[] Dendrochronology Program Library Run ACRU Program COF 14:41 Wed 28 Jun 2017 Page 1

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[] P R O G R A M C O F E C H A Version 6.06P 30131

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QUALITY CONTROL AND DATING CHECK OF TREE-RING MEASUREMENTS

Title of run: ACRU\_LEMP11\_CORR2-50

File of DATED series: ACRU\_LEMP11\_CORR2

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 Y

8 Parts printed 1234567

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

Time span of Master dating series is 1866 to 2015 150 years

Continuous time span is 1866 to 2015 150 years

Portion with two or more series is 1893 to 2015 123 years

>> 132A 1971 absent in 2 of 28 series, but is not usually narrow: master index is -.020

>> 132A 1972 absent in 2 of 28 series, but is not usually narrow: master index is .614

>> 132A 1973 absent in 2 of 28 series, but is not usually narrow: master index is .276

>> 132B 1971 absent in 2 of 28 series, but is not usually narrow: master index is -.020

>> 132B 1972 absent in 2 of 28 series, but is not usually narrow: master index is .614

>> 132B 1973 absent in 2 of 28 series, but is not usually narrow: master index is .276

>> 241A 1982 absent in 1 of 28 series, but is not usually narrow: master index is -.395

>> 241A 1984 absent in 1 of 28 series, but is not usually narrow: master index is .697

>> 362B 1970 absent in 1 of 28 series, but is not usually narrow: master index is -.236

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

\*C\* Number of dated series 28 \*C\*

\*O\* Master series 1866 2015 150 yrs \*O\*

\*F\* Total rings in all series 2736 \*F\*

\*E\* Total dated rings checked 2709 \*E\*

\*C\* Series intercorrelation .625 \*C\*

\*H\* Average mean sensitivity .298 \*H\*

\*A\* Segments, possible problems 4 \*A\*

\*\*\* Mean length of series 97.7 \*\*\*

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

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

132A 5 absent rings: 1930 1948 1971 1972 1973

132B 4 absent rings: 1930 1971 1972 1973

241A 2 absent rings: 1982 1984

362A 1 absent rings: 1981

362B 3 absent rings: 1965 1970 1981

15 absent rings .548%

1900 .429 7 1950 .060 27 2000 -.218 28

1901 .521 7 1951 .079 27 2001 -.067 28

1902 -.840 7 1952 .232 27 2002 -.494 28

1903 .099 7 1953 -.816 27 2003 -1.732 28

1904 .782 7 1954 .378 27 2004 -1.054 28

1905 .745 7 1955 1.364 27 2005 -.354 28

1906 1.020 7 1956 .512 27 2006 -.784 28

1907 .856 7 1957 .573 27 2007 .152 28

1908 .592 8 1958 .726 27 2008 1.396 28

1909 .220 8 1959 -.296 27 2009 .986 28

1910 -.340 8 1960 .291 27 2010 .965 28

1911 -.819 8 1961 .749 27 2011 .776 28

1912 -.921 8 1962 -.177 27 2012 .969 27

1913 -1.140 8 1963 -.461 27 2013 .730 27

1914 -.980 8 1964 .316 27 2014 .425 27

1915 .060 8 1965 -.464 27 1 2015 -2.753 27

1866 -1.543 1 1916 -.291 9 1966 -1.576 27

1867 -2.251 1 1917 -.864 10 1967 -1.493 27

1868 .501 1 1918 .919 10 1968 -.092 27

1869 -.119 1 1919 .761 10 1969 .180 28

1870 -.533 1 1920 1.640 10 1970 -.236 28 1<<

1871 1.699 1 1921 -.107 11 1971 -.020 28 2<<

1872 1.563 1 1922 .514 15 1972 .614 28 2<<

1873 1.573 1 1923 .114 17 1973 .276 28 2<<

1874 1.026 1 1924 .940 18 1974 .439 28

1875 1.091 1 1925 .499 18 1975 .642 28

1876 .486 1 1926 .587 19 1976 .546 28

1877 1.314 1 1927 .596 20 1977 -.041 28

1878 2.313 1 1928 .123 22 1978 .679 28

1879 .320 1 1929 -.031 22 1979 1.022 28

1880 -.197 1 1930 -4.873 24 2 1980 .298 28

1881 -.315 1 1931 -.871 24 1981 -3.055 28 2

1882 -1.623 1 1932 .437 25 1982 -.395 28 1<<

1883 -2.232 1 1933 .321 25 1983 -.314 28

1884 -1.971 1 1934 .491 26 1984 .697 28 1<<

1885 -1.535 1 1935 .409 26 1985 .004 28

1886 -.385 1 1936 -2.041 26 1986 .155 28

1887 .123 1 1937 -.506 26 1987 .458 28

1888 -.362 1 1938 .298 26 1988 -.813 28

1889 1.093 1 1939 .282 26 1989 .900 28

1890 -.311 1 1940 .401 26 1990 .835 28

1891 -.026 1 1941 .940 26 1991 .307 28

1892 -.709 1 1942 1.114 26 1992 1.133 28

1893 -2.144 2 1943 .348 27 1993 .592 28

1894 -.031 4 1944 .707 27 1994 .030 28

1895 .706 4 1945 -1.572 27 1995 -.787 28

1896 1.187 4 1946 -.198 27 1996 -.571 28

1897 -.291 5 1947 .738 27 1997 .123 28

1898 -1.168 6 1948 -.676 27 1 1998 .702 28

1899 -.934 7 1949 -.520 27 1999 -.479 28

PART 5: CORRELATION OF SERIES BY SEGMENTS: ACRU\_LEMP11\_CORR2-50 14:41 Wed 28 Jun 2017 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 1875 1900 1925 1950 1975

1924 1949 1974 1999 2024

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

1 132A 1916 2015 .38 .51 .47 .58

2 132B 1917 2015 .41 .34B .55 .65

3 149A 1897 2015 .58 .58 .57 .64 .74

4 149B 1898 2015 .79 .78 .75 .46 .53

5 150A 1893 2015 .49 .72 .54 .21B .40B

6 150B 1894 2015 .56 .58 .70 .30A .44

7 151A 1922 2015 .80 .80 .53 .56

8 151B 1923 2015 .84 .84 .44 .48

9 153A 1894 2015 .55 .45 .39 .43 .67

10 153B 1866 2011 .39 .53 .45 .46 .52

11 154A 1922 2015 .83 .77 .52 .63

12 154B 1921 2015 .78 .76 .57 .70

13 156A 1928 2015 .75 .67 .75

14 156B 1930 2015 .46 .61 .61

15 158A 1932 2015 .79 .79 .73

16 158B 1934 2015 .73 .67 .66

17 241A 1927 2015 .73 .55 .80

18 241B 1930 2015 .54 .58 .71

19 355A 1924 2015 .76 .76 .65 .67

20 355B 1922 2015 .76 .75 .53 .63

21 356A 1926 2015 .80 .56 .63

22 356B 1928 2015 .70 .43 .62

23 362A 1923 2015 .48 .47 .53 .72

24 362B 1922 2015 .35 .40 .52 .60

25 363A 1908 2015 .73 .77 .49 .49

26 363B 1899 2015 .76 .78 .80 .60 .68

27 367A 1969 2015 .62

28 367B 1943 2015 .70 .76 .81

Av segment correlation .59 .64 .65 .54 .63

PART 6: POTENTIAL PROBLEMS: ACRU\_LEMP11\_CORR2-50 14:41 Wed 28 Jun 2017 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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132A 1916 to 2015 100 years Series 1

[B] Entire series, effect on correlation ( .488) is:

Lower 1919< -.025 2002> -.022 1917> -.021 1996< -.018 1989< -.017 1988> -.015 Higher 2015 .080 1981 .061

[D] 5 Absent rings: Year Master N series Absent

1930 -4.873 24 2

1948 -.676 27 1

1971 -.020 28 2 >> WARNING: Ring is not usually narrow

1972 .614 28 2 >> WARNING: Ring is not usually narrow

1973 .276 28 2 >> WARNING: Ring is not usually narrow

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

1917 +3.1 SD; 2002 +3.3 SD

132A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1916 52 77 82 39

1920 59 30 32 28 33 19 15 13 7 3

1930 0 4 5 5 5 8 6 5 15 24

1940 19 39 56 34 24 6 8 5 0 4

1950 6 8 24 44 81 203 79 87 74 43

1960 57 61 52 35 36 21 14 8 13 14

1970 10 0 0 0 11 10 27 30 14 33

1980 36 7 43 63 60 74 50 51 68 48

1990 61 82 90 88 75 101 58 100 118 98

2000 109 109 221 115 192 170 127 234 226 180

2010 215 187 151 144 163 18

====================================================================================================================================

132B 1917 to 2015 99 years Series 2

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

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

1925 1974 -7 -.06 -.14 -.14 .34\* .04 -.33 -.03 -.01 -.04 .33 .34|-.04 .15 -.03 -.14 -.06 -.22 -.11 .31 -.01 -.42

[B] Entire series, effect on correlation ( .647) is:

Lower 1988> -.025 1937< -.019 1977> -.014 1936> -.012 1945> -.012 1972< -.010 Higher 1930 .111 1981 .051

1925 to 1974 segment:

Lower 1937< -.041 1945> -.023 1936> -.023 1972< -.021 1953> -.020 1971< -.017 Higher 1930 .345 1955 .006

[D] 4 Absent rings: Year Master N series Absent

1930 -4.873 24 2

1971 -.020 28 2 >> WARNING: Ring is not usually narrow

1972 .614 28 2 >> WARNING: Ring is not usually narrow

1973 .276 28 2 >> WARNING: Ring is not usually narrow

132B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1917 63 86 55

1920 70 33 55 32 41 38 42 24 19 25

1930 0 9 13 29 24 43 23 11 19 26

1940 25 33 63 39 29 18 20 13 8 8

1950 12 8 13 29 53 55 65 59 55 21

1960 25 43 28 33 51 20 20 12 23 18

1970 24 0 0 0 22 65 50 176 65 206

1980 124 33 59 95 85 151 87 92 131 137

1990 151 105 99 80 66 75 50 75 110 65

2000 99 67 121 62 135 97 78 135 221 252

2010 231 181 130 144 232 25

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149A 1897 to 2015 119 years Series 3

[B] Entire series, effect on correlation ( .630) is:

Lower 1968< -.024 1951> -.014 1918< -.011 1909> -.007 1915< -.007 1920< -.006 Higher 1981 .057 1930 .036

[E] Outliers 3 3.0 SD above or -4.5 SD below mean for year

1930 +4.3 SD; 1951 +3.6 SD; 1968 -4.7 SD

149A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1897 139 114 113

1900 150 212 195 217 168 181 196 185 178 203

1910 150 115 70 58 30 26 49 42 33 29

1920 30 20 19 30 27 34 66 47 48 54

1930 24 49 52 47 49 42 22 39 66 62

1940 64 66 82 74 115 102 85 150 116 125

1950 153 231 169 99 129 148 129 97 90 73

1960 69 72 75 61 49 48 47 39 15 36

1970 32 40 41 47 94 111 105 73 73 72

1980 63 12 30 52 58 79 85 88 62 123

1990 107 81 106 94 91 73 69 62 90 81

2000 50 46 33 22 29 21 19 25 55 52

2010 64 74 89 77 73 10

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149B 1898 to 2015 118 years Series 4

[B] Entire series, effect on correlation ( .670) is:

Lower 2000< -.019 1968< -.015 1999> -.013 1943< -.010 1945> -.010 1950< -.008 Higher 1930 .100 1936 .017

149B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1898 176 168

1900 213 246 214 212 231 223 218 168 155 159

1910 143 113 122 124 118 123 112 97 158 165

1920 197 103 129 82 116 115 140 159 116 118

1930 42 48 103 100 105 113 65 65 92 86

1940 97 91 127 86 112 98 94 128 77 88

1950 73 101 107 77 120 124 98 99 123 112

1960 113 101 66 62 51 51 32 29 7 19

1970 22 30 51 35 77 85 108 90 114 79

1980 66 28 33 44 37 61 56 53 49 54

1990 56 43 70 58 60 30 26 24 32 43

2000 13 10 12 17 19 26 14 20 45 49

2010 40 44 55 57 57 9

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150A 1893 to 2015 123 years Series 5

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

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1950 1999 -4 -.17 -.04 .21 -.11 -.03 .06 .38\*-.09 -.03 -.01 .21|-.04 -.10 .05 -.17 -.15 -.02 .21 -.20 -.14 -.12

1966 2015 -4 -.14 -.12 .13 -.12 -.13 -.07 .44\*-.11 .00 .06 .40| - - - - - - - - - -

[B] Entire series, effect on correlation ( .444) is:

Lower 1893> -.102 1974< -.043 1985< -.028 1979< -.008 1921> -.007 1981> -.006 Higher 1930 .092 2015 .044

1950 to 1999 segment:

Lower 1974< -.082 1985< -.025 1979< -.020 1969< -.012 1988> -.010 1954< -.009 Higher 1955 .031 1992 .026

1966 to 2015 segment:

Lower 1974< -.093 1985< -.050 1981> -.039 1979< -.018 1988> -.013 1969< -.012 Higher 2015 .132 2003 .019

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

1893 1894 -4.3 SD

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

1893 +7.1 SD; 1937 +3.3 SD

150A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1893 254 249 226 269 208 154 117

1900 158 160 131 222 270 233 226 221 241 167

1910 147 119 117 111 102 135 148 87 148 198

1920 258 252 262 203 256 207 217 217 183 184

1930 96 117 180 270 266 303 238 419 336 326

1940 217 281 286 253 364 200 170 177 48 59

1950 71 72 89 76 65 164 130 180 125 120

1960 125 137 67 82 88 82 69 51 77 46

1970 30 42 82 99 40 40 34 45 68 46

1980 60 46 42 44 88 41 55 47 59 62

1990 97 97 126 104 103 80 77 112 124 89

2000 79 70 82 57 67 74 44 55 112 115

2010 134 156 173 177 163 11

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150B 1894 to 2015 122 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

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1950 1999 0 -.18 .03 .01 -.17 .07 -.09 .08 -.17 -.15 -.01 .30\* .17 -.08 .02 -.07 .11 -.06 .09 -.02 .13 .00

[B] Entire series, effect on correlation ( .506) is:

Lower 1994< -.072 1988> -.013 1901< -.010 1981> -.010 1903< -.009 1902< -.009 Higher 2015 .048 1930 .043

1950 to 1999 segment:

Lower 1994< -.127 1988> -.034 1981> -.016 1977> -.014 1976< -.012 1958< -.009 Higher 1955 .021 1953 .021

[E] Outliers 3 3.0 SD above or -4.5 SD below mean for year

1902 -6.3 SD; 1903 -5.3 SD; 1994 -5.4 SD

150B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1894 247 307 325 238 225 192

1900 192 113 17 37 87 118 162 175 214 202

1910 165 192 193 169 188 193 172 89 127 159

1920 269 188 212 183 205 145 150 131 114 103

1930 44 72 86 126 121 125 62 87 77 81

1940 101 165 152 158 156 104 128 127 48 93

1950 120 178 184 109 104 131 101 103 84 67

1960 111 104 89 74 80 89 83 76 97 112

1970 95 141 222 211 178 270 194 304 379 313

1980 307 238 221 243 370 269 302 268 317 351

1990 279 361 290 282 93 101 159 219 255 170

2000 206 167 156 111 127 148 148 192 191 143

2010 136 118 150 153 109 4

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151A 1922 to 2015 94 years Series 7

[B] Entire series, effect on correlation ( .711) is:

Lower 1981> -.015 2000> -.008 2015> -.007 2013< -.007 1962> -.006 1945> -.006 Higher 1930 .163 1948 .004

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

1930 -5.4 SD

151A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1922 318 314 330 251 211 268 236 217

1930 18 134 190 154 212 211 130 199 162 147

1940 227 170 217 178 300 166 157 253 141 162

1950 206 199 190 132 231 204 213 233 202 129

1960 181 155 190 140 189 176 133 99 233 118

1970 108 119 198 124 135 128 172 109 187 241

1980 215 99 170 130 230 196 139 127 118 222

1990 244 134 194 185 123 87 198 197 294 212

2000 275 197 172 134 157 162 190 231 220 188

2010 207 245 210 69 74 7

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151B 1923 to 2015 93 years Series 8

[B] Entire series, effect on correlation ( .712) is:

Lower 1981> -.044 1975< -.012 1939< -.008 1996> -.008 1962> -.007 1987< -.006 Higher 1930 .167 1955 .006

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

1930 -5.9 SD; 1981 +3.1 SD

151B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1923 299 302 246 241 253 257 230

1930 55 186 232 229 244 250 164 231 198 160

1940 243 243 238 216 272 169 197 298 206 203

1950 215 196 184 131 215 283 241 225 223 154

1960 202 184 216 177 236 208 155 112 237 158

1970 179 141 166 152 172 140 187 168 280 270

1980 301 234 348 247 380 361 338 231 200 380

1990 388 343 346 283 214 149 372 322 445 313

2000 353 229 265 202 286 214 291 335 384 439

2010 461 551 466 364 248 52

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153A 1894 to 2015 122 years Series 9

[B] Entire series, effect on correlation ( .509) is:

Lower 1947< -.041 1992< -.019 1967> -.015 1945> -.014 1894> -.014 1902> -.011 Higher 2015 .070 1981 .024

[E] Outliers 3 3.0 SD above or -4.5 SD below mean for year

1894 +4.4 SD; 1967 +3.0 SD; 1992 -4.5 SD

153A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1894 81 76 67 57 57 69

1900 74 71 76 87 78 94 94 89 72 70

1910 61 69 59 61 66 63 51 16 406 451

1920 307 213 193 157 212 211 237 271 230 205

1930 139 212 234 245 272 210 128 219 366 376

1940 414 353 282 232 259 248 285 123 122 126

1950 145 124 120 129 143 180 175 174 198 183

1960 179 160 181 198 211 176 157 207 219 237

1970 186 178 216 213 210 212 173 164 183 155

1980 133 103 142 131 168 130 108 160 104 206

1990 133 92 71 91 86 107 99 109 104 73

2000 82 119 92 55 48 95 55 62 101 89

2010 77 80 70 65 92 15

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153B 1866 to 2011 146 years Series 10

[\*] Early part of series cannot be checked from 1866 to 1892 -- not matched by another series

[B] Entire series, effect on correlation ( .388) is:

Lower 1893< -.066 1945> -.029 1998< -.016 1894< -.016 1986< -.012 1995> -.011 Higher 1981 .082 1936 .033

[E] Outliers 3 3.0 SD above or -4.5 SD below mean for year

1893 -7.1 SD; 1894 -6.4 SD; 1945 +3.6 SD

153B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1866 126 102 260 220

1870 198 376 360 356 301 298 246 290 351 201

1880 166 149 102 81 77 75 87 87 68 88

1890 54 52 38 6 8 27 48 36 23 21

1900 53 72 74 96 100 74 93 109 93 53

1910 68 62 48 75 87 105 115 80 262 247

1920 189 88 93 72 88 99 115 150 153 111

1930 65 125 193 215 211 189 92 132 221 229

1940 157 174 188 159 157 189 165 120 91 88

1950 98 61 65 85 112 109 139 153 149 152

1960 130 199 153 190 176 160 92 106 96 144

1970 137 173 144 159 143 133 92 60 64 84

1980 79 31 115 94 89 86 46 99 60 91

1990 87 67 62 66 61 74 35 52 30 30

2000 31 54 28 40 36 74 39 83 109 69

2010 68 76

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154A 1922 to 2015 94 years Series 11

[B] Entire series, effect on correlation ( .743) is:

Lower 1972< -.037 1981> -.013 1944< -.010 1962< -.010 1953> -.009 2006> -.008 Higher 1930 .127 2015 .019

154A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1922 240 250 277 232 219 202 163 135

1930 12 112 156 152 193 171 103 79 110 157

1940 183 156 119 96 70 42 73 104 89 85

1950 104 95 111 102 100 119 106 82 79 76

1960 68 99 58 59 82 60 43 34 47 69

1970 56 52 29 56 90 78 82 113 107 85

1980 69 49 142 139 155 102 86 97 72 110

1990 112 98 140 114 96 90 102 106 132 93

2000 71 76 73 70 66 104 124 128 156 116

2010 128 103 119 129 96 22

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154B 1921 to 2015 95 years Series 12

[B] Entire series, effect on correlation ( .746) is:

Lower 1972< -.020 1980< -.011 1944< -.011 1932< -.010 1957< -.010 2009< -.009 Higher 1930 .120 2015 .019

154B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1921 227 205 234 248 244 221 230 210 171

1930 29 118 136 131 173 171 102 111 127 176

1940 214 225 206 186 97 73 102 195 119 88

1950 85 72 91 77 64 72 68 47 60 56

1960 51 45 23 22 34 27 13 15 24 31

1970 18 14 9 14 25 29 27 37 40 37

1980 18 6 61 65 59 43 51 61 48 102

1990 134 92 147 134 116 106 129 116 123 99

2000 99 110 102 85 86 116 135 148 220 138

2010 138 132 151 151 117 36

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156A 1928 to 2015 88 years Series 13

[B] Entire series, effect on correlation ( .753) is:

Lower 1990< -.017 1996> -.012 1989< -.012 2003> -.008 1959> -.007 1945< -.006 Higher 1981 .035 1930 .032

156A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1928 219 178

1930 19 105 199 173 186 243 93 221 178 195

1940 169 202 207 135 132 54 92 160 125 153

1950 170 117 112 93 108 125 123 132 149 152

1960 192 167 155 103 137 120 73 63 92 127

1970 120 104 247 156 185 271 292 286 320 386

1980 276 74 237 228 256 189 238 197 125 164

1990 139 245 267 243 235 225 311 272 369 182

2000 229 263 184 199 178 214 132 210 329 252

2010 281 200 272 220 263 80

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156B 1930 to 2015 86 years Series 14

[B] Entire series, effect on correlation ( .497) is:

Lower 1930> -.064 1945< -.038 1996> -.013 1938< -.012 1990< -.007 1995> -.006 Higher 1981 .038 1936 .022

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

1930 +4.5 SD; 1931 +3.5 SD; 1945 -6.9 SD; 1996 +3.2 SD

156B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1930 129 344 231 149 182 179 80 145 90 80

1940 95 131 129 102 146 28 110 171 137 160

1950 140 141 140 108 156 167 133 143 125 89

1960 112 104 76 45 72 48 36 40 82 53

1970 62 70 161 131 191 237 290 143 266 257

1980 171 56 114 141 151 105 173 201 171 193

1990 155 194 252 225 291 277 361 285 228 116

2000 138 153 118 120 126 165 123 138 315 375

2010 402 309 231 242 163 69

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158A 1932 to 2015 84 years Series 15

[B] Entire series, effect on correlation ( .705) is:

Lower 2015> -.019 2003> -.018 1988> -.016 1992< -.009 1948> -.009 2004< -.008 Higher 1981 .088 1936 .018

158A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1932 216 123 130 103 45 123 145 208

1940 145 177 149 168 134 73 116 167 165 203

1950 250 265 250 171 180 260 190 165 163 164

1960 171 214 183 212 212 178 105 121 222 228

1970 220 201 266 188 175 229 205 179 257 257

1980 329 70 207 184 268 213 247 269 250 336

1990 269 241 205 234 205 156 163 171 184 92

2000 146 139 99 116 34 115 30 79 129 148

2010 140 78 109 112 84 11

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158B 1934 to 2015 82 years Series 16

[B] Entire series, effect on correlation ( .636) is:

Lower 1945> -.015 1960< -.011 1988> -.010 1994> -.009 2015> -.008 1954< -.008 Higher 1981 .106 1948 .010

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

1981 -6.2 SD

158B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1934 165 164 122 198 247 279

1940 265 311 352 284 273 227 201 313 139 183

1950 230 347 302 205 161 230 136 157 158 132

1960 112 171 121 128 163 147 111 141 186 166

1970 182 198 232 169 160 184 176 155 204 231

1980 282 48 149 216 202 173 162 236 237 302

1990 256 283 250 261 321 284 265 281 321 224

2000 248 265 223 146 65 87 43 85 161 153

2010 255 112 154 116 110 25

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241A 1927 to 2015 89 years Series 17

[B] Entire series, effect on correlation ( .694) is:

Lower 1984< -.026 1948> -.022 1982< -.013 1981> -.012 1957< -.011 1953> -.009 Higher 1930 .121 1936 .018

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

1982 -.395 28 1 >> WARNING: Ring is not usually narrow

1984 .697 28 1 >> WARNING: Ring is not usually narrow

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

1948 +3.3 SD

241A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1927 267 190 216

1930 111 152 163 173 153 124 85 137 115 119

1940 99 139 126 102 120 65 83 222 185 144

1950 135 94 116 110 97 93 77 61 78 47

1960 84 76 79 67 145 99 52 39 48 63

1970 53 67 99 98 107 98 92 78 139 140

1980 66 21 0 24 0 15 31 52 33 61

1990 69 82 136 93 92 76 73 101 130 108

2000 92 128 103 89 86 92 115 142 233 207

2010 248 227 248 205 153 40

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241B 1930 to 2015 86 years Series 18

[B] Entire series, effect on correlation ( .602) is:

Lower 1984< -.018 2006> -.014 1930> -.013 1945< -.013 1949> -.012 1936> -.010 Higher 2015 .041 1981 .021

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

1945 -6.2 SD

241B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1930 36 133 182 211 205 167 121 124 136 95

1940 100 124 137 114 117 62 83 127 97 154

1950 143 106 138 128 138 147 131 120 122 105

1960 126 104 123 94 142 112 66 63 148 109

1970 109 94 159 80 86 75 60 62 105 104

1980 81 13 12 36 14 16 38 64 8 45

1990 81 84 143 108 99 74 59 85 99 73

2000 74 109 90 77 74 86 147 113 182 163

2010 181 150 189 173 161 52

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355A 1924 to 2015 92 years Series 19

[B] Entire series, effect on correlation ( .738) is:

Lower 1948> -.021 1968> -.016 1934< -.014 1997< -.008 1936> -.008 1998< -.008 Higher 1930 .138 1981 .008

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

1968 +3.6 SD

355A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1924 232 229 212 207 166 171

1930 12 110 147 100 74 88 89 136 150 139

1940 106 132 157 138 166 119 152 159 178 111

1950 115 180 141 139 194 230 170 204 161 108

1960 150 213 122 104 123 103 93 73 225 127

1970 109 101 120 102 99 118 114 91 117 114

1980 87 58 102 81 147 138 150 120 88 169

1990 195 112 186 112 120 81 77 65 74 75

2000 98 106 80 58 92 84 90 113 127 159

2010 201 216 252 235 132 11

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355B 1922 to 2015 94 years Series 20

[B] Entire series, effect on correlation ( .699) is:

Lower 1997< -.016 1981> -.015 1945> -.011 1993< -.010 2006> -.008 1947> -.008 Higher 1930 .116 2015 .027

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

1947 +3.4 SD

355B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1922 318 215 246 216 227 167 196 196

1930 14 71 76 69 63 79 49 51 71 122

1940 108 142 144 97 109 99 135 272 119 97

1950 88 129 114 80 115 115 111 138 116 92

1960 142 169 97 71 69 54 47 43 151 88

1970 84 83 133 92 116 150 119 98 168 190

1980 147 107 211 128 193 157 235 162 148 259

1990 189 111 231 119 146 81 135 98 137 140

2000 160 148 142 106 127 128 169 246 222 170

2010 163 176 172 188 123 12

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356A 1926 to 2015 90 years Series 21

[B] Entire series, effect on correlation ( .730) is:

Lower 1996< -.054 1956< -.020 1988> -.020 1968< -.015 1995> -.007 1970> -.007 Higher 1930 .075 1981 .043

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

1996 -4.6 SD

356A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1926 229 207 207 203

1930 89 238 242 260 290 213 106 166 219 181

1940 182 192 203 190 219 142 220 274 175 209

1950 217 240 200 165 192 298 126 220 224 193

1960 166 185 179 123 146 113 103 109 89 129

1970 152 120 117 108 121 131 141 91 123 148

1980 90 37 98 94 153 122 117 135 136 108

1990 122 121 121 88 89 103 48 100 98 82

2000 97 88 73 58 62 81 91 122 130 145

2010 122 125 175 159 182 40

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356B 1928 to 2015 88 years Series 22

[B] Entire series, effect on correlation ( .678) is:

Lower 1956< -.028 1989< -.014 1947< -.012 1988> -.011 1942< -.009 1980< -.007 Higher 1930 .115 2015 .019

356B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1928 269 283

1930 72 236 288 304 287 220 133 129 195 184

1940 196 213 175 179 172 103 164 145 159 180

1950 206 233 240 193 218 289 157 181 158 156

1960 130 137 143 102 114 106 105 94 84 141

1970 175 182 145 136 142 169 160 137 144 147

1980 79 35 67 63 90 66 53 99 91 64

1990 102 98 76 78 71 48 35 79 63 54

2000 56 51 36 28 33 32 33 54 73 88

2010 89 119 132 110 118 15

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362A 1923 to 2015 93 years Series 23

[B] Entire series, effect on correlation ( .627) is:

Lower 1930> -.051 1952< -.019 1945> -.012 1933< -.008 1947< -.007 1966> -.007 Higher 1981 .057 2015 .020

[D] 1 Absent rings: Year Master N series Absent

1981 -3.055 28 2

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

1930 +3.7 SD; 1981 -7.0 SD

362A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1923 152 192 187 186 154 149 186

1930 135 190 207 145 146 206 134 202 214 227

1940 218 233 199 200 225 175 241 146 116 69

1950 123 90 36 25 91 103 86 64 70 47

1960 68 80 55 68 81 68 62 51 72 71

1970 60 78 84 66 68 54 60 48 59 76

1980 70 0 44 64 81 83 91 115 70 126

1990 111 130 148 152 140 127 147 157 154 130

2000 119 114 84 70 127 136 165 171 232 183

2010 181 185 184 195 166 33

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362B 1922 to 2015 94 years Series 24

[B] Entire series, effect on correlation ( .480) is:

Lower 1930> -.037 1988< -.027 1947< -.011 1929< -.011 1923> -.010 1948> -.009 Higher 2015 .034 1981 .018

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

1929 1930 4.7 SD

[D] 3 Absent rings: Year Master N series Absent

1965 -.464 27 1

1970 -.236 28 1 >> WARNING: Ring is not usually narrow

1981 -3.055 28 2

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

1930 +3.2 SD; 1988 -6.0 SD

362B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1922 127 282 138 157 109 138 106 70

1930 78 85 153 119 120 144 97 151 154 142

1940 157 165 145 137 156 93 159 79 99 56

1950 116 45 55 28 103 87 68 46 52 27

1960 19 31 14 18 19 0 20 15 14 54

1970 0 62 78 45 39 30 37 9 36 49

1980 7 0 22 49 49 32 42 74 7 50

1990 59 60 72 72 72 60 80 99 97 85

2000 91 90 76 68 135 136 140 156 233 232

2010 231 274 215 213 163 13

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363A 1908 to 2015 108 years Series 25

[B] Entire series, effect on correlation ( .605) is:

Lower 1978< -.020 1988< -.018 1981> -.018 1998< -.014 1948> -.014 1918< -.012 Higher 1930 .101 2015 .023

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

1981 +3.2 SD

363A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1908 227 272

1910 216 219 251 228 255 435 356 332 284 325

1920 474 361 415 286 418 333 260 270 172 175

1930 58 140 228 198 210 140 88 90 120 94

1940 121 129 136 113 108 83 86 88 104 84

1950 98 91 118 82 93 134 137 148 189 132

1960 121 139 125 147 127 106 84 90 142 125

1970 147 139 180 169 167 129 133 96 77 130

1980 148 103 99 79 113 94 102 97 46 86

1990 82 74 142 109 83 59 65 56 44 52

2000 53 81 101 68 61 81 61 48 98 91

2010 55 54 68 38 38 13

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363B 1899 to 2015 117 years Series 26

[B] Entire series, effect on correlation ( .706) is:

Lower 1962< -.013 2010< -.011 2002> -.011 1917> -.010 1916< -.009 1899> -.008 Higher 1930 .090 1936 .016

363B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1899 311

1900 351 259 104 129 257 221 234 265 284 205

1910 224 193 192 156 228 453 251 342 393 400

1920 459 342 414 322 500 437 386 337 322 278

1930 119 233 313 246 277 232 112 122 214 194

1940 227 252 252 217 165 137 137 127 108 98

1950 106 119 155 96 98 128 107 102 160 101

1960 85 113 16 16 21 12 27 31 44 63

1970 75 77 116 105 133 105 123 82 88 114

1980 102 73 98 86 118 123 158 110 79 164

1990 130 102 124 93 71 45 63 71 71 68

2000 93 111 130 64 53 70 46 66 119 123

2010 67 83 120 108 81 20

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367A 1969 to 2015 47 years Series 27

[B] Entire series, effect on correlation ( .623) is:

Lower 1972< -.144 2004> -.013 1988> -.011 2012< -.009 1992< -.008 2006> -.008 Higher 1981 .188 2015 .057

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

1972 -5.2 SD

367A Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1969 328

1970 278 299 210 284 278 324 300 253 254 318

1980 297 61 148 217 290 244 339 329 214 235

1990 177 84 109 116 75 49 70 62 101 101

2000 104 141 148 105 190 236 223 304 316 301

2010 358 351 260 344 255 52

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367B 1943 to 2015 73 years Series 28

[B] Entire series, effect on correlation ( .738) is:

Lower 1948< -.035 1967> -.026 1945> -.016 1964< -.014 1991< -.007 1986> -.007 Higher 1981 .054 2015 .019

367B Ring measurements

Annual values

Date 0 1 2 3 4 5 6 7 8 9

1943 45 58 30 37 81 6 12

1950 25 46 49 16 49 67 63 57 58 42

1960 64 69 25 39 32 15 12 170 201 265

1970 230 223 208 230 249 287 298 209 262 274

1980 214 53 104 124 238 225 348 278 155 261

1990 230 145 203 188 149 113 147 134 180 138

2000 146 161 145 92 129 119 124 146 217 183

2010 210 188 176 238 185 37

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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 ()

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1 132A 1916 2015 100 4 0 .488 .58 2.34 .596 .826 .483 2.79 .414 -.086 2

2 132B 1917 2015 99 4 1 .647 .64 2.52 .571 .714 .471 2.66 .426 -.033 3

3 149A 1897 2015 119 5 0 .630 .79 2.31 .503 .877 .264 2.77 .405 .006 1

4 149B 1898 2015 118 5 0 .670 .88 2.46 .548 .897 .255 2.51 .391 -.025 1

5 150A 1893 2015 123 5 2 .444 1.40 4.19 .840 .842 .253 2.64 .492 -.030 1

6 150B 1894 2015 122 5 1 .506 1.64 3.79 .794 .805 .256 2.54 .360 .065 1

7 151A 1922 2015 94 4 0 .711 1.81 3.30 .595 .364 .319 2.41 .292 .039 1

8 151B 1923 2015 93 4 0 .712 2.49 5.51 .891 .645 .251 2.33 .278 .003 1

9 153A 1894 2015 122 5 0 .509 1.52 4.51 .863 .802 .210 2.75 .372 -.010 2

10 153B 1866 2011 146 5 0 .388 1.17 3.76 .743 .840 .280 2.79 .468 -.029 1

11 154A 1922 2015 94 4 0 .743 1.06 2.77 .494 .783 .260 2.46 .333 .005 2

12 154B 1921 2015 95 4 0 .746 1.02 2.48 .658 .864 .278 2.56 .340 .001 2

13 156A 1928 2015 88 3 0 .753 1.85 3.86 .734 .540 .312 2.58 .482 -.028 1

14 156B 1930 2015 86 3 0 .497 1.59 4.02 .813 .706 .318 2.44 .308 -.098 1

15 158A 1932 2015 84 3 0 .705 1.73 3.36 .662 .608 .307 2.42 .349 -.045 1

16 158B 1934 2015 82 3 0 .636 1.97 3.52 .729 .636 .272 2.32 .289 -.036 1

17 241A 1927 2015 89 3 0 .694 1.08 2.67 .571 .766 .358 2.81 .399 -.021 1

18 241B 1930 2015 86 3 0 .602 1.05 2.11 .451 .678 .315 2.50 .385 .042 1

19 355A 1924 2015 92 4 0 .738 1.31 2.52 .497 .537 .282 2.64 .318 .002 1

20 355B 1922 2015 94 4 0 .699 1.34 3.18 .580 .519 .312 2.85 .392 .006 1

21 356A 1926 2015 90 3 0 .730 1.48 2.98 .582 .646 .240 2.57 .465 -.029 1

22 356B 1928 2015 88 3 0 .678 1.30 3.04 .698 .790 .239 2.62 .425 -.050 1

23 362A 1923 2015 93 4 0 .627 1.22 2.41 .586 .822 .263 2.27 .279 .012 1

24 362B 1922 2015 94 4 0 .480 .89 2.82 .639 .783 .478 2.55 .377 -.035 1

25 363A 1908 2015 108 4 0 .605 1.44 4.74 .943 .876 .236 2.72 .440 .014 1

26 363B 1899 2015 117 5 0 .706 1.62 5.00 1.102 .857 .277 2.60 .390 .053 1

27 367A 1969 2015 47 1 0 .623 2.16 3.58 .978 .728 .282 2.45 .459 -.092 1

28 367B 1943 2015 73 3 0 .738 1.40 3.48 .877 .805 .361 2.58 .460 .015 1

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Total or mean: 2736 107 4 .625 1.35 5.51 .698 .745 .298 2.85 .387 -.011

- = [ COFECHA ACRU COF ] = -