Analysis of Leuchars Historical Meteorological Data in Context of Oxford Climatology Analysis.©2007

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Abstract

Here I investigate similarities between meteorological data measured at Leuchars with data measured at Oxford in the same period..This compares the climatology trends of a station in the northern zone of the British land mass with trends discovered at a more central location. The similarities drawn between the two are supposed to be representative of the region as a whole. The data was sourced from the Meteorological Office included the average diurnal maximum temperature and average diurnal minimum temperature.

There is striking similarity between records for the two stations over the 5 measurements as observed from examination of their charts. Leuchars is on average 1.8 ^{o}c cooler than Oxford and has more than 10 hours deficit in sunshine hours per month during summer. The similarities lead to a conclusion that inferences made from examination of Oxford long term meteorological data may on whole be representative of the whole British climatic region.

Introduction

In my study "Analysis of Oxford Climatological Data" 2006, I investigate the trends in the historical meteorological measurements made at Oxford Radcliffe Meteorological Station. The essence of this study is to use the historical data recorded from Leuchars Meteorological Station between 1957 and 2005. to validate or disqualify aspects of my previous study.

Leuchars lies to the north of the England/ Scotland land mass on the east coast.. It is a rural town that has no significant development, apart from an Air Force base. This contrasts with the more central location of Oxford that lies 329 miles to the south, with it's rapid and extensive development as a university town. As such we can expect parallels and similarities in the character of the data from the two stations to originate from regional properties common to the general British weather system.

Data Sources

The Meteorological Office collates and makes available data from a network of stations in England, Wales, Scotland and Northern Ireland. On their website they give direct access to data from 26 stations from St Mawgan 45 miles NE of Lands End to Lerwick in the Shetlands, from Stornoway in the Outer Hebrides to Eastbourne.

In this study I used data published by The Meteorological Office.. Data from Leuchars Meteorological Station were downloaded from the link www.met-office.gov.uk/climate/uk/stationdata/leucharsdata.txt It provides records from 1957 to present. Data from Oxford Meteorological Station were downloaded from www.met-office.gov.uk/climate/uk/stationdata/oxforddata.txt.

The data are tabulated in monthly values for 1. mean diurnal maximum temperature (tmax, ^{o}c) . 2. mean diurnal minimum temperature(tmin, ^{o}c), 3. number of days of air frost(DoAF), 4. total rainfall (rain, mm), 5. total sunshine duration (sun, hours).

Charts and Tables

Data from the two stations over the period 1957 -2004 were processed into a number of charts shown in illustrations 1 - 9 Charts for tmax and tmin are arranged in 3 month blocks with Leuchars values and Oxford values for the same months available in the same chart, allowing easy visual comparisons. The Linear regression coefficients (trend lines) were calculated for each measurement, the results are charted in Table 1(Leuchars) and Table 2(Oxford). Table 3 is the subtraction of Table 1 from Table 2 and is the difference in values and as such indicates the direct comparison.

Comparison of Regression Coefficients

In considering the direct comparison between Tmax monthly records for Leuchars with similar recorded values for

Oxford as shown in illustration 1 – 2, the degree of similarity is striking. The single negative regression coefficient observed in October is matched in the Oxford record. The maximum tmax trend in Leucahars data is found to be 0.04125 in August The average Leuchars tmax trend regression value is 0.02185. This compares with the average Oxford tmax regression value of 0.03008. The average tmax value over the year is 12.143 at Leuchars and 14.06979 at Oxford the average difference in regression coefficients for the two sites is .00823, about 30% of the absolute value.

The maximum difference in the average tmax reading for each month was 3.3 ^{o}c Oxford greater than Leuchars for July. The average difference in average tmax reading was 1.93 ^{o}c in favour of Oxford.

In considering tmin, comparng Leuchars values to Oxford values we see remarkable similarity between the two record sets. The maximum regression coefficient in the Leuchars tmin data is found to be August, 0.02048, which is matched in Oxford data 0.0331. The average differences in regression coefficients for the two sites is 0.00602.

The maximum difference in tmin average monthly values for th two sites occurs for July with difference 2.22083 ^{o}c . The average difference in tmin value was 1.763 ^{o}c in favour of Oxford.

The DoAF measurements show on average Leuchars has 3 or 4 more frost days than Oxford.

The measurements for rainfall show remarkable similarity between the two sites. The charts for June rainfall show A increasing trend at Leuchars and a decreasing trend at Oxford. This shows a slight divergence in the nature of summer rainfall at the two sites. The charts for September show a marginal increasing trend at Leuchars and a decreasing trend at Oxford. The error between the two may not be of such significance to say the June measurements are showing different characteristics. The total measured rainfall for each site is similar with a minimal difference.

The relationship for sunshine hours show marked similarities for the two sites. Trends are similar for each month, excepting June, which shows no trend at Leuchars and a decreasiing trend at Oxford. In February and March Leuchars has average sunshine hours 8 and 7 hours per month more than Oxford. This is more than compensated for in July, August and September when Oxford has on average 16.5, 20.8 and 10.2 hours respectively more than Leuchars. The variance of sunshine hours measurements at Oxford for months June, July and August is much greater than the measurements at Leuchars.

Conclusion

The similarity between the measurements recorded at Leuchars with those made at Oxford is enough to say they are highy related and originate from the same weather patterns. The few differences recorded in linear trends are not of any major significance. Linear regression coefficients tmax and tmin for Oxford are generally greater than at Leuchars by up to 1/3 of the absolute value. This may be due to greater rate of urbanisation at Oxford which in turn makes an additional contribution.

The average Oxford trend coefficients made in the present study (1957 – 2004) for tmax 0.03008 and tmin 0.01986 are much higher than values calculated for the whole data set (1853 – 2004) as described in “Analysis of Oxford Climatological Data”, tmax 0.005926 and tmin 0.008278. This is evidence of an acceleration in rate of temperature rise with time, showing a more than 5 times increase in tmax rate and about 2.4 times increase in tmin rate.

This study serves to confirm the finding of a temperature warming of the British weather system over the duration of the last 150 years as described in my previous study “Analysis of Oxford Climatological Data” ,2006. Of 48 monthly average temperature measurements made at the two sites, 45 have positive trends and the remaining three have negligible negative trends.

Average temperatures at Leuchars are about 1.8 ^{o}c cooler than those of Oxford, this may be a consequence of Leuchars lying about 320 miles north of Oxford

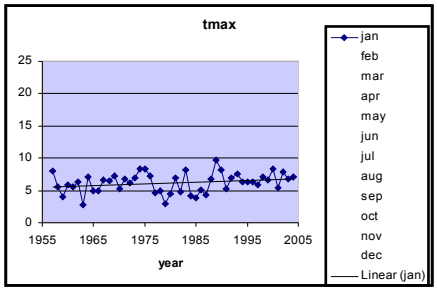
This study serves to confirm that temperature trends discovered in Oxford meteorological data of an average

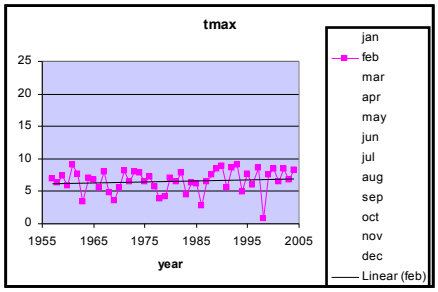
temperature increase in the order 0.8 -1.0 ^{o}c over 150 years are valid for the whole British climate region and are not just localised to Oxford.

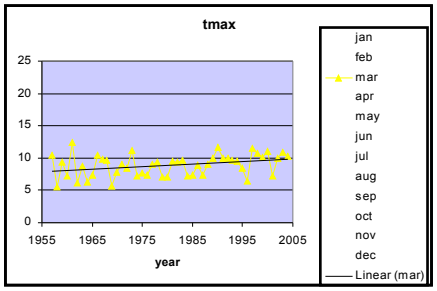
Coupled with evidence from climate related studies worldwide we have very consistent evidence of climate change on a global scale. The modest increase in temperature measurements found in my previous study of the order of 1 ^{o}c in 150 years may be no real indication of the gain in heat of the global system. This temperature change may just represent the disequilibrium and may be highly buffered by melting of high latitude/altitude ice reserves as observed by satellite observation of polar ice showing unprecedented rate of recession (refs 6,7,8).. The buffering effect of melting of ice shelves, glaciers, ice packs, permafrost and other ice reservoirs means a fantastic amount of heat is building in the global system with a minimum of temperature change. As these reservoirs get progressively consumed the temperature rise will become more radical.. This effect is irrespective of the ecological damage posed by loss of ice related habitats and shifting of climatic zones.

I conclude the Earth's energy balance is out of equilibrium and that the planet is annually absorbing huge amounts of heat that is melting sea ice and glaciers and heating sea water. These are acting as heat sinks and shielding the world from increased temperature change, however as the ice depletes temperature change will be increased in intensity. If we get to the stage of total ice loss, temperature change will be radical and possibly irreversible. The evidence is to-date temperature change is increasing and will continue to increase if there is no immediate intervention to curb global atmospheric CO_2 concentrations. This may sound a tall order but this is the stage we are at and it requires action.

Leuchars







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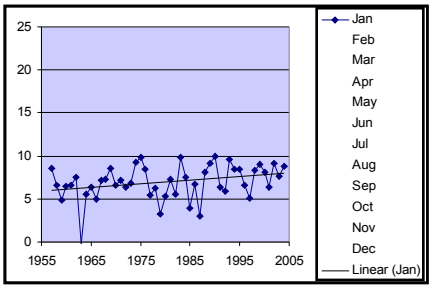
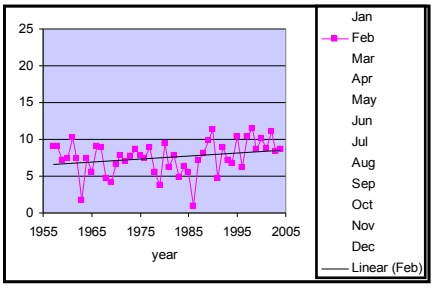
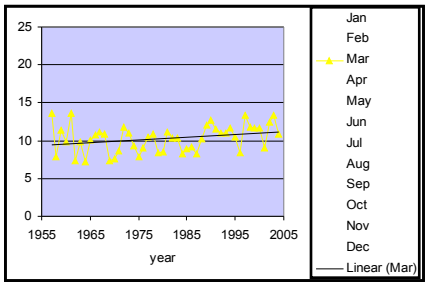
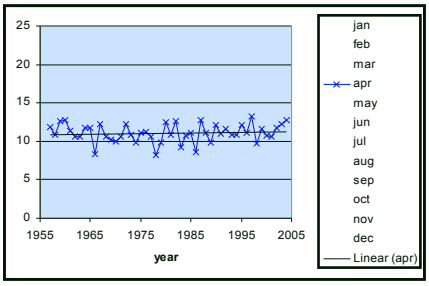
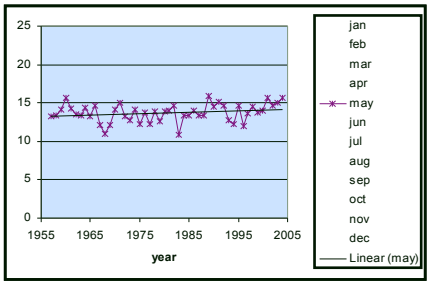


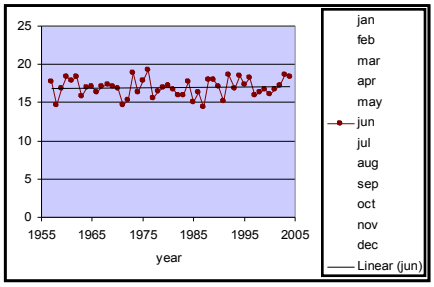




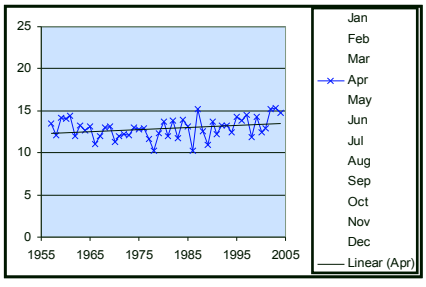
Leuchars

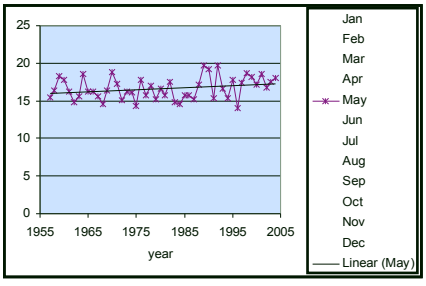






Oxford





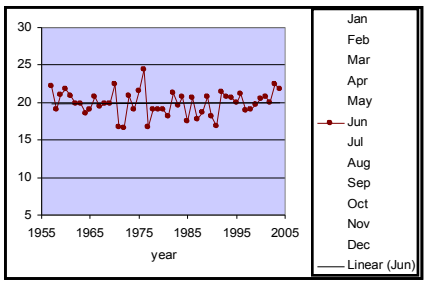
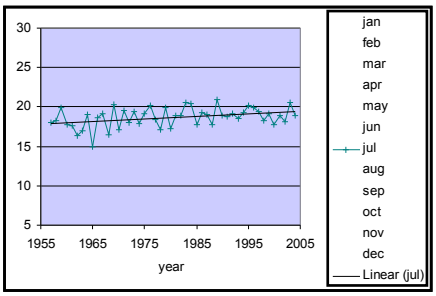
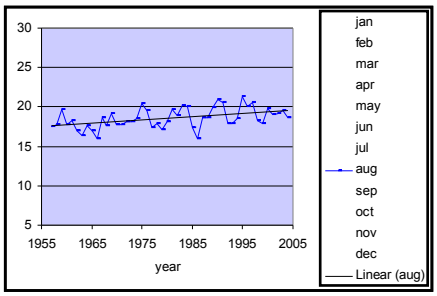
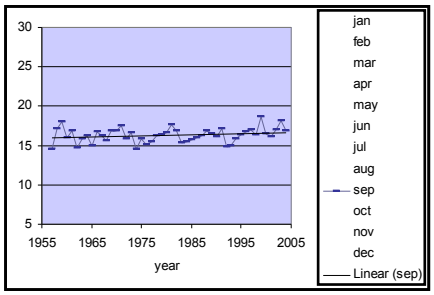


Illustration 1 Tmax Jan-June

Leuchars







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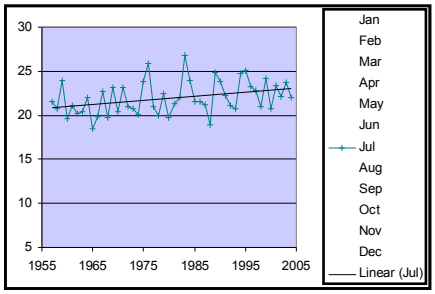
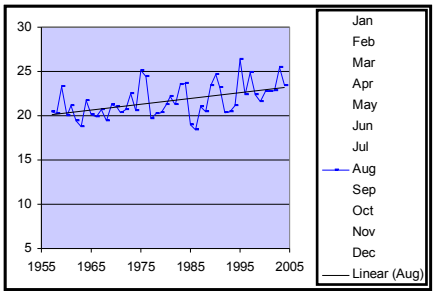
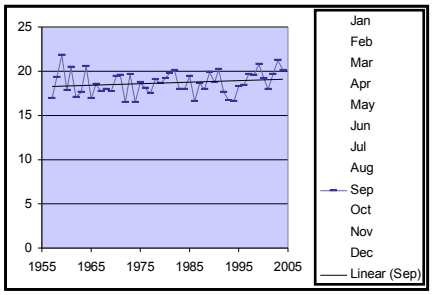
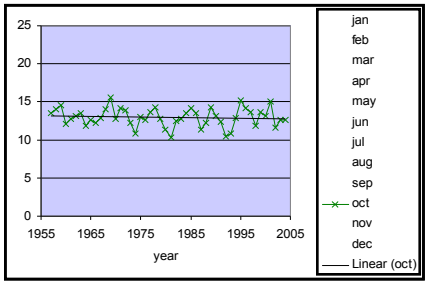
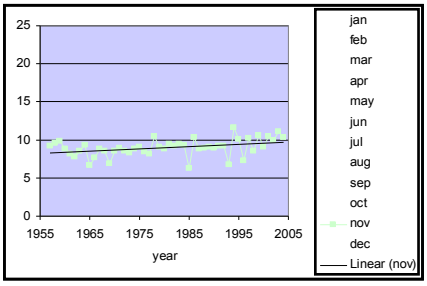


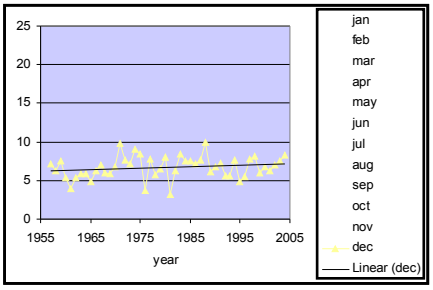




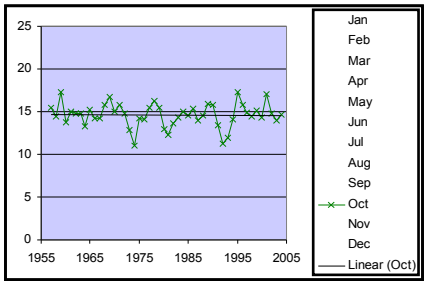
Leuchars

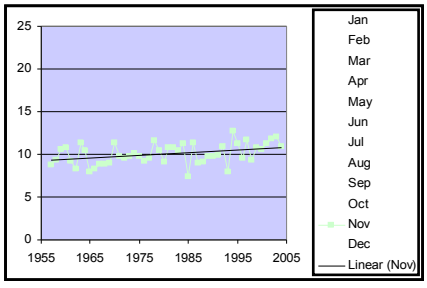






Oxford





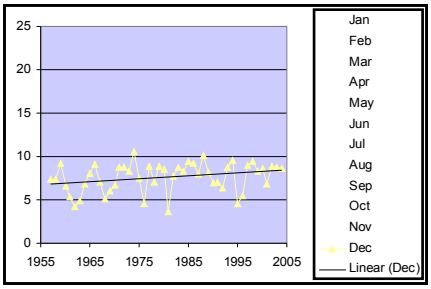
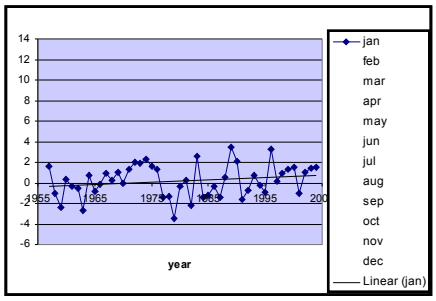
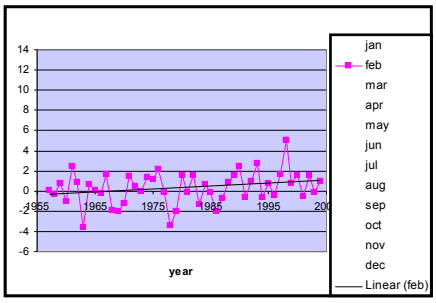
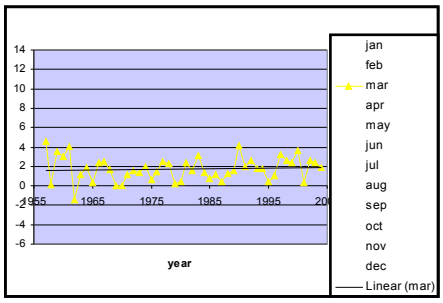


Illustration 2 Tmax Jul-Dec

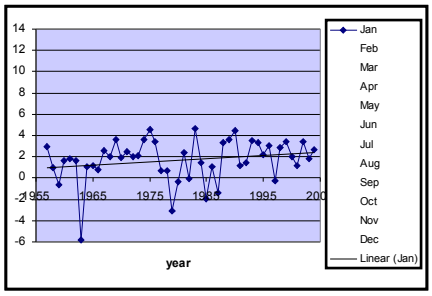
Leuchars

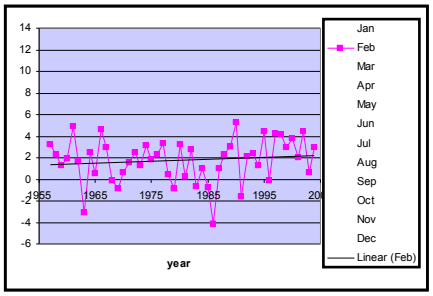


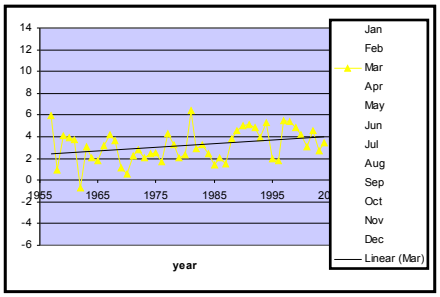




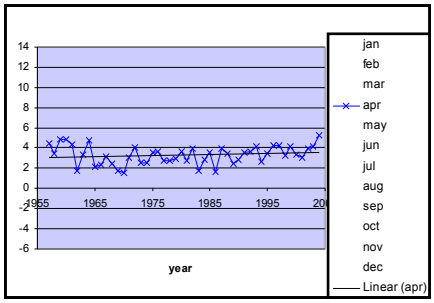
Oxford

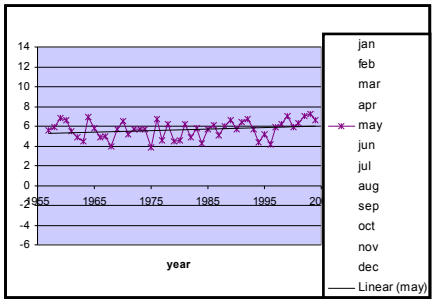


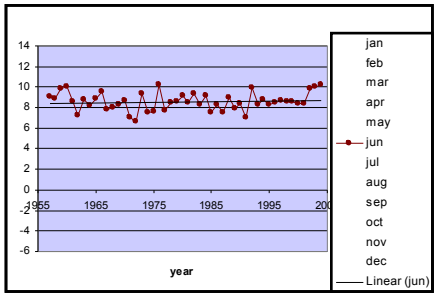




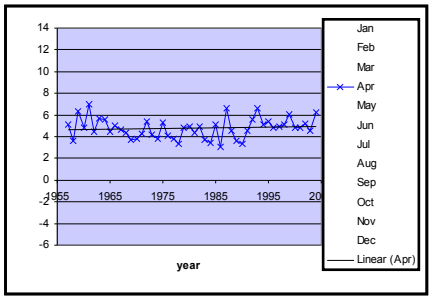
Leuchars

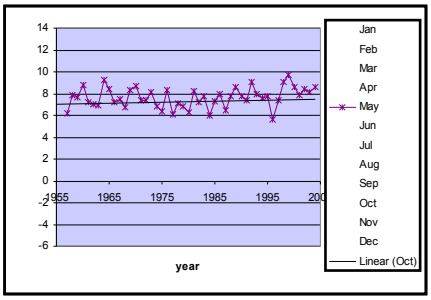






Oxford





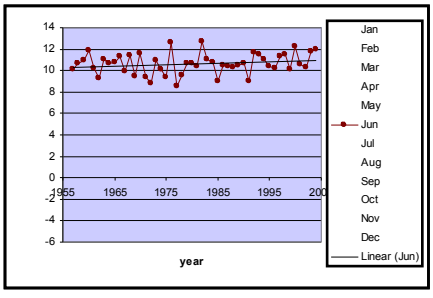
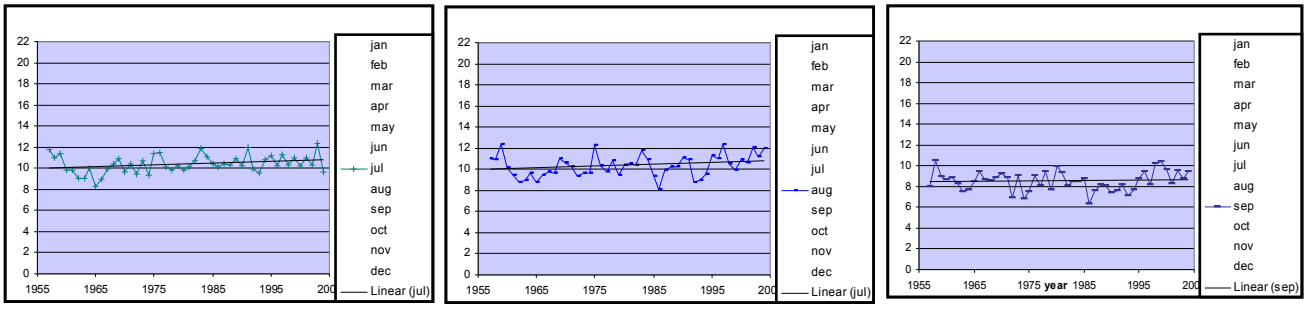
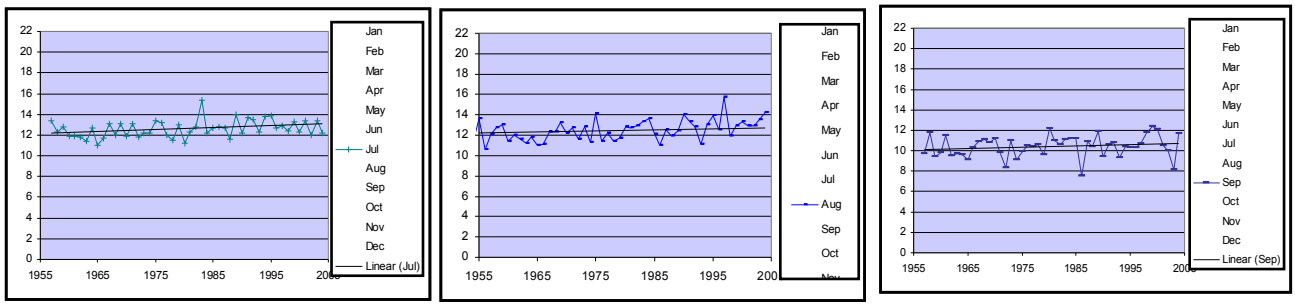


Illustration 3 Tmin Jan-June

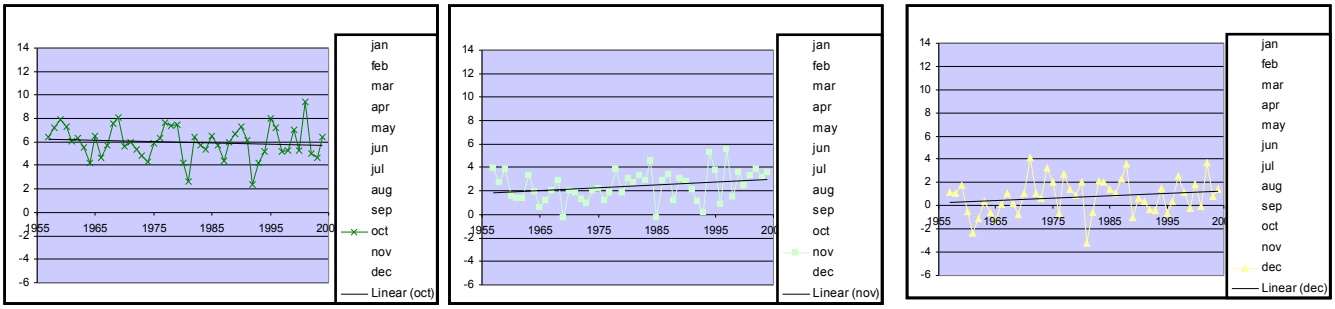
Leuchars



Oxford



Leuchars



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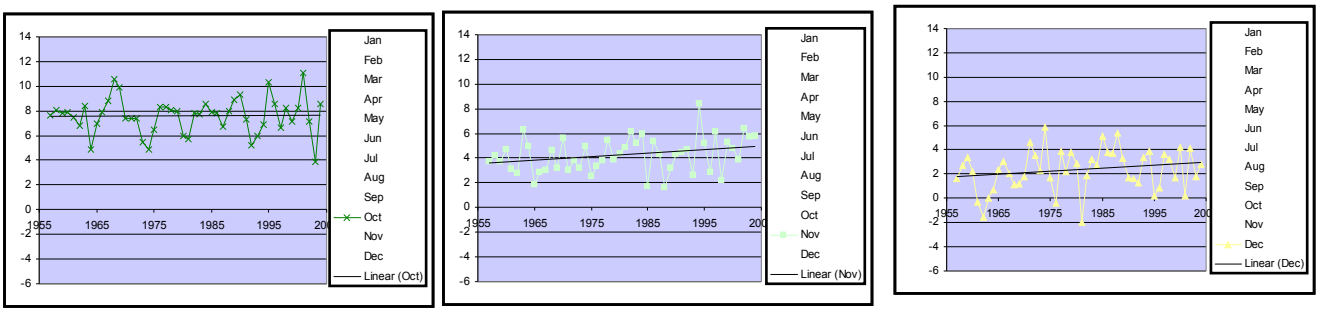
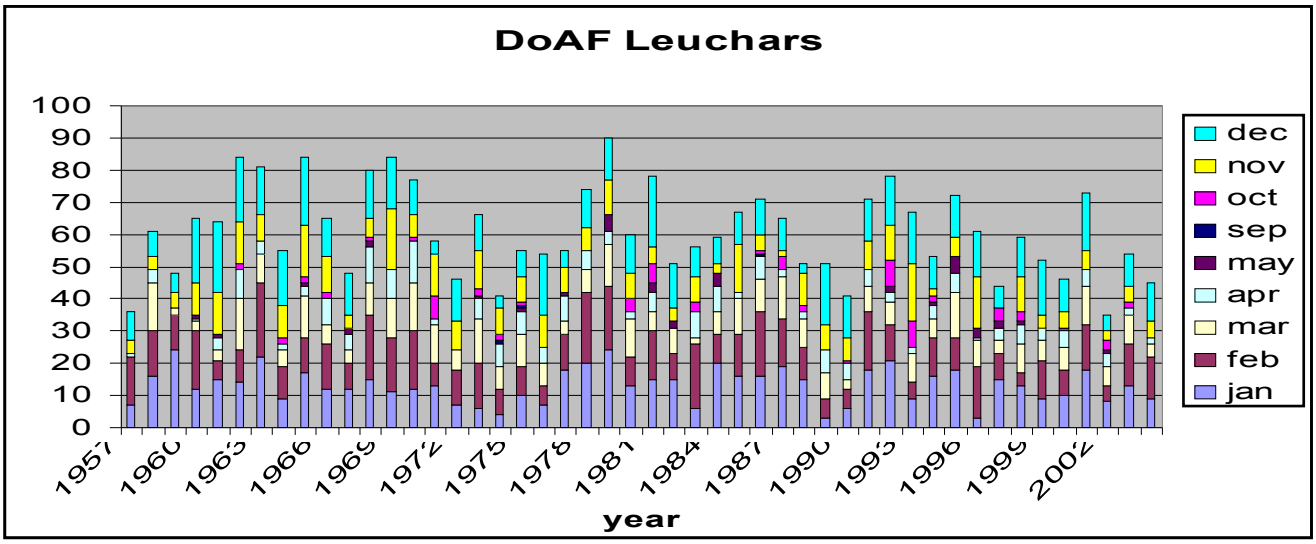


Illustration 4 Tmin Jul-Dec



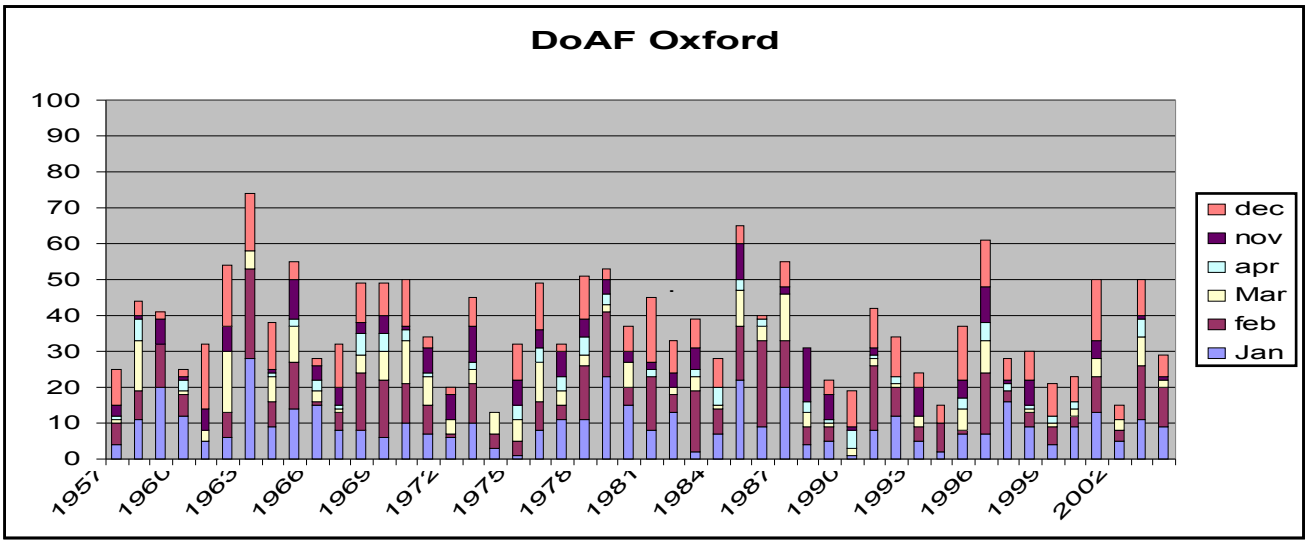


Illustration 5 Days of air frost

Rainfall
Leuchars

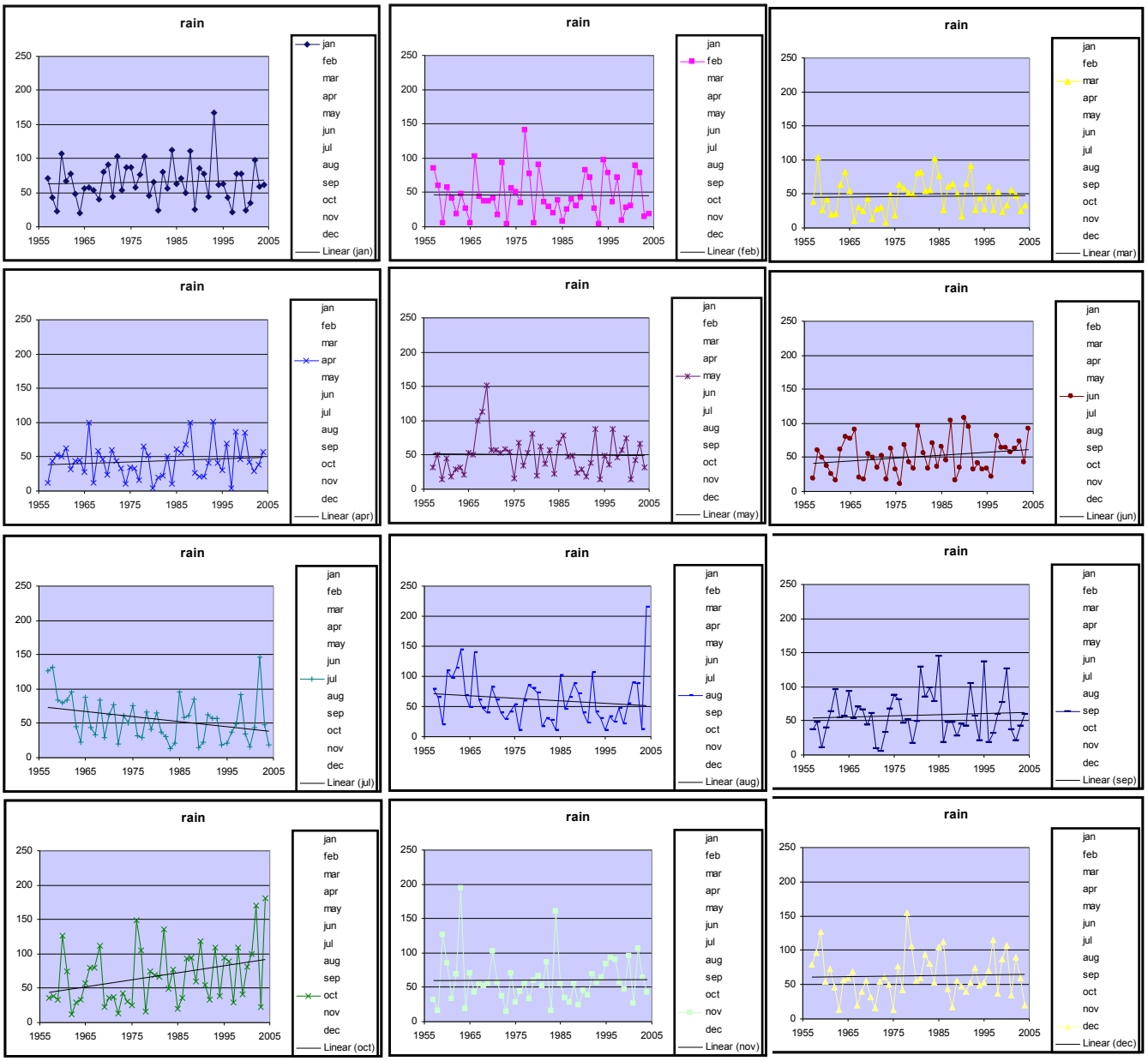


Illustration 6 Rain Leuchars

Rainfall
Oxford

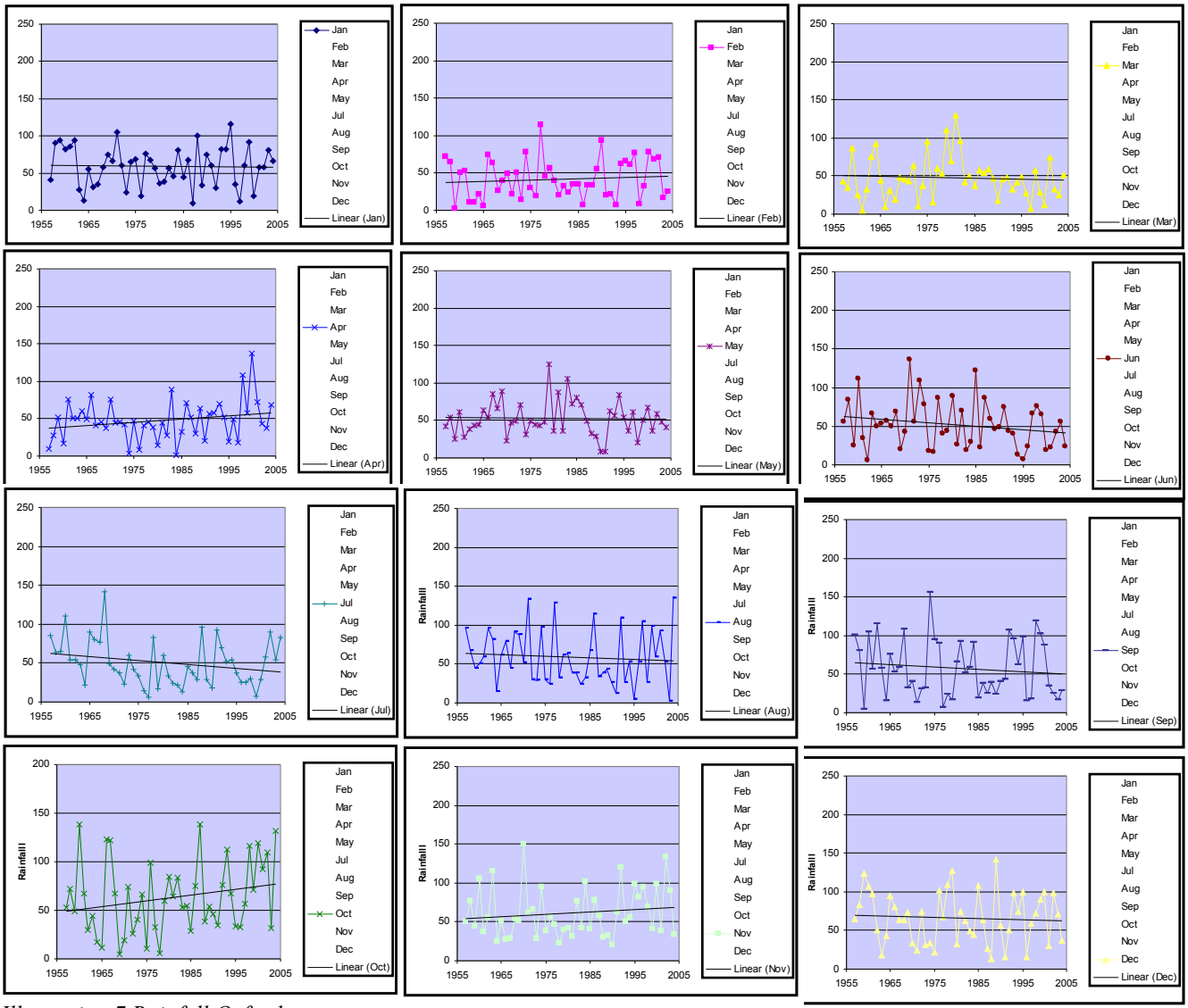


Illustration 7 Rainfall Oxford

Sunshine Hours

Leuchars

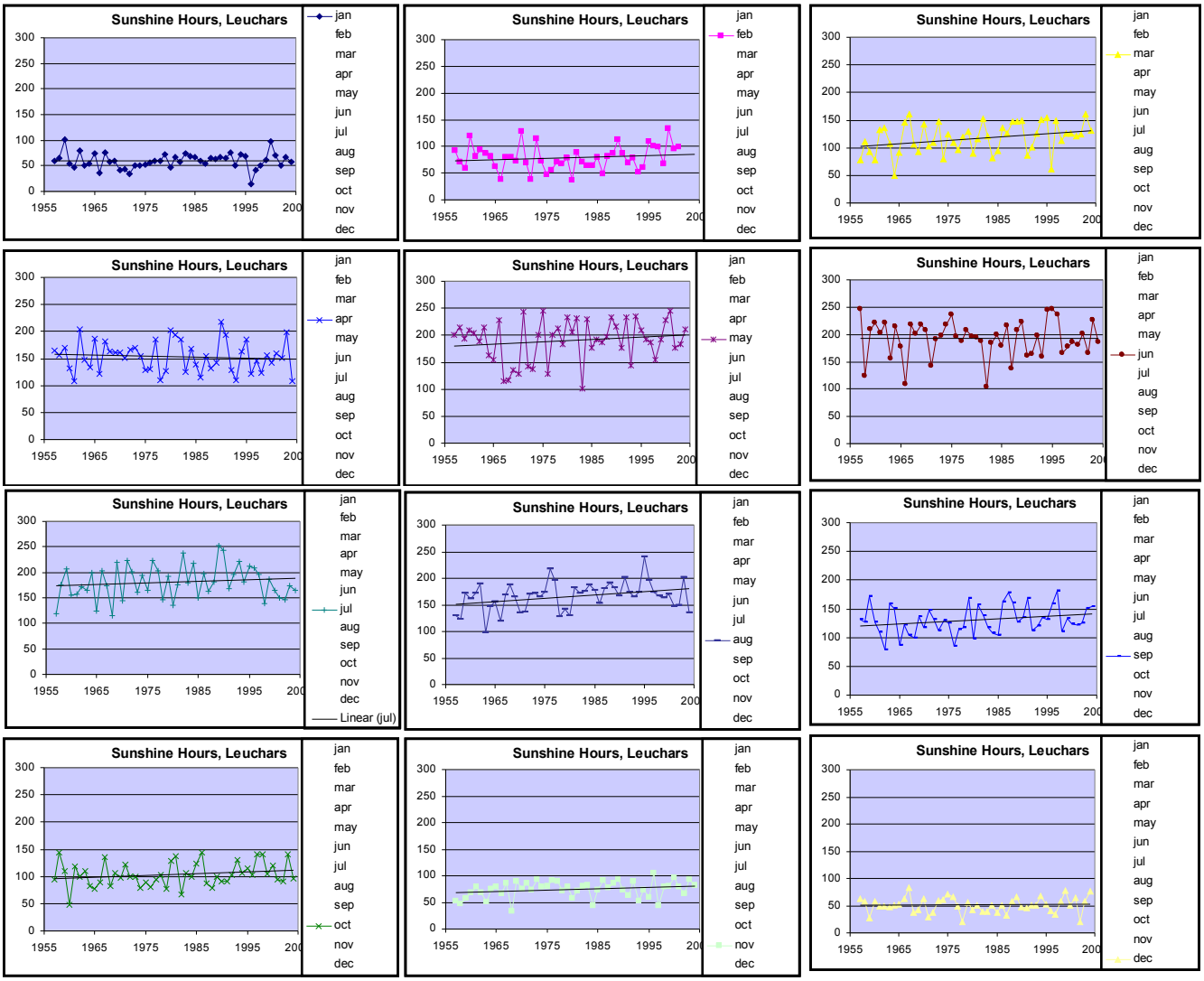


Illustration 8 Sunshine Leuchars

Sunshine Hours

Oxford

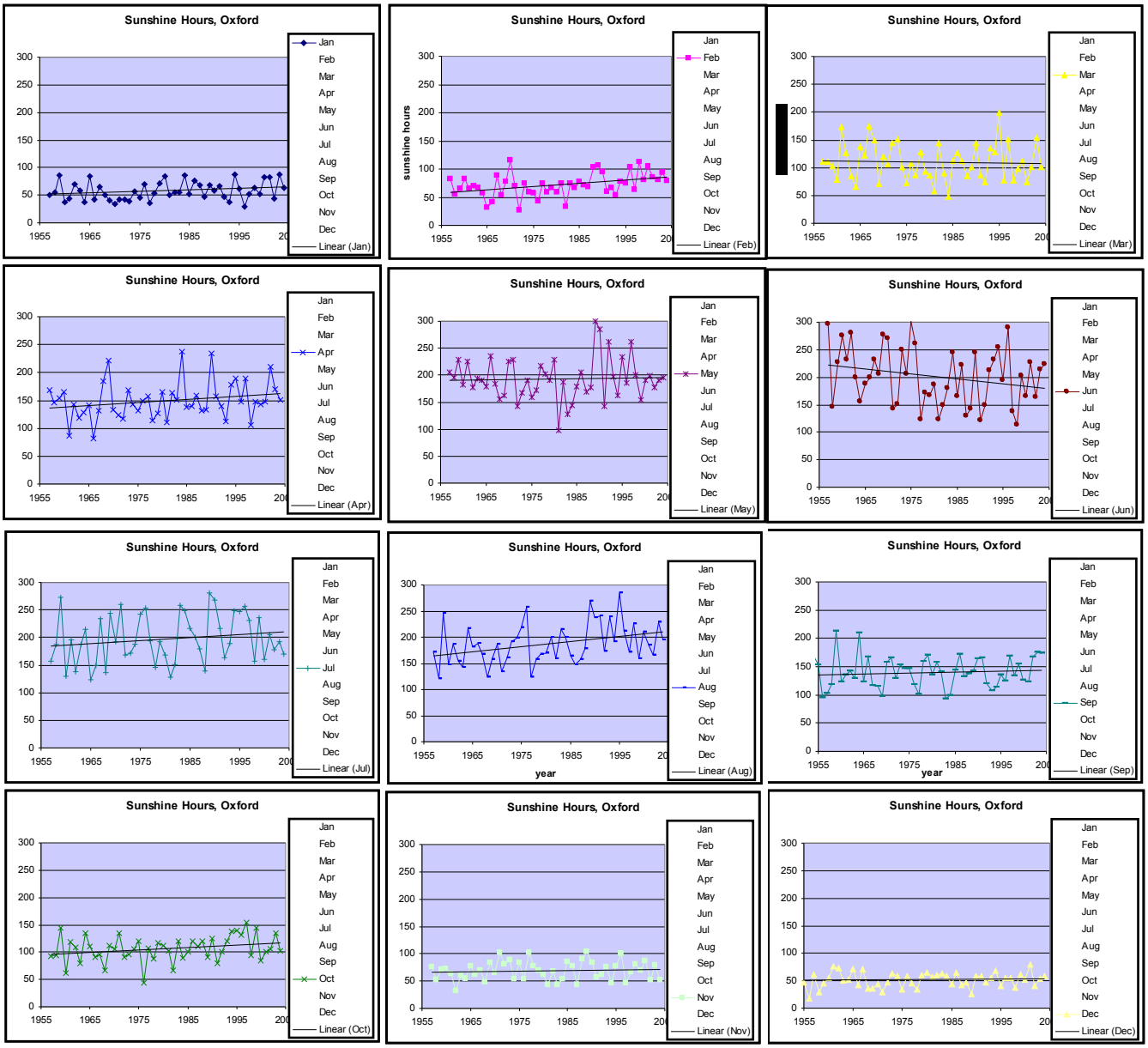


Illustration 9 Sunshine Oxford

Table 1 Regression Coefficients **Leuchars**

using Y=AX+B **Location: 3468E 7209N, 10 metres amsl**

	tmax degC		tmin degC		DoAF days		rain mm		sun hours	
month	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
1	0.02576	6.19583	0.02200	0.21875	-0.03968	13.14583	0.09531	65.52500	0.03320	59.68542
2	0.03393	6.75208	0.02959	0.34792	-0.07865	12.14583	-0.02030	45.55000	0.38699	80.13958
3	0.03847	8.87708	0.00707	1.74583	-0.00364	8.14583	0.06402	46.33125	0.60733	117.26250
4	0.00728	11.06458	0.00971	3.28958	-0.02003	4.60417	0.21945	43.68333	-0.15708	153.50417
5	0.02006	13.72500	0.01449	5.67292	0.01243	0.81250	-0.05695	50.18333	0.46990	190.22083
6	0.00587	16.93750	0.00598	8.57917	0.00000	0.00000	0.43330	51.26042	-0.02306	192.46458
7	0.03144	18.67917	0.01679	10.38542	0.00000	0.00000	-0.72126	55.60208	0.32115	180.90417
8	0.04125	18.55625	0.02048	10.30000	0.00000	0.00000	-0.40090	61.06458	0.61978	166.11250
9	0.01587	16.27917	0.00426	8.52708	-0.00071	0.06250	0.18830	58.41667	0.42196	130.54167
10	-0.00730	12.96458	-0.01052	5.97500	0.03018	1.54167	1.02331	67.42500	0.34357	103.69583
11	0.03075	8.96458	0.02593	2.41250	-0.07327	8.16667	0.01317	60.56458	0.29478	74.47500
12	0.01879	6.71875	0.02033	0.79792	-0.05053	12.43750	0.06617	62.71875	0.04047	51.11875
average	0.02185	12.14288	0.01384	4.85434	-0.01866	5.08854	0.07530	55.69375	0.27992	125.01042

	tmax		tmin		DoAF		rain		sun	
month	**mean**	**variance**	**mean**	**variance**	**mean**	**variance**	**mean**	**variance**	**mean**	**variance**
1	6.19583	2.22457	0.21875	2.35027	13.14583	28.08290	65.52500	828.88979	59.68542	219.00333
2	6.75208	2.77791	0.34792	2.53000	12.14583	23.54123	45.55000	971.76667	80.13958	530.42822
3	8.87708	2.81302	1.74583	1.51582	8.14583	14.83290	46.33125	560.25465	117.26250	718.33818
4	11.06458	1.32479	3.28958	0.88177	4.60417	8.36415	43.68333	595.32556	153.50417	796.39123
5	13.72500	1.31896	5.67292	0.76406	0.81250	1.69401	50.18333	754.35181	190.22083	1404.25832
6	16.93750	1.37276	8.57917	0.74290	0.00000	0.00000	51.26042	641.00239	192.46458	1085.85854
7	18.67917	1.48915	10.38542	0.71750	0.00000	0.00000	55.60208	998.06520	180.90417	1021.74832
8	18.55625	1.57163	10.30000	1.04583	0.00000	0.00000	61.06458	1606.36062	166.11250	704.34818
9	16.27917	0.83040	8.52708	0.85197	0.06250	0.05859	58.41667	1102.15931	130.54167	596.35493
10	12.96458	1.41145	5.97500	1.90313	1.54167	4.49826	67.42500	1748.96854	103.69583	465.53790
11	8.96458	1.24062	2.41250	1.72151	8.16667	18.26389	60.56458	1241.36104	74.47500	240.45521
12	6.71875	1.96902	0.79792	2.25979	12.43750	23.20443	62.71875	970.87569	51.11875	187.98152

Table 2 Regression Coefficients **Oxford**

using Y=AX+B from year 1957 **Location: 4509E 2072N, 63 metres amsl**

	tmax degC		tmin degC		DoAF days		rain mm		sun hours	
month	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
1	0.04163	6.96250	0.03125	1.70208	-0.06551	9.56250	-0.07192	59.15208	0.27762	57.63542
2	0.04231	7.56042	0.01843	1.75000	-0.02269	8.87500	0.16743	41.78958	0.56813	72.00625
3	0.03659	10.27292	0.03439	3.19167	-0.07881	4.70833	-0.13283	47.43750	-0.11270	110.25417
4	0.02288	12.92083	0.00556	4.77292	-0.00695	2.08333	0.44352	47.51250	0.55474	149.65833
5	0.02643	16.63750	0.01492	7.64583	0.00326	0.12500	-0.04797	52.52083	0.13174	192.98542
6	0.00151	19.89792	0.01330	10.62292	0.00000	0.00000	-0.42995	52.11667	-0.88709	200.92708
7	0.04593	21.97917	0.01905	12.60625	0.00000	0.00000	-0.50534	50.25208	0.56468	197.42083
8	0.06499	21.65625	0.03310	12.50417	0.00000	0.00000	-0.21780	59.15208	0.95880	186.98750
9	0.01711	18.66667	0.01337	10.41667	0.00000	0.00000	-0.31677	57.91667	0.11988	140.71667
10	-0.00414	14.60000	0.00118	7.59375	0.02508	0.62500	0.59382	63.39375	0.42089	106.20208
11	0.03368	10.06042	0.02850	4.25833	-0.03664	4.10417	0.31831	61.52083	0.11516	69.08542
12	0.03204	7.62292	0.02532	2.33958	-0.00923	8.12500	-0.13717	66.15833	0.03946	52.56250
average	0.03008	14.06979	0.01986	6.61701	-0.01596	3.18403	-0.02806	54.91024	0.22928	128.03681

	tmax		tmin		DoAF		rain		sun	
month	**mean**	**variance**	**mean**	**variance**	**mean**	**variance**	**mean**	**variance**	**mean**	**variance**
1	6.96250	3.91943	1.70208	3.84895	9.56250	33.66276	59.15208	693.78250	57.63542	266.91395
2	7.56042	5.14947	1.75000	3.97000	8.87500	37.35938	41.78958	670.24510	72.00625	399.69684
3	10.27292	3.05739	3.19167	2.25285	4.70833	16.28993	47.43750	732.51901	110.25417	1051.00123
4	12.92083	1.46165	4.77292	0.83781	2.08333	3.49306	47.51250	673.41568	149.65833	1069.43326
5	16.63750	2.12276	7.64583	0.83707	0.12500	0.15104	52.52083	539.67415	192.98542	1458.94291
6	19.89792	2.67770	10.62292	0.91052	0.00000	0.00000	52.11667	917.55472	200.92708	2703.81989
7	21.97917	3.43040	12.60625	0.69850	0.00000	0.00000	50.25208	854.48625	197.42083	1902.42748
8	21.65625	3.50579	12.50417	0.94873	0.00000	0.00000	59.15208	1172.77875	186.98750	1448.91318
9	18.66667	1.76264	10.41667	1.09972	0.00000	0.00000	57.91667	1330.10681	140.71667	732.95347
10	14.60000	1.84042	7.59375	2.05850	0.62500	1.52604	63.39375	1332.53892	106.20208	527.57979
11	10.06042	1.39864	4.25833	1.98035	4.10417	12.71832	61.52083	961.66707	69.08542	298.50250
12	7.62292	2.67802	2.33958	2.84406	8.12500	24.19271	66.15833	1060.86910	52.56250	159.70693

Table 3 Difference **Oxford – Leuchars**

	tmax		tmin		DoAF		rain		sun	
month	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
1	0.01587	0.76667	0.00925	1.48333	-0.02584	-3.58333	-0.16723	-6.37292	0.24442	-2.05000
2	0.00838	0.80833	-0.01115	1.40208	0.05596	-3.27083	0.18773	-3.76042	0.18114	-8.13333
3	-0.00188	1.39583	0.02732	1.44583	-0.07517	-3.43750	-0.19685	1.10625	-0.72003	-7.00833
4	0.01560	1.85625	-0.00415	1.48333	0.01308	-2.52083	0.22407	3.82917	0.71182	-3.84583
5	0.00637	2.91250	0.00043	1.97292	-0.00917	-0.68750	0.00898	2.33750	-0.33816	2.76458
6	-0.00436	2.96042	0.00732	2.04375	0.00000	0.00000	-0.86325	0.85625	-0.86403	8.46250
7	0.01449	3.30000	0.00226	2.22083	0.00000	0.00000	0.21592	-5.35000	0.24353	16.51667
8	0.02374	3.10000	0.01261	2.20417	0.00000	0.00000	0.18310	-1.91250	0.33903	20.87500
9	0.00124	2.38750	0.00911	1.88958	0.00071	-0.06250	-0.50507	-0.50000	-0.30208	10.17500
10	0.00316	1.63542	0.01170	1.61875	-0.00510	-0.91667	-0.42949	-4.03125	0.07732	2.50625
11	0.00293	1.09583	0.00256	1.84583	0.03664	-4.06250	0.30514	0.95625	-0.17962	-5.38958
12	0.01325	0.90417	0.00499	1.54167	0.04130	-4.31250	-0.20334	3.43958	-0.00101	1.44375
average	0.00823	1.92691	0.00602	1.76267	0.00270	-1.90451	-0.10336	-0.78351	-0.05064	3.02639

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