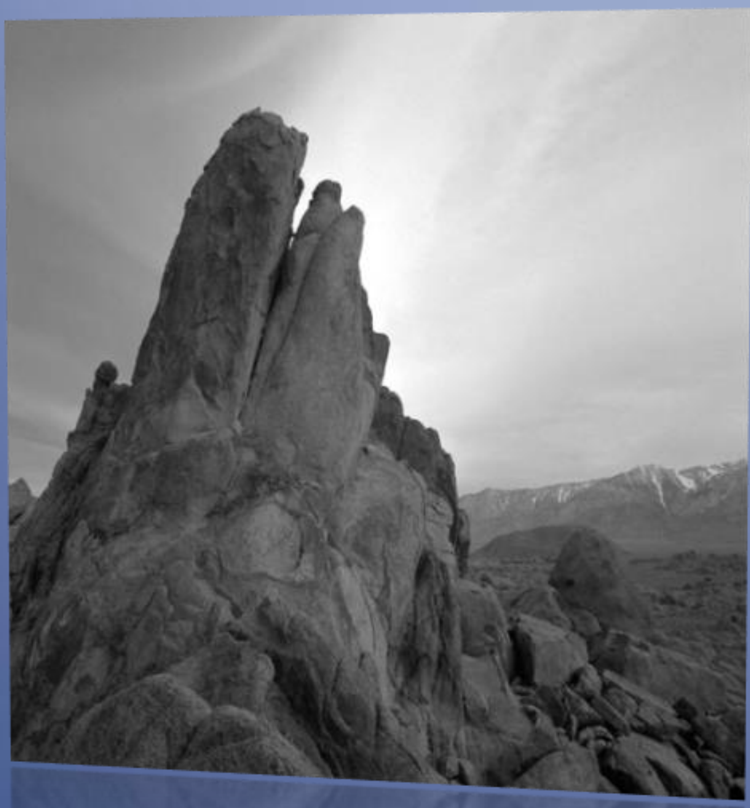

SP-PAM

User Manual Version 2.0

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Maryiana Lyubenova Alexandre Chikalanov	User Manual	1.1	20-12-2010	21-03-2010
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Table of Contents

Application and Structure

The SP-PAM system is designed for analysis of stress periods in tree growth. It consists of two parts:

1. Desktop Application.
2. Web Application.

Chapter Two describes the functions of the desktop application and Chapter Three of the web application.1.

1. Main Definitions

1.1 Stress periods

Tree rings are a reliable sistem for storing information about the event and the influence of environmental factors on growth.

The samples for the dendrohronological analysis were taken from dominant tree species in forest communities. Sampling is performed with Preslerov drill at 1 - 1,5 m. and the width of each ring is measured. The measurement result is obtained from the ordered sequence (year, latitude) probed for each individual as shown in Figure 1.

Figure 1 Change in the annual tree ring widths

The obtained data is used as an input for the regression analysis. The purpose of the regression analysis is to find a polynomial that approximates the best data from a dendrohronological row. Criterion of proximity of the approximative polynomials to the initial data is given by the determination coefficient h R^2 ($0 \leq R^2 \leq 1$). Bigger values of R^2 mean bigger approximation.

After calculating the approximated values the index values are calculated as a relationship to the approximated value of width for each year. Figure 3 shows a graph of the calculated indices compared to the measured ones shown on Figure 2. When the index value is outside of the acceptable range for normal values say that the year in which it is observed, is a stressful year for the growth. The sequence of one or more adjacent stress years is perceived as stress period. Each stress period is set by a couple years - the initial year (LB) and the end year (RB) sequence. When the stress period consists of one year the right and left border is the same.

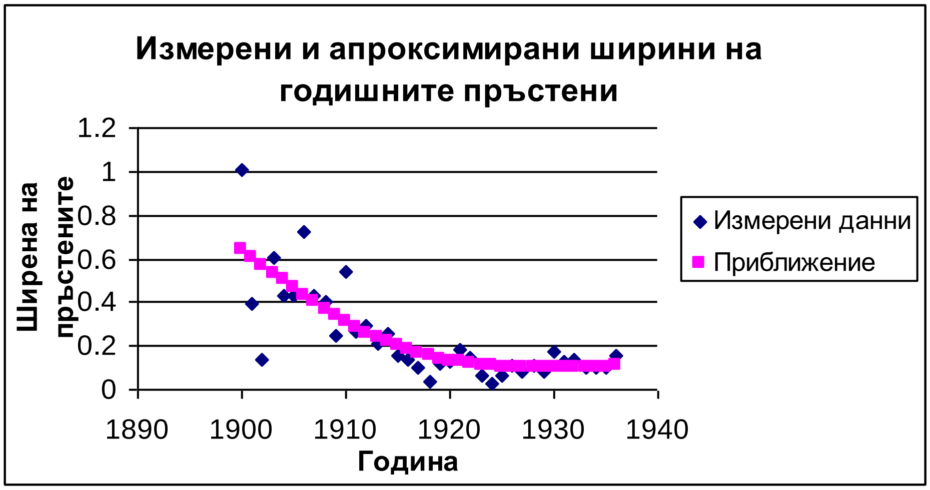

Figure 2 Measured and approximated annual tree ring widths

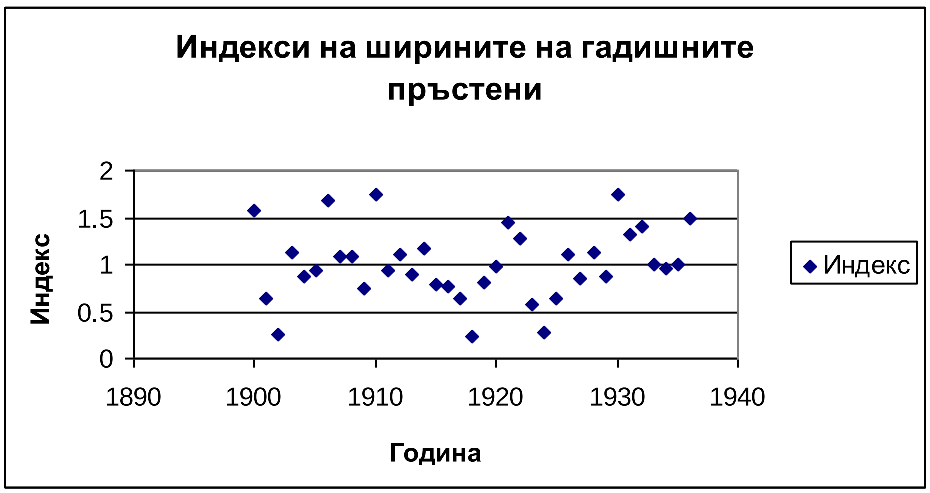

Figure 3 Indexes calculated through regression analysis

1.2 Stress years and Stress periods

Measurement of the stress periods of an individual sample of a species is not sufficient to conclude on the type of stress. Obviously it is necessary to find a common stress periods for a greater number of speciments of the same species.

Let A indicate the stress periods for one dendrohronological row:

(1) $A = \{ SI_i , i = 1 \ldots n, \}$,

where SI_i are the specific stress years. The stress years could be arranges in an increasing order i.e. in the multitude of A there is a specific order. S indicates the multitude of all multitudes of stress years for the sampled tree specimens from the same species:

(2) $S = \{A_i \;\; i \in \{1 \ldots n\} \}$, where A_i are the multitudes of stress years of separate dendrohronological rows;

$\Re$ represents a multitude of sections of stress years.

(3) $\Re = \{I \mid I = \{ SI_{i1}^{j1}, SI_{i2}^{j2}, \ldots, SI_{ik}^{jk} \} : SI_{i1}^{j1} \cap SI_{i2}^{j2} \cap \ldots \cap SI_{ik}^{jk} \neq \emptyset$ where $SI_{i1}^{j1} \in A_{i1}^{j1}, \ldots SI_{ik}^{jk} \in A_{ik}^{jk}$ $\wedge A_{ik}^{jk} \in S \wedge \neg\exists \; SI_{im}^{jm} \in A_{im}$ where $i_m \notin \{ i_1, \ldots i_k \}$ such that $SI_{im}^{jm} \cap SI_{i1}^{j1} \cap SI_{i2}^{j2} \cap \ldots \cap SI_{ik}^{jk} \neq \emptyset \}$.

This means that each element consists of multitudes of separate stress years from dendrohronological rows $A_i \in S$, which contain stress years with total non-empty section. For brevity sections of stress years will be called stress years. Sections that have consecutive years we would call stress periods. Stress periods characterize with the following parameters - cardinality (CARD), left border year (IL), right border year (IR), coverage (CO), confidence interval, standard deviation и alpha α . With cardinality we denote the number of the separate stress periods that belong to stress section $I \in \Re$. The coverage (CO, %) is the relation between the cardinality and the number (N) of all dendrohronological rows Ai such as :

$EY_i \leq IL \leq IR \leq LY_i$, where EY_i и LY_i are the earliest and the latest years from A_i.

(3) CO = 100*CARD/ N

With (IM) we denote the middle of each stress period.

(4) IM = (LB + RB +1)/2 .

The average values of the midpoints are denoted with M and $M = \frac{1}{s}\sum_{i=1}^{s} IM_i$,

where IM_i are the midpoints of the separate stress periods, constructing the stress section. The standard deviation (STD) is the standard deviation of the midpoints IM_i of the separate stress periods.

(MINT) is the middle of the shared interval..

AMPL is the amplitude (depth) of the stress.

(5) $AMPL = \frac{1}{s}\sum_{i=1}^{s}(1 - IND_i)$ where IND_i are the middle indexes of the stress years of the shared period and belong to the respective dendrohronological rows.

2. Description of the desktop application

2.1 Application purpose

The main purposes of the application are:

1. Locating sections of stress periods for each type of wood, for which data exists, and the characteristics that are described above.
2. Providing statistical information for the studied tree species.
3. Regression analysis of the calculated indices relative to the climatic data.

2.2 Language for input data description

Application input data.

Each line begins with a description of the keyword. Each keyword is followed by zero or more parameters. The description of the keywords and their importance and the related parameter follow.

SPECIMEN = {name and species} / {ROW| INDX} – specifies the name of the specific instance of which the dendrohronological row is measured / means that an option is set for the data type. ROW is a data option from the type year and tree ring width. INDX denotes indexes, and not tree ring widths. Mandatory keyword.

NROWS = {number of rows} – denote the number of rows that set the measured dendrohronological row.

RAW = {year} {tree ring width} – denotes a paired data sets describing the dendrohronological row. The width of annual rings is a real number.

INDX = {year, index} - denotes a paired data sets describing the indexes of the dendrohronological row.

An Example of input data is shown below:

Table 1 Example description of dendrohronological rows of Fagus sylvatica L.

```
SPECIMEN = Chuprene  2 /RAW
          NROWS = 34
RAW =  1968      1,19
RAW =  1969      0,935
RAW =  1970      0,73
RAW =  1971      0,685
RAW =  1972      0,715
RAW =  1973      0,57
RAW =  1974      0,52
RAW =  1975      0,535
RAW =  1976      0,505
RAW =  1977      0,575
RAW =  1978      0,885
RAW =  1979      0,88
RAW =  1980      0,835
RAW =  1981      0,735
RAW =  1982      0,865
RAW =  1983      0,89
```

2.3 Results Description.

The processing of input data is performed in two stages. The first one is pre-processing or compilation and the second is finding the stress sections. In both stages the results from the processing of input or intermediate data are displayed.

While compiling the following operations on the input data are performed:

1. Read the data and check for errors. For ease of use of the application and reducing error messages all lines starting with undefined keywords are ignored.

2 . Find the equations of polynomials approximating each dendrochronology . Selection of the polynomial approximating the best data by each of them. Dendrochronology for which R2 is less than 0.45 are rejected as unreliable. Calculating the indices of the dendrohronological rows which are considered as reliable.

3 . Calculating all the best formulas and the corresponding values of R2 by type , area of sampling , individual. Calculating the average of the indices of reliable dendrohronological ranks. Calculating the correlation coefficients between the indices of reliable dendrohronological ranks.

4 . Calculating the autocorrelation matrix of the width of annual growth rings for the location.

5 . Calculation of the correlation matrix between the indices of the rows of the location.

6 . Analysis of these climate data and calculated indices in the manner in which they are calculated for the width of the annual rings.

7 . Determine the type of each climate year .

Table 2 shows an example result of an analysis.

Table 2 Analysis result

Species	Fagus sylvatica		
Specimen	Type of Approximation	Formula	R^2
Western Balkan 1			
1	Linear	-0.00090872x+1.9134	0.14923
2	Polynomial of 2th degree	-4.9846e-05x^2+0.19299x^1-186.61	0.47914
3	Polynomial of 3th degree	-5.959e-07x^3+0.0034272x^2-6.5689x^1+4196.1	0.51253
4	Polynomial of 4th degree	+4.6505e-08x^4-0.0003624x^3+1.0589x^2-1374.9x^1+6.6932e+05	0.65468
5	Polynomial of 5th degree	-6.7204e-10x^5+6.5821e-06x^4-0.025784x^3+50.495x^2-49440x^1+1.9361e+07	0.67529
6	Polynomial of 6th degree	+1.0217e-11x^6-1.199e-07x^5+0.0005863x^4-1.529x^3+2242.9x^2-1.7547e+06x^1+5.7195e+08	0.67859
7	Polynomial of 7th degree	+5.8862e-13x^7-8.0038e-09x^6+4.6639e-05x^5-0.15097x^4+293.21x^3-3.4164e+05x^2+2.2113e+08x^1-6.1338e+10	0.68547
8	Polynomial of 8th degree	-4.5315e-15x^8+7.1099e-11x^7-4.8798e-07x^6+0.0019136x^5-4.6893x^4+7353.4x^3-7.206e+06x^2+4.0347e+09x^1-9.8819e+11	0.68572

Year	Measured data	Approximation	Index
1893	0.24	0.23193	1.0348
1894	0.23	0.22205	1.0358
1895	0.2	0.20569	0.97234
1896	0.145	0.19299	0.75132
1897	0.16	0.17737	0.90208
1898	0.155	0.16248	0.95399
1899	0.145	0.15344	0.94498
1900	0.13	0.14282	0.91022
1901	0.13	0.1322	0.98334
1902	0.135	0.12317	1.0961

Table 3 shows the calculated statistics by species, sampling region and individual. The first column is the name of the sampling region. The second – the names of the respective individuals. In the third – the equations of the best approximating polynomials for all dendrohronological rows. The forth column contains R^2.

Table 3 Statistics generated during input data compilation stage.

Location	Specimen	Best approximation polynomial	Best approximation R^2	Year	Average index	Number of samples
Western Balkan						
	Western Balkan 1	-4.5315e-15x^8+7.1099e-11x^7-4.8798e-07x^6+0.0019136x^5-4.6893x^4+7353.4x^3-7.206e+06x^2+4.0347e+09x^1-9.8819e+11	0.68572	1893	1.0348	1
	Western Balkan 2	+1.157e-13x^7-1.5473e-09x^6+8.8628e-06x^5-0.028185x^4+53.744x^3-61444x^2+3.8998e+07x^1-1.06e+10	0.38323	1894	1.0358	1
	Western Balkan 3	+2.8837e-09x^6-3.4209e-05x^5+0.16909x^4-445.74x^3+6.6095e+05x^2-5.2269e+08x^1+1.7223e+11	0.63614	1895	0.97234	1
	Western Balkan 4	+6.3521e-09x^6-7.5331e-05x^5+0.37223x^4-980.95x^3+1.4541e+06x^2-1.1496e+09x^1+3.7869e+11	0.65495	1896	0.75132	1
	Western Balkan 5	-6.8493e-12x^7+9.3757e-08x^6-0.00055x^5+1.7924x^4-3504.6x^3+4.1113e+06x^2-2.6794e+09x^1+7.4831e+11	0.2675	1897	0.90208	1
	Western Balkan 6	+2.1851e-10x^6-2.5732e-06x^5+0.012625x^4-33.037x^3+48627x^2-3.8172e+07x^1+1.2485e+10	0.53053	1898	0.95399	1
	Western Balkan 7	-2.4027e-12x^7+3.2805e-08x^6-0.00019194x^5+0.62389x^4-1216.6x^3+1.4234e+06x^2-9.2515e+08x^1+2.5768e+11	0.50751	1899	0.94498	1
	Western Balkan 8	-3.0122e-13x^7+4.108e-09x^6-2.4008e-05x^5+0.077943x^4-151.81x^3+1.774e+05x^2-1.1516e+08x^1+3.2035e+10	0.45368	1900	0.84806	3
	Western	-1.251e-12x^7+1.7125e-08x^6-	0.37904	1901	1.0409	4

Balkan 9	0.00010046x^5+0.32737x^4-640.06x^3+7.5082e+05x^2-4.8927e+08x^1+1.3664e+11				
Western Balkan 10	-6.9723e-12x^7+9.5438e-08x^6-0.00055986x^5+1.8245x^4-3567.3x^3+4.1847e+06x^2-2.7271e+09x^1+7.6164e+11	0.26156	1902	1.0219	4
Western Balkan 11	+2.6176e-10x^6-3.1084e-06x^5+0.01538x^4-40.581x^3+60227x^2-4.767e+07x^1+1.572e+10	0.47527	1903	1.0798	4
Western Balkan 12	-1.215e-11x^7+1.6753e-07x^6-0.00099002x^5+3.2501x^4-6401.5x^3+7.565e+06x^2-4.9664e+09x^1+1.3973e+12	0.31843	1904	1.0259	4

Table 4 shows the matrix of correlation coefficients between the indexes of the reliable dendrohronological rows.

Table 4 Correlation coefficients of dendrohronological rows indexes.

			Correlation coefficients	
	Wester	Western Balkan 3	Western Balkan 4	Western Balkan 6
Western Balkan 1		0.52	0.26	0.04
Western Balkan 3			0.15	0.11
Western Balkan 4				0.16

For each sampling region (location) additional average characteristics are shown:

- Location name.
- Sampled species names.
- Equation of the best approximating polynomial for each individual.
- Relative value of R^2.
- Average indexes, resulting from the reliable dendrohronological rows, specified for the species – year, average index, row number, for which the average index is calculated.

Table 5 shows a sample location characteristic.

Table 5 Location characteristics.

Location	Specimen	Best approximation polynomial	Best approximation R^2	Year	Average index	Number of samples
Petrohan						
	Petrohan_1	+8.9744e-05x^5-0.86219x^4+3313.3x^3-6.3663e+06x^2+6.1163e+09x^1-2.3504e+12	0.19298	1917	0.99328	2
	Petrohan_2	-5.0641e-05x^5+0.48668x^4-1870.9x^3+3.5959e+06x^2-3.4558e+09x^1+1.3285e+12	0.80171	1918	0.95286	2
	Perohan_3	-0.00078462x^5+7.539x^4-28975x^3+5.5681e+07x^2-5.3501e+10x^1+2.0563e+13	0.82908	1919	0.95306	2
				1920	1.0897	2
				1921	0.73507	2
				1922	1.0833	2
				1923	1.1631	2
				1924	0.8454	2
				1925	1.0482	2
				1926	0.89455	2

Also the following characteristics are displayed:

- The equations of approximative polynomials in temperature and precipitation.
- Suitable values of R2.
- For each year for which data are available for widths of annual rings, temperature and precipitation , the following information appears - year average index of the width of annual rings dendrohronologichnite forefront of location , temperature index, rainfall and type of the year. Type of year for short is specified as - the first letter may be N - normal year , W - warm year or C - cold year and the second N - normal year , W - wet year or D - dry year . These labels depend on the value of the corresponding index.

Table 6 Location characteristics connected to climate data.

Climate	Width	Temperature	Precipitation	Type of year
Polynomial		-3.4253e-11x^7+4.703e-07x^6-0.0027673x^5+9.0459x^4-17741x^3+2.0876e+07x^2-1.3646e+10x^1+3.8228e+12	+2.9087e-10x^7-3.9574e-06x^6+0.023072x^5-74.722x^4+1.4518e+05x^3-1.6924e+08x^2+1.0958e+11x^1-3.0408e+13	

Year	Width index	Temperature index	Precipitation index	
R^2		0.054965	0.15249	
1917	0.99328	1.0159	0.92622	NN
1918	0.95286	0.97602	1.0731	NN
1919	0.95306	1.011	1.2981	NW
1920	1.0897	0.9785	0.66689	ND
1921	0.73507	0.97166	1.053	NN
1922	1.0833	0.99343	0.86377	NN
1923	1.1631	1.0499	1.2729	NW
1924	0.8454	0.97775	0.99302	NN
1925	1.0482	1.0152	0.90687	NN
1926	0.89455	1.0443	0.84161	NN

After approximation and filtering of the input data the second stage of processing begins. During this stage the following operations on the intermediate reliable dendrohronological data are performed:

1. Locating the stress section and calculation of the statistical characteristics.
2. Calculating the statistical characteristics of dendrohronological rows separately by area of sampling and the species as a whole.

Stress sections and statistical data

Table 7 a and b shows a sample excerpt of a part of a description of a stress section. Columns (a) show the species name, number, name of the dendrohronological rows, first and last years of the dendrohronological rows, the stress period which is part of the section, amplitude of the shared stress period, cardinality, coverage, middle of the total period, standard deviation, confidence interval, α, intersection and union of the stress periods.

Table 7 a Stress sections and statistical data.

Pinus nigra	No	Specimen	Earliest Year	Latest Year	Interval		Amplitude	Cardinality
	1	Vitosha 1	1901	2000	1968	1972	0.204798	22
		Vitosha 2	1906	2000	1968	1974	0.181296	
		Vitosha 4	1903	2000	1968	1973	0.104699	
		Vitosha 6	1895	2000	1968	1969	0.277354	
		Vitosha 7	1909	2000	1968	1970	0.021656	
		Vitosha 8	1914	2000	1966	1976	0.1808	
		Vitosha 10	1912	2000	1966	1970	0.280289	
		Vitosha 11	1949	2000	1965	1969	0.066499	

Table 7 b Stress sections and statistical data (continued)

Coverage %	Mean	Standard deviation	Confidence	Alpha	Intersection		Union	
81.48	1968	1.708	16	0.25	1968	1968	1962	1978

The statistics related to the stress periods of the dendrohronological sequences are shown in Tables 8a and b. These include the period of each dendrohronological row, the number of stress periods, frequency of stress periods, calculated for 100 years, the average amplitude, the largest amplitude, the average length of the stress period, the longest stress period - initial and final year. The same data - aggregated and averaged are calculated and for the specific species sampling location.

Table 8 a Statistics connected to the stress periods of dendrohronological rows.

Fagus sylvatica	Period		Number of stress periods	Frequency
Petrohan				
Petrohan_2	1900	1909	5	50
Perohan_3	1900	1909	3	30
Average per Location	1900	1909	4	40
Boishte				
Boishte_1	1913	1922	3	30
Average per Location	1913	1922	3	30
Gabra				
Gabra_1	1900	1909	5	50
Gabra_2	1900	1909	3	30
Average per Location	1900	1909	4	40
Average per Species	1900	1922	3.667	36.67

Table 8 b Statistics connected to the stress periods of dendrohronological row (continued).

Average amplidude	Highest amplitude		Average period	Longest stress period		Longest stress period length
0.1094	1907	0.1904	1.2	1906	1907	2
0.2245	1907	0.4585	2.667	1900	1902	3
0.1669	1907	0.4585	1.933	1900	1902	3
0.05989	1915	0.103	2	1918	1920	3
0.05989	1915	0.103	2	1918	1920	3
0.1094	1907	0.1904	1.2	1906	1907	2
0.2245	1907	0.4585	2.667	1900	1902	3
0.1669	1907	0.4585	1.933	1900	1902	3
0.1313	1907	0.4585	1.956	1900	1902	3

2.4 Desktop application functions description

Figure 4 shows a general view of the application. The desktop application is a table containing the results from the processing of the input data.

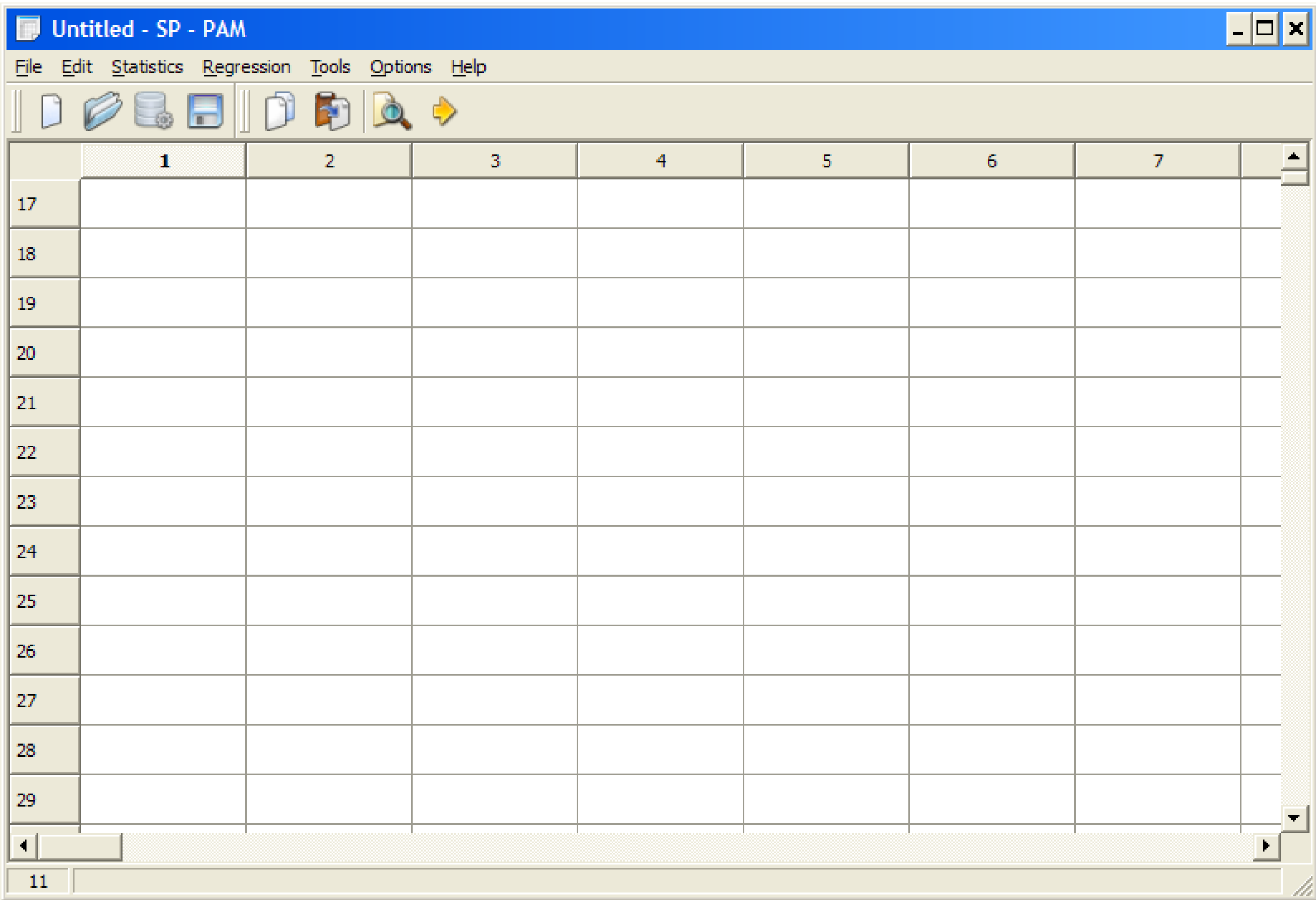

Figure 4 Overall application view.

With marking the cells or part or them the marked area could be copied Ctrl C on the clipboard and subsequently transferred into Excel, Open Office Calc or another application.

2.4.1 File manipulation functions

The file functions menu is shown in Figure 5. New input description opens with the sequence: File -> New description - a file choice dialog appears, as shown on Figure 6.

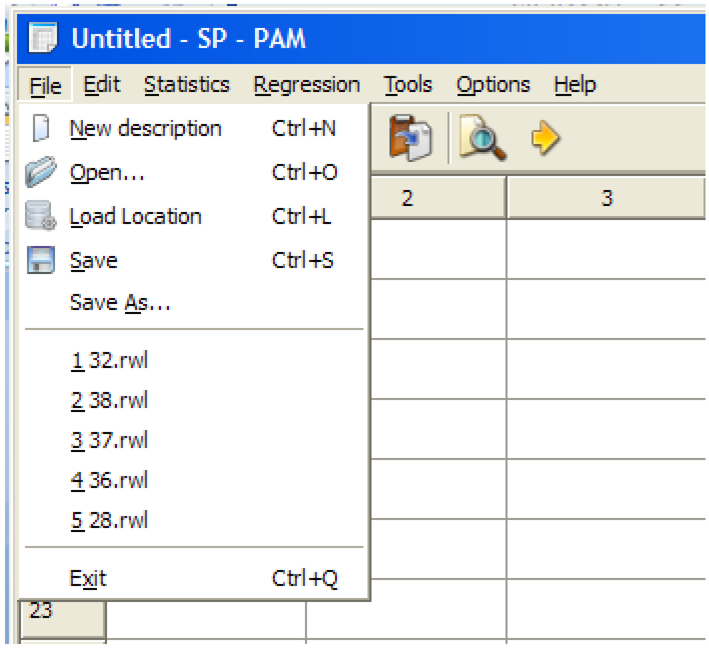

Figure 5 File manipulation menu.

If the function New Description is selected a dialog for file choice appears, containing a description of rows of tree ring widths from a location, as shown on Figure 6.

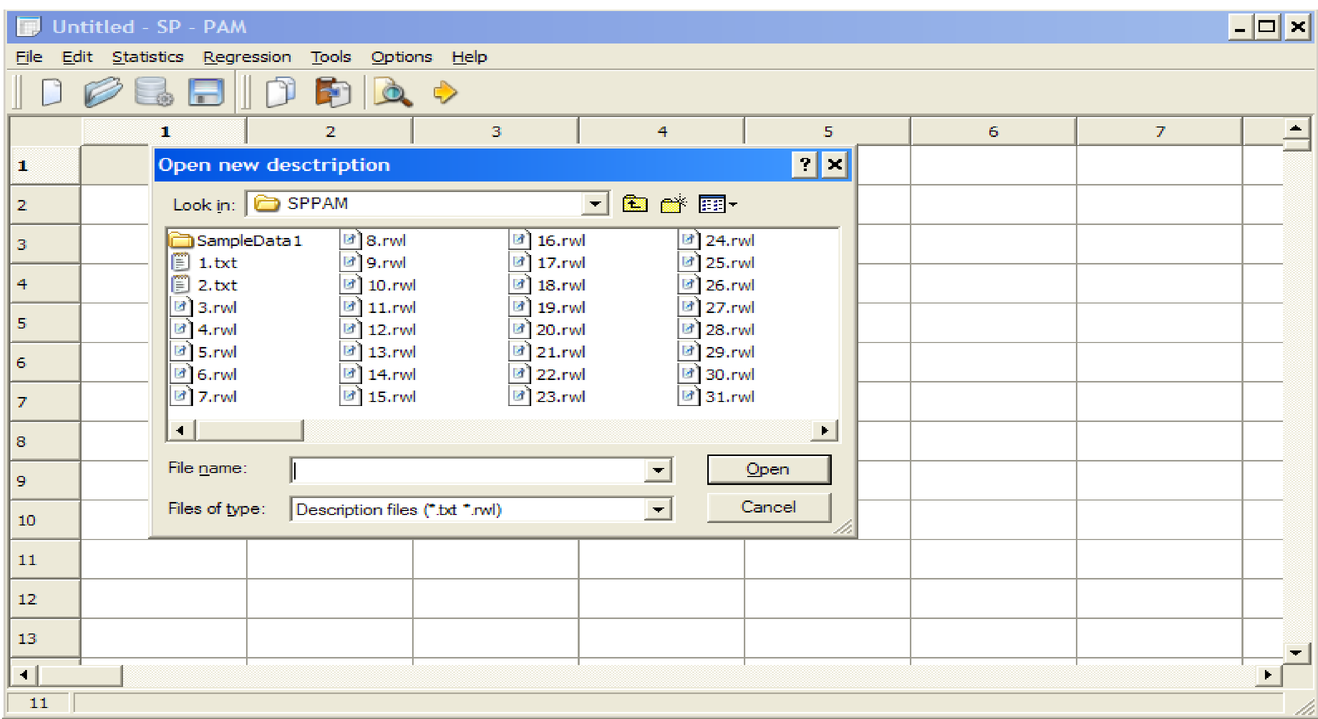

Figure 6 File choice with input description dialog.

Users can choose two types of input description formats – description, which is standa5rd for the application(.txt extention) and a description which is specific to some dendrohronological databases (.rwl extention). Table 9 shows an example of an .rwl description of the tree rings. The .rwl format is the de facto standard for the description of the measurements of widths of annual rings.

Table 9 Example data format from .rwl file.

```
626    1 Blumone, Malga WIDTH_RING PCAB -
626    2 Italy   Norway spruce 1650  4553-1025 1840 1980 -
626    3 FRITZ SCHWEINGRUBER -
626031  1851   262   241   176   188   300   295   230   262   290
626031  1860   251   321   263   350   305   404   369   379   340   265
626031  1870    53    47    97   132   132   118   151   118   138   145
626031  1880   143   116   113   104    98   137   138   124   155   130
626031  1890   120   117   137   177   175   189   177   167   159   168
626031  1900   152   194   213   208   307   242   215   185   187   166
626031  1910   112   184   205   158   103   150   181   225   206   165
626031  1920   217   185   157   129   175   159   158   184   184   218
626031  1930   198   166   135   123   154   138   114   133   106   133
626031  1940   133   132   253   211   238   300   263   313   273   313
626031  1950   252   179   273   309   246   275   262   253   190   262
626031  1960   278   243   210   223   323   292   258   273   288   293
626031  1970   260   283   239   250   233   229   218   198   208   241
626031  1980   187   999
```

After selecting the file with a description of the widths of the annual rings, the user must enter the place of sampling:,

1. From the list of countries a country is chosen.
2. In the Location name a name of the location must be entered.
3. In the fields Location latitude, Location longitude and Location altitude appropriately are fed geographical width geographical longitude and altitude of the location. The data is an integer format as in the standard .rwl files. The system converts them to decimal numbers. The last two digits are converted into tenths and hundredths of a geographical degree.

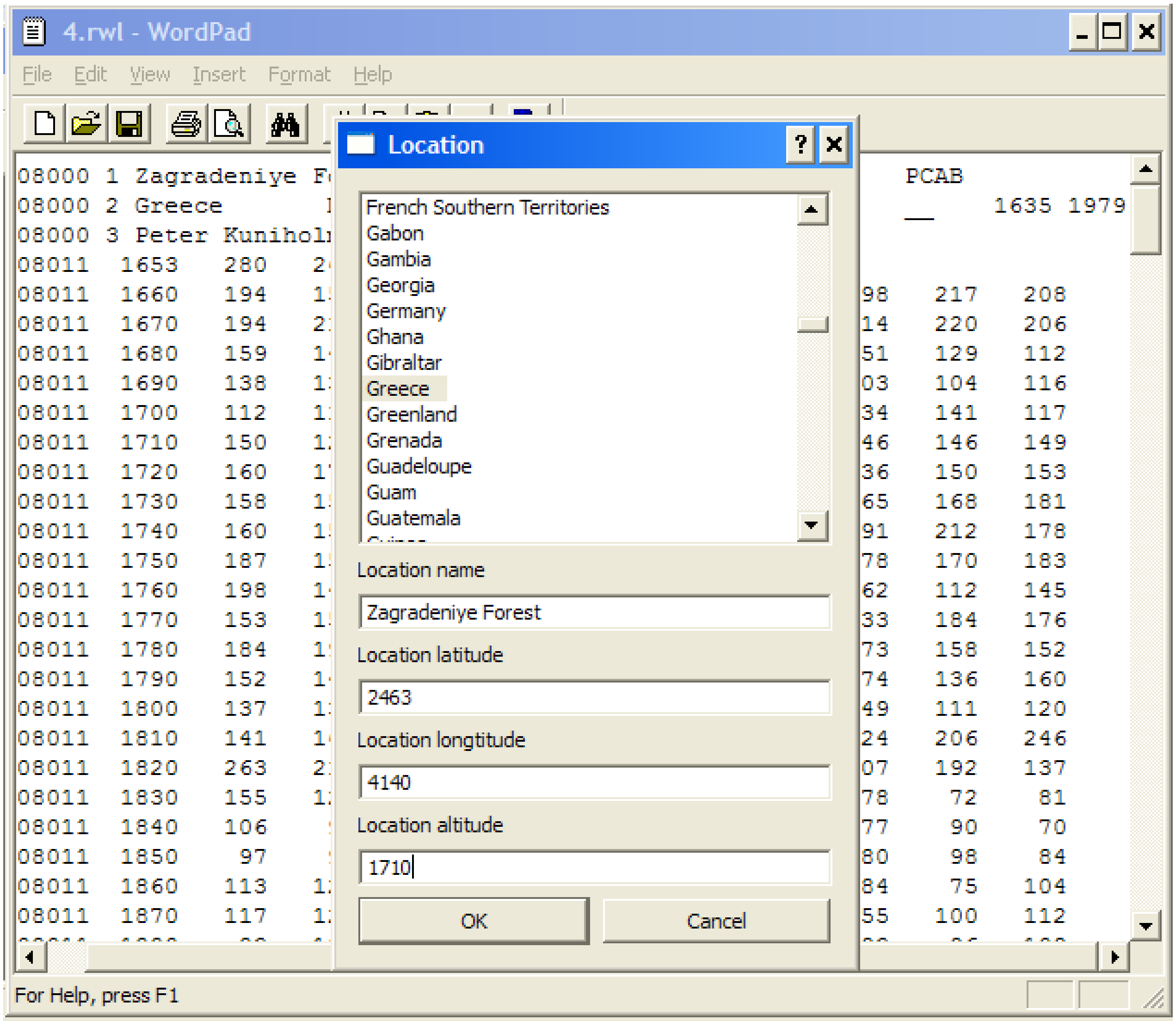

Figure 7Sample location data choice.

After selecting the OK button a dialog for selecting the sampled tree species is shown, as shown in Figure 8.

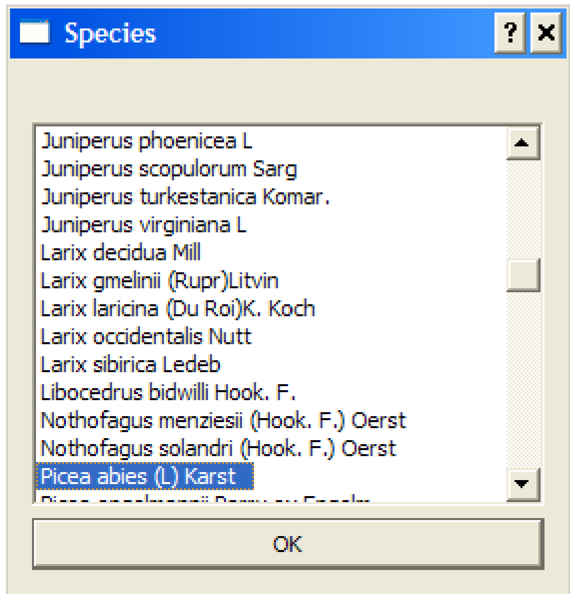

Figure 8 Tree species choice dialog.

The functions Open, Save and Save as in the current version work with files containing comma separated fields(csv). The buttons for the functions New description, Open and Save from the File menu are shown on Figure 9.

Figure 9 New description, Open and Save functions buttons.

2.4.2 Cell editing functions

The functions for cell redactions are located in the Edit menu. Figure 10 shows all cell redaction functions.

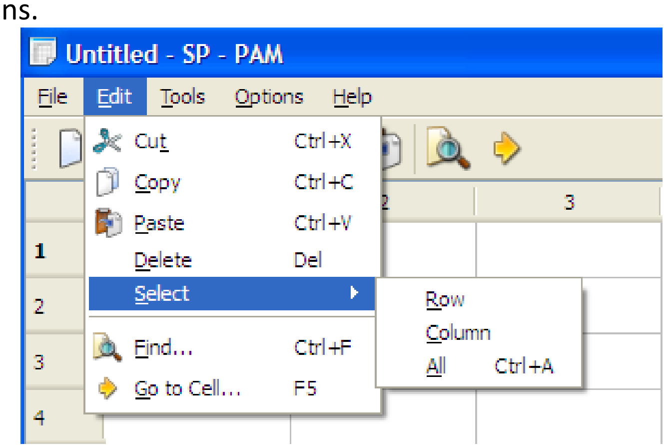

Figure 10 Cell editing functions.

2.4.3 Tools

When choosing Tools-> Settings the dialog shown on Figure 11 appears. Here it can be choosen which of the following data to appear when showing the data for stress sections.

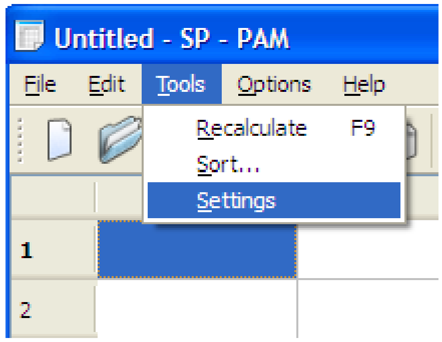

Figure 11 Tools

The options that can be set in the window shown below are:

- Minimal coverage – the minimum amount of coverage rates over which stress sections are considered reliable.
- Variation interval – The value of the percentage for which it is assumed that the indexes are not stressful. If this value is not set the confidence interval of the sequence of indices is chosen.

The following options determine whether to display certain characteristics of stress sections of all intervals or only those for which climate information is available.

The last group of options specifies which of the calculated data are to be virtualized.

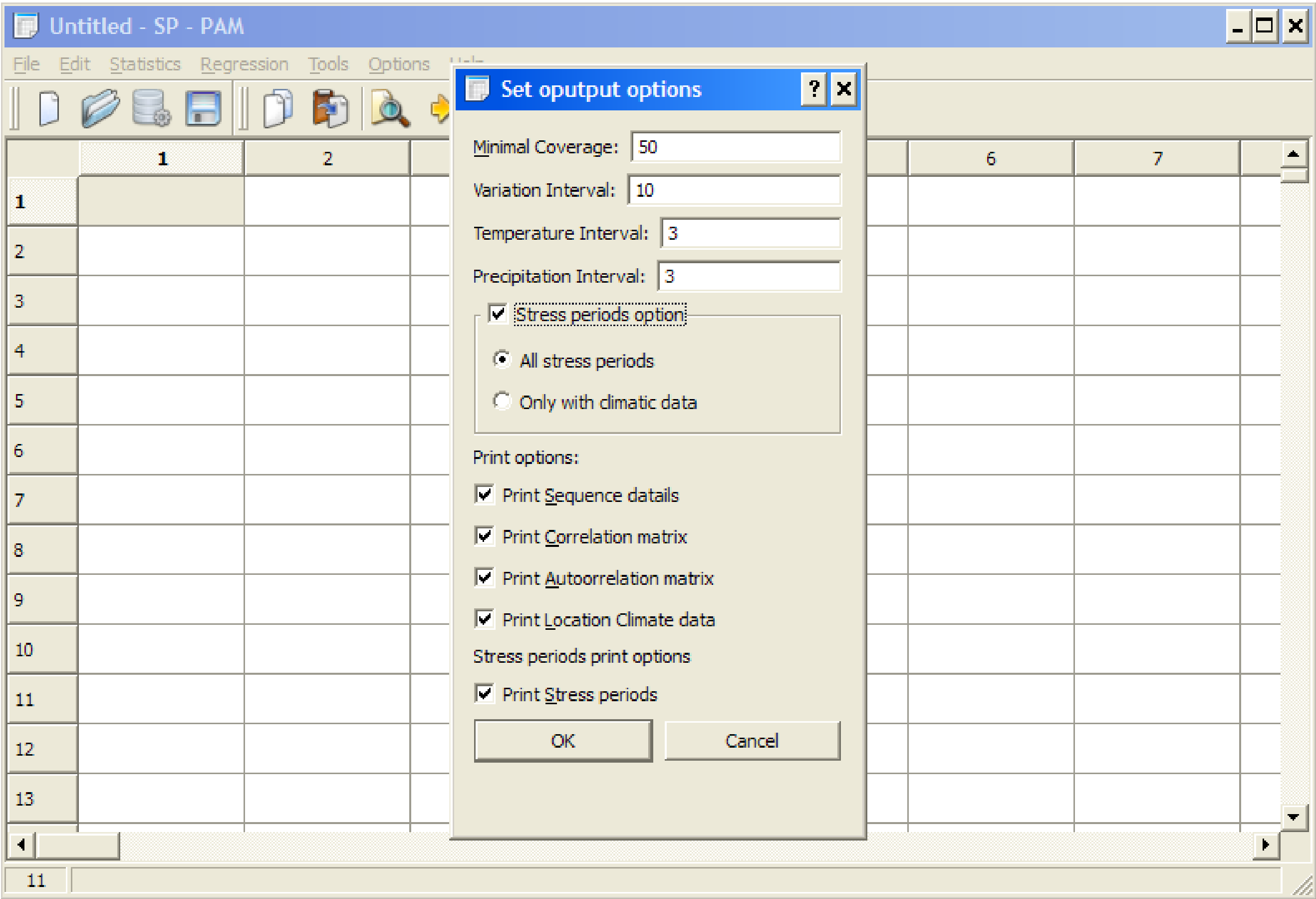

Figure 12 Stress sections characteristics condition choice.

2.4.5 Functions for displaying statistical information

Statistical information related to the results of data processing of the measured widths of annual rings and stored air information can be obtained by selecting the menu item - Statistics-> By Geolocation as shown in Figure 13. Then a wood species is selected, as shown in Figure 8. After the selection of tree species a parameters of statistics are introduced:

1. Geographic coordinates - longitude, latitude and altitude.
2. Select information output - on screen or csv file.
3. Choice of statistics data.

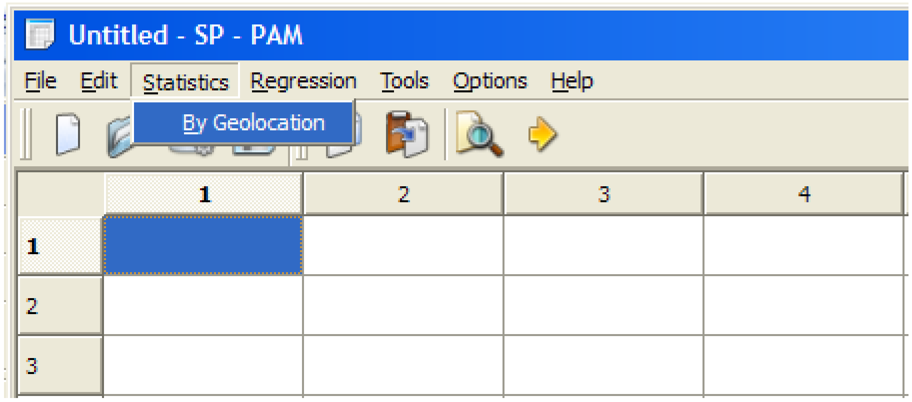

Figure 13 Geographic coordinates statistics function choice.

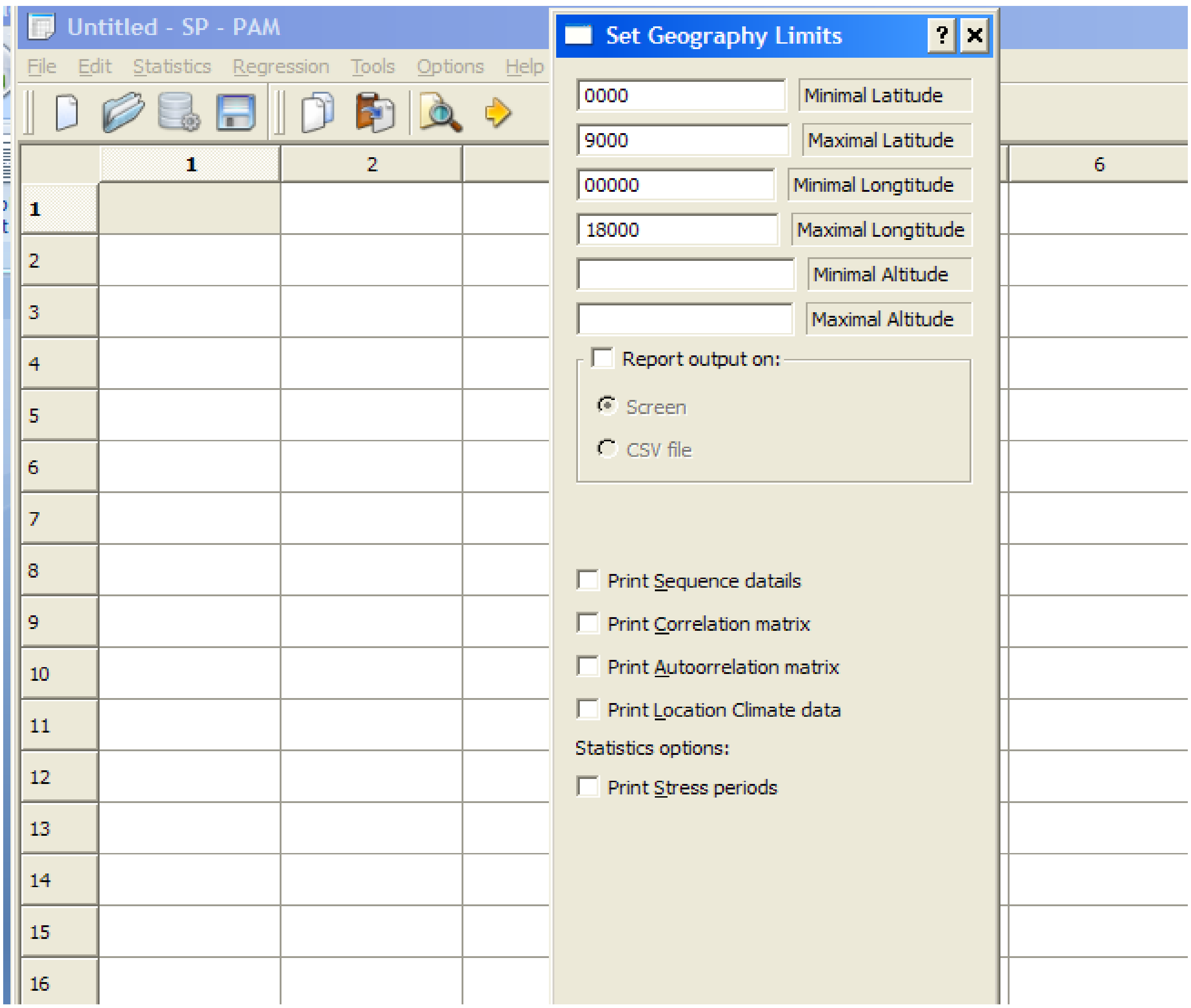

Figure 14 Geographic coordinates statistics parameters choice.

2.4.5 Functions for regression analysis

The application supports functions for regression analysis. Regression analysis includes functions for multidimensional linear analysis and one-dimensional nonlinear analysis. In both cases, the dependent variable is a variable of the values of the average index of the annual rings from a selected location.
The choice of one of two types of regression analysis is done by selecting the menu function Regression. Multivariate linear regression analysis is selected by
Regression-> Linear Regression, and non-linear regression analysis using
Regression-Nonlinear Regression as shown in Figure 15

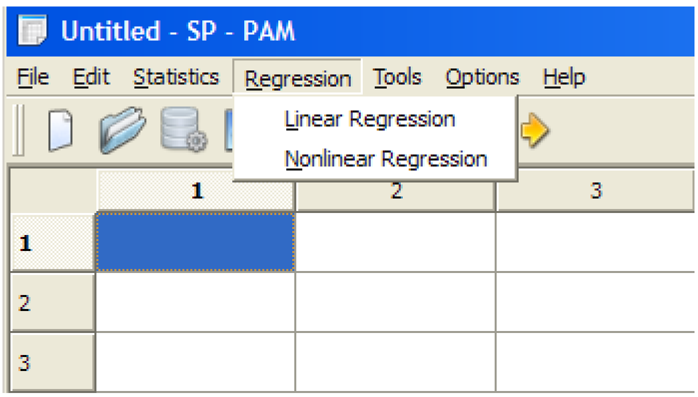

Figure 15Regression analysis type choice.

After selecting the type of the regression analysis is tree species is selected (Fig. 8).
Figure. 16 shows a window for selecting the location and the independent variables. The independent variables can be one or more of the following - the temperature for the years for which there is a calculated index difference of the mean temperatures , precipitation and a differential of average precipitations .
Figure 17 shows the window for selecting the location, type of nonlinear regression and independent variables. The independent variables can be one or more of the following - the temperature for years for which there is a calculated index, difference of the mean temperatures , and precipitation and a differential of average precipitations. In case more than one independent variable is selected a regression analysis for each of them is carried out .

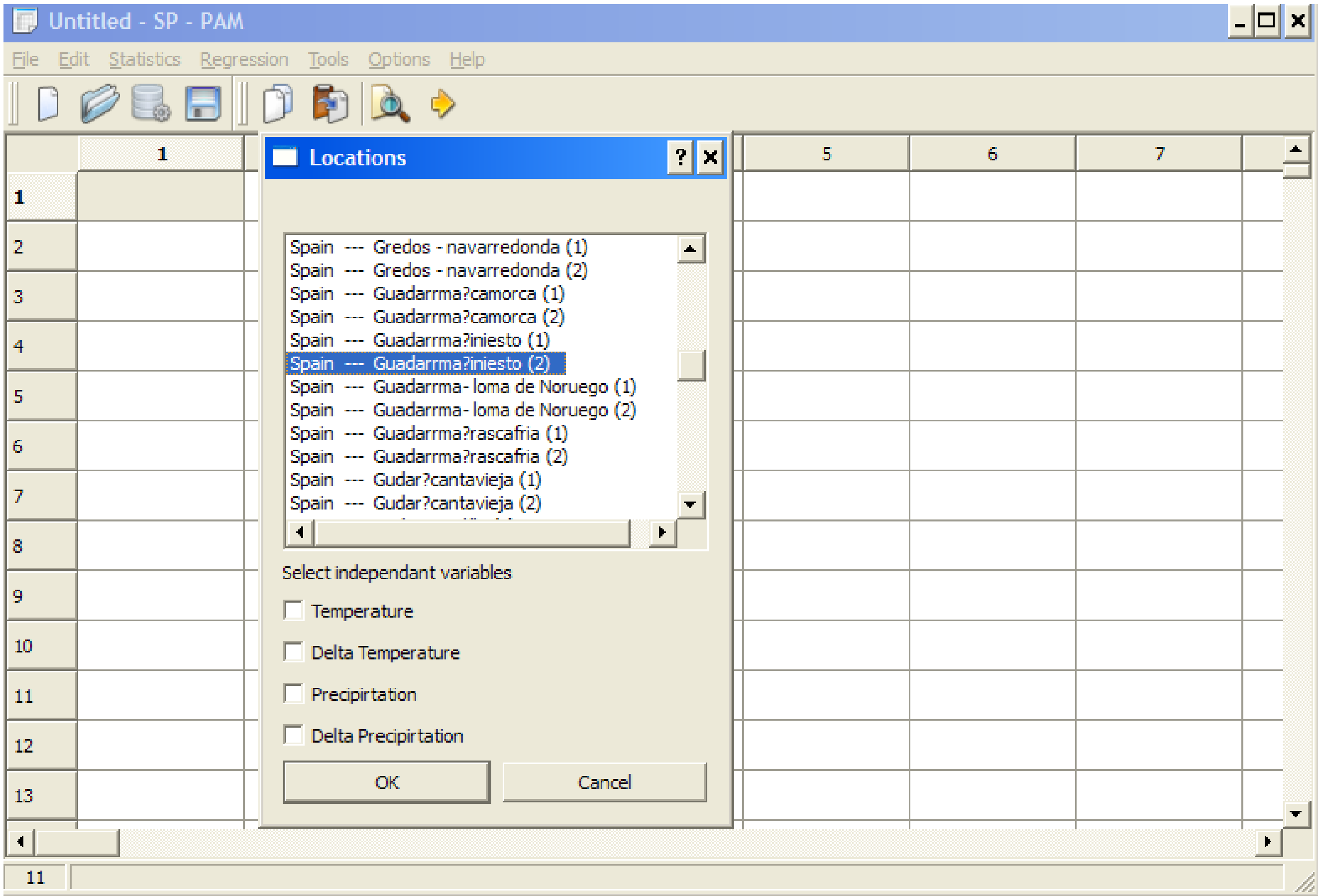

Figure 16 Dialog for choosing locations and independent variables for linear multidimensional regression analysis.

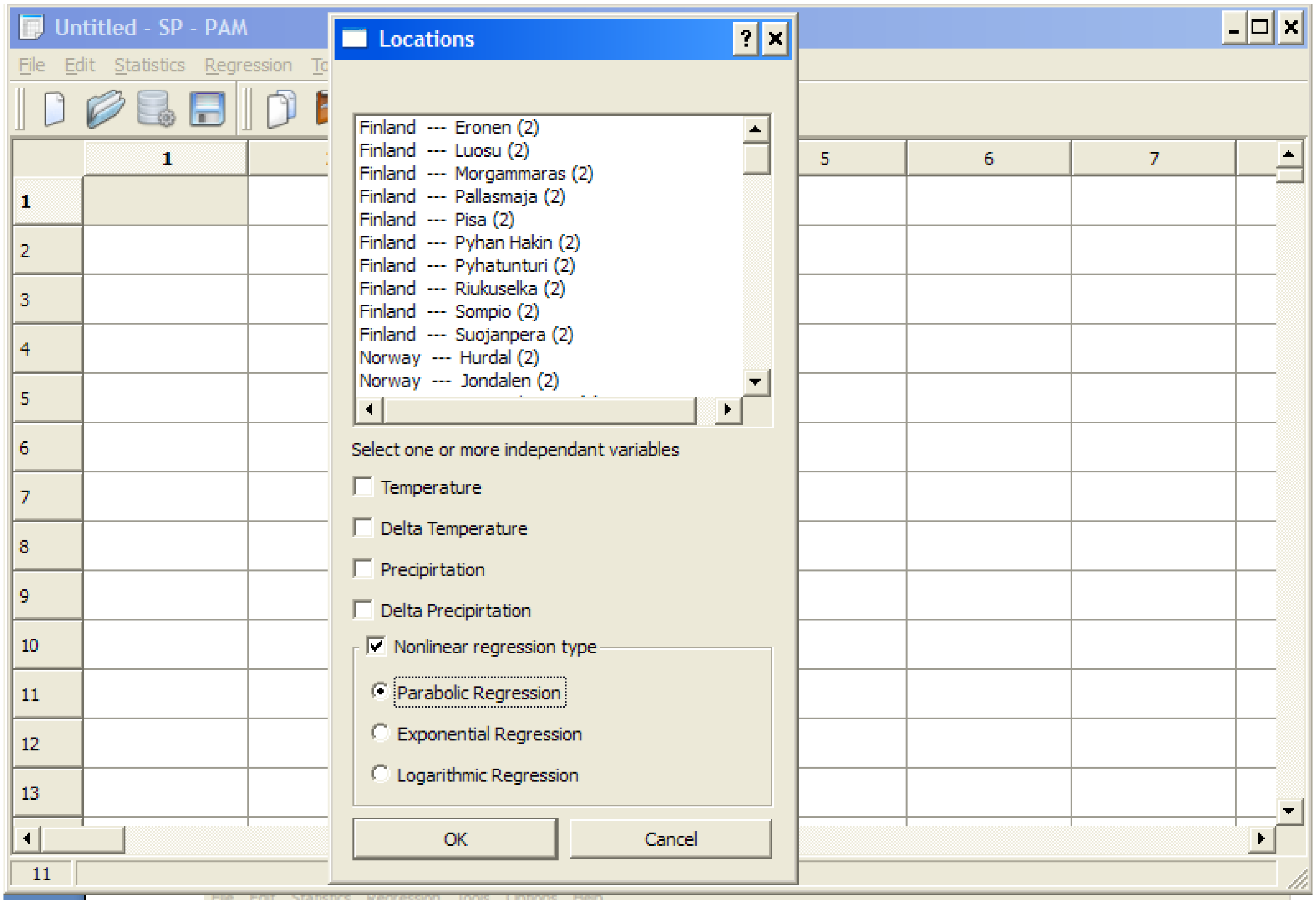

Figure 17 Dialog for choosing locations, independent variables and type for one dimensional regression analysis.

3. Web Application Description

The web application is designed for public access to information related to the processing of the widths of the annual rings of all locations processed and stored in the database.

3.1 Results

Entering the link - http://sppam.e-ecology.org/results to the results page as shown on Figure 18.

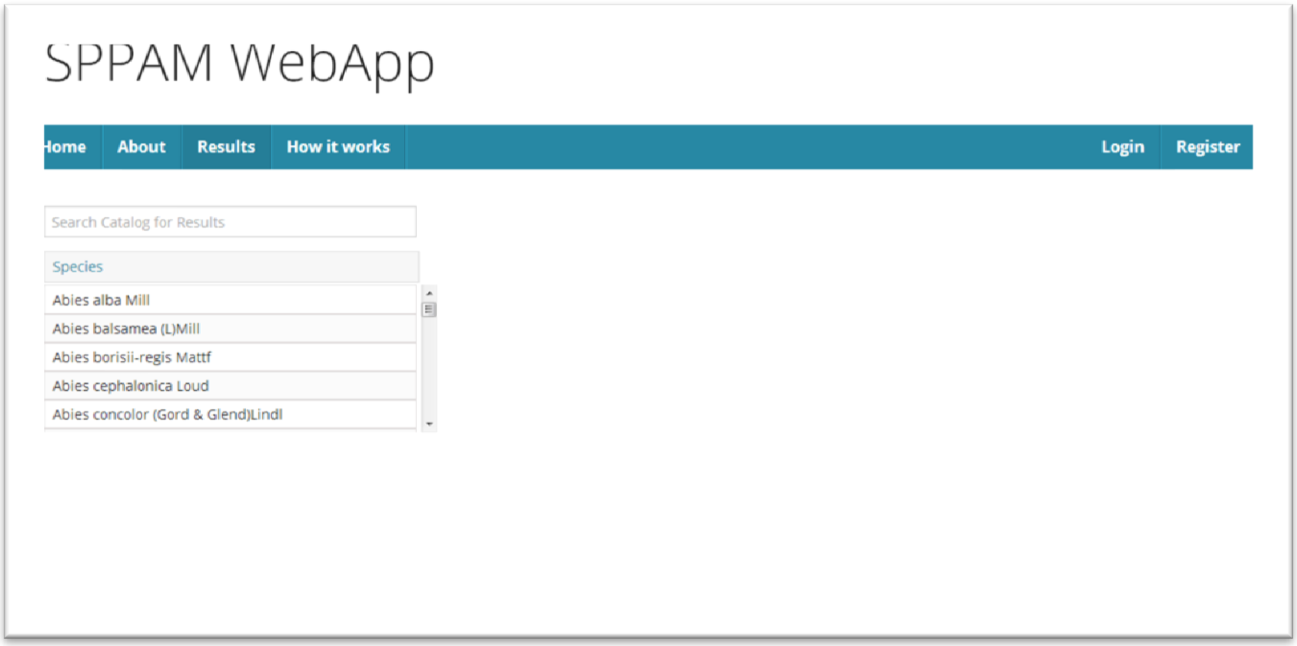

Figure 18 Results page of the wen application

3.1 Registration and Login

The system supports user registration, as logging-in is done by entering user name and a password as shown on Figure 19 and Figure 20.

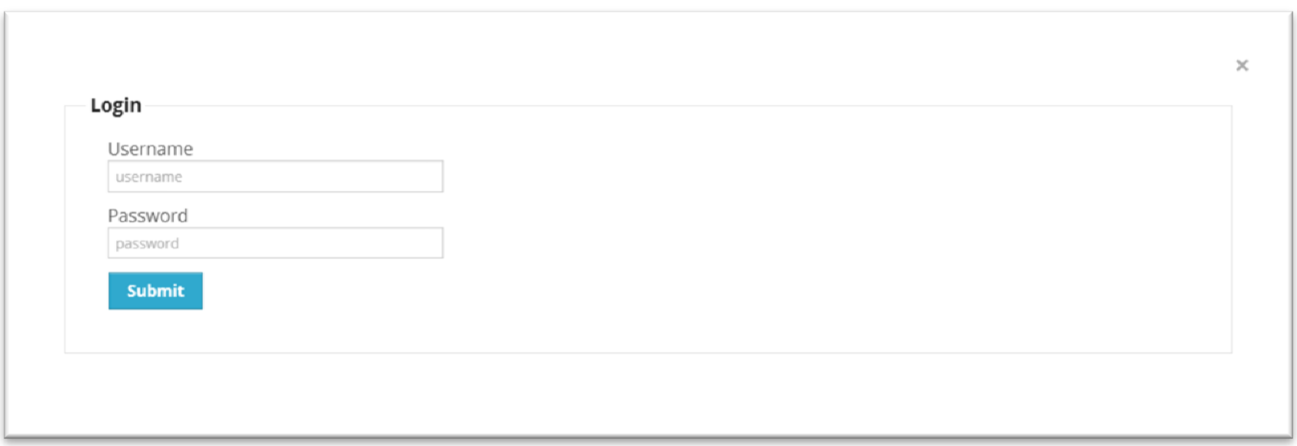

Figure 19 Web application login

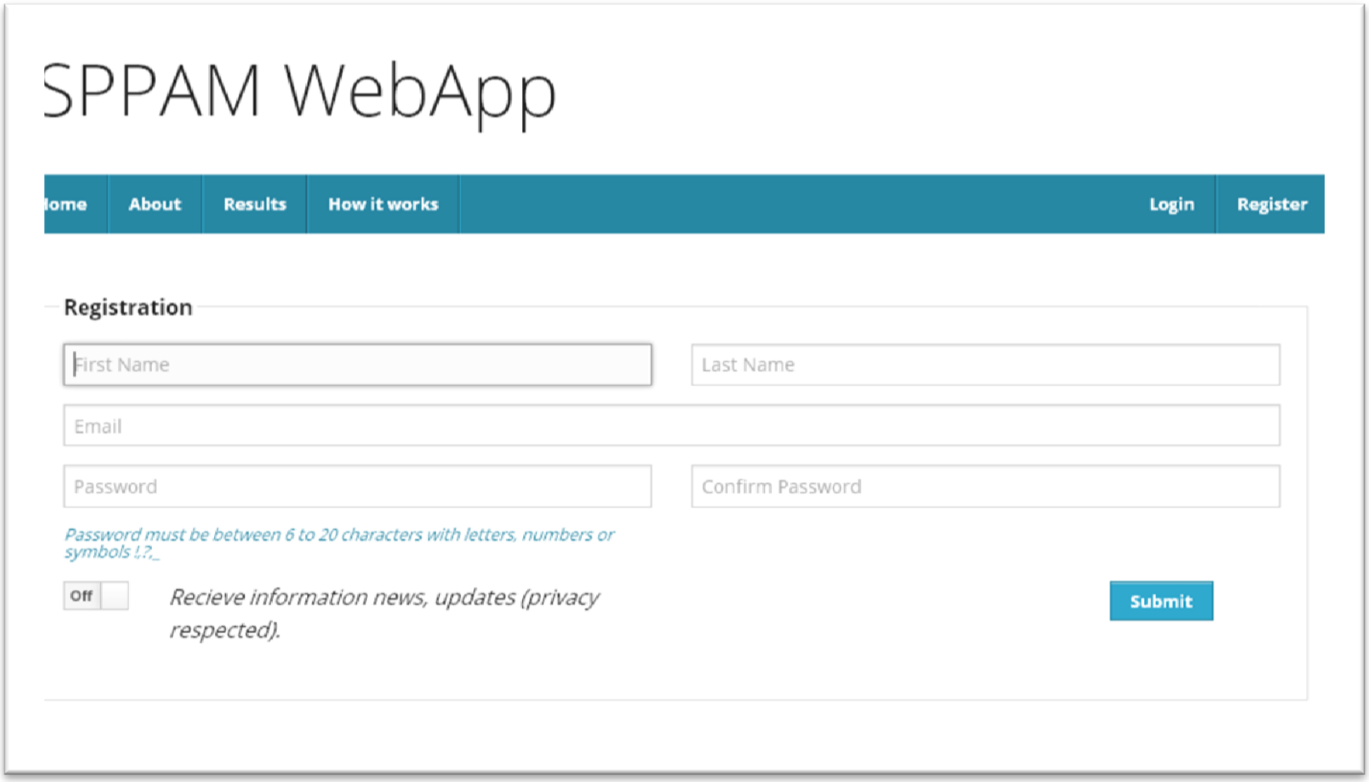

Figure 20 Web application registration.

3.2 Initial processing results display

Access to the data from the initial processing is open to any visitor to the site . It operates through a consistent choice of tree species (Fig. 21) , country and location (Fig. 22). After selecting a location a list of all rows of the location having R2> 0.45 is displayed. For each row the best approximation polygon and R2 are shown.

When selecting the id of a location two graphics are visualized :

1. The measured and approximated values of annual ring widths of the selected row.

2 . The calculated index as the ratio between the measured and calculated values for each year.

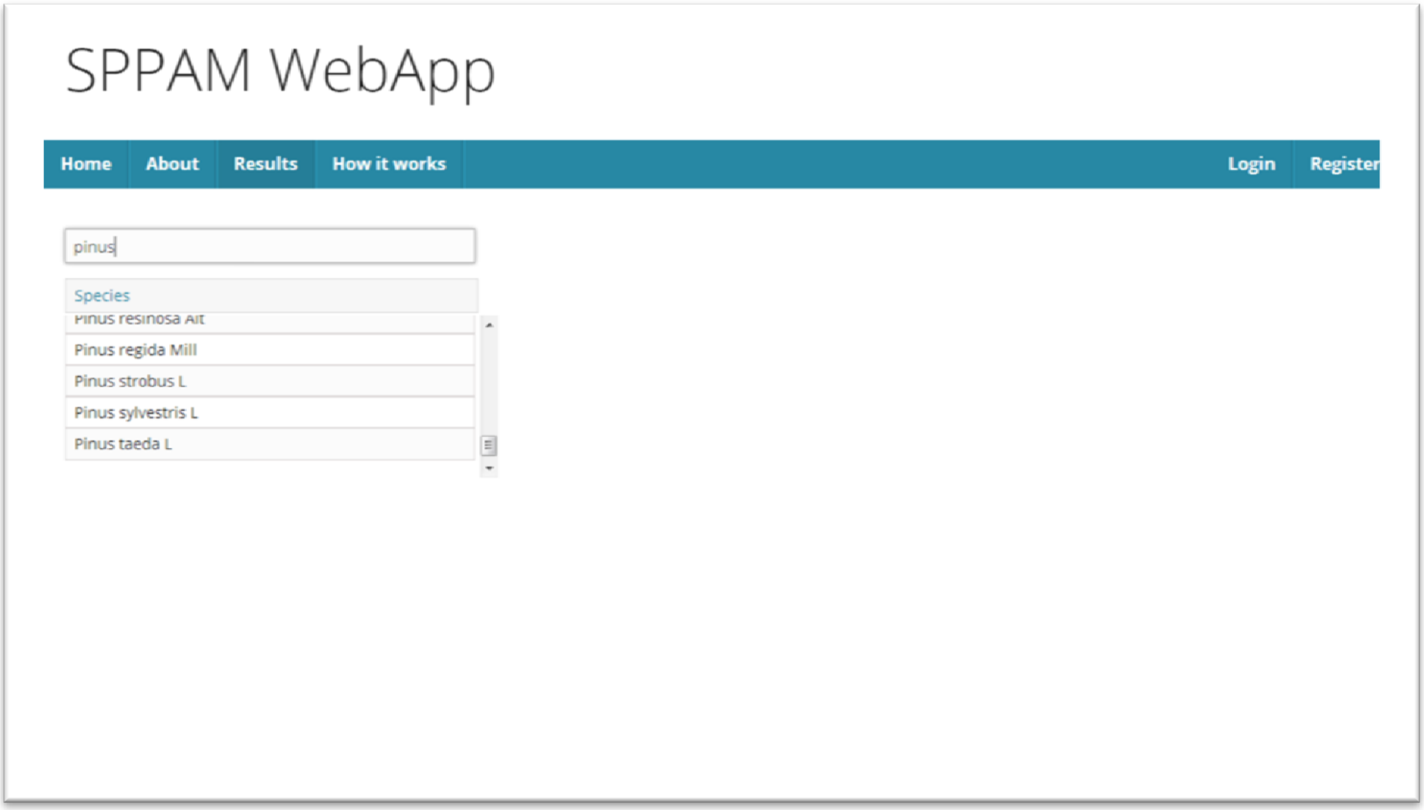

Figure 21 Tree species choice.

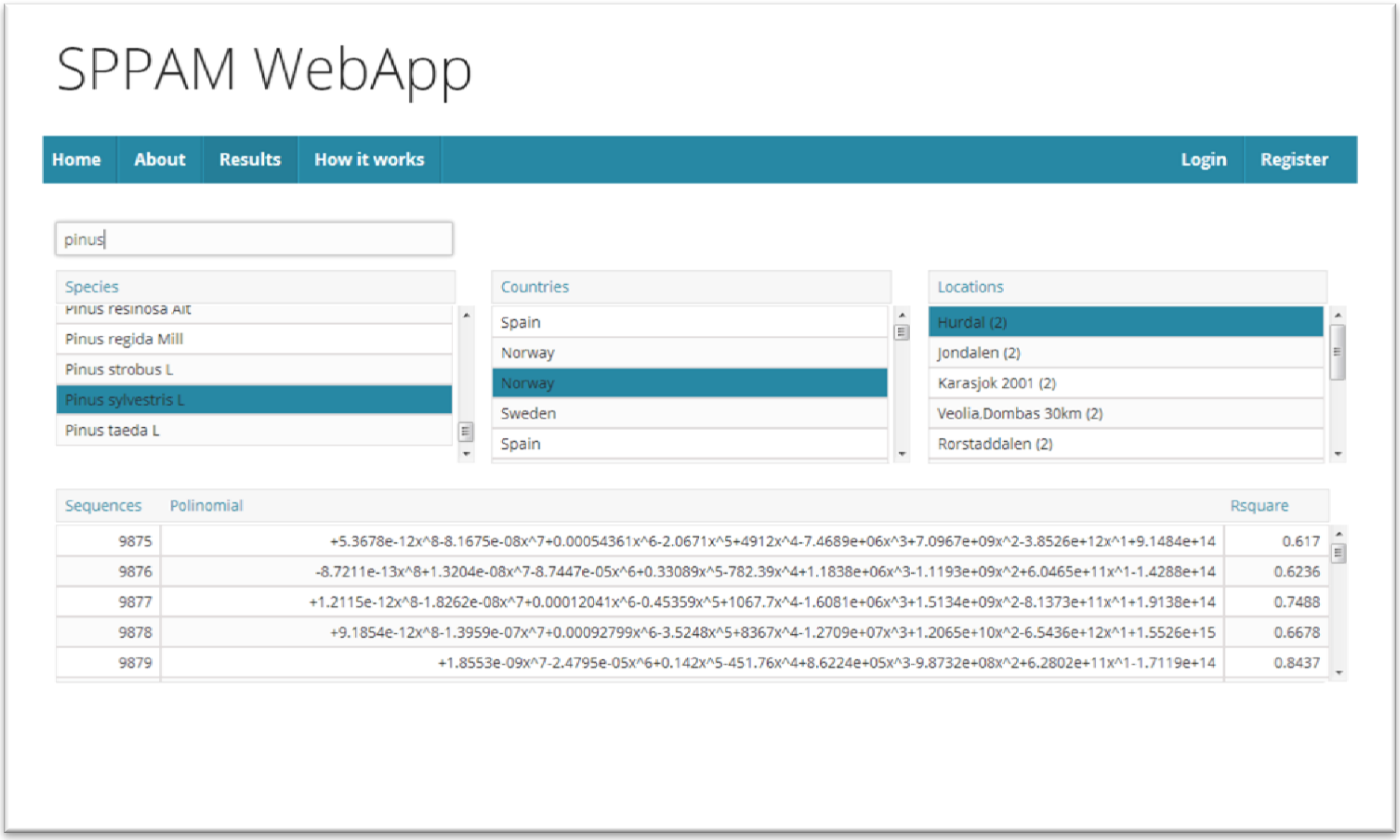

Figure 22Country and location choice

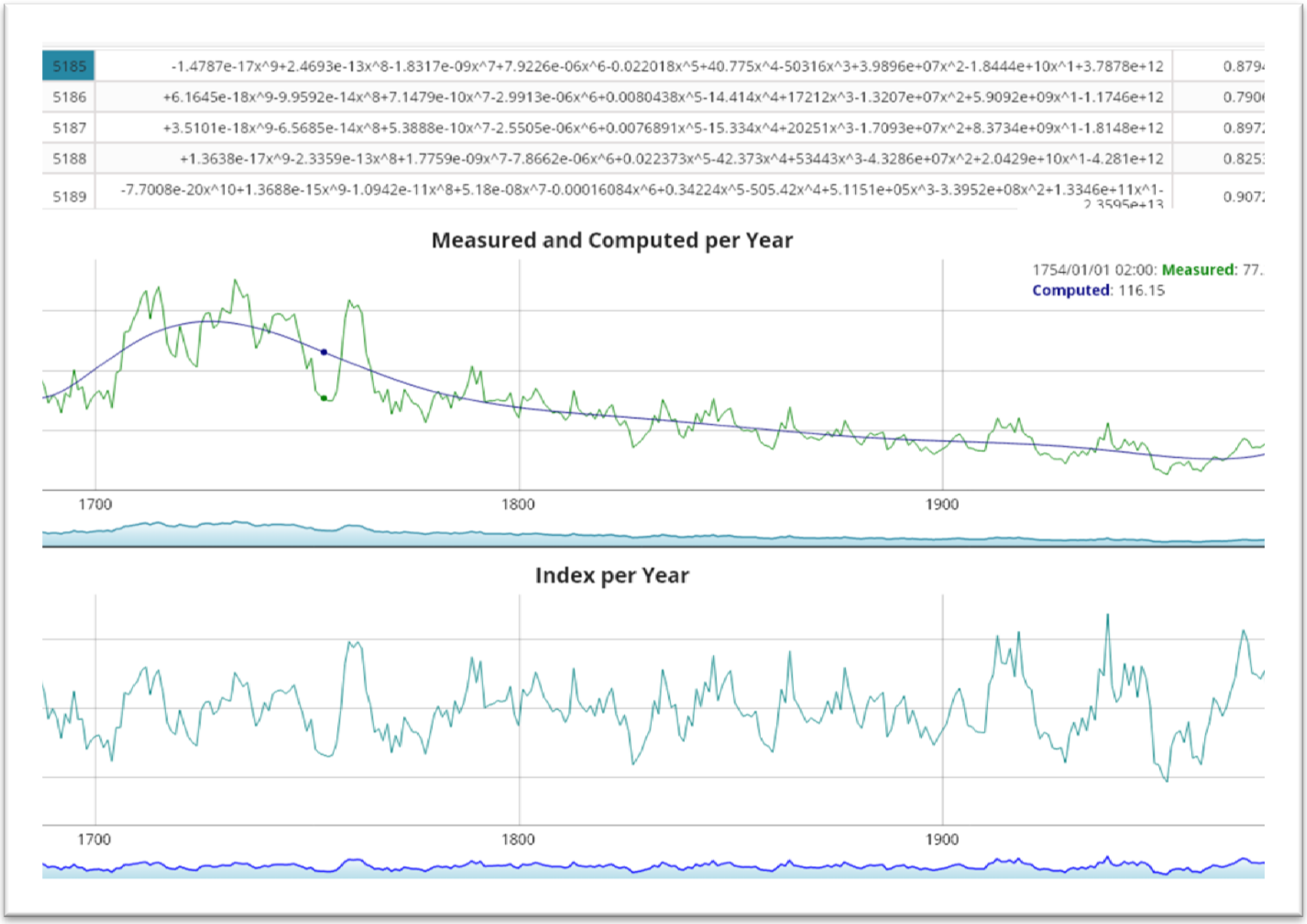

Figure 23Graphics per selected sequence id.