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Agroecological Resource Area Databases for the Prairies: User's Manual

Centre for Land
and Biological Resources Research

Centre de recherches sur les
terres et les ressources biologiques

Canada

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Conception par le Service aux programmes de recherches.

Agroecological Resource Area Databases for the Prairies: User's Manual

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Abstract

Data files associated with the Agroecological Resource Area (ARA) maps for the Canadian Prairies include compiled data on soil and landform, regional climate, soil moisture conditions, simulated wheat yields under dryland conditions, and farm economics and land use information from the Census of Agriculture. The data are stored within an ARC/INFO Geographic Information System (GIS).

Agroecological Resource Areas (ARAs) are biophysically homogenous units at a scale of 1:2 million, based on ecoclimatic zonation, landform and soil characteristics. These units can be used to study agricultural systems, land use, conservation, and the impacts of various management and socio-economic practices. They are a convenient planning unit upon which to develop databases for use in agricultural research.

The digitized ARA maps for Alberta, Saskatchewan and Manitoba, and the associated data files, currently reside in an ARC/INFO GIS which is part of the Canada Soil Information System (CanSIS).

Résumé

Les fichiers de données associées à la représentation cartographique de Zones de Ressources Agroécologiques (ZRA) des provinces des Prairies comprennent des données pédologiques, géomorphologiques et climatiques ainsi que des données d'eau dans le sol, des simulations de rendements de blé en conditions arides, et de l'information sur l'utilisation des terres et l'économie à l'échelle de la ferme du Recensement de l'Agriculture. Ce Système d'Information Géographique (SIG) regroupe plusieurs bases de données qui sont accessibles par ARC/INFO.

Les Zones de Ressources Agroécologiques (ZRA) sont des unités cartographiques comportant des caractères biophysiques homogènes rapportées à une échelle de 1:2,000,000. Ces zones sont délimitées par des facteurs particuliers de pédologie, de formes de terrain et d'éco-climat. Ces unités peuvent être utilisées pour la planification d'études sur la situation agricole, la conservation et l'utilisation des terres et l'impact de divers systèmes de régie et de politiques socio-économiques.

Des cartes numériques ZRA sont disponibles pour l'Alberta, la Saskatchewan et le Manitoba et leurs bases de données correspondantes, en système SIG, actionnées par ARC/INFO font aussi partie du Système d'Information sur les Sols au Canada (SISCan).

Preface

Many people have taken part in the development of the data files associated with the Agroecological Resource Area maps. The following is a list of the various data files, and the names of the people who developed them:

Basic Climate Data (CLIMBAS.DAT) – A. Bootsma
Climate Indices (CLIMIND.DAT) – A. Bootsma
Daily Climatic Data (DAILY.DAT) – A. Bootsma
Economic Data (ECONOMICS.DAT) – E.C. Huffman, J.C. Hiley, V. Kirkwood
Forage Aridity Index (FORARID.DAT) – A. Bootsma
Land Use Data (LANDUSE.DAT) – E.C. Huffman, J.C. Hiley, V. Kirkwood
Simulated Wheat Yields (SIMYLDWH.DAT) – C. Onofrei
General Soil and Landform Information (SOILBASE.DAT) – W.W. Pettapiece
Soil Cross Tabulation Link (SOILLINK.DAT) – R.G. Eilers, G.A. Padbury, J. Tajek, V. Kirkwood
Soil Temperature File (SOILTEMP.DAT) – A. Bootsma
Wheat Stress Data (WHTSTRESS.DAT) – R. de Jong

1.0 Introduction

The Agroecological Resource Area maps were developed to provide biophysically homogenous units at a scale of 1:2 million which can be used to study agriculture, land use and conservation. These Agroecological Resource Areas (ARAs) represent areas of generally similar agricultural potential, and are based on ecoclimatic zonation, landform and soil characteristics (Figure 1).

The ARAs have served as a convenient planning unit upon which to develop data for use in agricultural research. It is the purpose of this report to document the types of information stored in these data files.

The digitized ARA maps for Alberta, Saskatchewan and Manitoba, and the associated data files, currently reside in an ARC/INFO Geographic Information System (GIS). This GIS is part of the Canadian Soil Information System (CanSIS). The common linking factor, or key, between all the ARA data files is the combined ARA number and province designation. ARA numbers are unique within provinces. The addition of the province code makes the key unique country-wide. There is also a linkage, through the soil series code, to the Soil Names File and Soil Layer File, which are stored in the National Soil DataBase.

Data can be exported from these files in Arc Export or ASCII format, along with appropriate file documentation. Requests to obtain these data should be addressed to:

Dr. J. Dumanski, Research Scientist,
Centre for Land and Biological Resources Research,
Research Branch, Agriculture Canada,
Central Experimental Farm, Building 74,
Ottawa, Ontario,
Canada, K1A 0C6

The ARA maps can be obtained in electronic or hard copy format by contacting:

Head, CanSIS,
Centre for Land and Biological Resources Research,
Research Branch, Agriculture Canada,
Central Experimental Farm, Neatby Building,
Ottawa, Ontario
Canada, K1A 0C6

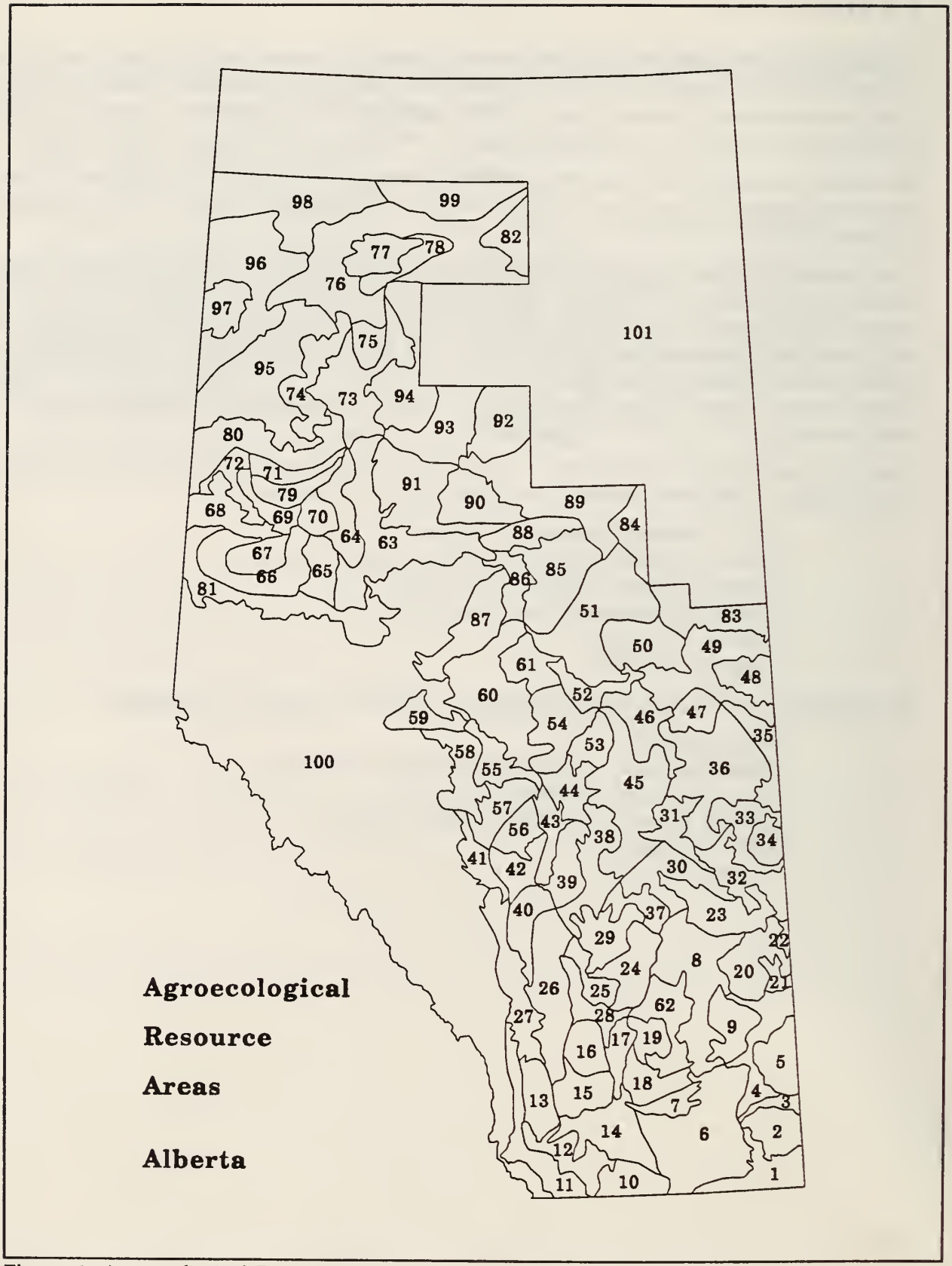

Figure 1 Agroecological Resource Area Map of Alberta

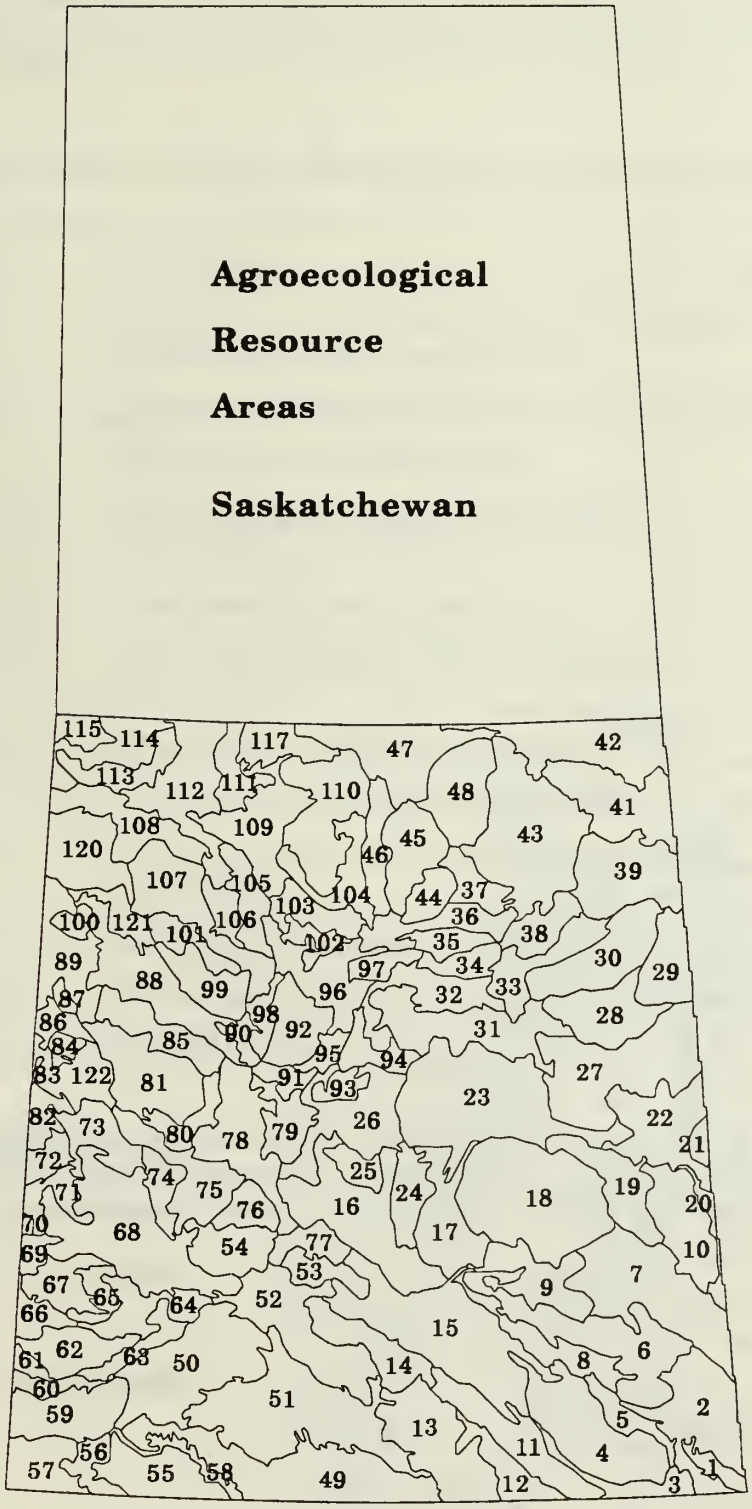

Figure 2 Agroecological Resource Area Map of Saskatchewan

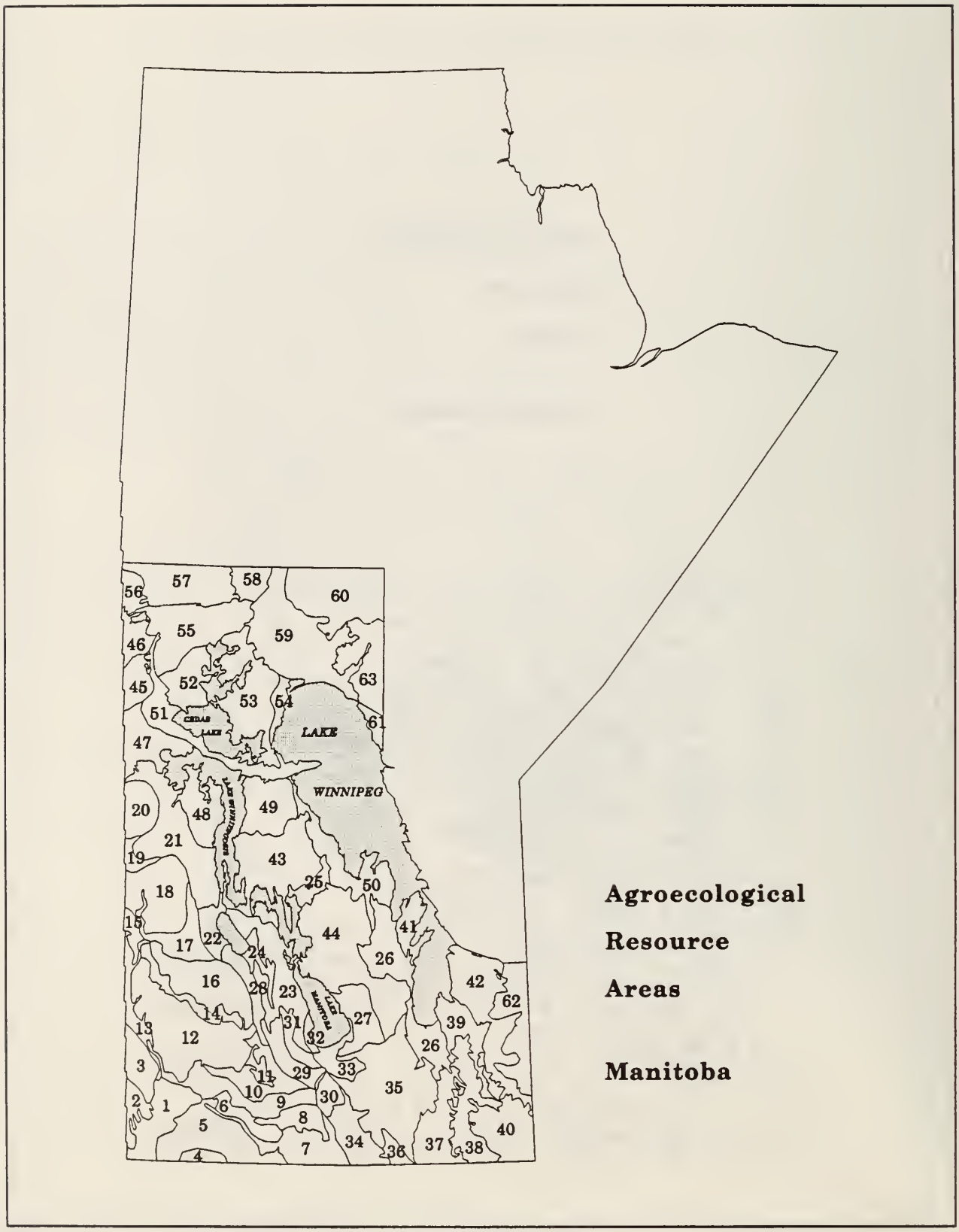

Figure 3 Agroecological Resource Area Map of Manitoba

2.0 Data Files Associated with the Agroecological Resource Area Maps

The data can be grouped into two broad categories: measured or derived physical values which can be used as input to various models; and the output from several crop, soil moisture and climate models (Table 1).

Table 1 Data Files Associated with the Agroecological Resource Area Maps

Data File Name	Description	Data Type
CLIMBAS.DAT	Basic Climate Data based on 1951–80 normals, reported as average monthly values	Derived
CLIMIND.DAT	Climate indices derived from the 1951–80 normals	Derived
DAILY.DAT	Daily climate data, 1955–1985	Measured
ECONOMICS.DAT	Economic data, Census of Agriculture, 1981 & 1986	Measured
FORARID.DAT	Forage Aridity Index, 1965–1985	Modelled
LANDUSE.DAT	Crop proportions, Census of Agriculture, 1981 & 1986	Measured
SIMYLDWH.DAT	Output from PIXMOD wheat model	Modelled
SOILBASE.DAT	General soil and landform information	Derived
SOILLINK.DAT	Cross tabulation link into Soil Names and Soil Layer files	Measured
SOILTEMP.DAT	Soil temperature data by month	Modelled
WHTSTRESS.DAT	Wheat stress data using Versatile Soil Moisture Budget	Modelled

Data file and variable names appear in this manual in the form in which they must be used during an ARC/INFO retrieval request. The ordering of the variables within each data file is the same as will appear on the computer screen during an ARC/INFO retrieval request.

2.1 Basic Climate Data CLIMBAS.DAT

This data file contains monthly values for a number of basic climate variables, which were derived from Atmospheric Environment Service (AES) station normals data (1951–1980) using a combination of Thiessen polygon routines and expert knowledge. Solar radiation data are based on a 100 km grid database of 1951–1980 climatic normals data. Vapour pressure and wind are from a 1941–1970 100 km grid.

Items from this file are retrieved by choosing the appropriate variable number, and the months desired. The variable numbers are as follows:

VARIABLE NUMBER	VARIABLE	REPORTING UNITS
2	Mean Daily Maximum Air Temperature	0.1°C
3	Mean Daily Minimum Air Temperature	0.1°C
4	Mean Daily Temperature	0.1°C
5	Rainfall	0.1 mm
6	Snowfall	0.1 cm
7	Total Precipitation	0.1 mm
8	Solar Radiation at Surface	0.01 $MJ/m^2/day$
9	Vapour Pressure	0.01 mb
10	Mean Wind Speed at 10 m or 33 ft. height	0.01 m/sec
11	Extreme Maximum Temperature	0.1°C
12	Extreme Minimum Temperature	0.1°C
13	Number of Days with Rain	0.1 day

N.B. The decimal point is not included in the data; therefore, for example, a mean daily maximum air temperature shown as 100 should be interpreted as 10.0.

One record per ARA per variable.

ITEM NAME	DESCRIPTION
ARANO	ARA Number
PROV	Province
VAR	Variable Number as explained above
JANV	Variable Value for January
FEBV	Variable Value for February
MARV	Variable Value for March
APRV	Variable Value for April
MAYV	Variable Value for May
JUNV	Variable Value for June
JULV	Variable Value for July
AUGV	Variable Value for August
SEPV	Variable Value for September
OCTV	Variable Value for October
NOVV	Variable Value for November
DECV	Variable Value for December

2.2 Climate Indices

CLIMIND.DAT

The data in this file were derived from the 1951–80 climate normals provided by the Atmospheric Environment Service (AES). AES station data were adjusted using a combination of Thiessen polygon routines and expert knowledge to provide one value per ARA. Potential evapotranspiration values were derived from daily temperature normals interpolated from monthly values using Baier and Robertson (1965) formula 1.

Reference: Bootsma and Boisvert (1991).

One record per ARA.

ITEM NAME	DESCRIPTION	REPORTING UNITS
ARANO	ARA Number	
PROV	Province	
JANPE	January Potential Evapotranspiration	.1 mm
FEBPE	February Potential Evapotranspiration	.1 mm
MARPE	March Potential Evapotranspiration	.1 mm
APRPE	April Potential Evapotranspiration	.1 mm
MAYPE	May Potential Evapotranspiration	.1 mm
JUNPE	June Potential Evapotranspiration	.1 mm
JULPE	July Potential Evapotranspiration	.1 mm
AUGPE	August Potential Evapotranspiration	.1 mm
SEPPE	September Potential Evapotranspiration	.1 mm
OCTPE	October Potential Evapotranspiration	.1 mm
NOVPE	November Potential Evapotranspiration	.1 mm
DECPE	December Potential Evapotranspiration	.1 mm
YEARPE	Annual PE	.1 mm

N.B. The following are based on mean daily air temperature, interpolated from monthly normal values using Brooks (1943) sine wave interpolation. All values are rounded to the nearest whole unit.

GDD>5C	Growing Degree Days >5°C - accumulated from 10 days after mean daily temp. >5°C or Apr. 1, whichever is later, to date of mean temp. min. ≤5°C or Oct 31, whichever is earlier	
YRGDD>5C	Seasonal Growing Degree Days >5°C - accumulated from date mean daily temp. >5°C in spring (GSS) to date mean temp. <5°C in fall (GSE)	
GSS	Growing Season Start - date mean daily air temp. ≥5°C in spring	Julian day #
GSE	Growing Season End - date mean daily air temp. ≤5°C in fall	Julian day #
GDD>15C	Growing Degree Days >15°C - accumulated from time mean temp. >15°C in spring to time mean temp. <15°C in fall	
ACCCHU1	Accumulated Corn Heat Units (CHUE1) - CHU for silage corn; from CHUS to CHUE1	
ACCCHU2	Accumulated Corn Heat Units (CHUE2) - CHU for grain corn from CHUS to CHUE2	

CHUS	Start date for CHU accumulation - Date when CHU accumulation starts as determined by when mean temp. ≥9°C (estimated seeding date)	Julian day #
CHUE1	End Date for ACCCHU1 - Day when CHU accumulation for silage corn ends; date mean minimum temp. ≤5°C (estimated average date of first fall frost)	Julian day #
CHUE2	End Date for ACCCHU 2 - Day when CHU accumulation for grain corn ends; date mean minimum temp. ≤3.6°C (first estimated average date of occurrence of –2°C)	Julian day #
TTLPTU	Total Photo-thermal Units - as calculated in Bootsma and Boisvert (1991)	

2.3 Daily Climatic Data from Atmospheric Environment Service Data

DAILY.DAT

The data in this file were derived from Atmospheric Environment Station (AES) data for the years 1955–85, and were generalized to the ARA level using Thiessen polygon routines and expert knowledge. The stations represented in this data file are not necessarily the same as those used for the basic monthly climate normals data, since not all the stations used in the Normals calculations have the long-term records used for the Daily file. The records in this file represent two time series: 1955–65 and 1966–85. The stations used differ between the two series, as weather stations were added to or deleted from the AES system in 1965.

N.B. The decimal point is not included in the data; therefore, for example, a maximum air temperature shown as 250 should be interpreted as 25.0.

One record per ARA per day for the 1955–85 period.

ITEM NAME	DESCRIPTION	REPORTING UNITS
ARANO	ARA Number	
PROV	Province	
YEAR	Year of data	
MONTH	Month of data	
DAY	Day of data	
TEMPMAX	Maximum Air Temperature	0.1°C
TEMPMIN	Minimum Air Temperature	0.1°C
RAIN	Precipitation as Rain	0.1 mm
SNOW	Precipitation as Snow	0.1 cm
PPTNTTL	Total Precipitation	0.1 mm
POTEVAP	Potential Evapotranspiration - based on Baier and Robertson (1965) formula 1	0.1 mm

2.4 Economic Data from the Census of Agriculture *ECONOMICS.DAT

The ARA polygons were manually overlaid on census Enumeration Area (EA) maps. Only EAs which were at least 70 percent within one ARA were included in the analysis. Individual farm records were processed through a farm typing routine discussed in Huffman et al. (1992), to produce statistics for each farm type within each ARA. The economic parameters in this data file are averages of the median values for all farm types within each polygon. This data file is valid only for dryland systems.

N.B. Sales and expenses information pertain to the year prior to the Census year, while capital values and livestock pertain to the Census year.

* Denotes data for the 1981 or 1986 Census, e.g., ECONOMICS81.DAT.

One record per ARA.

ITEM NAME	DEFINITION	REPORTING UNITS
ARANO	ARA Number	
PROV	Province	
FMSIZE	Farm Size	ha
VALLND	Value of Land & Buildings	as % of total value
VALLIV	Value of Livestock	as % of total value
VALMACH	Value of Machinery & Equipment	as % of total value
FUEL	Cost of Fuel (machinery + heating & drying)	as % of expenses
FERT	Cost of Fertilizer	as % of expenses
SALINV	Sales to Investment Ratio (total sales/total capital investment)	
SALEXP	Sales to Expenses Ratio (total sales/operating expenses)	
TOTEXP	Total Expenses	$
TOTSALES	Total Sales	$
TVALHA	Total Value (land, buildings, machinery, equipment, livestock)	$/ha
TSALHA	Total Sales	$/ha
EXPHA	Operating Expenses	$/ha
FUELHA	Fuel Costs	$/ha
FERTHA	Fertilizer Costs	$/ha
GMARHA	Gross Margin ((total sales - operating expenses) ÷ farm size)	$/ha
REGION	Agricultural Resource Region -- a grouping of ARAs to represent areas of similar agroclimatic potential.	

Notes

Farm size is the total farm area, including owned and rented land. For **Total Value**, the Census respondents estimate the present market value of their owned land, buildings, machinery and equipment. **TVALHA** = Total value ÷ farm size. Livestock value (cattle, pigs, sheep, bees, poultry and others) is a derived variable, calculated from information provided on the number of livestock. **Total sales** includes sales of all agricultural products, shares from tenants, cash advances for stored crops, Marketing Board or Agency payments, income from custom work and rebates. Sales of capital items (e.g., machinery) or forest products are not included. **Operating expenses** includes cash rent, share rent, cash wages, feed, fertilizer, chemicals, custom work, fuel,

repairs, electricity and other miscellaneous expenses. It does not include livestock purchases, veterinary bills, telephone and postage, professional services, insurance, Marketing Board fees, taxes, interest payments, mortgage payments nor depreciation.

2.5 Forage Aridity Index

FORARID.DAT

This file contains the Forage Aridity Index (Shields and Sly, 1984) for four soil water holding capacities. It also contains the start and end of the growing season, and the Accumulated Growing Degree-days (AGDD) >5°C to selected dates. The file contains data for each year for the 1965–1985 period. The soil textures and corresponding Available Water Holding Capacity (AWHC) are as follows:

TEXTURE	AWHC (mm)
SAND, SANDY LOAM	100
LOAM	150
CLAY LOAM	200
CLAY	250

If the soil is Solonized Solonetz or Organic, then the AWHC is not applicable. For the aridity index, water holding capacity of the soil = field capacity - permanent wilting point.

Reference: De Jong et al. (1991a).

One record per ARA per year.

ITEM NAME	DESCRIPTION	REPORTING UNITS
ARANO	ARA Number	
PROV	Province	
YEAR	Year	
ARID1	Aridity Index (AWHC 100mm)	mm
ARID2	Aridity Index (AWHC 150mm)	mm
ARID3	Aridity Index (AWHC 200mm)	mm
ARID4	Aridity Index (AWHC 250mm)	mm
GROWS	Start of Growing Season - Day when 5 day *weighted mean air temperature >5.5° C and stays above	Julian day #
GROWE	End of Growing Season - Day when 5 day *weighted mean air temperature goes below 5.5°C	Julian day #
MAY1	AGDD from GROWS to May 1	
MAY15	AGDD from GROWS to May 15	
JUN1	AGDD from GROWS to June 1	
JUN15	AGDD from GROWS to June 15	
AUG1	AGDD from GROWS to August 1	
AUG15	AGDD from GROWS to August 15	
SEP1	AGDD from GROWS to September 1	
SEP15	AGDD from GROWS to September 15	

OCT1	AGDD from GROWS to October 1
OCT15	AGDD from GROWS to October 15
NOV1	AGDD from GROWS to November 1
GROWSTTL	AGDD from GROWS to GROWE

N.B. All AGDD are reported to the nearest whole number.

$$* \text{ weighted mean for day } n = \frac{T_{n-2}+4T_{n-1}+6T_n+4T_{n+1}+T_{n+2}}{16}$$

where T is mean daily air temperature.

2.6 Land Use Data from the Census of Agriculture *LANDUSE.DAT

A land use file was developed from the same EA overlay onto the ARA polygons as was used to develop the Economic data file. The landuse data are based on an average of the mean values of all farm types within each polygon. Only dryland systems are included in this data file.

Reference: Huffman et al. (1992).

* Denotes data for the 1981 or 1986 census year, e.g., LANDUSE81.DAT. The data pertains to the current crop year.

One record per ARA

ITEM NAME	DEFINITION	REPORTING UNITS
ARANO	ARA Number	
PROV	Province	
CROP%	Cropland	as a % of Farmland
PASTURE	Pasture	as a % of Farmland
OATG	Oats for Grain	as a % of Cropland
BUCK	Buckwheat	as a % of Cropland
CORNE	Ensilage Corn	as a % of Cropland
CORNG	Grain Corn	as a % of Cropland
PEAS	Field Peas	as a % of Cropland
SUGARB	Sugar Beets	as a % of Cropland
SUNF	Sunflowers	as a % of Cropland
FCROP	Other Field Crops, e.g., beans, millet, canary seed and sod (1981 only)	as a % of Cropland
ALFAL	Alfalfa (1981 only)	as a % of Cropland
FORAGE	Forage Crops	as a % of Cropland
BARLEY	Barley	as a % of Cropland
CEFEED	Cereal Used as Feeds	as a % of Cropland
OILSEED	Oilseeds	as a % of Cropland
SMRFAL	Summerfallow	as a % of Cropland
SPECIAL	Specialty Crops, e.g., vegetables, berries and fruit	as a % of Cropland

WHEAT	Wheat (spring, Durum and winter)	as a % of Cropland
CATTLE	Cattle	#/ha
REGION	Agroecological Resource Region	
DFMTYPE	Dominant Farmtype (See codes, below)	
SDFMTYPE	Subdominant Farmtype (See codes, below)	
NFARM	Number of Farms Studied	

Notes

Farmland includes all land owned and rented. **Cropland** includes all annual crops, fallow, alfalfa, other forage crops and tame hay, but not improved pasture, other improved land, or unimproved land.

Codes for Farmtypes (DFMTYPE, SDFMTYPE)

PAST	Pasture System -- pasture >70% of farmland
DOMSP	Specialty System -- special crops (corn, sunflowers, potatoes, etc.) >10% of cultivated land
DOMWS	Wheat & Summerfallow System -- wheat >50% of cultivated land and summerfallow >20% of cultivated land
DOMWW	Wheat System -- wheat >50% of cultivated land and summerfallow <20% of cultivated land
DOMWO	Wheat & Oilseeds System -- wheat >30% of cultivated land and oilseeds >20% of cultivated land
DOMWB	Wheat & Barley System -- wheat >30% of cultivated land and barley >20% of cultivated land
DOMBB	Barley System -- barley >25% of cultivated land
DOMBF	Barley, Feeds and Forages System -- barley >25% of cultivated land, and feed grains plus forages are 25% to 50% of cultivated land
DOMFF	Feeds & Forages System -- feed grains plus forages >50% of cultivated land
MIXED	Mixed System -- farms not classified in any of the above systems

System Modifier

5	Low percentage of pasture: pasture <20% of farmland
6	Moderate percentage of pasture: pasture >20% and <70% of farmland

e.g., 05DOMWS = pasture <20% of farmland, wheat >50% of cultivated land, and summerfallow >20% of cultivated land.

2.7 Simulated Wheat Yields SIMYLDWH.DAT

This file contains data generated by the PIXMOD wheat model (Onofrei (1986)). Up to three major agricultural soils were identified within each ARA to provide input for the model. Each soil is identified by its soil series code (SOIL_CODE). The SOIL_CODE also provides a link to the Soil Names and Soil Layer files available through CanSIS (see SOILLINK). Thirty-one years of weather data (1955–1985) were used as input to the model.

One record per ARA per SOIL_CODE per year.

ITEM NAME	DESCRIPTION	REPORTING UNITS
ARANO	ARA Number	
PROV	Province	
SOIL_CODE	Soil Series Code	
YEAR	Year	
YLDS	Yield on Stubble	kg/ha
YLDF	Yield on Fallow	kg/ha

2.8 General Soil and Landform Information — SOILBASE.DAT

This data file contains information about the climate index, landform, texture class and soil development as identified on the Agroecological Resource Area maps for Alberta, Saskatchewan and Manitoba.

One record per ARA.

ITEM NAME	DESCRIPTION
ARANO	ARA Number
PROV	Province
NAME	ARA Name
ARR	Agroecological Resource Region
CLIMINDX	Climate Index
LANDFORM	Landform
TEXTURE	Texture
SOILDEV	Soil Development

GENERAL CONVENTIONS

The following conventions were used to show combinations of more than one category in each variable:

- dominantly one category, generally occupying over 70% of the ARA, e.g., [A]
- mainly one category with significant proportions (20–40%) of a second, e.g., [A(B)]
- about equal amounts of two categories, e.g., [A - B].

LANDFORM CLASSES

U or L	undulating and level plains with slopes <5%
H	hummocky uplands or hillands with slopes 5–15%
M	rolling uplands with slopes 5–15%
S	steeplands with slopes >15%

TEXTURE CLASSES

Eight classes were recognized, based on particle size distribution of an average of the surface and subsoil.

S	coarse sand and loamy sand
SL	moderately coarse sandy loam
L	medium to moderately fine loam
SIL	silt loam
CL	clay loam
SIC	silty clay
C	clay
O	organic

SOIL DEVELOPMENT CLASSES

BR	Brown Chernozemic
DB	Dark Brown Chernozemic
BL	Black Chernozemic
DG	Dark Gray Chernozemic
SS	Solodized Solonetz
SO	Solods and Solonetzic intergrades
GL	Gray Luvisol
DG	Dark Gray Luvisolic
BS	Brunisolic
RE	Regosolic
GY	Gleysolic
O	Organic
R	Rock

AGRO-CLIMATE CLASSES

2A	Slight Moisture Limitation
3A	Moderate Moisture Limitation
2H	Slight Heat Limitation
3H	Moderate Heat Limitation
4H	Severe Heat Limitation
5H	Very Severe Heat Limitation

Moderate Limitation means that one of the major cereal crops (wheat, barley, canola) is limited to less than 15% of the crop area.

Severe Limitation means that less than 30% of the cultivated area is in annual cereals for grain.

Very Severe Limitation is essentially beyond arable agriculture.

2.9 Soil Cross Tabulation Link into Soil Names and Soil Layer Files

SOILLINK.DAT

This cross tabulation file provides the link between the ARA polygons and the Soil Layer File, which is stored in the National Soil Data Base. For the purpose of running the PIXMOD wheat model, the output of which is in the data file SIMYLDWH, up to three agricultural soils in each ARA polygon were chosen to provide soil layer data for input to this model.

Reference: Soil Inventory Map Attribute Files for Alberta, Saskatchewan and Manitoba.

One record per soil code per ARA.

ITEM NAME	DESCRIPTION	REPORTING UNITS
ARANO	ARA Number	
PROV	Province	
SOIL_CODE	Soil Series Code	
SOILCULTPER	Percent of Cultivated Area Represented by Named Soil	%
ARACULTPER	Percent of ARA Cultivated	%
SOILPOLYPER	Percent of ARA Represented by Named Soil	%

2.10 Soil Temperature File

SOILTEMP.DAT

The data in this file were derived from ARA monthly normals data (1951–1980) and consist of an estimation of average monthly soil temperatures at 10 cm and 50 cm depth, and other derived soil climatic parameters.

Reference: Ouellet (1973).

One record per ARA per depth.

ITEM NAME	DESCRIPTION	REPORTING UNITS
ARANO	ARA Number	
PROV	Province	
DEPTH	Depth	cm
JAN	January Soil Temperature	°C
FEB	February Soil Temperature	°C
MAR	March Soil Temperature	°C
APR	April Soil Temperature	°C
MAY	May Soil Temperature	°C
JUN	June Soil Temperature	°C
JUL	July Soil Temperature	°C
AUG	August Soil Temperature	°C
SEP	September Soil Temperature	°C
OCT	October Soil Temperature	°C
NOV	November Soil Temperature	°C
DEC	December Soil Temperature	°C
MATEMP	Mean Annual Soil Temperature	°C
MSTEMP	Mean Summer Soil Temperature (June, July, Aug.)	°C
DD>5C	Average Seasonal Degree Days >5°C	
DD>15C	Average Seasonal Degree Days >15°C	
D>5C	Average Number of Days Soil Temperature >5°C	days
D>15C	Average Number of Days Soil Temperature >15°C	days
SLCLIMCLS1*	Soil Climate Class 1	
SLCLIMCLS2*	Soil Climate Class 2	

* The Soil Climate Class is from Clayton et al. (1977). If SLCLIMCLS2 is not 0.0, then the soil temperature is between two classes expressed in SLCLIMCLS1 and SLCLIMCLS2.

Class Definition

0.0 no class defined
1.0 Arctic
2.0 Subarctic
3.0 Cold to moderately cold Cryoboreal
3.1 Moderately cold Cryoboreal
4.0 Cool to moderately cool Boreal
4.1 Cool Boreal
4.2 Moderately cool Boreal
5.0 Mild to moderately warm Mesic
5.1 Mild Mesic
5.2 Moderately warm Mesic
6.0 Thermic
7.0 Hyperthermic

2.11 Wheat Stress Data

WHTSTRESS.DAT

This file contains output from a modified version of the Versatile Soil Moisture Budget.

References: De Jong and Bootsma (1988); Bootsma and De Jong (1988); De Jong et al. (1991).

One record per year per ARA per rotation.

ITEM NAME	DESCRIPTION	REPORTING UNITS
ARANO	ARA Number	
PROV	Province	
ROTATE	Indication of Rotation System - continuous, stubble or fallow	
AWHC	Available Water Holding Capacity - One of 100, 150, 200 or 250 mm - See definitions in FORARID.DAT.	
YEAR	Year	
LDSPRFROST	Last Date of 0°C Spring Frost	Julian day #
LDSPRFROST-2	Last Date of –2°C Spring Frost	Julian day #
FDFALFROST0	First Date of 0°C Fall Frost	Julian day #
FDFALFROST-2	First Date of –2°C Fall Frost	Julian day #
SEED	Seeding Date for Wheat - observed data on "date when seeding is general" (Statistics Canada)	Julian day #
HEADING	Calculated Heading Date for Wheat - calculated with the biometeorological time scale of Robertson (1968)	Julian day #
HARVWHT	Calculated Harvest Date for Wheat - Robertson (1968)	Julian day #
HARVBAR	Calculated Harvest Date for barley - Williams (1974).	Julian day #
TTLH20SEED	Total Available Water at Seeding	mm
H20SEED1ZN	Total Available Water at Seeding in 1st zone - (Available water-holding capacity of the 1st zone is 5% of the AWHC.)	mm
TTLH20HEAD	Total Available Water at Heading	mm
TTLH20HARV	Total Available Water at Harvest	mm
H20DIFHTOS	Change in Soil Water Content Between Previous Year's Harvest Date and Current Year's Seeding Date (approx. 9 months)	mm
H20DIFSTOH	Change in Soil Water Content Between Current Year's Seeding and Harvest Dates	mm
PRECIPH7	Accumulated Precipitation at Harvest + 7 days	mm
PRECIPH14	Accumulated Precipitation at Harvest + 14 days	mm
PRECIPH21	Accumulated Precipitation at Harvest + 21 days	mm
PRESCROP	Present Crop (W=wheat, F=fallow)	

N.B. The following data pertain to the time period from the previous year's harvest to the current year's seeding date.

ACCPRECIP	Accumulated Precipitation (rain + snow)	mm
ACCPRESNOW	Accumulated Precipitation (snow only)	mm
POTEVAP	Accumulated Potential Evapotranspiration	mm
ACTEVAP	Accumulated Actual Evapotranspiration	mm
RUNOFFRS	Accumulated Runoff (rain + snow)	mm
ACTDRAIN	Accumulated Drainage	mm
ACCSRUN	Accumulated Snow Runoff	mm
ACCSINFIL	Accumulated Snow Infiltration	mm
ACCSBLOWN	Accumulated Amount of Snow Blown Away	mm

N.B. The following data pertain to the time period from the current year's seeding date to the current year's harvest date.

ACCPRECIPR	Accumulated Precipitation (rain only)	mm
ACCPOTEVAP	Accumulated Potential Evapotranspiration	mm
ACCACTEVAP	Accumulated Actual Evapotranspiration	mm
ACCRUNOFFR	Accumulated Runoff	mm
ACCDRAINR	Accumulated Drainage	mm
ACCSTRESS	Accumulated Stress (1 - ACTEVAP/POTEVAP)	
ACCSTRESSJSD	Accumulated Stress Jointing to Soft Dough	
PRECIPFAL	Precipitation During Previous Fallow Year	mm
PERPREFAL	Percent of Precipitation Retained During Fallow Period	
WTHRFILE	Name of Weather File (AGMET) For Internal Use Only	

N.B. PRECIPFAL and PERPREFAL variables contain no data for fallow rotation.

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Appendix A

Simulated Wheat Yields: Manitoba Prototype PIXPROTO.DAT

This file was created during an initial stage of the development of the ARA maps. It contains output from the PIXMOD model for the province of Manitoba. The boundaries used to define the ARAs during this prototype stage differ from the finalized version (the boundaries in the agricultural areas of the province were essentially unchanged, but more ARA polygons were added in the north). The climate stations, years of data used (1964–1983), and in some cases, the soil series used, may also differ from those used to produce the files documented in section 2.7, SIMYLDWHT. Nevertheless, because this file was extensively validated, it is considered to be an important part of the ARA database.

One record per ARA per year per soil code per scenario.

ITEM NAME	DESCRIPTION	REPORTING UNITS
ARANO	ARA Number	
SOIL_CODE	Soil Code	
SCEN	Scenario	
YEAR	Year	
GSL	Growing Season Length (from seeding to maturity)	days
PPTNTTL	Total Precipitation (from seeding to maturity)	mm
POTPRODAG	Potential Above Ground Biomass Production	kg/ha
POTGRNBU	Potential Grain Yield (constrained only by solar radiation)	bu/ha
ACTPRODAG	Actual Above Ground Biomass Production	kg/ha
ACTGRNKG	Actual Grain Yield	kg/ha
ACTGRNBU	Actual Grain Yield	bu/ha
PRODLOSS	Actual Above Ground Net Production Lost Due to Severe Climatic Conditions (drought or excess moisture)	kg/ha

Scenarios

1 Fmax = 20 kg/ha/h, 75 kg/ha NO_3 fertilizer applied
2 Fmax = 20 kg/ha/h, 150 kg/ha NO_3 fertilizer applied
3 Fmax = 30 kg/ha/h, 75 kg/ha NO_3 fertilizer applied
4 Fmax = 30 kg/ha/h, 150 kg/ha NO_3 fertilizer applied

where Fmax is the maximum rate of CO_2 exchange (Stewart, 1981; van Keulen et al, 1982; Versteeg and van Keulen, 1986).