[] Dendrochronology Program Library Run LWM Program COF 16:15 Tue 06 Dec 2016 Page 1

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[] P R O G R A M C O F E C H A Version 6.06P 29927

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QUALITY CONTROL AND DATING CHECK OF TREE-RING MEASUREMENTS

File of DATED series: lwm.txt

CONTENTS:

Part 1: Title page, options selected, summary, absent rings by series

Part 2: Histogram of time spans

Part 3: Master series with sample depth and absent rings by year

Part 4: Bar plot of Master Dating Series

Part 5: Correlation by segment of each series with Master

Part 6: Potential problems: low correlation, divergent year-to-year changes, absent rings, outliers

Part 7: Descriptive statistics

RUN CONTROL OPTIONS SELECTED VALUE

1 Cubic smoothing spline 50% wavelength cutoff for filtering

32 years

2 Segments examined are 50 years lagged successively by 25 years

3 Autoregressive model applied A Residuals are used in master dating series and testing

4 Series transformed to logarithms Y Each series log-transformed for master dating series and testing

5 CORRELATION is Pearson (parametric, quantitative)

Critical correlation, 99% confidence level .3281

6 Master dating series saved N

7 Ring measurements listed N

8 Parts printed 1234567

9 Absent rings are omitted from master series and segment correlations (Y)

Time span of Master dating series is 1845 to 2015 171 years

Continuous time span is 1845 to 2015 171 years

Portion with two or more series is 1847 to 2015 169 years

>> LWM04B 1960 absent in 1 of 11 series, but is not usually narrow: master index is .145

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*C\* Number of dated series 11 \*C\*

\*O\* Master series 1845 2015 171 yrs \*O\*

\*F\* Total rings in all series 1303 \*F\*

\*E\* Total dated rings checked 1301 \*E\*

\*C\* Series intercorrelation .499 \*C\*

\*H\* Average mean sensitivity .305 \*H\*

\*A\* Segments, possible problems 5 \*A\*

\*\*\* Mean length of series 118.5 \*\*\*

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

ABSENT RINGS listed by SERIES: (See Master Dating Series for absent rings listed by year)

LWM04B 2 absent rings: 1960 1961

2 absent rings .153%

PART 2: TIME PLOT OF TREE-RING SERIES: 16:15 Tue 06 Dec 2016 Page 2

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1050 1100 1150 1200 1250 1300 1350 1400 1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000 2050 Ident Seq Time-span Yrs

: : : : : : : : : : : : : : : : : : : : : -------- --- ---- ---- ----

. . . . . . . . . . . . . . . . . <==========> . LWM01A 1 1908 2015 108

. . . . . . . . . . . . . . . . <================> . LWM02A 2 1847 2015 169

. . . . . . . . . . . . . . . . .<==============> . LWM02B 3 1869 2015 147

. . . . . . . . . . . . . . . . . <===========> . LWM03A 4 1890 2015 126

. . . . . . . . . . . . . . . . . <==========> . LWM03B 5 1905 2011 107

. . . . . . . . . . . . . . . . . <===========> . LWM04B 6 1896 2015 120

. . . . . . . . . . . . . . . . . . <========> . LWM05A 7 1922 2015 94

. . . . . . . . . . . . . . . . . <==========> . LWM05B 8 1908 2013 106

. . . . . . . . . . . . . . . . . . <========> . LWM06A 9 1924 2015 92

. . . . . . . . . . . . . . . . . . <=====> . LWM06B 10 1953 2015 63

. . . . . . . . . . . . . . . . <================> . LWM07A 11 1845 2015 171

: : : : : : : : : : : : : : : : : : : : :

1050 1100 1150 1200 1250 1300 1350 1400 1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000 2050

PART 3: Master Dating Series: 16:15 Tue 06 Dec 2016 Page 3

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Year Value No Ab Year Value No Ab Year Value No Ab Year Value No Ab Year Value No Ab Year Value No Ab

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1850 -2.187 2 1900 .773 5 1950 .995 10 2000 -1.809 11

1851 .472 2 1901 -.931 5 1951 1.199 10 2001 .038 11

1852 -.773 2 1902 -1.097 5 1952 -.645 10 2002 .342 11

1853 -.689 2 1903 -.910 5 1953 -1.233 11 2003 .166 11

1854 -.290 2 1904 .132 5 1954 -1.105 11 2004 1.050 11

1855 1.578 2 1905 .917 6 1955 -.220 11 2005 1.008 11

1856 -.954 2 1906 -.073 6 1956 .132 11 2006 .617 11

1857 .993 2 1907 .520 6 1957 1.441 11 2007 -.894 11

1858 -.325 2 1908 .170 8 1958 1.593 11 2008 -.964 11

1859 -.217 2 1909 .117 8 1959 .284 11 2009 .477 11

1860 .862 2 1910 .919 8 1960 .145 11 1<< 2010 1.468 11

1861 .234 2 1911 -.508 8 1961 -1.082 11 1 2011 -.554 11

1862 1.018 2 1912 -.630 8 1962 -.153 11 2012 -.940 10

1863 .417 2 1913 -2.260 8 1963 .489 11 2013 -.681 10

1864 -1.667 2 1914 -2.483 8 1964 -.775 11 2014 -.798 9

1865 .149 2 1915 .639 8 1965 .403 11 2015 .950 9

1866 -.462 2 1916 1.134 8 1966 .012 11

1867 -1.139 2 1917 .454 8 1967 -1.631 11

1868 -.558 2 1918 -.009 8 1968 .203 11

1869 -.145 3 1919 .059 8 1969 .022 11

1870 .577 3 1920 .669 8 1970 -.075 11

1871 -.820 3 1921 .004 8 1971 .297 11

1872 1.131 3 1922 -.503 9 1972 .468 11

1873 .925 3 1923 -.016 9 1973 1.037 11

1874 -.429 3 1924 1.377 10 1974 .681 11

1875 1.490 3 1925 .670 10 1975 .428 11

1876 .574 3 1926 -.077 10 1976 -.364 11

1877 -.090 3 1927 .891 10 1977 .181 11

1878 .206 3 1928 1.393 10 1978 .117 11

1879 -1.526 3 1929 .913 10 1979 -.792 11

1880 .102 3 1930 -.663 10 1980 .041 11

1881 -1.558 3 1931 -1.541 10 1981 -.132 11

1882 .739 3 1932 .234 10 1982 .867 11

1883 .602 3 1933 -.188 10 1983 -.158 11

1884 .617 3 1934 -.322 10 1984 -2.396 11

1885 -.307 3 1935 .750 10 1985 -1.127 11

1886 .426 3 1936 -1.660 10 1986 -.139 11

1887 -5.224 3 1937 -2.596 10 1987 .610 11

1888 -.347 3 1938 -.489 10 1988 -2.057 11

1889 2.465 3 1939 .350 10 1989 -.103 11

1890 1.073 4 1940 .109 10 1990 .286 11

1891 .344 4 1941 -.654 10 1991 -.073 11

1892 -.007 4 1942 .204 10 1992 1.409 11

1893 -2.274 4 1943 .332 10 1993 .937 11

1894 -.689 4 1944 -1.446 10 1994 .508 11

1845 .354 1 1895 .052 4 1945 .703 10 1995 -.096 11

1846 1.722 1 1896 1.440 5 1946 .167 10 1996 -.343 11

1847 1.068 2 1897 1.009 5 1947 .621 10 1997 .409 11

1848 .823 2 1898 .349 5 1948 .831 10 1998 .944 11

1849 .081 2 1899 -.152 5 1949 .996 10 1999 .031 11

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PART 4: Master Bar Plot: 16:15 Tue 06 Dec 2016 Page 4

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Year Rel value Year Rel value Year Rel value Year Rel value Year Rel value Year Rel value Year Rel value Year Rel value

1850i 1900--------C 1950---------D 2000g

1851-------B 1901-d 1951---------E 2001----@

1852--c 1902-d 1952--c 2002------A

1853--c 1903-d 1953-e 2003-----A

1854---a 1904-----A 1954-d 2004---------D

1855----------F 1905---------D 1955---a 2005---------D

1856-d 1906----@ 1956-----A 2006--------B

1857---------D 1907-------B 1957----------F 2007-d

1858---a 1908-----A 1958----------F 2008-d

1859---a 1909-----@ 1959------A 2009-------B

1860--------C 1910---------D 1960-----A 2010----------F

1861------A 1911--b 1961-d 2011--b

1862---------D 1912--c 1962---a 2012-d

1863-------B 1913i 1963-------B 2013--c

1864g 1914j 1964--c 2014-c

1865-----A 1915--------C 1965-------B 2015---------D

1866--b 1916---------E 1966----@

1867-e 1917-------B 1967g

1868--b 1918----@ 1968-----A

1869---a 1919-----@ 1969----@

1870-------B 1920--------C 1970----@

1871-c 1921----@ 1971------A

1872---------E 1922--b 1972-------B

1873---------D 1923----@ 1973---------D

1874--b 1924----------F 1974--------C

1875----------F 1925--------C 1975-------B

1876-------B 1926----@ 1976---a

1877----@ 1927---------D 1977-----A

1878-----A 1928----------F 1978-----@

1879f 1929---------D 1979-c

1880-----@ 1930--c 1980----@

1881f 1931f 1981---a

1882--------C 1932------A 1982---------C

1883-------B 1933---a 1983---a

1884--------B 1934---a 1984j

1885---a 1935--------C 1985-e

1886-------B 1936g 1986---a

1887u 1937j 1987-------B

1888---a 1938--b 1988h

1889----------J 1939------A 1989----@

1890---------D 1940-----@ 1990------A

1891------A 1941--c 1991----@

1892----@ 1942-----A 1992----------F

1893i 1943------A 1993---------D

1894--c 1944f 1994-------B

1845------A 1895-----@ 1945--------C 1995----@

1846----------G 1896----------F 1946-----A 1996---a

1847---------D 1897---------D 1947--------B 1997-------B

1848--------C 1898------A 1948--------C 1998---------D

1849-----@ 1899---a 1949---------D 1999----@

PART 5: CORRELATION OF SERIES BY SEGMENTS: 16:15 Tue 06 Dec 2016 Page 5

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Correlations of 50-year dated segments, lagged 25 years

Flags: A = correlation under .3281 but highest as dated; B = correlation higher at other than dated position

Seq Series Time\_span 1825 1850 1875 1900 1925 1950 1975

1874 1899 1924 1949 1974 1999 2024

--- -------- --------- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ----

1 LWM01A 1908 2015 .57 .49 .28B .27A

2 LWM02A 1847 2015 .41 .41 .65 .54 .52 .62 .59

3 LWM02B 1869 2015 .68 .75 .70 .75 .61 .65

4 LWM03A 1890 2015 .48 .49 .70 .48 .52

5 LWM03B 1905 2011 .53 .48 .63 .49

6 LWM04B 1896 2015 .31B .34 .50 .62 .51

7 LWM05A 1922 2015 .46 .43 .45 .39

8 LWM05B 1908 2013 .71 .72 .65 .58

9 LWM06A 1924 2015 .57 .54 .50 .55

10 LWM06B 1953 2015 .66 .63

11 LWM07A 1845 2015 .26B .26A .45 .47 .63 .56 .38

Av segment correlation .34 .45 .53 .54 .58 .55 .51

PART 6: POTENTIAL PROBLEMS: 16:15 Tue 06 Dec 2016 Page 5

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For each series with potential problems the following diagnostics may appear:

[A] Correlations with master dating series of flagged 50-year segments of series filtered with 32-year spline,

at every point from ten years earlier (-10) to ten years later (+10) than dated

[B] Effect of those data values which most lower or raise correlation with master series

Symbol following year indicates value in series is greater (>) or lesser (<) than master series value

[C] Year-to-year changes very different from the mean change in other series

[D] Absent rings (zero values)

[E] Values which are statistical outliers from mean for the year

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LWM01A 1908 to 2015 108 years Series 1

[A] Segment High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 +0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +10

--------- ---- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---

1950 1999 1 -.08 -.13 -.06 -.04 .17 -.01 -.15 -.06 .05 .12 .28| .30\* .03 -.02 -.06 -.08 .14 -.12 .04 -.31 -.09

1966 2015 0 -.18 -.13 -.02 -.12 .02 .14 -.09 -.10 .02 .16 .27\* - - - - - - - - - -

[B] Entire series, effect on correlation ( .419) is:

Lower 1982< -.035 1988> -.025 1979> -.020 1926< -.013 1966< -.013 1934> -.011 Higher 1984 .030 2000 .025

1950 to 1999 segment:

Lower 1982< -.081 1979> -.045 1988> -.044 1966< -.027 1976> -.014 1991> -.013 Higher 1984 .106 1957 .039

1966 to 2015 segment:

Lower 1982< -.063 1988> -.045 1979> -.038 1966< -.019 2003> -.016 2013> -.014 Higher 1984 .078 2000 .064

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LWM02A 1847 to 2015 169 years Series 2

[B] Entire series, effect on correlation ( .460) is:

Lower 1854> -.038 1850> -.033 1856> -.020 1865< -.013 1932< -.012 1851< -.008 Higher 1887 .060 1984 .012

[C] Year-to-year changes diverging by over 4.0 std deviations:

1850 1851 -4.0 SD 1853 1854 4.1 SD

[E] Outliers 4 3.0 SD above or -4.5 SD below mean for year

1850 +3.8 SD; 1854 +5.0 SD; 1856 +3.7 SD; 1882 +3.5 SD

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LWM02B 1869 to 2015 147 years Series 3

[B] Entire series, effect on correlation ( .686) is:

Lower 1870< -.024 1879> -.021 1903> -.021 1982< -.010 1956> -.008 1912> -.007 Higher 1887 .074 1913 .011

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LWM03A 1890 to 2015 126 years Series 4

[B] Entire series, effect on correlation ( .522) is:

Lower 1903< -.071 1895< -.015 1993< -.014 1984> -.009 1955< -.009 1988> -.008 Higher 1893 .019 1914 .015

[C] Year-to-year changes diverging by over 4.0 std deviations:

1902 1903 -4.5 SD

[E] Outliers 1 3.0 SD above or -4.5 SD below mean for year

1903 -5.4 SD

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LWM03B 1905 to 2011 107 years Series 5

[B] Entire series, effect on correlation ( .515) is:

Lower 2010< -.029 1937> -.023 2003< -.015 1945< -.012 1972< -.010 1927< -.010 Higher 1913 .021 2000 .020

[E] Outliers 1 3.0 SD above or -4.5 SD below mean for year

1937 +3.4 SD

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LWM04B 1896 to 2015 120 years Series 6

[A] Segment High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 +0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +10

--------- ---- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---

1896 1945 -1 -.31 .02 .01 .00 .17 -.12 -.18 -.04 .14 .36\* .31|-.06 .05 -.03 -.03 .14 .06 .04 .00 -.14 .10

[B] Entire series, effect on correlation ( .382) is:

Lower 1960< -.044 1913> -.030 1911> -.022 1915< -.021 1967> -.021 2003< -.018 Higher 1988 .055 1984 .038

1896 to 1945 segment:

Lower 1913> -.072 1911> -.059 1915< -.058 1932< -.035 1908< -.018 1942< -.015 Higher 1936 .076 1937 .040

[D] 2 Absent rings: Year Master N series Absent

1960 .145 11 1 >> WARNING: Ring is not usually narrow

1961 -1.082 11 1

[E] Outliers 2 3.0 SD above or -4.5 SD below mean for year

1960 -5.7 SD; 1961 -4.7 SD

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LWM05A 1922 to 2015 94 years Series 7

[B] Entire series, effect on correlation ( .407) is:

Lower 1951< -.031 2001< -.019 2000> -.019 1938< -.014 2014> -.014 1983> -.014 Higher 1967 .028 1988 .020

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LWM05B 1908 to 2013 106 years Series 8

[B] Entire series, effect on correlation ( .621) is:

Lower 1993< -.022 2000> -.014 2008> -.011 1963< -.011 1960< -.010 1915< -.009 Higher 1984 .027 1988 .027

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LWM06A 1924 to 2015 92 years Series 9

[B] Entire series, effect on correlation ( .610) is:

Lower 1968< -.021 1967> -.017 1970< -.012 1974< -.009 1931> -.009 1925< -.008 Higher 1936 .029 1988 .026

[E] Outliers 1 3.0 SD above or -4.5 SD below mean for year

1988 -4.8 SD

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LWM06B 1953 to 2015 63 years Series 10

[B] Entire series, effect on correlation ( .632) is:

Lower 1983< -.022 1996> -.015 1984> -.012 2007> -.010 1962> -.008 2008> -.007 Higher 1988 .045 2000 .031

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LWM07A 1845 to 2015 171 years Series 11

[\*] Early part of series cannot be checked from 1845 to 1846 -- not matched by another series

[A] Segment High -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 +0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +10

--------- ---- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---

1847 1896 8 - - - - - - - - -.26 -.01 .26|-.11 -.05 .00 -.24 -.03 .17 -.09 .27\*-.06 -.01

1850 1899 0 - - - - - -.07 -.16 -.08 -.29 -.03 .26\*-.13 -.01 .01 -.22 -.04 .14 -.10 .25 -.06 -.01

[B] Entire series, effect on correlation ( .348) is:

Lower 1854< -.038 1882< -.028 1850< -.017 1869> -.015 2007> -.015 1856< -.013 Higher 1887 .088 1936 .014

1847 to 1896 segment:

Lower 1854< -.071 1882< -.051 1850< -.031 1869> -.030 1856< -.025 1865> -.022 Higher 1887 .238 1889 .034

1850 to 1899 segment:

Lower 1854< -.069 1882< -.049 1869> -.031 1850< -.028 1865> -.023 1856< -.023 Higher 1887 .235 1889 .035

[C] Year-to-year changes diverging by over 4.0 std deviations:

1853 1854 -4.4 SD

[E] Outliers 5 3.0 SD above or -4.5 SD below mean for year

1854 -5.0 SD; 1865 +3.7 SD; 1869 +3.7 SD; 1882 -4.9 SD; 2007 +3.8 SD

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PART 7: DESCRIPTIVE STATISTICS: 16:15 Tue 06 Dec 2016 Page 6

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Corr //-------- Unfiltered --------\\ //---- Filtered -----\\

No. No. No. with Mean Max Std Auto Mean Max Std Auto AR

Seq Series Interval Years Segmt Flags Master msmt msmt dev corr sens value dev corr ()

--- -------- --------- ----- ----- ----- ------ ----- ----- ----- ----- ----- ----- ----- ----- --

1 LWM01A 1908 2015 108 4 2 .419 1.34 3.31 .754 .737 .293 2.86 .506 .056 1

2 LWM02A 1847 2015 169 7 0 .460 1.72 6.34 1.059 .760 .292 2.83 .426 .034 1

3 LWM02B 1869 2015 147 6 0 .686 1.95 5.23 1.046 .674 .357 2.52 .329 -.022 2

4 LWM03A 1890 2015 126 5 0 .522 2.56 6.23 1.097 .519 .322 2.67 .418 -.023 2

5 LWM03B 1905 2011 107 4 0 .515 2.24 5.08 .981 .675 .282 2.66 .459 -.016 1

6 LWM04B 1896 2015 120 5 1 .382 2.87 5.51 1.001 .547 .272 2.50 .417 .066 3

7 LWM05A 1922 2015 94 4 0 .407 1.23 4.18 .676 .703 .322 2.57 .406 -.071 2

8 LWM05B 1908 2013 106 4 0 .621 2.00 4.66 .969 .673 .298 2.57 .439 .015 1

9 LWM06A 1924 2015 92 4 0 .610 2.95 5.61 1.276 .731 .267 2.39 .337 .014 2

10 LWM06B 1953 2015 63 2 0 .632 3.59 8.57 2.056 .793 .290 2.60 .601 .029 1

11 LWM07A 1845 2015 171 7 2 .348 1.81 4.49 .762 .534 .330 2.65 .477 -.073 1

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Total or mean: 1303 52 5 .499 2.12 8.57 1.014 .657 .305 2.86 .431 -.002

- = [ COFECHA LWM COF ] = -