampened the climatic growth signal in the tree-patterns of the remaining trees).

The weak average correlation with the available Belgian and German standard chronologies around 1100 (Fig. 5) could be caused by the decreasing replication of NLFlanders/1.

Hoffsummer's Meusse Basin chronology shows little agreement with NLFlanders/1 (Fig. 5). In view of the proximity of the Meusse Basin to both Flanders and the Dutch sites included in NLFlanders/1, one would expect higher correlations. However, Hoffsummer's chronology is built from material dated against Hollstein's more continental chronology (1980) and as a result probably reflects quite different weather conditions and a somewhat marked topography. Therefore its low correlation with NLFlanders/1 is not altogether surprising.

Discussion

The strong similarity between archaeological tree-ring series from Flanders and locations as far away as the central-eastern Netherlands (Fig. 1) is surprising. It was our first intention to produce a Flanders chronology of indigenous oak. The distribution of sites, however, leads to the hypothesis that the oaks represented by NLFlanders/1 were brought in from an area at some distance from the spots where they were put to use. In this case, the Meusse and Rhine would have been the most likely route of transport. Given the fact that NLFlanders/1 includes series from river oaks found in the Meusse sediments at Stevensweert (Fig. 1), the Meusse is the more likely of the two. However, there are some arguments against this hypothesis:

Most series from Flanders were either dated against each other, or against chronology NLRom-R (Jansma 1995, updated version), which represents Dutch indigenous (bog) oaks from low, moist sites. Other important chronologies were the North-German Ostfriesland chronology by Leuschner (unpublished), and NLRom-W1, a Dutch chronology representing archaeological timber from the western coastal Netherlands (Jansma 1995). These three chronologies all represent oak from coastal, 'maritime' sites. They do not include oak transported along the Meusse or Rhine and, therefore, neither do the Flemish samples dated against them.

The later part of NLFlanders/1 is partly comprised of timbers from revetments at the Dutch town of Tiel. Dating these timbers was problematic, due to their lack of similarity to existing chronologies from this period. The average Tiel chronology proved useful in dating some Dutch ship wrecks that could not be dated otherwise (RING, unpublished data). This elaborate process in our opinion points to a local origin of the wood.

After completion of the study presented here, we were able to date oak posts from a farmhouse at Borsele (Zeeland) against NLFlanders/1 (RING 2002, unpublished data). The inhabitants of this site used local resources when building, which is illustrated by the fact that incidentally they even used Neolithic bog oaks that were preserved in the immediate surroundings (RING, unpublished data).

The question about the origin of the wood can not yet be solved. During future studies we will keep an open mind towards the possibility that (a) NLFlanders/1 represents indigenous oak from local, moist sites in the immediate surroundings of the archaeological sites where they were put to use, and/or (b) it represents oak transported over larger distances.

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