Dendroclimatological Analysis of the forests of the Kedrovaya Pad Nature Reserve,

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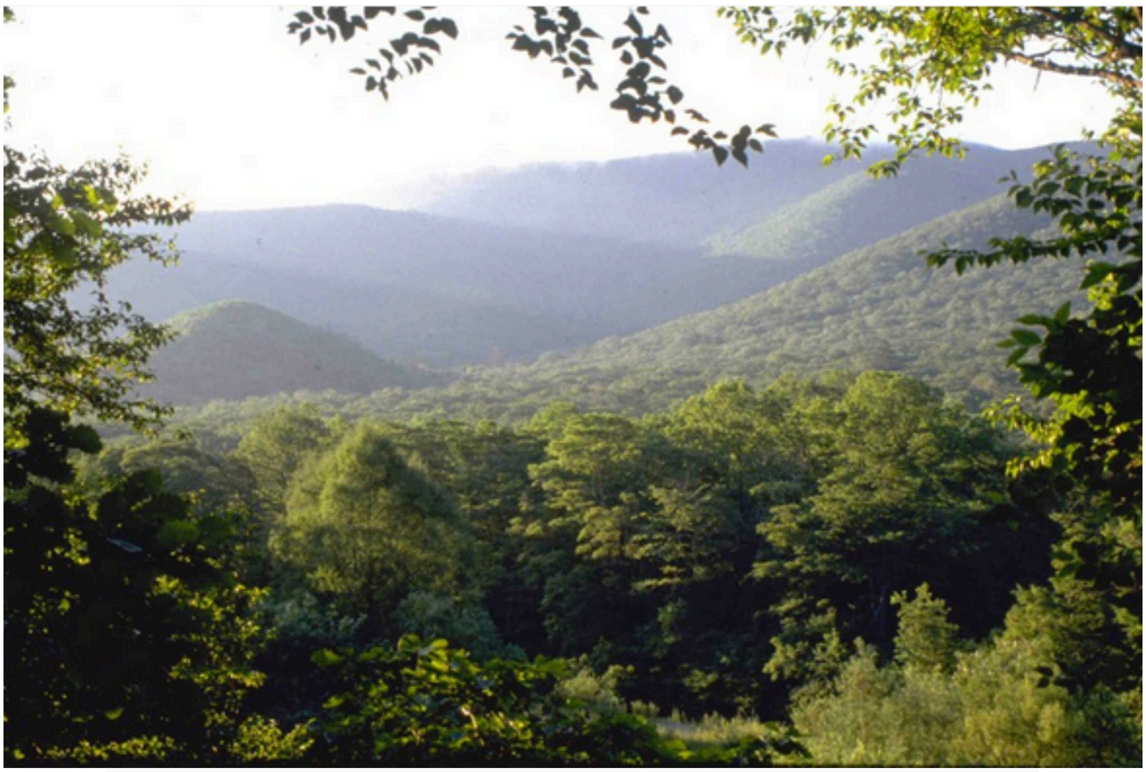

Sampled: 17th-24th August, 2013

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General

This report describes the tree-ring dating (dendrochronology) of the forests of the Kedrovaya Pad Nature Reserve. Living oak, fir, and pines were sampled by Olga Solomina, Eugenio Grabenko, Vladimir Matskovsky, Ekaterina Dolgova, Tatiana Kuderina, and Greg Wiles on the 17-24 of August, 2013. The objective of this work was to provide a general age of the forests and a summary of how these trees respond to climate.

Methods and Analyses

124 oak cores and 14 fir cores were collected from trees at five sites within the Kedrovaya Pad Nature Reserve (Table 1).

Table 1. Tree-ring sites sampled within the Kedrovaya Pad Nature Reserve. These sites were concentrated in two primary clusters, one in the northern and one in the southern area of the reserve.

	Site	Location	Species	Site Code	Period of Record	Cores (Trees)
Northern Kedrovaya Pad	Spring Nezhinka	43.49849N, 131.54408E	Quercus mongolica	SNQ	1745 – 2012	19 (10)
			Pinus koraiensis	SNP	1766 – 2012	48 (26)
	Spring Razdolnensky	43.51183N, 131.55127E	Quercus mongolica	SRQ	1785 – 2013	24 (12)
			Pinus koraiensis	SRP	1766 – 2013	2 (1)
Southern Kedrovaya Pad	Stream Glukhoy	43.12763N, 131.48563E	Quercus mongolica	SGQ	1801 – 2012	32 (16)
			Abies holophylla	SGA	1913 – 2013	2 (1)
	Kedrovaya Pad	43.11842N, 131.48616E	Quercus mongolica	KPQ	1748 – 2013	44 (22)
			Abies holophylla	KPA	1850 – 2013	10 (5)
	Krestovaya Mountain	43.09022N, 131.40544E	Quercus mongolica	GKQ	1740 – 2012	48 (24)

Cores were prepared and cross-dated using standard dendrochronological techniques (Figure 1: Homes, 1983; Stokes and Smiley, 1968). The samples were carefully glued into grooved mounts and sanded to a high polish to reveal the annual tree-rings clearly. The core samples were dated and the rings widths were then measured under a microscope to a precision of ±0.001 mm. and cross-dated. The cross-dating of the measurements was assisted by the COFECHA computer program (Holmes 1983).

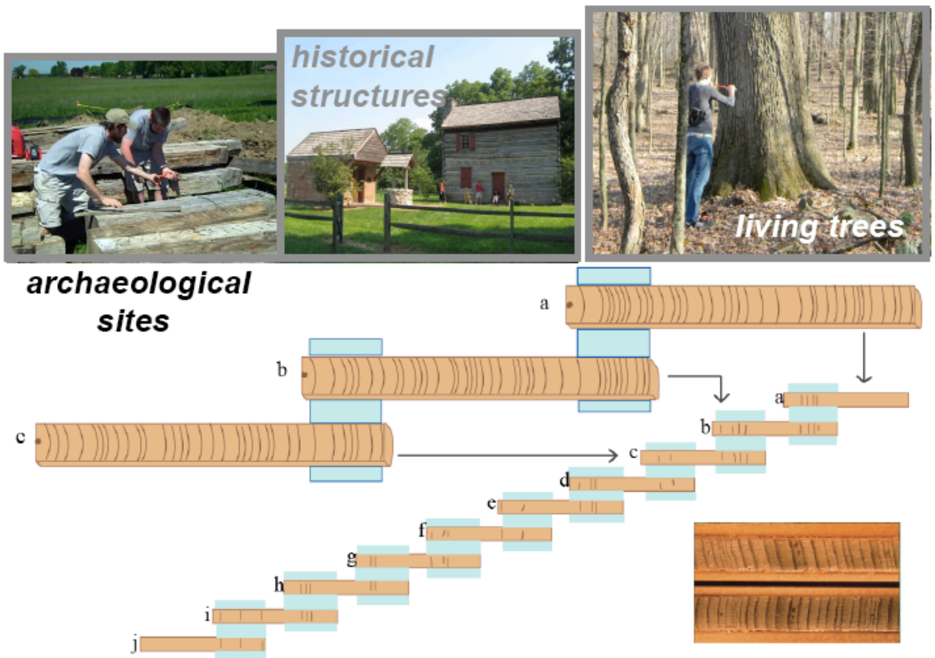

Figure 1. This diagram illustrates the process of tree-ring cross-dating. Patterns in ring widths from wood associated with historical and archeological sites are matched to living tree-ring chronologies and thus calendar dates can be assigned to each ring.

The ring width chronologies were subsequently standardized, using the computer program ARSTAN, in order to eliminate any systematic changes in ring width that are not climatically induced (Cook, 1985; Cook and Kairiukstis, 1990). A linear regression or negative exponential curve was used in standardization.

The site chronology was then correlated with average monthly temperature and precipitation values as recorded at the Vladivostok station.

Results

<u>Southern Kedrovaya Pad</u>

Oak:

All of the oak ring width series (124) at the three sites within the Southern Kedrovaya sampling area were combined as they were highly correlated and showed similar response to climate. The ring width indices are shown in Figure 2 and the correlations with average monthly temperature and average monthly precipitation are shown in Figures 3 and 4, respectively.

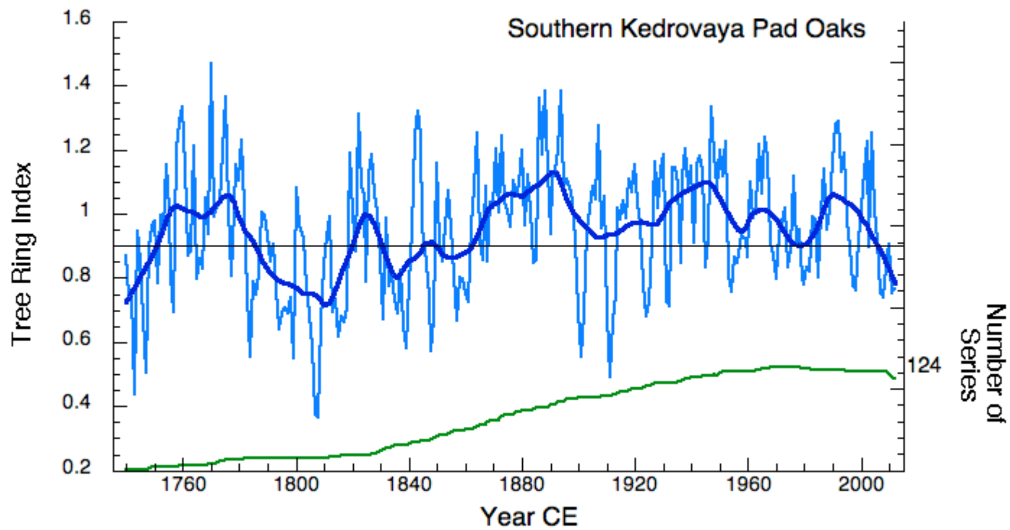

Figure 2. The oak tree-ring chronology for Southern Kedrovaya Pad. The indices as well as the number of series are shown.

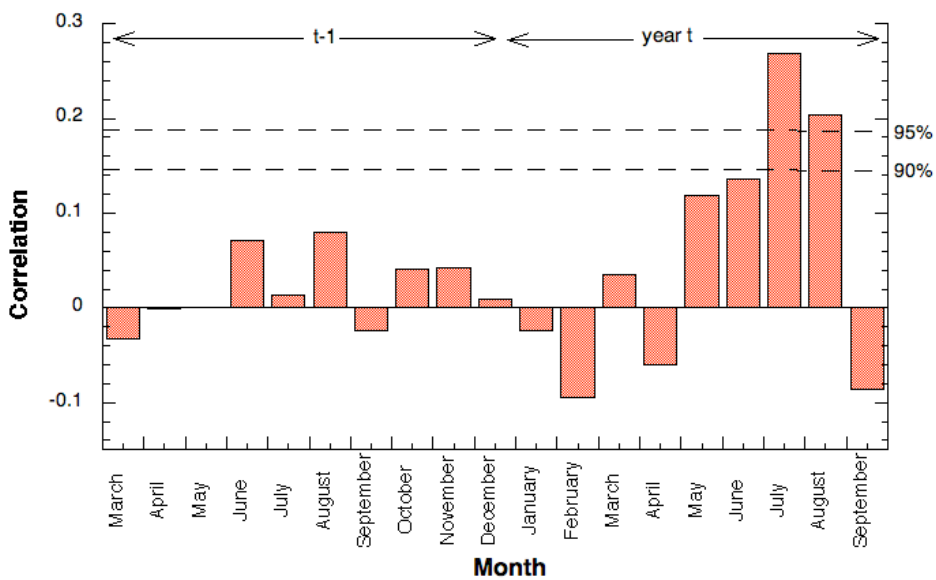

Figure 3. The correlations between the tree-ring width indices and average monthly temperature. The growth of these oak trees is shown to be most strongly correlated with July and August temperatures (both significant at the 95% confidence level).

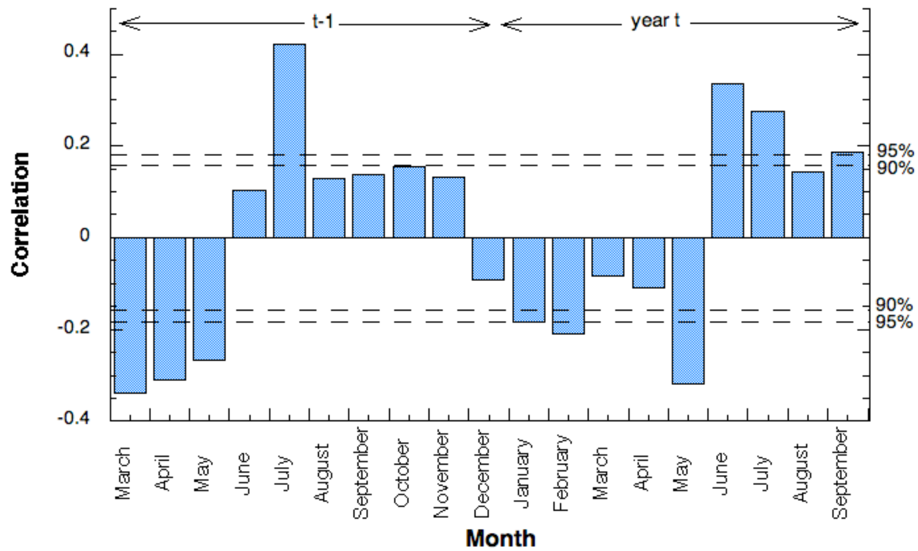

Figure 4. The correlations between the tree-ring width indices and average monthly precipitation. The growth of these oak trees is shown to have a strong positive correlated with June and July precipitation of the year of growth as well as July precipitation of the previous year. In addition, ring width shows a strong negative correlation with January, February, and May temperatures of the year of growth, as well as March, April, and May of the previous year.

Fir:

All of the fir ring width series (12) for the Southern Kedrovaya Pad sampling area were also compiled as they were highly correlated and showed similar response to climate. The ring width indices are shown in Figure 5. Correlation with average monthly temperature and average monthly precipitation are shown in Figures 6 and 7, respectively.

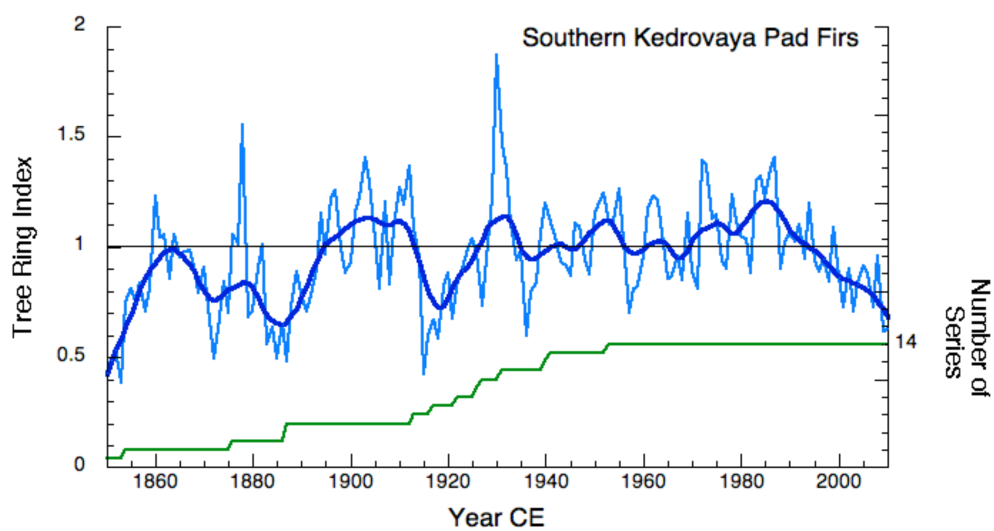

Figure 5. The fir tree-ring chronology for Southern Kedrovaya Pad. The indices as well as the number of series are shown.

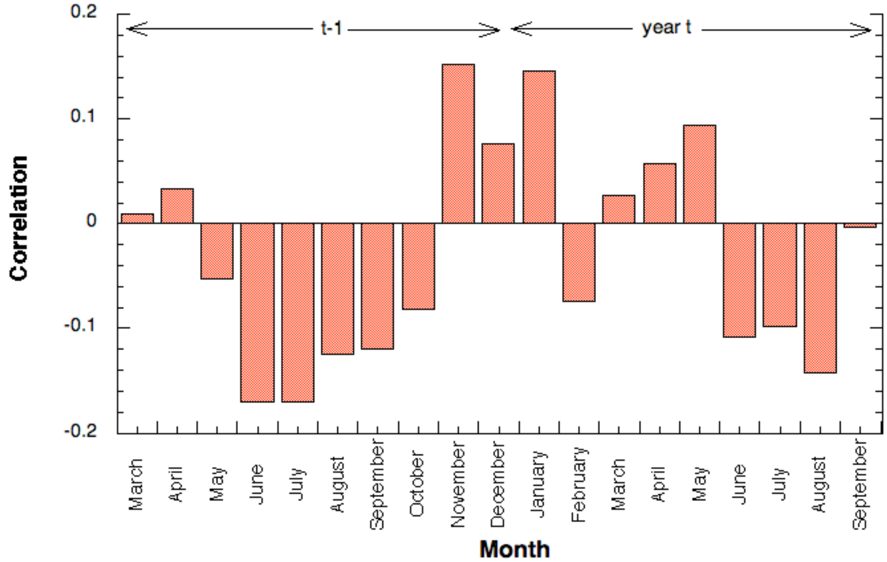

Figure 6. The correlations between the tree-ring width indices and average monthly temperature. The growth of these oak trees is shown to be only weakly correlated with temperature and none of the correlations are significant at the 90% confidence level.

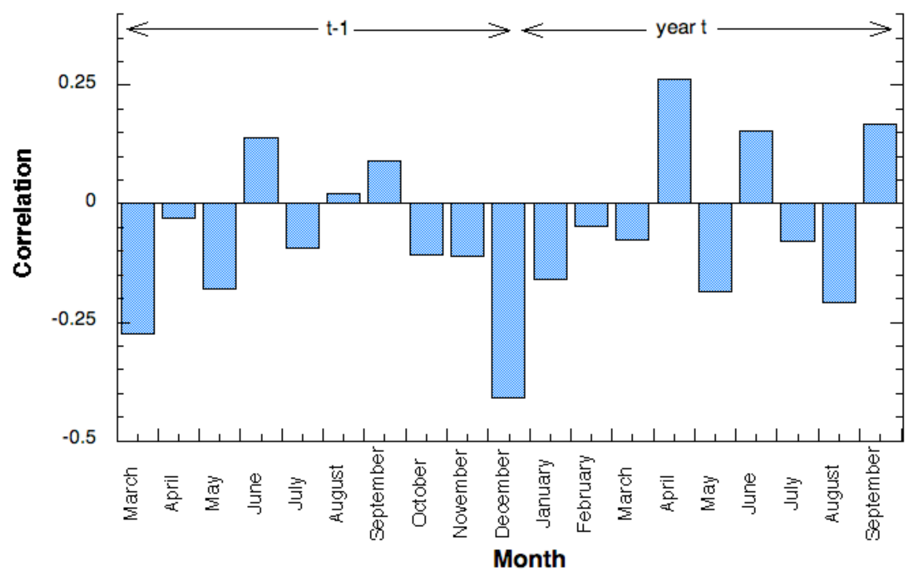

Figure 7. The correlations between the tree-ring width indices and average monthly precipitation. None of the correlations are significant at the 90% confidence level.

Northern Kedrovaya Pad

Oak:

All of the oak ring width series (43) at the two sites within the Northern Kedrovaya sampling area were combined as they were highly correlated and showed similar response to climate. The ring width indices are shown in Figure 8 and the correlations with average monthly temperature and average monthly precipitation are shown in Figures 9 and 10, respectively.

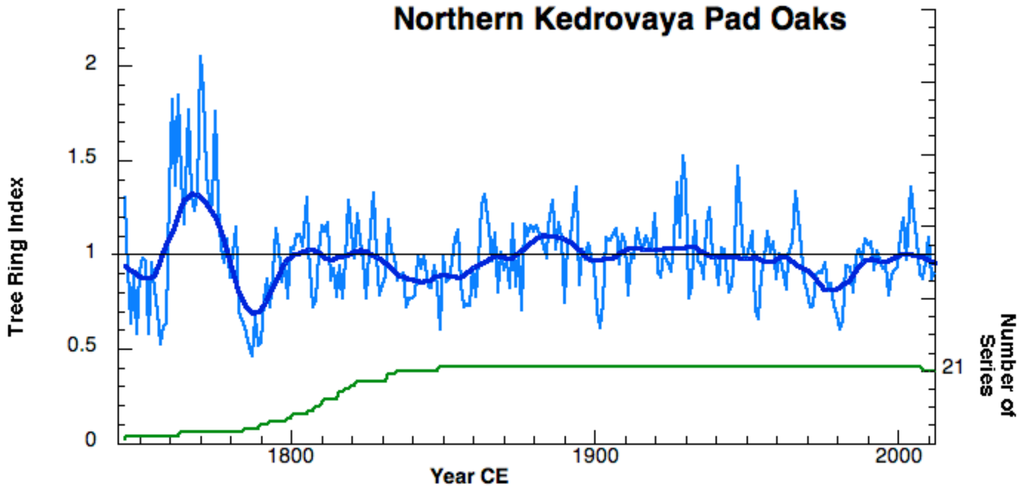

Figure 8. The oak tree-ring chronology for Northern Kedrovaya Pad. The indices as well as the number of series are shown.

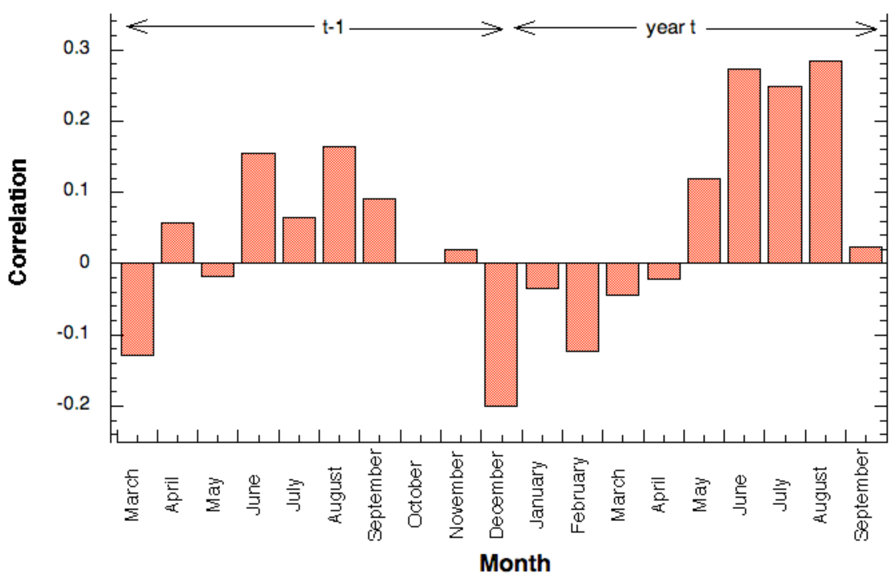

Figure 9. The correlations between the tree-ring width indices and average monthly temperature. The growth of these oak trees is shown to be only weakly correlated with temperature and none of the correlations are significant at the 90% confidence level.

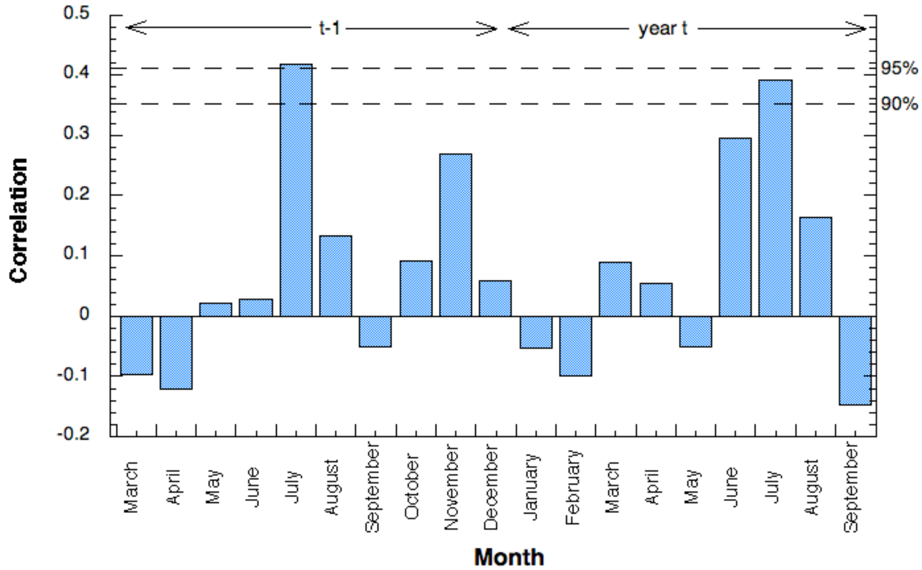

Figure 10. The correlations between the tree-ring width indices and average monthly precipitation. The growth of these oak trees is shown to have a strong positive correlation with July precipitation of both the year of growth as well as the year previous.

Pines:
All of the pine ring width series (50) at the two sites within the Northern Kedrovaya sampling area were combined as they were highly correlated and showed similar response to climate. The ring width indices are shown in Figure 11 and the correlations with average monthly temperature and average monthly precipitation are shown in Figures 12 and 13, respectively.

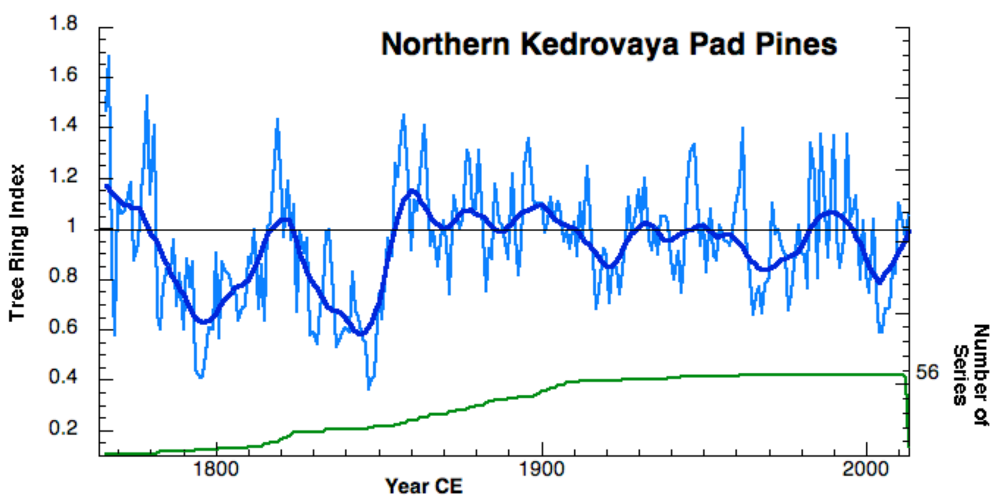

Figure 11. The pine tree-ring chronology for Northern Kedrovaya Pad. The indices as well as the number of series are shown.

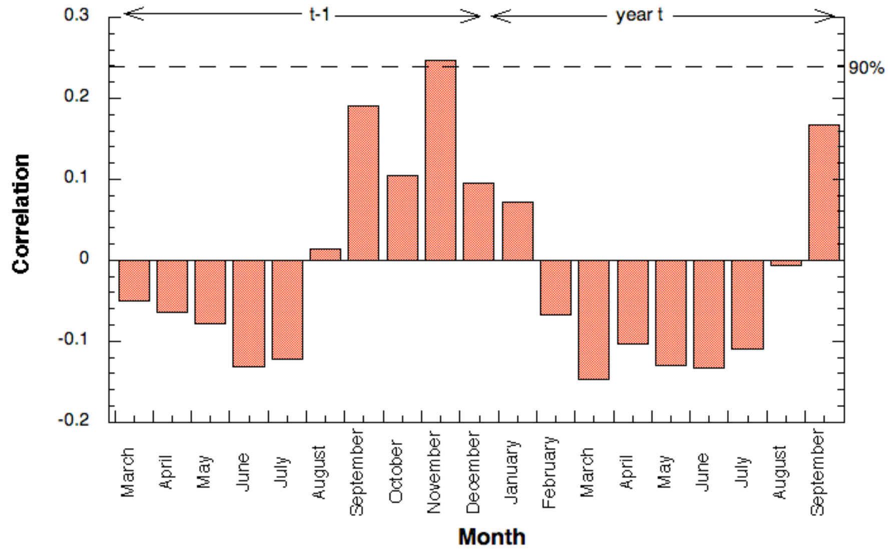

Figure 12. The correlations between the tree-ring width indices and average monthly temperature. The growth of these pine trees has a strong positive correlation with November temperatures, significant at the 90% confidence level. Though not significant at the 90% confidence level, spring and summer temperatures are shown to be negatively correlated with growth.

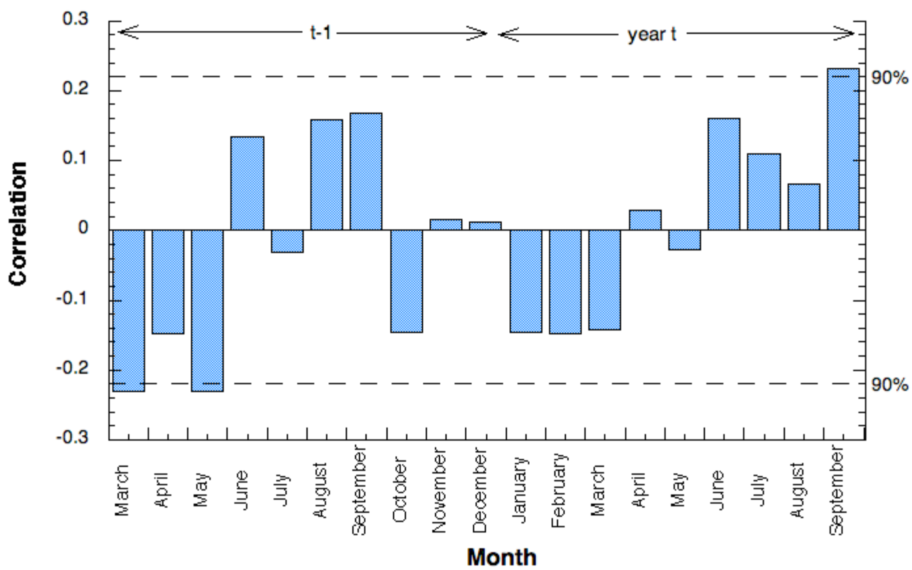

Figure 13. The correlations between the tree-ring width indices and average monthly precipitation. The growth of these pine trees has a strong positive correlation with September precipitation, and a strong negative correlation with March and May precipitation of the year previous to the year of growth.

Summary:

The oak trees sampled in the Kedrovaya Pad Nature Reserve date back to the mid-18th Century. The growth of these trees has a strong positive response to late summer (July and August) temperatures as well as June and July precipitation. In addition, a negative correlation is observed between growth and average precipitation of many of the late winter and spring months.

The fir trees sampled in the southern collection area date back to the early 19th Century. Though the annual growth rings of these trees do not have a strong climate signal, a common negative relationship between growth and summer temperatures is observed.

The pine trees sampled in the northern collection area date back to the late 18th Century. The growth of these trees has a strong positive response to November temperatures, and though weak, a common negative relationship between growth and spring-summer temperatures. A strong positive correlation between September precipitation and growth is observed. In addition, a weaker relationship between seasonal precipitation is detected: a positive relationship between growth and summer precipitation, as well as a negative relationship between growth and winter precipitation.

References:

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