Stable carbon isotope ratios of tree-ring cellulose from the site network of the EU-Project 'ISONET'

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1. Licence

2. Citation

When using the data please cite:

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The data are supplementary material to:
See References

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3. Data Description

24 European annually resolved stable isotope chronologies have been constructed from tree ring cellulose for the last 400 years (1600CE – 2003CE) for carbon and oxygen and for the last 100 years for hydrogen. Data was produced within the ISONET project (400 Years of Annual Reconstructions of European Climate Variability Using a Highly Resolved Isotopic Network,) to initiate an extensive spatiotemporal tree-ring stable isotope network across Europe funded as part of the fifth EC Framework Programme "Energy, Environment and Sustainable Development". This dataset comprises the ISONET δ13C records.

3.1. Sampling method

Fifteen or more co-dominant Pinus sylvestris, Quercus robur/petraea or Cedrus atlantica tree individuals of similar age from each site were cored at about 1.5 m above ground from two opposite positions using an increment corer of 5 mm diameter (Suunto, Finland or Mora, Sweden).

3.2. Analytical procedure

3.2.1. Dendrochronological cross-dating and dating

Dendrochronological cross-dating and dating was performed following standard dendrochronological procedures (Cook, 1990). Tree rings were visually crossdated and tree-ring widths (TRW) were measured at 0.01 mm precision. Cross-dating validation was carried out following standard procedures (Holmes, 1983).

3.2.2. Sampling for stable isotope analysis

Four to five precisely dendro-dated trees were selected for stable isotope analyses. Individual tree rings were dissected using razor blades or scalpels. Visible rays and other identified parenchymatous structures were removed from the wood slices to minimize possible contamination. While whole tree rings of P. sylvestris and C. atlantica were used, only latewood (LW) of individual tree rings from Q. petraea/robur was processed further after separation from earlywood (EW). Obtained wood samples of different radii and trees of each site were pooled year by year (Borella et al., 1998; Treydte et al., 2001; Laumer et al., 2009). For the Swiss Quercus site at Cavergno site (CAV) no separation between early- and latewood was possible because the rings were too narrow. Wood samples were homogenized by grinding (Retsch ZM1 Ultrazentrifugalmühle or coffeemill; (Borella et al., 1998; Treydte et al., 2001) or ultra-sonic treatment (UP200s Hielscher Ultrasonics, Teltow, Germany; (Laumer et al., 2009) before or after extraction of cellulose, respectively.

3.2.3. Cellulose extraction

The cellulose extraction procedure from wood was performed following the Jayme-Wise chemical approach (Jayme, 1942; Wise, 1945; Green, 1963) in a multistage procedure using (1) solvent extraction to remove minor components like resins (pretreatment), (2) delignification with acidified sodium chlorite (bleaching), and (3) subsequent alkaline hydrolysis with sodium hydroxide solution (purification) to eliminate short-chain cellulose products and other possible intermixtures such as mannan and xylan. Each participating laboratory has used their own routine procedure. For quality assurance of the cellulose extraction procedures six standard woods were distributed among the participating laboratories and processed together with normal samples regularly. Details on the cellulose extraction methods used by different participants (such as the identity and concentration of

reagents, treatment time, and reaction temperatures) are summarized by Boettger et al. (2007). The extracted cellulose samples were split in three parts for the analysis of the three isotope ratios (13C/12C, 18O/16O, D/H). Prior to IRMS analysis all samples were freeze-dried for at least 48 h.

3.2.4. IRMS Analyses of cellulose samples

Measurements of carbon isotope ratios were carried out using standard IRMS systems coupled to Elemental Analyzers at a combustion temperature of 1020 °C. For quality assurance of the IRMS measurements IAEA reference material was used (e.g. C-3, cellulose), as well six standard woods distributed among the participating laboratories. Furthermore, interlaboratory comparisons were performed (Boettger et al., 2007). The details of δ13C and δ18O analyses are described in Treydte et al. (2007) and in the site-specific publications listed in "2023-002_ISONET-Project-Members_13C_ISONET-Sites-Information.xlsx".

3.3. Data processing

The δ13C values of all sites are referenced to the IAEA Vienna PDB (VPDB). The long-term estimated upper limit for methodical error in IRMS measurements of δ13C of the cellulose samples was 0.15‰ (Boettger et al., 2007; Treydte et al., 2007).

4. File description

4.1. File inventory

Files are provided in the zipped folder "2023-002_Isonet-Project-Members_13C_Data" and contain:

- 2023-001_ISONET-Project-Members_13C_Data as excel and tab delimited txt files
- 2023-001_Isonet-Project-Members_13C_Data-Description.pdf
- 2023-002_ISONET-Project-Members_13C_ISONET-Sites-Information.xlsx
- 2023-001_ISONET-Project-Members_Members-and-Contributord.xlsx

4.2. Description of data tables

The first 10 lines of each column contains information about the site: Site code (3-letter code for each site), site name (name of forest site or nearest town), latitude (geographic coordinates, latitude in decimal degrees), longitude (geographic coordinates, longitude in decimal degrees), species (latin name of tree species), first year (first (oldest) year (CE) of δ13C site record), last year (last (youngest) year (CE) of δ13C site record), elevation (average elevation of tree site in meters above sea level). Missing values are indicated as NA (not analysed).

Column header	**unit**	**Description**
Site code		3-letter code for each site
Year CE	Year CE	Date of tree ring
13CVPDB	$^{13}C/^{12}C$ ratio	$^{13}C/^{12}C$ ratio in per mil versus Vienna PDB (VPDB)

5. References - Data are supplementary material to

Andreu-Hayles, L., Planells, O., Gutierrez, E., Muntan, E., Helle, G., Anchukaitis, K.J., Schleser, G.H., 2011. Long tree-ring chronologies reveal 20th century increases in water-use efficiency but no enhancement of tree growth at five Iberian pine forests. Global Change Biology 17, 2095-2112. https://doi.org/10.1111/j.1365-2486.2010.02373.x

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