

Example of Monthly Climate values for Minnipa

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The coloured table below shows monthly rainfall in mm for the 20 years at Minnipa 2000 to 2020. Each number is coloured by decile. We have had support from the RIG for this style of presentation. This approach has been used to convey warming. Using the ability of the human eye to immediately recognise patterns seems to be more effective than a time series graph, or at least complement a time series graph.

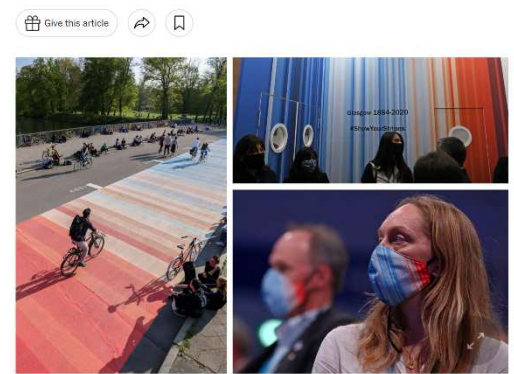
Preseason rain is sum of 1/3 of monthly rain above 20 mm in November, December, January and February and 1/2 of monthly rain above 20 mm in March (based on Minnipa Farming Systems book guidelines). The ranking of GSR, pre GSR +GSR and APSIM are from 1910 to 2022 (see next page for full period). In the ranking column only decile 2 (pink) and decile 1 (red) are coloured. The driest 5th percentile (1 in 20) is shown with a box around the red background.

APSIM simulated yield. A generic soil was used with PAWC of 80mm and 3.75% surface clay content (sandy soil). Soil water and soil nitrogen are reset each year on 1st Jan to 0mm and 50kg N as nitrate respectively. Wyalkatchem is sown using a variable rule of 20mm over 7 days between 20th Apr and 30th June, with forced sowing on 30th June if rule is not met. Nitrogen is supplied unlimited to crop growth.

The ranking for preGSR +GSR shows the single season, 2, 3, 4, and 5-year seasons.

In the example below, the 107mm of GSR in 2006 was the second driest on record (the driest was 101 mm in 1959). In 2008, 146mm was the 11th driest in the record and taking the preseason rainfall into account made it the 10th driest. The pair of years 2007 and 2008 was the 4th driest, but taking into account the preceding the 3, 4 and 5 years were the driest on record.

The New York Times
The surprising story of 'warming stripes'
One of the most popular ways to visualize rising temperatures is a simple graphic known as warming stripes. Here's the backstory.



Clockwise from left: Warming stripes on the Saxon Bridge in Leipzig, Germany; on the walls at the COP26 climate change conference in Glasgow; and on face masks at the conference. Jan Woitas/picture alliance via Getty Images; Paul Ellis/Agence France-Presse — Getty Images

1	146	162
2	185	186
3	202	209
4	222	230
5	234	245
6	253	261
7	270	284
8	294	310
9	335	343
10	492	503

MINNIPA													GSR (Apr-Oct)	GSR	PreSeasonRain	PSR + GSR	PSR + GSR	2Year	3Year	4Year	5Year	YIELD	
ENSO	IOD	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(mm)	RANK	(mm)	(mm)	RANK	RANK	RANK	RANK	RANK

L		2000	15	12	15	15	30	48	51	76	36	56	38	17	312	90	0	312	89	66	67	49	55	85
		2001	6	18	12	1	42	46	31	57	74	26	21	31	277	80	6	283	76	92	72	73	59	77
E		2002	6	0	2	7	46	54	55	28	11	17	27	24	216	42	4	220	38	59	77	59	58	44
		2003	13	34	0	15	22	34	24	74	12	24	16	9	206	35	9	214	35	29	44	63	44	72
		2004	5	6	13	18	15	46	40	79	29	2	23	13	230	52	0	230	44	32	22	36	49	31
		2005	8	5	1	7	11	81	31	37	62	31	27	23	260	73	1	261	65	51	38	28	38	69
E	Ip	2006	36	16	56	16	21	23	42	3	1	0	24	12	107	2	27	134	5	16	16	9	4	11
L		2007	16	0	73	44	27	14	24	11	8	10	20	50	136	7	28	164	12	1	5	3	3	53
L		2008	2	15	3	25	20	11	40	42	7	1	20	60	146	11	10	156	10	4	1	1	1	4
E		2009	0	1	70	27	36	83	97	29	36	8	18	4	316	92	39	355	103	61	25	6	6	74
E	Ip	2010	12	16	15	9	63	35	28	56	63	82	6	29	334	98	0	334	95	105	84	52	25	101
L		2011	0	51	69	13	34	37	47	61	40	37	11	19	268	76	38	306	85	98	103	91	69	96
	Ip	2012	29	18	17	21	34	68	28	22	16	6	2	2	194	27	3	197	26	58	81	96	76	84
		2013	4	28	28	27	28	48	70	42	23	6	18	16	244	62	7	251	58	34	56	78	95	43
	In	2014	27	61	7	56	81	65	70	8	14	2	9	8	294	87	16	310	88	80	58	74	87	64
E	Ip	2015	14	2	2	39	16	48	34	90	23	4	47	9	253	66	0	253	59	83	76	55	70	61
	In	2016	3	31	39	11	43	73	54	33	50	24	7	55	287	82	22	309	87	81	91	87	71	107
		2017	61	32	0	16	14	6	28	49	15	16	37	14	144	9	29	173	15	46	48	69	62	21
	Ip	2018	21	5	1	2	17	25	25	88	7	31	34	3	195	29	6	201	28	11	31	33	46	33
	Ip	2019	4	2	1	15	62	58	16	18	58	3	7	7	229	50	5	233	48	28	12	24	30	50
L		2020	16	34	26	35	20	19	18	44	33	63	1	28	232	54	7	239	50	43	23	12	28	48

ENSO	IOD	Year	MINNIPA												GSR (Apr-Oct)		PreSeasonRain		PSR + GSR		PSR + GSR		2Year		3Year		4Year		5Year		YIELD
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(mm)	RANK	(mm)	(mm)	RANK	RANK	RANK	RANK	RANK	RANK	RANK	RANK					
L		1910	1	2	15	2	119	33	102	17	46	34	32	9	352	104	0	352	102											100	
E		1911	2	28	3	1	42	46	52	40	36	17	9	32	235	57	7	242	51	91									90		
L		1912	0	48	27	2	7	54	56	32	35	20	44	6	206	36	17	223	39	39	78								41		
E	Ip	1913	0	35	9	9	24	4	24	55	37	43	8	9	196	30	13	209	33	27	24	61							45		
E		1914	3	4	30	27	21	18	23	9	13	9	25	18	120	3	5	125	3	5	4	4	27						1		
E	In	1915	16	1	2	31	42	47	55	87	36	7	1	13	305	89	2	306	86	26	19	14	14						87		
E	Ip	1916	8	0	10	5	26	99	83	57	49	47	25	5	366	106	0	366	104	101	71	51	43						111		
E	Ip	1917	47	14	21	5	68	57	77	67	60	27	38	8	361	105	11	372	106	108	108	92	84						97		
L		1918	4	1	14	19	29	34	24	63	1	38	3	8	209	40	6	214	36	87	100	104	86						36		
E	Ip	1919	10	48	1	13	18	17	18	27	35	16	1	43	145	10	9	154	8	7	51	84	89						15		
		1920	24	0	10	13	63	88	54	68	52	46	34	12	374	107	9	382	107	72	54	88	100						108		
		1921	48	115	77	9	68	61	23	20	23	27	18	31	229	51	74	303	82	104	82	72	91						56		
		1922	19	2	1	13	29	30	57	46	13	7	1	36	194	26	4	198	27	57	93	66	48						62		
	Ip	1923	1	1	1	8	40	70	69	48	35	18	1	55	288	84	5	294	79	52	70	93	73						94		
L		1924	10	11	7	7	27	47	4	40	42	77	14	3	243	60	12	255	60	75	53	71	93						40		
E		1925	5	45	4	11	41	21	38	32	37	23	10	0	202	34	8	210	34	40	59	39	50						20		
E	Ip	1926	0	1	14	38	51	82	41	74	29	29	1	13	343	102	0	343	101	77	73	81	63						102		
		1927	1	17	16	6	28	65	58	40	9	4	18	7	208	38	0	208	31	76	62	58	65						32		
L		1928	2	28	1	3	18	42	48	9	18	48	4	0	185	23	3	188	23	17	49	37	36						7		
L		1929	1	2	3	3	24	41	32	40	29	16	33	17	185	22	0	185	21	10	6	27	20						30		
	In	1930	0	7	0	19	18	4	59	51	19	53	9	9	222	44	4	226	41	21	8	5	26						18		
		1931	2	0	22	42	42	74	35	32	26	13	11	0	264	75	1	265	68	50	26	13	7						89		
		1932	0	38	2	42	28	79	34	71	50	31	4	10	335	99	6	341	97	93	79	57	35						110		
	In	1933	14	0	10	15	62	11	56	58	49	10	75	9	251	64	0	251	57	90	86	77	51						86		
		1934	3	22	16	8	17	20	19	46	35	22	28	0	167	18	19	186	22	30	66	68	52						13		
	Ip	1935	15	0	61	20	28	33	35	35	45	76	19	8	272	78	23	295	81	45	47	76	74						42		
		1936	2	12	0	10	14	23	85	30	7	30	10	27	197	32	0	197	25	53	28	32	53						26		
		1937	11	12	8	12	32	40	35	53	33	24	58	22	229	49	2	231	45	25	46	22	29						37		
L		1938	5	158	3	37	25	66	31	53	8	7	0	16	227	46	59	286	78	64	42	53	34						39		
		1939	26	5	42	5	16	49	54	86	7	17	56	1	235	56	8	243	53	70	60	40	47						99		
E		1940	55	3	18	35	28	8	44	8	15	6	15	1	144	8	24	167	13	20	36	31	18						3		
E		1941	36	1	36	10	5	17	38	20	73	32	23	0	195	28	13	208	32	12	15	20	21						59		
E	Ip	1942	17	4	7	14	34	97	64	64	50	8	42	18	331	96	1	331	94	73	40	38	45						104		
		1943	5	49	1	15	6	32	53	60	21	28	3	4	215	41	17	232	47	82	64	34	32						46		
	Ip	1944	0	6	4	21	48	15	42	12	5	12	13	15	154	14	0	154	9	13	45	29	11						5		
		1945	13	4	0	0	21	40	8	29	23	31	31	79	153	13	0	153	7	2	2	17	9						6		
E	Ip	1946	37	84	9	13	31	57	54	19	8	11	35	81	192	25	50	243	52	18	3	2	15						70		
		1947	17	14	37	13	10	32	70	42	40	44	10	15	251	65	33	284	77	68	30	8	5						63		
		1948	0	1	0	19	32	18	19	32	3	40	26	10	162	15	0	162	11	33	33	11	2						8		
L		1949	2	24	0	2	34	18	55	20	42	58	58	8	228	47	3	231	46	15	27	26	8						47		
L		1950	4	23	0	9	29	29	21	56	19	42	13	54	206	37	14	220	37	36	13	19	24						24		
E		1951	5	0	7	23	80	49	101	72	42	33	4	15	399	108	11	411	108	96	89	60	64						79		
		1952	6	1	3	38	121	23	31	33	41	37	42	11	323	94	0	323	91	107	101	94	75						82		
		1953	25	21	5	5	7	78	29	56	55	27	20	57	257	69	9	266	69	88	104	100	97						67		
L		1954	25	2	1	41	7	49	26	13	15	37	15	29	188	24	14	202	29	42	69	97	90						19		
L		1955	2	54	34	27	45	102	33	70	23	21	3	11	320	93	21	342	98	74	74	89	106						93		
L		1956	5	27	31	49	75	115	86	42	43	82	9	7	492	111	11	503	111	110	109	107	107						73		
E	Ip	1957	0	2	3	3	13	67	41	30	16	11	8	15	181	21	0	181	19	103	107	101	101						22		
	In	1958	1	0	50	3	59	4	39	77	67	40	30	30	289	85	15	304	83	48	102	108	104						83		
		1959	0	11	39	5	17	9	29	4	23	13	19	15	101	1	16	117	1	23	10	82	96						2		
	In	1960	16	48	7	53	61	31	59	45	64	3	29	10	315	91	9	314	92	31	52	30	92						95		
	Ip	1961	0	10	1	62	10	22	24	44	16	4	18	1	170	19	3	173	14	55	14	25	13						14		
		1962	3	4	8	1	60	24	21	35	16	41	6	14	197	31	0	197	24	9	35	7	16						35		
E	Ip	1963	11	2	4	46	51	49	74	55	11	4	3	0	279	81	0	279	75	44	20	45	10						55		
E	Ip	1964	5	5	1	25	40	52	88	23	63	45	45	4	335	100	0	335	96	94	75	46	66						91		
		1965	1	0	3	5	46	29	41	71	25	3	9	28	220	43	8	228	42	84	83	67	39						92		
		1966	19	36	36	5	36	60	41	31	59	25	29	72	256	68	16	272	72	56	80	85	68						81		
		1967	33	24	2	1	14	8	63	35	31	2	0	1	153	12	26	179	17	35	29	56	61						17		
		1968	23	57	60	31	60	117	54	88	31	28	21	23	408	109	33	442	110	95	95	86	99						68		
E		1969	8	55	18	20	58	35	42	33	56	1	11	8	244	61	13	257	62	106	92	90	82						88		
L		1970	9	1	0	12	37	39	25	64	49	3	17	4	228	48	0	228	43	49	97	83	83						54		
L		1971	2	3	57	42	48	39	37	54	33	6	67	14	258	72	18	277	74</												

The long-term pattern shows the severity of the Millennium drought, but also the decadal variability with the worst simulated yield in 1914.

In last 20 years (2001 to 2020) there have been 11 growing seasons drier than long term median, 11 Pre-season + growing season rain drier than long term median and 17 growing seasons warmer than the long-term median. In a random world we would expect around 10 warmer or drier.

We can look at the same data as a time series for GSR (Figure 1) or broken into seasons (Figure 2)

Minnipa

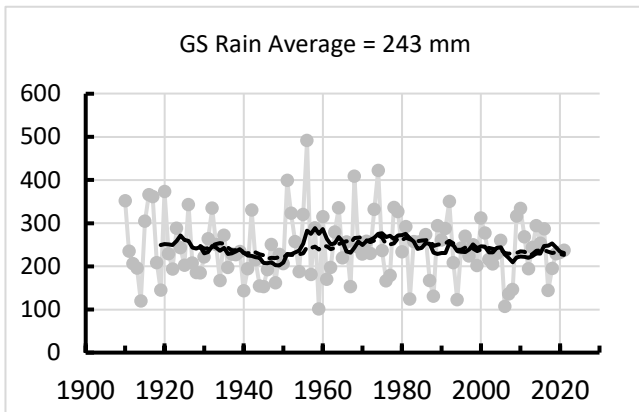


Figure 1 GSR for Minnipa

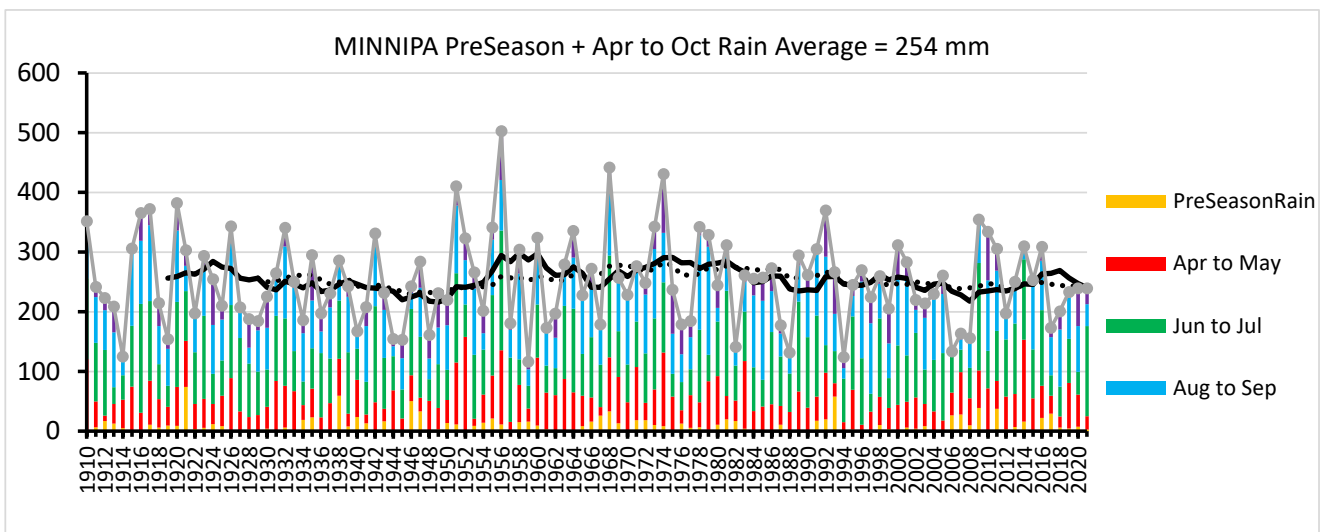


Figure 2 GSR for Minnipa separated into seasons

The Climate Services for Ag website funded by the Future Drought Fund gives the impression of a drying trend using the 30 years 1961 to 1990 compared to 1991 to 2020. This is true for farmers living through this period, however the 1961 to 1990 was a relatively wet period compared to the earlier part of the 20th Century.

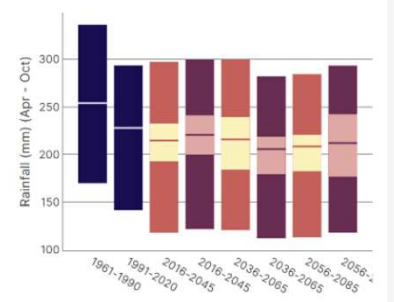


Figure 3 Screen grab from Climate Services for Agriculture (Minnipa)

The time series of APSIM yield for Minnipa tend not to show strong trends. Importantly the simulate water use efficiency doesn't show a strong trend.

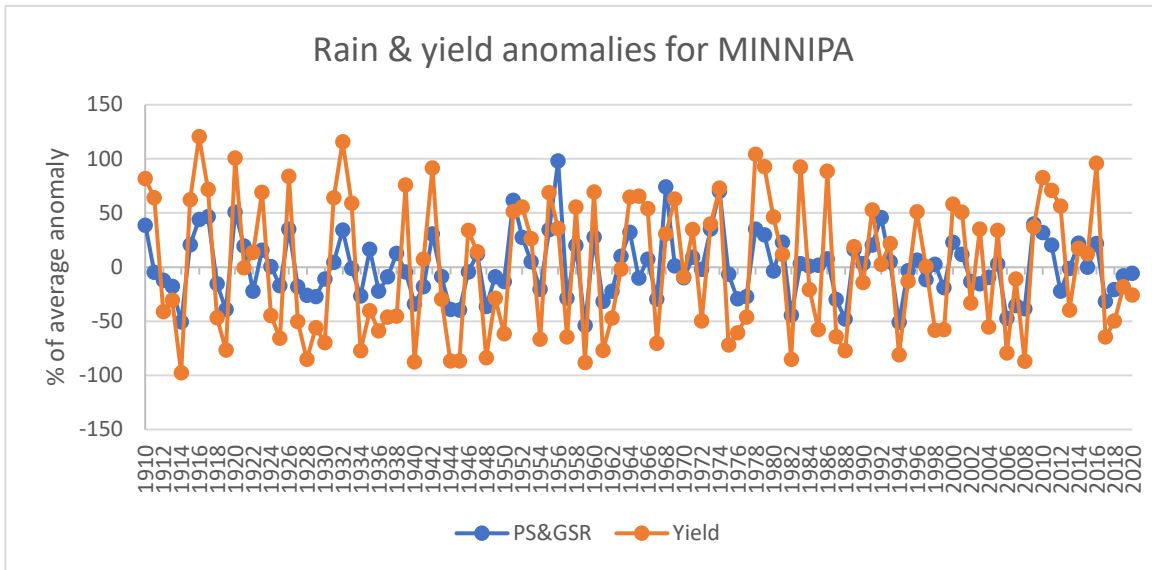


Figure 4 Rainfall (Pre-season and GSR) for Minnipa

When expressed as a percent of average, the yield is more variable than rainfall. Decile 1 GSR for Minnipa is less than 146 mm which is a 40% reduction from the long term average. A decile 1 yield at Minnipa might be less than 0.5t/ha which is 75% less than 2t/ha.

The relationship between rainfall and yield is not perfect and this is captured in the simulated Water Use Efficiency. There is no trend in the simulated WUE, this means that APSIM simulations are not detecting an impact of pattern of rainfall or the higher evaporation or temperature. It might be that APSIM is not capturing the essential processes (dealing with heat waves etc). However these simulations do not take into account the carbon dioxide fertilisation effect nor do they account for the substantial improvements in agronomy and varieties.

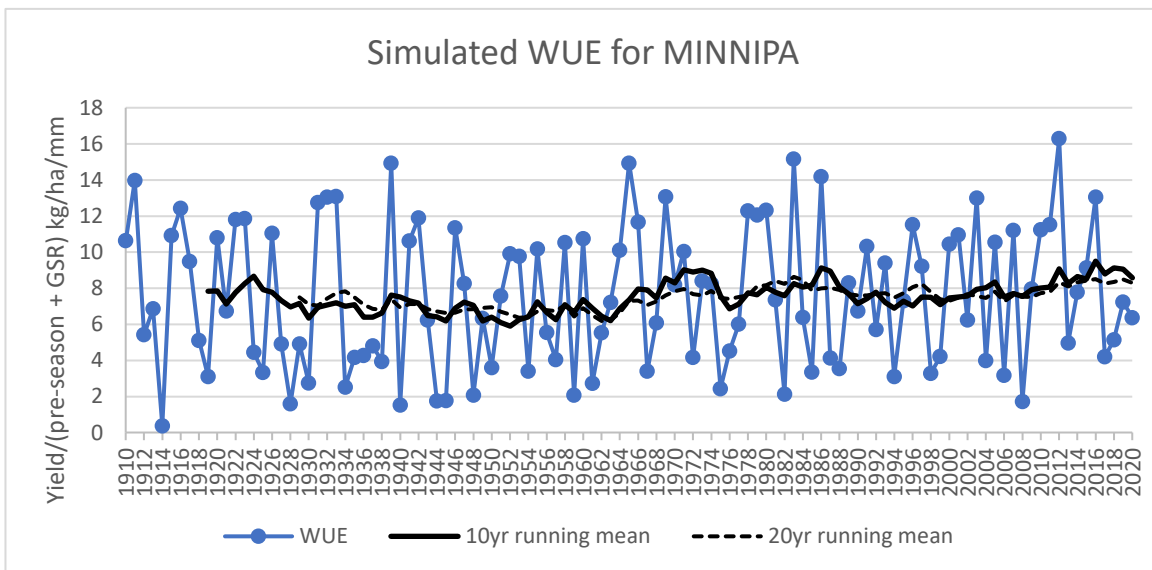


Figure 5 Rainfall (Pre-season and GSR) for Minnipa

