Adaptive capacity of communities to drought impacts

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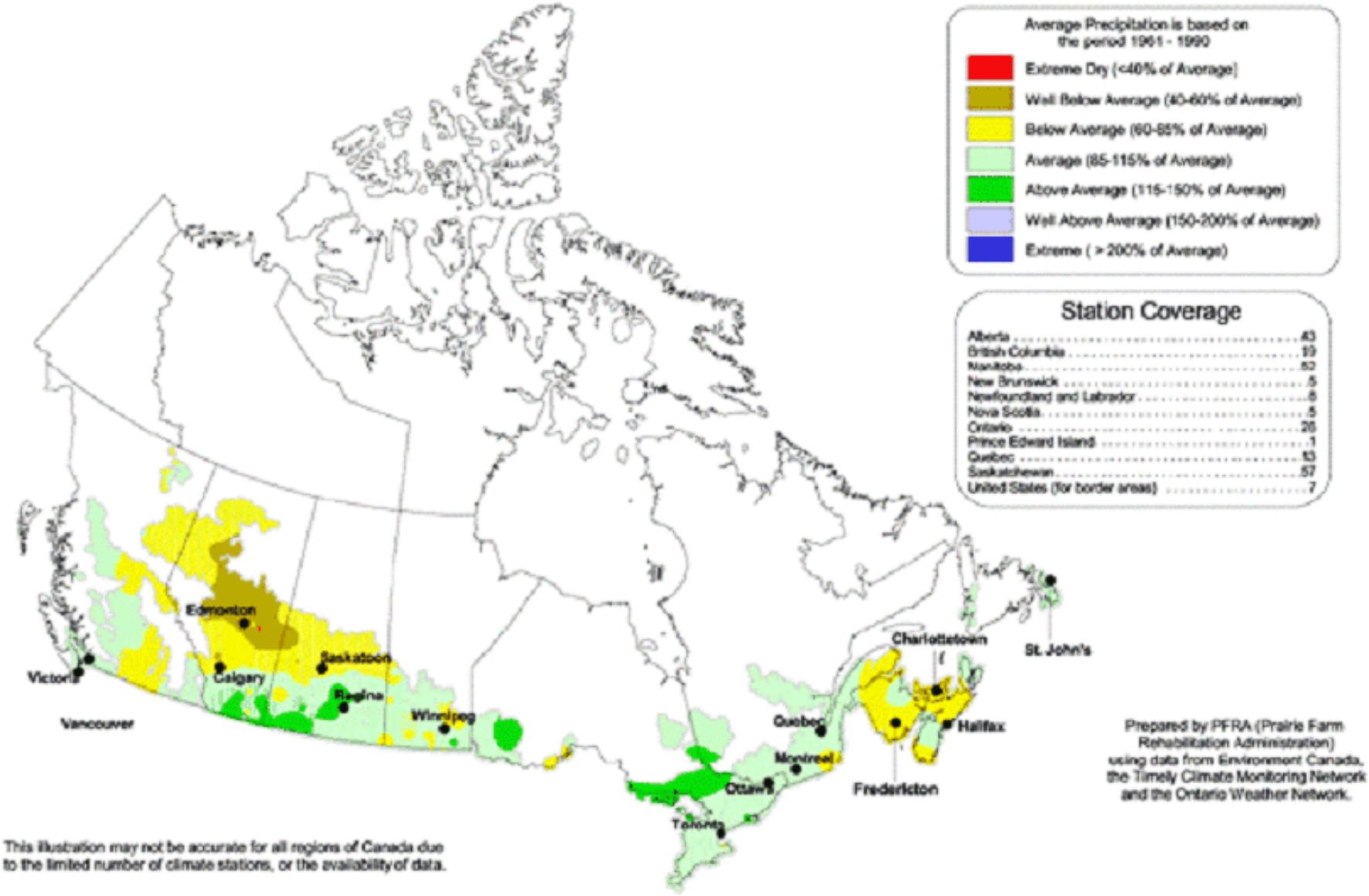
University of Regina

C-CIARN Landscape Hazards Workshop
Hull, Québec, October 3-5, 2002

Percent of Average Precipitation in Agricultural Areas

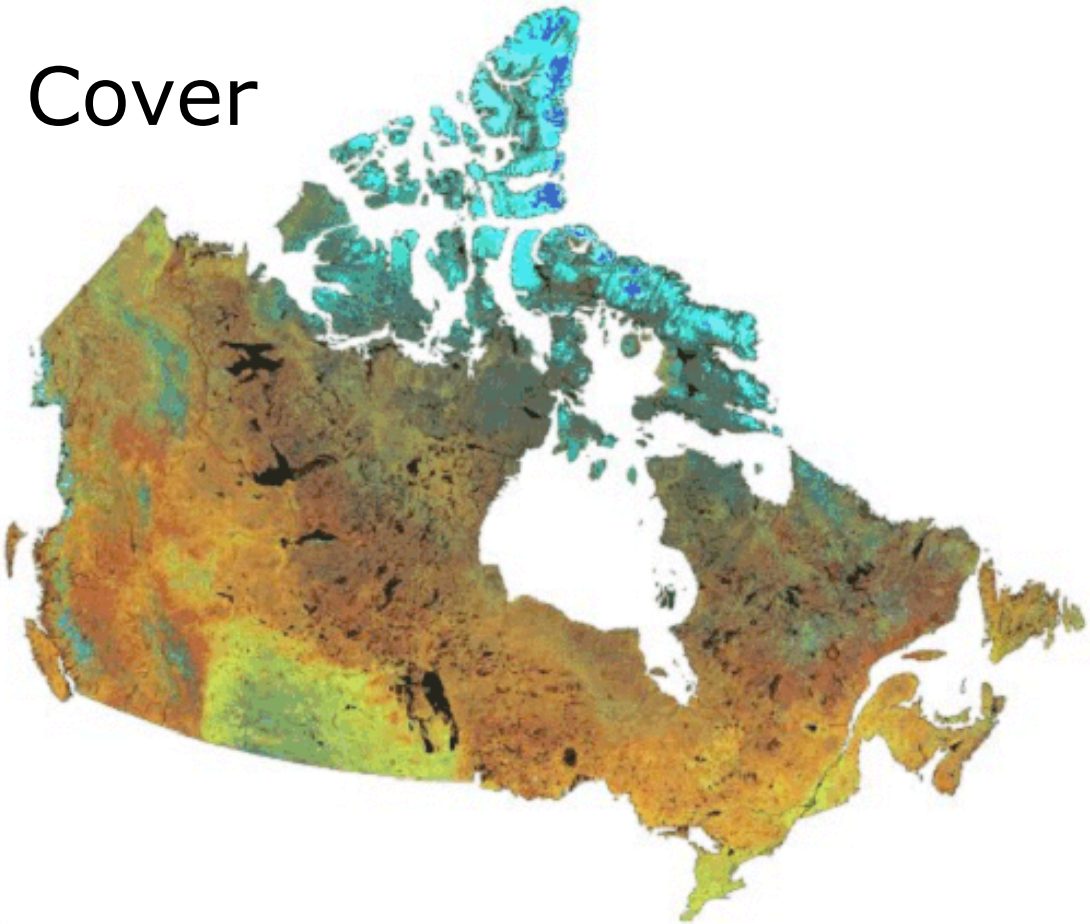
September 1, 2001 to August 23, 2002

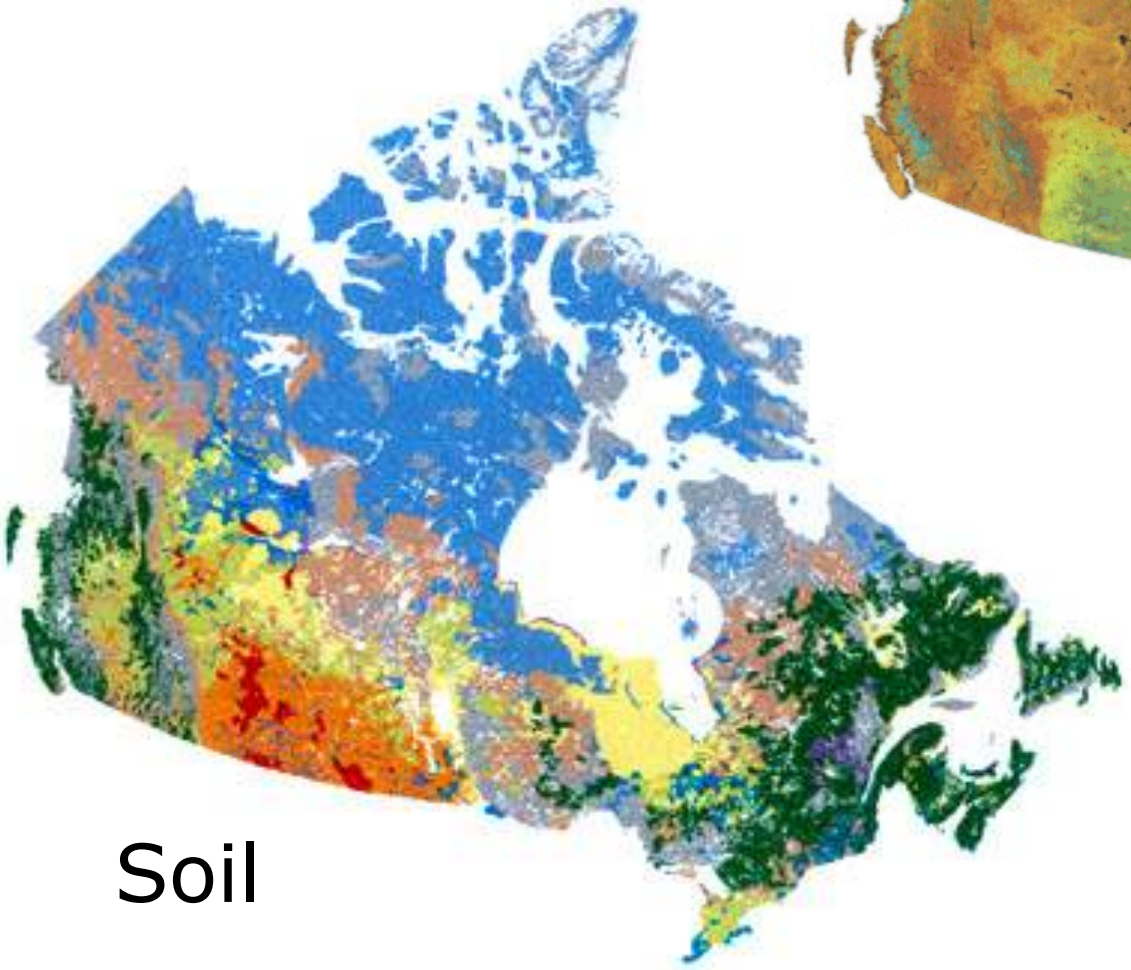


Prepared by PFRA (Prairie Farm Rehabilitation Administration) using data from Environment Canada, the Timely Climate Monitoring Network and the Ontario Weather Network.

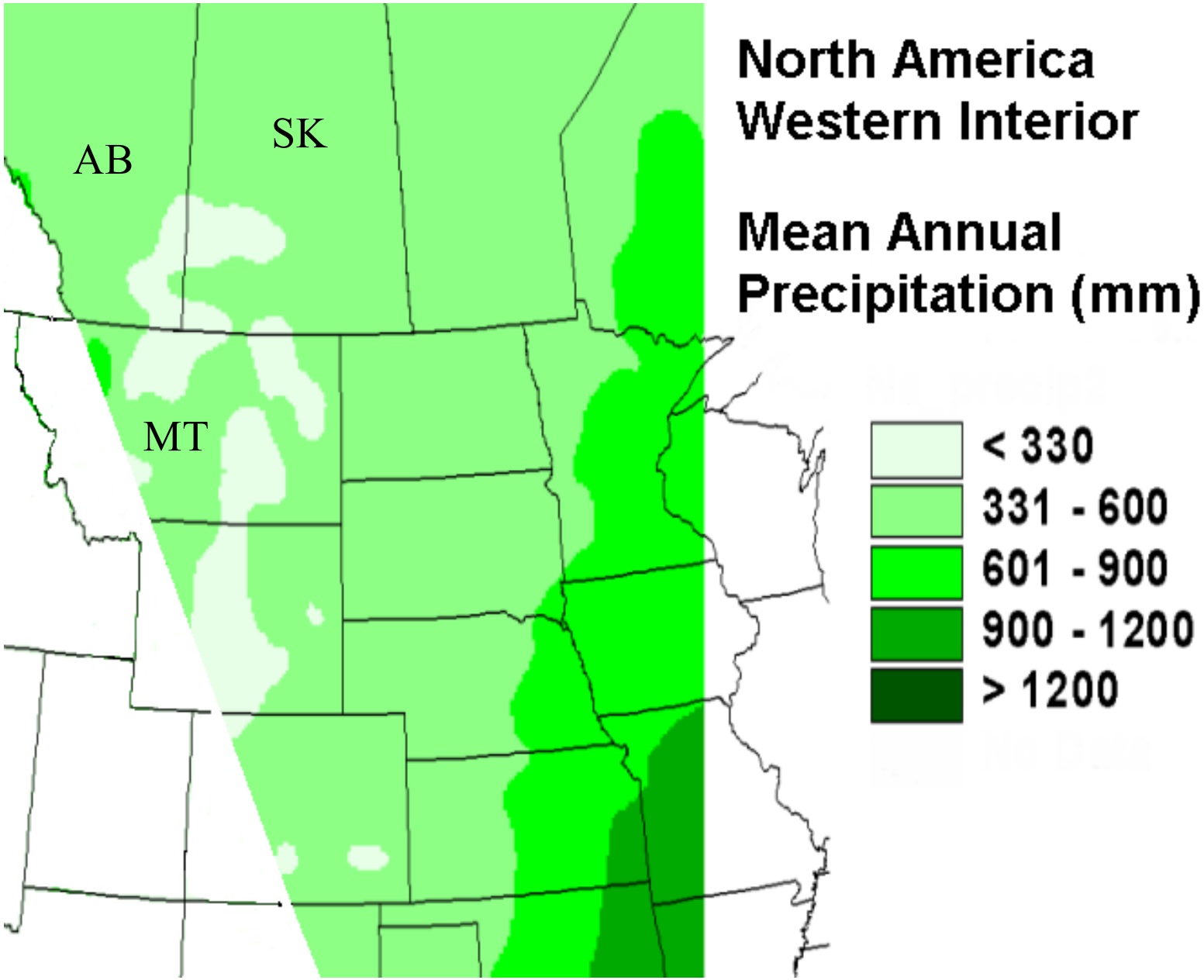
This illustration may not be accurate for all regions of Canada due to the limited number of climate stations, or the availability of data.

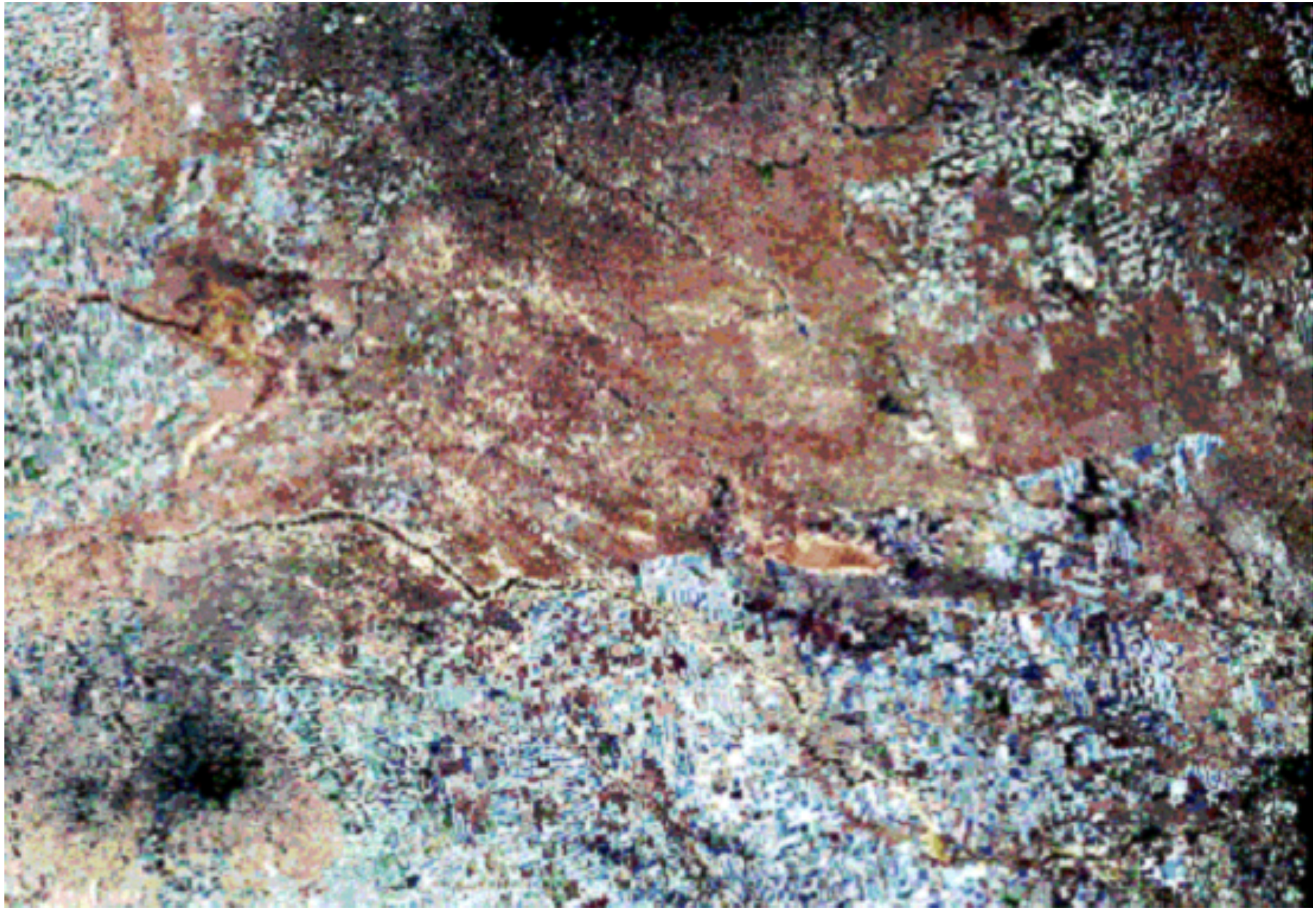
Land Cover



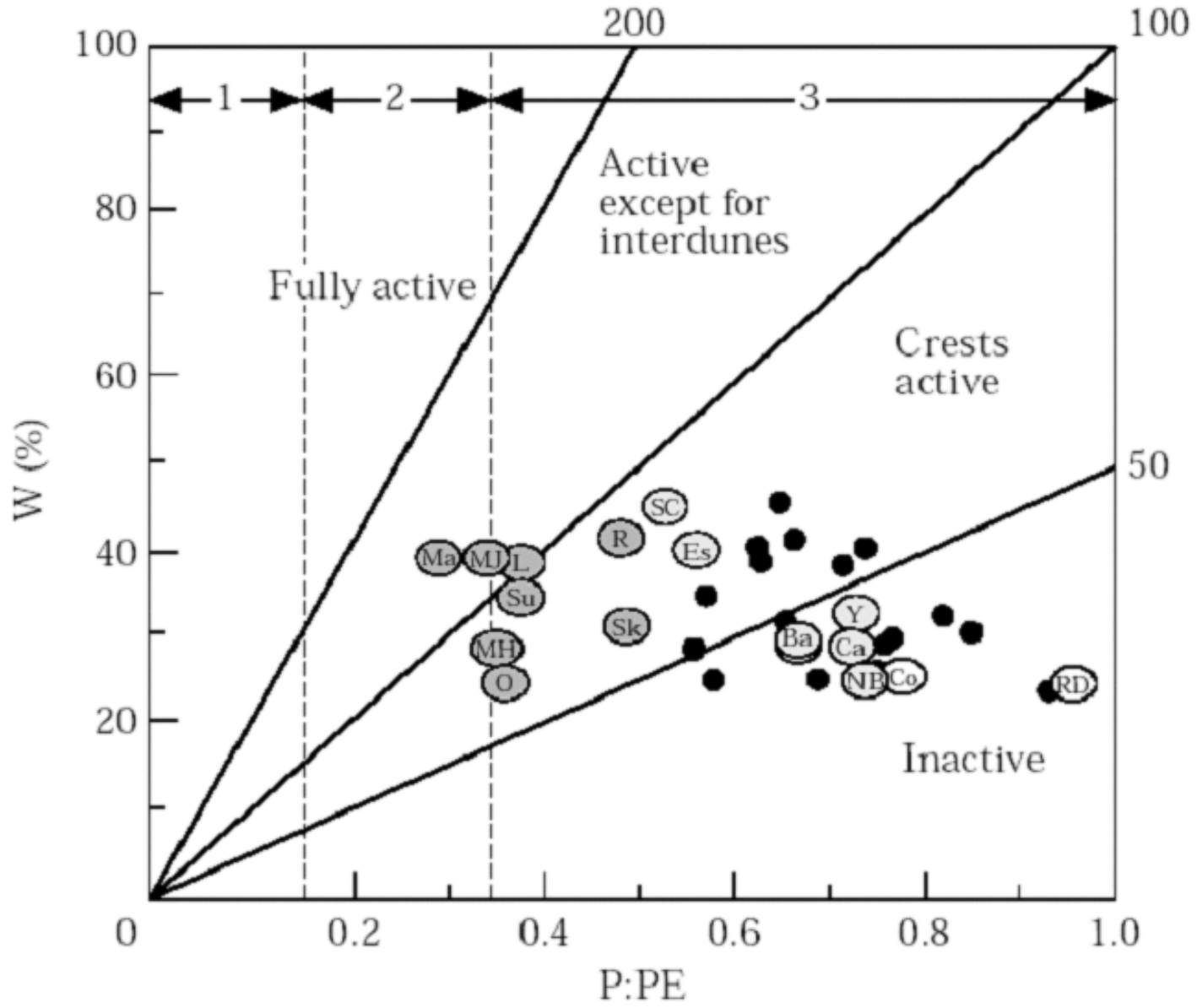


Soil

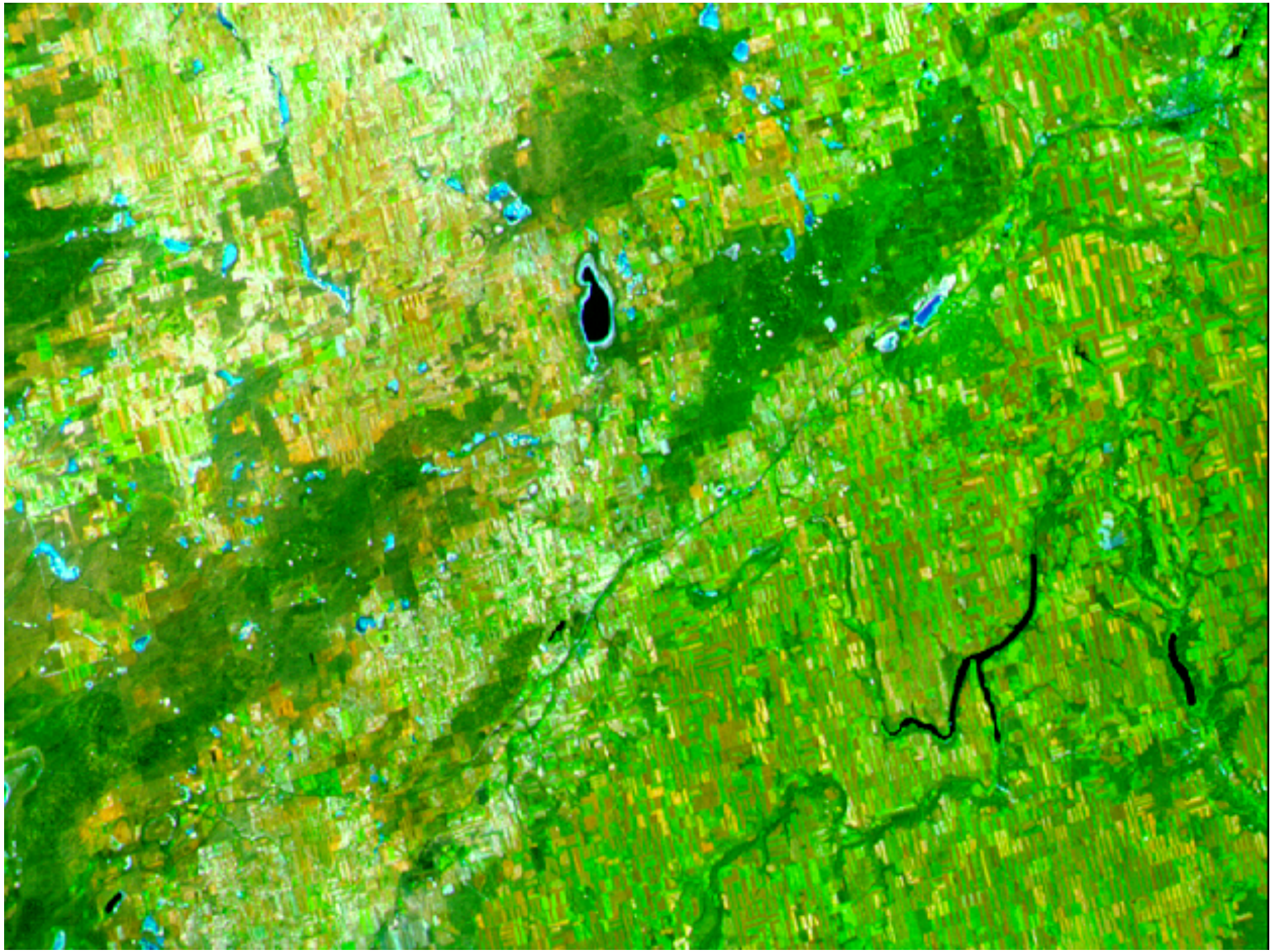

AB
SK
MT
North America
Western Interior
Mean Annual
Precipitation (mm)
< 330
331 - 600
601 - 900
900 - 1200
> 1200

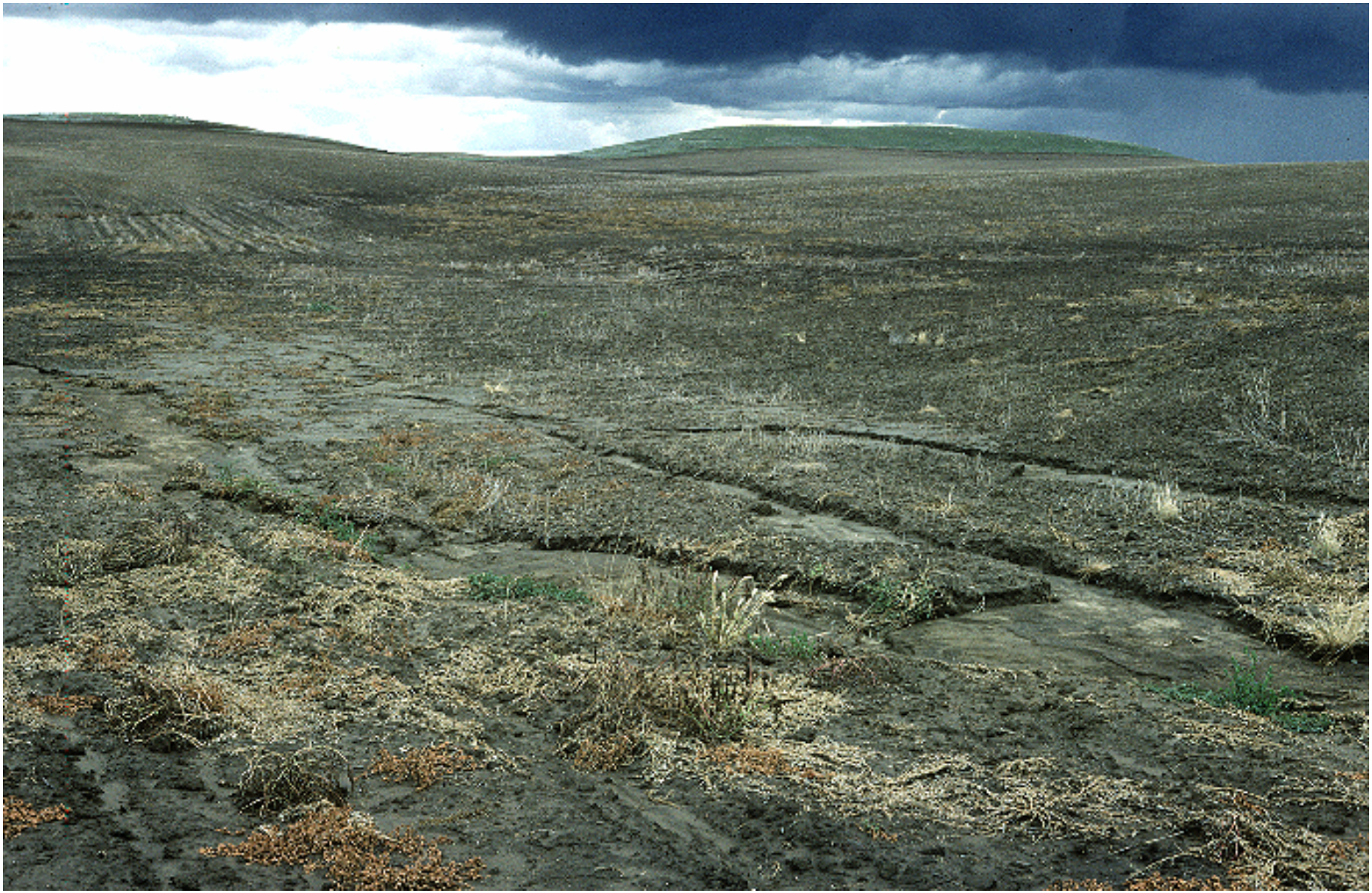


Landsat 7, July, 2000



Wolfe, S,A. 1997. Impact of increased aridity on sand dune activity in the Canadian Prairies. Journal of Arid Environments, v. 36, p. 421-432.





Soil drifting near Oyen, Alberta, May 5, 2002

Climate Regions for Residue Requirements (PFRA, 1987)

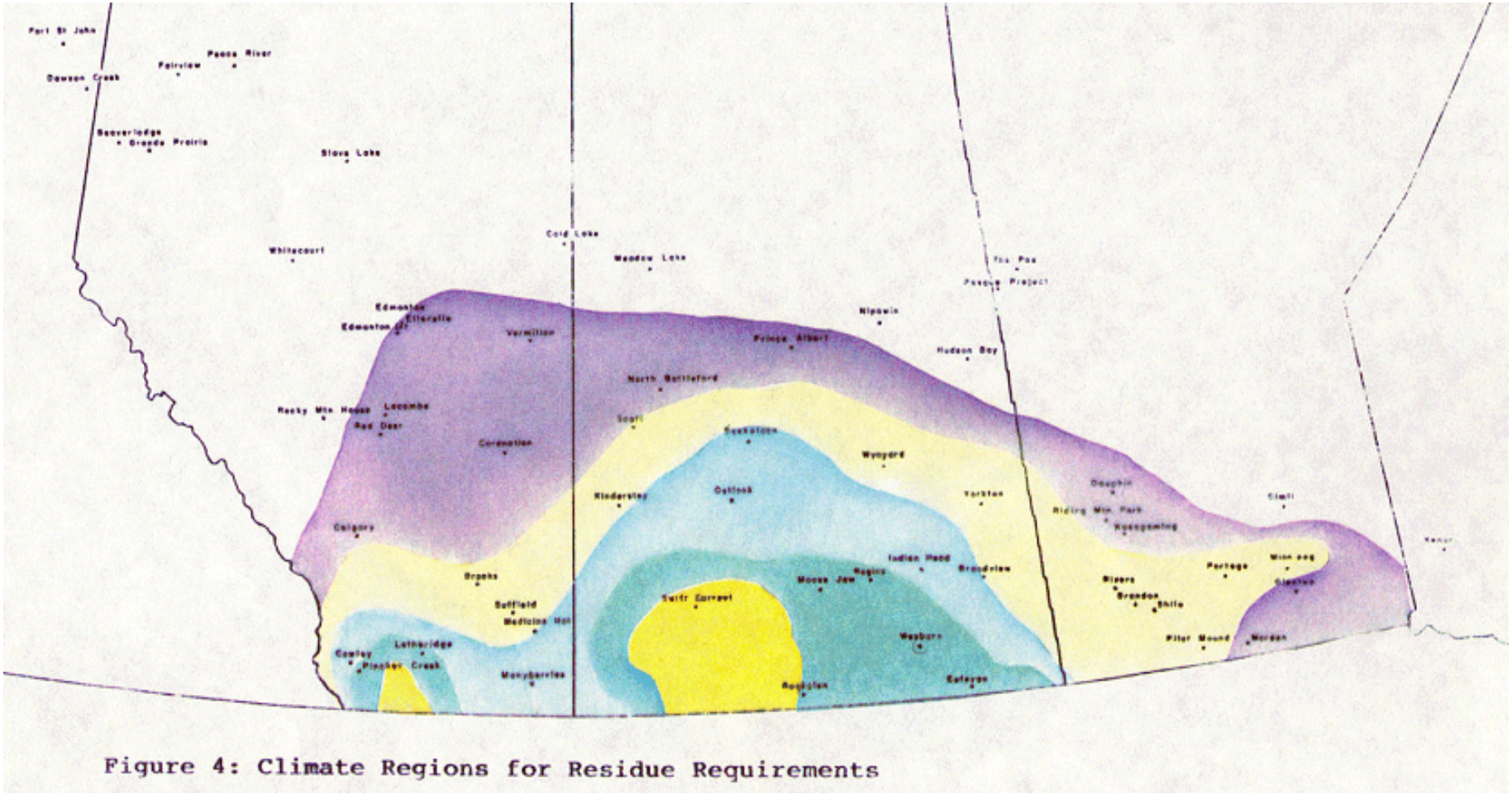


Figure 4: Climate Regions for Residue Requirements

Crop Residue Requirement for Wind Erosion Control (PFRA, 1987)

Table 12
CROP RESIDUE REQUIREMENTS FOR WIND EROSION CONTROL LBS./AC.

EROSION RISK LEVEL	SOIL TEXTURE	CROP* TYPE	CLIMATE REGION				
			FLAT lbs/ac (% Cover)	FLAT lbs/ac (% Cover)	FLAT lbs/ac (% Cover)	FLAT lbs/ac % Cover)	FLAT lbs/ac (% Cover)
Extreme	Sands, Dune Sands, Badly Eroded Areas	Small Grains and Fallow	2 500 (85)	2 000 (80)	1 750 (75)	1 500 (70)	1 250 (60)
		Oilseeds	3 500 (85)	3 200 (80)	3 000 (75)	2 900 (70)	2 600 (60)
	WEG 1-2						
Extreme and High	Loamy Sands	Small Grains and Fallow	2 000 (80)	1 500 (70)	1 500 (70)	1 250 (60)	1 000 (50)
	Well Worked Heavy Clays	Oilseeds	3 200 (80)	2 900 (70)	2 900 (70)	2 600 (60)	2 200 (50)
	WEG 2						
High, Moderate and Low	Sandy Loam Clays Clay Loam	Small Grains	1 500 (70)	1 250 (60)	1 000 (50)	1 000 (50)	750 (40)
		Oilseeds	2 900 (70)	2 600 (60)	2 200 (50)	2 200 (50)	1 900 (40)
	WEG 3-4						
High, Moderate and Low	Loam Silt Loam	Small Grain and Fallow	1 000 (50)	1 000 (50)	750 (40)	500 (25)	500 (25)
	WEG 5	Oilseeds	2 200 (50)	2 200 (50)	1 900 (40)	1 500 (25)	1 500 (25)

Prairie Agricultural Landscapes (PFRA 2000: 32-33)

Severe and widespread erosion could still occur during extreme climatic events and especially during a period of years with back-to-back droughts.

Soil eroded from the conventional and minimum till plots in 1990 [two events] was 70% and 73%, respectively, of the total soil eroded during the operation of the plots from 1986 to 1993.

Very severe wind and water erosion is dominated by infrequent occurrences of when highly erosive events impact exposed soil. Such events may only happen once during the farming lifetime of an individual farmer, making it difficult to justify the expense and inconvenience of many soil conservation practices.


Dust, Regina, May 22, 2002

Annual frequency of dust storms, 1977-85 (Wheaton and Chakravarti, 1990)

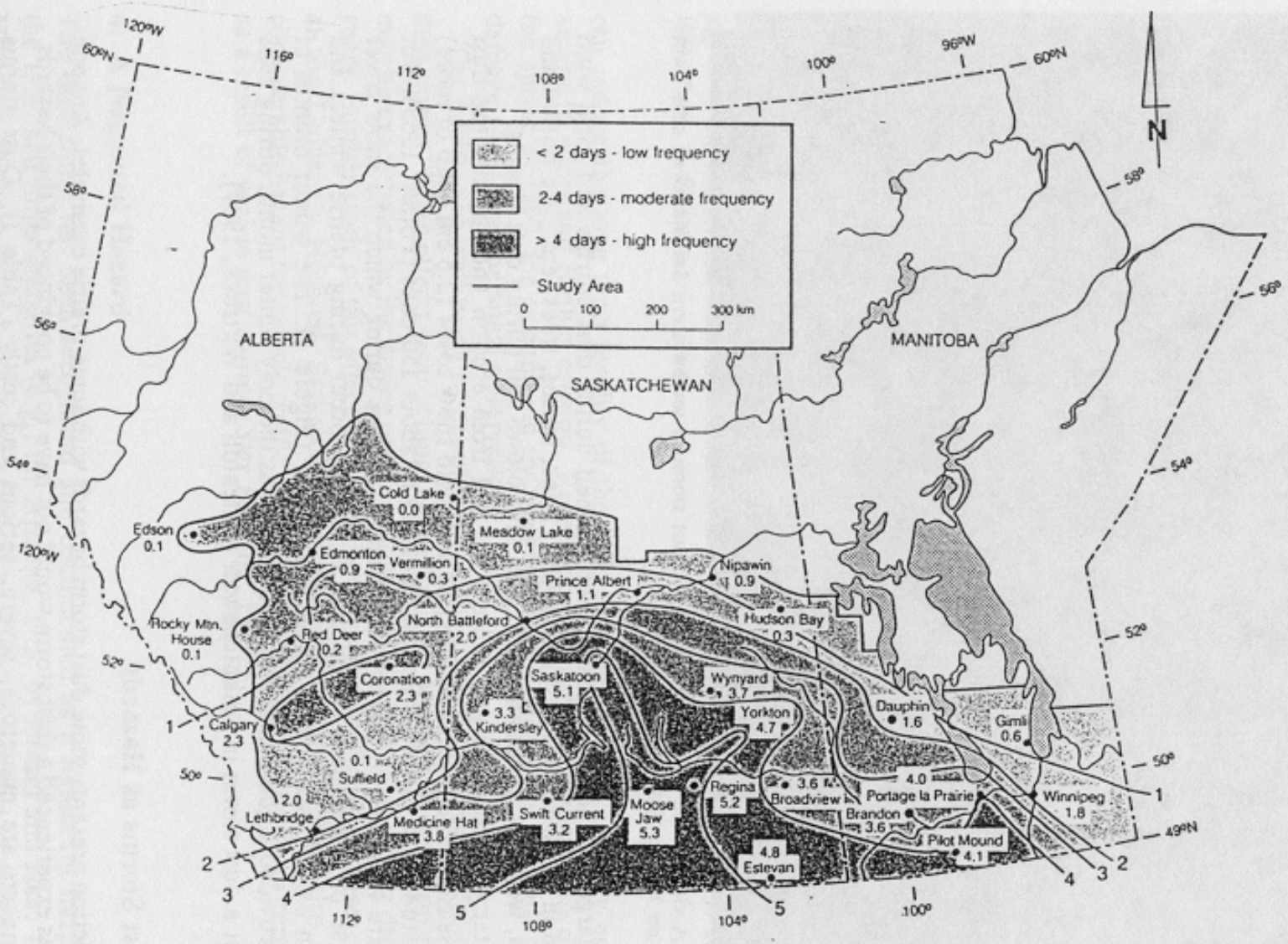


Fig. 1. Spatial variation of the average annual frequency of dust storm days, Canadian Prairies (1977–1985). (Study area stations are included. Wheaton and Chakravarti (1990).

April dust storm totals versus PDSI (Wheaton, 1990)

Table 1. April dust storm totals and ASpril Palmer drought indices in order of severity, southern Saskatchewan.

Year	April dust storm totals	Year	April PDI
1981	57	1981	-3.31
1977	31	1977	-2.89
1987	19	1988	-2.76
1982	18	1980	-2.73
1984	8	1982	-2.25
1988	5	1978	-2.09
1985	3	1984	-1.50
1986	1	1987	-1.06
1978	0	1983	-0.82
1979	0	1979	-0.56
1980	0	1986	-0.40
1983	0	1985	-0.01

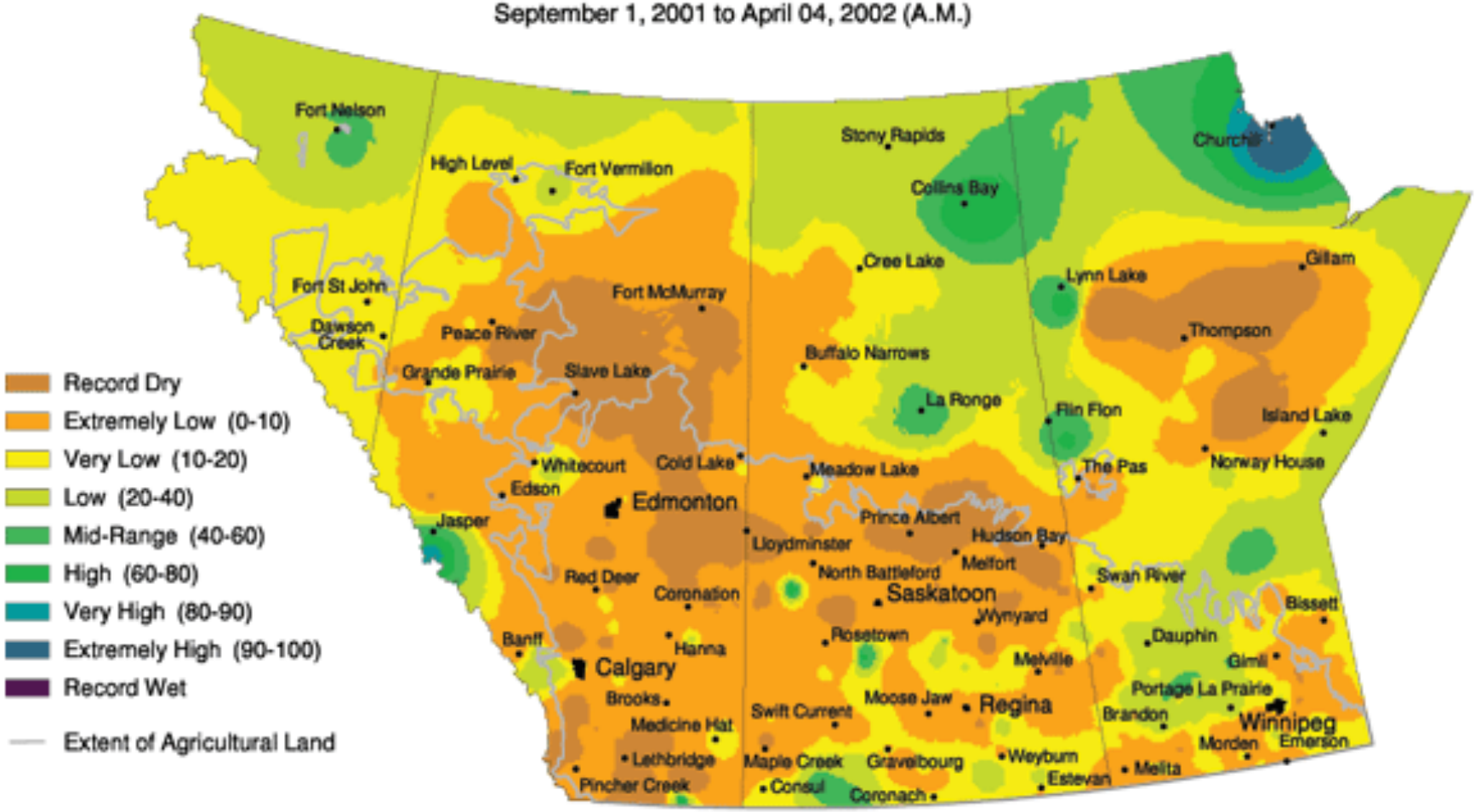
Sources: PDI data, K. Jones, Pers. Comm. (1990) (10 station southern Saskatchewan averages). Dust storm data, Wheaton and Chakravarti (1990), remainder abstracted from AES (1981-1988).

Drought Watch

on the Prairies

Precipitation Percentiles

September 1, 2001 to April 04, 2002 (A.M.)



Prepared by PFRA (Prairie Farm Rehabilitation Administration) using data from the Timely Monitoring Network and the many federal and provincial agencies and volunteers that support it.


Near Outlook, Saskatchewan, May 2, 2002

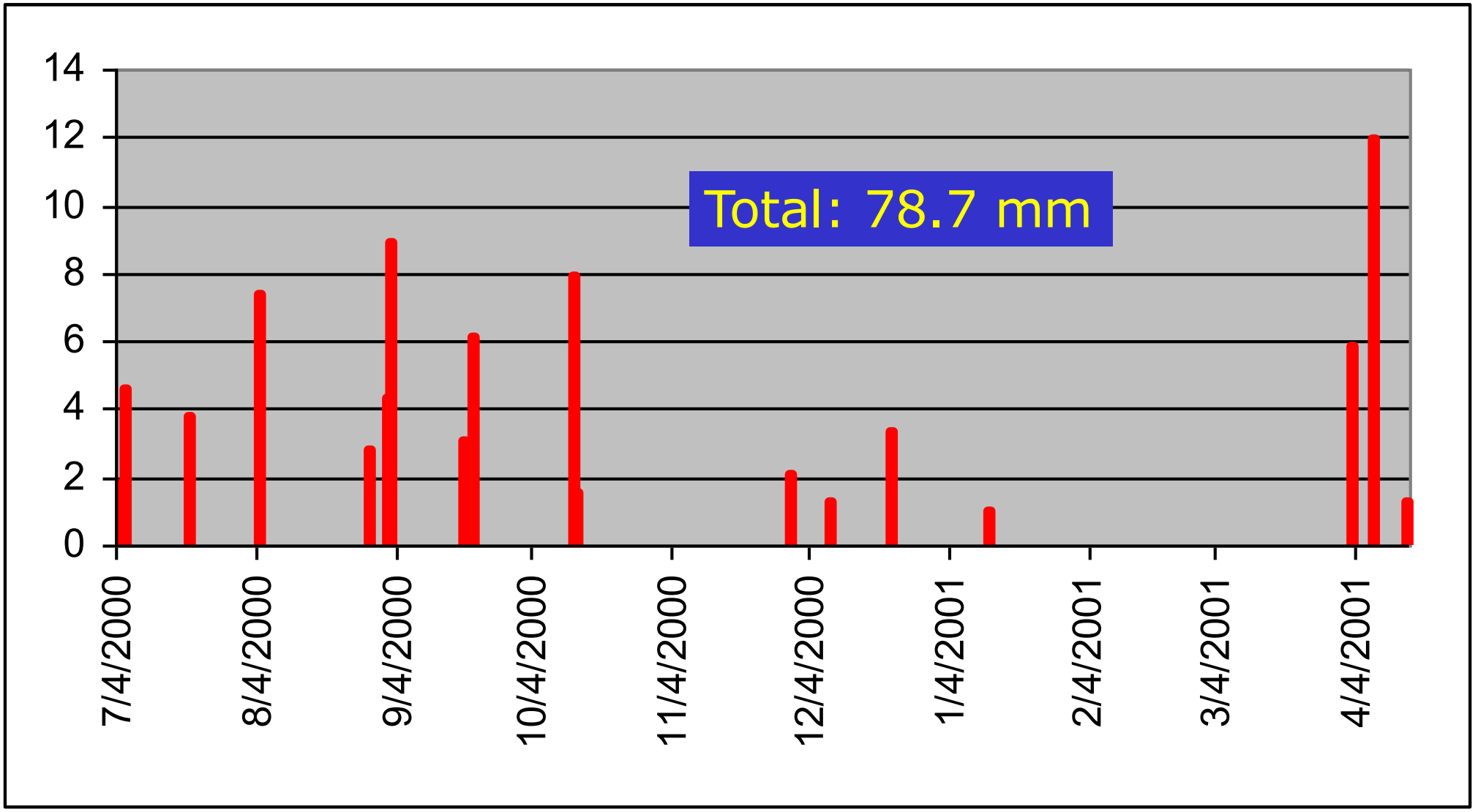
Dust storm 'blackout' causes 8-vehicle crash, closes major Alberta Highway

CARSTAIRS, Alta., May 19, 2001 (CP) - Alberta motorists got a horrifying glimpse of the Dirty 30s Saturday when a dust storm caused a multi-vehicle accident on a major highway. Police said dust blown by 100 km/h winds severely reduced visibility on Highway 2 about 50 km north of Calgary and triggered a 15-vehicle pileup. Eight people were treated in the Didsbury, Alta., hospital then released, said Innisfail RCMP.

RCMP Constable Barry Neely of Didsbury said that … Somebody is losing some topsoil somewhere," he said.

Dust piling up in houses during unusually dry May

Edmonton Journal, Thursday 17 May 2001



Daily Precipitation (mm), Sweetgrass, Montana
July 1, 2000 – April 30, 2001

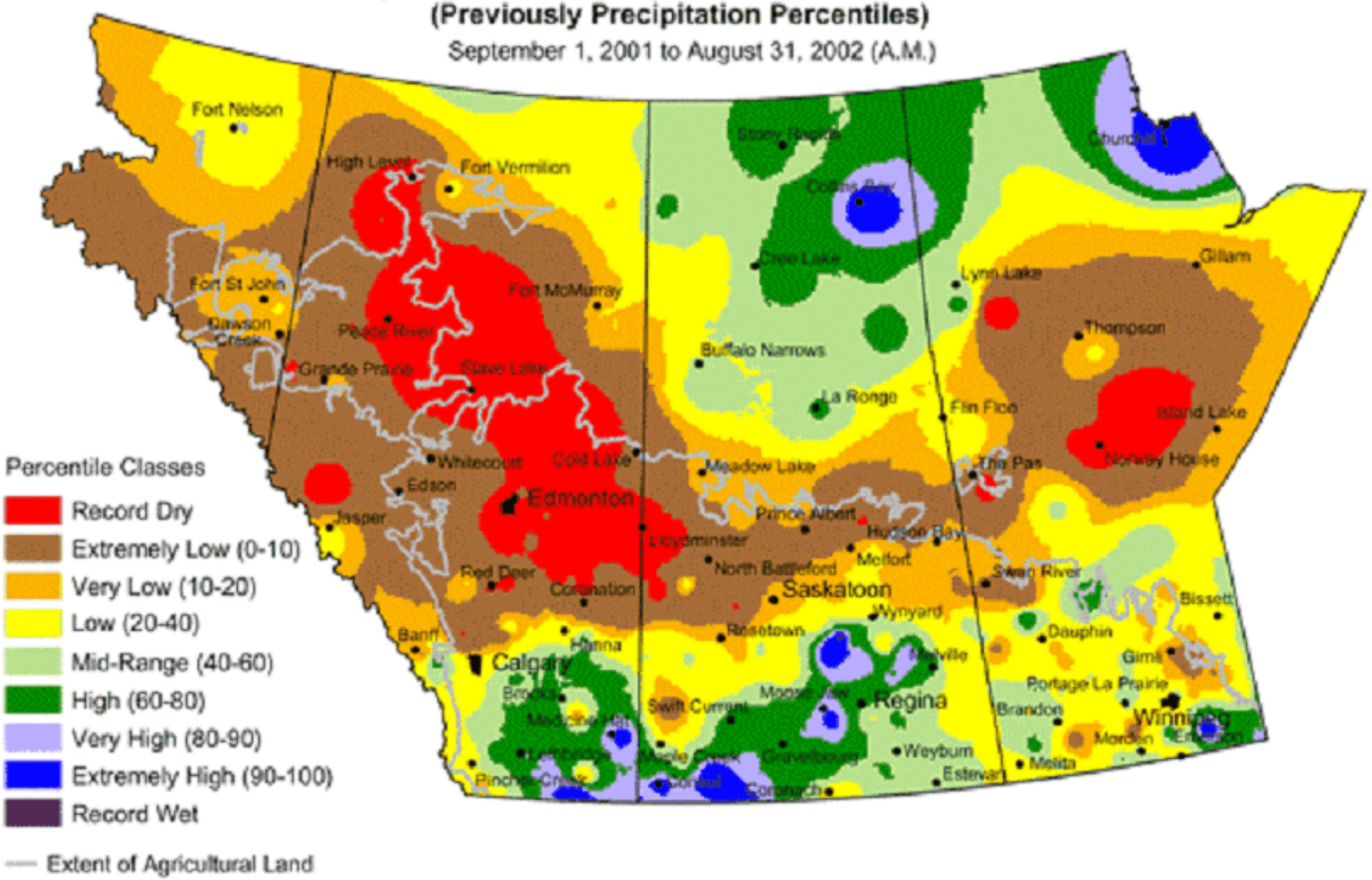
Medicine Hat (1884-2001)

Single Years		Three-year droughts	
2001	**147.3**	**1999-2001**	**662.6**
1907	173.1	1907-09	681.6
1943	182.2	1918-20	716.4
1928	194.1	1905-07	721.5
1919	195.6	1928-30	724.9
1997	197.3		
1929	207.0		
1924	207.6		
1961	207.7		
2000	**214.3**		

Current Precipitation Compared to Historical Distribution

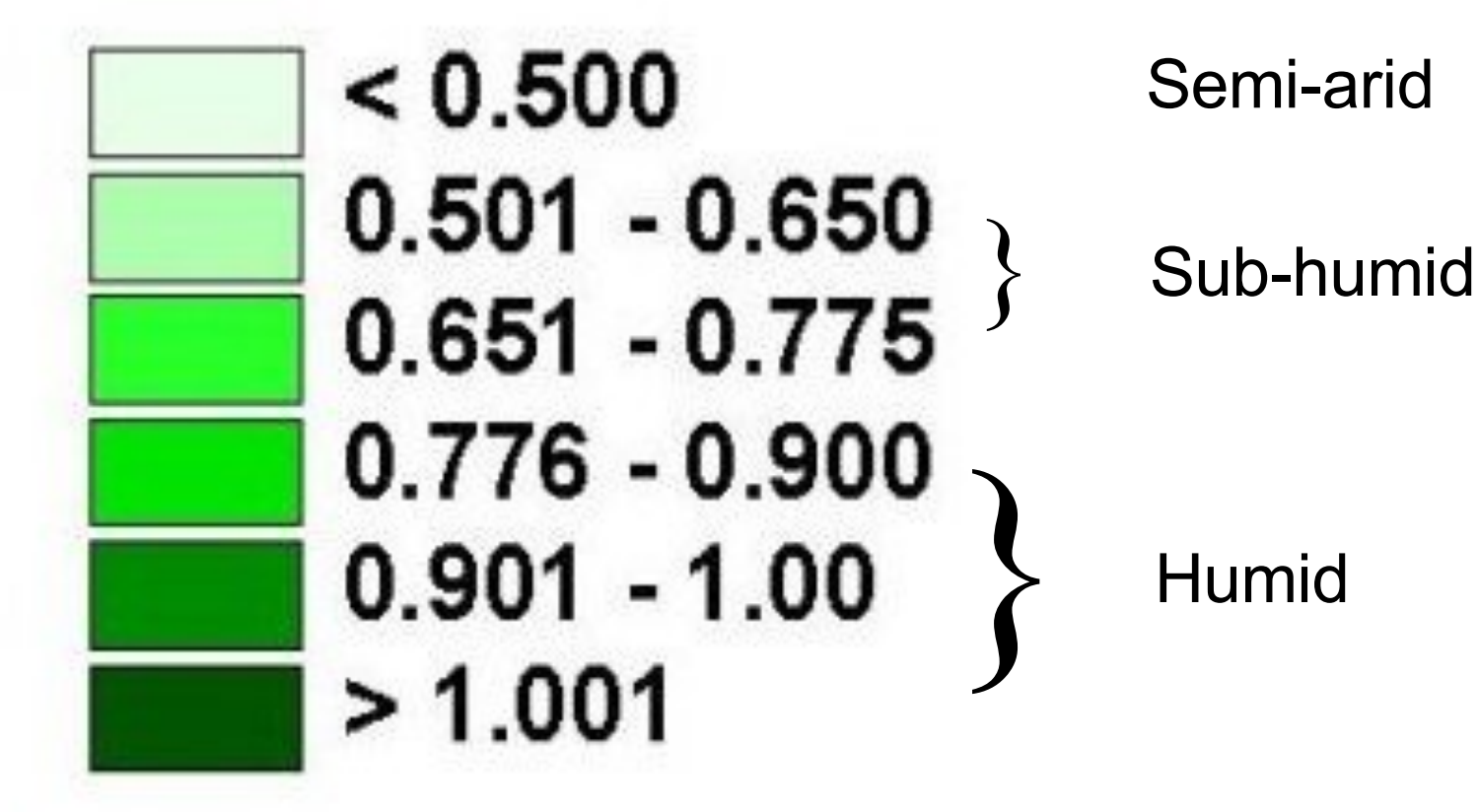
(Previously Precipitation Percentiles)

September 1, 2001 to August 31, 2002 (A.M.)

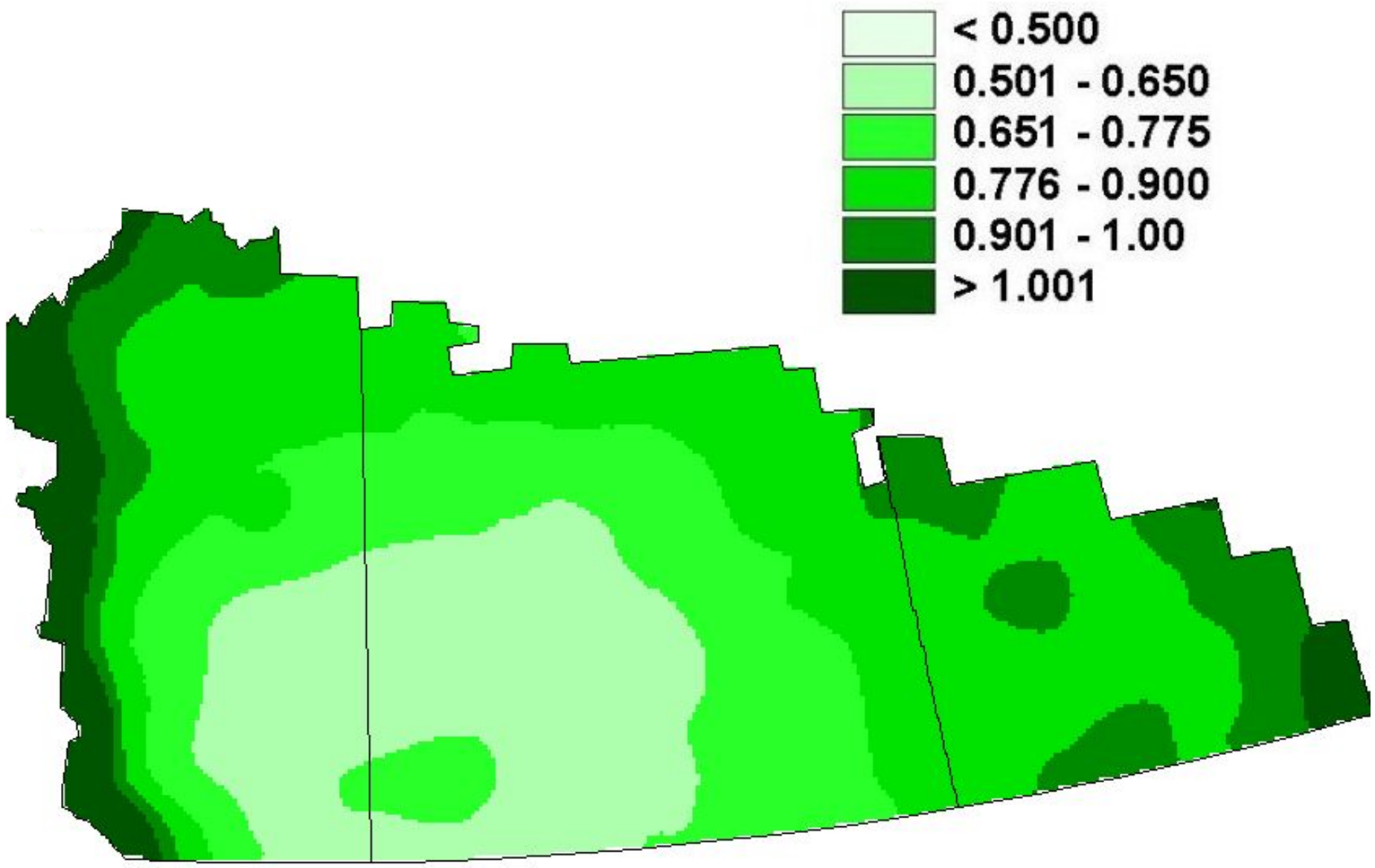


Prepared by PFRA (Prairie Farm Rehabilitation Administration) using data from the Timely Climate Monitoring Network and the many federal and provincial agencies and volunteers that support it.

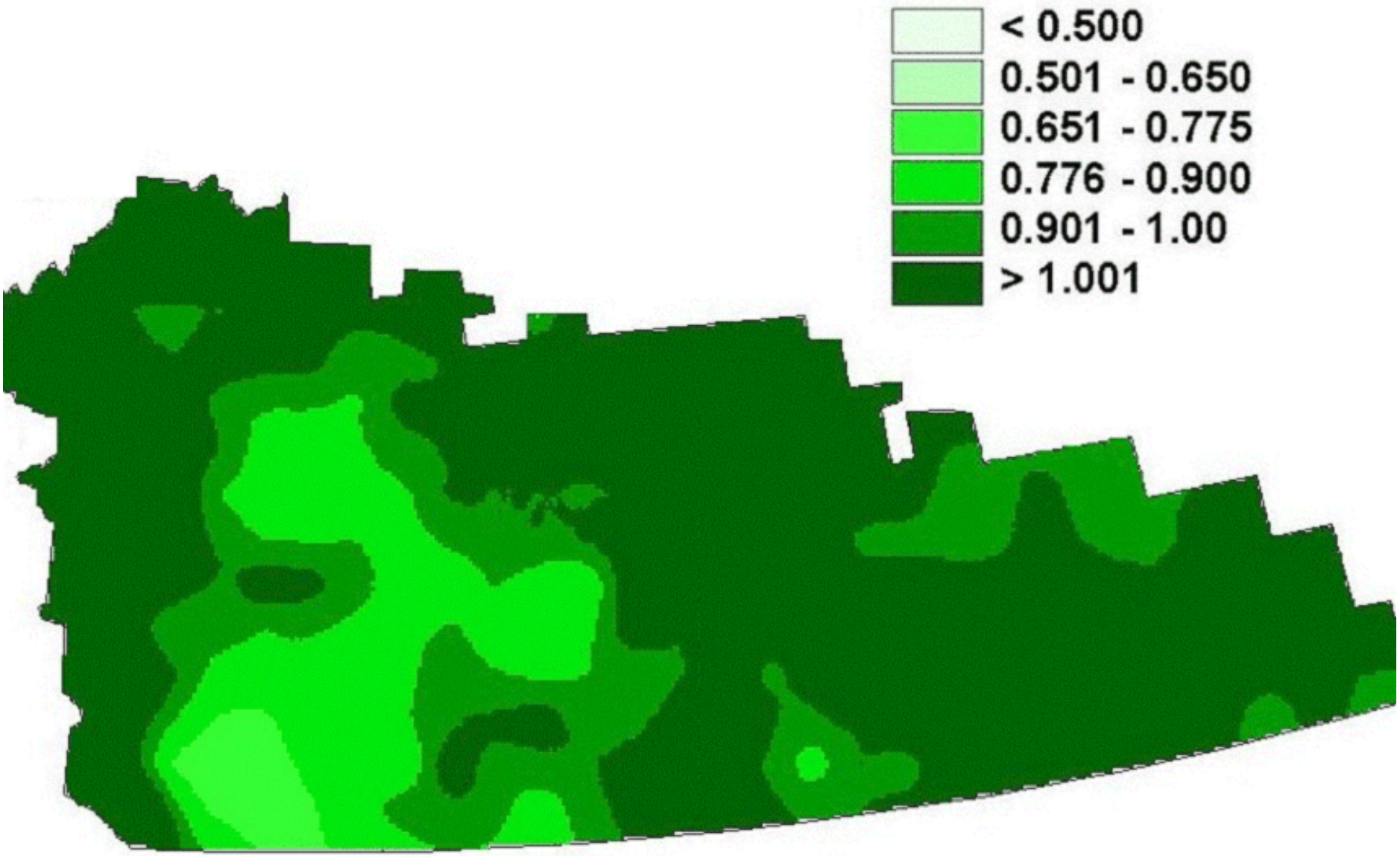
Aridity Index:
Precipitation / Potential Evapotranspiration



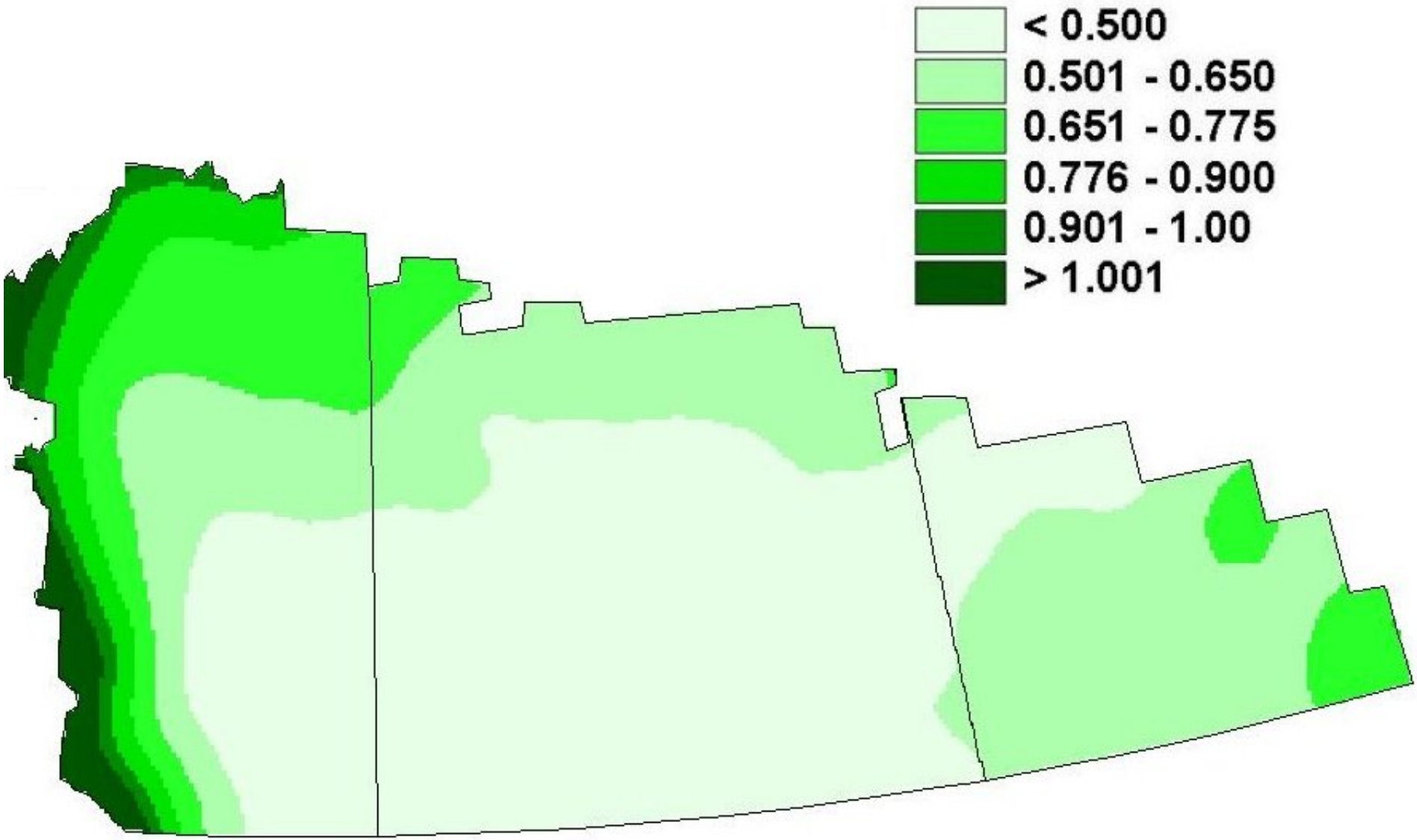
Aridity Index (P/PE), 1961-90



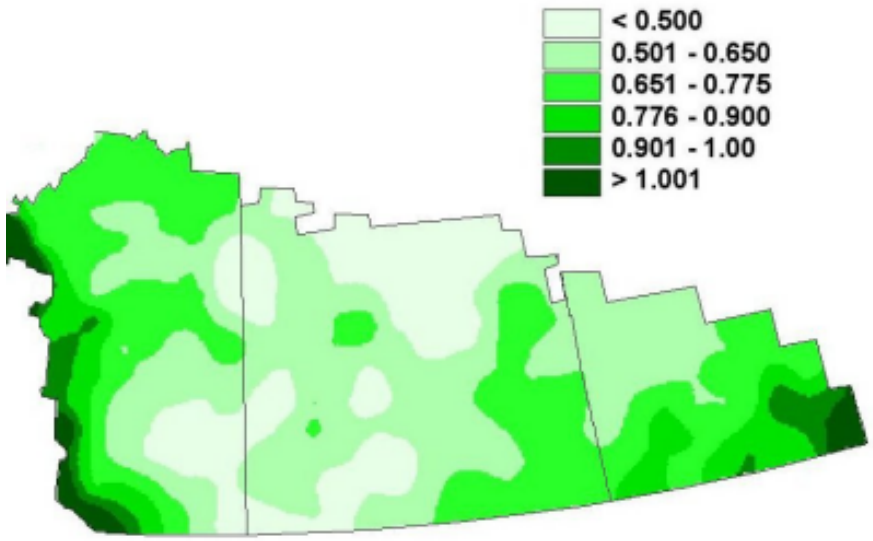
Aridity Index (P/PE), 1954



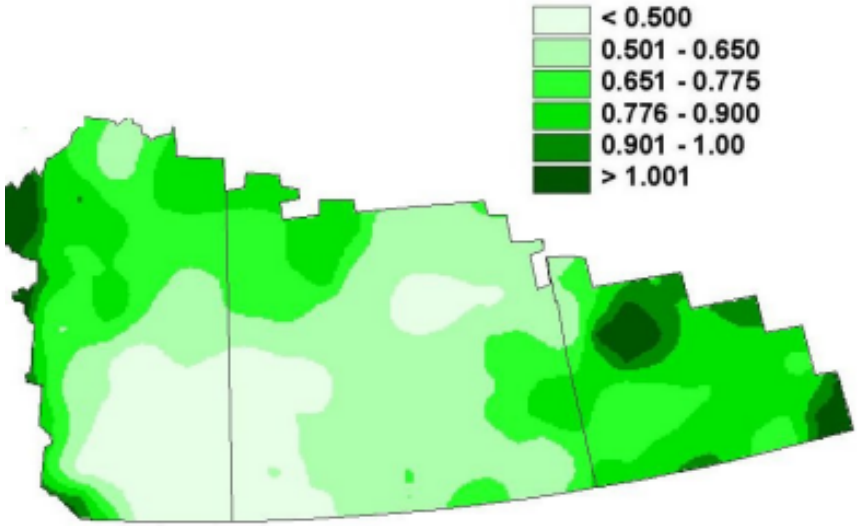
Aridity Index (P/PE), 1961



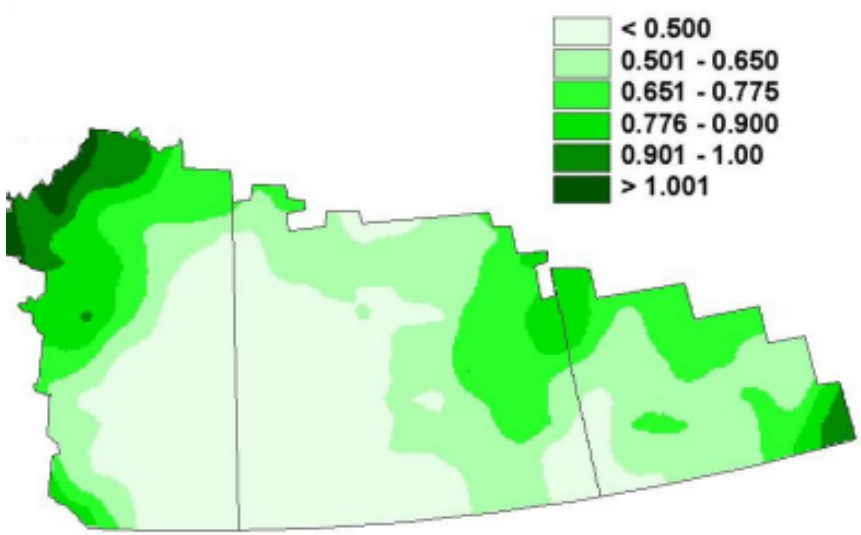
Aridity Index (P/PE), 1928



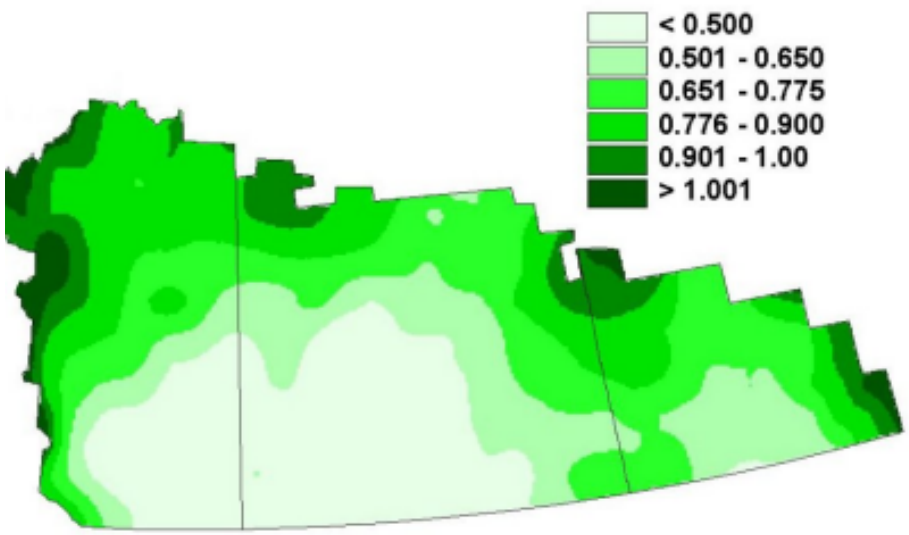
Aridity Index (P/PE), 1943

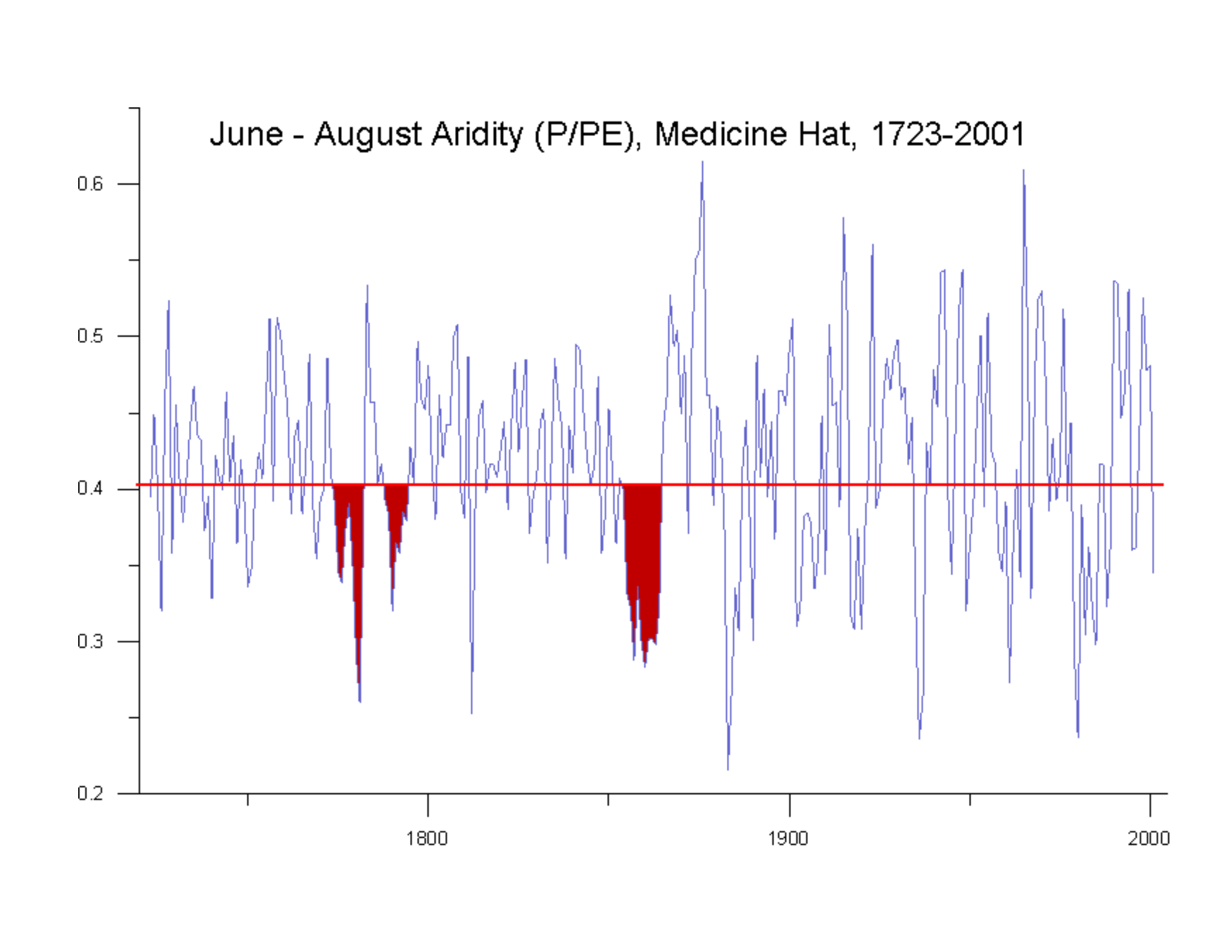


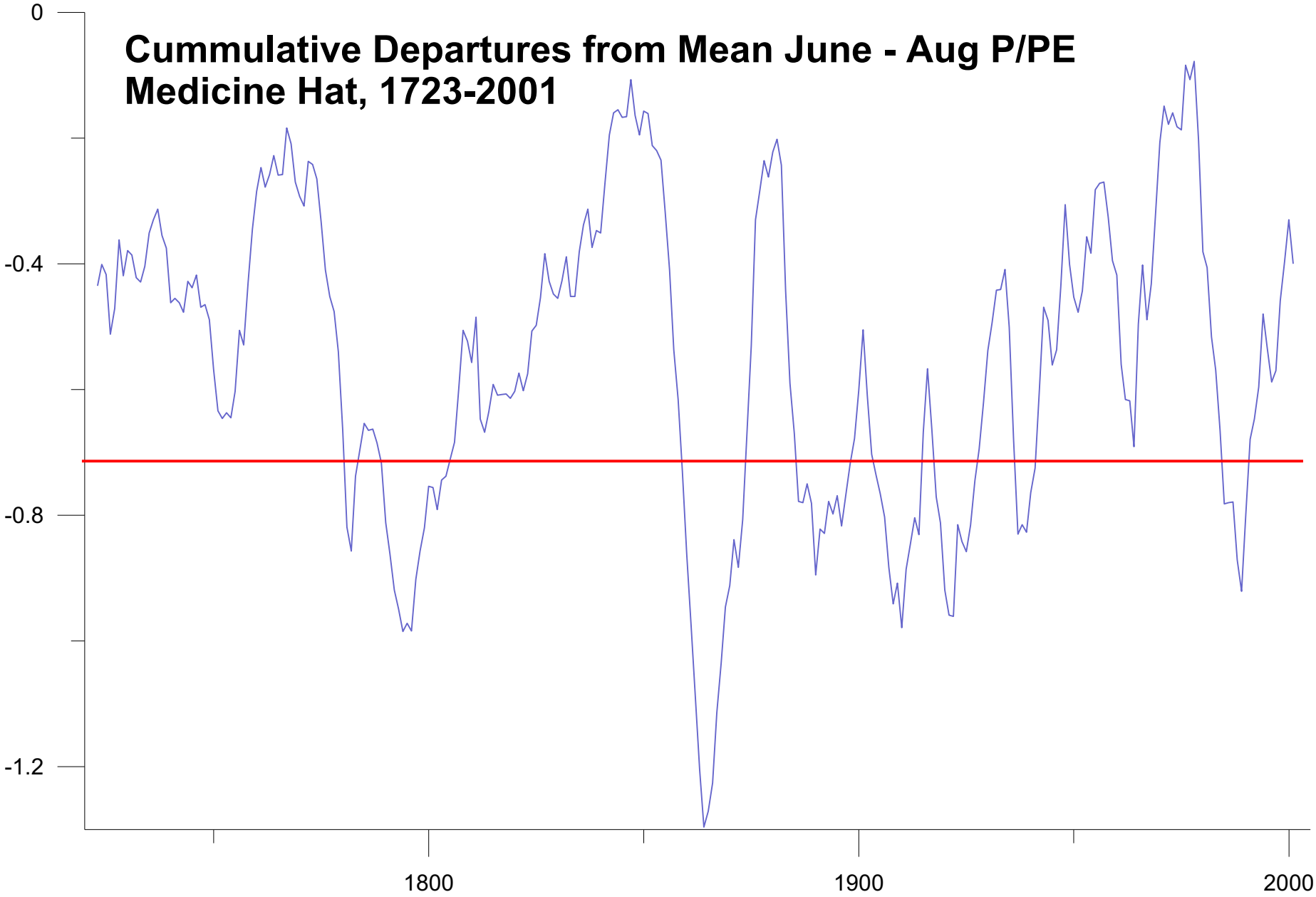
Aridity Index (P/PE), 1936



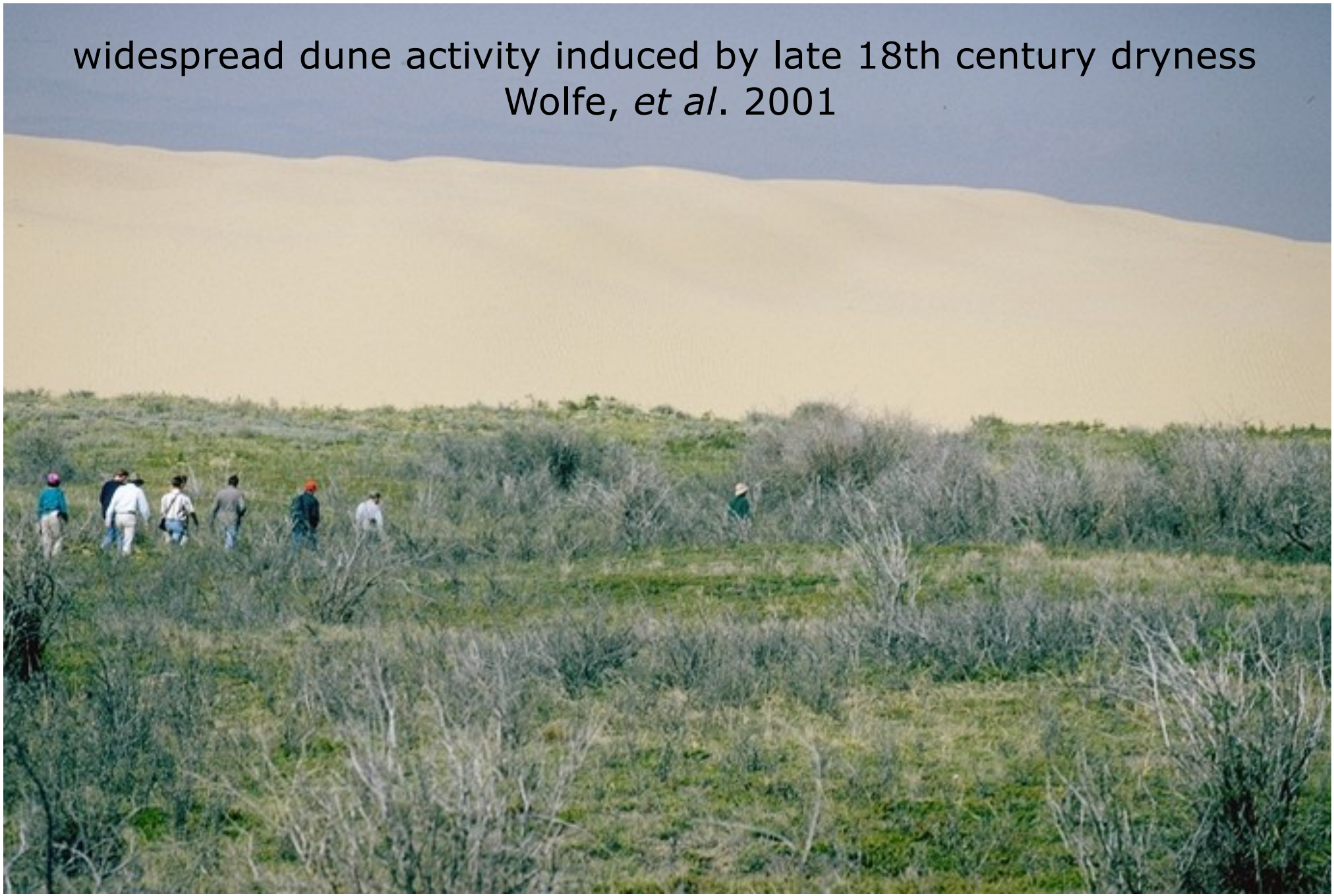
Aridity Index (P/PE), 1988




June - August Aridity (P/PE), Medicine Hat, 1723-2001
0.6
0.5
0.4
0.3
0.2
1800
1900
2000


Cummulative Departures from Mean June - Aug P/PE
Medicine Hat, 1723-2001
0
-0.4
-0.8
-1.2
1800
1900
2000

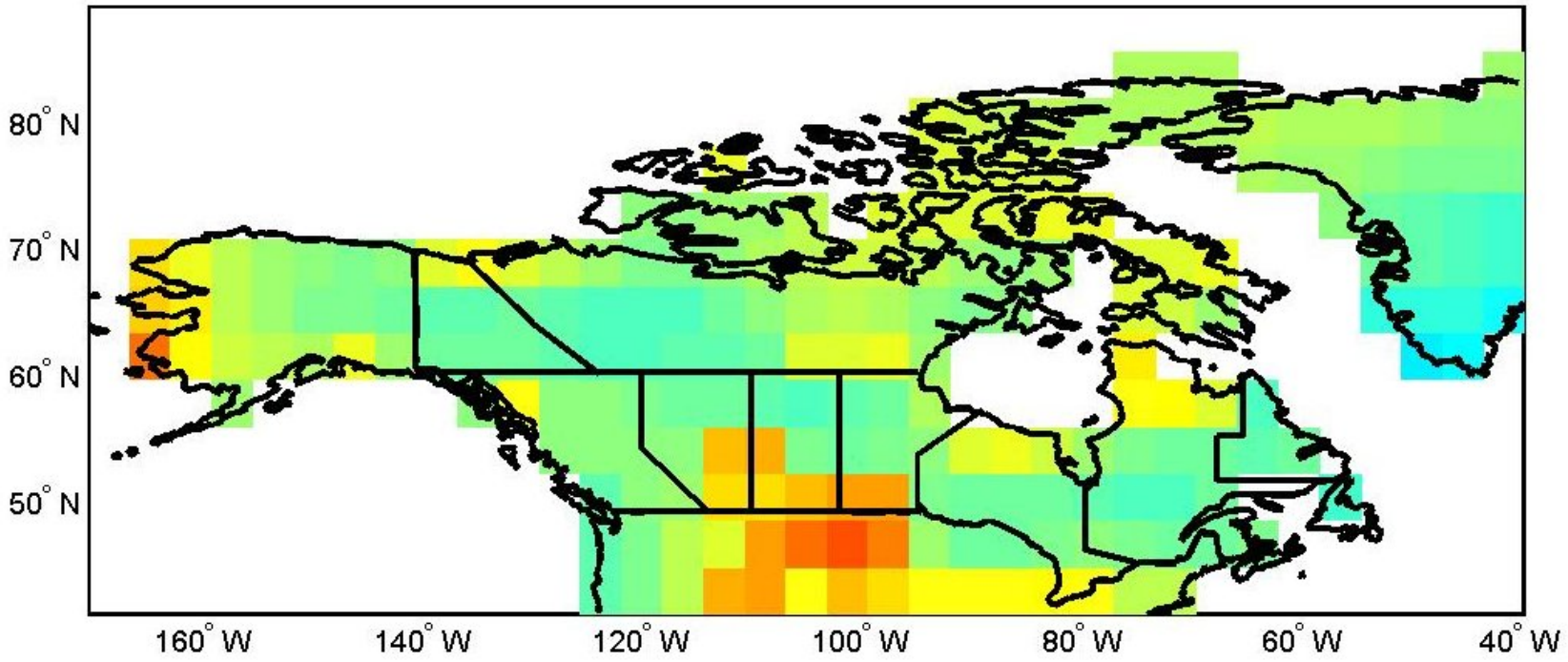
widespread dune activity induced by late 18th century dryness
Wolfe, *et al*. 2001



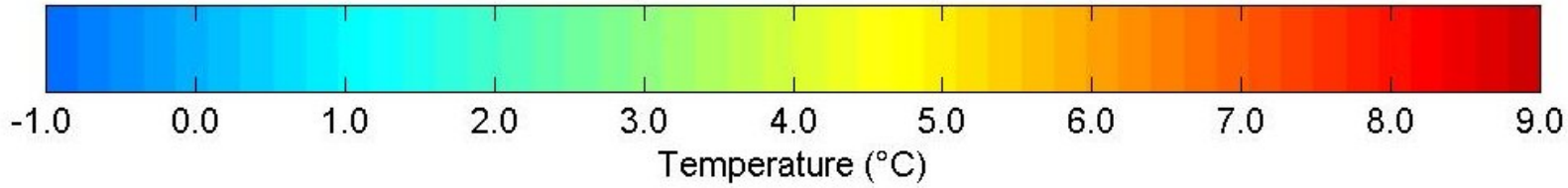
Fort Edmonton – HBC Archives

At Edmonton House, a large fire burned "all around us" on April 27th (1796) and burned on both sides of the river. On May 7th, light canoes arrived at from Buckingham House damaged from the shallow water. Timber intended to be used at Edmonton House could not be sent to the post "for want of water" in the North Saskatchewan River. On May 2nd, William Tomison wrote to James Swain that furs could not be moved as, "there being no water in the river." (Johnson 1967: 33-39, 57)

In 1800 "Fine weather" continued into April at Edmonton House. On April 18th, James Bird repeated his observation that the poor trade with both the Slave and Southern Indians was the result of "the amazing warmness of the winter" diminishing both the bison hunt and creating a "want of beaver." Bird reported "clear weather except for the smoke which almost obscures the sun. The country all round is on fire." On June 15th, he noted that the "amazing shallowness of the water" prevented the shipment of considerable goods from York Factory (Johnson 1967: 240-248)

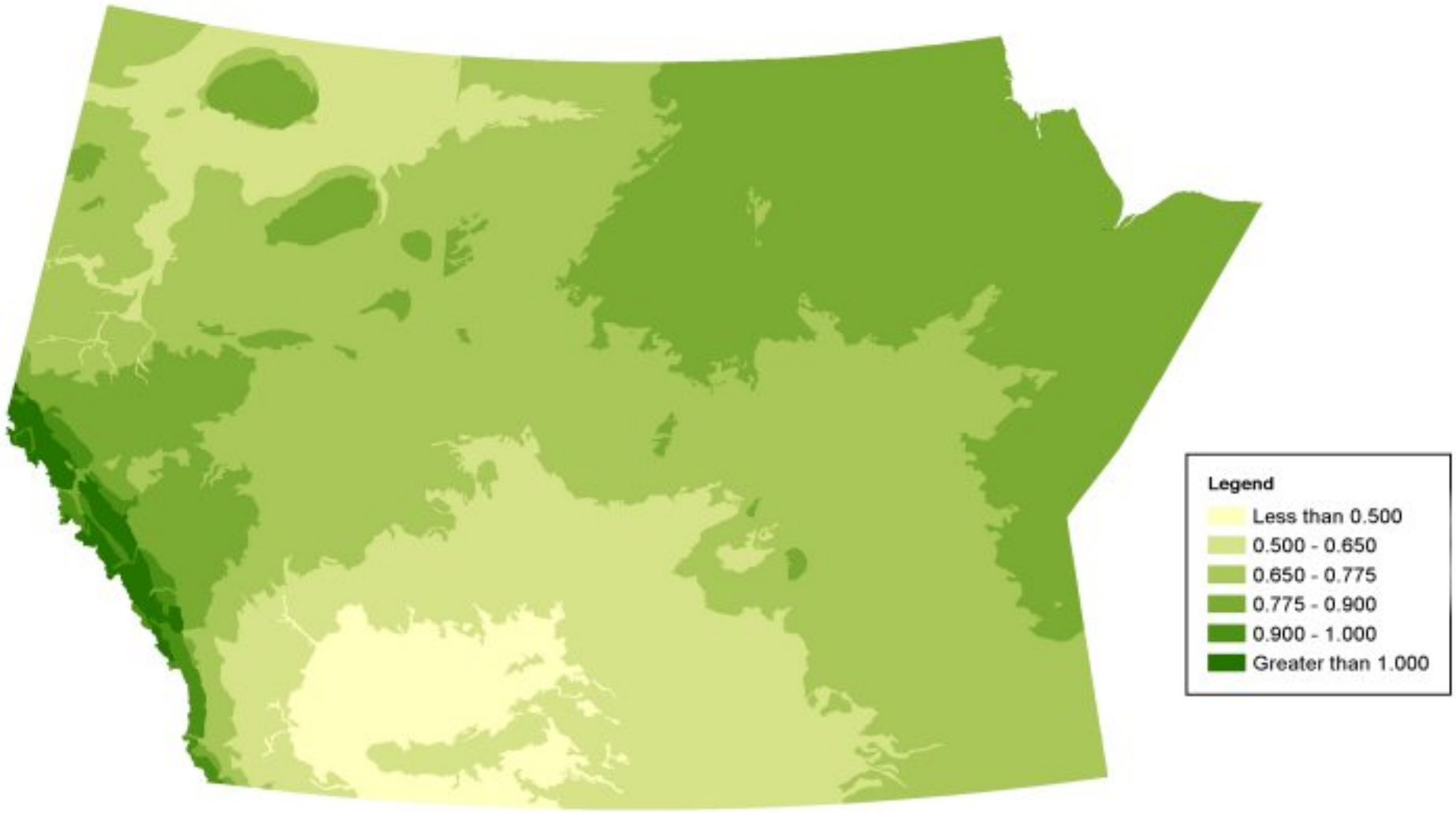


CGCM1, Mean Spring Temperature Change 2050

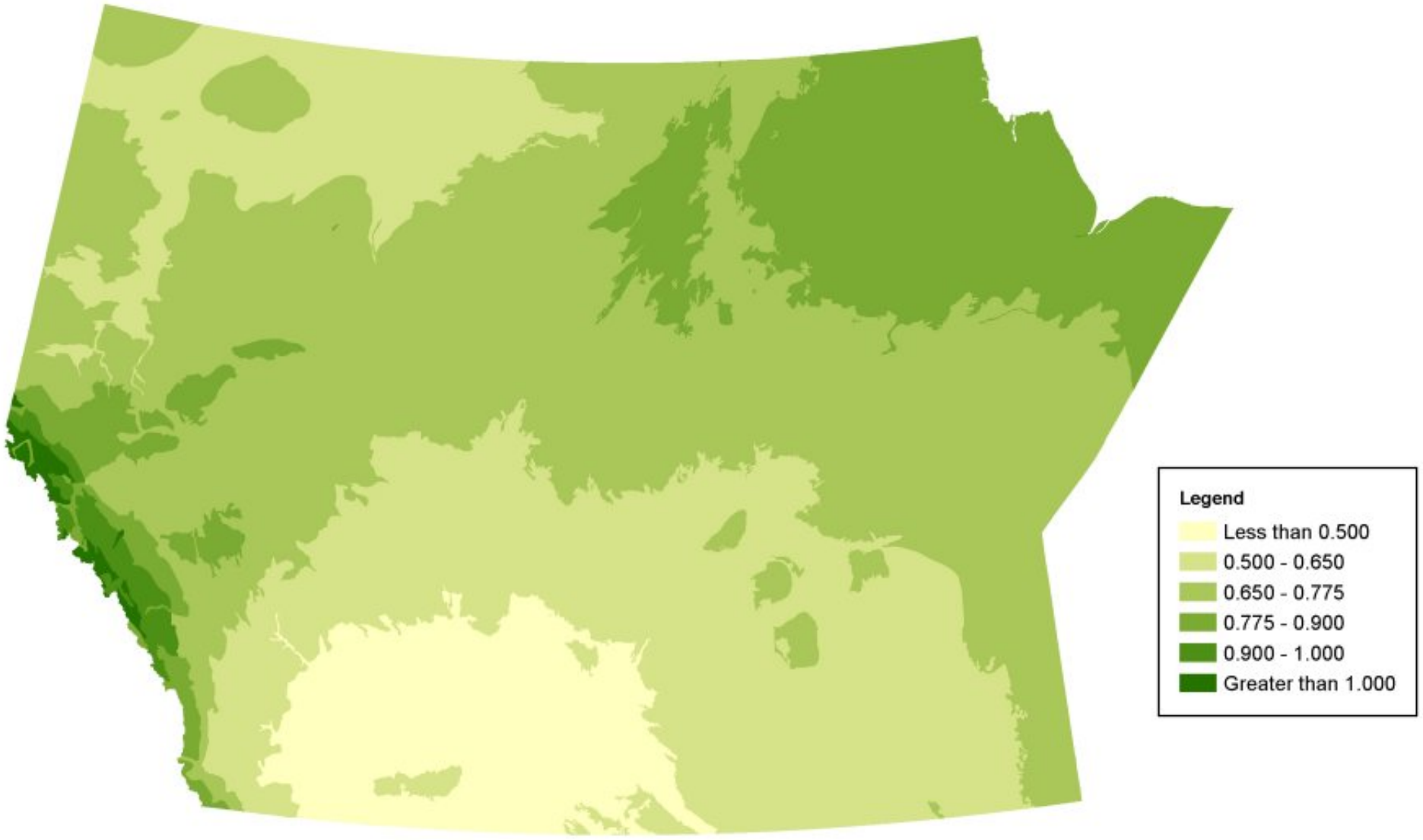


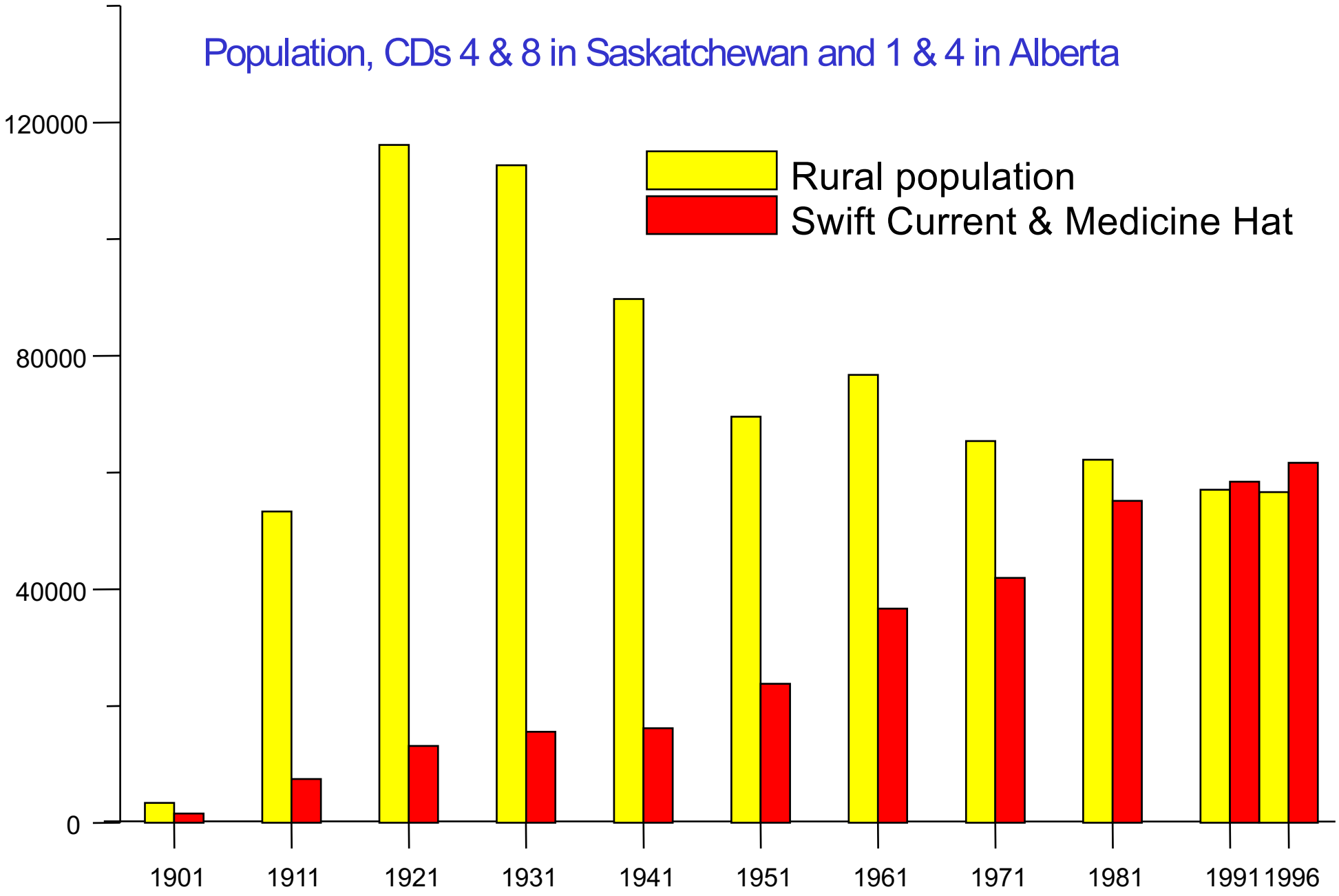
http://www.cics.uvic.ca/scenarios/index.cgi

Summer Aridity Index (P/PE), 1961-1990



Summer Aridity Index (P/PE), 2040-2069




Population, CDs 4 & 8 in Saskatchewan and 1 & 4 in Alberta
120000
80000
40000
0
Rural population
Swift Current & Medicine Hat
1901
1911
1921
1931
1941
1951
1961
1971
1981
1991
1996

Agriculture
Drought Risk Management Plan
for Alberta

STRATEGIC PLAN

Agriculture Drought Risk Management Plan for Alberta

Ad hoc responses to an existing drought crisis may lead to untimely and costly short-term solutions. In contrast, a risk management approach to drought allows an immediate, effective response during a drought crisis, and also reduces drought impacts over the long term through planning and preparedness.

Strategies

- Drought Preparedness — taking action before a drought to increase the level of readiness by all stakeholders.
- Drought Reporting — conducting monitoring, evaluating and reporting on drought-related conditions.
- Drought Response — taking action during and immediately following a drought to reduce its impacts.

The level of drought will be determined objectively, using science-based drought indicators. Accurate, consistent information on drought severity will help policy makers determine the appropriate response to the existing conditions.

1. Normal Conditions Actions

• Conduct ongoing activities such as: developing drought preparedness information for producers; assessing water demands and water resources; and monitoring drought-related characteristics.

2. Drought Alert Actions

• Advise the Ministers of the partner agencies of the Drought Alert status.

• Prepare communications for producers and others on the drought situation and drought-related activities.

• Identify possible actions suited to the needs of the affected areas.

3. Drought Actions

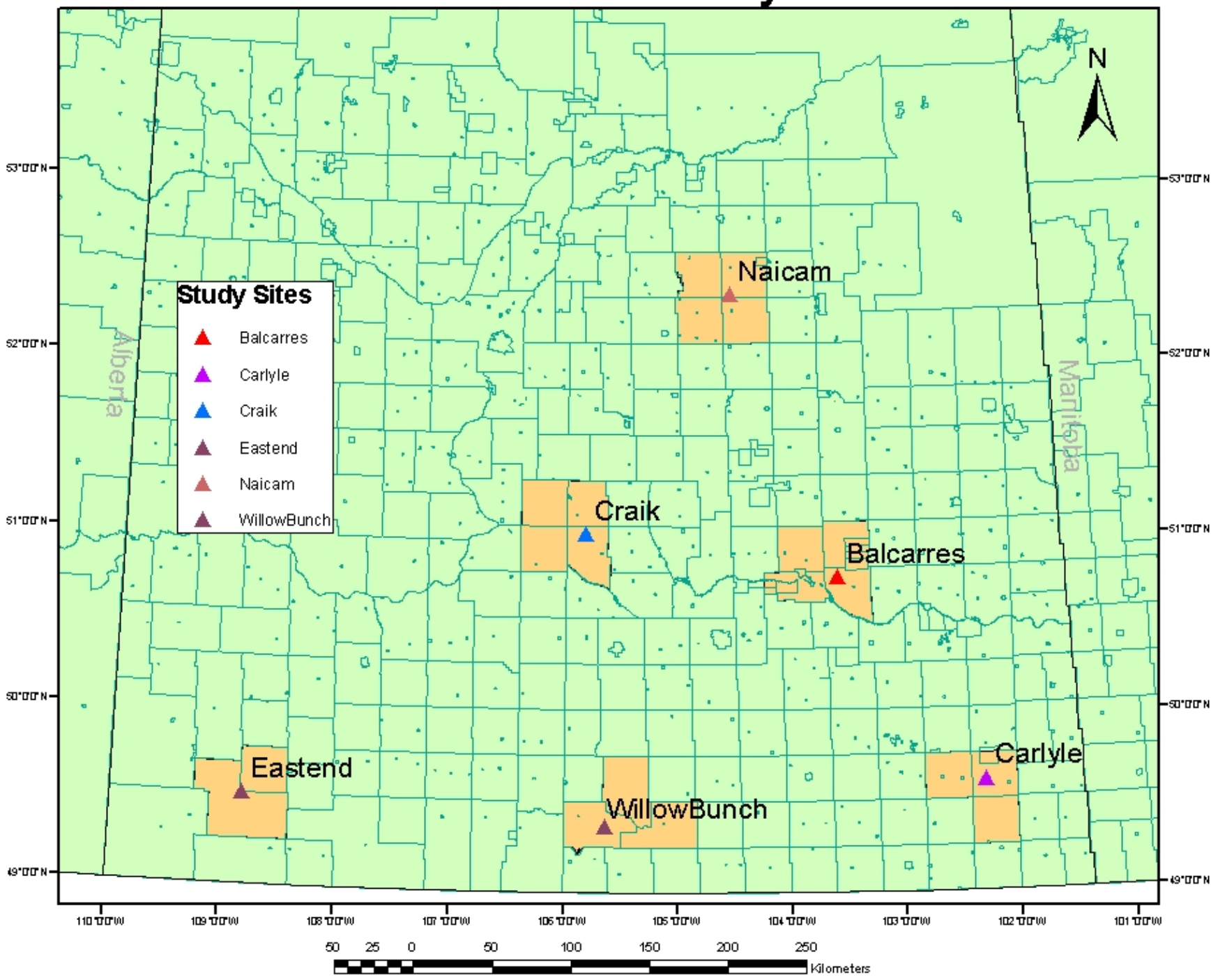
• Recommend that the Alberta Minister of Agriculture declare a Drought in the affected areas.

• Recommend to the appropriate Ministers possible options to respond to the Drought, such as: feed/livestock freight assistance program, emergency water hauling program, reduced rates for dugout water pumping, early assessment for tax deferral, drought disaster loan program, grasshopper control program, direct acreage payments,

• Implement the approved programs.

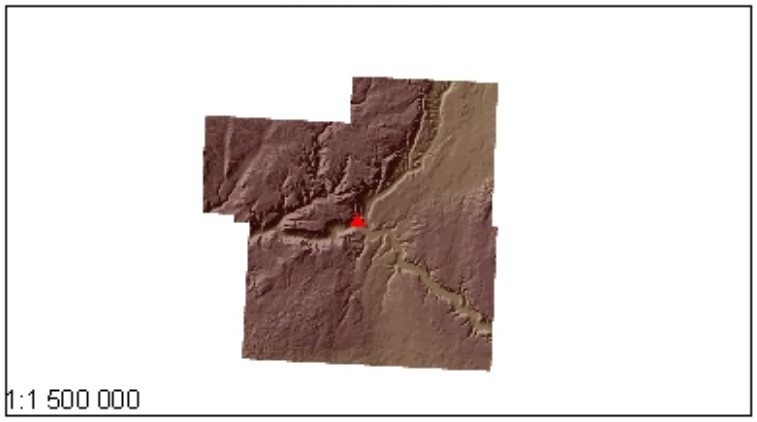

PIONEER

Social Cohesion Project RMs



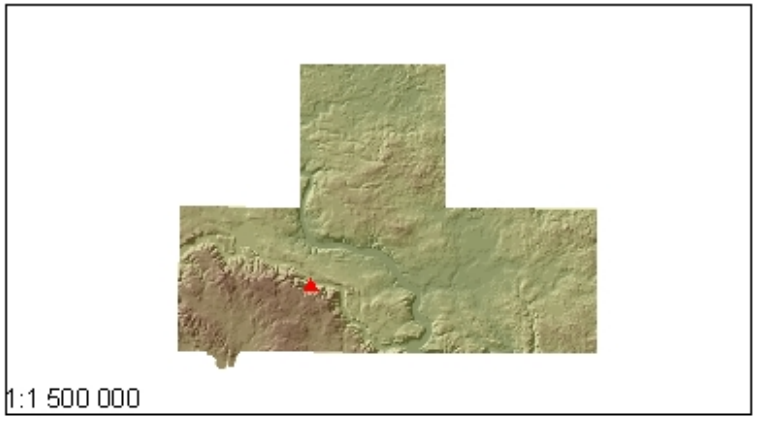
DEM of Study Sites

Eastend



Craik

Willowbunch

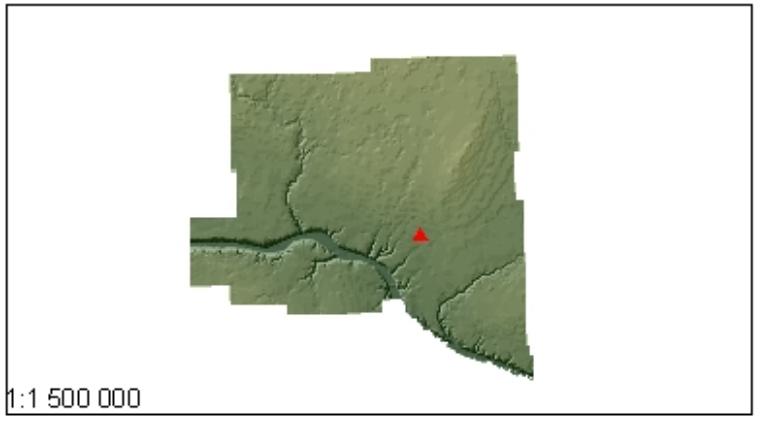


Elevation (m)

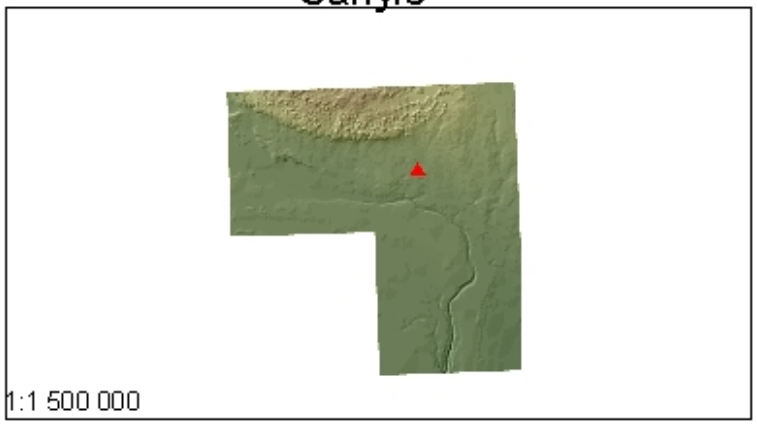
High : 1208

Low : 470

Balcarres

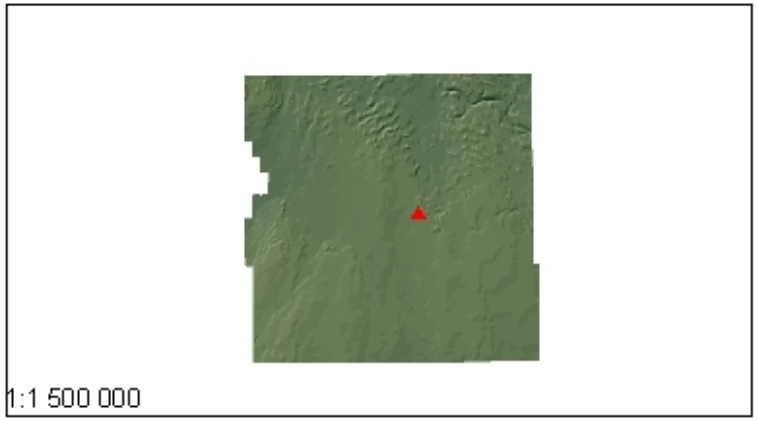


Carlyle

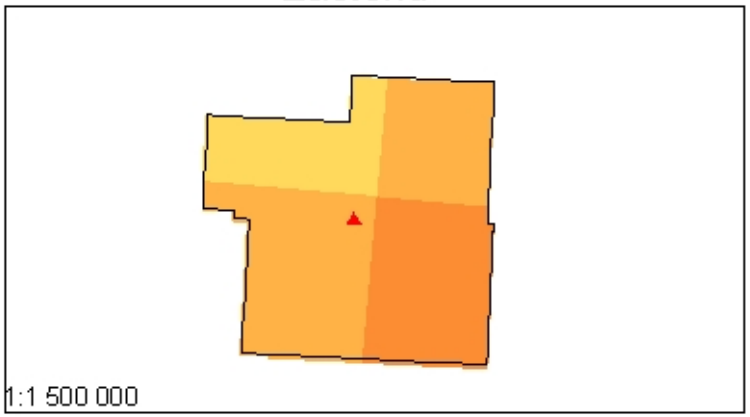


N

Naicam



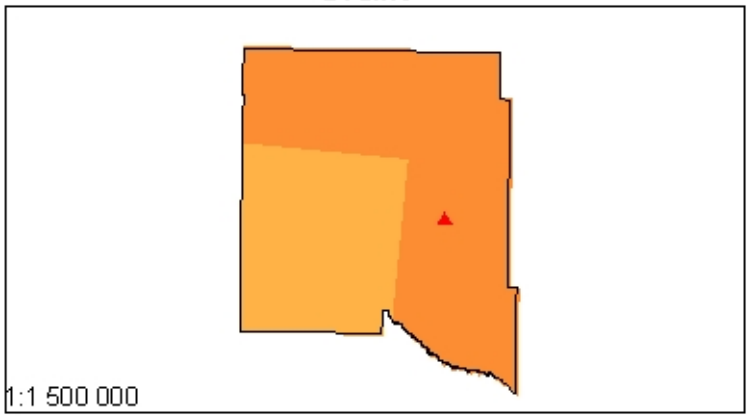
Eastend



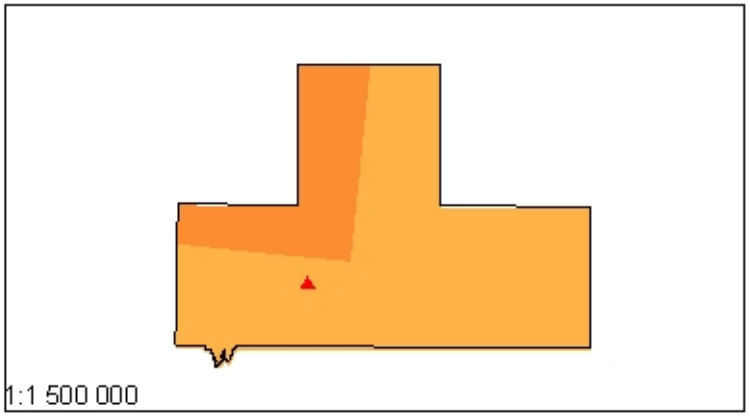
P / P E
1961 - 1990

(Thornthwaite Method)

Craik



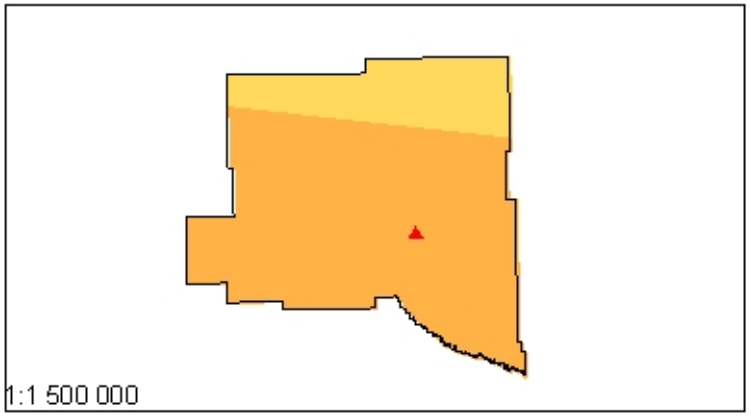
Willowbunch



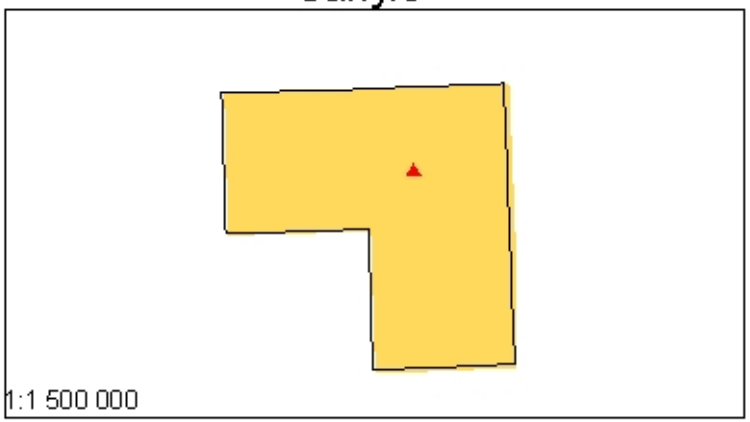
Aridity Index (AI)

- 0 - 0.05
- 0.05 - 0.2
- 0.20 - 0.5
- 0.50 - 0.65
- 0.65 - 0.75
- 0.75 - 0.85
- 0.85 - 1.0

Balcarres

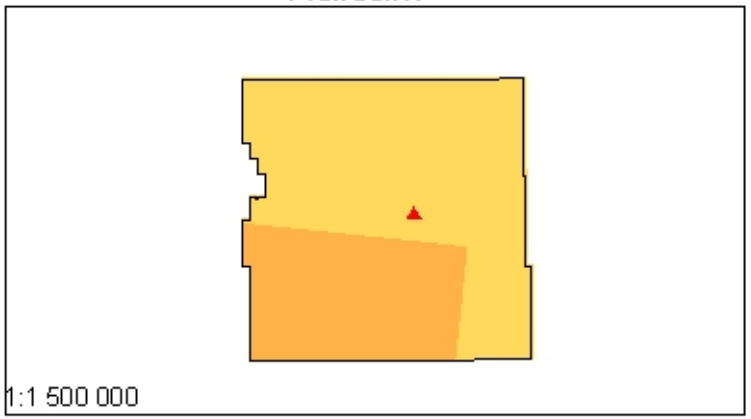


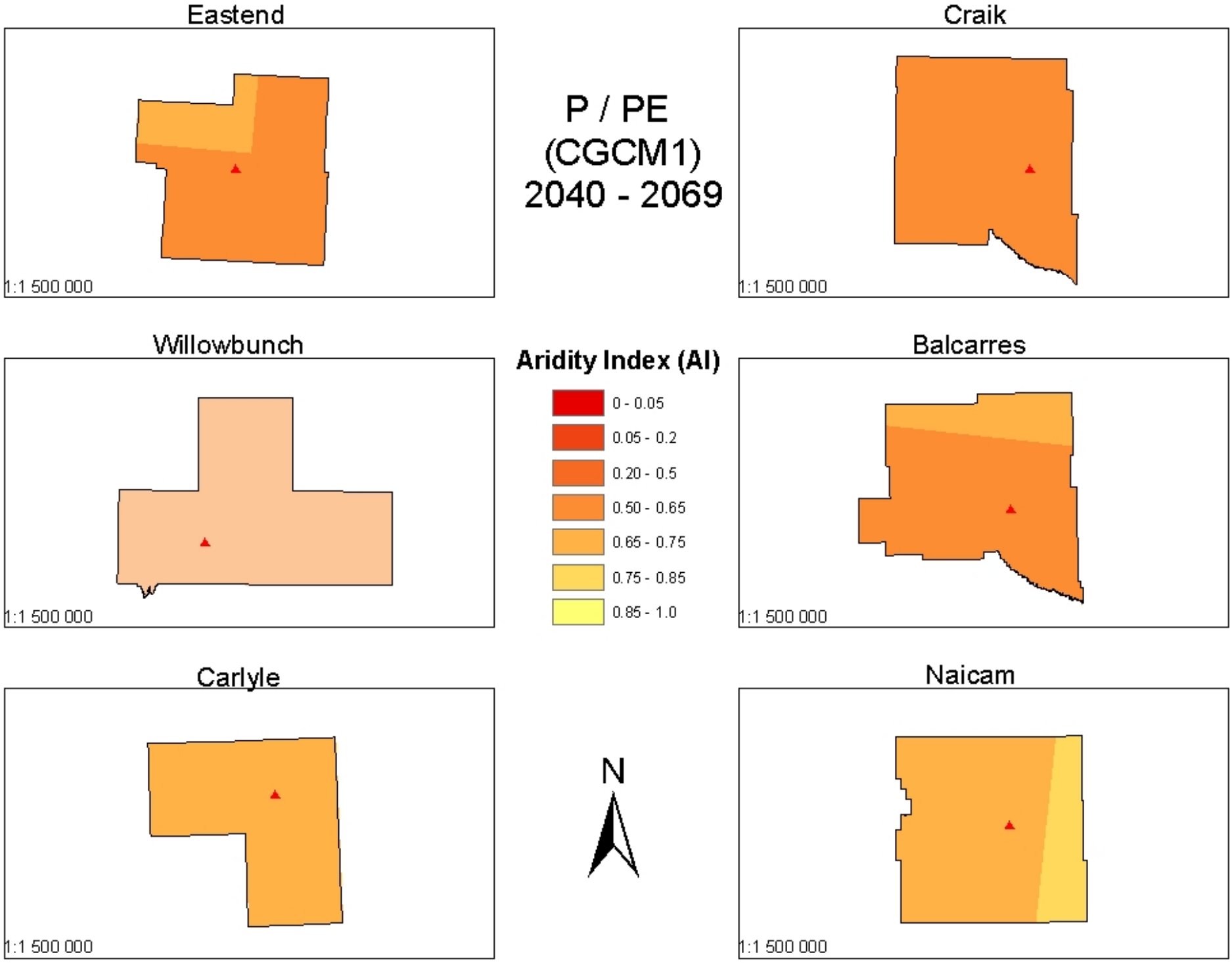
Carlyle



N

Naicam




Eastend
1:1 500 000
P / PE
(CGCM1)
2040 - 2069
Craik
1:1 500 000
Willowbunch
1:1 500 000
Aridity Index (AI)
0 - 0.05
0.05 - 0.2
0.20 - 0.5
0.50 - 0.65
0.65 - 0.75
0.75 - 0.85
0.85 - 1.0
Balcarres
1:1 500 000
Carlyle
1:1 500 000
N
Naicam
1:1 500 000

Social Cohesion Survey

B1 Seriousness of Climate Change

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Serious	209	43.3	45.2	45.2
	Somewhat Serious	205	42.4	44.4	89.6
	Not at all Serious	48	9.9	10.4	100.0
	Total	462	95.7	100.0	
Missing	Don't know	19	3.9		
	Refusal	2	.4		
	Total	21	4.3		
Total		483	100.0		

B2 Doing Anything to Adjust to Climate Change?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Doing Nothing About it Yet	221	45.8	46.2	46.2
	Following Climate Change Issues	161	33.3	33.7	79.9
	Doing Something More Active	96	19.9	20.1	100.0
	Total	478	99.0	100.0	
Missing	Don't Know	1	.2		
	No Response	4	.8		
	Total	5	1.0		
Total		483	100.0		

B3.1 Attempting to Produce Less Greenhouse Gasses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	35	7.2	36.5	36.5
	No	61	12.6	63.5	100.0
	Total	96	19.9	100.0	
Missing	System Missing	387	80.1		
	Total	387	80.1		
Total		483	100.0		

B3.2 Attending Workshops

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	10	2.1	10.4	10.4
	No	86	17.8	89.6	100.0
	Total	96	19.9	100.0	
Missing	System Missing	387	80.1		
	Total	387	80.1		
Total		483	100.0		

B3.4 Modifying Farm/Business Management to Take Advantage of Change

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	6.2	31.3	31.3
	No	66	13.7	68.8	100.0
	Total	96	19.9	100.0	
Missing	System Missing	387	80.1		
	Total	387	80.1		
Total		483	100.0		

B3.3 Modifying Farm/Business Management Reduce Vulnerability

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	47	9.7	49.0	49.0
	No	49	10.1	51.0	100.0
	Total	96	19.9	100.0	
Missing	System Missing	387	80.1		
	Total	387	80.1		
Total		483	100.0		

B4.2 Importance of Government Policies: Facilitate Such Adjustments

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Important	40	8.3	44.0	44.0
	Somewhat Important	40	8.3	44.0	87.9
	Not Important	11	2.3	12.1	100.0
	Total	91	18.8	100.0	
Missing	N/A	1	.2		
	Don't know	3	.6		
	Refusal	1	.2		
	System Missing	387	80.1		
	Total	392	81.2		
Total		483	100.0		

B1 Seriousness of Climate Change: Taken Post-Secondary Education - Crosstabulation

			C2 Taken Post-Secondary Education		
			1 Yes	2 No	Total
B1 Seriousness of Climate Change	Very Serious	Count	118	90	208
		% within C2 Taken Post-Secondary Education	44.0%	46.9%	45.2%
	Somewhat Serious	Count	126	78	204
		% within C2 Taken Post-Secondary Education	47.0%	40.6%	44.3%
	Not at all Serious	Count	24	24	48
		% within C2 Taken Post-Secondary Education	9.0%	12.5%	10.4%
Total		Count	268	192	460
		% within C2 Taken Post-Secondary Education	100.0%	100.0%	100.0%

B2 Doing Anything to Adjust to Climate Change? Taken Post-Secondary Education - Crosstabulation

			C2 Taken Post-Secondary Education		
			1 Yes	2 No	Total
B2 Doing Anything to Adjust to Climate Change?	Doing Nothing About it Yet	Count	102	118	220
		% within C2 Taken Post-Secondary Education	37.9%	56.7%	46.1%
	Following Climate Change Issues	Count	97	64	161
		% within C2 Taken Post-Secondary Education	36.1%	30.8%	33.8%
	Doing Something More Active	Count	70	26	96
		% within C2 Taken Post-Secondary Education	26.0%	12.5%	20.1%
Total		Count	269	208	477
		% within C2 Taken Post-Secondary Education	100.0%	100.0%	100.0%

B1 Seriousness of Climate Change: Own Farm and/or Business? Crosstabulation

			D3 Own Farm and/or Business?				
			1 Yes, Own a Farm	2 Yes, Own a Business	3 Yes, Own a Farm & Business	4 No	Total
B1 Seriousness of Climate Change	Very Serious	Count	78	20	12	99	209
		% within D3 Own Farm and/or Business?	**46.7%**	**34.5%**	24.5%	52.7%	45.2%
	Somewhat Serious	Count	71	33	30	71	205
		% within D3 Own Farm and/or Business?	42.5%	56.9%	61.2%	37.8%	44.4%
	Not at all Serious	Count	18	5	7	18	48
		% within D3 Own Farm and/or Business?	10.8%	8.6%	14.3%	9.6%	10.4%
Total		Count	167	58	49	188	462
		% within D3 Own Farm and/or Business?	100.0%	100.0%	100.0%	100.0%	100.0%

B2 Doing Anything to Adjust to Climate Change? Own Farm and/or Business? Crosstabulation

			D3 Own Farm and/or Business?				
			1 Yes, Own a Farm	2 Yes, Own a Business	3 Yes, Own a Farm & Business	4 No	Total
B2 Doing Anything to Adjust to Climate Change?	Doing Nothing About it Yet	Count	68	35	17	101	221
		% within D3 Own Farm and/or Business?	39.5%	62.5%	34.7%	50.2%	46.2%
	Following Climate Change Issues	Count	54	14	18	75	161
		% within D3 Own Farm and/or Business?	31.4%	25.0%	36.7%	37.3%	33.7%
	Doing Something More Active	Count	50	7	14	25	96
		% within D3 Own Farm and/or Business?	**29.1%**	12.5%	**28.6%**	12.4%	20.1%
Total		Count	172	56	49	201	478
		% within D3 Own Farm and/or Business?	100.0%	100.0%	100.0%	100.0%	100.0%

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