**Appendix: Tables as Online Materials**

Tables: S1 through S5

Table S1. The regression coefficient (Equation (3)) for the following variables: *T* (mean monthly temperature, b unit: ‰/oC), *P* (total monthly precipitation, b unit:: ‰/mm), *S* (monthly hours of Sunshine, b unit: ‰/hours of sunshine ), the test of significance gives a *p*-value.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | HK | | KK | | LA | |
| Climate factor | Year | Month | b | p | b | p | b | p |
| Temperature |  |  |  |  |  |  |  |  |
|  | Previous | Oct | 0.5487 | 0.61 | 0.0695 | 0.83 | -0.0405 | 0.73 |
|  | Previous | Nov | 0.5090 | 0.58 | 0.1221 | 0.67 | -0.0982 | 0.41 |
|  | Previous | Dec | -0.3505 | 0.59 | -0.1723 | 0.46 | 0.0049 | 0.94 |
|  | Given | Jan | 0.1203 | 0.62 | 0.0425 | 0.59 | 0.0217 | 0.47 |
|  | Given | Feb | 0.3151 | 0.48 | 0.0821 | 0.55 | -0.0739 | 0.27 |
|  | Given | Mar | -0.2877 | 0.56 | 0.0484 | 0.75 | 0.0587 | 0.38 |
|  | Given | Apr | 0.3847 | 0.66 | 0.0687 | 0.80 | -0.1951 | 0.23 |
|  | Given | May | 0.0576 | 0.94 | 0.0020 | 0.99 | 0.0248 | 0.76 |
|  | Given | Jun | -0.4357 | 0.50 | -0.0923 | 0.64 | -0.0886 | 0.32 |
|  | Given | Jul | 0.0959 | 0.91 | -0.0090 | 0.97 | -0.0370 | 0.70 |
|  | Given | Aug | 0.3434 | 0.78 | 0.0204 | 0.96 | -0.1107 | 0.48 |
|  | Given | Sep | 0.1399 | 0.89 | -0.1090 | 0.76 | -0.0785 | 0.56 |
| Precipiation |  |  |  |  |  |  |  |  |
|  | Previous | Oct | 0.0027 | 0.94 | -0.0088 | 0.53 | -0.0045 | 0.41 |
|  | Previous | Nov | -0.0312 | 0.64 | -0.0169 | 0.48 | -0.0011 | 0.87 |
|  | Previous | Dec | -0.0254 | 0.55 | -0.0045 | 0.72 | 0.0064 | 0.31 |
|  | Given | Jan | -0.0169 | 0.81 | 0.0160 | 0.53 | 0.0112 | 0.32 |
|  | Given | Feb | -0.0393 | 0.59 | -0.0106 | 0.65 | 0.0112 | 0.31 |
|  | Given | Mar | 0.0062 | 0.88 | -0.0017 | 0.90 | 0.0021 | 0.66 |
|  | Given | Apr | 0.0108 | 0.87 | 0.0118 | 0.62 | -0.0075 | 0.42 |
|  | Given | May | -0.0247 | 0.53 | -0.0025 | 0.83 | 0.0002 | 0.96 |
|  | Given | Jun | 0.0290 | 0.48 | 0.0050 | 0.67 | -0.0084 | 0.22 |
|  | Given | Jul | -0.0054 | 0.66 | -0.0019 | 0.64 | 0.0002 | 0.88 |
|  | Given | Aug | 0.0091 | 0.82 | -0.0034 | 0.79 | -0.0055 | 0.35 |
|  | Given | Sep | -0.0003 | 0.99 | -0.0041 | 0.72 | 0.0037 | 0.44 |
| Sunshine |  |  |  |  |  |  |  |  |
|  | Previous | Oct | -0.0025 | 0.94 | -0.0071 | 0.59 | -0.0011 | 0.79 |
|  | Previous | Nov | 0.0082 | 0.89 | -0.0142 | 0.52 | -0.0031 | 0.66 |
|  | Previous | Dec | -0.0236 | 0.73 | -0.0047 | 0.83 | -0.0091 | 0.37 |
|  | Given | Jan | -0.0157 | 0.83 | 0.0064 | 0.79 | 0.0014 | 0.86 |
|  | Given | Feb | -0.0130 | 0.79 | -0.0043 | 0.79 | 0.0049 | 0.46 |
|  | Given | Mar | -0.0030 | 0.92 | -0.0024 | 0.80 | 0.0014 | 0.67 |
|  | Given | Apr | 0.0035 | 0.87 | 0.0039 | 0.60 | -0.0052 | 0.22 |
|  | Given | May | 0.0005 | 0.99 | -0.0041 | 0.64 | -0.0031 | 0.40 |
|  | Given | Jun | 0.0337 | 0.50 | 0.0016 | 0.91 | -0.0063 | 0.34 |
|  | Given | Jul | -0.0077 | 0.72 | 0.0012 | 0.86 | 0.0032 | 0.33 |
|  | Given | Aug | -0.0380 | 0.57 | -0.0028 | 0.89 | 0.0096 | 0.32 |
|  | Given | Sep | -0.0024 | 0.94 | 0.0000 | 1.00 | 0.0045 | 0.38 |

Table S2. Variability of Δ14Co in atmospheric CO2 and in tree ring cellulose and differences (Δ) between Δ14Co and Δ14C tree ring cellulose (median, mean, minimum and maximum values for the period 1975–2012)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Δ14Co,‰ | Δ14C,‰ | Δ14C,‰ | Δ14C,‰ | Δ(Δ14C),‰ | Δ(Δ14C),‰ | Δ(Δ14C),‰ |
|  | atmosphere | HK | LA | KK | HK | LA | KK |
| Median |  |  |  |  | -3.4 | 7.7 | -2.1 |
| Mean |  |  |  |  | -4.2 | 9.0 | -2.6 |
| Min | 30.6 | 32.5 | 25.7 | 32.1 | -16.6 | -3.5 | -21.6 |
| Max | 387.7 | 399.6 | 375.9 | 409.3 | 6.1 | 20.6 | 7.5 |

Table S3. Carbon isotopic composition of the needles (δ13C and Δ14Cneedles) and difference between Δ14Co in the atmospheric CO2 and Δ14Cneedles in the needles from the trees growing at 15 sampling sites in proximity to the heat and power plant in Laziska (LA), the nitrogen plant in Kedzierzyn-Kozle (KK) and the steelworks in Dabrowa Gornicza (HK). The needles were collected in winter 2013 (created in 2012), summer 2013 (created in 2013) and summer 2014 (created in 2014).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | δ13C, ‰ | | | | | | | Δ14C needles,‰ | | | | | | Δ14Co -Δ14Cneedles,‰ | | |
| Sampling site | | 2013 winter | | 2013 summer | | 2014 summer | | 2013 winter | | 2013 summer | | 2014 summer | | 2013 winter | 2013 summer | 2014 summer |
| δ13C, ‰ | u, ‰ | δ13C, ‰ | u, ‰ | δ13C, ‰ | u, ‰ | Δ14C,‰ | u, ‰ | Δ14C,‰ | u, ‰ | Δ14C,‰ | u, ‰ |
| KK\_1 | |  |  | -30.9 | 0.06 | -31.4 | 0.15 |  |  | 26.8 | 7.3 | 30.6 | 6.2 |  | -4.4 | -11.5 |
| KK\_2 | | -31.6 | 0.06 | -31.2 | 0.07 | -29.2 | 0.05 | 23.4 | 5.1 | 38.6 | 5.3 | 71.0 | 6.5 | 7.2 | -16.1 | -51.8 |
| KK\_3 | | -29.5 | 0.37 | -30.0 | 0.12 | -29.6 | 0.07 | 36.1 | 6.5 | 18.1 | 5.1 | 83.2 | 8.7 | -5.4 | 4.3 | -64.1 |
| KK\_4 | | -32.0 | 0.11 | -31.9 | 0.15 | -30.1 | 0.21 | 56.6 | 4.5 | 37.7 | 5.3 | 35.7 | 7.3 | -25.9 | -15.2 | -16.5 |
| KK\_5 | | -29.1 | 0.05 | -29.2 | 0.50 | -29.5 | 0.02 | 34.2 | 6.5 | 26.3 | 9.4 | 26.5 | 6.6 | -3.6 | -3.9 | -7.3 |
| KK\_6 | |  |  | -29.9 | 0.38 | -28.0 | 0.09 |  |  | 24.4 | 6.8 | 64.1 | 6.2 |  | -1.9 | -45.0 |
| KK\_7 | | -30.3 | 0.25 | -31.6 | 0.02 | -28.8 | 0.07 | 32.5 | 6.5 | 26.2 | 9.6 | 15.2 | 5.9 | -1.8 | -3.8 | 4.0 |
| KK\_8 | |  |  | -29.2 | 0.04 | -28.1 | 0.46 |  |  | 86.1 | 6.9 | 65.4 | 6.0 |  | -63.7 | -46.2 |
| LA\_9 | | -28.6 | 0.09 | -29.3 | 0.18 | -27.9 | 0.07 | 33.1 | 5.1 | 30.7 | 3.8 | 34.9 | 5.2 | -2.4 | -8.3 | -15.7 |
| LA\_10 | | -31.2 | 0.01 | -31.1 | 0.50 | -31.1 | 0.05 | 39.4 | 8.1 | 26.1 | 7.3 | 37.4 | 7.8 | -8.8 | -3.6 | -18.2 |
| LA\_11 | | -28.5 | 0.20 | -30.9 | 0.61 | -28.1 | 0.70 | 23.7 | 5.2 | 34.2 | 5.4 | 47.5 | 5.9 | 6.9 | -11.7 | -28.4 |
| HK\_12 | | -28.9 | 0.22 | -28.7 | 0.06 | -26.7 | 0.03 | 28.2 | 8.4 | 38.6 | 5.7 | 15.6 | 9.1 | 2.5 | -16.2 | 3.5 |
| HK\_13 | | -28.1 | 0.04 | -28.9 | 0.36 | -27.4 | 0.19 | 28.1 | 6.3 | 8.3 | 5.7 | 69.9 | 6.1 | 2.5 | 14.1 | -50.8 |
| HK\_14 | |  |  | -27.8 | 0.00 | -28.1 | 0.69 |  |  | 23.5 | 6.5 | 68.3 | 7.8 |  | -1.1 | -49.1 |
| HK\_15 | | -30.2 | 0.37 | -28.7 | 0.14 | -29.4 | 0.20 | 19.7 | 6.2 | 36.9 | 7.1 | 41.6 | 6.0 | 10.9 | -14.5 | -22.5 |

Table S4. Median, mean, standard deviation (SD), maximum and minimum values of carbon isotopic composition of the needles (δ13C and Δ14C) and difference between Δ14Co in the atmospheric CO2 and Δ14C in the needles of pine growing in 3 regions: Laziska (LA), Kedzierzyn-Kozle (KK), and Dabrowa Gornicza (HK).

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | δ13C, ‰ | | | Δ14C needles,‰ | | | Δ14Co -Δ14Cneedles,‰ | | |
| Region |  | 2013 winter | 2013 summer | 2014 summer | 2013 winter | 2013 summer | 2014 summer | 2013 winter | 2013 summer | 2014 summer | |
| KK | Median | -30.3 | -30.4 | -29.3 | 34 | 27 | 50 | -4 | -4 | -31 | |
|  | Mean | -30.5 | -30.5 | -29.3 | 37 | 36 | 49 | -6 | -13 | -30 | |
|  | SD | 1.3 | 1.1 | 1.1 | 12 | 22 | 25 | 12 | 22 | 25 | |
|  | Maximum | -29.1 | -29.2 | -28.0 | 57 | 86 | 83 | 7 | 4 | 4 | |
|  | Minimum | -32.0 | -31.9 | -31.4 | 23 | 18 | 15 | -26 | -64 | -64 | |
| LA | Median | -28.6 | -30.9 | -28.1 | 33 | 31 | 37 | -2 | -8 | -18 | |
|  | Mean | -29.5 | -30.4 | -29.0 | 32 | 30 | 40 | -1 | -8 | -21 | |
|  | SD | 1.5 | 1.0 | 1.8 | 8 | 4 | 7 | 8 | 4 | 7 | |
|  | Maximum | -28.5 | -29.3 | -27.9 | 39 | 34 | 48 | 7 | -4 | -16 | |
|  | Minimum | -31.2 | -31.1 | -31.1 | 24 | 26 | 35 | -9 | -12 | -28 | |
| HK | Median | -28.9 | -28.7 | -27.7 | 28 | 30 | 55 | 3 | -8 | -36 | |
|  | Mean | -29.1 | -28.5 | -27.9 | 25 | 27 | 49 | 5 | -4 | -30 | |
|  | SD | 0.9 | 1.1 | 1.0 | 4 | 13 | 22 | 4 | 13 | 22 | |
|  | Maximum | -28.1 | -27.8 | -26.7 | 28 | 39 | 70 | 11 | 14 | 4 | |
|  | Minimum | -30.2 | -28.9 | -29.4 | 20 | 8 | 16 | 2 | -16 | -51 | |
| TOTAL | Median | -29.5 | -29.9 | -28.8 | 32 | 27 | 42 | -2 | -4 | -22 | |
|  | Mean | -29.8 | -29.9 | -28.9 | 32 | 32 | 47 | -2 | -10 | -28 | |
|  | SD | 1.3 | 1.2 | 1.3 | 10 | 17 | 22 | 10 | 17 | 22 | |
|  | Maximum | -28.1 | -27.8 | -26.7 | 57 | 86 | 83 | 11 | 14 | 4 | |
|  | Minimum | -32.0 | -31.9 | -31.4 | 20 | 8 | 15 | -26 | -64 | -64 | |

Table S5. Year-to-year comparison of carbon isotope composition of the needles.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sampling site | Δ14C2013-Δ14C2012,  ‰ | Δ14C2014-Δ14C2013,  ‰ | δ13C2013-δ13C2012,  ‰ | δ13C2014-δ13C2013,  ‰ |
| KK\_1 |  | 3.80 |  | -0.54 |
| KK\_2 | 15.18 | 32.39 | 0.34 | 2.06 |
| KK\_3 | -17.94 | 65.11 | -0.54 | 0.34 |
| KK\_4 | -18.90 | -1.95 | 0.14 | 1.83 |
| KK\_5 | -7.91 | 0.15 | -0.05 | -0.27 |
| KK\_6 |  | 39.74 |  | 1.82 |
| KK\_7 | -6.24 | -11.02 | -1.23 | **2.73** |
| KK\_8 |  | -20.74 |  | 1.05 |
| LA\_9 | -2.36 | 4.16 | -0.65 | 1.38 |
| LA\_10 | -13.33 | 11.28 | 0.04 | 0.08 |
| LA\_11 | 10.47 | 13.35 | -2.34 | **2.80** |
| HK\_12 | 10.45 | -22.98 | 0.17 | 2.02 |
| HK\_13 | -19.75 | 61.59 | -0.80 | 1.46 |
| HK\_14 |  | 44.74 |  | -0.30 |
| HK\_15 | 17.19 | 4.72 | 1.54 | -0.69 |