

SEASONAL TRENDS IN PRECIPITATION AND TEMPERATURES FOR THE NORTH STANN CREEK WATERSHED.

Method:

Three stations were chosen within the North Stann Creek watershed. These were Melinda, Pomona and Middlesex.

Years were divided into seasons:

- i. December, January, February (DJF)
- ii. March, April, May (MAM)
- iii. June, July August (JJA)
- iv. September, October and November. (SON)

The DJF represents the cool transitional or “winter” months. MAM is the warm and dry part of the year. The rainy season typically starts in earnest in June and that section of the year is represented at the JJA quarter. The earlier part of SON marks the heart of the rainy season but also involves the start of the cool season in November. Seasonal totals were plotted in the analysis of the observations.

Note: Line graphs in the precipitation analyses were used simply for their aesthetic properties. The author is aware that precipitation is not a continuous variable.

Output

The outputs include:

1. Time series plots showing linear trends and 5-year moving averages in both historical data and projections.
2. Tables showing seasonal and decadal averages along with extremes and time of occurrence
3. Plots of monthly averages
4. Summaries and Observations
5. Tables of decadal and seasonal projections
6. Snapshot plots of monthly average projections for years 2030, 2070 and 2099.
7. Tables of averages, projections and along with magnitudes and percentage changes.

Pomona

(17.0 ° N Latitude, 88.4 °W longitude)

Temperatures

A consistent and reliable block of data could not be found for realistic trend analyses of temperatures at this station

Rainfall

Annual Total

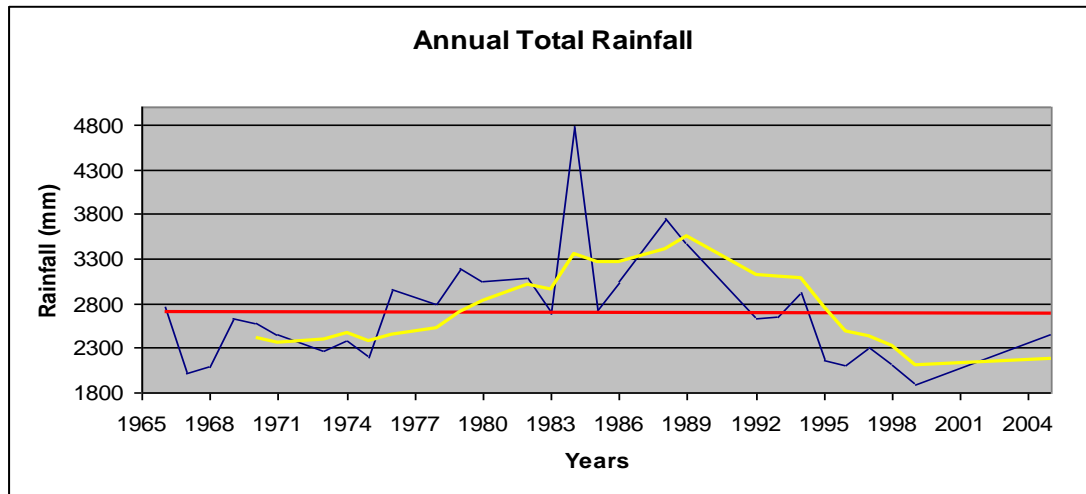


Figure 2. Annual total rainfall at Pomona

- i. The data set includes the period from 1966 to 2005 with 1972, 1981, 1987, 1990 and 1991 missing or deleted.
- ii. Linear trend shows no significant changes in rainfall.

Monthly Average

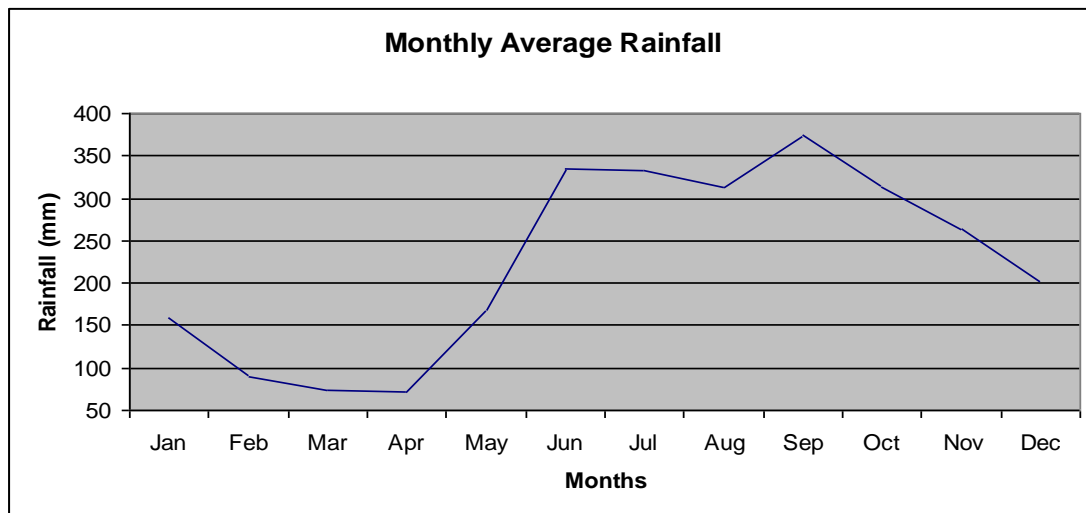


Figure 3. Monthly average temperatures

Table 1 Seasonal and decadal averages in rainfall (mm) at Pomona

	DJF	MAM	JJA	SON
Averages	148.7	104.7	326.8	316.8
1970's	140.3	90.1	303.6	321.4
1980's	185.9	122.0	407.3	399.9
1990's	129.5	92.4	291.3	272.1
2000's	----	---	----	---
Maximums	279.7 (1984)	238.9 (1978)	624.0 (1984)	494.6 (1989)
Minimums	97.5 (1970)	19.9 (1975)	90.1 (1975)	199.9(1993)

SUMMARY and OBSERVATIONS

The mid to late 80's were the wettest years as shown by the 5-year moving averages. However, linear trend analyses indicate minimal changes occurred in rainfall at Pomona.

PROJECTIONS

Temperatures

Average yearly

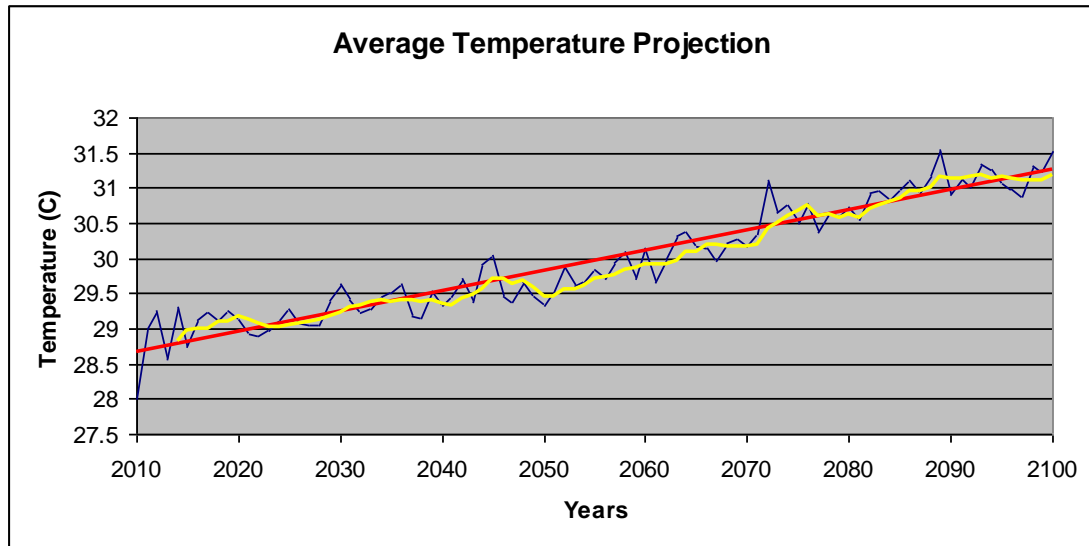


Figure 4. Average yearly temperature projection

- i. Trend indicates a 2.7 °C increase in average yearly temperatures.

Monthly Average

2040

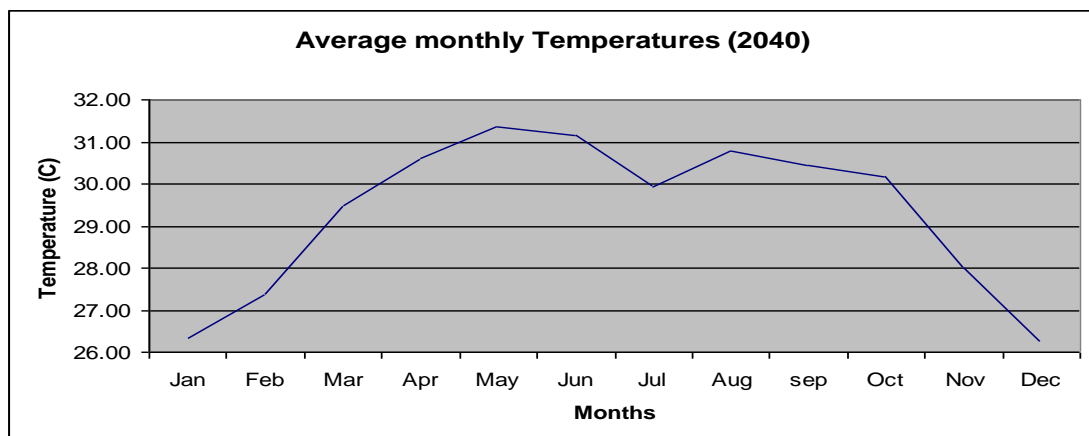


Figure 5. Average monthly temperature projections for the year 2040.

2070

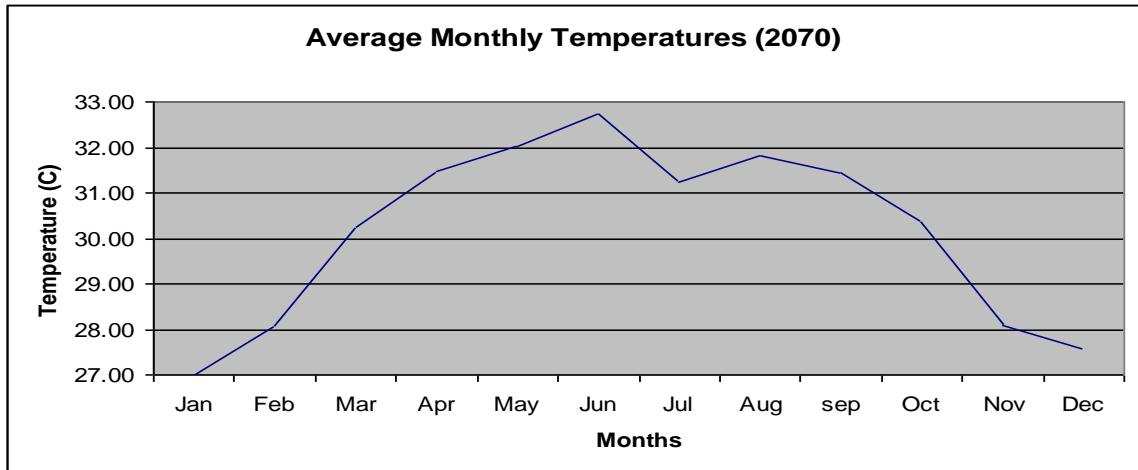


Figure 6. Average monthly temperature projections for the year 2070.

2099

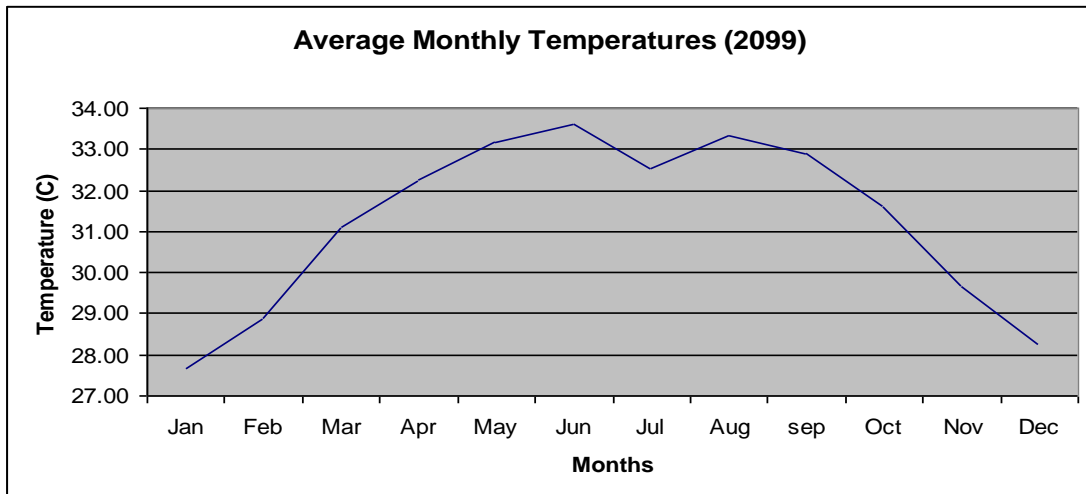


Figure 7. Average monthly temperature projections for the year 2099.

DJF

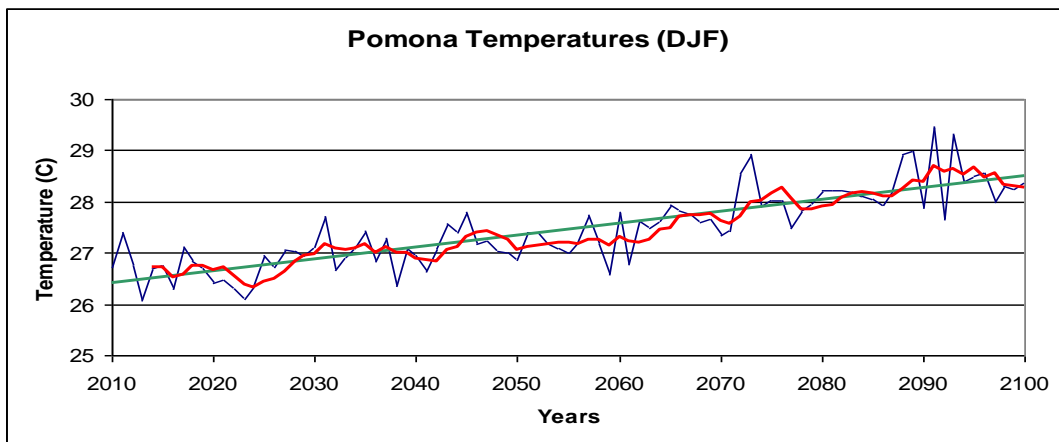


Figure 8. Projected temperature changes, linear trend (green) and five-year moving average at Pomona for DJF

- i. Trend is for an increase of 1.8 °C for DJF.

MAM

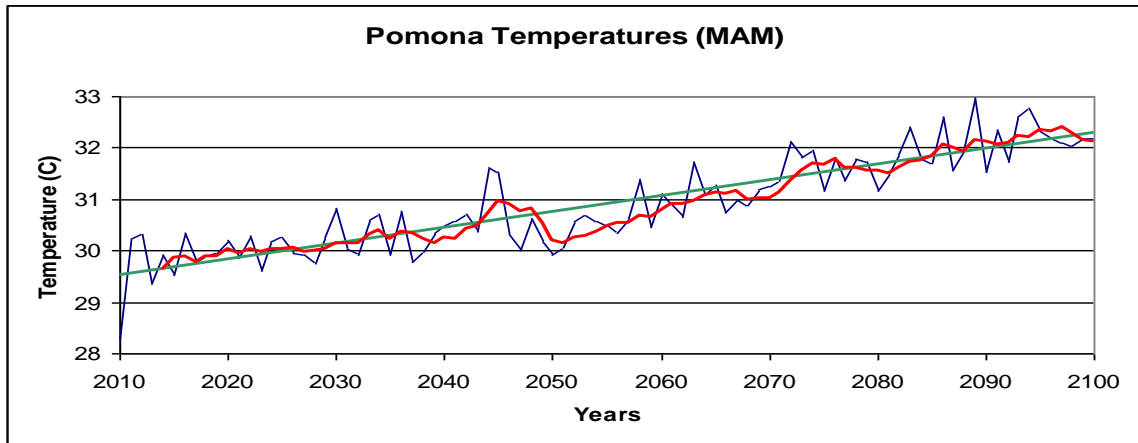


Figure 9. Projected temperature changes, linear trend (green) and five-year moving average at Pomona for MAM.

- i. An increase of 2.7 °C is projected.

JJA

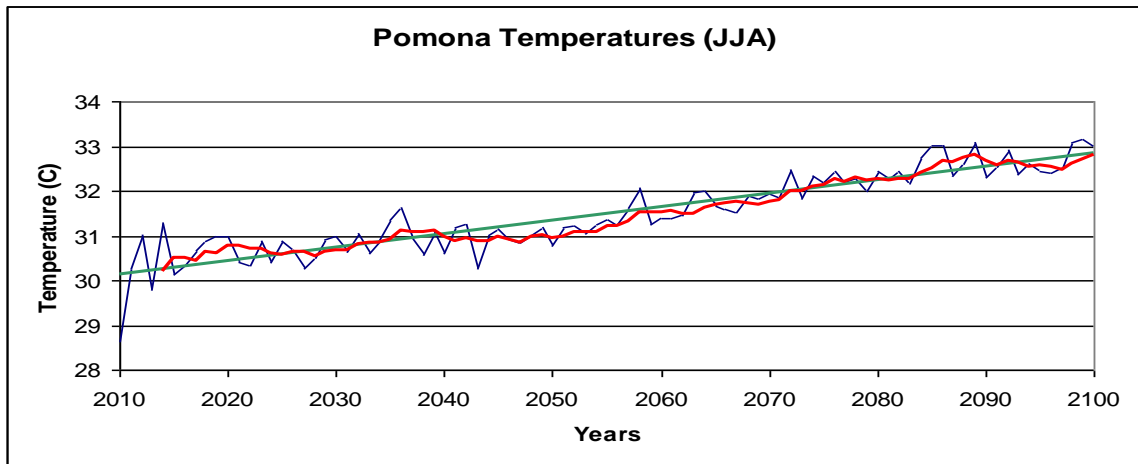


Figure 10. Projected temperature changes, linear trend (green) and five-year moving average at Pomona for MAM..

- i. An increase of 2.6 °C is projected.

SON

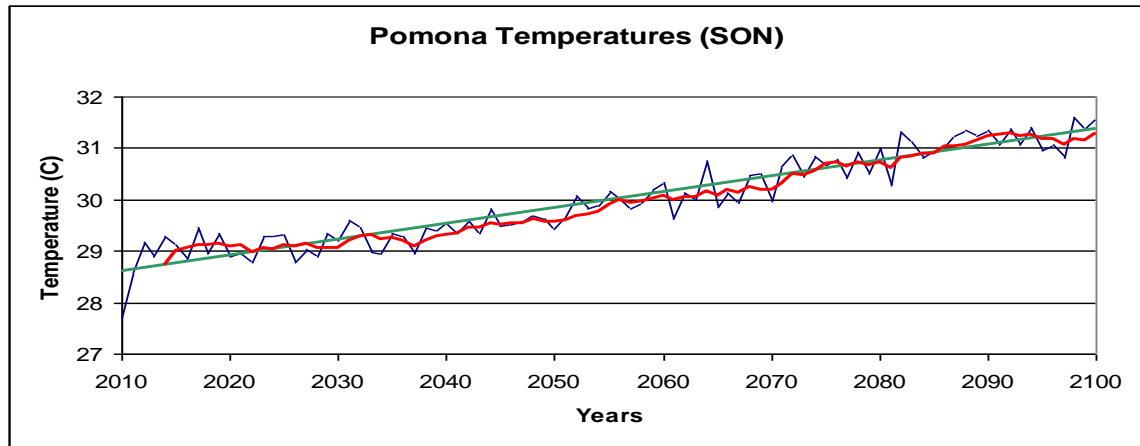


Figure 11. Projected temperature changes, linear trend (green) and five-year moving average at Pomona for SON.

- i. An increase of 2.7 °C is projected.

Table 2. Decadal and seasonal projections in temperature at Pomona

	Average	DJF	MAM	JJA	SON
91-yr average	30.0	27.5	30.9	31.5	30.0
2010's	29.0	26.7	29.8	30.4	28.9
2020's	29.1	26.6	30.1	30.6	29.1
2030's	29.4	27.0	30.3	31.0	29.2
2040's	29.6	27.2	30.6	30.9	29.6
2050's	29.7	27.2	30.6	31.3	29.9
2060's	30.1	27.6	31.1	31.7	30.2
2070's	30.6	27.9	31.6	32.1	30.6
2080's	31.0	28.3	32.0	32.6	31.0
2090's	31.1	28.4	32.2	32.6	31.2

Summary and Observations

By 2040 the warmest month becomes May. This shifts to June by 2070 and this month remains the warmest through the end of the century. The coolest month is projected to be December by 2040 then January through to the end of century based on the three chosen illustrations.

Rainfall

Yearly totals

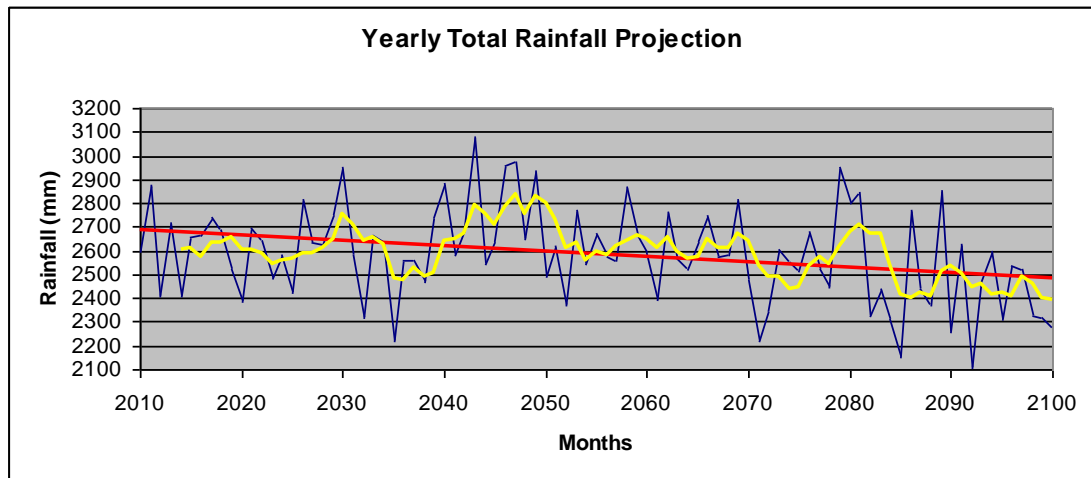


Figure 12. Projections of yearly total rainfall. Linear trend (red). Five-year moving average (yellow)

Monthly average

2040

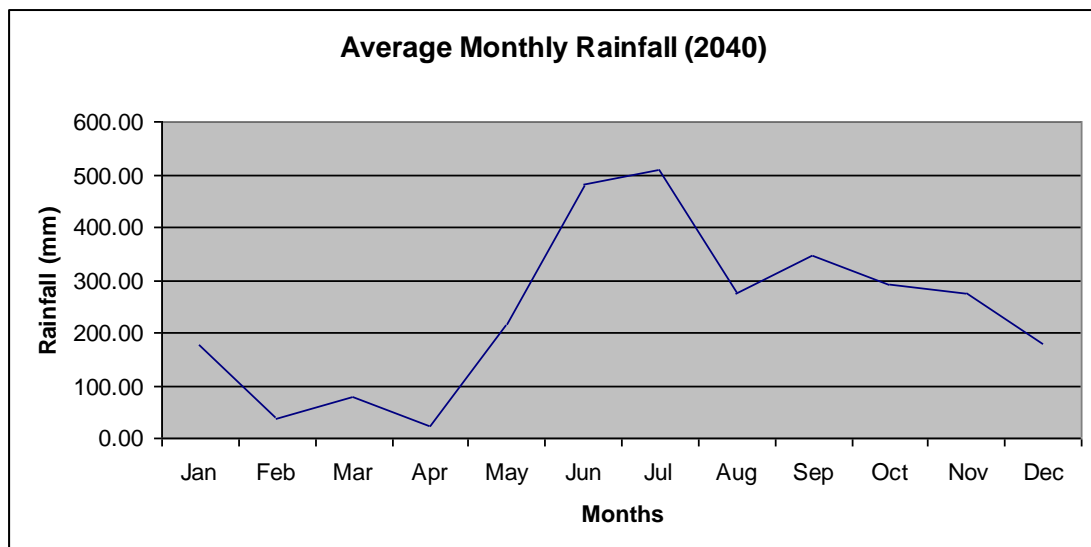


Figure 13. Projected average monthly rainfall for the year 2040.

2070

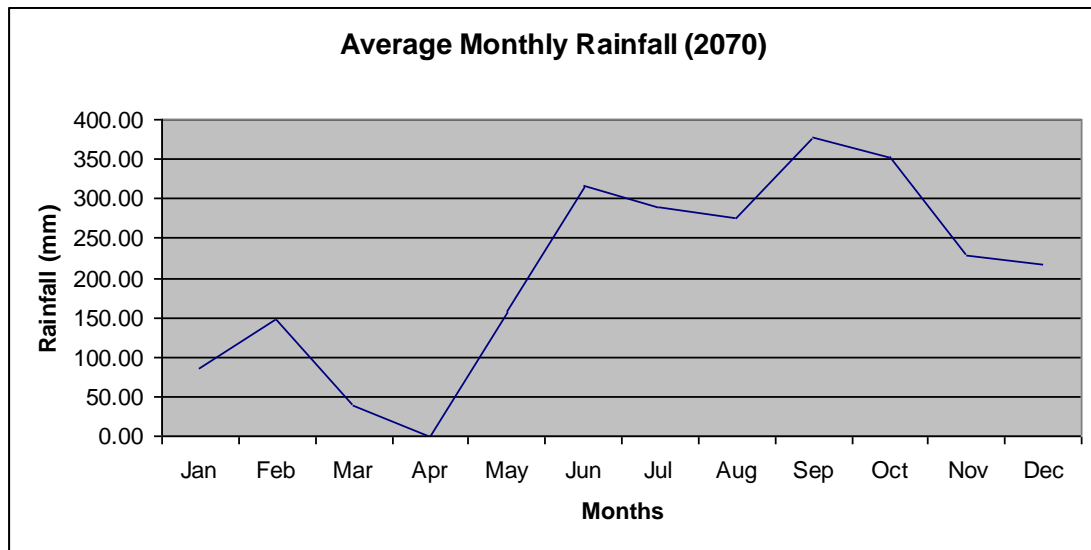


Figure 14. Projected average monthly rainfall for the year 2070.

2099

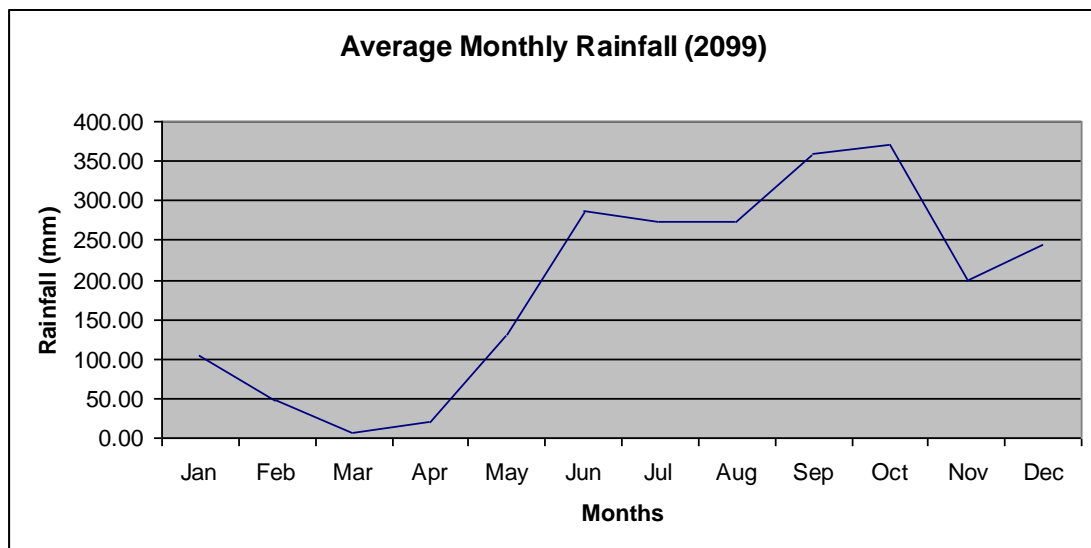


Figure 15. Projected average monthly rainfall for the year 2099.

DJF

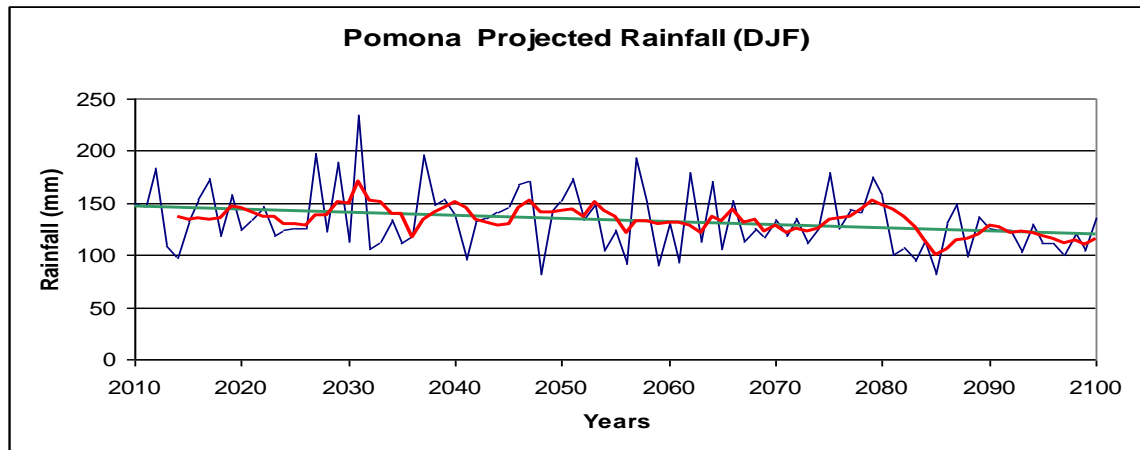


Figure 16 Model projections of rainfall, linear trend (green) and five-year moving average (red) at Pomona for DJF.

- i. A 25 mm decrease in precipitation is projected for DJF from about 150 mm to 125 mm.

MAM

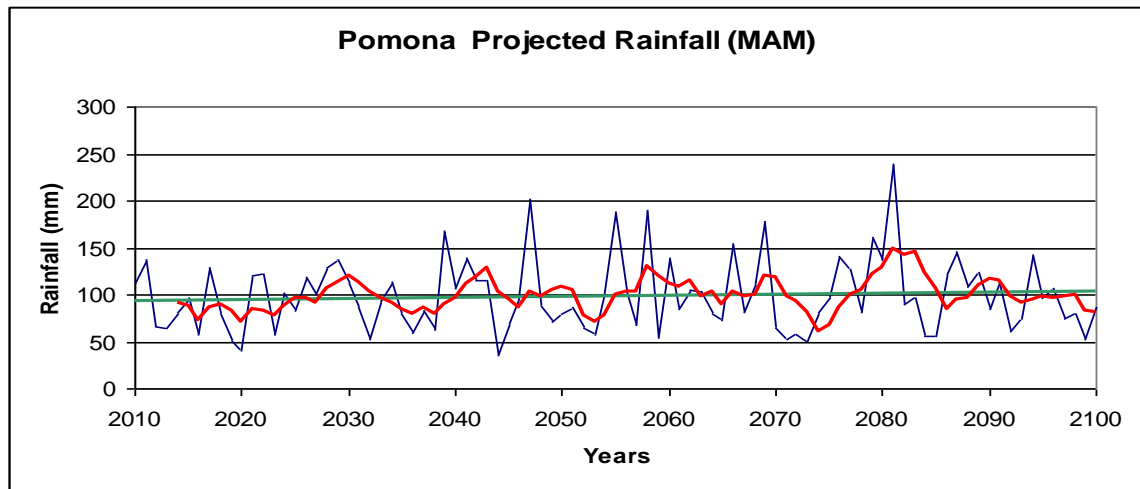


Figure 17 Model projections of rainfall, linear trend (green) and five-year moving average (red) at Pomona for MAM

- i. There is about 8 mm s increase in precipitation projected for this period.

JJA

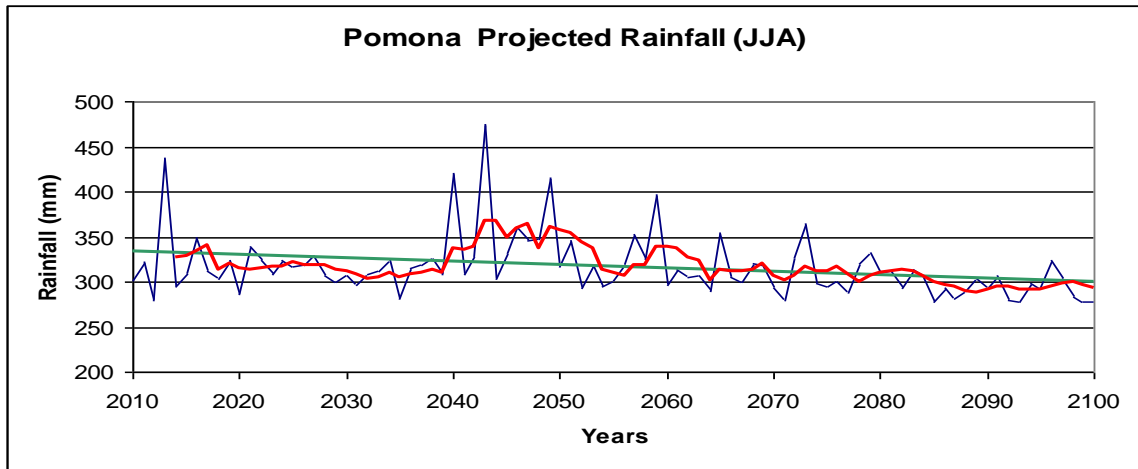


Figure 18. Model projections of rainfall, linear trend (green) and five-year moving average (red) at Pomona for JJA

- i. Trend shows a 32 mm decrease in precipitation for the MAM season.

SON

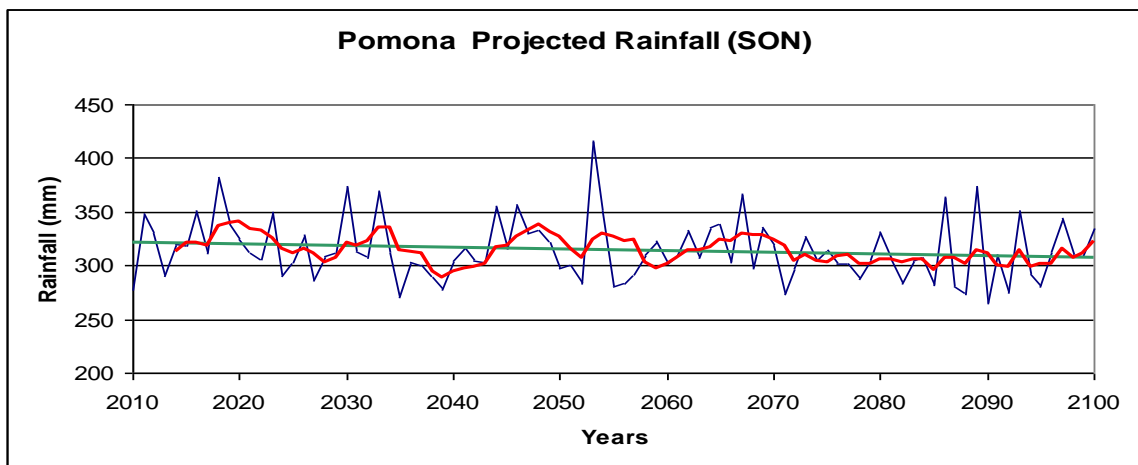


Figure 19 Model projections of rainfall, linear trend (green) and five-year moving average (red) at Pomona for SON.

- i. Linear trend indicates a 12 mm decrease in precipitation for SON at Pomona.

Table 3. Decadal and seasonal projections in rainfall (mm) at Pomona

	Average	DJF	MAM	JJA	SON
91-yr average	2588.8	133.4	99.0	316.4	314.6
2010's	2628.2	142.5	87.4	323.4	326.9
2020's	2605	140.7	101	315.5	311.8
2030's	2570	142.9	90.9	309.8	311.8
2040's	2793.6	135.3	104.1	363.7	324.0
2050's	2612.8	136.3	99.4	326.7	313.7
2060's	2619.7	130.3	111.3	311.1	322.7
2070's	2531.4	139.2	91.5	309.7	303.1
2080's	2494	117.3	117.4	297.5	310.5
2090's	2462.2	115.8	88.7	293.6	304.9

Table 4. Seasonal projections and change in seasonal temperatures at Pomona

	Average	Projection	Change
DJF	148.7 (28)	133.4	-15.3 [-10.2 %]
MAM	104.7 (28)	99.0	-5.7 [-5.4 %]
JJA	326.8 (28)	316.4	-10.4 [- 3.2 %]
SON	316.8 (28)	314.6	-2.2 [-0.7 %]
Yearly Average	2694.5 (28)	2588.8	-105.7 [-3.9 %]

Numbers in () indicate years of data

Numbers in [] indicate % change between observations and projections.

SUMMARY and OBSERVATIONS

Projections show relatively small decreases in rainfall through to the end of the century. Only the DJF rainfall is projected to increase by 2040.

The month with the most rainfall shifts from September to July. There is another shift projected for 2070 back to September then to June by the end of the century. The bulk of the rainfall moves towards the latter part of the year.

2) MIDDLESEX

(latitude 17.0 °N, longitude 88.5 °W, elevation 120 meters)

Temperature

Trends in temperature could not be determined as a consistent block of reliable data was unavailable.

Average monthly

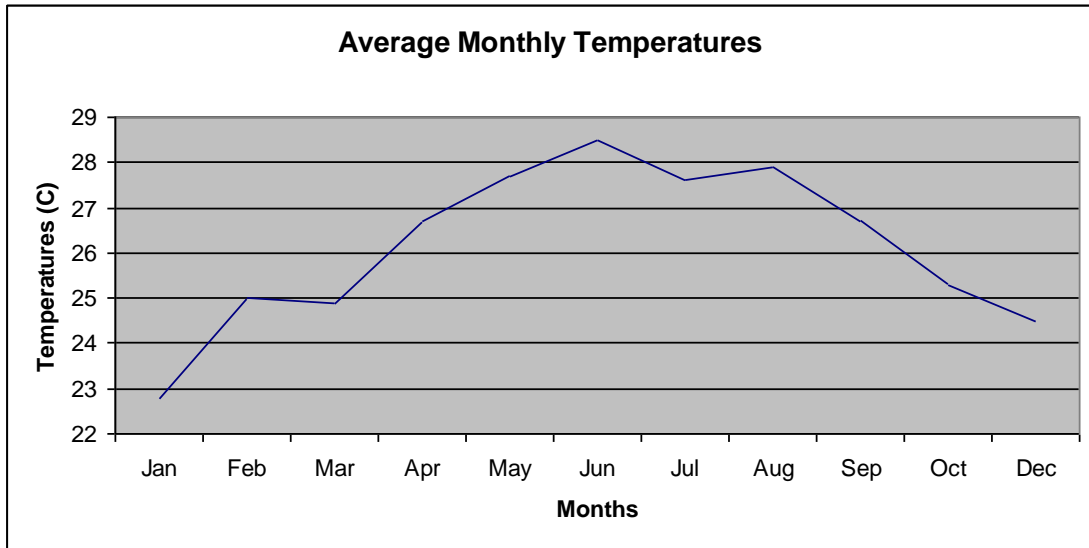


Figure 1. Average monthly rainfall at Middlesex

Rainfall

Data in the section covers the period 1966 to 2001 with 1975, 1981, 1986, 1987, 1988, 1990, 1991, 1993, 1996 and 1999 either missing or deleted.

Annual totals

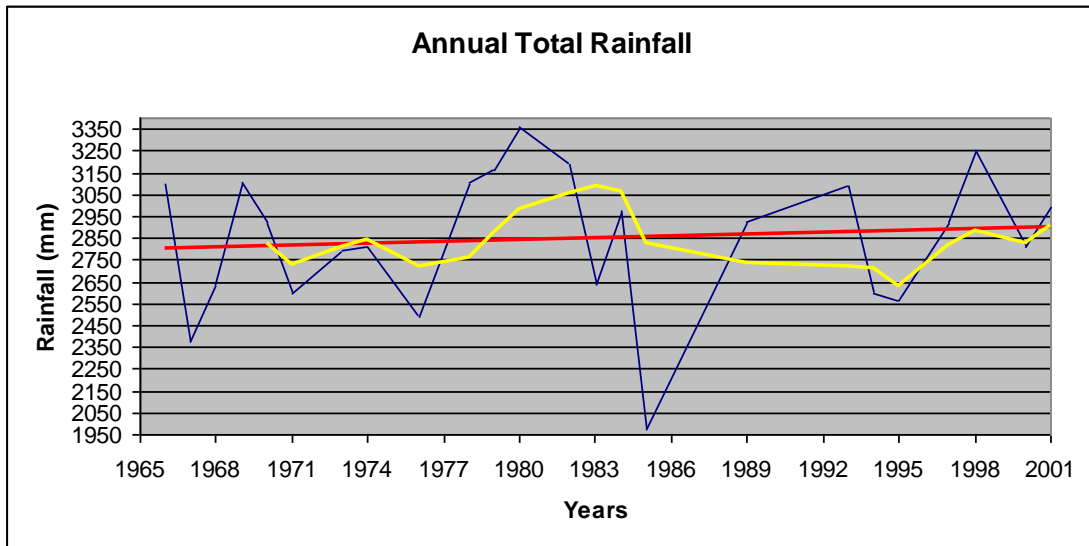


Figure 20. Annual total rainfall. Linear trend (red). Five-year moving average (yellow)

- i. Linear trend analysis indicates about 95 to 100 mm increase in annual total rainfall.

Average monthly

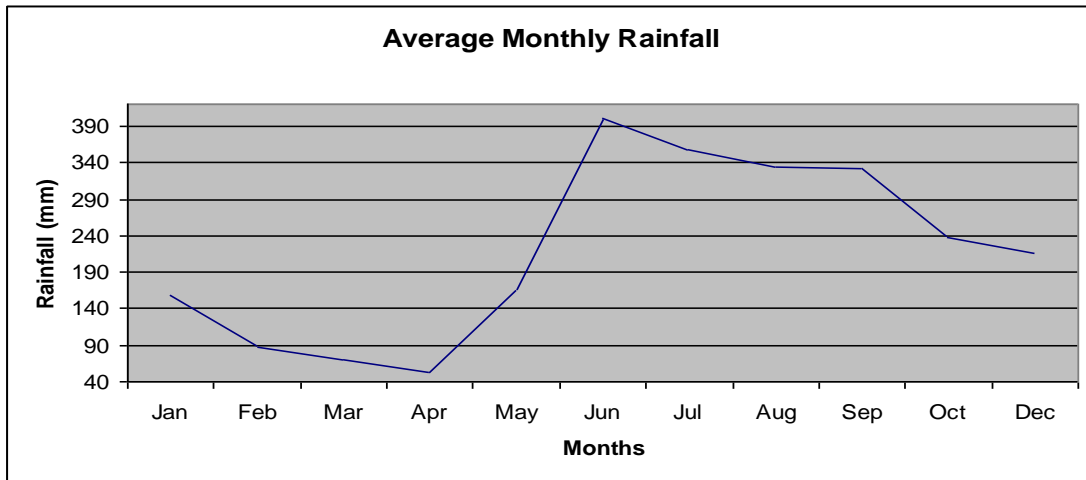


Figure 21. Average monthly rainfall

PROJECTION

Temperature

Yearly Average

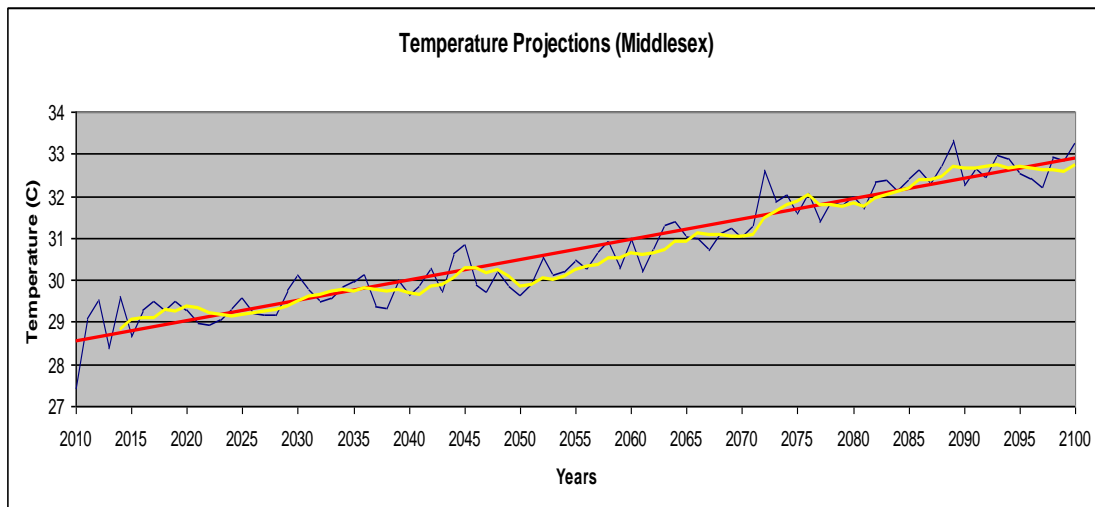


Figure 22. Yearly average temperature projections

Monthly average

2040

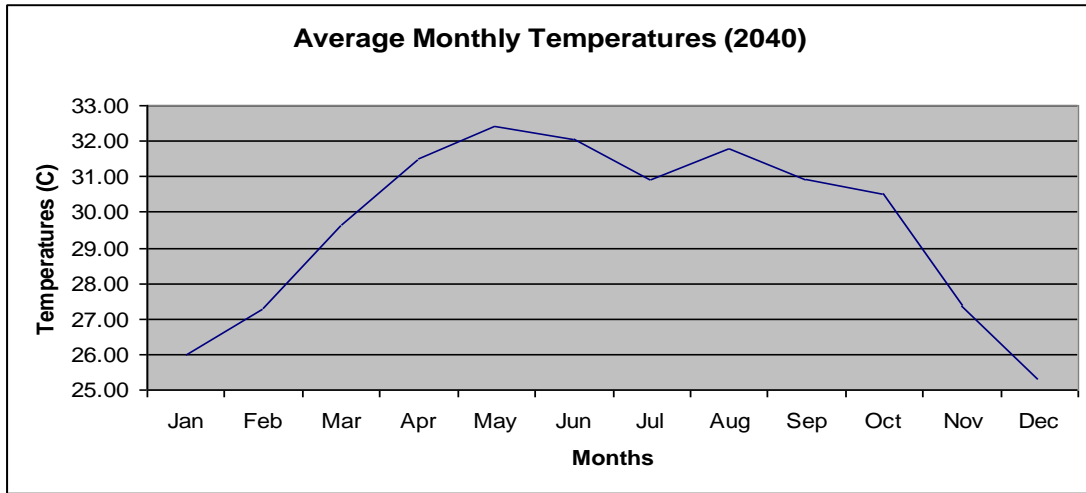


Figure 23. Projected average monthly temperatures for the year 2040

2070

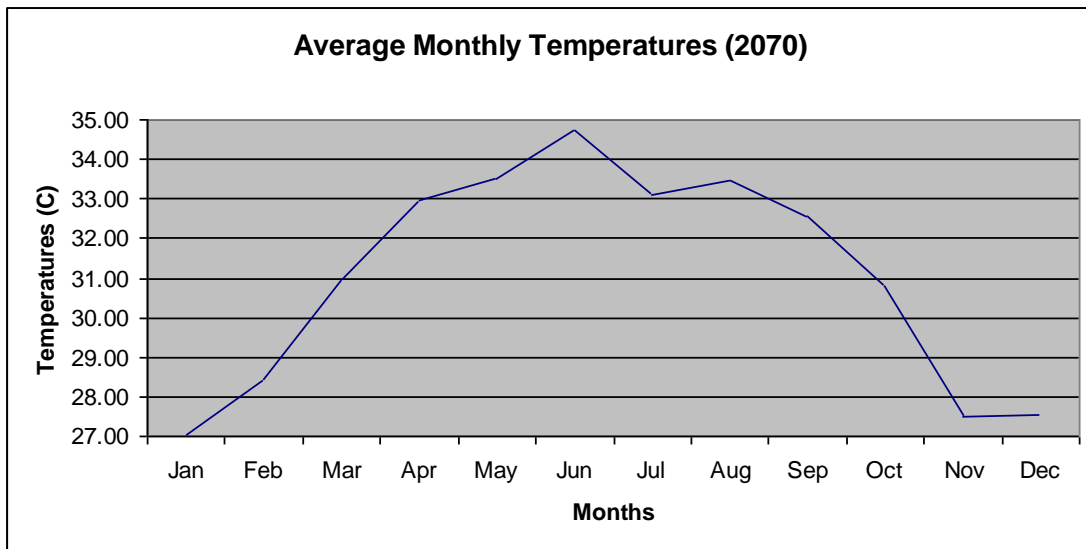


Figure 24. Projected average monthly temperatures for the year 2070

2099

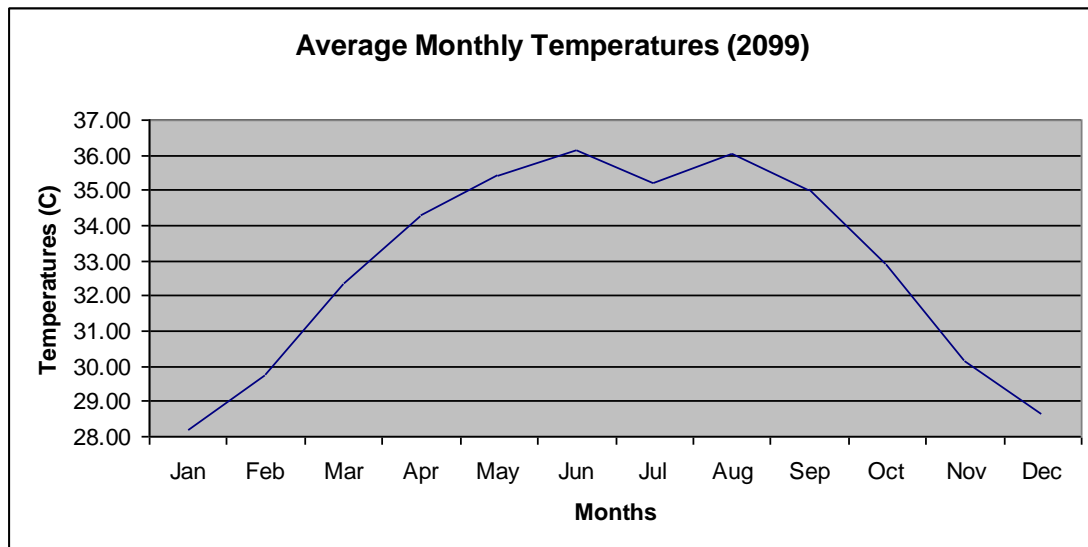


Figure 25. Projected average monthly temperatures for the year 2099

DJF

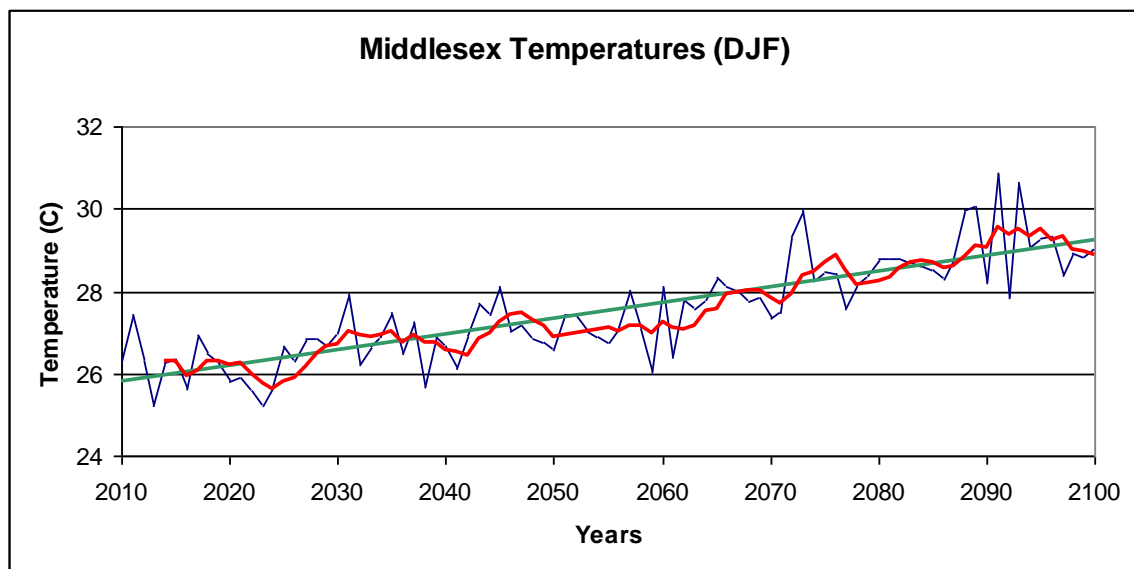


Figure 26. Projected temperature changes, linear trend (green) and five-year moving average at Middlesex for DJF

- i. An increase of 2.6 °C is projected for the DJF period.

MAM

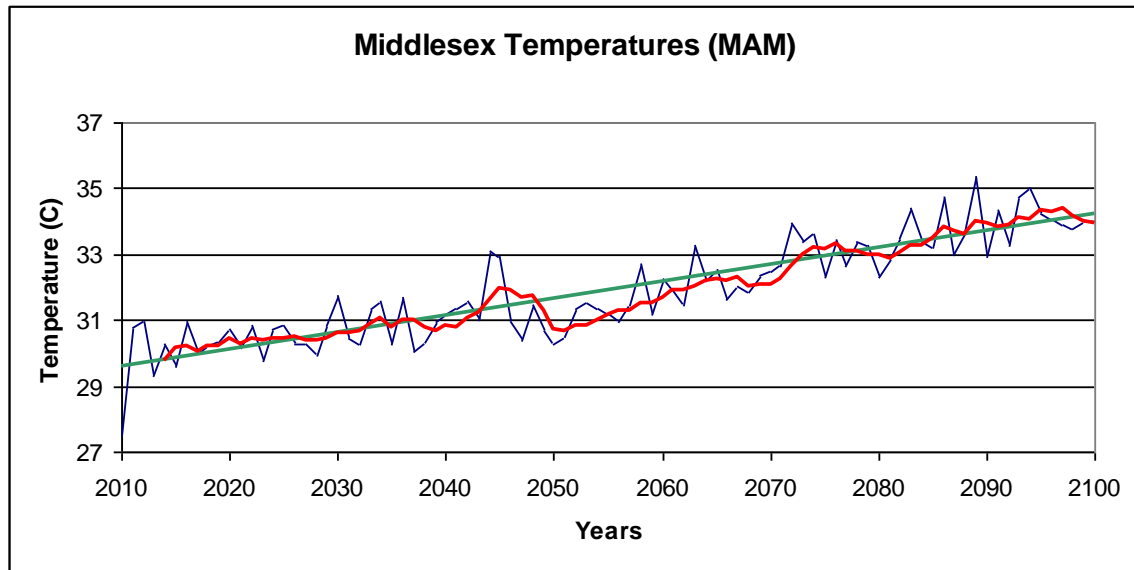


Figure 27. Projected temperature changes, linear trend (green) and five-year moving average at Middlesex for MAM.

- i. The linear trend shows an increase of $4.6\text{ }^{\circ}\text{C}$ for the MAM period.

JJA

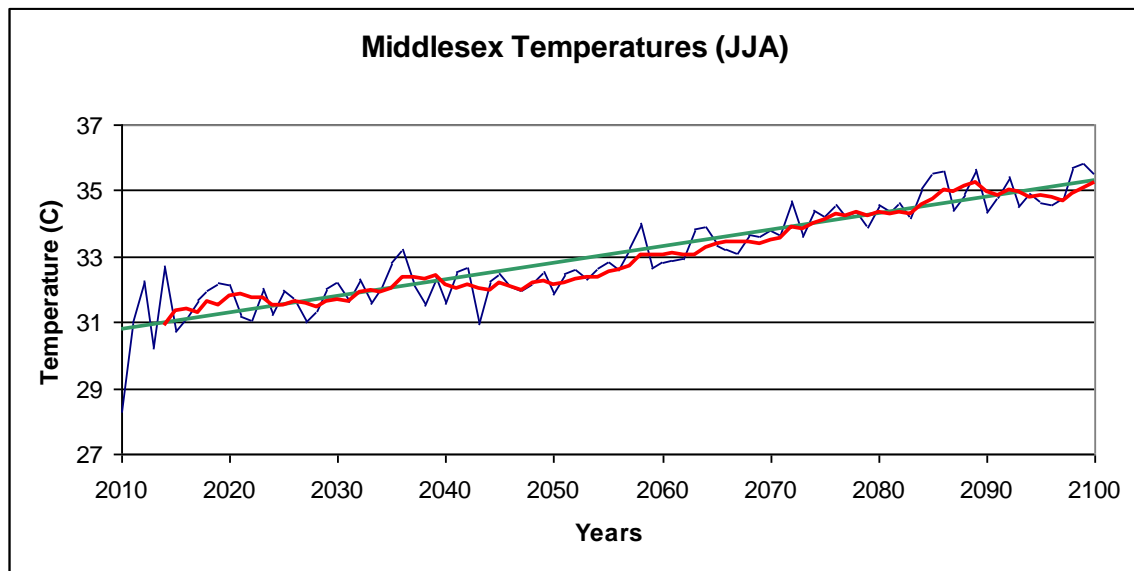


Figure 28. Projected temperature changes, linear trend (green) and five-year moving average at Middlesex for JJA.

- i. The linear trend analysis indicates an increase of $4.2\text{ }^{\circ}\text{C}$ for the JJA quarter.

SON

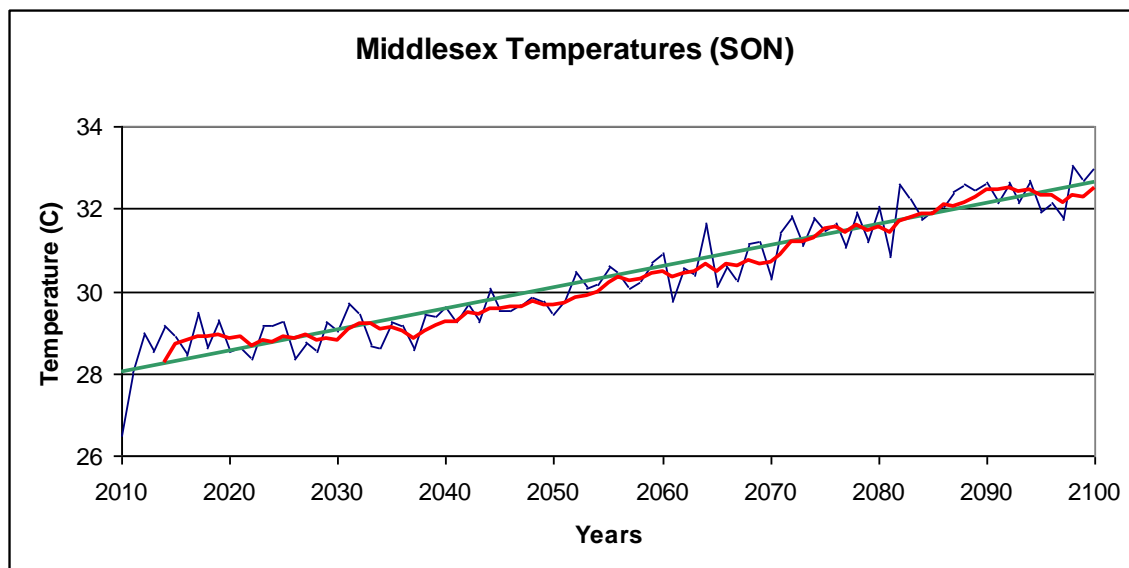


Figure 29. Projected temperature changes, linear trend (green) and five-year moving average at Middlesex for SON

- i. A 4.5 °C increase in average temperatures is projected for this SON period.

Table 5. Seasonal and decadal projections of average temperatures.

	Averages	DJF	MAM	JJA	SON
91 yr	30.7	27.5	31.9	33.0	30.3
2010's	29.0	26.3	30.0	31.2	28.6
2020's	29.2	26.1	30.4	31.6	28.8
2030's	29.8	26.8	30.9	32.1	29.1
2040's	30.1	27.1	31.5	32.1	29.6
2050's	30.3	27.0	31.2	32.7	30.2
2060's	31.0	27.7	32.1	33.3	30.7
2070's	31.7	28.3	33.1	34.1	31.4
2080's	32.4	28.9	33.6	34.9	32.1
2090's	32.6	29.1	34.0	34.9	32.4

Table 6. Seasonal averages and projected changes in average temperatures

	Average	Projection	Change [%]
DJF	23.8 (15)	27.5	+3.7 [+13.4 %]
MAM	26.4 (15)	31.9	+5.5 [+17.2 %]
JJA	28.1 (15)	33.0	+4.9 [+14.8 %]
SON	26.6 (15)	30.3	+3.7 [+12.2 %]
Yearly	24.2 (15)	30.7	+6.5 [+21.2 %]

Numbers in () depict years of data

Numbers in [] indicate percentage change.

SUMMARY and OBSERVATIONS

Maximum temperatures occur in June and the minimum in January at this station. The sampled years (2040, 2070 and 2099) reveal that only in 2040 was there a change in the warmest and coolest months to May and December respectively.

Rainfall

Yearly Total

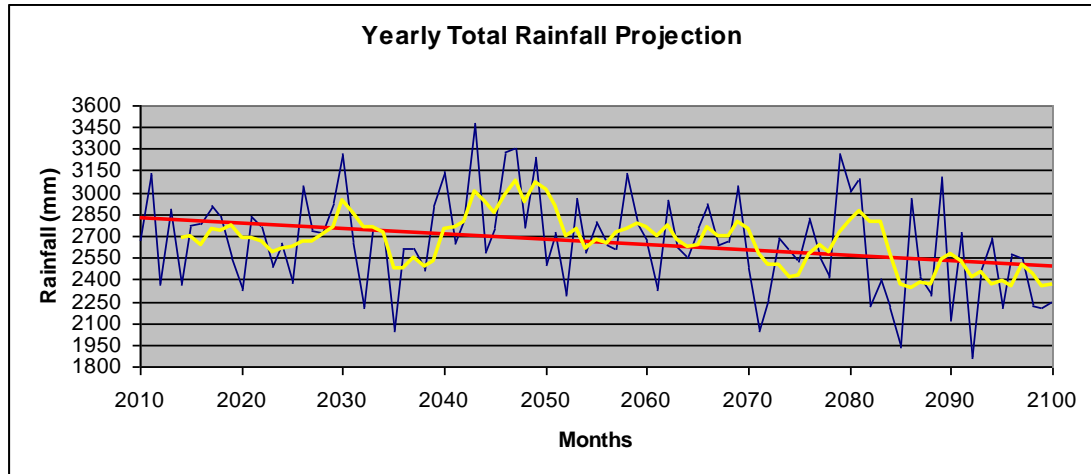


Figure 30. Yearly total rainfall projection. Linear trend (red). Five-year moving average (yellow)

- i. Linear trend shows some 320 mm decrease in total yearly rainfall.

2040

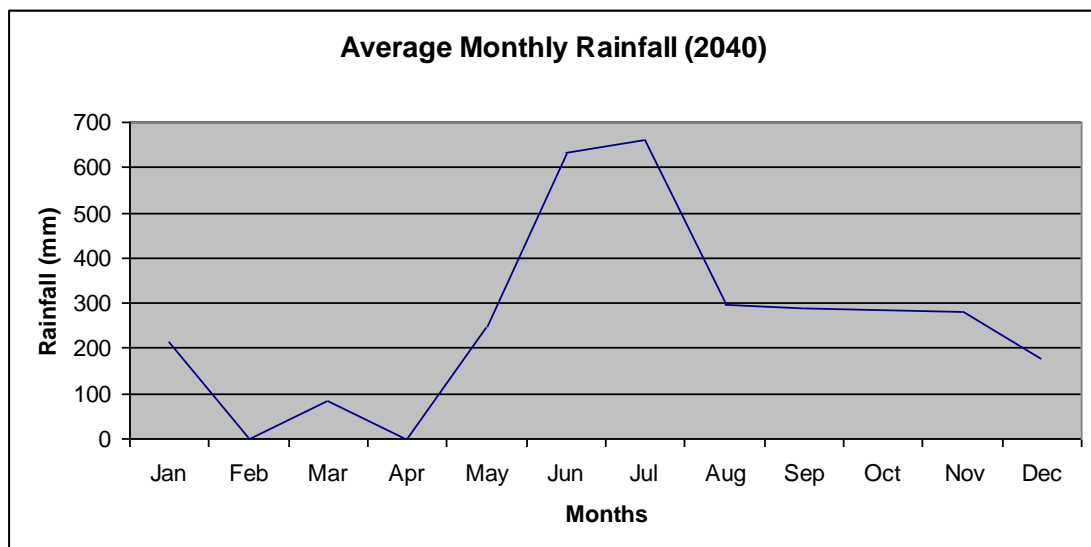


Figure 31. Monthly average rainfall for the year 2040

2070

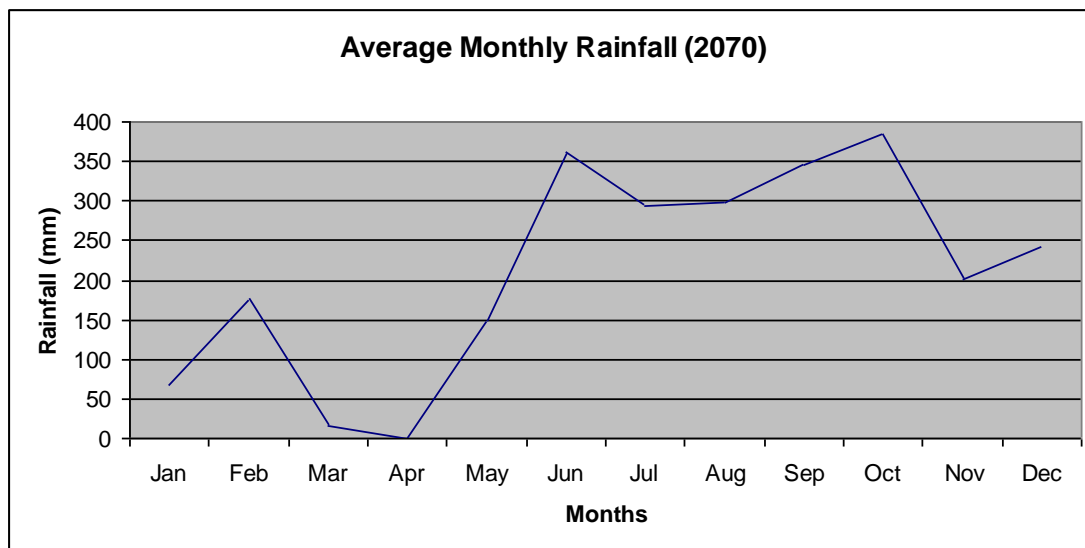


Figure 32. Monthly average rainfall for the year 2070

2099

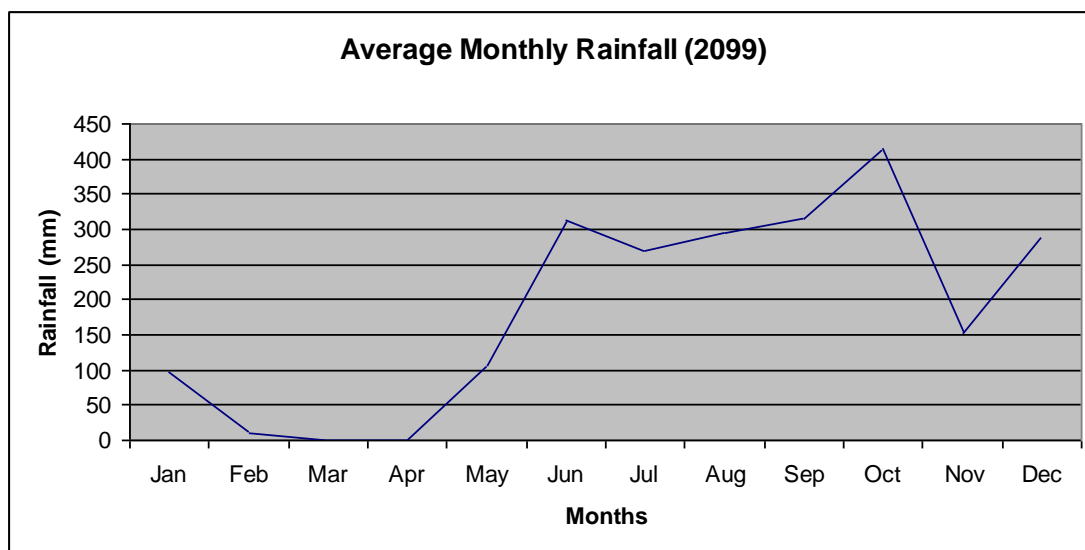


Figure 33. Monthly average rainfall for the year 2099

DJF

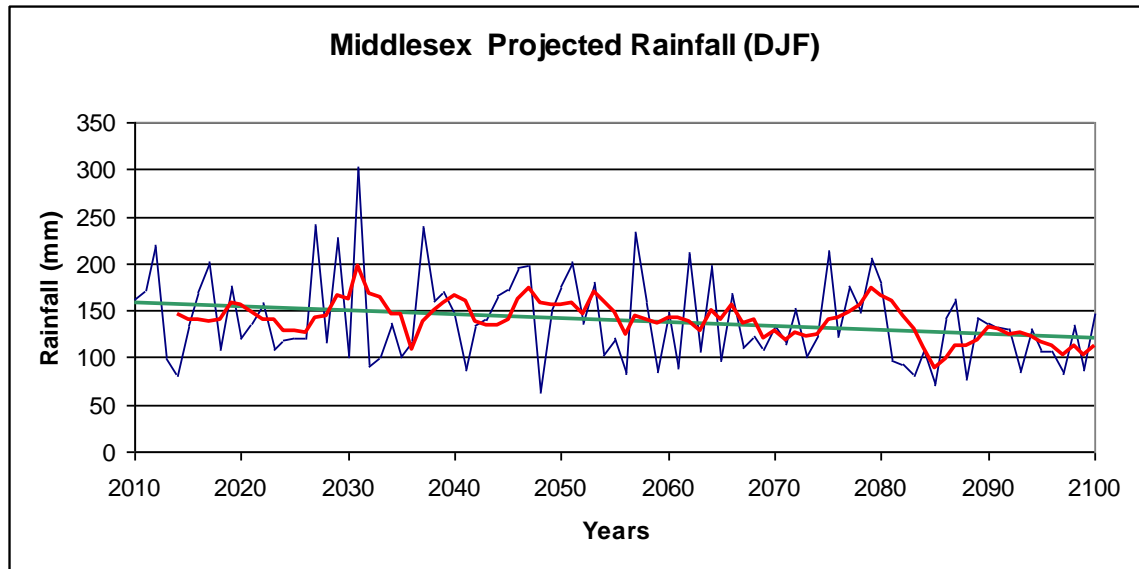


Figure 34. Model projections of rainfall, linear trend (green) and five-year moving average (red) at Middlesex for DJF.

- i. Projection shows about 30 mm decrease in rainfall for DJF at Middlesex.

MAM

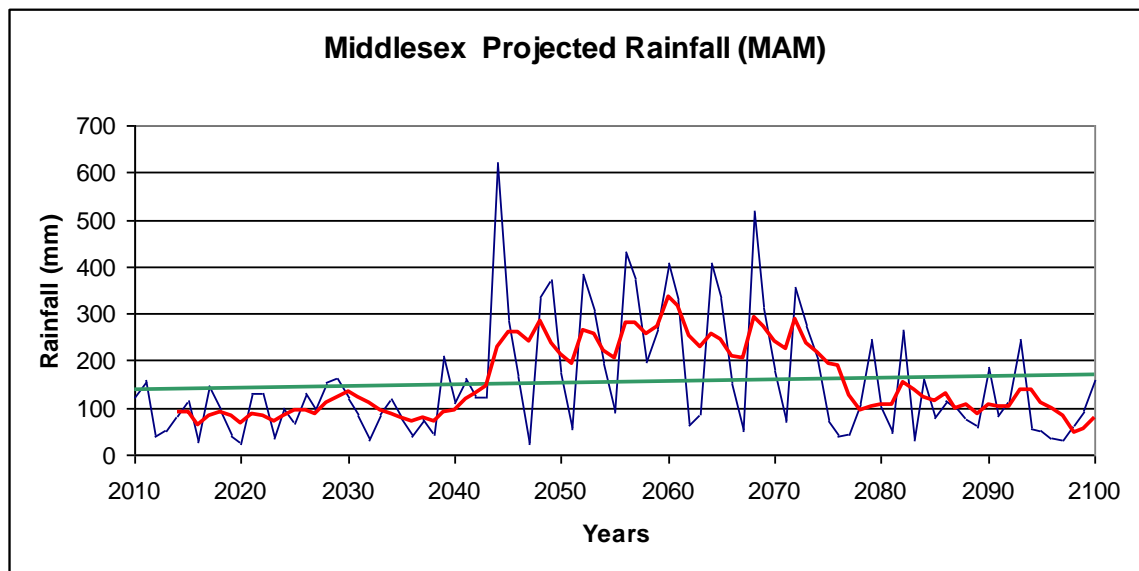


Figure 35. Model projections of rainfall, linear trend (green) and five-year moving average (red) at Middlesex for MAM.

- i. Projection shows a slight increasing of about 30 mm in precipitation.

JJA

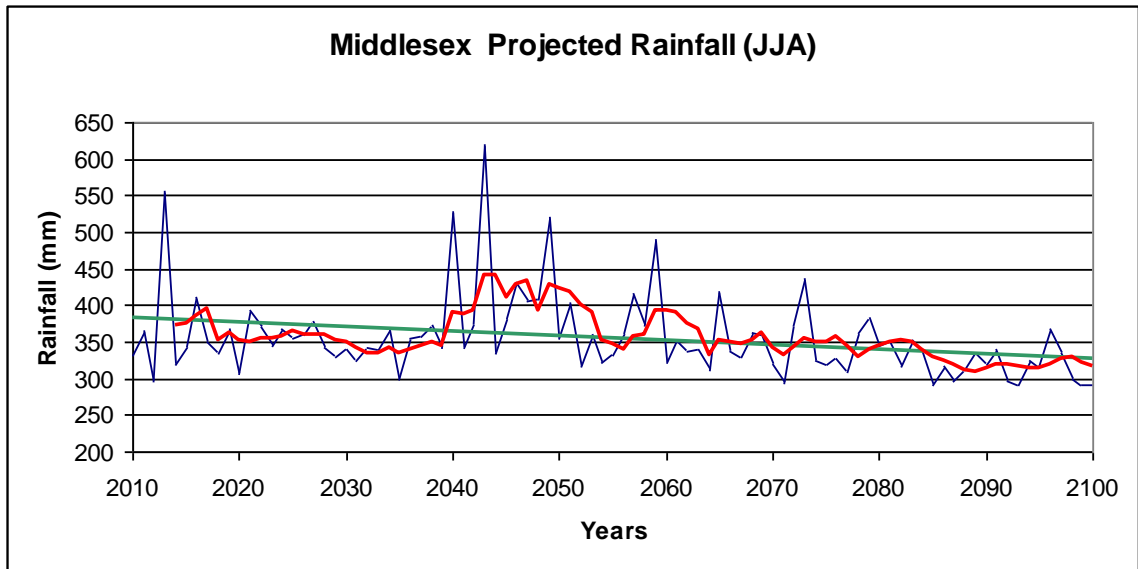


Figure 36. Model projections of rainfall, linear trend (green) and five-year moving average (red) at Middlesex for JJA.

- i. Trend analysis depicts about 50 mm decrease in precipitation.

SON

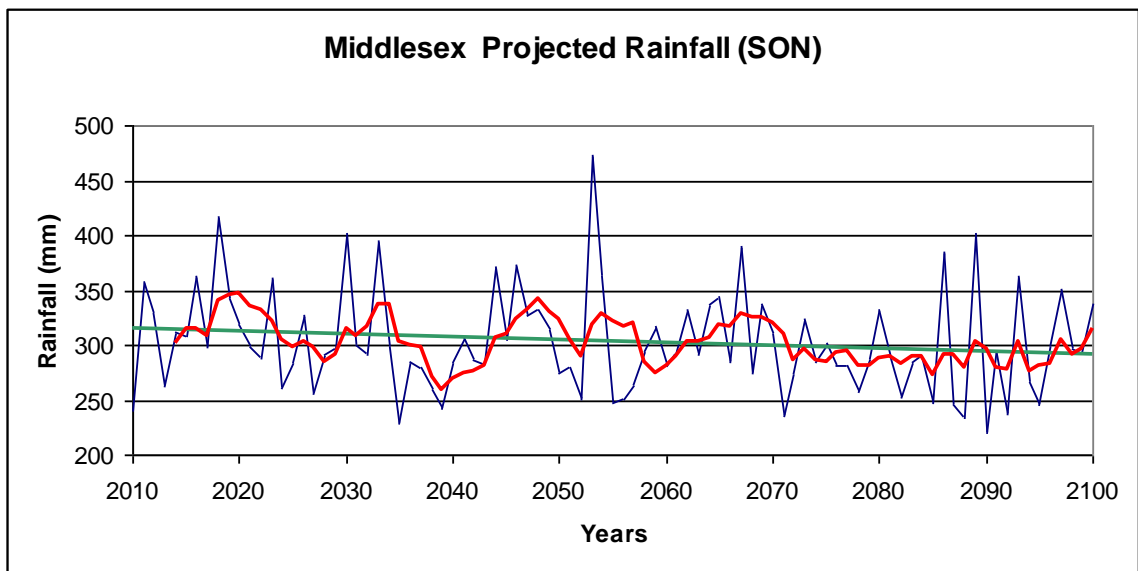


Figure 37. Model projections of rainfall, linear trend (green) and five-year moving average (red) at Middlesex for SON.

- i. Approximately 25 mm decrease in rainfall is projected for the SON quarter.

Table 7. Seasonal and decadal projections of total and average rainfall (mm)

	Averages	DJF	MAM	JJA	SON
91 yr	2662.4	140.0	153.8	356.0	302.2
2010's	2728.4	152.7	87.5	367.8	323.4
2020's	2689.6	147.3	103.6	353.3	298.2
2030's	2629.1	152.0	88.5	344.4	298.2
2040's	3004.0	145.1	116.9	434.9	318.6
2050's	2702.6	148.1	247.5	373.2	301.4
2060's	2714.1	136.2	266.0	347.3	316.5
2070's	2567.0	149.2	158.7	344.8	283.7
2080's	2504.8	115.5	103.6	325.5	296.1
2090's	2451.7	113.2	96.1	318.1	286.8

Table 8. Seasonal averages and projected changes in average temperatures

	Average	Projection	Change [%]
DJF	154.2(40)	140.0	-14.2 [-9.2 %]
MAM	96.7 (40)	153.8	+57.1 [+59.0 %]
JJA	363.8 (40)	356	-7.8 [-2.1 %]
SON	304.6 (40)	302.2	-4.4 [-0.9 %]
Yearly	2758.1 (40)	2662.4	-95.7 [-3.5 %]

Numbers in () depict years of data

Numbers in [] indicate percentage change.

SUMMARY and OBSERVATIONS

The most significant change is projected to occur in the MAM (dry season) where some 59% increase in rainfall could occur. A wetter dry season is being projected through the end of the century at Middlesex.

Towards the year 2100 the monthly rainfall distribution is projected to shift with the bulk of the precipitation occurring during the latter part of the year.

MIDDLESEX

(latitude 17.0 °N, longitude 88.5 °W, elevation 120 meters)

Temperature

Trends in temperature could not be determined as a consistent block of reliable data was unavailable.

Average monthly

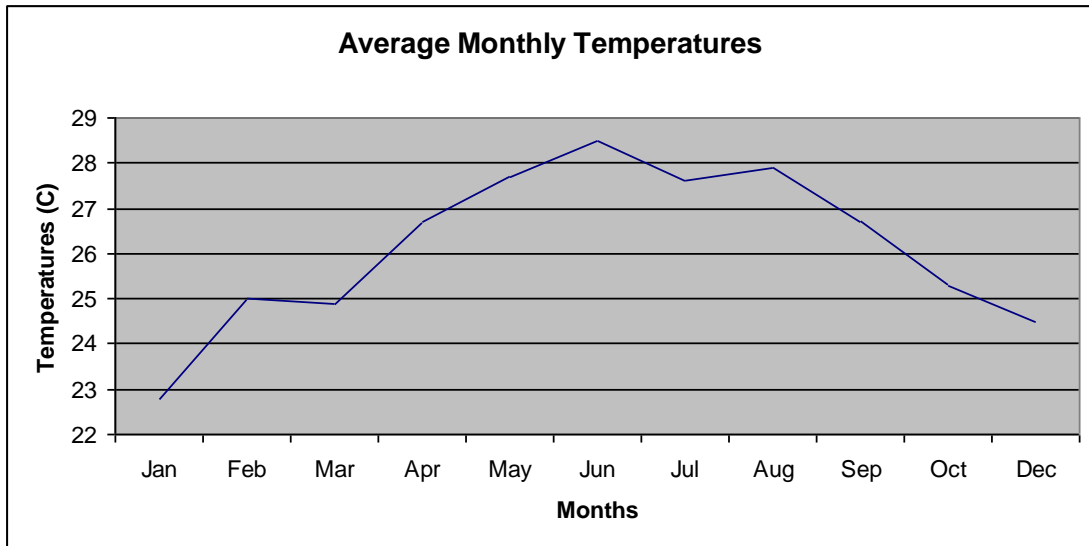


Figure 38. Average monthly rainfall at Middlesex

Rainfall

Data in the section covers the period 1966 to 2001 with 1975, 1981, 1986, 1987, 1988, 1990, 1991, 1993, 1996 and 1999 either missing or deleted.

Annual totals

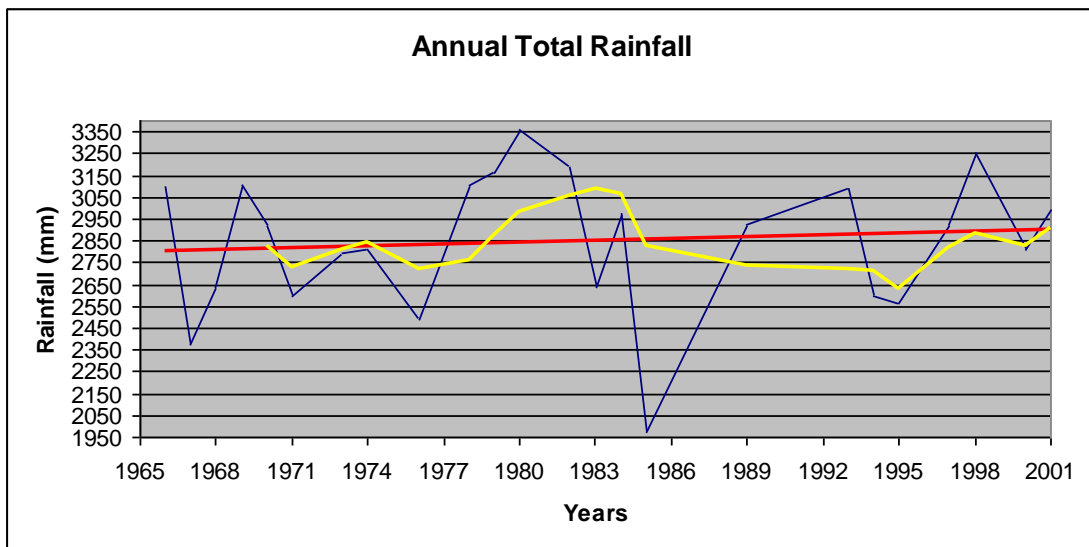


Figure 39. Annual total rainfall. Linear trend (red). Five-year moving average (yellow)

- i. Linear trend analysis indicates about 95 to 100 mm increase in annual total rainfall.

Average monthly

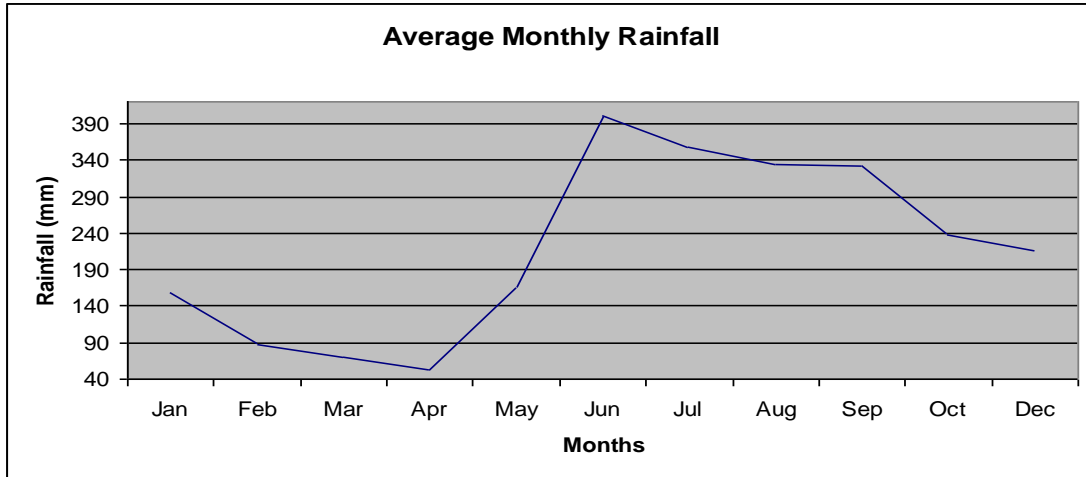


Figure 40. Average monthly rainfall

PROJECTION

Temperature

Yearly Average

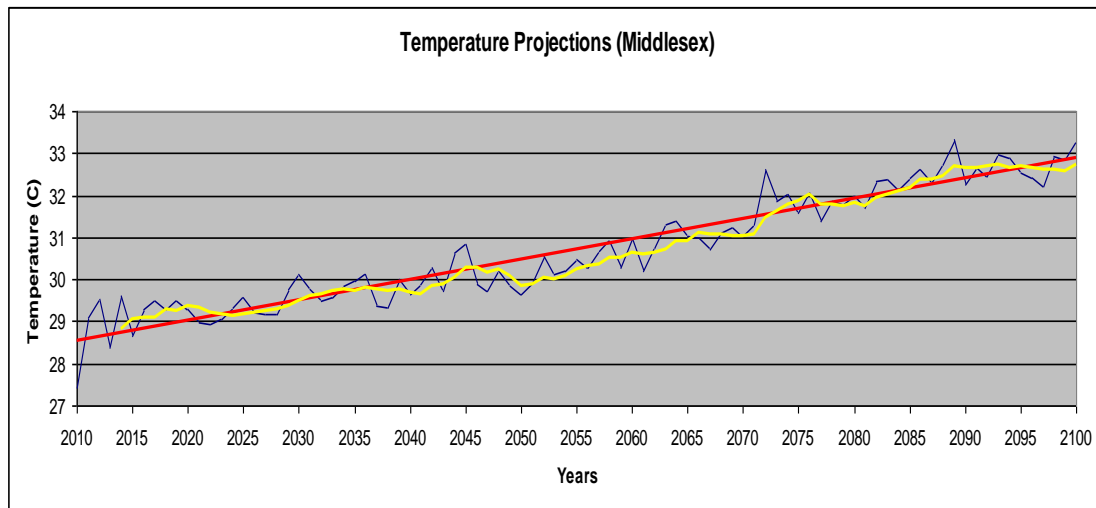


Figure 41. Yearly average temperature projections

Monthly average
2040

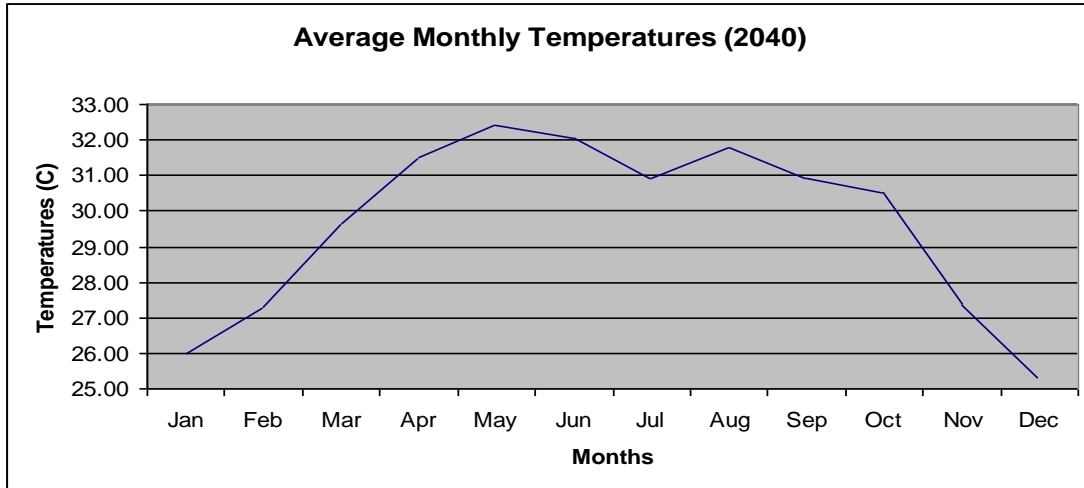


Figure 42. projected average monthly temperatures for the year 2040

2070

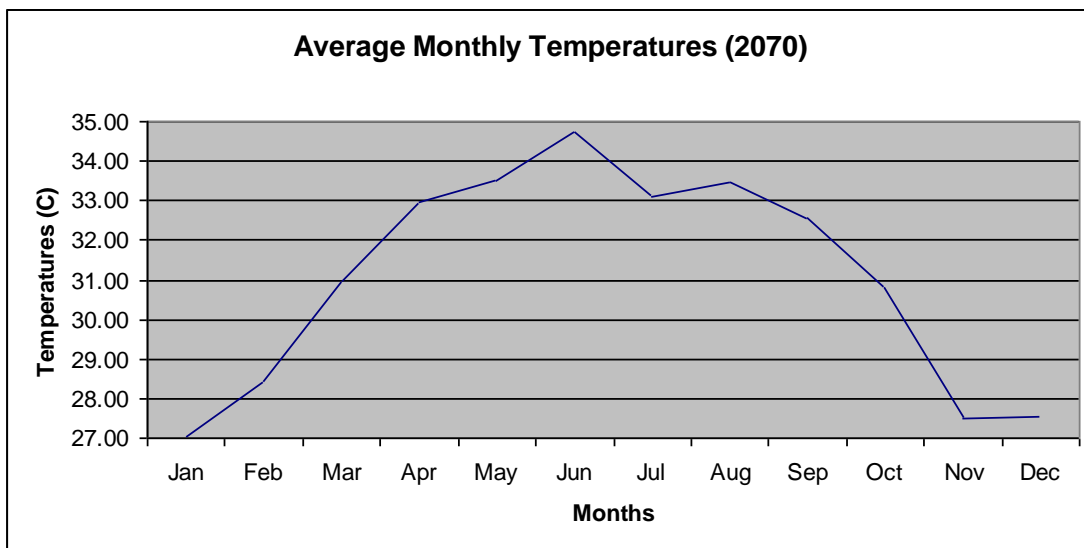


Figure 43. Projected average monthly temperatures for the year 2070

2099

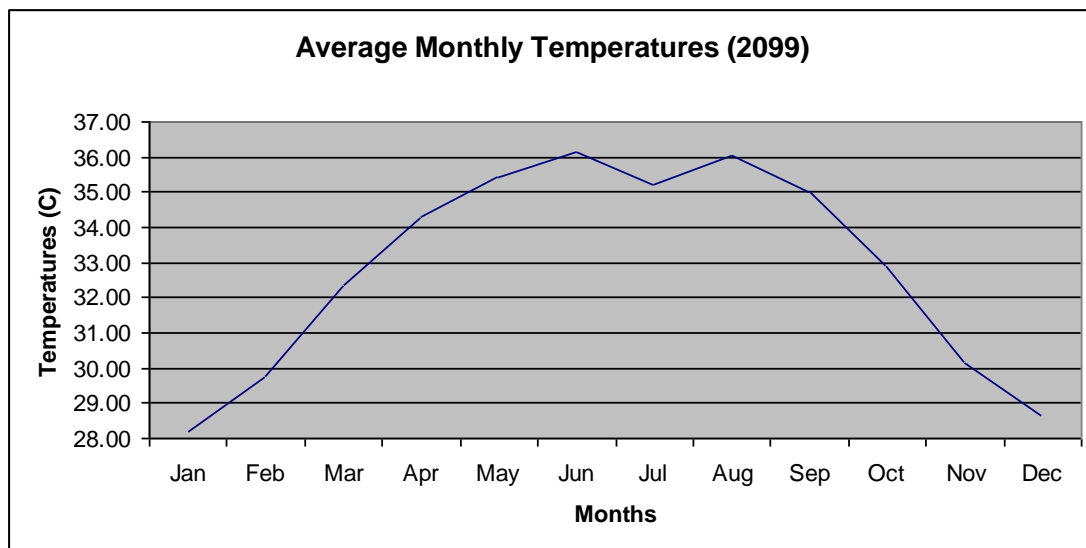


Figure 44. Projected average monthly temperatures for the year 2099

DJF

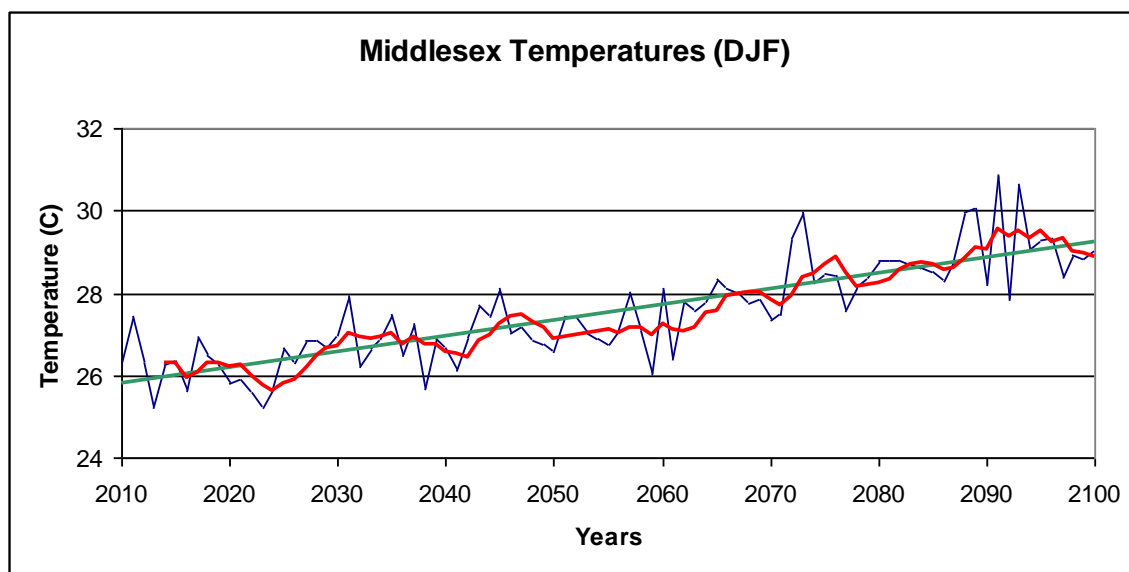


Figure 45. Projected temperature changes, linear trend (green) and five-year moving average at Middlesex for DJF

- i. An increase of 2.6 °C is projected for the DJF period.

MAM

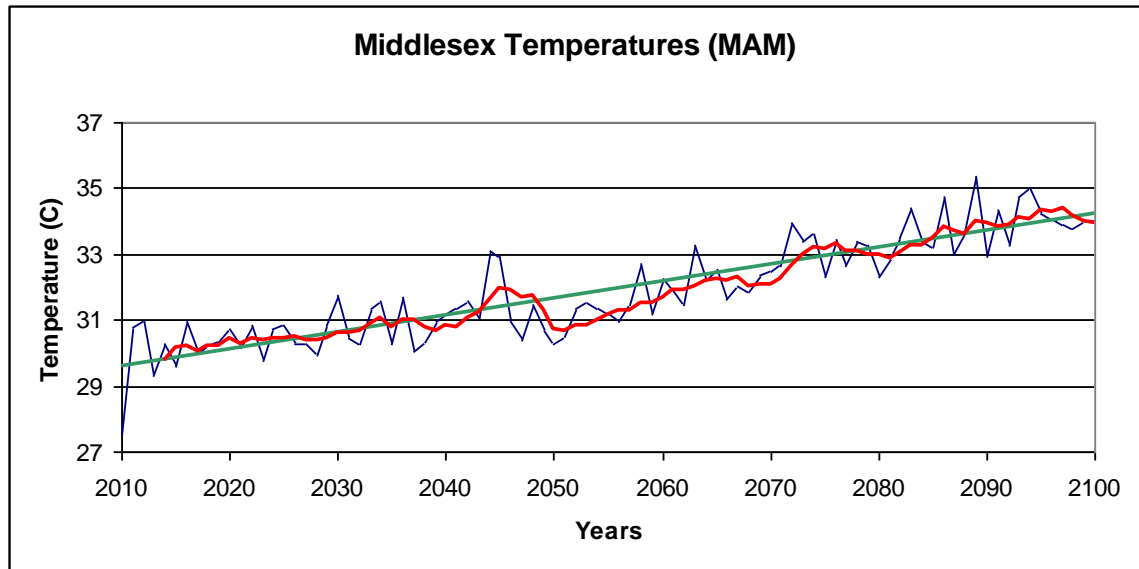


Figure 46. Projected temperature changes, linear trend (green) and five-year moving average at Middlesex for MAM.

- i. The linear trend shows an increase of 4.6 °C for the MAM period.

JJA

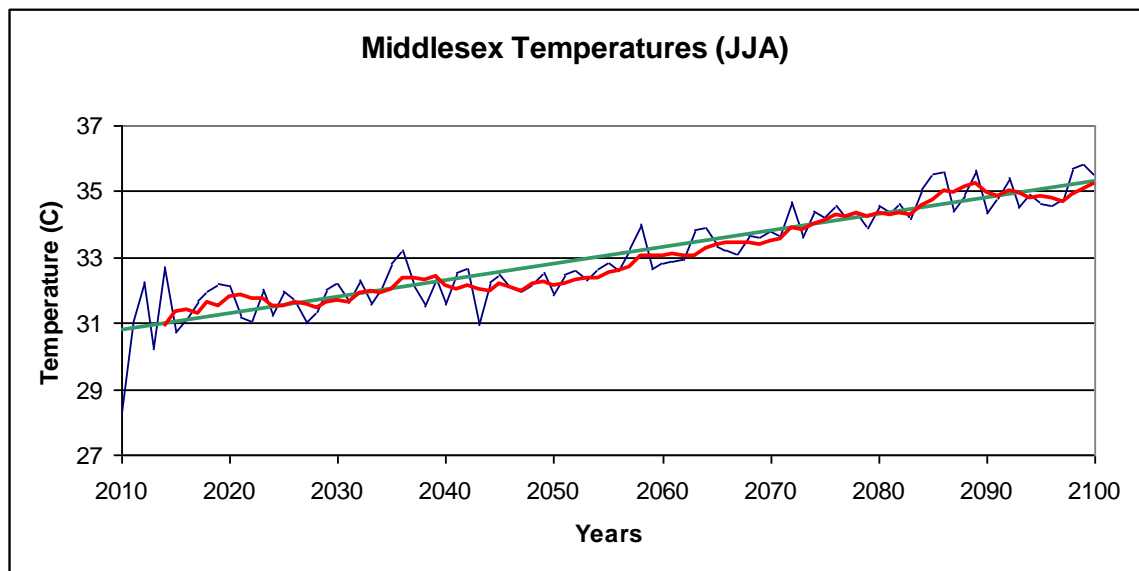


Figure 47. Projected temperature changes, linear trend (green) and five-year moving average at Middlesex for JJA.

- i. The linear trend analysis indicates an increase of 4.2 °C for the JJA quarter.

SON

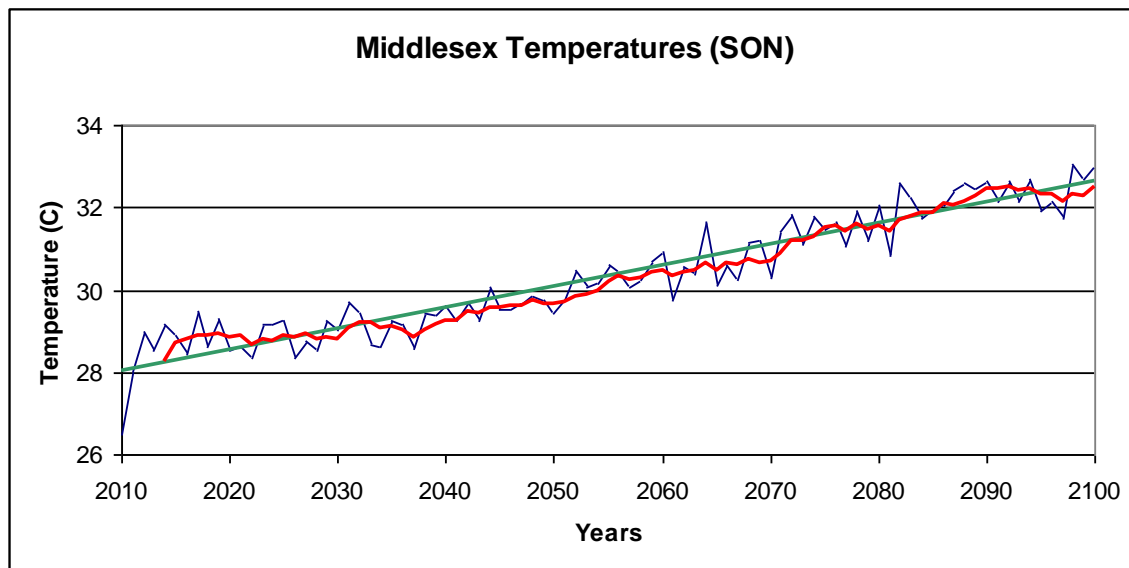


Figure 48. Projected temperature changes, linear trend (green) and five-year moving average at Middlesex for SON

- i. A 4.5 °C increase in average temperatures is projected for this SON period.

Table 9. Seasonal and decadal projections of average temperatures.

	Averages	DJF	MAM	JJA	SON
91 yr	30.7	27.5	31.9	33.0	30.3
2010's	29.0	26.3	30.0	31.2	28.6
2020's	29.2	26.1	30.4	31.6	28.8
2030's	29.8	26.8	30.9	32.1	29.1
2040's	30.1	27.1	31.5	32.1	29.6
2050's	30.3	27.0	31.2	32.7	30.2
2060's	31.0	27.7	32.1	33.3	30.7
2070's	31.7	28.3	33.1	34.1	31.4
2080's	32.4	28.9	33.6	34.9	32.1
2090's	32.6	29.1	34.0	34.9	32.4

Table 10. Seasonal averages and projected changes in average temperatures

	Average	Projection	Change [%]
DJF	23.8 (15)	27.5	+3.7 [+13.4 %]
MAM	26.4 (15)	31.9	+5.5 [+17.2 %]
JJA	28.1 (15)	33.0	+4.9 [+14.8 %]
SON	26.6 (15)	30.3	+3.7 [+12.2 %]
Yearly	24.2 (15)	30.7	+6.5 [+21.2 %]

Numbers in () depict years of data

Numbers in [] indicate percentage change.

SUMMARY and OBSERVATIONS

Maximum temperatures occur in June and the minimum in January at this station. The sampled years (2040, 2070 and 2099) reveal that only in 2040 was there a change in the warmest and coolest months to May and December respectively.

Rainfall

Yearly Total

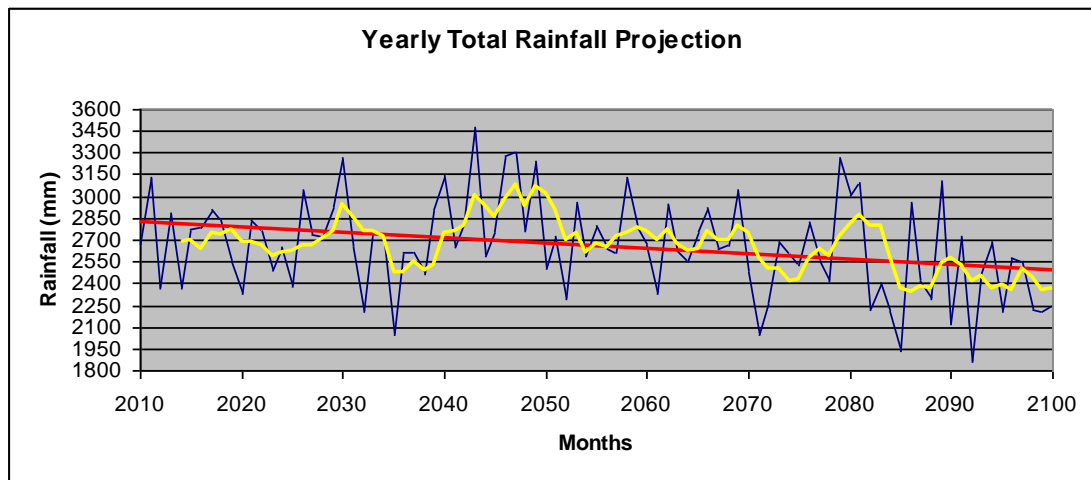


Figure 49. Yearly total rainfall projection. Linear trend (red). Five-year moving average (yellow)

- i. Linear trend shows some 320 mm decrease in total yearly rainfall.

2040

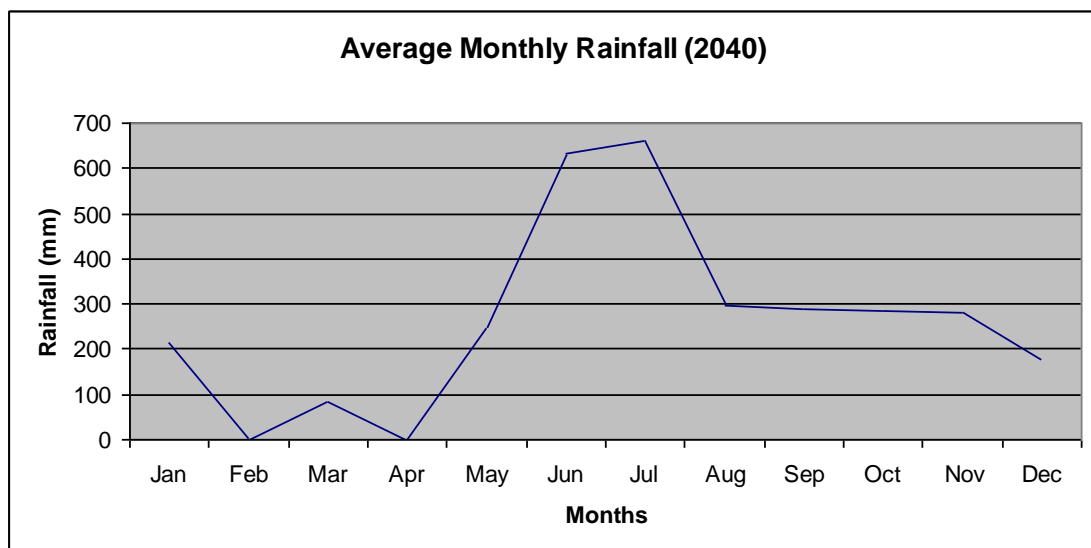


Figure 50. Monthly average rainfall for the year 2040

2070

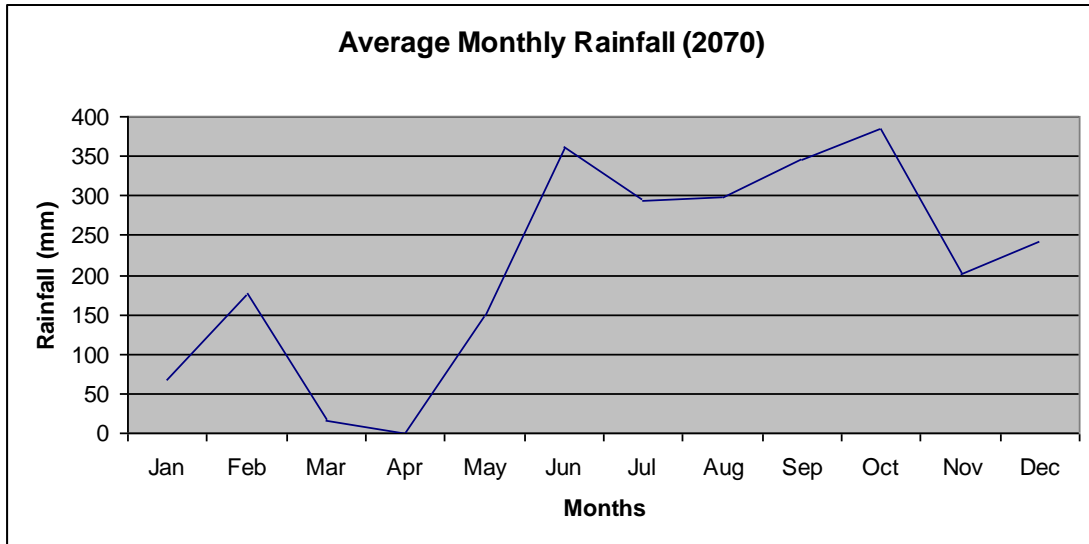


Figure 51. Monthly average rainfall for the year 2070

2099

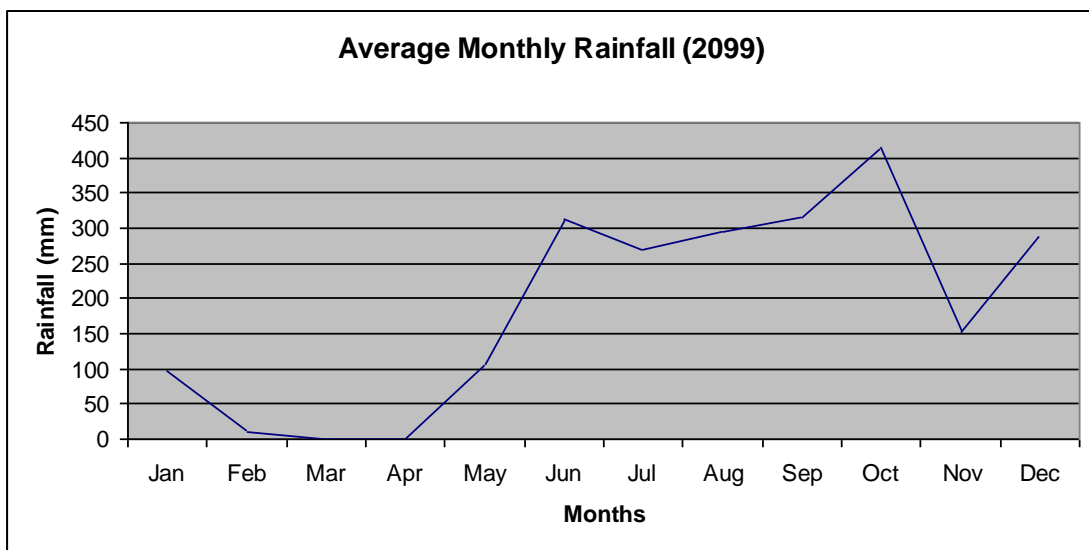


Figure 52. Monthly average rainfall for the year 2099

DJF

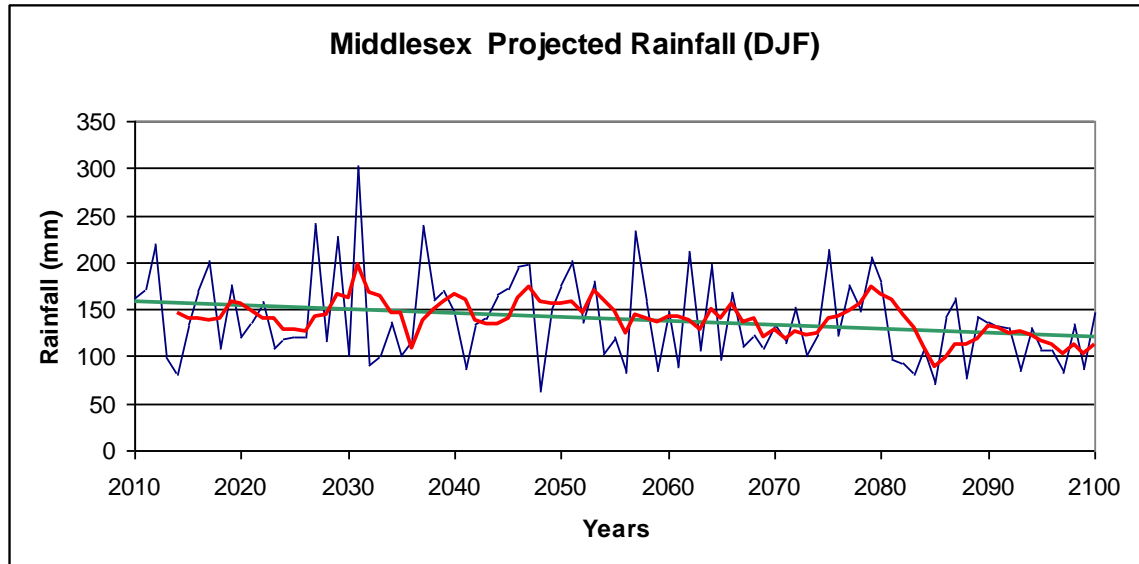


Figure 53. Model projections of rainfall, linear trend (green) and five-year moving average (red) at Middlesex for DJF.

- i. Projection shows about 30 mm decrease in rainfall for DJF at Middlesex.

MAM

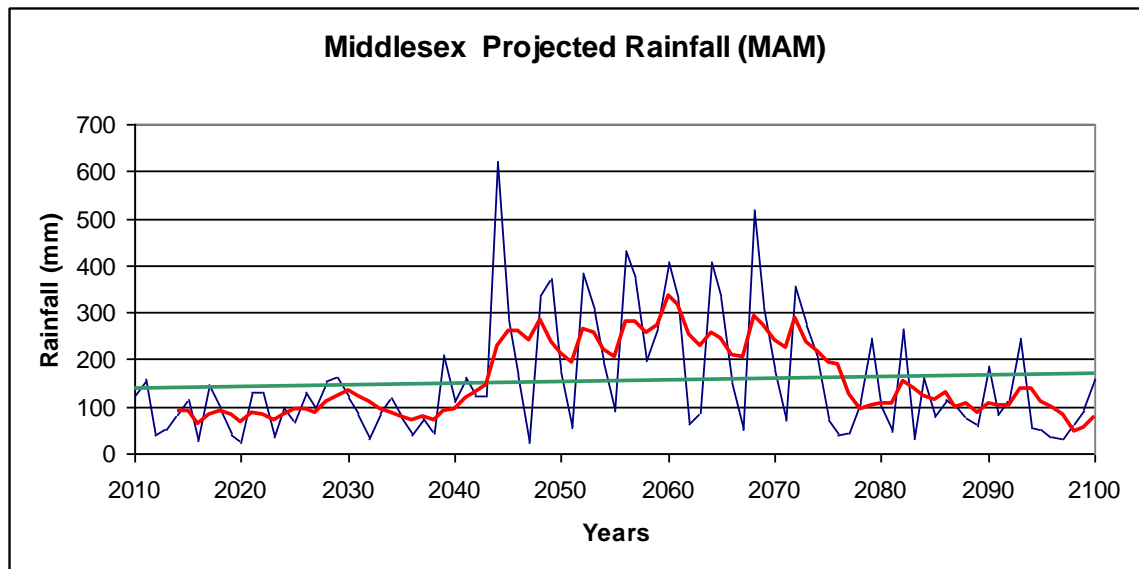


Figure 54. Model projections of rainfall, linear trend (green) and five-year moving average (red) at Middlesex for MAM.

- i. Projection shows a slight increasing of about 30mm in precipitation.

JJA

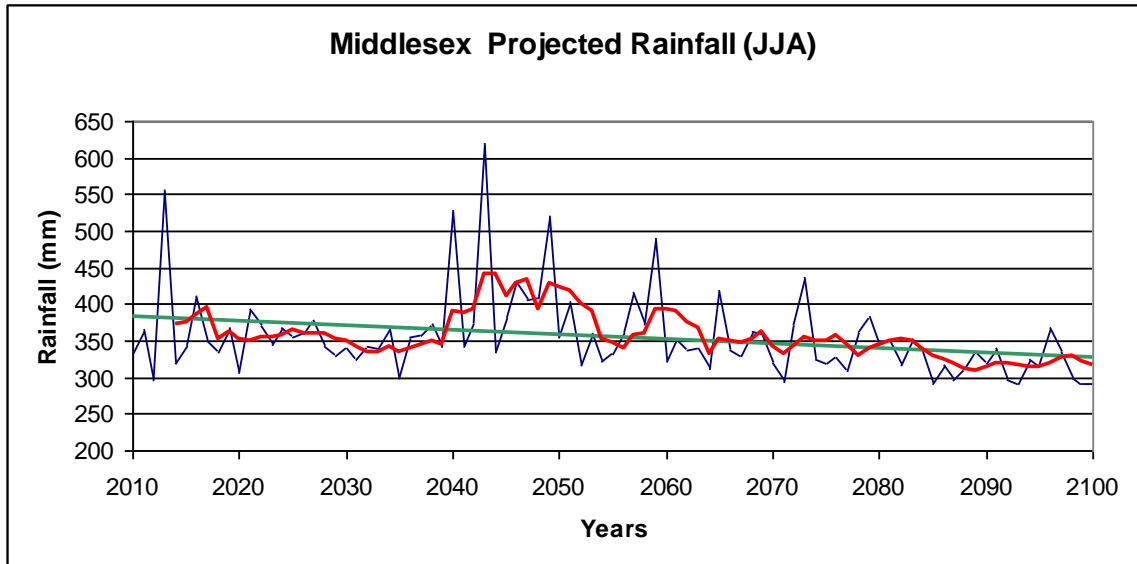


Figure 55. Model projections of rainfall, linear trend (green) and five-year moving average (red) at Middlesex for JJA.

- i. Trend analysis depicts about 50 mm decrease in precipitation.

SON

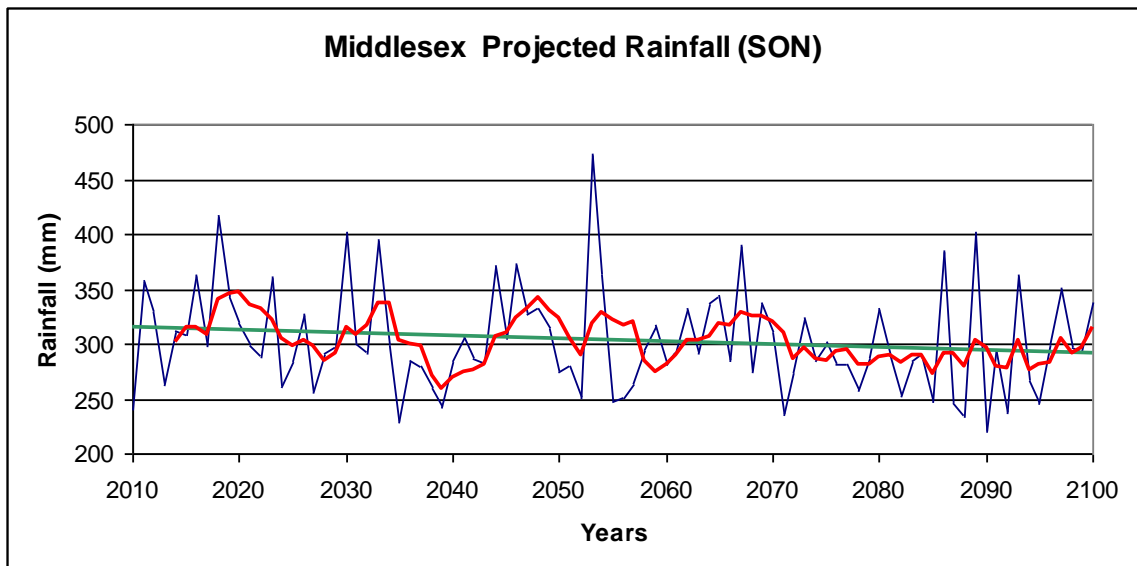


Figure 56. Model projections of rainfall, linear trend (green) and five-year moving average (red) at Middlesex for SON.

- i. Approximately 25 mm decrease in rainfall is projected for the SON quarter.

Table 11. Seasonal and decadal projections of total and average rainfall (mm)

	Averages	DJF	MAM	JJA	SON
91 yr	2662.4	140.0	153.8	356.0	302.2
2010's	2728.4	152.7	87.5	367.8	323.4
2020's	2689.6	147.3	103.6	353.3	298.2
2030's	2629.1	152.0	88.5	344.4	298.2
2040's	3004.0	145.1	116.9	434.9	318.6
2050's	2702.6	148.1	247.5	373.2	301.4
2060's	2714.1	136.2	266.0	347.3	316.5
2070's	2567.0	149.2	158.7	344.8	283.7
2080's	2504.8	115.5	103.6	325.5	296.1
2090's	2451.7	113.2	96.1	318.1	286.8

Table 12. Seasonal averages and projected changes in average temperatures

	Average	Projection	Change [%]
DJF	154.2(40)	140.0	-14.2 [-9.2 %]
MAM	96.7 (40)	153.8	+57.1 [+59.0 %]
JJA	363.8 (40)	356	-7.8 [-2.1 %]
SON	304.6 (40)	302.2	-4.4 [-0.9 %]
Yearly	2758.1 (40)	2662.4	-95.7 [-3.5 %]

Numbers in () depict years of data

Numbers in [] indicate percentage change.

SUMMARY and OBSERVATIONS

The most significant change is projected to occur in the MAM (dry season) where some 59% increase in rainfall could occur. A wetter dry season is being projected through the end of the century at Middlesex.

Towards the year 2100 the monthly rainfall distribution is projected to shift with the bulk of the precipitation occurring during the latter part of the year.

3. MELINDA (MEL)

(latitude 17.0 °N, longitude 88.3 °W, elevation 30 meters)

All linear trends are indicated in red and 5-year moving averages by yellow.

TEMPERATURES

Average Temperatures

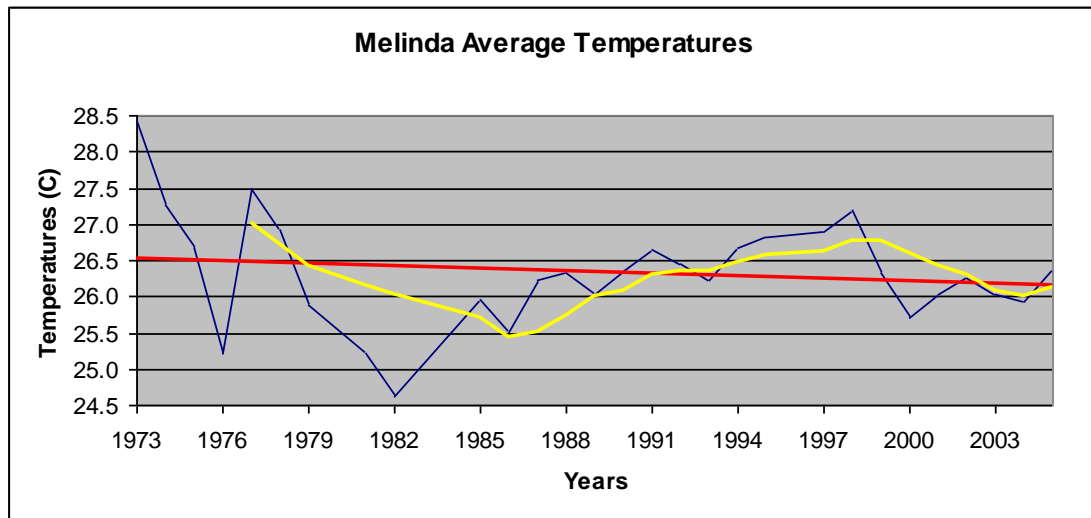


Figure 57. Time series of average temperatures at Melinda

- i. The data includes the years 1973 to 2005 with 1980, 1983, 1984 and 1996 missing or deleted.
- ii. Average temperature at Melinda was 26.3 °C.
- iii. The warmest year was 1973 with an average temperature of 28.4 °C.
- iv. 1982 was the coolest year with a temperature of 24.6 °C.
- v. There was a decrease in temperature of about 0.4 °C.

Average Monthly

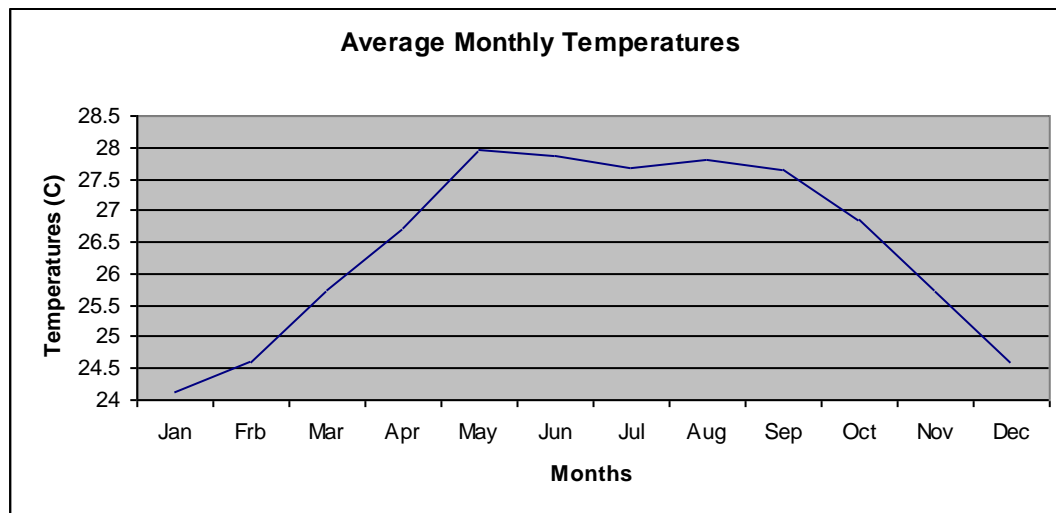


Figure 58. Average monthly temperatures at MEL

DJF

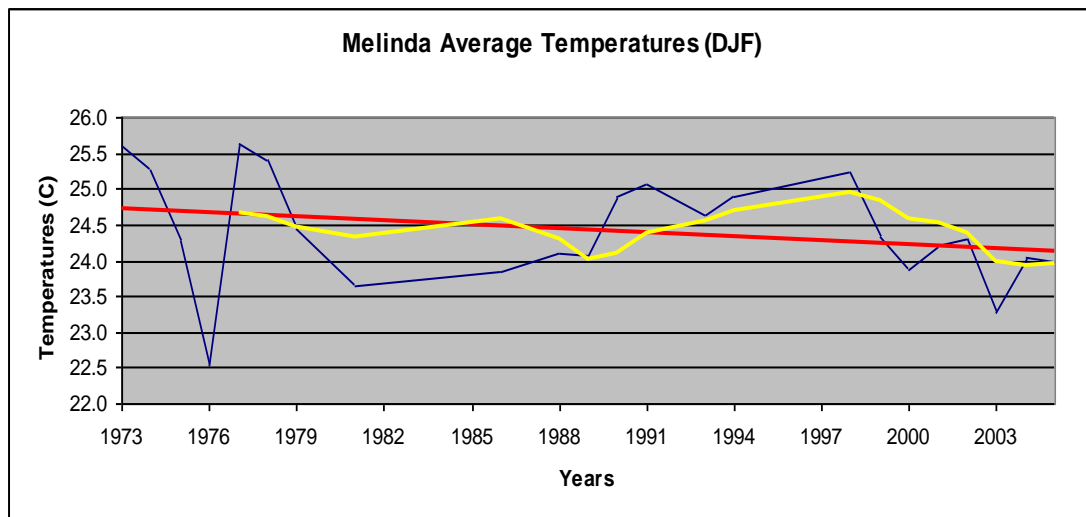


Figure 59. Average temperatures for DJF at MEL

- i. There is a 0.5 °C decrease in temperature for DJF.
- ii. The data used were from the period 1973 to 2005 with 1980, 1982, 1983, 1984, 1985, 1987, 1992, 1995, 1996 and 1997 either deleted or missing.
- iii. 1976 was the coolest year with a temperature of 22.5 °C.

MAM

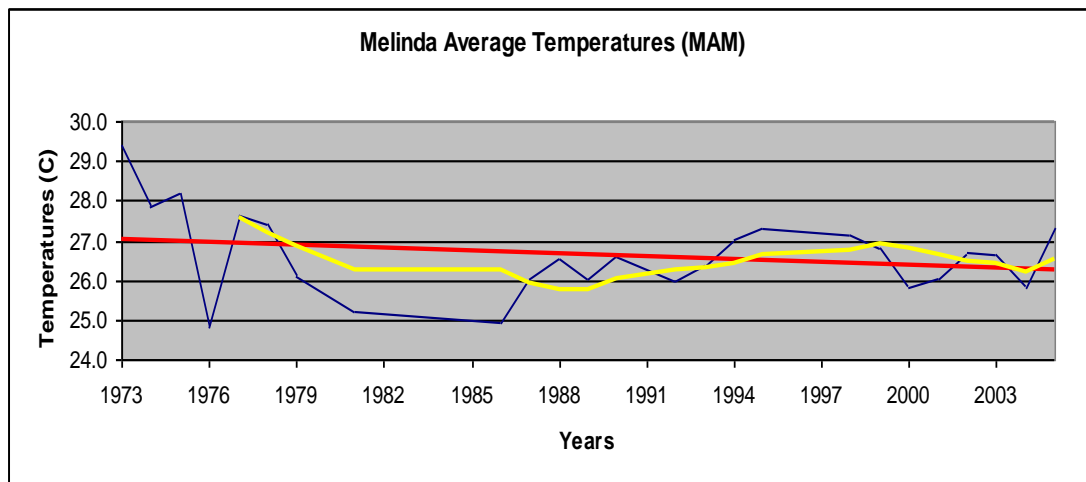


Figure 60. Average temperatures for MAM at Melinda

- i. The dataset was from 1973 to 2005 with 1980, 1982, 1983, 1984, 1985, 1991, 1996 and 1997 either deleted or missing.
- ii. Linear trend shows a 0.6 °C decrease in temperature for the MAM period.

JJA

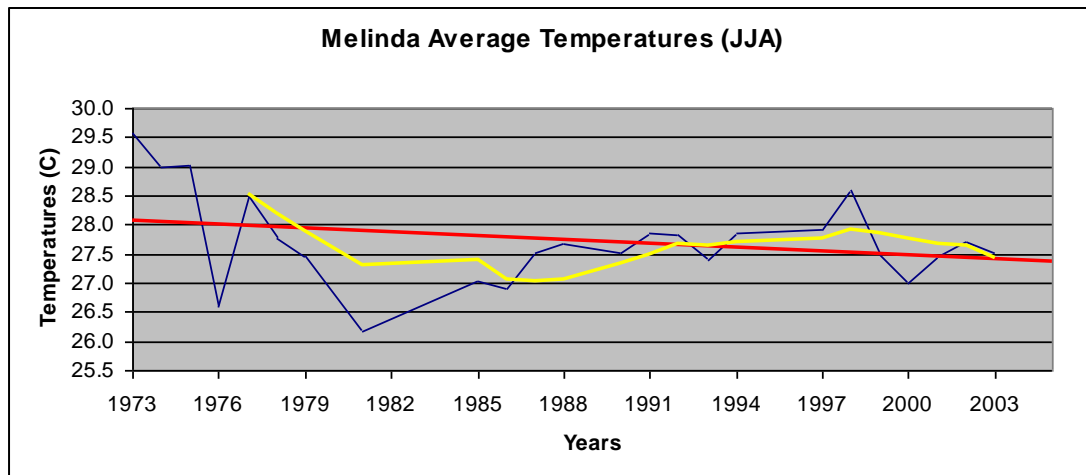


Figure 61. Average temperatures for JJA at Melinda

- i. The data used spanned the period 1973 to 2005 with 1980, 1982, 1983, 1984, 1989, 1995 and 1996 missing or deleted.
- ii. The trend indicates a 0.6 °C decrease in temperatures.

SON

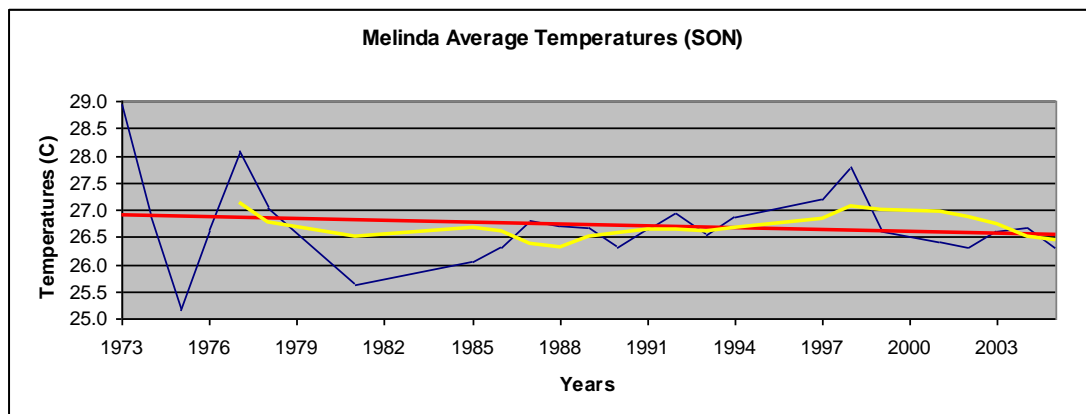


Figure 62. Average temperatures for SON at MEL

- i. The linear trend indicates a 0.4 °C decrease in temperature for the SON period.
- ii. The period ran from 1973 to 2005 with 1979, 1980, 1982, 1983, 1984, 1995, 1996 and 2000 missing or deleted.

Table 13 Seasonal and decadal temperature averages at Melinda

	DJF	MAM	JJA	SON
Averages	24.4	26.6	27.7	26.7
1970's	24.7	27.3	28.3	27.1
1980's	23.9	25.8	27.1	26.4
1990's	24.8	26.7	27.8	26.9
2000's	23.9	26.4	27.5	26.4
Maximums	25.6 (1977, 1997)	29.4 (1972)	29.6 (1973)	28.9 (1973)
Minimums	22.5 (1976)	24.8 (1976)	26.2 (1981)	25.2 (1975)

SUMMARY and OBSERVATIONS

With large segments of missing or deleted data some inaccuracies are inherent in the decadal averages in Table 1 above. Therefore any conclusions drawn from this data should be dealt with a degree of skepticism.

Rainfall

Annual Total

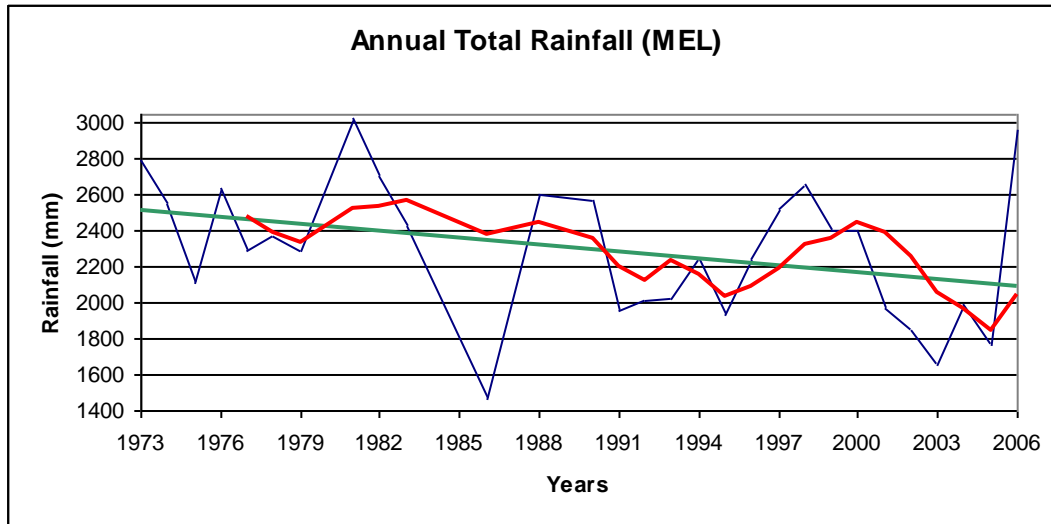


Figure 63. Annual total rainfall at MEL

- i. The period is from 1973 to 2006 with 1980, 1984, 1985, 1987 and 1989 missing or deleted.
- ii. Linear trend analysis shows a 420 mm decrease in rainfall

Average Monthly

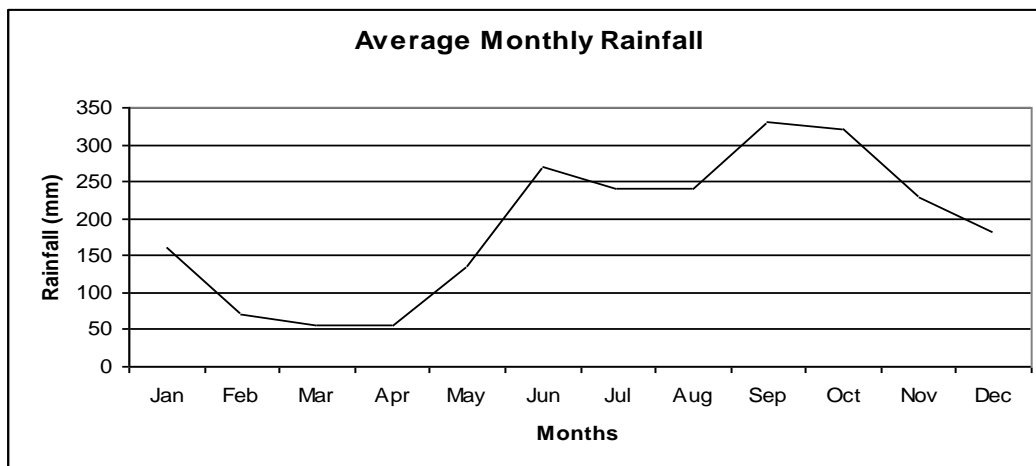


Figure 64. Average Monthly Rainfall at MEL

DJF

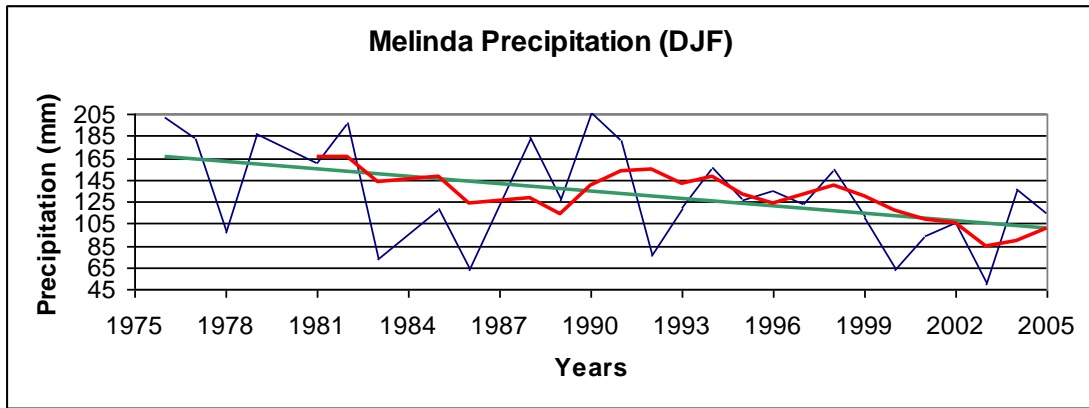


Figure 65. Yearly totals, five-year moving average (red) and linear trend (green) for DJF precipitation at Melinda

- i. 27 years formed the data set with 1980, 1984 and 1987 missing.
- ii. Trend shows decreasing precipitation. The linear tendency is for a decrease of 50 mm for DJF.
- iii. Average monthly precipitation = 131.3 mm.

MAM

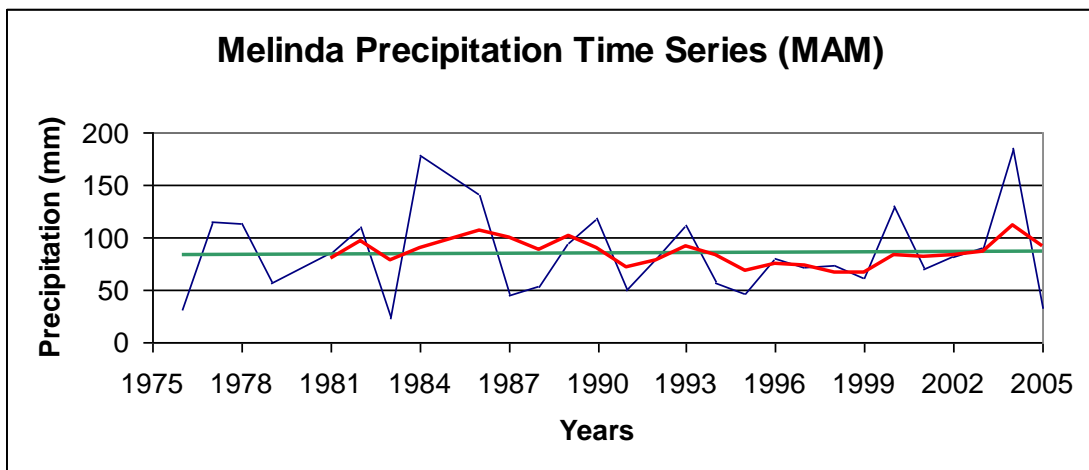


Figure 66. Yearly totals five-year moving average (red) and linear trend (green) for MAM precipitation at Melinda

- i. 28 years were used with 1980 and 1985 missing.
- ii. Trend was for no notable or significant changes during the MAM season.
- iii. Average monthly precipitation = 85.1 mm.

JJA

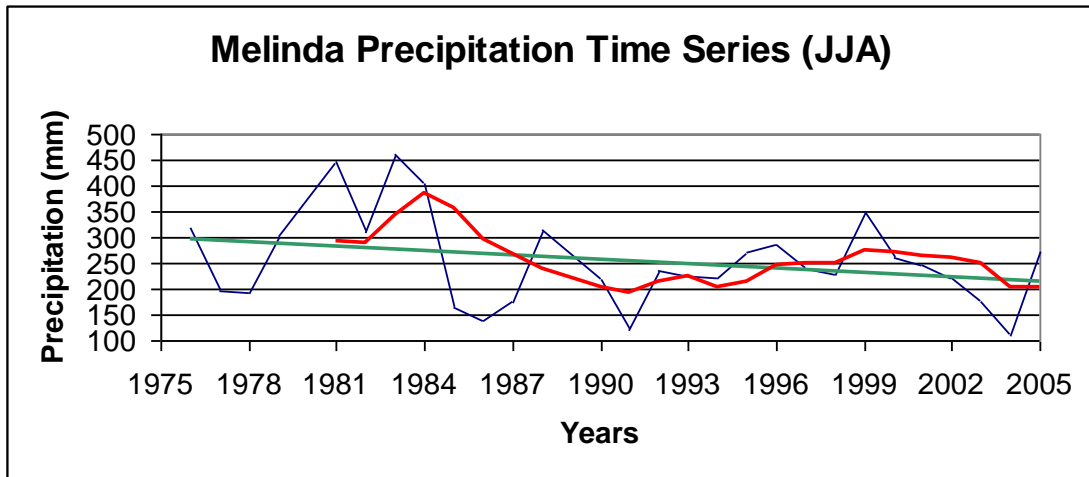


Figure 67. Yearly total, five-year moving average (red) and linear trend (green) for JJA precipitation at Melinda.

- i. This data set included 28 years with 1980 missing and 1989 deleted.
- ii. According to figure 16 the trend is for decreasing precipitation during the JJA season from approximately 890 mm to 640 mm.
- iii. Average monthly precipitation = 254 mm.

SON

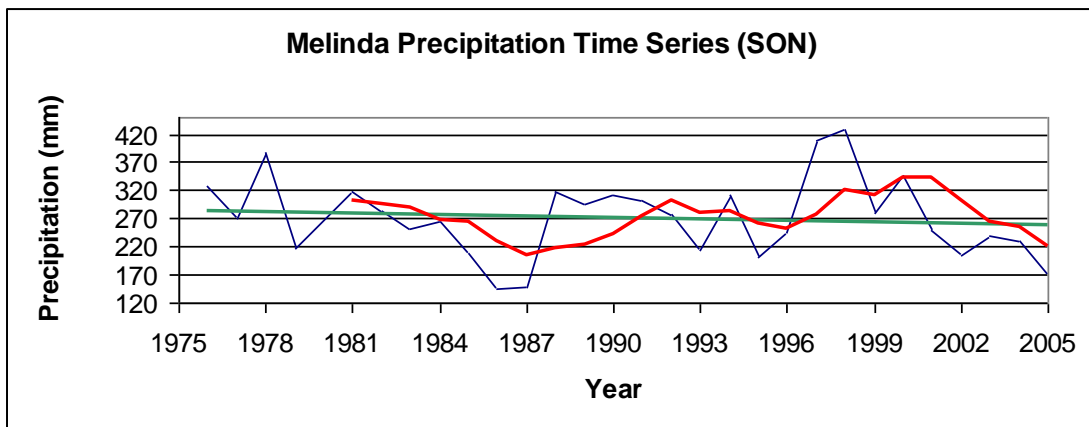


Figure 68 Yearly total, five-year moving average (red) and linear trend (green) for SON at Melinda

- i. 29 years data were used with 1980 missing
- ii. Trend shows a small decrease (20 mm) for SON.
- iii. Average monthly precipitation = 271.2 mm.
- iv. 60% of the 87 months showed negative anomalies.

Table 14. Seasonal and decadal average precipitation (mm)

	DJF	MAM	JJA	SON
Averages	131.3	85.1	254	271.2
1970's	-----	-----	---	-----
1980's	132.2	91.3	302	248
1990's	138.9	74.9	239.7	299
2000's	93.7	97.9	214.6	240.4
Maximum	206.3(1990)	178 (1984)	461.6 (1983)	428 (1998)
Minimum	50.1 (2003)	23.5 (1983)	109.8 (2004)	145.7 (1986)

SUMMARY and OBSERVATIONS

A large portion of the 1970's data was missing or deleted due to inaccuracies. Most of the other decades were not complete either. So conclusions to be drawn from this dataset would be somewhat suspect.

PROJECTIONS

Projection I

Temperature

Average Annual

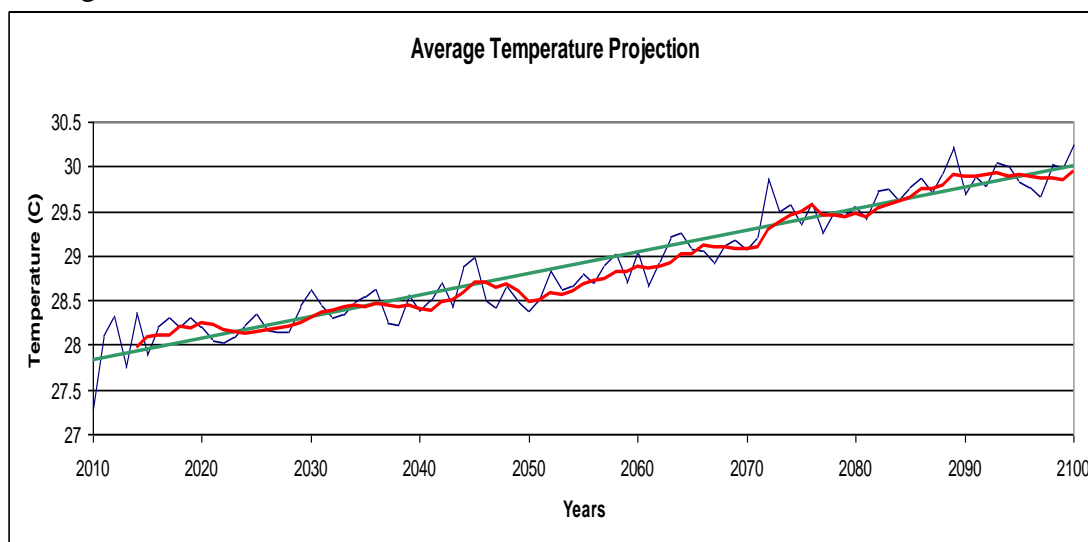


Figure 69. Average temperature projections. Linear trend (green). Five-year moving average (red)

- i. Trend indicates a 2.3 °C increase in average temperatures at Melinda.

2040

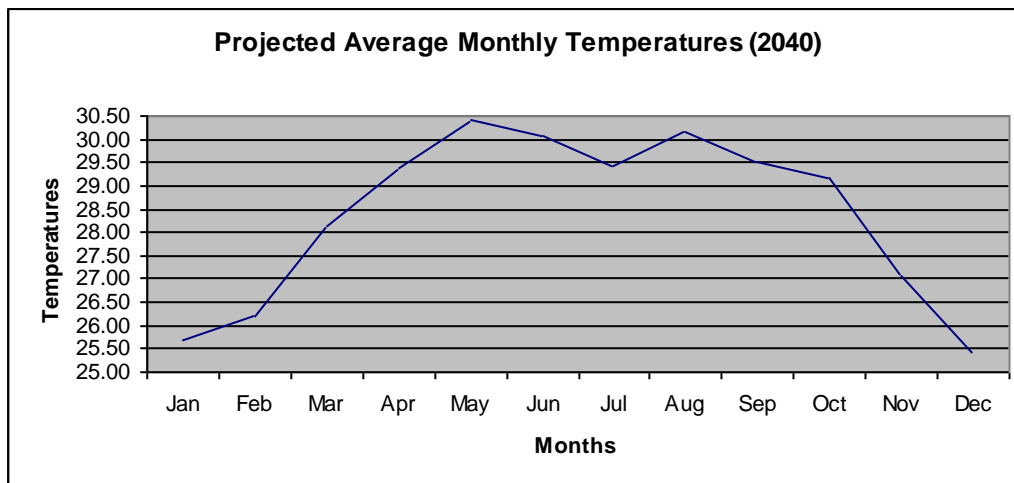


Figure 70. Projected average monthly temperatures for year 2040

2070

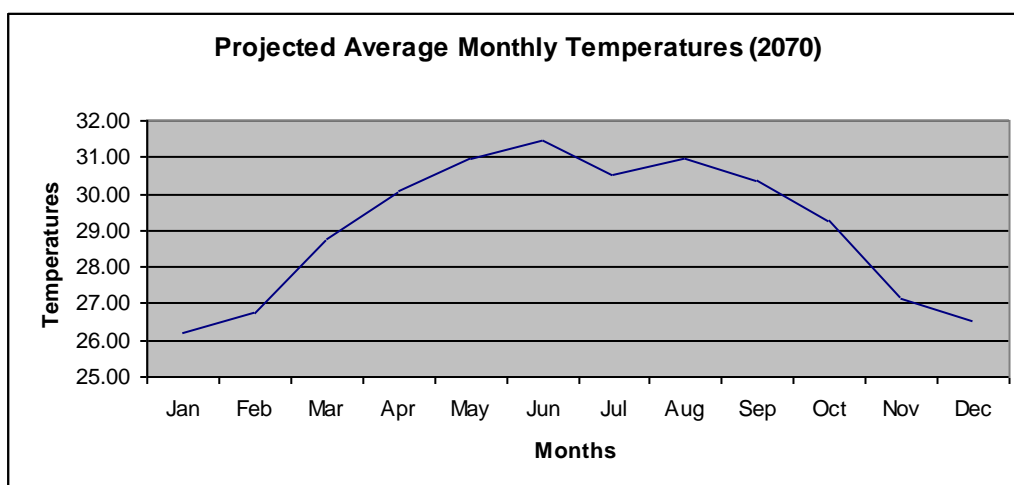


Figure 71. Projected average monthly temperatures for year 2070

2099

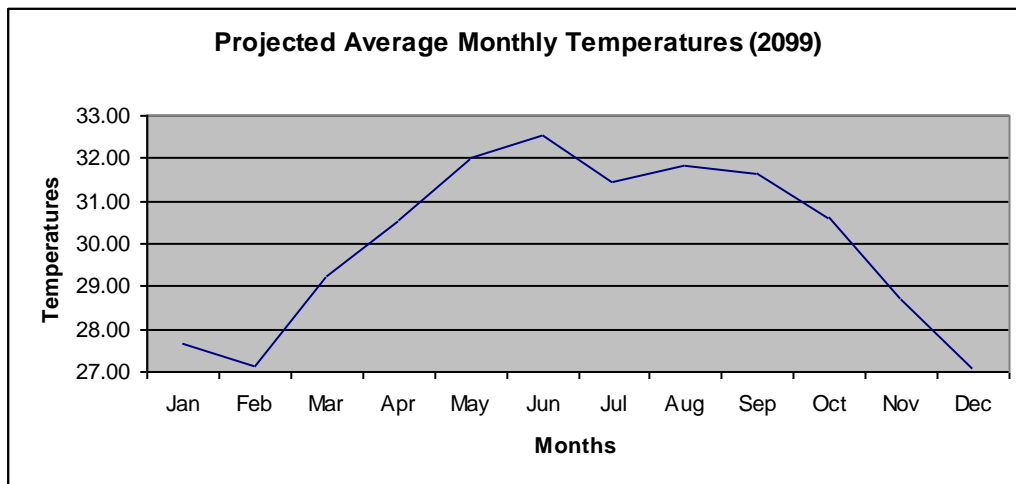


Figure 72. Projected average monthly temperatures for year 2099

DJF

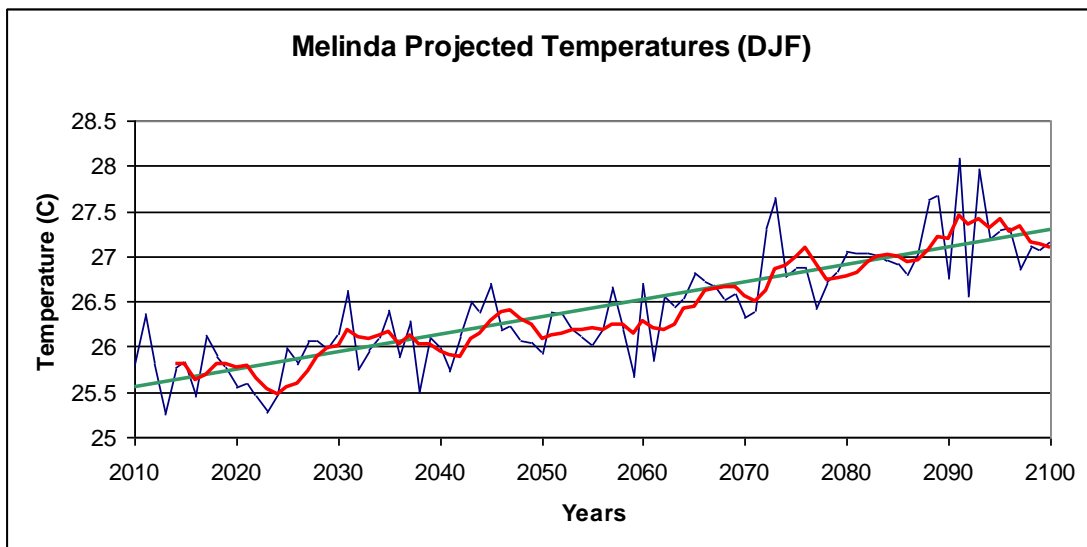


Figure 73. Temperature projections for DJF. Linear trend (green). Five year moving average (red)

i. Linear trend shows a 1.8 °C increase in temperatures for DJF at Melinda.

MAM

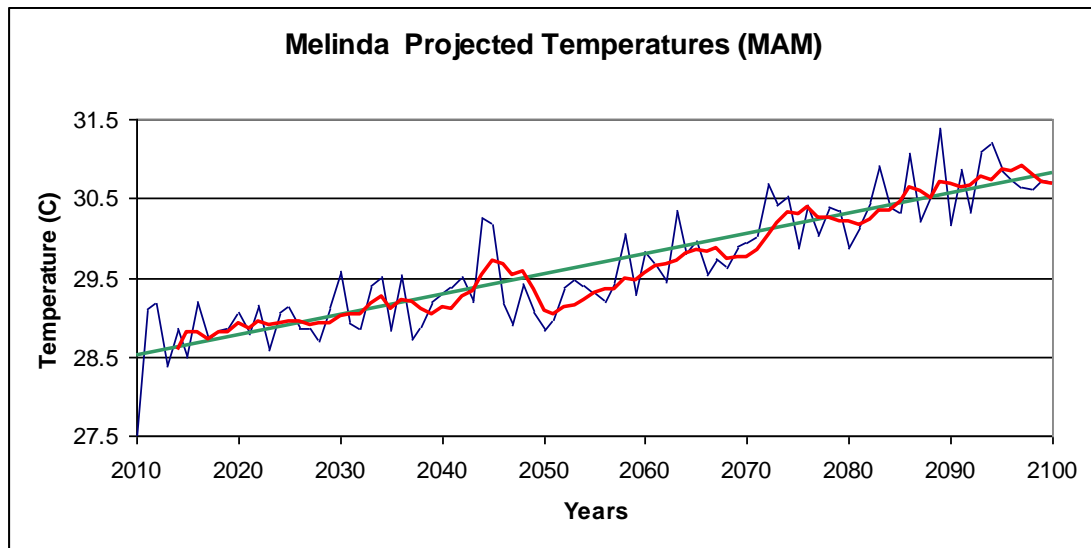


Figure 74. Temperature projections for MAM. Linear trend (green). Five year moving average (red)

- i. For the period 2010 to 2100 the projections are for an increase of 2.2 °C increase in temperature at Melinda for the MAM period.

JJA

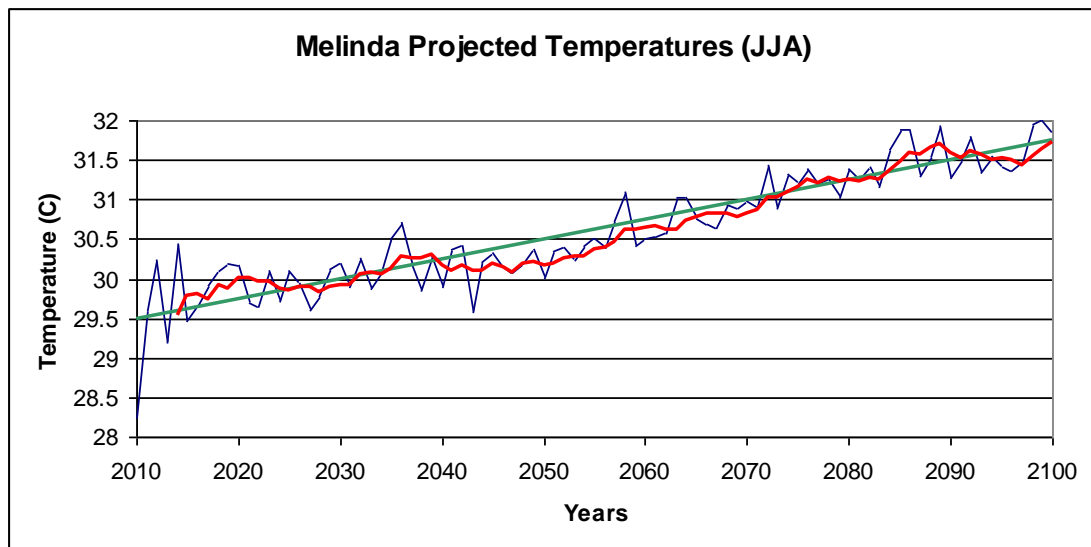


Figure 75. Temperature projections for JJA. Linear trend (green). Five year moving average (red)

- i. Linear trend shows a projection of 2.2 °C increase in temperatures for JJA.

SON

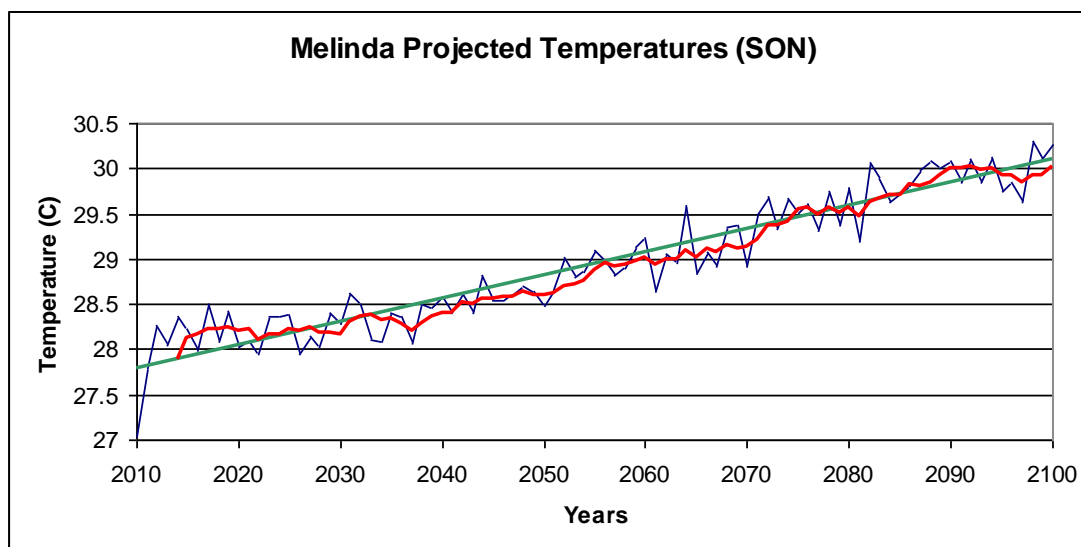


Figure 76. Temperature projections for SON. Linear trend (green). Five year moving average (red)

- i. A 2.2 °C increase in temperature is projected for SON at Melinda.

Table 15. Decadal and seasonal projections in temperature at Melinda.

	Average	DJF	MAM	JJA	SON
91-yr average	28.9	26.4	29.7	30.6	28.9
2010's	28.1	25.8	28.7	29.7	28.1
2020's	28.2	25.7	28.9	29.9	28.2
2030's	28.4	26.1	29.1	30.2	28.3
2040's	28.6	26.2	29.4	30.2	28.6
2050's	28.7	26.2	29.3	30.5	28.9
2060's	29.0	26.5	29.8	30.8	29.1
2070's	29.4	26.8	30.3	31.2	29.5
2080's	29.8	27.1	30.5	31.5	29.8
2090's	29.9	27.2	30.7	31.6	30.0

Table 16. Seasonal projections and change in seasonal temperatures at Melinda

	Average	Projection	Change
DJF	24.4 (23)	26.4	+2.0 [+7.8 %]
MAM	26.6 (25)	29.7	+3.3 [+10.4 %]
JJA	27.7 (30)	30.6	+2.3 [+9.5 %]
SON	26.7 (25)	28.9	+2.2 [+7.6 %]
Yearly Average	26.3 (31)	28.9	+2.6 [+9.9 %]

Numbers in () indicate years of data

Numbers in [] indicate % change between observations and projected change.

Summary and Observations

All projections show about 2 to 3 ° C increases in average temperatures. The largest increase of 10.4 % occurs during what is climatologically the warmest months (MAM).

Rainfall

Annual Total

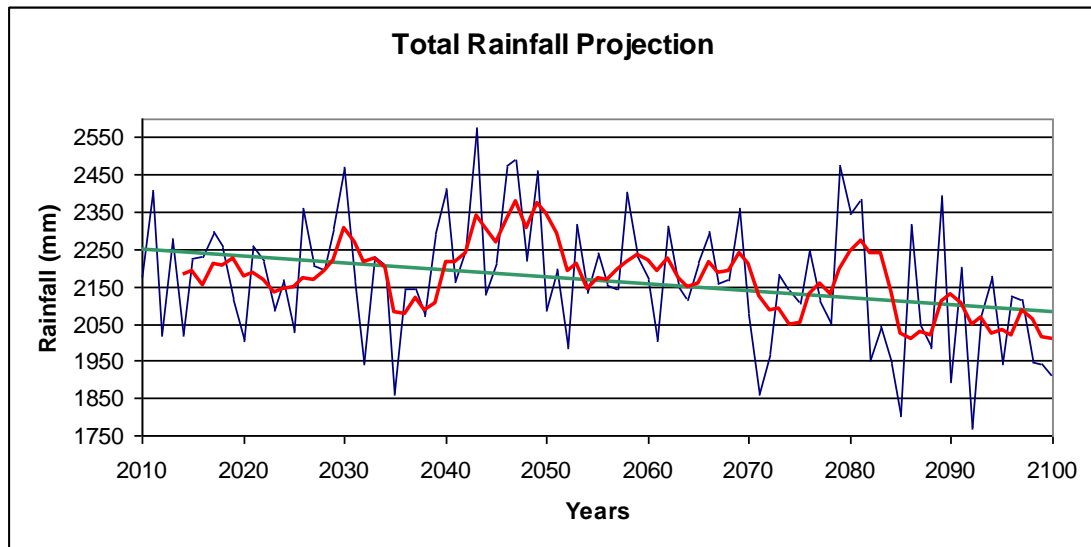


Figure 77. Projections of total yearly rainfall at Melinda. Linear trend (green). Five-year moving average (red)

- i. A decrease of 165 mm is projected in the yearly averages at Melinda.
- ii. The 2040's is the decade with the highest rainfall total.

2040

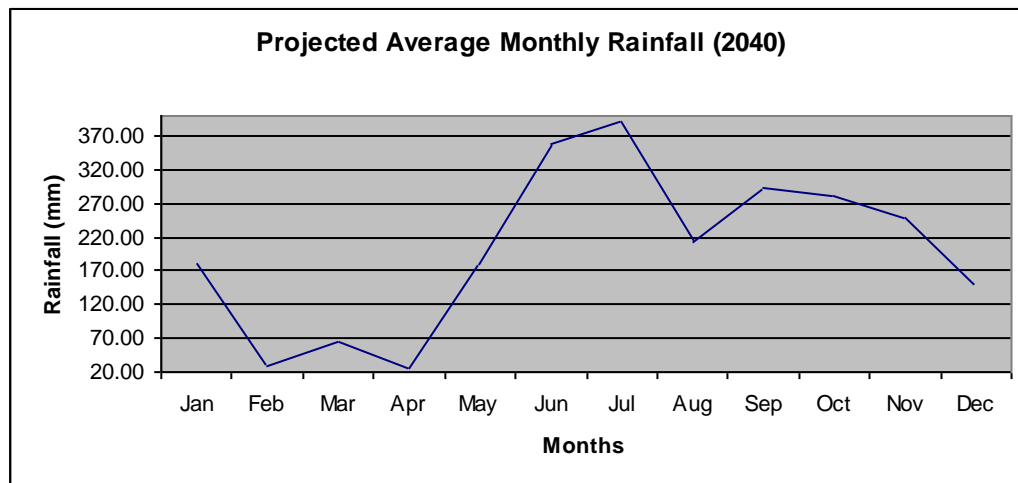


Figure 78. Projected monthly average rainfall for the year 2040

2070

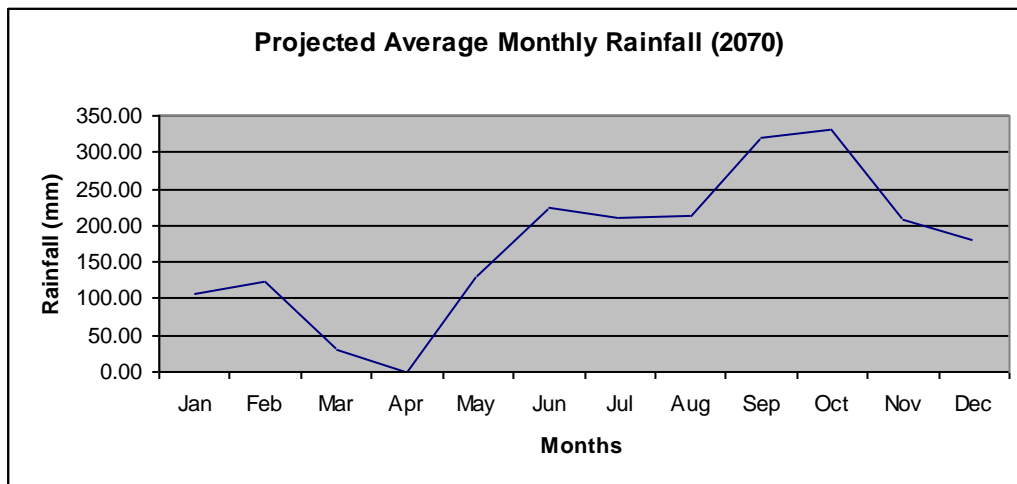


Figure 79. Projected average monthly rainfall for the year 2070.

2099

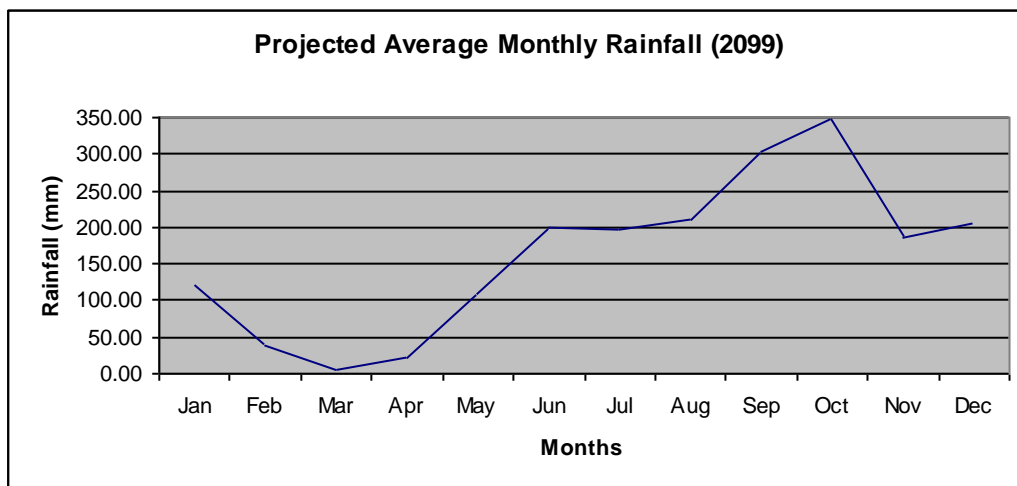


Figure 80. Projected average monthly rainfall for the year 2099

DJF

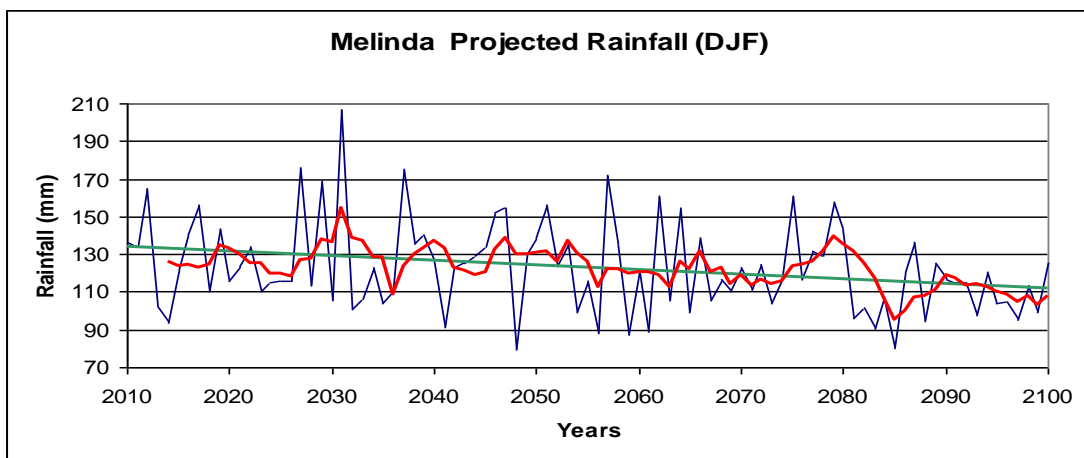


Figure 81 Model projections of rainfall, linear trend (green) and five-year moving average (red) at Melinda for DJF.

- i. Trend analysis depicts a decrease in precipitation of 20 mm for DJF at Melinda.
- ii. Seasonal average=122.9 mm

MAM

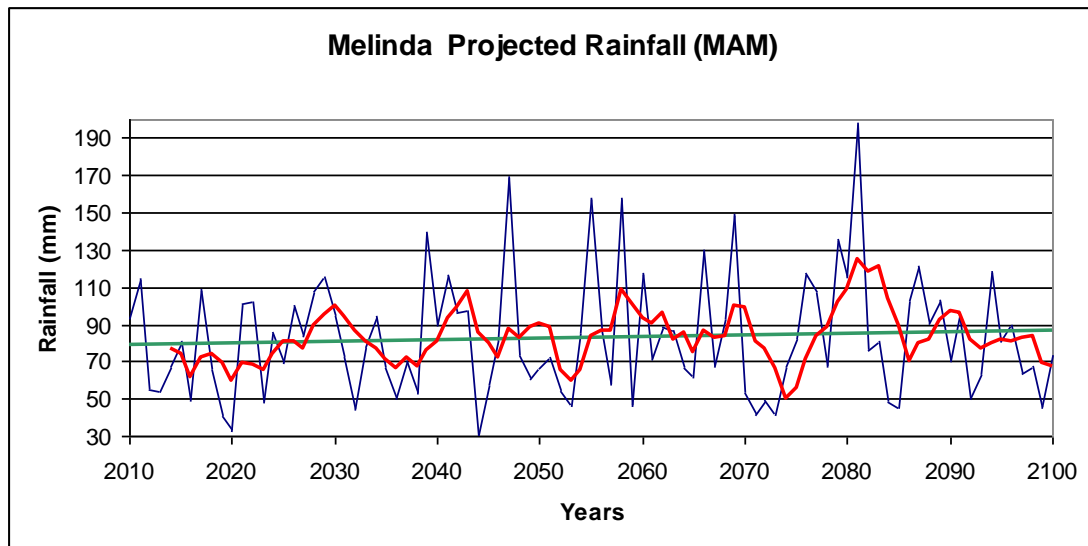


Figure 82. Model projections of rainfall, linear trend (green) and five-year moving average (red) at Melinda for MAM.

- i. Trend shows a slight increase of about 8 mm in rainfall.
- ii. Seasonal average=82.9 mm

JJA

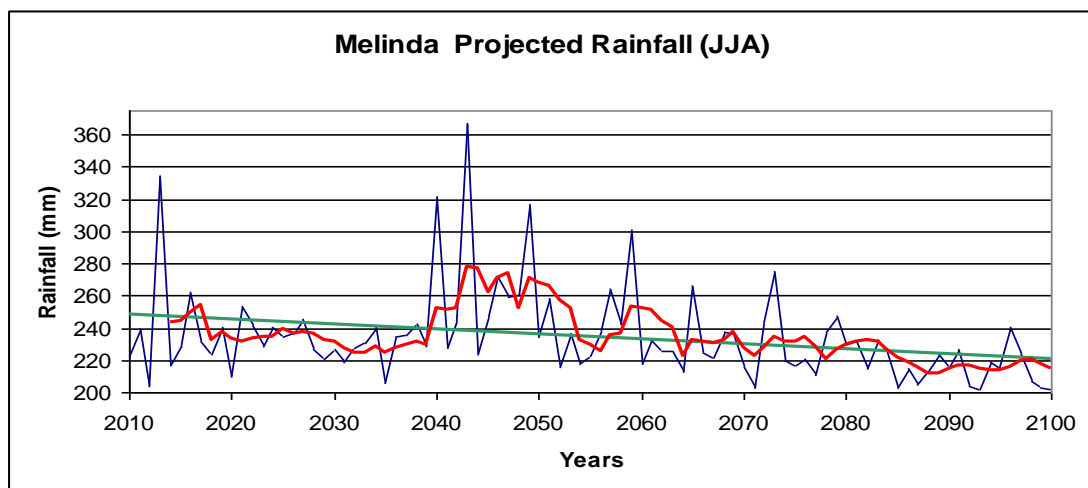


Figure 83. Model projections of rainfall, linear trend (green) and five-year moving average (red) at Melinda for JJA.

- i. There is a decreasing trend of about 30 mm in for the JJA season at Melinda.
- ii. Seasonal average=234.6 mm
- iii. The 2040's look to be the wettest .

SON

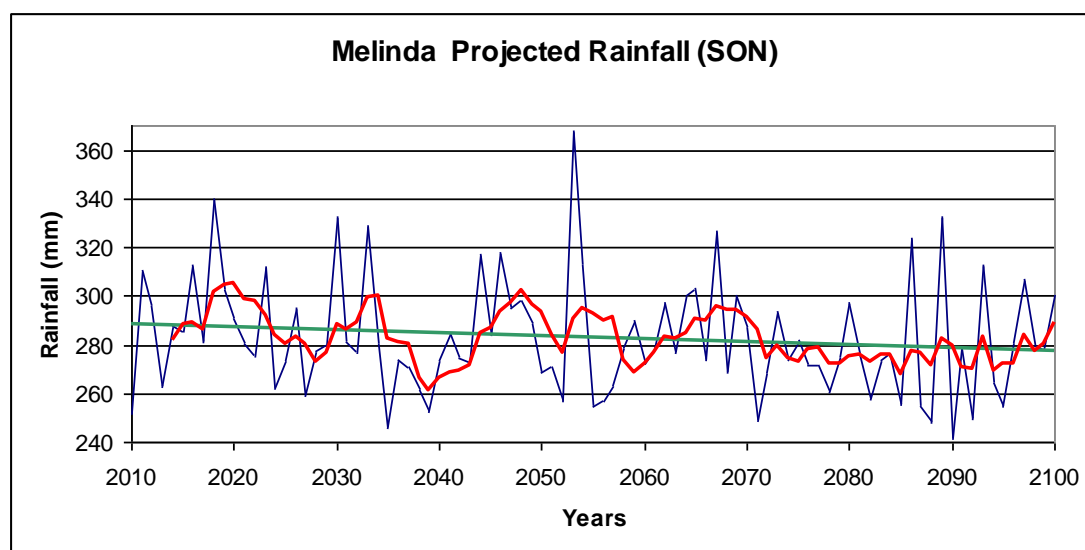


Figure 84. Model projections of rainfall, linear trend (green) and five-year moving average (red) at Melinda for SON.

- i. The projection is for an 11 mm decrease in precipitation for the SON season at Melinda.
- ii. Seasonal average= 282.9 mm

Table 17. Seasonal and decadal projections of total and average rainfall at Melinda.

	*Average	DJF	MAM	JJA	SON
91-yr average	2166.3	122.9	82.9	234.6	282.9
2010's	2202	130.4	73.0	240.4	293.1
2020's	2182.7	129.0	84.7	233.9	280.5
2030's	2153.5	130.8	76.4	229.1	280.5
2040's	2339.9	124.5	87.3	274	290.7
2050's	2189.2	125.3	83.2	243.2	282.1
2060's	2194.9	120.3	93.3	230.2	289.6
2070's	2121.4	127.7	76.3	229	273.3
2080's	2120.3	109.5	98.2	219.3	279.5
2090's	2018.8	108.2	74.5	215.6	274.8

Table 18. Projections and change in seasonal average precipitation at Melinda

	Average	Projection	Change
DJF	131.3 (27)	122.9	-8.4 [-6.4 %]
MAM	85.1 (28)	82.9	-2.2 [-2.6 %]
JJA	254 (28)	234.6	-19.4 [-7.6 %]
SON	271.2 (29)	282.9	+11.7 [+4.3 %]
Yearly Total	2319.5 (28)	2166.3	-153.2 [-6.6 %]

Numbers in () indicate years of data

Numbers in [] indicate % change between observed and projected change.

SUMMARY and OBSERVATIONS

From table 5 it can be noted that a shift in the rainfall pattern is projected. The SON period becomes the wettest with an average precipitation of 282.9 mm. The rainfall in the other seasons is projected to decrease while the SON period shows an increase..

Additional detailed analyses not in this document are available upon request.

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