

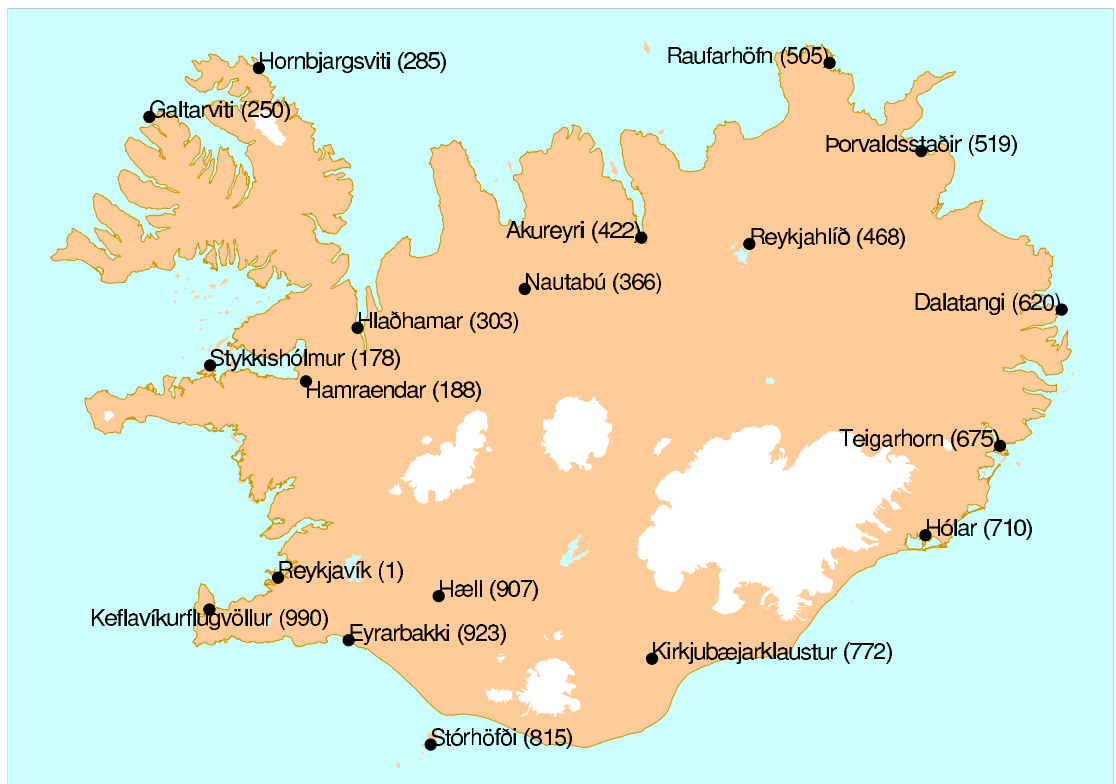
Steen Henriksen

Applications of the tension spline method to 18 weather stations in Iceland

1 Introduction

This report is a collection of various results obtained from the tension spline method described in the report “Report on the approximation of the annual cycle of temperature in Iceland”.

We have used the following manual stations in Iceland 1, 178, 188, 250, 285, 303, 366, 422, 468, 505, 519, 620, 675, 710, 772, 815, 907, 923, 990, because for these stations only there is sufficient data. The location and names of these stations are shown in the figure below. The time period we have worked with is 1961 to 1990, i.e. 30 years. However for the station 178 we have also been looking at the periods 1874-1923 and 1951-2000, i.e. 50 years.



In the following sections we will give descriptions of the contents in the appendices 1 to 7.

2 Mean temperature (Appendix 1)

The first appendix contains for each station a plot of respectively; the annual temperature cycle obtained from averaging daily mean temperatures (blue curve), the tension spline approximation of the annual temperature cycle (red curve), the measured monthly mean temperatures (red dots) and an estimate for the red curve of when the temperature begins to rise in the spring (green line). The number next to the green line is the estimated day number of the rise.

To make an estimate of when the temperature rises in the spring, we first determine the slope of the line between the two following points. The minimum of the small drop in temperature in March and the yearly maximum temperature (reached in July/August). The temperature has to rise from this minimum to the yearly maximum; a rise represented by the slope. We will now define the rise in temperature in spring to begin the day when the first derivative of the red tension spline curve in the period March to April equals the slope.

Two alternative methods were considered, but were not used because they are difficult to justify. One was similar to the method above, just using the slope between the yearly minimum and the yearly maximum. The problem is that the minimum is not unique in the sense, that for some stations it is reached in January and others in March, see e.g. station number 1 and 250. The second method was just to take the day when the minimum of the small drop in temperature in March is reached. This approach gives unreliable results. See e.g. station 468 or 772 where the magenta colored line marks the position of the local minimum, at these points the temperature has not really begun to rise.

3 Maximum temperature (Appendix 2)

The second appendix contains for each station a plot of respectively; the annual maximum temperature cycle obtained from averaging daily maximum temperatures (blue curve), the tension spline approximation of the annual maximum temperature cycle (red curve) and the measured monthly mean temperatures (red dots).

Note when making the blue curve, for some of the stations the data set is not complete. Station 285 is missing 31 days, 422 is missing 31 days, 675 is missing 16

days and 710 is missing 140 days. But compared to the total number of days 10950 the error is negligible.

4 Minimum temperature (Appendix 3)

The third appendix contains for each station a plot of respectively; the annual minimum temperature cycle obtained from averaging daily minimum temperatures (blue curve), the tension spline approximation of the annual minimum temperature cycle (red curve) and the measured monthly mean temperatures (red dots).

Note when making the blue curve, for some of the stations the data set is not complete. Station 285 is missing 61 days, 303 is missing 123 days, 468 is missing 49 days, 505 is missing 24 days, 675 is missing 59 days and 710 is missing 62 days. But compared to the total number of days 10950 the error is again negligible.

5 The small drop in temperature (Appendix 4)

The fourth appendix is based on the results in appendix one. For the red tension spline curve the small drop in temperature in March is recorded as “Length of drop” (the day the local minimum is reached minus the day the local maximum is reached), and as “Amplitude of drop” (temperature at the local maximum minus temperature at the local minimum). In addition we have also recorded the day number where the local maximum and minimum is reached and the temperature value of the local maximum and minimum, see respectively the columns “Top” and “Bottom”.

6 Yearly maximum and minimum temperatures (Appendix 5)

The fifth appendix is also based on the results in appendix one. The yearly maximum and yearly minimum temperature of both the red and blue curve for all the stations are plotted as respectively red and blue dots. The uppermost pairs of red and blue dots on the figure are the maximum temperatures and the pairs of red and blue dots at the bottom are the minimum temperatures.

7 Stykkishólmur (station 178) A (Appendix 6)

The sixth appendix shows plots for the station 178 over two different time periods. Each plot contains respectively; the annual temperature cycle obtained from averaging daily mean temperatures (measured 9 am) (blue curve), the tension spline

approximation of the annual temperature cycle (red curve), the measured monthly mean temperatures (red dots). The time periods are from 1874-1923 and 1951-2000, i.e. 50 years each.

8 Stykkishólmur (station 178) B (Appendix 7)

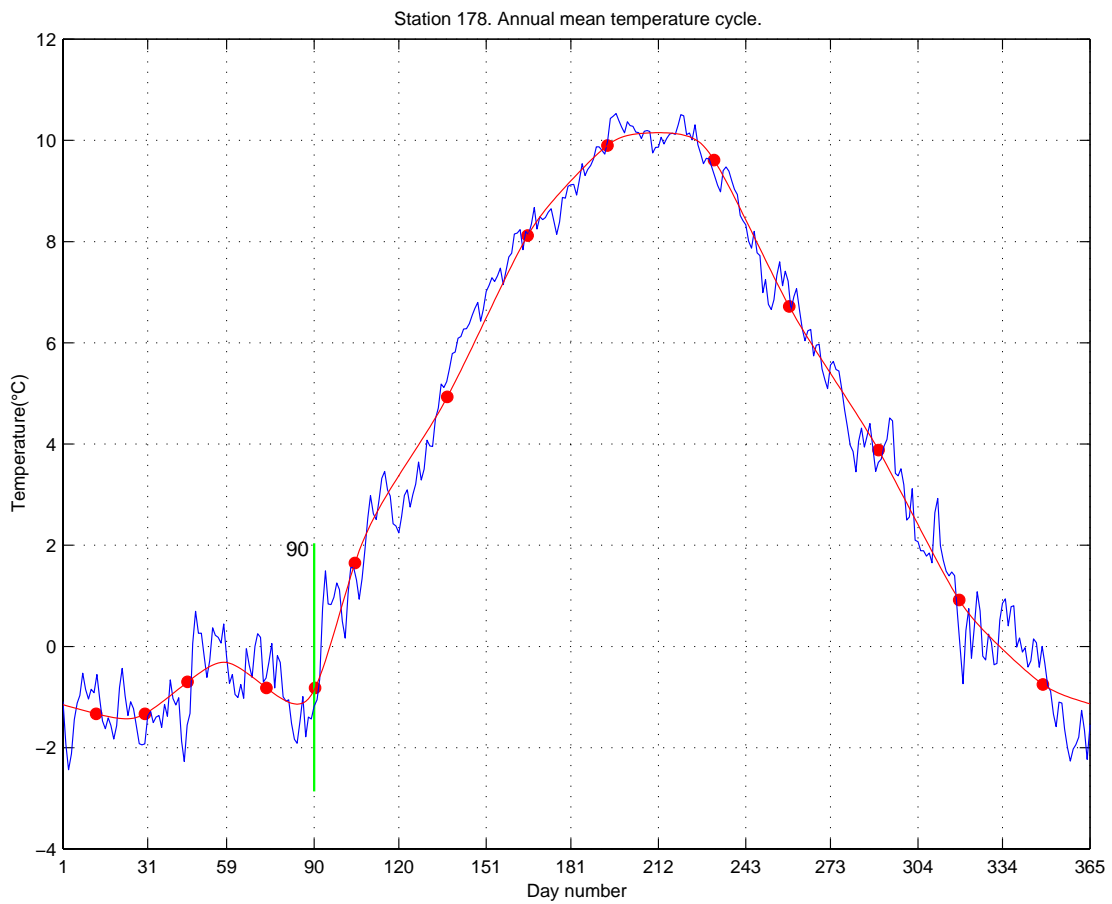
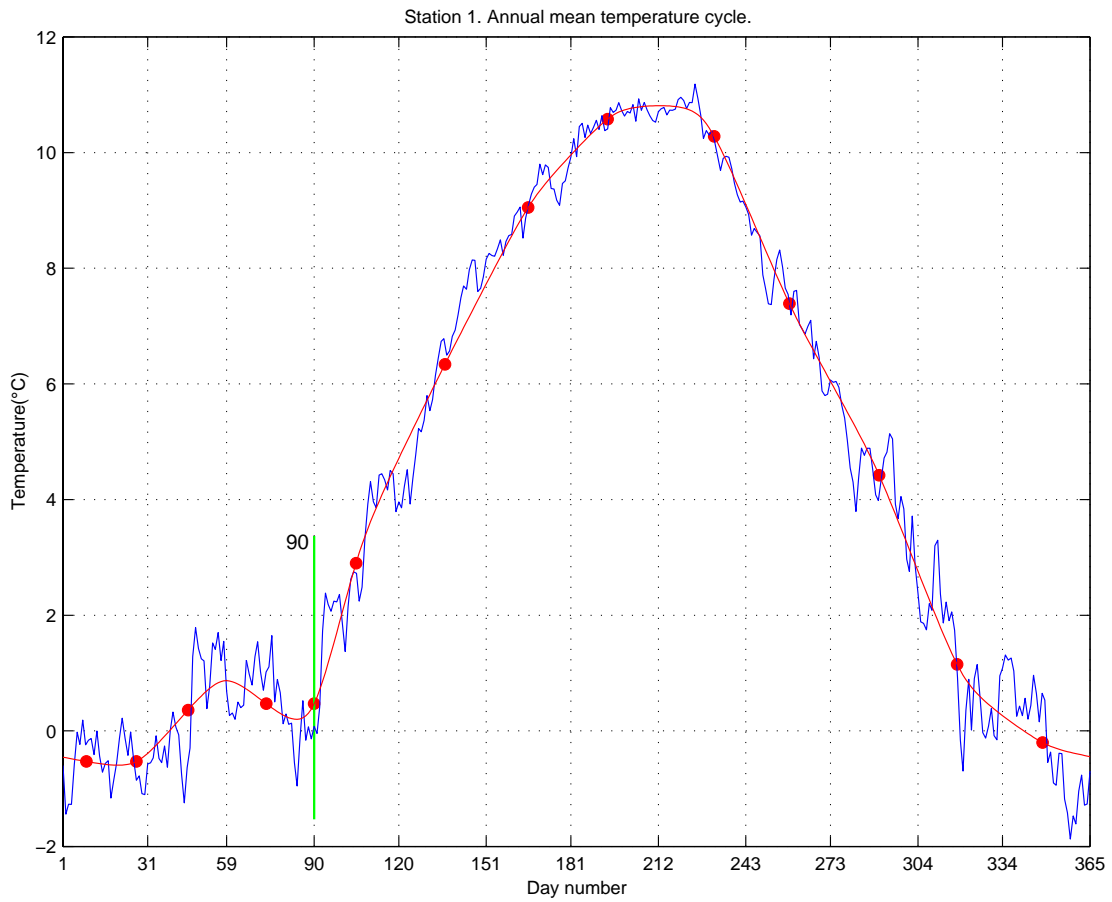
The seventh appendix joins the two results from appendix six. The first figure shows a plot of the annual temperature cycles obtained from averaging daily mean temperatures (blue=1874-1923, red=1951-2000).

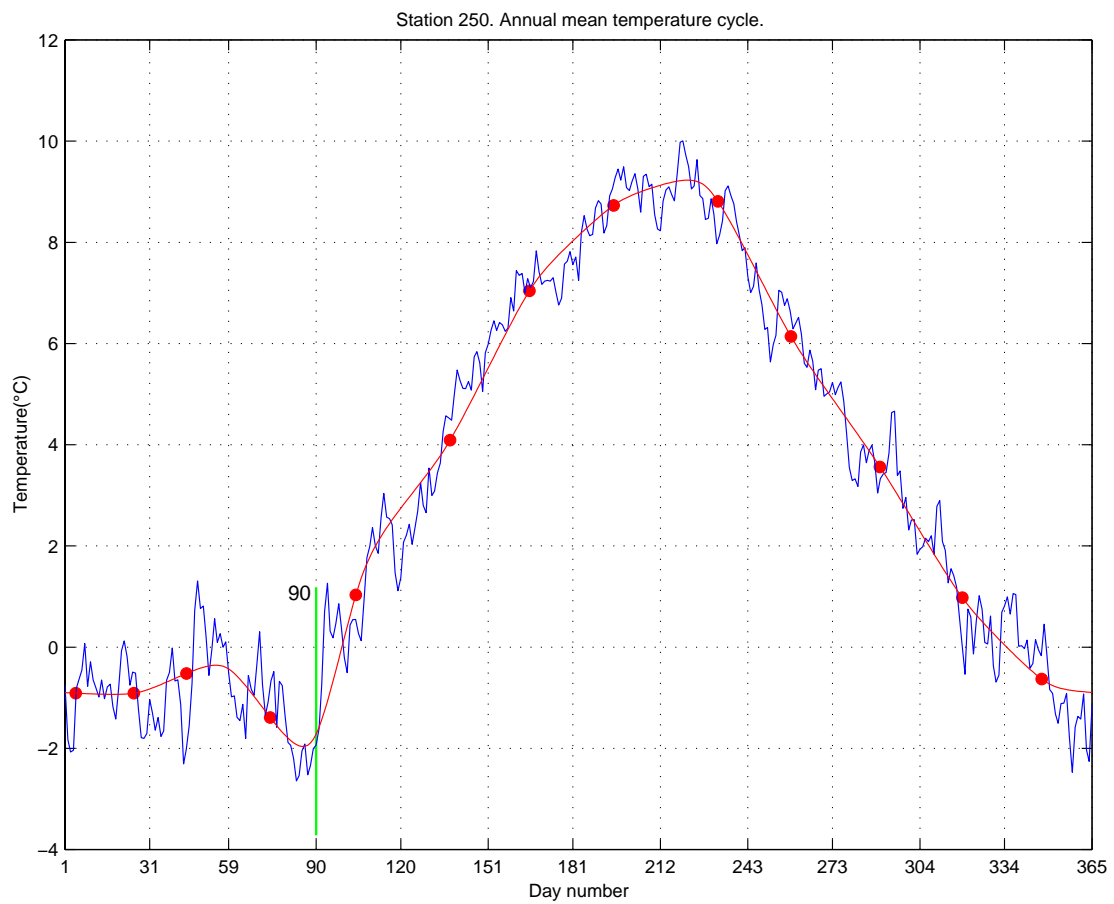
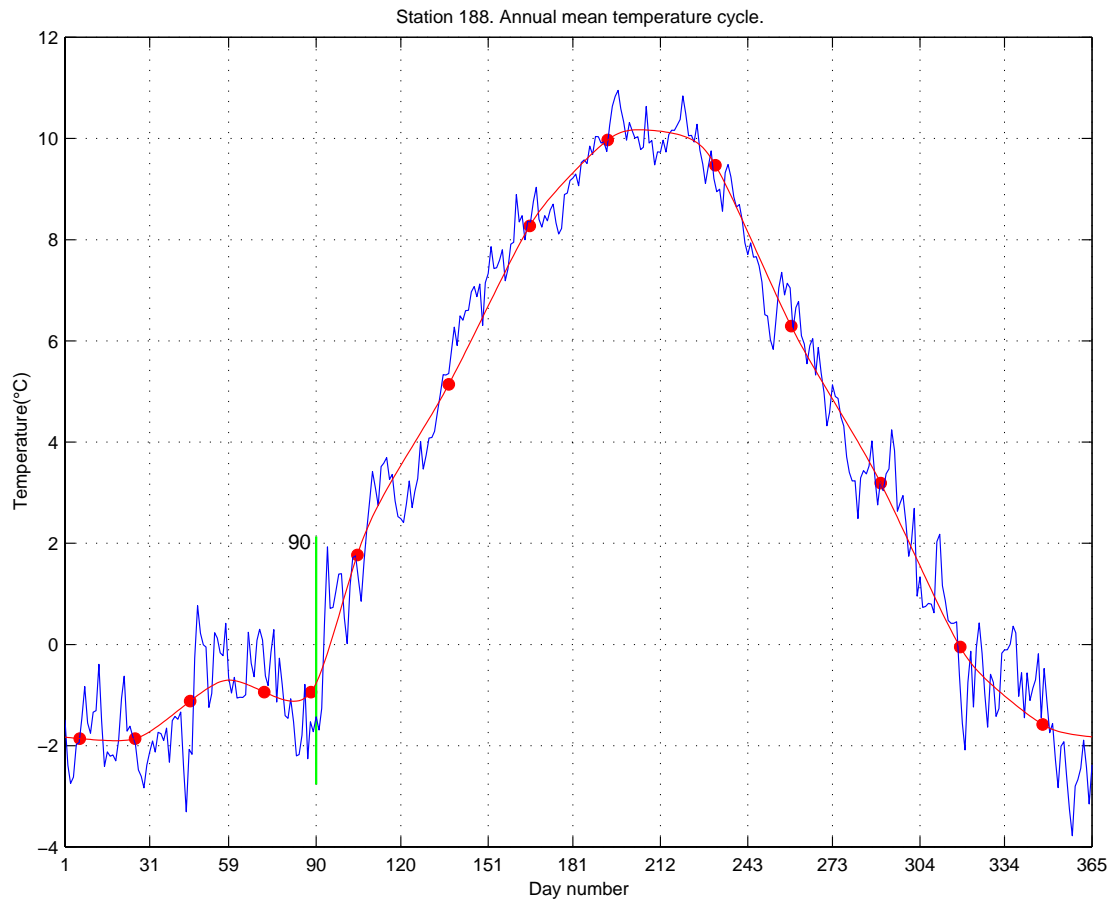
The second figure shows a plot of the tension spline approximations of the annual temperature cycles (blue=1874-1923, red=1951-2000).

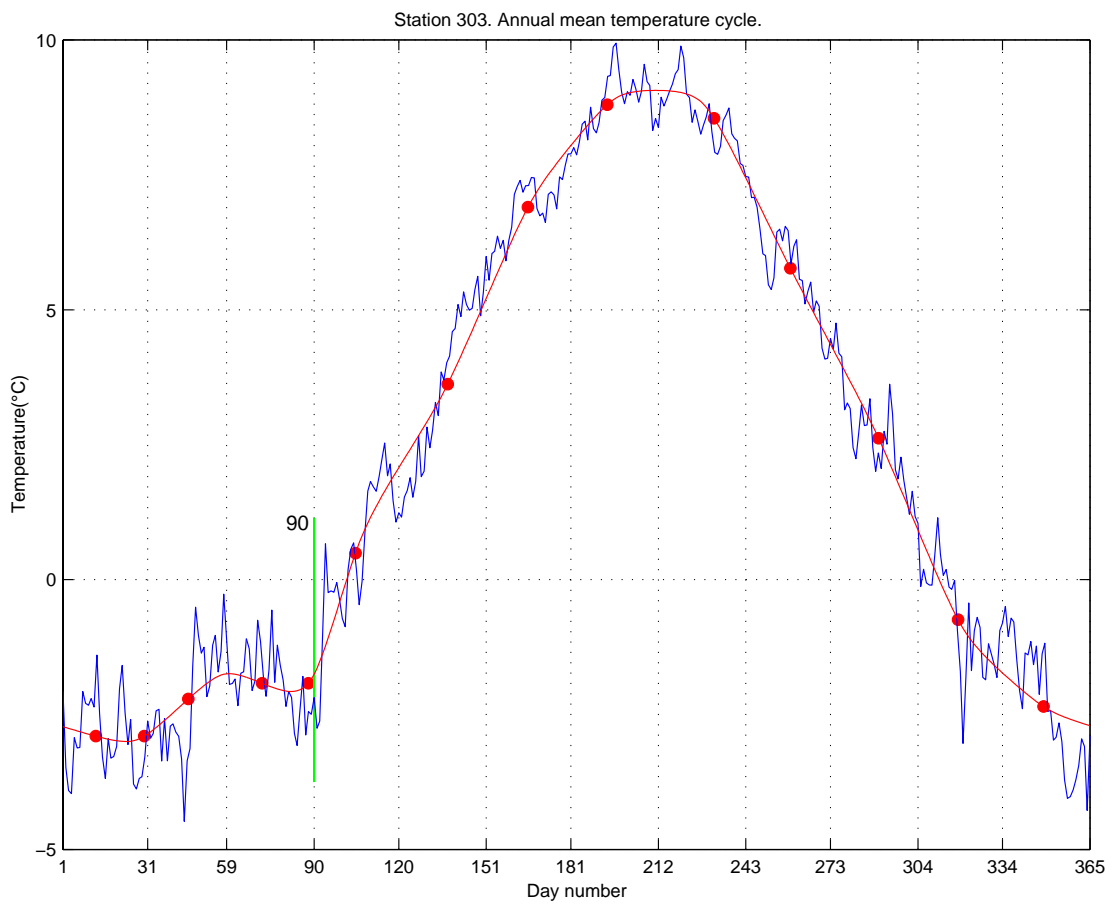
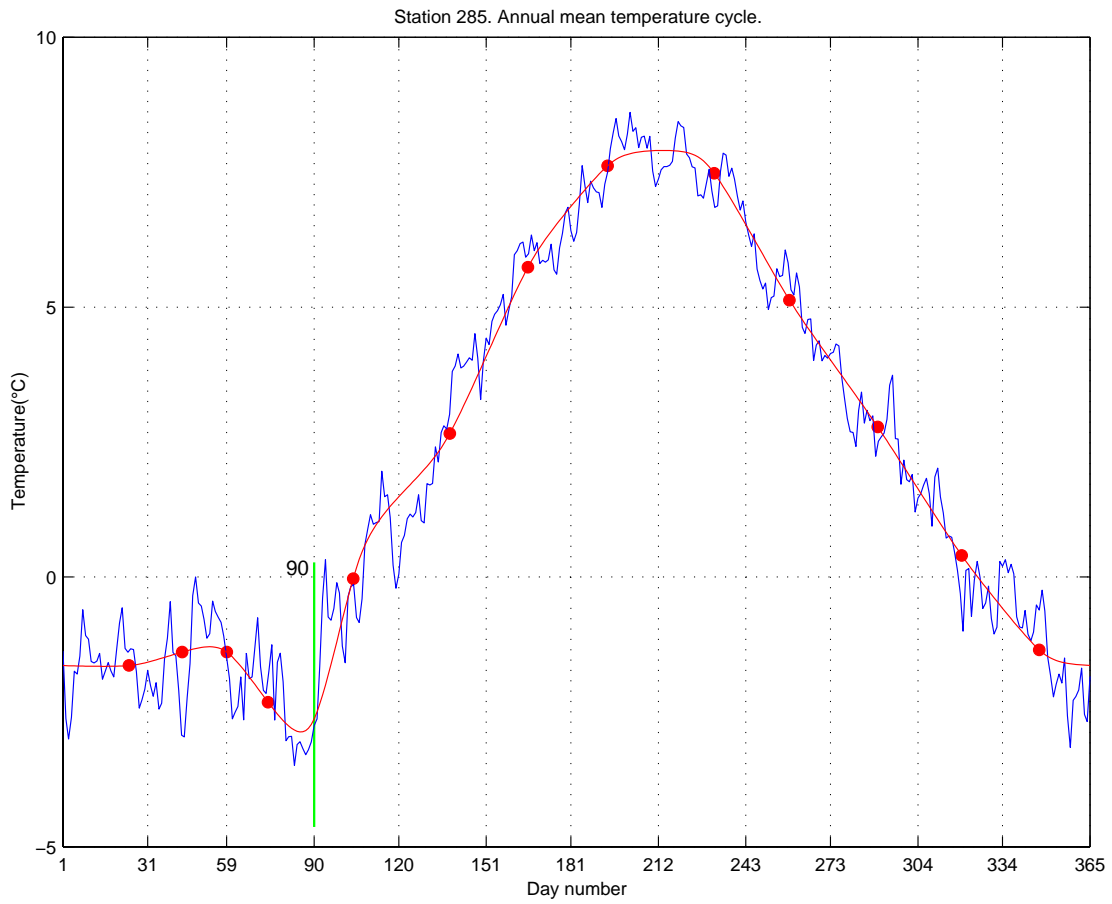
The third figure shows a plot of the differences. That is the blue curve is the red curve minus the blue curve from the first figure in this appendix and the red curve is the difference between the red curve minus the blue curve from the second figure in this appendix.

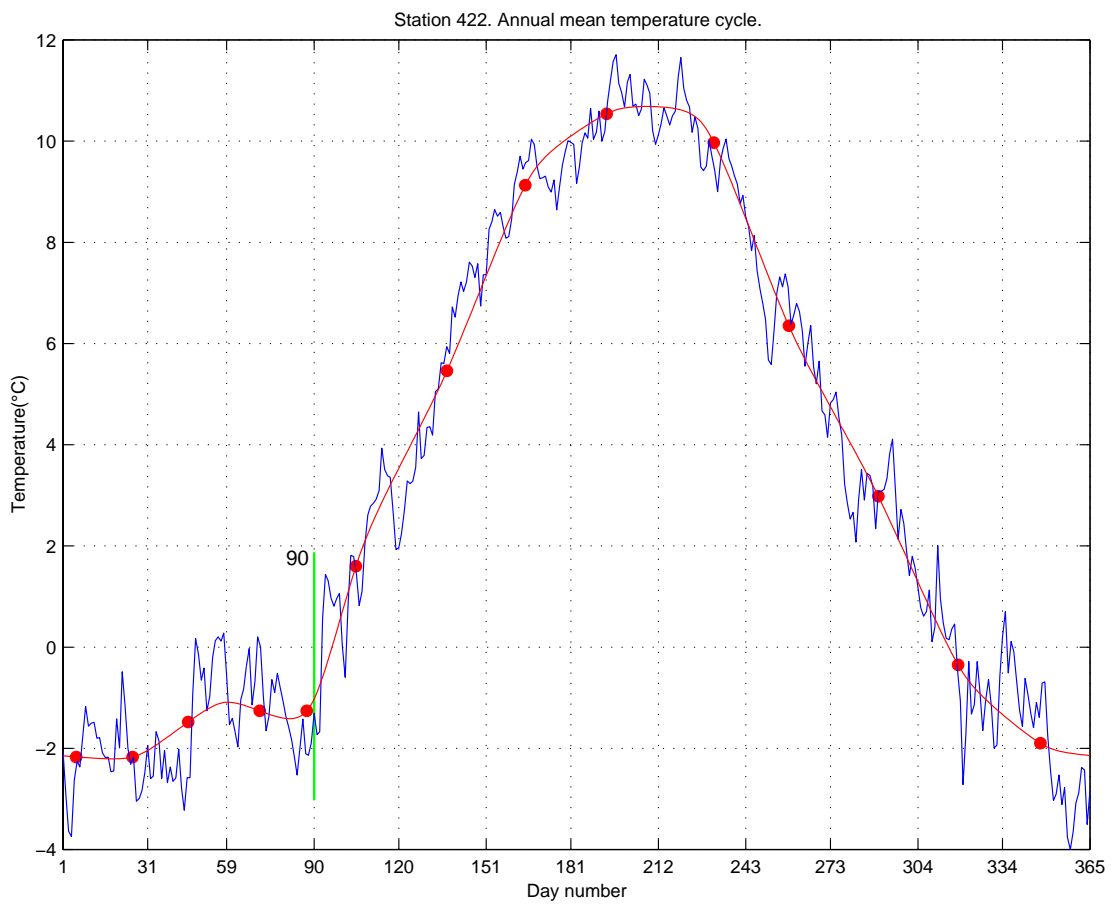
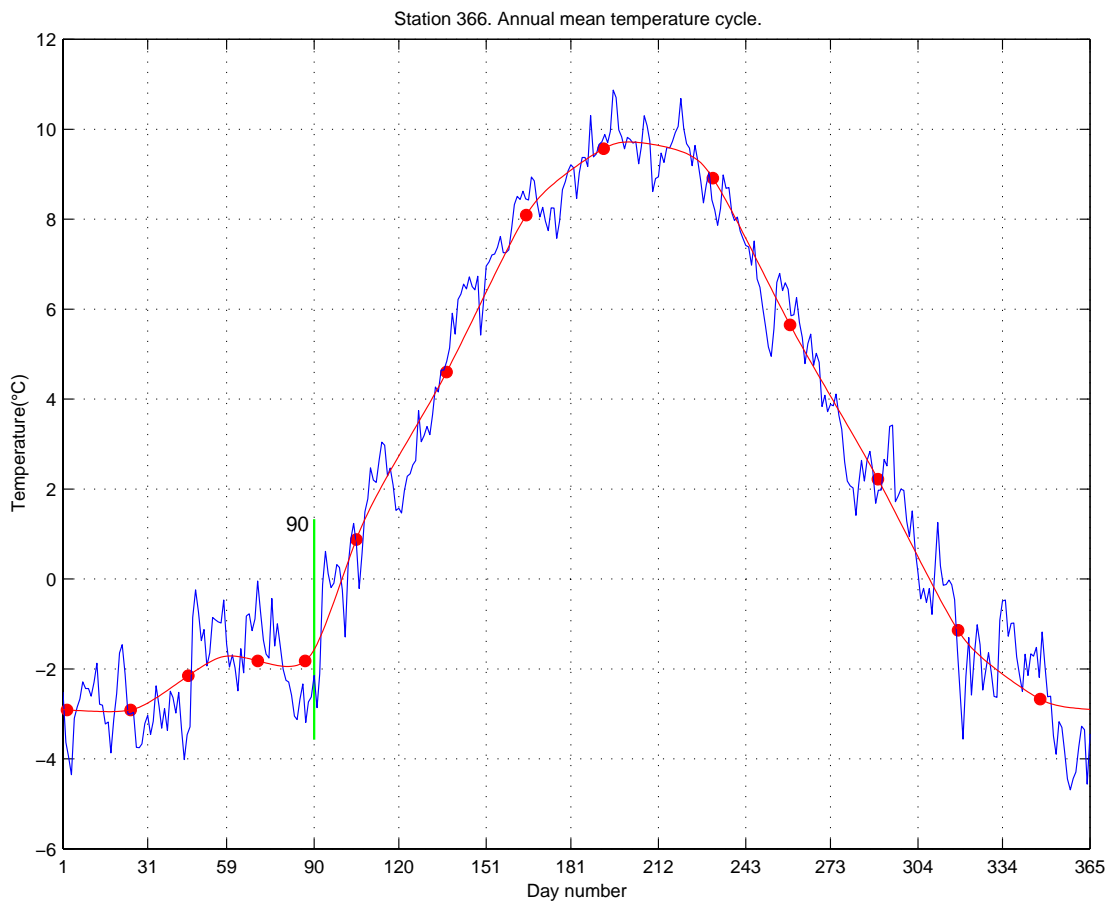
For the month of March one can see that the blue curve in the second figure has difficulties catching the small peak of the blue curve in the first figure. So the blue tension spline curve is in this month a rough approximation. We need to mention that it is the only case we have seen where the tension spline has “difficulties”.

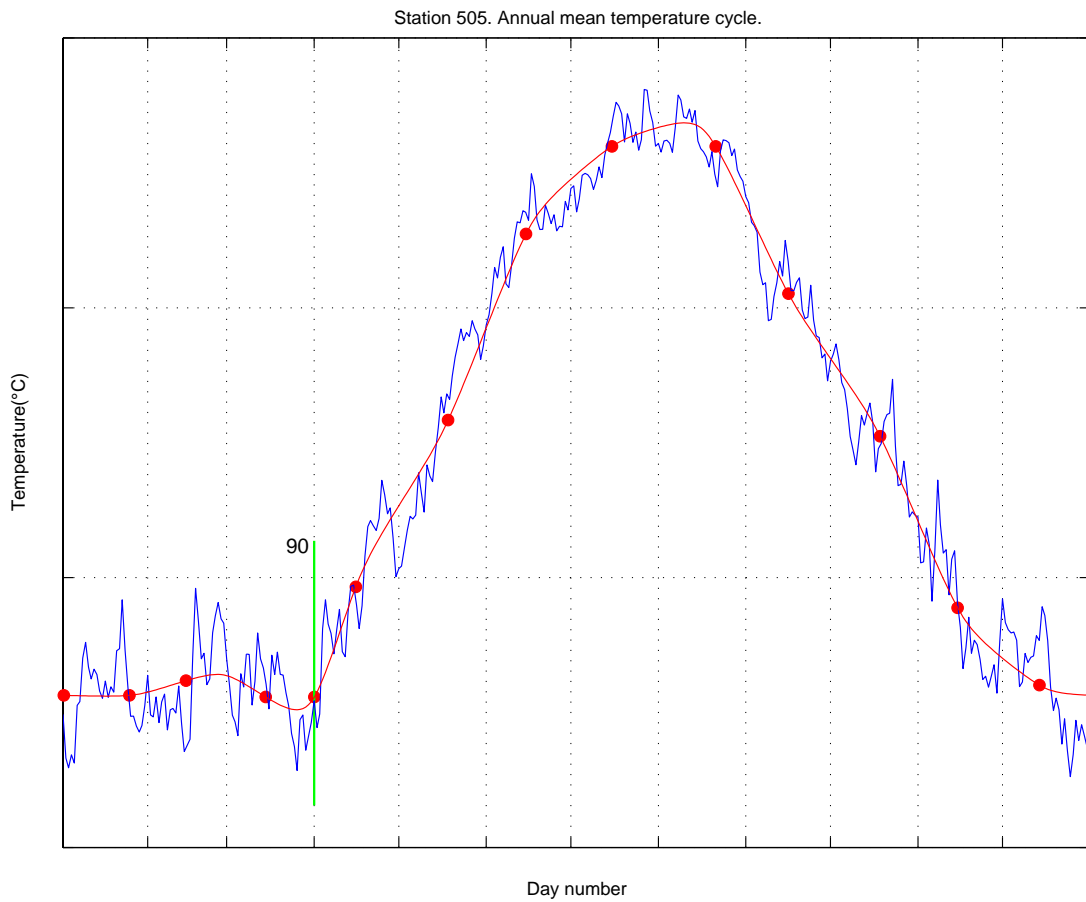
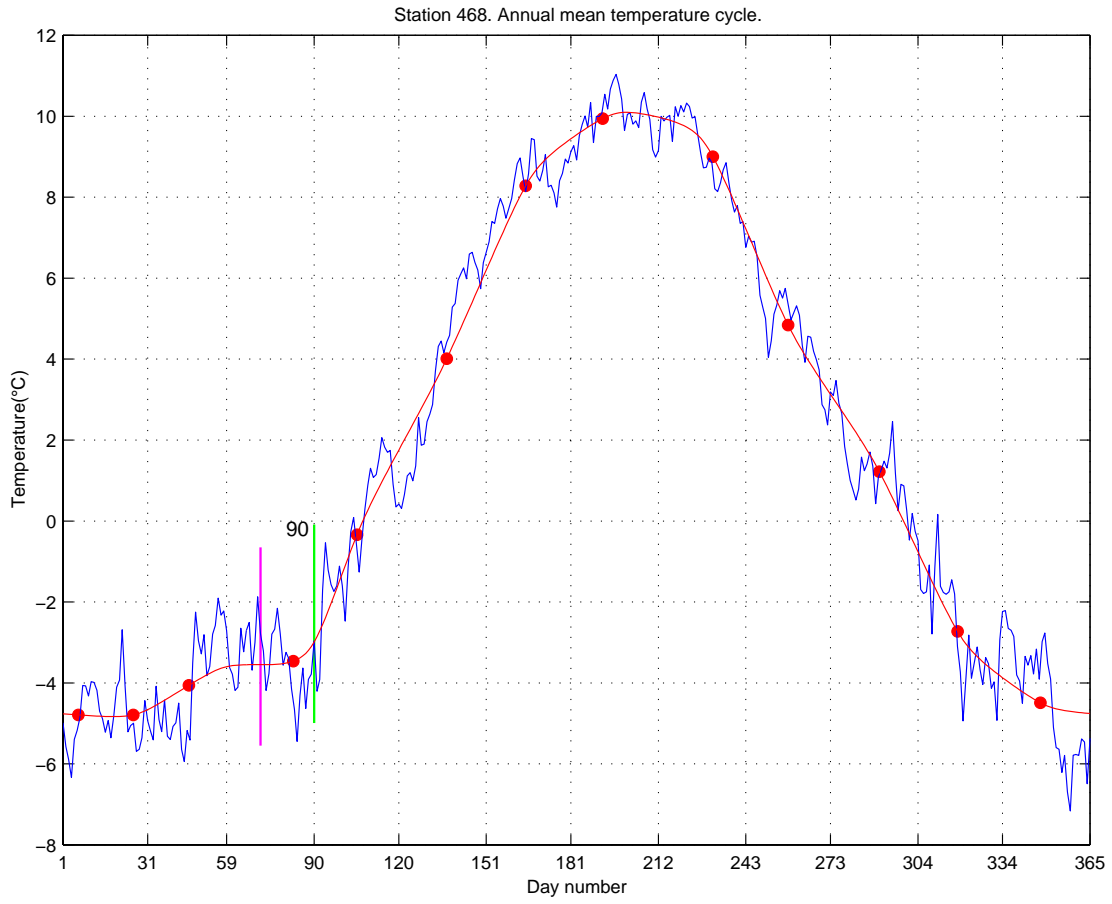
Appendix 1

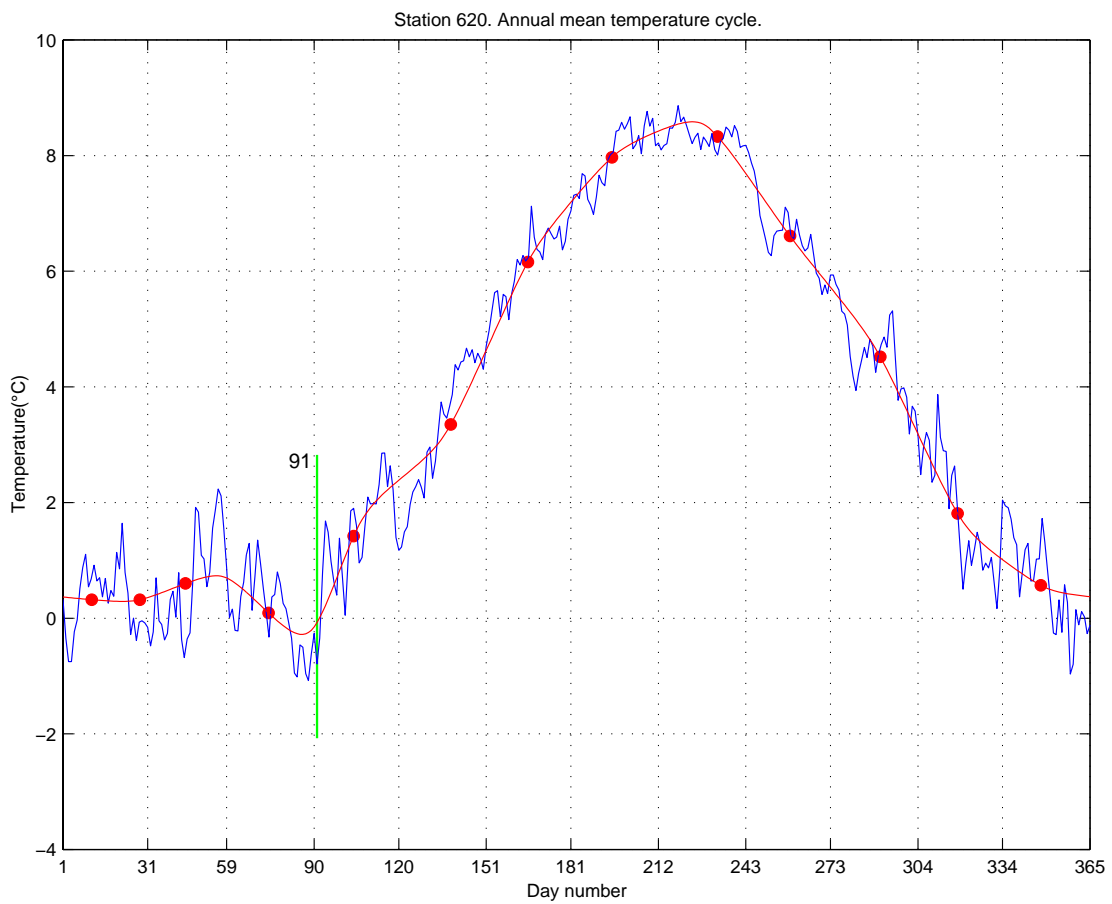
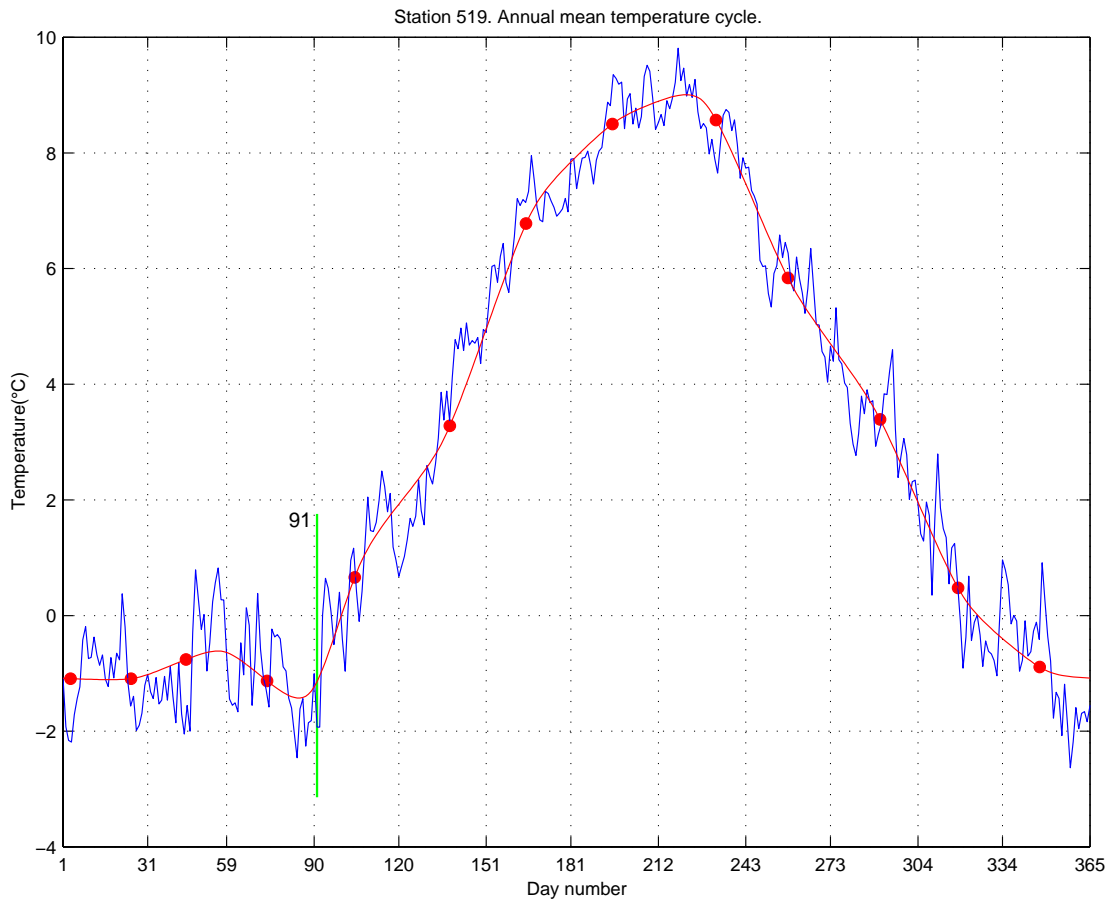


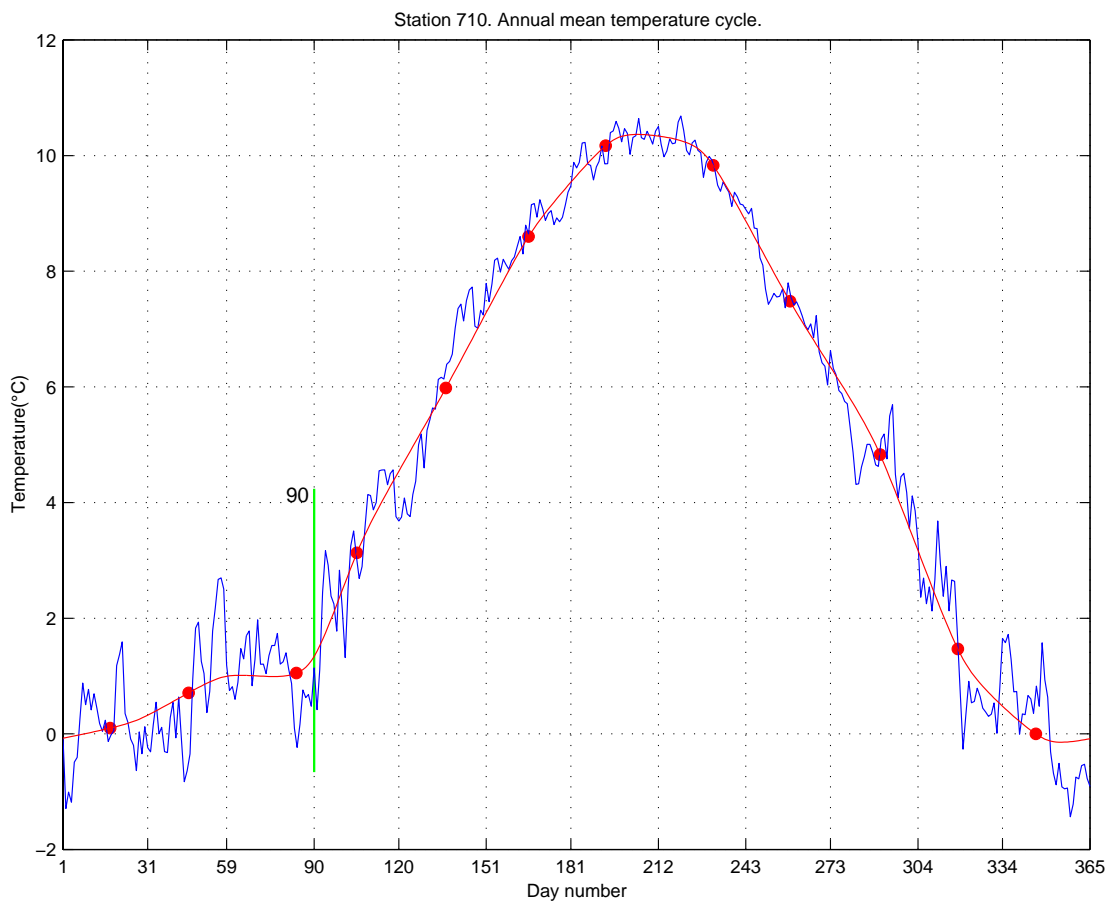
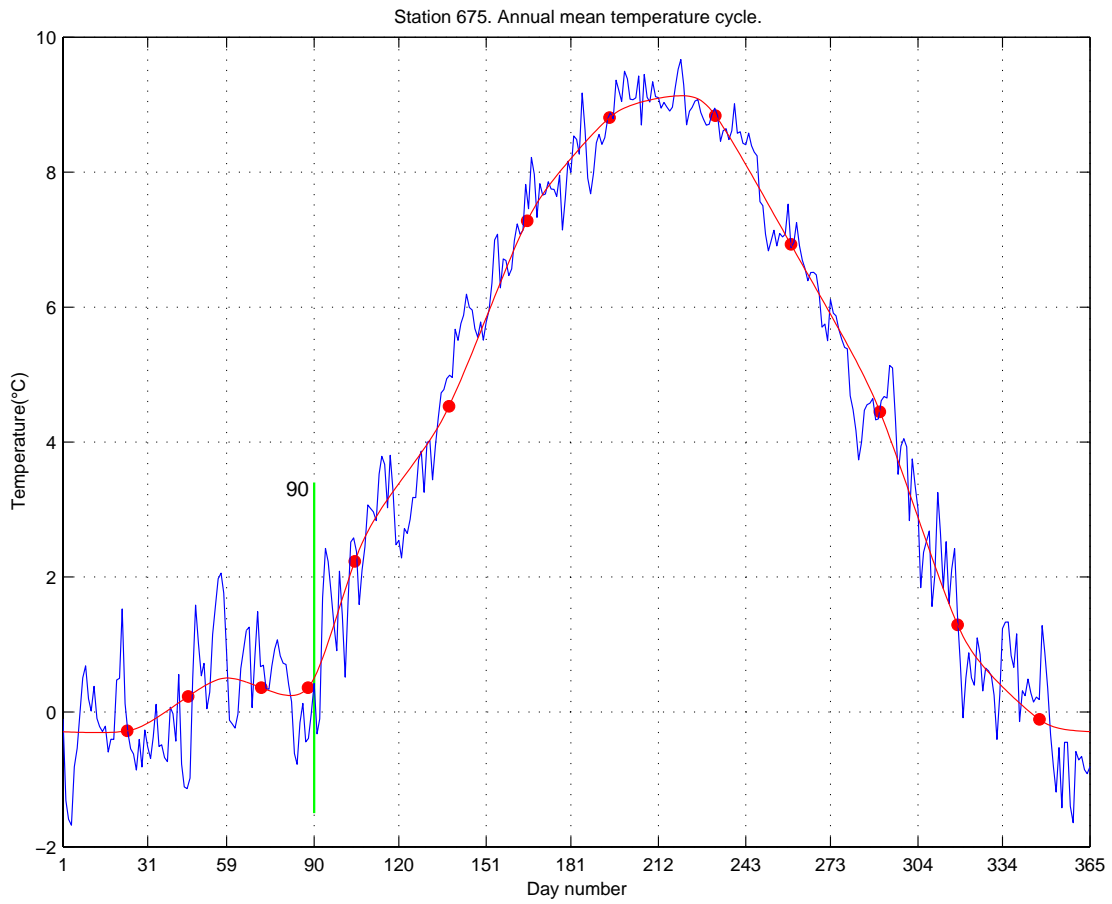


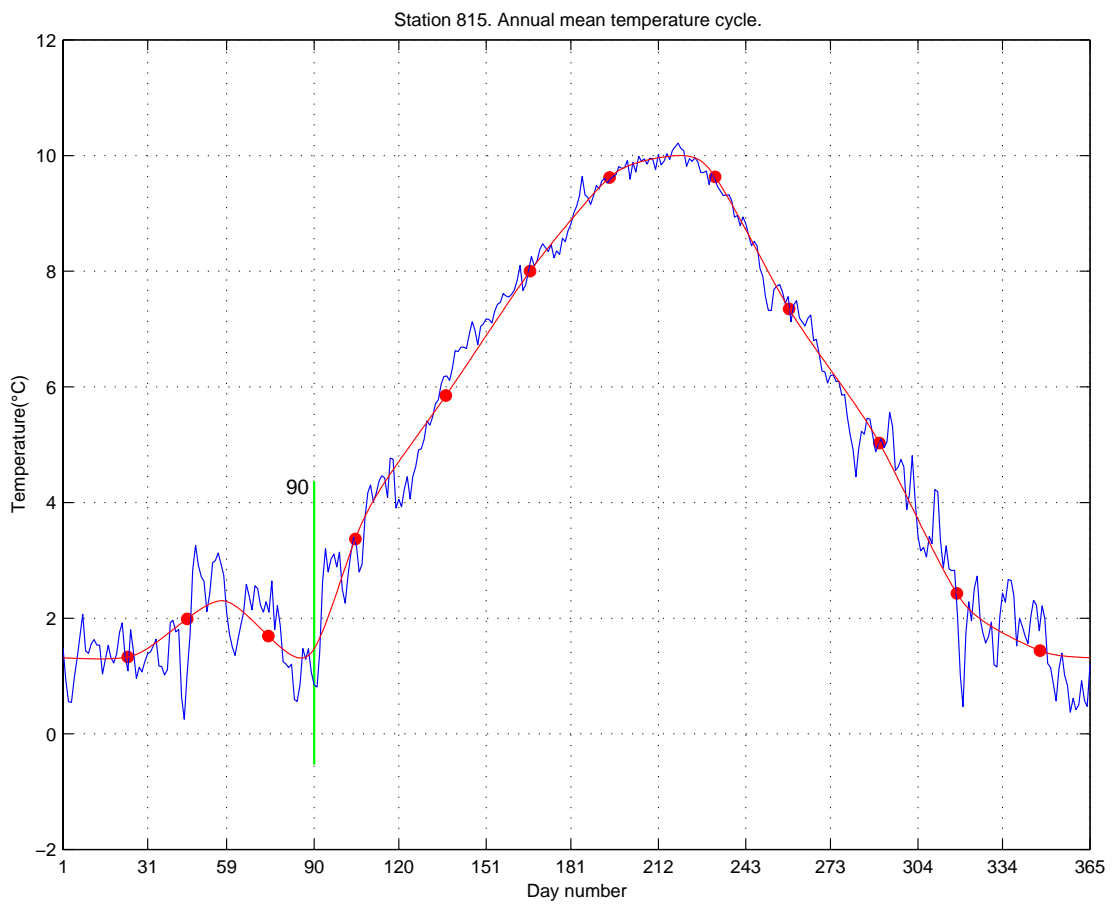
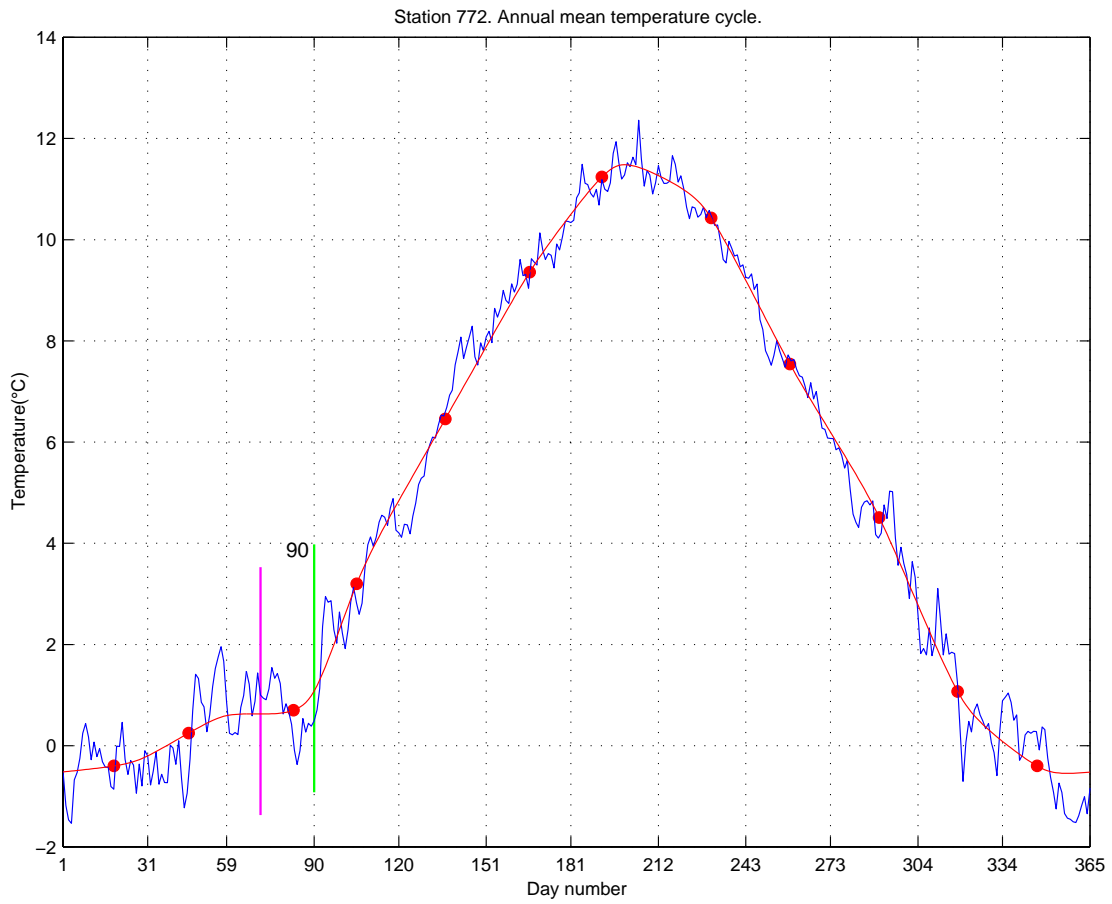


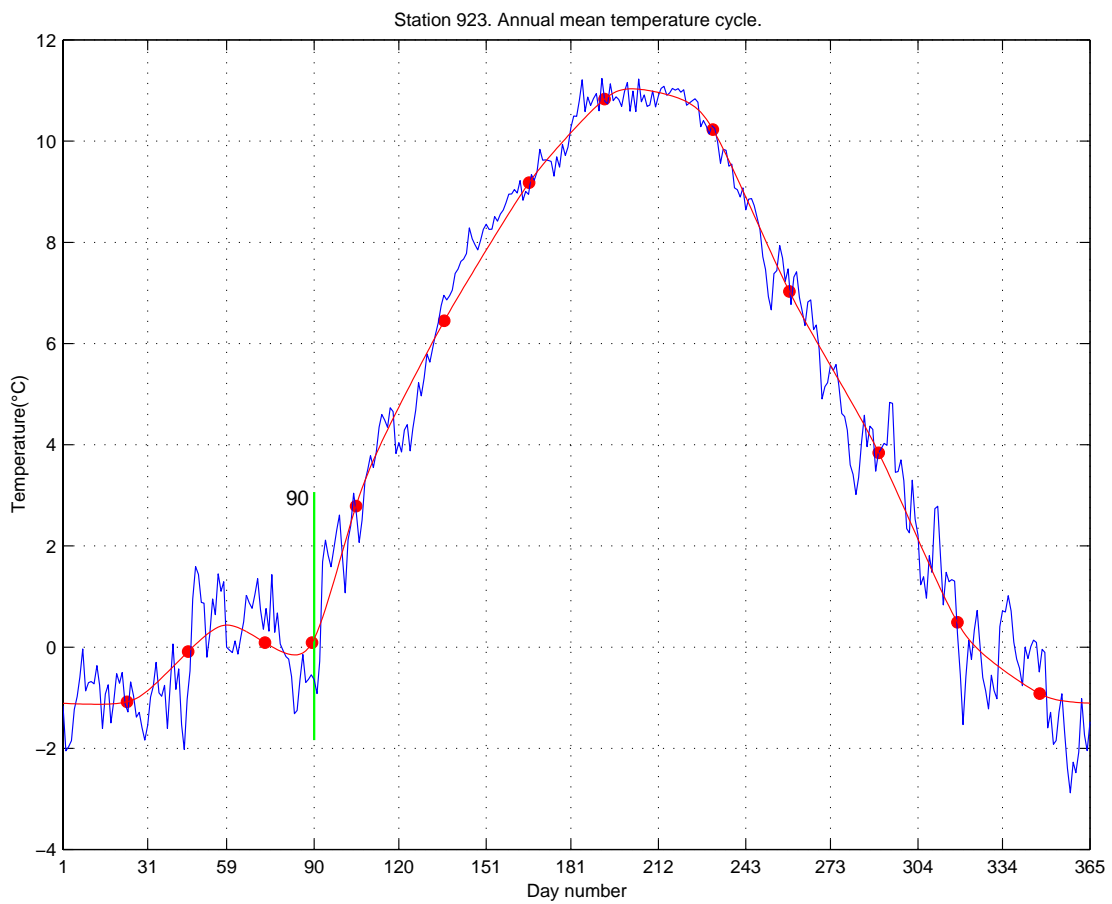
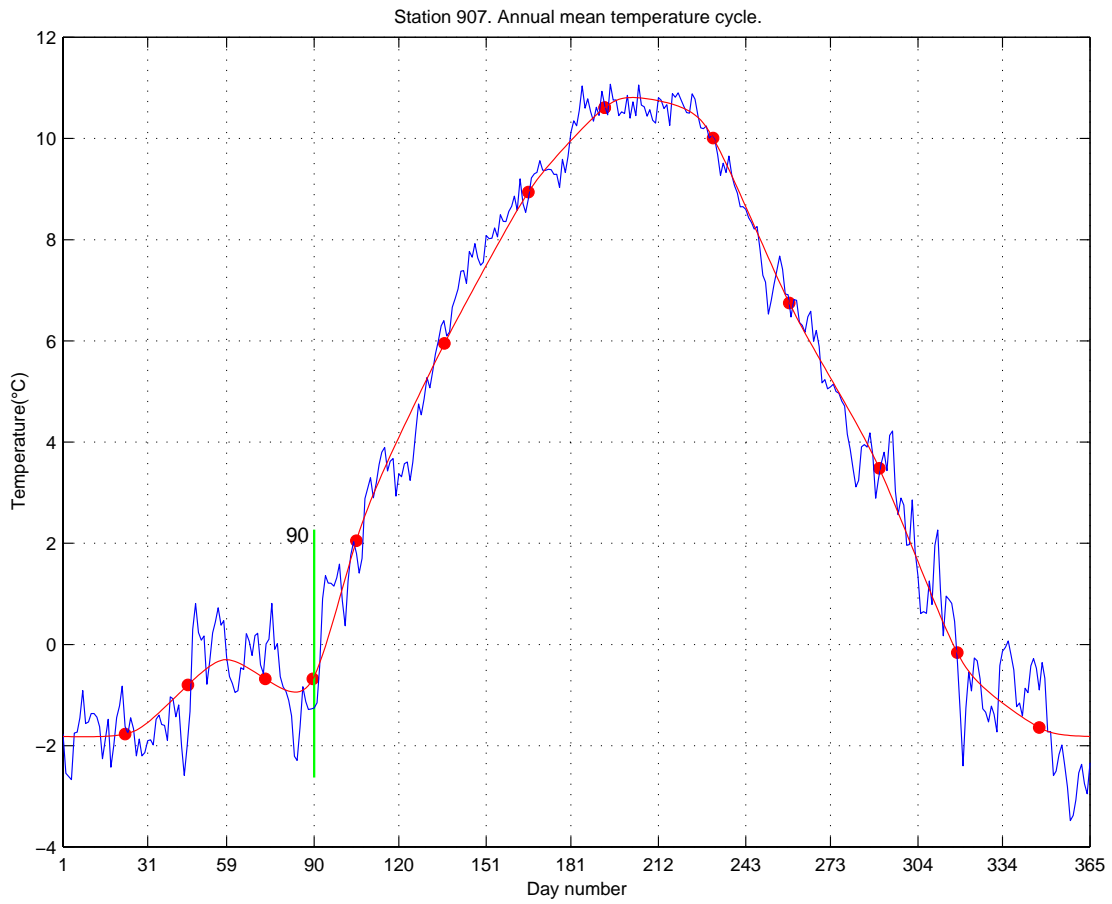


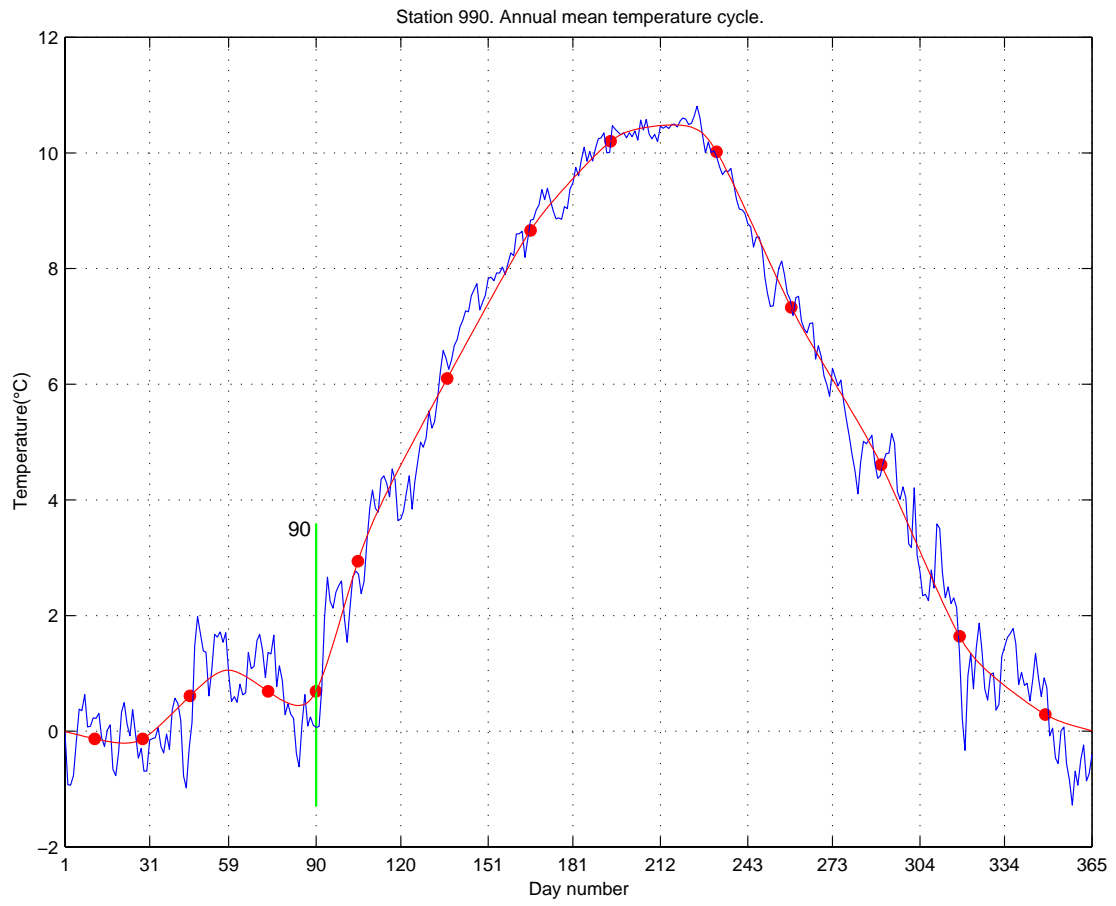




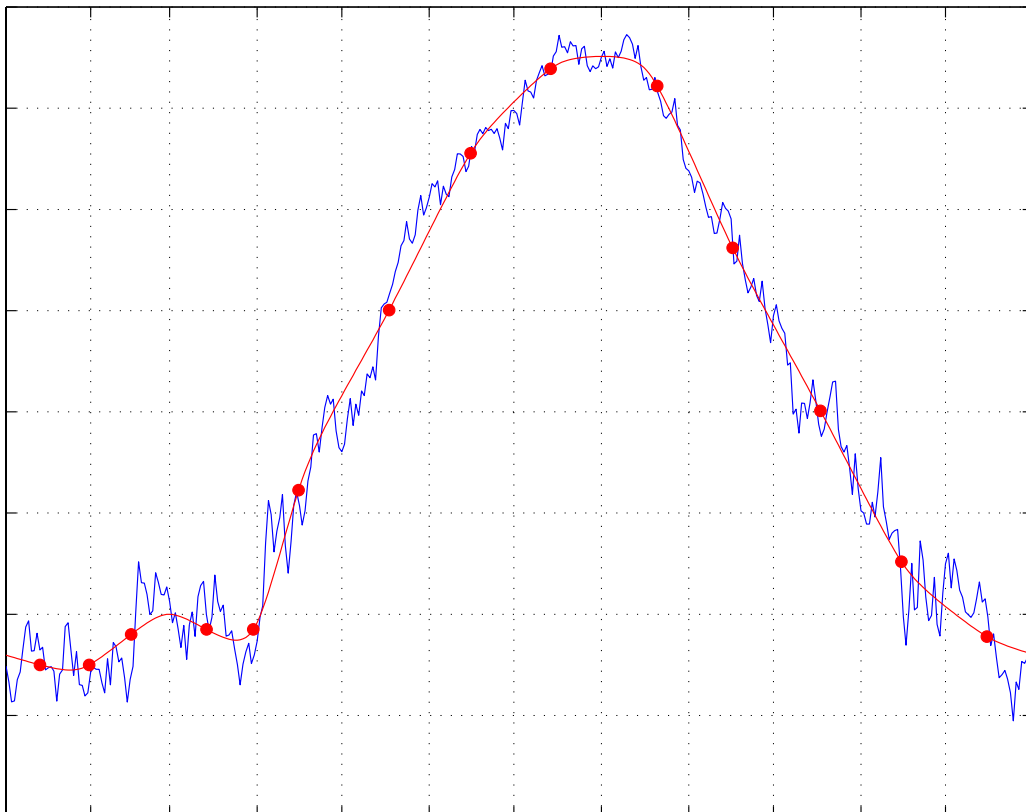
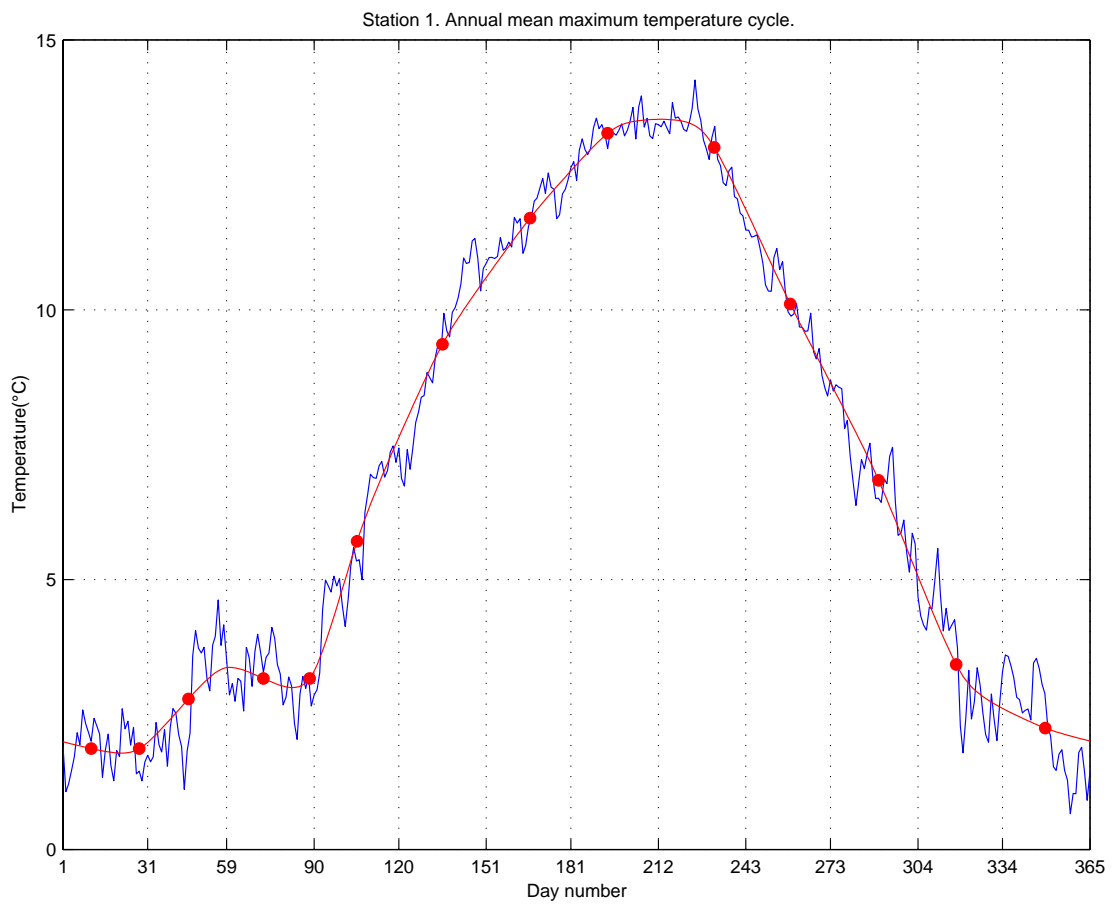


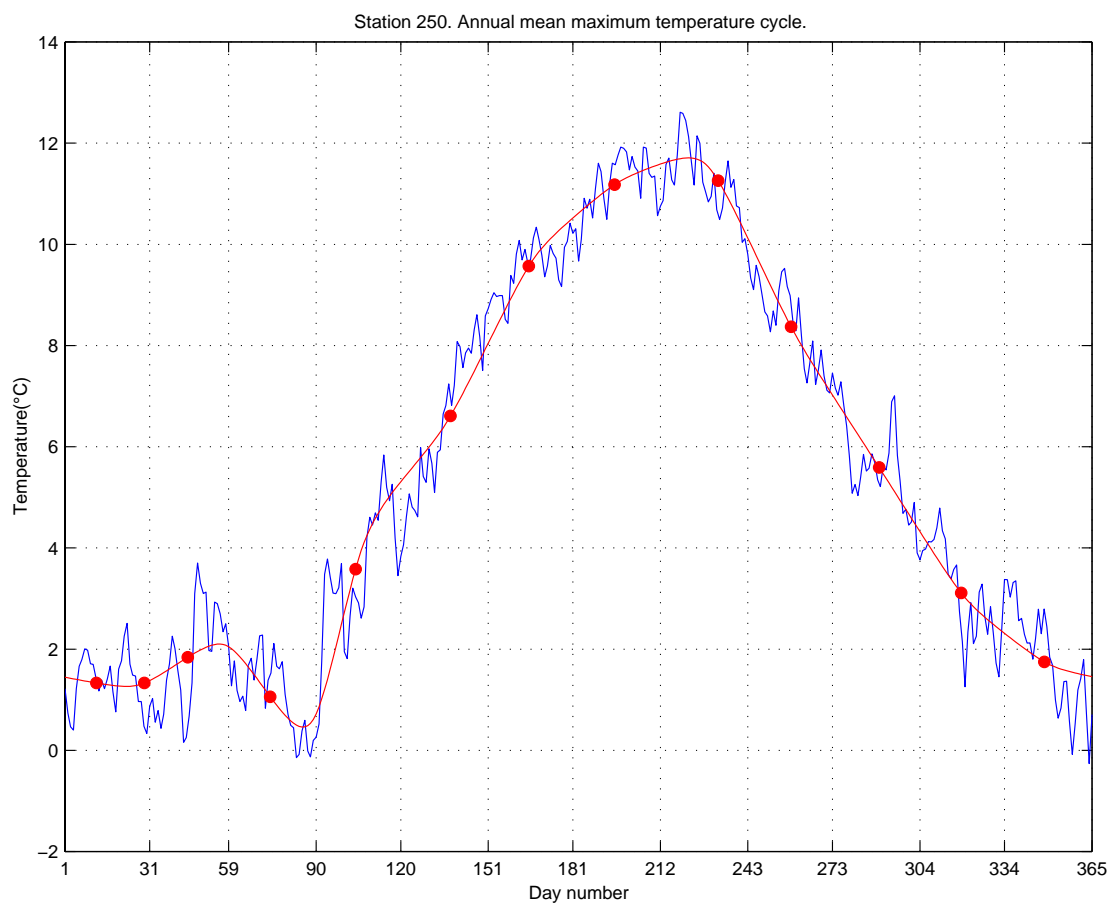
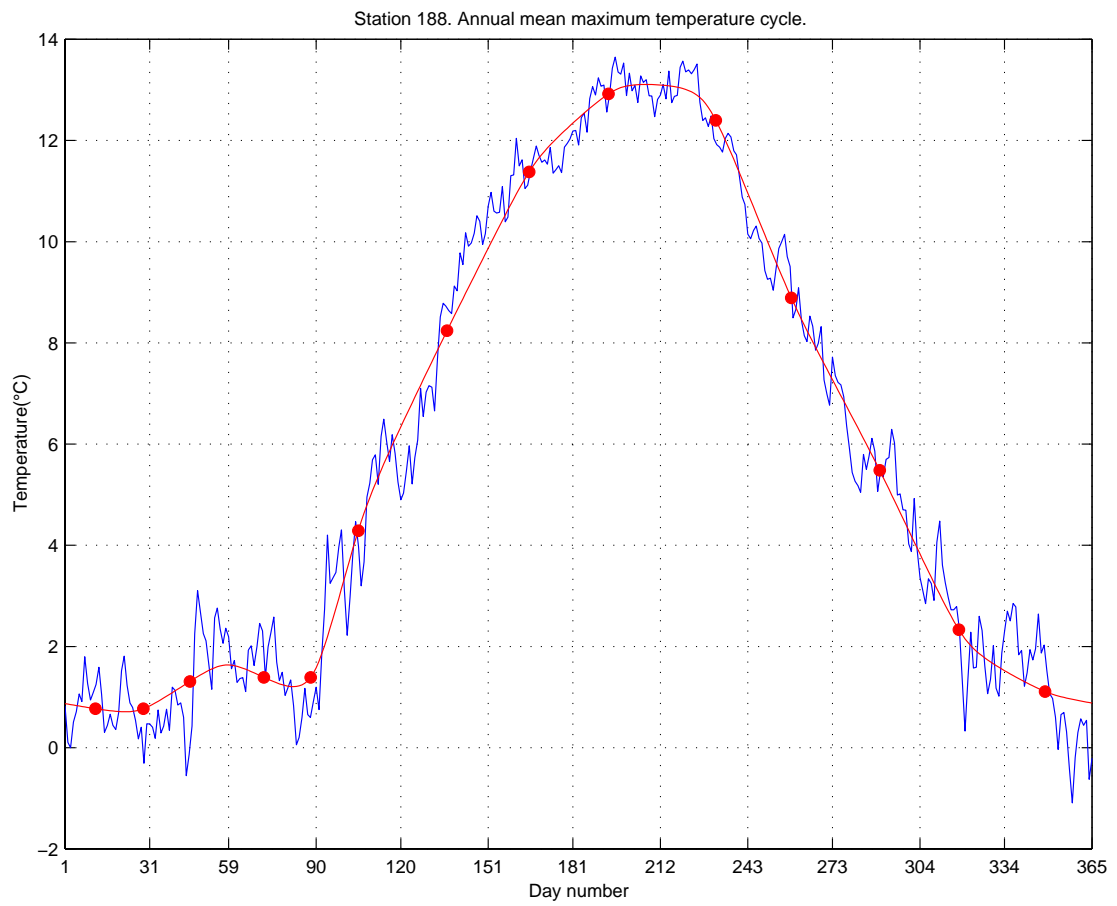


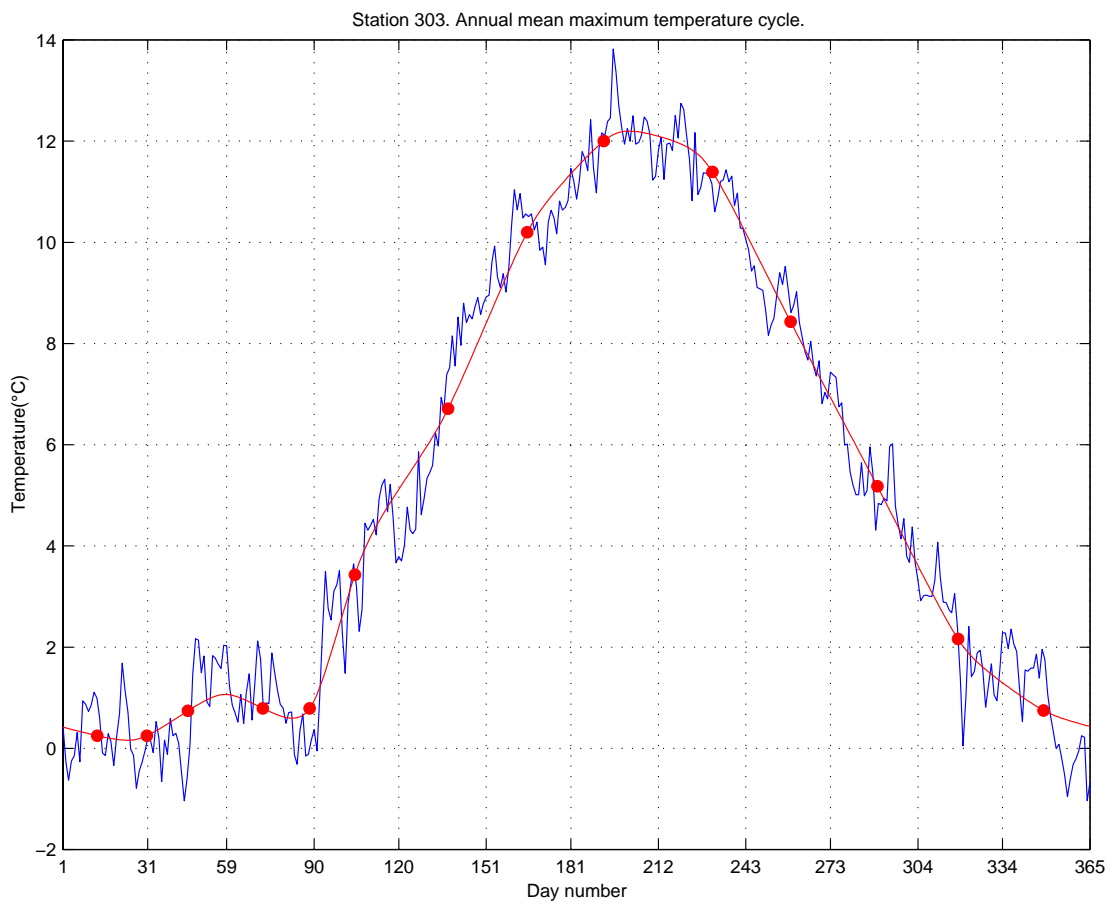
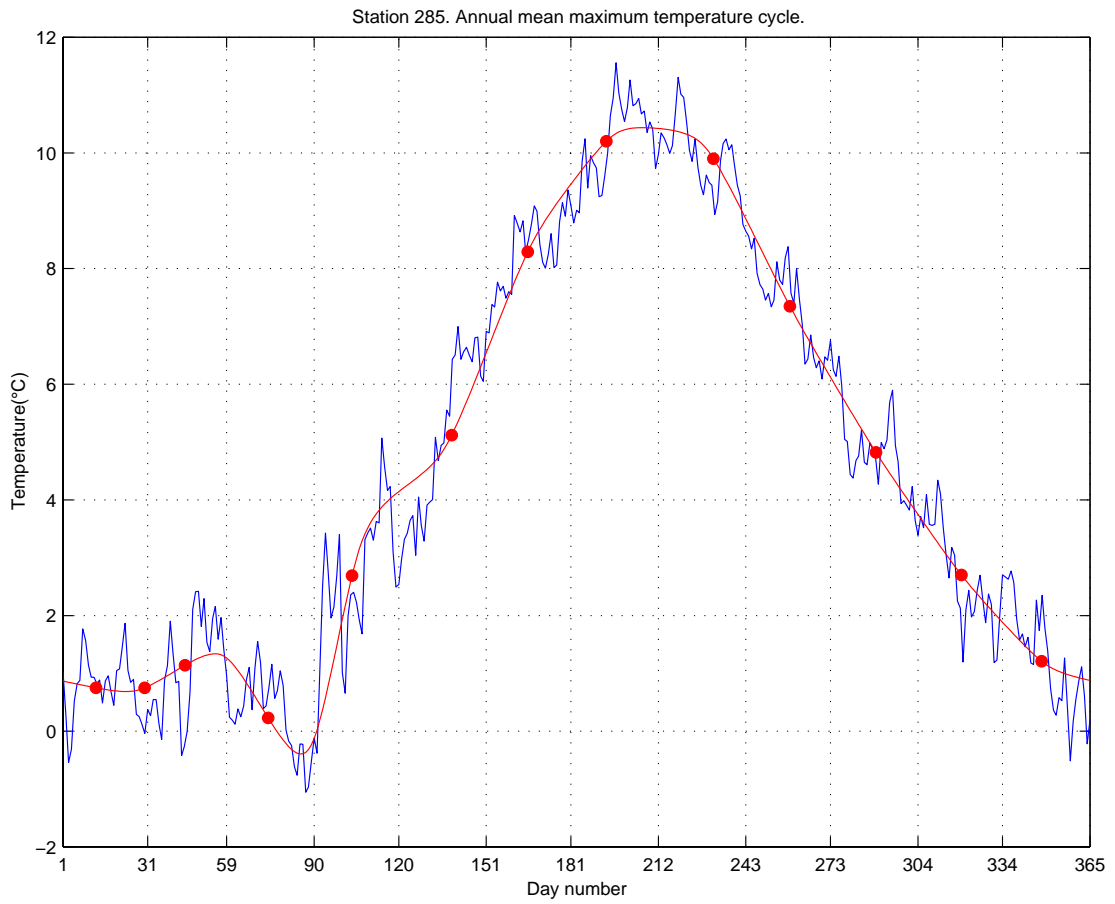


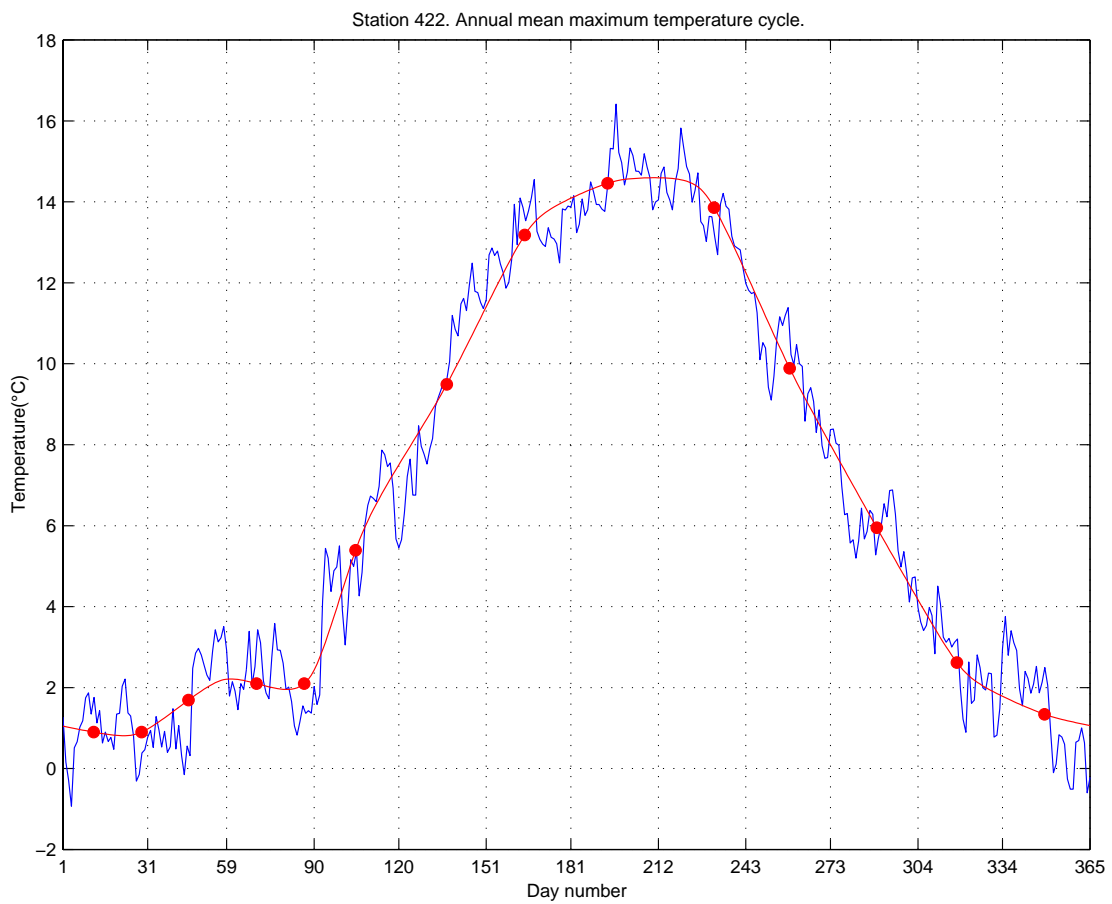
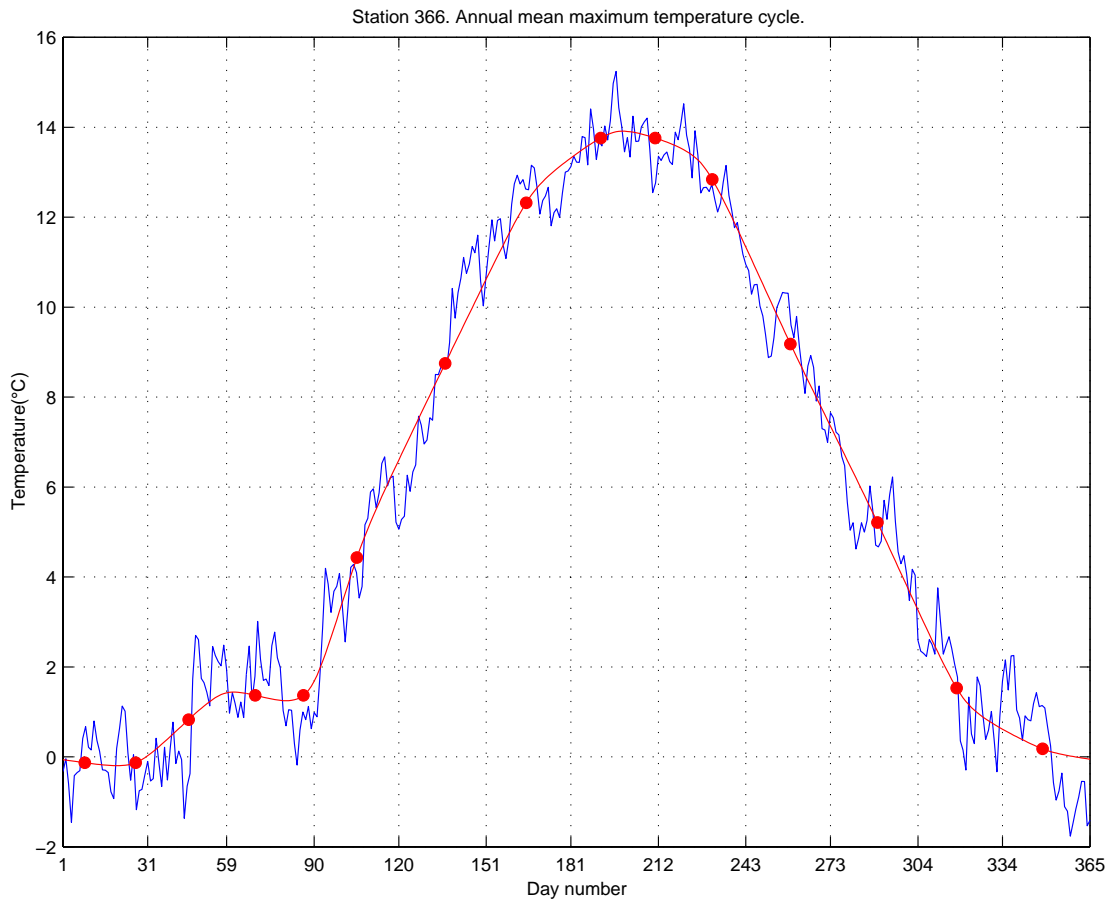


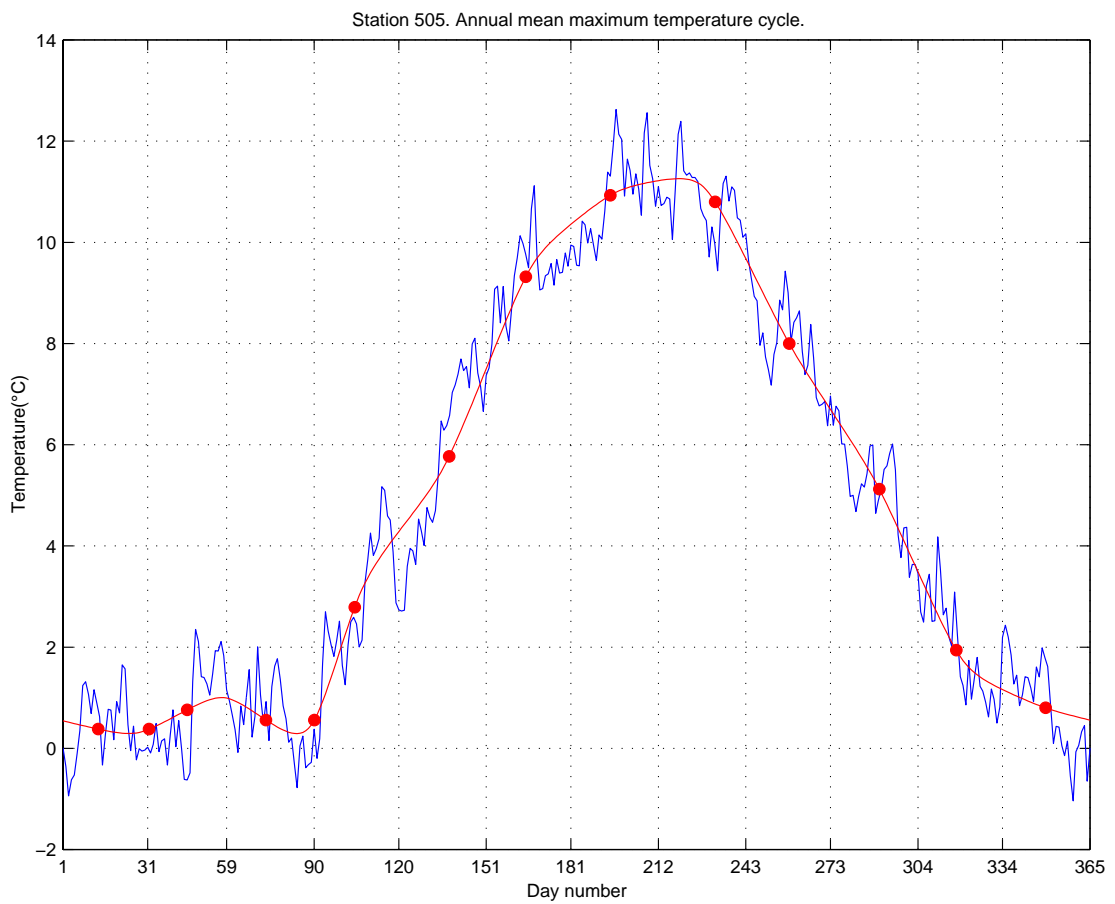
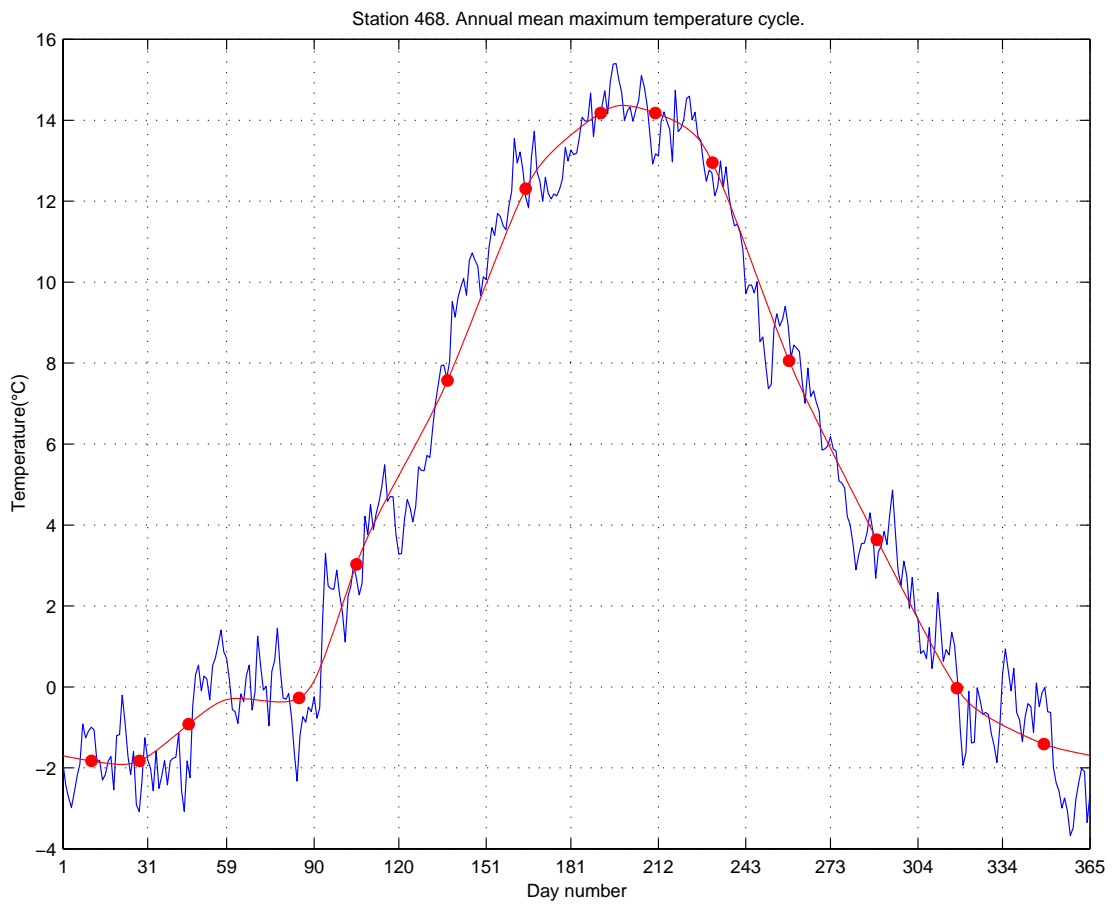
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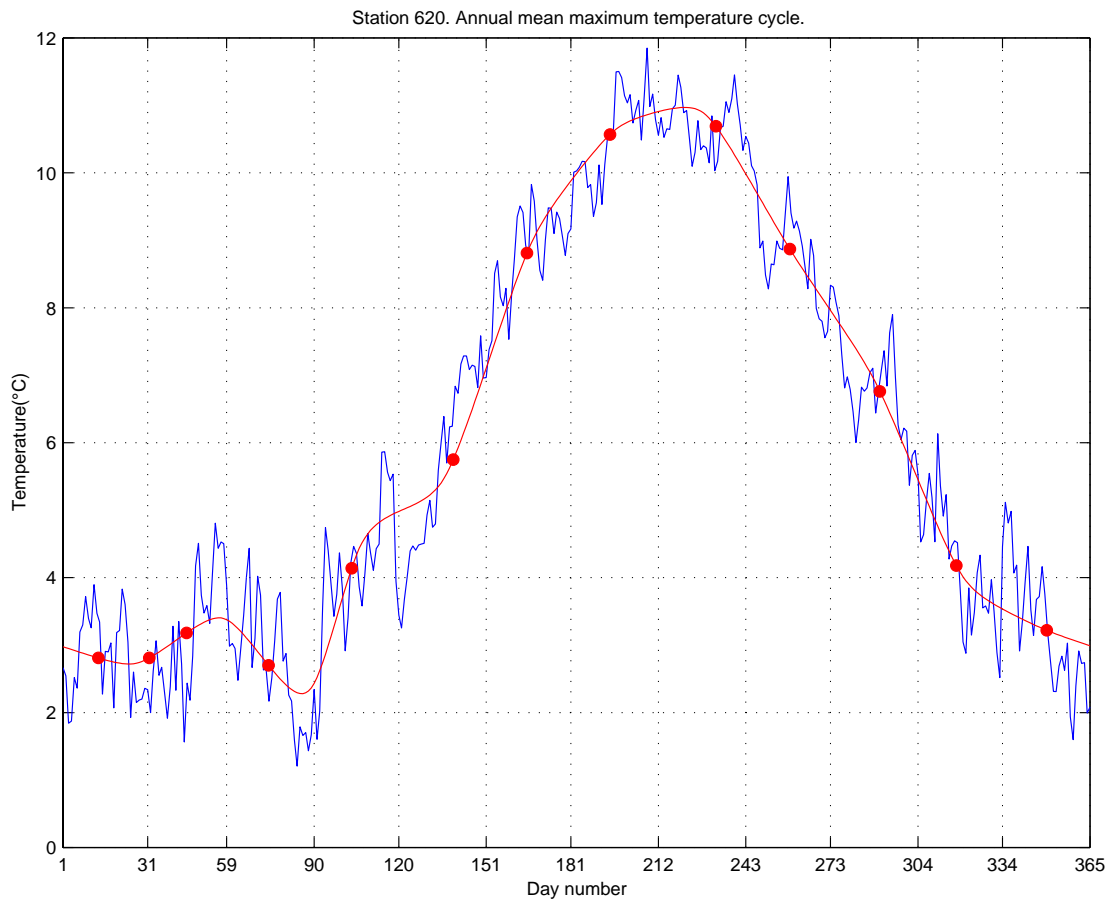
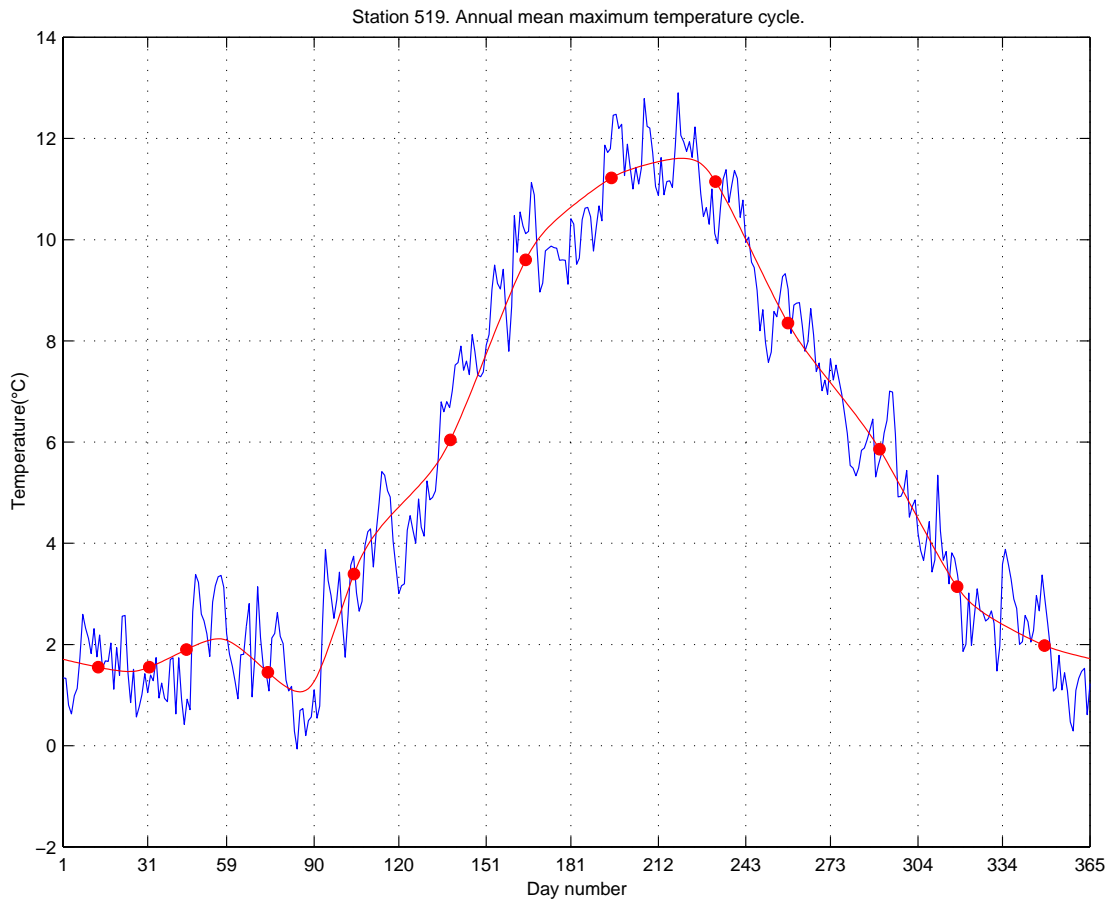


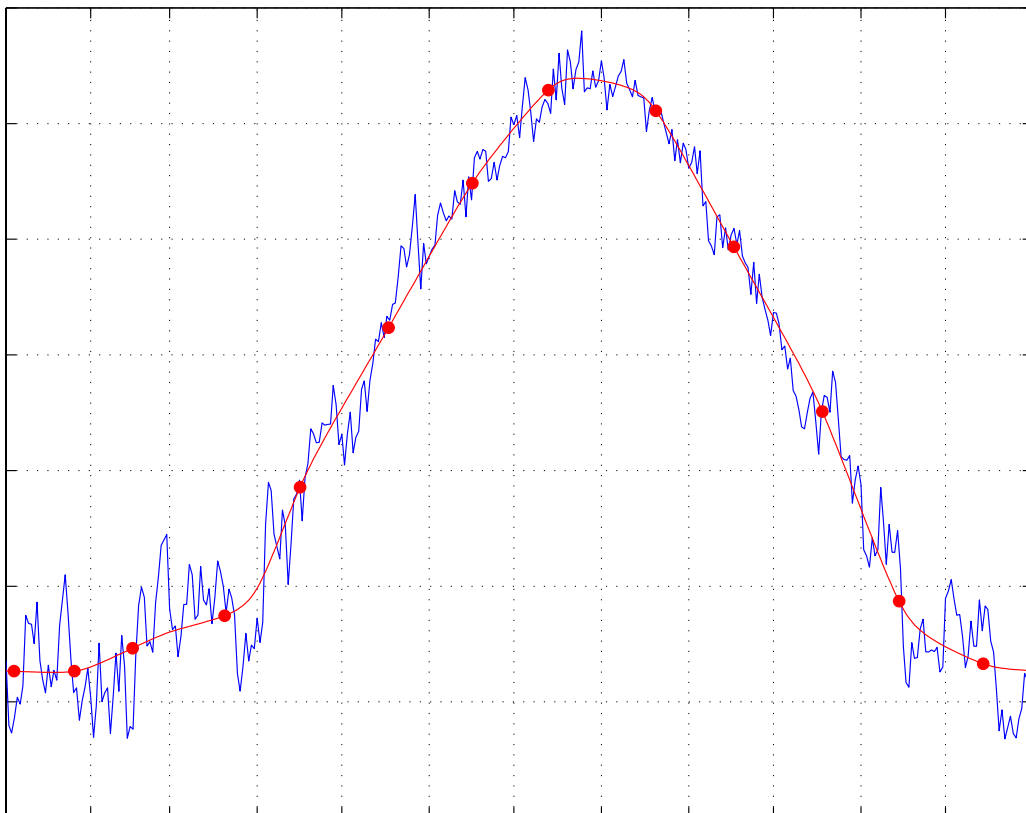
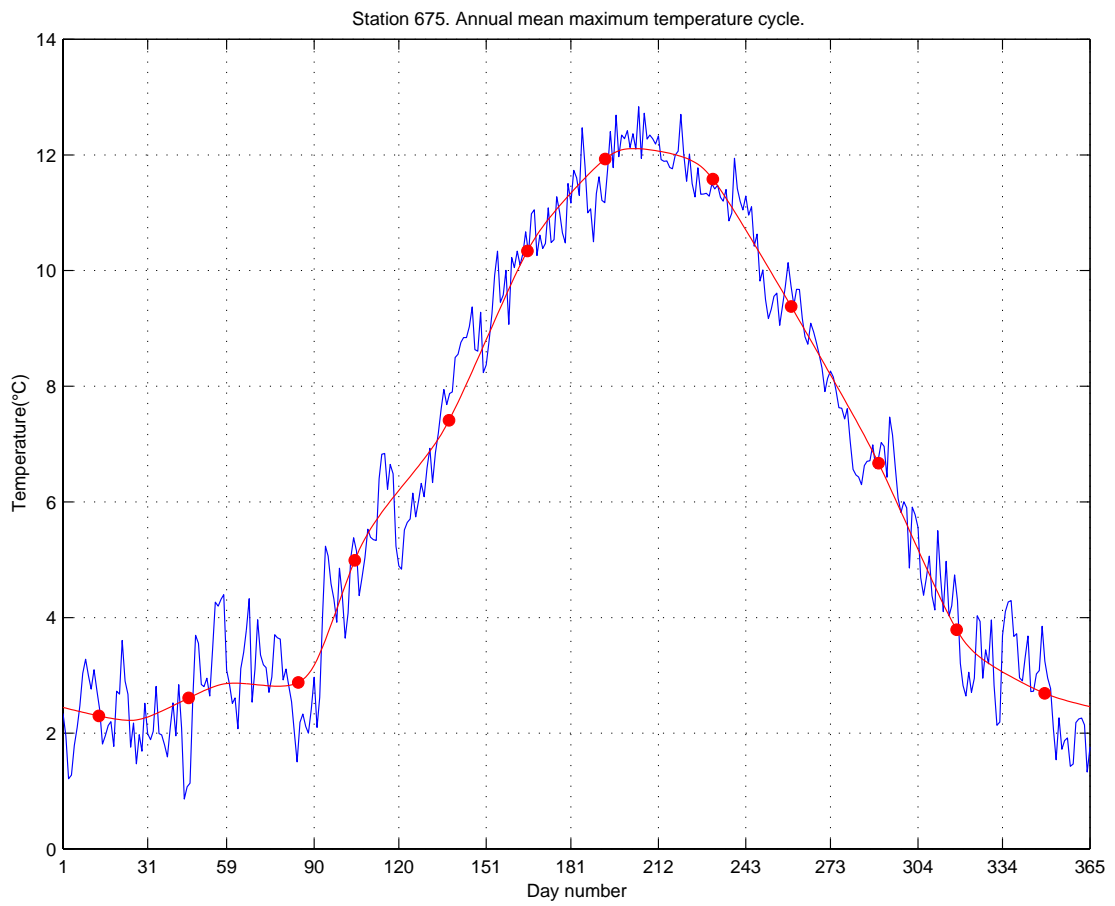


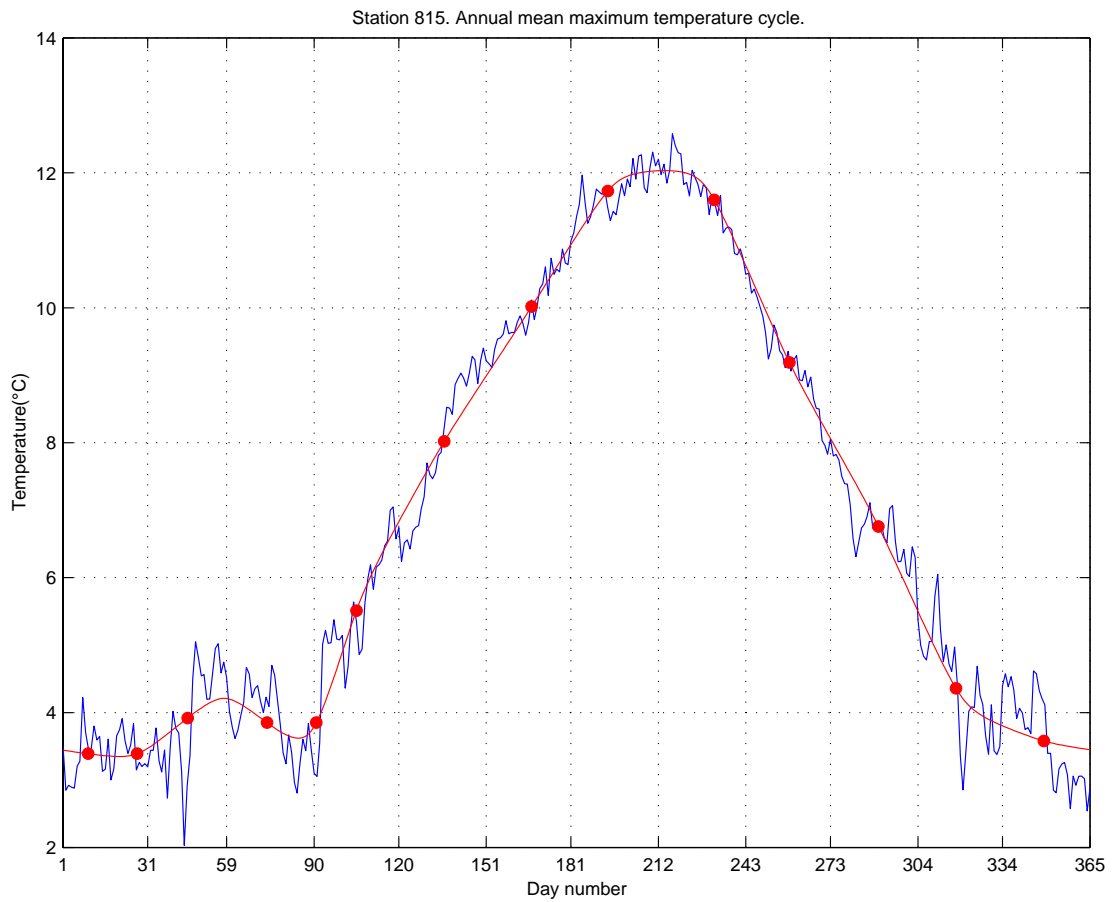
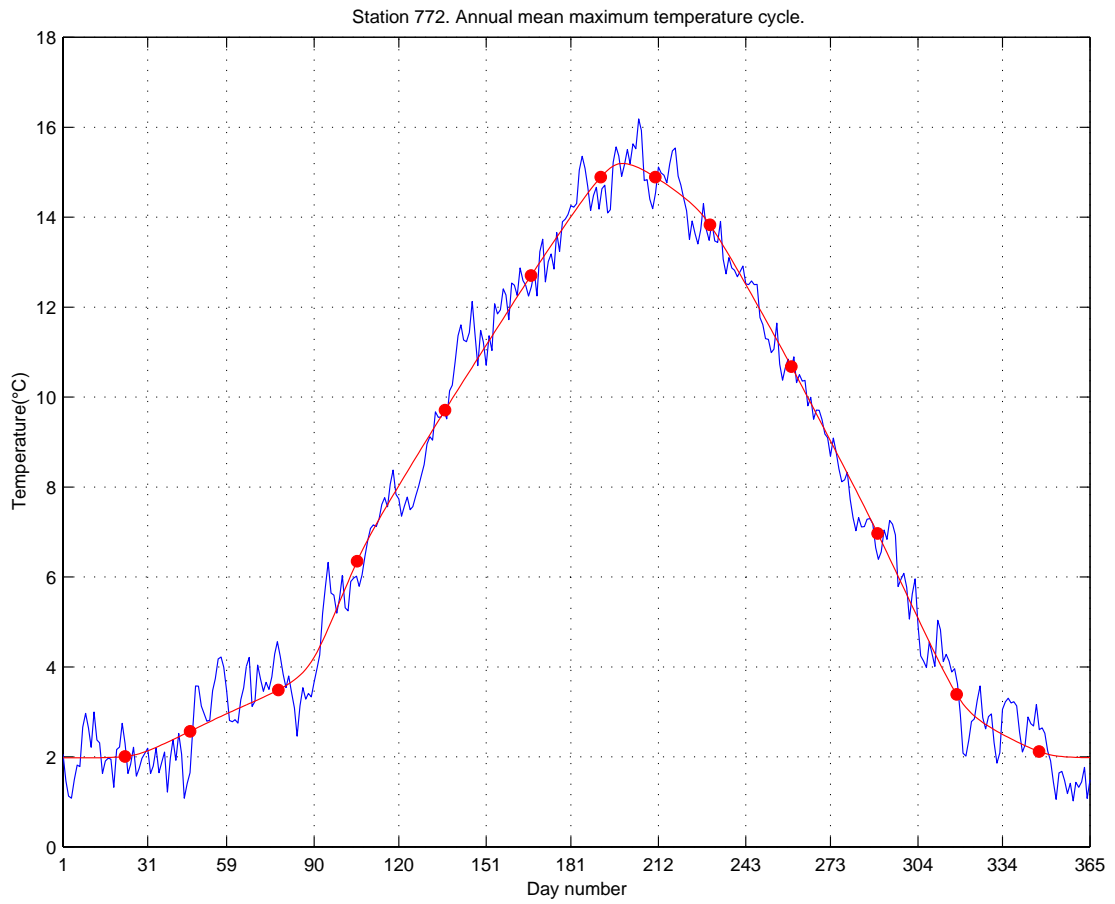


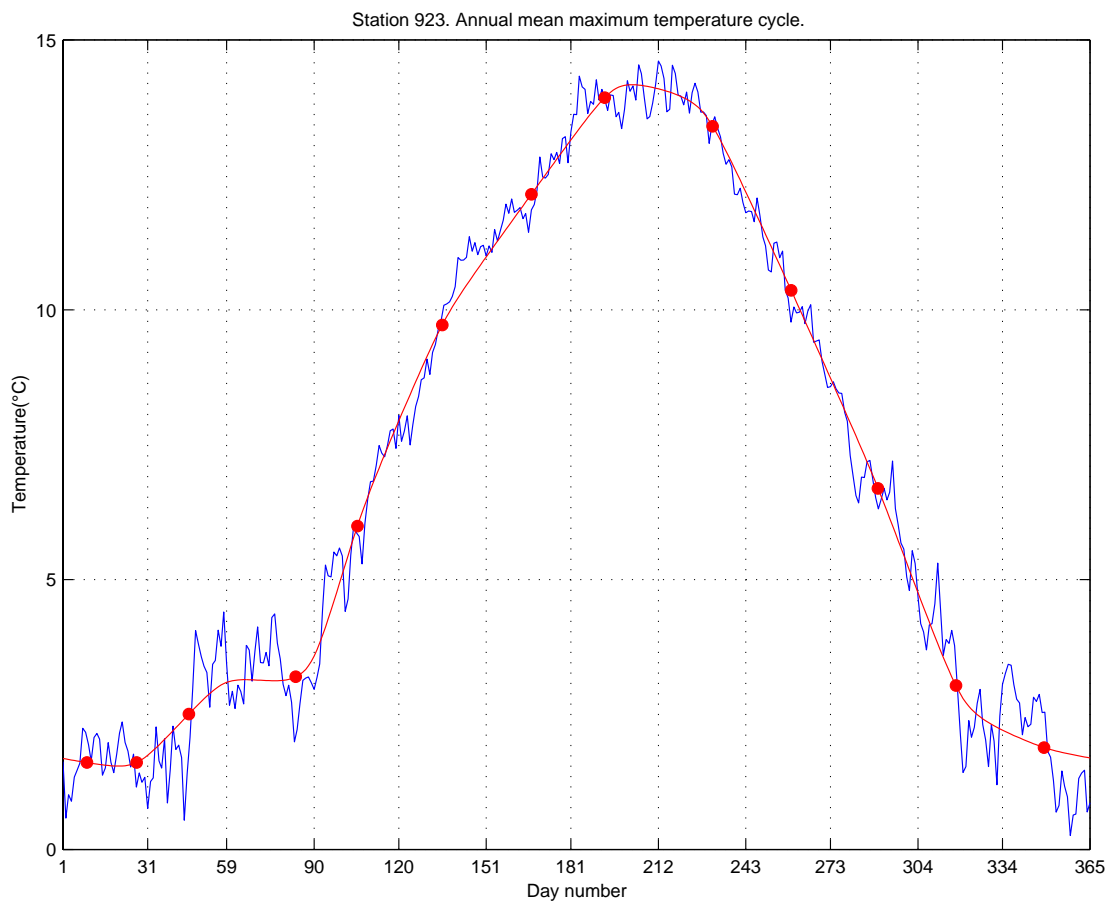
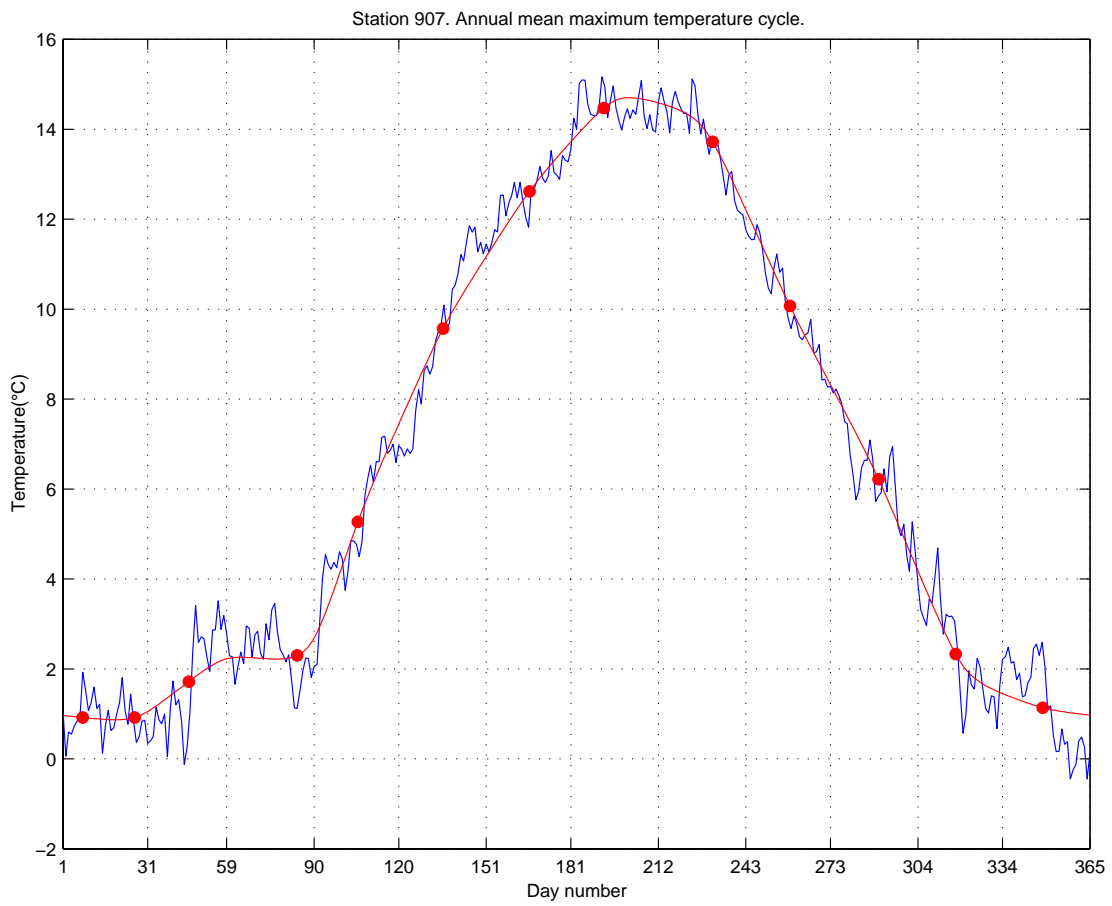


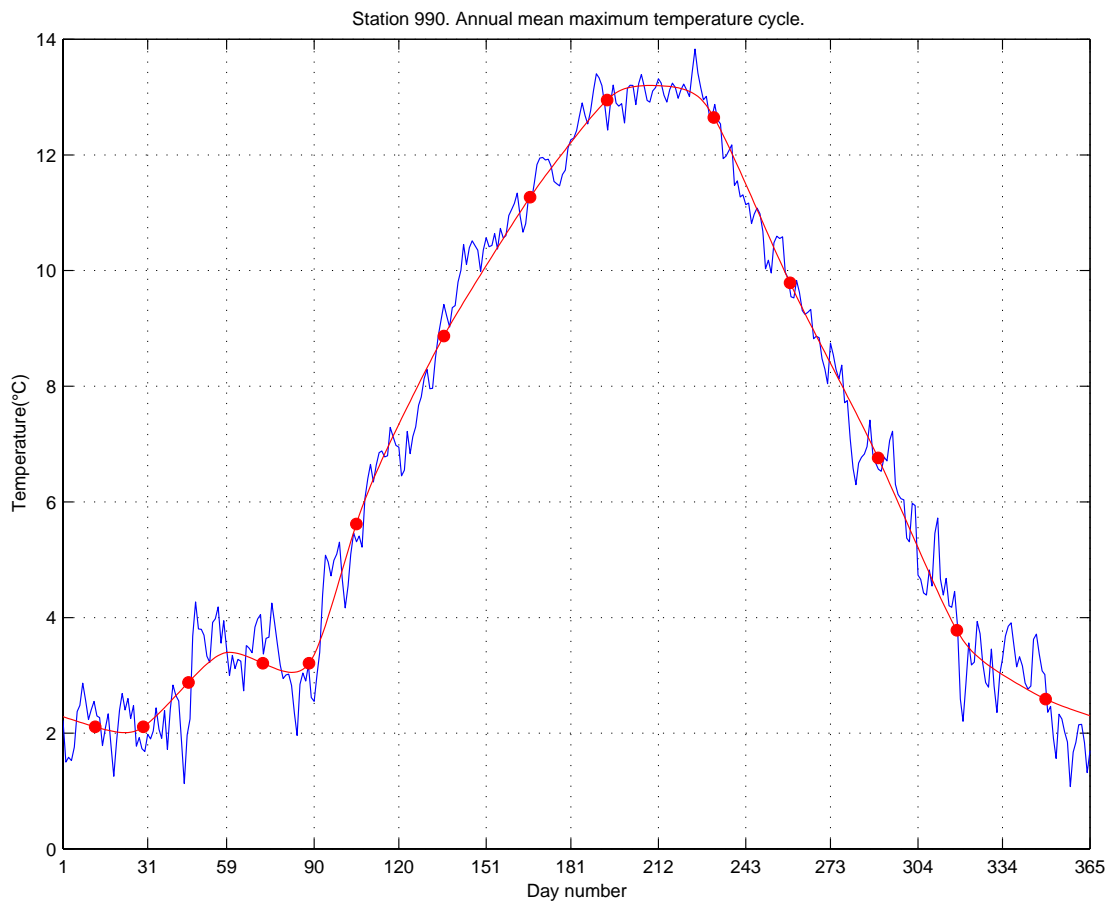




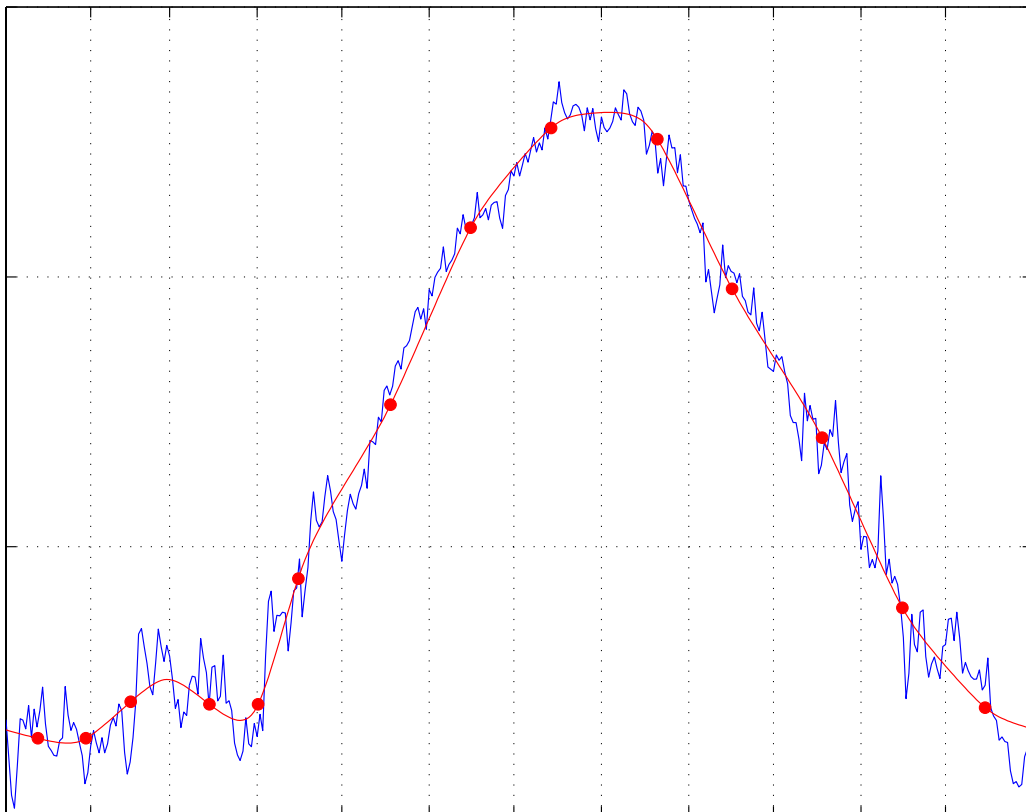
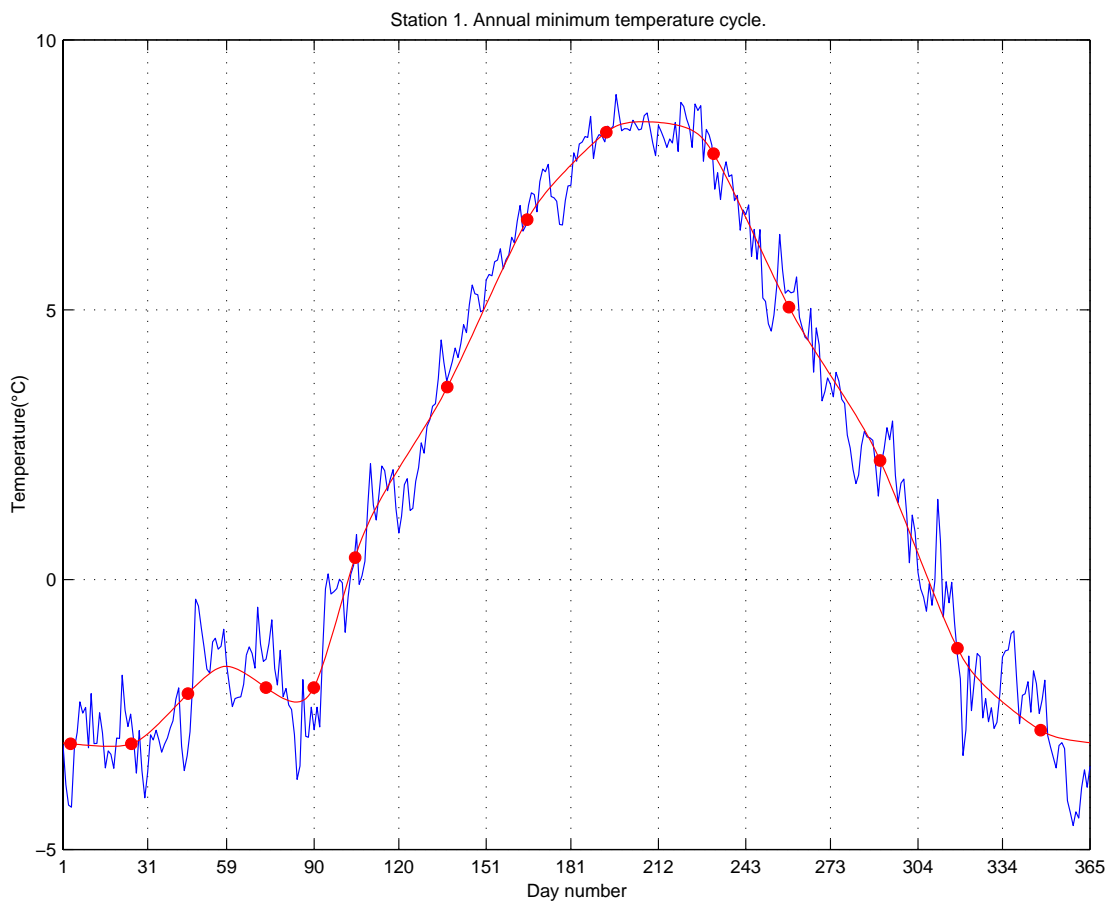


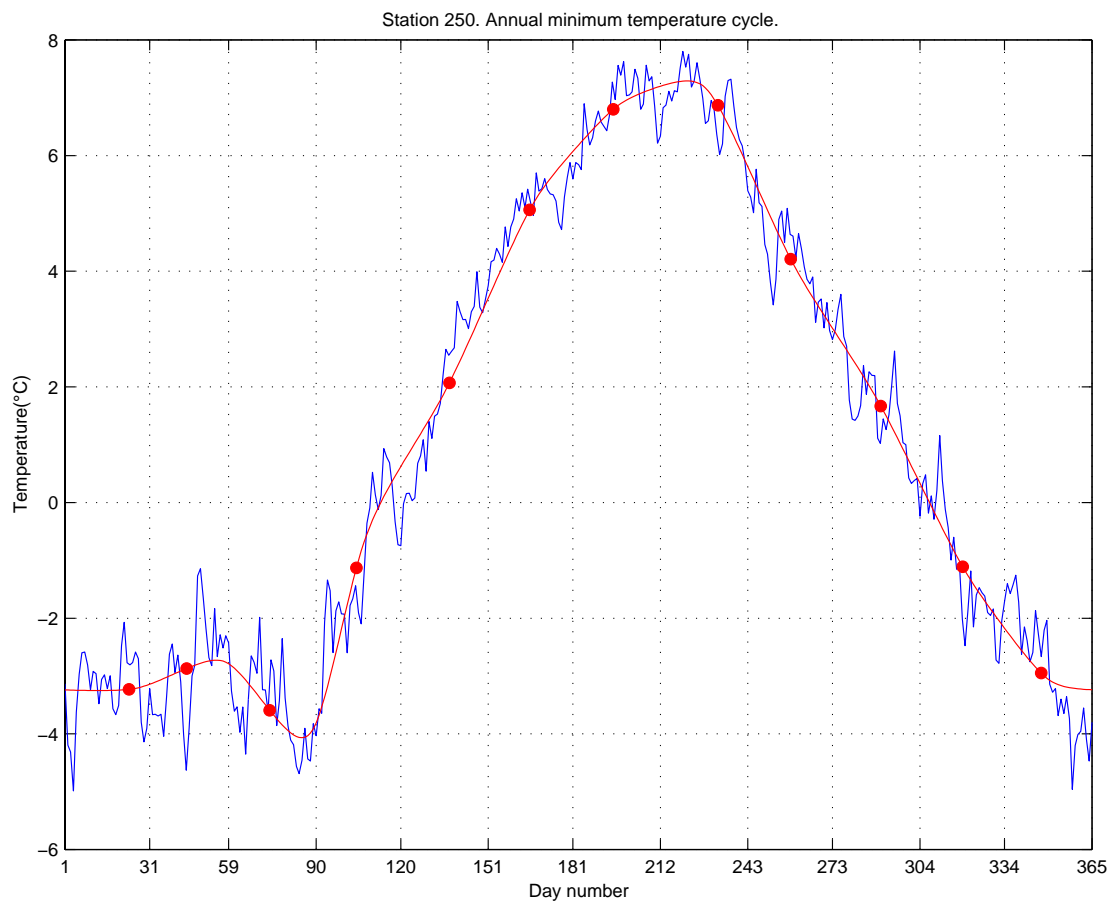
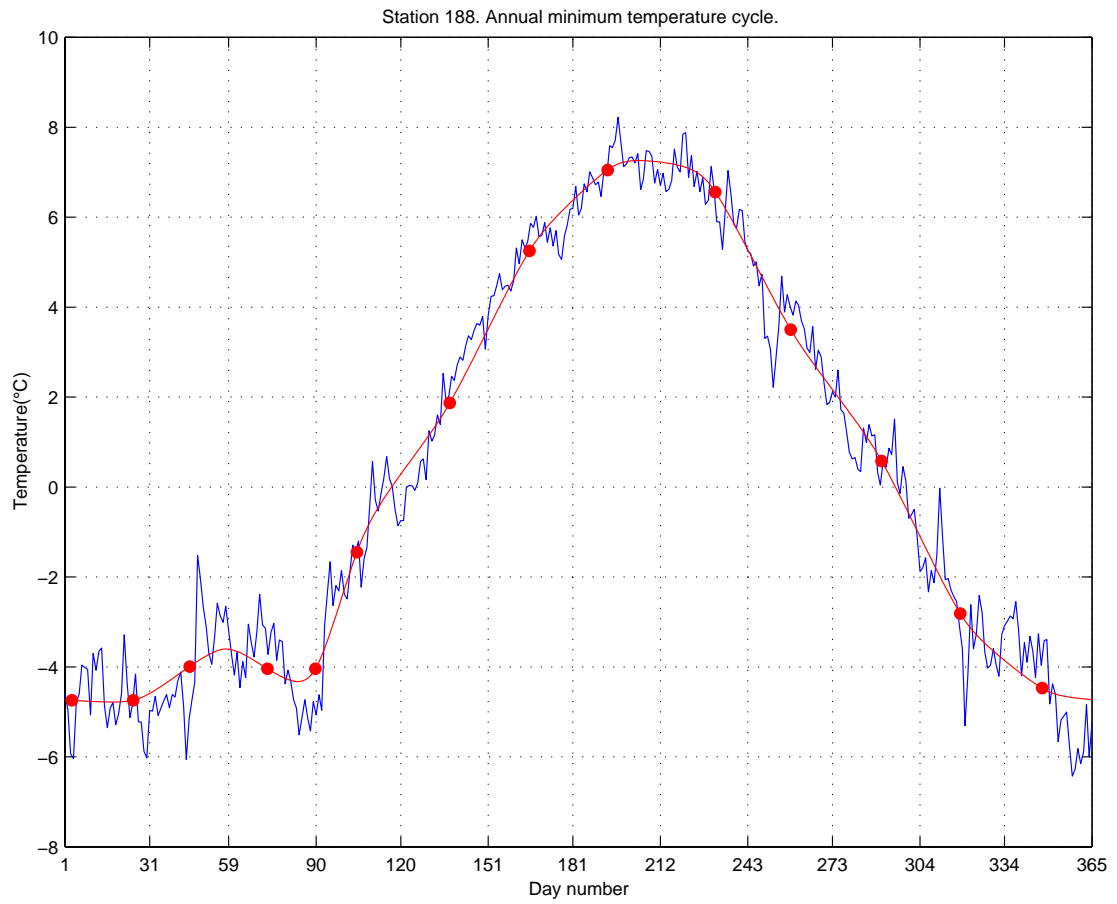


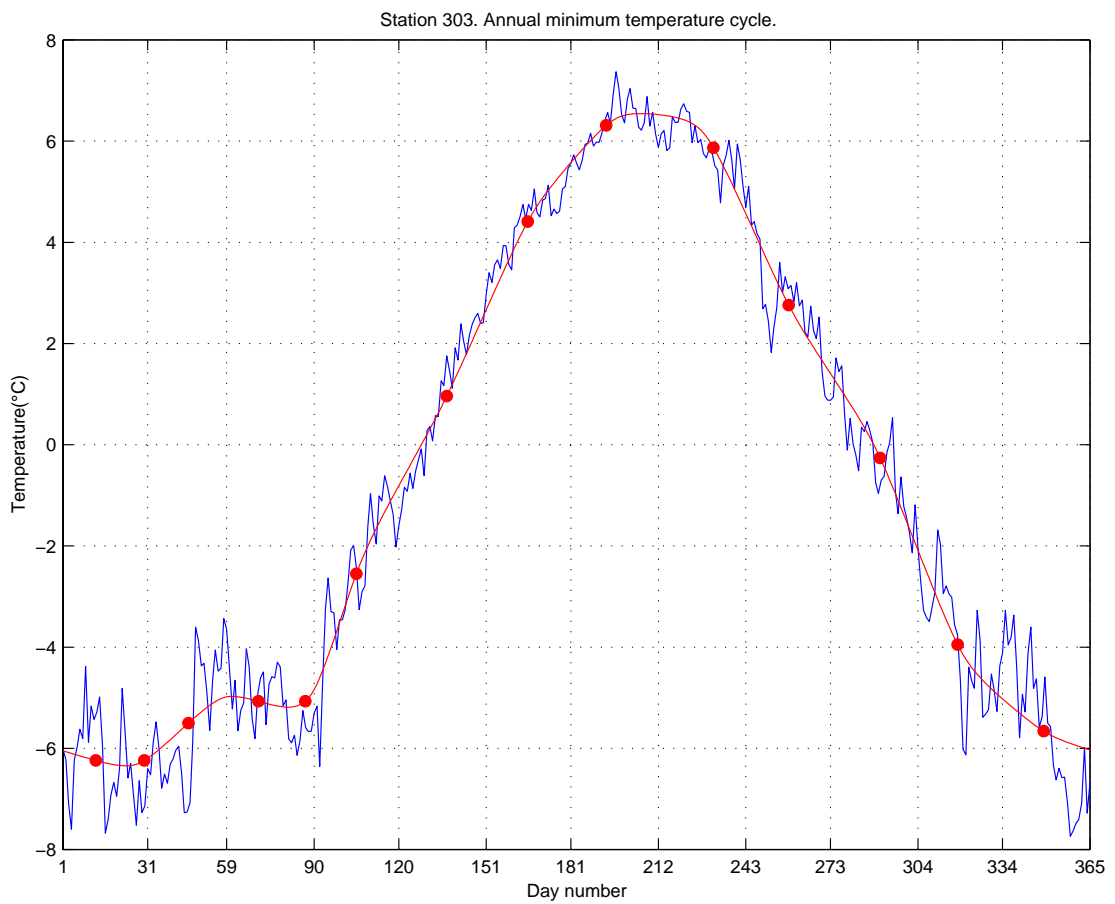
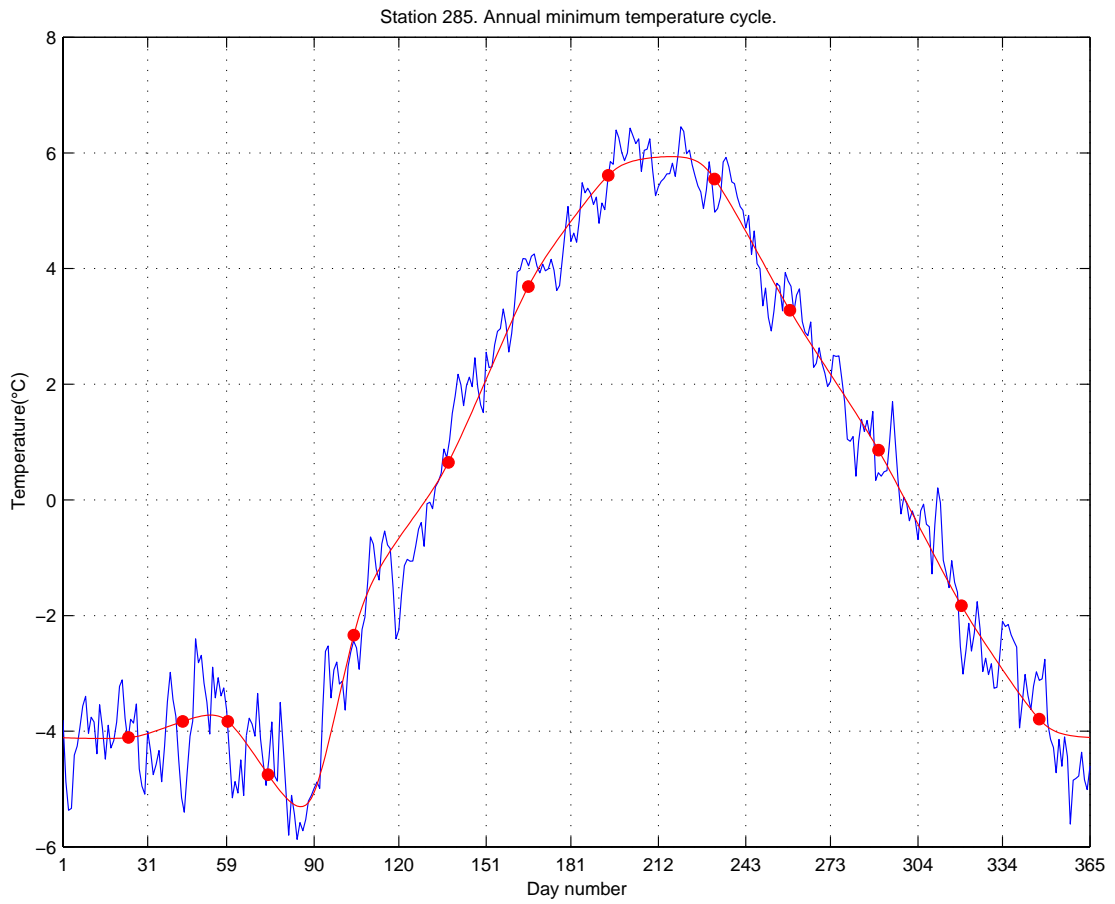


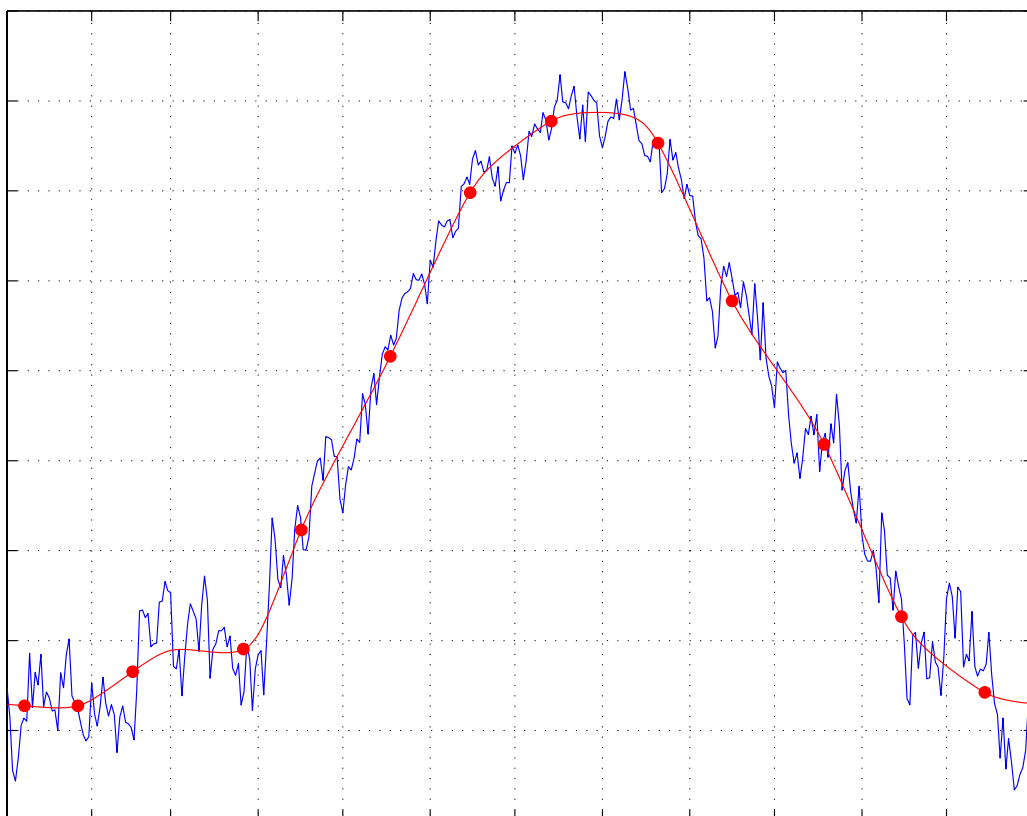
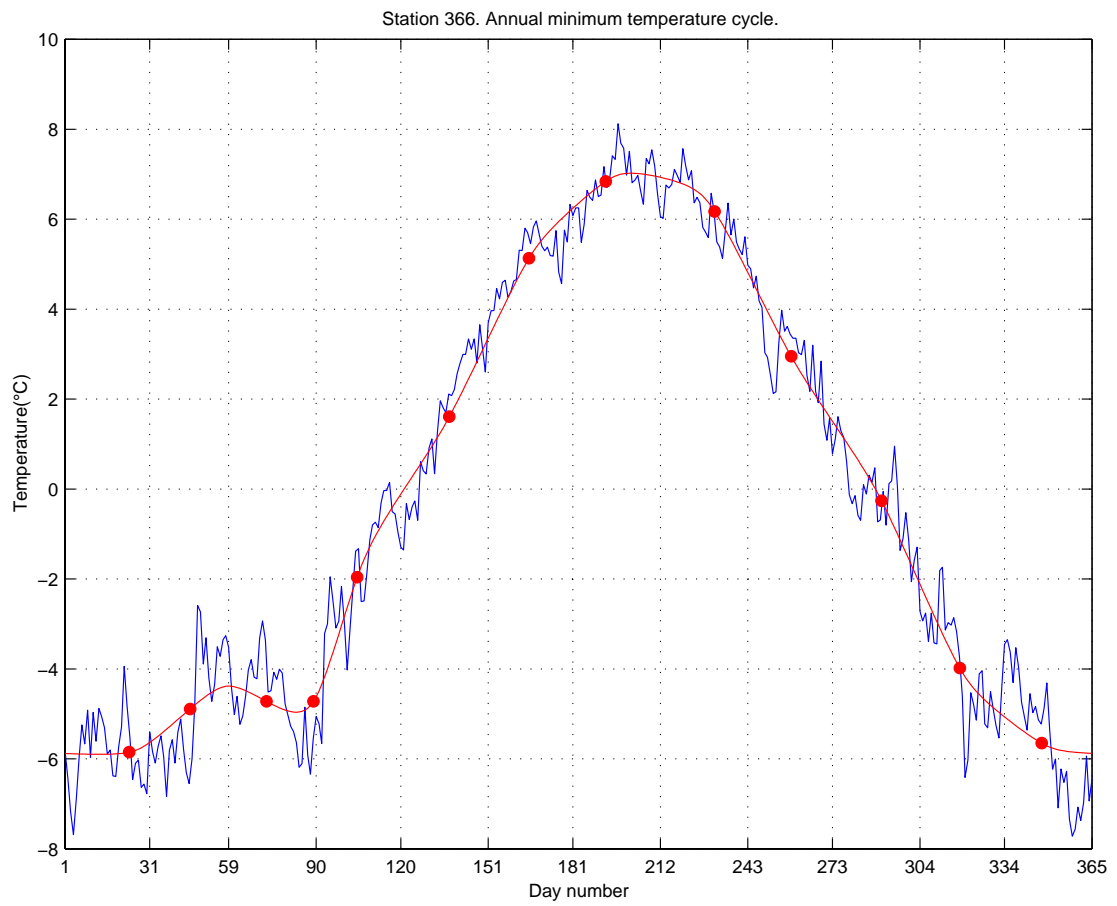


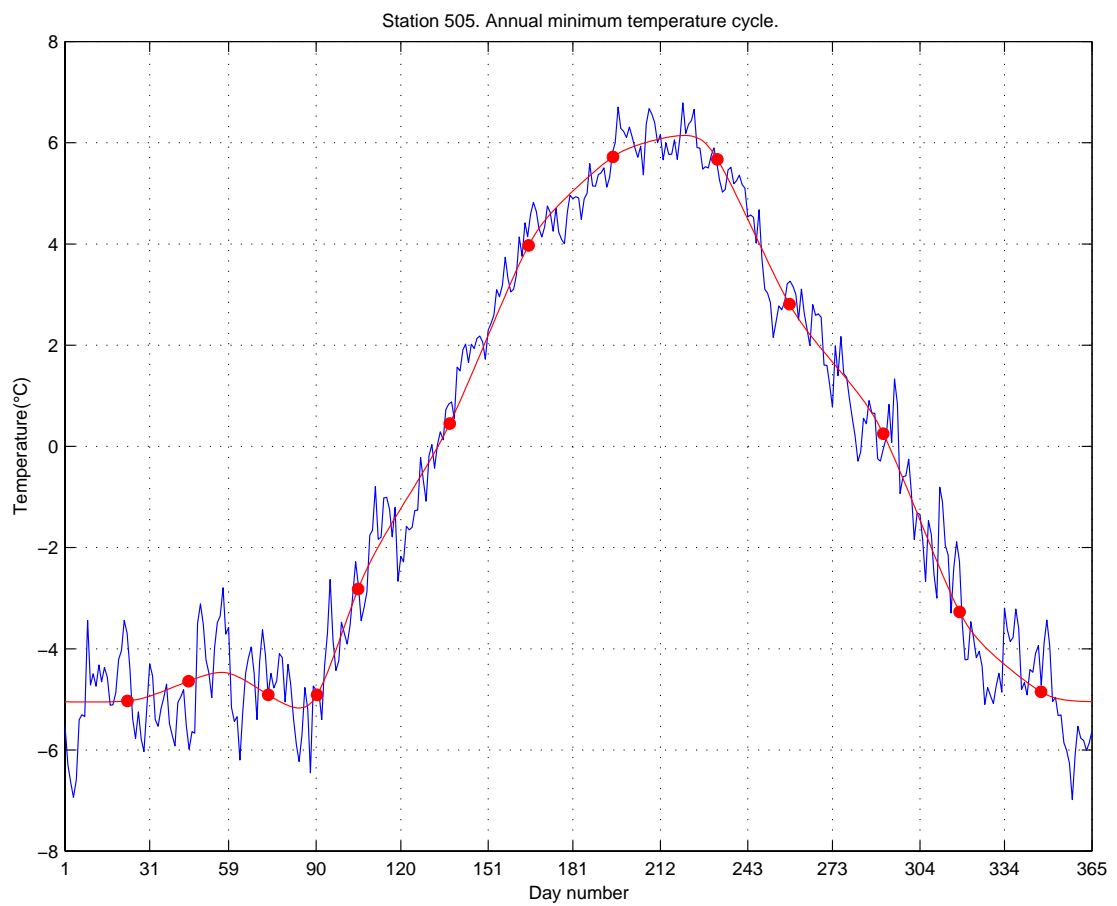
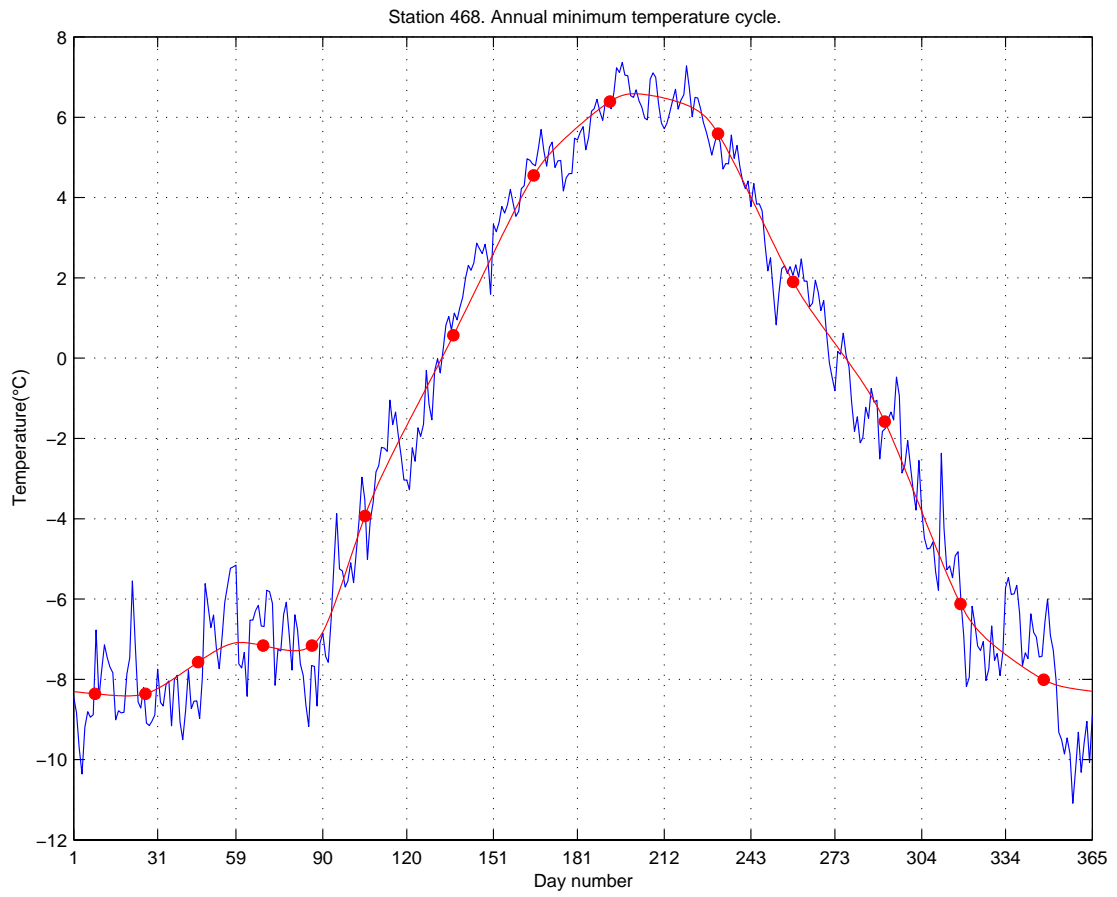
Appendix 3

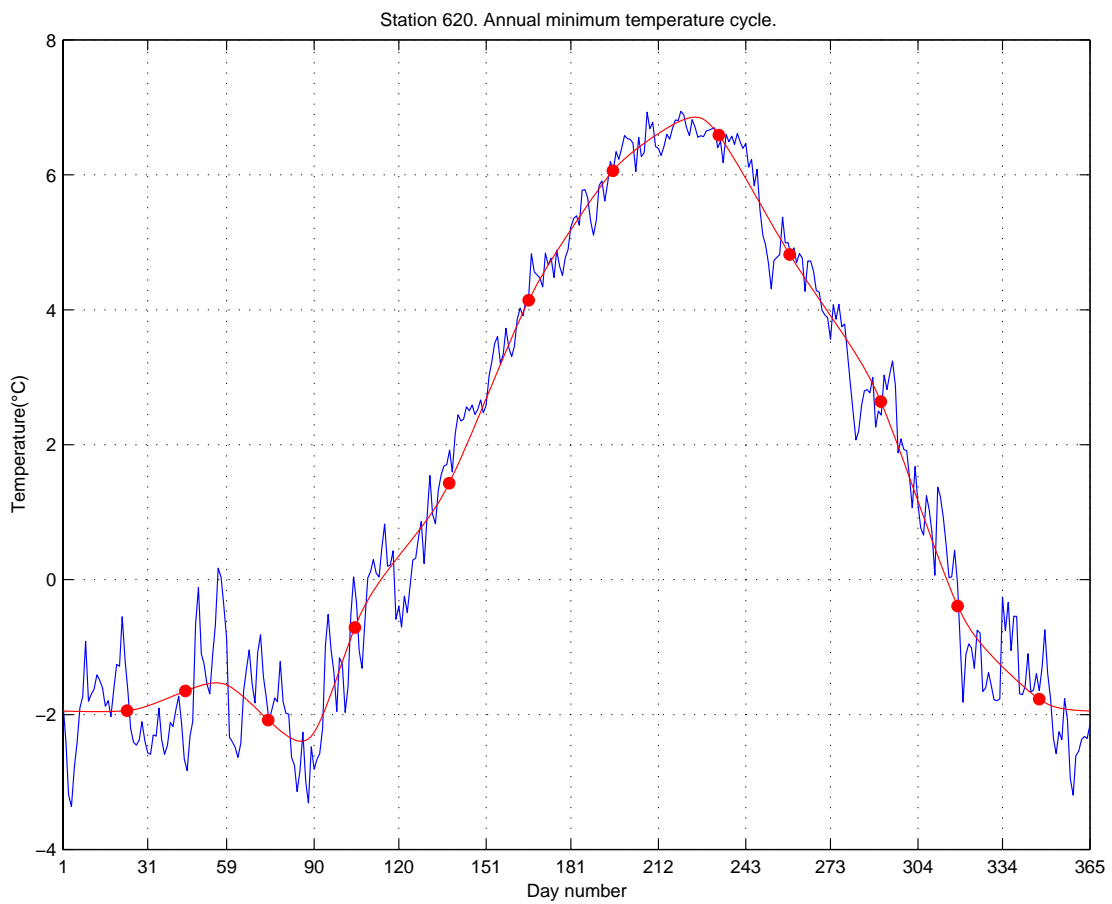
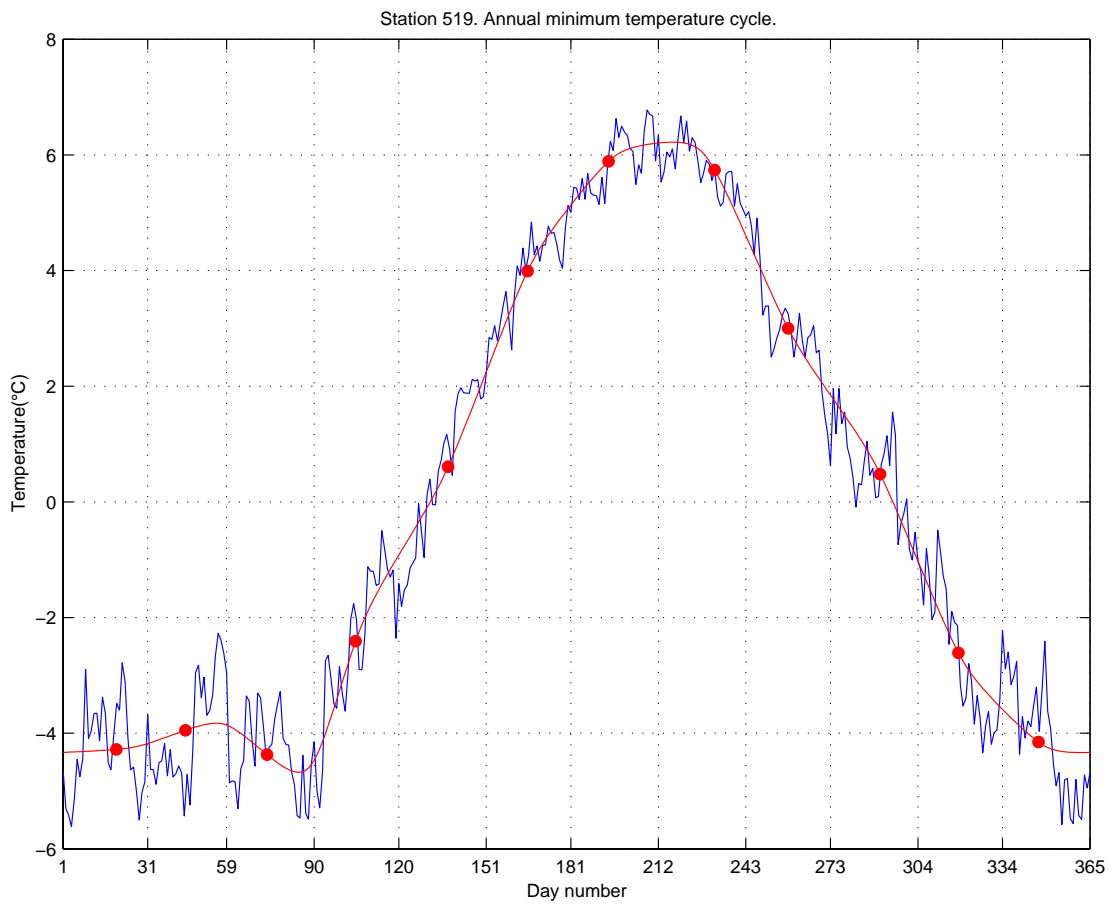


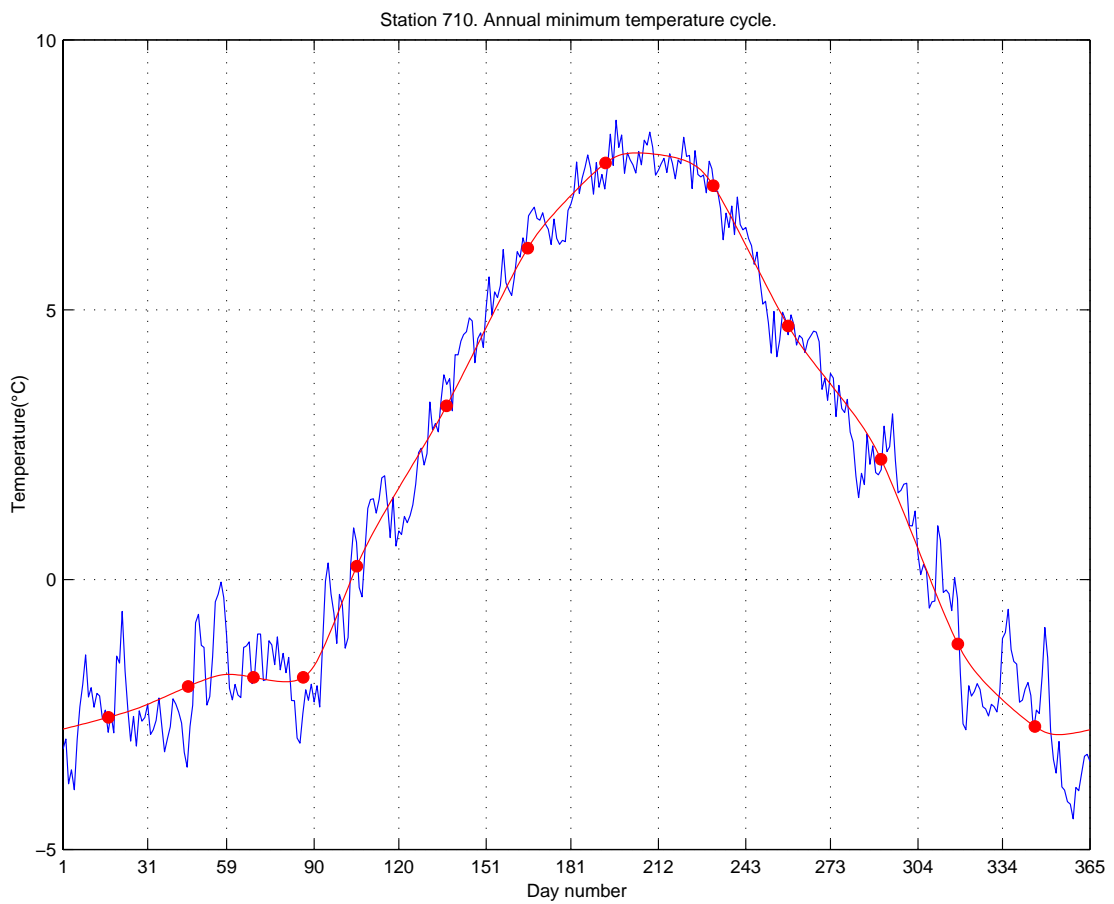
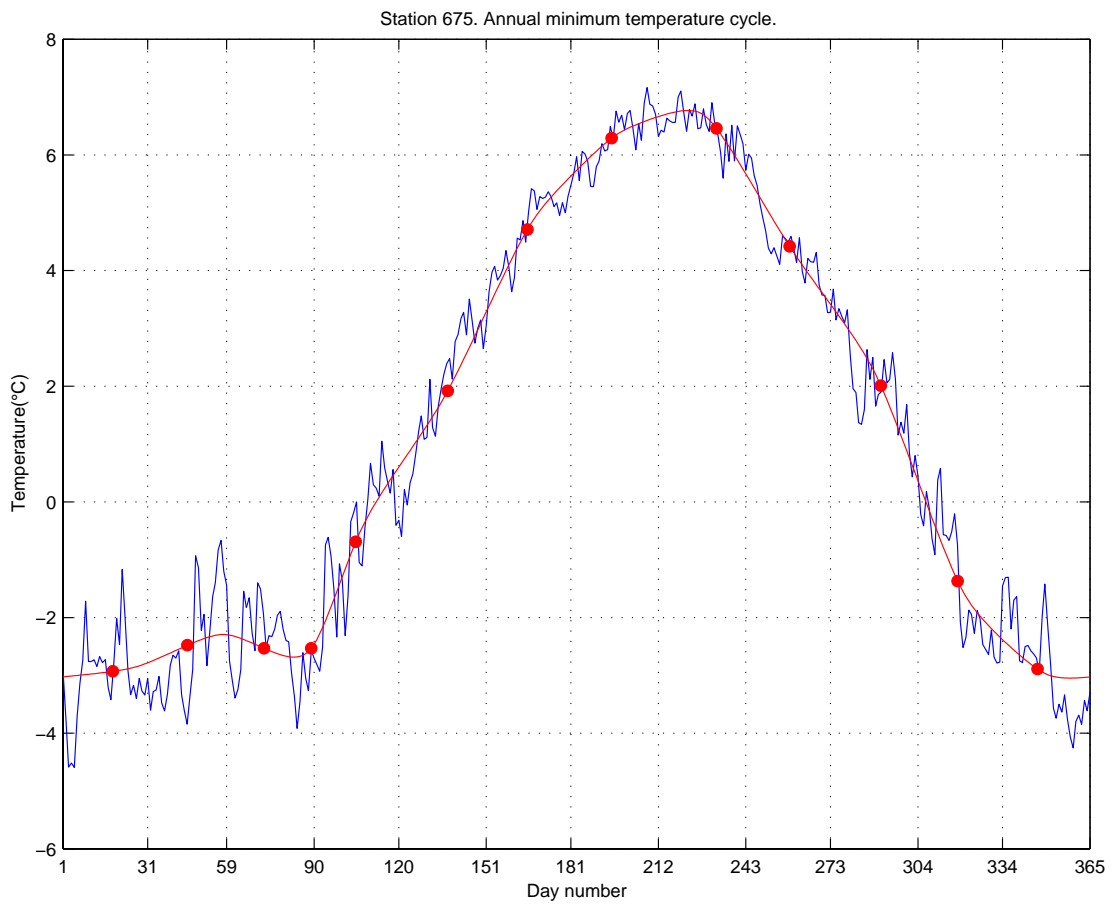


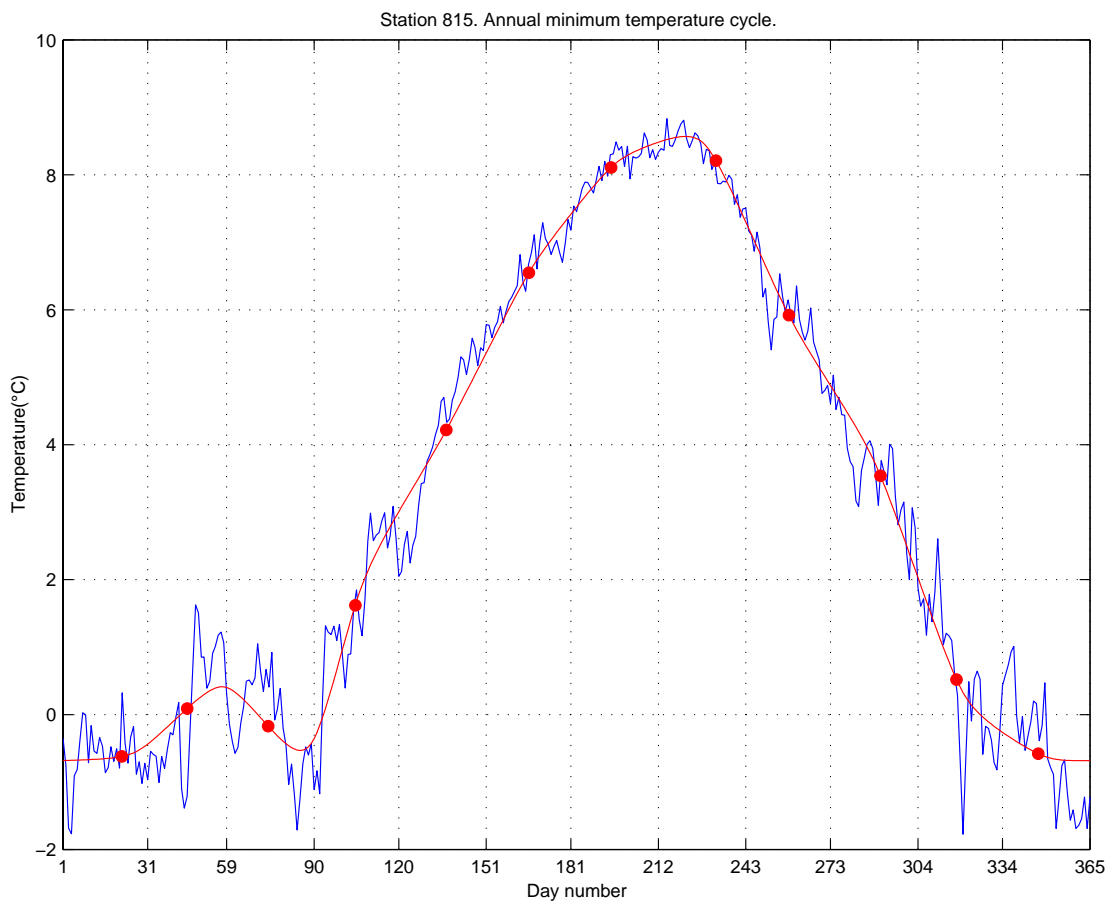
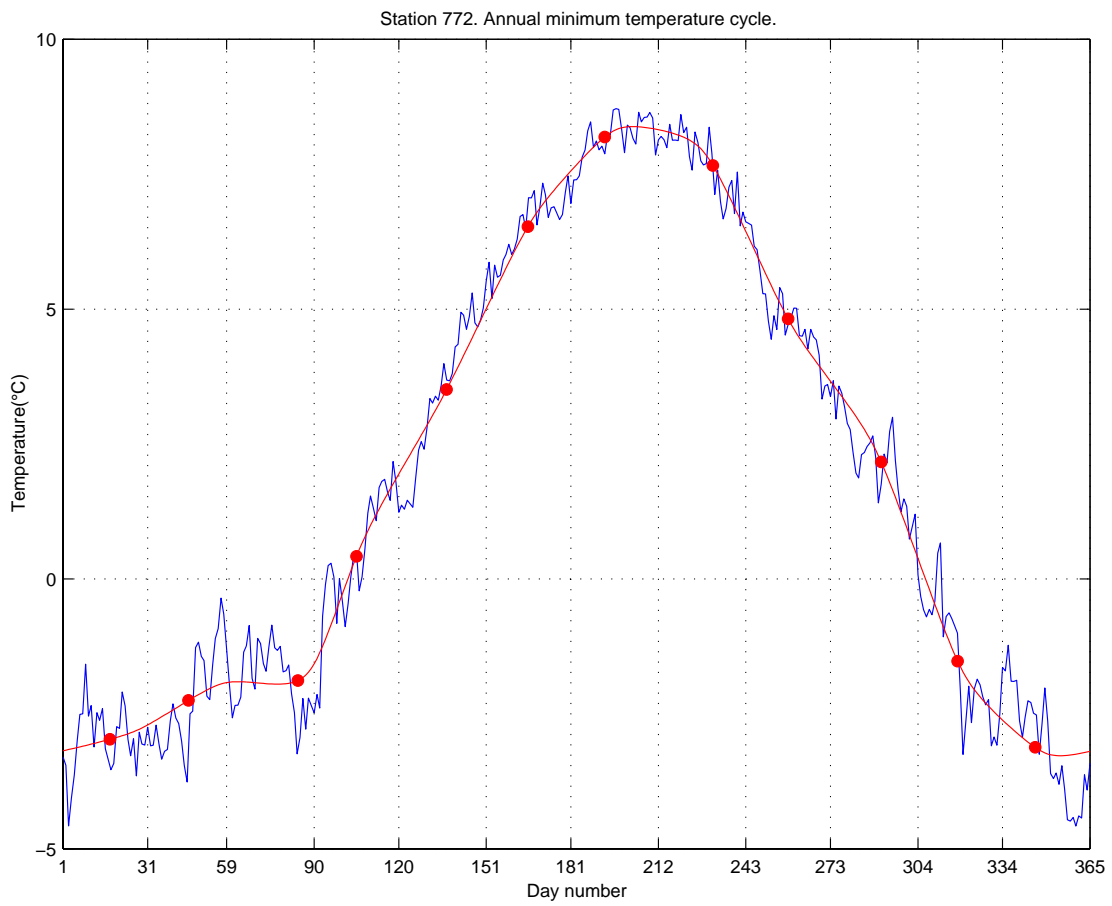


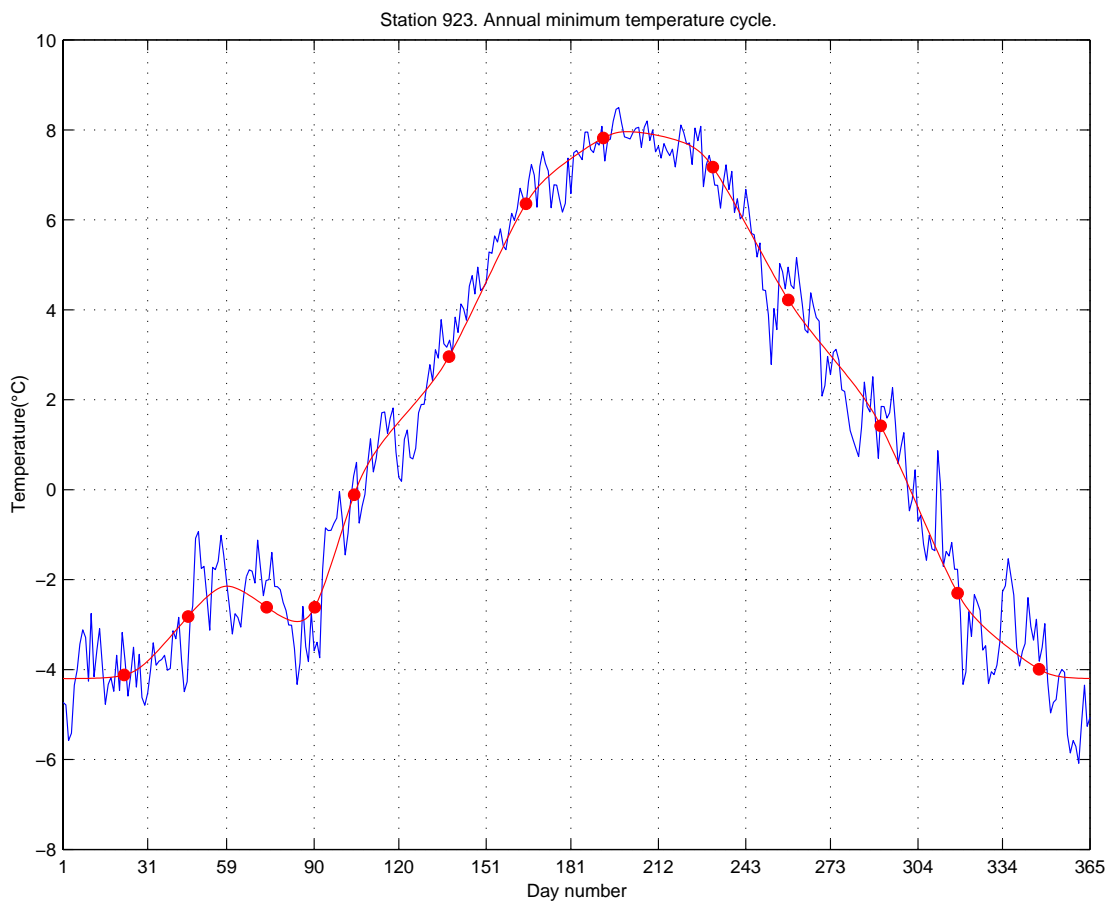
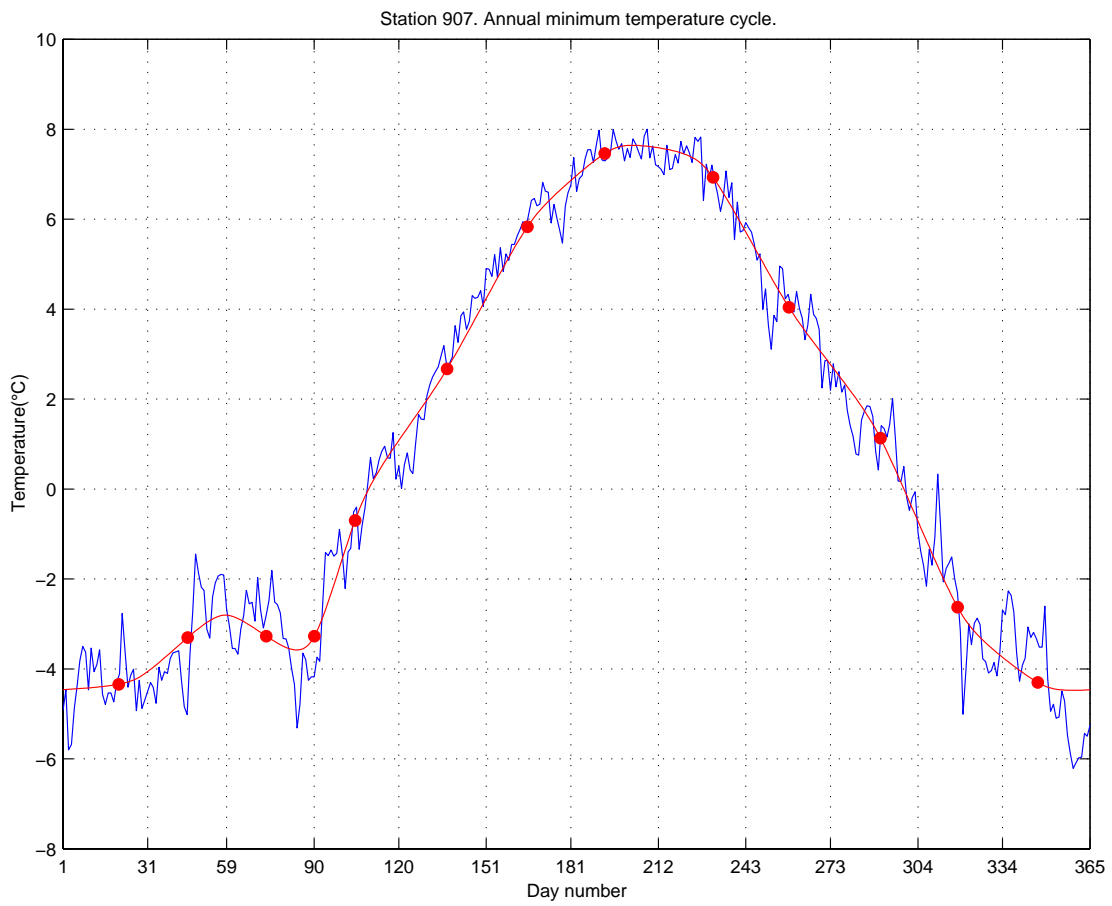


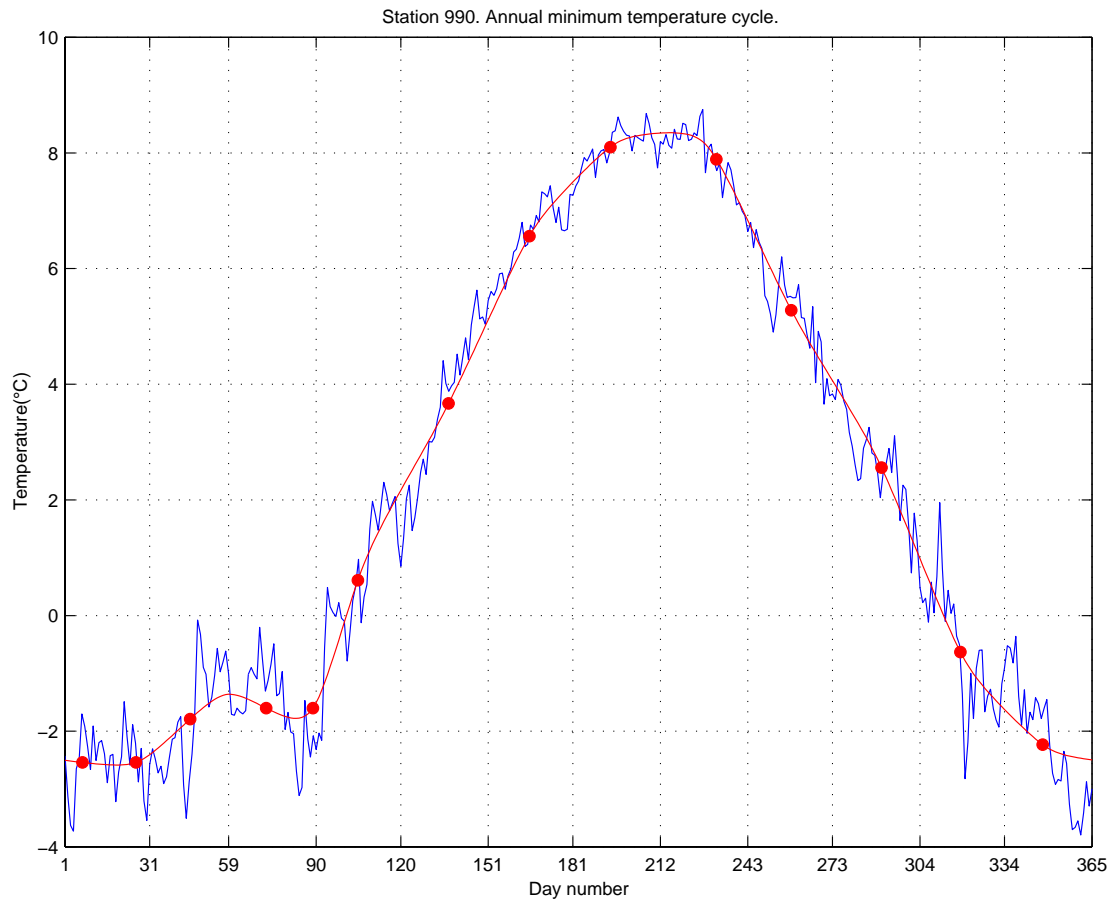








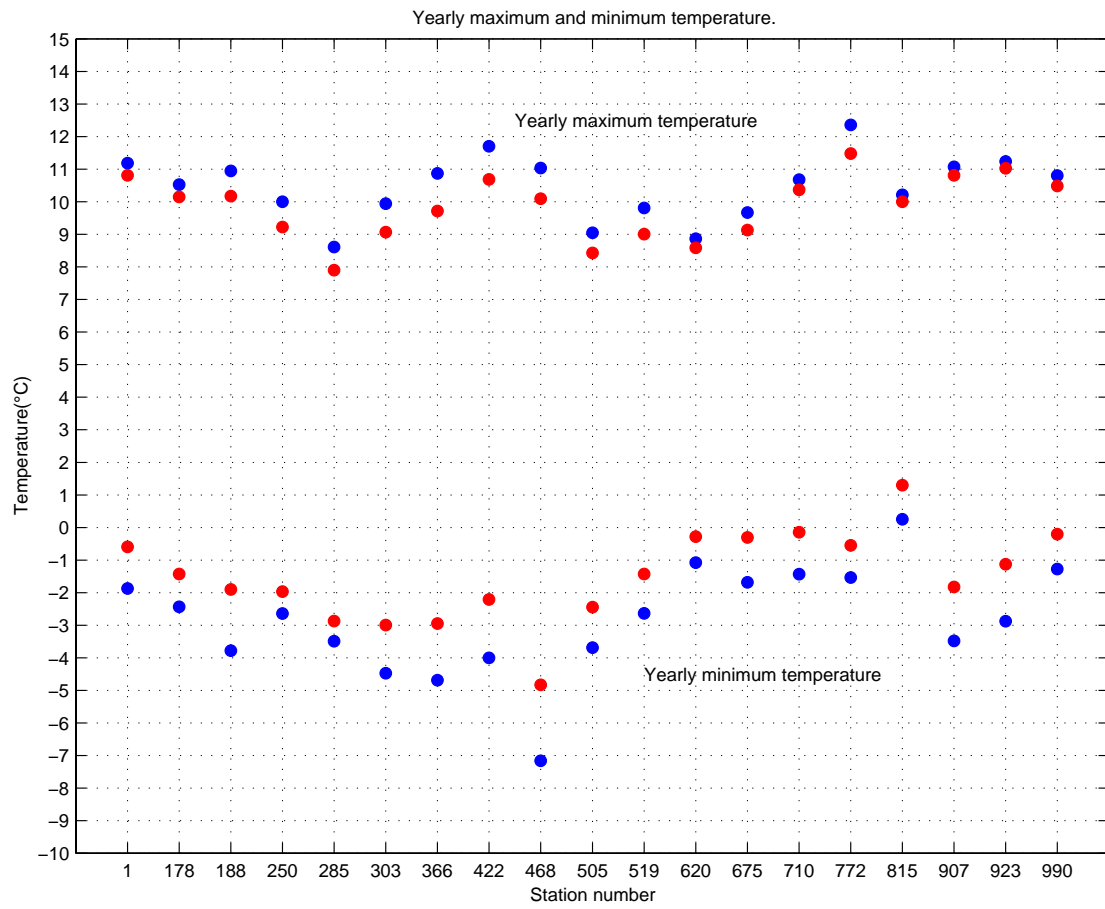




Appendix 4

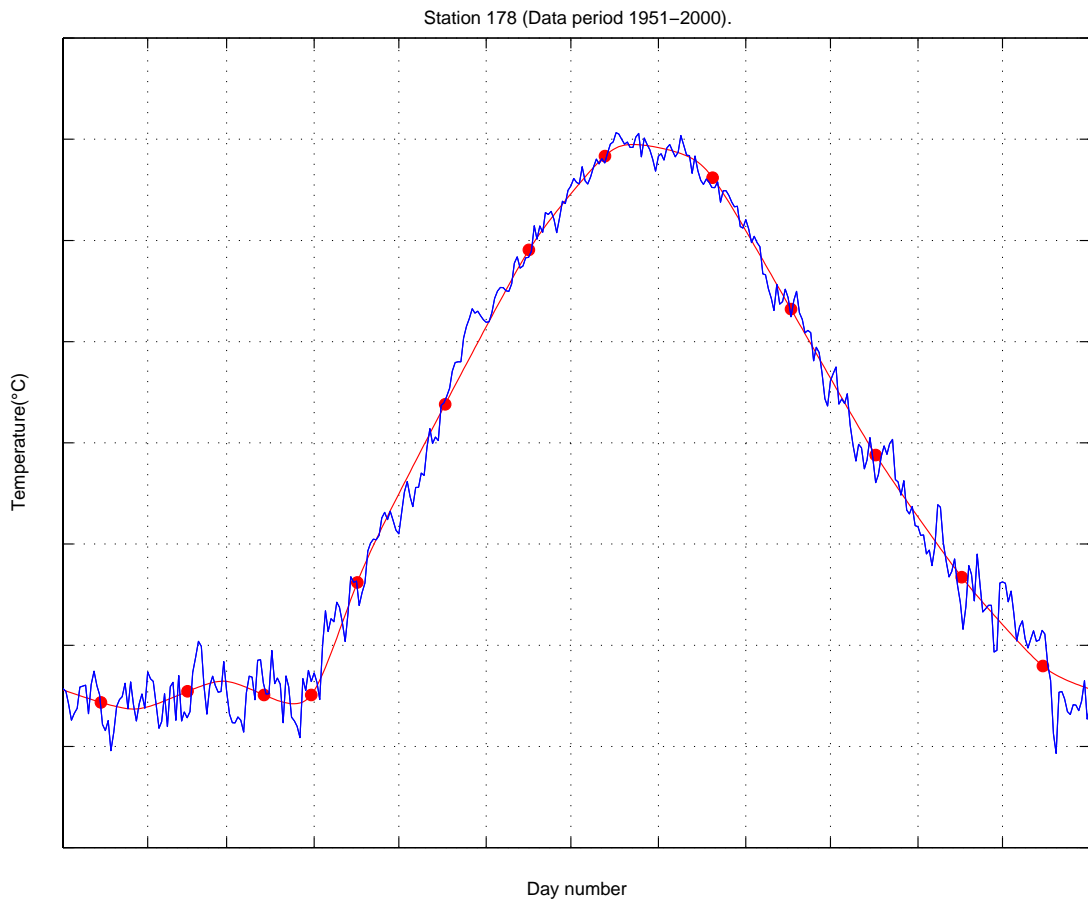
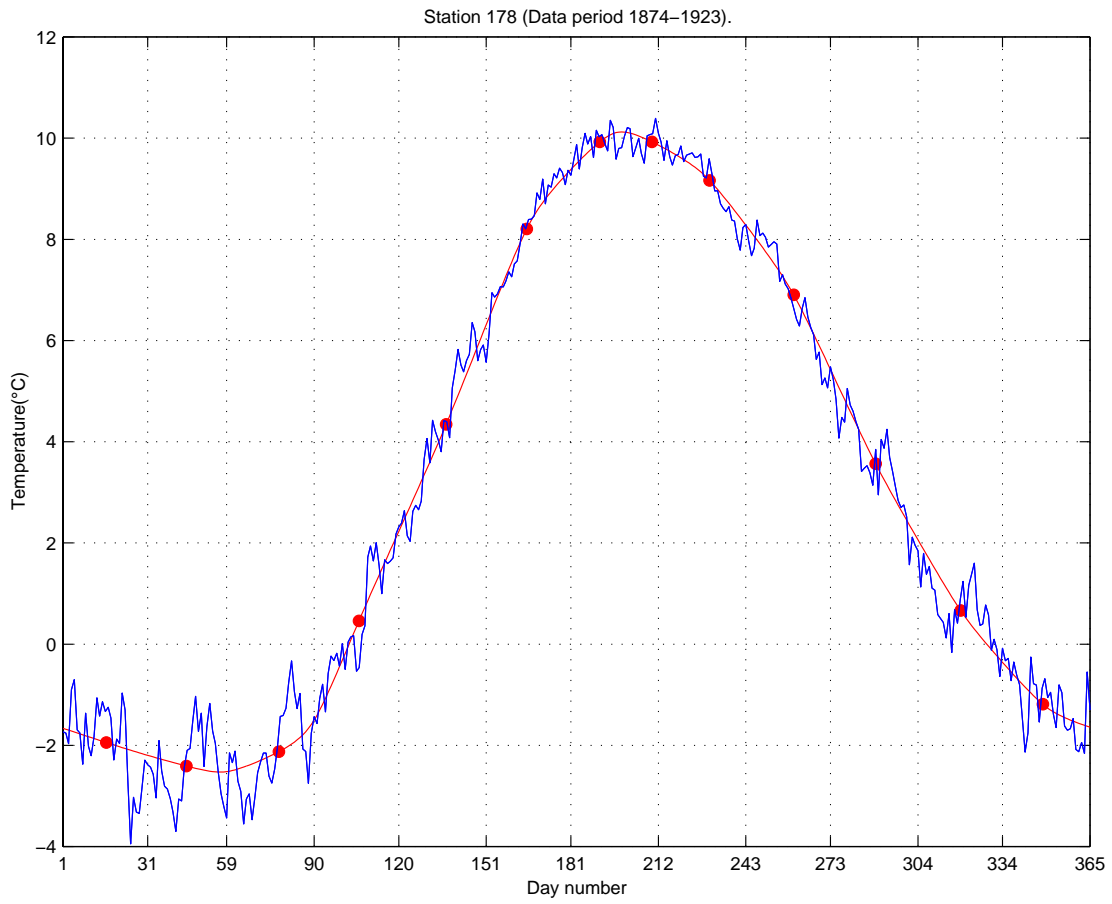
Station number	Length of drop (Days)	Amplitude of drop (°C)	Top (Day)	Top (°C)	Bottom (Day)	Bottom (°C)
1	25	-0.6688	59	0.8687	84	0.1999
178	26	-0.8288	58	-0.3118	84	-1.1406
188	23	-0.4192	59	-0.7042	82	-1.1234
250	30	-1.606	55	-0.3579	85	-1.9639
285	32	-1.5786	53	-1.2921	85	-2.8707
303	22	-0.3308	60	-1.7416	82	-2.0724
366	21	-0.2367	60	-1.7092	81	-1.9459
422	22	-0.3259	59	-1.0886	81	-1.4145
468	2	-0.0003	69	-3.5484	71	-3.5487
505	28	-0.6554	56	-1.7924	84	-2.4478
519	29	-0.813	56	-0.6129	85	-1.4259
620	31	-1.014	55	0.7337	86	-0.2803
675	23	-0.2605	59	0.5032	82	0.2427
710	12	-0.0215	64	1.0129	76	0.9914
772	3	-0.0006	68	0.6279	71	0.6273
815	28	-0.9907	57	2.3026	85	1.3119
907	24	-0.6412	59	-0.2999	83	-0.9411
923	24	-0.5909	59	0.4360	83	-0.1549
990	25	-0.6119	59	1.0557	84	0.4438

Appendix 5

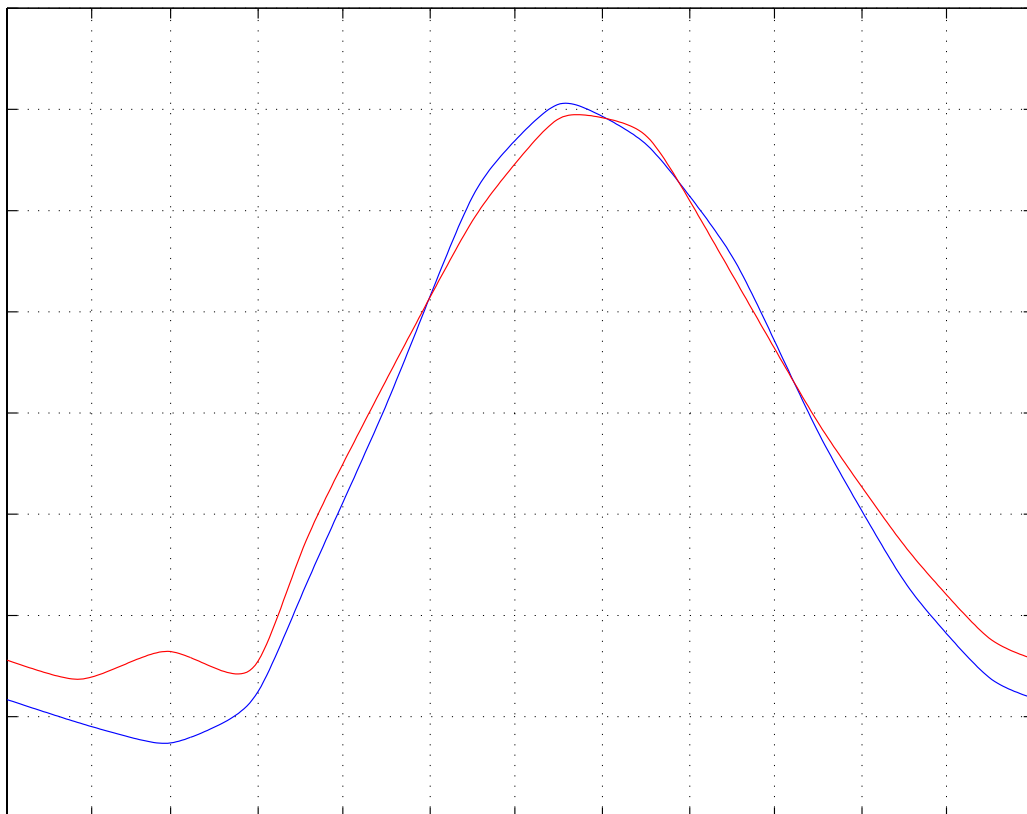
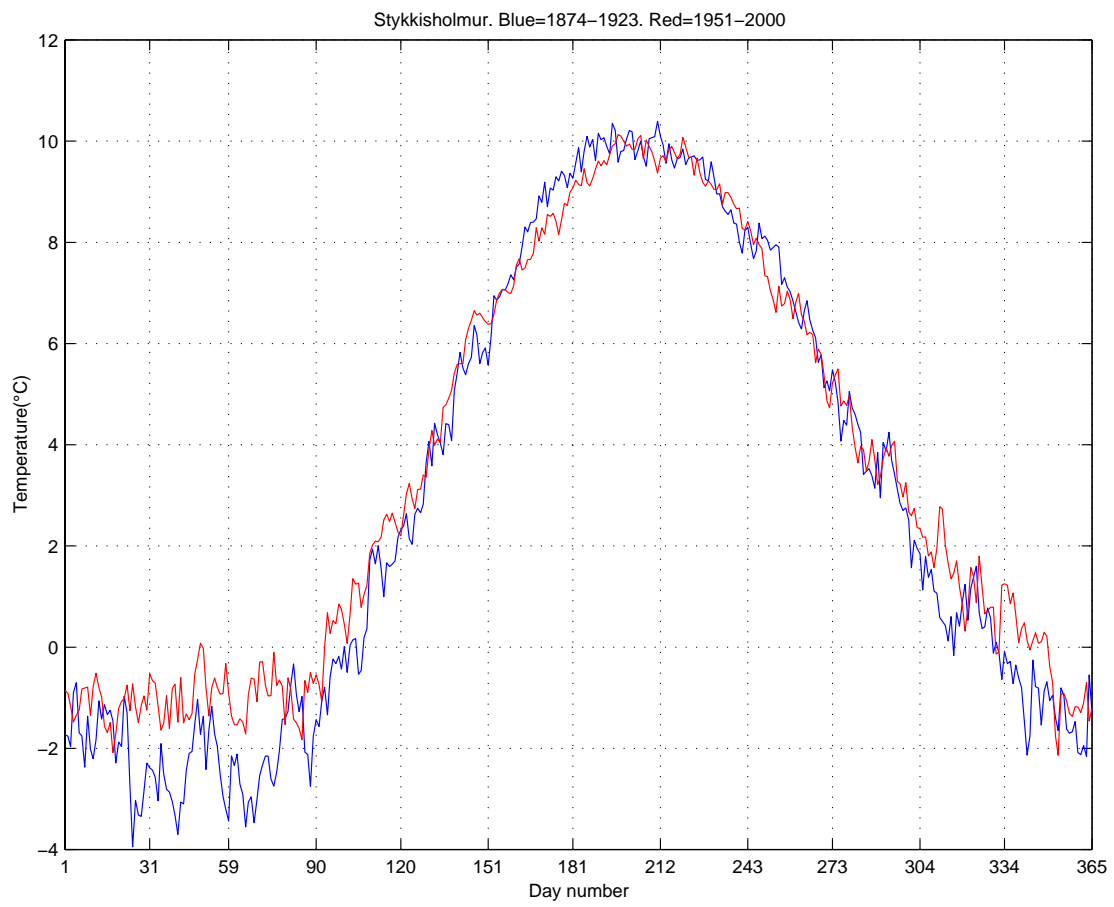


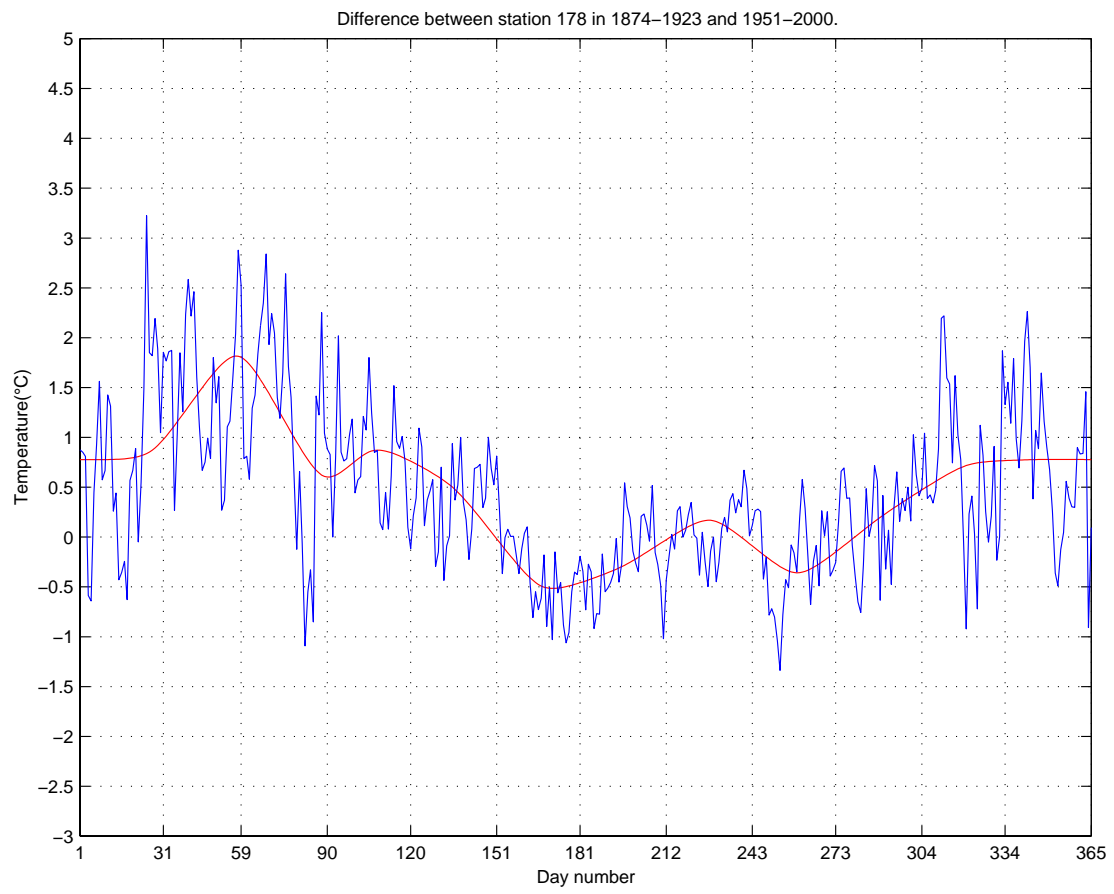
Blue points = measured temperature cycle. Red points = tension spline cycle.

Appendix 6



Appendix 7





Appendix 8

The plots in appendix 1 to 7 are all based on data files stored on IMO's server "skuggi", on the 'urs/steen' area.

See the Readme file for a complete description of the contents of the data files. This report can also be found as a word file in the directory.

For the red tension spline approximation curves in appendix 1,2 and 3, one finds the data for these in columns 4,6 and 8 in the data file **MeanMaxMin_AnnualTempCycle.dat** or **MeanMaxMin_AnnualTempCycle.mat**